ENVIRONMENTAL INTEGRITY PROJECT

1000 Vermont Avenue, NW
Suite 1100
Washington, DC 20005
Main: 202-296-8800
Fax: 202-296-8822
www.environmentalintegrity.org

April 8, 2015

Robert A. Kaplan, Regional Counsel
Office of Regional Counsel
U.S. Environmental Protection Agency, Region 5
77 West Jackson Blvd.
Chicago, IL 60604-3507

The Honorable Brad D. Schimel
Attorney General of Wisconsin
Wisconsin Department of Justice
P.O. Box 7857
Madison, WI 53707-7857

Cathy Stepp, Secretary
Wisconsin Department of Natural Resources
101 S. Webster St.
Madison, WI 53707-7921

Re: Kinnard Farms, Inc. in Lincoln Township, Kewaunee County, Wisconsin

Dear Mr. Kaplan, Attorney General Schimel, and Secretary Stepp:

This letter is written on behalf of Kewaunee Citizens Advocating Responsible Environmental Stewardship (Kewaunee CARES) and Clean Water Action Council of Northeast Wisconsin to respectfully request that Region 5 of the United States Environmental Protection Agency (EPA) investigate and initiate enforcement against Kinnard Farms, Inc. (Kinnard) regarding its dairy concentrated animal feeding operation (CAFO) in Lincoln Township, Kewaunee County. Specifically, data indicate that application of large quantities of liquid waste on crop fields with high susceptibility to contamination has caused significant amounts of pollution, including nitrates and bacteria, to be discharged to groundwater, Casco Creek, and ultimately Lake Michigan, which are waters of the state and/or the United States. It appears that these discharges, described below, violate the Resource Conservation and Recovery Act (RCRA), the Clean Water Act (CWA), and Wisconsin's Pollution Discharge Elimination law.

The Wisconsin Department of Natural Resources (WDNR) has not issued an order, assessed a penalty, or entered into any enforceable agreement with Kinnard regarding these serious violations. In fact, in the context of the contested case hearing regarding Kinnard's Wisconsin Pollution Discharge Elimination System (WPDES) permit, Administrative Law Judge Jeffrey Boldt recently declared that the extraordinarily high incidence of contaminated drinking water wells in the community immediately surrounding Kinnard and its waste application fields is attributable to a "massive regulatory failure."[1]

We therefore urge you to:

1. Commence a comprehensive, site-wide compliance investigation;

2. Require Kinnard to develop a site-wide cleanup/corrective plan that assesses the extent of contamination, identifies and stops ongoing leaching and discharges, and restores all affected groundwater and surface waters to state and federal health-based and environmental standards;

3. Assess an appropriate penalty and natural resource damages, which may include requiring Kinnard to fund restoration of the watershed; and

4. Ensure that Kinnard does not expand its CAFO operations in the Town of Lincoln or surrounding communities until it has completed cleanup and demonstrated compliance with all state and federal environmental laws.[2]

EIP obtained the information contained in this letter from WDNR and Kewaunee County files made publicly available through Wisconsin's Open Records Law, expert analysis of these files and publicly available geological records, lab analysis of expert-collected residential well samples, and lab analysis of citizen-collected surface water monitoring data. We would welcome the opportunity to meet with you regarding our findings and look forward to hearing your responses.

---

[1] Findings of Fact, Conclusions of Law and Order, In the Matter of the Wisconsin Pollutant Discharge Elimination System Permit No. WI-0059536-03-0 (WPDES Permit) issued to Kinnard Farms, Inc., Town of Lincoln, Kewaunee County, No.: IH-12-071 at 13 (Oct. 29, 2014).

[2] Kinnard, which already holds a WPDES permit in Kewaunee County, is seeking to expand its existing CAFO during the current permit cycle. Kinnard WPDES Permit (Attachment A).

I. Summary of Violations Described in this Letter

Kinnard currently disposes of approximately 35 million gallons per year of dairy waste by first storing it in two large manure lagoons and then spreading it onto thousands of acres of cropland near the facility.[3] The amount of waste produced and disposed is scheduled to double to approximately 70 million gallons per year in 2016.[4] This waste contains nitrogen, phosphorus, and bacteria, as well as pharmaceuticals and hormones that may be administered via feed or injection. Although WDNR has issued Kinnard a WPDES permit, it continues to discharge pollution to groundwater and surface water through leaching and runoff from excessive land application.

The categories of violations indicated by our investigation include: 1) field application of waste that causes or contributes to an imminent and substantial endangerment under RCRA due to groundwater contamination; 2) field application of waste that constitutes open dumping under RCRA due to nitrate groundwater contamination; 3) field application of waste that results in unpermitted discharges of pollutants to groundwater in violation of Kinnard's WPDES permit and Wisconsin's Pollution Discharge Elimination law; and (4) field application of waste that results in unpermitted discharges to waters of the United States via tile lines, in violation of the CWA and Wisconsin's Pollution Discharge Elimination law.

II. Kinnard Farms, Inc.

Kinnard is a large and expanding dairy CAFO located in the Town of Lincoln, Kewaunee County, Wisconsin. The facility currently houses 5,822 animal units and reported generating approximately 34.7 million gallons of manure in 2012.[5] It spreads this waste on roughly 5,000 acres of owned and rented farmland near the production areas.[6] Kinnard is permitted to expand to 8,710 animal units during its current permit cycle, after which it will generate approximately 70 million gallons of manure and process wastewater annually. According to the WPDES Permit Fact Sheet, the planned expansion of the CAFO includes the construction of a second production area ("Site 2") approximately one quarter mile northeast of the existing production area ("Site 1"). Site 2 will include a 2000-foot long barn to house the cattle, a milking parlor, a silage pad, two manure lagoons, and a sand recycling building.[7] Site 2 will result in tens of millions of gallons of additional manure that must be spread on nearby cropland.

---

[3] Kinnard Farms, Inc. 2012 Annual Report at 2 (Jan. 30, 3013) (Attachment B).

[4] Wisconsin DNR, WPDES permit fact sheet for Kinnard Farms, Inc., Permit No. WI-0059536-03-0 3 (2012) [Fact Sheet] (Attachment C).

[5] Kinnard Farms, Inc. 2012 Annual Report at 2 (Jan. 30, 3013).

[6] Fact Sheet.

[7] *Id*.

Figure 1: Kinnard Site 1 and Site 2, at approximately 44°37’04 N, 87°38’02 W (Imagery from Oct. 10, 2013).

Kinnard is located in Lincoln Township, and spreads waste on approximately 5,000 acres in and around Lincoln and Red River, the township to Lincoln’s west. Site 1 is located in the immediate vicinity of numerous residences and Site 2 will also be close to several homes.

III. Facts Related to Pollution from Kinnard

To evaluate groundwater and surface water pollution and risk related to Kinnard's waste management practices, EIP worked with independent consultant Kenneth Wade from 2012 to 2014. Mr. Wade is registered as both a Wisconsin Professional Engineer and a Wisconsin Professional Geologist, and has previously worked as a hydrogeologist for WDNR. Mr. Wade's curriculum vitae is attached as Attachment D. EIP asked Mr. Wade to analyze Kinnard's manure application practices and to assess the susceptibility of surface water and groundwater to manure-related contamination. Mr. Wade produced reports for EIP in 2013 and 2014 and those reports ("Wade 2013" and "Wade 2014") are attached to this letter as Attachments E and F, respectively.

EIP also evaluated peer-reviewed studies of groundwater susceptibility and quality in Kewaunee County and in Lincoln Township, county residential well test data, citizen surface water quality data, and the results of targeted residential well tests identified through Mr. Wade's analysis. These various sources indicate, individually and collectively, that Kinnard's waste application practices are contributing to groundwater contamination affecting the safety of residential well water in and around Lincoln, as well as to surface water pollution that degrades local streams and Lake Michigan.

a) Kewaunee County Geology and Groundwater Quality

Kewaunee County is highly susceptible to groundwater contamination because the local bedrock has a high incidence of karstic features, including dissolved cavities, fissures, and sinkholes that can lead to rapid fluxes of pollution from soil to groundwater. The County, including areas in the vicinity of Kinnard Farms, also has large areas of thin soil and exposed bedrock that allow for rapid percolation of manure contaminants into the underlying fractured dolomite. The glacial till soils prevalent in the site area contain a significant quantity of clay-sized particles, which allows for ponding in areas of poor drainage or increased surface runoff in areas where the soils are thick enough to prevent percolation into the underlying dolomite.

Fig. 2. Kewaunee County Groundwater Susceptibility Analysis (Wade 2013)

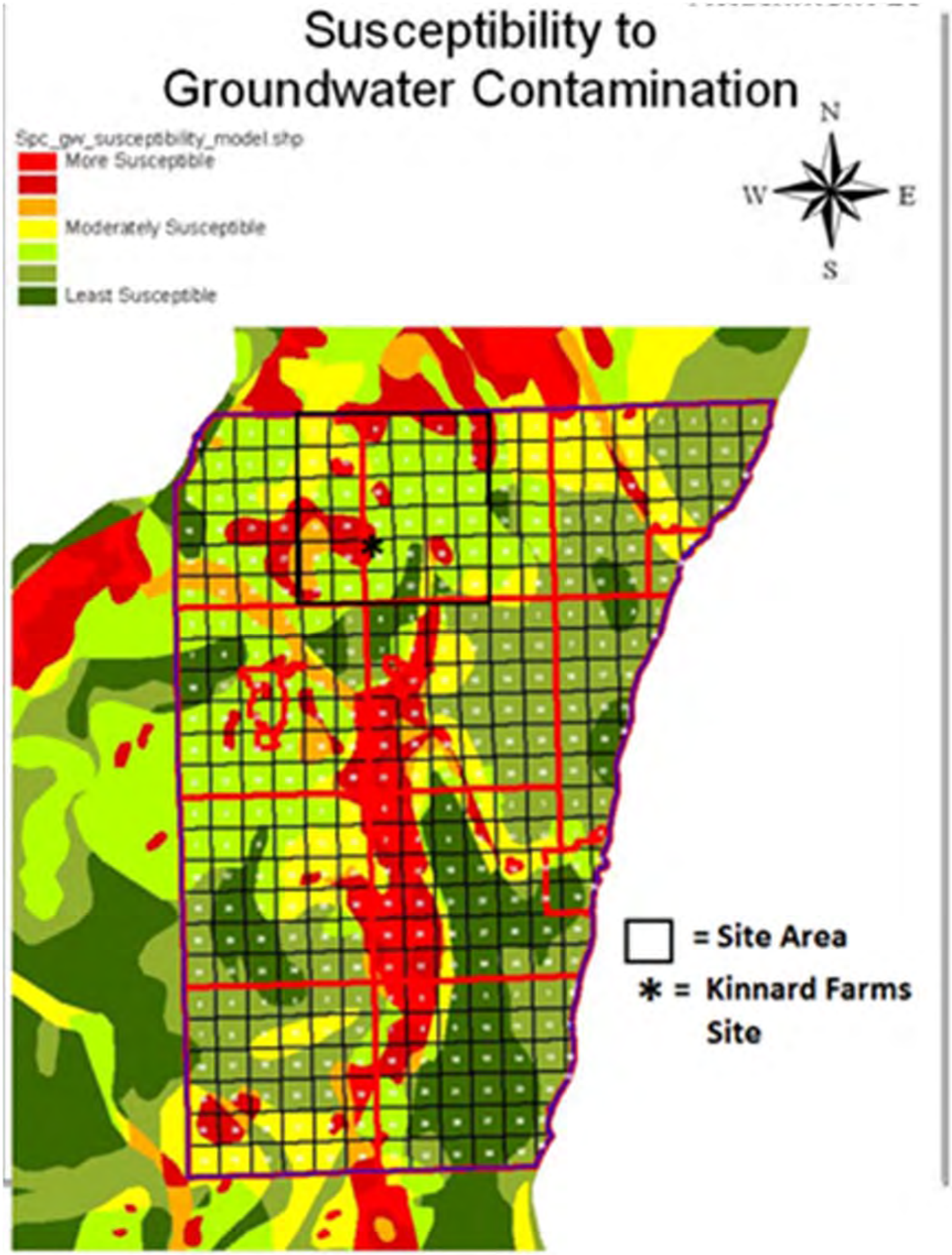
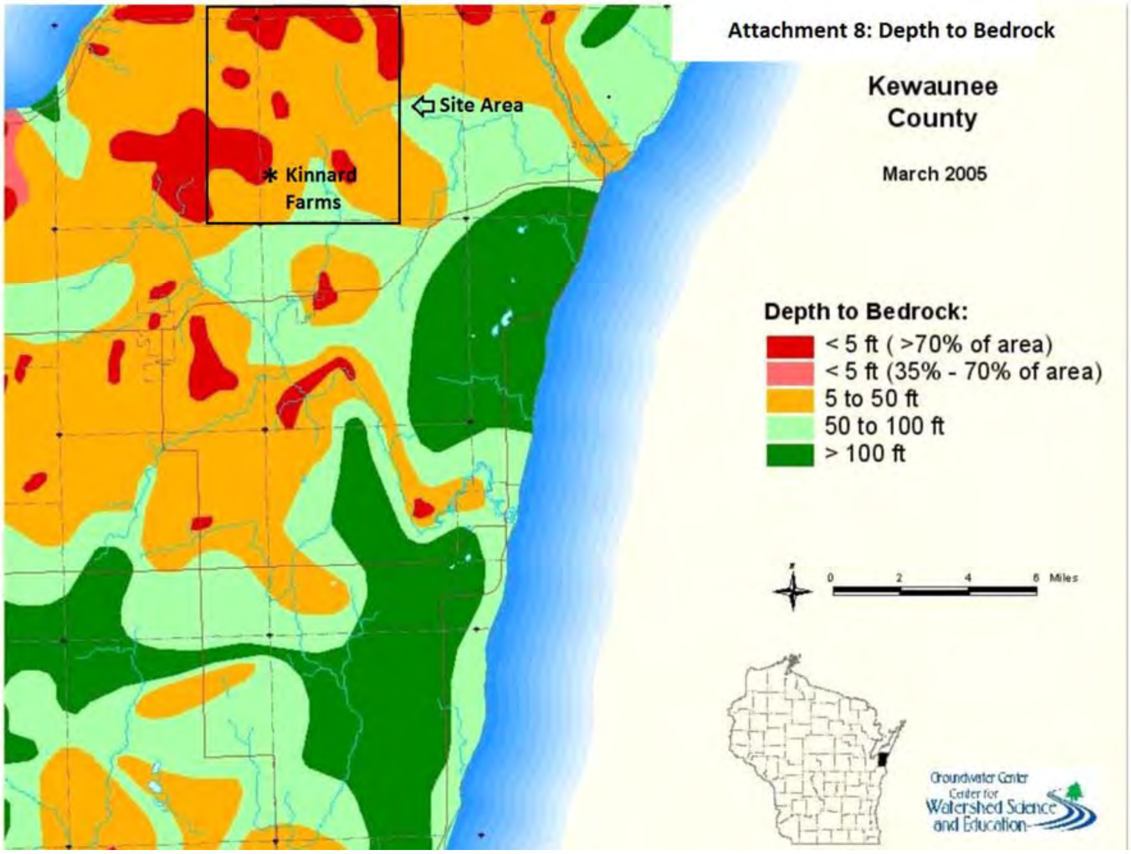


Fig. 3. Kewaunee County Depth to Bedrock (Wade 2013)



These geological features, combined with highly agricultural land use patterns throughout the county – including the spreading of waste from the county's 15 large CAFOs on cropland – have resulted in widespread contamination of groundwater with constituents of livestock waste. University of Wisconsin research has shown that groundwater in Kewaunee County (with a focus on wells in the vicinity of Kinnard and its spreading fields) and its neighboring counties is frequently contaminated with nitrates, bacteria, and endocrine-disrupting chemicals, all of which are associated with manure.[8] A recent pilot study of 10 Kewaunee County wells found that 70% of tested wells were positive for microbial contamination, and 30% were positive for contaminants specific to bovine sources.[9] Further, the WDNR has documented county-wide nutrient over-application: the 2014 nutrient balance sheet for Kewaunee County shows that 12.4 million pounds of nitrogen were produced in manure, while only approximately 11.3 million

---

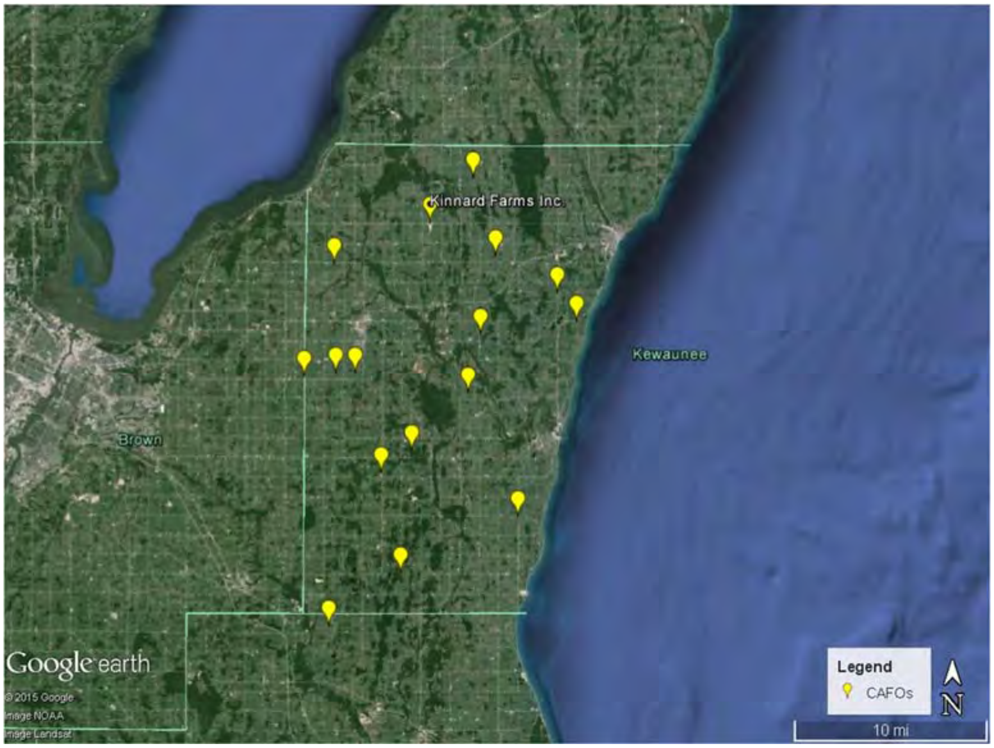
[8] *See, e.g.*, A.C. Bauer et al., Well Water in Karst Regions of Northeastern Wisconsin Contains Estrogenic Factors, Nitrate, and Bacteria, 85 WATER ENVIRON. RES. 318 (2013) (Attachment G). *See id.*, Fig. 1, for a map of tested wells.

[9] See Kate Golden, In the state's karst area, even good farming may pollute groundwater (Aug. 19, 2014), http://wisconsinwatch.org/2014/08/in-states-karst-area-even-good-farming-may-pollute-groundwater/. *See also*, Virus Pilot Study Letter (Attachment H).

pounds were utilized by growing crops, leaving an excess of more than 1 million pounds of nitrogen.[10]

Although nutrient pollution and contaminated wells are county-wide problems, well tests demonstrate that the worst pollution appears to be in the immediate vicinity of Kinnard and its spreading fields. Moreover, while the county is home to 15 large CAFOs, Kinnard is in Lincoln Township, the town with the highest rate of contamination, and is in a part of Lincoln with particularly high rates of contamination, indicating that it is the most significant source of concern. (See Fig. 7 and 8).

Fig. 4. Large CAFOs in Kewaunee County



b) Kinnard Manure Application

Kinnard spreads manure on numerous fields near the facility, in both Lincoln and Red River Townships (see Wade 2013, Attachments 4a and 4b). Kinnard's annual nutrient management reports provide details about the field application of nitrogen from manure and other sources, and provide evidence that Kinnard routinely applies manure at rates highly likely to exceed the receiving crop's agronomic need. Such application rates are likely to result in excess nitrates and other nutrients, which are then susceptible to leaching below the crop root

---

[10] Wisconsin DNR, Draft 2014 Kewaunee County Agricultural Nutrient Management Summary (Attachment I).

zone into groundwater and tile lines, as well as surface runoff to waterways. For example, Mr. Wade's 2013 report identifies several fields where 2010 applications of nitrogen ranged from 187 to 3,281 pounds per acre despite the fact that these fields were cropped with nitrogen-fixing alfalfa, and therefore had little or no agronomic need for nitrogen.

Mr. Wade's 2014 report used Kinnard's annual nutrient management reports to calculate total manure nitrogen applications per field from 2010 through 2013; when combined with information about geological and hydrological vulnerability, Mr. Wade's analysis can be used to identify fields with the highest contamination potential. As described in more detail below, contaminated residential wells have been found in close proximity to several of the manure application fields identified by Mr. Wade as high-risk. Moreover, this report found that certain fields were particularly vulnerable to contamination by other manure pollutants applied in large volumes of liquid manure, such as bacteria and pharmaceuticals, which have no agronomic use.

c) Groundwater Pollution Data

Due to widespread residential well contamination and concerns over the vulnerability of the region's groundwater quality, various governmental entities, researchers, and citizens have compiled a substantial groundwater dataset in the immediate vicinity of Kinnard Farms and its application fields, as well as throughout Lincoln Township and Kewaunee County. These numerous sources each indicate that Kinnard's manure management practices are a major contributor to – if not the major cause of - public health risks and ongoing well contamination in Lincoln Township.

1. Kewaunee County Database

EIP obtained a database of Kewaunee County groundwater quality from the University of Wisconsin Stevens Point in May 2013.[11] The county database, to preserve confidentiality, does not provide precise well locations. Instead, the authors of the database divided Public Land Survey Sections into sixteen subsections (quarter quarter sections) and identified each well as being in one of these subsections (e.g., T25N, R24E, section 30, NW, NE). The database includes nitrate results in units of mg/L, and total and *E. Coli* bacteria results in binary units (presence or absence) from tests conducted between 2004 and 2013. Over this time period, Kewaunee County wells tested above the 10 mg/L nitrate drinking water standard, or Maximum Contaminant Level (MCL), 12.8% of the time. They tested positive for bacterial contamination 20.6% of the time.

---

[11] Email from Katherine P. Jore, Records Custodian, University of Wisconsin – Stevens Point, to Tarah Heinzen, EIP, transmitting "non-confidential test results of groundwater wells in Kewaunee County since January 1, 2003" (May 6, 2013) (Attachment J).

The Town of Lincoln, where Kinnard and many of its land application fields are located, is disproportionately impacted by groundwater contamination, even when compared with other Kewaunee County townships. As many as 50% of the private wells in Lincoln are contaminated with unsafe levels of nitrates and/or bacteria, creating a "groundwater contamination crisis in areas near [Kinnard's Site 2]."[12] Between 2004 and 2013, Lincoln Township wells tested above the nitrate MCL 24.8% of the time and positive for bacterial contamination 37.6% of the time. This trend has persisted in recent well tests, with Lincoln leading the County in unsafe wells throughout 2013 (see Fig. 5). Lincoln's approximately 334 households are entirely reliant on groundwater for their drinking water.[13] Kinnard is located near the border with Red River Township, and also spreads manure on numerous fields in that town. Red River has the second highest rate of contaminated wells in Kewaunee County, with more than 44% of wells testing unsafe for nitrates and/or bacteria in 2013.

Fig. 5. Kewaunee County Well Testing Data, 2013 (see Attachment J)

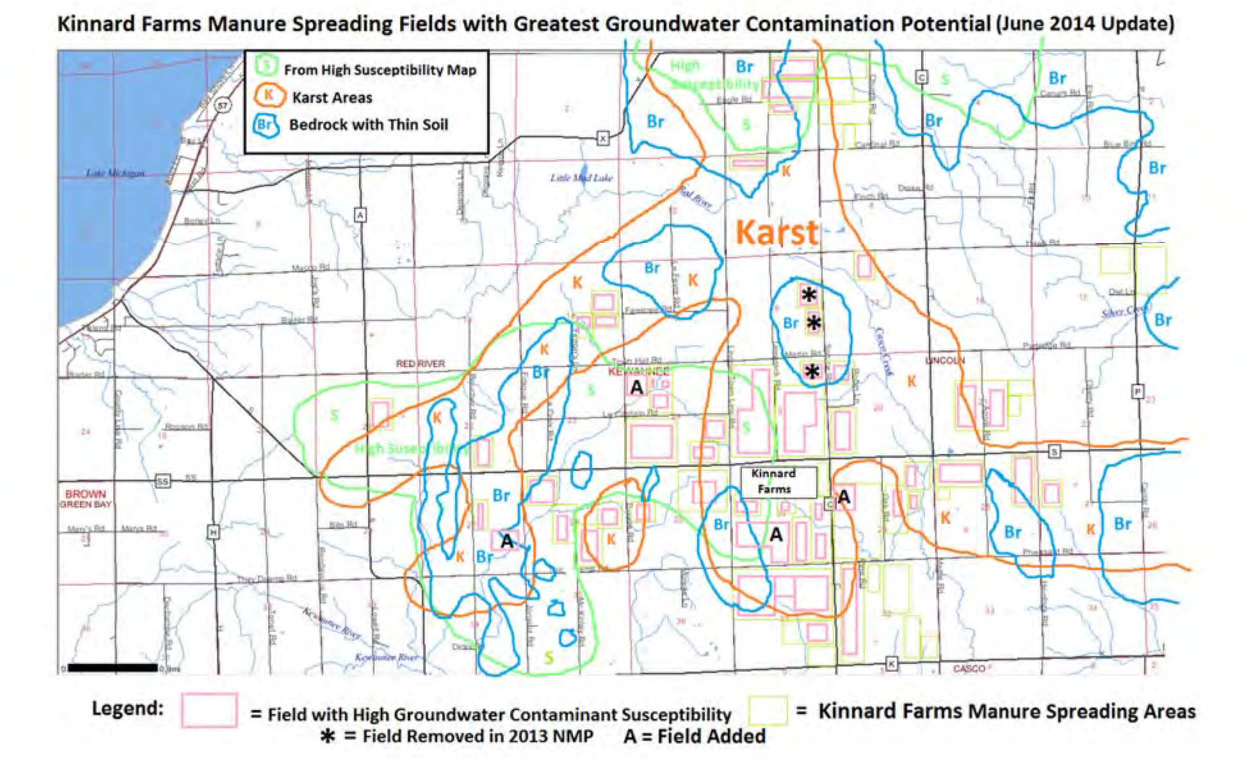
Kewaunee Co. Townships	**Unsafe wells:** bacteria present and/or nitrate > 10ppm # of wells (% of wells sampled)
Ahnapee	4 (13.8%)
Carlton	6 (23.1%)
Casco & Village of Casco	16 (25.0%)
Franklin	8 (17.8%)
Lincoln	**38 (50.7%)**
Luxemburg	20 (29.4%)
Montpelier	8 (25.8%)
Pierce	6 (24.0%)
Red River	**35 (44.3%)**
West Kewaunee	8 (19.5%)
Total:	149 (30.85%)

---

[12] Findings of Fact, Conclusions of Law and Order, In the Matter of the Wisconsin Pollutant Discharge Elimination System Permit No. WI-0059536-03-0 (WPDES Permit) Issued to Kinnard Farms, Inc., Town of Lincoln, Kewaunee County, No.: IH-12-071 ¶ 51 (Oct. 29, 2014) (Attachment K).

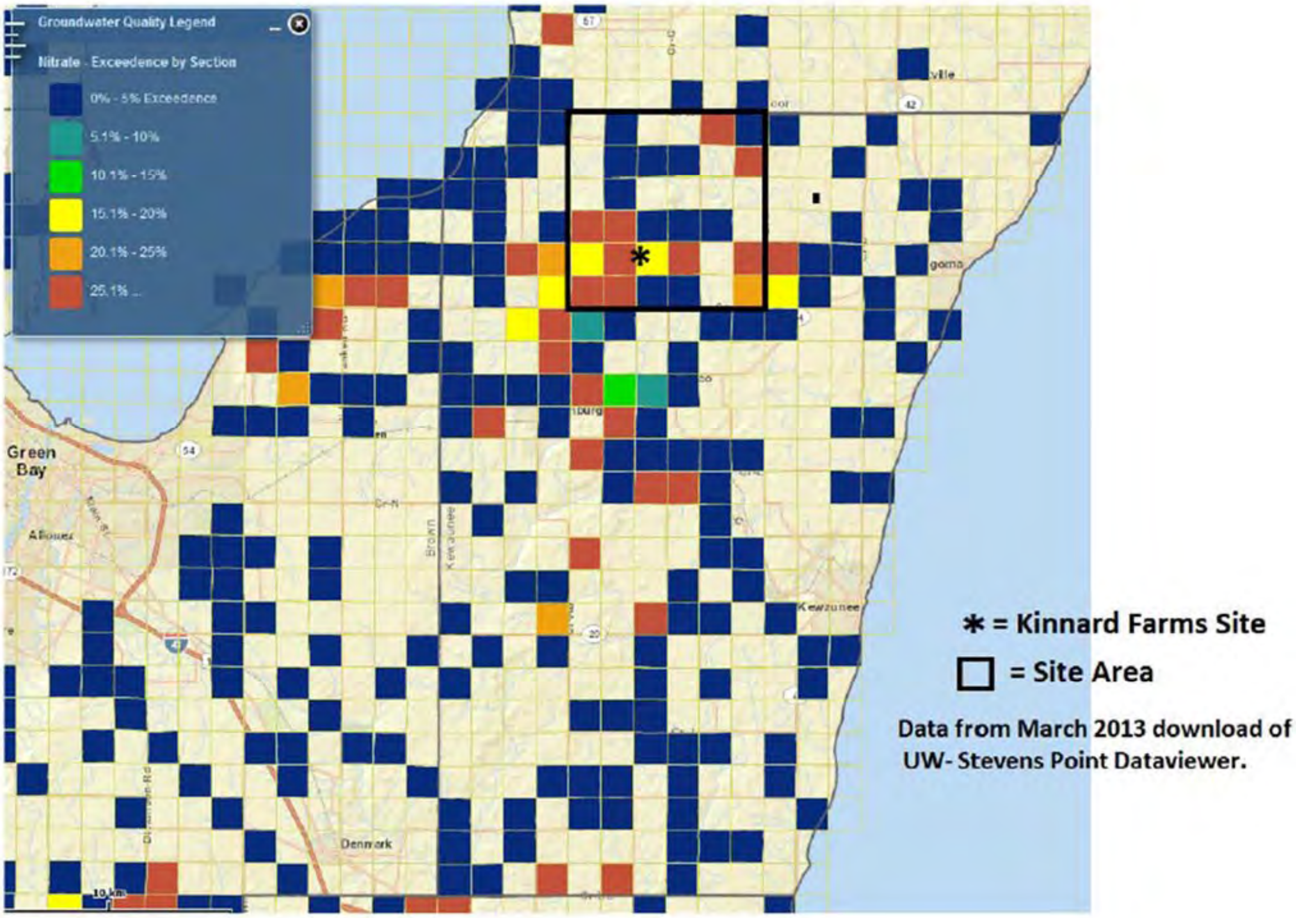
[13] D. Bonness and K. Masarik, Investigating Intra-Annual Variability of Well Water Quality in Lincoln Township at 8 (June 2014) (Attachment L).

Fig. 6. Kinnard Manure Spreading Fields and Contamination Susceptibility (Wade 2014)



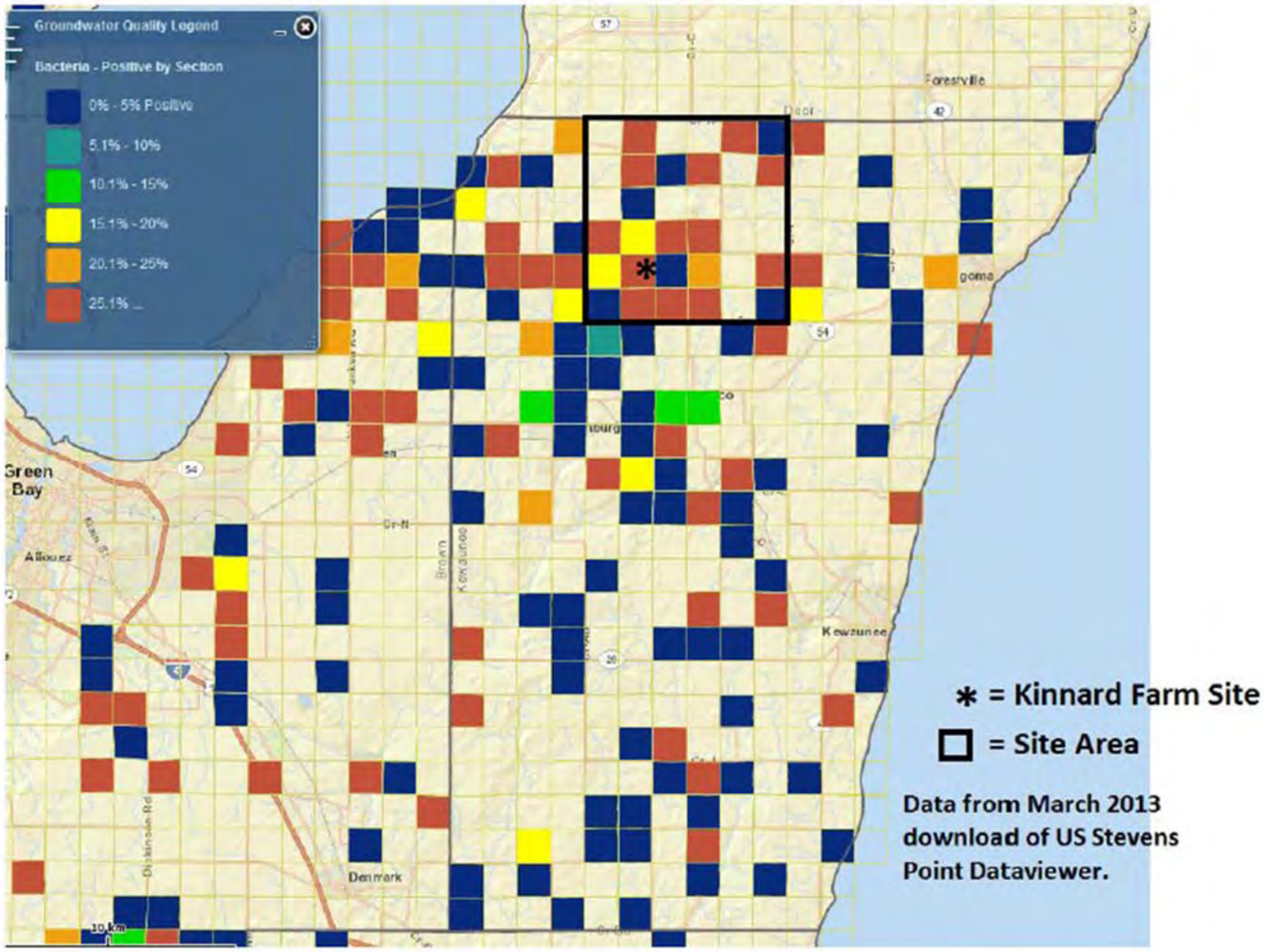
Figs. 7 and 8. Kewaunee County Nitrogen and Bacteria Well Tests (Att. 16 and 17 of Wade 2013)

Attachment 16: Nitrate Exceedences > 10 mg/l by Section



Data from March 2013 download of UW- Stevens Point Dataviewer.

Attachment 17: Positive Detection of Bacteria by Section



These state well test records persuasively demonstrate the impact of Kinnard's manure disposal practices; county-wide, the highest rates of nitrate standard exceedances and positive bacterial tests are in the area immediately surrounding Kinnard's facility, and in the areas where Kinnard spreads its millions of gallons of waste.

2. *2014 Kewaunee County – University of Wisconsin Study*

In June 2014, Kewaunee County and the University of Wisconsin completed a study of 10 residential wells in the Town of Lincoln, after testing each well for various parameters monthly for one year.[14] The study found mean nitrate concentrations greater than the 10 mg/L MCL in six of the wells.[15] After estimating the amount of nitrogen entering local groundwater from various sources, the study authors concluded that *96%* of groundwater nitrogen originated from agricultural sources (both manure and commercial fertilizer), as opposed to other sources

---

[14] D. Bonness and K. Masarik, Investigating Intra-Annual Variability of Well Water Quality in Lincoln Township.
[15] *Id*. at 21.

such as septic systems.[16] The researchers further estimated that *20%* of all agricultural nitrogen inputs in this area will leach below the root zone, and subsequently enter groundwater and tile drainage systems, regardless whether the application is in compliance with an NMP.[17]

The study also detected the presence of total coliform bacteria in six wells over the course of the year. One well tested positive for bacteria in seven of twelve tests.[18] The high incidence of bacteria indicates that manure, rather than commercial fertilizer, is a common source of the identified contamination. The authors did not expressly attempt to attribute contamination to any individual farm or source of fertilizer. However, the likely primary source is quite clear: Kinnard and its spreading fields are the dominant agricultural features of the area of Lincoln with the most persistent well contamination.

3. Targeted Citizen Residential Well Monitoring

EIP asked Mr. Wade to identify areas that are vulnerable to groundwater contamination from Kinnard's land application of manure. Mr. Wade did this by analyzing WDNR maps of contamination susceptibility, karst geology data from the Kewaunee County Land Conservation Department, and information about areas of shallow bedrock and thin soils from a Pleistocene geologic map of the county, along with maps of Kinnard manure application fields. Mr. Wade also analyzed Kinnard's Nutrient Management Plan (NMP) and associated annual reports to quantify the manure nitrogen applied to each field during the 2010-2013 period. Attachment 19 to Mr. Wade's 2013 report shows, among other things, the result of his analysis in the form of "field[s] with high groundwater susceptibility." Mr. Wade updated this map in his 2014 report, as shown above in Fig. 6. These maps demonstrate the high correlation between Kinnard's manure spreading fields and high susceptibility to groundwater contamination, karst geology, and bedrock with thin soil. Attachment 20 to Mr. Wade's 2013 report shows the wells that are vulnerable to contamination based on the same criteria. Again, Mr. Wade updated these maps in his 2014 report.

Mr. Wade also added a classification in 2014 based on the extent of nitrogen applications from manure. Specifically, he calculated the total manure nitrogen applications over the 2010-2013 period and assigned each field a score based on that total. Fields cumulatively receiving more than 400 pounds of manure nitrogen per acre were given a score of "1+." Mr. Wade selected this threshold based on his professional judgment that 100 pounds of nitrogen per acre

---

[16] *Id*. at 22.

[17] *Id*. The authors note that NMPs are developed to maximize crop yield and economic benefit, not to prevent groundwater pollution. The 20% estimate appears to be very conservative, as the authors indicate it is based on research on the Midwest broadly, not specifically on fields in highly susceptible karst regions. *Id.*

[18] *Id*. at 14-17.

per year would likely result in exceedances of the nitrate MCL.[19] There were 68 fields in the "1+" category. Within this group of 68 fields, the average annual nitrogen application rate, including both manure and other sources of nitrogen, was over 200 pounds per acre per year, with 86% of that total coming from manure. Although we could not calculate the agronomic nitrogen need for each field over this four-year period, the University of Wisconsin Nitrogen Guidelines for Corn[20] indicates that agronomic nitrogen application rates rarely exceed 200 pounds per acre for a single year.

Based on these analyses, EIP conducted two rounds of targeted residential well testing in the fall of 2013 and spring of 2014. EIP selected residential wells that were either identified as vulnerable by Mr. Wade or were adjacent to fields that were identified as vulnerable by Mr. Wade. Applied Ecosystem Services, Inc. (AES), a firm based in Brodhead, Wisconsin, conducted the 2013 sample collection. On December 7 and 8, 2013, AES collected samples from eight homes, including duplicate samples from two homes, and sent them to the Wisconsin State Laboratory of Hygiene in Madison. The laboratory tested for nitrates, chlorides, coliform bacteria, and *E. coli*.[21]

EIP has obtained permission to share the results for the four homes with December 2013 testing results finding nitrate levels above the 10mg/L nitrate MCL. The locations of the four wells are shown in Figure 9; groundwater testing results for chemical parameters are shown in Table 1. Although three of the four wells had detectable levels of total coliform bacteria, none tested positive for *E. coli*. In April 2014, Mr. Wade collected samples for a second round of testing from several wells, including the four wells shown in Table 1. Results were similar to those in 2013, with three of the four wells showing nitrates above 10 mg/L, and two of the four wells showing some evidence of bacteria.[22]

Figure 9 shows that the four homes are surrounded by Kinnard manure spreading fields. Attachment 19 to Mr. Wade's 2013 report, and the corresponding map in his 2014 report, show that these fields are nearly all high-risk fields by virtue of being located over karst bedrock.

---

[19] Specifically, Mr. Wade estimated a 40% manure leaching rate and an annual water recharge of 8 inches per year, and estimated that 100 pounds of nitrogen per acre per year would result in a groundwater nitrate-N concentration of 21 mg/L (Kenneth Wade, personal communication).

[20] University of Wisconsin Nitrogen Guidelines for Corn, http://corn.agronomy.wisc.edu/Management/pdfs/L025_N_card_extended.pdf.

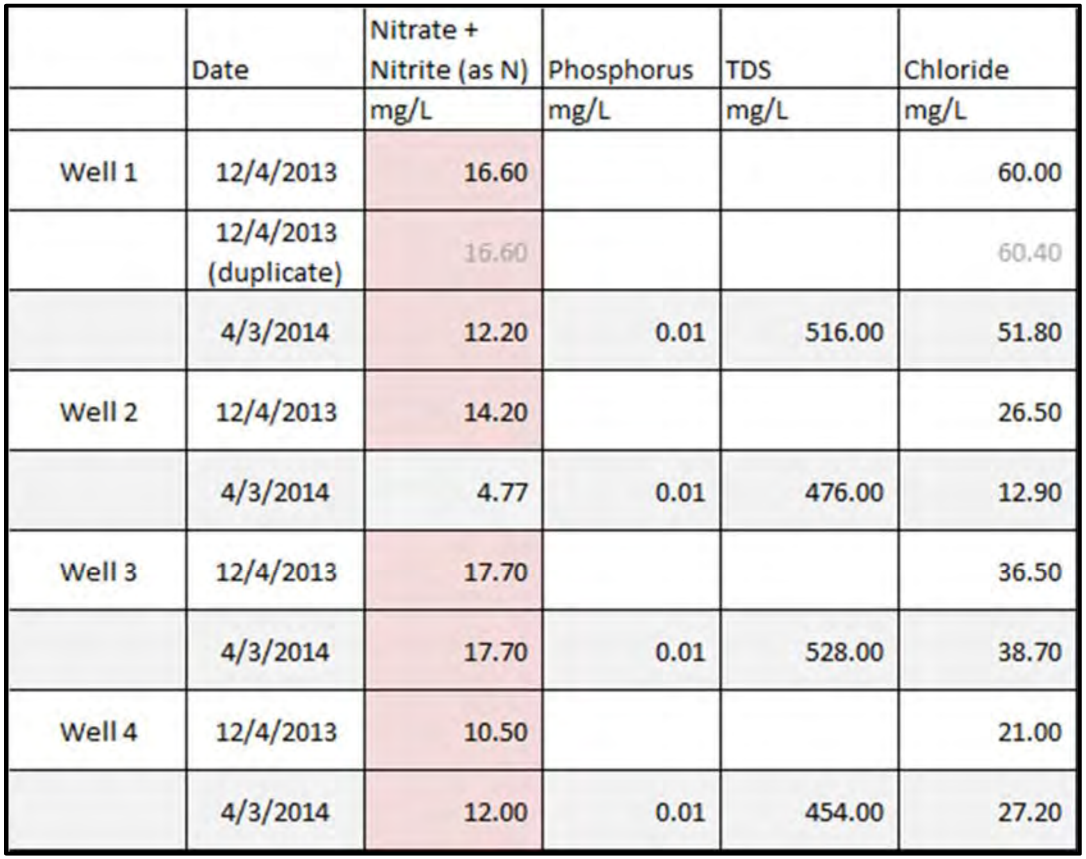
[21] The lab also tested for a bovine marker using a polymerase chain reaction (PCR) assay that targets *Bacteroides* bacteria species. *See* A. Layton et al., *Development of Bacteroides 16S rRNA Gene TaqMan-Based Real-Time PCR Assays for Estimation of Total, Human, and Bovine Fecal Pollution in Water*, 72 APPL. ENVIRON. MICROBIOL. 4214 (June 2006). The tests for the bovine marker were inconclusive, because according to the lab, all of the samples contained unknown PCR inhibitors, making it impossible to complete the analyses.

[22] Because the bovine marker assays did not result in usable data in 2013, EIP only had the lab run this test for the two wells showing a positive signal for coliform bacteria. PCR inhibition was not a problem for these samples, and neither of the wells had detectable levels of *Bacteroides* markers for humans or cows.

Figures 10 through 13 provide more detailed information about the manure application history of each field over the past few years.

In summary, Kewaunee County, and Lincoln and Red River Townships in particular, are known to be vulnerable to groundwater contamination, and are known to have a high incidence of nitrate contamination at unsafe levels. Recent research has attributed the vast majority of this contamination to agricultural sources. Kinnard and its manure-spreading fields dominate land use in areas of Lincoln and Red River with high rates of contamination. A close examination of residential groundwater quality in close proximity to specific high-risk Kinnard fields shows clear evidence of nitrate contamination. It therefore appears very likely that Kinnard is the primary or a leading cause of the residential nitrate contamination described above.

Table 1: Chemistry results of residential wells sampled under contract with EIP



	Date	Nitrate + Nitrite (as N)	Phosphorus	TDS	Chloride
		mg/L	mg/L	mg/L	mg/L
Well 1	12/4/2013	16.60			60.00
	12/4/2013 (duplicate)	16.60			60.40
	4/3/2014	12.20	0.01	516.00	51.80
Well 2	12/4/2013	14.20			26.50
	4/3/2014	4.77	0.01	476.00	12.90
Well 3	12/4/2013	17.70			36.50
	4/3/2014	17.70	0.01	528.00	38.70
Well 4	12/4/2013	10.50			21.00
	4/3/2014	12.00	0.01	454.00	27.20

Figure 9: Residential wells tested by EIP in 2013 and 2014, with current Kinnard manure application fields highlighted in red, and former Kinnard fields highlighted in orange.

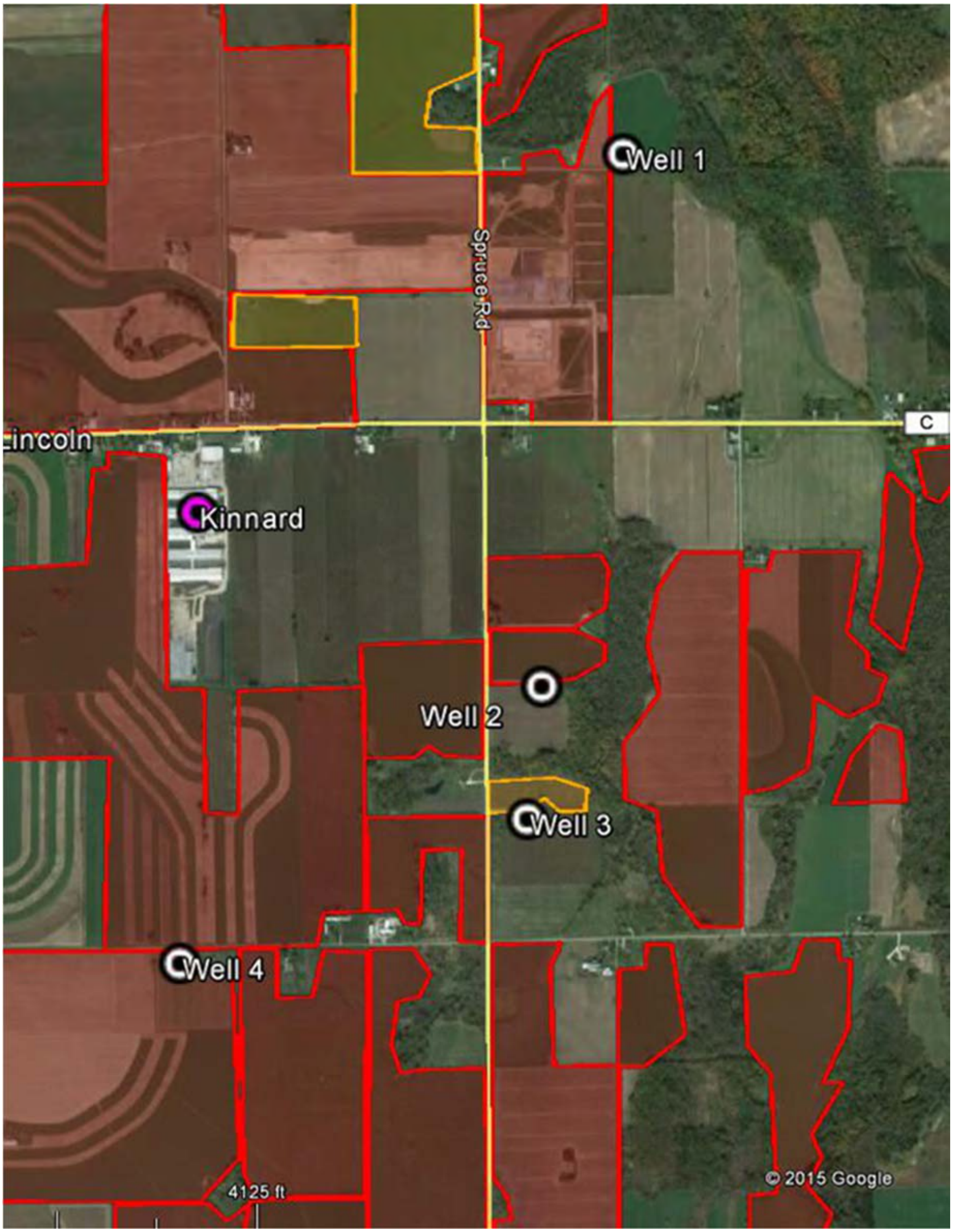
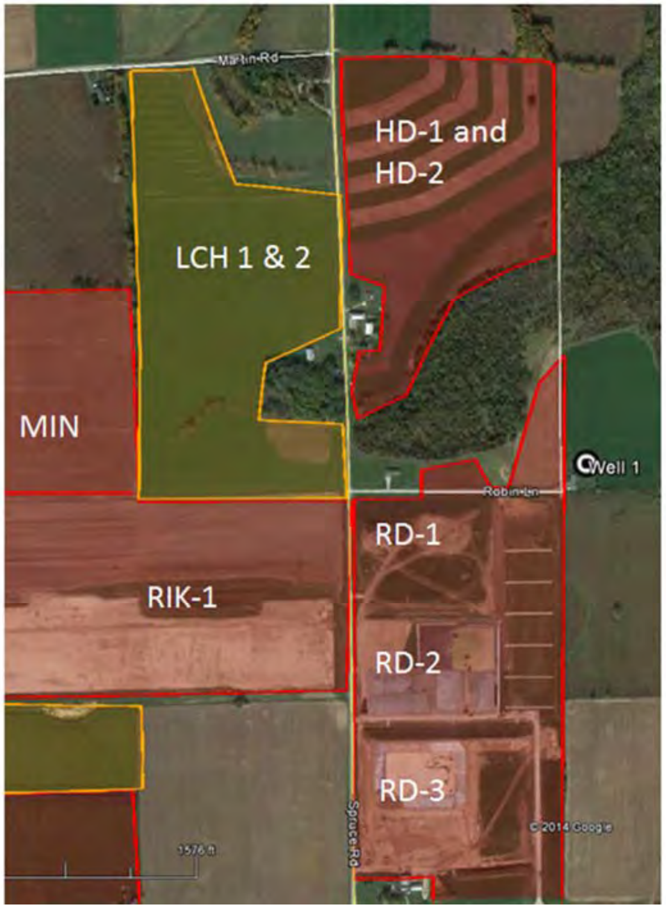
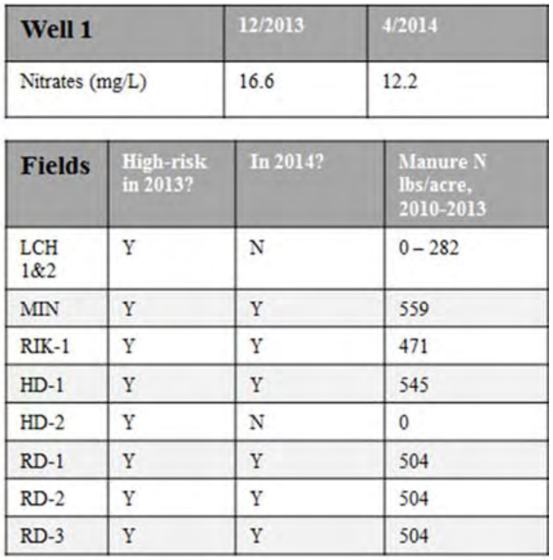


Figure 10: Well 1 and Kinnard manure applications on neighboring fields. Mr. Wade identified Well 1 as vulnerable in 2013 and again in 2014. Fields RD-1, RD-2, and RD-3 are the site of the new Kinnard lagoon and other structures.

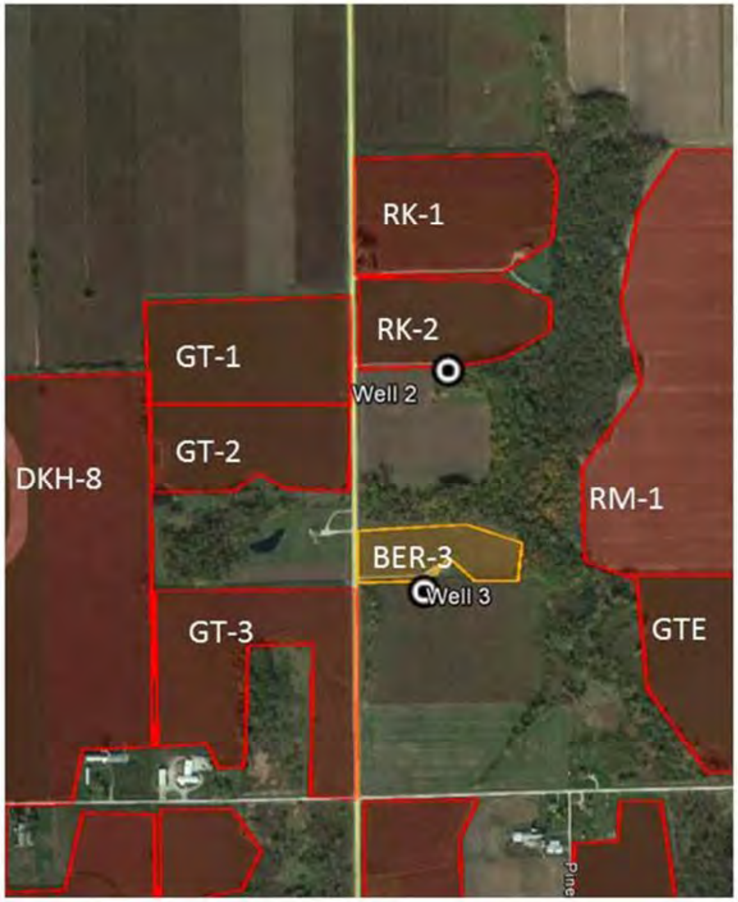


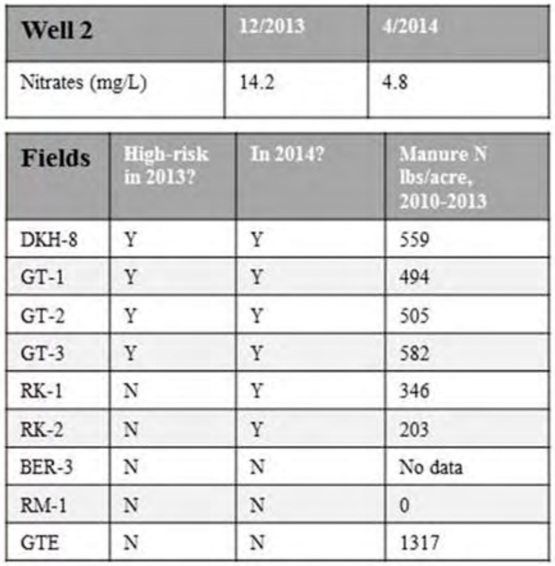


Well 1	12/2013	4/2014
Nitrates (mg/L)	16.6	12.2

Fields	High-risk in 2013?	In 2014?	Manure N lbs/acre, 2010-2013
LCH 1&2	Y	N	0 – 282
MIN	Y	Y	559
RIK-1	Y	Y	471
HD-1	Y	Y	545
HD-2	Y	N	0
RD-1	Y	Y	504
RD-2	Y	Y	504
RD-3	Y	Y	504

Figure 11: Well 2 and Kinnard manure applications on neighboring fields. Mr. Wade identified Well 2 as vulnerable in 2013, and gave it a “low potential” designation in 2014. Mr. Wade’s “low potential” designation was intended to signify an intermediate level of risk between “no potential” and “high potential.”

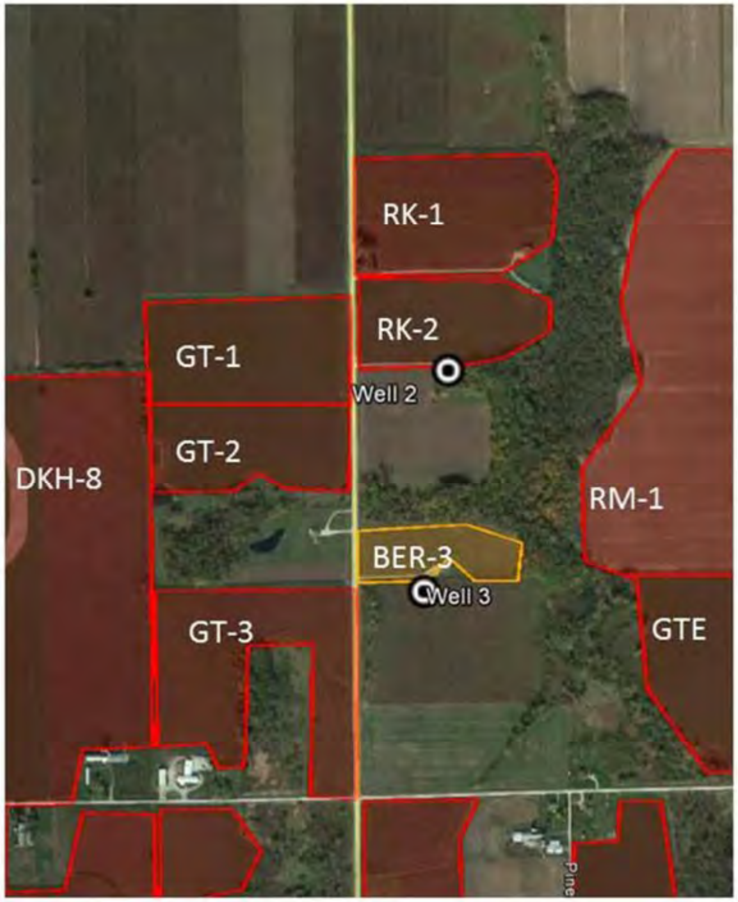


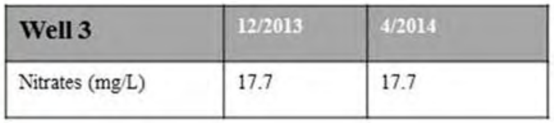


Well 2	12/2013	4/2014
Nitrates (mg/L)	14.2	4.8

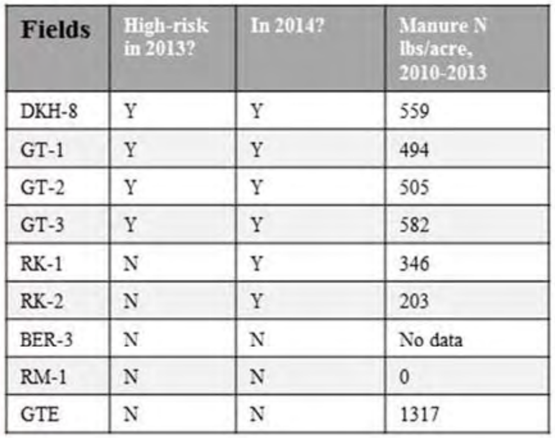
Fields	High-risk in 2013?	In 2014?	Manure N lbs/acre, 2010-2013
DKH-8	Y	Y	559
GT-1	Y	Y	494
GT-2	Y	Y	505
GT-3	Y	Y	582
RK-1	N	Y	346
RK-2	N	Y	203
BER-3	N	N	No data
RM-1	N	N	0
GTE	N	N	1317

Figure 12: Well 3 and Kinnard manure applications on neighboring fields. Mr. Wade identified Well 3 as vulnerable to ongoing contamination in 2013, but not in 2014, due to changes in Kinnard's NMP. However, the well still contained unsafe levels of nitrates, which can persist in groundwater, in 2014.



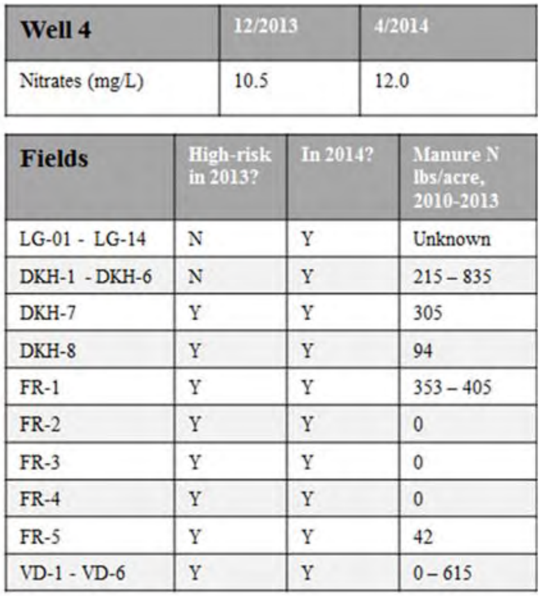


Well 3	12/2013	4/2014
Nitrates (mg/L)	17.7	17.7



Fields	High-risk in 2013?	In 2014?	Manure N lbs/acre, 2010-2013
DKH-8	Y	Y	559
GT-1	Y	Y	494
GT-2	Y	Y	505
GT-3	Y	Y	582
RK-1	N	Y	346
RK-2	N	Y	203
BER-3	N	N	No data
RM-1	N	N	0
GTE	N	N	1317

Figure 13: Well 4 and Kinnard manure applications on neighboring fields. Mr. Wade identified this well as vulnerable in 2013 and again in 2014. Many of the fields north of Well 4 are narrow strips of land running north-south (see attachments to Mr. Wade's reports). It is not clear whether a CAFO spreads manure on the LG fields; they do not appear in any Kinnard nutrient management plan reports and may have other names.



Well 4	12/2013	4/2014
Nitrates (mg/L)	10.5	12.0

Fields	High-risk in 2013?	In 2014?	Manure N lbs/acre, 2010-2013
LG-01 - LG-14	N	Y	Unknown
DKH-1 - DKH-6	N	Y	215 – 835
DKH-7	Y	Y	305
DKH-8	Y	Y	94
FR-1	Y	Y	353 – 405
FR-2	Y	Y	0
FR-3	Y	Y	0
FR-4	Y	Y	0
FR-5	Y	Y	42
VD-1 - VD-6	Y	Y	0 – 615

d) Tile Drainage from Kinnard Fields to Surface Waters

Kinnard's waste disposal practices also affect surface waters, including Casco Creek and Lake Michigan. Several of Kinnard's land application fields contain drainage tile systems, which are designed to transport contaminants and water that percolate below the crop root zone from fields and discharge them into ditches and tributary streams. As noted previously, a 2014 groundwater study in Lincoln Township confirmed prior research indicating that as much as 20% of agricultural nitrogen inputs to land in this area will percolate below the root zone of crops, where they will enter any tile systems constructed in the field to drain excess water and/or enter the groundwater aquifer.[23]

Several of the tile systems in Kinnard's land application fields discharge into or adjacent to surface waters. Examples include: (1) tiles in field RR outlet to a tributary of the Kewaunee River, (2) tiles in fields RM 01-07 outlet to a tributary of Casco Creek, (3) tiles in field PP3 outlet adjacent to a tributary to Casco Creek, and (4) tiles in field RVM-2 outlet adjacent to a tributary to Silver Creek (see Wade 2014). These tile lines function as direct conduits that carry pollutants to waters of the state and waters of the United States. Such discharges are violations of Kinnard's WPDES permit and the CWA.[24]

e) Surface Water Pollution Data

Surface water data also indicate chronic pollution from Kinnard's manure spreading fields. Members of Kewaunee CARES have been regularly conducting surface water testing since 2012. Water samples analyzed by Analytichem LLC Laboratory Services in Luxemburg, Wisconsin are summarized in Attachment M.[25] There is some overlap between the Kewaunee CARES sampling points and sampling points recommended by Mr. Wade for monitoring runoff from Kinnard application fields. Specifically, Kewaunee Cares has sampled the location identified in Attachment M as "Maple Rd & Co S" roughly 15 times since 2012, consistently finding high total coliform bacteria, high *E. coli*, and high nitrates (12-20 mg/L). Mr. Wade recommended sampling Casco Creek at this location (which he identified as location 1 in attachment 23 to the 2013 report)[26] because there are Kinnard spreading fields upstream of location 1 (seen on the western side of the "Lincoln Sec. 20" map attached to Mr. Wade's 2014 report). The fields labeled RD-1, RD-2, and RD-3 in the "Lincoln Sec. 20" map have been replaced by Kinnard's new lagoon and other structures, which will likely become additional

---

[23] D. Bonness and K. Masarik, Investigating Intra-Annual Variability of Well Water Quality in Lincoln Township at 22 (June 2014).

[24] Kinnard WPDES Permit 1.6.1.

[25] We have attempted to give each sample point a consistent name in Attachment B under the column heading "uniform sample location."

[26] Mr. Wade provides more detail in attachment 22 to the 2013 report, in the report itself, and in his 2014 report.

upstream sources for Kinnard discharges of manure, feed pile runoff, and contaminated process wastewater to Casco Creek. Recent NMP records indicate that Kinnard still uses fields upstream of this sampling location for manure application. And indeed, Kinnard's construction of the Site 2 production area has not led to any improvement in Kewaunee CARES' monitoring results at the Maple Rd and Co S sampling point.

IV. RCRA and CWA Violations

The groundwater and surface water pollution described above violates several provisions of federal law, including RCRA's imminent and substantial endangerment provision, RCRA's prohibition on open dumping of solid waste, and the CWA's prohibition on point source discharges to a water of the U.S. that are not authorized by a National Pollutant Discharge Elimination System (NPDES) permit.

a) Violations of the Resource Conservation and Recovery Act: Imminent and Substantial Endangerment

Section 7003 of RCRA authorizes the EPA Administrator to bring suit against, or issue an administrative enforcement order to, any person who "has contributed or is contributing to" the "past or present handling, storage, treatment, transportation or disposal of any solid waste or hazardous waste" which "may present an imminent or substantial endangerment to health or the environment."[27] Kinnard Farms is the generator, transporter, and owner and/or operator of a treatment, storage, and disposal facility that is contributing to the past and present storage, treatment, transportation and/or disposal of solid waste, namely liquid and solid manure and process wastewater. Kinnard's cattle manure and process wastewater constitute "solid wastes" under RCRA because they are "any . . . discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations . . . ." 42 U.S.C. § 6903(27). Kinnard's practices in storing, treating, transporting, applying, and disposing of liquid and solid manure may, and do, present an imminent and substantial endangerment to the health of nearby residents and to the environment.

In particular, Kinnard and/or its agents have applied and are reasonably likely to continue to apply liquid and solid manure wastes to nearby agricultural fields in amounts that pose a risk of groundwater contamination by various pollutants, including excessive applications of nitrogen. Kinnard's NMP annual reports from 2010 - 2013 show that many fields receive over 200 pounds of nitrogen each year, which is likely to be more than crops can absorb. *See* Wade 2014. Application beyond that which the current crop can effectively utilize enables nitrates to leach through soil and into groundwater. Once these nitrates percolate below the root zone and enter the water table, they can no longer be beneficially used by crops and can readily migrate away from the Kinnard application fields and into the wells of nearby residents, as well as any

---

[27] 42 U.S.C. § 6973(a)

tile drainage systems that may be in the fields. As a result, these nitrates and other pollutants are "discarded" solid wastes for purposes of RCRA.

Several data sets indicate that these practices are responsible for groundwater contamination at levels beyond the MCL for nitrate. The MCLs are health-based standards that specify contaminants known to have an adverse effect on human health at levels beyond the parameters set forth by regulations. Observed levels for nitrate in several wells identified as at high risk of contamination from Kinnard Farms' practices (identified as Wells 1 – 4) exceed the MCL for nitrate, and in two separate tests Well 3 had 17.70 mg/L nitrate; nearly double the 10 mg/L limit. *See* 40 C.F.R. Part 141 and Appendix I. The practices responsible for this contamination appear to have been ongoing since Kinnard began its operations and to have been continuous for at least the past five years.

Numerous residents of Lincoln Township and Kewaunee County use and consume well water that is susceptible to contamination from Kinnard Farms and its many application fields due to geological characteristics and groundwater flow patterns, and many of these residential wells are contaminated with nitrate and/or bacterial contamination. Human consumption of water containing more than 10 mg/L of nitrate causes a variety of severe health problems, including but not limited to methemoglobinemia ("blue baby syndrome," a fatal condition that affects infants). The excessive nitrates and other contaminants contained in these wells can be attributed with a high degree of likelihood to Kinnard Farms' improper practices of storing and disposing (through application or otherwise) of liquid and solid manure wastes. Moreover, RCRA liability does not require Kinnard to be the sole source of the existing or ongoing contamination or ongoing risk of endangerment. As such, these practices present an imminent and substantial endangerment to health and the environment.

Section 7003 of RCRA, 42 U.S.C. § 6973, authorizes EPA and WDNR to investigate and abate this endangerment and to hold Kinnard accountable. We urge the agencies to use this authority, including: seeking temporary and/or permanent injunctive relief; assessing past, present, and future response, remediation, removal, and/or clean-up costs against Kinnard; and imposing the maximum civil penalties authorized by law. EPA has relied upon this authority to address nitrate and bacteria contamination in groundwater before, and to bring about response actions from agricultural sources of pollution which caused and contributed to public health endangerment.[28] Section 7003 also gives EPA broad authority to order each person responsible for the endangerment "to take such action as may be necessary," which EPA has interpreted to

---

[28] *See, e.g.*, EPA Memorandum, Findings in Support of Use of the Comprehensive Response Compensation and and Liability Act, Section 104(e) to Address Contamination in Yakima Valley Groundwater, Washington (April 15, 2010); *In the Matter of Golden Gate Hop Ranches, Inc.*, Magistrate No. MJ-10-4066-0, Administrative Warrant for Entry, Inspection, and Sampling Under CERCLA Section 104(e) and Safe Drinking Water Act Section 1431 (E.D. Wash., April 16, 2010); *In the Matter Of Seaboard Farms, Inc.*, U.S. EPA Docket No. RCRA-06-2001-0908, Unilateral Administrative Order (June 26, 2001) (hereinafter, "Seaboard Farms Order").

include a range of injunctive relief, and the authority to "to require in appropriate cases environmental assessment, controls on future operations, and, potentially, environmental restoration."[29]

b) Violations of the Resource Conservation and Recovery Act: Open Dumping

In addition to presenting an imminent and substantial endangerment to health and the environment, evidence indicates Kinnard Farms' manure application practices constitute "open dumping" in violation of RCRA. 42 U.S.C. § 6945(a) prohibits the operation of "any solid waste management practice or disposal of solid waste which constitutes the open dumping of solid waste." "Disposal" means "the discharge, deposit, injection, dumping, spilling, leaking, or placing of any solid waste ... into or on any land or water[.]" 42 U.S.C. § 6903(3). As required by statute, EPA has promulgated criteria under RCRA § 6907(a)(3) defining solid waste management practices that constitute open dumping. *See* 42 U.S.C. § 6944(a); 40 C.F.R. Parts 257 and 258. These regulations prohibit the contamination of any underground drinking water source beyond the solid waste boundary of a disposal site. 40 C.F.R. § 257.3-4(a).

The definition of "underground drinking water source" includes an aquifer supplying drinking water for human consumption or any aquifer in which the groundwater contains less than 10,000 mg/l total dissolved solids. 40 C.F.R. § 257.3-4(c)(4). The aquifer underlying Kewaunee County supplies drinking water and therefore clearly meets this definition. "Contaminate" means to introduce a substance that would cause: (i) the concentration of that substance in the groundwater to exceed the MCL specified in Appendix I, or (ii) an increase in the concentration of that substance in the groundwater where the existing concentration of that substance exceeds the MCLs specified in Appendix 1. 40 C.F.R. § 257.3-4(c)(2).

As established, Appendix I to 40 C.F.R. Part 257 lists the MCL for nitrate as 10 mg/L. Groundwater samples taken from wells downgradient of Kinnard's application fields revealed levels of nitrate in excess of the 10 mg/L MCL. The evidence presented in this letter support a finding that Kinnard Farms' past and present waste disposal practices have caused nitrate contamination to travel beyond the facility boundaries, in violation of RCRA's open dumping prohibitions. An analysis of Kinnard's recent annual reports shows high rates of nitrogen application on application fields already identified as vulnerable to groundwater contamination. This review found numerous fields with more than 400 pounds of nitrogen applied per acre between 2010 and 2013, a strong indication that Kinnard has applied manure in excess of realistic agronomic rates. *See* Wade 2014 and Spreadsheet Attachment. Application beyond that which the current crop can effectively utilize causes nitrates to leach through soil and into groundwater, which in turn causes nitrate levels in the groundwater to exceed the MCLs. These

---

[29] EPA Memorandum, Guidance on the Use of Section 7003 of RCRA (October 1997) (hereinafter, "RCRA Guidance") at 2.

practices appear to have been ongoing since Kinnard Farms began its operations, and to have been continuous for at least the past five years, and constitute a violation of RCRA's open dumping prohibition.

A recent federal court decision confirms that improper storage and disposal of CAFO waste can incur RCRA liability for both open dumping and contributing to an imminent and substantial endangerment. On January 14, 2015, the U.S. District Court for the Eastern District of Washington issued a Summary Judgment Order finding that a large dairy CAFO in Washington's Yakima Valley is in violation of both RCRA prohibitions.[30]

c) Violations of the Clean Water Act and Wisconsin's Pollution Discharge Elimination law

Kinnard's tile line discharges to surface waters and groundwater contamination each constitute CWA violations and violations of Kinnard's WPDES permit. Kinnard's WPDES permit authorizes tile line discharges in only extremely limited circumstances:

> "Manure or process wastewater may not run off the application site nor discharge to waters of the state through subsurface drains due to precipitation or snowmelt except if the permittee has complied with all land application restrictions in NR 243 and this permit, and the runoff or discharge occurs as a result of a rain event that is equal to or greater than a 25-year, 24-hour rain event."[31]

The permit further prohibits all discharges from subsurface drainage systems in dry weather conditions[32] and requires Kinnard to "identify, to the maximum extent practicable, the presence of subsurface drainage systems in fields where its manure or process wastewater is applied as part of the nutrient management plan."[33] Kewaunee Cares' surface water monitoring data and available maps of field tiles on Kinnard's application fields demonstrate chronic surface water pollution, not merely sporadic discharges occurring from extreme rain events while in compliance with the WPDES permit and state law. To the extent that these discharges are the result of Kinnard's failure to identify all tile systems, that also constitutes a permit violation.

Kinnard's groundwater pollution also violates the CWA and the permit. The objective of the CWA is to "'to restore and maintain the chemical, physical, and biological integrity of the

---

[30] Order Re: Cross Motions for Summary Judgment, *Cmty. Ass'n for Restoration of the Env't, Inc., v. Cow Palace, LLC.*, No. 2:13-cv-3016 (Jan. 14, 2015) (Attachment N).
[31] WPDES Permit Sec. 1.6.1.
[32] *Id*.
[33] *Id*. at Sec. 1.6.3.

Nation's waters.'"[34] Although the CWA imposes standards and effluent limitations to further this objective, it also expressly reserves to the states the right to adopt and enforce state standards or limitations more stringent that those imposed by the federal government.[35] More stringent state limitations in furtherance of the CWA's objective include "those necessary to meet water quality standards, treatment standards, or schedules of compliance. . . ."[36] Kinnard's WPDES Permit is an example of the state of Wisconsin's exercise of its delegated authority to impose permitting limitations beyond EPA's minimum federal requirements in furtherance of the objectives of the Act.[37]

Wisconsin statutes define groundwater as a water of the state.[38] Wisconsin groundwater quality standards for nitrate are 10 mg/L (enforcement standard) and 2 mg/L (preventive action limit). The standard for total coliform bacteria is effectively zero.[39] Wisconsin provides WDNR with clear authority to regulate land application practices that threaten groundwater.[40] In accordance with these standards and the state's statutory protections for groundwater resources, Kinnard's WPDES Permit includes restrictions on the land application of manure. Specifically:

> Land application practices shall maximize the use of available nutrients for crop production, prevent delivery of manure and process wastewater to waters of the state, and minimize the loss of nutrients and other contaminants to waters of the state to prevent exceedances of groundwater and surface water quality standards and to prevent impairment of wetland functional values.[41]

---

[34] *Friends of the Everglades v. S. Fla. Water Mgmt. Dist.*, 570 F.3d 1210, 1225 (11th Cir. 2009) (quoting 33 U.S.C. § 1251(a)).

[35] 33 U.S.C. § 1370.

[36] 33 U.S.C. § 1311(b)(1)(B) (CWA § 301). Along these lines, the State of Alabama has explicitly stated that groundwaters in Alabama are waters of the state. *See* Code of Ala. § 22-22-1(b)(2) (defining "waters" for purposes of Alabama's Water Pollution Control Act as "[a]ll waters of any river, stream, watercourse, pond, lake, coastal, *ground or surface water*, wholly or partially within the state, natural or artificial.") (emphasis added).

[37] See, e.g., Wis. Stat. Ann. § 283.001(2) ("The purpose of this chapter is to grant to the department of natural resources all authority necessary to establish, administer and maintain a state pollutant discharge elimination system to effectuate the policy set forth under sub. (1) and consistent with all the requirements of the federal water pollution control act amendments of 1972, P.L. 92-500; 86 Stat. 816 [the Clean Water Act].").

[38] Wis. Stat. Ann. § 281.01(18).

[39] See Wisconsin Administrative Code section NR 140.10, Table 1, available at http://docs.legis.wisconsin.gov/code/admin_code/nr/100/140.pdf ("Total coliform bacteria may not be present in any 100 ml sample using either the membrane filter (MF) technique, the presence−absence (P−A) coliform test, the minimal medium ONPG−MUG (MMO−MUG) test or not present in any 10 ml portion of the 10−tube multiple tube fermentation (MTF) technique.").

[40] *See* Wis. Stat. Ann. § 283.31(3)(f), stating that "[t]he department may issue a permit under this section for the discharge of any pollutant . . . upon condition that such discharge will meet . . . [g]roundwater protection standards established under ch. 160." *See also, e.g., Maple Leaf Farms, Inc. v. Wisconsin Dep't. Natural Res*, 633 N.W. 2d 720, 729 ("[B]ecasue a CAFO's overapplication of manure to fields can be a discharge to groundwater under the statute, we determine that the DNR has authority to issue permits regulating Maple Leaf's off-site landspreading operations."

[41] *Id*. at 4.

The permit further prohibits “caus[ing] the fecal contamination of water in a well.”[42] As Mr. Wade’s reports and the attached summary of citizen groundwater monitoring data show, there is abundant evidence that Kinnard does not apply manure to land in a way that “minimize[s] the loss of nutrients and other contaminants to waters of the state to prevent exceedances of groundwater and surface water quality standards” or has prevented well contamination; on the contrary, for years Kinnard has been applying manure at excessive rates on land that is known to be sensitive to contamination, and in areas that are known to be contaminated.

Conclusion

Extensive evidence indicates that Kinnard’s CAFO operation and waste disposal practices have caused and continue to cause significant harm to groundwater and surface waters, as well as significant degradation of surface water quality and threats to public health. Although WDNR has been aware of or had access to the majority of the facts described in this letter, and is aware of the widespread, land use-driven nitrate and bacteria contamination in Lincoln Township, Kinnard is still not operating under an enforceable order or agreement and WDNR has assessed no penalties. As the residents of Lincoln Township and Kewaunee County face increasing threats from over-application of CAFO waste, a strong enforcement presence is vital to protect the health and welfare of Wisconsin residents and the environment.

If you have any questions concerning this letter or the violations described herein, please contact us at the phone numbers or email addresses below. We would welcome the opportunity to discuss our findings further by telephone or meeting.

Thank you for your prompt attention to this matter.

Sincerely,

Abel Russ
Tarah Heinzen
Environmental Integrity Project
1000 Vermont Ave. NW, Suite 1100
Washington, DC 20005
aruss@environmentalintegrity.org
theinzen@environmentalintegrity.org
(202) 263-4441

---

[42] WPDES Permit 1.6.1.

Lynn Utesch
Kewaunee CARES
P.O. Box 84
Kewaunee, WI 54216

Clean Water Action Council of Northeast Wisconsin
P.O. Box 9144
Green Bay, WI 54308

Attachment A

WISCONSIN
DEPT. OF NATURAL RESOURCES

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

Scott Walker, Governor
Cathy Stepp, Secretary
Jean Romback-Bartels, Regional Director

Northeast Region Headquarters
2984 Shawano Avenue
Green Bay, WI 54313-6727
Telephone (920) 662-5100
FAX (920) 662-5159
TTY Access via relay - 711

Lee Kinnard
Kinnard Farms Inc
E2675 County Hwy S
Casco, WI 54205

SUBJECT: WPDES Permit Reissuance No. WI-0059536-03-0
Kinnard Farms Inc, E2669 County Hwy S, Casco, WI

Dear Permittee:

Your Wisconsin Pollutant Discharge Elimination System (WPDES) Permit is enclosed. The conditions of the attached permit reissuance were determined using the permit application, information from your WPDES permit file, other information available to the Department, comments received during the public notice period, and applicable Wisconsin Administrative Codes. Your operation is considered a large farm, and is regulated under the authority of ch. NR 243, Wis. Adm. Code. All discharges from this operation and actions or reports relating thereto shall be in accordance with the terms and conditions of this permit.

This permit requires you to submit monitoring results and landspreading summaries to the Department annually. Please send this information to the DNR Northeast Region, 2984 Shawano Avenue, Green Bay, WI 54313-6727. If this permit also requires you to submit engineering evaluations, and plans & specifications for manure storage facilities and runoff controls, please send this information to the Bureau of Watershed Management WT/2, P.O. Box 7921, Madison, WI 53707-7921.

The Department has the authority under chs. 160 and 283, Stats., to establish effluent limitations, monitoring requirements, and other permit conditions for discharges to groundwater and surface waters of the State. The Department also has the authority to issue, reissue, modify, suspend, or revoke WPDES permits under ch. 283, Stats.

To challenge the reasonableness of or necessity for any term or condition of the enclosed permit, s. 283.63, Stats., and ch. NR 203, Wis. Adm. Code, require that you file a verified petition for review with the Secretary of the Department of Natural Resources within 60 days of the date the permit was issued (see "Date Permit Signed/Issued" after the signature on the front page of the enclosed permit). For permit-related decisions that are not reviewable pursuant to s. 283.63, Stats., it may be possible for permittees or other persons to obtain an administrative review pursuant to s. 227.42, Stats., and s. NR 2.05(5), Wis. Adm. Code, or a judicial review pursuant to s. 227.52, Stats. If you choose to pursue one of these options, you should know that Wisconsin Statutes and Administrative Code establish time periods within which requests to review Department decisions must be filed.

Sincerely,

Casey J. Jones

Casey Jones
Agricultural Runoff Management Specialist
Dated: 8-16-12

cc: Cyndi Barr, Tom Bauman, Andrew Craig – DNR
U.S. Fish and Wildlife Service
Kewaunee County LWCD
Northeast Region - DNR

WPDES PERMIT

STATE OF WISCONSIN
DEPARTMENT OF NATURAL RESOURCES

PERMIT TO DISCHARGE UNDER THE WISCONSIN POLLUTANT DISCHARGE ELIMINATION SYSTEM

Kinnard Farms Inc

is permitted, under the authority of Chapter 283, Wisconsin Statutes, to manage and utilize manure from livestock facilities located in
Sections 19 and 30, T25N, R24E in the Town of Lincoln, Kewaunee County
to cropland within

Lake Michigan Basin, Kewaunee River Watershed and groundwaters of the state

in accordance with the effluent limitations, monitoring requirements and other conditions set forth in this permit.

The permittee shall not discharge after the date of expiration. If the permittee wishes to continue to discharge after this expiration date an application shall be filed for reissuance of this permit, according to Chapter NR 200, Wis. Adm. Code, at least 180 days prior to the expiration date given below.

State of Wisconsin Department of Natural Resources
For the Secretary

By Casey L. Jones
Casey L. Jones
Agricultural Runoff Management Specialist

8-16-12
Date Permit Signed/Issued

PERMIT TERM: EFFECTIVE DATE – September 1, 2012 **EXPIRATION DATE – August 31, 2017**

TABLE OF CONTENTS

1 Livestock Operational and Sampling Requirements

1.1 Production Area Discharge Limitations

The permittee shall comply with the livestock performance standards and prohibitions in ch. NR 151. In accordance with s. NR 243.13, the permittee may not discharge manure or process wastewater pollutants to navigable waters from the production area, including approved manure stacking sites, unless all of the following apply:

- Precipitation causes an overflow of manure or process wastewater from a containment or storage structure.
- The containment or storage structure is properly designed, constructed and maintained to contain all manure and process wastewater from the operation, including the runoff and the direct precipitation from a 25-year, 24-hour rainfall event for this location (**Kewaunee County – 4.2 inches**).
- The production area is operated in accordance with the inspection, maintenance and record keeping requirements in s. NR 243.19.
- The discharge complies with groundwater and surface water quality standards.

All structures shall be designed and operated in accordance with ss. NR 243.15 and NR 243.17 to control manure and process wastewater for the purpose of complying with discharge limitations established above and groundwater standards.

The permittee may not discharge pollutants to navigable waters under any circumstance or storm event from areas of the production area, including manure stacks on cropland, where manure or process wastewater is not properly stored or contained by a structure.

NOTE: Wastewater treatment strips, grassed waterways or buffers are examples of facilities or systems that by themselves do not constitute a structure.

1.2 Runoff Control

All runoff control systems shall be designed and maintained to comply with production area discharge limitations. Uncontaminated runoff shall be diverted away from manure and process wastewater storage and containment areas, raw materials storage and containment areas, and outdoor animal lots. All storage and containment structures associated with runoff control systems shall be operated in accordance with the "Proper Operations and Maintenance" section.

1.3 Manure and Process Wastewater Storage

All permittees shall have and maintain adequate storage for all manure and process wastewater generated at the operation to ensure that wastes can be properly stored and land applied in compliance with the conditions and timing restrictions of the permit, a Department approved nutrient management plan and s. NR 243.14(9).

1.3.1 Proper Operation and Maintenance

The permittee shall at all times properly operate and maintain all manure and process wastewater facilities and systems in compliance with the conditions of this permit. The permittee shall comply with the permit and s. NR 243.17, including the following requirements:

- All liquid manure and process wastewater storage or containment facilities shall have the permanent markers specified in s. NR 243.15(3)(e) (margin of safety and maximum operating level for liquid manure and process wastewater storage and the 180-day storage marker for liquid manure storage).
- Chemicals and other pollutants may not be added to manure, process wastewater or stormwater storage facilities or treatment systems without prior Department approval.
- Liquid manure storage facilities or systems shall be emptied to the point that the 180-day level indicator is visible on at least one day between October 1 and November 30, except for liquid manure remaining due to unusual fall weather conditions prohibiting manure applications during this time period. The permittee shall record the day on

which the 180-day level indicator was visible during this time period. Permittees unable to empty their storage facility to the 180-day level indicator between October 1 and November 30, shall notify the department in writing by December 5.

- The permittee shall maintain a design storage capacity of 180 days for liquid manure unless the Department approves a temporary reduction in design storage capacity to 150 days in accordance with s. NR 243.17(4).
- Prior to introducing any influent additives to a digester, other than manure, the permittee shall obtain written Department approval. If any materials other than manure are used in the digester, the permittee shall maintain daily records of the volumes of all manure and non-manure components added to the digester influent. As part of its approval, the Department may apply additional requirements in accordance with s. NR 243.17(1). As part of the Department's review, the Department may also require amendments to the permittee's nutrient management plan and the permittee shall submit an amended plan to the Department to incorporate the additional requirements.

1.3.2 Discharge Prevention

A permittee shall operate and maintain storage and containment facilities to prevent overflows and discharges to waters of the state.

- The permittee may not exceed the maximum operating level in liquid storage or containment facilities except as a result of recent precipitation or conditions that do not allow removal of material from the facility in accordance with permit conditions.
- The permittee shall maintain a margin of safety in liquid storage or containment facilities that levels of manure, process wastewater and other wastes placed in the storage or containment facility may not exceed. Materials shall be removed from the facility in accordance with the approved nutrient management plan to ensure that the margin of safety is not exceeded. Failure to maintain a margin of safety is permit noncompliance that must be reported to the Department in accordance with the timeframes specified in the Noncompliance-24 Hour Reporting subsection in the Standard Requirements.

1.3.3 Liquid Manure – 180-day storage

The permittee shall demonstrate compliance with the 180-day design storage capacity requirement at all the following times:

- As part of an application for permit reissuance.
- At the time of submittal of plans and specifications for proposed reviewable facilities or systems.
- In annual reports to the department.
- When an operation is proposing, at any time, a 20% expansion in animal units or an increase by an amount of 1,000 animal units or more unless the Department has approved reductions in design storage in accordance with s. NR 243.17(4).

1.3.4 Facility Closure and Abandonment

In accordance with s. NR 243.17, if the permittee plans to close or abandon structures or systems regulated by this permit, a closure or abandonment plan shall be submitted to the Department and written Department approval must be granted before closing the facility. Manure storage facilities shall be closed or abandoned in accordance with NRCS Standard 360 (December 2005). Closure or abandonment of a manure storage facility shall occur when manure has not been added or removed for a period of 24 months, unless the owner or operator can provide information to the Department that the structure is designed to store manure for a longer period of time or that the storage structure will be utilized within a specific period of time.

1.4 Solid Manure Stacking

All proposed stacking of solid manure outside of a Department approved storage facility shall be submitted to the department for approval and identified in the permittee's nutrient management plan. A permittee may not stack manure on a site unless the permittee has obtained Department approval to stack. Stacking practices shall comply with requirements of s. NR 243.141. Stacking approvals may be rescinded by the Department based on documented impacts to waters of the state at or from the stacking site or ruuoff onto another persons land. Stacking shall comply with following requirements:

- When piled in a stack, the solid manure stack must be able to maintain its shape with minimal sloughing such that an angle of repose of 45 degrees or greater is maintained when the manure is not frozen.
- Stacking of solid manure outside of a department approved manure storage facility shall, at a minimum, meet the specifications in NRCS Standard 313, Table 9, dated December 2005. Alternatively, stacks may be placed on sites with soils in the hydrologic soil group D provided the manure has a solids content of greater than 32% and all other criteria in NRCS Standard 313, Table 9, are met.
- The permittee shall implement any necessary additional best management practices to ensure stacking areas maintain compliance with the production area requirements in s. NR 243.13. Best management practices may include upslope clean water diversions or downslope containment structures.
- The stacked manure shall have minimal leaching so that leachate from the stack is contained within the designated stacking area and does not cause an exceedance of groundwater quality standards.
- Solid manure may not be stacked in a water quality management area.
- Stacks may only be placed on cropland.

As part of the Department approval, the Department may require additional restrictions on stacking of solid manure needed to protect water quality. The permittee shall manage the stack in compliance with the additional restrictions specified in the approval.

1.5 Ancillary Service and Storage Areas

The permittee may discharge contaminated storm water to waters of the state from ancillary service and storage areas provided the discharges of contaminated stormwater comply with groundwater and surface water quality standards. The permittee shall take preventive maintenance actions and conduct periodic visual inspections to minimize the discharge of pollutants from these areas to surface waters. For CAFO outdoor vegetated areas, the permittee shall also implement the following practices:

- Manage stocking densities, implement management systems and manage feed sources to ensure that sufficient vegetative cover is maintained over the entire area at all times.
- Prohibit direct access of livestock or poultry to surface waters or wetlands located in or adjacent to the area unless approved by the department.

1.6 Nutrient Management

Except as provided for in s. NR 243.142(2), the permittee is responsible for ensuring that the manure and process wastewater generated by the operation is land applied or disposed of in a manner that complies with the terms of this permit, the approved nutrient management plan and s. NR 243.14.

The permittee shall land apply manure and process wastewater in compliance with the Department approved nutrient management plan, s. NR 243.14 and the terms and conditions of this permit. Land application practices shall not exceed crop nutrient budgets determined in accordance with NRCS Standard 590, this permit and s. NR 243.14 and shall be based on manure and process wastewater analyses, soil tests, as well as other nutrient sources applied to a field. The permittee shall review and amend the nutrient management plan on an annual basis to reflect any changes in operations over the previous year (including incorporation of the previous year's amendments and new soil test results) and to include projected changes for the upcoming year. Annual updates are due in accordance with the Schedules section of the permit.

The management plan may be amended at any time provided the proposed amendments are approved in writing by the department and meet the requirements of s. NR 243.14. Changes requiring a plan amendment include, but are not limited to, changes to application rates, new spreading sites, changes in the number of livestock, changes in manure storage procedures, or changes in the type of manure spreading equipment. Unless specified in the "Special Permit Conditions" section of the permit, an amendment does not become effective and may not be implemented until the department has reviewed and approved the amendment. In addition, all approved amendments in a given year shall be included in the Annual Update.

The permittee shall maintain daily spreading records and submit annual reports relating to land application activities in accordance with s. NR 243.19.

1.6.1 General Spreading Restrictions

The permittee shall land apply manure and process wastewater in compliance with the following:

- Manure or process wastewater may not pond on the application site.
- During dry weather conditions, manure or process wastewater may not run off the application site, nor discharge to waters of the state through subsurface drains.
- Manure or process wastewater may not cause the fecal contamination of water in a well.
- Manure or process wastewater may not run off the application site nor discharge to waters of the state through subsurface drains due to precipitation or snowmelt except if the permittee has complied with all land application restrictions in NR 243 and this permit, and the runoff or discharge occurs as a result of a rain event that is equal to or greater than a 25-year, 24-hour rain event.
- Manure or process wastewater may not be applied to saturated soils.
- Land application practices shall maximize the use of available nutrients for crop production, prevent delivery of manure and process wastewater to waters of the state, and minimize the loss of nutrients and other contaminants to waters of the state to prevent exceedances of groundwater and surface water quality standards and to prevent impairment of wetland functional values. Practices shall retain land applied manure and process wastewater on the soil where they are applied with minimal movement.
- Manure or process wastewater may not be applied on areas of a field with a depth to groundwater or bedrock of less than 24 inches.
- Manure or process wastewater may not be applied within 100 feet of a direct conduit to groundwater.
- Manure or process wastewater may not be applied within 100 feet of a private well or non-community system as defined in ch. NR 812 or within 1000 feet of a community well as defined in ch. NR 811.
- Unless specified otherwise in this permit, where incorporation of land applied manure is required, the incorporation shall occur within 48 hours of application.
- Manure or process wastewater may not be surface applied when precipitation capable of producing runoff is forecast within 24 hours of the time of planned application.
- Manure may not be spread in a waterway, terrace channel or any areas where there may be a concentration of runoff.
- Fields receiving manure and process wastewater may not exceed tolerable soil loss ("T").

1.6.2 Non-Cropland Applications

Manure may be applied to non-cropland if pre-approval in writing is issued by the Department. Considerations for approval may include acceptable application timing, amounts and methods.

1.6.3 Additional Nutrient Management Plan Requirements

- If applicable, the permittee shall specify the method(s) of incorporation in its nutrient management plan.
- The permittee shall identify, to the maximum extent practicable, the presence of subsurface drainage systems in fields where its manure or process wastewater is applied as part of the nutrient management plan.
- In accordance with s. NR 243.14(3), the permittee shall account for 1st and 2nd year nutrient credits.
- On a field-by-field basis, the permittee shall select and implement one of the practices listed in s. NR 243.14(4) for manure and process wastewater applications in a SWQMA (defined in ch. NR 243), and include the selected practices in the nutrient management plan. Whenever manure or process wastewater is applied within a SWQMA, the permittee shall apply the material in compliance with the SWQMA practices specified in the approved nutrient management plan.
- On a field-by-field basis, the permittee shall select one of the methods specified in s. NR 243.14(5) for assessing and minimizing the potential delivery of phosphorus to surface waters, and include the selected method in the nutrient management plan. The permittee shall apply manure and process wastewater to fields in compliance with the

phosphorus methods specified in the approved nutrient management plan. On a field-by-field basis, the permittee shall select and implement one of the methods.

1.6.4 Frozen or Snow Covered Ground – General Spreading Restrictions

If the permittee applies manure on frozen or snow-covered ground, the permittee shall land apply the manure in compliance with all of the restrictions in s. NR 243.14(6)-(8). Some of these restrictions include:

- Any incorporation of manure on frozen or snow-covered ground must be done immediately after application.
- The permittee shall identify acceptable sites for allowable applications on frozen or snow-covered ground as part of its nutrient management plan.
- The permittee shall evaluate each field at the time of application to determine if conditions are suitable for applying manure and complying with the requirements of this permit. All surface applications of manure or process wastewater on frozen or snow-covered ground shall occur on those fields that represent the lowest risk of pollutant delivery to waters of the state and where the application results in a winter acute loss index value of 4 or less using the Wisconsin phosphorus index.
- Manure or process wastewater may not be land applied on fields when snow is actively melting such that water is flowing off the field.
- On fields with soils that are 60 inches thick or less over fractured bedrock, manure may not be applied on frozen ground or where snow is present.
- Manure may not be incorporated on areas of fields with greater than 4 inches of snow.

[NOTE: Please refer to ch. NR 243 for all requirements contained in s. NR 243.14(6)-(8).]

1.6.5 Frozen or Snow Covered Ground – Solid Manure (12% solids or more)

The permittee may surface apply solid manure on frozen or snow-covered ground in compliance with the following restrictions:

- Solid manure may not be surface applied on slopes greater than 9%.
- Solid manure may not be surface applied from February 1 through March 31 on areas of fields where an inch or more of snow is present or where the ground is frozen.
- The surface application shall comply with the restrictions in Table 1.

Table 1
Restrictions for Surface Applying Solid Manure on Frozen and Snow Covered Ground

Criteria	**Restrictions for fields with 0-6% slopes**	**Restrictions for fields with slopes > 6% and up to 9%**
Required fall tillage practice prior to application	Chisel or moldboard plow, no-till or a department approved equivalent^A	Chisel or moldboard plow, no-till or department approved equivalent^A
Minimum % solids allowed	12%	> 20%
Application rate (cumulative per acre)	Not to exceed 60 lbs. P_2O_5 per winter season, the following growing season's crop P_2O_5 budget taking into account nutrients already applied, or phosphorus application restrictions specified in a department approved nutrient management plan, whichever is less	Not to exceed 60 lbs. P_2O_5 per winter season, the following growing season's crop P_2O_5 budget taking into account nutrients already applied, or phosphorus application restrictions specified in a department approved nutrient management plan, whichever is less
Setbacks from surface waters	No application allowed within SWQMA	No application allowed within 2.0 x SWQMA

Table 1
Restrictions for Surface Applying Solid Manure on Frozen and Snow Covered Ground

Criteria	Restrictions for fields with 0-6% slopes	Restrictions for fields with slopes > 6% and up to 9%
Setbacks from downslope areas of channelized flow, vegetated buffers, and wetlands	200 feet	400 feet
Setbacks from direct conduits to groundwater	300 feet	600 feet
A – All tillage and farming practices shall be conducted in accordance with the following requirements; 0-2% slope = no contouring required, >2-6% slope = tillage and practices conducted along the general contour, >6% slope = tillage and farming practices conducted along the contour. The department may approve alternative tillage practices on a case-by-case basis in situations where conducting practices along the contour is not possible. Allowances for application on no-till fields only apply to fields where no-till practices have been in place for a minimum of 3 years.		

1.6.6 Frozen or Snow Covered Ground – Allowances for Surface Applications of Liquid Manure (<12% solids)

The permittee is prohibited from surface applying liquid manure during February and March, and is prohibited from surface applying liquid manure on frozen or snow-covered ground except for the following conditions:

- The permittee may surface apply liquid manure on frozen or snow covered ground, including during February and March, on an emergency basis in accordance with Table 2 and s. NR 243.14(7)(d) on fields the Department has approved for emergency applications. The permittee must notify the department verbally prior to the emergency application. Unless the emergency application is necessitated by imminent impacts to the environment or human or animal health, the permittee may not apply manure to a field on an emergency basis until the department has verbally approved the application. The permittee shall submit a written description of the emergency application and the events leading to the emergency application to the department within 5 days of the emergency application.
- Liquid manure that is frozen and cannot be transferred to a manure storage facility may be surface applied on frozen or snow-covered ground, including during February and March, in accordance with the restrictions in Tables 2 and s. NR 243.14(f). Surface applications of frozen liquid manure do not require prior department approval or notification provided application sites for frozen liquid manure are identified in the approved nutrient management plan. During February and March, the permittee shall notify the department if the permittee expects to surface apply frozen liquid manure more than 5 days in any one month.

Table 2
Restrictions for Surface Applications of Liquid Manure on Frozen or Snow Covered Ground

Criteria	Restrictions for fields with 0-2% slopes	Restrictions for fields with >2-6% slopes
Required fall tillage practice prior to application	Chisel or moldboard plow or department approved equivalent^A	Chisel or moldboard plow or department approved equivalent^A
Application rate (cumulative per acre)	Maximum application volume of 7,000 gallons per acre per winter season, not to exceed 60 lbs. P_2O_5, the following growing season's crop P_2O_5 budget taking into account nutrients already applied or other phosphorus application restrictions specified	Maximum application volume of 3,500 gallons per acre per winter season, not to exceed 30 lbs. P_2O_5, the following growing season's crop P_2O_5 budget taking into account nutrients already applied, or other phosphorus application

Table 2
Restrictions for Surface Applications of Liquid Manure on Frozen or Snow Covered Ground

Criteria	Restrictions for fields with 0-2% slopes	Restrictions for fields with >2-6% slopes
	in a department approved nutrient management plan, whichever is less	restrictions specified in a department approved nutrient management plan, whichever is less
Setbacks from surface waters	No application allowed within SWQMA	No application allowed within SWQMA
Setbacks from downslope areas of channelized flow, vegetated buffers, wetlands	200 feet	200 feet
Setbacks from direct conduits to groundwater	300 feet	300 feet

A – All tillage and farming practices shall be conducted along the contour in accordance with the following requirements; 0-2% slope = no contouring required, >2-6% slope = tillage and practices conducted along the general contour. The department may approve alternative tillage practices on a case-by-case basis in situations where conducting practices along the contour is not possible

1.6.7 Frozen or Snow Covered Ground – Process Wastewater

If a permittee land applies process wastewater on frozen or snow-covered ground, the permittee shall land apply the process wastewater in compliance with s. NR 214.17(2) through (6) and the other land application restrictions in this permit, except for the restrictions in the "Frozen or Snow Covered Ground – Solid Manure (12% solids or more)" and "Frozen or Snow Covered Ground – Allowances for Surface Applications of Liquid Manure (<12% solids)" sections of this permit.

1.6.8 Spreading Sites Submittals

Permittee requests to amend a nutrient management plan to include landspreading sites not found in an approved management plan shall include the following information:

- The location of the site on maps and aerial photographs, and soil survey maps.
- A unique site identification number
- Information used to verify the site meets locational requirements of the permit,
- A nutrient budget for the site consistent with permit requirements. This includes a completed worksheet outlining the process in determining appropriate spreading rates for each additional site, including a crop history identifying the previous season's crops and future cropping plans for each site and estimated nutrient uptake.
- A demonstration that the field(s) in question meets tolerable soil loss rate.
- Maps that show where land application is prohibited or restricted on a map or aerial photograph of the site.
- Soil samples if available for one-time applications. If the permittee wishes to use the site for subsequent applications, soil samples shall be submitted prior to additional landspreading.

1.7 Monitoring and Sampling Requirements

The permittee shall comply with the monitoring and sampling requirements specified below for the listed sampling point(s), and the following conditions.

1.7.1 Monitoring and Inspection Program

As specified in the Schedules section of this permit, the permittee shall submit a monitoring and inspection program designed to determine compliance with permit requirements. The program shall be consistent with the requirements of this section and shall identify the areas that the permittee will inspect, the person responsible for conducting the inspections and how inspections will be recorded and submitted to the department.

Visual inspections shall be completed by the permittee or designee in accordance with the following frequencies:

- Daily inspections for leakage of all water lines that potentially come into contact with pollutants or drain to storage or containment structures or runoff control systems, including drinking or cooling water lines.
- Weekly inspections to ensure proper operation of all storm water diversion devices and devices channeling contaminated runoff to storage or containment structures.
- Weekly inspections of liquid storage and containment structures. For liquid storage and containment facilities, the berms shall be inspected for leakage, seepage, erosion, cracks and corrosion, rodent damage, excessive vegetation and other signs of structural weakness. In addition, the level of material in all liquid storage and containment facilities shall be measured and recorded in feet or inches above or below the margin of safety level.
- Quarterly inspections of the production area, including outdoor animal pens, barnyards and raw material storage areas. CAFO outdoor vegetated areas shall be inspected quarterly.
- Periodic inspections and calibration of landspreading equipment to detect leaks and ensure accurate application rates for manure and process wastewater. An initial calibration of spreading equipment shall be followed by additional calibration after any equipment modification that may impact application of manure or process wastewater or after changes in product or manure or process wastewater consistency. Spreading equipment for both liquid and solid manure shall be inspected just prior to the hauling season, and equipment used for spreading liquids shall be inspected at least once per month during months when hauling occurs.
- Inspections of fields each time manure or process wastewater is surface applied on frozen or snow-covered ground to determine if applied materials have run off the application site. Inspections shall occur during and shortly after application.

The permittee shall take corrective actions as soon as practicable to address any equipment, structure or system malfunction, noncompliance, failure or other problem identified through monitoring or inspections. If the permittee fails to take corrective actions within 30 days of identifying a malfunction, noncompliance, failure or other problem, the permittee shall contact the Department immediately following the 30-day period and provide an explanation for its failure to take action.

1.7.2 Sampling Requirements

The permittee shall collect and analyze representative samples of land applied manure and process wastewater for the parameters outlined in the monitoring requirements for each sample point. The permittee shall also collect and analyze soils from fields used for manure or process wastewater applications at least once every four years. Sampling of manure, process wastewater and soils shall be done in accordance with s. NR 243.19(1)(c).

1.8 Sampling Point(s)

The permittee is authorized to use only the facilities identified below, in accordance with the conditions specified in this permit. The permittee may not install or use new facilities or structures or land apply manure or other process wastewaters from these facilities unless written Department approval is received. A new facility is any facility that is not specifically identified in this permit. If a new facility is approved in writing by the Department, the conditions in the corresponding 'New Facility' sampling point (e.g. Manure Storage Facilities, Runoff Control Systems) will apply.

1.8.1 Manure and Process Wastewater Storage Facilities - Sampling Required

In accordance with the Production Area Discharge Limitations subsection, manure and process wastewater storage facilities shall be operated and maintained to prevent discharges to navigable waters and to comply with surface water quality standards. In addition, manure and process wastewater storage facilities shall be operated and maintained to minimize leakage for the purpose of complying with groundwater standards. Unless specifically approved and designated by the Department as a sampling point, in-field unconfined storage of manure (manure stacking) is prohibited. The permittee is anthorized to use facilities identified below, in accordance with the conditions specified in this permit.

Sampling Point Designation	
Sampling Point Number	**Sampling Point Location, System Description (including capacity, legal location, and action needed as applicable), and Treatment Description**
001	Sample point 001 is for any manure laden sand from the sand settling lane south of freestall barns at Site One that is directly land applied or headland stacked. Once Site Two is constructed, headland stacking will no longer be allowed on cropland.
002	Sample point 002 is for manure and process wastewater removed from cell one of the two stage earthen waste storage facility at Site One.
003	Sample point 003 is for manure and process wastewater removed from the cell two of the two stage earthen waste storage facility at Site One.
004	Sample point 004 is to be used to track all solid manure generated at Site One that is directly land applied.
006	Sample point 006 is for manure and process wastewater stored in concrete waste storage facility 1 at Site Two.
007	Sample point 007 is for manure and process wastewater stored in concrete waste storage facility 2 at Site Two.
008	Sample point 008 is for any solid manure generated at Site Two and directly land applied.
012	Sample point 012 is to be used to track all solid manure generated at Heifer Farm 1 (Theise Farm) that is directly land applied or headland stacked.
013	Sample point 013 is for manure removed from the concrete waste storage facility located at Heifer Farm 2 (Kruswick Farm).
014	Sample point 014 is for manure and process wastewater stored in concrete waste storage facility 3 at Site Two.

Manure and Process Wastewater Storage Facilities - Action Needed: For manure and process wastewater storage facilities that are to be installed, evaluated or abandoned (as indicated in the above table), see the Schedules section herein for actions required. Although this permit may require actions for installing permanent facilities, or controls, or modifications to existing facilities, interim measures shall be immediately implemented to prevent discharges of pollutants to navigable waters. Specifically, if monitoring or inspection reports indicate any storage facility may not be able to prevent discharges to navigable waters in accordance with the conditions in the Production Area Discharge Limitations subsection, the permittee shall immediately install interim control measures to contain the discharges. Plans and specifications for permanent facilities must be submitted to the Department for review and approval in accordance with Chapter 281.41, Wis. Statutes, and Chapter NR 243, Wis. Adm. Code.

1.8.2 Runoff Control System(s) - No Sampling Required

In accordance with the Production Area Discharge Limitations subsection, the permittee shall control contaminated runoff from all elements of the livestock operation to prevent a discharge of pollutants to navigable waters and to comply with surface water quality standards and groundwater standards.

Sampling Point Designation	
Sampling Point Number	**Sampling Point Location, System Description (including capacity, legal location, and action needed as applicable), and Treatment Description**
005	Sample point 005 is for inspection and maintenance of the feed storage area and runoff controls at Site One. An evaluation of this system is required to ensure it meets standards and permit requirements.
009	Sample point 009 is for inspection and maintenance of the feed storage area and runoff controls at Site Two.
010	Sample point 010 is for inspection and management of feedlot areas at Heifer Farm 1 (Theise Farm). It is anticipated that this facility will no longer be used once Site Two is constructed. If site use is continued, see Schedules section of permit for requirements.
011	Sample point 011 is for inspection and management of feedlot areas at Heifer Farm 2 (Kruswick Farm). It is anticipated that this facility will no longer be used once Site Two is constructed. If site use is continued, see Schedules section of permit for requirements.

Runoff Control System(s) - Action Needed: For runoff control systems that are to be installed, evaluated or abandoned (as indicated in the above table), see the Schedules section herein for actions required. Although permanent control measures may be required by this permit, interim measures shall be implemented to prevent discharges of pollutants to navigable waters. Specifically, if monitoring or inspection reports indicate that manure or process wastewater may be discharged to navigable waters from the animal production area, in violation of the conditions in the Production Area Discharge Limitations subsection, the permittee shall immediately install interim control measures to contain the discharges. Plans and specifications for permanent runoff controls must be submitted to the Department for review and approval in accordance with Chapter 281.41. Wis. Statutes, and Chapter NR 243, Wis. Adm. Code.

1.8.3 Sampling Point 001 - Sand Settling Cell - Site One; 004- Solid Manure - Site One; 008- Solid Manure - Site Two; 012- Solid Manure - Heifer Farm 1

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limits and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Nitrogen, Total		lbs/ton	Quarterly	Grab	
Nitrogen, Available		lbs/ton	Quarterly	Calculated	
Phosphorus, Total		lbs/ton	Quarterly	Grab	
Phosphorus, Available		lbs/ton	Quarterly	Calculated	
Solids, Total		Percent	Quarterly	Grab	

Reporting: Sampling test results shall be submitted with the Annual Report. Sampling is only required when land application has actually occurred.

Daily Log Requirements

The permittee shall document all discharge and monitoring activities on daily log report form 3200-123A or a Department approved equivalent log sheet. Originals of the daily log reports shall be kept by the permittee as described under Record Keeping and Retention in the Standard Requirements section, and if requested, made available to the Department.

Parameters	Units
Date of Application	Date
Field ID	Number/Name
Acres Applied	Number of Acres
Manure/Process Wastewater Source	Specify Storage Facility or Barn
Spreader Volume	Tons or Gallons
Number of Loads	Number
Soil Conditions	Dry, Wet, Frozen, Snow Covered
Temperature During Application	°F
Precipitation During Application	Describe Precipitation
Application Method	Surface Applied, Injected, Incorporated

Annual Report

The permittee shall submit an Annual Report, including Form 3200-123 or a Department approved equivalent, that summarizes all landspreading activities and includes the information identified below, the lab analyses of the manure and other waste landspread, the "I" compliance worksheet for all fields, and the soil test frequency in the past four years. The Annual Report is due each year by the date specified in the Schedules section of this permit. Nitrogen and phosphorus from all sources applied to a given field, including commercial fertilizers, shall be included in the "Total Nitrogen" and "Total Phosphorus" sections of the Annual Report.

Parameters	Units	Sample Type
Date of Application	Date	-
Field ID	Number/Name	-
Acres Applied	Number of Acres	-
Slope	Percent	-
Soil Test P Ave.	ppm	-
Manure Source	-	Composite
Current Crop	-	-
Crop Nitrogen Needs (per soil test)	Pounds/Acre	-
Crop P_2O_5 Needs (per soil test)	Pounds/Acre	-
Manure Analysis: Available Nitrogen	Pounds/Ton	Calculated

Annual Report

The permittee shall submit an Annual Report, including Form 3200-123 or a Department approved equivalent, that summarizes all landspreading activities and includes the information identified below, the lab analyses of the manure and other waste landspread, the "T" compliance worksheet for all fields, and the soil test frequency in the past four years. The Annual Report is due each year by the date specified in the Schedules section of this permit. Nitrogen and phosphorus from all sources applied to a given field, including commercial fertilizers, shall be included in the "Total Nitrogen" and "Total Phosphorus" sections of the Annual Report.

Parameters	Units	Sample Type
Manure Analysis: Available P_2O_5	Pounds/Ton	Calculated
Manure Application Rate	Tons/Acre	-
Manure/Process Wastewater Applied: Nitrogen	Pounds/Acre	-
Manure/ Process Wastewater Applied: P_2O_5	Pounds/Acre	-
Previous Crop	-	-
Legume Nitrogen Credit	Pounds/Acre	-
Second Year Manure Credit	Pounds/Acre	-
Additional Fertilizer: Nitrogen	Pounds/Acre	-
Additional Fertilizer: P_2O_5	Pounds/Acre	-
Total Nitrogen Applied	Pounds/Acre	-
Total P_2O_5 Applied	Pounds/Acre	-
Soil Conditions	Dry, Wet, Frozen, Snow Covered	-
Application Method	Surface Applied, Injected, Incorporated	-
Banked	Yes/No	-
Field Restrictions	Per Nutrient Management Plan	-

1.8.4 Sampling Point 002 - Earthen WSF 1 - Site One; 003- Earthen WSF 2 - Site One; 006- WSF 1 - Site Two; 007- WSF 2- Site Two; 013- Concrete WSF - Heifer Farm 2, and 014- WSF 3 - Site Two

Monitoring Requirements and Limitations

Parameter	Limit Type	Limits and Units	Sample Frequency	Sample Type	Notes
Nitrogen, Total		lb/1000gal	2/Month	Grab	
Nitrogen, Available		lb/1000gal	2/Month	Calculated	
Phosphorus, Total		lb/1000gal	2/Month	Grab	
Phosphorus, Available		lb/1000gal	2/Month	Calculated	

Solids, Total		Percent	2/Month	Grab	

Reporting: Sampling test results shall be submitted with the Annual Report. Sampling is only required when land application has actually occurred.

Daily Log Requirements

The permittee shall document all discharge and monitoring activities on daily log report form 3200-123A or a Department approved equivalent log sheet. Originals of the daily log reports shall be kept by the permittee as described under Record Keeping and Retention in the Standard Requirements section, and if requested, made available to the Department.

Parameters	**Units**
Date of Application	Date
Field ID	Number/Name
Acres Applied	Number of Acres
Manure/Process Wastewater Source	Specify Storage Facility or Barn
Spreader Volume	Tons or Gallons
Number of Loads	Number
Soil Conditions	Dry, Wet, Frozen, Snow Covered
Temperature During Application	°F
Precipitation During Application	Describe Precipitation
Application Method	Surface Applied, Injected, Incorporated

Annual Report

The permittee shall submit an Annual Report, including Form 3200-123 or a Department approved equivalent, that summarizes all landspreading activities and includes the information identified below, the lab analyses of the manure and other waste landspread, the "T" compliance worksheet for all fields, and the soil test frequency in the past four years. The Annual Report is due each year by the date specified in the Schedules section of this permit. Nitrogen and phosphorus from all sources applied to a given field, including commercial fertilizers, shall be included in the "Total Nitrogen" and "Total Phosphorus" sections of the Annual Report.

Parameters	**Units**	**Sample Type**
Date of Application	Date	-
Field ID	Number/Name	-
Acres Applied	Number of Acres	-
Slope	Percent	-
Soil Test P Ave.	ppm	-
Manure Source	-	Composite

Annual Report

The permittee shall submit an Annual Report, including Form 3200-123 or a Department approved equivalent, that summarizes all landspreading activities and includes the information identified below, the lab analyses of the manure and other waste landspread, the "I" compliance worksheet for all fields, and the soil test frequency in the past four years. The Annual Report is due each year by the date specified in the Schedules section of this permit. Nitrogen and phosphorus from all sources applied to a given field, including commercial fertilizers, shall be included in the "Total Nitrogen" and "Total Phosphorus" sections of the Annual Report.

Parameters	Units	Sample Type
Current Crop	-	-
Crop Nitrogen Needs (per soil test)	Pounds/Acre	-
Crop P_2O_5 Needs (per soil test)	Pounds/Acre	-
Manure/Process Wastewater Analysis: Available Nitrogen	Pounds/1000 Gallons	Calculated
Manure/Process Wastewater Analysis: Available P_2O_5	Pounds/1000 Gallons	Calculated
Manure/Process Wastewater Application Rate	Gallons/Acre	-
Manure/Process Wastewater Applied: Nitrogen	Pounds/Acre	-
Manure/ Process Wastewater Applied: P_2O_5	Pounds/Acre	-
Previous Crop	-	-
Legume Nitrogen Credit	Pounds/Acre	-
Second Year Manure Credit	Pounds/Acre	-
Additional Fertilizer: Nitrogen	Pounds/Acre	-
Additional Fertilizer: P_2O_5	Pounds/Acre	-
Total Nitrogen Applied	Pounds/Acre	-
Total P_2O_5 Applied	Pounds/Acre	-
Soil Conditions	Dry, Wet, Frozen, Snow Covered	-
Application Method	Surface Applied, Injected, Incorporated	-
Banked	Yes/No	-
Field Restrictions	Per Nutrient Management Plan	-

2 Schedules

2.1 Annual Reports

Submit Annual Reports by January 31st of each year in accordance with the Annual Reports subsection in Standard Requirements.

Required Action	Date Due
Submit Annual Report #1: Inspection and landspreading summaries from 2012.	01/31/2013
Submit Annual Report #2: Inspection and landspreading summaries from 2013.	01/31/2014
Submit Annual Report #3: Inspection and landspreading summaries from 2014.	01/31/2015
Submit Annual Report #4: Inspection and landspreading summaries from 2015.	01/31/2016
Submit Annual Report #5: Inspection and landspreading summaries from 2016.	01/31/2017
Ongoing Annual Reports: Continue to submit Annual Reports until permit reissuance has been completed.	January 31st each year

2.2 Nutrient Management Plan

Updates to NMP due each year on March 31st.

Required Action	Date Due
Written certification for all landowners within nutrient management plan: For all land not owned by Kinnard Farms, certification signed by each landowner shall be submitted to the Department to further confirm that land base identified in NMP is available for Kinnard Farms to land apply manure and process wastewater.	10/01/2012
Management Plan Annual Update #1: Submit an Annual Update to the Nutrient Management Plan by March 31st each year. Note: In addition to Annual Updates, submit Management Plan Amendments to the Department for written approval prior to implementation of any changes to nutrient management practices, in accordance with the Nutrient Management requirements in the Livestock Operational and Sampling Requirements section.	03/31/2013
Management Plan Annual Update #2: Submit an Annual Update to the Nutrient Management Plan.	03/31/2014
Management Plan Annual Update #3: Submit an Annual Update to the Nutrient Management Plan.	03/31/2015
Management Plan Annual Update #4: Submit an Annual Update to the Nutrient Management Plan.	03/31/2016
Management Plan Annual Update #5: Submit an Annual Update to the Nutrient Management Plan.	03/31/2017
Ongoing Management Plan Annual Updates: Continue to submit Annual Updates to the Nutrient Management Plan until permit reissuance has been completed.	March 31st each year

2.3 Runoff Control System - Feedlot Engineering Evaluation

Outdoor lot areas at Heifer Farms 1 and 2 (only if use of sites is continued in 2013).

Required Action	Date Due
Written Description of Existing System: Submit a written description of the existing runoff control system and its adequacy to permanently meet the conditions in the Production Area Discharge	12/31/2012

Limitations and Runoff Control subsections and s. NR 243.15, Wis. Adm. Code. (See Standard Requirements for report details.)	
Plans and Specifications: Submit plans and specifications for Department review and approval to permanently correct any adverse runoff control conditions in accordance with Chapter 281.41, Wis. Stats., and Chapter NR 243, Wis. Adm. Code.	03/01/2013
Corrections and Post Construction Documentation: Complete construction of runoff controls that permanently correct any adverse runoff control conditions in concurrence with and approval by the Department, by the specified Date Due. Submit post construction documentation within 60 days of completion of the project.	11/01/2013

2.4 Feed Storage - Engineering Evaluation

Site One - Feed storage runoff controls.

Required Action	Date Due
Written Description of Existing System: Submit an engineering evaluation that includes a written description of the existing feed storage area and its adequacy to meet the conditions found in the Production Area Discharge Limitations subsection and NR 243.15, Wis. Adm. Code. If it does not meet requirements, temporary control measures shall be put in place until modifications are completed.	10/01/2012
Plans and Specifications: Submit plans and specifications for Department review and approval to permanently correct any adverse conditions identified as part of the engineering evaluation for the feed storage area in accordance with Chapter 281.41, Wis. Stats., and Chapter NR 243, Wis. Adm. Code.	03/01/2013
Corrections and Post Construction Documentation: Complete construction of improvements to permanently correct any adverse conditions in concurrence with and approval by the Department, by the specified Date Due. Submit post construction documentation within 60 days of completion of the project.	09/01/2013

2.5 Manure Storage Facility - Installation

Site Two - These structures must be completed prior to placement of animals on the site.

Required Action	Date Due
Complete Installation: Complete construction of the manure storage facility. The facility shall be functional and in operation by the specified Date Due. Post construction documentation shall be submitted within 60 days of completion of the project.	Construction shall start once plans are approved.

2.6 Feed Storage Runoff Control System - Installation

Site Two - This structure must be completed prior to placement of feed on the site.

Required Action	Date Due
Complete Installation: Complete construction of runoff control system. System shall be functional and in operation by the specified Date Due. Post construction documentation shall be submitted within 60 days of completion of the project.	Construction shall start once plans are approved.

2.7 Manure Headland Stacking - Discontinue Practice

Upon completion of the manure storage at Site Two, all stacked manure (including used sand bedding) shall be moved to approved storage or land applied according to approved nutrient management plan.

Required Action	Date Due
Discontinue Practice: Once Department approved manure laden sand stacking area is constructed at Site Two all headland stacking of used sand bedding materials must discontinue.	06/01/2013

2.8 Submit Permit Reissuance Application

Required Action	Date Due
Reissuance Application: Submit a complete permit reissuance application 180 days prior to permit expiration.	03/01/2017

3 Standard Requirements

3.1 General Conditions

NR 205, Wisconsin Administrative Code: The conditions in s. NR 205.07(1), Wis. Adm. Code, are included by reference in this permit. The permittee shall comply with all of these requirements. Some of these requirements are outlined in the Standard Requirements section of this permit. Requirements not specifically outlined in the Standard Requirement section of this permit can be found in s. NR 205.07(1).

3.1.1 Duty to comply

The permittee shall comply with all conditions of the permit. Any permit noncompliance is a violation of the permit and is grounds for enforcement action, permit revocation or modification, or denial of a permit reissuance application.

3.1.2 Permit Actions

As provided in s. 283.53, Stats., after notice and opportunity for a hearing the permit may be modified or revoked and reissued for cause. If the permittee files a request for a permit modification, revocation or reissuance, or a notification of planned changes or anticipated noncompliance, this action by itself does not relieve the permittee of any permit condition.

3.1.3 Property Rights

The permit does not convey any property rights of any sort, or any exclusive privilege. The permit does not authorize any injury or damage to private property or any invasion of personal rights, or any infringement of federal, state or local laws or regulations.

3.1.4 Schedules

Reports of compliance or noncompliance with interim and final requirements contained in any schedule of the permit shall be submitted in writing within 14 days after the schedule date, except that progress reports shall be submitted in writing on or before each schedule date for each report. Any report of noncompliance shall include the cause of noncompliance, a description of remedial actions taken and an estimate of the effect of the noncompliance on the permittee's ability to meet the remaining schedule dates.

3.1.5 Inspection and Entry

The permittee shall allow an authorized representative of the Department, upon the presentation of credentials, to:

- enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records are required under the conditions of the permit;
- have access to and copy, at reasonable times, any records that are required under the conditions of the permit;
- inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices or operations regulated or required under the permit; and
- sample or monitor at reasonable times, for the purposes of assuring permit compliance, any substances or parameters at any location.

3.1.6 Transfers

A permit is not transferable to any person except after notice to the Department. In the event of a transfer of control of a permitted facility, the prospective owner or operator shall file a new permit application and shall file a stipulation of permit acceptance with the Department WPDES permit section. The Department may require modification or revocation and reissuance of the permit to change the name of the permittee and to reflect the requirements of ch. 283, Stats.

3.1.7 Duty to Mitigate

The permittee shall take all reasonable steps to minimize or prevent any adverse impact on the waters of the state resulting from noncompliance with the permit.

3.1.8 Duty to Provide Information

The permittee shall furnish to the Department, within a reasonable time, any information which the Department may request to determine whether cause exists for modifying, revoking or reissuing the permit or to determine compliance with the permit. The permittee shall also furnish to the Department, upon request, copies of records required to be kept by the permittee.

3.1.9 Recording of Results-Sampling

For each manure, process wastewater or soil sample taken by the permittee, the permittee shall record the following information:

- The date, exact place, method and time of sampling or measurements,
- The individual or lab that performed the sampling or measurements,
- The date of the analysis was performed,
- The individual who performed the analysis,
- The analytical techniques or methods used
- The results of the analysis.

3.1.10 Recording of Results-Inspections

For each inspection conducted by the permittee, the permittee shall record the following information:

- The date and name of the person(s) performing the inspection,
- An inspection description, including components inspected,
- Details of what was discovered during the inspection,
- Recommendations for repair or maintenance,
- Any corrective actions taken.

3.1.11 Spill Reporting

The permittee shall notify the Department in in the event that a spill or accidental release of any material or substance results in the discharge of pollutants to the waters of the state at a rate or concentration greater than the effluent limitations or restrictions established in this permit, or the spill or accidental release of the material that is unregulated in this permit, unless the spill or release of pollutants has been reported to the Department in accordance with s. NR 205.07 (1)(s), Wis. Adm. Code, and the "Noncompliance - 24 Hour Reporting,"section of this permit.

3.1.12 Planned Changes

The permittee shall report to the Department any facility or operation expansion, production increase or process modifications which will result in new, different or increased amount of manure or process wastewater produced or handled by the permittee or which will result in new, different or increased discharges of pollutants to waters of the state. The report shall either be a new permit application, or if the new discharge will not violate the conditions of this permit, a written notice of the planned change. The report shall contain a description of the planned change, an estimate of the new, different or increased discharge of pollutants and a description of the effect of change will have on current manure and process wastewater handling practices. Changes cannot be implemented prior to reporting changes to the Department. Following receipt of this report, the Department may require that the permittee submit plans and specifications, or modify its nutrient management plan to address the planned change. Changes requiring Department action or approval may not be initiated prior to Department action or approval.

3.1.13 Submittal of Plans and Specifications

In accordance with s. NR 243.15, the permittee shall submit plans and specifications for proposed new or upgraded reviewable facilities or systems to the Department for approval prior to construction. Post construction documentation for these projects shall be submitted within 60 days of completion of the project, or as otherwise specified by the Department.

3.1.14 Other Information

Where the permittee becomes aware that it failed to submit any relevant facts in a permit application or submitted incorrect information in a permit application or in any report to the department, it shall promptly submit such facts or correct information to the department.

3.1.15 Noncompliance - 24 Hour Reporting

The permittee shall report any noncompliance which may endanger health or the environment. Any information shall be provided orally within 24 hours from the time the permittee becomes aware of the circumstances. A written submission shall also be provided within 5 days of the time the permittee becomes aware of the circumstances. This includes any upset which exceeds any effluent limitation in the permit, or violations of the discharge limitations listed in the permit.

NOTE: Section 292.11(2)(a), Wisconsin Statutes, requires any person who possesses or controls a hazardous substance or who causes the discharge of a hazardous substance to notify the Department of Natural Resources **immediately** of any discharge not authorized by the permit. The discharge of a hazardous substance that is not authorized by this permit or that violates this permit may be a hazardous substance spill. To report a hazardous substance spill, call DNR's 24-hour HOTLINE at **1-800-943-0003.**

3.1.16 Reports and Submittal Certification

Signature(s) on reports required by this permit shall certify to the best of the permittee's knowledge the reports to be true, complete and accurate. All reports required by this permit shall be signed:

- for a corporation by a principal executive officer of at least the level of Vice President or his duly authorized representative having overall responsibility for the operation of the facility of which this permit issued,
- for a partnership by a general partner, and
- for a sole proprietorship by the proprietor.

3.2 Livestock Operation General Requirements

3.2.1 Responsibility for Manure and Process Wastewater

The permittee is responsible for the storage, management and land application of all manure and process wastewater generated by the operation. The permittee is also responsible for any manure or process wastewater received from non-permitted operations that are accepted by the permittee for storage, management or land application.

3.2.2 Distribution of Manure and Process Wastewater

All manure and process wastewater generated by the permittee is the responsibility of the permittee and shall be stored and applied in compliance with the terms and conditions of this permit and the approved nutrient management plan, except if the manure or process wastewater is distributed to another person in accordance with s. NR 243.142 and the Department has approved the transfer of responsibility in writing.

To transfer responsibility for handling, storage and application of manure or process wastewater, a permittee shall submit a written request to the Department. At minimum the request shall indicate how the permittee will comply with all conditions identified in ch. NR 243.142(3), Wis. Adm. Code. If approved, the permittee will be responsible for the following recordkeeping and reporting:

- Update the nutrient management plan to include the estimated amount of manure and process wastewater to be transferred, and record the actual amount transferred at the time of transfer.
- Maintain records that identify the name and address of the recipient of the manure or process wastewater, quantity, and dates of transfer.
- Provide the recipient with written information regarding the nutrient content (nitrogen and phosphorus at minimum) of the manure and process wastewater.
- Submit transfer reports to the Department with the annual report.
- Records shall be maintained for at least 5 years.

Upon written approval from the Department, the permittee is not responsible for the land application, use or disposal of distributed manure or process wastewater if the manure or process wastewater is distributed in compliance with the conditions of the Department approval and s. NR 243.142.

3.2.3 Emergency Response Plans

Within 30 days of the effective date of the permit, the permittee shall develop a written emergency response plan, or update an existing plan if necessary, in accordance with s. NR 243.13(6). The plan shall be made available to the Department upon request. The emergency response plan shall be reviewed and, if appropriate or necessary, amended whenever the operation undergoes significant expansions or other changes that affect the volume or location of potential unauthorized spills or discharges. The plan shall be amended as needed to reflect changes in available equipment, available clean-up contractors or procedures to address unauthorized spills or discharges, or amended in accordance with comments provided by the department. The plan shall be retained at the production area and the permittee shall notify all employees involved in manure and process wastewater handling of the location of the plan.

3.2.4 Mortality Management

Animal carcasses may not be disposed of in a manner that results in a discharge of pollutants to surface waters, violates groundwater standards or impairs wetland functional values. Animal carcasses may not be disposed of directly into waters of the state. In addition, carcasses may not be disposed of in liquid manure or process wastewater containment, storage or treatment facilities unless the containment, storage or treatment facility is adequately designed to contain and treat carcasses and the facility has been approved by the department for that use.

The permittee shall record the date and method of carcass disposal.

[NOTE: The permittee should be aware that there are additional restrictions on the disposal of animal carcasses in ch. 95, Stats., and ATCP 3, Wis. Adm. Code. Furthermore, there may be local regulations regarding disposal of carcasses. If a carcass is disposed of off-site, the disposal may be subject to the requirements in ch. NR 502.12 or 518, Wis. Adm. Code]

3.2.5 Department Review of Nutrient Management Plans

The Department reserves the right to review the Nutrient Management Plan at any time for application rates and cover crop nutrient removal rates, as well as the timing and methods of application. If the Department determines that a landspreading site is no longer acceptable for manure and process wastewater applications, the permittee shall modify the Nutrient Management Plan to remove the site from the plan. In addition, if the Department determines application rates need to be adjusted for individual fields, the permittee shall modify the Nutrient Management Plan. All Department initiated modifications shall be completed by the permittee within 3 months of written notification from the Department.

3.2.6 Existing Runoff Control System(s) Evaluation

The following information shall be included in the written report evaluating the existing runoff control system(s):

- a narrative providing general background and operational information on the existing runoff control system(s), including a full description of each system's components;
- the adequacy of the system(s) to permanently meet the conditions in the Production Area Discharge Limitations and Runoff Control subsections;
- scaled drawings showing the locations of the runoff control system, any surface water, water supply wells, property boundaries, and other pertinent information;
- any post construction documentation available, including the date and materials of construction.
- an assessment of the ability of the facility to meet the design requirements for runoff control in s. NR 243.15; and
- any proposed actions to address issues identified as part of the evaluation

3.2.7 Manure Storage Facility, Composting and Compost Leachate Containment Systems - Installation Plan Requirements

New construction of manure storage/composting facilities shall be in accordance with s. NR 243.15. Exemptions to the design criteria may be given on a case-by-case basis. Prior written approval is required. The following (minimum) information shall be included in the plans and specifications submitted for the new construction of a manure storage facility(s) or composting system(s) (three complete copies are required):

- a narrative describing the proposed facility(s)/system(s);
- a written management and site assessment;
- an operation and maintenance plan;
- an assessment of the ability of the facility(s)/system(s) to meet the applicable design requirements in s. NR 243.15;
- the adequacy of each facility's proposed linings to prevent exfiltration of manure and other contaminants to groundwater and the facility's ability to permanently meet the conditions in the Production Area Discharge Limitations and Manure and Process Wastewater Storage subsections;
- the proximity of bedrock and the water table to the proposed elevation of each facility's floors verified through on-site soil test borings or pits;
- scaled drawings showing the design details and locations of each proposed storage unit, any surface water, water supply wells, property boundaries, and other pertinent information;
- details concerning the proposed materials of construction; and
- relevant engineering calculations.

3.2.8 Runoff Control Systems - Installation Plan Requirements

New construction of runoff control systems shall be in accordance with s. NR 243.15. Exemptions to the design criteria may be given on a case-by-case basis. Prior written approval is required. The following (minimum) information shall be included in the plans and specifications submitted for the new construction of a runoff control system(s) (three complete copies are required):

- a narrative describing the proposed system including a full description of the system's proposed components;
- a written management and site assessment;
- an operation and maintenance plan;
- an assessment of the ability of the system(s) to meet the applicable design requirements in s. NR 243.15;
- the adequacy of each proposed system to permanently meet the conditions in the Production Area Discharge Limitations and Runoff Control subsections;
- the proximity of bedrock and the water table to the proposed elevation of each system's floors verified through on-site soil test borings or pits;
- scaled drawings showing the design details and locations of each proposed system, any surface water, water supply wells, property boundaries, and other pertinent information;
- details concerning the proposed materials of construction; and
- relevant engineering calculations.

3.2.9 Record Keeping and Retention

The permittee shall keep records associated with production area and land application activities in accordance with s. NR 243.19(2). The permittee shall retain these records and copies of all reports required by the permit, and records of all data used to complete the application for the permit for a period of at least 5 years from the date of the sample, measurement, report or application. The Department may request that this period be extended by issuing a public notice to modify the permit to extend this period. These records shall be made available to the Department upon request.

Note: A form for recording daily land application activities (Form 3200-123A) can be obtained at regional offices of the Department or the Department's Bureau of Watershed Management, 101 S. Webster St., P.O. Box 7921, Madison, Wisconsin 53707.

3.2.10 Reporting Requirements

The permittee shall submit the following reports in accordance with s. NR 243.19(3)

- **Corrective Actions:** If the permittee fails to take corrective action within 30 days of identifying a malfunction, failure, permit noncompliance or other identified problem, the permittee shall contact the Department immediately following the 30-day period and provide an explanation for its failure to take action.
- **Quarterly Reports:** The permittee shall summarize the results of inspections conducted at the production area in a written quarterly report. The permittee shall maintain the quarterly reports onsite until the quarterly report is submitted to the Department as part of the annual report.
- **Annual Reports:** The permittee shall submit written annual reports to the department by the date specified in the Schedules section of permit for all manure and other process wastewater that is generated by the permittee. These annual reports shall cover quarterly reports, annual spreading activities and other information required in s. NR 243.19(3) for the previous calendar year or cropping year, as specified in this permit.

Note: Form 3200-123 (Annual Spreading Report) can be obtained at regional offices of the department or the department's Bureau of Watershed Management, 101 S. Webster St., P.O. Box 7921, Madison, Wisconsin 53707.

3.2.11 Duty to Maintain Permit Coverage

The permittee shall submit a reissuance application in accordance with s. NR 243.12(2)(b) at least 180 days prior to the expiration date of its current WPDES permit, unless the permittee submits a letter to the Department documenting all of the following:

- That the permittee has ceased operation or is no longer defined as a large CAFO under s. NR 243.03(28).
- That the permittee has demonstrated to the Department's satisfaction that it has no remaining potential to discharge of manure or process wastewater pollutants to waters of the state that was generated while the operation was a CAFO.

4 Summary of Reports Due

FOR INFORMATIONAL PURPOSES ONLY

Description	Date	Page
Annual Reports -Submit Annual Report #1	January 31, 2013	15
Annual Reports -Submit Annual Report #2	January 31, 2014	15
Annual Reports -Submit Annual Report #3	January 31, 2015	15
Annual Reports -Submit Annual Report #4	January 31, 2016	15
Annual Reports -Submit Annual Report #5	January 31, 2017	15
Annual Reports -Ongoing Annual Reports	January 31st each year	15
Nutrient Management Plan -Written certification for all landowners within nutrient management plan	October 1, 2012	15
Nutrient Management Plan -Management Plan Annual Update #1	March 31, 2013	15
Nutrient Management Plan -Management Plan Annual Update #2	March 31, 2014	15
Nutrient Management Plan -Management Plan Annual Update #3	March 31, 2015	15
Nutrient Management Plan -Management Plan Annual Update #4	March 31, 2016	15
Nutrient Management Plan -Management Plan Annual Update #5	March 31, 2017	15
Nutrient Management Plan -Ongoing Management Plan Annual Updates	March 31st each year	15
Runoff Control System - Feedlot Engineering Evaluation -Written Description of Existing System	December 31, 2012	16
Runoff Control System - Feedlot Engineering Evaluation -Plans and Specifications	March 1, 2013	16
Runoff Control System - Feedlot Engineering Evaluation -Corrections and Post Construction Documentation	November 1, 2013	16
Feed Storage - Engineering Evaluation -Written Description of Existing System	October 1, 2012	16
Feed Storage - Engineering Evaluation -Plans and Specifications	March 1, 2013	16
Feed Storage - Engineering Evaluation -Corrections and Post Construction Documentation	September 1, 2013	16
Manure Storage Facility - Installation -Complete Installation	Once approved.	16
Feed Storage Runoff Control System - Installation -Complete Installation	Once approved.	16
Manure Headland Stacking - Discontinue Practice -Discontinue Practice	June 1, 2013	17
Submit Permit Reissuance Application -Reissuance Application	March 1, 2017	17

All submittals required by this permit shall be submitted to:
Agricultural Specialist
DNR – Green Bay Service Center
2984 Shawano Avenue
Green Bay, WI 54313-6727

Attachment B

ANNUAL REPORT CHECKLIST

For WPDES Permitted CAFO Operations
WDNR

Date: January 30, 2013

Facility Name: Kinnard Farms Inc

Address: E2669 County Hwy S, Casco Wisconsin 54205

Phone: 920-255-0763 **Email:**

Permit Contact Name: Lee H. Kinnard

Signature:

The following items are required to be submitted to the Department on an annual basis as part of the Annual Report for a WPDES permitted CAFO. Annual Reports cover activities during the previous calendar year. Please use the following checklist to ensure that all of the necessary items are attached and submitted as required under the WPDES permit and s. NR 243.19(3)(c), Wisconsin Administrative Code. Note: Manure and soil sample results, land application summaries, etc. may be provided with the nutrient management plan update report due March 31st.

Report Page #	Annual Report information to be submitted
Page 1 Starting Page 4	Copies of quarterly reports shall be submitted and must include the following: ➢ Identified permit violations including all discharges of manure or process wastewater to surface waters, overflows of liquid manure or process wastewater storage and containment structures, and number of missed inspections ➢ Dates, times and approximate volume of discharges identified above ➢ Corrective actions taken ➢ Summary of any spill incidents. ➢ A summary of the condition of runoff control systems and storage and containment structures ➢ A summary of recorded levels of materials in liquid storage and containment structures, including exceedances of the maximum operating level. Copies of monitoring calendar pages or other forms of documentation showing recorded levels must be attached.
Page 1	Dates on which storage facilities were emptied to the 180-day marker between October 1st and November 30th.
Page 1	The total capacity of manure storage and containment facilities (capacity below MOL marker) and total amount of manure and process wastewater generated in previous 12 months, including precipitation and runoff diverted to storage or containment structures. Include calculation of days of storage based on capacity and amount generated.
Page 1	Total amount of manure and process wastewater distributed to another person by the permittee in accordance with s. NR 234.142 in the previous 12 months. This includes the volume of manure and process wastewater approved to be applied to land under another permittee's nutrient management plan.
Page 2-3	The number and type of mature and immature animals at the operation and whether the animals are in open confinement or housed under roof (please use form 3400-25A).
Page 1	Summary of any proposed changes planned at facility this upcoming year. Note: Engineering review may be required for reviewable structures.
Page 1	Other information requested by the department in writing or in the permit.

2013 Annual Report for Crop year 2012

Identified permit violations.	**None**
Discharges of manure or process wastewater to surface waters	**None**
Overflows of liquid manure or process wastewater storage and containment structures.	**None**
Number of missed inspections.	**None**
Dates, times and approximate volume of discharges identified above.	**N/A**
Corrective actions taken.	**N/A**
Summary of any spill incidents.	**N/A**

Summary of condition of runoff control systems and storage and containment structures

See compliance Calendar. Starting on page 4.

Summary of recorded levels of materials in liquid storage and containment structures

See compliance Calendar. Starting on page 4.

Any exceedances of the maximum operating level	**None**

Dates on which storage facilities were emptied to the 180-day marker between October 1st and November 30th.

November 20, 2012

Days of storage based on capacity and amount generated.

Waste storage facilities have a total 21,500,000 gallons of liquid capacity.
Estimated annual manure production is 34,692,338 gallons, this gives the dairy 226 days of liquid capacity.

Total amount of manure and process wastewater distributed to another person.

See Attached document from OLSON FARMS. 5513 Tons of solid manure was transferred.

The number and type of mature and immature animals at the operation.

See form 3400-25A. Pages 2-3.

Summary of any proposed changes planned at facility this upcoming year.

Additional information regarding the expansion will be included in a separate report and provided to the DNR.

Other information requested by the department in writing or in the permit.

None

All other information will be provided in the March 31st Agronomic update.

State of Wisconsin Department of Natural Resources

ANIMAL UNITS CALCULATION WORKSHEET INSTRUCTIONS Form 3400-25A Rev. 04/07

This worksheet must be submitted regardless of whether a permit is required.
Notice: Use this worksheet to calculate the number of animal units on your operation, both at the current time and after any proposed expansions planned within the next five years. You are required to complete these calculations to determine if you must apply for a Wisconsin Pollutant Discharge Elimination System (WPDES) permit under NR 243, Wis. Admin. Code. A WPDES permit is required for all livestock/poultry operations that will contain 1,000 or more animal units.

- If you do expect your operation to reach or exceed 1,000 animal units, a permit is required and you must complete and submit an initial Livestock/Poultry Operation WPDES Permit Application consisting of Form 3400-25 at least 12 months prior to reaching the 1,000 animal unit threshold. In addition, you will need to submit other WPDES application materials as part of a complete final permit application at least 6 months prior to reaching the 1,000 animal unit threshold. Please contact your regional DNR contact for more information on what is required as part of a final permit application.

- If you do not expect to reach or exceed 1,000 animal units, a WPDES permit is not required. However, if you have received an Animal Unit Verification Report (Form 3400-181), return it along with this worksheet to your regional DNR contact.

Completing AU worksheet using Microsoft Excel or Word:

1. To begin calculations using Microsoft Excel or Word, double-click on table below. If completing this form by hand see directions below.
    a. For existing operations, enter the current number of each animal type on your operation in the **Current Number** column. Count the highest number of animals on-site at any time during the past year, and include all animals that are part of your operation that are at adjacent locations or under common management.
    b. If you plan to expand within the next five years, also enter your proposed animal numbers in the **Projected Number** column on Page 2.
    c. For brand new operations where there currently aren't any animals present, enter 0 for Total Mixed and Non-Mixed Animal Units on Page 1. On Page 2 enter your proposed animal numbers in the **Projected Number** columns.
    d. Note: For some animal types (for example, dairy cattle and swine), animal categories are combined as part of non-mixed AU calculations.
2. The worksheet will automatically calculate the number of Mixed and Non-Mixed Animal Units (AU) on the operation. If either "Total Animal Units" is 1000 or more, you are required to obtain a WPDES permit.
3. Enter the dates of all proposed expansions, if applicable, within the next five years on Page 2.
4. To quit editing click anywhere outside of the table within the document.

Completing AU worksheet by hand:

1. Print out both pages of this document
    a. For existing operations, enter the current number of each animal type on your operation in the **Current Number** columns**.** Count the highest number of animals on-site at any time during the past year, and include all animals that are part of your operation that are at adjacent locations or under common management.
    b. If you plan to expand within the next five years, also enter your proposed animal numbers in the **Projected Number** columns on Page 2.
    c. For brand new operations where there currently aren't any animals present, enter 0 for Total Mixed and Non-Mixed Animal Units on Page 1. On Page 2 enter your proposed animal numbers in the **Projected Number** columns.
    d. Note: For some animal types (for example, dairy cattle and swine), animal categories are combined as part of non-mixed AU calculations.
2. Multiply the number entered in columns in the projected number by the appropriate equivalency factor to determine the equivalent number of animal units for each animal type.
3. Add all values in column d together. This equals the Total Mixed Animal Units. For column g, enter the equivalent animal unit number from the row with the highest animal unit number in Total Non-mixed AU.
4. If either "Total Animal Units" is 1000 animal units or more, you are required to obtain a WPDES permit
5. Enter the dates of all proposed expansions, if applicable, within the next five years on Page 2.

Animal Unit Calculations: Current Number of AUs on Operation

	Animal Type	I. Mixed Animal Units			II. Non-mixed Animal Units		
		b. Equiv. factor	c. Current Number	d. No. of AUs	e. Equiv. factor	f. Current Number	g. No. of Aus
	Example - Broilers (non-liquid manure):	*0.005 x*	***150,000***	*= 750*	*0.008 x*	***150,000***	*= 1200*
	Dairy/Beef Calves (under 400 lbs)	0.20 x	0	=	*Fed.numbers in this column comply with 40 CFR s. 122.23*		
Dairy Cattle	Milking & Dry Cows	1.40 x	2600	= 3640	1.43 x	2600	= 3718
	Heifers (800 lbs to 1200 lbs)	1.10 x	1022	= 1124.2	1.00 x	1022	= 1022
	Heifers (400 lbs to 800 lbs)	0.60 x	0	=			
Beef	Steers or Cows (400 lbs to market)	1.00 x		=	1.00 x		=
	Bulls (each)	1.40 x		=			
	Veal Calves	0.50 x		=	1.00 x		=
Swine	Pigs (up to 55 lbs)	0.10 x		=	0.10 x		=
	Pigs (55 lbs to market)	0.40 x		=	0.40 x		=
	Sows (each)	0.40 x		=			
	Boars (each)	0.50 x		=			
Chickens	Layers (each) -non-liquid manure system	0.01 x		=	0.0123 x		=
	Broilers/Pullets (each) -non-liquid manure system	0.005 x		=	0.008 x		=
	Per Bird -liquid manure system	0.033 x		=	0.0333 x		=
Ducks	Ducks (each) -liquid manure system	0.2 x		=	0.2 x		=
	Ducks (each) -non-liquid manure system	0.01 x		=	0.0333 x		=
	Turkeys (each)	0.018 x		=	0.018 x		=
	Sheep (each)	0.1 x		=	0.1 x		=
	Horses (each)	2 x		=	2 x		=

Total Animal Units:	**Total Mixed Animal Units =** **4764.2** (add all rows above)	**Total Non-Mixed Animal Units =** **3718** (Enter the single highest number from any row above; DO NOT add the totals)

Does operation need a WPDES permit? YES

Waste Facility Inspection Checklist

A Check in a shaded box suggest a problem

Farm: Kinnard Farms Inc
Year: 2012

Date	3-Jan	10-Jan	17-Jan	24-Jan	31-Jan	7-Feb	14-Feb	20-Feb	28-Feb	6-Mar	13-Mar	21-Mar	28-Mar	3-Apr	10-Apr	17-Apr	24-Apr
Inspected by (initials)	LK	LK	LK	LK	LK	LK	LK	LK	LK	LK	LK	LK	LK	LK	LK	LK	LK
Manure Level Observations																	
Na																	
Sampling Point: ***001 Sand Settling Cell***																	
Depth of waste in the storage	4	5	5	5	5	4	4	4	4	4	5	5	5	6	6	6	6
Sampling Point: ***002 First earthen pond***																	
Depth of waste in the storage	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
Sampling Point: ***003 Large earthen pond***																	
Depth of waste in the storage	5	5	5	6	6	6	6	6.5	6.5	7	7	7	7	8	8	9	9
Sampling Point: ***004 Feedwaste***																	
Height of waste in the storage	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
Sampling Point: ***006 FThayse Farm Concrete Pit***																	
% of Pit Use (Mult by 10(%))	N/A																
Sampling Point: ***007 Mike Krusweick Farm Concrete Pit***																	
% of Pit Use (Mult by 10(%))	0	0	0	1	1	1	1	1	1	2	2	2	3	3	3	3	3

Following Represents All Manure Structures

	3-Jan		10-Jan		17-Jan		24-Jan		31-Jan		7-Feb		14-Feb		20-Feb		28-Feb		6-Mar		13-Mar		21-Mar		28-Mar		3-Apr		10-Apr		17-Apr		24-Apr	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Does sufficient (1.0') freeboard exist?	✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓	
Manure pump/transfer pipes functioning	✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓	
Recycle pumps/transfer system functioning?	✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓	
Erosion or Damage Concerns																																		
At inlets		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓
At outlets		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓
Near agitation points		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓
Banks from rainfall		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓
Exterior banks		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓
Burrowing animals		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓
Trees		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓
Large weeds		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓
Poorly established sod		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓
Damp, soft, or slumping areas on berms		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓
Seepage near toe of berm		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓
Seepage around pipes through the berm		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓
Clean Water Diversion																																		
Are perimeter drains plugged or blocked		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓
Is roof water entering storage		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓
Is field runoff entering storage		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓
Are diversions/waterways maintained	✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓	
Visual Appearance, Safety and Odor																																		
Neatly mowed	✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓	
Hidden from the public	✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓	
Is there foreign material present		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓
Fenced and proper signage present	✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓	
Is the facility crusted over	✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓	
Rate down-wind odor from facility	1		1		1		1		1		1		1		1		1		1		1		1		1		1		1		1		1	

Down-wind odor from manure storage
1 - None; 2 - Faint; 3- Distinct;
4 - Strong; 5 - Unbearable

Temp Storage Sites Inspection Checklist

A Check in a shaded box suggest a problem

Farm: Kinnard Farms Inc
Year: 2012

Date	3-Jan	10-Jan	17-Jan	24-Jan	31-Jan	7-Feb	14-Feb	20-Feb	28-Feb	6-Mar	13-Mar	21-Mar	28-Mar	3-Apr	10-Apr	17-Apr	24-Apr
Inspected by (initials)																	
Manure Level Observations																	
Earthen Storage Structure																	
Sampling Point: ***005 FT-1 Sand Stacking Site***																	
Check if Site was inspected.	N/A	N/A	N/A	NM	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	—	—	—	—	—
Sampling Point: ***005 BLE-01 Feed Storage Site***																	
Check if Site was inspected.	X	X	X	X	X	X	X	X	X	NOT	N/A	N/A	N/A	N/A	—	—	—
Sampling Point: ***005 DEB Feed Storage Site***																	
Check if Site was inspected.	X	X	X	✓	✓	✓	✓	X	X	X	X	X	X	X	X	X	X
Sampling Point: ***005 TH-8 Feed Storage Site***																	
Check if Site was inspected.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Sampling Point: ***005 Temp Storage Site JK-1,JK-2***																	
Check if Site was inspected.	X	X	X	X	X	X	X	X	X	X	X	N/A	NM	NA	N/A	NA	NA

N/A = Not applicable or the site was no longer being used.

	3-Jan		10-Jan		17-Jan		24-Jan		31-Jan		7-Feb		14-Feb		20-Feb		28-Feb	
Clean Water Diversion	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Is Leachate Minimized and Controlled	✓		✓		✓		✓		✓		✓		✓		✓		✓	
Is feed stored only on the approved site.	✓		✓		✓		✓		✓		✓		✓		✓		✓	
Is Feed Moisture above 75%		✓		✓		✓		✓		✓		✓		✓		✓		✓
Is Feed Stored on bare Ground		✓		✓		✓		✓		✓		✓		✓		✓		✓
Is Waste Leaving Site via Surface Water		✓		✓		✓		✓		✓		✓		✓		✓		✓
Are diversions/waterways maintained	✓		✓		✓		✓		✓		✓		✓		✓		✓	
Visual Appearance, Safety and Odor																		
Neatly mowed	✓		✓		✓		✓		✓		✓		✓		✓		✓	
Dust Controlled	✓		✓		✓		✓		✓		✓		✓		✓		✓	
Is there foreign material present		✓		✓		✓		✓		✓		✓		✓		✓		✓
Is leachate Present		✓		✓		✓		✓		✓		✓		✓		✓		✓
Is Feed Stored at site Covered	✓		✓		✓		✓		✓		✓		✓		✓		✓	
Is all spilled Feed Removed	✓		✓		✓		✓		✓		✓		✓		✓		✓	
Rate down-wind odor from facility	1		1		1		1		1		1		1		1		1	

	6-Mar		13-Mar		21-Mar		28-Mar		3-Apr		10-Apr		17-Apr		24-Apr	
Clean Water Diversion	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Is Leachate Minimized and Controlled	✓		✓		✓		✓		✓		✓		✓		✓	
Is feed stored only on the approved site.	✓		✓		✓		✓		✓		✓		✓		✓	
Is Feed Moisture above 75%		✓		✓		✓		✓		✓		✓		✓		✓
Is Feed Stored on bare Ground		✓		✓		✓		✓		✓		✓		✓		✓
Is Waste Leaving Site via Surface Water		✓		✓		✓		✓		✓		✓		✓		✓
Are diversions/waterways maintained	✓		✓		✓		✓		✓		✓		✓		✓	
Visual Appearance, Safety and Odor																
Neatly mowed	✓		✓		✓		✓		✓		✓		✓		✓	
Dust Controlled	✓		✓		✓		✓		✓		✓		✓		✓	
Is there foreign material present		✓		✓		✓		✓		✓		✓		✓		✓
Is leachate Present		✓		✓		✓		✓		✓		✓		✓		✓
Is Feed Stored at site Covered	✓		✓		✓		✓		✓		✓		✓		✓	
Is all spilled Feed Removed	✓		✓		✓		✓		✓		✓		✓		✓	
Rate down-wind odor from facility	1		1		1		1		1		1		1		1	

Down-wind odor from feed storage
1 - None; 2 - Faint; 3- Distinct;
4 - Strong; 5 - Unbearable

Waste Facility Inspection Checklist

A Check in a shaded box suggest a problem

Farm: Kinnard Farms Inc
Year: 2012

Date	1-May	8-May	15-May	22-May	29-May	5-Jun	12-Jun	19-Jun	26-Jun	3-Jul	10-Jul	17-Jul	24-Jul	31-Jul	7-Aug	14-Aug	21-Aug
Inspected by (initials)	LK	LK	LK	LK	LK	LK	LK	LK	LK	LK	LK	LK	LK	LK	VK	LK	LK
Manure Level Observations																	
Na																	
Sampling Point: 001 ***Sand Settling Cell***																	
Depth of waste in the storage	6	5	6	6	x/x	1	1	2	2	3	4	5	6	1	1	1	2
Sampling Point: 002 ***First earthen pond***																	
Depth of waste in the storage	9	9	9	9	9	9	9	9	9	9	10	10	10	10	10	10	11
Sampling Point: 003 ***Large earthen pond***																	
Depth of waste in the storage	9	10	10	10	9½	9½	9½	9½	8½	10	10	10	11	x8½x	9	10	11
Sampling Point: 004 ***Feedwaste***																	
Height of waste in the storage	1	1	2	1	1	1	1	2	7	1	1	0	0	0	0	1	1
Sampling Point: 006 ***FThayse Farm Concrete Pit***																	
% of Pit Use (Mult by 10(%))																	
Sampling Point: 007 ***Mike Krusweick Farm Concrete Pit***																	
% of Pit Use (Mult by 10(%))	3	3	4	4	4	4	4	5	5	5	5	5	6	6	6	6	7

Following Represents All Manure Structures

	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Does sufficient (1.0') freeboard exist?	✓		✓				✓		✓		✓		✓		✓		✓		✓		✓		x		x		✓		x		✓		x	
Manure pump/transfer pipes functioning	✓		✓				✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓	
Recycle pumps/transfer system functioning?	✓		✓				✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓	
Erosion or Damage Concerns																																		
At inlets		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		x		x		x		x		✓		x
At outlets		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓
Near agitation points		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓
Banks from rainfall		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓
Exterior banks		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓
Burrowing animals		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓
Trees		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓
Large weeds		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓
Poorly established sod		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓
Damp, soft, or slumping areas on berms		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓
Seepage near toe of berm		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓
Seepage around pipes through the berm		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓
Clean Water Diversion																																		
Are perimeter drains plugged or blocked		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		x		x		x		✓		✓
Is roof water entering storage		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓
Is field runoff entering storage		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓
Are diversions/waterways maintained	✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		x		x		✓		x		✓		x	
Visual Appearance, Safety and Odor																																		
Neatly mowed	✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		x		✓		✓		✓		✓	
Hidden from the public	✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		x		✓		✓		✓		✓	
Is there foreign material present		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		x		x		x		✓		x
Fenced and proper signage present	✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		x		✓		✓	
Is the facility crusted over	✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓	
Rate down-wind odor from facility	1		1		1		1		1		1		1		1		1		1		1		1		1		1-2		1		1		1	

Down-wind odor from manure storage
1 - None; 2 - Faint; 3- Distinct;
4 - Strong; 5 - Unbearable

Revised 1-19-2011

Temp Storage Sites Inspection Checklis

A Check in a shaded box suggest a problem

Farm: Kinnard Farms Inc
Year: 2012

Date	1-May	8-May	15-May	22-May	29-May	5-Jun	12-Jun	19-Jun	26-Jun	3-Jul	10-Jul	17-Jul	24-Jul	31-Jul	7-Aug	14-Aug	21-Aug
Inspected by (initials)																	
Manure Level Observations																	
Earthen Storage Structure																	
Sampling Point: ***005 FT-1 Sand Stacking Site***																	
Check if Site was inspected.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Sampling Point: ***005 BLE-01 Feed Storage Site***																	
Check if Site was inspected.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Sampling Point: ***005 DEB Feed Storage Site***																	
Check if Site was inspected.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Sampling Point: ***005 TH-8 Feed Storage Site***																	
Check if Site was inspected.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Sampling Point: ***005 Temp Storage Site JK-1,JK-2***																	
Check if Site was inspected.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

N/A = Not applicable or the site was no longer being used.

	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Clean Water Diversion																																		
Is Leachate Minimized and Controlled	✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓	
Is feed stored only on the approved site.	✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓	
Is Feed Moisture above 75%		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓
Is Feed Stored on bare Ground		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓
Is Waste Leaving Site via Surface Water		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓
Are diversions/waterways maintained	✓		✓		✓				✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓	
Visual Appearance, Safety and Odor																																		
Neatly mowed	✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓	
Dust Controlled	✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓	
Is there foreign material present		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓
Is leachate Present		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓	o	✓	o	✓		✓		✓		✓		✓
Is Feed Stored at site Covered	✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓	
Is all spilled Feed Removed	✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓	
Rate down-wind odor from facility	1		1		1		1		1		1		1		1		1		1		1		1		1		1		1		1		1	

Down-wind odor from feed storage
1 - None; 2 - Faint; 3- Distinct;
4 - Strong; 5 - Unbearable

Waste Facility Inspection Checklist

A Check in a shaded box suggest a problem

Farm: Kinnard Farms Inc
Year: 2012

Date	28-Aug	4-Sep	11-Sep	18-Sep	25-Sep	2-Oct	10/9	10/16	10/23	10/30	11/6	11/13	11/20	11/27	12/4	12/11	12/18	12/25
Inspected by (initials)	LK	LK	LK	LK	LK	LK	LK	LK	LK	LK	LK	LK	LK	LK	LK	LK	LK	LK
Manure Level Observations																		
Na														180 DAY 11/21/12				
Sampling Point: ***001 Sand Settling Cell***																		
Depth of waste in the storage	2	2	2	2	2	1	1	1	1	1	1	1	2	2	2	1	1	1
Sampling Point: ***002 First earthen pond***																		
Depth of waste in the storage	4	11	11	11	11	Haul	x 1 x	1	1	1	3	6	7	9	11	11	11	11
Sampling Point: ***003 Large earthen pond***																		
Depth of waste in the storage	12	12½	12½	13	13	x10x	x8x	6	5	5	5	5	5	5	1	1	1	2
Sampling Point: ***004 Feedwaste***																		
Height of waste in the storage	1	1	1	2	2	1	0	0	0	0	0	0	1	0	0	0	0	0
Sampling Point: ***006 FThayse Farm Concrete Pit***																		
% of Pit Use (Mult by 10(%))																		
Sampling Point: ***007 Mike Krusweick Farm Concrete Pit***																		
% of Pit Use (Mult by 10(%))	7	7	8	8	8	8	9	9	9	9	9	1	1	1	1	1	1	1

Following Represents All Manure Structures

	28-Aug		4-Sep		11-Sep		18-Sep		25-Sep		2-Oct		10/9		10/16		10/23		10/30		11/6		11/13		11/20		11/27		12/4		12/11		12/18		12/25	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Does sufficient (1.0') freeboard exist?	x		x		x		x		x		x		x		|		|		|		|		|		|		|		|		|		|		|	
Manure pump/transfer pipes functioning	|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|	
Recycle pumps/transfer system functioning?	|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|	
Erosion or Damage Concerns																																				
At inlets		x		x		x		x		x		x		x		|		|		|		|		|		|		|		|		|		|		|
At outlets		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|
Near agitation points		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|
Banks from rainfall		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|
Exterior banks		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|
Burrowing animals		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|
Trees		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|
Large weeds		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|
Poorly established sod		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|
Damp, soft, or slumping areas on berms		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|
Seepage near toe of berm		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|
Seepage around pipes through the berm		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|
Clean Water Diversion																																				
Are perimeter drains plugged or blocked		|		|		|		x		x		x		x		|		|		|		|		|		|		|		|		|		|		|
Is roof water entering storage		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|
Is field runoff entering storage		|		|		|		|		|		|		|		|		|		|		|		|		|		|				|		|		|
Are diversions/waterways maintained	x		x		x		x		|		|		x		|		|		|		|		|		X		x		X		X		x		x	
Visual Appearance, Safety and Odor																																				
Neatly mowed	|		|		|		x		|		|		|		|		|		|		|		|		|		|		|		|		|		|	
Hidden from the public	|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|		|	
Is there foreign material present		x		x		x		x		\		\		\		|		|		\		|		|		x		x		x		X		x		X
Fenced and proper signage present	X		x		x		|		\		\		\		|		|		|		|		|		x		x		x		x		x		x	
Is the facility crusted over	|		|		|		|		\		\		\		|		|		|		|		|		|		|		|		|		|		|	
Rate down-wind odor from facility	1		1		1		x1		1		1-2		1-2		1		1		1		1		1		1		1		1		1		1		1	

Down-wind odor from manure storage
1 - None; 2 - Faint; 3- Distinct;
4 - Strong; 5 - Unbearable

Revised 1-19-2011

Temp Storage Sites Inspection Checklis

A Check in a shaded box suggest a problem

Farm: Kinnard Farms Inc
Year: 2012

Date	28-Aug		4-Sep		11-Sep		18-Sep		25-Sep		2-Oct		10/9		10/16		10/23	
Inspected by (initials)																		
Manure Level Observations																		
Earthen Storage Structure																		
Sampling Point: ***005 FT-1 Sand Stacking Site***																		
Check if Site was inspected.	—		—		—		—		—		—		—		—		—	
Sampling Point: ***005 BLE-01 Feed Storage Site***																		
Check if Site was inspected.	—		—		—		—		—		—		—		—		—	
Sampling Point: ***005 DEB Feed Storage Site***																		
Check if Site was inspected.	X		X		X		X		X		X		X		X		X	
Sampling Point: ***005 TH-8 Feed Storage Site***																		
Check if Site was inspected.	—		—		—		—		—		—		—		—		—	
Sampling Point: ***005 Temp Storage Site JK-1,JK-2***																		
Check if Site was inspected.	—		—		—		—		—		—		—		—		—	
N/A = Not applicable or the site was no longer being used.																		
Clean Water Diversion	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Is Leachate Minimized and Controlled	✓		✓		✓		✓		✓		✓		✓		✓		✓	
Is feed stored only on the approved site.	✓		✓		✓		✓		✓		✓		✓		✓		✓	
Is Feed Moisture above 75%		✓		✓		✓		✓		✓		✓		✓		✓		X
Is Feed Stored on bare Ground		✓		✓		✓		✓		✓		✓		✓		✓		X
Is Waste Leaving Site via Surface Water		✓		✓		✓		✓		✓		✓		✓		✓		X
Are diversions/waterways maintained	✓		✓		✓		✓		✓		✓		✓		✓		X	
Visual Appearance, Safety and Odor																		
Neatly mowed	✓		✓		✓		✓		✓		✓		✓		✓		X	
Dust Controlled	✓		✓		✓		✓		✓		✓		✓		✓		X	
Is there foreign material present		✓		✓		✓		✓		✓		✓		✓		✓		X
Is leachate Present		✓		✓		✓		✓		✓		✓		✓		✓		X
Is Feed Stored at site Covered	✓		✓		✓		✓		✓		✓		✓		✓		X	
Is all spilled Feed Removed	✓		✓		✓		✓		✓		✓		✓		✓		X	
Rate down-wind odor from facility	1		1		1		1		1		1		1		1		1	

Date	10/30		11/6		11/13		11/20		11/27		12/4		12/11		12/18		12/25	
Inspected by (initials)																		
Manure Level Observations																		
Earthen Storage Structure																		
Sampling Point: ***005 FT-1 Sand Stacking Site***																		
Check if Site was inspected.	—		—		—		—		—		—		—		—		—	
Sampling Point: ***005 BLE-01 Feed Storage Site***																		
Check if Site was inspected.	—		—		—		—		—		—		—		—		—	
Sampling Point: ***005 DEB Feed Storage Site***																		
Check if Site was inspected.	X		X		X		X		X		X		X		X		X	
Sampling Point: ***005 TH-8 Feed Storage Site***																		
Check if Site was inspected.	—		—		—		—		—		—		—		—		—	
Sampling Point: ***005 Temp Storage Site JK-1,JK-2***																		
Check if Site was inspected.	—		—		—		—		—		—		—		—		—	
N/A = Not applicable or the site was no longer being used.																		
Clean Water Diversion	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Is Leachate Minimized and Controlled	✓		✓		✓		✓		✓		✓		✓		✓		✓	
Is feed stored only on the approved site.	✓		✓		✓		✓		✓		✓		✓		✓		✓	
Is Feed Moisture above 75%		✓		✓		✓		✓		✓		✓		✓		✓		✓
Is Feed Stored on bare Ground		✓		✓		✓		✓		✓		✓		✓		✓		✓
Is Waste Leaving Site via Surface Water		✓		✓		✓		✓		✓		✓		✓		✓		✓
Are diversions/waterways maintained	✓		✓		✓		✓		✓		✓		✓		✓		✓	
Visual Appearance, Safety and Odor																		
Neatly mowed	✓		✓		✓		✓		✓		✓		✓		✓		✓	
Dust Controlled	✓		✓		✓		✓		✓		✓				✓			✓
Is there foreign material present		✓		✓		✓		✓		✓		✓		✓		✓		✓
Is leachate Present		✓		✓		✓		✓		✓		✓		✓		✓		✓
Is Feed Stored at site Covered	✓		✓		✓		✓		✓		✓		✓		✓		✓	
Is all spilled Feed Removed	✓		✓		✓		✓		✓		✓		✓		✓		✓	
Rate down-wind odor from facility	1		1		1		1		1		1		1		1		1	

Down-wind odor from feed storage
1 - None; 2 - Faint; 3- Distinct;
4 - Strong; 5 - Unbearable

Mike Kruswick Solid Manure

Field	Acres	Bergner Loads/Acre	KFI Loads/Acre	Total TONS	Tons/ Acre	#N/Acre	#P/Acre	#K/Acre	Fertilizer Value/Acre
LAV	35	64	21	1497.72	42.79	133.51	80.45	308.10	$281.90
VIS	35	72	24	1690.80	48.31	150.72	90.82	347.82	$318.24
SYN	30	53	18	1249.83	41.66	129.98	78.32	299.96	$274.45
WSW	8	13	4	300.07	37.51	117.03	70.52	270.06	$247.09
WSE	7	11	4	263.53	37.65	117.46	70.78	271.06	$248.01
WN	28.5	22	7	511.42	17.94	55.99	33.74	129.20	$118.21
Totals	143.5	235	78	5513.37					$247.98

Tractor	Net #'s	Net Tons
MX270	35940	17.97
MX230	36420	18.21
JD8930	37240	18.62

Spreader Weights

Avg Bergner Load	18.3	Tons
Avg KFI Load	15.65	Tons

Average Nutrient Value Solid

Nitrogen (N)	Phosphrous(P2O5)	Potassium(K20)	Total$/Ton
3.12 #/Ton	1.88 #/Ton	7.2 #/Ton	
1.87 $/Ton	1.26 $/Ton	3.46 $/Ton	6.59 $/Ton

Product	Price/Lb
Urea (N)	0.6
P2O5 (P)	0.67
K20 (K)	0.48

Attachment C

Permit Fact Sheet

1 General Information

Permit Number:	WI-0059536-03-0
Permittee Name:	Kinnard Farms Inc
Address:	E2675 County Hwy S
City/State/Zip:	Casco WI 54205
Discharge Location:	Cropland within the Kewaunee River Watershed, Lake Michigan Basin and groundwaters of state

Animal Units					
	Current AU		**Proposed AU** **(Note: If all zeroes, expansions are not expected during permit term)**		
Animal Type	**Mixed**	**Individual**	**Mixed**	**Individual**	**Date of Proposed Expansion**
Dairy Calves (under 400 lbs.)	65	0	150	0	02/01/2013
Milking and Dry Cows	4242	4333	8120	8294	02/01/2013
Heifers (400 lbs. to 800 lbs.)	195	325	0	0	
Heifers (800 lbs. to 1200 lbs.)	1320	1200	440	400	02/01/2013
Total	5822	4333	8710	8294	

2 Facility Description

Kinnard Farms Inc is a large dairy operation owned and operated by Rod and Lee Kinnard. The farm operation currently consists of 5,627 animal units of varying age and size. The proposed expansion will increase the existing number to 8,710 animal units of varying age and size), and will take place by adding a ground up facility about one quarter mile northeast of the existing dairy farm. The new site will consist of the following: A ten row-row mechanically ventilated barn designed to house all milking and dry cows as well as springing heifers. Dimensions will be 2000 feet long and 290 feet wide; a double 60 parallel milking parlor and holding area; a naturally ventilated pack barn designed to house heifers sized at 100 feet by 400 feet; a corn silage pad with leachate control systems sized at 600 feet by 600 feet; two clay lined manure storage facilities; and a sand recycling building 100 feet by 200 feet. Manure and feed storage facilities have been engineered by Robert E Lee and Associates. The two facilities will be covered under one WPDES permit.

Sample Point Designation For Animal Waste		
Sample Point Number	**Sample Point Location, WasteType/sample Contents and Treatment Description (as applicable)**	
001	Sample point 001 is for any manure laden sand from the sand settling lane south of freestall barns at Site One that is directly land applied or headland stacked .	
002	Sample point 002 is for manure and process wastewater removed from cell one of the two stage earthen waste storage facility at Site One.	
003	Sample point 003 is for manure and process wastewater removed from the cell two of the two stage earthen waste storage facility at Site One.	
004	Sample point 004 is to be used to track all solid manure generated at Site One that is directly land applied or headland stacked.	
005	Sample point 005 is for inspection and maintenance of the feed storage area and runoff controls at Site One.	
006	Sample point 006 if for manure and process wastewater stored in the HDPE-lined waste storage facility 1 at Site Two.	
007	Sample point 007 if for manure and process wastewater stored in the HDPE-lined waste storage facility 2 at Site Two.	
008	Sample point 008 is for any solid manure generated at Site Two and directly land applied or headland stacked.	
009	Sample point 009 is for inspection and maintenance of the feed storage area and runoff controls at Site Two.	
010	Sample point 010 is for inspection and management of feedlot areas at Heifer Farm 1 (Theise Farm). It is anticipated that this facility will no longer be used once Site Two is constructed. If site use is continued, see Schedules section of permit for requirements.	
011	Sample point 011 is for inspection and management of feedlot areas at Heifer Farm 2 (Kruswick Farm). It is anticipated that this facility will no longer be used once Site Two is constructed. If site use is continued, see Schedules section of permit for requirements.	
012	Sample point 012 is to be used to track all solid manure generated at Heifer Farm 1 (Theise Farm) that is directly land applied or headland stacked.	
013	Sample point 013 is for manure removed from the concrete waste storage facility located at Heifer Farm 2 (Kruswick Farm).	

3 Livestock Operations - Proposed Operation and Management

Production Area Discharge Limitations

Beginning on the effective date of the permit, the permittee may not discharge pollutants from the operation's production area (e.g., manure storage areas, outdoor animal lots, composting and leachate containment systems, milking center wastewater treatment/containment systems, raw material storage areas) to navigable waters, except in the event a 25-year, 24-hour rainfall event (or greater) causes the discharge from a structure which is properly designed and maintained to contain a 25-year, 24-hour rainfall event for this location (**Kewaunee County-4.2 inches**). If an allowable discharge occurs from the production area, state water quality standards may not be exceeded.

Runoff Control

The permit requires control of contaminated runoff from all elements of the production area to prevent a discharge of pollutants to navigable waters in accordance with the Production Area Discharge Limitations and to comply with surface water quality standards and groundwater standards. Beginning on the effective date of this permit, (if needed) interim measures shall be implemented to prevent discharges of pollutants to navigable waters. In addition, permanent runoff control system(s) shall be designed, operated and maintained in accordance with the requirements found in USDA Natural Resources Conservation Service standards and ch. NR 243, Wis. Adm. Code. If any upgrading or modifications to runoff controls are necessary, formal engineering plans and specifications must submitted to the Department for approval.

Manure and Process Wastewater Storage

The permit requires the operation to have adequate storage for manure and process wastewater and that storage or containment facilities are designed, operated and maintained to prevent overflows and discharges to waters of the state. In order to prevent overflows, the permittee must maintain levels of materials in liquid storage or containment facilities at or below certain levels including a one foot margin of safety that can never be exceeded. If any upgrading or modifications to the storage facilities are necessary, formal engineering plans and specifications must submitted to the Department for approval. The permittee currently has approximately 14 months of storage for liquid manure. The permittee must maintain 180 days of storage, unless temporary reductions in required storage are approved by the Department.

Solid Manure Stacking

The operation has proposed to stack solid manure. All stacking of solid manure shall be done in accordance ch. NR 243, Wis. Adm. Code, which includes restrictions from NRCS Standard 313. Stacking of manure is considered to be part of the production area and is subject to the Production Area Discharge Limitations.

Ancillary Service and Storage Areas

The permittee shall take preventative maintenance actions and conduct visual inspections to minimize pollutant discharges from areas of the operation that are not part of the production area or land application areas. These areas are called ancillary service and storage areas and include access roads, shipping and receiving areas, maintenance areas, refuse piles and CAFO outdoor vegetated areas.

Nutrient Management

With the proposed 8700 animal units, it is estimated that approximately 70 million gallons of manure and process wastewater will be produced per year. The permittee owns and rents about 5000 acres of cropland for landspreading wastes. The permit requires all landspreading of manure and process wastewater be completed in accordance with an approved nutrient management plan. The permit will require sampling and analysis of manure and process wastewater that will be landspread. Landspreading rates must be adjusted based on sample analysis. The permit requires the permittee to maintain a daily log that documents landspreading activities. The permit also requires the submittal of an annual report that summarizes all landspreading activities. Plans must be updated annually to reflect cropping plans and other operational changes. Among the requirements, the plans must include detailed landspreading information including field by field nutrient budgets.

The permittee is required to implement a number or practices to address potential water quality impacts associated with the land application of manure and process wastewater. Among the permit conditions are restrictions on manure ponding, restrictions on runoff of manure and process wastewater from cropped fields, and setbacks from wells and direct conduits to groundwater (e.g., sinkholes, fractured bedrock at the surface). In addition, the permittee must implement a phosphorus based nutrient management plan that addresses phosphorus delivery to surface waters by basing manure and process wastewater applications on soil test phosphorus levels or the Wisconsin Phosphorus index. Additional phosphorus application restrictions apply to fields that are high in soil test phosphorus (>100 ppm).

The permitee must also implement conservation practices when applying manure near navigable waters and their conduits, referred to as the Surface Water Quality Management Area (SWQMA). These practices include a 100-foot setback from navigable waters and their conduits, a 35-foot vegetated buffer adjacent to the navigable water or conduit, or a practice that provides equivalent pollutant reductions equivalent to or better than the 100-foot setback.

In addition, the permittee must comply with restrictions on land application of manure and process wastewater on frozen or snow-covered ground. Included in these restrictions is a prohibition on surface applications of solid manure (≥12% solids) on frozen or snow-covered ground during February and March. Non-emergency surface applications of liquid manure (<12%) on frozen or snow-covered ground are prohibited.

Monitoring and Sampling Requirements

The permittee must submit a monitoring and inspection program that outlines how the permittee will conduct self-inspections to determine compliance with permit conditions. These self-inspections include visual inspections of water lines, diversion devices, storage and containment structures and other parts of the production area. The permit requires periodic inspections and calibrations of landspreading equipment. The permittee must take corrective actions to problems identified inspections or otherwise notify the Department. Samples of manure, process wastewater and soils receiving land applied materials from the operation must also be collected and analyzed.

Sampling Points

The permit identifies the different sources of land applied materials (e.g., manure storage facilities, milking centers, egg-washing facilities) as "Sampling Points." For these Sampling Points, the permittee is required to sample and analyze the different sources for nutrients and other parameters which serve as the basis for determining rates of application for these materials. Other areas are also identified as Sampling Points as a means of identifying them as areas requiring action by the permittee, such as an upgrade or evaluation of a certain system or structure (e.g., runoff control systems), even though sampling is not actually required.

3.1 Sample Point Number:001- Sand Settling Cell - Site One; 004- Solid Manure - Site One; 008- Solid Manure - Site Two; 012- Solid Manure - Heifer Farm 1

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Nitrogen, Total		lbs/ton	Quarterly	Grab	
Nitrogen, Available		lbs/ton	Quarterly	Calculated	
Phosphorus, Total		lbs/ton	Quarterly	Grab	
Phosphorus, Available		lhs/ton	Quarterly	Calculated	
Solids, Total		Percent	Quarterly	Grab	

3.1.1 Changes from Previous Permit

Addition of satellite farm manure sources and proposed expansion site manure generation and storages have been included.

3.1.2 Explanation of Operation and Management Requirements

Manure shall be properly stored, sampled and land applied according to permit and approved nutrient management plan.

3.2 Sample Point Number:002- Earthen WSF 1 - Site One; 003- Earthen WSF 2 - Site One; 006- HDPE WSF 1 - Site Two; 007- HDPE WSF 2- Site Two, and 013- Concrete WSF - Heifer Farm 2

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Nitrogen, Total		lb/1000gal	2/Month	Grab	
Nitrogen, Available		lb/1000gal	2/Month	Calculated	
Phosphorus, Total		lb/1000gal	2/Month	Grab	
Phosphorus, Available		lb/1000gal	2/Month	Calculated	
Solids, Total		Percent	2/Month	Grab	

3.2.1 Changes from Previous Permit

Addition of satellite farm manure sources and proposed expansion site manure generation and storages have been included.

3.2.2 Explanation of Operation and Management Requirements

Manure shall be properly stored, sampled and land applied according to permit and approved nutrient management plan.

3.3 Sample Point Number:005- Feed Storage Area - Site One; 009- Feed Storage Area - Site Two; 010- Outdoor Lots - Heifer Farm 1, and 011- Outdoor Lots - Heifer Farm 2

3.3.1 Changes from Previous Permit

Satellite farm lots have been added to permit although it is likely these locations will not be used once proposed expansion site is built. The proposed feed storage area for expansion site has been added to the permit.

3.3.2 Explanation of Operation and Management Requirements

Runoff controls shall be inspected and properly operated to ensure they are adequately functioning to collect and store or treat runoff.

4 Schedules

4.1 Annual Reports

Submit Annual Reports by January 31st of each year in accordance with the Annual Reports subsection in Standard Requirements.

Required Action	Date Due
Submit Annual Report #1: Inspection and landspreading summaries from 2012.	01/31/2013

Submit Annual Report #2: Inspection and landspreading summaries from 2013.	01/31/2014
Submit Annual Report #3: Inspection and landspreading summaries from 2014.	01/31/2015
Submit Annual Report #4: Inspection and landspreading summaries from 2015.	01/31/2016
Submit Annual Report #5: Inspection and landspreading summaries from 2016.	01/31/2017
Ongoing Annual Reports: Continue to submit Annual Reports until permit reissuance has been completed.	

4.2 Nutrient Management Plan

Updates to NMP due each year on March 31st.

Required Action	Date Due
Management Plan Annual Update #1: Submit an Annual Update to the Nutrient Management Plan by March 31st each year. Note: In addition to Annual Updates, submit Management Plan Amendments to the Department for written approval prior to implementation of any changes to nutrient management practices, in accordance with the Nutrient Management requirements in the Livestock Operational and Sampling Requirements section.	03/31/2013
Management Plan Annual Update #2: Submit an Annual Update to the Nutrient Management Plan.	03/31/2014
Management Plan Annual Update #3: Submit an Annual Update to the Nutrient Management Plan.	03/31/2015
Management Plan Annual Update #4: Submit an Annual Update to the Nutrient Management Plan.	03/31/2016
Management Plan Annual Update #5: Submit an Annual Update to the Nutrient Management Plan.	03/31/2017
Ongoing Management Plan Annual Updates: Continue to submit Annual Updates to the Nutrient Management Plan until permit reissuance has been completed.	

4.3 Manure Storage Facility - Installation

Site Two manure storage facilities.

Required Action	Date Due
Complete Installation: Complete construction of the manure storage facility. The facility shall be functional and in operation by the specified Date Due. Post construction documentation shall be submitted within 60 days of completion of the project.	Post construction info due within 60 days of completion.

4.4 Runoff Control System - Installation

Feed storage area and runoff controls at Site Two.

Required Action	Date Due
Complete Installation: Complete construction of runoff control system. System shall be functional and in operation by the specified Date Due. Post construction documentation shall be submitted within 60 days of completion of the project.	Post construction info due within 60 days of

	completion.

4.5 Runoff Control System - Engineering Evaluation

Outdoor lot areas at Heifer Farms 1 and 2 (only if use of sites is continued in 2013).

Required Action	Date Due
Written Description of Existing System: Submit a written description of the existing runoff control system and its adequacy to permanently meet the conditions in the Production Area Discharge Limitations and Runoff Control subsections and s. NR 243.15, Wis. Adm. Code. (See Standard Requirements for report details.)	12/31/2012
Plans and Specifications: IF REQUIRED, submit plans and specifications for Department review and approval to permanently correct any adverse runoff control conditions in accordance with Chapter 281.41, Wis. Stats., and Chapter NR 243, Wis. Adm. Code.	03/01/2013
Corrections and Post Construction Documentation: Complete construction of runoff controls that permanently correct any adverse runoff control conditions in concurrence with and approval by the Department, by the specified Date Due. Submit post construction documentation within 60 days of completion of the project.	11/01/2013

4.6 Submit Permit Reissuance Application

Required Action	Date Due
Reissuance Application: Submit a complete permit reissuance application 180 days prior to permit expiration.	11/30/2016

4.7 Explanation of Schedules

Schedules are intended to track and monitor permit compliance and protect water quality.

5 Proposed Expiration Date: May 31, 2017

Prepared By: Casey Jones, Agricultural Runoff Management Specialist

Date: March 26, 2012

Attachment D

Kenneth S. Wade, P.E., P.G.

10747 Moyer Road, Blue Mounds, WI, 53517

Tel.: 608-767-3111

Email: kenneth.wade@tds.net

Experience

2011 to present – Hydrogeological and environmental engineering consulting in areas of land spreading of waste, high capacity wells, chlorinated solvent spills, and wetland hydrology.

1993 to 2011 – manage the hazardous materials program for Wisconsin Department of Transportation, Southeast Region. Major projects include Miller Park Baseball Stadium, Lake Arterial Parkway, Park East, and Marquette Interchange. Manage hydrologic assessment of WisDOT wetland program issues.

1987 to 1993 – Wisconsin Department of Natural Resources, Bureau of Solid Waste Management, made feasibility determinations for solid waste facilities, coordinated hydrologic assessments of Crandon Mine Environmental Impact Statement.

1986 to 1987 – Idaho National Engineering Laboratory, Department of Energy (EG&G), hazardous and radioactive waste assessments for soil and groundwater, dioxin soil testing at Agent Orange storage sites (U.S. Department of Defense), with Level 1 security clearance.

1980 to 1985 – Wisconsin DNR, Bureau of Solid and Hazardous Waste Management with duties similar to DNR above.

1978 to 1980 – Colorado State University, graduate research, uranium solution mining impacts, reported to Colorado Dept. of Health.

1976 to 1977 – Brodhead High School, taught chemistry, advanced chemistry, and physics

1975 to 1976 – Solar Specialists, Inc., solar space heating and hot water installation

Education

1981 – 1985, U. of Wisconsin-Madison, graduate study in numerical groundwater flow and contaminant transport modeling; USGS Training Center, groundwater modeling

1978 – 1980, Colorado State University, Master of Geology

1970 – 1974, U. of Wisconsin-Madison, BS in secondary education

Other Experience

Town Board Chair – Town of Middleton, Dane County Wisconsin, 1989-1990

Restoration Ecology – Ongoing prairie, oak-savanna, wetland restoration in conjunction with “The Prairie Enthusiasts” on 260 acres of land in western Dane County.

Extensive outdoor experience including: mountaineering and rock climbing, winter camping, bicycling, and kayaking

Registration

Wisconsin Professional Engineer, # 30156

Wisconsin Professional Geologist, # 556

Hazardous Waste Operations and Emergency Response Certified (29 CFR1910.120)

Attachment E

Kenneth S. Wade, P.E., P.G.

10747 Moyer Rd.

Blue Mounds, WI, 53517

Tel.: 608-767-3111

Email: kenneth.wade@tds.net

April 9, 2013

Tara Heinzen and Abel Russ
Environmental Integrity Project
1 Thomas Circle NW, Suite 00
Washington, DC 20005

RE: Hydrogeological Review – Kinnard Farms Inc., E 2669 County Hwy. S, Casco, WI, 54205, Sec. 19 & 30, T25N, R24E, Tn. Of Lincoln, Kewaunee County, WI, WPDES: WI-0059536-03-0

Dear Ms. Heinzen and Mr. Russ:

I have reviewed the WDNR files and other information regarding Kinnard Farms, Inc. (KFI) you provided me along with hydrogeological data and reports from the USGS, Wisconsin Geological and Natural History Survey, UW- Stevens Point, Kewaunee County Conservation Office, and surface water data from the Kewaunee Cares citizen group. Per your instructions I have concentrated on reviewing the activities associated with the current KFI dairy operation with particular focus on the impacts associated with their waste manure land spreading and evaluating the risk posed to adjacent residents. I have included all the significant hydrogeological information I could locate and have provided recommendations for potential surface and groundwater sampling that could help determine the degree and significance of impacts associated with the KFI dairy activities.

Introduction

KFI currently operates a 5822 animal dairy facility located in the northwest quarter of Section 30, Lincoln Township (T25N, R24E) accessed from CTH "S" at the intersection of Tamarack Road (see Attachment 1: Locator Map & Attachment 2: Aerial Map, & Attachment 3: Topographic Map). The dairy produces approximately 23 million gallons of liquid manure per year containing approximately 460,000 lbs. of nitrogen and 160,000 lbs. of phosphate. In 2009 KFI owned and leased 3775 acres of land available for land spreading manure waste from the current operation and spread waste on 1556 acres of those lands in 2009. The resulting average nutrient loading on the area land spread for 2009 was approximately 300 lbs. of nitrogen and 100 lbs. of phosphate per acre. Most of the manure is spread on farm fields in the Towns of Lincoln and Red River (see Attachments 4a and 4b). Kewaunee County contains 15 other CAFO operations with three of these located within about eight miles of KFI (see attachment 5 for Kewaunee

CAFO locations and information). It is possible that some of the manure land application fields used by the adjacent CAFOs may be in close proximity to some of the designated KFI manure spreading fields.

Hydrogeology

The KFI site area, including its manure spreading fields, lies in an area of northwest Kewaunee County where glacial soils generally less than 50 feet in thickness overlie the Silurian Niagara Dolomite (see Attachment 6: Kewaunee County geologic cross section; Attachment 7a, Pleistocene Geologic map of Kewaunee Co.; Attachment 7b, Pleistocene map legend; and Attachment 7c, Pleistocene map inset of site area). The thickness of the soils overlying the Niagara Dolomite in the KFI site area is shown in Attachment 8.

The large areas of thin soil and exposed bedrock in the site vicinity allows for rapid percolation of manure contaminants into the underlying fractured dolomite. The glacial till soils prevalent in the site area contain a significant quantity of clay-sized particles which allows for ponding in areas of poor drainage or increased surface runoff in areas where the soils are thick enough to prevent percolation into the underlying dolomite. A high density of karst features such as sinkholes have been inventoried by the Kewaunee County Land Conservation Department in the site area (See Attachment 9, Karst Features Inventory).

The Wisconsin Department of Natural Resources used data including: depth to bedrock, depth to groundwater, bedrock type and soil information to develop a “Susceptibility to Groundwater Contamination” map for the State. The mapped groundwater contaminant susceptibility for Kewaunee County is shown on Attachment 10.

KFI conducted a well inventory as part of its proposed expansion. The locations of the wells inventoried are shown on Attachment 11 and a table listing well characteristics is provided as Attachment 12. The survey reported the average hydraulic conductivity of the dolomite as 0.67 ft/day. Though there appears to be no groundwater map for the KFI site area or Kewaunee County, as a general rule it can be assumed that the groundwater discharges to the area streams with groundwater recharge occurring in the land areas adjacent to the streams with groundwater divides roughly corresponding to surface water divides. However some stream segments in the area appear to have no surface discharge which is consistent with the presence of karst environments where thin soil or exposed fractured dolomite bedrock can capture incipient streams and return the flow to the groundwater. See Sections 14 and 22 in the Town of Red River (Attachment 1) for examples of discontinuous stream segments. These areas would be particularly susceptible to groundwater contamination from manure applications.

A hydrogeologic study by Bradbury and Muldoon, 2010, included a detailed study of the groundwater conditions at a test well constructed in southeast Lincoln Township of Kewaunee County. The well was drilled to a depth of 35 feet into dolomite with 10 feet of silty soils overlying the bedrock. Three significant fractures were found at 21, 25, and 27 feet below the surface. The study showed the groundwater level fluctuated from 3 to 12 feet below the surface with the highest levels being associated with spring recharge. The nitrate concentrations varied from 3 to 12 mg/l during the year with the highest values from May through December and lowest values in spring, correlating with the period of high recharge.

A review of soils present in the site area showed that soils of the Namur Soil Series (NaB, NaC, and NrD) are very thin soils or exposed bedrock with excessive drainage underlain by dolomite. The Kolberg Soil Series (KwB, KwC2, and KxB) are thin glacial till soils overlying dolomite. These soils correlate with the Pleistocene units "h" and "gss" as mapped in Attachment 7c. A review of the soils information for the manure spreading fields used by KFI in the 36-section KFI study area (portions of Red River and Lincoln Townships) showed that 32 of the fields used for spreading contain Namur or Kolberg soils. Attachment 13 listed each of the 32 fields and the acres of each thin soil unit mapped in that field along with the percentage of thin soil of the entire field area. The total spreading fields area of 636 acres contains 243 acres mapped as thin soils for an average of 38%.

Groundwater Quality

Private well water quality analyses from Kewaunee County have been collected and reported by the Kewaunee County Conservation Department, UW-Stevens Point Kewaunee County Community Drinking Water Program, UW-Stevens Point Dataviewer, and as part of the final report of the Northeast Wisconsin Karst task Force, G3836, dated February 9, 2007 by Kevin Erb and Ron Stieglitz. Attachment 14 shows that high nitrate concentrations and positive bacteria tests are correlated with the shallow bedrock locations including the KFI facility and manure spreading areas. Attachment 15 indicates the higher concentrations of nitrate in the wells tested correlates with the areas of highest groundwater contamination susceptibility as shown on Attachment 10. The March 2013 download of well water quality data from the UW-Stevens Point Dataviewer system shown on Attachments 16 and 17 confirm the other reports, with higher frequency of nitrate drinking water exceedences and positive bacterial results in sections associated with conditions of highest groundwater contaminant susceptibility, including KFI and its associated manure spreading areas.

Potential Contamination Associated with Kinnard Farms Manure Spreading

The estimated annual nitrogen content of the liquid manure that was spread over 1556 acres of field area in 2009 resulted in an average application of 300 pounds of nitrogen per acre. The application of manure is regulated by the WDNR per the facility WPDES permit and associated NRCS Standard 590. In Wisconsin the "Nutrient application guidelines of field, vegetable, and fruit crops in Wisconsin" (A2809) is used as the guide for waste manure application rates as part of the WPDES and the 590 Std. The facility nutrient management plan (NMP) required by the WPDES permit details the application requirements.

However the NRCS Std. 590 and the UW A2809 have no groundwater quality standards associated with them. The A2809 guidance only considers nutrient cost relative to crop yield in order to determine cost effective nutrient application rates. Page 51 of the A2809 guidance, as part of its discussion of nutrient management planning, notes that while there are policy concerns with excessive release of nitrogen to the environment, and that university nutrient recommendations are often viewed as a vehicle for achieving environmental objectives, the basis for developing the nutrient recommendation is agronomic.

A review of the KFI 2010 annual manure spreading report (see Attachments 18A, B, C & D)) shows many manure field nutrient applications far in excess of even the A2809 agronomic guidelines. Alfalfa is a legume that naturally produces its own nitrogen. Fields cropped with alfalfa develop excess nitrogen that should be credited toward the nitrogen requirements of subsequent crops. The A2809 guidelines, Table 6.3, indicate no nitrogen should be added to alfalfa crops except in the case of initial seeding of alfalfa into soils with very low organic matter. In that case 30 pounds of nitrogen per acre is recommended. The following list of KFI fields cropped with alfalfa show the total nitrogen applied per acre in 2010:

Field Name	Lbs. of total Nitrogen/Acre
LCR 1 & 2	187
BLE 3, 5 & 7 TH-2	352
TH-1 East & TH7	361
HD1	222
RM-1	421
DKS	476
PP-3	542
DEC-1	404
BLN 13 & 15	3281
BDSR-2 & 4	337
BD-1 &2	224

.

While it is recognized that not all the manure total nitrogen will be available to leach into the groundwater immediately it is clear that the excessive nutrient load cannot be utilized by the plants. This excess nitrogen will be available to both leach into the groundwater underlying the fields or runoff into surface water. As an example, using a groundwater nitrogen loading rate of 100 pounds per acre per year and a groundwater recharge rate of 9 inches per year (0.75 ft/yr) the resultant nitrate concentration can be calculated as follows:

Nitrate-N concentration (mg/l) in groundwater underlying cropped field =

$$[(100 \text{ lbs. N/acre}) (454 \text{ g/lb.}) (1000\text{mg/g})]/ [(0.75 \text{ ft}) (43{,}569 \text{ ft}^{2}\text{/acre}) (27.7 \text{ l/ft}^{3})] = 50.2 \text{ mg/l}$$

This exceeds the NR 140 Enforcement Std. (ES), (Wis. Adm. Code) of 10 mg/l by a factor of five. The results of excessive manure application has been seen at the Rosendale Dairy where groundwater monitoring down gradient from an alfalfa field spread with manure with a total nitrogen content of 210 lbs./acre showed a spike in the groundwater nitrate concentration from 3 mg/l background concentration to 15 mg/l.

KFI Field Manure Spreading Areas with Greatest Groundwater Contamination Potential

Using the hydrogeological data in the KFI site area, each of the KFI dedicated manure spreading fields was evaluated and mapped to indicate those with the greatest groundwater contamination potential (See Attachment 19). The map shows the approximate location of KFI manure spreading fields outlined with green rectangles. Fields judged to have the greatest risk of groundwater contamination are highlighted in pink. The relevant hydrogeological data from the WDNR contaminant susceptibility mapping, Karst data from the Kewaunee County Land Conservation Department, and high bedrock or thin soils data from the Kewaunee Pleistocene map is also indicated.

Sectional manure spreading field maps from Lincoln and Red River Townships, developed by KFI as part of their 590 Std. Nutrient Management Plan (NMP), were evaluated using the site area hydrogeological data and assumptions of likely groundwater flow direction in the area of each spreading field to determine the potential for contamination for private water supply wells located in the field area. The following 15 Red River and Lincoln Township sectional maps indicate the locations of wells that are at potential elevated risk of groundwater contamination associated with the KFI manure spreading:

Red River, Section 27

Red River, Section 26

Red River, Section 25

Red River, Section 24

Red River, Section 22

Lincoln, Section 32

Lincoln, Section 31

Lincoln, Section 30

Lincoln, Section 29

Lincoln, Section 28

Lincoln, Section 20

Lincoln, Section 19

Lincoln, Section 18

Lincoln, Section 6

Lincoln, Section 5

The individual section maps with the wells with elevated potential for contamination indicated are included in Attachment 20. It should be understood that the contaminant evaluation was limited to the potential impacts of the KFI manure spreading. Non-KFI manure or commercial fertilizer applications to fields in the vicinity of the KFI fields may present additional contamination risk to wells located in the section. It is recommended that the wells with potential for contamination as indicated on the section maps be sampled at least annually for nitrate, total coliform and E coli bacteria in order to determine the distribution, magnitude and significance of potential contaminant levels.

Surface Water Impacts from KFI Operations

There has been a history of various surface water releases from the KFI facility, its manure storage areas, and spreading problems. The temporary nature of the impacts related to these occurrences have made it difficult to document their significance. The thicker areas of clay-rich till soils in the KFI area can lead to ponding and increase run-off potential. This can result in greater impacts to streams or groundwater impacts where surface runoff encounters shallow soil or bedrock exposures that allow infiltration to the fractured dolomite aquifer.

Some clay soil fields have drain tiles which can intercept manure contaminants and direct them via drain tile outlets into adjacent streams. The KFI manure spreading field PP-3, is indicated on a map in the NMP as being drained by tiles with the outlet located in the NE quadrant of Maple Rd. and CTH “K” (see Attachment 21). In 2010 this field received two fall applications of manure with a total nitrogen content of 555 lbs./acre. As noted previously alfalfa does not require nitrogen as a nutrient and since the plants are dormant until the following summer there was a long period of time available for conversion of the organic and ammonia nitrogen prevalent in the manure to the easily leachable nitrate form. If the outlet flow for the PP-3 tile line is accessible from the Town or County road rights-of-way this may serve as a good surface water sampling point for manure contact water and allow direct measurement of impact to tributaries to Casco Cr.

The increased risk to receiving surface waters from tile drain systems was demonstrated in a tile drain study at sites in Kewaunee, Waukesha, and Manitowoc Counties, Ruark, et. al., 2012. The study showed significant increases in drain tile phosphorus emissions for those fields where manure was incorporated into the soil, with average outfall dissolved phosphorus concentrations of 1.26 mg/l and average total phosphorus of 1.78 mg/l. found at those fields. It was noted by the authors that the tile line total phosphorus discharges often were greater than 1 mg/l which is 10 times higher than the concentration that the USEPA (1986) recommends for freshwater streams and lakes.

A citizen group, “Kewaunee Cares” has established a stream sampling program in Kewaunee Co. One of their sampling points is within the KFI area on Casco Cr. at the intersection of Maple Rd. and CTH “S” with the following results reported:

Casco Cr. @ Maple Rd. and CTH “S”

Date	Total Coliform*	E. Coli*	Nitrate, mg/l	Phosphorus, mg/l	Comments
9/24/12	>2419.6	325.5	19.7	<0.088	Low flow, good clarity
10/15/12	>2419.6	1299.7	NA	NA	After > 3’’ rain
10/30/12	>2419.6	517.2	15.49	<0.088	Low flow, good clarity
1/30/13	5794	530	NA	NA	Low flow, poor clarity
3/12/13	9804	52	NA	NA	Not reported

* Bacteria units are MPN-CFU/100 ml (most probable number of colony forming units per 100 ml)

“Kewaunee Cares” also sampled Casco Cr. at Robin Lane on the property of Troy Jandrin on March 11, 2013 finding 7701 CFU of total coliform and 798 CFU of E. Coli, 0.397 mg/l nitrate, and 1.0 mg/l phosphorus.

The high nitrate concentration and bacteria counts at Casco Cr. at Maple Rd. & CTH “S” are not surprising considering the stream headwaters drain KFI fields used for manure spreading. Additional sampling at the Robin Lane site with descriptions of stream flow conditions and previous rainfall notes would be needed to evaluate this sampling point.

A review of nitrate toxicity to aquatic animals, Carmargo, et. al., Chemosphere 58, 2005, indicates a maximum level of 2 mg/l NO_3-N/l would be appropriate for protecting the most sensitive freshwater species. Phosphorus surface water quality standards for streams in the KFI area also need to be evaluated.

A regularly conducted surface water sampling program for the KFI area would be the best way to determine the potential impacts of both the KFI dairy production facility and the associated manure land spreading areas. A suggested surface water sampling plan and map of sampling points is presented in Attachments 22 and 23. It may be practical to coordinate with the “Kewaunee Cares” citizen group to expand their program in consideration of the plan proposed. A contact person for “Kewaunee Cares” is Lynn Utesch, email: lnutesch@yahoo.com or by phone at 920-388-0868. Funds would be required to pay for their analytical costs and purchase of analytical meters for conductivity and dissolved oxygen field measurements, but a trained group volunteers could provide the labor. Funding applications for Wisconsin DNR River Protection & Planning Grants should also be considered (See: http://dnr.wi.gov/topic/rivers/grants.html).

Conclusion

The area of the KFI operation is dominated by hydrogeological conditions characterized by high susceptibility to groundwater contamination due to the presence of large areas of thin soil overlying fractured dolomite bedrock. It appears that the KFI manure spreading application rates exceed agronomic guidelines without consideration of groundwater quality standards. Water quality analyses from private wells in the KFI area show elevated nitrate concentrations and a high percentage of bacteria detection most likely as a result of manure spreading from dairy waste application to agricultural fields.

The installation of effective groundwater monitoring networks at the KFI manure application sites with the goal of determining potential KFI impact is problematic due to the lack of good up- and down-gradient field position access for the wells, the difficulty in monitoring the fractured bedrock aquifer and the use of nutrient applications on adjacent non-KFI properties.

The implementation of regular monitoring of the private water supply wells and surface waters adjacent the KFI production facility and manure spreading areas as proposed appears to be the most practical way of determining KFI impacts and assessing the degree of risk to human health and the environment. Coordination of both surface and groundwater sampling with a citizen group such as “Kewaunee Cares” may save costs and provide the public outreach needed to obtain citizen cooperation. The practicality of implementing site specific groundwater monitoring programs could be revisited after the results of the proposed private well and surface water sampling program are evaluated. A similar approach could be used to evaluate the impacts of other CAFO operations located in similar hydrogeological environments within the karst areas of northeast Wisconsin.

Prepared by Kenneth S. Wade, P.E., P.G. –April 9, 2013

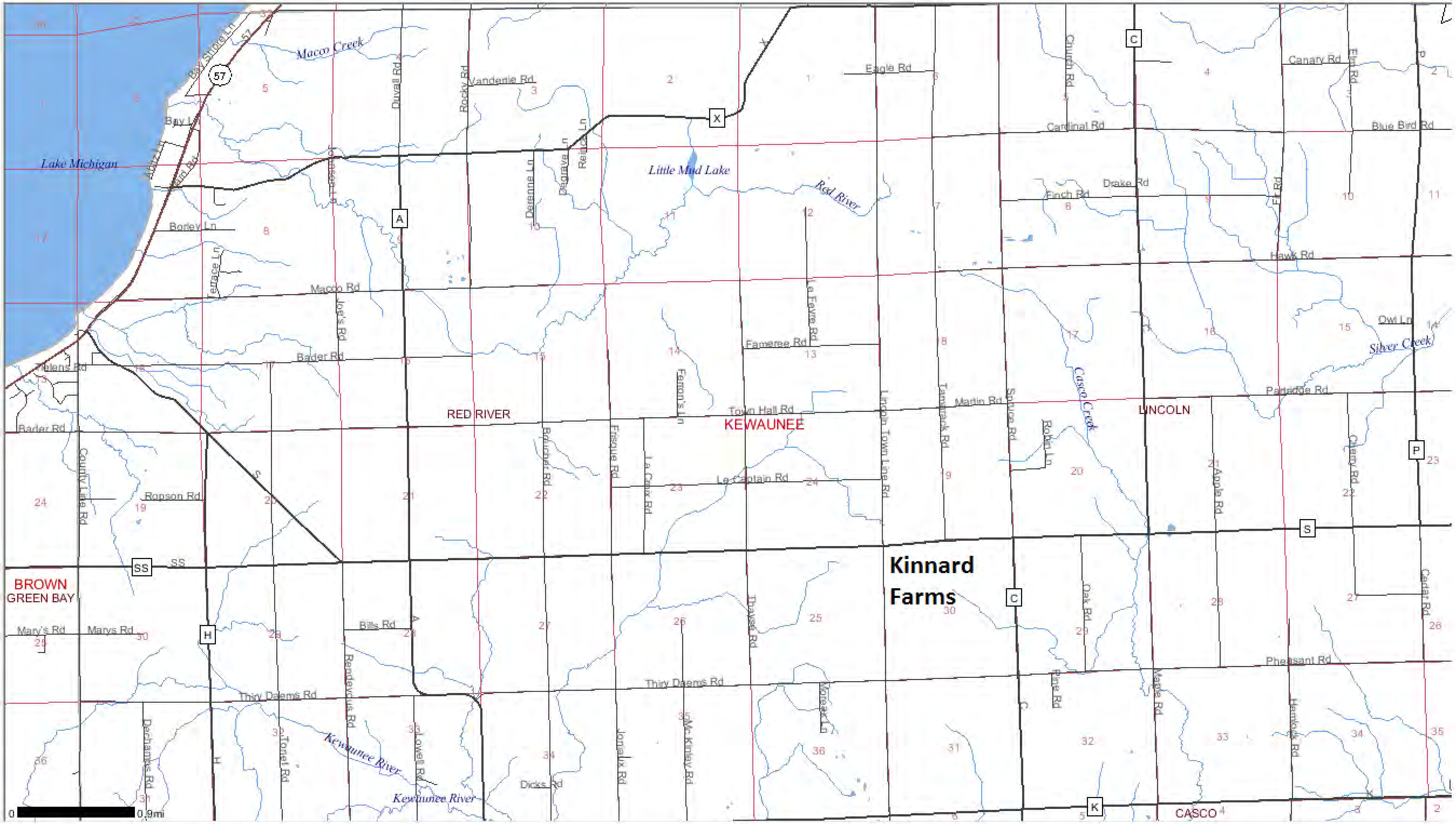
References:

Bradbury, K. R. and Muldoon, M. A., Assessing Seasonal Variations in Recharge and Water Quality in the Silurian Aquifer in Areas with Thicker Soil Cover, Final report to the Wisconsin Department of Natural Resources, April, 2010.

Carmargo, J.A., Alonso, A., Salamanca, A., 2005. Nitrate toxicity to aquatic animals: a review with new data for freshwater invertebrates. Chemosphere 58, 1255-1267.

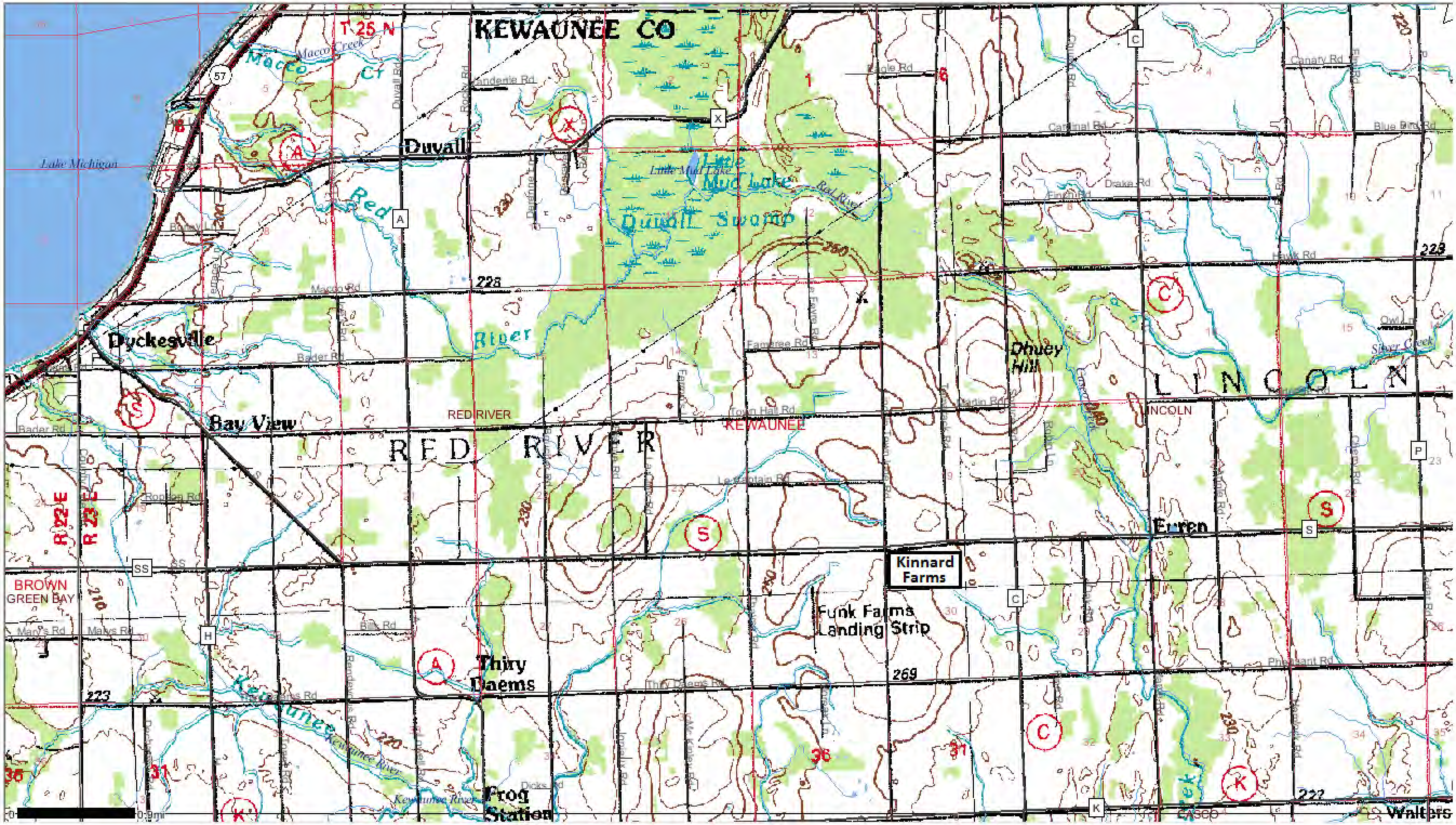
Ruark, M., Madison, A., Cooley, E., Stuntebeck, T., and Komiskey, M., Phosphorus loss from tile drains: should we be concerned?, Proc. Of the 2012 Wisconsin Crop Management Conference, Vol. 51, 9-14.

Attachment 1: Kinnard Farms Locator Map



Attachment 2: Kinnard Farms 2010 Aerial Map

Attchment 3: Kinnard Farms Topographic Map

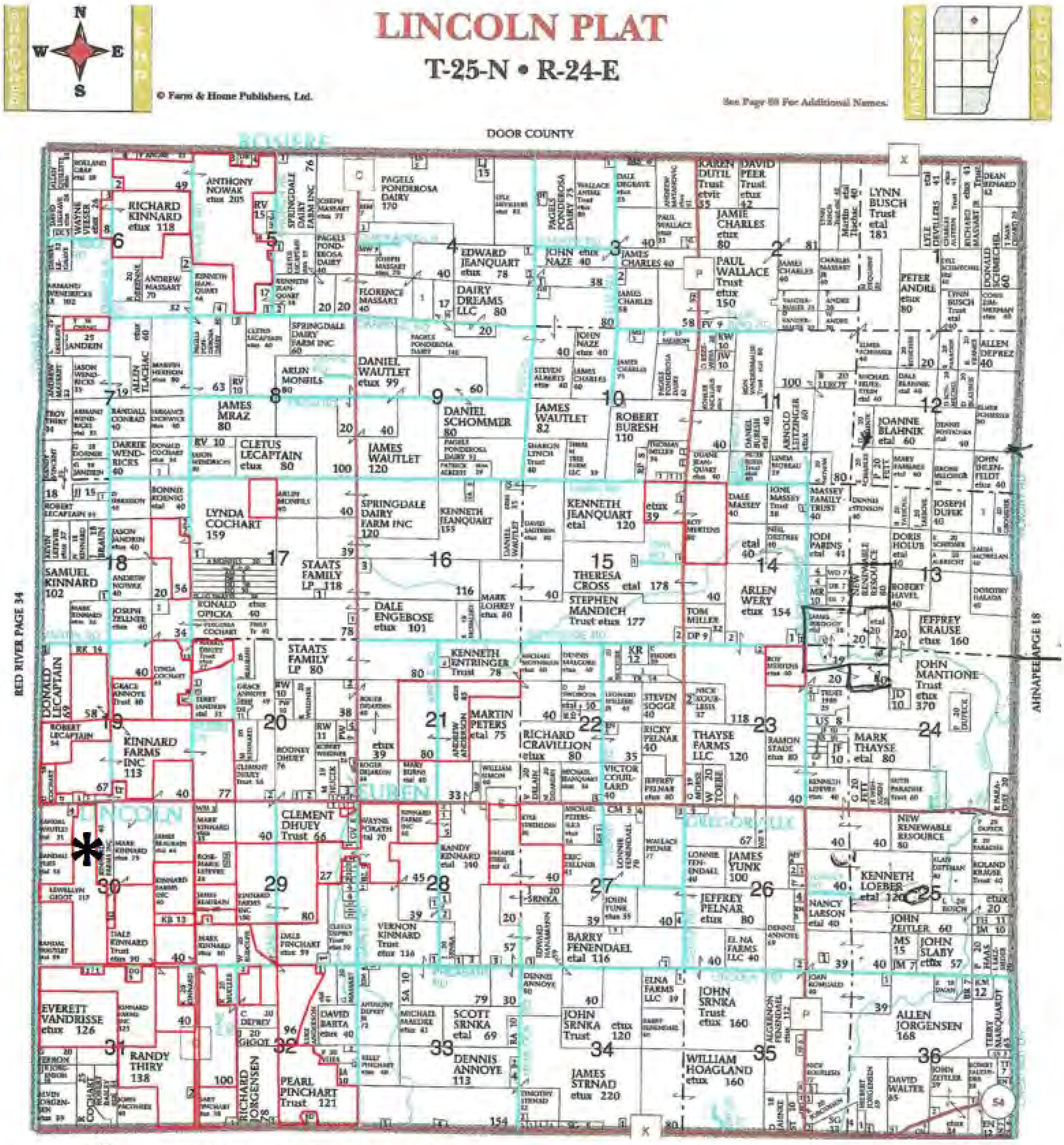


LINCOLN PLAT

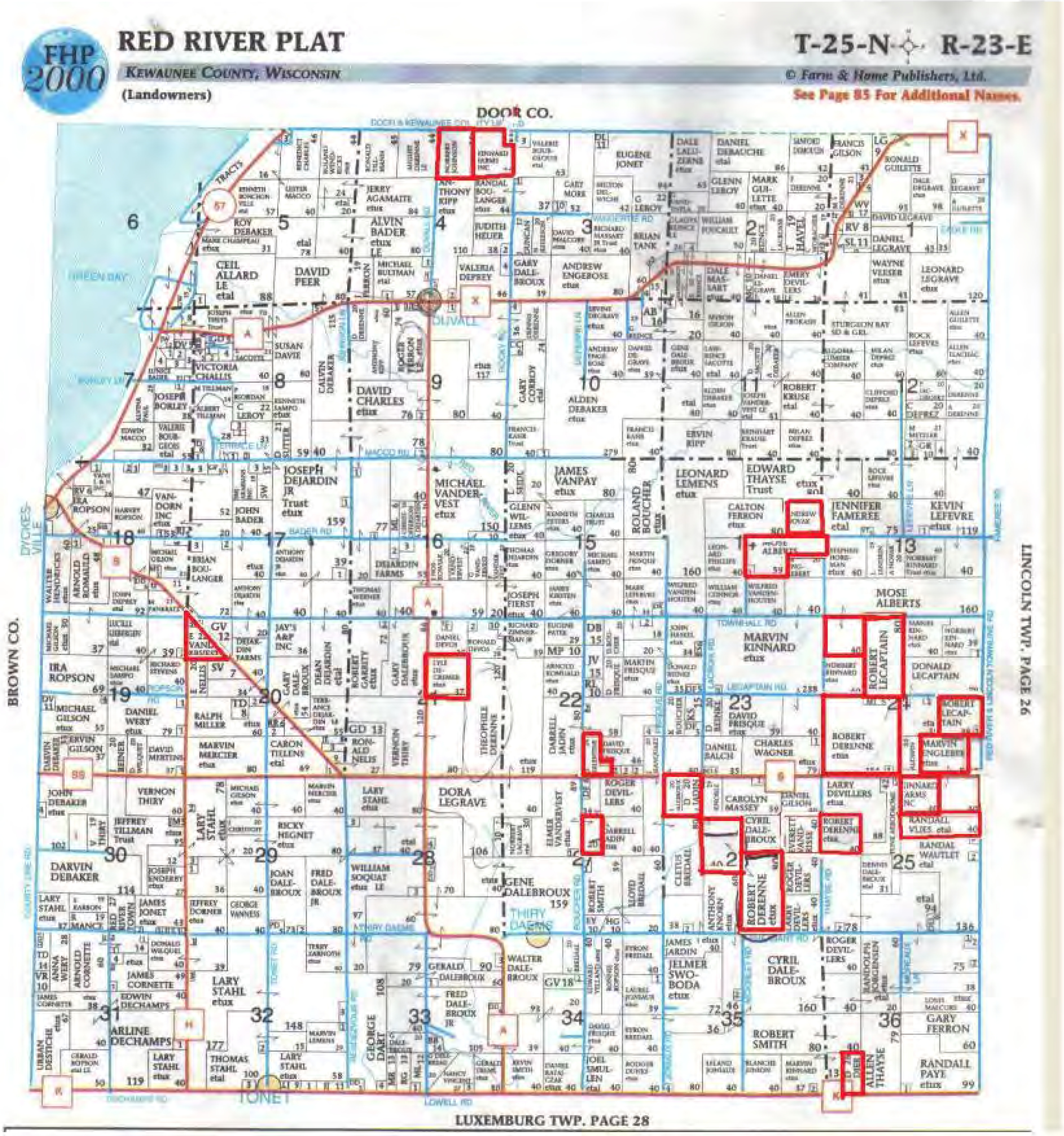
T-25-N • R-24-E

© Farm & Home Publishers, Ltd.

See Page 60 For Additional Names.

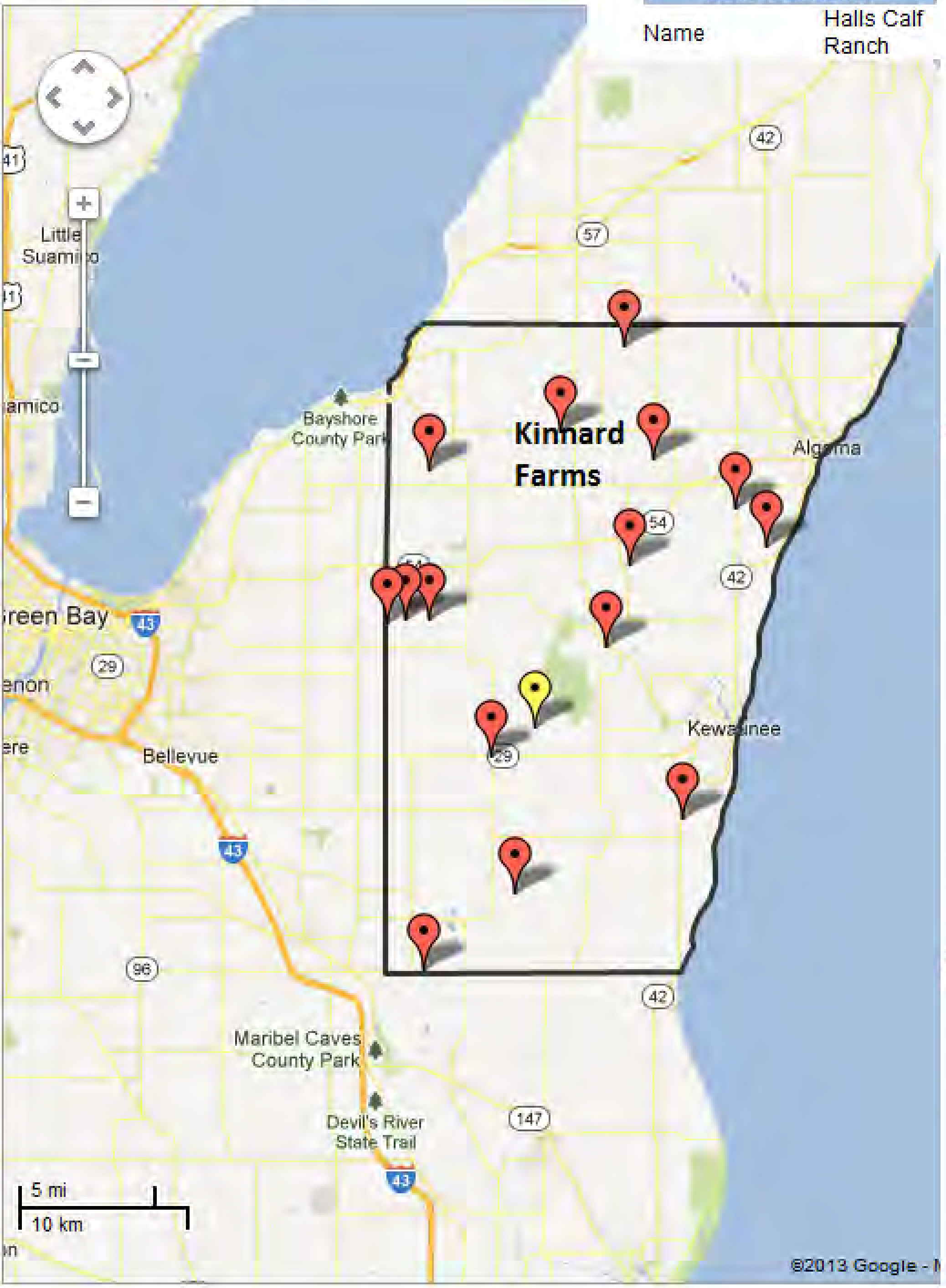


***** = Kinnard Farms Site ☐ = Manure Spreading Area



☐ = Manure Spreading Area

Attachment 5: Kewaunee County CAFOs



Kewaunee County Industrial Agriculture Locations

Halls Calf Ranch

Halls Calf Ranch	
Name	Halls Calf Ranch

Da-Ran Dairy LLC

Da-Ran Dairy LLC	
Name	Da-Ran Dairy LLC
PermitNumber	59579
Address	5232 BK Line Road
City	Luxemburg
State	Wisconsin
ZipCode	54217
PermitStatus	Current
IssueDate	10/12/2010
EffectiveDate	11/1/2010
Expires	10/31/2015
AnimalType	Dairy
Number	2347
ProposedNumber	2907

Dairy Dreams LLC

Dairy Dreams LLC	
Name	Dairy Dreams LLC
PermitNumber	62057
Address	E3576 Cardinal Road
City	Casco
State	Wisconsin
ZipCode	54205
PermitStatus	Current
IssueDate	3/26/2007
EffectiveDate	4/1/2007
Expires	3/13/2012
AnimalType	Dairy
Number	4218
ProposedNumber	6249

Deer Run Dairy LLC

Deer Run Dairy LLC	
Name	Deer Run Dairy LLC
PermitNumber	63789
Address	N1215 Sleep Hollow Road
City	Kewaunee
State	Wisconsin
ZipCode	54216
PermitStatus	Current
IssueDate	6/16/2008
EffectiveDate	7/1/2008
Expires	6/30/2013
AnimalType	Dairy
Number	1073
ProposedNumber	4530

Deuschers Lengendairy Farm

Deuschers Lengendairy Farms	
Name	Deuschers Lengendairy Farms
PermitNumber	59005
Address	N6388 Longfellow Road
City	Algoma
State	Wisconsin
ZipCode	54201
PermitStatus	Expired
IssueDate	1/6/2004
EffectiveDate	1/1/2004
Expires	12/31/2008
AnimalType	Dairy
Number	3460
ProposedNumber	3460

Ebert Dairy Enterprises LLC

Ebert Dairy Enterprises LLC	
Name	Ebert Dairy Enterprises LLC
PermitNumber	62235
Address	6939 County Road D
City	Algoma
State	Wisconsin
ZipCode	54201
PermitStatus	Current
IssueDate	6/28/2010
EffectiveDate	7/1/2010
Expires	9/30/2015
AnimalType	Dairy
Number	2730
ProposedNumber	5460

El-Na Farms LLC

El-Na Farms LLC	
Name	El-Na Farms LLC
PermitNumber	63061
Address	E4029 Pheasant Road
City	Algoma
State	Wisconsin
ZipCode	54201
PermitStatus	Expired
IssueDate	11/30/2005
EffectiveDate	12/1/2005
Expires	9/30/2010
AnimalType	Dairy
Number	1161
ProposedNumber	3888

Heims Hillcrest Dairy LLC

Heims Hillcrest Dairy LLC	
Name	Heims Hillcrest Dairy LLC
PermitNumber	64131
Address	E3730 Rocklege Road
City	Algoma Casco
State	Wisconsin
ZipCode	54201
PermitStatus	Current
IssueDate	9/24/2010
EffectiveDate	10/1/2010
Expires	9/30/2015
AnimalType	Dairy
Number	962
ProposedNumber	2358

Kinnard Farms Inc

Kinnard Farms Inc	
Name	Kinnard Farms Inc
PermitNumber	59536
Address	E2675 County Road S
City	Casco
State	Wisconsin
ZipCode	54205
PermitStatus	Current
IssueDate	10/5/2006
EffectiveDate	11/1/2006
Expires	9/30/2011
AnimalType	Dairy
Number	2714
ProposedNumber	8710

Pagels Ponderosa Dairy

Pagels Ponderosa Dairy	
Name	Pagels Ponderosa Dairy
PermitNumber	59374
Address	N4893 County Road C
City	Kewaunee
State	Wisconsin
ZipCode	54216
PermitStatus	Current
IssueDate	10/22/2010
EffectiveDate	11/1/2010
Expires	10/31/2015
AnimalType	Dairy
Number	6578
ProposedNumber	8080

Seidls Mountain View Dairy

Seidls Mountain View Dairy LLC	
Name	Seidls Mountain View Dairy LLC
PermitNumber	63665
Address	E745 Luxemburg Road
City	Luxemburg
State	Wisconsin
ZipCode	54217
PermitStatus	Current
IssueDate	12/4/2007
EffectiveDate	12/1/2007
Expires	9/30/2012
AnimalType	Dairy
Number	915
ProposedNumber	1617

Skyline Blue Acres

Skyline Blue Acres	
Name	Skyline Blue Acres
PermitNumber	63410
Address	E612 County Road BB
City	Denmark
State	Wisconsin
ZipCode	54208
PermitStatus	Current
IssueDate	9/21/2006
EffectiveDate	10/1/2006
Expires	9/30/2011
AnimalType	Beef
Number	1000
ProposedNumber	1400

Stahl Brothers Dairy LLC

Stahl Brothers Dairy LLC	
Name	Stahl Brothers Dairy LLC
PermitNumber	61999
Address	N7518 Tonet Road
City	Luxemburg
State	Wisconsin
ZipCode	54217
PermitStatus	Current
IssueDate	3/14/2007
EffectiveDate	4/1/2007
Expires	3/31/2012
AnimalType	Dairy
Number	1716
ProposedNumber	2140

Stahl Farms

Stahl Farms	
Name	Stahl Farms
PermitNumber	62332
Address	E389 Luxemburg Road
City	Luxemburg
State	Wisconsin
ZipCode	54217
PermitStatus	Expired
IssueDate	6/30/2003
EffectiveDate	7/1/2003
Expires	6/30/2008
AnimalType	Dairy
Number	1335
ProposedNumber	2006

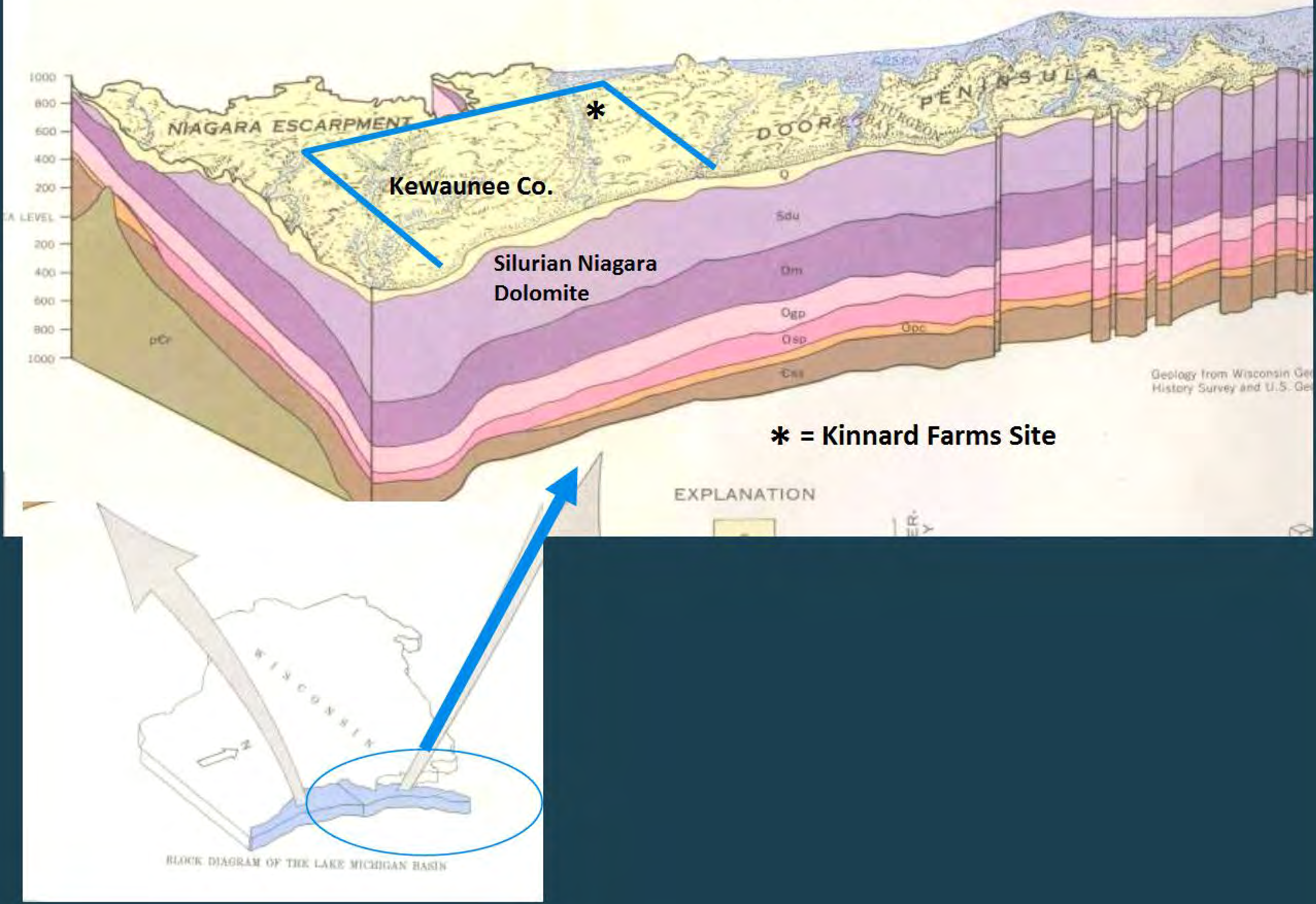
Rolling Hills Dairy Farm

Rolling Hills Dairy Farm	
Name	Rolling Hills Dairy Farm
PermitNumber	62707
Address	N3265 County Road AB
City	Luxemburg
State	Wisconsin
ZipCode	54217
PermitStatus	Expired
IssueDate	1/14/2004
EffectiveDate	2/1/2004
Expires	12/31/2008
AnimalType	Dairy
Number	1181
ProposedNumber	2556

Wakker Dairy Farm Inc

Wakker Dairy Farm Inc	
Name	Wakker Dairy Farm Inc
PermitNumber	63673
Address	N2348 Highway 42
City	Kewaunee
State	Wisconsin
ZipCode	54216
PermitStatus	Current
IssueDate	12/4/2007
EffectiveDate	12/1/2007
Expires	9/30/2012
AnimalType	Dairy
Number	930
ProposedNumber	4612

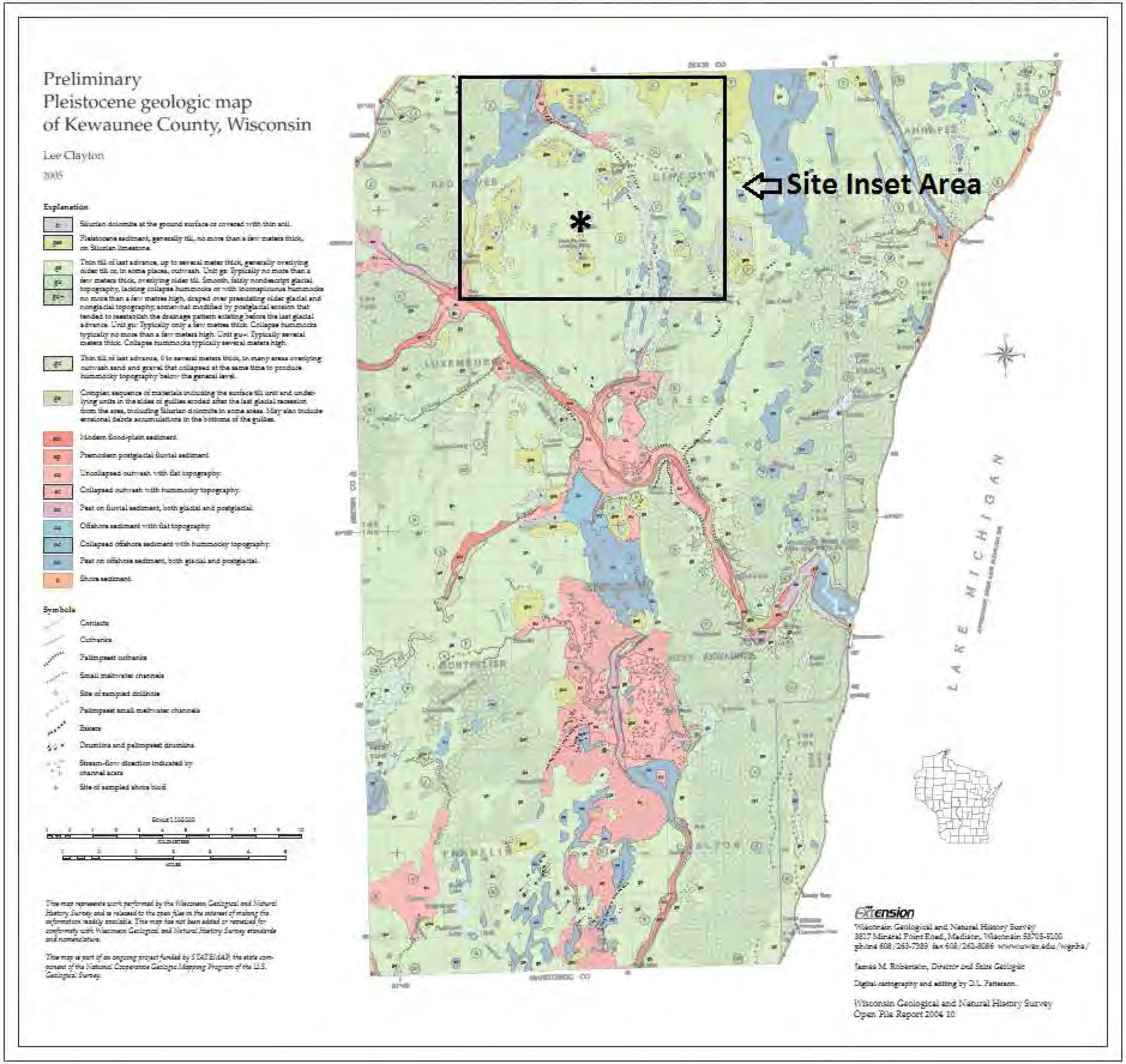
Attachment 6: Geologic Cross Section



Geology from Wisconsin Ge
History Survey and U.S. Ge

* = Kinnard Farms Site

Attachment 7a: Pleistocene Map of Kewaunee County



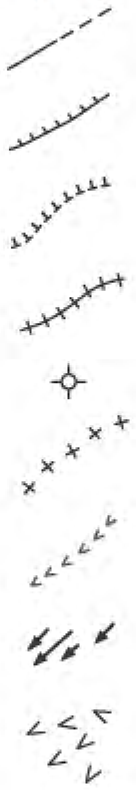
***** = Kinnard Farms Site

Attachment 7b: Legend for Pleistocene Maps

Explanation

h	Silurian dolomite at the ground surface or covered with thin soil.
gss	Pleistocene sediment, generally till, no more than a few meters thick, on Silurian limestone.
gs gu gu+	Thin till of last advance, up to several meter thick, generally overlying older till or, in some places, outwash. Unit gs: Typically no more than a few meters thick, overlying older till. Smooth, fairly nondescript glacial topography, lacking collapse hummocks or with inconspicuous hummocks no more than a few metres high, draped over preexisting older glacial and nonglacial topography, somewhat modified by postglacial erosion that tended to reestablish the drainage pattern existing before the last glacial advance. Unit gu: Typically only a few metres thick. Collapse hummocks typically no more than a few meters high. Unit gu+: Typically several meters thick. Collapse hummocks typically several meters high.
gc	Thin till of last advance, 0 to several meters thick, in many areas overlying outwash sand and gravel that collapsed at the same time to produce hummocky topography below the general level.
ge	Complex sequence of materials including the surface till unit and underlying units in the sides of gullies eroded after the last glacial recession from the area, including Silurian dolomite in some areas. May also include erosional debris accumulations in the bottoms of the gullies.
sm	Modern flood-plain sediment.
sp	Premodern postglacial fluvial sediment.
su	Uncollapsed outwash with flat topography.
sc	Collapsed outwash with hummocky topography.
oo	Peat on offshore sediment, both glacial and postglacial.

Symbols



Contacts

Cutbanks

Palimpsest cutbanks

Small meltwater channels

Site of sampled drillhole

Palimpsest small meltwater channels

Eskers

Drumlins and palimpsest drumlins

Stream-flow direction indicated by channel scars

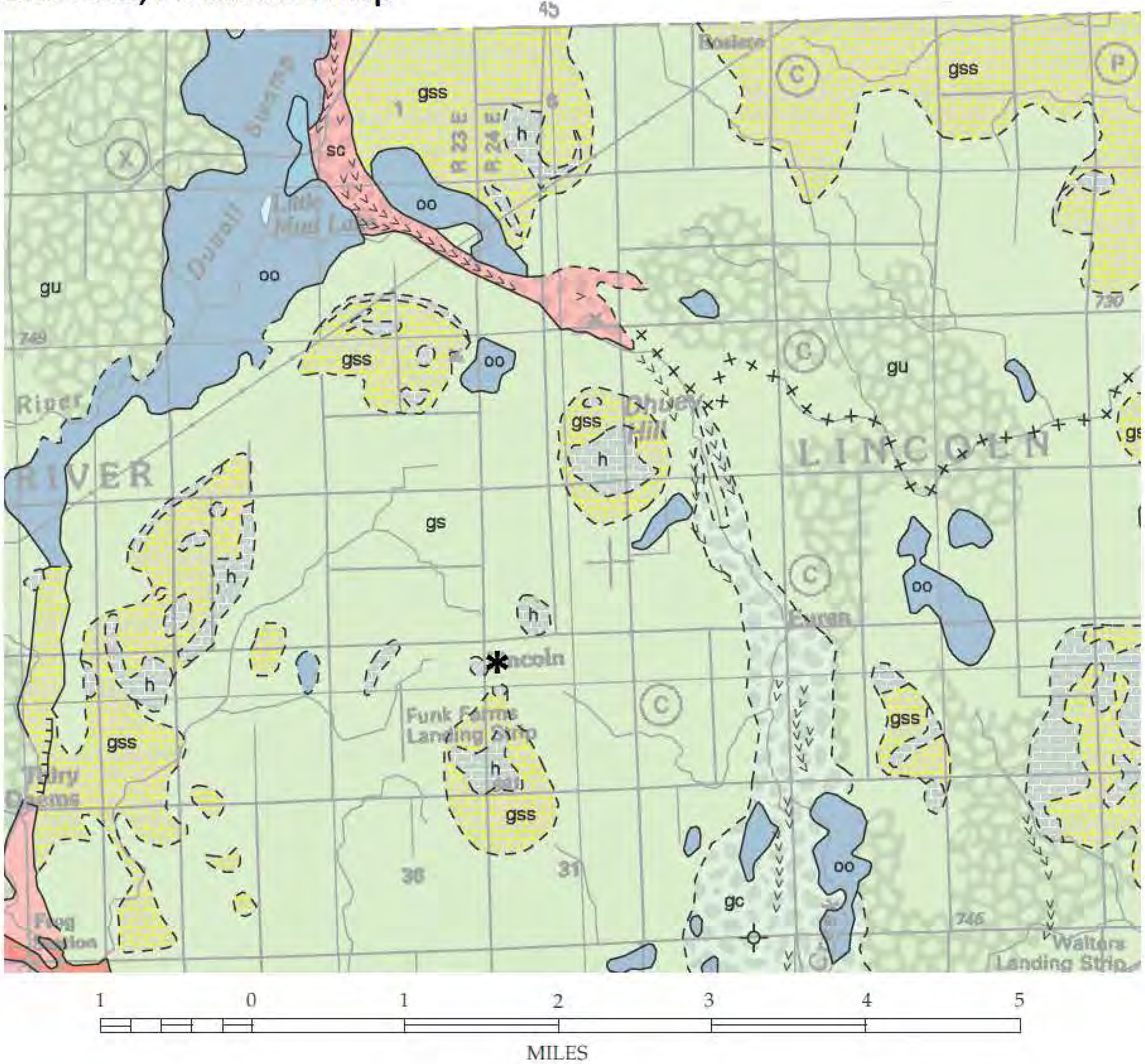
From: Preliminary
Pleistocene geologic map
of Kewaunee County, Wisconsin

Lee Clayton

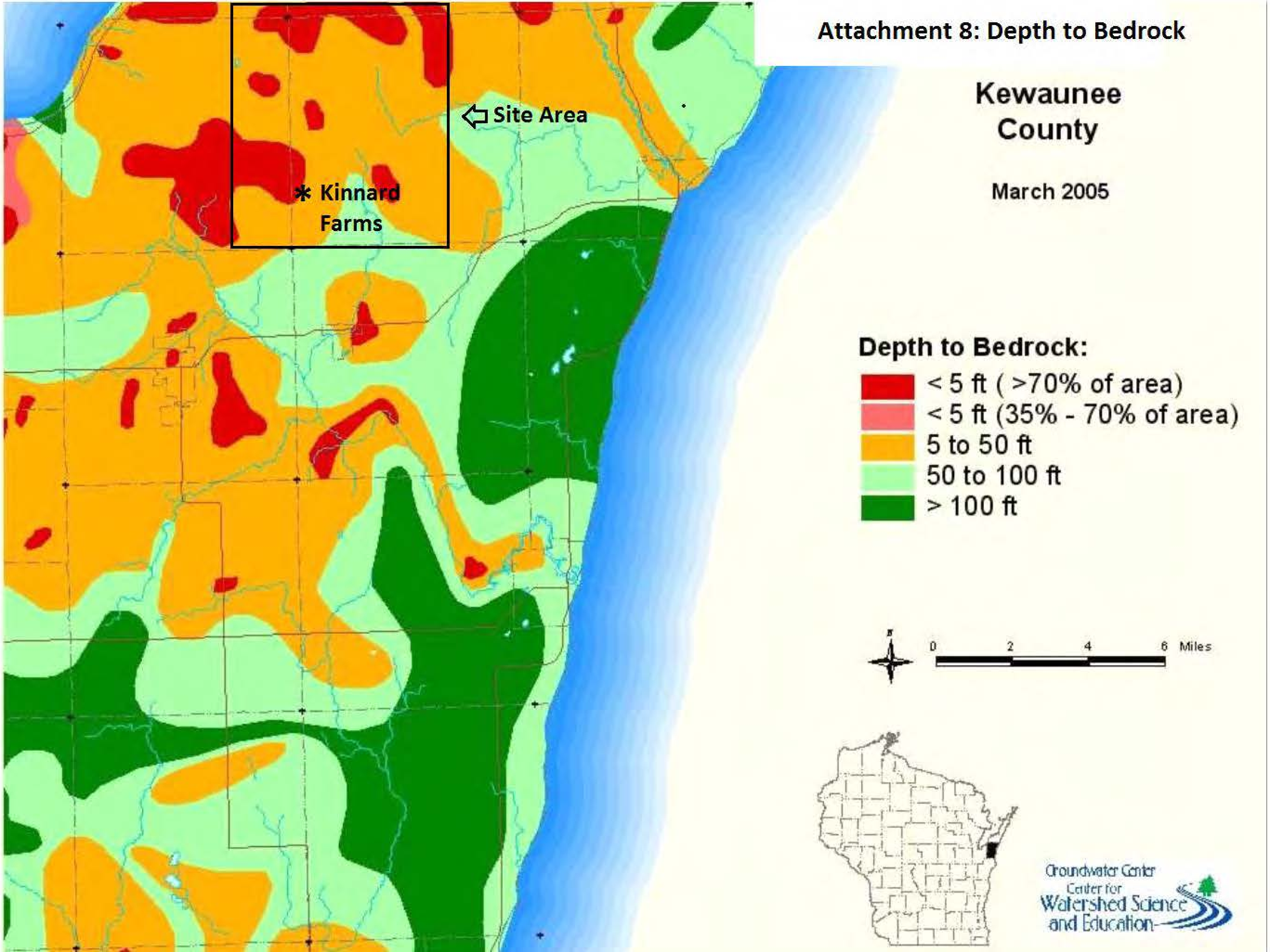
2005

Attachment 7c: Site Inset, Pleistocene Map

*** = Kinnard Farms Site**



Attachment 8: Depth to Bedrock

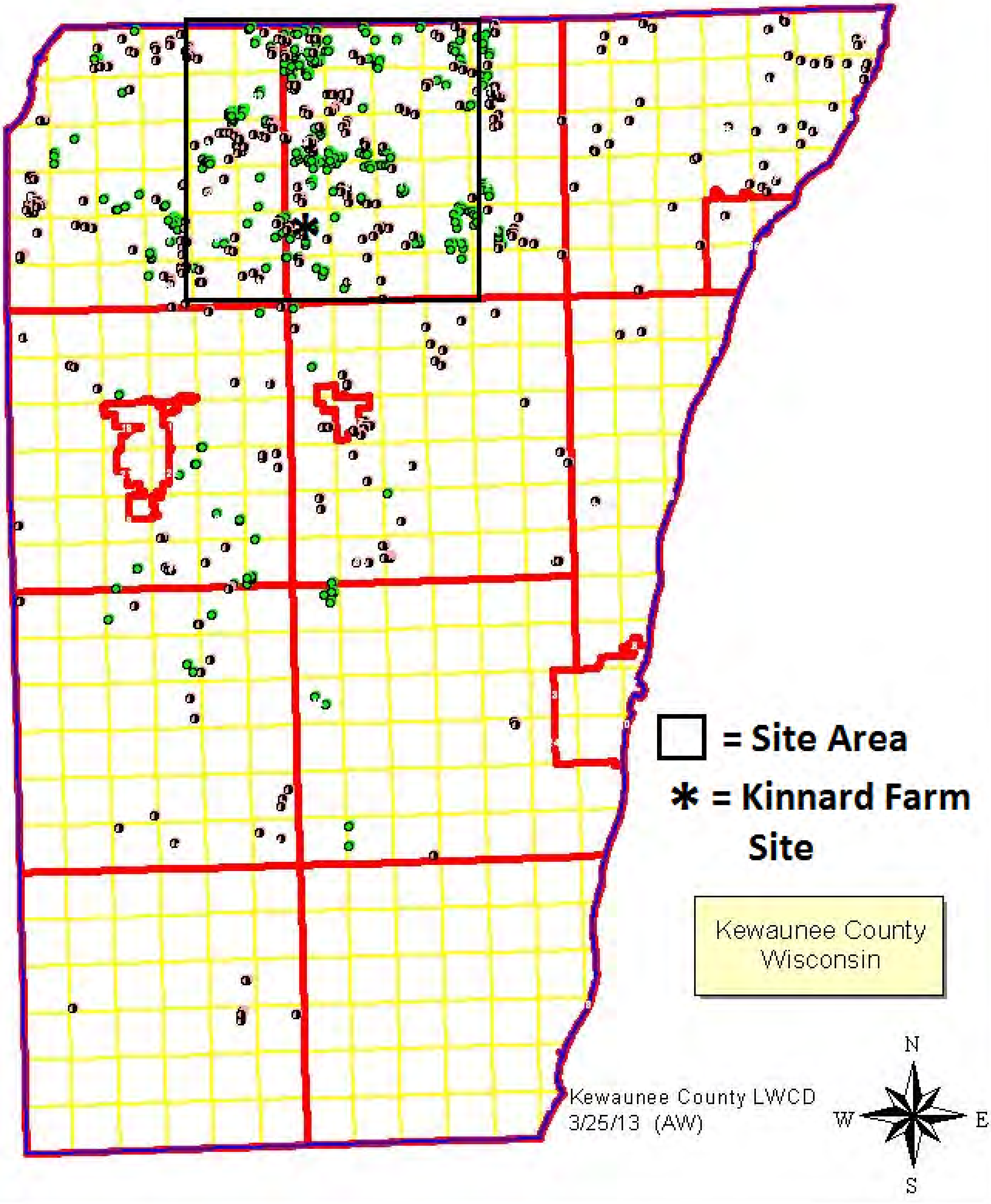


Attachment 9

Karst Features Inventory

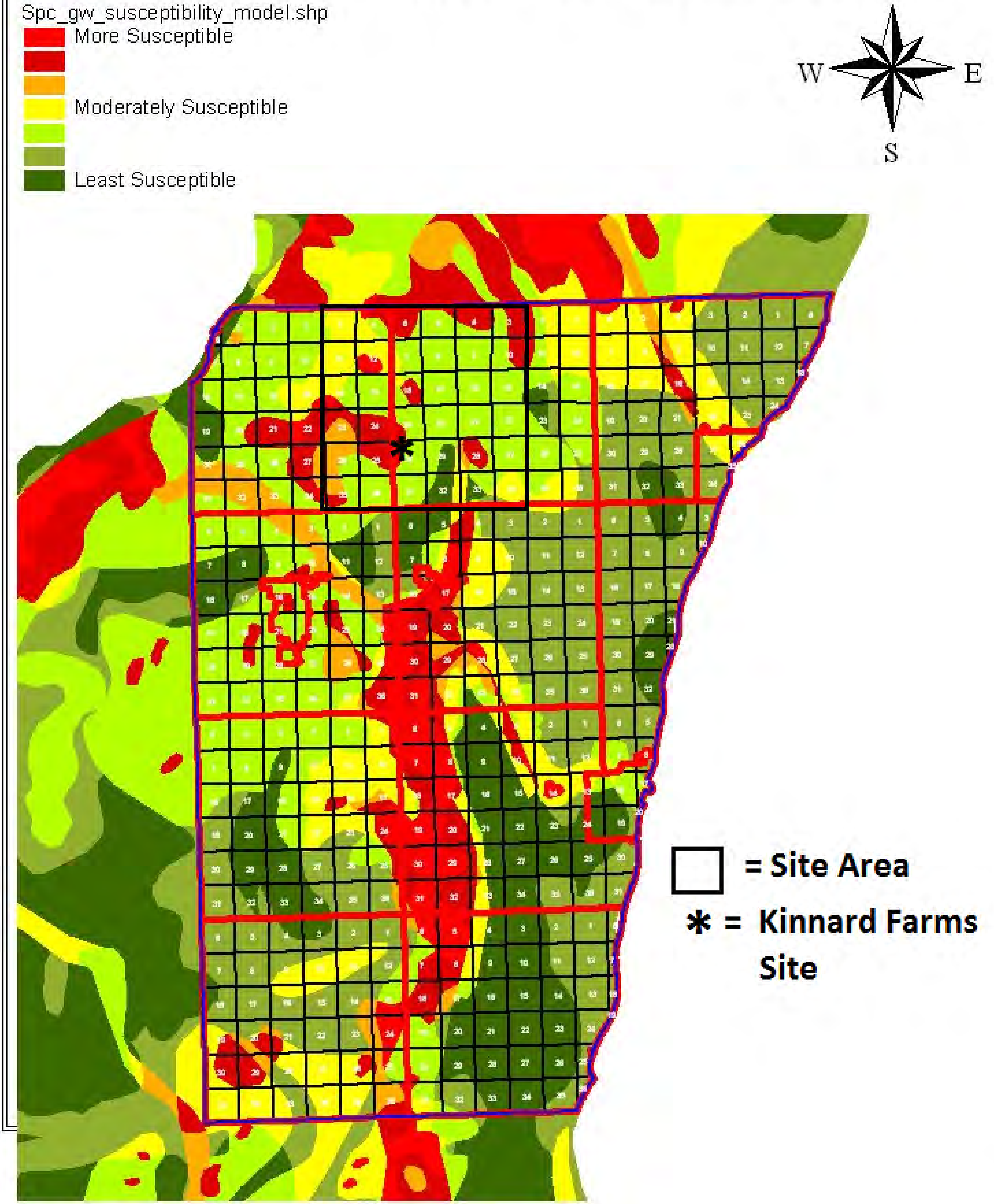
● Possible Karst Feature (Photo/Roadside Inventory)

🟢 Karst Features (field verified w/gps coorddinates)

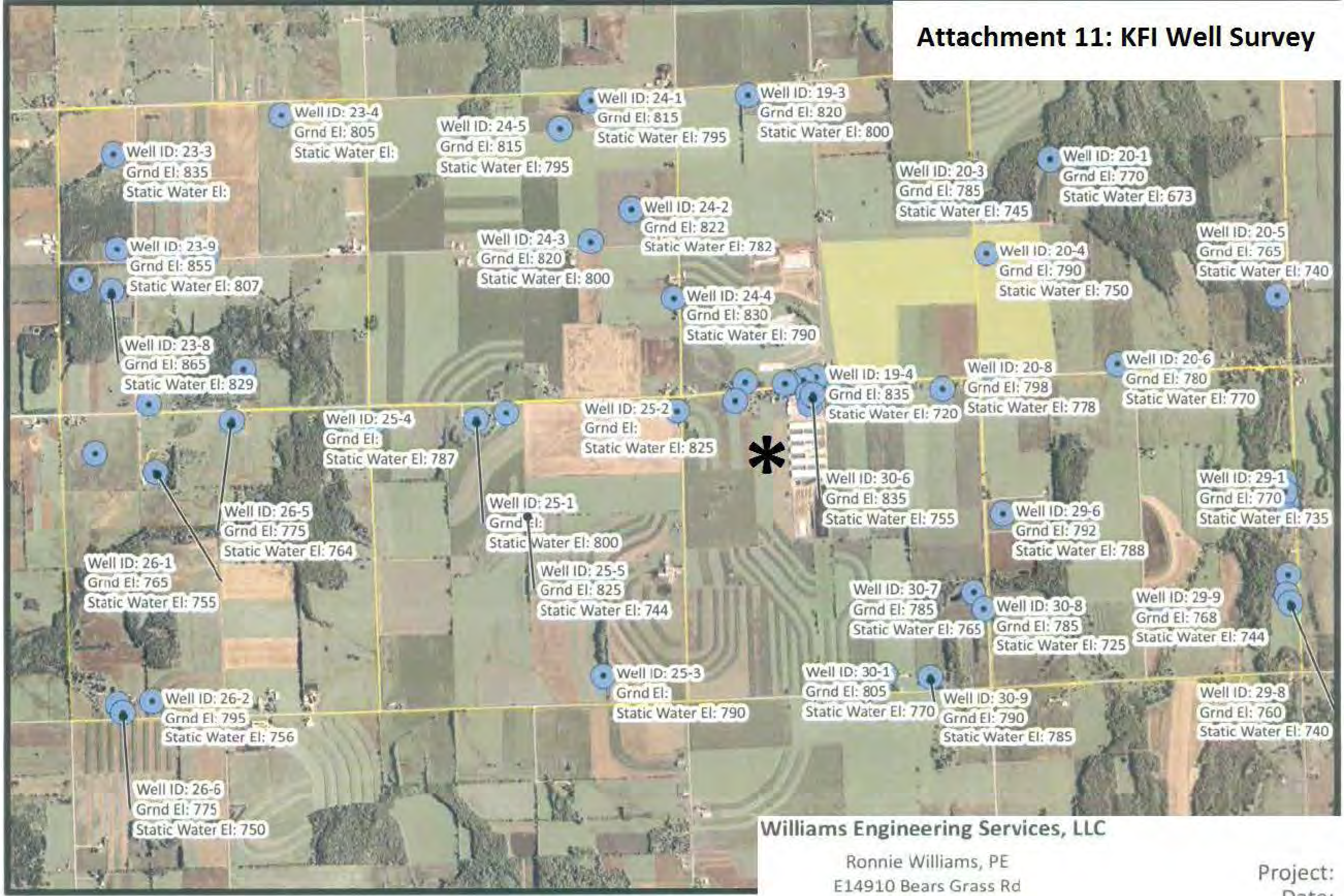


Attachment 10

Susceptibility to Groundwater Contamination



Attachment 11: KFI Well Survey



Williams Engineering Services, LLC

Ronnie Williams, PE
E14910 Bears Grass Rd
Augusta WI 54722
(715) 829-3231

Project: Kinnard Farms
Date: 7/5/2012
Municipality: Town of Lincoln
County: Kewaunee

*** = Kinnard Farm Facility**

Attaachment 12: KFI Well Survey Data

*	Well ID [23/24]	Estimated Ground Elevation	Year Installed	Depth of Well (ft)	Overburden Thickness (ft)					Bedrock Surface Elevation	Thickness of Dolomite (ft), LS - limestone, Dolo - Dolomite	Depth to Sandstone	Static Water Level (ft)	Piezometric Surface	Spec Cap			Transmissivity (gpd/ft)		
					Thickness	Breakdown of Thickness									hrs	gpm	Drawdpown			
					KEY: RC = red clay SC= sandy clay H= hardpan C= clay G= gravel SG= sand/gravel S= sand															
	Township T25N, Range 23E																	T	Thickness	K (ft/day)
	23-1 NE SW	815	2001	183	11	11 CS				804	172 LS	-	28	787	1	25	60	833	172	0.6
	23-2 SW SE	782	1996	123	2	2 C				780	121 LS		42	740	1	20	70	571	121	0.6
	23-3 NW NW	835																		
	23-4 NW NE	805																		
	23-5 SW SW	780	2000	143	12	12 C				768	131 LS		68	712	1	15	110	272.73	131	0.28
	23-6 NW SW	860	2001	183	5	5 C				855	178 LS		120	740	1	25	145	344.83	178	0.26
	23-7 SW SE SE NW	800	1981	105	3	3 C				797	232 LS		40	760	2	10	100	200.00	232	0.12
	23-8 NW SW	865	1984	184	6	4 C	2 CS			859	178 LS		36	829	3	10	60	333.33	178	0.25
	23-9 SW NW	855	2001	143	3	3 C				852	140 LS		48	807	1	25	70	714.29	140	0.68
	* end of section 23 wells *																			
	24-1 NE NE NW NE	815	1987	220	15	15 CG				800	205 LS		20	795	2	10	100	200.00	205	0.13
	24-2 SE NE	822	1981	360	21	21 CG				801	339 LS		40	782	2	15	80	375.00	339	0.15
	24-3 SW NE	820	1985	205	16	16 CG				804	189 LS		20	800	2	10	100	200.00	189	0.14
	24-4 NE SE NE SE	830	1981	235	48	48 CG				782	187 LS		40	790	2	10	160	125.00	187	0.09
	24-5 NW NE	815	1981	330	18	18 CG				797	312 LS		20	795	2	15	100	300.00	312	0.13
	* end of section 24 wells *																			
	25-1 NE NW	870	2001	183	11	11 C				859	172 LS		70	800	1	25	100	500.00	170	0.39
	25-2 NE NE	845	2001	164	44	28 S, RC	16 G			801	120 LS		20	825	1	10	120	166.67	120	0.19
	25-3 SW SE	850	1996	163	10	10 C				840	153 LS		60	790	1	20	75	533.33	153	0.47
	25-4 NW NW	795	1995	100	68	50 C	18 G			727	32 LS		8	787	1	20	40	1000.00	32	4.18
	25-5 SE NE	825	1994	283	10	10 C				815	273 LS		81	744	1	20	120	333.33	273	0.16
	25-6 NE NW	870	1994	223	2	2C				868	221 LS		79	791	2	15	100	300.00	221	0.18
	* end of section 25 wells *																			
	26-1 NE NW	765	2000	123	22	22 CG				743	101 LS		10	755	1	35	35	2000.00	101	2.65
	26-2 SE SW	795	2000	123	3	3 G				792	120 LS		39	756	1	30	60	1000.00	120	1.11
	26-3 SW SW	775	1981	163	8	8 C				767	155 LS		27	748	1	20	60	666.67	155	0.58
	26-4 NW NW	780	1996	120	8	8 C				772	112 LS		63	717	1	20	90	444.44	112	0.53
	26-5 NE NW	775	1994	140	5	5 C				770	135 LS		11	764	1	20	30	1333.33	135	1.32
	26-6 SW SW	775	1991	163	8	8 C				767	155 LS		25	750	1	15	25	1200.00	155	1.04
	* end of section 26 wells *																			
	Township T25N, Range 24E																			
	19-1 SW SW	835	1946	200																
	19-2 SW SE	835	2006	263	21	21 RC				814	242 LD		70	765	1	6	200	60.00	242	0.03
	19-3 NE NE	820	1997	284	14	14 CG				806	270 LS		20	800	1	5	200	50.00	270	0.02
	19-4 SE SW	835	1994	243	1	1 C				834	242 LS		115	720	1	15	140	214.29	242	0.12
	19-5 SE SW	840	1993	243	4	4 C				836	239 LS		60	780	1	10	130	153.85	239	0.09
	19-6 NE NW	815	1982	160	6	6 SC				809	154 LS		20	795	1	8	80	200.00	154	0.17
	19-7 SE SW	840	1981	203	5	5 C				835	198 LS		50	790	1	15	120	250.00	198	0.17
	19-8 SE SW	842	1984	304	7	5 C	2 LR			835	297 LS		45	797	3	5	165	60.61	297	0.03
	* end of section 19 wells *																			
	20-1 SW NW	770	2006	343	25	25 SGS				745	318 LS		97	673	3	20	150	266.67	318	0.11
	20-2 SE SE	775	2004	340	12	12 S/C				763	328 LS		10	765	2	10	240	83.33	328	0.03
	20-3 SW NW	785	1999	343	18	18 CG				767	325 LS		40	745	3	30	70	857.14	325	0.35
	20-4 NW SW	790	1993	437	12	12 C				778	425 LS		40	750	3	20	40	1000.00	425	0.31
	20-5 NE SE	765	1985	84	33	5 S	18 SC	10 G		732	51 LS		25	740	3	10	42	476.19	51	1.25
	20-6 SW SE	780	1985	224	29	3 C	10 SG	16 SG		751	195 LS		10	770	3	5	60	125.00	195	0.09
	20-7 SE SW	780	1984	203	58	20 C	38 G			722	132 LS, 145 SS	190	16	764	1	10	110	181.82	145	0.17
	* end of section 20 wells *																			
	29-1 SE NE	770	1988	144	35	35 S				735	111 LS		35	735	3	8	60	266.67	111	0.32
	29-2 SE NE	765	1989	70	51	35 CG	16 H			714	19 LS		30	735	0.5	15	50	600.00	19	4.22
	29-3 SE NE	765	1992	164	44	3 CG	35 SG	6 CG		721	120 LS		22	743	1	7	80	175.00	120	0.19
	29-4 NE SE	760	1996	105	55	22 SCG	33 CG			705	150 LS		10	750	1	15	60	500.00	150	0.45
	29-5 SE SE	750	1997	163	63	40 CG	10 C	13 G		687	100 LS		80	670	1	15	120	250.00	100	0.33
	29-6 SW NW	792	1998	222	29	22 CG	7 G			763	193 LS		4	788	1	10	140	142.86	193	0.10
	29-7 SE NE	765	1999	144	41	41 SCG				724	103 LS		15	750	0.1	20	40	1000.00	103	1.30
	29-8 SE SE	760	1999	84	51	51 SCG				709	33 LS		20	740	1	15	40	750.00	33	3.04
	29-9 SE SW	768	2005	163	41	10 RC	8 RCG	23 CG		727	122 LS		24	744	1	10	100	200.00	122	0.22
	29-10 NE NW	795	2006	263	63	34 RCG	29 CG			732	200 LS/DS		40	755	1	5	240	41.67	200	0.03
	29-11 SE NE	750	1981	164	28	28 S				722	136 LS		30	720	3	10	87	229.89	136	0.23
	29-12 NE SE	750	1983	103	57	15 C	42 G			693	46 LS		24	726	1	25	24	2083.33	46	6.05
	* end of section 29 wells *																			
	30-1 SW SE	805	1994	245	45	39 CG	6 G			760	200 LS		35	770	1	20	140	285.71	200	0.19
	30-2 NE NW	835	1995	405	3	3 C				832	402 LS		60	775	1	60	120	1000.00	402	0.33
	30-3 NW NW	830	1986	224	7	7 CG				823	217 LS		40	790	3	10	60	333.33	217	0.21
	30-4 NE NW	830	1995	385	9	9 CG				821	104 LS		50	780	3	130	200	1300.00	104	1.67
	30-5 NE NE	800	2000	181	20	20 CG				780	161 LS		50	750	1	25	100	500.00	161	0.42
	30-6 NE NW	835	2003	390	9	9 CG				826	381 LS		80	755	2	100	240	833.33	381	0.29
	30-7 NE SE	785	2002	333	333	333 CG				452	110 LS		20	765	1	20	60	666.67	110	0.81
	30-8 NW SE	785	2003	142	42	30 C	12 G			743	100 LS		60	725	1	25	100	500.00	100	0.67
	30-9 SE SE	790	2006	180	36	36 CG				754	144 LS		5	785	2	15	80	375.00	144	0.35
	30-10 NE NE	810	1985	184	76	8 C	13 SC	5 G	50 SG	734	108 LS		30	780	3	10	65	307.69	108	0.38
	30-11 NW NW	830	1986	224	7	7 CG				823	217 LS		40	790	3	10	60	333.33	217	0.21
	30-12 NW NW	835	1981	244	6	6 C				829	238 LS		40	795	3	20	60	666.67	238	0.37
	* end of section 30 wells *																			

Attachment 12: Well Data Cont.

* Well ID [23/24]	Estimated Ground Elevation	Year Installed	Depth of Well (ft)	Overburden Thickness (ft)					Bedrock Surface Elevation	Thickness of Dolomite (ft); LS - limestone, Dolo - Dolomite	Depth to Sandstone	Static Water Level (ft)	Piezometric Surface	Spec Cap			Transmissivity (gpd/ft)		
				Thickness	Breakdown of Thickness									hrs	gpm	Drawdpown			
KEY: RC = red clay SC= sandy clay H= hardpan C= clay G= gravel SG= sand/gravel S= sand																			
Township T25N, Range 23E																	T	Thickness	K (ft/day)
23-1 NE SW	815	2001	183	11	11 CS				804	172 LS		28	787	1	25	60	833	172	0.6
23-2 SW SE	782	1996	123	2	2 C				780	121 LS		42	740	1	20	70	571	121	0.6
23-3 NW NW	835																		
23-4 NW NE	805																		
23-5 SW SW	780	2000	143	12	12 C				768	131 LS		68	712	1	15	110	272.73	131	0.28
23-6 NW SW	860	2001	183	5	5 C				855	178 LS		120	740	1	25	145	344.83	178	0.26
23-7 SW SE SE NW	800	1981	105	3	3 C				797	232 LS		40	760	2	10	100	200.00	232	0.12
23-8 NW SW	865	1984	184	6	4 C	2 CS			859	178 LS		36	829	3	10	60	333.33	178	0.25
23-9 SW NW	855	2001	143	3	3 C				852	140 LS		48	807	1	25	70	714.29	140	0.68
* end of section 23 wells *																			
24-1 NE NE NW NE	815	1987	220	15	15 CG				800	205 LS		20	795	2	10	100	200.00	205	0.13
24-2 SE NE	822	1981	360	21	21 CG				801	339 LS		40	782	2	15	80	375.00	339	0.15
24-3 SW NE	820	1985	205	16	16 CG				804	189 LS		20	800	2	10	100	200.00	189	0.14
24-4 NE SE NE SE	830	1981	235	48	48 CG				782	187 LS		40	790	2	10	160	125.00	187	0.09
24-5 NW NE	815	1981	330	18	18 CG				797	312 LS		20	795	2	15	100	300.00	312	0.13
* end of section 24 wells *																			
25-1 NE NW	870	2001	183	11	11 C				859	172 LS		70	800	1	25	100	300.00	170	0.39
25-2 NE NE	845	2001	164	44	[illegible]	16 G			801	120 LS		20	825	1	10	120	166.67	120	0.19
25-3 SW SE	850	1996	163	10	10 C				840	153 LS		60	790	1	20	75	533.33	153	0.47
25-4 NW NW	795	1995	100	68	50 C	18 G			727	32 LS		8	787	1	20	40	1000.00	32	4.18
25-5 SE NE	825	1994	283	10	10 C				815	273 LS		81	744	1	20	120	333.33	273	0.16
25-6 NE NW	870	1994	223	2	2C				868	221 LS		79	791	2	15	100	300.00	221	0.18
* end of section 25 wells *																			
26-1 NE NW	765	2000	123	22	22 CG				743	101 LS		10	755	1	35	35	2000.00	101	2.65
26-2 SE SW	795	2000	123	3	3 G				792	120 LS		39	756	1	30	60	1000.00	120	1.11
26-3 SW SW	775	1981	163	8	8 C				767	155 LS		27	748	1	20	60	666.67	155	0.58
26-4 NW NW	780	1996	120	8	8 C				772	112 LS		63	717	1	20	90	444.44	112	0.53
26-5 NE NW	775	1994	140	5	5 C				770	135 LS		11	764	1	20	30	1333.33	135	1.32
26-6 SW SW	775	1991	163	8	8 C				767	155 LS		25	750	1	15	25	1200.00	155	1.04
* end of section 26 wells *																			
Township T25N, Range 24E																			
19-1 SW SW	835	1946	200																
19-2 SW SE	835	2006	263	21	21 RC				814	242 LD		70	765	1	6	200	60.00	242	0.03
19-3 NE NE	820	1997	284	14	14 CG				806	270 LS		70	800	1	5	200	50.00	270	0.02
19-4 SE SW	835	1994	243	1	1 C				834	242 LS		115	720	1	15	140	214.29	242	0.12
19-5 SE SW	840	1993	243	4	4 C				836	239 LS		60	780	1	10	130	153.85	239	0.09
19-6 NE NW	815	1982	160	6	6 SC				809	154 LS		20	795	1	8	80	200.00	154	0.17
19-7 SE SW	840	1981	203	5	5 C				835	198 LS		50	790	1	15	120	250.00	198	0.17
19-8 SE SW	842	1984	304	7	5 C	2 H			835	297 LS		45	797	3	5	165	60.61	297	0.03
* end of section 19 wells *																			
20-1 SW NW	770	2006	343	25	25 SGS				745	318 LS		97	673	1	20	150	266.67	318	0.11
20-2 SE SE	775	2004	340	12	12 S/C				763	328 LS		10	765	2	10	240	83.33	328	0.03
20-3 SW NW	785	1999	343	18	18 CG				767	325 LS		40	745	1	30	70	857.14	325	0.35
20-4 NW SW	790	1991	437	12	12 C				778	425 LS		40	750	3	20	40	1000.00	425	0.31
20-5 NE SE	765	1985	84	33	5 S	18 SC	10 G		732	51 LS		25	740	3	10	42	476.19	51	1.25
20-6 SW SE	780	1983	224	29	3 C	10 SG	16 SG		751	195 LS		10	770	3	5	80	125.00	195	0.09
20-7 SE SW	780	1984	203	58	20 C	38 G			722	132 LS, 145 SS	190	16	764	1	10	110	181.82	145	0.17
* end of section 20 wells *																			
29-1 SE NE	770	1988	144	35	35 S				735	111 LS		35	735	3	8	60	266.67	111	0.32
29-2 SE NE	765	1989	70	51	35 CG	16 H			714	19 LS		30	735	0.5	15	50	600.00	19	4.22
29-3 SE NE	765	1992	164	44	3 CG	35 SG	6 CG		721	120 LS		22	743	1	7	80	175.00	120	0.19
29-4 NE SE	760	1996	105	55	22 SCG	33 CG			705	150 LS		10	750	1	15	60	500.00	150	0.45
29-5 SE SE	750	1997	163	63	40 CG	10 C	13 G		687	100 LS		80	670	1	15	120	250.00	100	0.33
29-6 SW NW	792	1998	222	29	22 CG	7 G			763	193 LS		4	788	1	10	140	142.86	193	0.10
29-7 SE NE	765	1999	144	41	41 SCG				724	103 LS		15	750	0.3	20	40	1000.00	103	1.30
29-8 SE SE	760	1999	84	51	51 SCG				709	33 LS		20	740	1	15	40	750.00	33	3.04
29-9 SE SW	768	2005	163	41	10 RC	8 RCG	23 CG		727	122 LS		24	744	1	10	100	200.00	122	0.22
29-10 NE NW	795	2006	263	63	34 RCG	29 CG			732	200 LS/DS		40	755	1	5	240	41.67	200	0.03
29-11 SE NE	750	1981	164	28	28 S				722	136 LS		30	720	3	10	97	229.89	136	0.23
29-12 NE SE	750	1983	103	57	15 C	42 G			693	46 LS		24	726	1	25	24	2083.33	46	6.05
* end of section 29 wells *																			
30-1 SW SE	805	1994	245	45	39 CG	6 G			760	200 LS		35	770	1	20	140	285.71	200	0.19
30-2 NE NW	835	1995	465	3	3 C				832	402 LS		60	775	1	60	120	1000.00	402	0.33
30-3 NW NW	830	1986	224	7	7 CG				823	217 LS		40	790	3	10	60	333.33	217	0.21
30-4 NE NW	830	1999	385	9	9 CG				821	104 LS		50	780	3	130	200	1300.00	104	1.67
30-5 NE NE	800	2000	181	20	20 CG				780	161 LS		50	750	1	25	100	500.00	161	0.42
30-6 NE NW	835	2003	390	9	9 CG				826	381 LS		80	755	2	100	240	833.33	381	0.29
30-7 NE SE	785	2002	333	333	333 CG				452	110 LS		20	765	1	20	60	666.67	110	0.81
30-8 NW SE	785	2003	142	42	30 C	12 G			743	100 LS		60	725	1	25	100	500.00	100	0.67
30-9 SE SE	790	2006	180	36	36 CG				754	144 LS		5	785	2	15	80	375.00	144	0.35
30-10 NE NE	810	1985	184	76	8 C	13 SC	5 G	50 SG	734	108 LS		30	780	3	10	65	307.69	108	0.38
30-11 NW NW	830	1986	224	7	7 CG				823	217 LS		40	790	3	10	60	333.33	217	0.21
30-12 NW NW	835	1981	244	6	6 C				829	238 LS		40	795	3	20	60	666.67	238	0.37

Attachment 13:

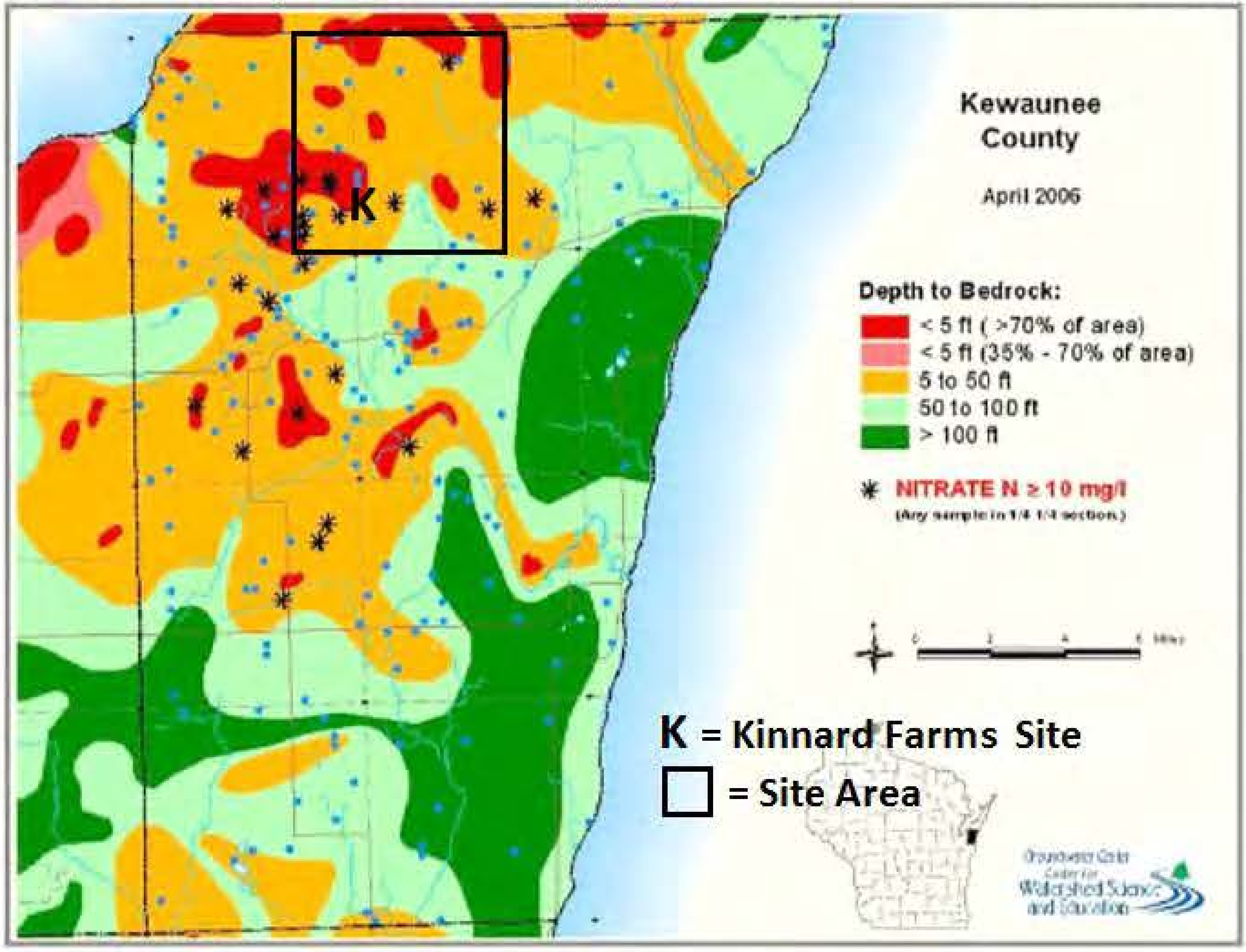
Kinnard Farm Manure Spreading Fields with Thin Soils

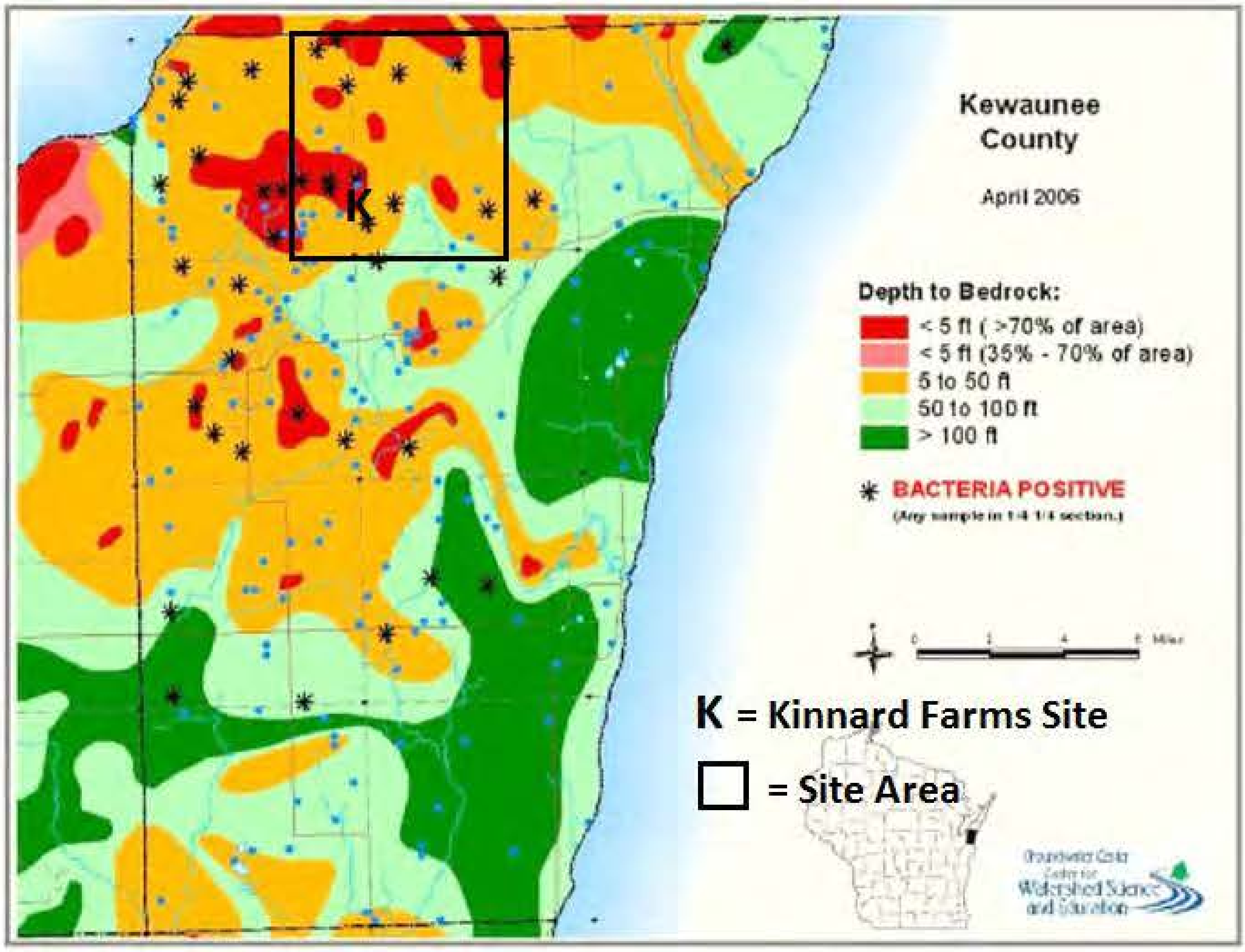
Town -Sec.	Field Name	Field Acres	Thin Soil Type Acres						Thin Soil Acres	% Thin Soil in Field
			NaB	NaC	NrD	KwB	KwC2	KxB		
L-6 **(*)**	NOW-1	20.4					1.13		1.13	7.5
L-6	NOW-2	18.0				1.62	3.69		5.31	37
L_6	RWM-1	7.6				5.67			5.67	75
L-6	RWM-2	12.2				11.3	0.9		12.2	100
L-6	RWM-3	6.5			0.14	0.6	2.5		3.25	50
L-6	RWM-4	26.8					1.84		1.84	7
L-6	RWM-5	53.7			0.35	30.8	0.03	20.8	52	97
L-18	LCR-1	18.9					4.6	4.7	9.3	49
L-18	LCR-2	33.9			0.7		12.4	2.7	15.8	46
L-19	LCH-1	44.7			0.36		26	5.9	32.3	72
L-19	TH1- E	6.9				2.0			2.0	29
L-19	TH-2	16.4				3.5			3.5	21
L-19	TH-6	5.4			1.25				1.25	23
L-19	TH-7	6.5			0.7	0.9			1.6	25
L-19	CRP	3.6	0.48		2.96	0.1			2.45	87
L-20	HD-1	14.8	1.01		0.1		11	2.7	13.8	100
L-20	HD-2	11.14			0.1		9.82	1.24	11.14	100
L-27	FTB	53.1			0.1				0.1	0.17
L-30	VLI-1	6				1.94		3.75	5.7	95
L-30	VLI-2	30.4			0.44	0.78		0.25	1.47	5
L-31	FR-1	33.5				27.4		5.8	33.2	99
L-31	FR-2	12.7				1.63			1.63	13
RR-14	MA-1W	19.1				0.55			0.55	2.8
RR-24	BDF-10	3.7	0.07						0.07	1.9
RR-24	BDF-12	8.6	1.29					2.82	4.1	48
RR-25	BDSR-4	10						1.9	1.9	19
RR-25	MES	37.5				2.4	1.27	3.67	3.7	10
RR-26	BD-3	19.8				5.3			5.3	27
RR-26	BD-2	19.0				0.56			0.56	3
RR-26	BD-4	18.2				0.32			0.32	1.8
RR-26	BD-5	31				0.05		1.53	1.54	5
RR-27	VANH	18.5				4.27			4.27	23
Totals:		636	285		7.2	102	75.6	57.9	243	38%

* L = Lincoln Township (T25N, R24E), RR = Red River township (T25N, R23E)

Attachment 14:

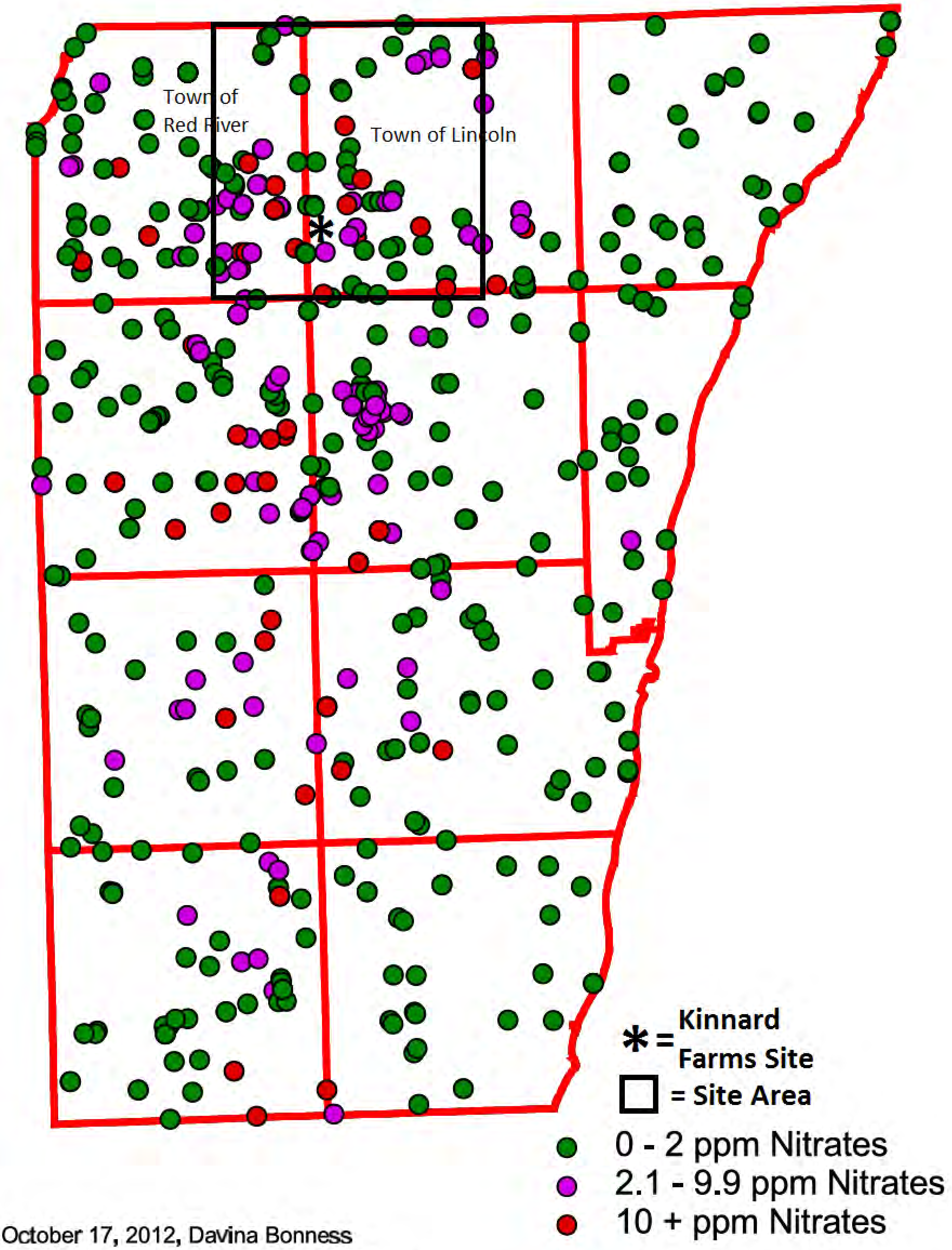
Kewaunee County LWCD well testing program results – Nitrate and Bacteria





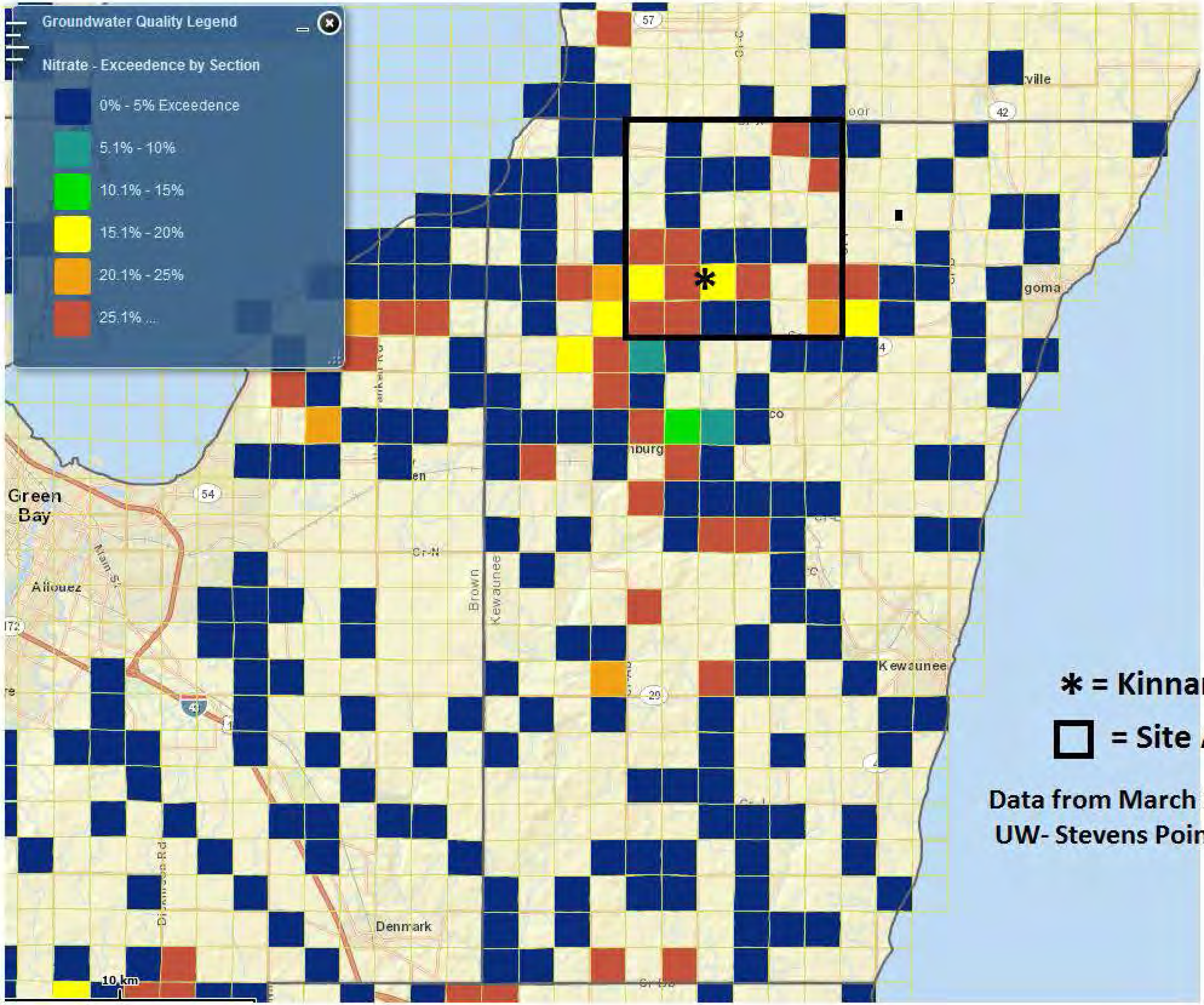
Attachment 15:

Kewaunee County Well Testing Program
Nitrates



Created: October 17, 2012, Davina Bonness
Kewaunee Co. Land Conservation Dept.

Attachment 16: Nitrate Exceedences > 10 mg/l by Section

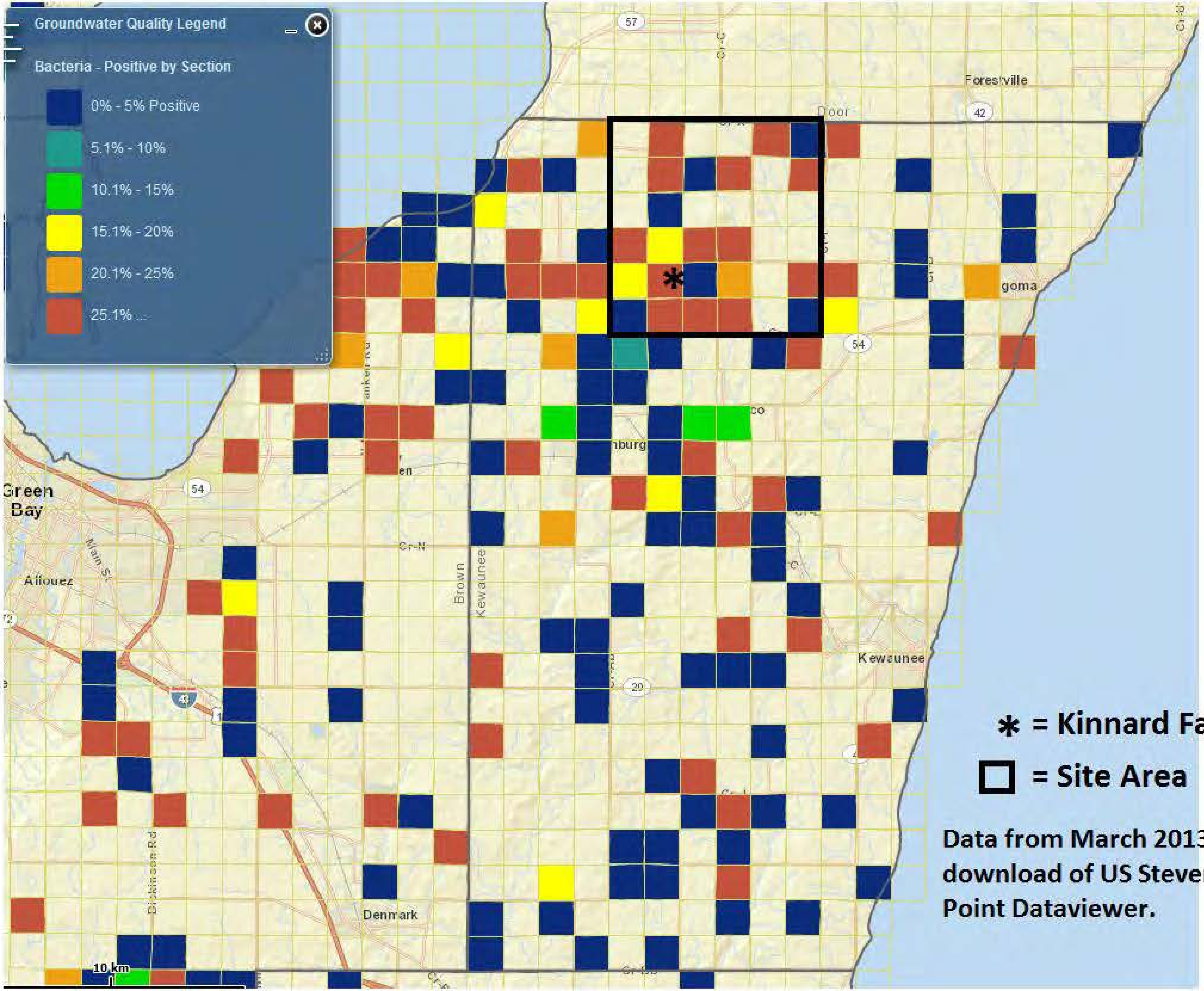


✱ = Kinnard Farms Site

□ = Site Area

Data from March 2013 download of UW- Stevens Point Dataviewer.

Attachment 17: Positive Detection of Bacteria by Section



*** = Kinnard Farm Site**

☐ = Site Area

Data from March 2013 download of US Stevens Point Dataviewer.

31.1.11_DNR_Report

Attachment 18A: 2010 DNR Report

Nutrient Accounting Liquid

Field	Acres	Crop	Yield		P Factor	P Removal by Crop	Manure This Crop		Manure Sample Test Total Nutrients					Leg. Cred.	Prior Years Manure Credits (From Snap)			Avail. 1st Year Manure Credits (From Snap)			Fertilizer Credit (From Snap)			Manure Total This Crop	Total lbs/Field		Available/ Acre		Balance P2O5/Field
				Unit			Gal/a	Sam#	N		P_2O_5		K_2O		N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O		N	P_2O_5	N	P_2O_5	
AN-1	38	Cs	21	T	3.6	75.6			0.00	0	0.00	0	0.00					0	0	0	145	16	5	0	5,467	603	145	16	-2,247
BD-1.3	35	Alf	5	T	13	65	9,007	15510	24.90	224	5.70	51	14.94					67	31	108	0	0	92	311,642	7,760	1,776	67	31	-1,176
BD-2.4	37	Rye	3	T	4.11	12.33			0.00	0	0.00	0	0.00											0	0	0	0	0	-459
BDF-01	17	Alf	5	T	13	65			0.00	0	0.00	0	0.00		26	7	16				0	0	122	0	0	0	26	7	-992
BDF-03	46	Alf	5	T	13	65			0.00	0	0.00	0	0.00		27	8	18				0	0	122	0	0	0	27	8	-2,594
BDF-07	4.7	Alf	5	T	13	65			0.00	0	0.00	0	0.00		27	8	18				0	0	122	0	0	0	27	8	-268
BDF-09	4.2	Alf	5	T	13	65			0.00	0	0.00	0	0.00		27	9	21				0	0	122	0	0	0	27	9	-235
BDF-11	2.6	Alf	4	T	13	52			0.00	0	0.00	0	0.00		27	9	21				0	0	122	0	0	0	27	9	-112
BDSR-1	8.1	Alf	5.6	T	13	72.8			0.00	0	0.00	0	0.00		14	5	10				0	0	122	0	0	0	14	5	-549
BDSR-2	12	Alf	5.6	T	13	72.8	17,655	96487	19.10	337	8.33	147	17.45					135	88	246				203,033	3,878	1,692	135	88	175
BDSR-3	8.9	Alf	5.6	T	13	72.8			0.00	0	0.00	0	0.00		14	5	10				0	0	122	0	0	0	14	5	-603
BDSR-4	10	Alf	5.6	T	13	72.8	17,655	96487	19.10	337	8.33	147	17.45					135	88	246				175,844	3,359	1,465	135	88	151
BLE-1	18	Cs	21	T	3.6	75.6			0.00	0	0.00	0	0.00	90							56	16	5	0	2,555	280	146	16	-1,043
BLE-3	3.2	Alf	5	T	13	65	18,450	96486	19.10	352	8.57	158	18.16					106	95	268				59,040	1,128	506	106	95	96
BLE-4	2.7	Cs	21	T	3.6	75.6			0.00	0	0.00	0	0.00	90							26	16	5	0	313	43	116	16	-161
BLE-5	2.9	Alf	5	T	13	65	18,450	96486	19.10	352	8.57	158	18.16					106	95	268				53,505	1,022	458	106	95	87
BLE-6	2.9	Cs	21	T	3.6	75.6			0.00	0	0.00	0	0.00	90							26	16	5	0	336	46	116	16	-173
BLE-7	2.9	Alf	5	T	13	65	18,450	96486	19.10	352	8.57	158	18.16					106	95	268				53,505	1,022	458	106	95	87
BLE-8	12	C	21	T	0.38	7.98			0.00	0	0.00	0	0.00	90							26	16	5	0	1,392	192	116	16	96
BLH-09	8.9	Alf	5.6	T	13	72.8			0.00	0	0.00	0	0.00		27	11	26				0	0	122	0	0	0	27	11	-550
BLH-10	5.1	Pas	18	T	0	0			0.00	0	0.00	0	0.00											0	0	0	0	0	0
BLH-11	8	Alf	5.6	T	13	72.8			0.00	0	0.00	0	0.00		27	11	26				0	0	122	0	0	0	27	11	-494
BLH-12	12	Alf	5.6	T	13	72.8			0.00	0	0.00	0	0.00		27	11	26				0	0	122	0	0	0	27	11	-754
BLN13	7.3	Alf	5	T	13	65	14,708	96487	19.10	281	8.33	123	17.45					112	74	205				107,368	2,051	895	112	74	66
BLN14	6.3	Cs	21	T	3.6	75.6			0.00	0	0.00	0	0.00	130							26	16	5	0	983	101	156	16	-375
BLN15	6	Alf	3	T	13	39	14,708	96487	19.10	281	8.33	123	17.45					112	74	205				88,248	1,686	735	112	74	210
BLN16	6.6	Cs	21	T	3.6	75.6			0.00	0	0.00	0	0.00	130							26	16	5	0	1,030	106	156	16	-393
BLN17	11	Alf	5.6	T	13	72.8			0.00	0	0.00	0	0.00		27	9	22				0	0	122	0	0	0	27	9	-702
BLN18	8.9	Alf	4.5	T	13	58.5			0.00	0	0.00	0	0.00		27	9	22				0	0	122	0	0	0	27	9	-441
BLN19	3.7	Alf	4.5	T	13	58.5			0.00	0	0.00	0	0.00		27	9	22				0	0	92	0	0	0	27	9	-183
BLN20	6.6	Alf	4.5	T	13	58.5			0.00	0	0.00	0	0.00		27	9	22				0	0	92	0	0	0	27	9	-327
BLN21	8.7	Alf	4.5	T	13	58.5			0.00	0	0.00	0	0.00		27	9	22				0	0	92	0	0	0	27	9	-431
BOONERS	5	Cs	21	T	3.6	75.6	20,338	27848	19.93	405	7.60	155	16.94		26	11	26	122	93	276	5	16	5	101,690	2,051	853	153	120	222
C-1	11	Rye	3	T	4.11	12.33			0.00	0	0.00	0	0.00		52	15	40							0	0	0	52	15	29
C-2	39	Rye	3	T	4.11	12.33			0.00	0	0.00	0	0.00		52	15	40							0	0	0	52	15	104
CB-1	21	Cs	18	T	3.6	64.8	20,749	96489	20.90	434	8.23	171	19.35		8	3	6	130	103	321	26	16	5	439,879	9,745	3,961	164	122	1,213
CB-2	6.3	Cs	18	T	3.6	64.8	18,224	96490	19.93	363	8.27	151	18.98		13	3	11	109	90	277	26	16	5	114,811	2,451	1,050	148	109	278
CB-3	23	Cs	21	T	3.6	75.6	16,224	96490	19.93	323	8.27	134	18.98		13	3	11	97	80	246	5	16	5	378,019	7,649	3,498	115	99	545
CD-1	17	Cs	16	T	3.6	57.6			0.00	0	0.00	0	0.00		14	6	10				115	16	5	0	1,911	266	129	22	-592
CD-2	37	Alf	5	T	13	65	9,525	15511	24.90	237	5.70	54	14.94		14	5	10	71	33	114	0	0	122	348,806	8,685	1,988	85	38	-989
CDE	39	Rye	3	T	4.11	12.33			0.00	0	0.00	0	0.00		18	12	22				30			0	1,157	0	48	12	-13
CJ-1	21	Cs	21	T	3.6	75.6			0.00	0	0.00	0	0.00								148	29	97	0	3,078	603	148	29	-969
CJ-2	70	Cs	21	T	3.6	75.6			0.00	0	0.00	0	0.00								148	29	97	0	10,301	2,018	148	29	-3,243
DD-1	29	Cs	21	T	3.6	75.6	22,530	96489	20.90	471	8.23	185	19.35		14	6	10	141	111	349	5	16	5	646,611	13,658	5,783	160	133	1,647
DD-2	35	Cs	21	T	3.6	75.6	22,530	96489	20.90	471	8.23	185	19.35		14	6	10	141	111	349	5	16	5	781,791	16,513	6,992	160	133	1,992
DD-3	25	Cs	21	T	3.6	75.6			0.00	0	0.00	0	0.00	130							58	16	5	0	4,644	395	188	16	-1,472
DD-4	18	Cs	21	T	3.6	75.6			0.00	0	0.00	0	0.00		14	6	10	141	111	349	5	16	5	0	89	285	160	133	1,022
DEB	57	Alf	5.6	T	13	72.8			0.00	0	0.00	0	0.00		25	7	16							0	0	0	25	7	-3,757
DEC	30	Alf	5	T	13	65	20,278	96490	19.93	404	8.27	168	18.98		14	4	12	121	101	308				612,396	12,202	5,062	135	105	1,208

Attachment 18B: 2010 DNR Report

Field	Acres	Crop	Yield		P Factor	P Removal by Crop	Manure This Crop		Manure Sample Test Total Nutrients					Leg. Cred.	Prior Years Manure Credits (From Snap)			Avail. 1st Year Manure Credits (From Snap)			Fertilizer Credit (From Snap)			Manure Total This Crop	Total lbs/Field		Available/ Acre		Balance P2O5/Field
				Unit			Gal/a	Sam#	N		P_2O_5		K_2O		N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O		N	P_2O_5	N	P_2O_5	
DELAIN-1	25	Alf	5.6	T	13	72.8			0.00	0	0.00	0	0.00		26	9	20						427	0	0	0	26	9	-1,589
DELAIN-2	17	Cs	21	T	3.6	75.6	21,025	27848	19.93	419	7.60	160	16.94		8	2	5	126	96	285	28	16	5	351,118	7,464	2,936	162	114	641
DELAIN-3	10	Cs	21	T	3.6	75.6	21,025	27848	19.93	419	7.60	160	16.94		8	2	5	126	96	285	28	16	5	212,353	4,514	1,775	162	114	388
DELAIN-4	14	Alf	5	T	13	65			0.00	0	0.00	0	0.00		26	9	20				0	0	122	0	0	0	26	9	-806
DELAIN-5	20	Cs	21	T	3.6	75.6	21,025	27848	19.93	419	7.60	160	16.94		8	2	5	126	96	285	28	16	5	418,398	8,894	3,498	162	114	764
DELAIN-6	7.2	Cs	21	T	3.6	75.6	20,636	27849	19.93	411	5.70	118	17.93		38	12	34	123	71	296	5	16	5	148,579	2,996	962	166	99	168
DELAIN-7	23	Cs	21	T	3.6	75.6	20,636	27849	19.93	411	5.70	118	17.93		56	16	44	123	71	296	5	16	5	470,501	9,489	3,047	184	103	625
DELAIN-8	16	Cs	21	T	3.6	75.6	20,129	27849	19.93	401	5.70	115	17.93					120	69	289	26	16	5	312,000	6,620	2,026	146	85	146
DKH-1	2.8	Cs	21	T	3.6	75.6			0.00	0	0.00	0	0.00	90	26	10	23				26	16	5	0	325	45	142	26	-139
DKH-2	3.3	Alf	5.6	T	13	72.8			0.00	0	0.00	0	0.00		26	10	23				0	0	61	0	0	0	26	10	-207
DKH-3	2.8	Alf	5.6	T	13	72.8			0.00	0	0.00	0	0.00								6	26	79	0	17	73	6	26	-131
DKH-4	6.4	Cs	21	T	3.6	75.6			0.00	0	0.00	0	0.00	130							26	16	5	0	998	102	156	16	-381
DKH-5	5.6	Alf	5.6	T	13	72.8			0.00	0	0.00	0	0.00		26	10	23				0	0	61	0	0	0	26	10	-352
DKH-6	6.9	Alf	5.6	T	13	72.8			0.00	0	0.00	0	0.00		26	10	23				0	0	122	0	0	0	26	10	-433
DKH-7	22	Cs	21	T	3.6	75.6			0.00	0	0.00	0	0.00	130							26	16	5	0	3,432	352	156	16	-1,311
DKH-8	35	Alf	5.6	T	13	72.8			0.00	0	0.00	0	0.00		27	7	18							0	0	0	27	7	-2,277
DKS	30	Alf	5	T	13	65	22,766	96489	20.90	476	8.23	187	19.35					143	112	352				689,810	14,417	5,679	143	112	1,424
DNG	36	Alf	5	T	13	65	20,749	96490	19.93	413	8.27	172	18.98		50	14	30	124	103	315				753,189	15,007	6,226	174	117	1,888
DSB	38	Alf	5	T	13	65	20,749	96490	19.93	413	8.27	172	18.98		46	13	28	124	103	315				784,312	15,627	6,484	170	116	1,928
EVER-1-2	52	Alf	5.6	T	13	72.8	21,959	96489	20.90	459	8.23	181	19.35		12	5	9	138	108	340				1,130,889	23,636	9,311	150	113	2,070
FR-1	34	Cs	21	T	3.6	75.6			0.00	0	0.00	0	0.00	90							26	16	5	0	3,886	536	116	16	-1,997
FR-3	29	Alf	5.6	T	13	72.8			0.00	0	0.00	0	0.00		26	7	17				17	78	366	0	488	2,239	43	85	350
FR-4	5.5	Alf	5.6	T	13	72.8			0.00	0	0.00	0	0.00		26	7	17				17	78	366	0	94	429	43	85	67
FR-5	39	Alf	5.6	T	13	72.8			0.00	0	0.00	0	0.00		26	7	17				17	78	366	0	668	3,065	43	85	479
FRE	16	Cs	21	T	3.6	75.6	18,000	96487	19.10	344	8.33	150	17.45		19	6	14	138	90	251	26	15	5	286,200	5,880	2,624	183	111	563
FT-2	2.5	Alf	5.6	T	13	72.8			0.00	0	0.00	0	0.00		14	5	10				0	0	122	0	0	0	14	5	-170
FT-4	2.5	Alf	5.6	T	13	72.8			0.00	0	0.00	0	0.00		14	5	10				0	0	122	0	0	0	14	5	-170
FTB	53	Cs	21	T	3.6	75.6	21,812	96489	20.90	456	8.23	180	19.35		15	6	11	137	108	338	5	16	5	1,158,217	24,472	10,386	157	130	2,889
GP	36	Alf	5	T	13	65	9,525	15511	24.90	237	5.70	54	14.94		14	5	10	71	33	114	0	0	122	340,995	8,491	1,944	85	38	-967
GT-1	19	Cs	21	T	3.6	75.6	21,501	14447	13.28	285	5.70	123	14.94		30	12	29	114	74	257	26	16	5	413,679	5,992	2,666	170	102	508
GT-2	15	Cs	21	T	3.6	75.6	20,235	14447	13.28	269	5.70	115	14.94		30	12	29	107	69	242	26	16	5	303,323	4,416	1,969	163	97	321
GT-3	22	Cs	21	T	3.6	75.6			0.00	0	0.00	0	0.00								145	16	5	0	3,225	356	145	16	-1,326
GTE-1	20	Cs	21	T	3.6	75.6	25,385	27849	19.93	506	5.70	145	17.93		0	0	0	152	87	364	26	16	5	509,985	10,684	3,228	178	103	550
GTN-1	60	Alf	5.6	T	13	72.8	8,924	15511	24.90	222	5.70	51	14.94		14	5	10	67	31	107	6	26	153	539,456	13,795	4,647	87	62	-653
GTN-2	8.1	Alf	5.6	T	13	72.8	8,924	15511	24.90	222	5.70	51	14.94		14	5	10	67	31	107	6	26	153	72,552	1,855	625	87	62	-88
HD-1	14	Alf	5.6	T	13	72.8	10,134	96489	20.90	212	8.23	83	19.35		2	5	3	64	50	157	26	16	5	140,863	3,305	1,382	92	71	-25
HD-2	11	Alf	5.6	T	13	72.8			0.00	0	0.00	0	0.00		27	9	19				0	0	153	0	0	0	27	9	-670
JADIN-1	33	Cs	21	T	3.6	75.6			0.00	0	0.00	0	0.00		14	13	18				115	16	5	0	3,821	532	129	29	-1,549
JADIN-2	5.1	Cs	21	T	3.6	75.6			0.00	0	0.00	0	0.00		14	4	12				145	16	5	0	740	82	159	20	-284
JADIN-3	8.7	Cs	21	T	3.6	75.6			0.00	0	0.00	0	0.00								145	16	5	0	1,262	139	145	16	-519
JK-1	69	Cs	21	T	3.6	75.6	23,998	14447	13.28	319	5.70	137	14.94		39	13	32	127	82	287	26	16	5	1,658,262	23,810	10,558	192	111	2,446
JK-2	65	Cs	21	T	3.6	75.6	23,998	14447	13.28	319	5.70	137	14.94		39	13	32	127	82	287	26	16	5	1,559,870	22,397	9,931	192	111	2,301
JK-3	11	Cs	21	T	3.6	75.6	23,998	14447	13.28	319	5.70	137	14.94		0	0	0	127	82	287	26	16	5	251,979	3,618	1,604	153	98	235
JK-4	8.9	Cs	21	T	3.6	75.6	23,998	14447	13.28	319	5.70	137	14.94		0	0	0	127	82	287	26	16	5	213,582	3,067	1,360	153	98	199
LCB	19	Cs	21	T	3.6	75.6			0.00	0	0.00	0	0.00		2	5	3				115	16	5	0	2,182	304	117	21	-1,036
LCH-1	45	Cs	21	T	3.6	75.6			0.00	0	0.00	0	0.00		34	11	25				115	16	5	0	5,141	715	149	27	-2,172
LCH-2	12	Cs	21	T	3.6	75.6			0.00	0	0.00	0	0.00		39	12	29				100	16	5	0	1,200	192	139	28	-571
LCR-1	19	Alf	5.6	T	13	72.8	7,521	15510	24.90	187	5.70	43	14.94		11	3	7	56	26	90	0	0	92	141,395	3,521	806	67	29	-823
LCR-2	34	Alf	5.6	T	13	72.8	7,521	15510	24.90	187	5.70	43	14.94		11	3	7	56	26	90	0	0	92	254,210	6,330	1,449	67	29	-1,480

Attachment 18C: 2010 DNR Report

Field	Acres	Crop	Yield		P Factor	P Removal by Crop	Manure This Crop		Manure Sample Test Total Nutrients					Leg. Cred.	Prior Years Manure Credits (From Snap)			Avail. 1st Year Manure Credits (From Snap)			Fertilizer Credit (From Snap)			Manure Total This Crop	Total lbs/Field		Available/ Acre		Balance P2O5/Field
				Unit			Gal/a	Sam#	N		P_2O_5		K_2O		N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O		N	P_2O_5	N	P_2O_5	
LT	46	Alf	5.6	T	13	72.8	23,021	96489	20.90	481	8.23	190	19.35		18	7	13	144	114	356				1,056,664	22,084	8,700	162	121	2,212
MA-1E	17	Cs	21	T	3.6	75.6	10,222	96486	19.10	195	8.57	88	18.16	90	0	0	0	59	53	149	5	16	5	177,454	5,039	1,798	154	69	-115
MA-1W	19	Cs	21	T	3.6	75.6	30,115	27848	19.93	600	7.60	229	16.94					180	137	408	5	16	5	575,197	11,556	4,677	185	153	1,478
MA-3	39	Alf	3	T	13	39			0.00	0	0.00	0	0.00		0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1,503
MEN	38	Rye	3	T	4.11	12.33			0.00	0	0.00	0	0.00		40	13	27							0	0	0	40	13	25
MES	38	Rye	3	T	4.11	12.33			0.00	0	0.00	0	0.00		40	13	27							0	0	0	40	13	25
MIN	38	Alf	5.6	T	13	72.8			0.00	0	0.00	0	0.00		14	5	10				0	0	122	0	0	0	14	5	-2,563
MIS-1	66	Cs	21	T	3.6	75.6			0.00	0	0.00	0	0.00		38	14	29				145	16	5	0	9,498	1,048	183	30	-2,987
MP-1	16	Cs	21	T	3.6	75.6	26,338	27849	19.93	525	5.70	150	17.93		40	13	27	158	90	378	0	0	0	415,087	8,271	2,366	198	103	432
MP-2	1.6	Alf	5.6	T	13	72.8			0.00	0	0.00	0	0.00		27	8	18				0	0	122	0	0	0	27	8	-104
MP-3	22	Alf	5.6	T	13	72.8			0.00	0	0.00	0	0.00		27	10	22				0	0	122	0	0	0	27	10	-1,375
NJ-1	24	Rye	3	T	4.11	12.33			0.00	0	0.00	0	0.00		40	13	27							0	0	0	40	13	16
NJ-2	21	Rye	3	T	4.11	12.33			0.00	0	0.00	0	0.00		40	13	27							0	0	0	40	13	14
NJ-3	34	Rye	3	T	4.11	12.33			0.00	0	0.00	0	0.00		38	14	29							0	0	0	38	14	57
NOW-1	15	Rye	3	T	4.11	12.33			0.00	0	0.00	0	0.00		51	15	34							0	0	0	51	15	39
NOW-2	12	Rye	3	T	4.11	12.33			0.00	0	0.00	0	0.00		43	14	34							0	0	0	43	14	20
NOW-3	92	Rye	3	T	4.11	12.33			0.00	0	0.00	0	0.00		41	17	43							0	0	0	41	17	428
NOW-3A	4.6	Rye	3	T	4.11	12.33			0.00	0	0.00	0	0.00		0	0	0				0	0	0	0	0	0	0	0	-57
NOW-3B	15	Rye	3	T	4.11	12.33			0.00	0	0.00	0	0.00		33	16	43							0	0	0	33	16	54
NOW-3C	25	Rye	3	T	4.11	12.33			0.00	0	0.00	0	0.00		41	17	43							0	0	0	41	17	117
NOW-4	13	Rye	3	T	4.11	12.33			0.00	0	0.00	0	0.00		33	16	43							0	0	0	33	16	47
NOW-5A	17	Rye	3	T	4.11	12.33			0.00	0	0.00	0	0.00		42	17	42							0	0	0	42	17	79
NOW-5B	7.4	Rye	3	T	4.11	12.33			0.00	0	0.00	0	0.00		41	17	43							0	0	0	41	17	35
NOW-5C	12	Rye	3	T	4.11	12.33			0.00	0	0.00	0	0.00		33	16	43							0	0	0	33	16	43
NOW-6A	23	Rye	3	T	4.11	12.33			0.00	0	0.00	0	0.00		41	17	43							0	0	0	41	17	106
NOW-7	12	Rye	3	T	4.11	12.33			0.00	0	0.00	0	0.00		0	0	0							0	0	0	0	0	-142
PP-1	25	Alf	5.6	T	13	72.8			0.00	0	0.00	0	0.00								6	26	183	0	150	650	6	26	-1,170
PP-2	24	Alf	5.6	T	13	72.8			0.00	0	0.00	0	0.00								6	26	153	0	143	619	6	26	-1,114
PP-3	40	Cs	21	T	3.6	75.6	10,125	96489	20.90	212	8.23	83	19.35		8	2	5	162	125	381	5	16	5	403,988	8,643	3,965	175	143	2,689
PP-3	40	Cs	21	T	3.6	75.6	16,545	27848	19.93	330	7.60	126	16.94		8	2	5	162	125	381	5	16	5	660,146	13,353	5,656	175	143	2,689
PP-4	7.2	Cs	21	T	3.6	75.6	20,000	96490	19.93	399	8.27	165	18.98		0	0	0	120	99	304	26	16	5	144,000	3,056	1,306	146	115	284
RD-1	19	Alf	5.6	T	13	72.8	19,746	96490	19.93	393	8.27	163	18.98		17	6	11	118	98	300	0	0	0	367,276	7,318	3,036	135	104	580
RD-2-3	57	Alf	3.5	T	13	45.5	19,746	96490	19.93	393	8.27	163	18.98		0	0	0	118	98	300	0	0	0	1,117,624	22,269	9,239	118	98	2,972
RIK-1	77	Alf	5.6	T	13	72.8			0.00	0	0.00	0	0.00		14	5	10				0	0	0	0	0	0	14	5	-5,234
RIK-2	33	Alf	5.6	T	13	72.8			0.00	0	0.00	0	0.00		14	5	10				0	0	122	0	0	0	14	5	-2,251
RK-1	19	Alf	5.6	T	13	72.8			0.00	0	0.00	0	0.00		26	7	17				0	0	366	0	0	0	26	7	-1,217
RK-2	14	Rye	3	T	4.11	12.33			0.00	0	0.00	0	0.00		11	10	14	107	69	241	26	16	5	0	356	219	144	95	1,133
RM-01	61	Alf	5	T	13	65	21,111	96490	19.93	421	8.27	175	18.98		0	0	0	126	105	320	0	0	0	1,283,549	25,575	10,611	126	105	2,432
RM-02	8.2	Alf	5.6	T	13	72.8			0.00	0	0.00	0	0.00		26	7	17				0	0	92	0	0	0	26	7	-536
RM-03	3.2	Alf	5.6	T	13	72.8			0.00	0	0.00	0	0.00		26	7	17				0	0	92	0	0	0	26	7	-211
RM-04	2.9	Alf	5	T	13	65			19.93	0	5.70	0	17.93								0	0	92	0	0	0	0	0	-189
RM-05	4.3	Cs	21	T	3.6	75.6			0.00	0	0.00	0	0.00	130							26	16	5	0	671	69	156	16	-256
RM-06	3.3	Alf	5.6	T	13	72.8			0.00	0	0.00	0	0.00								0	0	122	0	0	0	0	0	-240
RM-07	12	Cs	21	T	3.6	75.6	26,338	27849	0.00	0	0.00	0	0.00		2	5	6	158	90	378	5	16	5	326,591	62	198	165	111	439
RM-08	7.8	Rye	3	T	4.11	12.33			0.00	0	0.00	0	0.00											0	0	0	0	0	-96
RM-09	3.5	Cs	21	T	3.6	75.6			0.00	0	0.00	0	0.00	90							26	16	5	0	406	56	116	16	-209
RM-10	10	Rye	3	T	4.11	12.33			0.00	0	0.00	0	0.00											0	0	0	0	0	-123
RM-11	0	Gras	5	T	0	0			0.00	0	0.00	0	0.00											0	0	0	0	0	0
RM-13	7	Alf	5.6	T	13	72.8			0.00	0	0.00	0	0.00								0	0	92	0	0	0	0	0	-510

Attachment 18D: 2010 DNR Report

31.1.11_DNR_Report

Nutrient Accounting Liquid

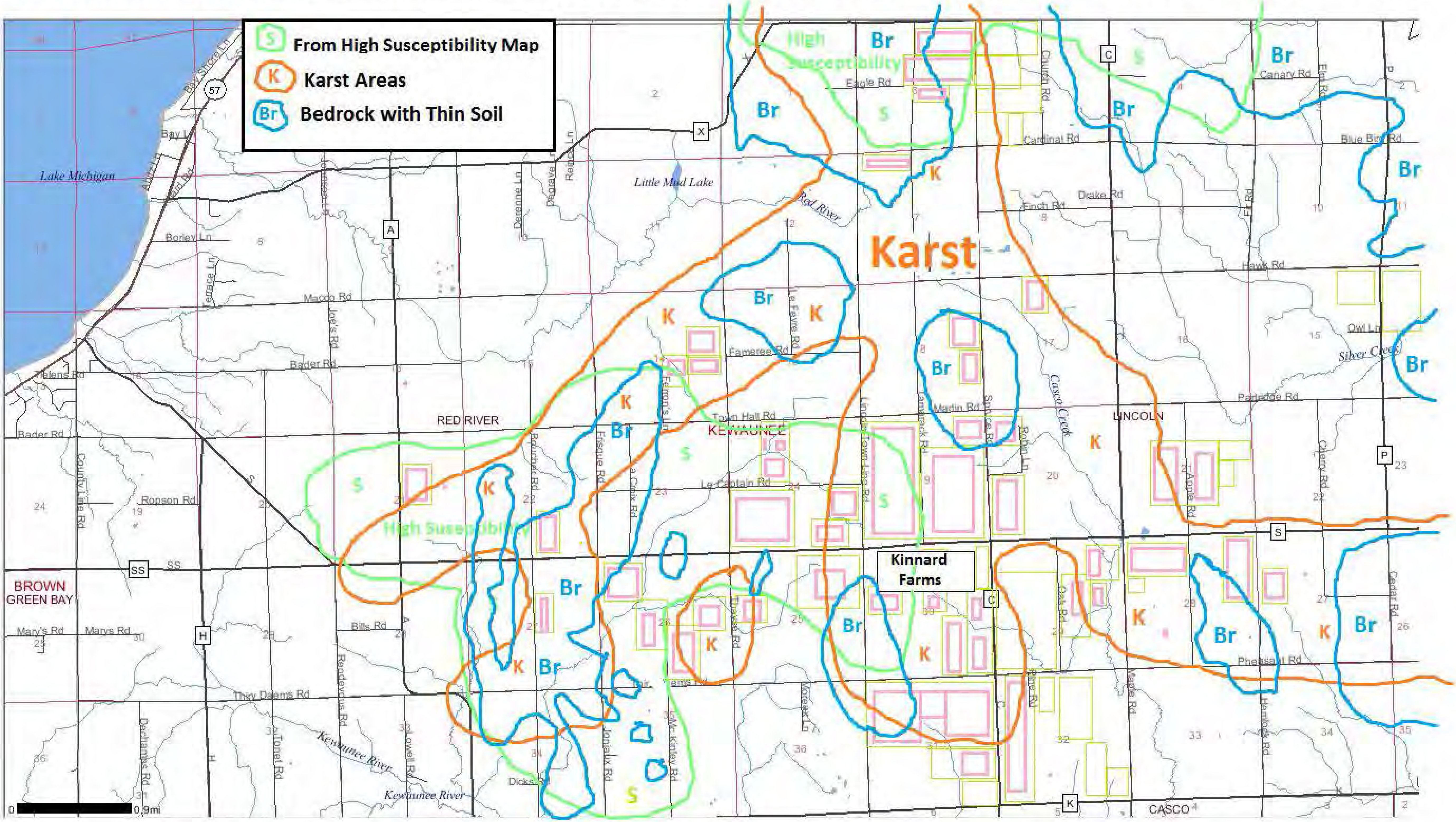
Field	Acres	Crop	Yield		P Factor	P Removal by Crop	Manure This Crop		Manure Sample Test Total Nutrients					Leg. Cred.	Prior Years Manure Credits (From Snap)			Avail. 1st Year Manure Credits (From Snap)			Fertilizer Credit (From Snap)			Manure Total This Crop	Total lbs/Field		Available/ Acre		Balance P2O5/Field
				Unit			Gal/a	Sam#	N		P_2O_5		K_2O		N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O		N	P_2O_5	N	P_2O_5	
RR	39	Rye	3	T	4.11	12.33			0.00	0	0.00	0	0.00		40	13	27							0	0	0	40	13	26
RT-1	110	Cs	21	T	3.6	75.6			0.00	0	0.00	0	0.00								145	16	5	0	15,950	1,760	145	16	-6,556
RT-2	26	Cs	21	T	3.6	75.6			0.00	0	0.00	0	0.00								145	16	5	0	3,770	416	145	16	-1,550
RT-3	16	Cs	21	T	3.6	75.6			0.00	0	0.00	0	0.00								145	16	5	0	2,291	253	145	16	-942
RVM-1	37	Cs	21	T	3.6	75.6			0.00	0	0.00	0	0.00		29	11	21				145	16	5	0	5,365	592	174	27	-1,798
RVM-2	57	Cs	21	T	3.6	75.6			0.00	0	0.00	0	0.00		35	9	23				145	16	5	0	8,236	909	180	25	-2,874
RVM-3	35	Cs	21	T	3.6	75.6			0.00	0	0.00	0	0.00		35	9	23				145	16	5	0	5,075	560	180	25	-1,771
RWM-1	7.5	Cs	21	T	3.6	75.6			0.00	0	0.00	0	0.00		8	2	5				115	16	5	0	863	120	123	18	-432
RWM-2	12	Cs	21	T	3.6	75.6			0.00	0	0.00	0	0.00		8	2	5				115	16	5	0	1,392	194	123	18	-697
RWM-3	6.5	Cs	21	T	3.6	75.6			0.00	0	0.00	0	0.00		8	2	5				115	16	5	0	748	104	123	18	-374
RWM-4	27	Alf	5.6	T	13	72.8			0.00	0	0.00	0	0.00		14	5	10				6	26	244	0	160	694	20	31	-1,116
RWM-5	54	Cs	21	T	3.6	75.6			0.00	0	0.00	0	0.00		8	2	5				115	16	5	0	6,164	858	123	18	-3,087
TH-1	6.8	Alf	5.6	T	13	72.8			0.00	0	0.00	0	0.00		14	5	10				0	0	244	0	0	0	14	5	-464
TH-1 West (G	8	Gras	3	T	0	0			0.00	0	0.00	0	0.00								90	0	61	0	724	0	90	0	0
TH-10	7.6	Gras	3	T	0	0			0.00	0	0.00	0	0.00								90	0	61	0	684	0	90	0	0
TH-1E	6.8	Alf	5.6	T	13	72.8	18,875	96487	19.10	361	8.33	157	17.45					168	113	302	0	0	0	128,350	2,451	1,070	168	113	273
TH-2	16	Alf	5.6	T	13	72.8			0.00	0	0.00	0	0.00		14	5	10				0	0	244	0	0	0	14	5	-1,112
TH-5	9.8	Cs	0	T	3.6	0			0.00	0	0.00	0	0.00											0	0	0	0	0	0
TH-6	5.4	Cs	21	T	3.6	75.6			0.00	0	0.00	0	0.00	90							56	16	5	0	788	86	146	16	-322
TH-7	6.5	Alf	5	T	13	65	18,875	96487	19.10	361	8.33	157	17.45					179	131	392				122,688	2,343	1,022	179	131	429
TH-8	7	Alf	5.6	T	13	72.8			0.00	0	0.00	0	0.00		114	5	10				0	0	122	0	0	0	114	5	-475
TH-9	3.7	Alf	5.6	T	13	72.8			0.00	0	0.00	0	0.00		14	5	10				0	0	122	0	0	0	14	5	-251
VAL-1	14	Alf	5.6	T	13	72.8	7,995	15510	24.90	199	5.70	46	14.94					60	27	96				111,930	2,787	638	60	27	-641
VAL-2	3.3	Alf	5.6	T	13	72.8	7,995	15510	24.90	199	5.70	46	14.94					60	27	96				26,384	657	150	60	27	-151
VANBV	24	Cs	21	T	3.6	75.6			0.00	0	0.00	0	0.00		8	2	5				145	16	5	0	3,408	376	153	18	-1,354
VANH	19	Cs	21	T	3.6	75.6	26,608	27849	19.93	530	5.70	152	17.93		8	2	5	159	91	382	26	16	5	492,248	10,289	3,102	193	109	618
VD-1	29	Alf	5.6	T	13	72.8			0.00	0	0.00	0	0.00		27	11	26				6	26	92	0	172	746	33	37	-1,027
VD-3	6.5	Alf	5.6	T	13	72.8			0.00	0	0.00	0	0.00		27	11	26				0	0	92	0	0	0	27	11	-402
VD-5	4.9	Alf	5.6	T	13	72.8			0.00	0	0.00	0	0.00		27	11	26							0	0	0	27	11	-303
VD-6	47	Cs	21	T	3.6	75.6	25,510	27849	19.93	508	5.70	145	17.93		38	16	35	153	87	366	0	0	0	1,199,735	23,905	6,838	191	103	1,289
VD-7	7.6	Cs	21	T	3.6	75.6			0.00	0	0.00	0	0.00		32	13	33	0	0	0	115	16	5	0	874	122	147	29	-354
VLI-1	6	Cs	21	T	3.6	75.6			0.00	0	0.00	0	0.00		7	2	5				115	16	5	0	690	96	122	18	-346
VLI-2	30	Cs	21	T	3.6	75.6			0.00	0	0.00	0	0.00		7	2	5				115	16	5	0	3,496	486	122	18	-1,751
VLI-3	39	Alf	5.6	T	13	72.8			0.00	0	0.00	0	0.00		24	10	23				6	26	244	0	232	1,004	30	36	-1,420
	3806																							26,200,808	647,848	224,802			-50,932
	acres				*Crop year 2010.																			gallons	#Total	#Total			P205
																								manure	N	P2O5			Balance

Notes:

Yields are expressed in Tons of Dry Matter for Alf- Alfalfa,C- Corn in Bushels of 15.5% moisture,Cs- Corn Silage in 70% moisture,W-Wheat 12% moisture

Nutrient balance for P205 is expressed as yield multiplied by acres per field multiplied by factors in Nutrient Management Fast Facts sheet P205 removal less add.

Attachment 19: Kinnard Farms Manure Spreading Fields with Greatest Groundwater Contamination Potential



Legend: ☐ = Field with High Groundwater Contaminant Susceptibility ☐ = **Kinnard Farms Manure Spreading Areas**

T25N R24E
Section 5
Kewaunee Co.

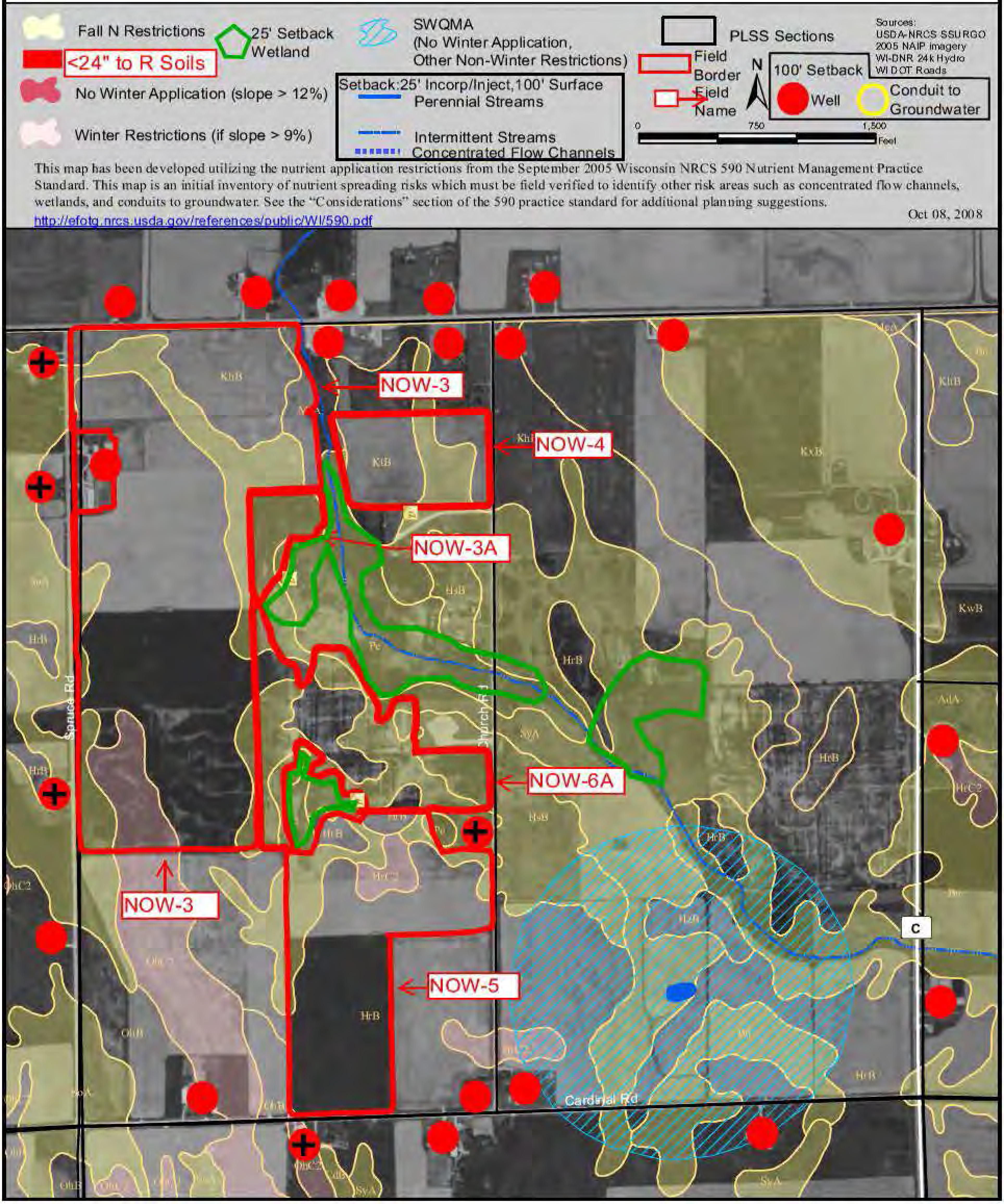
Wisconsin 590
Nutrient Management Application Restrictions

Attachment 20: Lincoln, Sec. 5

This map has been developed utilizing the nutrient application restrictions from the September 2005 Wisconsin NRCS 590 Nutrient Management Practice Standard. This map is an initial inventory of nutrient spreading risks which must be field verified to identify other risk areas such as concentrated flow channels, wetlands, and conduits to groundwater. See the "Considerations" section of the 590 practice standard for additional planning suggestions.

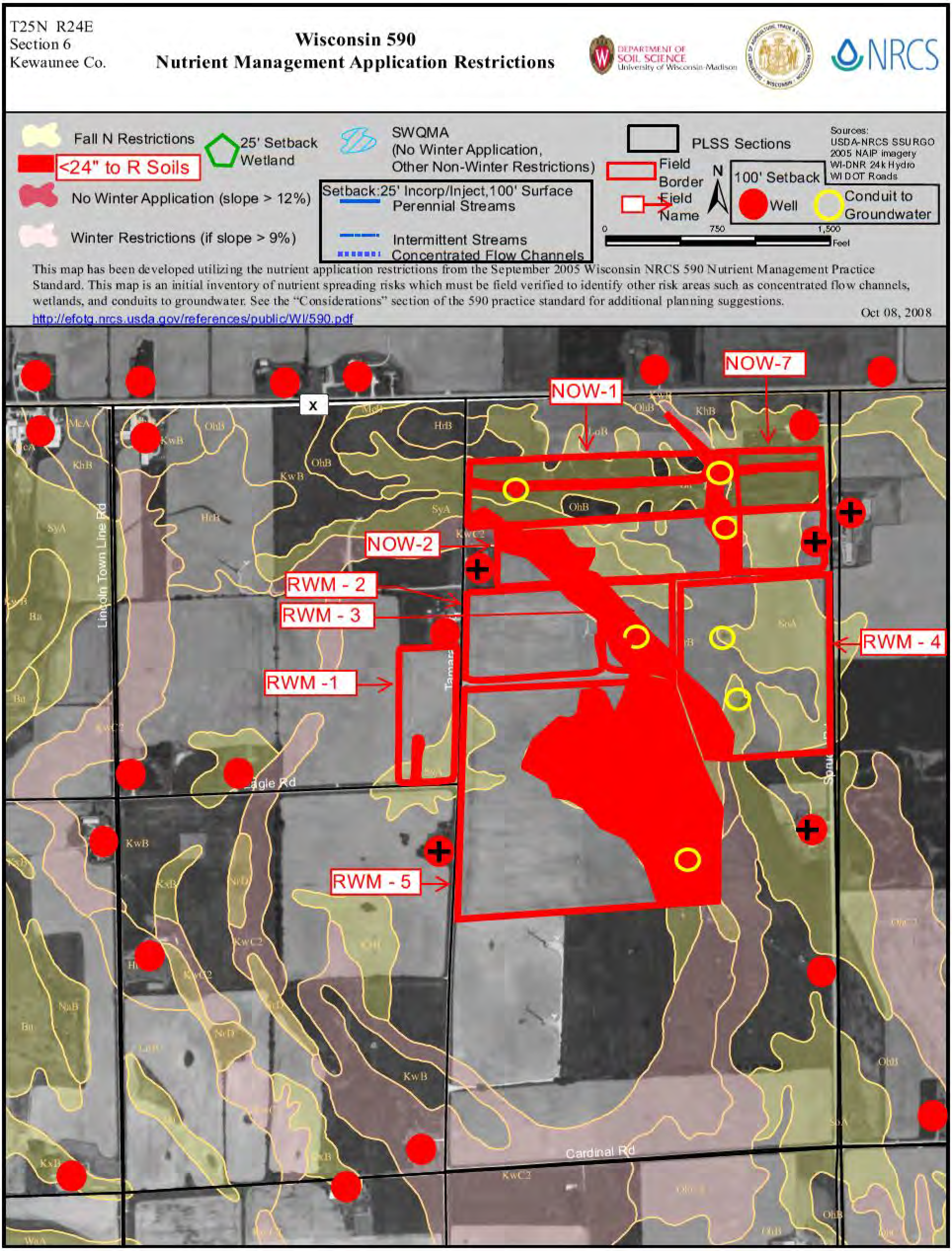
http://efotg.nrcs.usda.gov/references/public/WI/590.pdf

Oct 08, 2008



+ = Potentially Contaminated Well

Attachment 20: Lincoln, Sec. 6

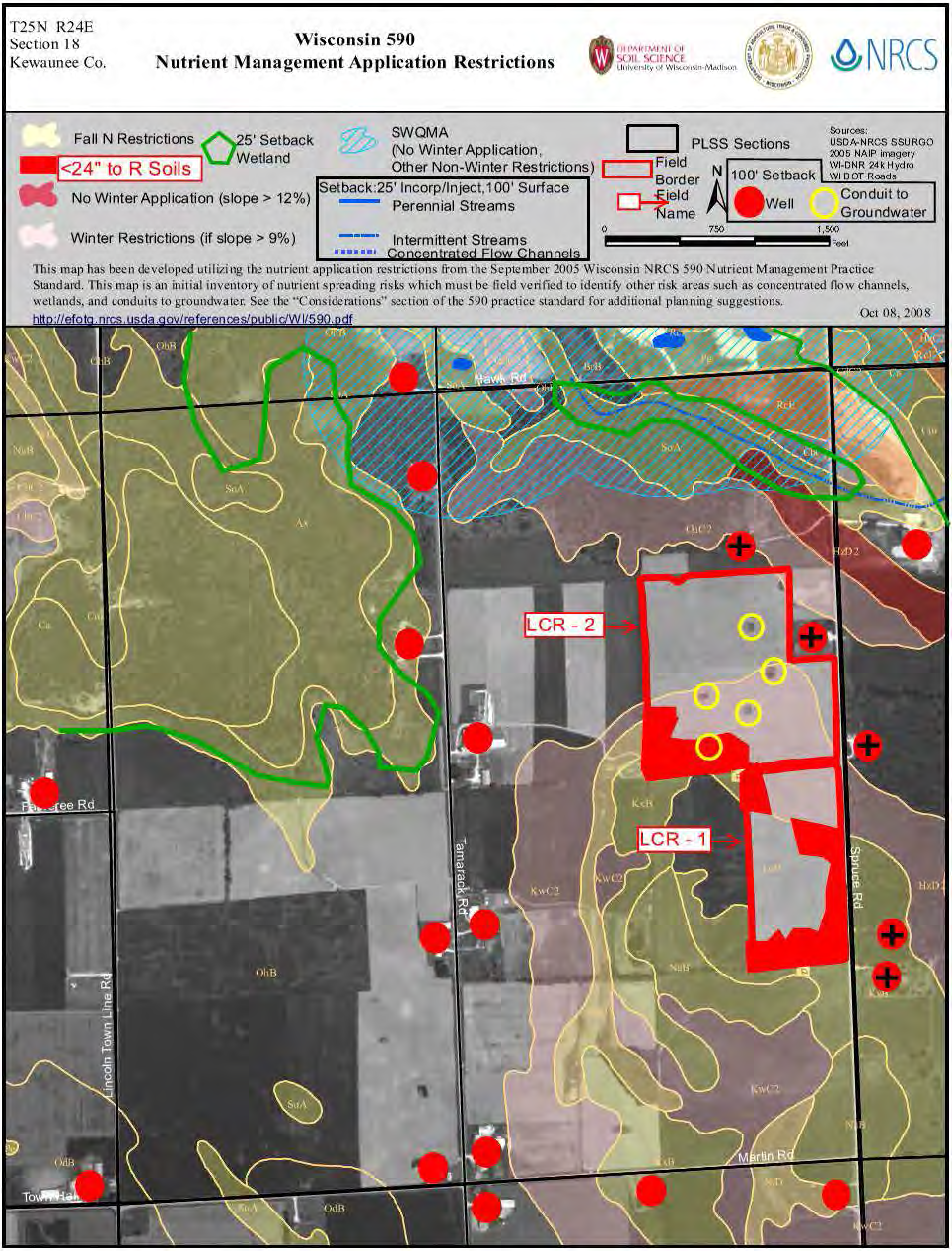


This map has been developed utilizing the nutrient application restrictions from the September 2005 Wisconsin NRCS 590 Nutrient Management Practice Standard. This map is an initial inventory of nutrient spreading risks which must be field verified to identify other risk areas such as concentrated flow channels, wetlands, and conduits to groundwater. See the "Considerations" section of the 590 practice standard for additional planning suggestions.

http://efotg.nrcs.usda.gov/references/public/WI/590.pdf

+ = Potential Contaminated Well

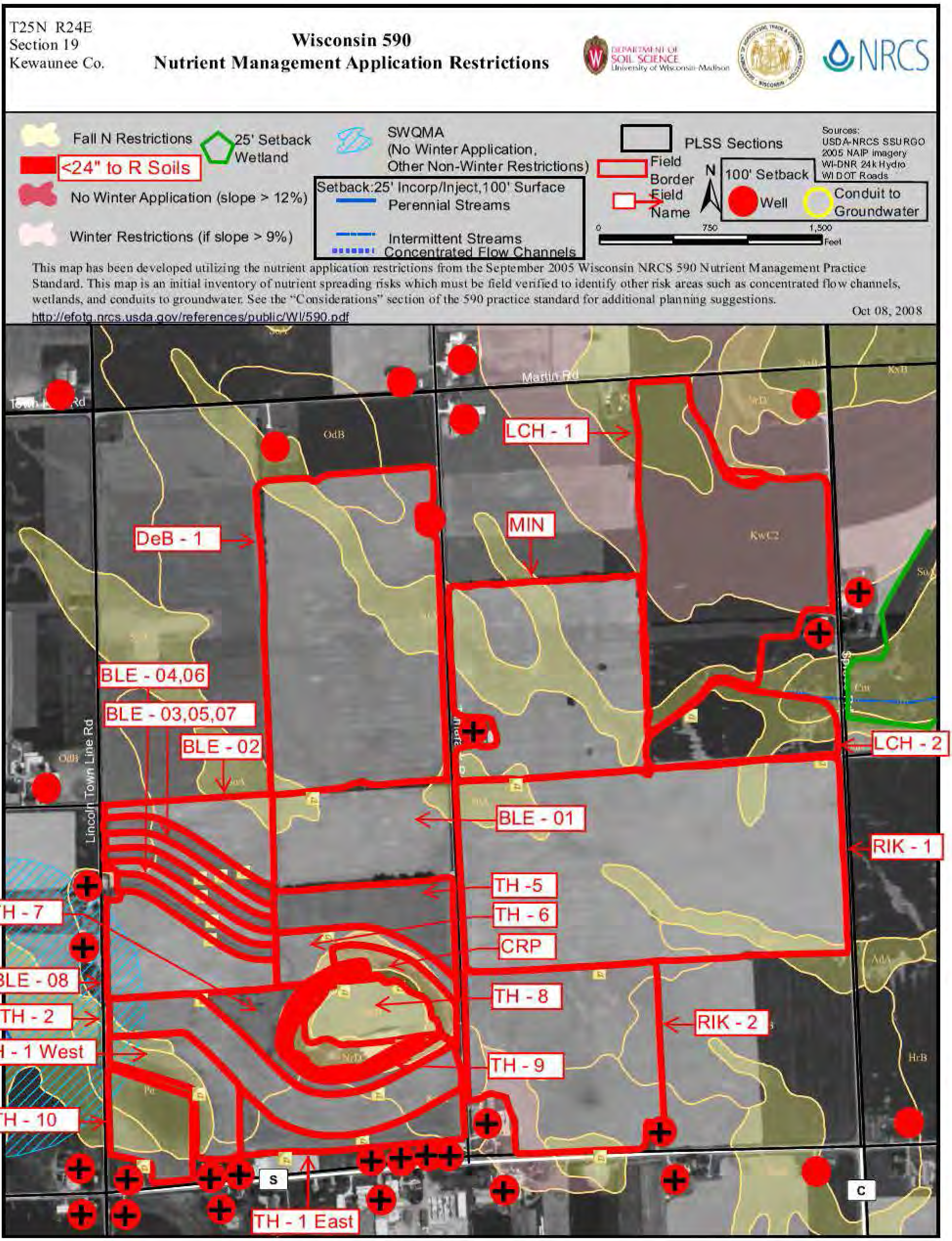
Attachment 20: Lincoln, Sec. 18



This map has been developed utilizing the nutrient application restrictions from the September 2005 Wisconsin NRCS 590 Nutrient Management Practice Standard. This map is an initial inventory of nutrient spreading risks which must be field verified to identify other risk areas such as concentrated flow channels, wetlands, and conduits to groundwater. See the "Considerations" section of the 590 practice standard for additional planning suggestions.

+ = Potential Contaminated Well

Attachment 20: Lincoln, Sec. 19



T25N R24E
Section 19
Kewaunee Co.

Wisconsin 590
Nutrient Management Application Restrictions

This map has been developed utilizing the nutrient application restrictions from the September 2005 Wisconsin NRCS 590 Nutrient Management Practice Standard. This map is an initial inventory of nutrient spreading risks which must be field verified to identify other risk areas such as concentrated flow channels, wetlands, and conduits to groundwater. See the "Considerations" section of the 590 practice standard for additional planning suggestions.

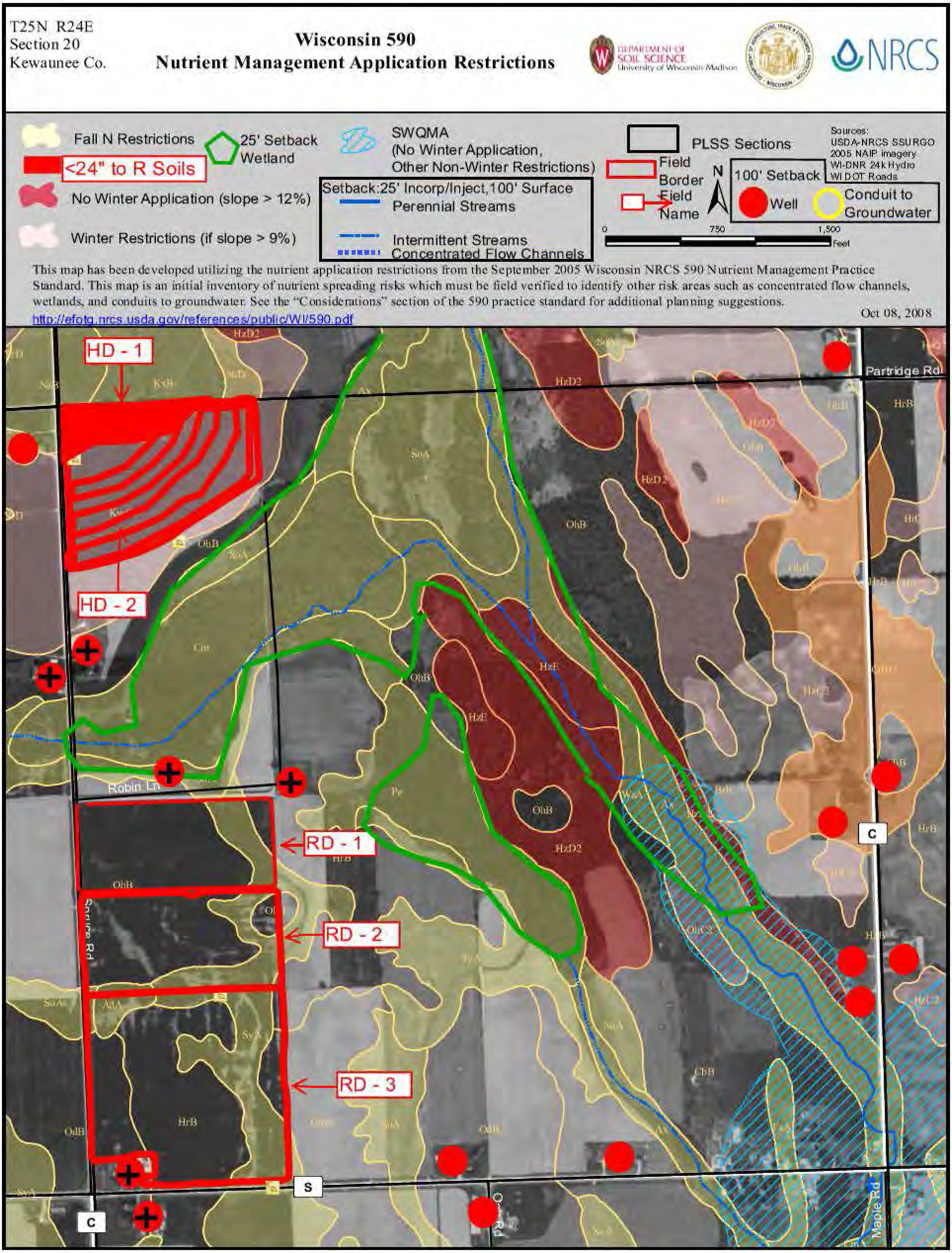
http://efotg.nrcs.usda.gov/references/public/WI/590.pdf

Oct 08, 2008

Sources:
USDA-NRCS SSURGO
2005 NAIP imagery
WI-DNR 24k Hydro
WI DOT Roads

+ = Potential Contaminated Well

Attachment 20: Lincoln, Sec. 20



T25N R24E
Section 20
Kewaunee Co.

Wisconsin 590
Nutrient Management Application Restrictions

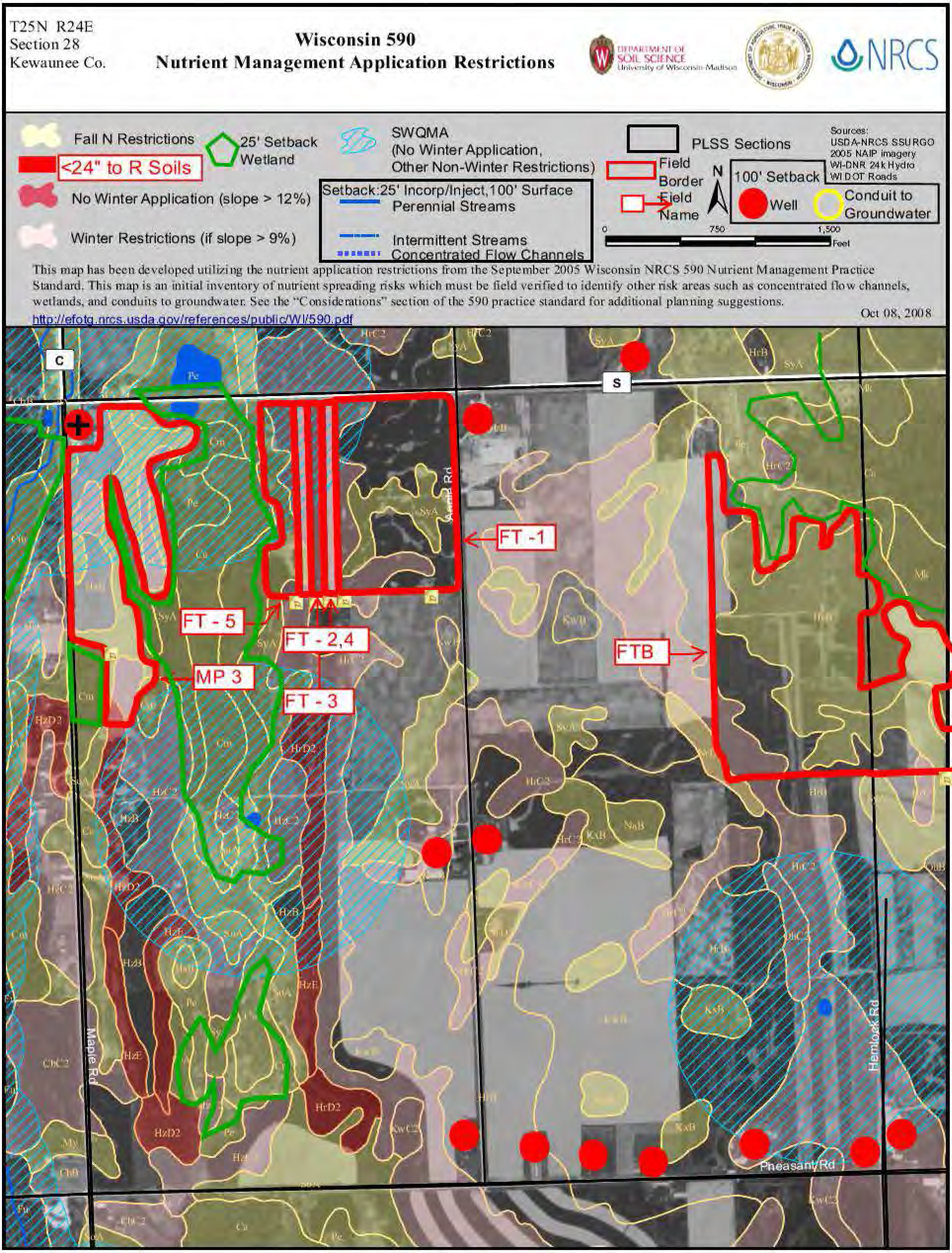
This map has been developed utilizing the nutrient application restrictions from the September 2005 Wisconsin NRCS 590 Nutrient Management Practice Standard. This map is an initial inventory of nutrient spreading risks which must be field verified to identify other risk areas such as concentrated flow channels, wetlands, and conduits to groundwater. See the "Considerations" section of the 590 practice standard for additional planning suggestions.

http://efotg.nrcs.usda.gov/references/public/WI/590.pdf

Oct 08, 2008

+ = Potential Contaminated Well

Attachment 20: Lincoln, Sec. 28



T25N R24E
Section 28
Kewaunee Co.

Wisconsin 590
Nutrient Management Application Restrictions

This map has been developed utilizing the nutrient application restrictions from the September 2005 Wisconsin NRCS 590 Nutrient Management Practice Standard. This map is an initial inventory of nutrient spreading risks which must be field verified to identify other risk areas such as concentrated flow channels, wetlands, and conduits to groundwater. See the "Considerations" section of the 590 practice standard for additional planning suggestions.

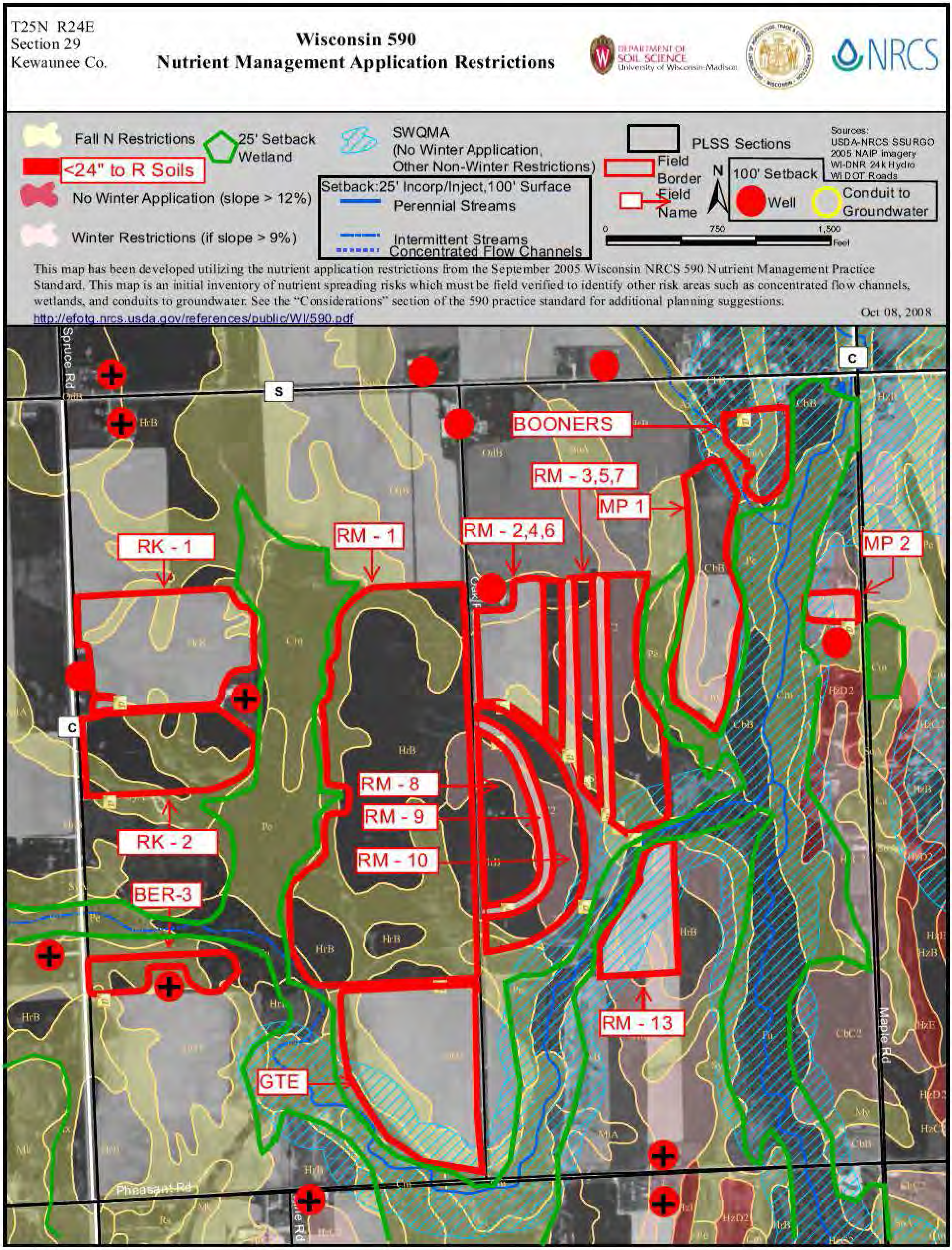
http://efotg.nrcs.usda.gov/references/public/WI/590.pdf

Oct 08, 2008

Sources:
USDA-NRCS SSURGO
2005 NAIP imagery
WI-DNR 24k Hydro
WI DOT Roads

+ = Potential Contaminated Well

Attachment 20: Lincoln, Sec. 29



T25N R24E
Section 29
Kewaunee Co.

Wisconsin 590
Nutrient Management Application Restrictions

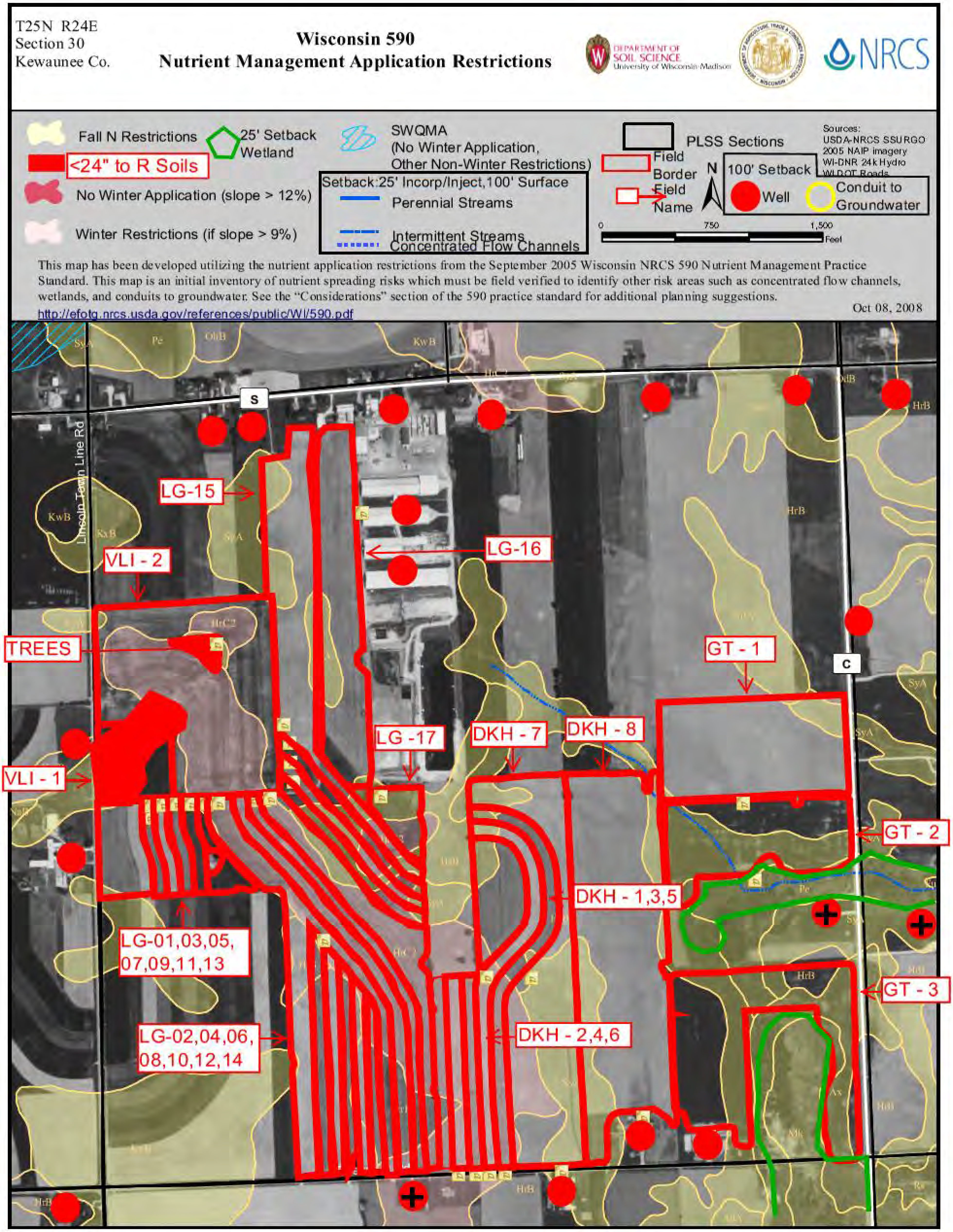
This map has been developed utilizing the nutrient application restrictions from the September 2005 Wisconsin NRCS 590 Nutrient Management Practice Standard. This map is an initial inventory of nutrient spreading risks which must be field verified to identify other risk areas such as concentrated flow channels, wetlands, and conduits to groundwater. See the "Considerations" section of the 590 practice standard for additional planning suggestions.

http://efotg.nrcs.usda.gov/references/public/WI/590.pdf

Oct 08, 2008

+ = Potential Contaminated Well

Attachment 20: Lincoln, Sec. 30

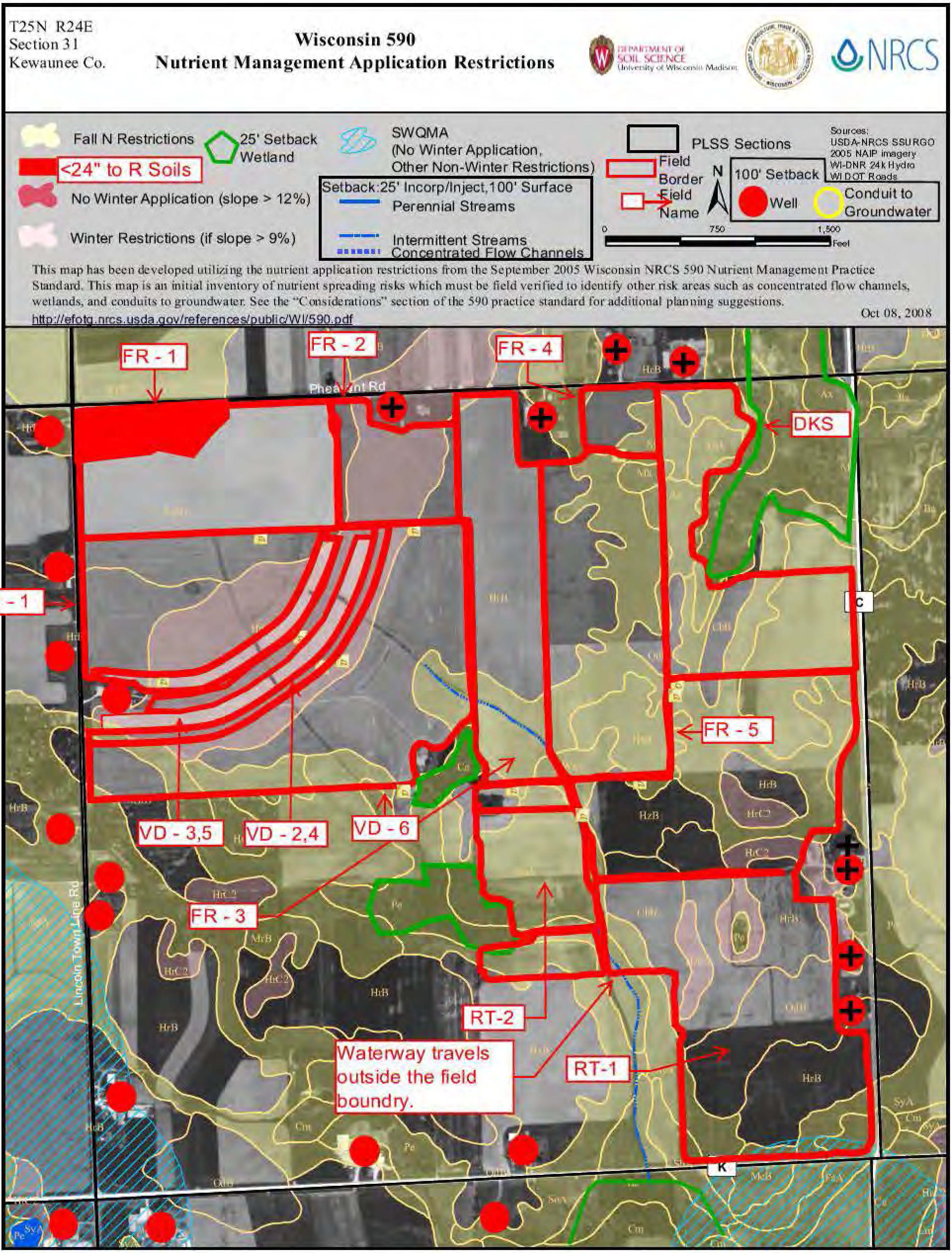


This map has been developed utilizing the nutrient application restrictions from the September 2005 Wisconsin NRCS 590 Nutrient Management Practice Standard. This map is an initial inventory of nutrient spreading risks which must be field verified to identify other risk areas such as concentrated flow channels, wetlands, and conduits to groundwater. See the "Considerations" section of the 590 practice standard for additional planning suggestions.

http://efotg.nrcs.usda.gov/references/public/WI/590.pdf

+ = Potential Contaminated Well

Attachment 20: Lincoln, Sec. 31



T25N R24E
Section 31
Kewaunee Co.

Wisconsin 590
Nutrient Management Application Restrictions

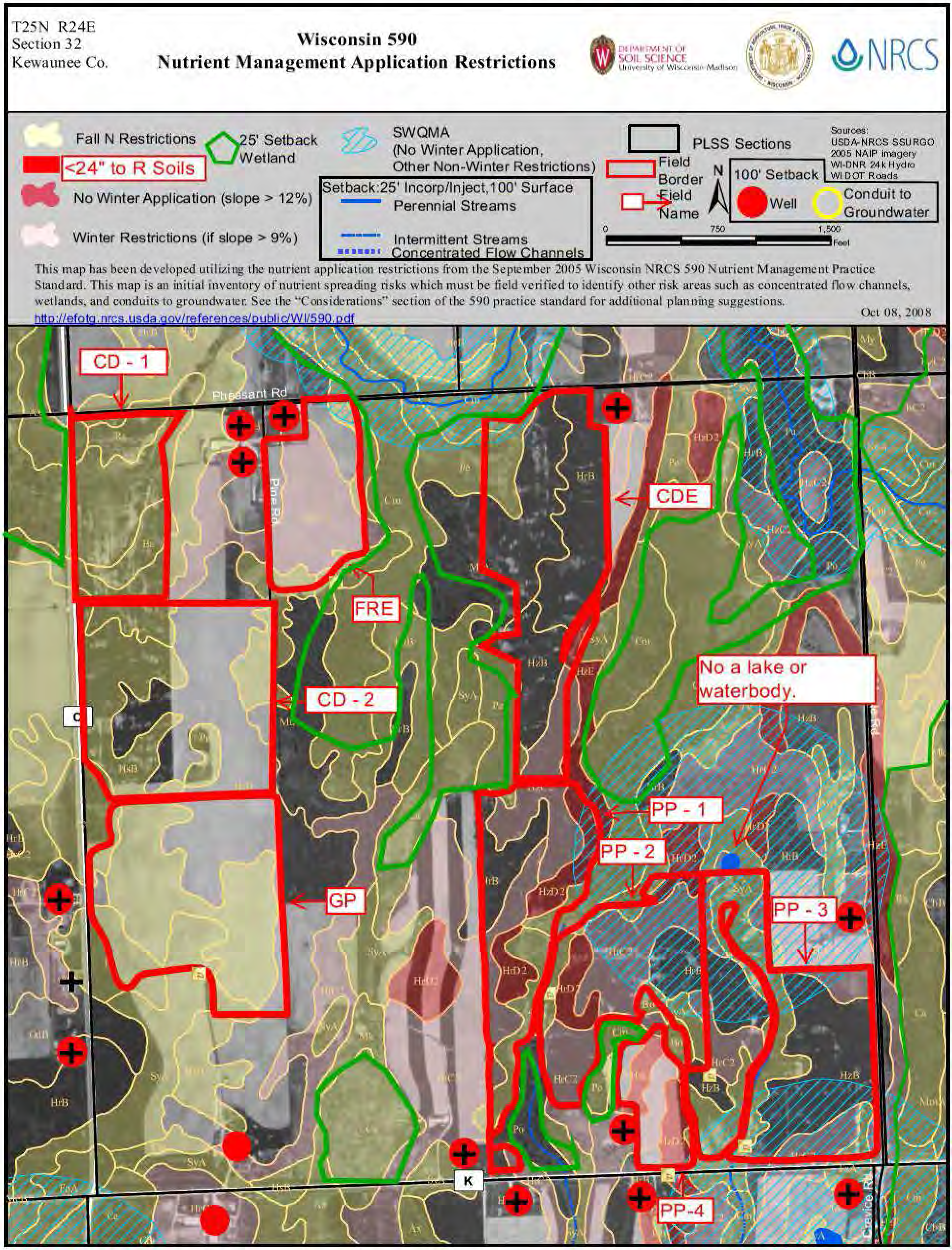
This map has been developed utilizing the nutrient application restrictions from the September 2005 Wisconsin NRCS 590 Nutrient Management Practice Standard. This map is an initial inventory of nutrient spreading risks which must be field verified to identify other risk areas such as concentrated flow channels, wetlands, and conduits to groundwater. See the "Considerations" section of the 590 practice standard for additional planning suggestions.

http://efotg.nrcs.usda.gov/references/public/WI/590.pdf

Oct 08, 2008

+ = Potential Contaminated Well

Attachment 20: Lincoln, Sec. 32



T25N R24E
Section 32
Kewaunee Co.

Wisconsin 590
Nutrient Management Application Restrictions

This map has been developed utilizing the nutrient application restrictions from the September 2005 Wisconsin NRCS 590 Nutrient Management Practice Standard. This map is an initial inventory of nutrient spreading risks which must be field verified to identify other risk areas such as concentrated flow channels, wetlands, and conduits to groundwater. See the "Considerations" section of the 590 practice standard for additional planning suggestions.

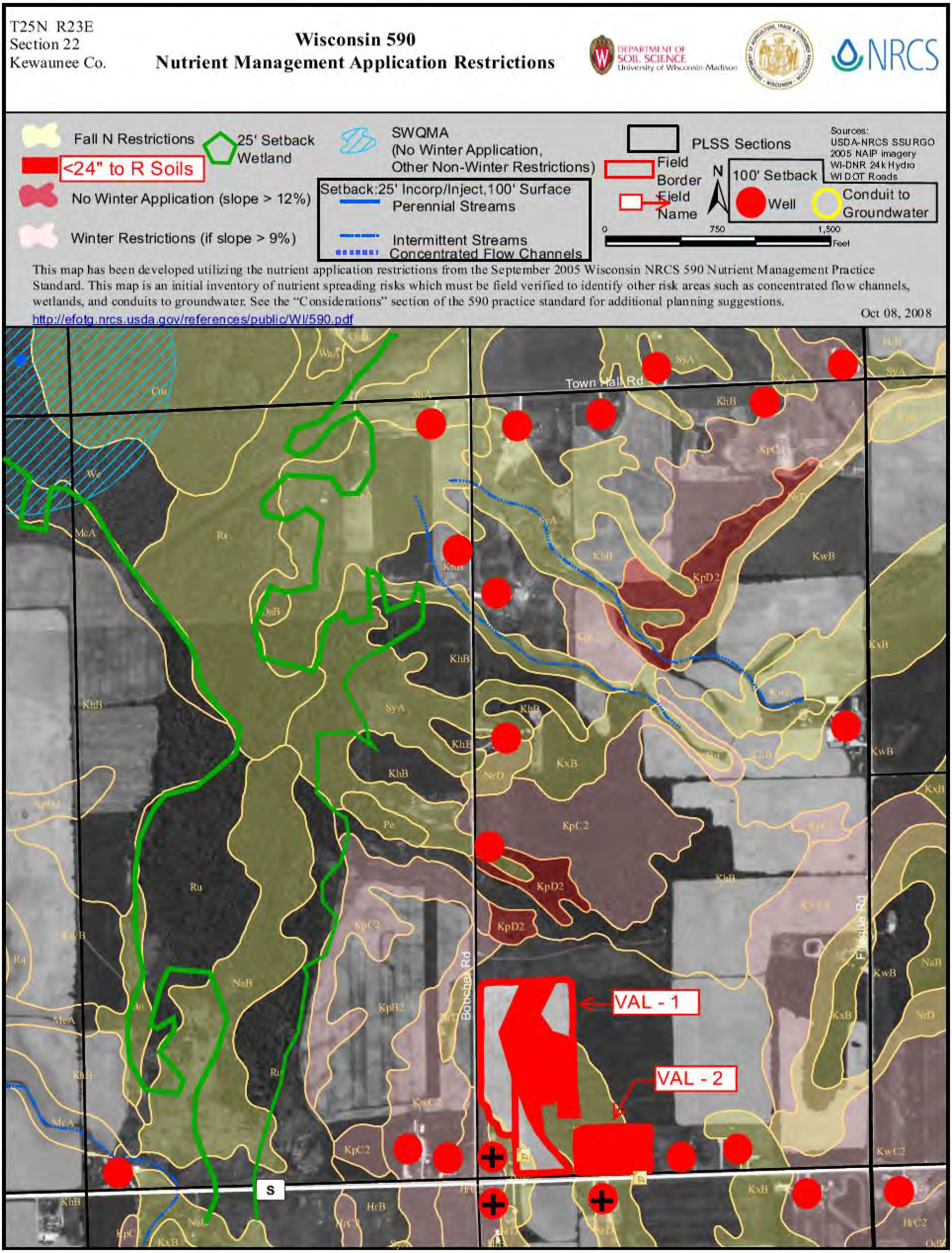
http://efotg.nrcs.usda.gov/references/public/WI/590.pdf

Oct 08, 2008

Sources:
USDA-NRCS SSURGO
2005 NAIP imagery
WI-DNR 24k Hydro
WI-DOT Roads

+ = Potential Contaminated Wells

Attachment 20: Red River, Sec. 22

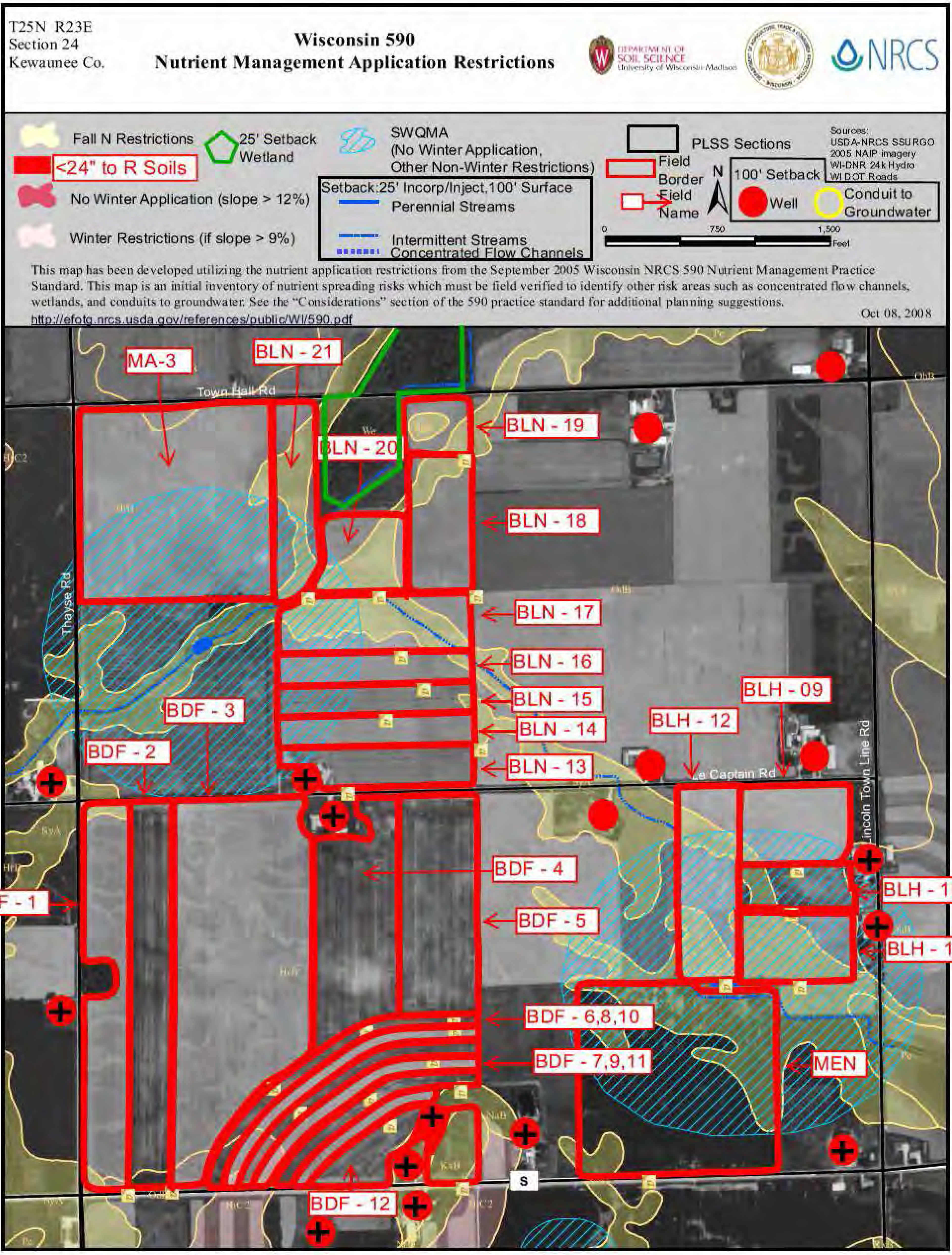


This map has been developed utilizing the nutrient application restrictions from the September 2005 Wisconsin NRCS 590 Nutrient Management Practice Standard. This map is an initial inventory of nutrient spreading risks which must be field verified to identify other risk areas such as concentrated flow channels, wetlands, and conduits to groundwater. See the "Considerations" section of the 590 practice standard for additional planning suggestions.

http://efotg.nrcs.usda.gov/references/public/WI/590.pdf

+ = Potential Contaminated Wells

Attachment 20: Red River, Sec. 24


T25N R23E
Section 24
Kewaunee Co.

Wisconsin 590
Nutrient Management Application Restrictions

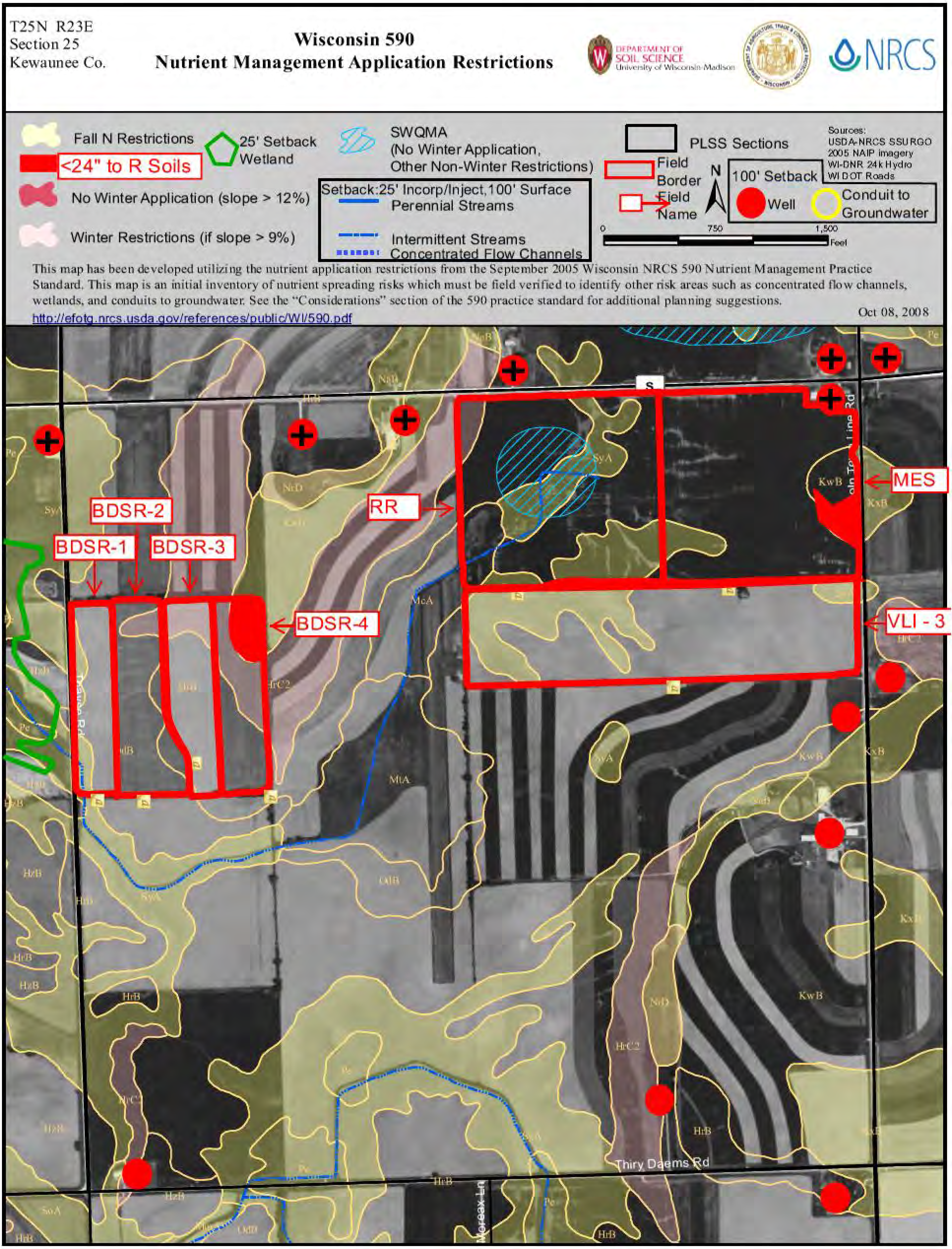
This map has been developed utilizing the nutrient application restrictions from the September 2005 Wisconsin NRCS 590 Nutrient Management Practice Standard. This map is an initial inventory of nutrient spreading risks which must be field verified to identify other risk areas such as concentrated flow channels, wetlands, and conduits to groundwater. See the "Considerations" section of the 590 practice standard for additional planning suggestions.

http://efotg.nrcs.usda.gov/references/public/WI/590.pdf

Oct 08, 2008

+ = Potential Contaminated Well

Attachment 20: Red River, Sec. 25



T25N R23E
Section 25
Kewaunee Co.

Wisconsin 590
Nutrient Management Application Restrictions

This map has been developed utilizing the nutrient application restrictions from the September 2005 Wisconsin NRCS 590 Nutrient Management Practice Standard. This map is an initial inventory of nutrient spreading risks which must be field verified to identify other risk areas such as concentrated flow channels, wetlands, and conduits to groundwater. See the "Considerations" section of the 590 practice standard for additional planning suggestions.

http://efotg.nrcs.usda.gov/references/public/WI/590.pdf

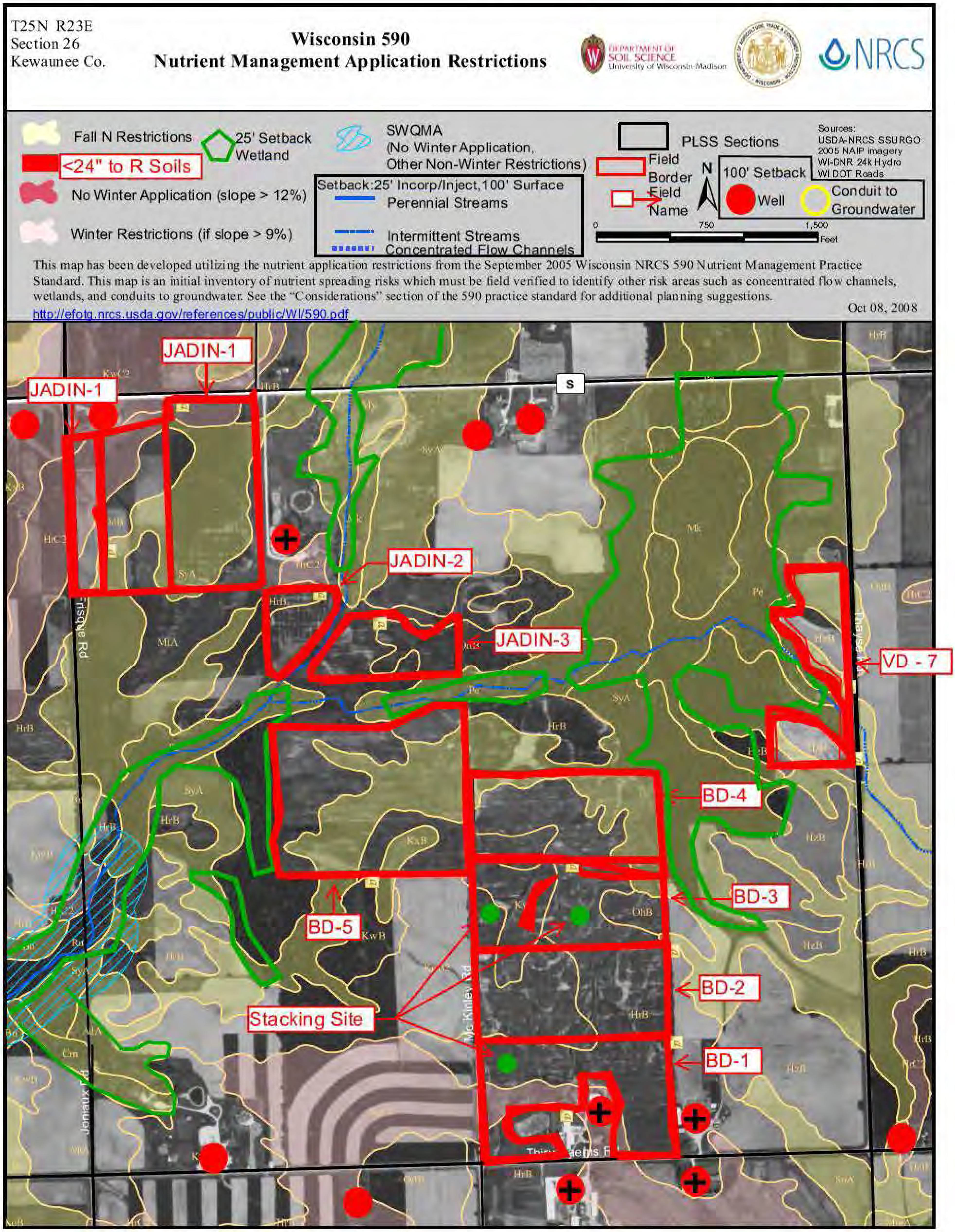
Oct 08, 2008

+ = Potential Contaminated Well

Attachment 20: Red River, Sec. 26

T25N R23E
Section 26
Kewaunee Co.

Wisconsin 590
Nutrient Management Application Restrictions



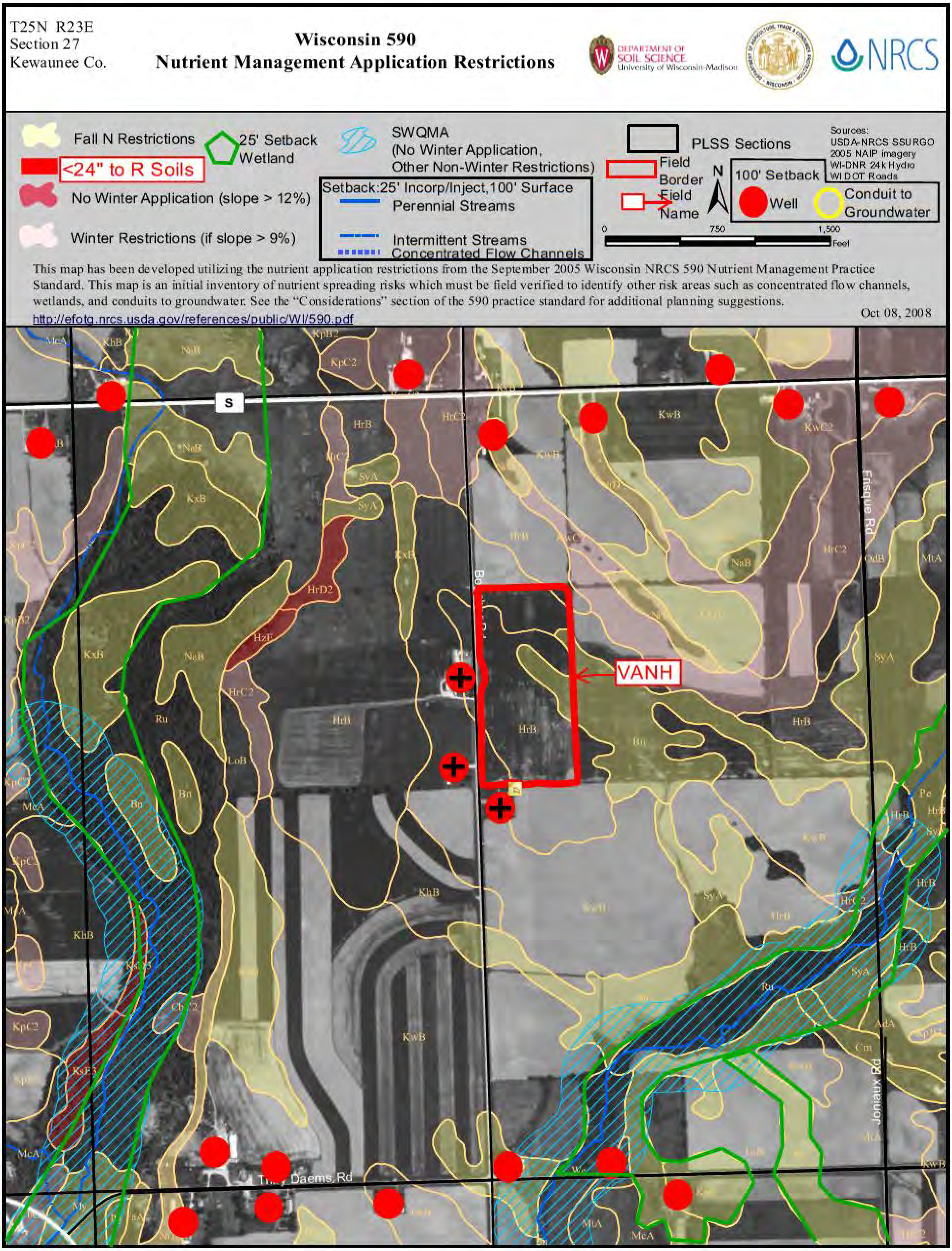
This map has been developed utilizing the nutrient application restrictions from the September 2005 Wisconsin NRCS 590 Nutrient Management Practice Standard. This map is an initial inventory of nutrient spreading risks which must be field verified to identify other risk areas such as concentrated flow channels, wetlands, and conduits to groundwater. See the "Considerations" section of the 590 practice standard for additional planning suggestions.

http://efotg.nrcs.usda.gov/references/public/WI/590.pdf

Oct 08, 2008

+ **Potential Contaminated Well**

Attachment 20: Red River, Sec. 27



This map has been developed utilizing the nutrient application restrictions from the September 2005 Wisconsin NRCS 590 Nutrient Management Practice Standard. This map is an initial inventory of nutrient spreading risks which must be field verified to identify other risk areas such as concentrated flow channels, wetlands, and conduits to groundwater. See the "Considerations" section of the 590 practice standard for additional planning suggestions.

http://efotg.nrcs.usda.gov/references/public/WI/590.pdf

Oct 08, 2008

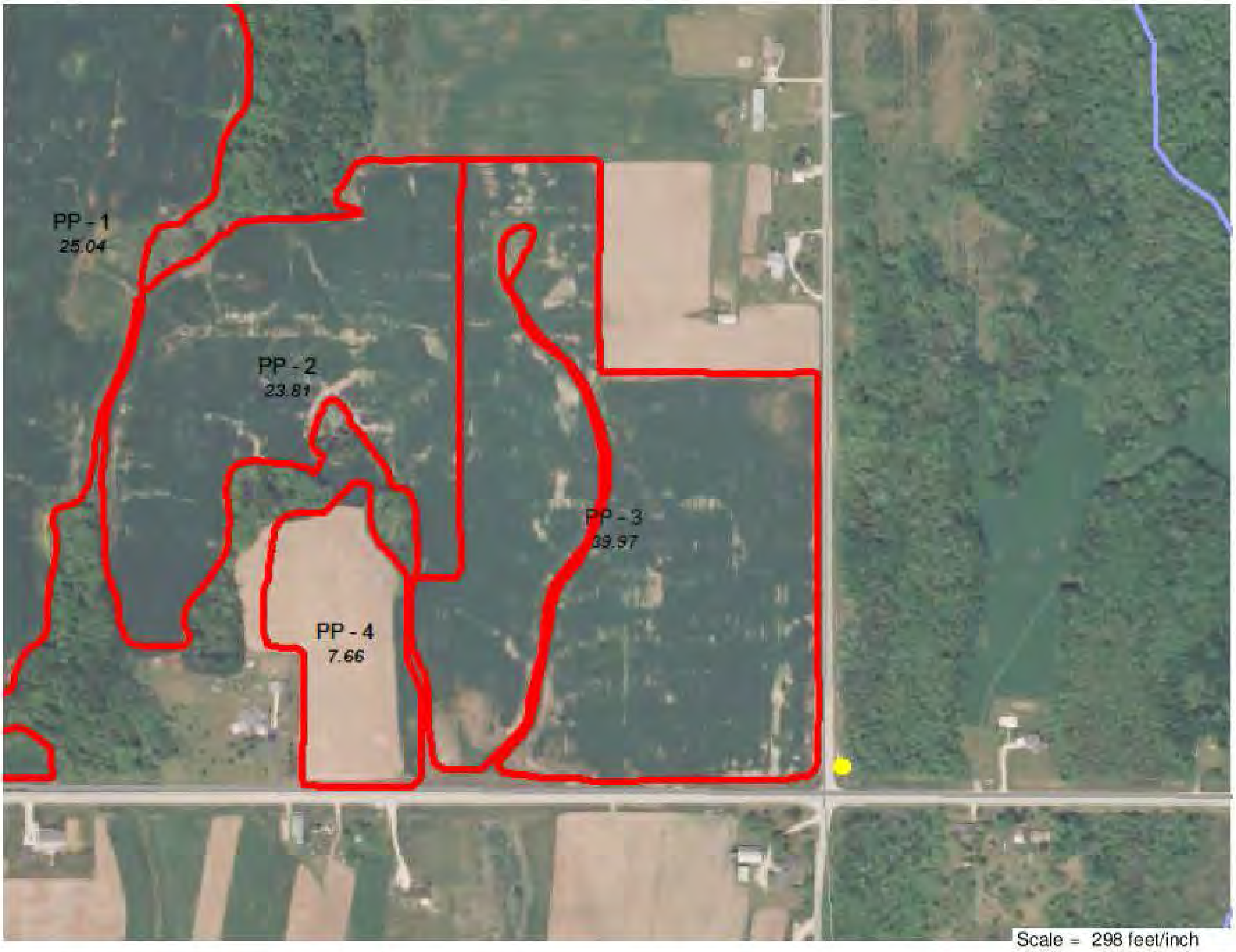
+ = Potential Contaminated Well

Attachment 21: PP-3 Tile Outlet

Kinnard Farms Inc

Tile Outlet

Prepared For:	Kinnard Farms Inc	**County:**	Kewaunee, WI
Farm:	Kinnard Farm Inc.	**Twp Rng Sec:**	
Field:	PP - 3	**Directions:**	
Crop Zone:			
Crop Year:	**Acres:** 39.97		



Scale = 298 feet/inch

Layer Summary

Layer: Tile Line Outlet
Attribute: Tile Outlet

Records: 1

Average:
Weighted Average:

Minimum:
Maximum:

Attachment 22: Proposed Surface Water Sampling Plan for the Kinnard Farms Area

Monitoring points for the plan were chosen for stream areas accessible by public road right-of-way for those streams draining the Kinnard Farms production facility and the associated manure land spreading areas. In addition, the tile outlet from manure spreading field PP-3 located in the southeast quarter of section 32, Town of Lincoln is also included. The surface water sampling locations include the following:

1. Casco R. at Maple Rd. and CTH "S". Currently monitored by "Kewaunee Cares".
2. Drain tile outlet from Kinnard Farms manure spreading field "PP-3" located in the SW1/4, S/W1/4, Sec. 32, Tn. Of Lincoln (see Attachment 21). The tile outlet is mapped by KFI as being in the northeast quadrant of Maple Rd. and CTH "K". This field was spread with very large amounts of manure in 2010.
3. Tributary of Casco Cr. at CTH "K" in the SW ¼, Sec. 31, Tn. of Lincoln.
4. Tributary of Casco Cr. draining the KFI production facility at the Oak Rd. and Pheasant Rd. intersection.
5. Tributary of Casco Cr. at CTH "C", the closest drainage monitoring point of the KFI production facility.
6. Tributary of Casco Cr. at Robin Lane in the middle of the NW ¼ of Sec. 20, Tn. Of Lincoln. This point appears to be near the point sampled by "Kewaunee Cares" on March 11, 2013, Troy Jandrin property.
7. Tributary of Casco Cr. at Spruce Rd, upstream of #6, just north of the intersection of Spruce Rd. and Robin Lane.
8. Tributary of Kewaunee River at LeCaptain Rd., Sec. 24, Tn. of Red River, 1/3 mile west of Lincoln Town Line Rd.
9. Tributary of Kewaunee River, Sec. 23, Tn. of Red River, downstream of #8.
10. Tributary of Kewaunee River at Thayse Rd., 1/2 mile south of CTH "S".
11. Tributary to Kewaunee River at Thiry Daems Rd., 0.6 miles east of CTH "C", downstream of #8, 9 and 10.
12. Tributary of Silver Cr. at Church Rd., Sec. 5, Tn. of Lincoln, ½ mile north of Cardinal Rd.

See Attachment 23 for a map of the proposed surface sampling locations. A field inspection of each of the proposed sites should be made to ensure sampling access is practical and sufficient flow currently exists.

The sampling sites could be sampled once a month during base flow conditions i.e. no significant preceding rainfall or snow melt so as to evaluate groundwater discharge quality. Sampling could also be conducted three or four times a year after a rainfall or snow melt event to evaluate surface runoff characteristics.

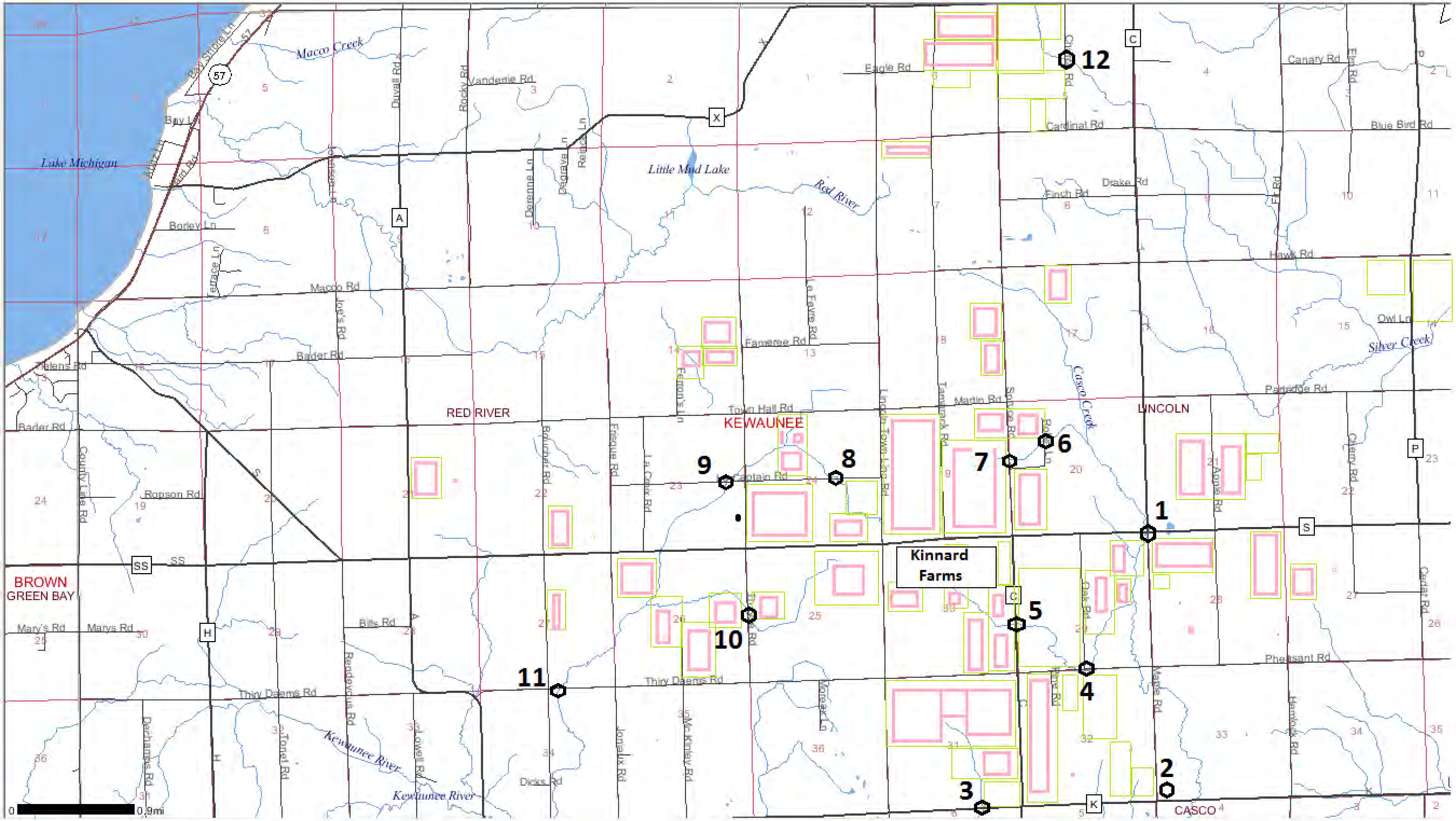
The sampling protocol should include the following:

1. Date and time of collection
2. Qualitative description of flow conditions including: amount of flow, water color, turbidity, or odor. Notation of any preceding rainfall or snow melt runoff.
3. Water temperature.
4. Electrical conductivity field measurements are optional but provide a good general indicator of dissolved materials in the water. The portable field instruments needed is relatively inexpensive and easy to operate.
5. Dissolved oxygen field measurements are optional but could be valuable in documenting biotic impact potential. Portable field instruments are not too costly and could be operated by trained citizen volunteers. Early morning measurements for dissolved oxygen are preferred to capture the lowest daily values usually present at that time.

The following parameters are suggested laboratory analyses:

6. Nitrate-nitrite nitrogen is a very important parameter to evaluate nutrient impacts.
7. Dissolved phosphorus is another important manure contaminant constituent.
8. Chloride analysis is less important, but is associated with manure contamination and serves as a good indicator parameter.
9. Total coliform and E. coli bacterial analyses are significant manure contaminants of health concern.

Attachment 23: Proposed Surface Water Sampling Locations: ⬡ 1



☐ = **Field with High Groundwater Contaminant Susceptibility**

☐ = **Manure Spreading Areas**

Attachment F

Kenneth S. Wade, P.E., P.G.

10747 Moyer Rd.

Blue Mounds, WI, 53517

Tel.: 608-767-3111

Email: kenneth.wade@tds.net

June 24, 2014

Tara Heinzen and Abel Russ
Environmental Integrity Project
1000 Vermont Ave., NW, Suite 1100
Washington, DC 20005

RE: Update of Hydrogeological Review – Kinnard Farms Inc., E 2669 County Hwy. S, Casco, WI, 54205, Sec. 19 & 30, T25N, R24E, Tn. Of Lincoln, Kewaunee County, WI, WPDES: WI-0059536-03-0

Dear Ms. Heinzen and Mr. Russ:

The following report provides an update and reanalysis of the hydrogeological reporting for Kinnard Farms (KF) made in my April 9, 2013 report. New file information regarding manure applications and NMP (nutrient management plan) modifications for 2012 and 2013 were used along with the previous 2010 and 2011 data to determine cumulative nutrient application to the designated spreading fields and the results used in conjunction with private water supply well locations and anticipated groundwater flow direction to determine the well contamination potential. The results of my analysis are provided in the attached spreadsheet and updated maps as described below.

Nutrient Application 2010 - 2013 Lincoln & Red River Townships (See Attached Spreadsheet)

The DNR annual reports for 2010 through 2013, including daily application logs, were used to determine the total nitrogen in lbs. /acre for each spreading field in the contamination sensitive areas previously identified for Lincoln and Red River Townships. Manure and chemical + legume credit nutrients were tabulated separately and cumulative totals for each type were calculated. A groundwater contamination potential score was used based on the following categories:

Groundwater Contamination Potential Score:

1 = Less than 400 lbs. total nitrogen per acre manure applied 20210-2013.

1+ = Greater than 400 lbs. total nitrogen per acre manure applied 2010-2013.

2 = Chemical + legume credit nutrients only applied 2010 -2013.

3 = Potential identified manure spreading area, but no nutrients applied 2010-2013.

Notes regarding additions or deletions of the spreading fields identified in the KF nutrient management plans are include in the spreadsheet. Specific comments regarding discrepancies between the DNR annual report and the daily spreading log data is also provided. The spreadsheet can be updated with the annual data as reported yearly by KF to WDNR. The spreadsheet is best printed in legal size format.

Site Area Map of KF Manure Spreading Fields with Greatest Groundwater Contamination Potential

The map of KF manure spreading fields with the greatest groundwater contamination potential, provided as Attachment 19 in the April 9, 2013 report was updated to reflect the additions and deletions of spreading fields identified by KF in nutrient management plan revisions. This updated attachment is best printed in legal format.

Lincoln and Red River Section Maps of Well Contamination Potential

The following township section maps (see attachments) were produced using the groundwater contamination potential scores for each spreading field as provided in the spreadsheet. The groundwater potential score is shown for each spreading field identified on the section maps. The anticipated discharge points at streams in the field areas was used to determine the most probable groundwater flow direction locally and then the position of identified water supply wells relative to the spreading field and its potential contamination score was used to characterize the potential for KF manure contamination at each of the wells. Wells identified on the section maps with a "1" are designated as having lower contamination potential and wells identified with a "+" are designated as having higher contamination potential.

Town of Lincoln	Town of Red River
Section 5	Section 14
Section 6	Section 22
Section 14	Section 24
Section 19	Section 25
Section 21	Section 26
Section 28	Section 27
Section 29	
Section 30	
Section 31	
Section 32	

Spreading Field Drainage Tile Maps

The NMP update submitted to the WDNR in April 2014 contained additional information regarding drainage tile systems associated with the spreading fields. Tile system water quality is of importance because the tile drainage may contain elevated concentrations of manure contaminants. The following tile line systems are of concern in the project area (see attached drain tile maps):

Red River Sec. 14 - Field MA-1W

This tile system drains a field with high manure application and has an outlet adjacent to a closed drainage karst stream segment with wells within about 750 feet.

Red River Sec. 25 - Field RR

This tile system drains a designated manure spreading field that has not historically received any application. The tile outlet is at a tributary to the Kewaunee River.

Red River Sec. 26 - Field Jadin 1

This tile system drains a field with a high manure application to an outlet in a probable closed depression with no surface water drainage. A water supply well lies about 500 feet northeast of the tile outlet.

Lincoln Sec. 29 - Fields RM 01-07

This tile system drains fields with low to high manure applications to an outlet to a tributary to Casco Creek. The creek adjacent the tile outlet may be navigable and therefore allow access as a potential surface water monitoring point for determination of manure application impacts.

Lincoln Sec. 32 - Field PP3

This tile system drains a field with a high manure application to an outlet adjacent to a tributary to Casco Creek immediately adjacent CTH "K". The creek adjacent to the tile outlet may be navigable and also be within the right-of-way of CTH "K" and therefore allow access as a potential surface water monitoring point.

Lincoln Sec 14 - Field RVM-2

This tile system drains a field with a high manure application to an outlet adjacent to a tributary to Silver Creek. Although this field does not lie within the project area most hydrogeologically susceptible to contamination the creek adjacent the tile outlet may be navigable and therefore allow access as a potential surface water monitoring point to evaluate the leaching of manure contaminants into the groundwater.

Conclusions

The spreadsheet tabulation of nutrient loading at KF spreading fields can be used to determine the relative groundwater contamination potential associated with the amount of KF manure spreading and to assess the potential impact to specific adjacent water supply wells using the interpreted groundwater flow direction. The spreadsheet can be updated with future KF reporting to the WDNR. The section maps can be used as a reference for the locations of wells with potential contamination.

The mapped drainage tile locations adjacent to fields with high levels of manure spreading have the potential to be sampled to determine the groundwater impacts associated with the fields identified.

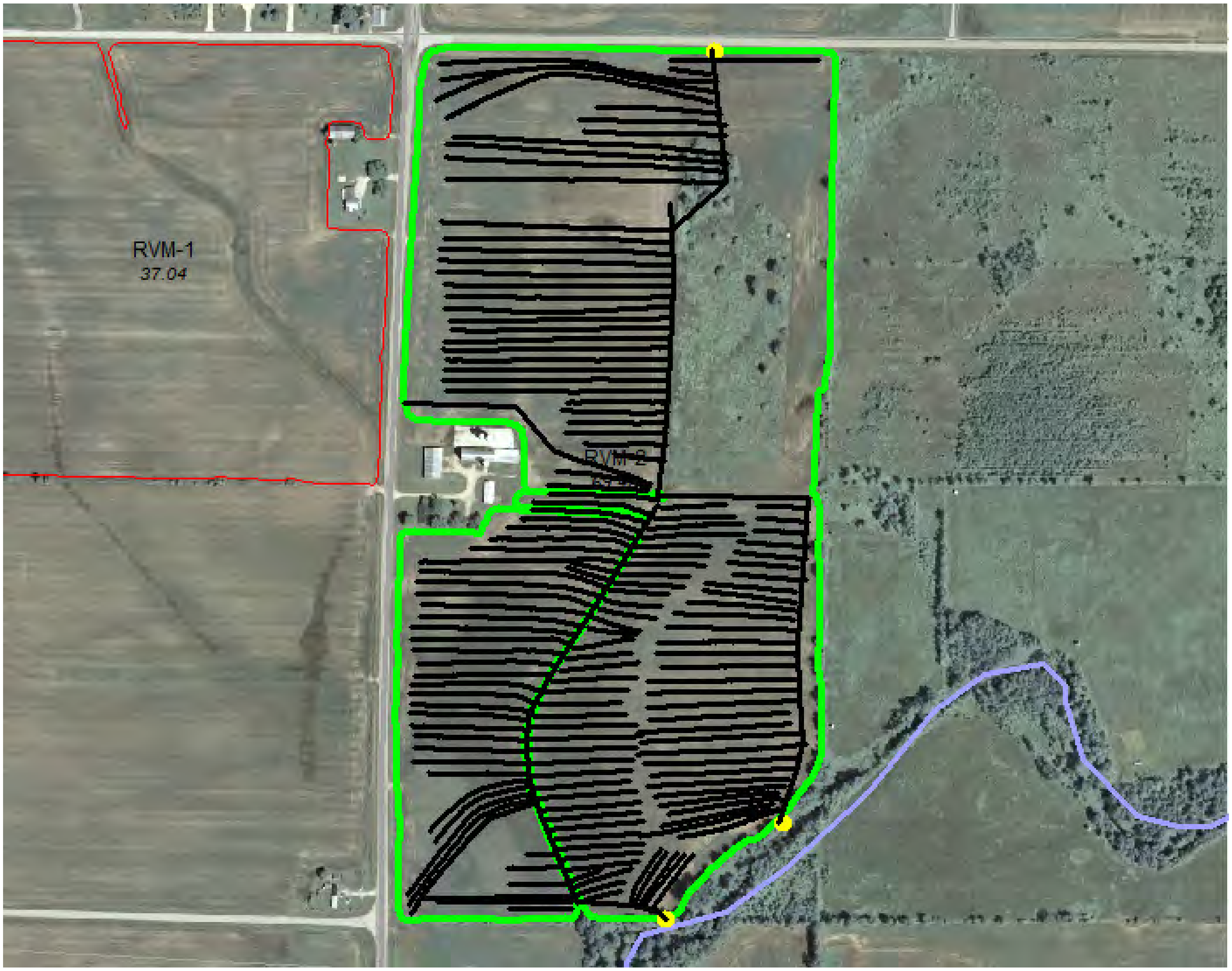
Lincoln Sec. 14 - Tile Map for Field RVM-2 at Silver Cr.

Polenske
Agronomic
Consulting

Kinnard Farms Inc

Tile Map

Prepared For:	Kinnard Farms Inc	**Crop Zone:**	
Farm:	Roy & Valerie Mertin	**Crop Year:**	
Field:	RVM-2		
County:	Kewaunee, WI	**Prepared By:**	



Data Values

Attribute	Tile Outlet
Records	3
Empty	0
Average	
Min	
Max	

Tile Outlet

Lincoln Sec. 14 - Tile Map for Field RVM-2 at Silver Cr.

Polenske
Agronomic
Consulting

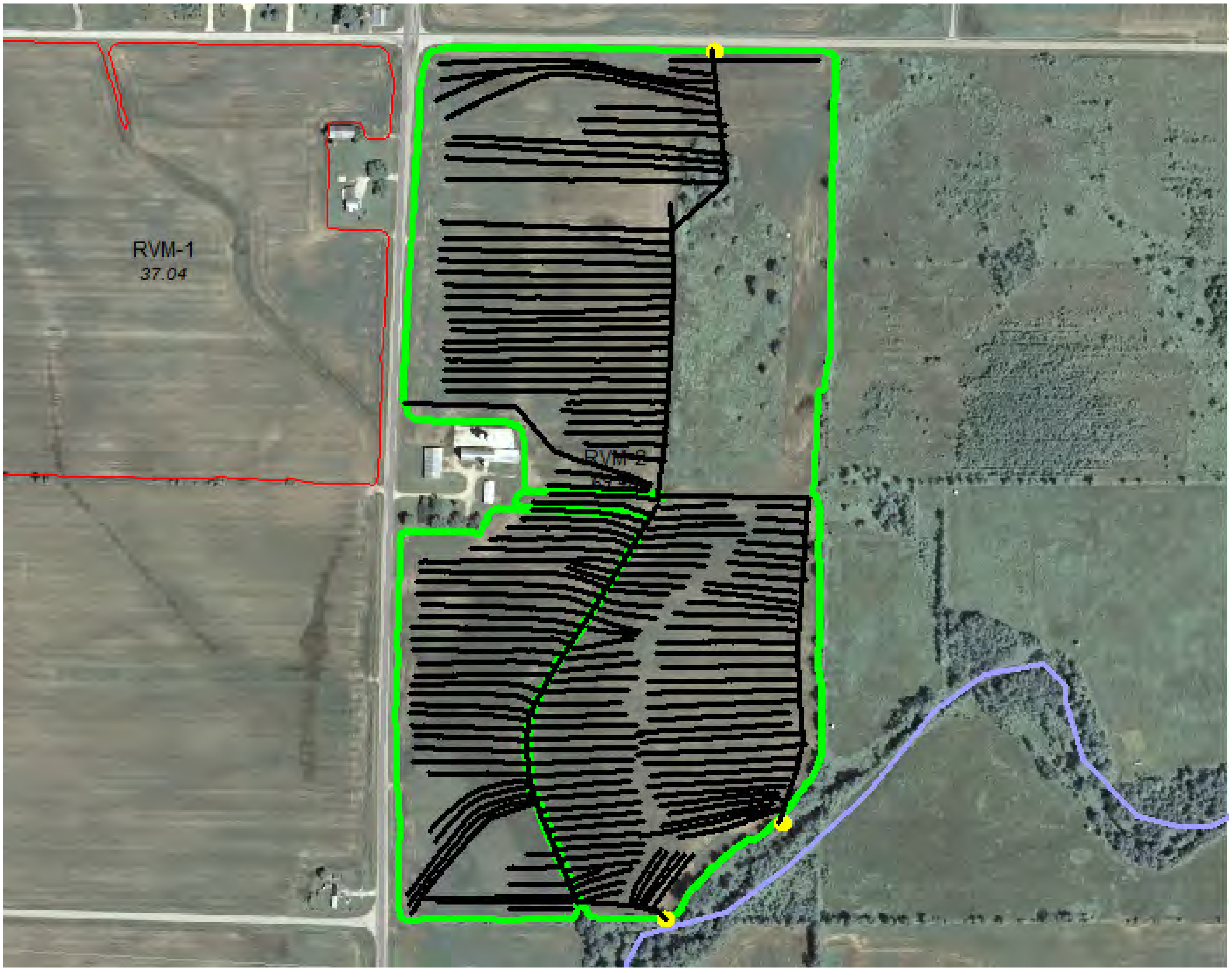
Kinnard Farms Inc

Tile Map

Prepared For: Kinnard Farms Inc
Farm: Roy & Valerie Mertin
Field: RVM-2
County: Kewaunee, WI

Crop Zone:
Crop Year:

Prepared By:



Data Values

Attribute	Tile Outlet
Records	3
Empty	0
Average	
Min	
Max	

Tile Outlet

Lincoln Sec. 14 - Tile Line Outlets for Field RVM-2

T25N R24E
Section 14
Kewaunce Co.

Wisconsin 590
Nutrient Management Application Restrictions

X = Tile Outlet

- Fall N Restrictions
- 🟥 <24" to R Soils
- No Winter Application (slope > 12%)
- Winter Restrictions (if slope > 9%)
- 25' Setback Wetland
- SWQMA (No Winter Application, Other Non-Winter Restrictions)
- Setback: 25' Incorp/Inject, 100' Surface
  - Perennial Streams
  - Intermittent Streams
  - Concentrated Flow Channels
- PLSS Sections
- Field Border
- Field Name
- 100' Setback
  - ● Well
  - ○ Conduit to Groundwater

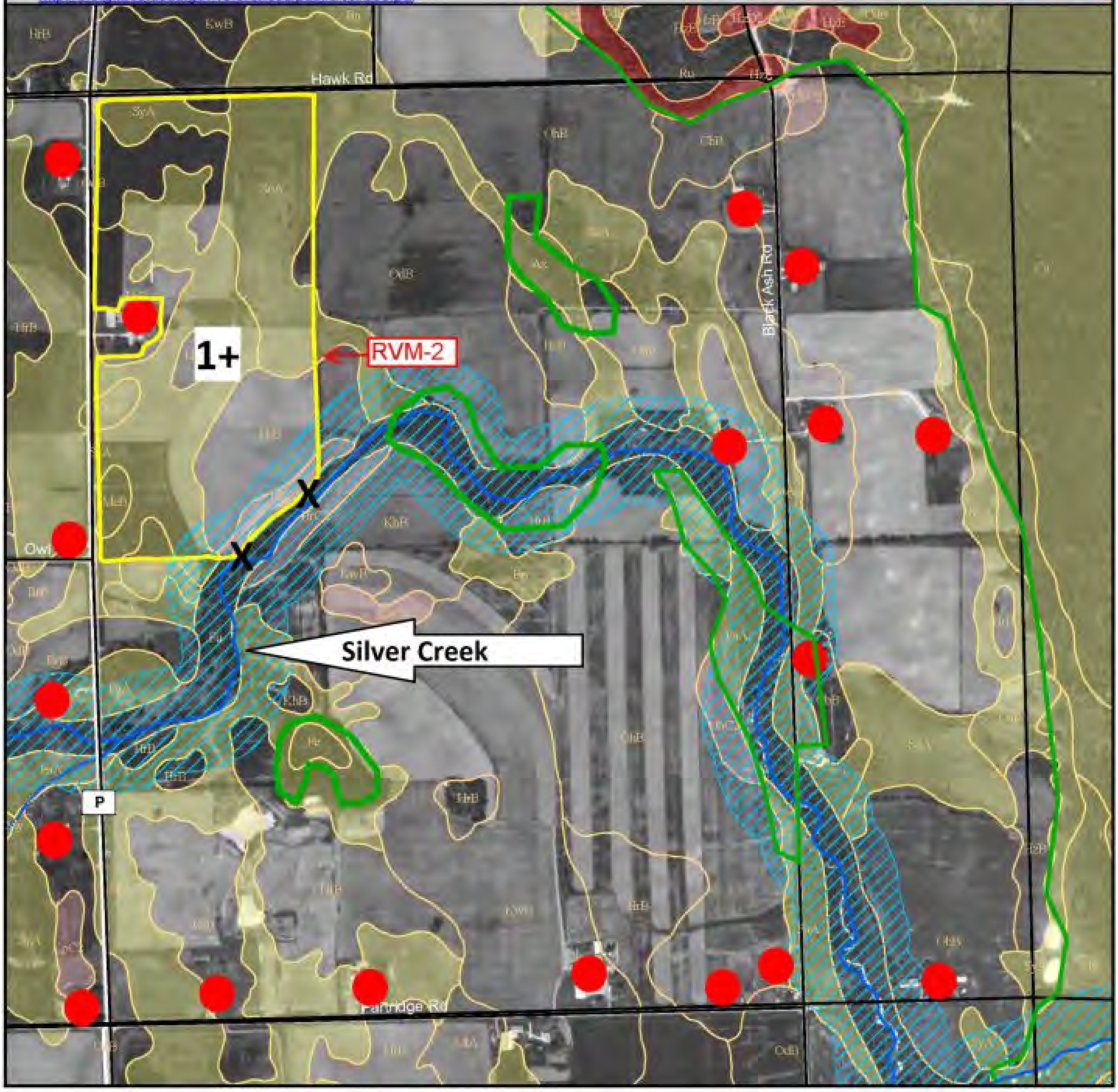
N

0 750 1,500 Feet

Sources:
USDA-NRCS SSURGO
2005 NAIP imagery
WI-DNR 24k Hydro
WI DOT Roads

This map has been developed utilizing the nutrient application restrictions from the September 2005 Wisconsin NRCS 590 Nutrient Management Practice Standard. This map is an initial inventory of nutrient spreading risks which must be field verified to identify other risk areas such as concentrated flow channels, wetlands, and conduits to groundwater. See the "Considerations" section of the 590 practice standard for additional planning suggestions. http://efotg.nrcs.usda.gov/references/public/WI/590.pdf

Revised 1.28.13



Lincoln Sec. 19 - Well Contamination Potential

1 = low potential
+ = high potential

T25N R24E
Section 19
Kewaunee Co.

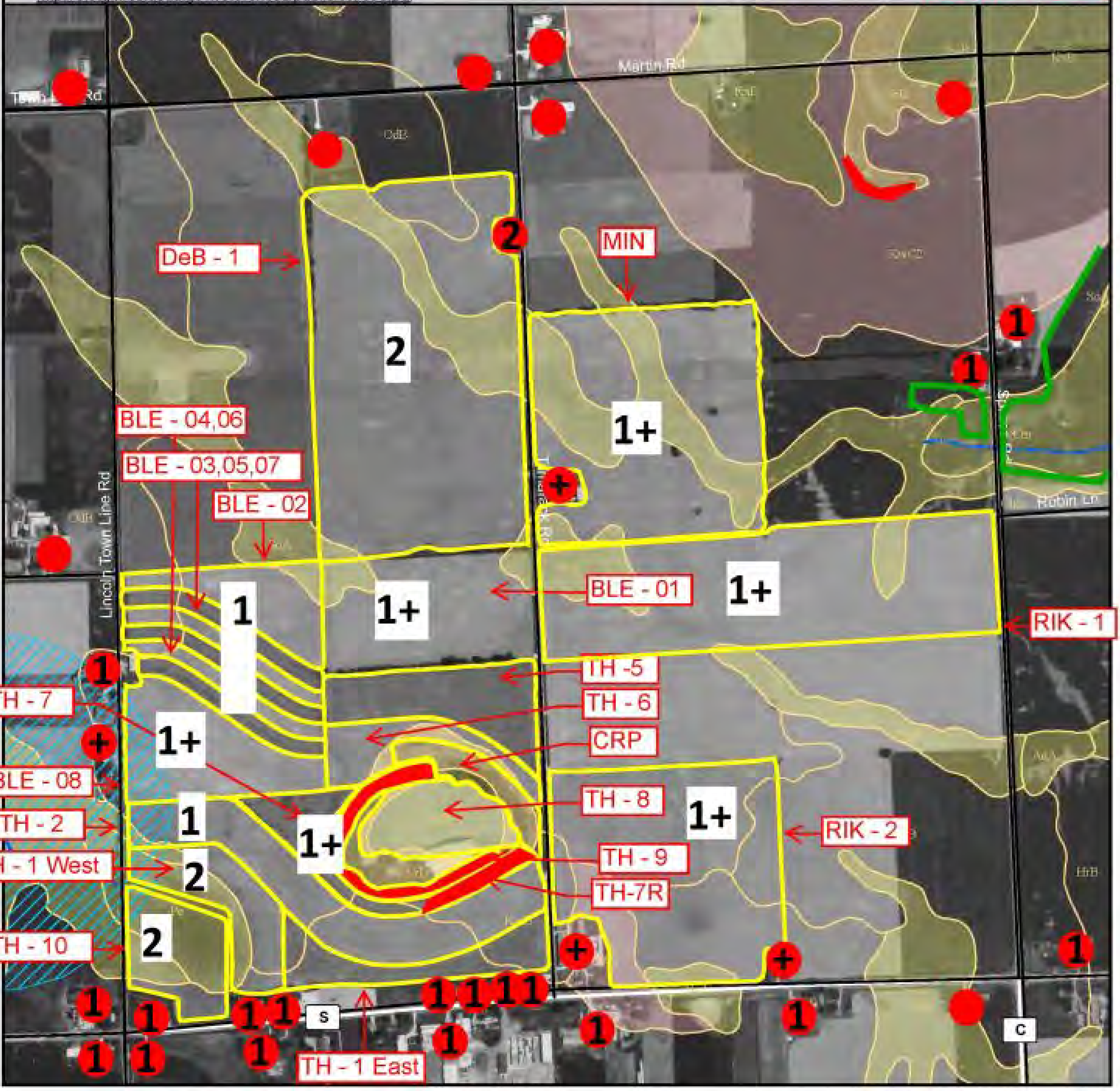
Wisconsin 590
Nutrient Management Application Restrictions

Fall N Restrictions
🟥 <24" to R Soils
No Winter Application (slope > 12%)
Winter Restrictions (if slope > 9%)
25' Setback Wetland
▨ SWQMA (No Winter Application, Other Non-Winter Restrictions)
Setback: 25' Incorp/Inject, 100' Surface
Perennial Streams
Intermittent Streams
Concentrated Flow Channels
☐ PLSS Sections
Field Border
Field Name
N
100' Setback
● Well
○ Conduit to Groundwater
0 750 1,500 Feet

Sources:
USDA-NRCS SSURGO
2005 NAIP imagery
W-DNR 24k Hydro
W DOT Roads

This map has been developed utilizing the nutrient application restrictions from the September 2005 Wisconsin NRCS 590 Nutrient Management Practice Standard. This map is an initial inventory of nutrient spreading risks which must be field verified to identify other risk areas such as concentrated flow channels, wetlands, and conduits to groundwater. See the "Considerations" section of the 590 practice standard for additional planning suggestions.
http://efotg.nrcs.usda.gov/references/public/WI/590.pdf

Revised 1.28.13

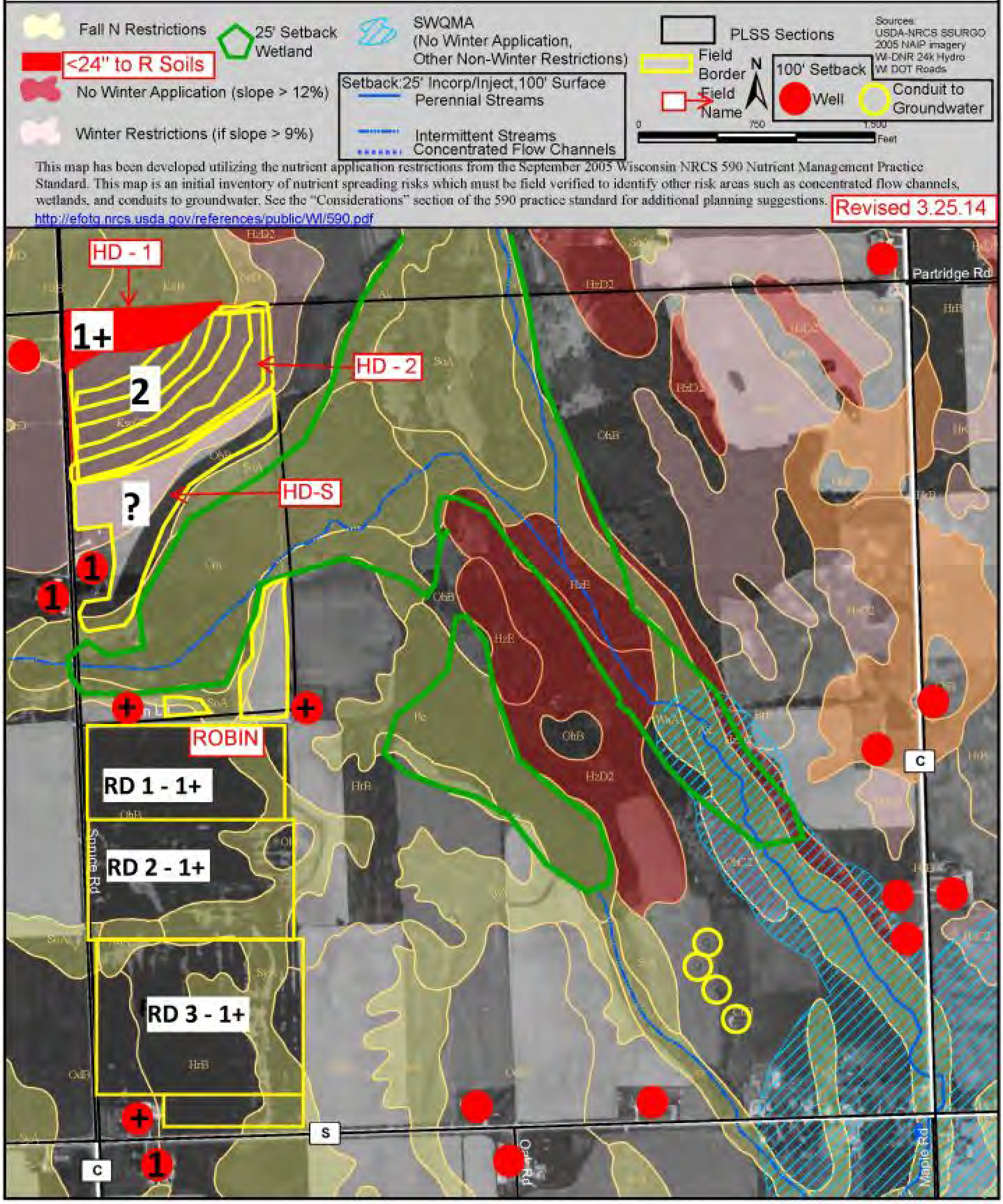


Lincoln Sec. 20 - Well Contamination Potential

T25N R24E
Section 20
Kewaunee Co.

Wisconsin 590
Nutrient Management Application Restrictions

1 = low potential
+ = high potential



This map has been developed utilizing the nutrient application restrictions from the September 2005 Wisconsin NRCS 590 Nutrient Management Practice Standard. This map is an initial inventory of nutrient spreading risks which must be field verified to identify other risk areas such as concentrated flow channels, wetlands, and conduits to groundwater. See the "Considerations" section of the 590 practice standard for additional planning suggestions.

http://efotg.nrcs.usda.gov/references/public/WI/590.pdf

Revised 3.25.14

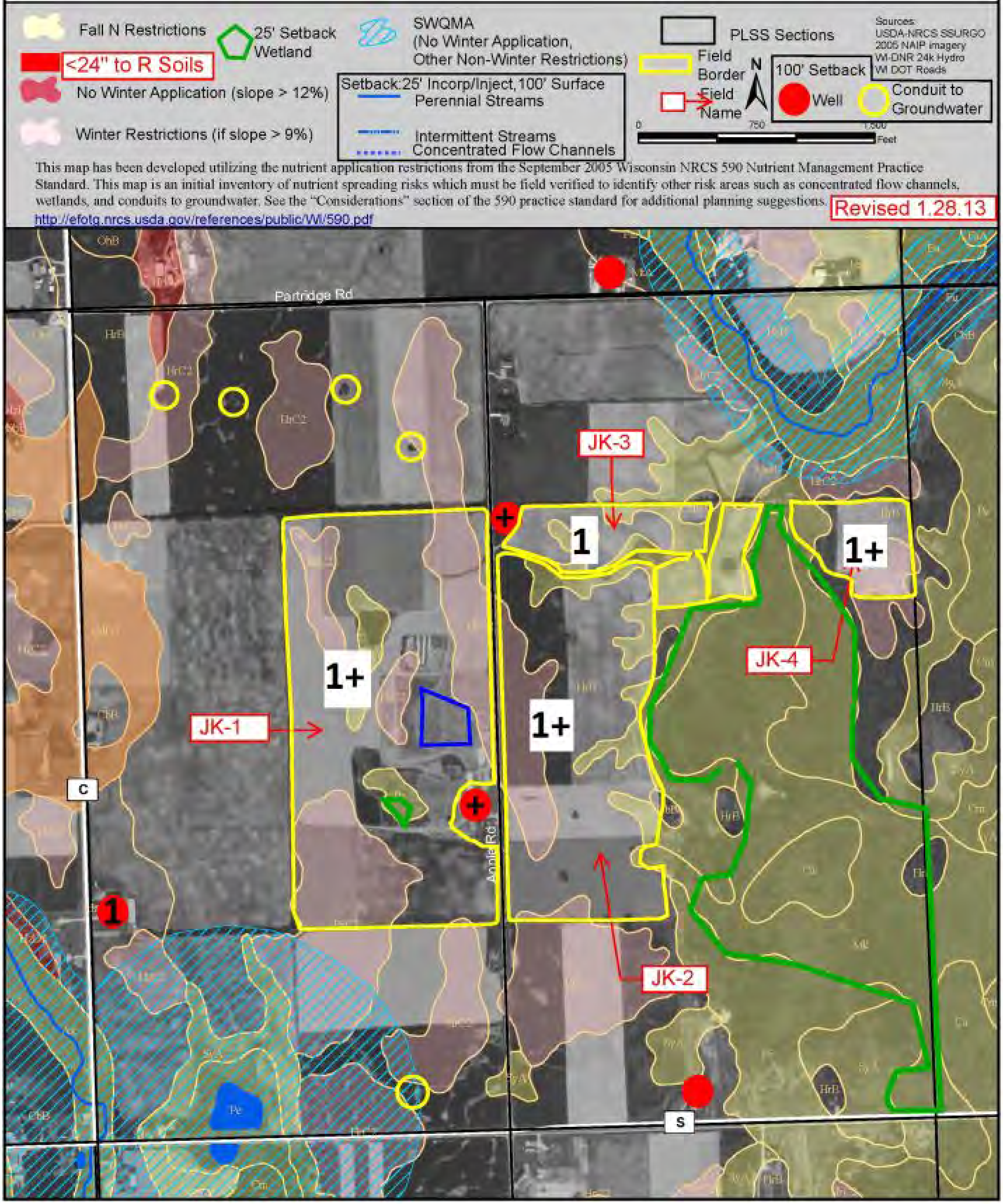
Lincoln Sec. 21 - Well Contamination Potential

1 = low potential

+ = high potential

T25N R24E
Section 21
Kewaunee Co.

Wisconsin 590
Nutrient Management Application Restrictions



This map has been developed utilizing the nutrient application restrictions from the September 2005 Wisconsin NRCS 590 Nutrient Management Practice Standard. This map is an initial inventory of nutrient spreading risks which must be field verified to identify other risk areas such as concentrated flow channels, wetlands, and conduits to groundwater. See the "Considerations" section of the 590 practice standard for additional planning suggestions.

http://efotg.nrcs.usda.gov/references/public/WI/590.pdf

Lincoln Sec. 28 - Well Contamination Potential

1 = low potential
+ = high potential

T25N R24E
Section 28
Kewaunee Co.

Wisconsin 590
Nutrient Management Application Restrictions

- Fall N Restrictions
- 🟥 <24" to R Soils
- No Winter Application (slope > 12%)
- Winter Restrictions (if slope > 9%)
- 25' Setback Wetland
- SWQMA (No Winter Application, Other Non-Winter Restrictions)
- Setback: 25' Incorp/Inject, 100' Surface
  - Perennial Streams
  - Intermittent Streams
  - Concentrated Flow Channels
- PLSS Sections
- Field Border
- Field Name
- 100' Setback
  - ● Well
  - ○ Conduit to Groundwater

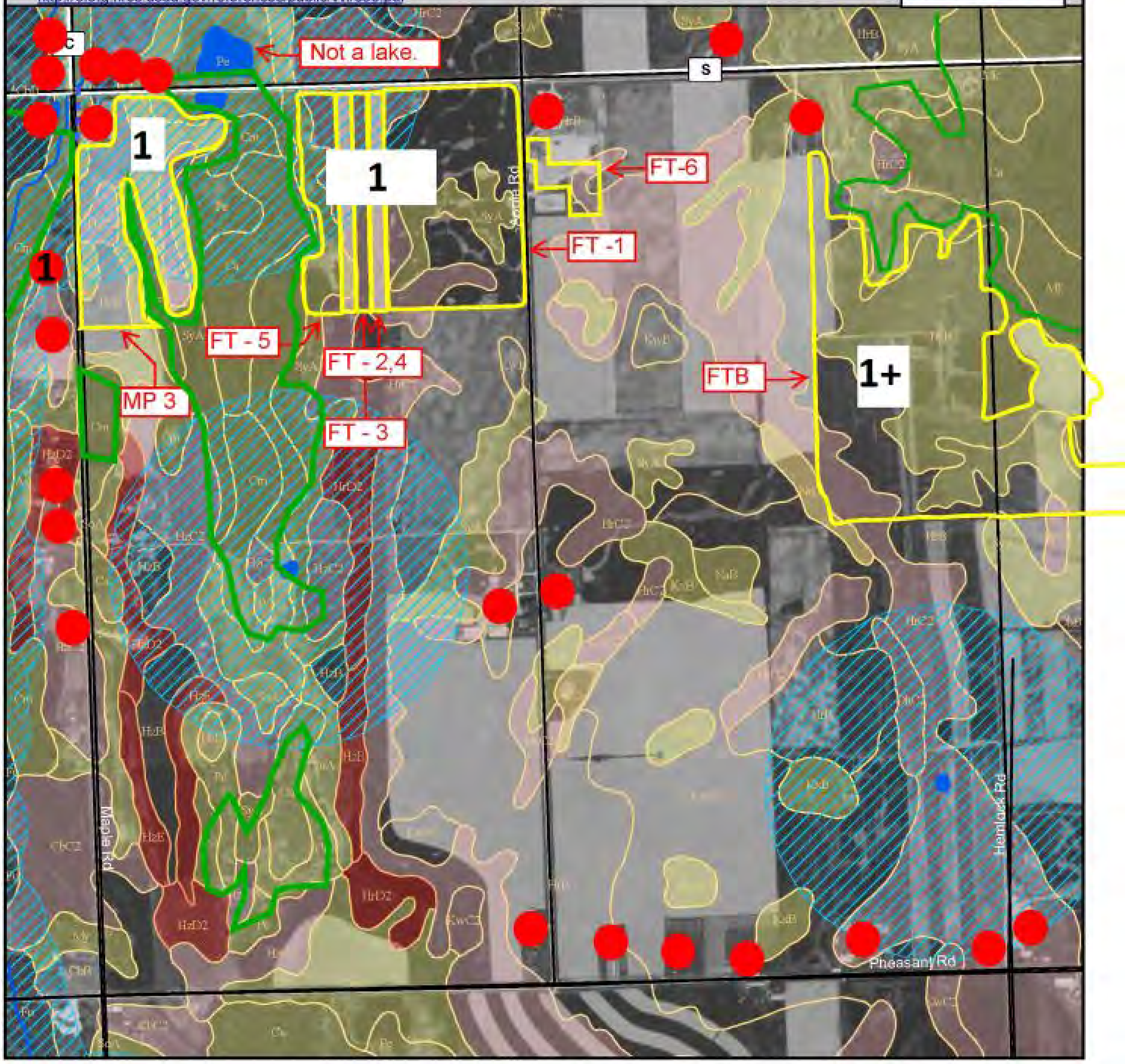
0 750 1,500 Feet

Sources:
USDA-NRCS SSURGO
2005 NAIP imagery
W-DNR 24k Hydro
W. DOT Roads

This map has been developed utilizing the nutrient application restrictions from the September 2005 Wisconsin NRCS 590 Nutrient Management Practice Standard. This map is an initial inventory of nutrient spreading risks which must be field verified to identify other risk areas such as concentrated flow channels, wetlands, and conduits to groundwater. See the "Considerations" section of the 590 practice standard for additional planning suggestions.

http://efotg.nrcs.usda.gov/references/public/WI/590.pdf

Map Revised 2/15/13



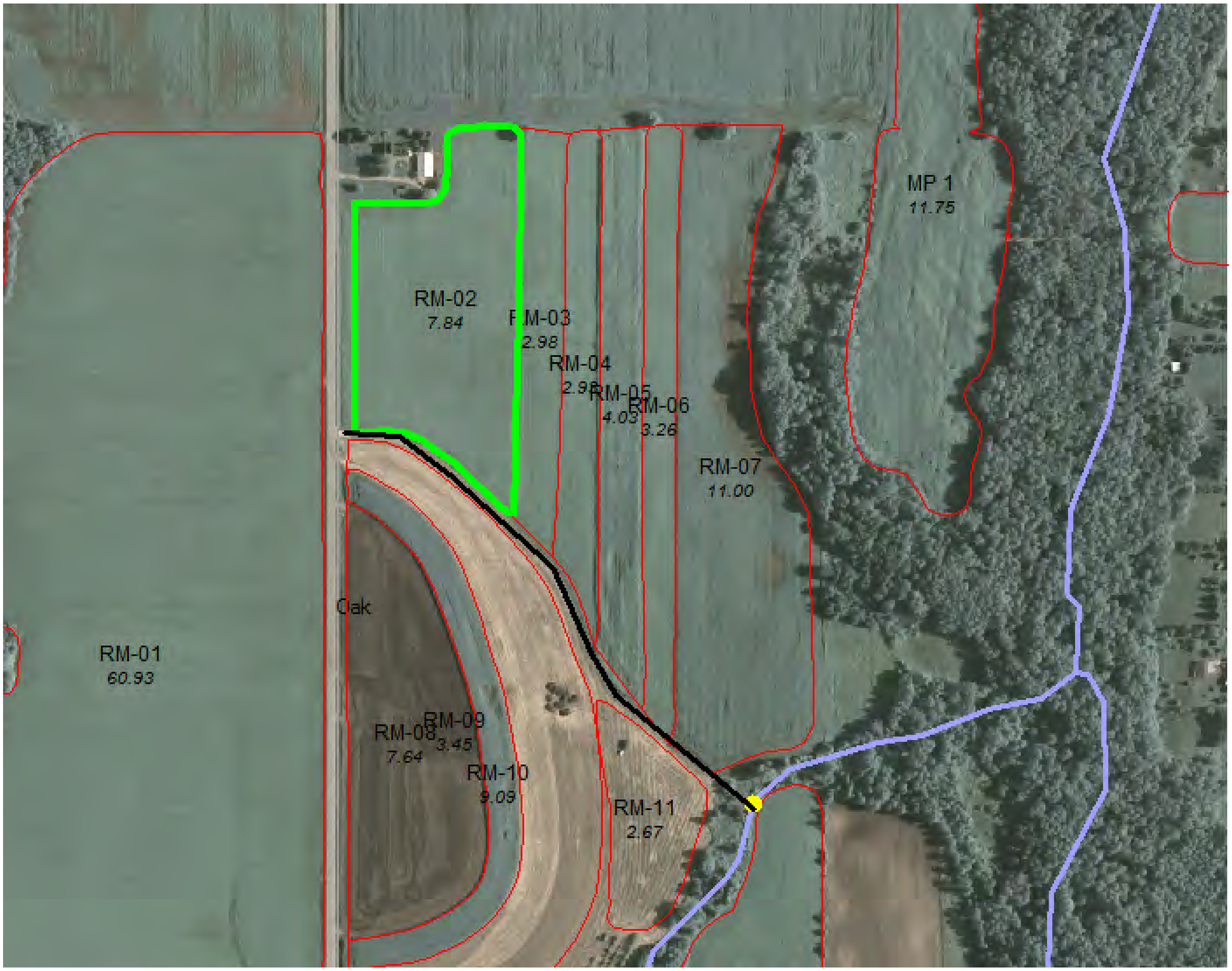
Lincoln Sec. 29 - Tile Map for Fields RM 2-7, Casco Cr.

Polenske Agronomic Consulting

Kinnard Farms Inc

Tile Map

Prepared For:	Kinnard Farms Inc	**Crop Zone:**	
Farm:	Rod & Maureen Kinnard	**Crop Year:**	
Field:	RM-02		
County:	Kewaunee, WI	**Prepared By:**	



Data Values

Attribute	Tile Outlet
Records	1
Empty	0
Average	
Min	
Max	

Tile Outlet

Lincoln Sec. 29 - Well Contamination Potential

1 = low potential
+ = high potential
X = Tile Outlet For Fields RM 2-7 @ Casco Cr.

T25N R24E
Section 29
Kewaunee Co.

Wisconsin 590
Nutrient Management Application Restrictions

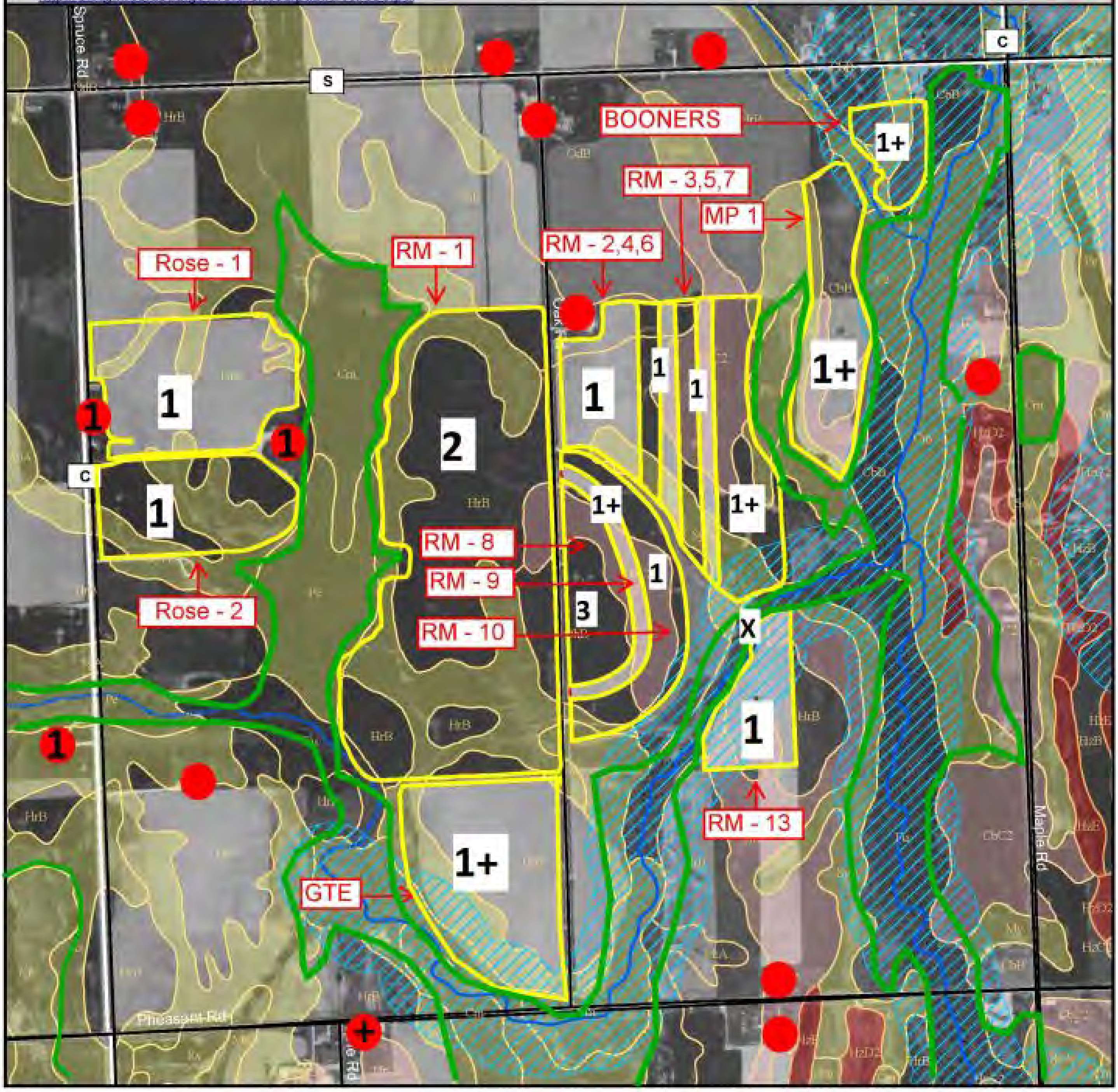
Fall N Restrictions
<24" to R Soils
No Winter Application (slope > 12%)
Winter Restrictions (if slope > 9%)
25' Setback Wetland
SWQMA (No Winter Application, Other Non-Winter Restrictions)
Setback:25' Incorp/Inject,100' Surface
Perennial Streams
Intermittent Streams
Concentrated Flow Channels
PLSS Sections
Field Border
Field Name
N
100' Setback
● Well
Conduit to Groundwater
0 750 1,500 Feet

Sources:
USDA-NRCS SSURGO
2005 NAIP imagery
WI-DNR 24k Hydro
WI DOT Roads

This map has been developed utilizing the nutrient application restrictions from the September 2005 Wisconsin NRCS 590 Nutrient Management Practice Standard. This map is an initial inventory of nutrient spreading risks which must be field verified to identify other risk areas such as concentrated flow channels, wetlands, and conduits to groundwater. See the "Considerations" section of the 590 practice standard for additional planning suggestions.

Revised 1.28.13

http://efotg.nrcs.usda.gov/references/public/WI/590.pdf



Lincoln Sec. 30 - Well Contamination Potential

1 = low potential

\+ = high potential

T25N R24E
Section 30
Kewaunee Co.

Wisconsin 590
Nutrient Management Application Restrictions

▨ Fall N Restrictions

🟥 <24" to R Soils

▨ No Winter Application (slope > 12%)

▨ Winter Restrictions (if slope > 9%)

⬠ 25' Setback Wetland

▨ SWQMA (No Winter Application, Other Non-Winter Restrictions)

Setback:25' Incorp/Inject,100' Surface
- Perennial Streams
- Intermittent Streams
- Concentrated Flow Channels

☐ PLSS Sections

☐ Field Border

☐ Field Name

N

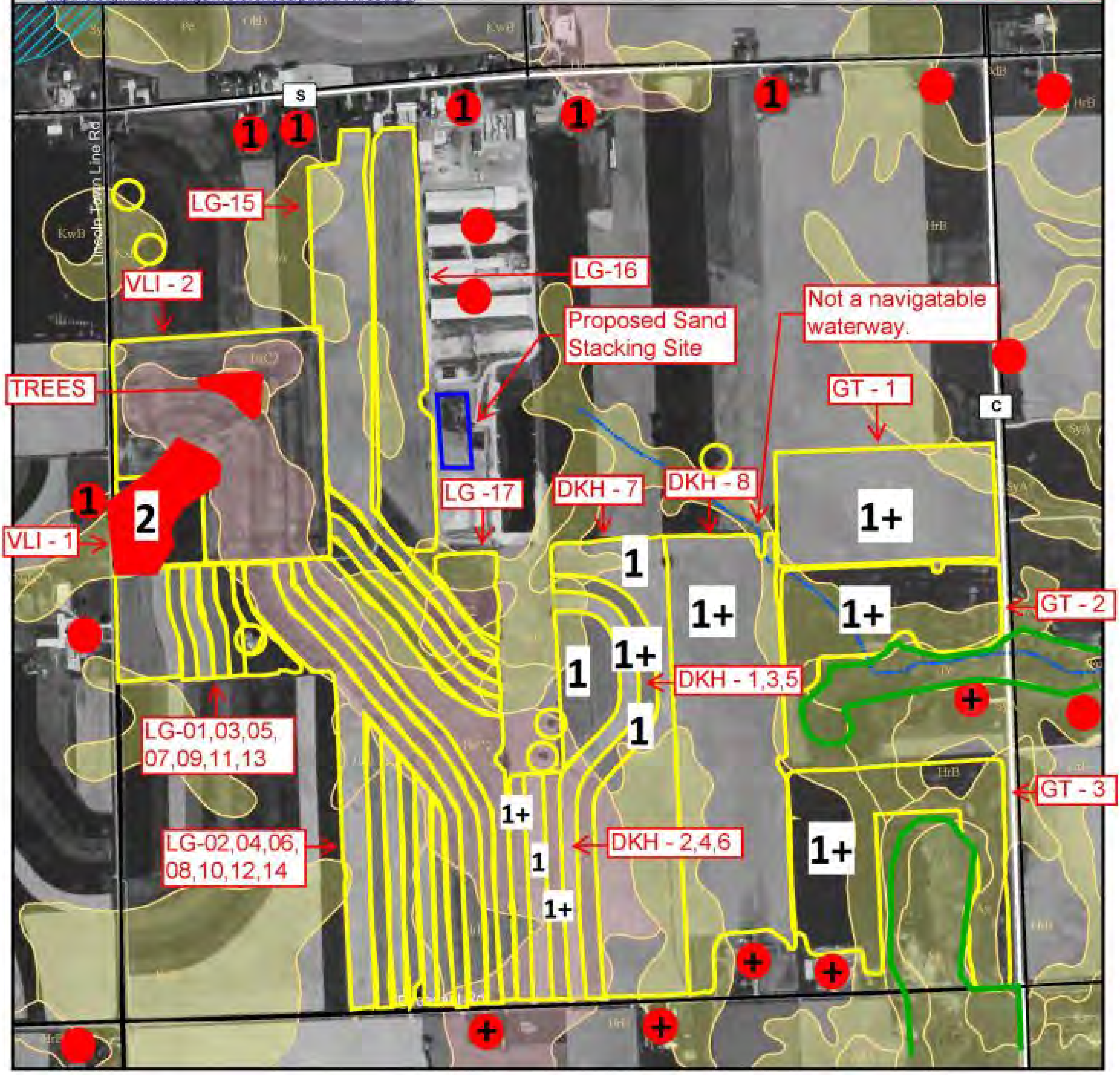
0 750 1,500 Feet

100' Setback
● Well
○ Conduit to Groundwater

Sources:
USDA-NRCS SSURGO
2005 NAIP imagery
W-DNR 24k Hydro
W DOT Roads

This map has been developed utilizing the nutrient application restrictions from the September 2005 Wisconsin NRCS 590 Nutrient Management Practice Standard. This map is an initial inventory of nutrient spreading risks which must be field verified to identify other risk areas such as concentrated flow channels, wetlands, and conduits to groundwater. See the "Considerations" section of the 590 practice standard for additional planning suggestions. http://efotg.nrcs.usda.gov/references/public/WI/590.pdf

Revised 1.28.13



Lincoln Sec. 31 - Well Contamination Potential

1 = low potential

+ = high potential

T25N R24E
Section 31
Kewaunee Co.

Wisconsin 590
Nutrient Management Application Restrictions

Fall N Restrictions

🟥 <24" to R Soils

No Winter Application (slope > 12%)

Winter Restrictions (if slope > 9%)

25' Setback Wetland

SWQMA (No Winter Application, Other Non-Winter Restrictions)

Setback:25' Incorp/Inject,100' Surface

Perennial Streams

Intermittent Streams

Concentrated Flow Channels

PLSS Sections

Field Border

Field Name

100' Setback

● Well

○ Conduit to Groundwater

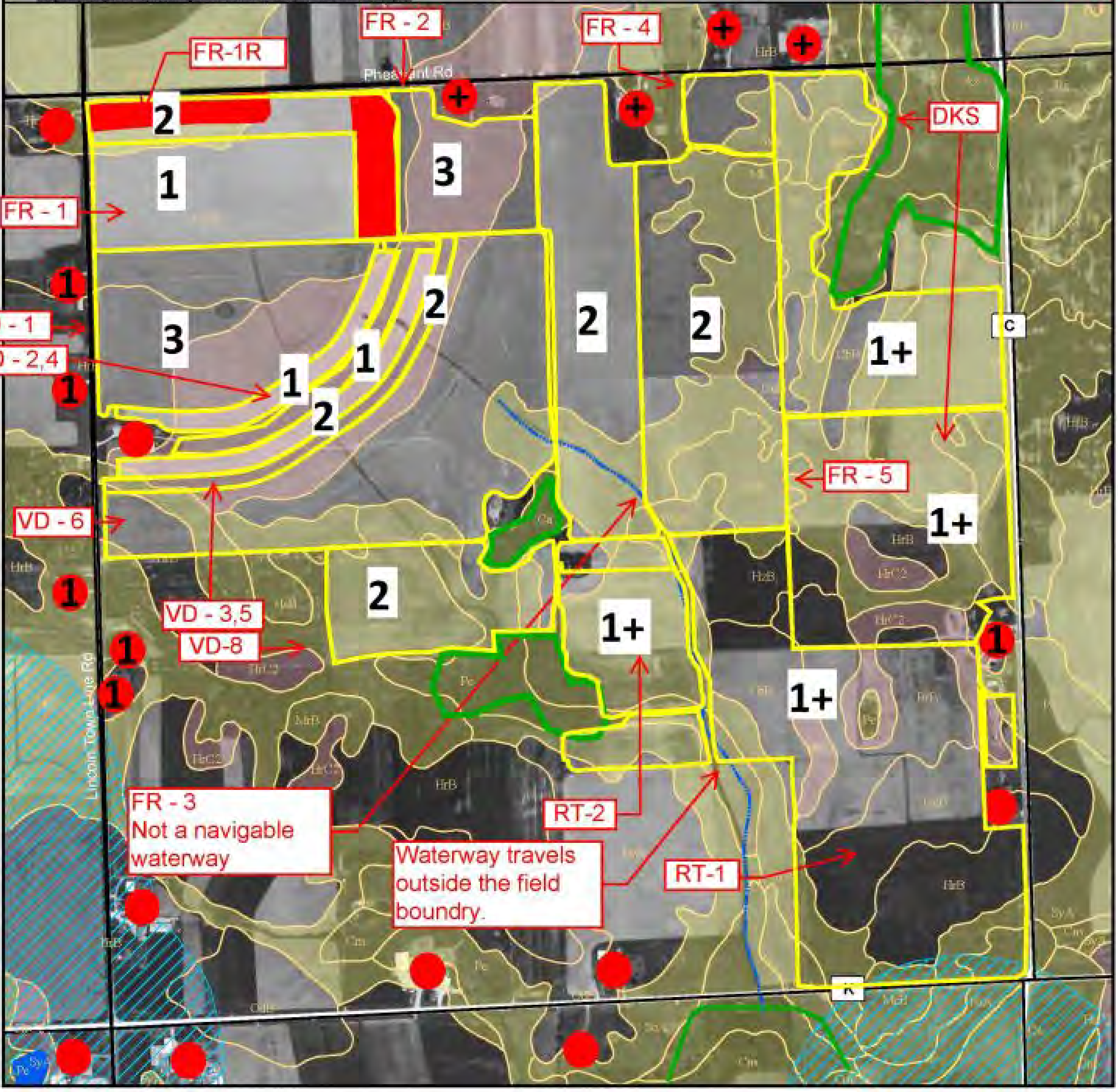
0 750 1,500 Feet

Sources:
USDA-NRCS SSURGO
2005 NAIP imagery
WI-DNR 24k Hydro
WI DOT Roads

This map has been developed utilizing the nutrient application restrictions from the September 2005 Wisconsin NRCS 590 Nutrient Management Practice Standard. This map is an initial inventory of nutrient spreading risks which must be field verified to identify other risk areas such as concentrated flow channels, wetlands, and conduits to groundwater. See the "Considerations" section of the 590 practice standard for additional planning suggestions.

http://efotg.nrcs.usda.gov/references/public/WI/590.pdf

Revised 1.28.13



Lincoln Sec. 32 - Well Contamination Potential

1 = low potential

+ = high potential

X = Tile Outlet for Field PP-3 at CTH "K"

T25N R24E
Section 32
Kewaunee Co.

Wisconsin 590
Nutrient Management Application Restrictions

Fall N Restrictions

🟥 <24" to R Soils

No Winter Application (slope > 12%)

Winter Restrictions (if slope > 9%)

25' Setback Wetland

SWQMA
(No Winter Application,
Other Non-Winter Restrictions)

Setback: 25' Incorp/Inject, 100' Surface
Perennial Streams
Intermittent Streams
Concentrated Flow Channels

PLSS Sections

Field Border

Field Name

N

0 750 1,500 Feet

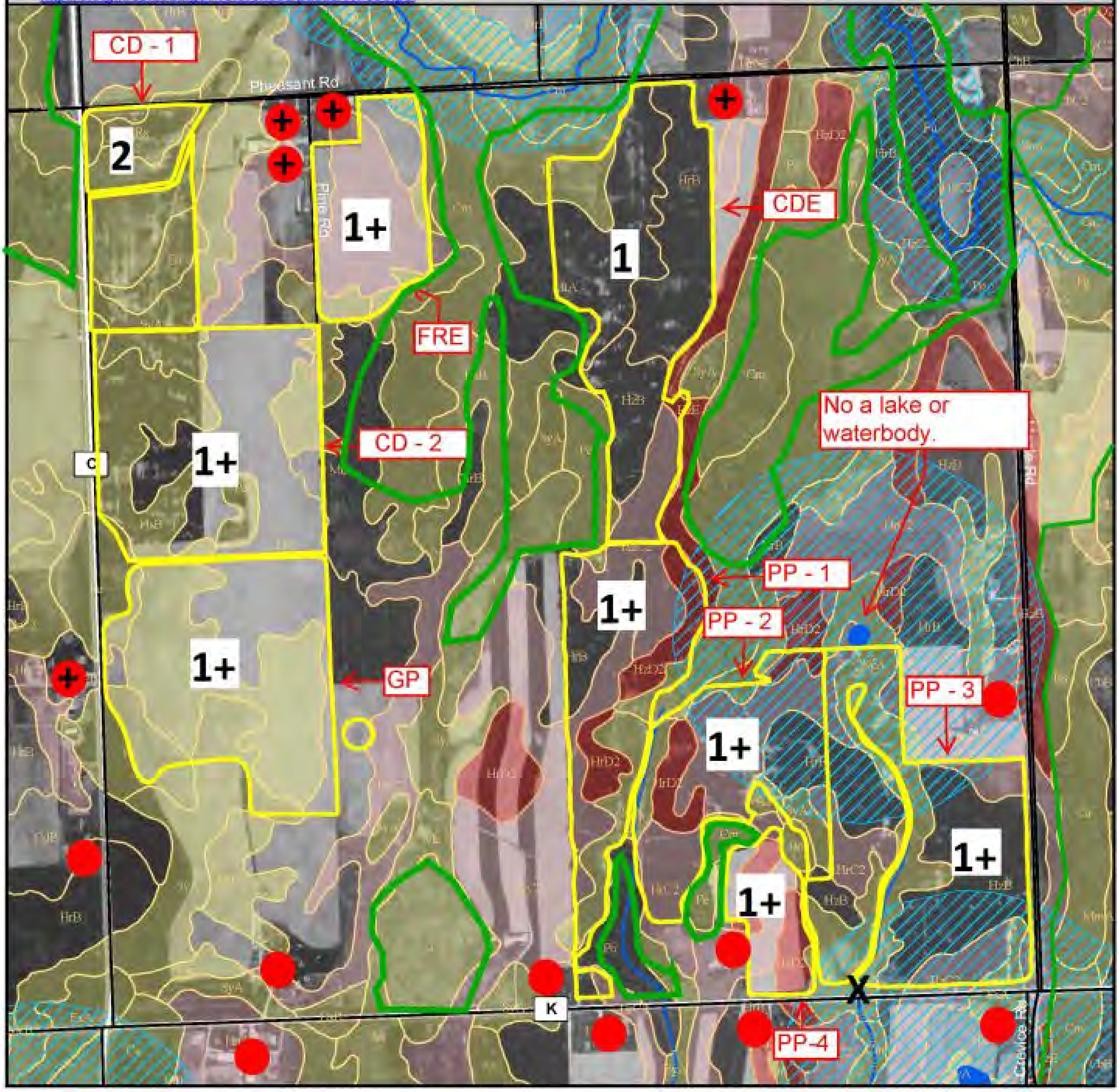
100' Setback
● Well
○ Conduit to Groundwater

Sources:
USDA-NRCS SSURGO
2005 NAIP imagery
W-DNR 24k Hydro
W. DOT Roads

This map has been developed utilizing the nutrient application restrictions from the September 2005 Wisconsin NRCS 590 Nutrient Management Practice Standard. This map is an initial inventory of nutrient spreading risks which must be field verified to identify other risk areas such as concentrated flow channels, wetlands, and conduits to groundwater. See the "Considerations" section of the 590 practice standard for additional planning suggestions.

Revised 1.28.13

http://efotg.nrcs.usda.gov/references/public/WI/590.pdf



Lincoln Sec. 32, Field PP-3 Tile Line Outlet

Polenske
Agronomic
Consulting

Kinnard Farms Inc

Tile Outlets

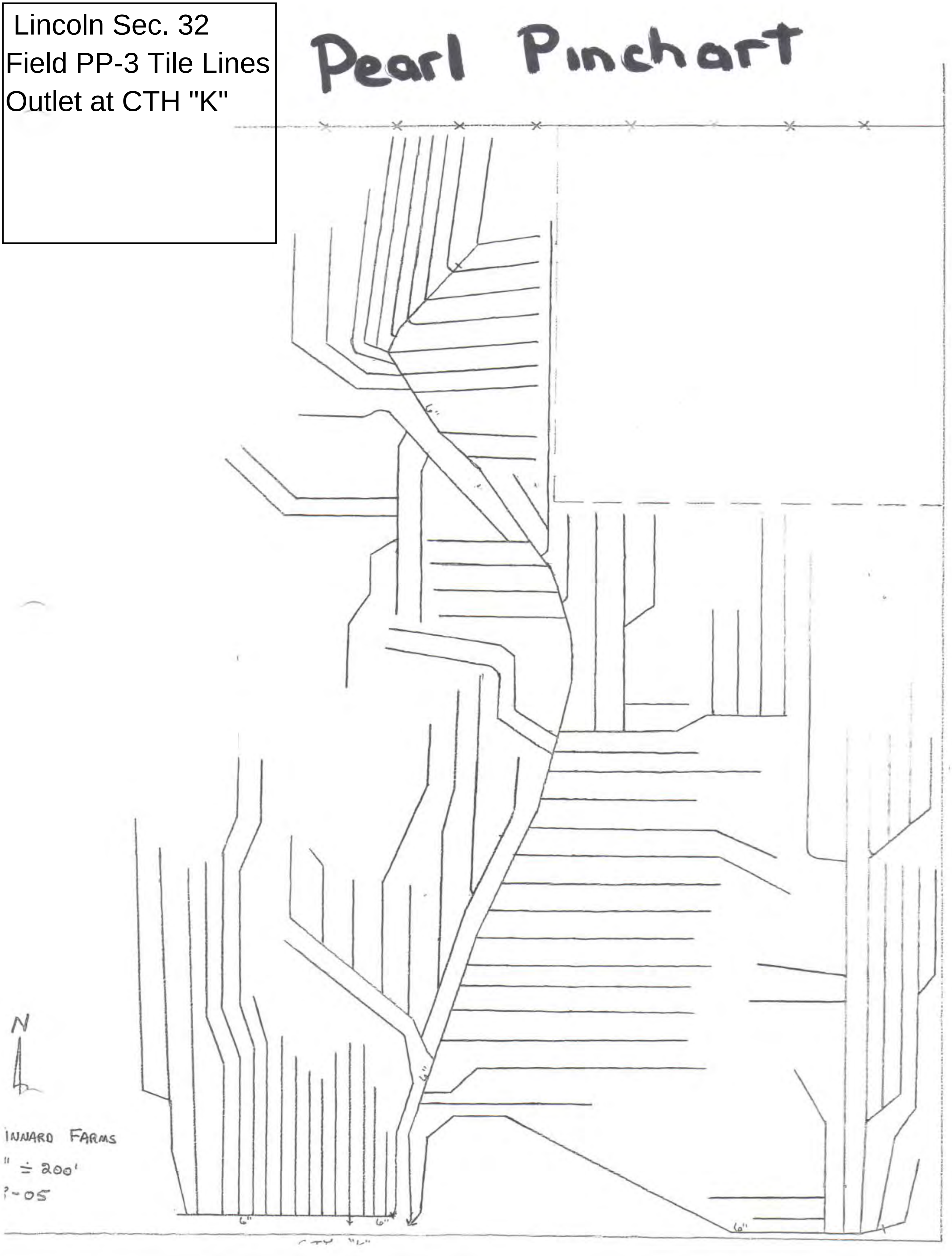
Prepared For:	Kinnard Farms Inc	**Crop Zone:**	
Farm:	Pearl Pinchart	**Crop Year:**	
Field:	PP - 2		
County:	Kewaunee, WI	**Prepared By:**	

Data Values

Attribute	Tile Outlet
Records	1
Empty	0
Average	
Min	
Max	

Tile Outlet

Lincoln Sec. 32
Field PP-3 Tile Lines
Outlet at CTH "K"

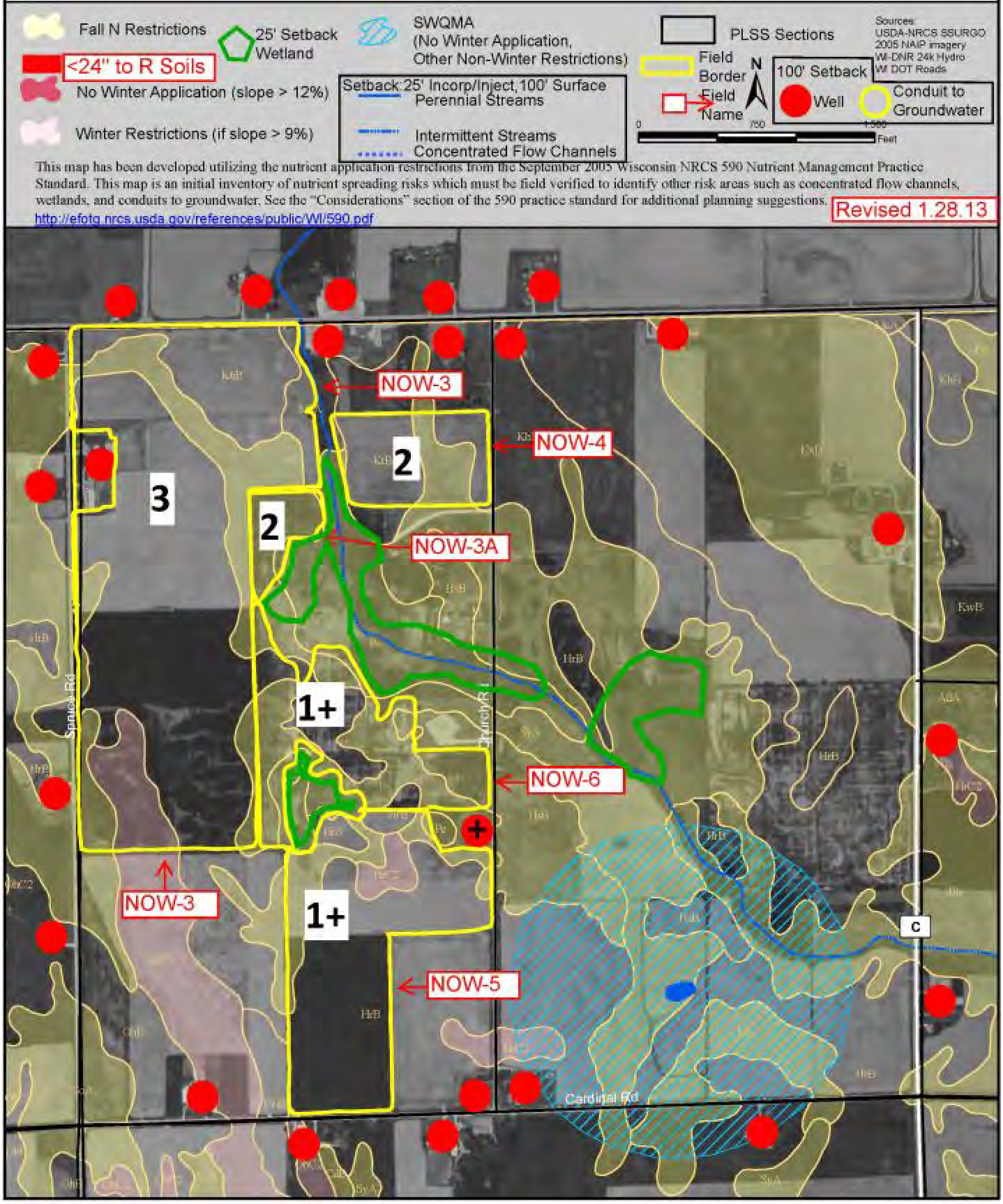


Lincoln Sec. 5 - Well Contamination Potential

T25N R24E
Section 5
Kewaunee Co.

Wisconsin 590
Nutrient Management Application Restrictions

1 = low potential
+ = high potential



This map has been developed utilizing the nutrient application restrictions from the September 2005 Wisconsin NRCS 590 Nutrient Management Practice Standard. This map is an initial inventory of nutrient spreading risks which must be field verified to identify other risk areas such as concentrated flow channels, wetlands, and conduits to groundwater. See the "Considerations" section of the 590 practice standard for additional planning suggestions.

Revised 1.28.13

http://efotg.nrcs.usda.gov/references/public/WI/590.pdf

Lincoln Sec. 6 - Well ContaminationPotential

T25N R24E
Section 6
Kewaunee Co.

Wisconsin 590
Nutrient Management Application R

1 = low potential
+ = high potential

- Fall N Restrictions
- 25' Setback Wetland
- SWQMA (No Winter Application, Other Non-Winter Restrictions)
- PLSS Sections
- 🟥 <24" to R Soils
- No Winter Application (slope > 12%)
- Winter Restrictions (if slope > 9%)
- Setback:25' Incorp/Inject,100' Surface
  - Perennial Streams
  - Intermittent Streams
  - Concentrated Flow Channels
- Field Border
- Field Name
- 100' Setback
  - ● Well
  - ○ Conduit to Groundwater

N

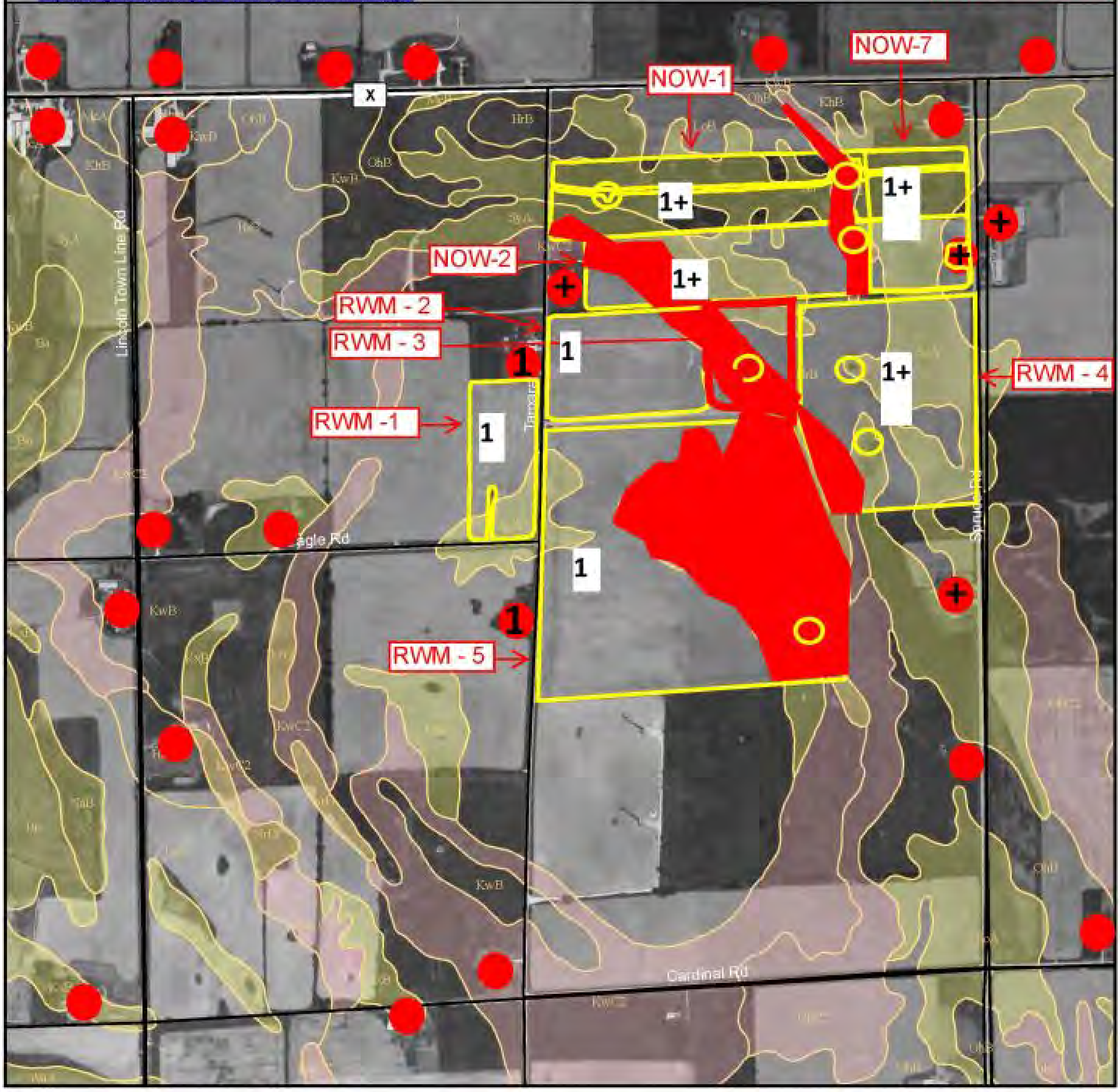
0 750 1,500 Feet

Sources:
USDA-NRCS SSURGO
2005 NAIP imagery
W-DNR 24k Hydro
W DOT Roads

This map has been developed utilizing the nutrient application restrictions from the September 2005 Wisconsin NRCS 590 Nutrient Management Practice Standard. This map is an initial inventory of nutrient spreading risks which must be field verified to identify other risk areas such as concentrated flow channels, wetlands, and conduits to groundwater. See the "Considerations" section of the 590 practice standard for additional planning suggestions.

http://efotg.nrcs.usda.gov/references/public/WI/590.pdf

Revised 1.28.13

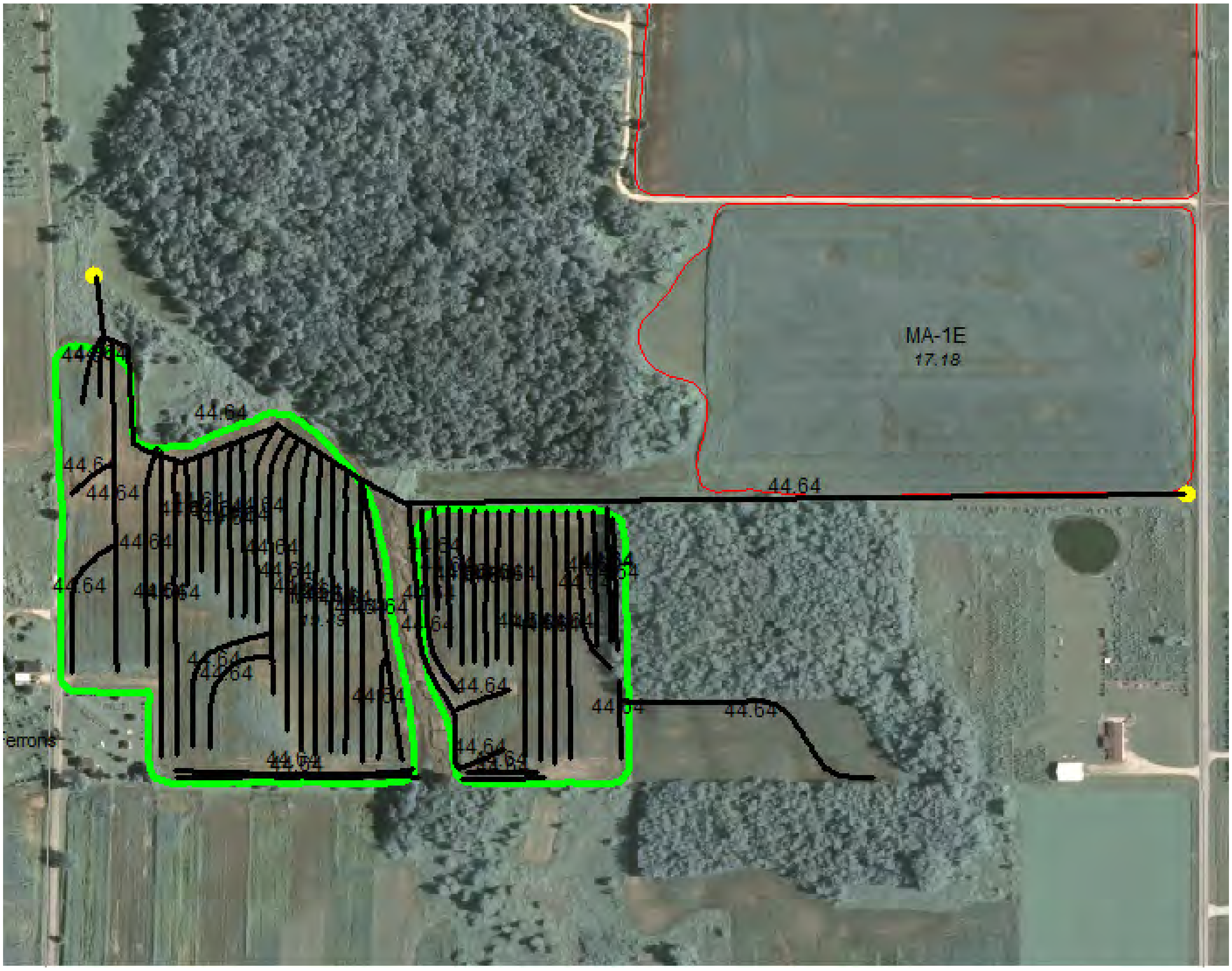


Red River Sec. 14 - Tile Map for Field MA-1W

Kinnard Farms Inc

Tile Map

Prepared For:	Kinnard Farms Inc	**Crop Zone:**	
Farm:	Mose Albert	**Crop Year:**	
Field:	MA-1W		
County:	Kewaunee, WI	**Prepared By:**	



Data Values

Attribute	Tile Outlet
Records	2
Empty	0
Average	
Min	
Max	

Tile Outlet

Red River Sec. 14 - Well Contamination Potential

1 = low potential

+ = high potential

X = Field MA-1W Tile Outlet

T25N R23E
Section 14
Kewaunee Co.

Wisconsin 590
Nutrient Management Application Restrictions

- 🟨 Fall N Restrictions
- 🟥 <24" to R Soils
- 🟥 No Winter Application (slope > 12%)
- 🟪 Winter Restrictions (if slope > 9%)
- ⬠ 25' Setback Wetland
- ▨ SWQMA (No Winter Application, Other Non-Winter Restrictions)
- Setback: 25' Incorp/Inject, 100' Surface
  - Perennial Streams
  - Intermittent Streams
  - Concentrated Flow Channels
- ☐ PLSS Sections
- 🟨 Field Border
- ☐→ Field Name
- 100' Setback
  - ● Well
  - ○ Conduit to Groundwater

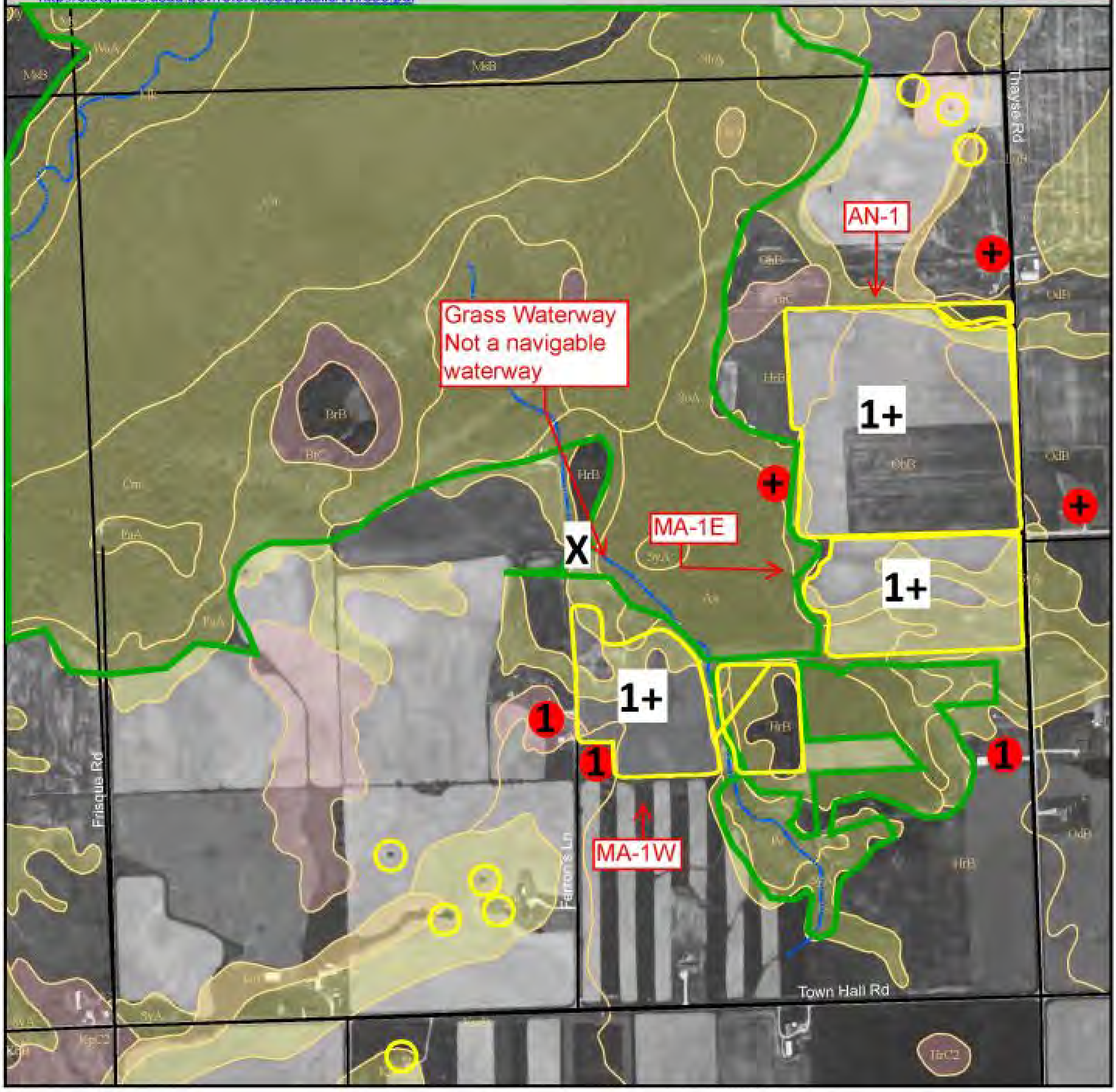
N

0 750 1,500 Feet

Sources:
USDA-NRCS SSURGO
2005 NAIP imagery
W-DNR 24k Hydro
WI DOT Roads

This map has been developed utilizing the nutrient application restrictions from the September 2005 Wisconsin NRCS 590 Nutrient Management Practice Standard. This map is an initial inventory of nutrient spreading risks which must be field verified to identify other risk areas such as concentrated flow channels, wetlands, and conduits to groundwater. See the "Considerations" section of the 590 practice standard for additional planning suggestions. http://efotg.nrcs.usda.gov/references/public/WI/590.pdf

Revised 1.28.13



Red River Sec. 22 - Well Contamination Potential

1 = low potential

+ = high potential

T25N R23E
Section 22
Kewaunee Co.

Wisconsin 590
Nutrient Management Application Restrictions

- Fall N Restrictions
- <24" to R Soils
- No Winter Application (slope > 12%)
- Winter Restrictions (if slope > 9%)
- 25' Setback Wetland
- SWQMA (No Winter Application, Other Non-Winter Restrictions)
- Setback:25' Incorp/Inject,100' Surface
  - Perennial Streams
  - Intermittent Streams
  - Concentrated Flow Channels
- PLSS Sections
- Field Border
- Field Name
- 100' Setback
  - Well
  - Conduit to Groundwater

N

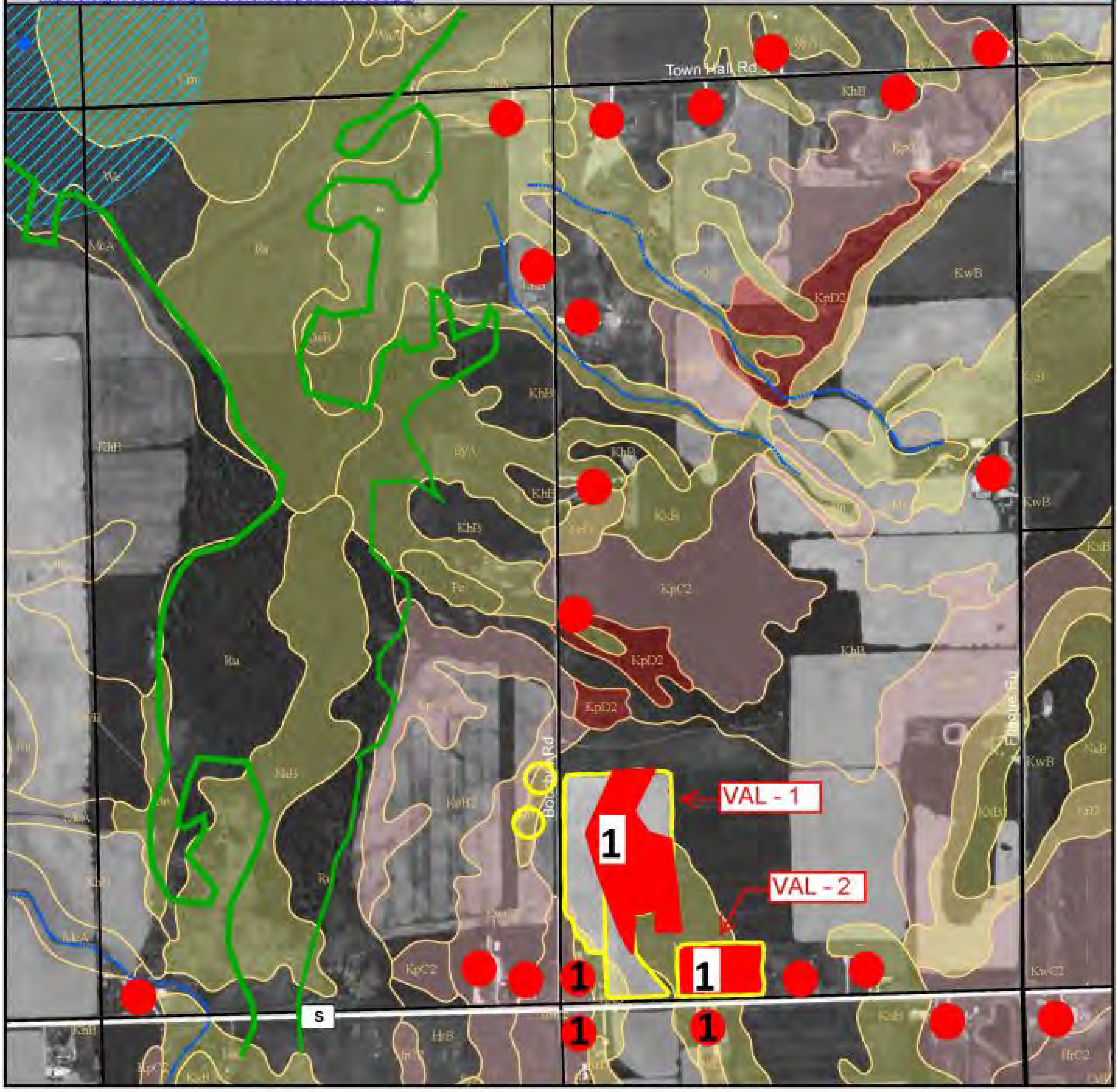
0 750 1,500 Feet

Sources:
USDA-NRCS SSURGO
2005 NAIP imagery
W-DNR 24k Hydro
W DOT Roads

This map has been developed utilizing the nutrient application restrictions from the September 2005 Wisconsin NRCS 590 Nutrient Management Practice Standard. This map is an initial inventory of nutrient spreading risks which must be field verified to identify other risk areas such as concentrated flow channels, wetlands, and conduits to groundwater. See the "Considerations" section of the 590 practice standard for additional planning suggestions.

Revised 1.28.13

http://efotg.nrcs.usda.gov/references/public/WI/590.pdf



Red River Sec. 24 - Well Contamination Potential

1 = low potential

+ = high potential

T25N R23E
Section 24
Kewaunee Co.

Wisconsin 590
Nutrient Management Application Restrictions

- 🟨 Fall N Restrictions
- ⬠ 25' Setback Wetland
- ▨ SWQMA (No Winter Application, Other Non-Winter Restrictions)
- ☐ PLSS Sections
- 🟥 <24" to R Soils
- No Winter Application (slope > 12%)
- Winter Restrictions (if slope > 9%)
- Setback: 25' Incorp/Inject, 100' Surface
  - Perennial Streams
  - Intermittent Streams
  - Concentrated Flow Channels
- Field Border
- Field Name
- 100' Setback: ● Well ○ Conduit to Groundwater

N

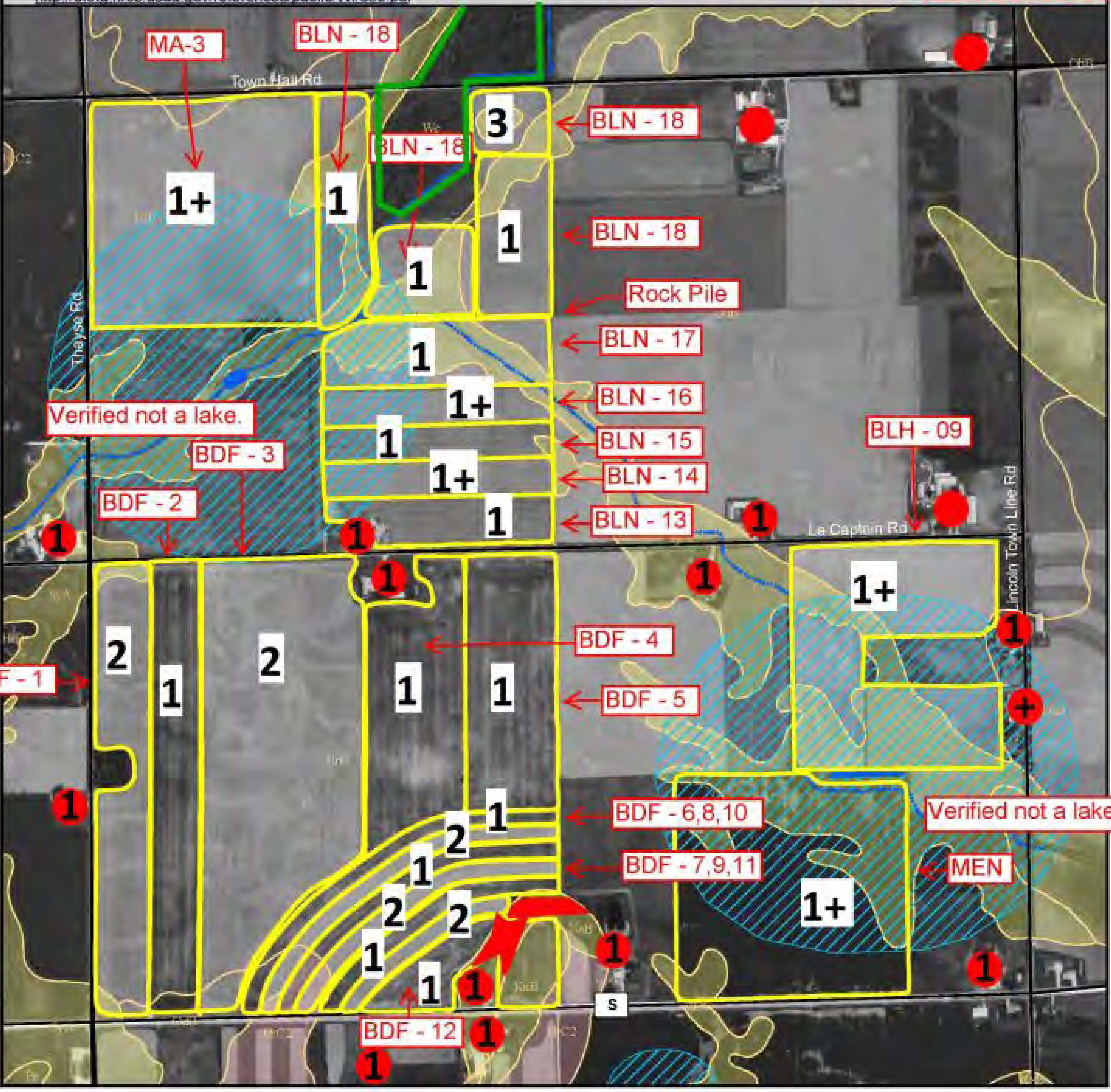
0 750 1,500 Feet

Sources:
USDA-NRCS SSURGO
2005 NAIP imagery
W-DNR 24k Hydro
W DOT Roads

This map has been developed utilizing the nutrient application restrictions from the September 2005 Wisconsin NRCS 590 Nutrient Management Practice Standard. This map is an initial inventory of nutrient spreading risks which must be field verified to identify other risk areas such as concentrated flow channels, wetlands, and conduits to groundwater. See the "Considerations" section of the 590 practice standard for additional planning suggestions.

http://efotg.nrcs.usda.gov/references/public/WI/590.pdf

Revised 1.28.13



Red River Sec. 25 - Tile Lines for Field RR

Polenske
Agronomic
Consulting

Kinnard Farms Inc

Tile Lines

Prepared For: Kinnard Farms Inc
Farm: Kinnard Farms Inc.
Field: RR
County: Kewaunee, WI

Crop Zone:
Crop Year:

Prepared By:

Data Values

Attribute	Tile Outlet
Records	1
Empty	0
Average	
Min	
Max	

Tile Outlet

Produced with EASi Suite

Mar 21, 2013

Red River Sec. 25 - Well Contamination Potential

1 = low potential

+ = high potential

X = Tile Outlet from Field RR

T25N R23E
Section 25
Kewaunee Co.

Wisconsin 590
Nutrient Management Application Restrictions

- Fall N Restrictions
- <24" to R Soils
- No Winter Application (slope > 12%)
- Winter Restrictions (if slope > 9%)
- 25' Setback Wetland
- SWQMA (No Winter Application, Other Non-Winter Restrictions)
- Setback: 25' Incorp/Inject, 100' Surface
  - Perennial Streams
  - Intermittent Streams
  - Concentrated Flow Channels
- PLSS Sections
- Field Border
- Field Name
- 100' Setback
  - ● Well
  - ○ Conduit to Groundwater

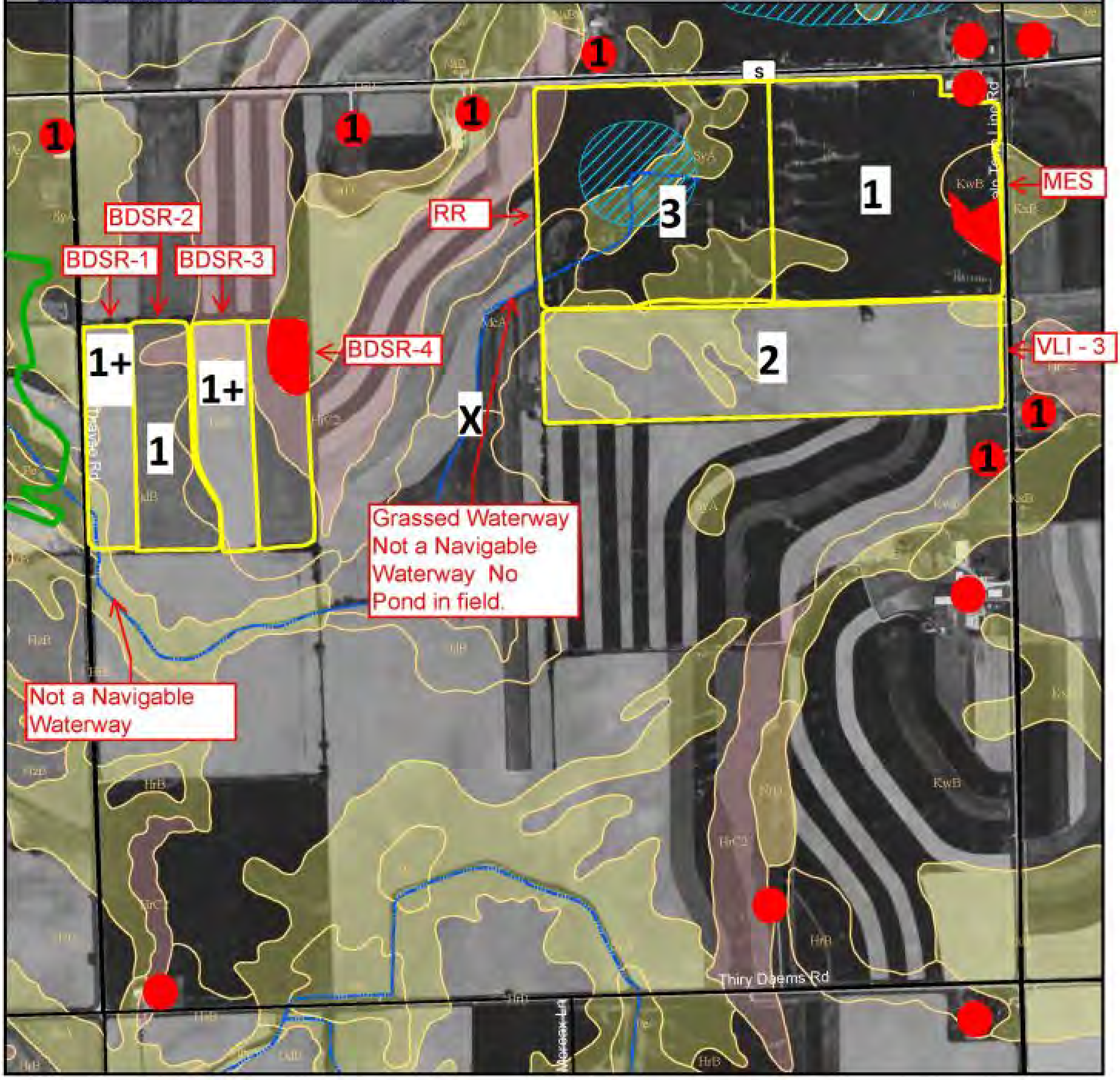
0 750 1,500 Feet

Sources:
USDA-NRCS SSURGO
2005 NAIP imagery
W-DNR 24k Hydro
W DOT Roads

This map has been developed utilizing the nutrient application restrictions from the September 2005 Wisconsin NRCS 590 Nutrient Management Practice Standard. This map is an initial inventory of nutrient spreading risks which must be field verified to identify other risk areas such as concentrated flow channels, wetlands, and conduits to groundwater. See the "Considerations" section of the 590 practice standard for additional planning suggestions.

Revised 1.28.13

http://efotg.nrcs.usda.gov/references/public/WI/590.pdf



Grassed Waterway Not a Navigable Waterway No Pond in field.

Not a Navigable Waterway

Red River Sec. 26 - Tile Lines for Field Jadin 01

Polenske
Agronomic
Consulting

Kinnard Farms Inc

Tile Map

Prepared For:	Kinnard Farms Inc	**Crop Zone:**	
Farm:	Jadin Farm	**Crop Year:**	
Field:	Jadin-01		
County:	Kewaunee, WI	**Prepared By:**	

Data Values

Attribute	Tile Outlet
Records	1
Empty	0
Average	
Min	
Max	

Tile Outlet

Red River Sec. 27 - Well Contamination Potential

1 = low potential
+ = high potential

T25N R23E
Section 27
Kewaunee Co.

Wisconsin 590
Nutrient Management Application Restrictions

- Fall N Restrictions
- 🟥 <24" to R Soils
- No Winter Application (slope > 12%)
- Winter Restrictions (if slope > 9%)
- 25' Setback Wetland
- ▨ SWQMA (No Winter Application, Other Non-Winter Restrictions)
- Setback: 25' Incorp/Inject, 100' Surface
  - Perennial Streams
  - Intermittent Streams
  - Concentrated Flow Channels
- PLSS Sections
- Field Border
- Field Name
- 100' Setback
  - ● Well
  - ○ Conduit to Groundwater

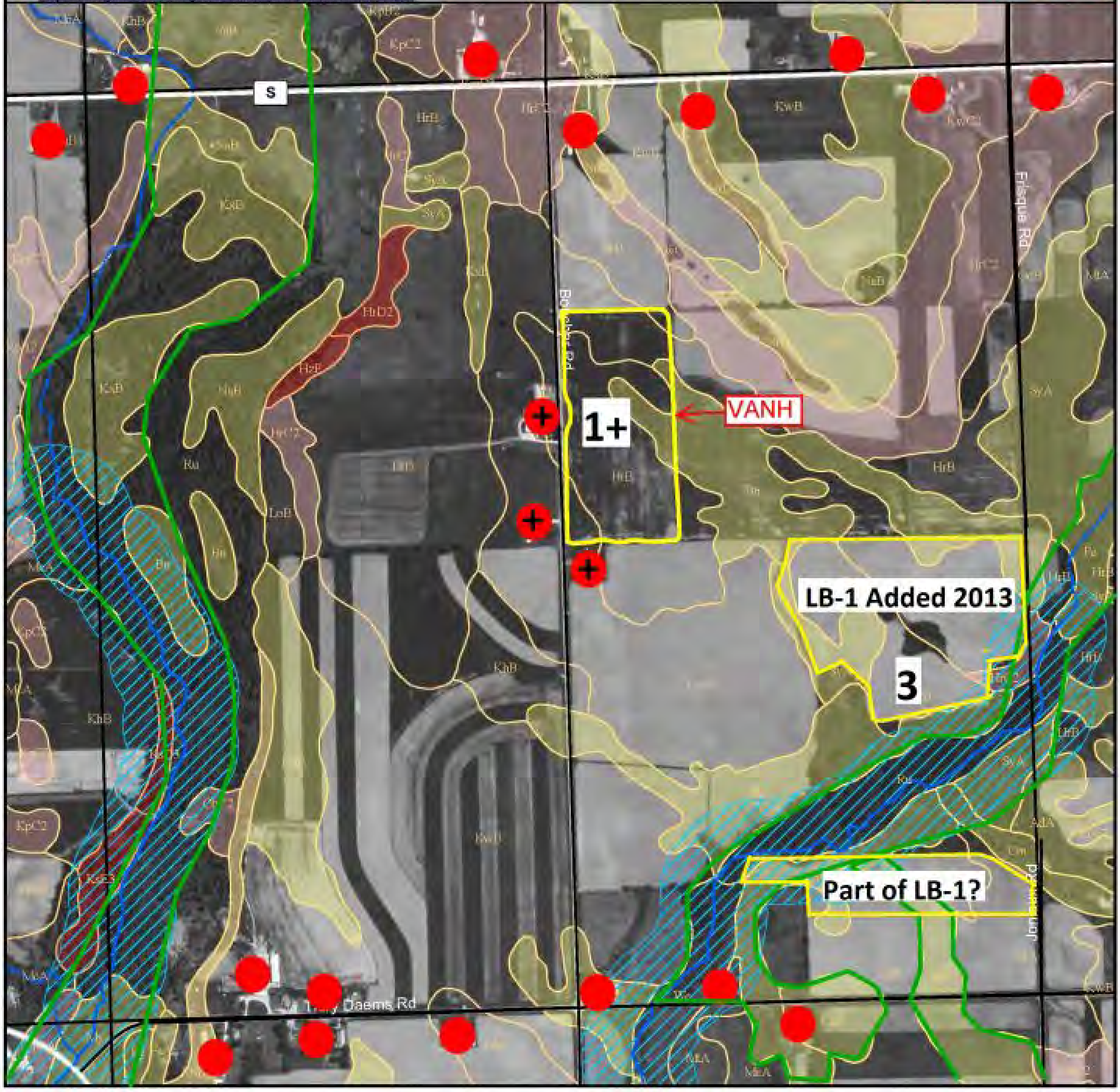
N

0 750 1,500 Feet

Sources:
USDA-NRCS SSURGO
2005 NAIP imagery
W-DNR 24k Hydro
WI DOT Roads

This map has been developed utilizing the nutrient application restrictions from the September 2005 Wisconsin NRCS 590 Nutrient Management Practice Standard. This map is an initial inventory of nutrient spreading risks which must be field verified to identify other risk areas such as concentrated flow channels, wetlands, and conduits to groundwater. See the "Considerations" section of the 590 practice standard for additional planning suggestions. Revised 1.28.13

http://efotg.nrcs.usda.gov/references/public/WI/590.pdf



Kinnard Farms - Spreadable Acres & Nutrient Applications 2010 - 2014 - Lincoln & Red River Townships

Field Name	Township	Map #	Spreadable Acres	2010 Manure N -lbs./A	2010 Chemical + Legume Credit N-lbs./A	2011 Manure N-lbs./A	2011 Chemical + Legume Credit N-lbs./A	2012 Manure N-lbs./A	2012 Chemical + Legume Credit N-lbs./A	2013 Manure N-lbs./A	2013 Chemical + Legume Credit N-lbs./A	Manure Total N-lbs./A	Chemical + Legume Credit Total N-lbs./A	Nutrient Total N-lbs./A	Groundwater Contamination Potential Score (See Below)
AN-1	Red River	25-23-14	37.37		145	206	56	530			50	736	251	987	1+
BD-1,3	Red River	25-23-26	33.5	224		215	90		123	67		506	213	719	1+
BD-2,4 [#1]	Red River	25-23-26	36.7	458								458	0	458	1+
BD-5 (BD-05)	Red River	25-23-26	30			317		556				873	0	873	1+
BDF-01	Red River	25-23-24	17.1								124	0	124	124	2
BDF-02	Red River	25-23-24	16.8			291						291	0	291	1
BDF-03	Red River	25-23-24	45.5								124	0	124	124	2
BDF-04	Red River	25-23-24	18.2			291						291	0	291	1
BDF-05	Red River	25-23-24	17.6			291						291	0	291	1
BDF-06	Red River	25-23-24	4.8			279						279	0	279	1
BDF-07	Red River	25-23-24	4.7								124	0	124	124	2
BDF-08 [#10]	Red River	25-23-24	4.3			233						233	0	233	1
BDF-09	Red River	25-23-24	4.2								124	0	124	124	2
BDF-10	Red River	25-23-24	3.6			209						209	0	209	1
BDF-11	Red River	25-23-24	2.6								124	0	124	124	2
BDF-12	Red River	25-23-24	4.4			163						163	0	163	1
BDSR-1	Red River	25-23-25	8.1					112	94	292		404	94	498	1+
BDSR-2	Red River	25-23-25	11.5	337							94	337	94	431	1
BDSR-3	Red River	25-23-25	8.9					119	94	266		385	94	479	1+
BDSR-4	Red River	25-23-25	6.6	337							94	337	94	431	1
BE-1, 004-BE-1 in 2013	Lincoln	25-24-07	13.5			252	86					252	86	338	1
BLE-1	Lincoln	25-24-19	17.5		146	163	56	70	63	343	4	576	269	845	1+
BLE-2	Lincoln	25-24-19	7.4			140	56	69				209	56	265	1
BLE-3	Lincoln	25-24-19	3.2	352							94	352	94	446	1
BLE-4	Lincoln	25-24-19	2.7		116	163	56	94				257	172	429	1
BLE-5	Lincoln	25-24-19	2.9	352							94	352	94	446	1
BLE-6	Lincoln	25-24-19	2.9		116	163	56	88				251	172	423	1
BLE-7	Lincoln	25-24-19	2.9	352							194	352	194	546	1+
BLE-8	Lincoln	25-24-19	12		116	163	56	375				538	172	710	1+

BLH-09-12	Red River	25-23-24	28					166	94	370	4	536	98	634	1+
BLN-13	Red River	25-23-24	7.1	281							94	281	94	375	1
BLN-14	Red River	25-23-24	6.3		156	292	56	287				579	212	791	1+
BLN-15	Red River	25-23-24	6	281							94	281	94	375	1
BLN-16	Red River	25-23-24	6.6		156	292	56	287				579	212	791	1+
BLN-17	Red River	25-23-24	10.24						124	384	4	384	128	512	1
BLN-18	Red River	25-23-24	8.8						124	384	4	384	128	512	1
BLN-19	Red River	25-23-24	3.3									0	0	0	3
BLN-20	Red River	25-23-24	6.3									0	0	0	3
BLN-21	Red River	25-23-24	7.8									0	0	0	3
BOONERS	Lincoln	25-24-29	5	405		353	21				23	758	44	802	1+
CD-1	Lincoln	25-24-32	16.6				112		143		130	0	385	385	2
CD-2	Lincoln	25-24-32	36.6	237		148	95	222	4	357	4	964	103	1067	1+
CDE $^{\#2}$	Lincoln	25-24-32	37.7	470	30						38	470	68	538	1+
CT-1 added	Red RIver	25-23-?	7.3							363	34	363	34	397	1
DD-4	Red River	25-23-36	17.1		5	217	25	201	4	316		734	34	768	1+
DEB	Lincoln	25-24-19	57.1								124	0	124	124	2
DEC	Red River	25-23-21	30.2	404						263	94	667	94	761	1+
DKH-1	Lincoln	25-24-30	2.8		116	215		131				346	116	462	1
DKH-2	Lincoln	25-24-30	3.3			215	90	224	4	385	4	824	98	922	1+
DKH-3	Lincoln	25-24-30	2.8			215	90	235	4	385	4	835	98	933	1+
DKH-4	Lincoln	25-24-30	6.4		156	215					36	215	192	407	1
DKH-5	Lincoln	25-24-30	5.6			215	90	224		385	4	824	94	918	1+
DKH-6	Lincoln	25-24-30	6.9			215	90	199	4	385	4	799	98	897	1+
DKH-7	Lincoln	25-24-30	22		156	305					27	305	183	488	1
DKH-8	Lincoln	25-24-30	34.6					168	90	391	4	559	94	653	1+
DKS	Lincoln	25-24-31	29.6 (59,2012)	476					94	385	4	861	98	959	1+
DSB	Red River	25-23-04	37.8	413		115	90	255	4	339	51	1122	145	1267	1+
FR-1(FR-1 & FR1R, 2013)	Lincoln	25-24-31	26.9		116	189	26	216	4			405	146	551	1+
FR-1, add in 2013	Lincoln	25-24-31	21							353	4	353	4	357	1
FR-1R, add in 2013	Lincoln	25-24-31	12								130	0	130	130	2
FR-2	Lincoln	25-24-31	12.5									0	0	0	3
FR-3	Lincoln	25-24-31	28.2		17						124	0	141	141	2
FR-4	Lincoln	25-24-31	5.5		17						124	0	141	141	2
FR-5	Lincoln	25-24-31	39.2		17					42	124	42	141	183	1

FRE	Lincoln	25-24-32	15.1	344	26	212	56	579				1135	82	1217	1+
FT-1	Lincoln	25-24-28	23.5			232						232	0	232	1
FT-2	Lincoln	25-24-28	2.5					83	247		130	83	377	460	1
FT-3	Lincoln	25-24-28	2.6			233						233	0	233	1
FT-4	Lincoln	25-24-28	2.5					83	153		130	83	283	366	1
FT-5	Lincoln	25-24-28	5.6			260			176		18	260	194	454	1
FTB	Lincoln	25-24-27	51.2	456	5					289	34	745	39	784	1+
GP	Lincoln	25-24-32	35.8	237		148	95	222	4	351	4	958	103	1061	1+
GT-1	Lincoln	25-24-30	19.2	285	26	209						494	26	520	1+
GT-2	Lincoln	25-24-30	13.7	269	26	214		22				505	26	531	1+
GT-3	Lincoln	25-24-30	21.1		145		107	210	4	372	4	582	260	842	1+
GTE-1	Lincoln	25-24-29	19	506	26	223	56	588				1317	82	1399	1+
HD-1	Lincoln	25-24-20	10.1	212	26	333					30	545	56	601	1+
HD-2	Lincoln	25-24-20	9.2						94		130	0	224	224	2
JADIN-1	Red River	25-23-26	33.2		115		21	245		388	34	633	170	803	1+
JADIN-2	Red River	25-23-26	4.6		145		21	245			130	245	296	541	1
JADIN-3	Red River	25-23-26	8.1		145		21				130	0	296	296	2
JK-1	Lincoln	25-24-21	69	319	26	328	26	79	94	157	8	883	154	1037	1+
JK-2	Lincoln	25-24-21	65	319	26	257	26	340	42			916	94	1010	1+
JK-3	Lincoln	25-24-21	9.8	319	26		21		4			319	51	370	1
JK-4	Lincoln	25-24-21	8.5	319	26		21		123	291	4	610	174	784	1+
LB-1, add 2013	Red River	25-23-27	21.1								4	0	4	4	3
LCB, out 2013	Lincoln	25-24-17	18.8		115	328	5					328	120	448	Field Out
LCH-1, out 2013	Lincoln	25-24-19	38.4		115	282						282	115	397	Field Out
LCH-2, out 2013	Lincoln	25-24-19	11.8		100		21					0	121	121	Field Out
LCR-1, out 2013	Lincoln	25-24-18	14.1	187								187	0	187	Field Out
LCR-2, out 2013	Lincoln	25-24-18	29.7	187								187	0	187	Field Out
MA-1E	Red River	25-23-14	17	195	95	237	26	556				988	121	1109	1+
MA-1W	Red River	25-23-14	18.4	600	5		21	264	4		130	864	160	1024	1+
MA-3	Red River	25-23-24	38.5			336	26	210	4	335	51	881	81	962	1+
MEN $^{\#3}$	Red River	25-23-24	37.4	267		266	40					533	40	573	1+
MES $^{\#4}$	Red River	25-23-25	35.8	271								271	0	271	1
MIN	Lincoln	25-24-19	37.6			136		76	94	347	4	559	98	657	1+
MP-1	Lincoln	25-24-29	15.1	525		226	21				23	751	44	795	1+
MP-2	Lincoln	25-24-29	1.6									0	0	0	3

MP-3	Lincoln	25-24-28	20.2						124	290	4	290	128	418	1
NJ-1 #8	Red River	25-23-04	23.1	459		358					22	817	22	839	1+
NJ-2 #9	Red River	25-23-04	20.7	459		358					31	817	31	848	1+
NOW-1	Lincoln	25-24-06	14.3				126	215	4	454		669	130	799	1+
NOW-2	Lincoln	25-24-06	12				126	215	4	635		850	130	980	1+
NOW-3	Lincoln	25-24-05	91.5								28	0	28	28	2
NOW-3A	Lincoln	25-24-05	4.6						130			0	130	130	2
NOW-4 #5	Lincoln	25-24-05	12.5	282							124	282	124	406	1
NOW-5 #6	Lincoln	25-24-05	35.5	287				112			25	399	25	424	1
NOW-6,6A #7	Lincoln	25-24-05	22.3	287					94	278	4	565	98	663	1+
NOW-7	Lincoln	25-24-06	11.3					215	4	390		605	4	609	1+
PP-1	Lincoln	25-24-32	24.4 (34,2013)		6	152	116	223		352	4	727	126	853	1+
PP-2	Lincoln	25-24-32	23.3 (62,2013)		6	152	116	298				450	122	572	1+
PP-3	Lincoln	25-24-32	38.4	542	10	239	26					781	36	817	1+
PP-4	Lincoln	25-24-32	6.6	399	26	233	26					632	52	684	1+
RD-1	Lincoln	25-24-20	18.6	393		111					190	504	190	694	1+
RD-2-3	Lincoln	25-24-20	56.4	393		111					190	504	190	694	1+
RIK-1	Lincoln	25-24-19	77.2			136		17		318	4	471	4	475	1+
RIK-2	Lincoln	25-24-19	32.9			136		41		373	4	550	4	554	1+
RK-1 (ROSE-1 in 2011)	Lincoln	25-24-29	17.8						94	346	54	346	148	494	1
RK-2(ROSE-2 in 2011)	Lincoln	25-24-29	13.4		26	203	21				33	203	80	283	1
RM-01	Lincoln	25-24-29	58.9		421						94	0	515	515	2
RM-02	Lincoln	25-24-29	8.2						94	268	34	268	128	396	1
RM-03	Lincoln	25-24-29	3.2						94	268	34	268	128	396	1
RM-04	Lincoln	25-24-29	2.9				176		4	272	34	272	214	486	1
RM-05	Lincoln	25-24-29	4.3		156		145	211			51	211	352	563	1
RM-06	Lincoln	25-24-29	3.3				146	229	4		4	229	154	383	1
RM-07	Lincoln	25-24-29	11.6		5	293	21	40	4	281	4	614	34	648	1+
RM-08	Lincoln	25-24-29	7.8									0	0	0	3
RM-09	Lincoln	25-24-29	3.5		116		124	224	4	425	51	649	295	944	1+
RM-10	Lincoln	25-24-29	10			134	40				34	134	74	208	1
RM-11	Lincoln	25-24-29	2.7								30	0	30	30	3
RM-13	Lincoln	25-24-29	7					173	94	82	51	255	145	400	1
RR	Red River	25-23-25	38.1									0	0	0	3
RT-1	Lincoln	25-24-31	97.2		145	288	26	208	4	346	51	842	226	1068	1+

RT-2	Lincoln	25-24-31	25.4		145	288	26	208	4	208	51	704	226	930	1+
RVM-1	Lincoln	25-24-15	36.9		145	267	26	194	4	330	51	791	226	1017	1+
RVM-2	Lincoln	25-24-14	55.8		145		51	220	4	241	34	461	234	695	1+
RVM-3	Lincoln	25-24-23	34.9		145	208	21				28	208	194	402	1
RWM-1	Lincoln	25-24-06	7.4		115	215					34	215	149	364	1
RWM-2	Lincoln	25-24-06	11.8		115	366					18	366	133	499	1
RWM-3	Lincoln	25-24-06	4.5		115	343					26	343	141	484	1
RWM-4	Lincoln	25-24-06	25		6		146		123	271	4	271	279	550	1
RWM-5	Lincoln	25-24-06	32.4		115	350					24	350	139	489	1
TH-1 West (Grass)	Lincoln	25-24-19	8		90						107	0	197	197	2
TH-1E	Lincoln	25-24-19	6.9	361							4	361	4	365	1
TH-2	Lincoln	25-24-19	16.4					109	94	77	51	186	145	331	1
TH-5	Lincoln	25-24-19	9.8					71	4		34	71	38	109	1
TH-6	Lincoln	25-24-19	4.2		146		115		123	77	174	77	558	635	1
TH-7 & 7R, split in 2013	Lincoln	25-24-19	5.8	361				75	94			436	94	530	1+
TH-7	Lincoln	25-24-19	4.9								34	0	34	34	3
TH-7R	Lincoln	25-24-19	1.6 (no manure)								130	0	130	130	2
TH-8	Lincoln	25-24-19	0				190		84		130	0	404	404	2
TH-9	Lincoln	25-24-19	0.6					98	94		130	98	224	322	1
TH-10, add 2013	Lincoln	25-24-19	7.6								144	0	144	144	2
VAL-1	Red River	25-23-22	8.33	199			116		115		21	199	252	451	1
VAL-2	Red River	25-23-22	1.1	199			116		115			199	231	430	1
VANBV	Red River	25-23-26	23.3			288	26	492				780	26	806	1+
VANH	Red River	25-23-27	18.5	530	26	315		532			129	1377	155	1532	1+
VD-1	Lincoln	25-24-31	28.7									0	0	0	3
VD-2	Lincoln	25-24-31	5			292	26	60				352	26	378	1
VD-3	Lincoln	25-24-31	6.5								124	0	124	124	2
VD-4	Lincoln	25-24-31	6.1			279	26	74				353	26	379	1
VD-5	Lincoln	25-24-31	4.9								129	0	129	129	2
VD-6	Lincoln	25-24-31	46.8	508		106					26	614	26	640	1+
VD-7	Red River	25-23-26	6.8		115		47	244	34	273	34	517	230	747	1+
VD-8, add 2013	Lincoln	25-24-31	17.4								130	0	130	130	2
VLI-1	Lincoln	25-24-30	2.3		115	103	21				29	103	165	268	1
VLI-2	Lincoln	25-24-30	29.7		115	103	21		11		36	103	183	286	1
VLI-3	Red River	25-23-25	38.6		6				124		130	0	260	260	2

Groundwater Contamination Potential Score:
1 = Less than 400 lbs. total N per acre manure applied 2010-2013
1+ = Greater than 400 lbs. total N per acre manure applied 2010-2013
2 = Chemical nutrients only applied 2010-2013
3 = Potential spreading area. No nutrients applied 2010-2013

Footnotes:

#1 - 2010 Application Log (BD-2,4) 21,223 gal/A of 003 liquid at 21.6 lb total N/1000 gal. applied on 7/29/10 = 458 lb. N/A, but DNR Report for Year 2010 shows no manure application (possible confusion with BDSR - 1 and 2)
#2 - 2010 Application Log for CDE: 7/12/10, 21,772 gal/A 003 liquid manure (7/13/10 analysis = 21.6 lb total N/1000 gal.) results in 470 lb. total N/A.
#3 - 2010 Application Log for MEN: 20,109 gal./A 003 liquid manure (7/22/10 analysis = 13.3 lb. N total/1000 gal.) spread 7/22/10 = 267 lb. total N/A
#4 - 2010 Application Log for MES: 20,351 gal./A 003 liquid manure (7/22/10 analysis = 13.3 lb. N total/1000 gal.) spread 7/22/10 = 271 lb. total N/A
#5 - 2010 Application Log for NOW-4: 21,200 gal./A 003 liquid manure (7/22/10 analysis = 13.3 lb. N total/1000 gal.) spread 7/22/10 = 282 lb. total N/A
#6 - 2010 Application Log for NOW-5: 21,577 gal./A 003 liquid manure (7/22/10 analysis = 13.3 lb. N total/1000 gal.) spread 7/22/10 = 287 lb. total N/A
#7 - 2010 Application Log for NOW-6: 21,577 gal./A 003 liquid manure (7/22/10 analysis = 13.3 lb. N total/1000 gal.) spread 7/22/10 = 267 lb. total N/A
#8 - 2010 Application Log for NJ-1: 21,270 gal.A 003 liquid manure (7/14/10 analysis = 21.6 Lb total N/1000 gal.) spread 7/18/10 = 459 lb. total N/A
#9 - 2010 Application Log for NJ-2: 21,270 gal.A 003 liquid manure (7/14/10 analysis = 21.6 Lb total N/1000 gal.) spread 7/18/10 = 459 lb. total N/A
#10 - 2012 Application Log for BLE-08: 15,000 gal./A of 003 liquid manure (estimated at 20 lb. total N/1000 gal.) spread 6/25 - 7/17/12 = 300 lb. total N/A

Attachment G

Well Water in Karst Regions of Northeastern Wisconsin Contains Estrogenic Factors, Nitrate, and Bacteria

Angela C. Bauer[1*], Sarah Wingert[2], Kevin J. Fermanich[3], Michael E. Zorn[3]

ABSTRACT: Well water in karst regions is particularly susceptible to contamination by various nonpoint source pollutants such as nitrate, fecal bacteria, and endocrine disrupting chemicals (EDCs). This study analyzed 40 wells in heavily farmed karst areas of northeastern Wisconsin to determine whether these and other pollutants are present, and if so, whether their presence is (1) correlated with other contaminants and (2) exhibits seasonal variation. Nitrate, bacteria, and estrogenicity (indicating the presence of EDCs) were present in at least some of well water samples collected over the course of four time periods between the summers of 2008 and 2009. Although estrogenicity was greatest during the summer months, bacterial contamination was most prevalent during snowmelt. Levels of estrogenicity present in some well water samples approached a threshold concentration that is known to exert endocrine disruption in wildlife. Strong correlations between estrogenicity and other water quality parameters were not found. *Water Environ. Res.*, **85,** 318 (2013).

KEYWORDS: groundwater, nitrate, coliform, *Escherichia coli*, enterococci, endocrine disruptors (EDCs), estrogenicity, E-screen assay.

doi:10.2175/106143012X13373575831358

Introduction

Groundwater in karst regions moves rapidly into the subsurface through conduits (sink holes, sinking streams, and springs) or porous, fractured bedrock where relatively little filtration of water contaminants occurs (Vesper et al., 2001). Thus, karst aquifers are particularly vulnerable to groundwater pollution. The susceptibility of karst aquifers to pollution is particularly problematic in rural, agricultural areas where residents commonly rely on private wells and springs for their drinking water. Studies in northeastern Wisconsin (e.g., Erb and Stieglitz, 2007) have documented that well water in agricultural regions possessing karst topography frequently contains contaminants (e.g., bacteria and nitrate [NO_3-]) that pose a significant human health threat. Potential sources of these contaminants include land spread manure and sewerage sludge, and sewage effluent from improperly constructed septic systems.

Consumption of well water contaminated with fecal bacteria and nitrate from human or animal waste is associated with a variety of adverse health effects, some of which can be life-threatening or even lethal. For example, consumption of water containing verotoxin- (Shiga toxin) producing strains of *Escherichia coli* such as *E. coli* O157:H7 (an enteric pathogen commonly found in livestock manure) can produce symptoms ranging from mild gastrointestinal illness to hemorrhagic colitis to renal failure and death (Pell, 1997). Consumption of water containing high concentrations of nitrate, such as from cropland runoff of synthetic fertilizers, can cause methemoglobinemia (*blue baby syndrome*) in infants (Karr, 2012). The significant human health threat posed by the consumption of well water contaminated with bacteria and nitrate has led many U.S. counties and states to enact legislation that regulates the land application of animal and human waste (Brown County Wisconsin, 2007; Illinois Department of Agriculture, 2012; Kewaunee County Wisconsin, 2010; Wisconsin Department of Natural Resources, 2002).

Public health concern continues to grow over the presence of another class of organic compounds found within groundwater that might pose a human health threat. These chemicals—called endocrine disrupting chemicals or EDCs—originate from a wide variety of sources (NRC, 1999), including human waste (e.g., synthetic hormones from contraceptives), animal waste (e.g., endogenous or synthetic hormones injected into livestock to induce growth), and pesticides commonly applied to croplands (Hodges et al., 2000). Many EDCs have been shown to mimic or block the actions of endogenous sex hormones (estrogens and androgens) within the body. Given that sex hormones are the principal regulators of the development and function of a wide variety of tissues, a great potential exists for EDCs to cause physiological abnormalities in exposed organisms (Colburn et al., 1996).

Of particular concern for humans is the possible association between EDC exposure and endocrine-related cancers. For example, cumulative exposure to estrogen is a known risk factor for the development of breast cancer (Dorgan et al., 1996; Toniolo et al., 1995). In addition to laboratory studies linking EDC exposure with the development of breast cancer in mice (Murray et al., 2007), research has also found a correlation between elevated levels of EDCs such as DDT (dichlorodiphenyltrichloroethane) and the development of breast cancer in young women (Cohn et al., 2007). Additional concerns have been raised about EDC exposure and a male's risk for infertility

---

[1*] Department of Human Biology, University of Wisconsin-Green Bay, 2420 Nicolet Drive, Green Bay, Wisconsin, 54311; e-mail: bauera@uwgb.edu.

[2] Environmental Science and Policy Graduate Program, University of Wisconsin-Green Bay, Green Bay, Wisconsin.

[3] Department of Natural and Applied Sciences, University of Wisconsin-Green Bay, Green Bay, Wisconsin.

(Sakaue et al., 2001; Susiarjo et al., 2007; Toppari et al., 1996, 2002) and for developing androgen-sensitive cancers such as testicular (Skakkebaek et al., 2001; Weir et al., 2000) and prostate cancer (Fleming et al., 1999; Ho et al., 2006).

A critical step toward minimizing exposure to EDCs and thereby decreasing associated health risks is identifying routes of contamination within the environment. Recently, attention has turned to livestock waste as a source of EDCs. Manure is a rich source of EDCs because it contains both endogenous estrogens from cattle (estradiol, estriol, and estrone) (Hanselman et al., 2006; Peterson et al., 2000) and synthetic steroids administered to livestock as growth-enhancing agents (Herschler et al., 1995). One important route for manure-borne EDCs to enter the environment results from the common practice of applying animal wastes to pastures and croplands as fertilizer. Several studies have suggested that land application of animal wastes results in EDC contamination of agricultural drainage water and groundwater (Hanselman et al., 2006; Peterson et al., 2000) at concentrations that are known to elicit biological effects (Irwin et al., 2001; Panter et al., 1998).

Groundwater contamination by manure runoff is of particular concern to residents of northeastern Wisconsin given the unique geology of the region, much of which is characterized by carbonate bedrock areas, shallow soil depths, and karst features (sink holes and bedrock openings). These allow ready access of surface contaminants to well water. A 2007 report of the Northeast Wisconsin Karst Task Force (Erb and Stieglitz, 2007) found that a significant portion of water supply wells in northeastern Wisconsin are contaminated by bacteria or high levels of nitrate. Numerous instances of contamination have been linked to manure runoff in recent years, particularly during the spring thaw. When the Calumet County Land and Water Conservation Department conducted voluntary well water testing in spring of 2007, they found that 32% of samples tested positive for some level of coliform bacteria (an indicator of fecal contamination by livestock, humans, or other animals), and contained high nitrate levels (Calumet County Wisconsin, 2007). Similar findings were reported by the neighboring Brown County Land Conservation Department in an analysis of well water samples collected from the Town of Morrison (Erb and Stieglitz, 2007).

The majority of coliform-positive well water samples identified in the above county studies originated from areas in northeastern Wisconsin that are heavily farmed with relatively shallow soils over fractured dolomite. Thus, it is likely that groundwater contamination in this region is a result of land application of livestock manure as fertilizer to pastures and croplands. Given that livestock manure contains appreciable amounts of steroid hormones (Hanselman et al., 2006; Peterson et al., 2000), concerns have arisen that manure-born EDCs are also contaminating well water.

In this study, well water samples were collected from drinking water wells in five northeastern Wisconsin counties and analyzed for nitrate and bacteria (including total coliforms, *E. coli*, and enterococci). In addition, levels of estrogenicity (indicating the presence of EDCs) were measured through use of the MCF-7 breast cancer cell proliferation assay, which is commonly referred to as the E-screen assay (Soto et al., 1995). Well water samples were collected during four time periods to examine seasonality trends as well as potential changes associated with recharge periods (i.e., heavy rainfall or spring thaw).

Methodology

Well Selection and Sample Collection. The study area consisted of rural land in northeastern Wisconsin with known instances of past groundwater contamination of the uppermost Silurian aquifer. Forty private wells within five counties (Brown, Calumet, Dodge, Fond du Lac, and Kewaunee Counties) (Figure 1) were selected to investigate the potential for groundwater contamination with estrogenic chemicals, fecal bacteria, and nitrate. A significant portion of each of these counties is underlain by the Silurian bedrock aquifer, has extensive areas where the unconsolidated surficial sediment and soil is <15 m deep, and contains karst features (i.e., swalets, sink-holes, fractures). In addition to their susceptibility to groundwater contamination, these counties were chosen because representatives from local environmental agencies were willing to help contact well owners and sample the wells. Ten wells per county were selected for sampling in Brown, Calumet, and Kewaunee Counties. Eight wells were selected from Fond du Lac County and two from Dodge County that were immediately south of the Fond du Lac wells. For sample collection and analysis purposes, the Dodge County wells were included with those of Fond du Lac because of their close proximity. Figure 1 shows the distribution and approximate locations of the study wells.

Note that the 40 wells chosen for this study were not selected in a statistically rigorous manner, nor were they chosen with the intent to represent county-level water quality trends. Rather, well selection was based on following characteristics: (1) they were cased into the Silurian aquifer, (2) they were shallow (all but two wells were <60 m in depth), (3) historical sampling data for fecal bacteria and nitrate were available, (4) the well owners agreed to participate in the study, and (5) the wells were located in areas with suspected or known sources of agricultural contamination.

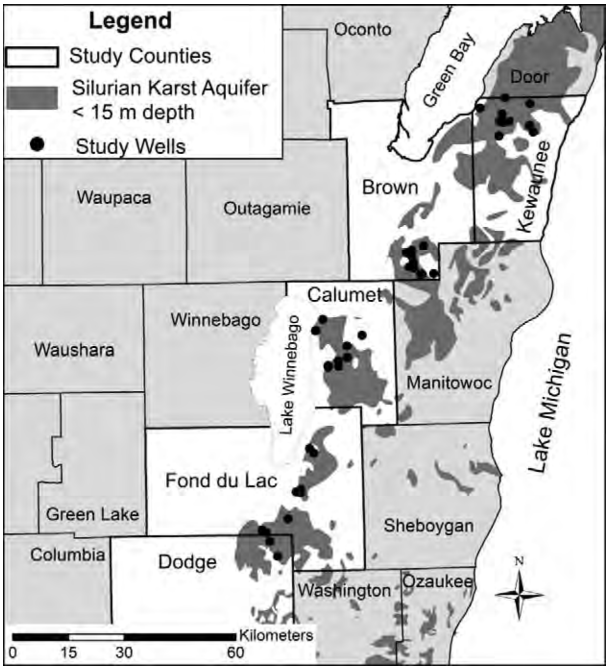


Figure 1—Location of study counties in northeastern Wisconsin and approximate locations of drinking water wells. The relationship to areas dominated by the shallow Silurian karst aquifer is also shown.

A total of eight wells from each county were designated *susceptible* to contamination; two wells from each county were deemed *control* wells based on low levels of past contamination (no or low fecal bacteria counts and <2 mg/L of nitrate measured as NO_3-N). Groundwater samples were collected from each well in mid-August 2008, mid-November 2008, mid-to-late February 2009, and mid-March 2009 by a county representative or University of Wisconsin-Green Bay researcher.

Bacteria. Samples were analyzed for fecal bacteria within 24 h of collection at the University of Wisconsin-Oshkosh Halsey Science Center's Environmental Microbiology Laboratory. *Escherichia coli* and total coliforms were measured using the IDEXX Laboratories (Westbrook, Maine) Colilert reagent; enterococci was measured using the IDEXX Enterolert test kit.

Nitrate. Samples were analyzed for nitrate within 48 h of collection at the University of Wisconsin-Green Bay using a Lachat (Loveland, Colorado) QuickChem 8500 Flow Injection Analysis system, and following Lachat QuikChem Method 10-107-04-1-A (Wendt, 2007). Nitrate results were reported as mg/L NO_3-N with a detection limit of 0.1 mg/L NO_3-N.

Conductivity. The conductivity of each sample was measured using a Hydrolab Quanta G water quality sonde (Hydrolab Corporation, Loveland, Colorado) within 48 h of collection and reported in mS/cm.

Sample Extraction for Biological Assays. One sample from each well was extracted for estrogenicity testing within 48 h of collection at the University of Wisconsin-Green Bay per Drewes et al., (2005). The extraction procedure involved vacuum filtering a 1 L sample through an Empore C-18 extraction disk (Product No. 2215, Fisher Scientific, Pittsburgh, Pennsylvania) that was preconditioned using a 1:1 solution of ethyl acetate/methylene chloride, methanol, and high-purity water. Materials remaining in the sample bottle and on the extraction disk were eluted into a 15-mL glass vial using the following solvent series: 5 mL of ethyl acetate, 5 mL of 1:1 ethyl acetate/methylene chloride, and 5 mL of methylene chloride. Samples were stored at 4 °C pending further processing and analysis. Next, a nitrogen dry-down procedure was performed in which a sample extract was dried almost completely with ultra-high purity nitrogen (99.999% purity, <1 ppm oxygen, and <0.5 ppm hydrocarbons) before being rinsed with methanol three times. The remaining sample extract and methanol rinses were transferred to a 1.5 mL amber vial and evaporated with nitrogen to 1 mL. The extracts in methanol were stored in a freezer.

Field blanks, duplicates, spikes, and a high-purity water blank underwent the above extraction procedure for quality assurance purposes. For each sampling period, four duplicates (one per county) and two spiked samples were selected at random and extracted for use in the biological assays. In the spiked samples, 1 mM 17β-estradiol was used to achieve a concentration of 20 pM estradiol in the 1 L sample. The spiked samples were extracted as described above and concentrated to 20 000 pM using the nitrogen dry-down procedure.

Five hundred microliters of each sample extract were transferred to a new 1.5 mL amber vial, evaporated with nitrogen, re-suspended in 500 µL of diluted extraction buffer, and frozen until used in the E-screen assay.

Prior to the extraction procedure, all glassware was cleaned to eliminate organic compounds. In addition, the 15 mL glass vials, 1.5 mL glass amber vials, and glass Pasteur pipets were heated at 450 °C for 4 h in a furnace prior to use.

E-Screen Assay. The E-screen assay was used to measure the estrogenic activity of groundwater samples. The MCF-7 BOS human breast cancer cells used in the assay were obtained from the laboratory of Dr. Ana Soto and Dr. Carlos Sonnenschein at the Tufts University School of Medicine in Boston, Massachusetts. Additional cells were grown and maintained at the University of Wisconsin-Green Bay using a Soto Laboratory procedure.

To harvest cells for use in the E-screen assay, tissue culture flasks were rinsed with phosphate buffered saline and trypsinized with 1.5 mL of trypsin-EDTA (ethylenediaminetetraacetic acid) solution. Cells were counted with a hemocytometer, diluted to a concentration of 7000 cells per mL with DMEM (Dulbecco's modified eagle medium), and seeded in 24-well tissue culture plates (1 mL/tissue culture well). After 24 h of incubation, DMEM was removed and an estradiol standard dose-response curve and groundwater samples were added to the plates in experimental media. Note that DMEM without a pH indicator (phenol red) was used as the experimental media because of phenol red's known estrogenic properties (Shappell, 2006). The experimental media was supplemented with 1% antibiotic-antimycotic solution and 5% charcoal dextran stripped fetal bovine serum (CD-FBS).

The standard curve for each assay contained 16 concentrations of 17β-estradiol and ranged from 0.05 pM to 10 000 pM 17β-estradiol. A dilution series was created for each groundwater sample included in an assay. A total of five different dilutions were used for each individual groundwater sample, 1:100, 1:200, 1:400, 1:800, and 1:1600. Standards and experimental samples were plated at a volume of 500 µL/tissue culture well. Additional plate wells contained, along with each dilution of experimental sample, the estrogen receptor antagonist ICI 182,780. This was done to determine if any proliferative effects generated by the samples could be attributed to actions exerted specifically via the estrogen receptor. After an incubation period of 5 days, the assay was assessed for cell proliferation using the sulforhodamine B (SRB) protein assay. After staining with SRB dye, the absorbance of each sample was read at a wavelength of 515 nm with a Molecular Devices (Sunnyvale, California) Versa Max Tunable Microplate Reader. The standard curve was fit using a 4-parameter logistic equation and the Softmax PRO v. 2.6 analytical software package (Molecular Devices, Sunnyvale, California). Estradiol equivalency (EEq) was determined by inserting the absorbance readings into the equation generated by the standard curve (Soto et al., 1995); results were reported as pM EEq. A representative standard curve for the E-screen assays used in this study is shown in Figure 2.

The limit of sensitivity for the E-screen varied for each assay and ranged from 0.4 to 1 pM in the sample extracts. In reporting EEqs, only groundwater samples exhibiting an estrogenic response above the limit of sensitivity (1 pM) were counted as *detects* and analyzed statistically.

Statistical Analyses. Statistical analyses employed SAS statistical software (SAS Institute, Inc., Cary, North Carolina) to determine if any trends existed between estrogenicity and other parameters, including nitrate, total coliforms, *E. coli*, enterococci, and conductivity. Spearman's rank correlation test was used to examine potential correlations between the results of all six tests (PROC CORR) (Cody and Smith, 2006; Peterson et al., 2000). Seasonality was assessed by comparing the results of the four sampling periods. For nitrate and conductivity results, a

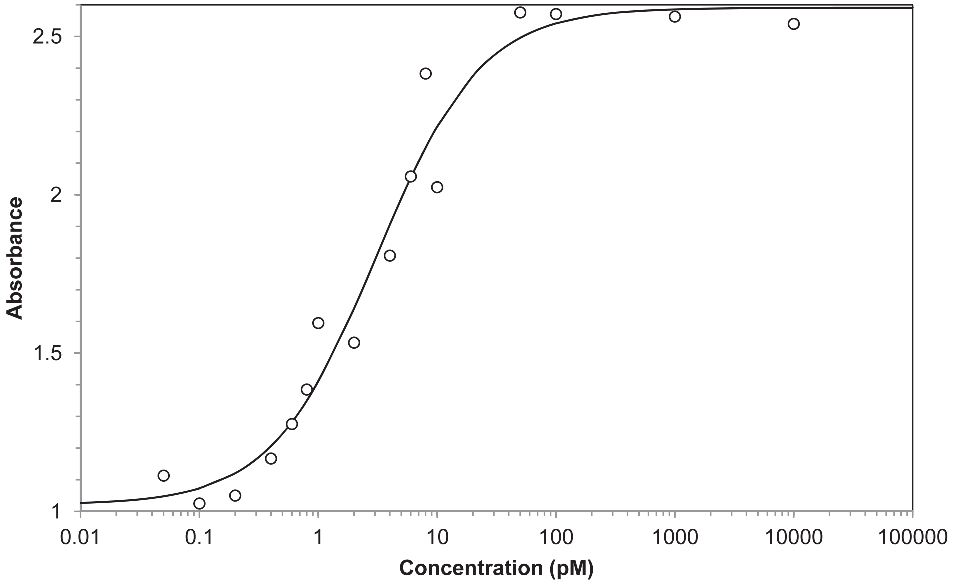


Figure 2—A representative standard curve for the E-screen assays (absorbance versus concentration) used in this study.

repeated measures analysis on one factor was conducted to examine seasonality using the well identification number as the random effect and the sampling period as the fixed effect (PROC MIXED) (Cody and Smith, 2006; Shappell, 2006). The Tukey multiple comparison adjustment for p-values was used in the repeated measures analysis. For the remaining four parameters, seasonality was analyzed using the Wilcoxon Signed Rank test—a nonparametric test for non-normal, paired data sets (PROC UNIVARIATE) per Cody and Smith (2006). A nonparametric statistical test (comparison of mean Wilcoxon scores using the T approximation test) was used to determine if the results of the control wells differed significantly from the susceptible wells (PROC NPAR1WAY). The results were also analyzed for county-level differences using a one-way analysis of variance test for the nitrate and conductivity results (PROC GLM). The Kruskal-Wallis test was used for the remaining parameters (PROC NPARIWAY). Although county-level differences were not expected because the groundwater wells were selected based on similar characteristics, differences could occur as a result of sampling technique (i.e., each county was sampled separately by different individuals) or geological variations in an area. All statistical results were analyzed for significance at the $p < 0.05$ level.

Results and Discussion

Weather Conditions. Groundwater samples were collected on the following four sampling periods: (1) August 11 to 12, 2008; (2) November 17 to 18, 2008; (3) February 13, 17, 24 and March 2, 2009; and (4) March 18 to 19, 2009. Precipitation data from the National Oceanic and Atmospheric Administration's National Weather Service station in Green Bay were obtained prior to each sampling period (NOAA, 2009). The largest and only significant rain event prior to the first sampling period occurred 26 days before sampling with a precipitation total of 34 mm. No significant rain events occurred within 16 days of the second sampling period. Because of the lack of significant rain events, it was assumed that groundwater levels in the study area were at low or baseflow conditions during the first and second sampling periods.

The third and fourth sampling periods were conducted with the express intent of capturing potential groundwater recharge events following instances of snowmelt. In February 2009, record temperature highs occurred in the Green Bay area on the 7th, 8th, and 10th day of the month, whereas daily maximum temperatures were above freezing from the 6th to the 12th. A maximum temperature of 10 °C was record on February 10, 2009. Although no major precipitation events occurred between February 1st and 10th, the Green Bay area already had accumulated 0.31 m of snow. The record high temperatures caused much of the snow to melt by February 10, 2009, and only 25 mm remained on the 12th. The Fond du Lac/Dodge (February 13, 2009) and Kewaunee (February 17, 2009) wells were sampled within 1 week of the majority of snow melt. However, wells in the remaining three counties were not sampled until February 24, 2009, following minor melting of new snow and about 12 mm of rain. Prior to the fourth sampling period (March 18 to 19, 2009) two additional warming periods from March 4 to 17, 2009, led to the melting of about 330 mm of existing and new snow.

Nitrate. Nitrate concentrations were relatively consistent for a given well across all four sampling periods. Individual results ranged from below detection (<0.1 mg/L NO_3-N) to 31.1 mg/L NO_3-N. The average nitrate concentration of the control groundwater wells slightly exceeded 1 mg/L NO_3-N for each sampling period, and the average concentration of the susceptible wells ranged from 11 to 14 mg/L NO_3-N. For each sampling period, there was a significant difference between the average nitrate concentration of the control wells and susceptible wells (i.e., the control wells had much lower nitrate concentrations). Although no significant differences were found between the average nitrate concentrations of wells in individual counties for any of the four sampling periods, Brown County consistently had the highest average nitrate concentrations and Fond du Lac/Dodge Counties the lowest.

A concentration of 10 mg/L NO_3-N is both the maximum contaminant level for public drinking water systems (U.S. EPA, 2009) and the groundwater quality enforcement standard in Wisconsin (Wisconsin Department of Natural Resources, 2010). Table 1 shows that 22 to 55% of groundwater wells in this study exceeded this health standard across the four sampling periods. Moreover, the percentage of wells exceeding 10 mg/L NO_3-N would have likely increased for the second, third, and fourth sampling periods if all 40 wells had been sampled during each sampling period. A total of seven wells were not sampled (once each) over the course of the study. One well was in Brown County in the fourth sampling period; five wells were in Calumet County in the second (3 wells), third (1 well), and fourth (1 well) periods; and one well was in Fond du Lac County in the fourth period. Six of the seven wells not sampled had average nitrate concentrations >10 mg/L NO_3-N for the other three sampling periods. One additional Calumet County well not sampled also had a relatively high average nitrate concentration (8.4 mg/L NO_3-N) for the other three sampling periods.

These elevated nitrate levels are indicative of anthropogenic sources such as agricultural fertilizers and manure (Panno et al., 2006). The relatively consistent nitrate concentrations in conjunction with the largely unchanging number of contaminated wells (>2.0 mg/L NO_3-N) over the four sampling periods suggests widespread contamination of the shallow carbonate aquifer in these areas of northeastern Wisconsin.

Bacteria. Table 2 shows a high percentage of sampled groundwater wells were contaminated with one or more types of fecal bacteria (coliforms, *E. coli*, and enterococci) over the course of the study. A bacterial detection of 1 MPN (most probable number)/100 mL or greater is unsafe by public drinking water standards (U.S. EPA, 2009). Coliform bacteria levels ranged from below detection (<0.1 MPN/100 mL) to >2420 MPN/100 mL, enterococci levels from below detection to 579 MPN/100 mL, and *E. coli* levels from below detection to 816 MPN/100 mL. The highest average coliform bacteria and enterococci levels as well as the highest number of *E. coli* detections occurred during the fourth sampling period (during the spring thaw). Coliform bacteria were detected most frequently, followed by enterococci. In the first, third, and fourth sampling periods, coliforms and enterococci were detected in more than 50 and 25% of the wells, respectively. *Escherichia coli* was detected the least frequently, with 2 contaminated wells in the first, 1 in the second, 3 in the third, and 10 in the fourth sampling period. *Escherichia coli* and enterococci were highly correlated (data not shown); enterococci were present in all wells with detectable *E. coli*.

Because *E. coli* and enterococci are both indicators of animal or human waste, they could originate from the same source. Fecal *E. coli* have been shown to be less resistant in the environment than enterococci and occur at a lower ratio in animal feces than enterococci (Celico et al., 2004). This could explain why *E. coli* was found less frequently than enterococci. In 59 spring water samples from a fractured limestone aquifer in Italy, Celico and colleagues reported that approximately 52% of their samples were contaminated with enterococci, whereas only 22% were contaminated with *E. coli*. That aquifer was known to be influenced by manure from grazing cattle. Those contamination percentages are similar to the results found in the fourth sampling period in this study.

With the exception of during the first sampling period, the control groundwater wells exhibited less bacterial contamination than the susceptible wells. A total of four control wells had detectable levels of coliform bacteria twice during this study; three wells also had at least one enterococci detection. No *E. coli* detections were recorded for the control wells in any of the sampling periods, and no coliforms or enterococci detections occurred in the control wells during the fourth sampling period.

EDC Activity. Estrogenic activity was found in groundwater during all four sampling periods. Based on the number of wells run through the E-screen in each sampling period, 50, 27, 14, and 5% of groundwater samples exhibited estrogenicity in the first, second, third, and fourth sampling periods, respectively (Table 3). Groundwater extract-induced cell proliferation was determined to be estrogen receptor-dependent through use of the estrogen receptor antagonist ICI 182,780. Estradiol equivalency ranged from 0.0114 to 12.87 pM (0.003 to 3.51 ng/L) in the actual well water samples.

The EEqs levels found in this study are within the range of levels reported in other studies that employed the E-screen. For example, Shappell et al. (2007) reported EEqs between 0.1 and 858 pM in lagoons, manure pits, and wetlands receiving swine wastewater. Water samples collected from 20 ponds and wetlands located in agricultural areas near Fargo, North Dakota, yielded EEqs within approximately one order of magnitude (0.1 to 1 pM) (Shappell, 2006). By comparison, approximately 62% of the EEqs in this groundwater study fell within an order of magnitude range; the remaining 27 and 10% fell between 0.01 and 0.1 pM, and 1 and 10 pM, respectively. Note that most groundwater samples in this study were either lower than or near the bottom of the range reported by Shappell et al. (2007), which can be attributed to the different types of water sampled in each study. That is, Shappell and colleagues evaluated water bodies directly affected by pollution whereas this study assessed groundwater that might be affected by pollution. One might expect the concentrations of estrogenic chemicals originating at the surface to decrease as they enter the water table, whether by filtration through the unsaturated zone, degradation by microbes, or dilution through mixing with other water sources. During transport through an aquifer, concentrations can become

Table 1—Percentage of groundwater wells in different nitrate (NO_3-N) concentration ranges during each sampling period.

		Concentration (mg/L NO_3-N)			
Sampling period	Number of wells sampled	0–2	2–5	5–10	>10
1	40	17.5%	7.5%	20.0%	55.0%
2	37	21.6%	8.1%	21.6%	48.7%
3	39	18.0%	12.8%	18.0%	51.3%
4	37	11.1%	33.3%	33.3%	22.2%

Table 2—Percentage of groundwater wells with unsafe levels of coliform bacteria, enterococci, and *Escherichia coli* during each sampling period. Number of wells sampled is same as in Table 1.

Sampling period	Coliform bacteria	*Escherichia coli*	Enterococci
1	62.5%	12.5%	27.5%
2	40.5%	2.7%	10.8%
3	59.0%	7.7%	29.7%
4	64.9%	27.0%	46.0%

Table 3—Percentage of sampled groundwater wells with detectable estradiol equivalents (EEq) in the E-screen assay during each sampling period.

Sampling period	EEq detections[a]
1	50.0 %
2	27.0 %
3	13.9 %
4	5.4 %

[a] Limit of sensitivity = 1 pM EEq in sample extracts.

even more diluted before reaching a groundwater well, depending on the distance from the source of the estrogenic chemicals.

No public drinking water health standard exists for estrogenicity. However, several studies have shown that low concentrations of estradiol in surface waters (37 to 370 pM or 10 to 100 ng/L) can disrupt the endocrine systems of aquatic species including fish, turtles, and frogs (Hanselman et al., 2003). In a study analyzing the reproductive capacity of a fish population and with the goal maintaining population sustainability, the Environment Agency of England and Wales estimated 36.7 pM estradiol (10 ng/L) as the *lowest observable effect concentration*, and 3.7 pM (1 ng/L) as the threshold concentration yielding no effect on the fish (Shappell et al., 2007). Other researchers have predicted that the *no-observed-effect-concentration* for 17β-estradiol is between 18.4 to 91.8 pM (5 to 25 ng/L) (Harper and Sinh, 2006). Although the vast majority of groundwater samples in this study were well below the 3.7 pM *no effect* threshold identified by Shappell et al. (2007), the E-screen results in this study show that some wells had concentrations near or above this level. Three wells in Calumet County exhibited EEqs >0.37 pM during the first sampling period, whereas one well in Brown County, two wells in Calumet County, and two wells in Fond du Lac/Dodge County exhibited EEqs >0.37 pM during the second sampling period. In addition, two wells recorded values exceeding 3.7 pM during the second sampling period, one in Brown County (12.9 pM) and the other in Calumet County (7.2 pM). No groundwater samples exceeded an EEq of 0.37 pM in the third or fourth sampling periods.

Seasonality. As noted previously, the third and fourth sampling periods followed groundwater recharge events; because of little rainfall in late summer and fall, the first and second sampling periods were mostly representative of baseflow conditions within the aquifer. No significant differences in conductivity existed between control and susceptible wells for all four sampling periods. A comparison of the least squares means with the Tukey adjustment showed that susceptible wells during the first and second sampling periods had significantly greater conductivity values relative to the fourth sampling period ($p = 0.0006$ and $p = 0.0005$, respectively.) This reduction in average conductivity in the fourth sampling period corresponded with the recharge that occurred following snowmelt events in February and March 2009. These results are consistent with those reported by Muldoon and Bradbury (2010) in shallow carbonate aquifer monitoring wells adjacent to agricultural fields in Brown, Calumet, Manitowoc, and Kewaunee Counties, Wisconsin. Those researchers found that most groundwater recharge occurring between September 2007 and August 2008 followed snowmelt events in January and March/April 2009. In addition, rapid declines in conductivity in response to recharge were observed in all four of their continuously monitored wells, which indicated that low conductivity recharge water traveled from the soil surface to the saturated zone within 1 to 2 days of the event.

Table 4 summarizes the significance of conductivity and the other five parameters discussed below among the four different sampling periods. When the dataset was analyzed as a whole, a significant difference was found among the four sampling periods for nitrate ($p = 0.0151$). Similar to conductivity, the Tukey adjustment indicated that this was a result of the significant difference between the first and fourth sampling periods ($p = 0.0086$). When the control and susceptible wells were analyzed separately, the control wells did not differ significantly among the four sampling periods ($p = 0.6543$). Thus, the difference between sampling periods was a result of a difference in contamination of the susceptible wells, which had significantly greater nitrate contamination in the first sampling period compared to the fourth ($p = 0.0081$).

Several significant seasonal differences in bacteria levels were observed in susceptible wells across the four time periods of this study. Average coliform bacteria contamination was significantly greater in the fourth sampling period compared to the first, second, and third sampling period, as indicated by the Wilcoxon Signed Rank test ($p = 0.0017$, $p \leq 0.0001$, $p = 0.0014$, respectively). Average coliform levels in the third sampling period were also significantly greater than those of the second sampling period ($p = 0.0019$). In other words, the second sampling period had less average microbial contamination than the fourth and third sampling period, but was not significantly different from the first ($p = 0.0554$).

Similar to coliform bacteria, the susceptible wells had significantly less average enterococci contamination in the second sampling period than the other three periods ($p = 0.0469$, $p = 0.0059$, $p \leq 0.0001$). Enterococci contamination of the susceptible wells in the fourth sampling period was also significantly greater than the third sampling period ($p = 0.0249$). Although the fourth sampling period had greater average enterococci values compared to the first sampling period, the difference was not significant ($p = 0.6993$). Differences between the average *E. coli* results of the susceptible wells were similar to the coliform and enterococci parameters. *Escherichia coli* contamination in the fourth sampling period was significantly greater than in the first ($p = 0.0164$) and second ($p = 0.002$) sampling periods.

Collectively, the seasonality results indicate that bacteria levels were greatest during winter/spring thaw compared to summer and fall months (Table 4). The fourth sampling period exhibited the largest bacterial contamination, the third period had the

Table 4—Summary of significant differences in average concentrations between sampling periods for susceptible well water samples.

	Sampling periods					
Parameter	**1 and 2**	**1 and 3**	**1 and 4**	**2 and 3**	**2 and 4**	**3 and 4**
Nitrate	–	–	1 > 4	–	–	–
Conductivity	–	–	1 > 4	–	2 > 4	–
Coliform bacteria	–	–	4 > 1	3 > 2	4 > 2	4 > 3
Enterococci	1 > 2	–	–	3 > 2	4 > 2	4 > 3
E. coli	–	–	4 > 1	–	4 > 2	–
E-screen	–	1 > 3	1 > 4	–	2 > 4	–

second largest, and the second had the least. Sample timing relative to snowmelt recharge events likely influenced the frequency and level of bacteria found in wells during the third and fourth sampling periods. All 37 wells in the fourth period were sampled over the course of 2 days immediately following complete snow melt. In contrast, half of the 39 wells sampled during period three were sampled within 1 week of the major thaw; the remaining wells were sampled 12 days after the thaw. For the wells sampled soon after melt events for both periods, 37 to 53% and 15 to 21% of the wells had detectable levels of enterococci and *E. coli*, respectively. For wells sampled more than a week after the snow melt in period three, 21 and 0% tested positive for enterococci and *E. coli*. But when these same wells were sampled within 2 days of the period four melt, 39 and 17% tested positive for enterococci and *E. coli*. Because of the rapid nature of groundwater recharge processes in the vicinity of the study well, it is possible that the period three observations underestimated bacterial frequency and concentrations resulting from the February 2009 thaw.

Generally, monitored fecal bacteria groups were significantly correlated for all sampling periods. In addition, bacterial levels were inversely correlated with conductivity in sample periods three and four (data not shown). During the March 2009 recharge event (period four), 14 of 17 wells testing positive for enterococci had lower conductivity values than those measured under baseflow conditions (period one). The average reduction in fluid conductivity was 22% with the largest changes in conductivity (49 to 52%) corresponding to wells with the two highest enterococci levels (579 and 248 MPN/100 mL, respectively). This dramatic change implies that a large volume of low conductivity surface water carrying fecal bacteria, pathogens, and potentially other constituents penetrated rapidly from land surface to the well intake.

As stated previously, the presence of enterococci or *E. coli* in a groundwater well indicates contamination with some type of human or animal waste. Because of the nature of *E. coli* and enterococci, both of which are found in the intestines of warm-blooded animals, these results suggest that as many as 46% of tested wells were contaminated with animal or human waste in the fourth sampling period. Unlike the fecal bacteria and nitrate results, EEqs were significantly lower in the fourth sampling period compared to sampling periods one ($p = 0.0006$) and two ($p = 0.002$). No significant differences were found between the first and second sampling periods, which had both the greatest average EEqs and most estrogenicity detections ($p = 0.6995$). Sampling period three also had significantly less contamination than period one ($p = 0.001$). No differences were found between sampling periods three and four, which had the fewest E-screen detections ($p = 0.2188$), or between sampling periods two and three ($p = 0.25$).

Overall, fewer detections of estrogenicity were found in the groundwater wells compared to fecal bacteria and nitrate detections across all four sampling periods. This result can be attributed to one or more factors. First, estrogen contamination might simply occur less frequently in the test wells than fecal bacteria and nitrate contamination events. Perhaps there are fewer sources of estrogenic contamination in the study area than fecal bacteria or nitrate sources. Second, some samples might have had estrogenic activity below the measurement sensitivity of the assay (1 pM) that prevented detection. Third, higher levels of estrogenicity during the summer and fall sampling periods might reflect the presence of estrogenic pesticides (e.g., methoxychlor and dieldrin; Hodges et al., 2000) that were applied to crops in the spring. Fourth, and perhaps most importantly, the E-screen is a biological assay that depends on the consistent response of a living cell line. If the groundwater extracts contained chemicals that were toxic to cell growth, the ability of the E-screen assay to properly measure estrogenicity would be compromised. In samples containing both estrogenic and toxic chemicals, toxicity could inhibit an estrogenic response (cell proliferation). This would affect the estrogenicity results by (1) lowering EEqs, or (2) reducing values below the sensitivity of the assay and thus preventing detection.

Toxicity, which was assessed by comparing the difference in cell proliferation in response to a given sample of groundwater extract in the presence or absence of a known concentration of estrogen, occurred very frequently in the assays—especially during the third and fourth sampling periods. Although limitations in extract volume prevented an assessment of toxicity for individual well water samples included in this study, a limited analysis revealed an average toxicity level of 31% during sampling periods one and two compared to 99% during sampling periods three and four. Therefore, it is possible that the estrogenicity of the groundwater samples might be greater than these study results indicate, particularly during the third and fourth sampling periods. This possibility exists because cell death resulting from the presence of toxic chemicals in the sample prevented or lowered EEq detection by the E-screen. Thus, it is possible that wells with apparent toxicity and that registered below detection in the E-screen might have contained estrogenic chemicals, but the dose-dependent response of the cells was masked by the toxic components of the sample.

The above limitations of bioassays such as the E-screen highlight the need for a method that allows the identification and detection of specific estrogenic chemicals in complex water samples containing unknown compounds, such as LC-MS (liquid chromatography-mass spectrometry) or GC-MS (gas chromatography-mass spectrometry) (Chen et al., 2006; Drewes et al., 2005; Soliman et al., 2007). Although an initial goal of this study was to analyze samples with high EEqs by LC-MS to determine the presence of specific EDCs, this was not possible because the entire sample from each well was required for the E-screen assay procedures.

EDC Correlation with Nitrate, Coliform Bacteria, and Escherichia coli. Strong correlations between estrogenicity (i.e., E-screen data) and the other water quality parameters were not found. However, one significant, albeit weak correlation was found—a positive correlation between the *E. coli* results and the E-screen results in the fourth sampling period. The weakness of this correlation ($r = 0.364$) makes it difficult to draw any conclusions. This relationship was driven by two samples collected from Fond du Lac/Dodge Counties. Both samples tested positive for estrogenicity, *E. coli*, coliform bacteria, and enterococci.

Several possible explanations exist for the lack of correlation between measured water quality parameters and estrogenicity. For example, and as noted above, toxicity of groundwater samples during the fourth sampling period (which could have led to low or undetectable EEqs) might have prevented the detection of a correlation of fecal bacteria and estrogenicity data. Also, sources of groundwater contamination are widespread and estrogenic activity could have originated from non-bacterial contamination sources such as land application of estrogenic pesticides.

Implications. The study results indicate that areas susceptible to groundwater contamination by fecal bacteria and nitrate can also exhibit elevated levels of estrogenicity. Contaminant sources are likely to be land-applied animal or human wastes, underground septic systems, or land-applied agrochemicals such as fertilizers and pesticides. In addition to the karst areas of northeastern Wisconsin evaluated in this study, other areas with shallow depth-to-bedrock or areas with sandy soils over shallow unconfined aquifers could also be susceptible to similar drinking water contaminants. Groundwater in areas containing high organic content and that have sufficient soil depths and textures (i.e., longer retention time) would presumably be less affected by EDCs because the contaminants would be less mobile and have a longer period of time to degrade.

Conclusions

Results from this study indicate that groundwater contamination with EDCs, fecal bacteria, and nitrate is a common problem in karst areas of northeastern Wisconsin. Contamination by waterborne pathogens can occur rapidly during winter and spring groundwater recharge events. Endocrine disrupting chemicals contamination was greatest during the months of August and November 2008. Although potential sources of EDC contamination within the study area (e.g., pharmaceuticals from leaky septic systems, land-applied manure, estrogenic pesticides) remain speculative, their identification provides an intriguing avenue for future research. It will also be worthwhile to identify fracture zones, bedrock openings, and other potential hazardous areas that allow for rapid transport of surface runoff to groundwater. Local and state resource management agencies (including Calumet County, Brown County, and the State of Wisconsin) have begun to collect and compile these and related types of data. The effect of individual well characteristics (well depth, depth to bedrock, age, and soil type) on water quality parameters is also worthy of additional research. Finally, the specific contaminants exerting estrogenic activity within the water samples should be identified through the use of LC-MS or other technique.

Acknowledgments

This study was funded through grant WR08R004 from the Wisconsin Groundwater Coordinating Council (University of Wisconsin System and University of Wisconsin-Madison Water Resources Institute) titled *Assessing Levels and Potential Health Effects of Endocrine Disrupting Chemicals in Groundwater Associated with Karst Areas in Northeast Wisconsin*. The authors would like to thank the following Wisconsin state and county representatives for making initial contacts with homeowners and for assisting with sampling: Bill Hafs (Brown County), Eugene McLeod and Danielle Santry (Calumet County), Elizabeth Heinen (Wisconsin Department of Natural Resources), Andy Wallander and Davina Boness (Kewaunee County), and Wendy Giese (Fond du Lac County). The authors also thank Senior Lab Technician Mark Damie and undergraduate student Kari Hagenow at the University of Wisconsin-Green Bay for technical assistance with this project.

Submitted for publication July 20, 2012; accepted for publication September 17, 2012.

References

Brown County Wisconsin (2007) *Brown County Animal Waste Management Ordinance,* Chapter 26; Brown County Land and Water Conservation Department: Green Bay, Wisconsin.

Calumet County Wisconsin (2007) *Land and Water Resource Management Plan, 2007–2011,* Calument County Land and Water Conservation Department: Chilton, Wisconsin.

Celico, F.; Varcamonti, M.; Guida, M.; Naclerio, G. (2004) Influence of Precipitation and Soil on Transport of Fecal Enterococci in Fractured Limestone Aquifers. *Appl. Environ. Microbiol.,* **70** (5), 2843–2847.

Chen, M.; Ohman, K.; Metcalfe, C.; Ikonomou, M. G.; Amatya, P. L.; Wilson, J. (2006) Pharmaceuticals and Endocrine Disruptors in Wastewater Treatment Effluents and in the Water Supply System of Calgary, Alberta, Canada. *Water Qual. Res. J. Can.,* **41** (4), 351–364.

Cody, R. P.; Smith, J. K. (2006) *Applied Statistics and the SAS Programming Language,* 5th Ed., Pearson Education, Inc.: Upper Saddle River, New Jersey.

Cohn, B. A.; Wolff, M. S.; Cirillo, P. M.; Sholtz, R. I. (2007) DDT and Breast Cancer in Young Women: New Data on the Significance of Age at Exposure. *Environ. Health Perspect*., **115** (10), 1406–1414.

Colburn, T.; Dumanoski, D.; Myers, J. P. (1996) *Our Stolen Future: Are We Threatening Our Fertility, Intelligence and Survival? A Scientific Detective Story.* Dutton: New York.

Dorgan, J. F.; Longcope, C.; Stephenson, H. E.; Falk, R. T.; Miller, R.; Franz, C.; Kahle, L.; Campbell, W. S.; Tangrea, J. A.; Schatzkin, A. (1996) Relation of Prediagnostic Serum Estrogen and Androgen Levels to Breast Cancer Risk. *Cancer Epidemiol. Biomark. Prev.,* **5** (7), 533–539.

Drewes, J. E.; Hemming, J.; Ladenburger, S. J.; Schauer, J.; Sonzogni, W. (2005) An Assessment of Endocrine Disrupting Activity Changes during Wastewater Treatment through the Use of Bioassays and Chemical Measurements. *Water Environ. Res.,* **77** (1), 12–23.

Erb, K.; Stieglitz, R., Eds. (2007) *Final Report of the Northeast Wisconsin Karst Task Force*. University of Wisconsin Extension: Madison, Wisconsin.

Fleming, L. E.; Bean, J. A.; Rudolph, M.; Hamilton, K. (1999) Mortality in a Cohort of Licenced Pesticide Applicators in Florida. *Occup. Environ. Med.,* **56** (1), 14–21.

Hanselman, T. A.; Graetz, D. A.; Wilkie, A. C. (2003) Manure-Borne Estrogens as Potential Environmental Contaminants: a Review. *Environ. Sci. Technol.,* **37** (24), 5471–5478.

Hanselman, T. A.; Graetz, D. A.; Wilkie, A. C.; Szabo, N. J.; Diaz, C. S. (2006) Determination of steroidal Estrogens in Flushed Dairy Manure Wastewater by Gas Chromatography-Mass Spectrometry. *J. Environ. Qual.,* **35** (3), 695–700.

Harper, S.; Sinha P. (2006) Tackling Emerging Contaminants at POTWs. *Pollut. Eng.*, Nov., 22–25.

Herschler, R. C.; Olmsted, A. W.; Edwards, A. J.; Hale, R. L.; Montgomery, T.; Preston, R. L.; Bartle, S. J.; Sheldon, J. J. (1995) Production Responses to Various Doses and Ratios of Estradiol Benzoate and Trenbolone Acetate Implants in Steers and Heifers. *J. Anim. Sci.,* **73** (1), 2873–2881.

Ho, S. M.; Tang, W. Y.; de Frausto, J. B.; Prins, G. S. (2006) Developmental Exposure to Estradiol and Bisphenol A Increases Susceptibility to Prostate Carcinogenesis and Epigenetically Regulates Phosphodiesterase Type 4 Variant 4. *Cancer Res.,* **66** (11), 5624–5632.

Hodges, L. C.; Bergerson, J. S.; Hunter, D. S.; Walker, C. L. (2000) Estrogenic Effects of Organochlorine Pesticides on Uterine Leiomyoma Cells in Vitro. *Toxicol. Sci.,* **54** (2), 355–364.

Illinois Department of Agriculture (2012) *Title 8: Agriculture and Animals, Chapter I; Department of Agriculture, Sub Chapter T: Waste Management;* Illinois Administrative Code: Springfield, Illinois.

Irwin, L. K.; Gray, S.; Oberdorster, E. (2001) Vitellogenin Induction in Painted Turtle, *Chrysemys picta*, as a Biomarker of Exposure to Environmental Levels of Estradiol. *Aquat. Toxicol.,* **55** (1–2), 49–60.

Karr, C. (2012) Children's Environmental Health in Agricultural Settings. *J. Agromedicine,* **17** (2), 127–139.

Kewaunee County Wisconsin (2010) *Kewaunee County land and Water Resource Management Plan*. Kewaunee County Land and Water Conservation Department: Kewaunee, Wisconsin.

Muldoon, M. A.; Bradbury, K. R. (2010) *Assessing Seasonal Variations in Recharge and Water Quality in the Silurian Aquifer in Areas with Thicker Soil Cover.* Wisconsin Department of Natural Resources: Madison, Wisconsin.

Murray, T. J.; Maffini, M. V.; Ucci, A. A.; Sonnenschein, C.; Soto, A. M. (2007) Induction of Mammary Gland Ductal Hyperplasias and Carcinoma in Situ Following Fetal Bisphenol A Exposure. *Reprod. Toxicol.,* **23** (3), 383–390.

National Research Council (NRC) (1999) *Hormonally Active Agents in the Environment;* National Academy Press: Washington, D.C.

National Oceanic and Atmospheric Association (NOAA) (2009) National Oceanic and Atmospheric Administration Green Bay, Wisconsin Weather Forecast Data. http://www.nws.noaa.gov/climate/index.php?wfo=grb (accessed March 31, 2009).

Panno, S. V.; Kelly, W.; Martinsek, A.; Hackley, K. (2006) Estimating Background and Threshold Nitrate Concentrations Using Probability Graphs. *Ground Water,* **44** (5), 697–709.

Panter, G. H.; Thompson, R. S.; Sumpter, J. P. (1998) Adverse Reproductive Effects in Male Fathead Minnows (*Pimephales promelas*) Exposed to Environmentally Relevant Concentrations of the Natural Oestrogens, Oestradiol and Oestrone. *Aquat. Toxicol.,* **42** (4), 243–253.

Pell, A. N. (1997) Manure and Microbes: Public and Animal Health Problem? *J. Dairy Sci.,* **80** (10), 2673–2681.

Peterson, E. W.; Davis, R. K.; Orndorff, H. A. (2000) 17 Beta-Estradiol as an Indicator of Animal Waste Contamination in Mantled Karst Aquifers. *J. Environ. Qual.,* **29** (1), 826–834.

Sakaue, M.; Ohsako, S.; Ishimura, R.; Kurosawa, S.; Kurohmaru, M.; Hayashi, Y.; Aoki, Y.; Yonemoto, J.; Tohyama, C. (2001) Bisphenol-A Affects Spermatogenesis in the Adult Rat Even at a Low Dose. *J. Occup. Health,* **43** (4), 185–190.

Shappell, N. W. (2006) Estrogenic Activity in the Environment: Municipal Wastewater Effluent, River, Ponds, and Wetlands. *J. Environ. Qual.,* **35** (1), 122–132.

Shappell, N. W.; Billey, L. O.; Forbes, D.; Matheny, T. A.; Poach, M. E.; Reddy, G. B.; Hunt, P. G. (2007) Estrogenic Activity and Steroid Hormones in Swine Wastewater through a Lagoon Constructed-Wetland System. *Environ. Sci. Technol.,* **41** (2), 444–450.

Skakkebaek, N. E.; Rajpert-De Meyts, E.; Main, K. M. (2001) Testicular Dysgenesis Syndrome: an Increasingly Common Developmental Disorder with Environmental Aspects. *Hum. Reprod.,* 16 (**5**), 972–978.

Soliman, M. A.; Pedersen, J. A.; Park, H.; Castaneda-Jimenez, A.; Stenstrom, M. K.; Suffet, I. (2007) Human Pharmaceuticals, Antioxidants, and Plasticizers in Wastewater Treatment Plant and Water Reclamation Plant Effluents. *Water Environ. Res.,* **79** (2), 156–167.

Soto, A. M.; Sonnenschein, C.; Chung, K. L.; Fernandez, M. F.; Olea, N.; Serrano, F. O. (1995) The E-Screen Assay as a Tool to Identify Estrogens – an Update on Estrogenic Environmental Pollutants. *Environ. Health Perspect.,* **103** (Suppl. 7), 113–122.

Susiarjo, M.; Hassold, T. J.; Freeman, E.; Hunt, P. A. (2007) Bisphenol A Exposure in Utero Disrupts Early Oogenesis in the Mouse. *PLoS Genet.,* **3** (1): e5.

Toniolo, P. G.; Levitz, M.; Zeleniuchjacquotte, A.; Banerjee, S.; Koenig, K. L.; Shore, R. E.; Strax, P.; Pasternack, B. S. (1995) A Prospective Study of Endogenous Estrogens and Breast Cancer in Postmenopausal Women. *J. Natl. Cancer Inst.,* **87** (3), 190–197.

Toppari, J.; Haavisto A. M.; Alanen, M. (2002) Changes in Male Reproductive Health and Effects of Endocrine Disruptors in Scandinavian Countries. *Cad. Saude. Publica,* **18** (2), 413–420.

Toppari, J.; Larsen, J. C.; Christiansen, P.; Giwercman, A.; Grandjean, P.; Guillette, L. J.; Jegou, B.; Jensen, T. K.; Jouannet, P.; Keiding, N.; Leffers, H.; McLachlan, J. A.; Meyer, O.; Muller, J.; Rajpert-DeMeyts, E.; Scheike, T.; Sharpe, R.; Sumpter, J.; Skakkebaek, N. E. (1996) Male Reproductive Health and Environmental Xenoestrogens. *Environ. Health Perspect.,* 104 (Suppl. 4), 741–803.

U.S. EPA (U.S. Environmental Protection Agency) (2009) *National Primary Drinking Water Regulations;* EPA 816-F-09-004; U.S. Environmental Protection Agency: Washington, D.C.

Vesper, D. J.; Loop, C. M.; White, W. B. (2001) Contaminant Transport in Karst Aquifers. *Speleogenesis Evol. Karst Aquifers,* **1:** 1–11.

Weir, H. K.; Marrett, L. D.; Kreiger, N.; Darlington, G. A.; Sugar, L. (2000) Pre-Natal and Peri-Natal Exposures and Risk of Testicular Germ-Cell Cancer. *Int. J. Cancer,* **87** (3), 438–443.

Wendt, K. (2007) *Determination of Nitrate/Nitrite in Surface and Wastewaters by Flow Injection Analysis (Low Flow Method): QuickChem Method 10-107-04-1-A;* Lachat Instruments: Loveland, Colorado.

Wisconsin Department of Natural Resources (2002) *Runoff Management, NR 151;* Wisconsin State Register: Madison, Wisconsin.

Wisconsin Department of Natural Resources (2010) *Groundwater Quality, NR 140;* Wisconsin State Register: Madison, Wisconsin.

Attachment H

Researchers from USDA- Agricultural Research Service, University of Wisconsin – Oshkosh, and US Geological Survey Wisconsin Water Science Center sampled 10 household wells in Kewaunee County the last week of May, 2014.

The purpose of this sampling is to gather preliminary information for a research proposal to the Wisconsin Groundwater Coordinating Council. The long-term goal of the research is twofold: 1) Quantify the levels of viruses, bacteria, and protozoa from human wastewater and cattle manure in groundwater in northeastern Wisconsin; 2) Identify management practices for septic systems and manure application that minimize groundwater contamination from these sources.

Tests were performed for four groups of microorganisms in groundwater: 1) Human viruses and bacteria that are only found in human wastewater; 2) Bovine viruses and bacteria that are only found in cattle manure; 3) Disease-causing bacteria and protozoa that are found in both human wastewater and cattle manure; 4) Microorganisms that do not cause disease, but finding them in a well indicates there is a fast route for water to travel from the surface to groundwater.

In interpreting the pilot study results it is important to keep in mind each well was sampled only once. This means the conditions at the time the sample was collected can be reported, but no conclusions can be made about the severity or frequency of contamination. In the fractured bedrock of northeastern Wisconsin water contamination can appear and disappear very quickly. In addition, the contamination source, human or livestock, can change with time, depending on the volume of wastewater and manure near the well, the number of infections from these microorganisms in humans and cattle, and weather conditions. The full study will address these questions.

Summary of Results

1) Among the 10 wells samples, 7 (70%) were positive for microbial contaminants. For a one-time sample of groundwater this is a very high contamination rate.
2) Three wells (30%) had definite evidence of contamination from human wastewater.
3) Three wells (30%) had definite evidence of cattle manure contamination.
4) Only one well was positive for the conventional indicators of water sanitary quality, total coliform and E. coli.
5) Four wells had evidence of contamination of *Salmonella* bacteria and one well was positive for the bacterium *Campylobacter jejuni*. The sources of these bacteria are unknown; they could be humans, livestock, poultry, wild birds or other wild animals. These bacteria can cause severe illness in humans. However, only genetic tests were performed for this pilot study and these tests cannot distinguish live from dead bacteria. Therefore it is not possible to make any conclusions about health risks.

It is important to note the tests used to detect human wastewater and cattle manure are very specific. When the tests are positive there is no ambiguity about the fecal source. These tests are well established in the scientific literature and have been used in research studies for years. The tests are used less often by commercial laboratories because they are highly technical and expensive.

Researcher names and affiliations

Mark A. Borchardt, Ph.D.
Research Microbiologist, USDA-ARS

Susan Spencer

Microbiologist, USDA-ARS

Maureen Muldoon, Ph.D.
Professor of Geology, UW-Oshkosh

Randall Hunt, Ph.D.
Research Hydrogeologist
USGS Wisconsin Water Science Center

Laura Hubbard
Hydrologist
USGS Wisconsin Water Science Center

Attachment I

2014 Kewaunee County Agricultural Nutrient Balance Summary

Manure Production:
76,000 cattle and calves

42,000 dairy cows (1,400 lb. lactating)	1,134,420 tons manure/year
32,848 dairy replacements	
- 5,256 Wet calves (0-4 month)	20,132 tons manure/year
- 13,797 Open heifers (4-14 month)	105,746 tons manure/year
- 13,797 Bred heifers (14 month to calving)	206,457 tons manure/year
1,151 beef cows (1,100 lb. high energy)	16,805 tons manure/year

Nutrient Production:

1,134,420 tons dairy cow manure with approximate available nutrient content of 10(N) 6(P2O5) 7(K2O)	11,344,200 lbs. N 6,806,520 lbs. P2O5 19,285,140 lbs. K2O
206,457 tons Bred heifer manure w/ approximate available nutrient content of 3(N) 3(P2O5) 6(K2O)	619,371 lbs. N 619,371 lbs. P2O5 1,238,742 lbs. K2O
105,746 tons Open heifer manure w/ approximate available nutrient content of 3(N) 3(P2O5) 6(K2O)	317,238 lbs. N 317,238 lbs. P2O5 634,476 lbs. K2O
20,132 tons Wet calf manure w/ approximate available nutrient content of 3(N) 3(P2O5) 6(K2O)	60,396 lbs. N 60,396 lbs. P2O5 120,792 lbs. K2O
16,805 tons beef cow manure w/ approx. available nutrient content of 4(N) 6(P2O5) 10(K2O)	67,218 lbs. N 100,830 lbs. P2O5 168,050 lbs. K2O
Nutrient Totals:	**12,408,423 lbs. N** **7,904,355 lbs. P2O5** **21,447,200 lbs. K2O**

Nutrient Utilization:	N	P2O5	K2O
130,228 harvested acres of agricultural crops			
Corn Silage: 25,000 ac/ 437,500 tons	4,750,000 lbs.	1,625,000 lbs.	3,625,000 lbs.
Corn Grain: 28,500 ac/4,101,150 bu.	5,415,000 lbs.	1,567,500 lbs.	1,140,000 lbs.
Soybeans: 10,400 ac/525,200 bu.	0 lbs.	416,000 lbs.	728,000 lbs.
Oats: 5,500 ac/345,950 bu.	220,000 lbs.	110,000 lbs.	605,000 lbs.
W. Wheat: 11,600 ac/887,400 bu.	870,000 lbs.	290,000 lbs.	928,000 lbs.
Forage 49,228 ac/260,100 tons (land used for all hay and all haylage, grass silage and greenchop; tons, dry equivalent)	0 lbs.	2,461,400 lbs.	11,814,720 lbs.
Total:	**11,255,000 lbs.**	**6,955,500 lbs.**	**18,840,720 lbs.**

Other considerations:

Applying manure to alfalfa has several advantages. Alfalfa provides a significant amount of available cropland for spreading manure through-out the summer months. Alfalfa removes/requires relatively high rates of nutrients and can benefit from the secondary and micronutrients as well as the primary nutrients in manure. Environmentally, alfalfa will preferentially use available N, up to 300 lb. N/acre/year, rather than symbiotically-fixing N, and because of its deep root system, can extract mobile nutrients (N, S, and B) at greater depths than corn.

A challenging exercise would be to review all nutrient management plans to calculated the amount of manure applied to alfalfa fields in Kewaunee County.

Soybeans absorb significant amounts of nitrogen from manure. Soybeans are not only very good at searching for P and K in the soil they are also very good at using up excess nitrogen. A soybean crop usually removes more nitrogen and potash than a comparable corn crop.

WDNR has permits for 15 livestock operations (14 dairies and 1 beef) in Kewaunee County. There are no pending applications for new CAFO's in Kewaunee County at this time.

A final acknowledgement is that Kewaunee County produced manure is applied to farm land in Brown, Door and Manitowoc counties, and manure is applied to Kewaunee County farmland from farms in these counties. This exchange of manures across county lines would infer that the total manure mass produced in a specific county is not necessarily applied in that same county. Thus, in any given year, it would be possible to have a manure production total which is greater than a manure utilization total for that same county. However, that is not the case in Kewaunee County currently.

Data generated from:

- 2013 Wisconsin Agricultural Statistics
- UW-Extension Nutrient and Pest Management Program-Nutrient Management Fast Facts (1/13)
- 2012 USDA Census of Agriculture
- SnapPlus Nutrient Management Planning Software

Attachment J

SAMPLE_ID	SAMP_DATE	SAMP_TIME	CO	COUNTY	TOWN	TOWNSHIP	RANGE	RANGE_DIR	SECTION	QS	QQS	NO3_Qual	Nitrate (mg/l N)	Bact_Qual	Bacteria (1=POS)	Ecoli_Qual	Ecoli (1=POS)
55146	10/9/2003	11:00	31	KEWAUNEE	West Kewaunee	23	24	E	4			<	0.1				
55950	2/22/2004	12:32	31	KEWAUNEE	Luxemburg	24	23	E	36	SE	NE		7.5		0		
56525	4/27/2004	11:00	31	KEWAUNEE	Ahnapee	25	25	E	7	SE	NE	<	0.1		0		
56562	4/26/2004	07:30	31	KEWAUNEE	Casco	24	24	E	12	SE	SE	<	0.1		0		
56998	6/8/2004		31	KEWAUNEE	Luxemburg	24	23	E	36	SE	NE		7		0		
57824	8/9/2004	07:30	31	KEWAUNEE	Red River	25	23	E	25	NW	NE		22.2		1		0
57825	8/9/2004	05:00	31	KEWAUNEE	Red River	25	23	E	1	NW	SW	<	0.1		1		0
57826	8/9/2004	07:00	31	KEWAUNEE	Red River	25	23	E	32	NW	SW	<	0.1		0		
57827	8/9/2004	11:00	31	KEWAUNEE	Luxemburg	24	23	E	2	NW	SE		3.4		0		
57828	8/9/2004	06:45	31	KEWAUNEE	Lincoln	25	24	E	19	SW	SW		0.7		1		0
57829	8/9/2004	05:00	31	KEWAUNEE	Luxemburg	24	23	E	8	NW	SW	<	0.1		0		
57830	8/9/2004		31	KEWAUNEE	Luxemburg	24	23	E	4	SW	NW	<	0.1		0		
57831	8/9/2004	08:30	31	KEWAUNEE	Red River	25	23	E	26	NW	NW		4.1		1		0
57832	8/9/2004	06:45	31	KEWAUNEE	Montpelier	23	23	E	15	SW	SW		4.8		0		
57833	8/9/2004	08:55	31	KEWAUNEE	Luxemburg	24	23	E	5	NW	NE	<	0.1		1		0
57834	8/9/2004	09:00	31	KEWAUNEE	Lincoln	25	24	E	33	SE	SW		0.3		0		
57835	8/9/2004	12:05	31	KEWAUNEE	Red River	25	23	E	32	NW	NW		0.2		0		
57836	8/9/2004	08:30	31	KEWAUNEE	Lincoln	25	24	E	34	SW	NW		0.6		0		
57837	8/9/2004	05:40	31	KEWAUNEE	Lincoln	25	24	E	29	SW	NW		4.6		1		0
57838	8/9/2004	10:00	31	KEWAUNEE	Red River	25	23	E	18	NW	NW	<	0.1		0		
57839	8/9/2004	07:15	31	KEWAUNEE	Red River	25	23	E	3	SW	SE		0.9		1		0
57840	8/9/2004	07:30	31	KEWAUNEE	Luxemburg	24	23	E	31	SW	SE	<	0.1		0		
57841	8/9/2004	09:55	31	KEWAUNEE	Luxemburg	24	23	E	31	SW	SE		0.3		0		
57842	8/9/2004		31	KEWAUNEE	Lincoln	25	24	E	26	SE	NE		11.7		1		0
57843	8/9/2004	06:30	31	KEWAUNEE	Lincoln	25	24	E	25	SW	SE	<	0.1		0		
57844	8/9/2004	05:00	31	KEWAUNEE	Lincoln	25	24	E	8	NW	NE	<	0.1		1		0
57845	8/9/2004	05:15	31	KEWAUNEE	Red River	25	23	E	13	SW	NW		9.6		0		
57846	8/9/2004	09:50	31	KEWAUNEE	Lincoln	25	24	E	35	SE	SW		1.7		0		
57847	8/9/2004	07:00	31	KEWAUNEE	Luxemburg	24	23	E	24	SE	NE		1		0		
57848	8/9/2004		31	KEWAUNEE	Red River	25	23	E	34	NE	SE		19.7		1		0
57849	8/9/2004	08:45	31	KEWAUNEE	Luxemburg	24	23	E	19	SW	SW	<	0.1		0		
57850	8/9/2004	08:00	31	KEWAUNEE	Lincoln	25	24	E	2	SW	SW		6.6		1		1
57851	8/9/2004	07:00	31	KEWAUNEE	Red River	25	23	E	19	SE	SE	<	0.1		1		0
57852	8/9/2004	06:45	31	KEWAUNEE	Red River	25	23	E	8	NE	NW		3.9		1		1
57853	8/9/2004	12:45	31	KEWAUNEE	Luxemburg	24	23	E	33	NE	NE		9.2		0		
57854	8/9/2004	07:05	31	KEWAUNEE	Red River	25	23	E	30	NE	SE		0.2		0		
57855	8/9/2004	12:35	31	KEWAUNEE	Luxemburg	24	23	E	10	NE	NW		20.3		0		
57856	8/9/2004	08:00	31	KEWAUNEE	Luxemburg	24	23	E	21	SE	SW		0.3		0		
57857	8/9/2004	12:48	31	KEWAUNEE	Luxemburg	24	23	E	33	NE	NE		1.3		0		
57858	8/9/2004	11:00	31	KEWAUNEE	Luxemburg	24	23	E	22	SE	SW	<	0.1		0		
57859	8/9/2004		31	KEWAUNEE	Luxemburg	24	23	E	22	SE	SW	<	0.1		0		
57860	8/9/2004	07:45	31	KEWAUNEE	Red River	25	23	E	20	NE	NE	<	0.1		1		0
57861	8/9/2004	10:00	31	KEWAUNEE	Red River	25	23	E	25	NW	NE		26.9		0		
57862	8/9/2004	07:00	31	KEWAUNEE	Lincoln	25	24	E	29	SW	NW		13.9		0		
57863	8/9/2004	15:25	31	KEWAUNEE	Red River	25	23	E	23	SE	SW		9		1		0
58245	9/13/2004	14:34	31	KEWAUNEE	Luxemburg	24	23	E	36	SE	NE		6.9		0		
58275	9/20/2004		31	KEWAUNEE	Franklin	22	23	E	1	SW	SW		0.3		0		
59079	2/8/2005	13:46	31	KEWAUNEE	Luxemburg	24	23	E	36	SE	NE		7.6		0		
59339	3/29/2005	15:15	31	KEWAUNEE	Montpelier	23	23	E	18	SE	SE	<	0.1		0		
59372	3/28/2005	09:05	31	KEWAUNEE	Luxemburg	24	23	E	36	SE	NE		7.6		0		
59379	3/28/2005	07:15	31	KEWAUNEE	Lincoln	25	24	E	29	SW	NW		1.4		1		0
59380	3/28/2005	09:54	31	KEWAUNEE	Luxemburg	24	23	E	16	SW	SE	<	0.1		0		
59381	3/28/2005	07:15	31	KEWAUNEE	Casco	24	24	E	32	NW	NE		5.1		1		0
59382	3/28/2005	04:00	31	KEWAUNEE	Red River	25	23	E	30	SE	SE		1.8		0		
59383	3/28/2005	16:00	31	KEWAUNEE	Carlton	22	24	E	17	SE	SE	<	0.1		0		
59384	3/28/2005	07:30	31	KEWAUNEE	Casco	24	24	E	18	NE	SE		3.3		0		
59385	3/28/2005	16:00	31	KEWAUNEE	Carlton	22	24	E	2	SE	NE	<	0.1		0		
59386	3/28/2005	06:35	31	KEWAUNEE	Red River	25	23	E	23	SW	NE		2		0		
59387	3/28/2005	07:30	31	KEWAUNEE	Red River	25	23	E	25	NW	NE		6.9		1		0
59388	3/28/2005	06:00	31	KEWAUNEE	Red River	25	23	E	1	NE	NW		6.7		1		0
59389	3/28/2005	07:11	31	KEWAUNEE	Red River	25	23	E	26	SE	SE		3.1		0		
59390	3/28/2005	10:15	31	KEWAUNEE	Pierce	24	25	E	32	SW	SW	<	0.1		0		
59391	3/28/2005	06:30	31	KEWAUNEE	Casco	24	24	E	10	SW	SW	<	0.1		0		
59392	3/28/2005	09:21	31	KEWAUNEE	Luxemburg	24	23	E	25	NE	SE		3.7		0		
59393	3/28/2005	13:10	31	KEWAUNEE	Ahnapee	25	25	E	32	SE	SE	<	0.1		0		
59394	3/28/2005	16:00	31	KEWAUNEE	Lincoln	25	24	E	19	SW	SW		0.4		0		
59395	3/28/2005	09:30	31	KEWAUNEE	Lincoln	25	24	E	31	NW	NE		9.7		1		0
59396	3/28/2005	04:35	31	KEWAUNEE	Lincoln	25	24	E	8	NW	NE	<	0.1		0		
59397	3/28/2005	07:54	31	KEWAUNEE	Red River	25	23	E	3	SW	SE		0.3		0		
59398	3/28/2005	12:00	31	KEWAUNEE	Carlton	22	24	E	9	NE	NW	<	0.1		0		
59399	3/28/2005	08:00	31	KEWAUNEE	Luxemburg	24	23	E	3	SW	SE		4.8		0		
59400	3/28/2005	10:05	31	KEWAUNEE	Montpelier	23	23	E	15	NW	NE		4.2		0		
59401	3/28/2005	13:00	31	KEWAUNEE	Luxemburg	24	23	E	2	NW	SE		3.4		0		
59402	3/28/2005	15:40	31	KEWAUNEE	West Kewaunee	23	24	E	21	SW	SW	<	0.1		0		
59403	3/28/2005	15:50	31	KEWAUNEE	West Kewaunee	23	24	E	18	NE	SW		3.5		0		
59404	3/28/2005	04:40	31	KEWAUNEE	Luxemburg	24	23	E	31	SE	NE	<	0.1		0		
59405	3/28/2005	12:10	31	KEWAUNEE	Franklin	22	23	E	13	NE	NW	<	0.1		0		
59406	3/28/2005	15:35	31	KEWAUNEE	Franklin	22	23	E	3	NW	NW	<	0.1		0		
59407	3/28/2005	08:25	31	KEWAUNEE	Luxemburg	24	23	E	10	NE	SE		0.2		0		
59408	3/28/2005	08:30	31	KEWAUNEE	Luxemburg	24	23	E	10	NE	NW		11.8		0		
59409	3/28/2005	16:03	31	KEWAUNEE	West Kewaunee	23	24	E	15	SW	SE	<	0.1		1		0
59410	3/28/2005	13:00	31	KEWAUNEE	Luxemburg	24	23	E	1	SE	NE	<	0.1		0		
59411	3/28/2005	13:20	31	KEWAUNEE	Casco	24	24	E	17	NW	SE		4.4		0		
59412	3/28/2005	07:00	31	KEWAUNEE	West Kewaunee	23	24	E	10	NE	SE	<	0.1		0		
59413	3/28/2005	15:00	31	KEWAUNEE	Red River	25	23	E	34	NE	SE		16.1		1		0
59414	3/28/2005	12:40	31	KEWAUNEE	Casco	24	24	E	4	SW	SE		5.3		0		
59415	3/28/2005	10:00	31	KEWAUNEE	Casco	24	24	E	4	NE	SE	<	0.1		0		
59416	3/28/2005	15:45	31	KEWAUNEE	West Kewaunee	23	24	E	4	NW	NW	<	0.1		0		
59417	3/28/2005	12:30	31	KEWAUNEE	Franklin	22	23	E	31	NW	NE	<	0.1		0		
59418	3/28/2005	08:48	31	KEWAUNEE	Casco	24	24	E	17	SW	SE		4.8		0		
59419	3/28/2005	09:30	31	KEWAUNEE	Carlton	22	24	E	27	NE	NE	<	0.1		0		
59420	3/28/2005	11:00	31	KEWAUNEE	Casco	24	24	E	27	NE	SE	<	0.1		0		
59421	3/28/2005	13:00	31	KEWAUNEE	Casco	24	24	E	6	NE	NW		0.9		1		0
59422	3/28/2005	06:20	31	KEWAUNEE	Montpelier	23	23	E	24	SE	SE		2.2		0		
59423	3/28/2005	08:00	31	KEWAUNEE	Red River	25	23	E	35	NE	SW		15.4		0		
59424	3/28/2005	12:00	31	KEWAUNEE	Lincoln	25	24	E	4	SE	SW		4.5		0		
59425	3/28/2005	10:25	31	KEWAUNEE	Casco	24	24	E	17	SW	SE		5.5		0		
59426	3/28/2005	07:00	31	KEWAUNEE	Red River	25	23	E	35	NE	NW		13.2		0		
59427	3/28/2005	09:00	31	KEWAUNEE	Casco	24	24	E	8	SW	SW		0.3		0		
59428	3/28/2005	07:25	31	KEWAUNEE	Luxemburg	24	23	E	31	SW	SE	<	0.1		0		
59429	3/28/2005	06:45	31	KEWAUNEE	Montpelier	23	23	E	16	SE	SE		2.1		0		
59430	3/28/2005	10:00	31	KEWAUNEE	Pierce	24	25	E	5	NW	NE	<	0.1		0		
59431	3/28/2005	10:45	31	KEWAUNEE	Pierce	24	25	E	3	SW	NE	<	0.1		0		
59432	3/28/2005	15:15	31	KEWAUNEE	Red River	25	23	E	24	SW	SE		10		0		
59433	3/28/2005	12:00	31	KEWAUNEE	Lincoln	25	24	E	4	SE	SW		10.3		0		
59434	3/28/2005	15:55	31	KEWAUNEE	West Kewaunee	23	24	E	4	SE	NE	<	0.1		0		
59435	3/28/2005	09:00	31	KEWAUNEE	Casco	24	24	E	20	NW	NW		1.4		0		
59436	3/28/2005	12:45	31	KEWAUNEE	Red River	25	23	E	12	NE	SE		0.3		0		
59437	3/28/2005	14:30	31	KEWAUNEE	Franklin	22	23	E	1	SW	SW		5.7		0		
59438	3/28/2005	08:00	31	KEWAUNEE	Red River	25	23	E	25	SE	SW		12.9		0		
59439	3/28/2005	12:40	31	KEWAUNEE	West Kewaunee	23	24	E	9	NW	NW	<	0.1		0		
59440	3/28/2005	12:00	31	KEWAUNEE	Lincoln	25	24	E	4	SE	SE		0.3		1		1
59441	3/28/2005	08:20	31	KEWAUNEE	Montpelier	23	23	E	22	NE	NE		28.8		0		
59442	3/28/2005	10:15	31	KEWAUNEE	Ahnapee	25	25	E	5	NE	NW	<	0.1		0		
59443	3/28/2005	08:10	31	KEWAUNEE	Carlton	22	24	E	7	NE	NE	<	0.1		0		
59444	3/28/2005	15:00	31	KEWAUNEE	Pierce	24	25	E	17	SW	SW		0.2		0		
60287	7/25/2005	08:35	31	KEWAUNEE	Luxemburg	24	23	E	36	SE	NE		7.5		0		
60880	9/28/2005	09:29	31	KEWAUNEE	Luxemburg	24	23	E	36	SE	NE		7.4		0		
61442	11/7/2005	11:40	31	KEWAUNEE	Luxemburg	24	23	E	15	NW	NW	<	0.1		0		
61443	11/7/2005	13:00	31	KEWAUNEE	Red River	25	23	E	34	NE	SE	<	0.1		0		
61444	11/7/2005		31	KEWAUNEE	Luxemburg	24	23	E	16	SE	NW	<	0.1		0		

SAMPLE_ID	SAMP_DATE	SAMP_TIME	CO	COUNTY	TOWN	TOWNSHIP	RANGE	RANGE_DIR	SECTION	QS	QQS	NO3_Qual	Nitrate (mg/l N)	Bact_Qual	Bacteria (1=POS)	Ecoli_Qual	Ecoli (1=POS)
61445	11/7/2005	05:45	31	KEWAUNEE	Montpelier	23	23	E	19	NE	SE	<	0.1		1		0
61446	11/7/2005	13:00	31	KEWAUNEE	Casco	24	24	E	17	NW	NE		4.5		0		
61447	11/7/2005	14:45	31	KEWAUNEE	Luxemburg	24	23	E	13	NW	NW	<	0.1		0		
61448	11/6/2005	17:15	31	KEWAUNEE	West Kewaunee	23	24	E	30	NE	NW		1.8		1		1
61449	11/7/2005	06:35	31	KEWAUNEE	Franklin	22	23	E	2	NE	SE		2.3		0		
61450	11/7/2005	06:00	31	KEWAUNEE	Luxemburg	24	23	E	26	NW	NE		11.3		1		0
61451	11/7/2005	09:20	31	KEWAUNEE	Luxemburg	24	23	E	2	NE	NE	<	0.1		0		
61452	11/7/2005	11:43	31	KEWAUNEE	Carlton	22	24	E	29	NW	NE	<	0.1		0		
61453	11/7/2005	11:45	31	KEWAUNEE	Red River	25	23	E	24	NE	NW		1.1		0		
61454	11/7/2005	14:15	31	KEWAUNEE	Franklin	22	23	E	28	NW	NE	<	0.1		0		
61455	11/7/2005	07:45	31	KEWAUNEE	Red River	25	23	E	27	NE	NW		16.1		1		1
61456	11/7/2005	10:12	31	KEWAUNEE	Casco	24	24	E	19	SW	SW	<	0.1		0		
61457	11/6/2005	18:30	31	KEWAUNEE	West Kewaunee	23	25	E	30	SE	NW	<	0.1		0		
61458	11/7/2005	09:30	31	KEWAUNEE	Red River	25	23	E	3	SW	SE	<	0.1		0		
61459	11/7/2005	12:50	31	KEWAUNEE	Luxemburg	24	23	E	25	SE	SW	<	0.1		1		0
61460	11/7/2005	07:40	31	KEWAUNEE	Montpelier	23	23	E	7	NE	NE		1.1		0		
61461	11/7/2005	10:45	31	KEWAUNEE	Luxemburg	24	23	E	2	NE	NW		11.2		0		
61462	11/6/2005	18:45	31	KEWAUNEE	West Kewaunee	23	25	E	30	SE	NW	<	0.1		0		
61463	11/7/2005	11:48	31	KEWAUNEE	Carlton	22	24	E	20	SW	SE	<	0.1		0		
61464	11/7/2005	08:00	31	KEWAUNEE	Luxemburg	24	23	E	11	NW	NW	<	0.1		0		
61465	11/7/2005	09:00	31	KEWAUNEE	Casco	24	24	E	29	NW	NE		3		0		
61466	11/7/2005	09:10	31	KEWAUNEE	West Kewaunee	23	24	E	17	SE	NE	<	0.1		1		0
61467	11/7/2005	08:15	31	KEWAUNEE	Luxemburg	24	23	E	16	SE	NW	<	0.1		1		0
61468	11/7/2005	12:25	31	KEWAUNEE	Lincoln	25	24	E	27	SE	SW		14.6		1		0
61469	11/7/2005	07:41	31	KEWAUNEE	Luxemburg	24	23	E	31	SW	SE	<	0.1		0		
61470	11/7/2005	04:25	31	KEWAUNEE	Luxemburg	24	23	E	10	SE	NE	<	0.1		0		
61471	11/7/2005	06:57	31	KEWAUNEE	Franklin	22	23	E	12	NW	NW	<	0.1		0		
61472	11/7/2005	15:30	31	KEWAUNEE	Luxemburg	24	23	E	33	NE	NE		2.7		0		
61473	11/7/2005	07:15	31	KEWAUNEE	Red River	25	23	E	35	NW	SE		9.2		0		
61474	11/7/2005	05:00	31	KEWAUNEE	Red River	25	23	E	24	SW	SE		5.1		0		
61475	11/7/2005	05:00	31	KEWAUNEE	Montpelier	23	23	E	11	SW	NW	<	0.1		0		
61476	11/7/2005	15:20	31	KEWAUNEE	Ahnapee	25	25	E	28	SE	SW	<	0.1		0		
61477	11/7/2005	14:45	31	KEWAUNEE	West Kewaunee	23	24	E	19	NW	NW		3.2		0		
61478	11/7/2005	10:00	31	KEWAUNEE	Luxemburg	24	23	E	33	NE	NE		10		1		0
61479	11/7/2005	08:20	31	KEWAUNEE	Red River	25	23	E	18	NW	SW	<	0.1		0		
61480	11/7/2005	08:25	31	KEWAUNEE	Red River	25	23	E	8	NE	NW		1.3		1		1
61481	11/7/2005	15:00	31	KEWAUNEE	Carlton	22	24	E	32	SE	SE	<	0.1		0		
61482	11/7/2005	08:10	31	KEWAUNEE	Red River	25	23	E	7	NE	NE	<	0.1		0		
61483	11/7/2005	15:38	31	KEWAUNEE	Ahnapee	25	25	E	32	NW	SW	<	0.1		0		
61484	11/7/2005	06:45	31	KEWAUNEE	Ahnapee	25	25	E	28	SW	NE	<	0.1		0		
61485	11/7/2005	13:30	31	KEWAUNEE	Red River	25	23	E	8	SW	NE		7.2		1		0
61486	11/7/2005	16:00	31	KEWAUNEE	Red River	25	23	E	23	SE	SW		21.1		1		1
61487	11/7/2005	10:15	31	KEWAUNEE	Franklin	22	23	E	5	NW	NW	<	0.1		0		
61488	11/7/2005	06:00	31	KEWAUNEE	Ahnapee	25	25	E	2	SW	NW	<	0.1		1		0
61489	11/7/2005	06:30	31	KEWAUNEE	Red River	25	23	E	13	SW	NW		3.9		0		
61490	11/5/2005	16:00	31	KEWAUNEE	Luxemburg	24	23	E	10	NE	NW		10.1		0		
61491	11/7/2005	15:45	31	KEWAUNEE	Casco	24	24	E	17	NE	NW		3.2		0		
61492	11/7/2005	10:00	31	KEWAUNEE	Luxemburg	24	23	E	14	NW	NE		1.9		0		
61493	11/7/2005	07:45	31	KEWAUNEE	Casco	24	24	E	1	SE	SE	<	0.1		0		
61494	11/7/2005		31	KEWAUNEE	Ahnapee	25	25	E	29	NW	SW		0.5		0		
61495	11/7/2005	10:30	31	KEWAUNEE	Red River	25	23	E	27	NE	NW		6.2		0		
62222	3/27/2006	12:00	31	KEWAUNEE	West Kewaunee	23	24	E	10	NW	NE		0.1		0		
62223	3/27/2006	06:00	31	KEWAUNEE	Casco	24	24	E	9	SE	SE		0.1		0		
62224	3/27/2006	09:15	31	KEWAUNEE	Luxemburg	24	23	E	13	NW	NW		0.1		0		
62225	3/27/2006	15:00	31	KEWAUNEE	Red River	25	23	E	34	NE	SE		0.1		0		
62226	3/27/2006	13:00	31	KEWAUNEE	West Kewaunee	23	24	E	36	NW	NW		0.1		0		
62227	3/27/2006	05:30	31	KEWAUNEE	Red River	25	23	E	13	SW	NW		9		0		
62228	3/27/2006	07:30	31	KEWAUNEE	Franklin	22	23	E	31	NW	NE		0.1		0		
62229	3/26/2006	23:30	31	KEWAUNEE	Luxemburg	24	23	E	13	NW	SE		0.1		0		
62230	3/27/2006	06:45	31	KEWAUNEE	Luxemburg	24	23	E	25	NE	SE		4.9		0		
62231	3/27/2006	09:00	31	KEWAUNEE	West Kewaunee	23	25	E	19				0.2		0		
62232	3/27/2006	08:30	31	KEWAUNEE	Casco	24	24	E	16	SW	NW		3.4		0		
62233	3/27/2006	12:15	31	KEWAUNEE	West Kewaunee	23	24	E	21	NW	SW		5.1		0		
62234	3/27/2006	11:00	31	KEWAUNEE	Red River	25	23	E	12	NE	SE		9.5		1		0
62235	3/27/2006	13:00	31	KEWAUNEE	Lincoln	25	24	E	27	NW	SE		0.1		0		
62236	3/27/2006	07:00	31	KEWAUNEE	Red River	25	23	E	28	SE	NW		15.6		0		
62237	3/27/2006	07:30	31	KEWAUNEE	Casco	24	24	E	2	SE	NW		0.1		0		
62238	3/27/2006		31	KEWAUNEE	Red River	25	23	E	18	SE	SE		8.6		0		
62239	3/27/2006	11:45	31	KEWAUNEE	Red River	25	23	E	23	SE	SW		20.4		1		0
62240	3/27/2006	09:40	31	KEWAUNEE	Luxemburg	24	23	E	15	NW	NW	<	0.1		0		
62241	3/27/2006	05:30	31	KEWAUNEE	Lincoln	25	24	E	30	NW	NW		0.1		0		
62242	3/27/2006	08:12	31	KEWAUNEE	Red River	25	23	E	26	SE	SW		12.3		0		
62243	3/27/2006	12:15	31	KEWAUNEE	Red River	25	23	E	35	NW	SW		8.8		0		
62245	3/27/2006	11:00	31	KEWAUNEE	Red River	25	23	E	25	NW	NE		21.7		1		0
62246	3/27/2006		31	KEWAUNEE	Luxemburg	24	23	E	24	NW	NE		16.4		0		
62247	3/27/2006	07:30	31	KEWAUNEE	Red River	25	23	E	27	NE	NW		26.1		1		0
62248	3/27/2006	14:00	31	KEWAUNEE	Luxemburg	24	23	E	20	SE	SW	<	0.1		0		
62249	3/27/2006	13:50	31	KEWAUNEE	Luxemburg	24	23	E	20	SE	SW		17.2		1		0
62250	3/27/2006	13:00	31	KEWAUNEE	Montpelier	23	23	E	35	SW	SE	<	0.1		1		0
62251	3/27/2006	07:00	31	KEWAUNEE	Luxemburg	24	23	E	10	NE	NW		12.4		0		
62252	3/27/2006	10:30	31	KEWAUNEE	West Kewaunee	23	24	E	20	SE	SW	<	0.1		0		
62253	3/27/2006		31	KEWAUNEE	Luxemburg	24	23	E	23	NE	NW		3.9		0		
62254	3/27/2006	12:30	31	KEWAUNEE	Carlton	22	24	E	24	NE	SW	<	0.1		0		
62255	3/27/2006	11:30	31	KEWAUNEE	West Kewaunee	23	24	E	23	SW	SW	<	0.1		0		
62256	3/27/2006	06:45	31	KEWAUNEE	Red River	25	23	E	3	SW	SE		0.7		0		
62257	3/27/2006	09:03	31	KEWAUNEE	Franklin	22	23	E	21	SE	SE	<	0.1		0		
62258	3/27/2006	06:40	31	KEWAUNEE	Red River	25	23	E	23	SW	NE		2		0		
62259	3/27/2006	07:00	31	KEWAUNEE	Franklin	22	23	E	24	NW	NW	<	0.1		0		
62260	3/27/2006	07:30	31	KEWAUNEE	Red River	25	23	E	18	NE	NE		1		0		
62261	3/27/2006	08:00	31	KEWAUNEE	Ahnapee	25	25	E	26	NE	NW	<	0.1		0		
62262	3/27/2006	14:30	31	KEWAUNEE	Casco	24	24	E	32	NW	NE		10.5		0		
62263	3/27/2006	05:00	31	KEWAUNEE	Red River	25	23	E	24	SW	SE		18.8		1		0
62264	3/27/2006	10:40	31	KEWAUNEE	Franklin	22	23	E	14	SW	NW		7.6		0		
62265	3/27/2006	14:35	31	KEWAUNEE	Luxemburg	24	23	E	2	NE	NW		9.8		0		
62266	3/27/2006	05:00	31	KEWAUNEE	Red River	25	23	E	9	SW	SE	<	0.1		0		
62267	3/27/2006		31	KEWAUNEE	West Kewaunee	23	24	E	29	NW	NE		0.2		0		
62303	4/11/2006	15:14	31	KEWAUNEE	Luxemburg	24	23	E	36	SE	NE				0		
62549	5/8/2006	13:27	31	KEWAUNEE	Casco	24	24	E	17	NW	SE		2.9		0		
62558	5/8/2006	14:00	31	KEWAUNEE	Ahnapee	25	25	E	7	SE	NE	<	0.1		0		
62786	5/23/2006	13:00	31	KEWAUNEE	Carlton	22	24	E				<	0.1		0		
63396	7/31/2006	08:00	31	KEWAUNEE	Lincoln	25	24	E	20				7.2		1		0
63399	7/31/2006	10:00	31	KEWAUNEE	Red River	25	23	E					3.3		0		
63898	9/11/2006	14:00	31	KEWAUNEE								<	0.1		0		
64023	9/25/2006	08:00	31	KEWAUNEE	West Kewaunee	23	24	E	36	NW	NW	<	0.1		1		0
64258	10/16/2006	13:00	31	KEWAUNEE	Red River	25	23	E					0.8		1		0
64545	11/14/2006	10:50	31	KEWAUNEE	Luxemburg	24	23	E	36	SE	NE		7.2		0		
64759	1/22/2007	09:30	31	KEWAUNEE	Red River	25	23	E				<	0.1		0		
64772	1/16/2007	14:05	31	KEWAUNEE	Red River	25	23	E	1	NE	NE		0.2		1		1
64805	1/29/2007	09:00	31	KEWAUNEE	Luxemburg	24	23	E				<	0.1		0		
65047	2/26/2007	08:10	31	KEWAUNEE	Luxemburg	24	23	E	36	SE	NE		7.7		0		
65281	3/19/2007	10:30	31	KEWAUNEE	Red River	25	23	E	6	NE	SE	<	0.1		1		0
65282	3/19/2007	16:00	31	KEWAUNEE	Montpelier	23	23	E	27	NE	SE	<	0.1		0		
65283	3/19/2007	14:00	31	KEWAUNEE	Red River	25	23	E	9	NW	NE	<	0.1		0		
65284	3/19/2007	08:00	31	KEWAUNEE	Franklin	22	23	E	1	SW	NW		2.8		0		
65285	3/19/2007	06:30	31	KEWAUNEE	Montpelier	23	23	E	19	NE	NE	<	0.1		0		
65286	3/19/2007	06:40	31	KEWAUNEE	Red River	25	23	E	8	SW	NE		6.7		1		1
65287	3/19/2007	05:00	31	KEWAUNEE	West Kewaunee	23	24	E	15	SE	SE	<	0.1		0		
65288	3/19/2007	05:00	31	KEWAUNEE	West Kewaunee	23	24	E	10	SE	NE	<	0.1		0		
65289	3/19/2007	07:20	31	KEWAUNEE	Red River	25	23	E	27	SE	NW		6.6		0		
65290	3/19/2007	09:00	31	KEWAUNEE	Carlton	22	24	E	6	SW	NE	<	0.1		1		0
65291	3/19/2007	20:30	31	KEWAUNEE	Casco	24	24	E	32	NW	NE		10.6		1		0

SAMPLE_ID	SAMP_DATE	SAMP_TIME	CO	COUNTY	TOWN	TOWNSHIP	RANGE	RANGE_DIR	SECTION	QS	QQS	NO3_Qual	Nitrate (mg/l N)	Bact_Qual	Bacteria (1=POS)	Ecoli_Qual	Ecoli (1=POS)
65292	3/19/2007	04:55	31	KEWAUNEE	Luxemburg	24	23	E	13	NW	NW	<	0.1		0		
65293	3/19/2007	05:00	31	KEWAUNEE	Casco	24	24	E	17	NW	NW		0.7		0		
65294	3/18/2007	18:00	31	KEWAUNEE	Luxemburg	24	23	E	3	SW	SE		12.3		0		
65295	3/19/2007	10:37	31	KEWAUNEE	Lincoln	25	24	E	29	SE	SE		1.4		0		
65296	3/19/2007	14:00	31	KEWAUNEE	Franklin	22	23	E	30	NE	NE	<	0.1		0		
65297	3/19/2007	11:15	31	KEWAUNEE	Luxemburg	24	23	E	26	NW	NE		10.6		0		
65298	3/19/2007	15:30	31	KEWAUNEE	Luxemburg	24	23	E	13	NW	NW	<	0.1		0		
65299	3/19/2007	10:00	31	KEWAUNEE	Luxemburg	24	23	E	27	SE	NE		22.9		0		
65300	3/19/2007	07:30	31	KEWAUNEE	Red River	25	23	E	32	NW	NW	<	0.1		0		
65301	3/19/2007	09:48	31	KEWAUNEE	Franklin	22	23	E	21	SE	SW	<	0.1		0		
65302	3/19/2007	08:00	31	KEWAUNEE	Franklin	22	23	E	19	SE	SE	<	0.1		0		
65303	3/19/2007	08:00	31	KEWAUNEE	Luxemburg	24	23	E	4	NE	SE	<	0.1		0		
65304	3/19/2007	08:00	31	KEWAUNEE	Ahnapee	25	26	E	6	NE	SE	<	0.1		0		
65305	3/19/2007	08:50	31	KEWAUNEE	Red River	25	23	E	3	SW	SE		0.2		0		
65306	3/19/2007	13:00	31	KEWAUNEE	Franklin	22	23	E	36	NE	SE		12.2		0		
65307	3/19/2007	15:30	31	KEWAUNEE	Lincoln	25	24	E	10	NE	NW		23.3		1		0
65308	3/19/2007	09:30	31	KEWAUNEE	Red River	25	23	E	34	NE	SE	<	0.1		0		
65309	3/19/2007	16:10	31	KEWAUNEE	Carlton	22	24	E	29	SE	NE	<	0.1		0		
65310	3/19/2007	12:30	31	KEWAUNEE	Montpelier	23	23	E	29	SW	NE	<	0.1		0		
65311	3/19/2007	08:00	31	KEWAUNEE	Ahnapee	25	25	E	15	NE	SE		0.5		0		
65312	3/19/2007	06:30	31	KEWAUNEE	Luxemburg	24	23	E	2	NW	SE		2.7		0		
65313	3/19/2007	12:15	31	KEWAUNEE	Carlton	22	24	E	29	NW	NE	<	0.1		0		
65314	3/19/2007	09:30	31	KEWAUNEE	Lincoln	25	24	E	2	SW	SW		9.1		1		0
65315	3/19/2007	12:45	31	KEWAUNEE	Pierce	24	25	E	32	SE	NW	<	0.1		0		
65316	3/19/2007	10:00	31	KEWAUNEE	Casco	24	24	E	30	NW	NE	<	0.1		0		
65317	3/19/2007	08:00	31	KEWAUNEE	Casco	24	24	E	28	NE	NE	<	0.1		1		0
65318	3/19/2007	08:00	31	KEWAUNEE	Carlton	22	24	E	17	SW	SE	<	0.1		0		
65319	3/19/2007	07:50	31	KEWAUNEE	Casco	24	24	E	17	SE	NW		4.8		0		
65320	3/19/2007	06:30	31	KEWAUNEE	Red River	25	23	E	23	SE	SW		16.3		1		1
65321	3/19/2007	07:30	31	KEWAUNEE	Red River	25	23	E	25	NW	NE		13		1		1
65322	3/19/2007	06:00	31	KEWAUNEE	Casco	24	24	E	17	NW	NW		4.3		0		
65323	3/19/2007	05:30	31	KEWAUNEE	Franklin	22	23	E	34	NW	SW	<	0.1		0		
65324	3/19/2007	05:00	31	KEWAUNEE	Red River	25	23	E	23	NE	SE		6.3		0		
65325	3/19/2007	08:30	31	KEWAUNEE	Lincoln	25	24	E	32	NE	NE		1.3		0		
65326	3/19/2007	07:00	31	KEWAUNEE	Red River	25	23	E	27	NE	NW		2.1		0		
65327	3/19/2007	04:30	31	KEWAUNEE	Red River	25	23	E	18	SE	SE		3		0		
65328	3/19/2007	07:45	31	KEWAUNEE	Lincoln	25	24	E	35	SW	SW		16		0		
65329	3/19/2007	10:30	31	KEWAUNEE	Red River	25	23	E	12	NE	SE		4		1		0
65330	3/19/2007	06:20	31	KEWAUNEE	Red River	25	23	E	20	NE	NW	<	0.1		0		
65331	3/19/2007	11:00	31	KEWAUNEE	West Kewaunee	23	24	E	17	NE	NE		6.2		1		0
65332	3/19/2007	08:00	31	KEWAUNEE	Casco	24	24	E	18	NE	NE		2.8		1		0
65334	3/19/2007	07:10	31	KEWAUNEE	Luxemburg	24	23	E	25	NE	SE		3.8		0		
65401	4/2/2007	07:30	31	KEWAUNEE	Pierce	24	25	E	19	NE	SE	<	0.1		0		
65452	4/9/2007	05:54	31	KEWAUNEE	Red River	25	23	E	4	SW	SE	<	0.1		0		
65832	5/21/2007	15:00	31	KEWAUNEE	Red River	25	23	E	16	SE	NW	<	0.1		0		
66247	6/25/2007	12:40	31	KEWAUNEE	Luxemburg	24	23	E	7			<	0.1		0		
66256	6/25/2007	15:30	31	KEWAUNEE	Ahnapee	25	25	E	22	SE	SE	<	0.1		0		
66698	7/16/2007	10:05	31	KEWAUNEE	Luxemburg	24	23	E	36	SE	NE		7.4		0		
66972	8/13/2007	11:30	31	KEWAUNEE	Casco	24	24	E	32	NE	SW		5		0		
67082	8/28/2007	09:30	31	KEWAUNEE	Franklin	22	23	E				<	0.1		0		
67417	9/17/2007		31	KEWAUNEE	Red River	25	23	E	23	NW	NE		19.6		0		
67748	10/29/2007	14:45	31	KEWAUNEE	Luxemburg	24	23	E	36	SE	NE		7.6		0		
68102	12/10/2007	13:41	31	KEWAUNEE	Pierce	24	25	E	3	NE		<	0.1		1		0
68105	12/10/2007	11:30	31	KEWAUNEE	Casco	24	24	E	18	NW	SW	<	0.1		0		
68264	1/28/2008	09:00	31	KEWAUNEE	Carlton	22	24	E	6	SW	NE	<	0.1		1		0
68419	2/19/2008	13:32	31	KEWAUNEE	Luxemburg	24	23	E	36	SE	NE		7.8		0		
68436	2/25/2008	09:00	31	KEWAUNEE	Carlton	22	24	E					0.1		1		0
68687	3/24/2008	10:30	31	KEWAUNEE	Carlton	22	24	E				<	0.1		1		0
68716	3/31/2008	08:00	31	KEWAUNEE	Franklin	22	23	E	23	SW	NE	<	0.1		0		
68880	4/7/2008	19:10	31	KEWAUNEE	Ahnapee	25	25	E	22	SE	SE	<	0.1		0		
68900	4/7/2008	12:00	31	KEWAUNEE	Pierce	24	25	E	5	NW	NE	<	0.1		0		
68921	4/14/2008	09:00	31	KEWAUNEE	Franklin	22	23	E	13	SW	SW	<	0.1		0		
69049	4/20/2008	11:30	31	KEWAUNEE	Franklin	22	23	E	35	SE	SW		12.9		1		0
69109	4/28/2008	13:45	31	KEWAUNEE	Lincoln	25	24	E	31	SE	SE	<	0.1		0		
69137	5/5/2008	07:00	31	KEWAUNEE	Franklin	22	23	E	24	NW	NW	<	0.1		0		
69145	5/4/2008	14:00	31	KEWAUNEE	Lincoln	25	24	E	35	SE	SW	<	0.1		0		
69182	5/12/2008	15:00	31	KEWAUNEE	Luxemburg	24	23	E	25	SE	NW		1.5		0		
69304	5/20/2008	14:10	31	KEWAUNEE	Luxemburg	24	23	E	36	SE	NE		8		0		
69682	6/15/2008	22:45	31	KEWAUNEE	Luxemburg	24	23	E	17	NE	SW	<	0.1		0		
69742	6/23/2008	12:00	31	KEWAUNEE	Red River	25	23	E	27	NE	NW	<	0.1		0		
69806	6/30/2008	14:00	31	KEWAUNEE	Casco	24	24	E	32	NE	SW		8.6		1		0
69808	6/30/2008	12:30	31	KEWAUNEE	Ahnapee	25	25	E	28	SE	NW		0.1		1		0
69950	7/14/2008	12:30	31	KEWAUNEE	Carlton	22	24	E	8	SE	NW		0.3		1		0
70724	9/30/2008	10:35	31	KEWAUNEE	Luxemburg	24	23	E	36	SE	NE		7.8		0		
71198	10/27/2008	08:30	31	KEWAUNEE	Ahnapee	25	25	E	16	SE	SE	<	0.1		1		0
71199	10/27/2008	11:20	31	KEWAUNEE	West Kewaunee	23	24	E	25	SW	SE	<	0.1		0		
71200	10/27/2008	08:00	31	KEWAUNEE	Red River	25	23	E	3	SW	SE	<	0.1		0		
71201	10/27/2008	05:37	31	KEWAUNEE	Luxemburg	24	23	E	13	NW	NW	<	0.1		0		
71202	10/27/2008	07:15	31	KEWAUNEE	West Kewaunee	23	24	E	36	NE	SW	<	0.1		0		
71203	10/27/2008	06:00	31	KEWAUNEE	Casco	24	24	E	31	SE	SE		9.1		0		
71204	10/27/2008	05:20	31	KEWAUNEE	Lincoln	25	24	E	29	SW	NW		16		0		
71205	10/27/2008	07:25	31	KEWAUNEE	Lincoln	25	24	E	32	SE	NE	<	0.1		0		
71206	10/27/2008	05:50	31	KEWAUNEE	Luxemburg	24	23	E	19	SW	NW	<	0.1		0		
71207	10/27/2008	06:00	31	KEWAUNEE	Luxemburg	24	23	E	11	SW	SW	<	0.1		0		
71208	10/27/2008	09:00	31	KEWAUNEE	Red River	25	23	E	29	SE	SW	<	0.1		1		0
71209	10/27/2008	14:20	31	KEWAUNEE	Montpelier	23	23	E	31	SW	SE	<	0.1		0		
71210	10/27/2008	14:15	31	KEWAUNEE	Luxemburg	24	23	E	2	NW	SE		3		1		0
71211	10/27/2008	07:20	31	KEWAUNEE	Red River	25	23	E	33	NE	NE	<	0.1		0		
71213	10/27/2008	09:00	31	KEWAUNEE	Luxemburg	24	23	E	20	SE	SW		20.7		0		
71214	10/27/2008	08:45	31	KEWAUNEE	Casco	24	24	E	30	NW	NE	<	0.1		0		
71215	10/27/2008	07:50	31	KEWAUNEE	Carlton	22	24	E	7	NE	NE	<	0.1		0		
71216	10/27/2008	08:45	31	KEWAUNEE	Ahnapee	25	25	E	14	NE	NE	<	0.1		0		
71217	10/27/2008	05:00	31	KEWAUNEE	Carlton	22	24	E	8	SE	NW		0.6		0		
71218	10/27/2008	10:30	31	KEWAUNEE	Carlton	22	24	E	11	SW	NW	<	0.1		0		
71219	10/27/2008	12:45	31	KEWAUNEE	Casco	24	24	E	33	SE	NE	<	0.1		0		
71220	10/27/2008	08:00	31	KEWAUNEE	Casco	24	24	E	18	NE	SE		4.7		0		
71221	10/27/2008	07:44	31	KEWAUNEE	Casco	24	24	E	18	NE	SE	<	0.1		0		
71575	1/13/2009	10:00	31	KEWAUNEE	Luxemburg	24	23	E	36	SE	NE				0		
71633	1/27/2009	12:15	31	KEWAUNEE	Luxemburg	24	23	E	36	SE	NE		8		0		
71667	2/11/2009	15:00	31	KEWAUNEE	Luxemburg	24	23	E					15.1		1		1
71961	3/9/2009	09:15	31	KEWAUNEE	Red River	25	23	E	34	NE	SE	<	0.1		0		
71963	3/9/2009	08:00	31	KEWAUNEE	Red River	25	23	E	9	SW	SE	<	0.1		0		
71964	3/9/2009	13:00	31	KEWAUNEE	Luxemburg	24	23	E	25	SW	NW		8.2		0		
71965	3/9/2009	06:00	31	KEWAUNEE	Ahnapee	25	25	E	15				1.3		0		
71966	3/9/2009	09:30	31	KEWAUNEE	Casco	24	24	E	19	NW	NE	<	0.1		1		0
71967	3/9/2009	15:00	31	KEWAUNEE	Lincoln	25	24	E	34	SW	SW		15.3		0		
71968	3/9/2009	12:25	31	KEWAUNEE	Franklin	22	23	E	23	SE	NE		3.2		0		
71969	3/9/2009	09:50	31	KEWAUNEE	Franklin	22	23	E	24	NW	NW	<	0.1		0		
71970	3/9/2009	10:55	31	KEWAUNEE	Franklin	22	23	E	14	SE	SE	<	0.1		0		
71971	3/9/2009	11:55	31	KEWAUNEE	Franklin	22	23	E	24	NW	NW	<	0.1		0		
71972	3/9/2009	12:05	31	KEWAUNEE	Franklin	22	23	E	24	NW	SW	<	0.1		0		
71973	3/9/2009	11:25	31	KEWAUNEE	Franklin	22	23	E	14	SW	NE		2.2		0		
71975	3/9/2009	08:30	31	KEWAUNEE	Red River	25	23	E	3	SW	SE	<	0.1		0		
71976	3/9/2009	06:00	31	KEWAUNEE	Lincoln	25	24	E	26	NE	SW		8.3		1		0
71977	3/9/2009	06:00	31	KEWAUNEE	Casco	24	24	E	17	SW			5.1		0		
71978	3/9/2009	06:30	31	KEWAUNEE	Carlton	22	24	E	11	SE	NE	<	0.1		0		
71996	3/23/2009	15:45	31	KEWAUNEE	Luxemburg	24	23	E					8		0		
72133	3/30/2009	13:15	31	KEWAUNEE	Carlton	22	24	E	23	NE	NW	<	0.1		0		
72395	4/27/2009	09:30	31	KEWAUNEE	Luxemburg	24	23	E	36	SE	NE		8.6		0		
72751	6/8/2009	12:30	31	KEWAUNEE	Carlton	22	24	E	9	NE	NW	<	0.1		0		
72836	6/22/2009	09:10	31	KEWAUNEE	West Kewaunee	23	24	E	19	NW	NW		10.8		0		

SAMPLE_ID	SAMP_DATE	SAMP_TIME	CO	COUNTY	TOWN	TOWNSHIP	RANGE	RANGE_DIR	SECTION	QS	QQS	NO3_Qual	Nitrate (mg/l N)	Bact_Qual	Bacteria (1=POS)	Ecoli_Qual	Ecoli (1=POS)
72852	6/22/2009	13:00	31	KEWAUNEE	Lincoln	25	24	E	26	SE	NW		3.5		0		
73627	8/18/2009	13:00	31	KEWAUNEE	West Kewaunee	23	24	E	1	SE	SE	<	0.1		0		
74432	11/30/2009	13:30	31	KEWAUNEE	Pierce								2.5		1		0
74477	12/21/2009	09:00	31	KEWAUNEE	Luxemburg	24	23	E	36	SE	NE		8.7		0		
75291	3/29/2010	13:30	31	KEWAUNEE	Lincoln	25	24	E	7	SE	NE	<	0.1		0		
75292	3/28/2010	13:30	31	KEWAUNEE	Casco	24	24	E	27	SW	SE	<	0.1		0		
75294	3/29/2010	13:48	31	KEWAUNEE	Casco	24	24	E	33	SE	SW	<	0.1		0		
75295	3/29/2010	11:30	31	KEWAUNEE	West Kewaunee	23	24	E	4	NE	NE	<	0.1		0		
75296	3/29/2010	13:45	31	KEWAUNEE	Lincoln	25	24	E	7	NE	SE		0.2		0		
75297	3/29/2010	10:15	31	KEWAUNEE	West Kewaunee	23	24	E	4	SE	NE	<	0.1		0		
75298	3/29/2010	13:15	31	KEWAUNEE	Lincoln	25	24	E	4	SE	SW		26.7		1		0
75299	3/29/2010	12:45	31	KEWAUNEE	Lincoln	25	24	E	4	SE	SW		5.9		0		
75300	3/29/2010	10:46	31	KEWAUNEE	West Kewaunee	23	24	E	4	NW	NW	<	0.1		0		
75301	3/29/2010	09:45	31	KEWAUNEE	Red River	25	23	E	23	SE	SW		4.5		0		
75302	3/29/2010	09:20	31	KEWAUNEE	Red River	25	23	E	34	NE	SE	<	0.1		0		
75303	3/29/2010	07:00	31	KEWAUNEE	Ahnapee	25	25	E	19	NE	NE	<	0.1		0		
75304	3/29/2010	06:00	31	KEWAUNEE	Casco	24	24	E	30	NW	SE		7		0		
75305	3/29/2010	15:30	31	KEWAUNEE	Red River	25	23	E	7			<	0.1		0		
75306	3/29/2010	10:45	31	KEWAUNEE	Lincoln	25	24	E	3	NE	SE	<	0.1		0		
75307	3/29/2010	05:00	31	KEWAUNEE	Lincoln	25	24	E	35	SW	NW	<	0.1		0		
75308	3/29/2010	10:30	31	KEWAUNEE	Montpelier	23	23	E	14	SE	SW		7.9		0		
75309	3/29/2010	07:50	31	KEWAUNEE	Lincoln	25	24	E	36	SE	SE	<	0.1		0		
75310	3/29/2010	14:00	31	KEWAUNEE	Red River	25	23	E	29	NW	SE	<	0.1		0		
75311	3/29/2010	12:24	31	KEWAUNEE	Lincoln	25	24	E	19	SW	SW		0.6		1		0
75312	3/29/2010	11:00	31	KEWAUNEE	West Kewaunee	23	24	E	8	NE	NE	<	0.1		0		
75313	3/29/2010	07:21	31	KEWAUNEE	Luxemburg	24	23	E	2	NW	SE		4.4		0		
75314	3/29/2010	13:25	31	KEWAUNEE	Luxemburg	24	23	E	2	NE	NW		8.3		0		
75315	3/29/2010	08:30	31	KEWAUNEE	Luxemburg	24	23	E	16	SE	NW	<	0.1		0		
75316	3/29/2010	13:00	31	KEWAUNEE	Casco	24	24	E	18	NE	SE		3.4		0		
75317	3/29/2010	13:07	31	KEWAUNEE	Lincoln	25	24	E	10	NE	NW		18.7		0		
75318	3/30/2010	06:15	31	KEWAUNEE	Red River	25	23	E				<	0.1		0		
75319	3/28/2010	12:00	31	KEWAUNEE	Ahnapee	25	25	E	30	SE	SW	<	0.1		0		
75400	4/19/2010	14:30	31	KEWAUNEE	Luxemburg	24	23	E	32	SE	SE		0.4		1		0
75420	4/27/2010	10:03	31	KEWAUNEE	Luxemburg	24	23	E	36	SE	NE		8		0		
76521	7/19/2010	08:49	31	KEWAUNEE	Luxemburg	24	23	E	36	SE	NE		7.6		0		
77227	10/4/2010	10:30	31	KEWAUNEE	Luxemburg	24	23	E	1	SE	NE		0.1		0		
77725	11/16/2010	11:22	31	KEWAUNEE	Luxemburg	24	23	E	36	SE	NE		8.3		0		
77780	11/28/2010	15:20	31	KEWAUNEE	Lincoln	25	24	E	20				9.3		1		0
77948	2/8/2011	15:50	31	KEWAUNEE	Montpelier	23	23	E	22	SE	SW	<	0.1		0		
78286	4/4/2011	15:10	31	KEWAUNEE	Luxemburg	24	23	E	18	SW	NW	<	0.1		0		
78370	4/19/2011	13:00	31	KEWAUNEE	Pierce	24	25	E	30	NE	SW	<	0.1		0		
78521	4/24/2011	17:15	31	KEWAUNEE	Luxemburg	24	23	E	16	NW		<	0.1		0		
78535	4/18/2011	15:15	31	KEWAUNEE	Luxemburg	24	23	E	36	SE	NE		7.9		0		
78992	3/28/2011	10:00	31	KEWAUNEE	Luxemburg	24	23	E	4	SE	NE		1.4		0		
78993	3/28/2011	09:40	31	KEWAUNEE	Casco	24	24	E	35	NW	SW	<	0.1		0		
78994	3/28/2011	10:55	31	KEWAUNEE	Red River	25	23	E	7	SE	NE	<	0.1		0		
78995	3/28/2011	05:50	31	KEWAUNEE	Lincoln	25	24	E	4	NW	NE	<	0.1		0		
78996	3/28/2011	11:20	31	KEWAUNEE	Lincoln	25	24	E	19	SW	SW	<	0.1		1		0
78997	3/28/2011	03:45	31	KEWAUNEE	Red River	25	23	E	25	SE	SW		16.3		0		
78998	3/28/2011	13:00	31	KEWAUNEE	Red River	25	23	E	26	NE	NW	<	0.1		0		
78999	3/28/2011	08:30	31	KEWAUNEE	Red River	25	23	E	9	SW	SE	<	0.1		0		
79000	3/28/2011	08:50	31	KEWAUNEE	Red River	25	23	E	28	SE	NW		10.3		1		1
79001	3/28/2011	14:20	31	KEWAUNEE	Ahnapee	25	25	E	32	NW	SW	<	0.1		0		
79002	3/28/2011	09:10	31	KEWAUNEE	Red River	25	23	E	25	NW	NE		17.9		1		0
79003	3/28/2011	08:00	31	KEWAUNEE	Lincoln	25	24	E	4	SE	NE		1		1		0
79004	3/28/2011	06:19	31	KEWAUNEE	Lincoln	25	24	E	17	SW	SW		1.2		1		0
79005	3/28/2011	10:00	31	KEWAUNEE	Franklin	22	23	E	21	SE	SW	<	0.1		0		
79006	3/28/2011	10:30	31	KEWAUNEE	Pierce	24	25	E	19	NE	NE	<	0.1		0		
79007	3/28/2011	07:45	31	KEWAUNEE	Red River	25	23	E	3	SW	SE	<	0.1		1		0
79008	3/28/2011	09:00	31	KEWAUNEE	Luxemburg	24	23	E	2	NW	SE		3.1		0		
79009	3/28/2011	07:10	31	KEWAUNEE	Ahnapee	25	26	E	6	NE	SE	<	0.1		0		
79010	3/28/2011	06:30	31	KEWAUNEE	Lincoln	25	24	E	3	SE	SE		6.7		0		
79011	3/27/2011	19:25	31	KEWAUNEE	Red River	25	23	E	34	NW	NW		3.2		0		
79012	3/28/2011	06:50	31	KEWAUNEE	Red River	25	23	E	13	SW	NW		7.9		0		
79013	3/28/2011	14:20	31	KEWAUNEE	Pierce	24	25	E	31	NE	SE	<	0.1		0		
79014	3/28/2011	13:30	31	KEWAUNEE	Red River	25	23	E	22	SW	SE		0.4		0		
79015	3/28/2011	09:08	31	KEWAUNEE	Red River	25	23	E	26	SW	SW		4.9		0		
79016	3/28/2011	12:15	31	KEWAUNEE	Montpelier	23	23	E	16	NW	NW		0.3		0		
79017	3/28/2011	15:45	31	KEWAUNEE	Luxemburg	24	23	E	16	SW	NE	<	0.1		0		
79018	3/28/2011	06:00	31	KEWAUNEE	Luxemburg	24	23	E	2	NE	NE	<	0.1		0		
79019	3/28/2011	11:17	31	KEWAUNEE	Franklin	22	23	E	34	NE	NE		13.8		0		
79020	3/28/2011	11:30	31	KEWAUNEE	West Kewaunee	23	24	E	20	SE	SW	<	0.1		0		
79021	3/28/2011	10:00	31	KEWAUNEE	Red River	25	23	E	23	NE	SE		5.3		0		
79022	3/28/2011	10:30	31	KEWAUNEE	Red River	25	23	E	23	NW	NE		15.4		0		
79023	3/28/2011	10:30	31	KEWAUNEE	Red River	25	23	E	23	NW	SE		1.8		0		
79024	3/28/2011	09:55	31	KEWAUNEE	Pierce	23	25	E	7	NE	NW	<	0.1		0		
79025	3/28/2011	11:05	31	KEWAUNEE	Carlton	22	24	E	24	NE	SW	<	0.1		0		
79026	3/28/2011	07:30	31	KEWAUNEE	West Kewaunee	23	24	E	10	NE	NW	<	0.1		0		
79027	3/28/2011	09:45	31	KEWAUNEE	Carlton	22	24	E	20	SE	SE		0.1		0		
79028	3/28/2011	09:45	31	KEWAUNEE	Carlton	22	24	E	20	SE	SE	<	0.1		1		0
79029	3/28/2011	05:45	31	KEWAUNEE	Red River	25	23	E	1	NW			2.2		1		0
79030	3/28/2011	07:30	31	KEWAUNEE	Luxemburg	24	23	E	3	SW	SE		11		0		
79031	3/28/2011	10:30	31	KEWAUNEE	Luxemburg	24	23	E	3	SW	SE		2.7		0		
79032	3/28/2011	13:20	31	KEWAUNEE	Casco	24	24	E	18	NE	SE		4		0		
79033	3/28/2011	11:10	31	KEWAUNEE	Pierce	24	25	E	19	NE	NW	<	0.1		0		
79034	3/28/2011	12:25	31	KEWAUNEE	Ahnapee	25	25	E	28	SE	SW	<	0.1		0		
79035	3/28/2011	09:55	31	KEWAUNEE	West Kewaunee	23	25	E	30	SW	NW	<	0.1		0		
79036	3/28/2011	07:25	31	KEWAUNEE	Lincoln	25	24	E	19	NE	NE		0.7		0		
79037	3/28/2011	14:20	31	KEWAUNEE	Casco	24	24	E	4	SE	SE		0.7		0		
79038	3/28/2011	05:10	31	KEWAUNEE	Carlton	22	24	E	29	SE	NE	<	0.1		0		
79039	3/28/2011	10:50	31	KEWAUNEE	Luxemburg	24	23	E	7	SE	NE	<	0.1		0		
79040	3/28/2011	10:55	31	KEWAUNEE	Pierce	24	25	E	20	NE	NE	<	0.1		0		
79041	3/28/2011	07:45	31	KEWAUNEE	Lincoln	25	24	E	10	NE	NW		17.8		1		0
79042	3/28/2011	08:00	31	KEWAUNEE	Red River	25	23	E	23	NW	NW		1.8		1		0
79043	3/28/2011	07:12	31	KEWAUNEE	Luxemburg	24	23	E	16	SW	NE	<	0.1		0		
79044	3/28/2011	06:25	31	KEWAUNEE	Franklin	22	23	E	24	NW	NW	<	0.1		0		
79045	3/28/2011	09:40	31	KEWAUNEE	Casco	24	24	E	33	SE	NE	<	0.1		0		
79046	3/28/2011	13:00	31	KEWAUNEE	Red River	25	23	E	34	NW	NE	<	0.1		0		
79047	3/28/2011	08:45	31	KEWAUNEE	Casco	24	24	E	17	SE	NE		0.1		1		0
79048	3/28/2011	10:45	31	KEWAUNEE	Red River	25	23	E	36	NE	NE		7.6		1		0
79049	3/28/2011	08:30	31	KEWAUNEE	Ahnapee	25	25	E	19	NE	NE	<	0.1		0		
79050	3/28/2011	11:00	31	KEWAUNEE	Pierce	24	25	E	16	SW	SW	<	0.1		1		0
79051	3/28/2011	14:10	31	KEWAUNEE	Franklin	22	23	E	9	NE	SE	<	0.1		0		
79052	3/28/2011	14:05	31	KEWAUNEE	Red River	25	23	E	1	NW			2.8		0		
79053	3/28/2011		31	KEWAUNEE	Luxemburg	24	23	E	13	NW	NW	<	0.1		0		
79054	3/28/2011	12:10	31	KEWAUNEE	Franklin	22	23	E	32	NE	SE		0.8		0		
79055	3/28/2011	10:00	31	KEWAUNEE	West Kewaunee	23	24	E	33	SW	NW	<	0.1		0		
79056	3/28/2011	10:45	31	KEWAUNEE	Red River	25	23	E	32	NW	NW	<	0.1		0		
79057	3/28/2011	14:40	31	KEWAUNEE	Lincoln	25	24	E	27	SE	SE		12		0		
79058	3/28/2011	14:40	31	KEWAUNEE	Lincoln	25	24	E	26	NE	SW		14.7		1		0
79059	3/28/2011	04:30	31	KEWAUNEE	Pierce	24	25	E	29	NW	NW	<	0.1		0		
79060	3/28/2011	05:00	31	KEWAUNEE	Montpelier	23	23	E	2	NE	SE		9.9		1		0
79061	4/4/2011	08:44	31	KEWAUNEE	Carlton	22	24	E	27	NE	NW	<	0.1		0		
79698	7/18/2011	10:30	31	KEWAUNEE	Luxemburg	24	23	E	36	SE	NE		8.4		0		
79779	7/25/2011	09:15	31	KEWAUNEE									2.6		0		
80214	8/29/2011	14:00	31	KEWAUNEE	Pierce	24	25	E	5	NW	NE	<	0.1		0		
80373	9/6/2011		31	KEWAUNEE	West Kewaunee							<	0.1		1		
80403	9/13/2011	10:30	31	KEWAUNEE	Pierce	24	25	E	3			<	0.1		1		0
80455	9/19/2011	13:20	31	KEWAUNEE	Lincoln	25	24	E	35				1.1		1		0
80622	10/11/2011	10:45	31	KEWAUNEE	West Kewaunee	23	24	E	22			<	0.1		1		0
80829	10/24/2011	13:00	31	KEWAUNEE	Luxemburg	24	23	E	36	SE	NE		8.7		0		

SAMPLE_ID	SAMP_DATE	SAMP_TIME	CO	COUNTY	TOWN	TOWNSHIP	RANGE	RANGE_DIR	SECTION	QS	QQS	NO3_Qual	Nitrate (mg/l N)	Bact_Qual	Bacteria (1=POS)	Ecoli_Qual	Ecoli (1=POS)
81076	11/14/2011	06:00	31	KEWAUNEE	Casco	24	24	E	31	SE	SE		11.8		0		
81077	11/14/2011	09:00	31	KEWAUNEE	Casco	24	24	E	28	NW	NE	<	0.1		1		0
81078	11/14/2011	05:30	31	KEWAUNEE	Luxemburg	24	23	E	13	SW	SE		20.5		0		
81079	11/14/2011	06:50	31	KEWAUNEE	Casco	24	24	E	21	NE	NE	<	0.1		1		0
81080	11/14/2011	09:00	31	KEWAUNEE	Red River	25	23	E	34	NE	SE	<	0.1		0		
81081	11/14/2011	08:30	31	KEWAUNEE	Lincoln	25	24	E	26	NE	SW		5.1		1		0
81082	11/14/2011	09:30	31	KEWAUNEE	Lincoln	25	24	E	19	SW	SW	<	0.1		0		
81083	11/14/2011	06:45	31	KEWAUNEE	Montpelier	23	23	E	26	NE	NE	<	0.1		0		
81084	11/14/2011	13:40	31	KEWAUNEE	Lincoln	25	24	E	27	SE	SW		7.4		1		0
81085	11/14/2011	06:00	31	KEWAUNEE	Red River	25	23	E	28	SE	NW		16		1		0
81086	11/14/2011	08:00	31	KEWAUNEE	Franklin	22	23	E	28	NW	NE	<	0.1		0		
81087	11/14/2011	11:00	31	KEWAUNEE	Red River	25	23	E	36	NE	NE		14.6		1		1
81088	11/14/2011	09:00	31	KEWAUNEE	Red River	25	23	E	13	SW	NW		7.1		0		
81089	11/14/2011	08:00	31	KEWAUNEE	Franklin	22	23	E	21	SE	SW	<	0.1		1		0
81090	11/14/2011	08:00	31	KEWAUNEE	Carlton	22	24	E	6	NE	NE	<	0.1		1		0
81091	11/14/2011	10:15	31	KEWAUNEE	Pierce	24	25	E	32	SE	NE	<	0.1		1		0
81092	11/14/2011	12:45	31	KEWAUNEE	Ahnapee	25	25	E	19	NE	NE	<	0.1		0		
81094	11/14/2011	14:00	31	KEWAUNEE	Casco	24	24	E	17	SW	NE		4.8		0		
81095	11/14/2011	09:30	31	KEWAUNEE	Ahnapee	25	25	E	30	NE	SE	<	0.1		0		
81096	11/14/2011	04:30	31	KEWAUNEE	Red River	25	23	E	28	NE	NE	<	0.1		0		
81097	11/14/2011	13:20	31	KEWAUNEE	Luxemburg	24	23	E	15	NW	NW	<	0.1		0		
81098	11/14/2011	06:00	31	KEWAUNEE	Luxemburg	24	23	E	26	NE	NW		8.9		0		
81099	11/14/2011	07:30	31	KEWAUNEE	Red River	25	23	E	1	NW	NE	<	0.1		0		
81100	11/14/2011	07:00	31	KEWAUNEE	Carlton	22	24	E	4	NE	NW	<	0.1		1		0
81101	11/14/2011	06:45	31	KEWAUNEE	Casco	24	24	E	17	NW	SE		5		1		0
81102	11/14/2011	08:00	31	KEWAUNEE	West Kewaunee	23	24	E	14	SE	NE	<	0.1		0		
81103	11/14/2011	09:30	31	KEWAUNEE	Montpelier	23	23	E	25	SE	SW		13.1		1		1
81104	11/14/2011	09:00	31	KEWAUNEE	Casco	24	24	E	5	SE	SW	<	0.1		0		
81105	11/14/2011	13:45	31	KEWAUNEE	Lincoln	25	24	E	10	SE	SE		2.5		1		0
81106	11/14/2011	09:10	31	KEWAUNEE	Casco	24	24	E	17	SE	NW		8		0		
81107	11/14/2011	13:00	31	KEWAUNEE	Red River	25	23	E	18	NE	SE	<	0.1		1		0
81108	11/14/2011	09:35	31	KEWAUNEE	Red River	25	23	E	22	NE	NE		0.2		0		
81109	11/14/2011	13:10	31	KEWAUNEE	Lincoln	25	24	E	20	SW	SW		4.3		0		
81110	11/14/2011	10:30	31	KEWAUNEE	Red River	25	23	E	24	SW	NE		18.8		0		
81111	11/14/2011	08:30	31	KEWAUNEE	West Kewaunee	23	24	E	33	SW	NW	<	0.1		0		
81112	11/14/2011	12:45	31	KEWAUNEE	Lincoln	25	24	E	32	SW	SW	<	0.1		1		0
81113	11/14/2011	15:15	31	KEWAUNEE	Casco	24	24	E	17	SW	NE		7.7		0		
81114	11/14/2011	10:30	31	KEWAUNEE	Montpelier	23	23	E	8	NW	SW	<	0.1		0		
81115	11/14/2011	07:40	31	KEWAUNEE	Pierce	24	25	E	5	NE	SW	<	0.1		0		
81116	11/14/2011	08:00	31	KEWAUNEE	Franklin	22	23	E	21	SW	SE	<	0.1		0		
81117	11/14/2011	08:00	31	KEWAUNEE	Franklin	22	23	E	15	SW	NE	<	0.1		0		
81118	11/14/2011	07:00	31	KEWAUNEE	Luxemburg	24	23	E	11	SW	SW	<	0.1		0		
81119	11/14/2011	13:00	31	KEWAUNEE	Casco	24	24	E	17	NW	NE		0.2		0		
81120	11/14/2011	14:00	31	KEWAUNEE	Casco	24	24	E	17	NW	NE		0.1		0		
81121	11/14/2011	14:30	31	KEWAUNEE	Lincoln	25	24	E	27	SE	SE		11.3		0		
81122	11/15/2011	08:30	31	KEWAUNEE	Red River	25	23	E	36	NE	NE		19		0		
81213	12/12/2011	05:00	31	KEWAUNEE	Montpelier	23	23	E					1.4		0		
81310	1/9/2012	14:00	31	KEWAUNEE	Franklin	22	23	E	30	NE	NW	<	0.1		0		
81382	1/31/2012	11:00	31	KEWAUNEE	Luxemburg	24	23	E	36	SE	NE		8.6		0		
81489	2/28/2012	11:45	31	KEWAUNEE	Luxemburg	24	23	E				<	0.1		0		
81646	3/12/2012	10:30	31	KEWAUNEE	Lincoln	25	24	E	30				18.4		0		
81698	3/20/2012	10:00	31	KEWAUNEE	Luxemburg	24	23	E				<	0.1		1		0
81977	4/24/2012	07:45	31	KEWAUNEE	Luxemburg	24	23	E	36	SE	NE		8.2		0		
82141	5/7/2012	10:47	31	KEWAUNEE	Ahnapee	25	25	E	29	NW	SW		0.8		0		
82170	5/15/2012	15:05	31	KEWAUNEE	Luxemburg	24	23	E	10	NE	NW		8.6		1		0
82251	5/7/2012	13:12	31	KEWAUNEE	Pierce	24	25	E	19	NE	SW	<	0.1		0		
82252	5/7/2012	11:25	31	KEWAUNEE	Luxemburg	24	23	E	13	SW	SE		18.4		0		
82253	5/7/2012	12:00	31	KEWAUNEE	Pierce	24	25	E	5	NW	NE	<	0.1		0		
82254	5/7/2012	12:10	31	KEWAUNEE	Luxemburg	24	23	E	19	SE	SE	<	0.1		0		
82255	5/7/2012	05:30	31	KEWAUNEE	Casco	24	24	E	31	SE	SE		15		0		
82256	5/7/2012	06:30	31	KEWAUNEE	Casco	24	24	E	11	NE	SW	<	0.1		0		
82257	5/7/2012	11:30	31	KEWAUNEE	Lincoln	25	24	E	35	SW	NW	<	0.1		0		
82258	5/7/2012	06:15	31	KEWAUNEE	Lincoln	25	24	E	29	SW	NW		20.2		0		
82259	5/7/2012	06:17	31	KEWAUNEE	Lincoln	25	24	E	29	SW	NW		4.8		0		
82260	5/7/2012	10:00	31	KEWAUNEE	Pierce	24	25	E	30	NE	SW	<	0.1		0		
82261	5/7/2012	13:45	31	KEWAUNEE	Lincoln	25	24	E	20	NW	SW		6.7		0		
82262	5/7/2012	08:32	31	KEWAUNEE	Red River	25	23	E	8	SW	NE	<	0.1		0		
82263	5/7/2012	11:45	31	KEWAUNEE	Lincoln	25	24	E	20	SE	SE		4.8		1		0
82264	5/7/2012	07:50	31	KEWAUNEE	Lincoln	25	24	E	20	SW	SE		1.2		0		
82265	5/7/2012	08:30	31	KEWAUNEE	Pierce	23	25	E	5	NW	NW	<	0.1		0		
82266	5/7/2012	06:15	31	KEWAUNEE	West Kewaunee	23	24	E	10	NE	SE	<	0.1		0		
82267	5/7/2012	09:00	31	KEWAUNEE	Lincoln	25	24	E	18	NE	SE		14		0		
82268	5/7/2012	06:08	31	KEWAUNEE	Franklin	22	23	E	12	NW	NW		11.7		0		
82269	5/7/2012	06:00	31	KEWAUNEE	Lincoln	25	24	E	20	SE	SW		0.1		0		
82270	5/7/2012	14:30	31	KEWAUNEE	West Kewaunee	23	24	E	2	NE	NW		0.1		1		1
82271	5/7/2012	09:40	31	KEWAUNEE	Lincoln	25	24	E	31	SW	SE		12.6		0		
82272	5/7/2012	09:00	31	KEWAUNEE	Lincoln	25	24	E	10	NE	NW		16.3		0		
82273	5/7/2012	09:45	31	KEWAUNEE	Lincoln	25	24	E	19	NE	SE		0.5		0		
82274	5/7/2012	13:35	31	KEWAUNEE	Franklin	22	23	E	27	SW	NW	<	0.1		0		
82275	5/7/2012	06:10	31	KEWAUNEE	Franklin	22	23	E	24	NW	NW	<	0.1		0		
82276	5/7/2012	04:30	31	KEWAUNEE	Lincoln	25	24	E	20	SE	NE	<	0.1		1		0
82277	5/7/2012	16:14	31	KEWAUNEE	Pierce	24	25	E	32	NW	NE	<	0.1		0		
82278	5/7/2012	07:15	31	KEWAUNEE	Franklin	22	23	E	4	NW	NW	<	0.1		1		0
82279	5/7/2012	14:00	31	KEWAUNEE	Pierce	24	25	E	32	SE	NW	<	0.1		0		
82280	5/7/2012	05:30	31	KEWAUNEE	Lincoln	25	24	E	20	NW	SE		16		0		
82281	5/7/2012	09:00	31	KEWAUNEE	Franklin	22	23	E	21	SE	SW	<	0.1		1		0
82282	5/7/2012	09:00	31	KEWAUNEE	Franklin	22	23	E	12	NE	NW		1		0		
82283	5/7/2012	13:40	31	KEWAUNEE	Luxemburg	24	23	E	13	NW	NW	<	0.1		0		
82284	5/7/2012	05:30	31	KEWAUNEE	Lincoln	25	24	E	29	SW	NW		2.9		1		0
82285	5/7/2012	05:45	31	KEWAUNEE	Red River	25	23	E	33	NW	SW	<	0.1		0		
82286	5/7/2012	09:00	31	KEWAUNEE	Franklin	22	23	E	33	SE	SW	<	0.1		0		
82287	5/7/2012	07:45	31	KEWAUNEE	Lincoln	25	24	E	19	SW	SW		0.4		0		
82288	5/7/2012	11:15	31	KEWAUNEE	Pierce	24	25	E	19	NE	NE	<	0.1		0		
82289	5/7/2012	09:10	31	KEWAUNEE	Franklin	22	23	E	22	SE	NE	<	0.1		0		
82290	5/7/2012	06:45	31	KEWAUNEE	Casco	24	24	E	30	NW	NE		0.9		0		
82291	5/7/2012	06:45	31	KEWAUNEE	Franklin	22	23	E	5	SW	SE	<	0.1		0		
82292	5/7/2012	06:15	31	KEWAUNEE	Franklin	22	23	E	5	SW	SE	<	0.1		0		
82293	5/7/2012	18:30	31	KEWAUNEE	Franklin	22	23	E	5	SW	SE	<	0.1		0		
82294	5/7/2012	10:30	31	KEWAUNEE	Red River	25	23	E	23	SE	SW		3		1		1
82295	5/7/2012	06:10	31	KEWAUNEE	Casco	24	24	E	32	NW	NE		20.4		1		0
82296	5/7/2012	09:00	31	KEWAUNEE	Lincoln	25	24	E	35	SE	SE		0.4		0		
82297	5/7/2012	09:00	31	KEWAUNEE	Lincoln	25	24	E	35	SE	SE		1.4		0		
82298	5/7/2012	11:15	31	KEWAUNEE	Lincoln	25	24	E	30	NW	NW	<	0.1		0		
82299	5/7/2012	06:30	31	KEWAUNEE	Red River	25	23	E	3	SW	SE	<	0.1		0		
82300	5/7/2012	09:40	31	KEWAUNEE	Casco	24	24	E	17	NW	SE		8.2		0		
82301	5/7/2012	07:23	31	KEWAUNEE	Montpelier	23	23	E	31	NE	SW	<	0.1		0		
82303	5/7/2012	09:30	31	KEWAUNEE	Luxemburg	24	23	E	24	NW	NW		26.8		1		1
82304	5/7/2012	09:30	31	KEWAUNEE	Luxemburg	24	23	E	12	SW	SW		3.6		1		1
82305	5/7/2012	05:45	31	KEWAUNEE	Lincoln	25	24	E	30	SE	NE		7.8		0		
82306	5/7/2012	12:30	31	KEWAUNEE	West Kewaunee	23	24	E	19	NW	NW		11.4		0		
82307	5/7/2012	05:00	31	KEWAUNEE	Ahnapee	25	25	E	10	SW	NW	<	0.1		0		
82308	5/6/2012	20:25	31	KEWAUNEE	Ahnapee	25	25	E	10	SW	NW	<	0.1		0		
82309	5/7/2012	05:00	31	KEWAUNEE	Ahnapee	25	25	E	10	NW	SE	<	0.1		0		
82310	5/7/2012	11:00	31	KEWAUNEE	Pierce	24	25	E	29	NW	NW	<	0.1		0		
82311	5/7/2012	12:57	31	KEWAUNEE	Montpelier	23	23	E	11	SW	SE		5.4		0		
82312	5/7/2012	07:30	31	KEWAUNEE	Ahnapee	25	25	E	16	NW	NW		0.3		0		
82313	5/7/2012	06:10	31	KEWAUNEE	West Kewaunee	23	25	E	18			<	0.1		0		
82314	5/7/2012	06:00	31	KEWAUNEE	West Kewaunee	23	25	E	18			<	0.1		0		
82315	5/7/2012	09:05	31	KEWAUNEE	Red River	25	23	E	30	SE	SE		1.5		1		0
82316	5/7/2012	08:00	31	KEWAUNEE	Franklin	22	23	E	32	NE	SE	<	0.1		0		
82317	5/7/2012	09:30	31	KEWAUNEE	Casco	24	24	E	20	SE	NW	<	0.1		0		

SAMPLE_ID	SAMP_DATE	SAMP_TIME	CO	COUNTY	TOWN	TOWNSHIP	RANGE	RANGE_DIR	SECTION	QS	QQS	NO3_Qual	Nitrate (mg/l N)	Bact_Qual	Bacteria (1=POS)	Ecoli_Qual	Ecoli (1=POS)
82318	5/7/2012	14:30	31	KEWAUNEE	Lincoln	25	24	E	27	SE	SE		7.4		1		0
82319	5/7/2012	13:00	31	KEWAUNEE	Lincoln	25	24	E	28	SE	NW		10.2		0		
82320	5/7/2012	07:00	31	KEWAUNEE	Lincoln	25	24	E	19	NE	NE		1.4		1		0
82321	5/7/2012	10:00	31	KEWAUNEE	Red River	25	23	E	7			<	0.1		0		
82322	5/7/2012	08:15	31	KEWAUNEE	Casco	24	24	E	35	SE	NE	<	0.1		0		
82323	5/7/2012	11:25	31	KEWAUNEE	Montpelier	23	23	E	22	NE	NE		33.7		0		
82324	5/7/2012	14:00	31	KEWAUNEE	Franklin	22	23	E	15	NE	NW	<	0.1		0		
82325	5/7/2012	14:00	31	KEWAUNEE	Lincoln	25	24	E	27	SE	SW		5.9		1		0
82326	5/3/2012	09:30	31	KEWAUNEE	West Kewaunee	23	24	E	28	NE	NW		26.7		1		1
82327	5/7/2012	14:33	31	KEWAUNEE	Montpelier	23	23	E	20	NW	NW	<	0.1		0		
82328	5/7/2012	05:15	31	KEWAUNEE	Red River	25	23	E	15	SW	NE	<	0.1		0		
82329	5/7/2012	10:00	31	KEWAUNEE	Red River	25	23	E	12	NE	SE		0.5		0		
82330	5/7/2012	05:45	31	KEWAUNEE	Lincoln	25	24	E	32	NW	NE		1		0		
82331	5/7/2012	06:45	31	KEWAUNEE	Montpelier	23	23	E	29	NE	NW	<	0.1		0		
82332	5/7/2012	10:30	31	KEWAUNEE	Casco	24	24	E	17	NW			4.5		0		
82333	5/7/2012	07:30	31	KEWAUNEE	Carlton	22	24	E	12	NE	NW	<	0.1		0		
82334	5/7/2012	11:30	31	KEWAUNEE	Lincoln	25	24	E	4	SW	NW		1.7		1		0
82335	5/7/2012	14:35	31	KEWAUNEE	Ahnapee	25	25	E	33	SE	NE	<	0.1		1		0
82337	5/7/2012	14:00	31	KEWAUNEE	Casco	24	24	E	18	NE	SE		5.7		0		
82338	5/7/2012	13:30	31	KEWAUNEE	Red River	25	23	E	24	SW	NE		18.1		0		
82339	5/7/2012	13:45	31	KEWAUNEE	Red River	25	23	E	36	NE	NE		1.9		1		1
82340	5/7/2012	06:00	31	KEWAUNEE	Casco	24	24	E	5	NE	NW	<	0.1		0		
82341	5/7/2012	10:15	31	KEWAUNEE	Luxemburg	24	23	E	31	SW	SE	<	0.1		0		
82342	5/7/2012	15:00	31	KEWAUNEE	Ahnapee	25	25	E	19	NE	NE	<	0.1		0		
82343	5/7/2012	07:00	31	KEWAUNEE	Red River	25	23	E	34	NE	SE	<	0.1		0		
82344	5/7/2012	13:15	31	KEWAUNEE	Casco	24	24	E	33	SE	SW	<	0.1		0		
82345	5/7/2012	13:30	31	KEWAUNEE	West Kewaunee	23	24	E	4	SE	NE	<	0.1		0		
82346	5/7/2012	13:45	31	KEWAUNEE	West Kewaunee	23	24	E	4	NW	NE	<	0.1		0		
82347	5/7/2012	12:46	31	KEWAUNEE	Casco	24	24	E	24	SE	SW	<	0.1		0		
82348	5/7/2012	13:00	31	KEWAUNEE	Casco	24	24	E	27	SW	SE		0.6		0		
82349	5/7/2012	13:00	31	KEWAUNEE	Franklin	22	23	E	16	NE	SE	<	0.1		0		
82674	6/19/2012	17:00	31	KEWAUNEE	Ahnapee	25	25	E	19	SW	NE	<	0.1		0		
82678	6/18/2012		31	KEWAUNEE	Luxemburg	24	23	E	20	SE	SW	<	0.1		0		
82895	7/9/2012	18:35	31	KEWAUNEE	Lincoln	25	24	E	20				6.9		0		
83111	7/24/2012	03:30	31	KEWAUNEE	Red River	25	23	E	19	SE	SE		0.6		0		
83160	7/31/2012	10:00	31	KEWAUNEE	Luxemburg	24	23	E	4	SE	NE		1.8		0		
83339	8/20/2012	15:32	31	KEWAUNEE	Casco	24	24	E	30	NW	SE		5		1		0
83364	8/29/2012	13:00	31	KEWAUNEE	Luxemburg	24	23	E	36	SE	NE				0		
83439	8/29/2012	13:00	31	KEWAUNEE	Luxemburg	24	23	E	36	SE	NE		3.9		0		
83825	10/8/2012	14:00	31	KEWAUNEE	Montpelier	23	23	E	25	SE	SW		9.9		0		
83870	10/15/2012	08:00	31	KEWAUNEE	Montpelier	23	23	E	31	SE	NE	<	0.1		0		
83928	10/30/2012	15:05	31	KEWAUNEE	Luxemburg	24	23	E	10	NE	NW		13.6		0		
83932	10/30/2012	14:30	31	KEWAUNEE	Luxemburg	24	23	E	36	SE	NE		2.1		0		
84135	10/31/2012	13:00	31	KEWAUNEE	Lincoln	25	24	E				<	0.1		1		0
84427	12/18/2012	11:30	31	KEWAUNEE	Lincoln	25	24	E	31				0.1		0		
84672	2/26/2013	14:20	31	KEWAUNEE	Luxemburg	24	23	E	36	SE	NE		3.1		0		
84800	3/18/2013	06:00	31	KEWAUNEE	Lincoln	25	24	E	29	SW	NW		15.1		0		
84802	3/18/2013	09:30	31	KEWAUNEE	Lincoln	25	24	E	10	NE	NW		15.4		1		1
84803	3/18/2013	09:30	31	KEWAUNEE	Red River	25	23	E	13	SW	NW		6.2		0		
84804	3/18/2013	05:15	31	KEWAUNEE	Pierce	24	25	E	8	NW	NW	<	0.1		0		
84805	3/18/2013	08:15	31	KEWAUNEE	Red River	25	23	E	30	SE	SE		2.4		0		
84806	3/18/2013	04:00	31	KEWAUNEE	Lincoln	25	24	E	31	SW	NW	<	0.1		0		
84807	3/18/2013	09:20	31	KEWAUNEE	Lincoln	25	24	E	29	SE	SE		10.9		0		
84808	3/18/2013	07:40	31	KEWAUNEE	Casco	24	24	E	17	NW	SW		4.9		0		
84809	3/18/2013	11:00	31	KEWAUNEE	Lincoln	25	24	E	35	SW	NW	<	0.1		0		
84810	3/18/2013	08:00	31	KEWAUNEE	Pierce	24	25	E	32	SE	NW	<	0.1		0		
84811	3/18/2013	07:20	31	KEWAUNEE	Casco	24	24	E	17	NW	SW		5.9		0		
84812	3/18/2013	10:30	31	KEWAUNEE	Luxemburg	24	23	E	2	SE	SE		0.3		0		
84813	3/18/2013	14:00	31	KEWAUNEE	Casco	24	24	E	18	NE	SE	<	0.1		0		
84814	3/18/2013	14:00	31	KEWAUNEE	Casco	24	24	E	18	NE	SE		5.4		0		
84815	3/18/2013	06:00	31	KEWAUNEE	Luxemburg	24	23	E	13	NW	NW	<	0.1		0		
84816	3/18/2013	09:30	31	KEWAUNEE	Pierce	24	25	E	19	SE	NE	<	0.1		1		0
84817	3/18/2013	09:00	31	KEWAUNEE	Franklin	22	23	E	15	SW	NE	<	0.1		0		
84818	3/18/2013	08:00	31	KEWAUNEE	Franklin	22	23	E	21	SE	SW	<	0.1		0		
84819	3/18/2013	07:30	31	KEWAUNEE	Montpelier	23	23	E	26	NE	NE	<	0.1		0		
84820	3/18/2013	08:25	31	KEWAUNEE	Carlton	22	24	E	7	NE	NE	<	0.1		0		
84821	3/18/2013	09:37	31	KEWAUNEE	Casco	24	24	E	20	NW	NW		4.2		0		
84822	3/18/2013	03:45	31	KEWAUNEE	Lincoln	25	24	E	19	SW	SE		6		0		
84823	3/18/2013	11:18	31	KEWAUNEE	Lincoln	25	24	E	16	SW	SW		10		1		0
84824	3/18/2013	07:30	31	KEWAUNEE	Red River	25	23	E	3	SW	SE	<	0.1		0		
84826	3/18/2013	20:00	31	KEWAUNEE	Lincoln	25	24	E	8	NE	SE		1.6		0		
84827	3/18/2013	10:00	31	KEWAUNEE	Lincoln	25	24	E	17	NW	NW		3		1		0
84828	3/18/2013	10:15	31	KEWAUNEE	Lincoln	25	24	E	17	NW	NW		2.3		1		0
84829	3/18/2013	10:10	31	KEWAUNEE	Lincoln	25	24	E	18	SE	NW		12.8		1		0
84830	3/18/2013		31	KEWAUNEE	Franklin	22	23	E	28	NW	NE	<	0.1		0		
84831	3/18/2013	11:00	31	KEWAUNEE	Red River	25	23	E	34	NE	SE	<	0.1		0		
84832	3/18/2013	11:20	31	KEWAUNEE	Luxemburg	24	23	E	16	SE	NW	<	0.1		0		
84833	3/18/2013	09:55	31	KEWAUNEE	Red River	25	23	E	23	SE	SW		8.3		1		0
84834	3/18/2013	09:30	31	KEWAUNEE	Pierce	24	25	E	5	NW	NE	<	0.1		0		
84835	3/18/2013	07:45	31	KEWAUNEE	Red River	25	23	E	8	SW	NE	<	0.1		0		
84836	3/18/2013	10:05	31	KEWAUNEE	Lincoln	25	24	E	18	NE	SE		13.2		0		
84837	3/18/2013	10:48	31	KEWAUNEE	Casco	24	24	E	32	NE	SW		4.7		0		
84838	3/18/2013	10:20	31	KEWAUNEE	West Kewaunee	23	24	E	4	NW	SE	<	0.1		0		
84839	3/18/2013	10:37	31	KEWAUNEE	Casco	24	24	E	33	SE	SW	<	0.1		0		
84840	3/18/2013	10:30	31	KEWAUNEE	West Kewaunee	23	24	E	4	SE	NE	<	0.1		0		
84841	3/18/2013	07:00	31	KEWAUNEE	Franklin	22	23	E	24	NW	NW	<	0.1		1		0
84842	3/18/2013	06:25	31	KEWAUNEE	Franklin	22	23	E	24	NW	NW	<	0.1		0		
84843	3/18/2013	13:30	31	KEWAUNEE	Lincoln	25	24	E	27	SE	SW		4.7		1		0
84844	3/18/2013	08:30	31	KEWAUNEE	Lincoln	25	24	E	4	SE	SW		6.7		0		
84845	3/18/2013	12:00	31	KEWAUNEE	Lincoln	25	24	E	7	NE	SE	<	0.1		1		0
84846	3/18/2013	09:00	31	KEWAUNEE	Carlton	22	24	E	6	SW	NE	<	0.1		0		
84847	3/18/2013	05:45	31	KEWAUNEE	Lincoln	25	24	E	29	SW	NW		7.1		0		
84849	3/18/2013	13:05	31	KEWAUNEE	Casco	24	24	E	11	NE	NW	<	0.1		0		
84850	3/18/2013	09:30	31	KEWAUNEE	Lincoln	25	24	E	19	NE	SE	<	0.1		0		
84851	3/18/2013	09:15	31	KEWAUNEE	Lincoln	25	24	E	19	NE	SE	<	0.1		0		
84852	3/18/2013	05:30	31	KEWAUNEE	Lincoln	25	24	E	30	SE	NE		7.3		0		
84853	3/18/2013	11:50	31	KEWAUNEE	Luxemburg	24	23	E	2	NW	SE		3.9		0		
84854	3/18/2013	08:20	31	KEWAUNEE	Casco	24	24	E	9	NE	SE		13.7		0		
84856	3/18/2013	15:30	31	KEWAUNEE	Ahnapee	25	25	E	20	SW	NW	<	0.1		0		
84857	3/18/2013	07:30	31	KEWAUNEE	Casco	24	24	E	17	SW	SE		7.6		0		
84858	3/18/2013	06:00	31	KEWAUNEE	Luxemburg	24	23	E	13	NW	NW	<	0.1		0		
84859	3/18/2013	05:28	31	KEWAUNEE	Lincoln	25	24	E	16	NE	NW		3.5		0		
84907	4/2/2013	14:15	31	KEWAUNEE	West Kewaunee	23	24	E	28	NE	NW		19.9		1		1

Attachment K

Before The
State Of Wisconsin
DIVISION OF HEARINGS AND APPEALS

In the Matter of the Wisconsin Pollutant Discharge
Elimination System Permit No. WI-0059536-03-0
(WPDES Permit) Issued to Kinnard Farms, Inc.,
Town of Lincoln, Kewaunee County

Case No.: IH-12-071

FINDINGS OF FACT, CONCLUSIONS OF LAW AND ORDER

Pursuant to due notice, hearing was held at Green Bay, Wisconsin on February 11-14, 2014, Jeffrey D. Boldt, Administrative Law Judge (ALJ) presiding. The parties requested an opportunity to submit written closing arguments, and the last was received on June 27, 2014. On September 24, 2014, the ALJ advised the parties that the decision would be issued prior to October 29, 2014.

In accordance with Wis. Stat. §§ 227.47 and 227.53(1)(c), the PARTIES to this proceeding are certified as follows:

Kinnard Farms, Inc., by

Attorney Jordan J. Hemaidan
Attorney Michael P. Screnock
Michael, Best & Friedrich, LLP
P. O. Box 1806
Madison, WI 53701-1806

Petitioners:

1. Lynda Cochart
2. Amy Cochart
3. Roger D. DeJardin
4. Sandra Winnemuller
5. Chad Cochart, by

Attorney Sarah Williams
Midwest Environmental Advocates
612 West Main Street, Suite 302
Madison, WI 53703

Wisconsin Department of Natural Resources (Department or DNR), by

Attorney Jane R. Landretti
Department of Natural Resources
P. O. Box 7921
Madison, WI 53707-7921

ISSUES FOR HEARING AND SUMMARY OF RULING

Prior to the hearing, the parties agreed to a slight modification of the issues and agreed that the issues for hearing are as follows:

1. Whether Sections 1.1, 1.7, and 1.8 of the WPDES Permit are unreasonable because the Permit was issued before the Department receipt and approval of plans and specifications for the facility.

   Holding: No statute or code requires the procedure preferred by the petitioners. The Petitioners have not demonstrated that this procedural approach has specifically led to the need for any substantive changes in either the NMP or the Permit.

2. Whether Section 1.1 of the WPDES Permit is unreasonable because it fails to ensure that all discharges authorized by the Permit comply with surface water quality standards.

   Holding: This issue included several sub-parts. First, the petitioners did not establish that discharges from the VTA into the culvert were a discreet conveyance subject to discharge monitoring under the WPDES program Second, at or after the hearing, both the DNR and the dairy agreed to some changes in the permit language relating to surface water discharges suggested by the petitioners. The permit has been modified to include the following provision relating to Outstanding and Exceptional Resource Waters: "For all new or increased discharges to an ORW or ERW, any pollutant discharged shall not exceed existing levels of the pollutants immediately up stream of the discharge site." The permit has been further modified as follows: "Production area discharges to waters of the state authorized under this permit shall comply with water quality standards, groundwater standards and may not impair wetland functional values."

3. Whether Sections 1.1, 1.7, and 1.8 of the WPDES Permit are unreasonable because they do not require that the Department evaluate background groundwater quality, they do not require sampling or monitoring of groundwater, and they do not require that discharges from the production area authorized by the Permit comply with groundwater quality standards.

   Holding: The petitioners and members of the public have carried their burden of proof in establishing that groundwater monitoring is feasible and appropriate because the "facilities are located on or near areas that are susceptible to groundwater contamination such as direct conduits to groundwater, sandy soils, and sites with minimal separations between bedrock and high water tables". (§ NR 243.15(3)(2)(a))

The Permit should be modified by the Department to establish a plan acceptable to the Department for groundwater monitoring "at or near" Site 2.

4. Whether Sections 1.3.1, 1.3.3, 2 and 3.1.12 of the WPDES Permit are unreasonable because they do not include a limit on the current and proposed number of animal units allowed at the facility.

   Holding: The Permit should be modified by the Department to include a limit on the number of animal units to better provide for long term operational planning and to avoid prior problems with manure storage limits. Existing storage requirements should also be maintained.

5. Whether Sections 1.6 and 2 of the WPDES Permit are unreasonable because they do not require that Kinnard Farms maintain adequate manure storage.

   Holding: The Petitioners have not carried their burden of proof on this issue, other than the overlap with issue four above.

6. Whether Section 1.6 of the WPDES Permit and the Nutrient Management Plan are unreasonable because they include unattainable yield goals.

   Holding: The Petitioners have not carried their burden of proof on this issue.

FINDINGS OF FACT

1. Kinnard Farms, Inc. (Kinnard Farms) has proposed to construct a concentrated animal feeding operation (CAFO) production area (Site 2) north of County Road S and in between Spruce Road and Tamarack Drive in the Town of Lincoln in Kewaunee County.

2. Kinnard Farms filed an application for reissuance of a Water Pollutant Discharge Elimination System (WPDES) permit with the Wisconsin Department of Natural Resources (DNR) on March 21, 2012.

3. As part of the WPDES permit reissuance application process, Kinnard Farms submitted a request for approval of the plans and specifications for its facility to the DNR on March 19, 2012. DNR issued a conditional approval of plans and specifications for the waste storage facility on November 30, 2012. (Ex. 9) DNR issued a conditional approval of plans and specifications for the feed storage pad and runoff control system on August 20, 2012. (Ex. 7)

4. As part of the WPDES permit reissuance application process, Kinnard Farms submitted a nutrient management plan (NMP) on March 21, 2012. The NMP was preliminarily approved on April 18, 2012.

5. On August 16, 2012, the DNR reissued coverage to Kinnard Farms under WPDES Permit No. WI-0059536-03-0. (Ex. 301)

6. On November 30, 2012, the DNR issued its conditional approval of the plans and specifications for Site 2. (Ex. 9)

7. On October 15, 2012, the DNR received a petition for a contested case hearing on behalf of petitioners (Petitioners) from Midwest Environmental Advocates. The DNR (by letter from Matt Moroney to Sarah Williams) granted a contested case hearing on seven issues. The parties later agreed on a new statement of issues for hearing submitted by Petitioners, intentionally omitted Issue Seven on which a hearing had been granted. Specifically, that issue challenged whether Section 1.6 of the Permit and the NMP are unreasonable because they do not require identification of drain tile lines to the maximum extent practicable.

8. The contested case hearing on the remaining six issues was held February 11-14, 2014.

9. A CAFO WPDES permit prohibits discharges of manure and process wastewater from the production area to navigable waters, except under certain circumstances, including for dairies that a 25-year, 24-hour storm event must have occurred. (Wis. Admin. Code § NR 243.13(2)) This basic framework is called the "no discharge" effluent limitation. (Bauman Pre-filed, p. 7, lines 146-147)

10. There are some practical limitations to using Water Quality Based Effluent Limits at CAFOs, including identifying a proper flow and discharge location for diffuse discharges and applying WQBELs to very intermittent discharges that may occur as a result of a 25-year, 24-hour storm event. (Bauman Pre-filed, p. 15, lines 327-330) In the absence of a defined pipe with exclusive discharges, the DNR conducts engineering review of plans for the production area, narrative water quality based restrictions (or TBELs) and identifies best management practices that a CAFO must implement. (Bauman Pre-filed, p. 19, lines 421-424) The parties disagree about whether there is a discreet conveyance in the proposed project. The dairy and the DNR note that water entering Culvert 9 will also include off-site stormwater. (Id) The Petitioners argue that drainage ditches four and five and stormwater ditches eight and five will discreetly discharge stormwater from Site 2 into Culvert 9. (Martin Pre-filed, p. 26)

11. The DNR has authority to review and approve design plans for manure and process wastewater handling and storage systems at CAFOs under Wis. Stat. § 281.41. Plan reviews conducted under s. 281.41, Wis. Stats., help to ensure that structures are designed in a manner that complies with applicable technical standards and permit requirements. Wisconsin Stat. § 281.41 requires that the DNR must approve or reject the plan within 90 days once they are complete. (Wheat Pre-filed, p. 10, 194-204)

12. DNR witness testified that a plans and specifications review provides one level of review and that WPDES permits issued under Wis. Stat. ch. 283 establish operational requirements and practices a CAFO must follow in order to protect water quality. (Bauman Pre-filed, p. 5, lines 102-110)

13. The permittee may not commence construction until the DNR approves its plans and specifications. (Wheat Pre-filed, p. 11, lines 209-210)

14. Ms. Wheat testified that from a technical perspective, she does not believe the chronological order of the plan approval and permit issuance to be important. (Wheat Pre-filed, p. 11, lines 207-209) The WPDES permit may be modified at any time to reflect changes in the plans and specifications. (Wheat Pre-filed, p. 11, lines 215-223)

15. Even after permit is issued, NR 243.15(1)(a) precludes the permittee from commencing construction until the DNR approves its plans and specifications. Even after the plan approval is issued, §§ NR 243.11(3) and 243.12(1) precludes the permittee from bringing animals onto the site. (Wheat Pre-filed, p. 11, lines 209-212)

16. Petitioners requested no remedy pursuant to their challenge of the chronological order of the plans and specifications, and the Petitioners have not demonstrated that this procedural approach has specifically led to the need for any substantive changes in either the NMP or the Permit.

17. The Waste Storage Facility design proposes a composite and water-tight concrete liner combination. (Wheat Pre-filed, p. 28, lines 541-542; Ex. 102)

18. Kinnard Farms' WPDES Permit implements DNR's "no discharge" requirement for the production area. (Bauman Pre-filed, pp. 6-7; TR Vol. 4, pp. 990-92, 1013 (Bauman))

19. Section 1.1 of the Kinnard Farms WPDES Permit provides that Kinnard Farms "may not discharge manure or process wastewater pollutants to navigable waters from the production area ...unless all of the following apply:

- Precipitation causes an overflow of manure or process wastewater from a containment or storage structure.

- The containment or storage structure is properly designed, constructed and maintained to contain all manure and process wastewater from the operation, including the runoff and the direct precipitation from a 25-year, 24-hour rainfall event for this location (Kewaunee County — 4.2 inches).

- The production area is operated in accordance with the inspection, maintenance and record keeping requirements in s. NR 243.19.

- The discharge complies with groundwater and surface water quality standards."

(Ex. 301, p. 1)

20. All manure generated at the Kinnard Farms Site 2 production area will be collected and transported to the manure storage facility and eventually land-applied in accordance with the Kinnard Farms NMP. (Williams Pre-filed, pp. 12, 14)

21. With one exception, all process wastewater from the Site 2 production area is transported to the manure storage facility and eventually land-applied in accordance with the NMP. The exception is that highly diluted runoff from the feed storage area generated after the runoff from the first 1/4 inch of precipitation from every rain event is collected and transported to the vegetated treatment area (VTA). (Williams Pre-filed, pp. 12, 26) Expert witnesses for both DNR and Kinnard Farms provided substantial testimony demonstrating the effectiveness of the design of the feed storage pad, leachate collection system and VTA.

22. The feed storage pad consists of a four-inch thick asphalt surface. Below the asphalt surface is a drainage layer of stone, which is lined with a geo-membrane lining. Any seepage collected by a four-inch drain within the drainage layer will be conveyed to the leachate lift station and then to the manure storage facility. The asphalt surface of the feed storage pad slopes from west to east to direct any stormwater and silage leachate towards a reinforced concrete collection channel, which diverts the runoff to a lift station. (Williams Pre-filed, p. 28) Kinnard Farms designed the concrete collection channel adjacent to the feed storage pad to handle precipitation from a 100-year, 24-hour storm. This exceeds the applicable regulatory standard, which requires the design to accommodate a 25-year, 24-hour storm, and it minimizes the potential for overtopping of the collection channel directly onto the VTA. (Wheat Pre-filed, p, 24)

23. The feed storage pad leachate runoff that is directed to the lift station is pumped to the manure storage facility. The lift station is designed to pump the initial 1/4 inch of every rainfall event during each 24-hour period. Once the design volume has been pumped to storage, the pumps will shut off and the remaining runoff is directed to the VTA. (Williams Pre-filed, p. 28) This design of collecting the initial runoff from each precipitation event is called the "first flush" collection.

24. The collection channel beyond the lift station has 25 slot weirs, which meter and spread the flow of the feed pad runoff water onto the VTA. The VTA is a designed and constructed earthen area 300 feet (100 yards) wide and 1200 feet (400 yards) long with grassy vegetation. The top 24 inches of the VTA soil profile is constructed with topsoil from the site, and the VTA is graded with a 0.5 percent downward slope to the north, in the direction of Culvert 9. The VTA has gravel spreader pads that run the entire width of the VTA located every 200 feet. The gravel spreader pads redistribute any channelized flow so that the flow down the VTA continues as sheet flow. The VTA is designed to infiltrate stormwater from rainfall events greater than 1/4 inch that originates from the feed storage area, and only after the first 1/4 inch of runoff have been collected and disposed of via the feed pad leachate collection system. (Williams Pre-filed, pp. 28-29; Ex. 102, Sheet Nos. C109, C116)

25. At the base of the VTA is a 35-foot grassed filter strip onto which any water that exits the VTA will flow. (Williams Pre-filed, p. 30) This filter strip or vegetated buffer is an additional safeguard not required by any regulation. (Wheat Pre-filed, p. 17; TR Vol. 4, p. 1156 (Wheat)) During normal conditions, there will be very little, if any, flow from the VTA onto the filter strip. (Williams Pre-filed, p. 41) Beyond the filter strip is the convergence of the two storm water diversion ditches, Ditch 5 and Ditch 8, in the vicinity of Culvert 9. (TR Vol. 2, p. 366 (Williams); TR Vol. 4, p. 1130-31 (Wheat); Ex. 102, Sheet Nos. C109, Cl 16)

26. DNR concluded it would be difficult to establish a reliable discharge monitoring system at the base of the VTA. It based this conclusion on the intermittent nature of any flow off the VTA, the diffuse nature of any such flow, which would be spread out along the 300 feet width of the VTA, and the potential for other environmental contaminant sources unrelated to the Kinnard Farms production area that could influence the monitoring data. (Bauman Pre-filed, p. 13; TR Vol. 2, pp. 387-92 (Williams); TR Vol. 4, pp. 994-95, 1039-40 (Bauman); TR Vol. 4; p. 1166 (Wheat))

27. DNR considered each of the design features of the VTA in concluding that no additional WPDES permit conditions were necessary to address potential pollutant discharges to surface waters from the feed storage area. (TR Vol. 4, pp. 1102-OS (Wheat))

28. The size of the first flush that Kinnard Farms will collect and transport to the manure storage facility directly reduces impacts from the concentration of nutrients that will be directed to the VTA for treatment. By collecting the first ¼ quarter inch of every rain event, Kinnard Farms will be collecting the largest amount of first flush of any VTA approved in Wisconsin. (TR Vol. 1, p. 261 (Shaw); TR Vol. 4, p. 1101 (Wheat))

29. Recent research at three VTA sites at Discovery Farms indicates that during rain events, at least 75 percent of all pollutants are being captured by systems that collect far less than the first 1/4 inch of rain. (TR Vol. 4, p. 1134 (Wheat))

30. The current NRCS standard is based on research that shows collection of 0.05 (1/20) inch of the first flush collects the vast majority of nutrients from a feed storage pad. That research also demonstrated that collection of the first 1/4 inch is the highest amount of first flush to be collected, because there is no demonstrable increase of nutrients that will be collected by a first flush collection that exceeds 1/4 inch. (TR Vol. 2, pp. 309-11 (Williams))

31. Kinnard Farms' VTA was designed to provide the highest possible infiltration rate and to minimize discharges at the base of the VTA. To accomplish this, the VTA was designed with the maximum length to width ratio (4:1), which provides for the longest possible flow length for the size of the VTA. It also was designed with the flattest slope allowed by DNR's guidance. The result is that the highly diluted runoff directed to the VTA will have the slowest flow velocity and longest resonance time possible. (Williams Pre-filed, p. 32)

32. DNR and Kinnard Farms specifically addressed the proximity of the VTA to the wetland beyond Culvert 9 by establishing a very high first flush collection and by designing and approving a VTA that was quite large compared to criteria in the NRCS Standard that was in effect at the time. (Wheat Pre-filed, p. 17)

33. The draft DNR guidance in place at the time Kinnard Farms designed the VTA was more restrictive than the then-current NRCS standard. (Pofahl Pre-filed, p. 11; TR Vol. 4, pp. 1102-04 (Wheat)) The design of Kinnard Farms' feed storage pad, leachate collection system and VTA exceeded the requirements of the applicable NRCS standard and DNR's draft guidance. (TR Vol. 4, pp. 1110-11 (Wheat))

34. Subsequent to DNR's approval of Kinnard Farms' feed storage pad and VTA, the applicable NRCS standard (MRCS Standard 635 (Sept. 2012)) was updated and DNR anticipates its draft guidance will no longer be necessary. (TR Vol. 4, pp. 1137-38 (Wheat))

35. The dimensions of the Kinnard Farms VTA exceed by nearly a factor of two the dimensions that are required by the latest NRCS standard. (TR Vol. 2, pp. 396-400 (Pofahl); TR Vol. 4, pp. 1138-39 (Wheat); Ex. 14, Table 2 & § V.D.I.)

36. The efficacy of VTAs has been established by ongoing scientific research and they have been demonstrated to work well at attenuating any concentrations of pollutants which

may remain in the stormwater that is sent to the VTA. (Wheat Pre-filed, p. 21; TR Vol. 2, p. 341 (Williams); TR Vol. 4, pp. 1157-58 (Wheat)

37. Under normal conditions, the concentration of pollutants entering the VTA will be negligible owing to the first flush design of the leachate collection system. (Williams Pre-filed, p. 26; Wheat Pre-filed, p. 17; TR Vol. 4, pp. 1133-35 (Wheat)) DNR concluded that the design of the VTA is more than adequate to attenuate the minute concentrations that remain. (Wheat Pre-filed, p. 21; TR Vol. 4, pp. 1134-35 (Wheat))

38. Based on the design features of the VTA, DNR was not unreasonable when it declined to require Kinnard Farms to monitor the surface water flow at the base of the VTA. Outflow for the VTA is not a discreet conveyance within the meaning of the WPDES program. The size of the vegetated treatment area (VTA) complied with NRCS Standard 635 that applied at the time of approval, and considering the (minimal) slope and distances to saturation and bedrock, Ms. Wheat testified that it substantively meets the current NRCS Standard 635. (Wheat Pre-filed, pp. 22-23, lines 422-441)

39. The feed storage design provides for a high first flush collection of rain (0.25 inch) to be collected. (Wheat Pre-filed, p. 17, lines 322-329) Ms. Wheat expects very low concentrations of pollutants in the remaining rainfall that is routed to the VTA. (Wheat Pre-filed, p. 17, lines 322-329)

40. DNR and Chapter NR 243 contemplate a technology-based approach to CAFO effluent limits. Due to the lack of discrete conveyances at CAFOs, the monitoring of which would have regulatory value, most CAFO effluent limitations are technology based. (Bauman Pre-filed, pp.6-7, 120-148) The TBEL approach replaces the water-quality based effluent limit applicable to most other point sources regulated under the WPDES program. In lieu of chemical specific monitoring, the WPDES permit program relies on proper design, construction, and operation of reviewable structures. (Bauman Pre-filed, p. 13, lines 286-287)

41. DNR testimony established that Culvert 9 is not a discrete conveyance solely from Kinnard Farms' production area. (Bauman and Wheat live testimony, February 14) DNR witnesses testified that other sources of pollutants not related to Kinnard Farms contribute to the flow that reaches Culvert 9. (Wheat and Bauman live testimony, February 14)

42. The Kinnard WPDES Permit does not require any monitoring that would establish "the volume of effluent discharges and the amount of each pollutant discharge." See Wis. Stat. § 283.55(1)(a)

43. Wastewater from the VTA and on-site stormwater are comingled into a ditch before entering Culvert 9.

44. For sampling to have regulatory meaning, it must account for background levels. CAFOs' "no discharge" standard is a high bar. DNR witness Tom Bauman testified that at Site 2, open-air conditions and run-on to the site present potential interference from unregulated farms and other CAFOs in the area, from farm fields spread with nutrients, septic systems, decaying vegetation, and wildlife. (Bauman Live testimony, February 14, morning)

45. The permit as a whole and § NR 243.13(1) require that all surface water discharges from Kinnard Farms must comply with the surface water quality standards in chs. NR 102 to 105, and 207. (Bauman Pre-filed, p. 14, lines 301-302; Ex. 301)

46. Antidegradation review applies to a person proposing to create an increase of an existing discharge or create a new discharge to surface waters of the state. (§ NR 207.01(2)) The Permit's reissuance to Kinnard Farms does not afford it an increased discharge or a new discharge to surface water, and so does not trigger antidegradation review. (Ex. 301, s. 1.1)

47. DNR witnesses testified that technology-based effluent limits are enforceable. The DNR has pursued enforcement against CAFOs even though it applies technology based effluent limits to most CAFOs rather than water quality-based effluent limits. (Bauman Pre-filed, p. 15, lines 337-341; Ex. 203)

48. Gretchen Wheat's testimony during the hearing indicated the Dairy had advised her that it would agree to conducting a breach analysis. (Wheat live testimony, February 14, afternoon)

49. The WPDES permit as a whole requires that the permittee comply with all groundwater quality standards. (Ex. 301)

50. Groundwater monitoring is not a standard requirement for WPDES permits or plans and specifications approval. (Bauman Pre-filed, p. 16, lines 360-361) Tom Bauman testified that an applicant is not required to gather background groundwater quality data before the DNR approves construction plans or issues a CAFO WPDES permit. (Bauman Pre-filed, p. 16, line 357) Neither the CAFO permit application process in § NR 243.12 nor the CAFO plan approval process in s. NR 243.15 requires installation of background wells and collection of groundwater quality monitoring data prior to construction or permit issuance or reissuance. In Mr. Bauman's 15 years with the Agricultural Runoff Program, he is not aware of any CAFO that has been required by the WPDES permit program to install background wells and collect groundwater data prior to site development or WPDES permit issuance. (*Id.* at p. 17, lines 366-373) However, the level of groundwater contamination including E Coli bacteria in the area at or near the project site is also very unusual, as is the proliferation of CAFO's in Kewaunee County. (Sagrillo, Mindak, et al)

51. Members of the public described what could fairly be called a groundwater contamination crisis in areas near the site. (Mindak, Cocharts, Weinewmueller, Rothieaux, Treml, Jerabek, Sagrillo, Dr. Iwen, Wautlet, Rybski) Several witnesses testified that up to 50 percent of private wells in the Town of Lincoln are contaminated and that as many as 30 percent of wells had tested positive for E.coli bacteria. No witness for the dairy or the DNR disputed these numbers. Mike Sagrillo, has lived in the Town of Lincoln for 36 years and is the former chair of its planning commission. Sagrillo testified under oath about numerous unusable, contaminated wells in the Town of Lincoln. Many public comment witnesses suggested a plausible and even likely connection between the large numbers of CAFO's in the County and area and well-known problems with groundwater contamination. Numerous witnesses testified credibly and forcefully about the hardship and financial ruin that well water contamination has had on their businesses, homes and daily life.

52. Nearby neighbors Mr. David Mindak, Ms. Lynda and Ms. Amy Cochart, and Ms. Sandra Weinnemueller all testified about how difficult life was contaminated well water. Mr. Mindak testified memorably to eating anti- diarrhea medicine "like it was candy" after being

sickened by e-coli contaminated well water that was under 100 feet from a Kinnard landspreading field. Ms. Winemueller, a registered nurse, testified that her property is on low ground near a swamp approximately 4.5 miles from Site 2 and that her well water is contaminated with e-coli. Her family does not have a septic system with a drain field, so that could not be the source of her contamination. She believes Kinnard Farms is the only likely source of the cloudy and contaminated water that comes through her tap and made her family sick with diarrhea and stomach cramps. Despite her family having invested in an expensive holding tank to treat its own waste, her family suffers the daily stress, embarrassment, and financial cost of e-coli contamination in its well. Ms. Erica Routhieaux lives just fifty feet from the proposed expansion and is concerned that she will now be forced to conduct regular expensive testing of her well water to ensure her family's safety. Similarly, Mr. Jessie Jerabek lives ¾ of a mile from the Kinnard farm and has regularly inspected and kept his septic system in good repair. However, his well water has tested with high nitrate concentrations. Jerabek has fears for his family's safety and has been testing his water recently on an almost daily basis. He testified memorably about his concerns for the safety of his three year old daughter, who sometimes consumes small amounts of bathwater.

53. Undisputed testimony on the record established that a particularly complex geology is present at Site 2. DNR witnesses testified that complex geology makes it difficult to link a positive sampling result with a particular source. (Wheat live testimony, February 14, afternoon) The ability to identify the source groundwater quality exceedances is fundamental to the value of groundwater monitoring as an effective enforcement tool. However, given the proliferation of contaminated wells at or near the project site, it is essential that the Department utilize its clear regulatory authority as set forth below to ensure that Kinnard Farms meet its legal obligation under Wis. Admin. Code NR 243.14(2)(b)(3) not to contaminate well water with fecal bacteria from manure or process wastewater.

54. Groundwater monitoring can be required in cases where "facilities are located on or near areas that are susceptible to groundwater contamination such as direct conduits to groundwater, sandy soils, and sites with minimal separations between bedrock and high water tables". (Wis. Admin. Code § NR 243.15(3)(2)(a))

55. During the plans and specifications approval process, the DNR required Kinnard Farms to conduct a site assessment regarding perched groundwater saturation, regional groundwater, and bedrock in order to determine if groundwater monitoring would be necessary. (Ex. 5)

56. Site assessment information, the design of structures, and the condition of structures inform DNR staff as to whether groundwater quality monitoring is necessary. (Wheat Pre-filed, p. 14, lines 265-267) She concluded that Site 2 to be among the most protective designs in the state.

57. Kinnard Farms performed 40 soil borings and 32 test pits to evaluate the soil conditions and depth-to-bedrock in the vicinity of the manure storage facility at Site 2, which is nearly twice as many as the applicable NRCS 313 practice standard requires. (Williams Pre-filed, p. 21)

58. The experts disagreed as to the proper interpretation of the data yielded during the soil probe and test pit excavations. Mr. Williams opined that the standard conservative assumptions are not useful for interpreting the data at Site 2 east of Spruce Road. First, the boring equipment used could not extend beyond a rock fragment or large stone in excess of six inches in diameter, and the soil in the area contains numerous large stones. Second, many borings of shallower depths were in

close proximity of other borings that did not terminate at shallow depths, supporting an interpretation that the shallower borings encountered large stones and not bedrock. Finally, none of the test pits that were dug in the vicinity of the manure storage facility with excavation equipment encountered any bedrock, including those test pits that were dug to a depth of 34 feet. (Williams Pre-filed, pp. 16-17)

59. The most conservative interpretation of the data is to assume that any encounter of rock or refusal is evidence of bedrock, and to assume bedrock lies just beyond the lowest recorded depth where refusal was not encountered. (Muldoon Pre-filed, p. 16; Williams Pre-filed, p. 16) Dr. Muldoon based her analysis on these conservative assumptions. (Muldoon Pre-filed, pp. 16-17)

60. Dr. Maureen Muldoon, a geology professor at nearby UW-Oshkosh, has extensive experience in this region investigating fractured carbonate bedrock aquifers like that present at Site 2. She testified persuasively that the area around Kinnard Farms is very vulnerable to groundwater contamination. (Muldoon Pre-filed, pp. 9-11, 12; Hr'g Test., at 04:25, 07:22; 57:34, 01:49:13-30) Any pollution at the surface can travel rapidly through the shallow, glacial till soils and fractured carbonate bedrock. (Hr'g Test., at 02:32 (Muldoon)) There is little opportunity for attenuation and dispersion given the rapid transport through groundwater. (Hr'g Test., at 02:44 (Muldoon); Muldoon Pre-filed, p. 8) The closest downstream private well is a half mile to the east of Site 2. (Hr'g Test., at 02:10:27 (Trainor)) In karst areas such as those beneath Site 2, pollution at the surface can travel rapidly through groundwater into down gradient wells. (Muldoon Pre-filed, pp. 9-11) In Dr. Muldoon's research and experience, she has observed pollutants transport over a half mile in 24 hours in similar hydro geologic conditions."

61. It is feasible and reasonably cost-effective to install a groundwater monitoring system in the fractured carbonate bedrock aquifer beneath Site 2. (Hr'g Test., at 08:20-08:45 (Muldoon)) A site characterization could be completed to identify fracture pathways and develop an effective groundwater monitoring system. (Muldoon Pre-filed, pp. 27-30) There are groundwater sampling devices that would be ideal for this type of groundwater monitoring because they have small, self-contained data-loggers that can record variations in water level as well as variations in fluid temperature and electrical conductivity, or a measure of the total dissolved solids in the water, at pre-programmed time intervals. (Muldoon Pre-filed, p. 28) Dr. Muldoon testified that she had installed a groundwater sampling system in similar hydrogeologic conditions for approximately $30,000. (Hr'g Test., at 01:04:33, 01:00:44-01:01:22 (Muldoon))

62. Given the proliferation of contaminated wells in the vicinity of Kinnard Farms, and the likely presence of karst features including fractured bedrock under the standard conservative geological assumptions, the DNR should exercise its clear regulatory authority to require groundwater monitoring near or at the site because it is "susceptible to groundwater contamination" within the meaning of § NR 243.15(3)(2)(a). The Department should review a plan for groundwater monitoring to include no less than six wells, preferably with no less than two that monitor areas subject to intensive landspreading by Kinnard Farms. Accordingly, the WPDES permit must be modified to include a groundwater monitoring plan which includes no less than six monitoring wells. If practicable, the permit-holder shall include at least two monitoring wells which are located off-site on voluntarily willing neighboring properties with water contamination issues or risks.

63. No applicable rule or statute requires a WPDES permit to specify a number of animal units at a CAFO facility. (Bauman Pre-filed, p. 25, lines 545-546) However, the Department has instituted this measure in other CAFO permits.

64. The number of animal units is not an effective sole method by which the DNR determines WPDES permit compliance. (Bauman Pre-filed, p. 23, lines 510-511) The measure of compliance with a discharge permit is how waste is managed, not to what extent it is generated. (Bauman Pre-filed, p. 24, lines 527-536) A practical short-term measure to determine whether a facility is exceeding the amount of waste it is able to store and land apply by looking at amount of manure in a pit. (Bauman Live Testimony, February 14, morning)

65. However, an enforceable maximum cap on animal units does provide a useful longer-term management tool for knowing when problems are likely to occur because both generation and the discharge of manure is directly related to the number of animal units on site. (Shaw, Polenske) Further, in 2009 and 2010 Kinnard failed to have permanent markers installed to allow a ready indication of when it had reached the 180-day limit of manure and wastewater storage. (Exs. 58-59) Under these circumstances, Sections 1.3, 1.3.3, 2 and 3.1.12 of the Permit should be modified to require that the permit articulate a maximum number of animal units allowed at the facility in addition to current storage requirements.

66. Section 1.3.2 of the Kinnard Farms WPDES permit requires the Dairy to maintain adequate manure storage. (Ex. 301) Requirements to maintain adequate manure storage are not included in other portions of the WPDES permit in order to minimize duplicate permit language. (Bauman Pre-filed, p. 25, lines 557-558)

67. Yield goals help calculate how much phosphorus growing crops remove from the soil. (Craig Pre-filed, p. 10, line 214) DNR calculations show that Kinnard Farms will produce approximately 300,000 lbs. of phosphorus and the crops selected will remove approximately 326,000 lbs. of phosphorus from the soil. (Craig Pre-filed, p. 10, lines 218-223)

68. The yield goals set within the NMP are considerably higher than county averages for the same crops in Kewaunee County. (Shaw) However, the yield goals set within the NMP reflect the average yield goals Kinnard Farms has achieved and documented on fields where it has recently completed yield monitoring. (Craig Pre-filed, p. 10, lines 215-216)

69. The Dairy selected the hand check and stem count method to calculate yield goals. (Craig Live Testimony, February 13, afternoon) The yield goal methods selected by the Dairy are reliable methods, and are generally more accurate than county averages. (Craig Live Testimony, February 13, afternoon)

DISCUSSION

There was something of a “disconnect” between the evidentiary portion of the hearing on the WPDES permit review and the testimony from members of the public that stretched until late in the evening. While there was some support for the Kinnard Farms and the quality of their farming operations, many members of the public were deeply upset about what could only be described as a crisis with respect to groundwater quality in the area. [1] The proliferation of contaminated wells represents a massive regulatory failure to protect groundwater in the Town of Lincoln. The Department needs to utilize its clear regulatory authority to require groundwater monitoring to enhance its ability to prevent further groundwater contamination.

Many public witnesses testified under oath credibly and forcefully about the hardship and financial ruin that this local groundwater contamination crisis has had on their businesses, homes and daily life. Numerous people echoed comments from Mike Sagrillo, who has lived in the Town of Lincoln for 36 years and has served as chair of its planning commission. Sagrillo testified about numerous unusable, contaminated wells in the Town of Lincoln. Several witnesses asserted that in the Town of Lincoln 50 percent of private wells are contaminated and as many as 30 percent of wells had tested positive for E.coli bacteria. It is not unreasonable for residents to see a link to large farming practices in the area. It is more likely than not that some portion of this contamination is from CAFO landspreading in a County where, according to unrebutted public testimony, there are more than a dozen permitted CAFO's and vast areas of its farmland subject to landspreading contracts.

The closest any of the members of the public came to directly linking groundwater contamination to the Kinnard Farms was the case of Kinnard neighbor David Mindak. Mr. Mindak testified that his contaminated well had to be replaced because of bacterial contamination that the DNR determined came from cow manure. (Ex. 400) The DNR's subsequent investigation was unable to determine the precise source of contamination of Mr. Mindak's well contamination because of the difficulties of tracing bacteria contamination back to the source without expensive DNA testing.[2]

Dr. Muldoon—who has extensive experience in this region investigating fractured carbonate bedrock aquifers like that present at Site 2—testified that the area around Kinnard Farms is very vulnerable to groundwater contamination. (Muldoon Pre-filed, pp. 9-11, 12; Hr'g Test., at 04:25, 07:22; 57:34, 01:49:13-30) Any pollution at the surface can travel rapidly through the shallow, glacial till soils and fractured carbonate bedrock. (Hr'g Test., at 02:32 (Muldoon)) There is little opportunity for attenuation and dispersion given the rapid transport through groundwater. (Hr'g Test., at 02:44 (Muldoon); Muldoon Pre-filed, p. 8) The closest downstream private well is a half mile to the east of Site 2. (Hr'g Test., at 02:10:27 (Trainor)) In karst such areas such as those beneath Site 2, pollution at the surface can travel rapidly through groundwater into down gradient wells. (Muldoon Pre-filed, pp. 9-11) In Dr. Muldoon's research and experience, she has observed pollutants transport over a half mile in 24 hours in similar hydro geologic conditions."

The petitioners argue forcefully that, "Without groundwater monitoring at Site 2, the only way for the DNR or citizens to detect that Site 2 is causing groundwater contamination is for a neighbor's well to become contaminated." Unfortunately, this has been the all too common state of affairs in the Town of Lincoln and Kewaunee County over the past years. This WPDES permit must be modified to do what is reasonably necessary to protect the drinking water of the residents and further groundwater contamination. While the Department has not previously required groundwater

---

[1] It is also striking that none of this important context was included in the Department's Environmental Assessment (EA). However, the sufficiency of the EA is not an issue for this contested case proceeding and the EA met the procedural requirements of WEPA.

[2] In fairness, it must be noted that Mindak replaced his old well and has not had further problems. It must also be noted that the cost of this replacement well was incurred by Wisconsin taxpayers, rather than by the most likely source of the cow manure caused contamination.

monitoring, it has clear regulatory authority to do so in the context of a CAFO WPDES permit. See Wis. Stat. § 283.31(3), (4); *see also* Wis. Admin. Code §§ NR 243.13(1), (5), 243.15(3)(c)2., (7).. It is also abundantly clear that the area is "susceptible to groundwater contamination" within the meaning of Wis. Admin. Code § NR 243.15(3)(2)(a).

Further, as DNR permit engineer Ms. Wheat opined, groundwater contamination from Site 2 itself could be "the least of the concerns" of the petitioners. It seems even more likely that further groundwater contamination could come from landspreading. For one thing, due to soil excavations undertaken by the Kinnards, more is known about the geology of the area under Site 2 than about many other off-site locations were Kinnard Farms manure will be land spread. The experts disagreed about the geology at Site 2, although using standard conservative assumptions Site 2 is susceptible to groundwater contamination. But it seems even more likely that groundwater contamination could result from landspreading than from Site 2 itself, which does have some portion of clay that may be more protective of groundwater than many off-site areas.

Nonetheless, given the dispute in the interpretation of the soil excavation results at Site 2, it is essential to undertake some groundwater monitoring on-site in areas close to neighbors who have experienced well water contamination. While it will be difficult to establish a reliable system of groundwater monitoring under these geologic circumstances, Dr. Muldoon was convincing that an effective groundwater monitoring system could be initiated for as little as $50,000. The fact that groundwater monitoring might be difficult—because of the very karst geological features that make the area particularly susceptible to groundwater contamination—must not be used as an excuse not to exercise the DNR's clear regulatory authority and duty to do so. Rather, such an effort must be undertaken to ensure that there is not further contamination of groundwater under these deplorable background conditions.

The permit must be amended to include a plan acceptable to the DNR for groundwater monitoring for all pollutants of concern at no less than six wells on and around site 2. It would be better and more likely to yield results that identified problem areas if this could also include two or three representative off-site landspreading fields. Obviously, this would require the voluntary participation of off-site property owners. However, no witness testified as to how such a system could be practically undertaken, and the petitioners have not offered such a plan as part of their request for relief. It was not their burden to do so. They have carried their burden of demonstrating that a groundwater monitoring plan is essential given that the area is "susceptible to groundwater contamination" within the meaning of Wis. Admin. Code § NR 243.15(3)(2)(a)

The permit has been further modified, and both the DNR and the Dairy agreed to some of the modified language. Petitioners requested a modification to Section 1.1 of Kinnard Farms' WPDES permit to incorporate two provisions of the corollary Production Area Discharge Limitations section of the state's Large Dairy CAFO General Permit (WPDES Permit No. WI-0063274-01) (excerpted in Ex. 201) First, they request inclusion of the following provision relating to Outstanding and Exceptional Resource Waters: "For all new or increased discharges to an ORW or ERW, any pollutant discharged shall not exceed existing levels of the pollutants immediately up stream of the discharge site." Mr. Bauman testified that DNR does not believe the inclusion of this language is necessary, but "for the sake of clarity [DNR] would be amenable to including" this language in Section 1.1 of the permit. (Bauman Pre-filed, p. 12)

Second, Petitioners requested inclusion of the following provision to foreclose any argument that the production area discharge limitations are inapplicable to non-navigable waters of the state:

"Production area discharges to waters of the state authorized under this permit shall comply with water quality standards, groundwater standards and may not impair wetland functional values." Again, Mr. Bauman testified that he does not believe the inclusion of this language is necessary, but he would not have a problem with including that language in Section 1.1 for clarification. (TR Vol. 4, pp. 1014-15 (Bauman))

Further, the Petitioners have established that the WPDES permit is unreasonable because it does not specify the number of animal units allowed at the facility. In support of that contention, Petitioners established that animal units are a common regulatory device in WPDES permitting, that the number of animal units corresponds directly to the amount of waste generated by a CAFO, and that imposition of a cap on animal units is a good idea in this particular case because of concerns over Kinnard Farms' ability to comply with regulatory requirements directly related to the current permit requirements for 180 day storage capacity. (Exs. 58-59) It is not a question of either/or—the 180 day storage requirement represents a good short term measure to detect an impending problem, but the maximum animal unit number represents a useful longer-term management tool that will ensure that there is not suddenly a mad rush to achieve permit compliance and get under the 180 day capacity threshold. Establishing a cap on the maximum number of animal units will provide clarity and transparency for all sides as to the limits that are necessary to protect groundwater and surface waters. The permit should accordingly be modified by the Department to reflect this *additional* requirement.

All of these modifications are necessary to ensure that the permit holder meets its legal obligations, but with these modifications, the permit is approved.

CONCLUSIONS OF LAW

1. The Division of Hearings and Appeals (the Division) by its ALJ, has authority to hear contested cases and issue necessary orders in cases relating to WPDES permits referred to the Division by the Department. (Wis. Stat. §§ 227.43(1)(b) and 283.63)

2. Pursuant to Wis. Stat. § 283.63 a permittee or petitioner may secure review of the reasonableness or necessity for any term or condition of any issued, reissued or modified permit by filing a verified petition with the DNR Secretary. The petitioner has the burden of proof on allegations made in such a petition. The Department shall, "consider anew all matters concerning the permit denial, modification, suspension or revocation."

3. Kinnard Farms is a "large animal feeding operation" within the meaning of § NR 243.04(13). Kinnard Farms' Site 2 is a "point source" subject to the WPDES program, specifically "a concentrated animal feeding operation" within the meaning of Wis. Stat. § 283.01(12)(a).

4. Wisconsin Admin. Code Chapter NR 243 is the administrative code that applies to CAFO WPDES Permit and plan approval actions. Chapter NR 243 does not require the calculation of water quality based effluent limits for CAFO WPDES permits. (Bauman Pre-filed, p.15, lines 326) A CAFO WPDES permit prohibits discharges of manure and process wastewater from the production area to navigable waters, except under certain circumstances, including for dairies that a 25-year, 24-hour storm event must have occurred. (§ NR 243.13(2))

5. For a CAFO, WPDES effluent limitations are based on proper manure and process wastewater storage and/or containment and land application practices. (Bauman Pre-filed, p. 19, lines 417-419) In the absence of a defined pipe with exclusive discharges, the DNR conducts engineering review of plans for the production area, narrative water quality based restrictions (or TBELs) and identifies best management practices that a CAFO must implement. (Bauman Pre-filed, p. 19, lines 421-424) The discharge from the VTA and or into the ditches or Culvert Nine is not a defined pipe or discreet conveyance because water from other sources is mixed with on-site discharges.

6. Neither the CAFO permit application process in § NR 243.12 nor the CAFO plan approval process in § NR 243.15 requires that plan and specification approvals precede permit issuance chronologically.

7. The Permit may be issued before the DNR approves the plans and specifications for the facility because no Wisconsin law requires chronologically that the DNR approve plans and specifications before issuance of the permit.

8. Section 1.1 of the Permit is reasonable as amended in that it specifically requires that discharges authorized by the Permit comply with surface water quality standards.

9. Sections 1.1, 1.7 and 1.8 of the Permit are reasonable as modified because they require that authorized discharges from the production area comply with groundwater quality standards.

10. The DNR's obligation to include conditions in a WPDES permit that assure compliance with groundwater protection standards may be met through its authority to require groundwater monitoring in a WPDES permit, when necessary. See Wis. Stat. § 283.31(3), (4); *see also* Wis. Admin. Code §§ NR 243.13(1), (5), 243.15(3)(c)2., (7).

11. The DNR administrative code for CAFO's requires the installation of groundwater monitoring wells at a facility if it determines that groundwater monitoring "is necessary to evaluate impacts to groundwater and geologic or construction conditions warrant monitoring." Wis. Admin. Code § NR 243.15(7) The petitioners and members of the public have carried their burden of proof in establishing that groundwater monitoring is necessary at or near Site 2.

12. The Petitioners and public witnesses have established that the area at or near Site 2 and subject to landspreading contracts is "susceptible to groundwater contamination within the meaning of Wis. Admin. Code § NR 243.15(3)(2)(a)

13. Groundwater monitoring is required to ensure that the permit holder meet the following affirmative legal obligations: that no landspreading may be undertaken with 100 feet of a direct conduit to groundwater, Wis. Admin. Code NR 243.14(2)(b)(8) and that the permit holder not cause fecal contamination of water in a well by either landspreading or management of process wastewater. Wis. Admin. Code NR 243.14(2)(b)(3)

14. Antidegradation review applies to surface water; it does not apply to groundwater. (§ NR 207.01(2))

15. The Permit is remanded to the DNR to be modified to require that the permit articulate the maximum number of animal units allowed at the facility. Section 1.3.3 of the Permit requiring the Dairy to maintain 180 day liquid manure storage shall remain in full force and effect.

16. Sections 1.6 of the Permit and the Nutrient Management Plan are reasonable and contain reasonable yield goals.

ORDER

WHEREFORE IT IS HEREBY ORDERED, the Permit issued by the DNR should be modified by this tribunal as follows:

Permit term 1.1 shall be amended to read:

Production Area Discharge Limitations

The permittee shall comply with the livestock performance standards and prohibitions in ch. NR 151. In accordance with § NR 243.13, the permittee may not discharge manure or process wastewater pollutants to navigable waters from the production area, including approved manure stacking sites, unless all of the following apply:

- Precipitation causes an overflow of manure or process wastewater from a containment or storage structure.
- The containment or storage structure is properly designed, constructed and maintained to contain all manure and process wastewater from the operation, including the runoff and the direct precipitation from a 25-year, 24-hour rainfall event for this location (**Kewaunee County – 4.2 inches**).
- The production area is operated in accordance with the inspection, maintenance and record keeping requirements in s. NR 243.19.
- The discharge complies with ~~groundwater and~~ surface water quality standards. For all new or increased discharges to an ORW or ERW, any pollutant discharged shall not exceed existing levels of the pollutants immediately up stream of the discharge site. For any new or increased discharges to other fish and aquatic life waters, the discharge shall not cause a significant lowering of water quality under chapter 207, Wis. Adm. Code.

All structures shall be designed and operated in accordance with §§ NR 243.15 and NR 243.17 to control manure and process wastewater for the purpose of complying with discharge limitations established above and groundwater standards.

The permittee may not discharge pollutants to navigable waters under any circumstance or storm event from areas of the production area, including manure stacks on cropland, where manure or process wastewater is not properly stored or contained by a structure.

Production area discharges to waters of the state authorized under this permit shall comply with water quality standards, groundwater standards and may not impair wetland functional values.

NOTE: Wastewater treatment strips, grassed waterways or buffers are examples of facilities or systems that by themselves do not constitute a structure.

Permit term 2.4.1 shall be inserted as follows:

2.4.1 Breach Analysis (Waste Storage Impoundment Cell No. 3)

Required Action	Due Date
Submittal of Plans: Submit a Breach Analysis for Waste Storage Impoundment Cell No 3. For Department review and approval. The analysis shall be based on a complete loss of the maximum volume of stored wastewater. Propose construction of any appropriate permanent engineering improvements such as an emergency spillway or secondary containment and describe how these measures would reduce impacts to the area.	3 months following ALJ decision
Improvements and Post Construction Documentation: Complete construction of any structures required as part of the Breach Analysis consistent with and approval by the Department by the specified Date Due. Submit post construction documentation within 60 days of completion of the project.	3 months following DNR approval

IT IS FURTHER ORDERED, that Sections 1.3, 1.3.3, 2 and 3.1.12 be modified to reflect a maximum number of animal units at the facility in addition to current storage requirements.

IT IS FURTHER ORDERED, that the Department should review and approve a plan for groundwater monitoring for pollutants of concern at or near the site because it has been demonstrated to be "susceptible to groundwater contamination" within the meaning of Wis. Admin. Code § NR 243.15(3)(2)(a). The plan should be submitted to the Department with 90 days of this Order, and shall include no less than six groundwater monitoring wells, and if practicable, at least two of which monitor groundwater quality impacts from off-site landspreading.

Dated at Madison, Wisconsin on October 29, 2014.

STATE OF WISCONSIN
DIVISION OF HEARINGS AND APPEALS
5005 University Avenue, Suite 201
Madison, Wisconsin 53705
Telephone: (608) 266-7709
FAX: (608) 264-9885

By: Jeffrey D. Boldt
Jeffrey D. Boldt
Administrative Law Judge

NOTICE

Set out below is a list of alternative methods available to persons who may desire to obtain review of the attached decision of the Administrative Law Judge. This notice is provided to insure compliance with Wis. Stat. § 227.48 and sets out the rights of any party to this proceeding to petition for rehearing and administrative or judicial review of an adverse decision.

1. Any party to this proceeding adversely affected by the decision attached hereto has the right within twenty (20) days after entry of the decision, to petition the secretary of the Department of Natural Resources for review of the decision as provided by Wisconsin Administrative Code NR 2.20. A petition for review under this section is not a prerequisite for judicial review under Wis. Stat. §§ 227.52 and 227.53.

2. Any person aggrieved by the attached order may within twenty (20) days after service of such order or decision file with the Division of Hearings and Appeals a written petition for rehearing pursuant to Wis. Stat. § 227.49. Rehearing may only be granted for those reasons set out in Wis. Stat. § 227.49(3). A petition under this section is not a prerequisite for judicial review under Wis. Stat. §§ 227.52 and 227.53.

3. Any person aggrieved by the attached decision which adversely affects the substantial interests of such person by action or inaction, affirmative or negative in form is entitled to judicial review by filing a petition therefore in accordance with the provisions of Wis. Stat. §§ 227.52 and 227.53. Said petition must be served and filed within thirty (30) days after service of the agency decision sought to be reviewed. If a rehearing is requested as noted in paragraph (2) above, any party seeking judicial review shall serve and file a petition for review within thirty (30) days after service of the order disposing of the rehearing application or within thirty (30) days after final disposition by operation of law. Since the decision of the Administrative Law Judge in the attached order is by law a decision of the Department of Natural Resources, any petition for judicial review shall name the Department of Natural Resources as the respondent and shall be served upon the Secretary of the Department either personally or by certified mail at: 101 South Webster Street, P. O. Box 7921, Madison, WI 53707-7921. Persons desiring to file for judicial review are advised to closely examine all provisions of Wis. Stat. §§ 227.52 and 227.53, to insure strict compliance with all its requirements.

Attachment L

Investigating Intra-annual Variability of Well Water Quality in Lincoln Township

June 2014

Final Report

Davina Bonness, Kewaunee County Land and Water Conservation Department

Kevin Masarik, Center for Watershed Science and Education, UW-Extension & UW-Stevens Point

Acknowledgements

This research study was conducted by Lincoln Township, UW Stevens Point, and Kewaunee County Land & Water Conservation Department, and was jointly funded by the Lakeshore Natural Resource Partnership and Lincoln Township. Sincere thank you to participants who agreed to have their wells sampled, without their cooperation this report would not have been possible.

EXECUTIVE SUMMARY

The purpose of this research study is to investigate the intra-annual variability of well water quality in Lincoln Township. Residents solely rely on private wells and groundwater as their primary water supply from the Silurian dolomite bedrock aquifer and have been experiencing higher contamination rates of nitrates and bacteria.

Ten wells were selected and tested monthly for one year to investigate seasonal variability, with a specific interest in bacteria and nitrate contamination of wells.

The goals of this research were:

1. Establish baseline data of the intra-annual variation of well water quality for ten wells.
2. Investigate groundwater and land-use interactions in the region.
3. Recommend a long-term strategy for monitoring Lincoln Township's well water.

Coliform bacteria were detected at least once in six different wells; four wells did not detect bacteria in any of the 12 sampling events. Levels of coliform bacteria measured were generally low, with the maximum number reported as 60.2 MPN cfu/100mL. The greatest number of sample periods that any one individual well tested positive was seven. Wells that were positive one period often came back negative the following sample period, even though no chlorination or corrective measures took place. None of the wells tested positive for *E.coli* bacteria. Coliform and *E.coli* bacteria testing methods are not capable of determining contamination source and have little utility for assessing changes in groundwater quality over time.

Nitrate concentrations were stable in one-half of the wells (standard deviation < 1.0 mg/L) while one-half were determined to have significant intra-annual variability (standard deviation >1.0 mg/L). The largest difference between the minimum and maximum concentration of nitrate-nitrogen in one well was 13.6 mg/L. Nitrate and chloride concentrations, which were correlated in six of ten wells, have potential for tracking trends or changes to groundwater over time.

Nitrate, chloride, alkalinity, total hardness and conductivity measurements suggest aquifer conditions were most stable during the winter period when the soil near the surface was below 0 degrees Celsius. Because this time period is likely to be uninfluenced by rapid recharge events, it represents an opportune time to sample for the purposes of long-term monitoring. Changes in well water quality of individual wells and increased variability measured between wells seemed to coincide with the snow-melt and spring recharge periods. Sampling following spring would help to identify those wells that are most susceptible to intra-annual variation.

Recommendations:

1. Sample 25 wells bi-annually
    a. We recommend: January when wells are under relatively stable aquifer conditions; and mid-June to assess groundwater conditions following the spring groundwater recharge period.
2. Test wells for nitrate and chloride because they have the most utility for understanding land-use trends or human changes, as well as alkalinity for its potential ability to inform interpretation of water quality results.
3. Recommend long term sampling of at least 10 years.

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

The purpose of this research study is to investigate the intra-annual variability of well water quality in Lincoln Township whose residents solely rely on private wells and groundwater as their primary water supply from the Silurian dolomite bedrock aquifer. Ten wells were selected and tested monthly for one year to investigate seasonal variability, with a specific interest in bacteria and nitrate contamination of wells.

Coliform bacteria were detected at least once in six different wells; four wells did not have detections of bacteria in any of the 12 sampling events. Levels of coliform bacteria measured were generally low, with the maximum number reported as 60.2 MPN cfu/100mL. The greatest number of sample periods that any one individual well tested positive was seven. Wells that were positive one period often came back negative the following sample period, even though no chlorination or corrective measures took place. None of the wells tested positive for *E.coli* bacteria.

Nitrate concentrations were stable in one-half of the wells (standard deviation < 1.0 mg/L) and showed in the other half greater monthly variability (standard deviation >1.0 mg/L). The largest difference between the minimum and maximum concentration of nitrate-nitrogen in one well was 13.6 mg/L. Nitrate and chloride concentrations, which were correlated in six of ten wells, have the most utility for monitoring changes in groundwater quality that result from land-use practices.

Nitrate, chloride, alkalinity, total hardness and conductivity measurements suggest groundwater chemistry was most stable during the winter period when the soil temperature near the surface was below 0 degrees Celsius. A change in groundwater chemistry indicated by increased variability seemed to coincide with the snow-melt and spring recharge periods.

Results suggest that, in this geologic setting, an annual coliform bacteria test is largely inadequate to assess the bacteriological safety of a water system year round and has limited ability to track changes in water quality over time. Even though significant intra-annual variability existed in nitrate concentrations, it seems that a cost-effective monitoring strategy could be implemented in Lincoln Township that would test private wells for nitrate and chloride to examine whether these chemical constituents are changing over time as a result of land-use practices.

Introduction

Groundwater is the primary water source for residents of Lincoln Township and its quality is a concern for all those that rely on private wells. Unlike public water systems, private water supplies have no requirements to routinely test and many homeowners have not done extensive testing to understand the quality of their household water supply. Knowing when and what to test for is critical to understanding the suitability of a private well. If drinking water does not meet the health-based water quality standards established by the U.S. Environmental Protection Agency (EPA) it is not recommended it be used for drinking and cooking, and in some extreme cases may not be suitable for bathing.

The Wisconsin well code is based on the premise that a properly constructed well should provide bacteriologically safe water continuously without the need for treatment. A summary of 159 private well water samples submitted to University of Wisconsin-Stevens Point by Lincoln Township residents between 2004 and 2014 show a greater percentage of coliform bacteria than is normally found statewide, 32% in the Township of Lincoln compared to the statewide average of approximately 15% (CWSE, 2014). While coliform bacteria do not generally cause people to become sick, the presence of coliform bacteria indicate a potential pathway for pathogens (i.e. *Eschericheria coli* (*E. coli*), giardia, cryptosporidium, norovirus, etc.) to enter the water supply. All coliform bacteria positive samples are also tested for *E. coli*; a specific type of bacteria that, if present, provides confirmation that a well is being contaminated by animal or human fecal waste. Fecal bacteria are an obvious water quality concern in areas where land-spreading of animal waste occurs or residences rely on private on-site wastewater treatment systems (POWTS).

The samples collected over the past decade also display a high percentage of wells with nitrate at concentrations in excess of what is considered suitable for drinking water purposes; 20% in the Township of Lincoln compared to the statewide average of 9% (DATCP, 2008). Nitrate is the most widespread groundwater contaminant in Wisconsin and concentrations greater than 2 mg/L of nitrate-nitrogen provide evidence of impacts from the following sources: nitrogen fertilizers, manure and/or bio-solid application of waste to agricultural fields, leaking manure storage lagoons, and/or septic system effluent. Fifty percent of wells tested in Lincoln Township provide conclusive evidence of nitrate concentrations above background or natural concentrations found in groundwater.

Anecdotal and documented evidence suggest “brown water” incidents (i.e. sudden changes in water quality that occur during snowmelt or spring rains) have occurred for many years throughout Northeast Wisconsin. Since 2006, sixty-four wells have been replaced throughout Wisconsin due to confirmed contamination by livestock manure (L. Chern, personal communication, April 8, 2014); three-quarters of these wells were located in areas of geologic concern in susceptibility criteria outlined in the Northeast Wisconsin Karst Task Force Report that occurs in portions of Door, Kewaunee, Brown, Calumet, Manitowoc, Fond du Lac and Dodge Counties.

The Karst Task Force Report assigns areas with shallow soils (<50 feet to carbonate bedrock) a significant vulnerability to contaminants such as bacteria and nitrate. These shallow soils, found throughout Lincoln Township, have little ability to attenuate or filter contaminants, and have a greater likelihood of containing landscape features (i.e. sinkholes, fracture traces, surface rock outcrops and disappearing streams) that provide direct conduits to groundwater (Erb & Stieglitz, 2007). Research has shown karst aquifers respond quickly to precipitation and snowmelt events and the largest recharge events occur in early spring and additional recharge often occurs after the first killing frost. Once contaminants are in a karst aquifer, they are able to travel long distances in a short time, making it difficult to pinpoint the original contamination source (Sherrill, 1978; Bradbury and Muldoon, 1992).

The percentage of wells detecting bacteria and elevated nitrate concentrations in Lincoln Township lends credence to groundwater vulnerability assessments. One limitation to the existing private well water data set is the ability to determine whether groundwater quality is changing or has changed over time, a key question. The annual and intra-annual variability of groundwater quality and infrequent testing behavior of well owners makes it difficult to infer water quality patterns or trends from voluntary private well water testing events. Given variability of groundwater quality in karst regions, a well sampled once per year for bacteria and nitrate may give homeowners a false sense of safety regarding their water supply. More detailed data are needed to establish better guidelines for homeowners to reliably assess the safety of their well water system and provide a foundation for monitoring potential changes to groundwater quality.

In an effort to understand the variability of well water quality during the year and potentially develop a long-term monitoring strategy to assess whether groundwater quality is changing, the Township agreed to investigate intra-annual variability of well water by sampling ten wells monthly for one year. The objective of the sampling project was threefold: 1) establish baseline data regarding the intra-annual variation of well water quality for ten wells, 2) investigate groundwater and land-use interactions in the region, and 3) recommend a long-term strategy for monitoring Lincoln Township's well water.

Methods and Materials

Study Area

The area of focus is Lincoln Township, a 35.7 square mile area located in northern Kewaunee County, Wisconsin. Lincoln Township has approximately 334 households that rely solely on private wells and groundwater as their primary water supply. The soils are predominantly medium to fine-textured. Thicknesses of Pleistocene glacial deposits vary from nearly absent in some areas to as much as 100 feet thick. The underlying geology consists of dolomite bedrock from the Silurian Period which is the principal aquifer for household private wells.

The dominant land cover is agricultural (70%) followed by wetland (21%) and forest (6%) (WI DNR, 1998). Kewaunee County is a leader in percentage of cropland acres under nutrient management at 76% (GCC, 2013). According to the 2013 Nutrient Management plans, Lincoln Township contains approximately 13,500 cows (calves, heifers, beef, and dairy) of which approximately 82% are located on three permitted Concentrated Animal Feeding Operations (CAFO) within the Township. All households in the town presumably rely on private wells and private on-site waste systems.

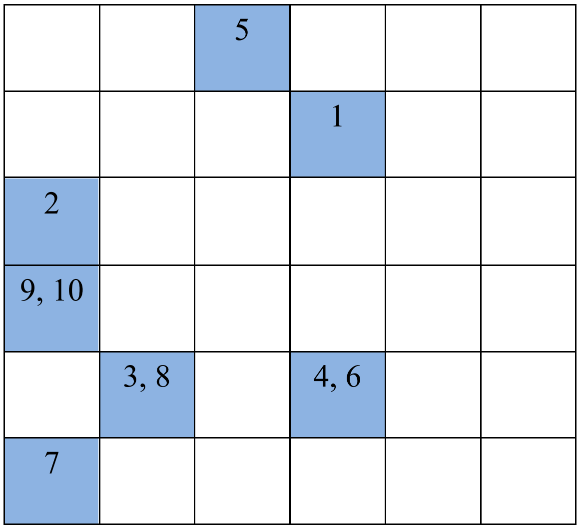
Weather & Soil Data

Daily climate and soil data was accessed using the Michigan State University Extension weather station located at the Roethle Orchards in Casco Township, located just south of Lincoln Township, at http://www.agweather.geo.msu.edu/mawn/station.asp?id=lux&rt=24. Parameters evaluated were soil moisture (in^3/in^3), minimum and maximum soil temperature at a 2 inch depth, precipitation, and maximum and minimum air temperature.

Well Sampling and Analysis

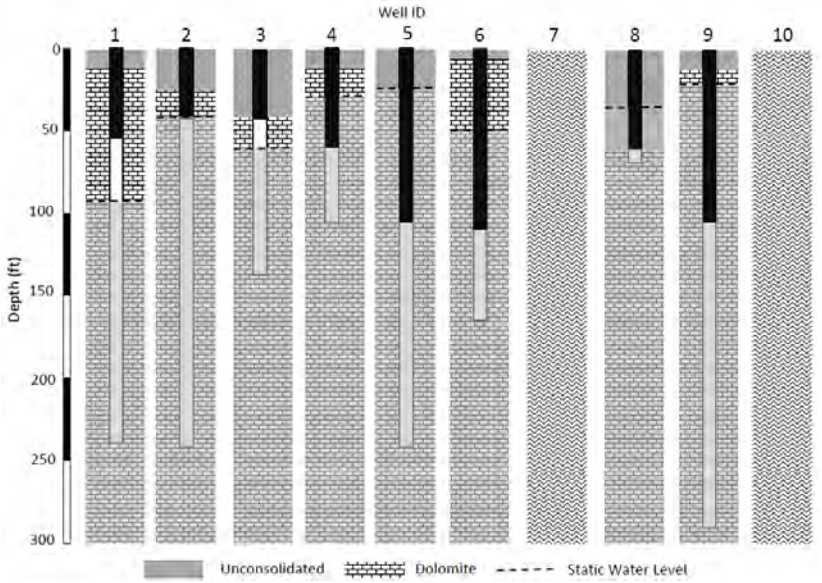
Ten wells were selected from participants of previous Kewaunee County voluntary testing programs. Attempts were made to ensure wells were spatially distributed and represented a variety of well and casing depths (Figure 1, Figure 2).

Figure 1: Schematic of Lincoln Township. Shaded regions represent location of sample well(s). Numbers correspond to well ID.



		5			
			1		
2					
9, 10					
	3, 8		4, 6		
7					

Figure 2: Diagram of well depth, casing depth (blackened portion of well), static water level and geologic record for wells with a known well construction. Well construction information could not be found for wells 7 and 10.



Preference was given to wells with a known well construction report and a previously measured nitrate-nitrogen concentration greater than 10 mg/L and/or a positive coliform/*E-coli* bacteria test. Data from private wells tested multiple times often shows that when an initial test measures nitrate concentrations less than 1 mg/L, over time there is often little to no change in future nitrate measurements. A low nitrate concentration in groundwater could be because: 1) there is no source of nitrate into the aquifer where a particular well receives its water from, 2) the groundwater accessed by the well is less susceptible to contamination by nitrate because of soils, geology or well construction, or 3) nitrate has yet to penetrate deep enough into the aquifer where a particular well is accessing groundwater. Since variability was the major focus of investigation, selecting wells that had elevated nitrate concentrations or a history of bacterial contamination was a more targeted use of resources for studying how intra-annual fluctuations would inform long-term monitoring efforts.

The wells were sampled over a twelve month period. All of the well testing dates were identified before the first sample was collected. During winter months, indoor faucets were used. Unfortunately, this meant that some water samples were collected from softened sources for a few of the periods and affected total hardness measurements and subsequent analysis. Measurements of other constituents were determined to not have been affected. Prior to sampling, each faucet was sterilized with a flame and cold water was allowed to run for 10 minutes before sample collection. All wells were sampled by Davina Bonness, Kewaunee County Land & Water Quality Specialist. Samples were placed in a cooler, kept cold using ice packs, and shipped to the Water Environmental Analysis Lab located in Stevens Point, WI where they arrived within 30 hours of sample collection.

The laboratory has a formal quality control program in place and holds certification from the Wisconsin (DNR State Certification Lab No. 750040280) and United States Geologic Survey for a wide-array of elements and matrices. Among the practices that the laboratory employs are periodic analyses of laboratory reagent blanks, fortified blanks, duplicate samples, and calibration solutions as continuing checks on performance.

All wells were sampled monthly and the water analyzed for: Total coliform/*E.coli*, nitrate-nitrogen, chloride, total hardness, alkalinity, conductivity, and pH. Total coliform and *E.coli* bacteria MPN (most probable number) counts were measured using the IDEXX Quanti-Tray/2000®. Nitrate-nitrogen and chloride were determined colorimetrically by flow injected analysis on a Lachat QuikChem 8000®. Hardness and alkalinity were measured by titration using Standard Methods. Probes were used to measure conductivity and pH in the laboratory.

Source Assessment

A geographic information system was used to map land-use and measure total non-cropland, total cropland acres, and cropland acres under nutrient management plans within a half mile radius of each well (Table 1). The average amount of cropland surrounding selected wells was 68%, while the percent of cropland acres under nutrient management averaged 89%.

Table 1: Land-use within half-mile radius of selected wells

Well ID	**Non-cropland (acres)**	**Non-cropland (%)**	**Total Cropland (acres)**	**Cropland (%)**	**Cropland with a Nutrient Management Plan (acres)**	**Cropland with a Nutrient Management Plan (%)**	**Fertilizer nitrogen (lbs/acre of cropland/yr)**	**Manure Nitrogen (lbs/acre of cropland/yr)**	**Total agricultural nitrogen (lbs/acre of cropland/yr)**	**Total nitrogen from agricultural sources (lbs)**	**# of septic systems**	**Nitrogen from septic systems (lbs)**
1	134	27	368	73	295	80	31	27	58	21,432	6	150
2	314	63	188	37	178	95	31	28	59	11,073	7	175
3	181	36	321	64	321	100	26	39	65	20,881	11	275
4	117	23	385	77	385	100	16	63	78	30,130	7	175
5	132	26	370	74	370	100	13	70	83	30,684	1	25
6	107	21	395	79	395	100	29	51	79	31,383	6	150
7	127	25	375	75	185	49	26	44	69	25,916	9	225
8	293	58	209	42	191	91	13	33	47	9,762	14	350
9	45	9	457	91	337	74	38	54	92	41,943	11	275
10	134	27	368	73	368	100	33	51	83	30,706	14	350
Average	**158**	**32**	**344**	**68**	**303**	**89**	**25**	**46**	**71**	**25,391**	**8.6**	**215**

Table 2: Lincoln Township manure nutrient sources and method/timing of applications

Types of Manure Applications	Spring Surface	Spring Incorp.	Summer Surface	Summer Incorp.	Fall Incorp.	Fall Surface	Winter Surface
Liquid Pit/Lagoon Manure	X	X	X	X	X		
Solid Heifer/Yard Manure	X	X	X		X	X	X
Calf Manure			X		X		
Sand Manure				X		X	

Table 3: Lincoln Township fertilizer nutrient sources and method/timing of applications

Fertilizer & N-P-K Analysis	Spring Surface	Spring Incorp.	Summer Surface	Summer Incorp.	Fall Incorp.
Ammonium Sulfate (21-0-0)	X	X	X		
28% Liquid UAN (28-0-0)	X	X			
Boron (0-0-0)	X				
Diammonium Phosphate, DAP (18-46-0)	X	X	X		
ESN (44-0-0)		X			
Liquid 6 (6-24-6)	X	X			
Liquid 7 (7-21-7)		X			
Liquid 9 (9-18-9)		X			
Potash (0-0-60)	X	X	X		
Potassium Chloride (0-0-61)	X	X	X		X
Seasons Pass Liquid (6-18-6)		X			
Starter 5 (5-14-42)	X	X			
Starter 9 (9-23-30)		X			
Starter Blend (13-15-20)		X			
Starter ESN19 (19-19-19)	X	X			
Super U (46-0-0)	X				
Urea (46-0-0)	X	X	X		
Yieldmaxx Corn Starter (17-17-17)	X	X			
Yieldmaxx Hayland (3-8-45)			X	X	
Yieldmaxx Soybeans (7-18-31)	X	X			
Yieldmaxx Wheat (21-12-15)	X				

To determine what general land-use practices exist, nutrient management plans from 2013 were used to summarize typical manure and/or fertilizer applications, and tillage practices around wells (Table 2, Table 3). The summary does not suggest that all of these practices occurred around each well, but rather outlines the common practices in those areas around the wells selected for investigation. While the intent of this summary is not to assign rankings or assert that any of these are better or worse than others, it speaks to the complexity of not only managing nutrients as a method to increase productivity but also as a groundwater contaminant.

Current nutrient management principles allow farmers to apply nutrients based on maximum economic return and implications to groundwater quality are not a criteria for setting nitrogen application rates (Laboski & Peters, 2012). When applied at recommended rates the amount of nitrate that ends up leaching past the root zone of plants is largely a function of how much is applied, which can be highly variable from year to year (Andraski et. al., 1999; Jaynes et al., 2001; Masarik et al. 2014). The risk of groundwater contamination by pathogens increases during certain times of the year or under certain climatic conditions (Pasquarell and Boyer, 1995; Zheng et al., 2013). Geologic and soil conditions also influence groundwater susceptibility, and data exists to show that the impact of agricultural practices on well water quality is greater and more obvious (i.e. greater occurrence of bacteria detects and elevated nitrate) in areas with shallow soils and carbonate rock, even though management practices may be similar or even more stringent (Erb & Stieglitz, 2007).

In order to account for all sources of groundwater nitrate and pathogens in Lincoln Township, septic systems were also quantified. In 2013, Kewaunee County Zoning identified 384 Lincoln Sanitary Permits (of which 63 are holding tanks). These data were used to quantify the number of septic systems and holding tanks within the half mile radius of each well, which contained an average of 8.6 septic systems, with a minimum of 1 and a maximum of 14. A typical septic system can leach approximately 20-25 pounds of nitrogen per year (U.S. EPA, 2002).

Results and Discussion

Weather

Weather data was summarized through the twelve month sampling period (Figure 3). Weather data six months prior to initial sampling was also included to provide insight into the conditions preceding the sample collection period. Maximum soil temperature data equal to or less than 0°C indicated frozen conditions for 120 days in the winter of 2014; 41 days longer than for the winter of 2013. Precipitation and soil moisture data for April 2013 indicated a slightly wetter period immediately following the start of unfrozen soil surface conditions. This suggests a more rapid infiltration of snow melt and/or rain than that which occurred in April 2014, where conditions indicate a slower and less intense infiltration period.

Well Sampling

The 159 wells previously sampled in Lincoln Township between 2006 and 2014 indicate an average pH of 7.74, average alkalinity of 312 mg/L as $CaCO_3$, and average total hardness of 354 mg/L as $CaCO_3$. Summary water quality statistics for the 10 individual wells sampled in this investigation indicate that these wells have average water quality (Table 4). This suggests that wells selected are typical for this area and water quality is comparable with previous samples. Individual wells were in some cases two to four times the Township's average concentration of 5.0 and 33.3 mg/L for nitrate-nitrogen and chloride respectively. However, a main objective of this investigation was to quantify variability; therefore the elevated nitrate and chloride concentrations are a result of the decision to study variability of impacted wells.

Bacteria

Coliform bacteria were detected at least once in six wells; four wells did not have detectable bacteria in any of the 12 sampling events (Table 4). The highest Most Probable

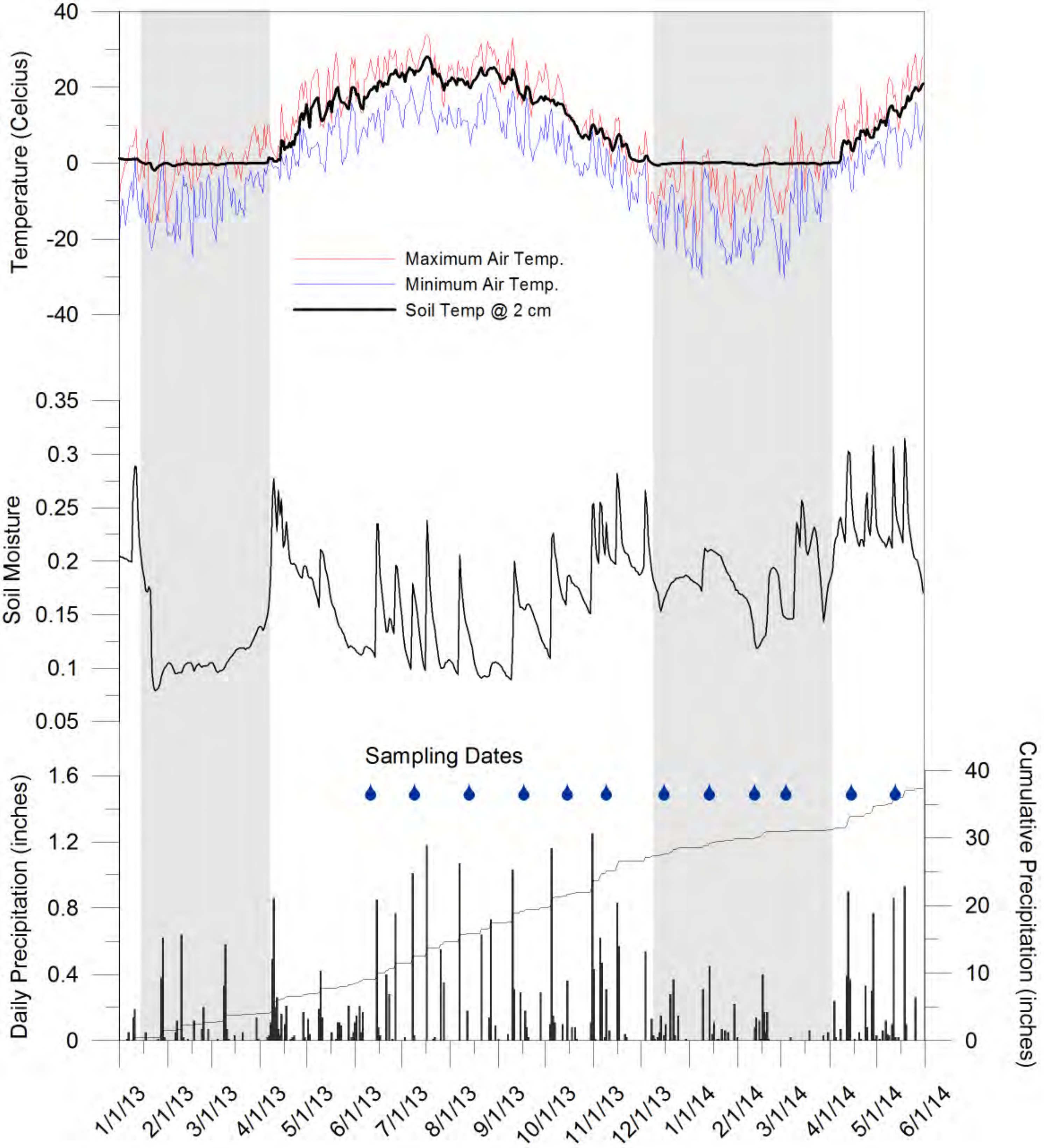


Figure 3. Weather and soil data representing period from Jan. 1 2013 to May 31 2014. Date of well water sample collection indicated by water droplets. Shaded region represents periods when the maximum soil temperature at 2 cm was less than or equal to 0 degrees Celcius (32 degrees Fahrenheit) indicating frozen or near frozen soils.

Table 4. Summary of monthly well testing data for the twelve month period from June 2013 to May 2014. Values represent the annual mean with standard deviation provided in parentheses.

Well	pH	Conductivity	Alkalinity	Total Hardness	Nitrate	Chloride	Total Coliform	Total Coliform	E-Coli
		µs cm^{-1}	mg L^{-1} $CaCO_3$	mg L^{-1} $CaCO_3$	mg L^{-1}	mg L^{-1}	Sample Periods Positive	MPN Cfu 100 mL^{-1}	Sample Periods Positive
1	7.84(0.3)	713(7)†	287(7)	389(11)	14.9(0.4)	17.9(1.0)	1	0.9(0.3)	0
2	7.85(0.3)	766(33)	324(4)	NR	16.0(0.5)	13.4(1.0)	0	ND	0
3	7.75(0.3)	909(42)	347(6)	478(13)	18.5(2.2)	41.1(3.7)	0	ND	0
4	7.79(0.3)	712(48)	336(11)	385(20)	7.4(2.2)	14.9(13.5)	6	6.2(17.1)	0
5	7.80(0.2)	783(31)	304(12)	413(32)	13.8(3.8)	30.9(3.2)	6	1.7(2.4)	0
6	7.80(0.2)	743(34)	309(7)	NR	9.0(2.7)	25.6(1.9)	0	ND	0
7	7.94(0.3)	836(33)	319(8)	NR	12.8(1.4)	33.2(1.6)	2	2.5(8.1)	0
8	7.74(0.2)	994(29)	377(6)	507(23)	10.2(0.7)	44.9(0.7)	7	3.4(5.1)	0
9	7.93(0.3)	628(14)	322(3)	349(8)	1.4(0.3)	11.1(1.1)	0	ND	0
10	7.87(0.2)	1032(112)	358(12)	509(36)	0.2(0.2)	95.1(36.0)	4	6.3 (13.1)	0

† Conductivity not measured in month of July, mean and standard deviation for 11 sampling dates.
ND None detected; indicates a Most Probable Number of <1 for total coliform bacteria.
NR Not reported; one or more samples from softened source.

Number (MPN) measured was 60.2 MPN cfu/100 mL in Well #4 on the 4/15/2014 sample date (Figure 4). The greatest number of sample periods that any one individual well tested positive was seven. Wells 4, 5, and 8 showed the most frequent occurrence of contamination by coliform bacteria, having detections in more than half of sampling events. The 11/9/2013 and 12/16/2013 sample dates had the greatest number of wells with a bacteria detect, both with four positive wells. Wells that were positive one period often came back negative the following sample period, even though no chlorination or corrective measures took place. None of the wells tested positive for *E.coli* bacteria, a specific type of fecal bacteria, on any of the sample dates.

When it comes to maintaining bacteriological safety of well water, wells cased below the water table are generally preferred. When the water table is at or below the casing of a well drilled into fractured carbonate rock, as in wells 1, 2, and 3, the concern is that fractures which receive throughfall from sinkholes and other rapid infiltration features which intersect the open borehole can directly inject leachate or surface water into the well causing sudden changes in water quality and increased risk of contamination from bacteria and potentially pathogens. With casing extended past the water table the idea is that groundwater deeper in the aquifer may be better buffered from contaminants delivered by rapid throughfall events, and is therefore less likely to be influenced by these types of contamination. Examination of eight out of ten wells for which well construction reports could be located, well construction alone cannot explain coliform bacteria results. Wells 1, 2, and 3, where well construction would perhaps be considered most susceptible based on water table and casing depth had only one bacteria detection over the course of the twelve sampling events.

The number and length of fractures along with the intersection of these fractures with bacteria sources is a more important factor for determining contamination susceptibility than

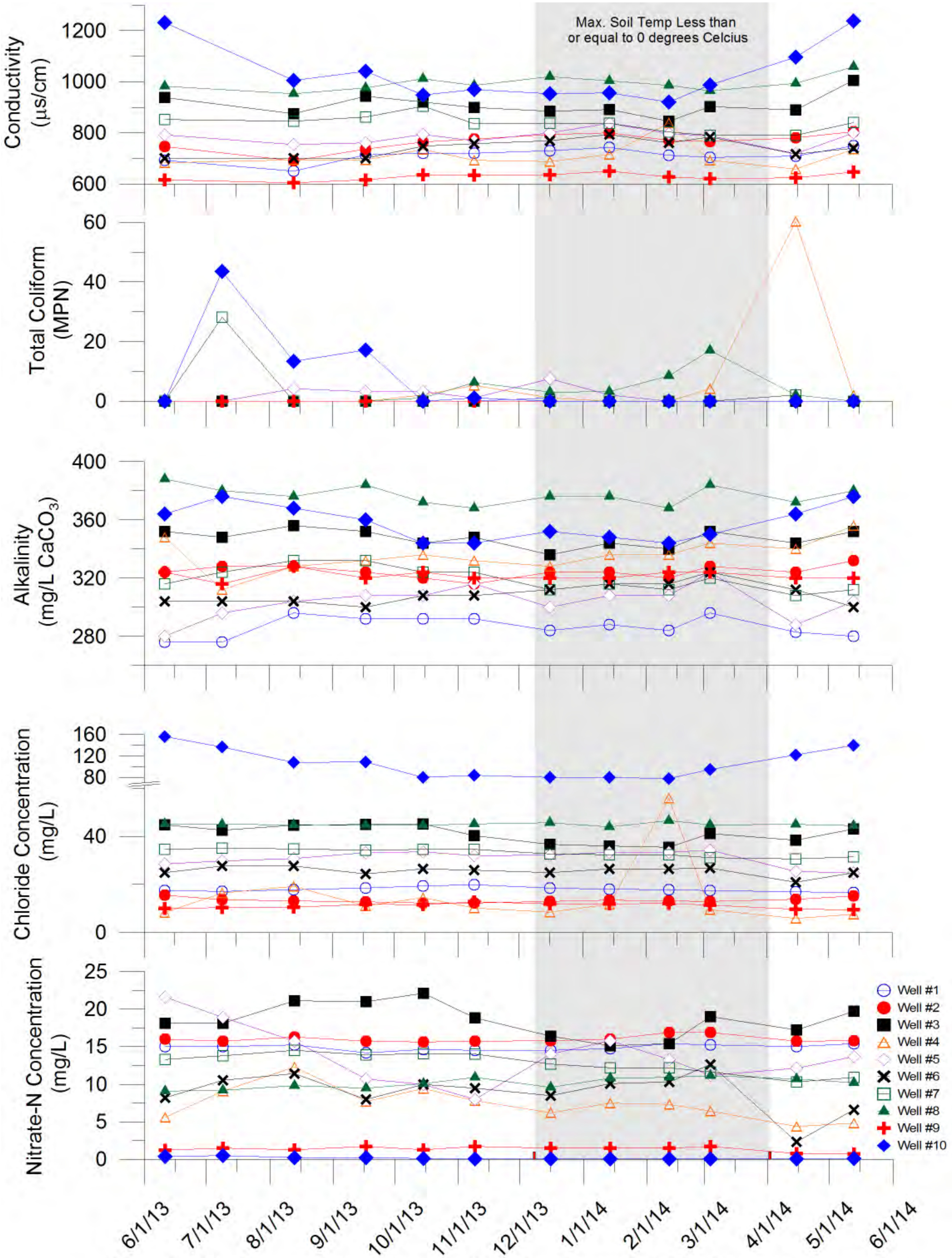


Figure 4. Monthly sample result for each of the 10 wells sampled. Shaded region represents period when maximum soil temperature at 2 cm was less than or equal to 0 degrees Celcius.

well construction; the stochastic nature of these features makes it difficult to say with certainty that drilling a deeper well or extending the casing deeper into the aquifer would lessen the risk of contamination (Bradbury and Muldoon, 1992). A study by Braatz (2004) showed that stricter casing requirements enacted in Door County because of similar geology and water quality concerns, although it may help reduce the severity of contamination or number of incidents, did not completely eliminate bacteria contamination of new wells.

Furthermore, other investigations that performed side-by-side testing of multiple fecal indicators revealed that wells absent of *E.coli* were sometimes positive for enterococci and coliphages, which are other indicators of fecal waste sources (Atherholt et al. 2003; Braatz, 2004). These studies suggest that only using *E.coli* as an indication of human or animal waste likely underestimates the number of wells that are contaminated with fecal types of bacteria or other pathogens. While a positive *E.coli* test confirms human or animal waste source contamination, the absence of *E.coli* does not necessarily mean that a well is free of pathogenic microorganisms.

Residents in Lincoln Township who perform a once yearly presence-absence coliform bacteria test (the test method that is recommended and most accessible to the average homeowner) could be providing false sense of bacteriological safety when the test comes back absent. The data presented here show variable coliform bacteria detections from month to month. It is important to point out that sample dates were pre-selected and because this investigation was not designed to specifically study well water conditions associated with snowmelt or large rain events, the maximum degree to which wells may have been affected by bacteria cannot be determined. In addition, this study did not determine the minimum length of time bacteria occupied the wells after they were contaminated. Certainly the data shows that the contamination period may be as little as one month; however, more frequent sampling may have shown contamination periods to be less than that length of time.

Because the timing of sample collection appears critical to the detection of bacteria, using annual coliform bacteria data collected by grab samples to interpret trends related to land-use is of little utility. Without the ability to quantify, detect and distinguish between specific bacteria or pathogens associated with known sources or carriers, the detection of coliform bacteria alone is simply an indication of a well's susceptibility to bacterial contamination and indicates the potential for other pathogenic contamination. Spatial analysis of coliform bacteria data has sometimes been useful for indicating regions, like Lincoln Township, that are more geologically sensitive to this type of contamination. Coliform and *E.coli* bacteria presence are considered inconclusive as to whether the particular source is of animal or human origin (Zheng et al., 2013). If coliform and *E.coli* bacteria counts were to be performed on the same wells consistently, it is a potentially useful metric for understanding annual climatic conditions that contribute to increased rates of bacterial contamination; however, the variability of this dataset and the time dependency of sampling for bacteria indicates that this could be difficult to show with any certainty.

In-line sampling methods that are capable of continuously sampling a portion of water coming into the home from a well would be a better method for assessing the variability and severity of bacteriological contamination of wells in these settings. Investigating the use of alternative methods of quantifying, detecting and identifying bacteria and viruses such as those described by Millen et al. (2012) would be beneficial to understanding the magnitude of contamination as well as determining the time of year with greater risk or likelihood of contamination. These methods have been successfully employed to detect and identify human enteric viruses found in municipal water systems and could also be applied to bovine viruses (Borchardt et al., 2012; Bradbury et al, 2013).

Nitrate-Nitrogen

Nitrate-nitrogen is the most widespread groundwater contaminant in Wisconsin. Background or natural levels of nitrate-nitrogen in groundwater are generally less than 1 mg/L. Concentrations above 1 mg/L indicate influence by one or more of the following sources: nitrogen fertilizers, manure or other bio-solids (both application to land-surface or leakage from storage), or septic system drainfields. Nitrate-nitrogen concentrations above the drinking water standard of 10 mg/L should not be consumed by infants or women who are pregnant or expecting to become pregnant, all other persons are encourage to avoid long-term consumption of water greater than 10 mg/L (WI DNR, 2014).

Six of the study wells had a mean nitrate-nitrogen concentration above the drinking water standard of 10 mg/L (Table 4). Four of those wells (4, 5, 6, and 8) had a maximum nitrate-N concentration greater than the drinking water standard of 10 mg/L while also including one or more sample periods with a nitrate-N concentration less than the standard. Five of these wells 3, 4, 5, 6, and 7 had a standard deviation greater than 1.0 mg/L indicating a greater degree of intra-annual variability. The largest difference between the minimum and maximum in one well was 13.6 mg/L in well number 5 (Figure 4). Wells 1, 2, 8, 9, and 10 had a standard deviation less than 1.0 mg/L and appear relatively stable during the course of the sample period. Given the greater variability of nitrate concentrations measured in some wells, anyone with a nitrate concentration above 2 mg/L and less than 10 mg/L who is concerned about drinking water above the 10 mg/L nitrate-nitrogen standard should consider testing more frequently than once per year.

Nitrate, because of its mobility through soils and groundwater, is generally considered to be a good indicator of groundwater susceptibility and land-use impacts. The source assessment (Table 1) estimates that agricultural fertilizer and manure applications accounted for an average of 25,391 lbs N added to agricultural fields within the ½ mile radius around the wells in 2013, while the average amount of nitrogen from septic systems was estimated to be 215 lbs N. Research on Midwestern agricultural systems have previously shown that around 20% of agricultural nitrogen inputs were leached below the root zone into tile-drainage or groundwater (Masarik et al., 2014; Randall and Iravagarapu, 1995); we feel this is a reasonable estimate of loss below agricultural fields in Lincoln Township. Assuming that all of the septic system N and 5,078 lbs N (or 20% of total N inputs) from agricultural sources will end up in groundwater, we estimated that 96% of nitrate in groundwater around these wells is from agricultural sources while 4% is attributable to septic systems.

Average nitrate concentrations of wells were not correlated to soil thickness, well construction or any of the source assessment fields in Table 1. While the connection between land-use and groundwater quality is well understood, connecting land-use to water quality of a particular well in shallow carbonate rock aquifers is challenging because water quality for that well is likely controlled by a very discrete portion of the area around the well (Gotkowitz, 2006), and fracture flow in these types of aquifers is hard to predict. As a result, a half mile radius is probably not an accurate representation of the actual recharge area. However, without a more detailed investigation, understanding what discrete portion of the radius around each of the wells should be used for identifying the recharge area was not possible.

The degree to which nutrient management has been implemented around these wells (89% of cropland acres) is extensive, Kewaunee County is second (by percent of crop acres) in the state for implementation of crop acres with a nutrient management plan (GCC, 2013). The extent to which nutrient management plans are being followed could not be verified; unless information exists to show otherwise, we assume here that they are an accurate representation of what is taking place on the landscape. As a result, we conclude that the elevated concentrations of nitrate in these ten wells are the result of what are considered to be acceptable agricultural management practices and not the result of gross mismanagement or negligence. The extent to which type of nutrient source and/or timing of nutrient applications correlate to the groundwater nitrate concentrations could not be quantified; understanding which practices may add to existing problems or alternatively result in less nitrate loss to groundwater is currently a major research priority for conservation professionals and policy makers.

While nitrate concentrations above 2 mg/L provide confirmation of being impacted by one or more human-related activity, the extent to which nitrate occurs in Lincoln wells is also largely a function of the soils and geology. Well sampling in areas with other soil or geologic conditions may reveal groundwater with little to no measurable nitrate, even if crops and management practices were similar or considered higher risk for nitrate leaching losses. If the goal is significant long-term reduction of nitrate concentrations in groundwater of Lincoln Township, it would likely require active efforts to reduce nitrogen inputs (e.g. less nutrient intensive cropping systems, strategic reduction in acreage, etc.) beyond the current source, rate and timing risk management strategies outlined in existing nutrient management plans.

Water quality correlations

An investigation of whether changes in one water quality constituent, such as nitrate, would also be expressed by changes in chloride, alkalinity, total hardness and/or bacteria was also performed. Correlation between constituents provides multiple lines of evidence to indicate changes in water quality, and can strengthen our understanding of groundwater movement and monitoring. Changes in nitrate concentrations over the twelve sample events were compared to changes in other water quality parameters for each well.

Nitrate and chloride were positively correlated in six out of ten wells suggesting a linear relationship between these two constituents, meaning as nitrate concentrations increased so did chloride concentrations (Table 5). No correlation was found in wells 2 and 8 which showed relatively stable concentrations of nitrate and chloride throughout the twelve month period. Nitrate and chloride are considered mobile ions and given that both can have similar sources it is common for nitrate and chloride to increase or decrease in groundwater at the same time; areas with extensive road salt application may represent an exception to this relationship. Nitrate is part of a complicated cycle in which nitrogen occurs in ionic, gasous or organic forms as it is transferred between soils microorganisms, plants, organic matter and the atmosphere. By contrast, chloride in soils and groundwater exists in the ionic form and is not targeted for uptake by plants or microorganisms. Therefore it is often considered a more stable tracer than nitrate and is also useful for monitoring of groundwater quality (Freeze and Cherry, 1979), for example chloride is unaffected by the denitrification process which reduces nitrate concentrations.

Fewer correlations existed between other constituents. Whereas the source of elevated nitrate and chloride is associated with various human related activities, alkalinity and total hardness are associated with the dissolution of carbonate minerals from the soil or bedrock that groundwater flows through. Alkalinity and total hardness are often related to 1) the length of time groundwater has been in the aquifer and 2) the carbonate content of the rock or soils that the water has contacted along the flow path. In aquifers where the flow path and amount of time it takes groundwater recharge to reach a well is consistent, alkalinity and total hardness values are

Table 5. Value of Pearson correlation analysis (r) and p-values calculated between water quality measurements for all periods for each individual well.

Correlation	Well ID									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
	------------r------------									
	----------p-value----------									
Nitrate/Chloride	**-0.699**	-0.070	**0.890**	**0.969†**	-0.308	**0.943**	**0.957**	0.026	**0.833**	**0.716**
	0.011	0.828	0.000	0.000	0.330	0.000	0.000	0.935	0.001	0.009
Nitrate/Alkalinity	-0.271	0.108	**0.624**	**-0.624**	**-0.695**	0.296	**0.825**	-0.554	-0.012	**0.792**
	0.394	0.738	0.030	0.030	0.012	0.350	0.001	0.062	0.972	0.004
Chloride/Alkalinity	0.560	0.554	**0.756**	-0.178	**0.640**	0.086	**0.735**	-0.368	0.026	**0.866**
	0.058	0.062	0.004	0.581	0.025	0.791	0.007	0.239	0.937	0.000
Chloride/Cond.	0.026	0.150	**0.604**	**0.891**	0.385	0.346	**0.754**	-0.157	0.179	**0.971**
	0.939	0.660	0.049	0.000	0.242	0.297	0.007	0.644	0.599	0.000
Cond./Alkalinity	-0.342	-0.050	0.477	0.064	0.246	**0.755**	0.516	-0.107	**-0.648**	**0.824**
	0.304	0.884	0.138	0.852	0.466	0.007	0.104	0.755	0.031	0.002
T. Hardness/Nitrate	-0.296	ND	**0.704**	0.010	0.097	ND	ND	0.542	**0.585**	**0.673**
	0.351		0.011	0.974	0.765			0.069	0.046	0.016
T. Hardness/Cond.	**0.606**	ND	**0.683**	-0.536	0.468	ND	ND	0.202	-0.005	**0.966**
	0.048		0.020	0.089	0.147			0.551	0.989	0.000

Bold values indicate significance ($p<0.05$).

ND, Not determined; one or more samples from softened source.

† Excludes chloride outlier from 2/12/14 sample date.

often relatively stable. Changes in these two constituents may be related to biogeochemical reactions or may be reflective of changes in groundwater flow paths. For instance, a sudden drop in alkalinity and hardness may reflect a sudden influx of surface water that has not had time for significant carbonate dissolution to occur or some seasonal variation in water within a well. Conductivity is a measure of total ions dissolved in water and since calcium and magnesium are responsible for a large portion of water's overall conductance, conductivity usually responds similarly to total hardness and alkalinity. A study by Muldoon & Bradbury (2010) successfully used a continuous monitoring probe to measure sudden declines in conductivity that were related to rapid groundwater recharge events. Chloride can also impact conductivity measurements which helps explain the strong correlation between these two constituents in Well 10 (Table 5).

In the Lincoln Township wells the standard deviation of conductivity, alkalinity and total hardness averaged less than 5, 5 and 2% of the mean concentration, respectively. The relative stability of these three measurements seems to indicate that these parameters were not overly influenced by rapid throughflow of precipitation or snow-melt into the aquifer. Overall, nitrate and chloride had greater variability; standard deviation averaged 24 and 18% respectively. Greater variability of nitrate and chloride when other constituents had relatively stable concentrations suggest that variability is not solely from rapid influxes of low conductivity surface water. Rather the greater variability in nitrate and chloride may reflect seasonal variability related to the source of these contaminants.

Relationship of variability to long-term monitoring

Characterizing the intra-annual variability of water quality is important in developing a useful long-term monitoring strategy. The absence of variability in groundwater quality occurs when the following two conditions are met: 1) the groundwater traveling to the well takes a consistent path through the aquifer and 2) the groundwater system is in equilibrium with land-use in the recharge area of a well. Equilibrium may be representative of natural conditions (unaffected by human impact) or in the case of elevated contaminants such as nitrate, reflect some repeatable land-use pattern that has been in place long enough for groundwater quality to have stabilized with the current practice(s). The lag time between what happens on the land surface and the point in which concentrations at some monitoring location below the ground stops changing will depend on the geologic properties of the soils and aquifer materials and depth below the water table.

When variability does occur, it becomes important to study why those changes are occurring and what implications they have for long-term groundwater monitoring. With a constituent such as nitrate, changes in water quality may be indicative of land-use change or, in the absence of land-use change, may reflect some sort of annual climatic variability (Randall and Iragavarapu, 1995; Masarik et. al., 2014). Changes in water quality over some period of time that signify water quality is better or worse could be validated by a trend (either increasing or decreasing) such as a linear relationship between sample date and concentration over some period of time, or a sudden change where the average concentrations before and after are statistically different. Alternating increases or decreases in concentration where no linear relationship exists would indicate that groundwater is impacted but is not better or worse than at some previous point in time.

In order to answer the question of whether groundwater quality is better, worse, or stayed the same, it is necessary to understand the intra-annual variability of groundwater quality. Knowing how concentrations may fluctuate during the year helps to provide context to historical data. If little variation exists, then utilizing annual sampling data from past well testing to interpret trends or changes over time may be useful and appropriate. If large amounts of intra-annual variability exist, sorting out the intra-annual variation from a long-term trend or change may require increasing the number of wells that are sampled on a regular basis and/or monitoring for a longer period of time.

Standard deviation is a measure of the average distance of values from the mean and is a standard way to measure and express variability. The standard deviation and average concentration of each parameter for the ten wells was plotted by sample period to understand variability during the year (Figure 5). Variability among nitrate, chloride, alkalinity and conductivity was lowest during the period when soil temperatures indicated frozen conditions and little to no groundwater recharge was likely occurring. Variability increased following the period indicating snow melt and non-frozen soil conditions when groundwater recharge commenced in the spring of 2014; variability was of similar magnitude at the beginning of the study period in June 2013 following the previous spring recharge period. While it is less obvious in the nitrate measurements, the chloride, alkalinity and conductivity all seem to indicate a gradual decline in variability following the spring recharge period in 2013.

Implications for long-term monitoring

These results suggest the composition of water from private wells was most stable during frozen soil conditions when little to no recharge was occurring, and most variable following the snow-melt and spring recharge season. The increased variability of June 2013 and April/May 2014 likely reflects the influx of groundwater recharge during the spring. The gradual decrease in variability that occurred in summer and fall may be the result of a prolonged period of little to no recharge, or perhaps smaller recharge events that did have as great an influence on groundwater quality. Because spring is a critical time for groundwater recharge in Wisconsin,

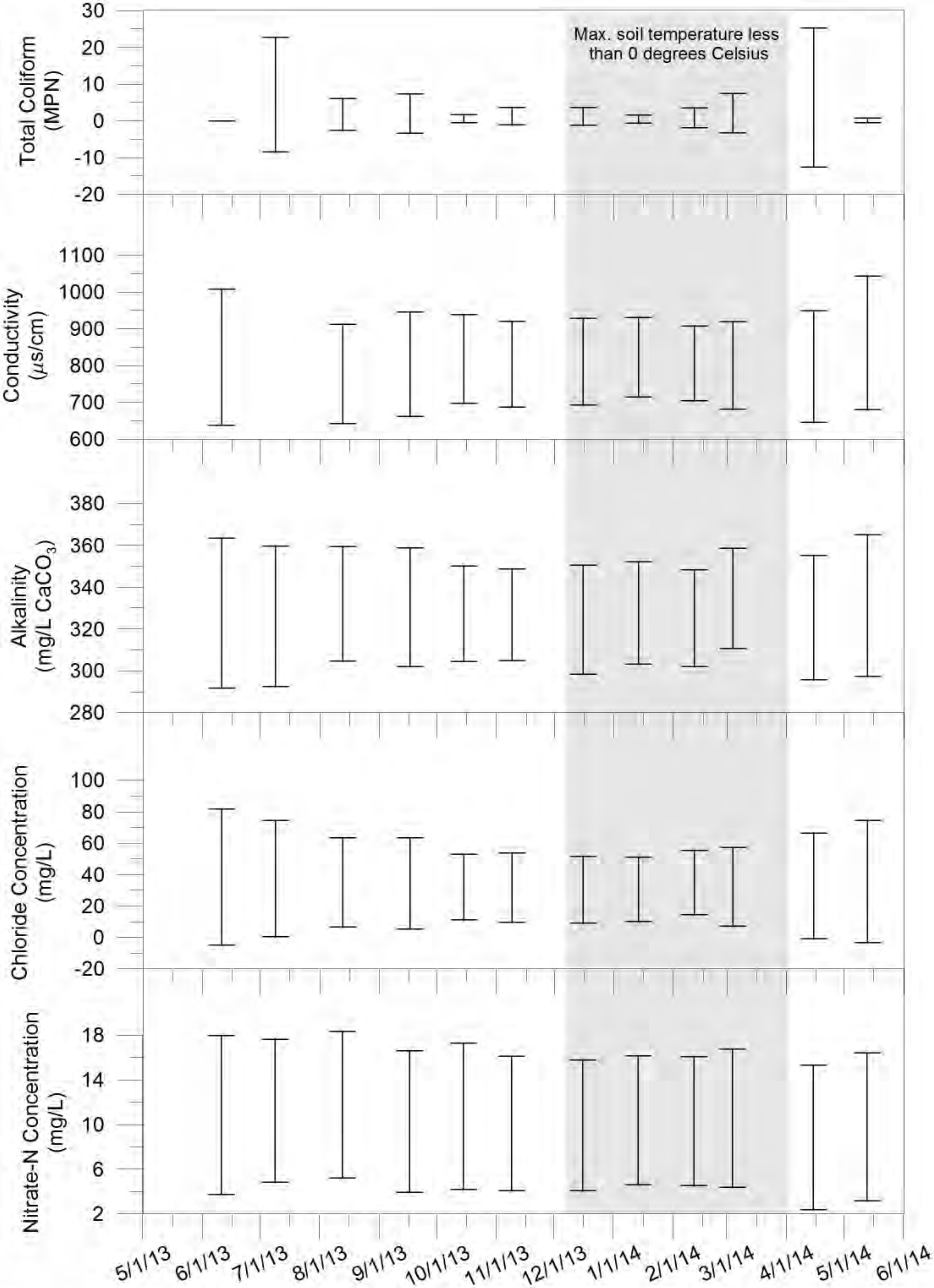


Figure 5. Standard deviation from the average of all ten wells for each sample period indicated by error bars.

monitoring nitrate and chloride concentrations after this period may prove insightful as to how the aquifer may or may not have been affected spring recharge each year.

For long-term monitoring purposes of private well water and groundwater quality, we feel that there are benefits to avoiding times of the year when variability is anticipated. Sampling wells when the groundwater aquifer is most stable appears to provide the best opportunity to detect trends or changes in groundwater over time. Measuring the magnitude of variability (difference between stable conditions and some minimum or maximum distance from the average) may also have benefits, in particular for understanding how annual climatic variability or particular land-uses may be influencing water quality from year to year.

Recommendations for future monitoring efforts

Even though there was significant intra-annual variability in private well water quality, it appears that these wells could be used in a cost-effective monitoring program in Lincoln Township to monitor groundwater quality. We feel that future monitoring efforts in Lincoln Township would benefit from an increasing the number of wells that are tested. In order to limit expenses related to sampling an increased number of wells, sampling frequency could be decreased from twelve down to twice per year. Because they are associated with human influences, nitrate and chloride have the most utility for understanding land-use trends or human influenced changes to groundwater; alkalinity is also potentially useful for characterizing aquifer properties. Sampling in January when soil conditions have the greatest potential to be frozen provides an opportunity to measure wells under relatively stable aquifer conditions. Sampling in mid-June provides some ability to assess groundwater conditions following the spring groundwater recharge period. Monitoring the magnitude of change between these two times of year could provide useful insight into land-use interactions with groundwater or climatic variability from year to year. Well water quality information collected with this type of organized approach would assist in tracking long-term water quality, and ultimately examine whether well water quality is changing over time as a result of land-use practices.

Given the inherent limitations of grab sampling methods of quantifying bacteria/pathogens, we feel that coliform/*E.coli* testing is of little utility for long-term monitoring in this type of sampling approach. If bacterial or pathogenic contamination of wells is to be studied, alternative methods to grab samples that are capable of measuring or quantifying the impact of rapid recharge events in this type of groundwater aquifer should be investigated. Because this is an emerging area of research it would likely require the pursuit of outside grants or partnering with researchers to investigate this particular aspect of well water quality.

Trends and changes are difficult to detect and a solid commitment from well owners would be critical before starting such an effort. We believe that a minimum of 25 wells should be selected for bi-annual testing. We also feel that there is little value in only collecting this type of information for one or two years, selecting landowners with an understanding that testing might last 10 or more years would be important for developing a consistent dataset. A committed funding source is equally important to ensuring such data collection is meaningful and testing efforts are not terminated prematurely. Reasonable assurance that testing costs can be covered for a set period of time (we recommend 10 years) would be necessary before undertaking such an effort. It may be possible to pursue grants to expand testing to a larger number of wells in certain years or perform more detailed analysis for emerging compounds of interest. Technology is available to measure specific pathogens related to human wastewater and bovine manure; because the sampling method can be performed in-line this technology may also be capable of determining a more complete picture of bacteria/pathogenic contamination of private wells (Borchardt et al., 2012).

Conclusions

The monthly sampling of ten wells in Lincoln Township measured significant variability in nitrate and chloride concentrations, both human-related contaminants. Nitrate variability was large enough that homeowners with an initial nitrate concentration above 2 mg/L should consider testing more than once per year to investigate the potential for the nitrate concentration to rise above the nitrate drinking water standard at some point during the year. Water quality results suggest aquifer conditions were most stable during the winter period when the soil near the surface was below 0 degrees Celsius. Changes in well water quality measured in individual wells and increased variability between wells seemed to coincide with the snow-melt and spring recharge periods.

Understanding whether a well is susceptible to bacterial contamination is important to anyone that relies on a private well, particularly when used as a source of water for drinking and cooking. The variability of coliform bacteria results and the inability to measure other pathogens of interest suggest that an annual present/absent type of coliform bacteria tests is likely insufficient to assess the bacteriological/pathogenic safety of a water supply over the course of the year. Until better test methods can be developed, homeowners that use private wells as their primary source of drinking and cooking water in Lincoln Township may also want to consider testing their well more frequently than once per year for coliform bacteria. While testing more frequently might help to identify wells that are more susceptible to local geologic conditions, testing methods are only a snapshot in time. Those relying on private wells as their primary drinking and cooking source, especially households that have noticed frequent occurrences of gastrointestinal illness, may want to consider a treatment system like ultra-violet (UV) light or other types of treatment that kill pathogens which would provide some level of protection from pathogens should minor contamination incidents occur.

REFERENCES

Andraski, T.W., L.G. Bundy, and K.R. Brye. 1999. Crop Management and Corn Nitrogen Rate Effects on Nitrate Leaching. *J. Environ. Qual.* Vol. 29 No. 4, p. 1095-1103.

Atherholt, T., E. Feerst, B. Hovendon, J. Kwak, and D. Rosen. 2003. Evaluation of Indicators of Fecal Contamination in Groundwater. *Am. Water Works Assoc. J.* Vol. 95, Issue 10, p.119-131.

Borchardt, M.A., S.K. Spencer, B.A. Kieke Jr., E. Lambertini, F.J. Loge. 2012. Viruses in non-disinfected drinking water from municipal wells and community incidence of acute gastrointestinal illness. *Environ. Health Perspectives.* 120:1272-1279.

Braatz, L.A. (2004). A Study of Fecal Indicators and other Factors Impacting Water Quality in Private Wells in Door County, WI. MS Thesis. University of Wisconsin – Green Bay.

Bradbury, K. R., and M. A. Muldoon. 1992. Hydrogeology & Groundwater Monitoring of Fractured Dolomite In The Upper Door Priority Watershed Door County. Wisconsin Geological and Natural History Survey Open File Report, WOFR 92-2, 84 p.

Bradbury, K.R., Borchardt, M.A., Gotkowitz, M., Spencer, S.K., Zhu, J., Hunt, R.J. 2013. Source and transport of human enteric viruses in deep municipal water supply wells. *J. Environ. Sci. and Tech.* 47:4096-4103.

Center for Watershed Science and Education (2013) WI Well Water Viewer. http://www.uwsp.edu/cnr-ap/watershed/Pages/wellwaterviewer.aspx

DATCP. 2008. Wisconsin Groundwater Quality: Agricultural Chemicals in Wisconsin Groundwater. WI Department of Agriculture, Trade and Consumer Protection. Environmental Quality Section. ARM Pub 180.qxd 04/08.

Groundwater Coordinating Council (GCC). 2013. WI Groundwater Coordinating Council FY2013 Report to the Legislature. WI Dept. of Natural Resources. http://dnr.wi.gov/topic/Groundwater/GCC/report.html

EPA, 2002, “Onsite Wastewater Treatment Systems Manual,” Office of Water, Office of Researchand Development, U.S. Environmental Protection Agency, Washington, DC, EPA/625/R-00/008.

Erb, Kevin and Ron Steiglitz (editors), (2007). Final Report of the Northeast Wisconsin Karst Task Force, 46 p. http://learningstore.uwex.edu/Final-Report-of-the-Northeast-Wisconsin-Karst-Task-Force-P1234C120.aspx

Freeze, R.A., and J.A. Cherry. 1979. Groundwater. Englewood Cliffs, New Jersey: Prentice Hall.

Gotkowitz, M.B. and S.J. Gaffield, 2006. Water-Table and Aquifer-Susceptibility Maps of Calumet County, Wiscoinsin. Wisconsin Geological and Natural History Survey Miscellaneous Map 56. Scale 1:100,000

Jaynes, D.B., T.S. Colvin, D.L. Karlen, C.A. Cambardella, and D.W. Meek. 2001. Nitrate Loss in Subsurface Drainage as Affected by Nitrogen Fertilizer Rate. *J. Environ. Qual.* 30:1305-1314.

Laboski, C. & J. B. Peters, J. 2012. Nutrient applications guidelines for field, vegetable, and fruit crops in Wisconsin. UW-Extension publication A2809.

Masarik, K. , Norman, J. and Brye, K. (2014) Long-Term Drainage and Nitrate Leaching below Well-Drained Continuous Corn Agroecosystems and a Prairie. *Journal of Environmental Protection*, **5**, 240-254. doi: 10.4236/jep.2014.54028.

Millen, H. T., Gonnering, J. C., Berg, R. K., Spencer, S. K., Jokela, W. E., Pearce, J. M., et al. Glass Wool Filters for Concentrating Waterborne Viruses and Agricultural Zoonotic Pathogens. *J. Vis. Exp.* (61), e3930, doi:10.3791/3930 (2012).

Muldoon, M.A & K.R. Bradbury. 2010. Assessing Seasonal Variations in Recharge and Water Quality in the Silurian Aquifer in Areas with Thicker Soil Cover. Report to WI Dept. of Natural Resources. DNR-198.

Pasquarell, G.C. and D.G. Boyer. 1995. Agricultural Impacts on Bacterial Water Quality in Karst Groundwater. *J. Environ. Qual.* 24:959-969.

Randall, G. W. and T. K. Iragavarapu. 1995. Impact of Long-Term Tillage Systems for Continuous Corn on Nitrate Leaching to Tile Drainage. *J. Environ. Qual.* 24:360–366. doi:10.2134/jeq1995.00472425002400020020x

Sherrill, M. G. 1978. Geology and Ground Water in Door County, Wisconsin, With Emphasis on Contamination Potential in the Silurian Dolomite. Wisconsin Geological Survey Water-Supply Paper 2047, 38 p.

WI DNR. 1998. WISCLAND Land Cover (WLCGW930). Madison, Wisconsin. Wisconsin Department of Natural Resources.

WI DNR. 2014. Nitrate in Drinking Water. WI Dept. of Natural Resources, Bureau of Drinking Water and Groundwater. PUB-DG-001 2014.

Zheng, Y., W.R. Kelly, S.V. Panno, W.T. Liu. 2013. Identification of Sources of Fecal Pollution of Karst Waters. Illinois State Water Survey. Champaign, Illinois. Contract Report 2013-02.

Appendix A. Water quality results of individual wells for each sample period.

Well #1

Sample Date	pH	Conductivity	Alkalinity	Total Hardness	Nitrate-Nitrogen	Chloride	Total Coliform	*E.Coli*
		μs/cm	mg/L $CaCO_3$	mg/L $CaCO_3$	mg/L	mg/L	MPN cfu/100mL	MPN cfu/ 100mL
6/11/2013	7.72	692	276	376	15.0	17.4	ND	ND
7/9/2013	7.74	NA	276	372	15.0	17.0	ND	ND
8/13/2013	8.23	650	296	372	15.2	17.8	ND	ND
9/17/2013	7.23	713	292	392	14.2	18.4	ND	ND
10/15/2013	8.11	720	292	396	14.6	19.4	ND	ND
11/9/2013	7.73	719	292	396	14.5	19.8	ND	ND
12/16/2013	8.00	729	284	388	14.5	18.4	1.0	ND
1/14/2014	8.09	743	288	405	14.7	18.0	ND	ND
2/12/2014	7.64	712	284	396	15.4	17.8	ND	ND
3/4/2014	7.68	704	296	400	15.2	17.5	ND	ND
4/15/2014	8.14	708	283	388	15.0	16.9	ND	ND
5/13/2014	7.72	750	280	384	15.4	16.5	ND	ND

Well #2

Sample Date	pH	Conductivity	Alkalinity	Total Hardness	Nitrate-Nitrogen	Chloride	Total Coliform	*E.Coli*
		μs/cm	mg/L $CaCO_3$	mg/L $CaCO_3$	mg/L	mg/L	MPN cfu/100mL	MPN cfu/ 100mL
6/11/2013	7.65	746	324	408	16.0	15.5	ND	ND
7/9/2013	7.74	NA	328	404	15.7	13.7	ND	ND
8/13/2013	8.44	690	328	400	16.3	13.1	ND	ND
9/17/2013	7.30	737	324	416	15.7	12.8	ND	ND
10/15/2013	8.08	763	320	408	15.6	12.2	ND	ND
11/9/2013	7.77	775	316	<4	15.7	12.3	ND	ND
12/16/2013	7.85	794	324	<4	15.8	12.9	ND	ND
1/14/2014	7.92	800	324	8†	16.0	13.5	ND	ND
2/12/2014	7.71	770	320	<4	16.9	13.0	ND	ND
3/4/2014	7.69	765	328	<4	16.9	12.9	ND	ND
4/15/2014	8.15	780	324	<4	15.7	13.8	ND	ND
5/13/2014	7.91	805	332	420	15.8	15.1	ND	ND

Well #3

Sample Date	pH	Conductivity	Alkalinity	Total Hardness	Nitrate-Nitrogen	Chloride	Total Coliform	*E.Coli*
		μs/cm	mg/L $CaCO_3$	mg/L $CaCO_3$	mg/L	mg/L	MPN cfu/100mL	MPN cfu/ 100mL
6/11/2013	7.59	938	352	484	18.1	44.8	ND	ND
7/9/2013	7.62	NA	348	472	18.1	42.6	ND	ND
8/13/2013	8.23	875	356	484	21.1	44.5	ND	ND
9/17/2013	7.14	943	352	492	21.0	44.9	ND	ND
10/15/2013	8.35	921	344	492	22.1	45.1	ND	ND
11/9/2013	7.73	899	348	464	18.8	40.2	ND	ND
12/16/2013	7.78	884	336	456	16.4	36.6	ND	ND
1/14/2014	7.80	891	344	480	15.1	36.0	ND	ND
2/12/2014	7.67	846	340	456	15.4	35.4	ND	ND
3/4/2014	7.63	903	352	488	19.0	41.1	ND	ND
4/15/2014	7.73	889	344	472	17.2	38.4	ND	ND
5/13/2014	7.69	1005	352	492	19.7	43.0	ND	ND

NA Not Analyzed; **ND** None Detected; **<4** Softened Water; † Partially Softened Water

Appendix A (cont.)

Well #4

Sample Date	pH	Conductivity	Alkalinity	Total Hardness	Nitrate-Nitrogen	Chloride	Total Coliform	*E.Coli*
		µs/cm	mg/L CaCO$_3$	mg/L CaCO$_3$	mg/L	mg/L	MPN cfu/ 100mL	MPN cfu/ 100mL
6/11/2013	7.52	683	348	388	5.6	8.3	ND	ND
7/9/2013	7.82	NA	312	376	9.1	16.4	ND	ND
8/13/2013	8.19	694	328	388	12.3	19.2	ND	ND
9/17/2013	7.37	694	332	388	7.7	11.1	ND	ND
10/15/2013	7.99	735	336	396	9.4	14.4	2.0	ND
11/9/2013	7.70	693	332	372	7.8	10.2	5.2	ND
12/16/2013	7.86	687	328	380	6.2	8.4	1.0	ND
1/14/2014	8.19	715	336	416	7.5	11.8	ND	ND
2/12/2014	7.57	839	336	336	7.3	55.8	ND	ND
3/4/2014	7.60	693	344	404	6.4	9.4	4.1	ND
4/15/2014	8.05	658	340	376	4.4	5.8	60.2	ND
5/13/2014	7.58	736	356	396	4.8	7.5	2.0	ND

Well #5

Sample Date	pH	Conductivity	Alkalinity	Total Hardness	Nitrate-Nitrogen	Chloride	Total Coliform	*E.Coli*
		µs/cm	mg/L CaCO$_3$	mg/L CaCO$_3$	mg/L	mg/L	MPN cfu/ 100mL	MPN cfu/ 100mL
6/11/2013	7.56	791	280	404	21.6	28.6	ND	ND
7/9/2013	7.84	NA	296	404	18.9	29.8	ND	ND
8/13/2013	8.19	755	304	400	15.7	30.7	4.1	ND
9/17/2013	7.57	760	308	408	10.7	33.2	3.1	ND
10/15/2013	8.03	793	308	412	10.0	33.5	3.1	ND
11/9/2013	7.91	768	316	396	8.0	31.9	1.0	ND
12/16/2013	7.79	800	300	404	14.0	32.1	7.5	ND
1/14/2014	7.95	838	308	440	15.8	33.3	2.0	ND
2/12/2014	7.53	797	308	424	13.3	33.3	ND	ND
3/4/2014	7.72	788	324	500	11.2	34.2	ND	ND
4/15/2014	7.71	718	288	372	12.1	25.4	ND	ND
5/13/2014	7.84	800	304	392	13.7	24.7	ND	ND

Well #6

Sample Date	pH	Conductivity	Alkalinity	Total Hardness	Nitrate-Nitrogen	Chloride	Total Coliform	*E.Coli*
		µs/cm	mg/L CaCO$_3$	mg/L CaCO$_3$	mg/L	mg/L	MPN cfu/ 100mL	MPN cfu/ 100mL
6/11/2013	7.62	700	304	372	8.2	24.9	ND	ND
7/9/2013	7.95	NA	304	368	10.5	27.7	ND	ND
8/13/2013	8.18	701	304	380	11.4	27.7	ND	ND
9/17/2013	7.51	701	300	376	8.0	24.4	ND	ND
10/15/2013	8.11	747	308	388	10.0	26.5	ND	ND
11/9/2013	7.85	758	308	<4	9.5	25.9	ND	ND
12/16/2013	7.71	768	312	<4	8.5	24.8	ND	ND
1/14/2014	7.85	794	316	<4	10.1	26.5	ND	ND
2/12/2014	7.72	761	316	8†	10.3	26.4	ND	ND
3/4/2014	7.61	784	324	104†	12.6	26.8	ND	ND
4/15/2014	7.80	717	312	80†	2.3	20.9	ND	ND
5/13/2014	7.79	740	300	368	6.6	24.8	ND	ND

NA Not Analyzed; **ND** None Detected; **<4** Softened Water; † Partially Softened Water

Appendix A (cont.)

Well #7

Sample Date	pH	Conductivity	Alkalinity	Total Hardness	Nitrate-Nitrogen	Chloride	Total Coliform	*E.Coli*
		µs/cm	mg/L $CaCO_3$	mg/L $CaCO_3$	mg/L	mg/L	MPN cfu/ 100mL	MPN cfu/ 100mL
6/11/2013	7.81	852	316	<4	13.3	34.6	ND	ND
7/9/2013	8.32	NA	324	<4	13.8	35.1	28.1	ND
8/13/2013	8.64	846	332	<4	14.5	34.7	ND	ND
9/17/2013	7.75	862	332	<4	13.9	34.3	ND	ND
10/15/2013	8.35	904	324	<4	14.1	34.5	ND	ND
11/9/2013	7.73	836	324	440	14.0	34.5	ND	ND
12/16/2013	7.75	838	312	440	12.7	32.7	ND	ND
1/14/2014	7.92	837	316	452	12.2	32.3	ND	ND
2/12/2014	7.80	803	312	436	12.2	32.3	ND	ND
3/4/2014	7.76	790	320	424	11.6	31.1	ND	ND
4/15/2014	7.75	790	308	424	10.3	30.5	2.0	ND
5/13/2014	7.73	840	312	412	10.9	31.4	ND	ND

Well #8

Sample Date	pH	Conductivity	Alkalinity	Total Hardness	Nitrate-Nitrogen	Chloride	Total Coliform	*E.Coli*
		µs/cm	mg/L $CaCO_3$	mg/L $CaCO_3$	mg/L	mg/L	MPN cfu/ 100mL	MPN cfu/ 100mL
6/11/2013	7.60	982	388	516	9.1	45.1	ND	ND
7/9/2013	7.90	NA	380	444	9.2	44.9	ND	ND
8/13/2013	8.13	953	376	500	9.8	44.8	ND	ND
9/17/2013	7.42	975	384	496	9.5	44.6	ND	ND
10/15/2013	8.07	1011	372	516	10.1	44.5	1.0	ND
11/9/2013	7.61	986	368	504	10.9	45.1	6.3	ND
12/16/2013	7.54	1019	376	516	9.6	45.7	3.0	ND
1/14/2014	7.80	1004	376	536	10.8	43.9	3.1	ND
2/12/2014	7.61	985	368	520	10.9	46.5	8.4	ND
3/4/2014	7.49	964	384	520	11.1	44.7	16.9	ND
4/15/2014	7.83	994	372	512	10.7	45.0	2.0	ND
5/13/2014	7.89	1059	380	380	10.2	44.4	ND	ND

Well #9

Sample Date	pH	Conductivity	Alkalinity	Total Hardness	Nitrate-Nitrogen	Chloride	Total Coliform	*E.Coli*
		µs/cm	mg/L $CaCO_3$	mg/L $CaCO_3$	mg/L	mg/L	MPN cfu/ 100mL	MPN cfu/ 100mL
6/11/2013	7.74	615	324	344	1.2	9.9	ND	ND
7/9/2013	8.25	NA	316	344	1.5	10.4	ND	ND
8/13/2013	8.48	604	328	340	1.3	10.6	ND	ND
9/17/2013	7.74	616	320	344	1.7	11.7	ND	ND
10/15/2013	8.25	635	324	348	1.3	11.6	ND	ND
11/9/2013	7.77	634	320	344	1.7	12.7	ND	ND
12/16/2013	7.79	635	320	348	1.5	11.9	ND	ND
1/14/2014	7.92	650	320	364	1.5	11.9	ND	ND
2/12/2014	7.71	627	324	360	1.5	12.0	ND	ND
3/4/2014	7.68	621	324	360	1.7	11.4	ND	ND
4/15/2014	7.78	624	320	348	0.8	9.6	ND	ND
5/13/2014	8.04	647	320	320	0.7	9.4	ND	ND

NA Not Analyzed; **ND** None Detected; **<4** Softened Water; † Partially Softened Water

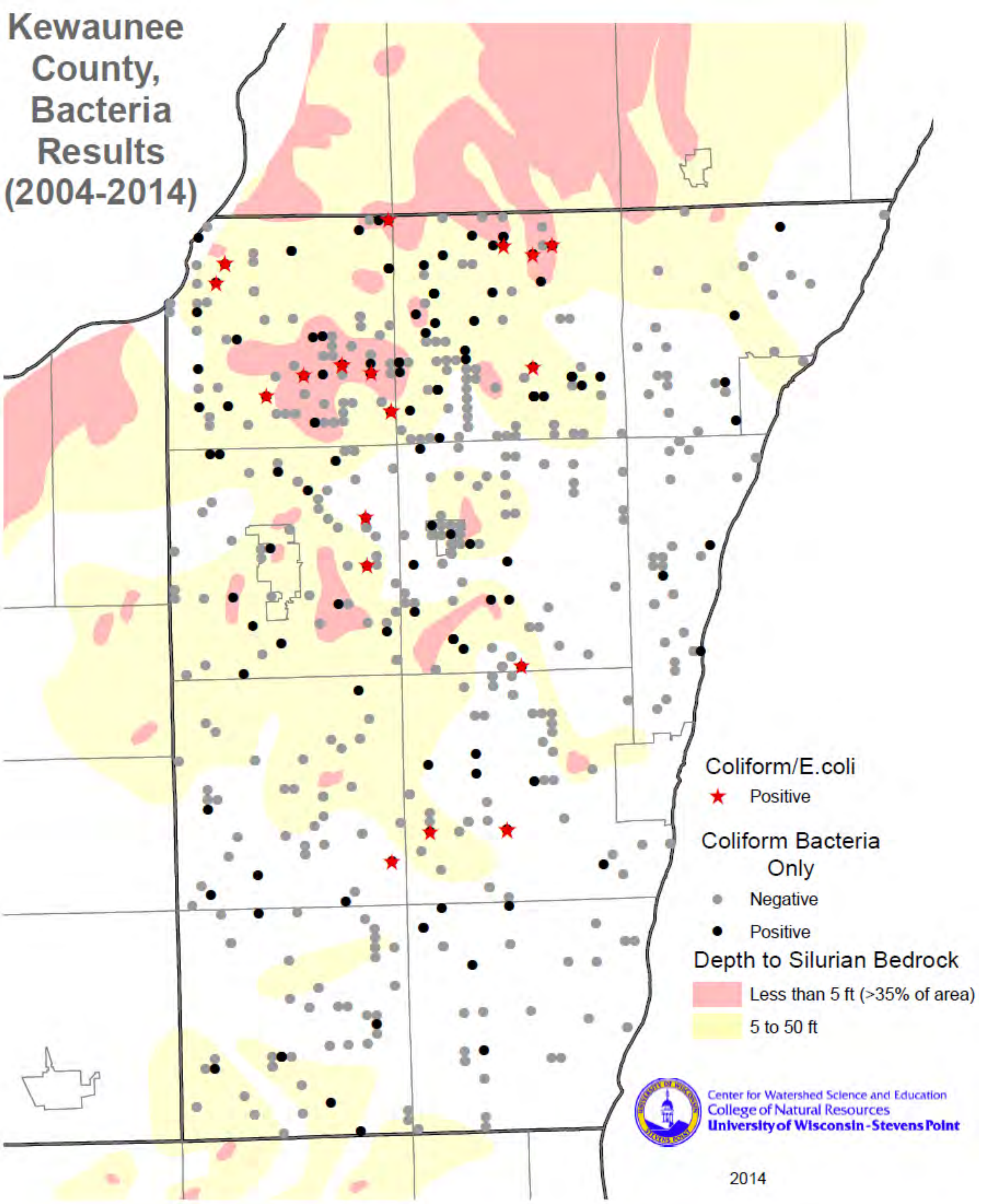
Appendix A (cont.)

Well #10

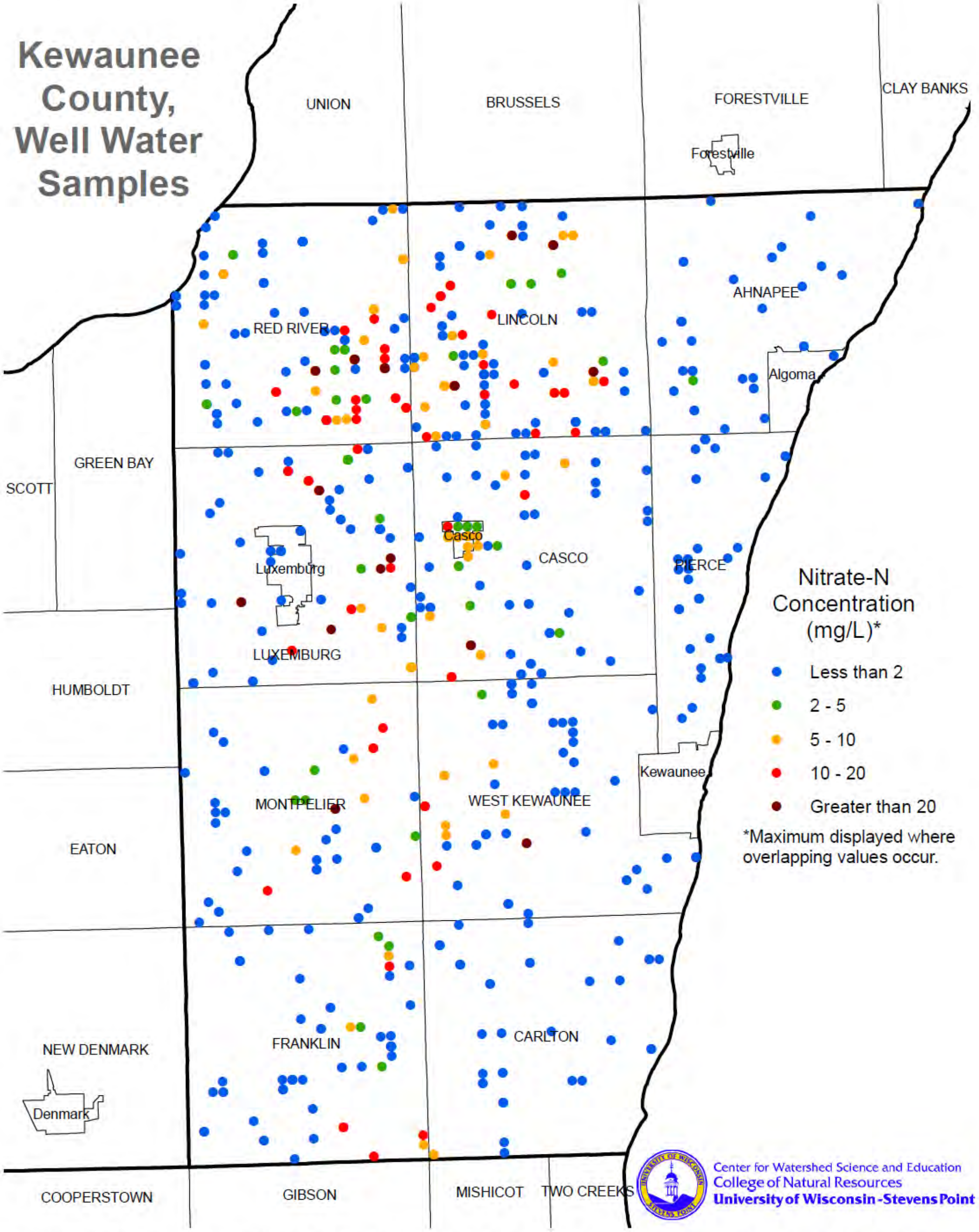
Sample Date	pH	Conductivity	Alkalinity	Total Hardness	Nitrate-Nitrogen	Chloride	Total Coliform	*E.Coli*
		µs/cm	mg/L $CaCO_3$	mg/L $CaCO_3$	mg/L	mg/L	MPN cfu/ 100mL	MPN cfu/ 100mL
6/11/2013	7.66	1231	364	584	0.4	156.0	ND	ND
7/9/2013	8.16	NA	376	540	0.5	137.0	43.5	ND
8/13/2013	8.01	1005	368	504	0.2	108.0	13.4	ND
9/17/2013	7.53	1040	360	508	0.2	109.0	17.1	ND
10/15/2013	8.28	949	344	476	0.1	79.8	ND	ND
11/9/2013	7.81	969	344	478	<0.1	83.9	1.0	ND
12/16/2013	7.76	952	352	484	<0.1	80.0	ND	ND
1/14/2014	7.95	956	348	488	<0.1	79.5	ND	ND
2/12/2014	7.76	921	344	480	<0.1	77.5	ND	ND
3/4/2014	7.73	988	350	480	<0.1	94.2	ND	ND
4/15/2014	7.89	1097	364	528	<0.1	122.0	ND	ND
5/13/2014	7.87	1238	376	556	0.1	140.0	ND	ND

NA Not Analyzed; **ND** None Detected; **<4** Softened Water; † Partially Softened Water

Appendix B. Maps of Kewaunee County Well Water Testing Results (2004 – 2014)

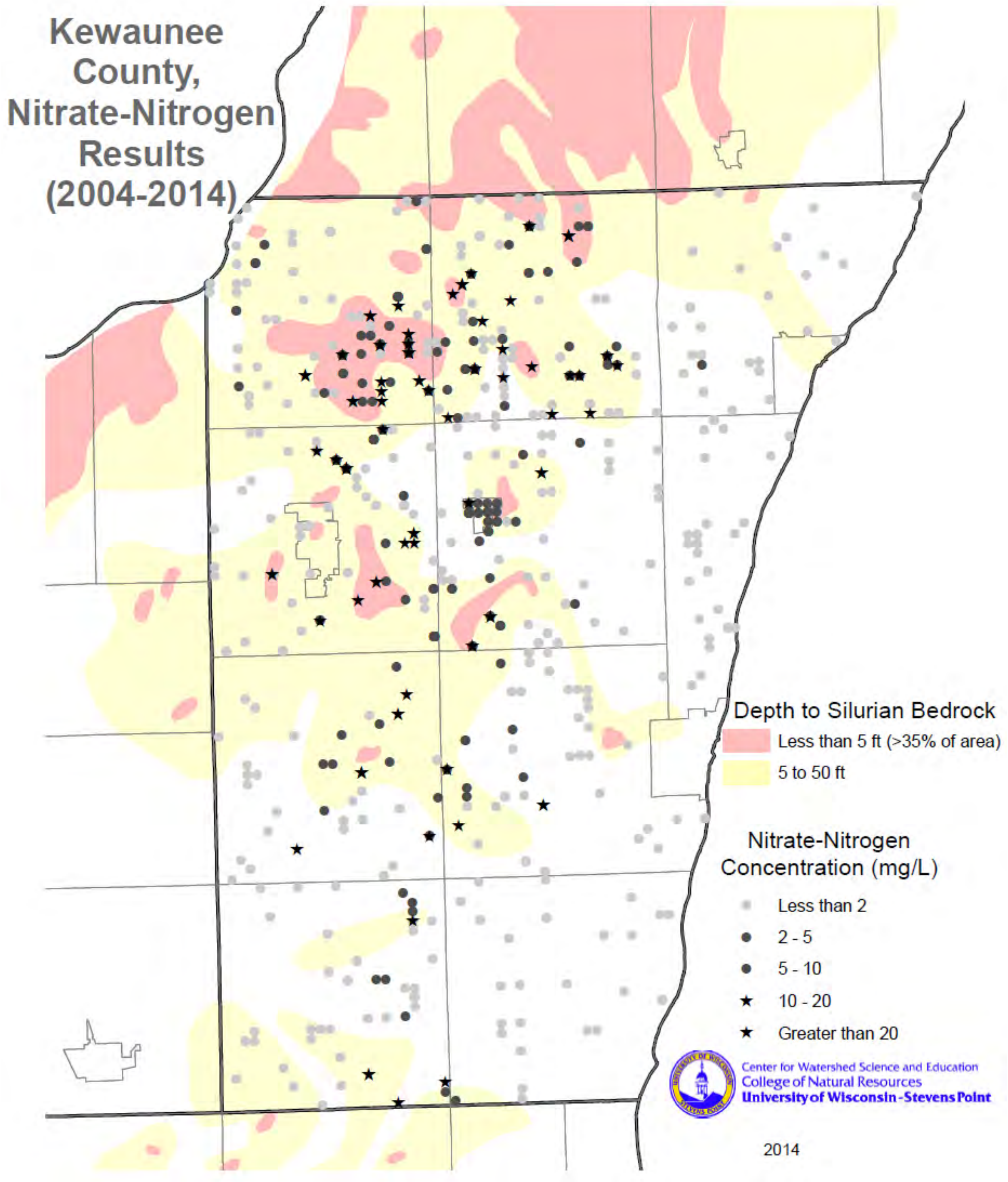


Appendix B (cont.)



Disclaimer: This map represents data in the Center for Watershed Science and Education database for the period from 2004-2014. It does not represent all known private well tests and does not represent a scientifically conducted study.

Appendix B (cont.)



Attachment M

Stream name	Uniform sample location	Collection date	Sample time	Total Coliform	E. Coli	Nitrate as N, mg/L	Total P, mg/L
Ahnapee River	Olson park	9/24/2012	12:23 PM	1046.2	131.4	0.7	<0.088
Ahnapee River	Olson park	10/15/2012	3:00 PM	> 2419.6	816.4	no data	no data
Ahnapee River - Mouth	Olson park	4/29/2013	9:50 AM	156	<10	2.41	<0.052
Ahnapee River - Mouth	Olson park	5/28/2013	10:00 AM	1553.1	124.6	1.12	<0.052
Ahnapee River - Mouth	Olson park	7/1/2013	10:00 AM	626.4	95.9	0.72	<0.052
Ahnapee River - Mouth	Olson park	7/31/2013	9:55 AM	>2419.6	149.7	0.41	0.12
Ahnapee River - Mouth	Olson park	8/28/2013	8:28 AM	1986.3	410.6	<0.014	<0.052
Ahnapee River - Mouth	Olson park	9/30/2013	12:15 PM	1203.3	156.5	0.22	0.12
Ahnapee River - Mouth	Olson park	10/29/2013	10:45 AM	158.5	3.1	<0.014	<0.052
Ahnapee River - Mouth	Olson park	5/7/2014	10:10 AM	517.2	13.2	1.54	<0.052
Ahnapee River - Mouth	Olson park	6/4/2014	10:15 AM	> 2419.6	486	0.83	0.1
Ahnapee River - Source	Stevenson Pier Rd & Cty H	4/29/2013	10:15 AM	1145	20	4.08	<0.052
Ahnapee River - Source	Stevenson Pier Rd & Cty H	5/28/2013	11:00 AM	>2419.6	35.5	6.77	<0.052
Ahnapee River - Source	Stevenson Pier Rd & Cty H	7/1/2013	10:30 AM	2419.6	261.3	5.94	<0.052
Ahnapee River - Source	Stevenson Pier Rd & Cty H	7/31/2013	11:20 AM	>2419.6	209.8	6.02	0.087
Ahnapee River - Source	Stevenson Pier Rd & Cty H	8/28/2013	10:25 AM	1413.6	78.9	5.95	<0.052
Ahnapee River - Source	Stevenson Pier Rd & Cty H	9/30/2013	12:40 PM	1553.1	58.8	7.86	0.088
Ahnapee River - Source	Stevenson Pier Rd & Cty H	10/29/2013	11:20 AM	1119.9	579.4	7.59	<0.052
Ahnapee River - Source	Stevenson Pier Rd & Cty H	5/7/2014	11:00 AM	1986.3	13.5	3.73	<0.052
Ahnapee River - Source	Stevenson Pier Rd & Cty H	6/4/2014	10:43 AM	> 2419.6	435.2	1.52	<0.052
Ahnapee River (source)	1/4 mile E of Stevenson Pier Rd & Cty H	9/24/2012	1:00 PM	1203.3	24.6	8.61	<0.088
Ahnapee River Source	Stevenson Pier Rd & Cty H	10/30/2012	12:00 PM	770.1	34.1	5.95	<0.088
Casco Creek	Maple Rd & Co S	10/30/2012	12:20 PM	>2419.6	517.2	15.49	<0.088
Casco Creek	Maple Rd & Co S	1/30/2013	11:05 AM	5794	530	no data	no data
Casco Creek	Maple Rd & Co S	1/30/2013	11:11 AM	19863	355	no data	no data
Casco Creek	Robin Lane Prop. Of Troy Jandrin	3/11/2013	4:06 PM	7701	798	0.397	1
Casco Creek	Maple Rd & Co S	3/12/2013	12:10 PM	9804	52	NA	NA
Casco Creek	Maple Rd & Co S	9/24/2012	1:35 PM	>2419.6	325.5	19.7	<0.088
Casco Creek	Maple Rd & Co S	10/15/2012	3:30 PM	> 2419.6	1299.7	no data	no data
Culvert Outlet	N6474 Hwy 42	4/22/2014	8:25 AM	1119.9	2.0	3.77	NA /not submitted

Stream name	Uniform sample location	Collection date	Sample time	Total Coliform	E. Coli	Nitrate as N, mg/L	Total P, mg/L
Ditchline Runoff	E 3561 Hawk Rd	3/12/2013	11:55 AM	>24196	12033	NA	NA
E Twin Lower	E Twin Lower	10/30/2012	9:45 AM	1413.6	410.6	1.39	<0.088
E Twin River - Exit	Cty Rd BB & Mill Lane	5/28/2013	8:50 AM	1986.3	727	2.81	<0.052
E Twin River - Exit	Cty Rd BB & Mill Lane	7/1/2013	8:40 AM	>2419.6	1203.3	3.21	0.12
E Twin River - Exit	Cty Rd BB & Mill Lane	7/31/2013	8:45 AM	>2419.6	1935	3.5	0.18
E Twin River - Exit	Cty Rd BB & Mill Lane	8/28/2013	8:45 AM	2416.6	1203.3	1.68	<0.052
E Twin River - Exit	Cty Rd BB & Mill Lane	9/30/2013	10:45 AM	2416.6	613.1	3.68	0.12
E Twin River - Exit	Cty Rd BB & Mill Lane	10/29/2013	8:50 AM	980.4	51.2	4.14	<0.052
E Twin River - Exit	Cty Rd BB & Mill Lane	5/7/2014	8:45 AM	1553.1	70.3	2.86	<0.052
E Twin River - Exit	Cty Rd BB & Mill Lane	6/4/2014	8:45 AM	> 2419.6	770.1	1.47	0.12
E Twin River - Exit Kew Co	Cty Rd BB & Mill Lane	4/29/2013	8:30 AM	402	31	2.24	<0.052
E Twin River - Source	Co F & AB	4/29/2013	9:00 AM	504	31	4.61	<0.052
E Twin River - Source	Co F & AB	5/28/2013	9:20 AM	>2419.6	365.4	4.78	<0.052
E Twin River - Source	Co F & AB	7/1/2013	9:05 AM	>2419.6	272	5.57	<0.052
E Twin River - Source	Co F & AB	7/31/2013	9:12 AM	>2419.6	1119.9	5.6	0.12
E Twin River - Source	Co F & AB	8/28/2013	9:12 AM	>2419.6	613.1	5.05	<0.052
E Twin River - Source	Co F & AB	9/30/2013	11:05 AM	>2419.6	547.5	5.38	0.12
E Twin River - Source	Co F & AB	10/29/2013	9:25 AM	272	24.3	4.97	<0.052
E Twin River - Source	Co F & AB	5/7/2014	9:15 AM	1553.1	13.4	4.51	<0.052
E Twin River - Source	Co F & AB	6/4/2014	9:15 AM	> 2419.6	1299.7	4.19	0.088
E Twin Source	E Twin Source	10/30/2012		1732.9	172.5	2.46	<0.088
East Twin River	Hwy 29 & Townline Rd	10/15/2012	2:20 PM	> 2419.6	> 2419.6	no data	no data
East Twin River	Tisch Mills BB & Mill Lane	10/15/2012	1:50 PM	> 2419.6	> 2419.6	no data	no data
East Twin River (midpoint)	Towline Rd & Hwy 29	9/24/2012	2:25 PM	2419.6	410.6	6.66	<0.088
East Twin River (source)	Janda's Bar-Ellisville	9/24/2012	2:10 PM	1986.3	206.4	7.63	<0.088
Kewaunee River	Kew Marina (Mouth)	9/24/2012	11:28 AM	1203.3	18.5	<0.014	0.13
Kewaunee River	Kewaunee Marina	10/15/2012	1:20 PM	> 2419.6	1553.1	no data	no data
Kewaunee River - Mouth	Harbor Area	4/29/2013	8:00 AM	145	<10	4	<0.052
Kewaunee River - Mouth	Harbor Area	5/28/2013	8:10 AM	>2419.6	410.6	2.33	<0.052
Kewaunee River - Mouth	Harbor Area	7/1/2013	8:10 AM	648.8	26.5	1.17	<0.052

Stream name	Uniform sample location	Collection date	Sample time	Total Coliform	E. Coli	Nitrate as N, mg/L	Total P, mg/L
Kewaunee River - Mouth	Harbor Area	7/31/2013	8:12 AM	>2419.6	39.3	0.16	0.15
Kewaunee River - Mouth	Harbor Area	8/28/2013	8:15 AM	>2419.6	77.1	0.11	<0.052
Kewaunee River - Mouth	Kewaunee River by Bridge - 'Mouth'	9/30/2013	10:05 AM	228.2	14.6	0.15	0.17
Kewaunee River - Mouth	Kewaunee River by Bridge - 'Mouth'	10/29/2013	8:17 AM	172.5	29.8	<0.014	<0.052
Kewaunee River - Mouth	Harbor Area	5/7/2014	8:10 AM	816.4	13.5	3.17	0.16
Kewaunee River - Mouth	Harbor Area	6/4/2014	8:05 AM	> 2419.6	920.8	2.55	0.37
Kewaunee River - Source	Maple Rd & Co S	4/29/2013	10:45 AM	487	<10	15.49	<0.052
Kewaunee River - Source	Maple Rd & Co S	5/28/2013	11:25 AM	>2419.6	108.1	20.11	<0.052
Kewaunee River - Source	Maple Rd & Co S	7/1/2013	11:00 AM	>2419.6	980.4	17.67	<0.052
Kewaunee River - Source	Maple Rd & Co S	7/31/2013	11:50 AM	>2419.6	365.4	18.44	0.17
Kewaunee River - Source	Maple Rd & Co S	8/28/2013	10:55 AM	>2419.6	>2419.6	13.58	<0.052
Kewaunee River - Source	Maple Rd & Co S	9/30/2013	1:05 PM	>2419.6	2419.6	17.71	0.11
Kewaunee River - Source	Maple Rd & Co S	10/29/2013	11:45 AM	>2419.6	190.4	17.17	<0.052
Kewaunee River - Source	Maple Rd & Co S	5/7/2014	11:20 AM	601.5	7.5	15.26	<0.052
Kewaunee River - Source	Maple Rd & Co S	6/4/2014	11:14 AM	> 2419.6	109	12.41	<0.052
Kewaunee River Marina	Kewaunee River Marina	10/30/2012	9:10 AM	2419.6	160.7	1.36	0.18
Kliment Pond	Co D	11/7/2012	1:15 PM	78.9	<1	no data	no data
Lower East Twin River	Mill Lane & County BB	9/24/2012	10:50 AM	1413.6	224.7	2.86	<0.088
Olson Park	Olson Park	10/30/2012	11:20 AM	1203.3	34.1	0.79	<0.088
Silver Creek	N8747 Black Ash Rd	9/17/2013	12:30 PM	1986.3	73.8	no data	no data

Attachment N

UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF WASHINGTON

COMMUNITY ASSOCIATION FOR RESTORATION OF THE ENVIRONMENT, INC., a Washington Non-Profit Corporation; and CENTER FOR FOOD SAFETY, INC., a Washington, D.C. Non-Profit Corporation, Plaintiffs, v. COW PALACE, LLC, a Washington Limited Liability Company, et al., Defendants.	NO: 13-CV-3016-TOR ORDER RE: CROSS MOTIONS FOR SUMMARY JUDGMENT

BEFORE THE COURT are the following motions: Defendant Cow Palace, LLC's Motion for Summary Judgment (ECF No. 190); Defendants The Dolsen Companies' and Three D Properties' Motion for Summary Judgment (ECF No. 191); Plaintiffs' Motion to Exclude Expert Testimony of Scott Stephen (ECF No. 193); Defendant Cow Palace, LLC's *Daubert* Motion to Exclude Testimony in

Reliance on the EPA Report and to Exclude EPA Report Under Rule 403 (ECF No. 200); Plaintiffs' Motion to Exclude Expert Testimony of James Maul (ECF No. 202); Plaintiffs' Motion to Exclude Expert Testimony of Michael Backe (ECF No. 206); Defendant Cow Palace LLC's Motion to Dismiss Under FRCP 12(b)(1) (ECF No. 209); Plaintiffs' Motion for, and Memorandum in Support of, Summary Judgment (ECF No. 211; *see* ECF No. 234-1 (praecipe)); and Cow Palace, LLC'S Motion to Strike Undisclosed Expert Testimony (ECF No. 237).

These matters were heard on January 6, 2015. Charles M. Tebbutt, Elisabeth A. Holmes, Daniel Snyder, Jessica L. Culpepper, and Blythe H. Chandler appeared on behalf of Plaintiffs. Debora K. Kristensen and Brendon V. Monahan appeared on behalf of Defendant Cow Palace. Ralph H. Palumbo appeared on behalf of Defendants Three D Properties and The Dolsen Companies. The Court has reviewed the motions and the file herein and heard from counsel, and is fully informed.

BACKGROUND

This is a case concerning Defendants' manure management practices and their effect on public health and the environment. Cow Palace Dairy ("Dairy"), located in Lower Yakima Valley, houses a large number of animals and must handle significant amounts of manure generated by its herd. The Dairy manages its manure in a variety of ways, including transforming it into compost and selling it, temporarily storing it in several earthen impoundments, and applying it to agricultural fields as fertilizer.

In February 2013, Plaintiffs commenced the instant lawsuit alleging violations under the Resource Conservation and Recovery Act ("RCRA").[1] According to Plaintiffs, Defendants' manure management practices constitute open dumping of solid waste and cause an imminent and substantial danger to public health and the environment because when the manure is improperly managed and stored, as well as over-applied to agricultural fields, it is discarded and consequently contributes to high levels of nitrates in underground drinking water. ECF No. 1. In March 2013, the U.S. Environmental Protection Agency ("EPA") exercised its regulatory power under the Safe Drinking Water Act and entered an Administrative Order on Consent ("AOC") with Defendants to address the high levels of nitrates found in underground drinking water. ECF No. 38-1.

Presently before the Court are a variety of motions which can be reduced to the following issues: (1) whether Plaintiffs have Article III standing; (2) whether certain evidence, including expert testimony, should be limited or excluded from trial; (3) whether animal waste, when over-applied onto soil and leaked into groundwater, is a "solid waste" under RCRA; (4) whether the Dairy's manure

---

[1] Plaintiffs filed their Third Amended Complaint on October 6, 2014. ECF No. 180.

management, storage, and application practices constitute "open dumping" under RCRA; (5) whether the Dairy's manure management, storage, and application practices may cause or contribute to an imminent and substantial endangerment to public health and the environment; and (6) whether Cow Palace, LLC, Three D Properties, LLC, and The Dolsen Companies are all responsible parties under RCRA.

FACTS

A. Cow Palace Dairy

Cow Palace Dairy is located in the Lower Yakima Valley, in Granger, Washington. ECF Nos. 211-1 ¶ 2; 181 at 14. The Dairy can be characterized as a "large concentrated animal feeding operation" ("CAFO") as defined in relevant state and federal laws. 40 C.F.R. § 122.23; Wash. Admin. Code 173-224-030. In 2012, Cow Palace reported its herd size to number over 11,000, with 7,372 milking cows, 897 dry cows, 243 springers, 89 breeding bulls, and 3,095 calves predominately housed in open lot containment pens. ECF Nos. 190-1 ¶ 2; 211-1 ¶ 24; 220-1 (COWPAL002097). The Dairy produces milk, meat, crops, and manure, ECF No. 190-1 ¶ 6; however, Plaintiffs assert the manure "produced" at the Dairy is less of a product than the unwanted byproduct of its primary milk operations, ECF No. 286-1 ¶ 6.

Specifically regarding its manure, the Dairy, like other CAFOs, generates massive amounts of manure from its operation. According to estimates, the Dairy creates, on an annual basis, over 100 million gallons of this substance that must be managed: 61,026,000 gallons of manure-contaminated water from washing the cows and 40,383,850 gallons of liquid manure excreted by the herd.[2] ECF No. 226-1 (COWPAL000511). Defendants contend the Dairy's manure is a "valuable product" sold and used in a variety of ways both on the Dairy's property and elsewhere. ECF No. 190-1 ¶ 13. The manure is gifted to third parties, allegedly to foster goodwill and deepen commercial relationships; transformed into compost and sold to third parties; and applied to the Dairy's fields to fertilize crops, such as silage corn and alfalfa, which in turn is fed to the herd. *Id.* ¶¶ 17, 23-25, 27. Plaintiffs, however, question how "valuable" Defendants' manure really is considering it is given away for free to third parties, over-applied to fields, stored in lagoons that leak, and managed on permeable surfaces that allow its constituents to freely leach into the soil. ECF No. 286-1 ¶ 13.

1. Manure and the Nitrogen Cycle

The parties strongly debate whether the Dairy's manure management practices are contributing to the high concentrations of nitrate found in the

---

[2] These amounts do not include the estimated 4,485,900 gallons of storm water runoff. ECF No. 226-1 (COWPAL000511).

groundwater. Central to this debate is the nitrogen cycle; specifically, the process by which manure constituents convert to nitrates in the soil.

The nitrogen cycle is well-documented and understood; however, it is affected by many environmental factors, which can be roughly predicted and estimated, but not controlled. ECF Nos. 190-1 ¶¶ 36-37; 211-1 ¶ 32; 256-1 ¶ 32. Manure contains organic nitrogen and ammonium. Although influenced by certain conditions—such as soil temperature, moisture-content, and oxygen-content—some of these manure constituents are converted to nitrate.[3] ECF Nos. 190-1 ¶¶ 31-34; 211-1 ¶¶ 33, 38-39; 256-1 ¶ 33. Nitrate, as well as ammonium, is available to plants as fertilizer, providing important and beneficial nutrients. ECF Nos. 190-1 ¶¶ 31-34; 211-1 ¶¶ 33, 38; 256-1 ¶ 33. Although some nutrients are immediately available to plants, a "lag" between the time the manure is applied to the soil and when its nutrients decompose and become available for crop use is expected. ECF No. 256-1 ¶ 39; *see* ECF No. 226-1 (COWPAL000477). Further, at low temperatures, the conversion of manure constituents to nitrate slows or stops. ECF

---

[3] Some of the nitrogen in manure may be converted to ammonia gas, released into the atmosphere, and redeposited onto nearby fields. ECF No. 211-1 ¶ 40 (citing the testimony of Dr. Melvin, Defendants' expert, who agrees that "probably some of" the ammonia will be redeposited onto nearby fields through this conversion process).

Nos. 256-1 ¶¶ 33, 39; *see* 211-1 ¶¶ 33, 39 (noting that ammonium converts if soil temperatures are above four degrees centigrade and that the mineralization and nitrification process slows when soil temperatures drop below fifty degrees Fahrenheit).

Once converted, nitrate is a highly mobile element to the extent there is sufficient water in the soil to transport it. ECF Nos. 211-1 ¶¶ 32, 39; 256-1 ¶ 32. Accordingly, because of its highly mobile nature, any residual nitrate not consumed by plants is susceptible to leaching deeper into the soil from irrigation, precipitation, snowmelt, and additional manure applications. ECF Nos. 211-1 ¶ 33; 256-1 ¶ 33 (acknowledging that nitrate is highly mobile and can move through soil with sufficient water to transport it). Once nitrate has leached below the root zone of crops, it will, with the presence of water to transport it, continue migrating downward, toward groundwater.[4] ECF Nos. 211-1 ¶ 34; 256-1 ¶ 34; *see* ECF No. 211-1 ¶ 37 (citing the deposition of Defendants' expert, Dr. Melvin, ECF No. 228-1, who agreed that nitrates below root zones will "eventually" reach groundwater and that, with sufficient rainfall, manure applications "will probably leach through

---

[4] Defendants do not dispute the possibility that nitrates may eventually reach groundwater; however, they question the timeframe for such a process and whether the conditions for such migration are present underneath the Dairy's operations. ECF No. 256-1 ¶ 34.

the system before you ever get the plant to grow into that root zone"). That is, however, in the absence of conditions suitable to denitrification: the process by which nitrate is converted to nitrogen gas. ECF No. 211-1 ¶ 34.

The parties dispute whether the conditions underlying the Dairy are conducive to denitrification. In support of their assertion that denitrification is unlikely to occur, Plaintiffs put forth evidence of the soil types underlying Cow Palace, with the predominant soil type presenting little potential for any loss of nitrate through denitrification. *Id.* ¶ 35. Plaintiffs' expert, Dr. Byron Shaw, stated the following regarding the soils underlying the Dairy:

> The dominant soils in the area of Cow Palace include the Warden soil series, which is characterized as a well-drained soil with silt loam surface texture originating from wind blown loess. The subsoil grades from the loess to alluvial deposits, originating from soil erosion in the nearby Rattle Snake Hills, many of which are highly permeable. The combination of well-drained, moderate to high permeability soils with coarse subsoil layers makes ideal conditions for movement of nitrate and other contaminants to groundwater.

ECF No. 223 ¶ 49. Further, EPA gas analyses similarly showed no evidence of denitrification, and its continued monitoring data shows oxygen to be present in all monitoring wells, signifying little chance of denitrification. ECF No. 211-1 ¶ 35. Finally, one of Defendants' experts, Dr. Melvin, concurred that "probably very little" denitrification occurs in the soils underlying Cow Palace. *Id.* (citing ECF No. 228-1).

In response, Defendants proffer testimony from their soil scientist, Mr. Scott Stephen, who opined soil compacting from large farm machinery used at the Dairy would result in the top one to two feet of soil having the capacity to hold water for long periods of time; in turn, such standing water would create conditions conducive to denitrification. ECF Nos. 256-1 ¶ 35; 256-11. Mr. Stephen concedes that some of the soils underlying Cow Palace are classified as well-drained; however, he maintains that "[w]hile denitrification rates would not be expected to be considerable, the potential does exist." ECF No. 190-10, ex. 9 at 10-11 (opining that that the "choppers and large trucks . . . driven on the fields" results in "compaction layers . . . at depth[s] from 12-18 inches or deeper and can curb water drainage by slowing travel times as it tries to move through the denser zone(s)," which in turn can cause temporary "perched" water where denitrification can occur). Thus, considering all the evidence presented, denitrification is unlikely to occur in the soils underlying the Dairy, and even if the potential exists, the rate of occurrence ranges from "very little" to "not . . . considerable."

2. Dairy Nutrient Management Plan

To help manage Cow Palace's millions of gallons of yearly generated manure, Cow Palace Dairy is required, pursuant to Washington regulations, to obtain a Dairy Nutrient Management Plan ("DNMP").[5] ECF No. 211-1 ¶ 41. The

---

[5] Previously titled, "Dairy Waste Management Plan." *See* ECF No. 228-3.

Dairy's DNMP was approved in 1998 and subsequently updated in 2008 and 2012 due to increases in herd size and acreage. ECF No. 226-1(COWPAL000459). As stated in the DNMP itself,

> [t]he purpose of [the DNMP] is to provide the dairy manager with Best Management Practices (BMP's) for the production, collection, storage, transfer, treatment, and agronomic utilization of the solid and liquid components of dairy nutrients in such a manner that will prevent the pollution or degradation of state ground waters and surface waters.

Id. (COWPAL000467). Specifically, the DNMP aims to prevent contaminated nutrients from entering nearby surface waters and underlying aquifers and to "agronomically recycle the nutrients produced through soil and crops." *Id.*

The DNMP provides ample guidance on applying manure as a fertilizer in both the body of the plan and its numerous appendices.[6] As an initial matter, the DNMP cautions, in bold, that the "**[a]pplication rates discussed . . . are based on the average values listed previously, and may need to be adjusted according to the actual test results**." *Id.* (COWPAL000476) (emphasis in original). The DNMP further explains that the "[a]pplication rates are established by balancing nitrogen with crop nutrient requirements." *Id.*

---

[6] Previous versions of the Dairy's DNMP contained the same guidelines. *See* ECF Nos. 228-3; 229-1.

First, the DNMP requires the Dairy to test the nutrient content of the manure generated by its herd. Although the DNMP provides an "estimated nutrient content" of the liquid manure, the DNMP explicitly states that "[i]t is **required** that that the dairy manager test the nutrient residuals in the soil along with nutrient content of the liquid in the storages ponds and solid (dry) manure **before** land application." *Id.* (COWPAL000471, -478) (emphasis in original). Under the "Testing Requirements" section, the DNMP requires the following: "**Nutrient analysis** for all sources of organic and inorganic nutrients including, but not limited to, manure and commercial fertilizer supplied for crop uptake. Manure and other organic sources of nutrients must be analyzed annually for organic nitrogen, ammonia nitrogen, and phosphorus." *Id.* (COWPAL000478) (emphasis in original). Thus, although the DNMP lists an estimated nitrogen content of 1.51 pounds per 1,000 gallons of liquid manure, the DNMP explicitly requires the Dairy test the nutrient content of the liquid in its lagoons to verify its actual concentration.

Second, the DNMP requires the Dairy to test its soils for residual nutrients. Under the "Testing Requirements" subsection, the DNMP states that "[r]egular testing for soil nutrient availability is essential for proper nutrient management" decision making. *Id.* (COWPAL000478). According to the DNMP, "[s]oil tests should be completed as close as possible to the time of seeding for best results" and are to be "completed on each field or management group for a starting point for nutrient and manure application recommendations." *Id.* The testing requirements include an "annual post-harvest soil nitrate nitrogen analysis," and "[i]f double cropping, a spring and a fall test should [be] completed prior to any manure application." *Id.*

Third, the DNMP instructs the Dairy to consider average crop yields when determining manure application. "When determining agronomic rates for manure application, it is important to choose achievable yield goals. Average yields for the past three to five years for each field should be used." *Id.* (COWPAL000477). The DNMP specifically lists the primary crops grown on Cow Palace's agricultural fields and provides each crop's nitrogen, phosphorus, and potassium "uptake." *Id.* However, it is very clear that the uptake amounts are merely estimates, as the DNMP expressly states, again in bold, "**[t]hese are guidelines only . . . farmers should vary timing and amounts of application depending on particular soil, crop type, [crop] needs, and weather conditions**." *Id.* (emphasis in original).

Finally, the DNMP provides guidance to the Dairy on application rates. Regarding application specifically, the DNMP notes that "[i]t is critical that the land application of the liquids from the storage ponds be scheduled agronomically throughout the growth period," and that "[t]he proper timing of nutrient application is an essential part of management." *Id.* (COWPAL000480). The application rate depends, in part, on "infiltration characteristics of the soil," with the DNMP advising the Dairy that its fields predominately contain "a very deep, well-drained [type of] soil." *Id.* Although the DNMP recognizes the "lag time" regarding the conversion process, it also states that "some nutrients are available immediately" after a manure application, *id.* (COWPAL000477), and advises that "[c]aution should be taken when applying manure to fields with long histories of manure application," *id.* (COWPAL000480).

The DNMP summarizes the above guidelines in a list of "Do's" (sic). According to the DNMP, the Dairy should engage in the following practices: (1) "[t]ake manure nutrient concentration into account before applying to crops;" (2) "[t]ake soil nutrient levels into account before applying additional nutrients;" (3) "[a]pply nutrients based on realistic yield . . . goals, based on soils, precipitation, climate, available soil moisture, and yield history for the field;" (4) apply manure during periods of low precipitation and when winds are relatively calm; (5) "[a]void applying manure to bare ground," which "may cause nitrogen to leach into the ground water;" (6) "[s]oil test to determine the proper application of manure and any supplemental fertilizers;" and (7) "[m]aintain a record for each field showing the crop sequence, crop, soil test data, . . . kind and amount of nutrients applied, crop yields, and water applied." *Id.* (COWPAL000482).

Further, the DNMP provides several appendices to offer further guidance to the Dairy on Best Management Practices, including guidance on calculating agronomic manure application rates. *See* ECF No. 226-1; *see also* ECF No. 226-2 (COWPAL000577) (providing a bullet-point guidance sheet, titled "To Insure Proper Utilization, Follow These Guidelines," which similarly instructs the Dairy to "[p]erform a nutrient test of animal waste," "[t]est soils for nutrient levels," "[s]et realistic crop yield goals and apply animal waste to fit crop needs," and "[t]ime the application of animal waste so that neither surface or ground water contamination will occur").[7]

---

[7] Laurie Crowe, an employee of the South Yakima Conservation District, assists dairies in obtaining and implementing DNMPs. ECF No. 190-1 ¶ 4. In her deposition, Ms. Crowe attested that she was "sure" she had given Cow Palace Dairy guidance on how to implement its DNMP, specifically with regards to manure application. ECF No. 211-1 ¶ 64 (citing ECF No. 229-2). However, Defendants highlight that Ms. Crowe also testified that she had never provided advice to Mr. Boivin about how to take into account residual soil nitrate levels in the soil and that she had only "possibly" spoken about determining an agronomic rate of manure application. ECF No. 256-1 ¶ 64 (citing ECF No. 229-2).

Thus, the DNMP provides extensive information and guidance to the Dairy on how to apply its manure in a way that is both most beneficial to its crops and least likely to cause environmental harm.

3. Land Application

One way the Dairy makes use of—or in Plaintiffs view, "gets rid of"—its millions of gallons of manure is by applying it to its agricultural fields as fertilizer. Out of Cow Palace's approximately 800 total acres, 533 acres are used for the application of manure to its crop fields. ECF No. 226-1 (COWPAL000467). After all, if "[p]roperly utilized, the manure generated by Cow Place Dairy has the potential to serve as a fertilizer for its crops. *Id.* (COWPAL000476).

Jeff Boivin, the general manager at Cow Palace Dairy, characterizes the DNMP as the "blueprint" for how he conducts manure management at Cow Palace and acknowledges that the DNMP contains "reference tools and best management practices" that he helps implement at the Dairy. ECF No. 132 ¶¶ 1, 11. Defendants contend Mr. Boivin "engaged in a series of calculations" when applying manure to the Dairy's agricultural fields. ECF No. 190-1 ¶ 49. Plaintiffs, on the other hand, strongly contest that Mr. Boivin engaged in any type of calculation when determining how much manure to apply to the fields. ECF No. 286-1 ¶¶ 48-49.

Considering Mr. Boivin's declaration, as well as his deposition testimony, it is clear that characterizing his practices as "engag[ing] in a series of calculations" is a stretch.

First, rather than calculating agronomic rates based on nutrient sampling, the Dairy used the "estimated" figure in the DNMP to determine application rates. ECF No. 211-1 ¶ 68.a (citing ECF No. 228-1); *see also* ECF Nos. 190-3 ¶ 58; 256-1 ¶ 68.a (admitting that Cow Palace Dairy historically applied manure based on the DNMP's estimate that the manure contained 1.5 pounds of nitrogen per 1,000 gallons, but asserting that it calculated manure applications with reference to manure sampling in 2014 and will continue to do so going forward). However, according to Cow Palace's records,[8] nutrient concentrations in the manure varied widely, with amounts ranging from 1.67 lbs/1000 gallons to 33.7 lbs/1000 gallons. ECF No. 211-1 ¶ 68.a (citing relevant records).

Second, rather than sampling concentrations from the specific impoundment that would be the source of the manure applied, the Dairy would only take sample concentrations from one lagoon. ECF No. 228-1 ("Q: "Just to clarify here, you used the main lagoon nutrient sampling for everything? A: Yes. Q: Regardless of

---

[8] Although the Dairy took and recorded manure samples, it admittedly did not actually take these samples into account when determining its application rates. ECF No. 286 at 3.

where the application actually came from? A: Yes.”). According to recent sampling under the AOC, nutrient concentrations vary widely from lagoon to lagoon. *See* ECF No. 211-1 ¶ 68.a. (citing relevant sampling, ECF No. 228-1 (COWPAL009262-63)). Defendants do not dispute that, historically, the Dairy would only sample from the main lagoon, believing it to be representative of the other lagoons because the manure in the main lagoon was used to fill some of the other impoundments to provide for additional storage or application needs; however, in 2014, the Dairy maintains that it took samples from the specific lagoon sourcing the manure and will continue to do so going forward. ECF Nos. 256-1 ¶ 68.a; 256-16 ¶ 11.

Third, the Dairy failed to calculate applications with regard to actual residual manure constituents already present in the fields and available for crop fertilization. ECF No. 211-1 ¶ 68.b (citing ECF No. 228-1). Rather, as Mr. Boivin stated, the Dairy would consider the amount the crop could uptake, according to the DNMP estimates, and merely apply less than that estimate knowing the soil already contained residual levels. *See e.g.*, ECF No. 228-1 (“Q: Sir, is that an over application of manure . . . A: Not sure. Q: Why aren’t you sure? A: Because I applied less than what the triticale would uptake . . . Q: But you didn’t take into account what was already there, did you? A: Probably not. Q: Probably not or is it no? A: No.”). Furthermore, the Dairy did not take spring soil samples when double-cropping its fields, although as Mr. Boivin admitted, he understood the importance of these samples "to see what that crop utilized." ECF No. 211-1 ¶ 68.b (citing ECF No. 228-1). Defendants contend that the Dairy *did* take into account residual soil nutrient, as Mr. Boivin explained, by simply applying less manure than the crop was anticipated to need based on the DNMP. ECF No. 256-1 ¶ 68.b.

Plaintiffs cite to several instances in which the Dairy applied considerably more nitrogen than the crop could possible use; for example, in 2012, although soil samples from the top two feet of the soil column showed nitrate levels in excess of what the alfalfa crop could use, the Dairy proceeded to apply *7,680,000 gallons* of manure onto the already sufficiently fertilized field. ECF No. 304 at 3. Plaintiffs' expert Dr. Shaw cited numerous similar examples of non-agronomic applications, which resulted in *tens of millions of gallons* of manure applied to fields requiring no fertilization. *See* ECF No. 237-2 ¶¶ 76-78, 83-84, 101, 107, 109, 133, 144, 145, 149, 155, 157.

Fourth, the Dairy did not calculate application rates with reference to actual yield goals; rather, the Dairy relied upon the basic guidelines for crop removal rates as identified in the DNMP. ECF Nos. 211-1 ¶ 68.c; 228-1.

> Q: And, again, you've got at the top triticale at 250 and corn at 250. How did you come up with those numbers?
>
> A: From the Dairy Nutrient Management Plan.

Q: So did you take into account any of the past yields of crops from Field 2 in coming up with that number?

A: Yes.

Q: And there's no variability whatsoever?

A: Yes, there is variability.

Q: So why didn't the 250 number change?

A: Because I use an average of what our crops – what we get for our crops from our property.

Q: So the average for the last year was such that you didn't need to change the pounds of "N" utilized by the crops?

A: I probably could have changed them.

Q: But you didn't?

A: No.

Q: Tell me about the calculation you would do to figure out how to change that number.

A: Well, I could look at the yields of that field or all our fields and come up with . . . what the yields are expected to get these amount of "N" to be used . . . and then calculate from there.

Q: But you didn't do that here? . . .

A: No, I just used the number that the Dairy Nutrient Management Plan has listed there.

Q: Right the standard –

A: Yes.

Q: - - number.

ECF No. 228-1. Defendants contend they did calculate agronomic rates with reference to yield goals; that is, the yield goals listed in the DNMP. ECF No. 256-1 ¶ 68.c.

Fifth, Mr. Boivin admitted that the Dairy failed to keep track of the amount of irrigation water applied to each field and never produced an annual report, conceding that the only record the Dairy would have is its water bill. ECF No. 211-1 ¶ 68.e (citing ECF No. 228-1). As stated above, irrigation water can cause unused nitrate to migrate through the soil.

Finally, Mr. Boivin testified that on numerous occasions, the Dairy applied manure to "bare ground"—that is, where no crop was planted. *Id.* ¶ 72 (citing ECF No. 228-1). Plaintiffs' expert Dr. Shaw uncovered even more instances in the Dairy's records. *Id.* ¶ 73 (citing ECF No. 223 ¶ 29). Defendants do not dispute this practice but explain that it intentionally applied manure before the crop was planted in order to ensure the manure constituents had sufficient time to convert to plant-available nutrients and to avoid damaging crops with the application. ECF No. 256-1 ¶¶ 72-32. Further, Plaintiffs highlight several instances in the Dairy's logbooks that suggest the Dairy applied manure to the fields until the lagoon was emptied, presumably, given the timing in late fall in an effort, to prepare for winter storage needs. ECF No. 211-1 ¶ 71. Defendants question how dispositive this evidence is, asserting that the Dairy applied manure according to DNMP guidance and merely noted when the lagoon was emptied. ECF No. 256-1 ¶ 71.

According to Mr. Boivin, the Dairy has followed the same manure management practices, as detailed above, since at least 2003. ECF No. 211-1 ¶ 69 (citing ECF No. 228-1).

In further support of its contention that the Dairy's land application of manure was not agronomic, Plaintiffs provide the following additional evidence. First, post-harvest soil sampling, conducted by both parties, showed consistently high nitrate, phosphorous, and potassium levels. *Id.* ¶ 77 (citing ECF No. 223 ¶¶ 31-40). Specifically, Plaintiffs' samples taken below crop root zones in the 3 to 5 foot range showed very high nitrate and phosphorous levels, which will continue to migrate toward the underlying aquifer.[9] *Id.* ¶ 77.b; *see also* ECF No. 305-4 at 4-5

---

[9] Although Defendants do not dispute these levels, they reiterate that nitrates will only reach groundwater if water is present to transport it and that, considering the thickness of the vadose zone, it could take decades for water to percolate through this zone, if ever. ECF No. 256-1 ¶ 77. The vadose zone is defined as that area from the surface of the ground to the water table. Defendant's expert Dr. Melvin, although in disagreement about the time it would take for this nitrate to reach groundwater acknowledges that these nitrates below the effective rooting zone are "destined" to reach groundwater. ECF No. 228-1 ("Q: 'Once nitrate leaches below

(discussing recent post-harvest soil samples which demonstrate excess concentrations of nitrate in the Dairy's agricultural fields). Second, testimony by Dr. Melvin shows that even Defendants' expert agrees that the Dairy's applications were not agronomic. ECF Nos. 211-1 ¶ 80; 228-1 ("Q: Sir, do you believe that Cow Palace's applications of manure were agronomic? A: Not really. Q: So it is your opinion that they were not agronomic? A: At that time they weren't . . . .").

It should be noted that both parties agree that applying more manure nutrients to a crop that already has sufficient fertilizer is unnecessary and/or wasteful and will not necessarily result in a better crop yield. ECF Nos. 211-1 ¶ 79; 256-1 ¶ 79.

4. Lagoon Storage

Cow Palace Dairy stores the millions of gallons of liquid manure generated annually from its herd in a series of earthen impoundments, spanning just over 9 acres, which include four storage ponds, two settling basins, a safety debris basin, and several catch basins (collectively, "lagoons" or "impoundments"). ECF No.

---

the root zone of the crops it is destined to reach groundwater.' Do you disagree with that statement? A: Yes. Well let me put a time horizon on that. It takes a long time to get down there. Q: So 'destined,' the word, would you agree that its' destined at some point to reach groundwater? A: I suppose it is. Everything's got to be somewhere.").

226-1 (COWPAL000468); *see also* ECF No. 212 ¶ 16 (citing the EPA report, ECF No. 222-1, which estimates the lagoon surface area at 400,000 square feet, or 9.2 acres). In total, the Dairy has the capacity to store only approximately 40 million gallons. ECF No. 226-1 (COWPAL000468). During winter months, "when application may not be possible" due to environmental conditions, the DNMP estimates the Dairy needs at least 30 million gallons of available manure storage. *Id.* (COWPAL000474, -475, -479).

The Natural Resource Conservation Service ("NRCS"), within the United States Department of Agriculture, issues guidance for construction of storage lagoons, such as the Dairy's impoundments. The NRCS standards are merely guidelines, rather than legal requirements governing waste storage facilities. *See* ECF No. 190-11. Generally, NRCS standards recommend that storage lagoons and ponds be lined with any material, including compacted soil, so long as the lagoon meets certain permeability requirements.[10] ECF Nos. 190-1 ¶ 70; 286-1 ¶¶ 69-70. However, when an impoundment is placed above an aquifer—a practice not recommended unless there is no reasonable alternative—the NRCS standards suggest that "additional measures of safety from pond seepage," such as a clay or

---

[10] Under the AOC, Cow Palace is required to prove that each of its lagoons and storage ponds meet NRCS' permeability requirements. ECF No. 190-1 ¶ 71; *see* ECF No. 38-1 at 12.

synthetic liner, should be considered. ECF Nos. 211-1 ¶ 87; 256-1 ¶ 87. Underlying the Dairy's lagoons is an aquifer used for residential drinking water. ECF Nos. 211-1 ¶ 85; 256-1 ¶ 85 (highlighting that the aquifer is 30 to 190 feet below the ground).

Save for one lagoon, Defendants do not have complete documentation for each lagoon.[11] ECF No. 190-1 ¶ 78. However, Defendants admit that none of the Dairy's lagoons have a synthetic liner. ECF No. 181 ¶ 52. Although Cow Palace asserts that SYCD documentation demonstrates that it had a "*practice* of designing its lagoons and ponds in accordance with guidelines in place at the time," that Laurie Crowe of the SYCD inspected the lagoons and opined that they "*appeared*" to meet NRCS standards, and the DNMP states the lagoons meet NRCS standards, these assertions cannot be affirmatively established. ECF Nos. 190-1 ¶ 78 (emphasis added); 256-1 ¶ 86; 286-1 ¶ 78. For instance, although Lagoon 1 documentation suggests that the lagoon was "designed to have a bentonite clay liner," ECF No. 190-1 ¶ 80, it cannot be established that it was actually built with a clay liner or that the clay liner was reinstalled when this lagoon was deepened in the 1990s, ECF No. 286-1 ¶ 80.

---

[11] The Dairy has documentation demonstrating conformance with NRCS standards for Lagoon 4 only. ECF No. 228-2 (DAIRIES000910-11).

Conformance with NRCS standards aside, Plaintiffs have also presented evidence that the lagoons are not structurally sound. Although Defendants contend that Cow Palace "actively maintains its lagoons and storage ponds," ECF No. 190-1 ¶ 68, Mr. Boivin testified during his deposition that the lagoons at Cow Palace frequently dry and crack and have been subject to repeated freezing and thawing during the winter months. ECF No. 211-1 ¶ 90 (citing ECF No. 228-1). Further, Plaintiff's expert Mr. Erickson personally observed areas in the Dairy's lagoons that were substantially eroded and impacted by vegetation. *Id.* ¶ 91. Finally, when drilling nearby monitoring wells, personnel observed "bubbling" in one of the lagoons, which Plaintiffs contend signifies very permeable subsurface and discrete vertical flow paths. *Id.* ¶ 100; *see* ECF No. 256-1 ¶ 100 (failing to respond).

Plaintiffs' expert Mr. Erickson provided estimates of leakage for each lagoon. Due to lacking information, Mr. Erickson relied upon the following assumptions when calculating seepage: (1) for liner thickness, a compacted soil liner of one foot, which is the same thickness of the soil liner estimated by Defendants' lagoon expert, Mr. Trainor; (2) for the amount of liquid in each lagoon, a 50% figure; (3) for permeability of the soils compromising the liner, a permeability of 1 x 10-7 cm/s. ECF No. 211-1 ¶ 97 (citing ECF No. 212 ¶¶ 24, 27-

28). Using Darcy's Law,[12] Mr. Erickson made the following, purportedly conservative, leakage estimates from the Dairy's lagoons: (1) Lagoon 1: 3,830 gallons per day or 460,000 gallons per year; (2) Settling Basins: 564 gallons per day, or 200,000 gallons, per year, per basin; (3) Lagoon 2: 1,018 gallons per day, or 185,000 gallons per year; (4) Lagoon 3: 763 gallons per day, or 91,000 gallons

---

[12] "Darcy's Law is the principle that governs the fluid movement in lagoons and the subsurface." ECF No. 212 ¶ 20. According to Mr. Erickson, "[i]t is the equation that describes how fluid moves through porous media" and the Agricultural Waste Management Field Handbook ("AWMFH") uses a mathematical variation of the principle to determine seepage rates. *Id.* ¶¶ 19, 20. Defendants maintain that Darcy's Law is a tool used to compare lagoon designs rather than actual seepage rates and thus should not be used to estimate actual seepage. ECF No. 256-1 ¶ 93 ("In some cases, the total seepage from a pond may be of interest, particularly for larger ponds in highly environmentally sensitive environments. In those cases, more elaborate three-dimensional seepage computations using sophisticated-element computer programs may be warranted.") (quoting the AWMFH).

per year; (5) Lagoon 4: 416 gallons per day, or 50,600 gallons per year;[13] (6) NW Catch Basin: 831 gallons per day; (7) NE Catch Basin: 193 gallons per day; and (8) Pond: 6,777 gallons per day, or 2.47 million gallons per year. *Id.* ¶ 98 (citing ECF No. 212 ¶¶ 28, 34, 39, 43, 48, 64, 69, 74). Thus, according to Plaintiff's expert, the Dairy's lagoons leak, on an annual basis, millions of gallons of manure. Defendants dispute the reliability of these calculations based on the method used and assumptions made. ECF Nos. 256-1 ¶¶ 93, 94, 98; 256-8, ex. 6 (Rebuttal report of Defendants' expert, Michael Backe, agreeing that Mr. Erickson's calculations are "theoretically correct, but fundamentally flawed").[14] That being said, although the parties dispute the magnitude of leakage, the fact that the lagoons leak is not genuinely in dispute.

Plaintiffs also assert that borings drilled between two of the Dairy's lagoons—borings which found high levels of nitrate at depths as great as 18 feet, as well as ammonium and phosphorus—evidence horizontal seepage between the

---

[13] Mr. Erickson varied the liner permeability between 5.7 x 10-8 cm/sec and 8.84 x 10-7 cm/sec when calculating Lagoon 4 seepage rates based on actual laboratory testing of the lagoon permeability conducted in 2004. ECF No. 212 ¶¶ 46-48.

[14] In his deposition, Mr. Trainor agreed that, assuming a seepage flux of 1 x10-7 cm/s and a one-foot liner, the lagoons would leak 924 gallons of manure per day, per acre of lagoon. ECF No. 211-1 ¶ 97.d (citing ECF No. 229-2).

lagoons and possible impact on groundwater. ECF No. 212 ¶ 57. Although the manure constituent levels dropped below 18.2 feet, they were still present at depths as great as 47 feet. *Id.* Defendants' expert, Dr. Melvin, acknowledged that this evidence could indicate horizontal seepage from the lagoons and that such seepage could result in "some impact" on groundwater. ECF No. 211-1 ¶ 102 (citing ECF No. 228-1). Defendants dispute the significance of these findings and instead contend that nitrate penetration, although admittedly mobile in nature, is limited to the upper few feet of soil. ECF Nos. 256-1 ¶¶ 101-102; 256-3 (Rebuttal report of Defendants' expert, Dr. Melvin, concluding that there is "little or no nitrate leaching vertically to the groundwater that lies some 100 ft. + below the basins but there had been some horizontal migration between the two basins").

Plaintiffs also presented samples from beneath another dairy's nearby abandoned lagoon to provide further support for evidence of leakage from the lagoons.[15] Plaintiffs advanced two borings, the second one of which was advanced 45 feet, into an abandoned manure storage lagoon, a lagoon of similar design and construction as Cow Palace lagoons and above similar soil. ECF No. 212 ¶¶ 77-78. Sampling from these borings evidenced substantial concentrations of nitrate, phosphorus, and ammonium in the first two feet of underlying soil. *Id.* ¶¶ 82-83.

---

[15] To prevent any accidental contamination, this Court did not permit Plaintiffs to drill for soil samples beneath the Dairy's lagoons. *See* ECF No. 136.

While Mr. Erickson noted that levels of nitrate and phosphorus decline after the first two feet, he noted their presence, without other sources of such contaminants, indicates that the Haak Lagoon was a source of contamination. *Id.* ¶ 86. In addition, Mr. Erickson noted the presence of perched groundwater, which Plaintiffs interpret as providing direct evidence that preferential pathways of contaminate migration exist below the lagoon. ECF No. 211-1 ¶¶ 104-105. Defendants interpret this evidence as showing declining concentrations of nitrates and thus minimal, if any, contributions of nitrates to groundwater and further question the significance of the perched groundwater. ECF No. 256-1 ¶¶ 104-105.

Although Defendants dispute the rate of seepage and nitrate accumulation around and beneath the lagoons, the parties do not genuinely dispute that both events are occurring. Plaintiffs highlight testimony of Defendants' experts who conceded that the lagoons are "potentially" leaking and contributing "some amount of nitrate" to the environment but refused to admit the leakage was "significantly" contributing to groundwater contamination. ECF No. 211-1 ¶ 106 (citing Trainor deposition, ECF No. 229-2); *see* ECF No. 229-2 (deposition of Mr. Backe conceding, in response to whether the lagoons leak, that "[e]verything that has a hydraulic conductivity [a.k.a. permeability] term to it implies that there is flow through" and that he has never seen a study showing "there is no seepage from a lagoon").

5. Composting & Cow Pen Contamination

Cow Palace composts solid manure on natural, unlined soil. ECF Nos. 190-1 ¶ 91; 211-1 ¶ 108; 212 at ¶ 88. According to the DNMP, Cow Palace generates 35,000 tons of finished compost each year that is used for light orchard application. ECF No. 190-5, ex. 3 at 5. Plaintiffs contend the composting practice allows for manure constituents to seep out of the solid manure into the soil, with the leaching aided by the high moisture content of the manure. ECF No. 211-1 ¶ 109. During his site visit, Plaintiffs' expert Mr. Erickson observed high liquid content of the solid manure being composted. *Id.* ¶ 109. Plaintiffs' 18-foot core sample of the soil beneath the composting area indicated vertical migration of nitrate, ammonium, and phosphorus. *Id.* ¶¶ 110-11.

In response, Defendants contend that Plaintiffs' sample shows "rapid attenuation" of the manure constituents, and at any rate, the boring was merely advanced to 18 feet, not to the depth of the groundwater. ECF No. 256-1 ¶ 110. Moreover, Defendants justify its composting operation by explaining that it is referenced in its DNMP and is inspected by the Washington State Department of Agriculture. *Id.* ¶ 108. The DNMP provides that "[a]ny run-off . . . from the stockpiled manure will be controlled at all times by whatever means the dairy manager deems necessary. . ." ECF No. 190-5, ex. 3 at 5. Defendants have not identified any means used to control the wet manure from leaching nitrates straight to native ground during the composting process used to generate 35,000 tons of dried manure.

The Dairy's herd lives and is fed in open containment pens on unlined native soil. ECF No. 190 at 18. Plaintiffs contend such operations allow manure constituents to leach into the permeable soil, which statement they support with sampling conducted by both parties demonstrating high levels of nitrate in the soil underlying the cow pens. ECF No. 286 at 19 (citing ECF No. 286-5 ¶¶ 166-69). Although the parties dispute the extent of the contamination in the cow pens, Defendants acknowledge that manure "might seep through the soil surface." ECF No. 190-1 ¶ 90.

6. Evidence of Groundwater Contamination

There is no dispute that the groundwater at or near Cow Palace Dairy is contaminated. Data shows high levels of nitrate contamination, with many of the nitrate concentrations exceeding the maximum contaminant level, 10 mg/L, as established by the EPA. ECF Nos. 211-1 ¶ 113; 213-1, ex. C (summarizing groundwater data). It is Plaintiffs' contention that the nitrate in the manure at the Dairy, when not used by the crops as fertilizer and without conditions conducive to denitrification, migrates deeper into the soil, moving past crop root zones and eventually reaching groundwater. ECF No. 211-1 ¶ 114. As detailed above, Defendants maintain that denitrification is possible in the soils underlying the

Dairy; but even if the nitrate continued to migrate, it could take many decades to move through the vadose zone and finally reach the groundwater, if ever. ECF No. 256-1 ¶ 114.

The Dairy, located at the northern end of the Lower Yakima Valley, is bounded to the north by the basalt ridges of Rattlesnake Hills. ECF No. 211-1 ¶¶ 26, 30. There are two main aquifer types in the area: one deeper basalt aquifer underlying the sedimentary deposits and the other a relatively shallow alluvial aquifer. *Id.* ¶ 28. According to the U.S. Geological Service, the deeper aquifer is believed to be semi-isolated from the shallower aquifer, as well as local stream systems, and eventually discharges to the Columbia River. *Id.* ¶ 28. The shallower aquifer eventually discharges to the Yakima River, *id.* ¶ 28; however, it is contested where the aquifer and river meet, the amount of water the aquifer contributes to the River, and the water quality of the river at this intersection, ECF No. 256-1 ¶ 28.

The Valley's groundwater is influenced by a variety of sources. Precipitation is the primary source of groundwater recharge in the area, with most natural groundwater recharge occurring in the winter and early spring months. ECF No. 211-1 ¶ 29. Irrigation water, both from irrigation canals and application practices, also influences groundwater recharge, *id.*; however, Defendants contest whether the Dairy's activities affect the underlying aquifer, ECF No. 256-1 ¶ 56.

Sediments in the region greatly influence groundwater movement, with grain size affecting groundwater velocities. ECF No. 211 ¶ 30. Plaintiffs contend water movement through the sediments tends to follow preferential flow paths composed of coarse sediments; as a result, one well located along a preferential flow path may draw its water from a particular source, whereas a neighboring well, located along a different preferential flow path, may draw its water from a different source that has differing water chemistry.[16] *Id.*

In support of their contention that Defendants are contaminating the groundwater, Plaintiffs use data generated from the Dairy's AOC. The site model for the project shows nitrate contamination in the groundwater can originate from Cow Palace's unlined manure storage lagoons, manure land applications that exceed agronomic rates, and infiltration from the compost areas and confinement pens. *Id.* ¶ 114; *see* ECF No. 223 ¶ 55 (conceptualization of site model).[17] Because of the steep gradient in the topography in the area, which results in high groundwater flow, Plaintiffs focused on data generated from the monitoring wells. ECF No. 211-1 ¶¶ 120-24. Plaintiffs examined the following evidence to

---

[16] Defendants dispute the existence, or at least proof thereof, of any preferential pathways underlying the Dairy's operations. ECF No. 256-1 ¶ 30.

[17] Defendants assert that this model cannot be used as proof of any fact. ECF No. 256-1 ¶ 115.

determine whether the nitrates found in the groundwater are actually originating from Cow Palace Dairy: (1) the presence of tracer chemicals associated with cow manure, such as chloride, sodium, phosphorus, sulfate, magnesium, calcium, bicarbonate, and ammonia; (2) the presence of dairy-related pharmaceuticals found in the groundwater, such as monensin; (3) and any potential upgradient sources of nitrate contamination. *Id.* ¶¶ 116-18.

First, Plaintiffs presented evidence showing downgradient monitoring wells with high nitrate levels, with concentrations ranging from 5.8 mg/L to 234 mg/L, as well as tracer chemicals associated with cow manure. *Id.* ¶ 124. Second, EPA testing found that the same dairy-related pharmaceuticals, including monensin, in downgradient wells were also present in the Dairy's lagoons, manure piles, and application fields; monensin was not found in upgradient monitoring wells. *Id.* ¶ 117.[18] Finally, Plaintiffs located no major upgradient sources of nitrate, with the exception of a handful of agricultural fields. *Id.* ¶ 119. Plaintiffs determined these agricultural fields are not a likely major nitrate contributor given the relatively low nitrate concentrations observed in upgradient wells. *Id.* Further, upgradient wells showed small amounts of nitrate, ammonia, dairy pharmaceuticals, and other tracer

---

[18] According to Plaintiffs' expert, this antibiotic was first used on livestock in the United States in the 1970s. ECF No. 223 ¶ 58.

chemicals associated with cow manure, with the most representative of upgradient wells showing no impact by human-influenced sources. *Id.* ¶ 121. Plaintiffs' expert did recognize that two dairies, not party to the instant suit, may have applied manure to one of their few agricultural fields upgradient to Cow Palace. ECF No. 237, ex. 1 ¶¶ 188, 191(f).

Defendants greatly dispute the significance of the well data. First, Defendants fault Plaintiffs for not considering other sources of nitrate, such as the long history of irrigation in the Yakima Valley, septic systems, and upgradient agricultural sources. ECF No. 256-1 ¶ 116. In Defendants' view, the high nitrate levels, considering the depth of the vadose zone, is from an historical plume moving through rather than a new plume currently being created. *Id.* Second, Defendants contend that the results of pharmaceutical tracers are "mixed at best": some tracers were found in both upgradient and downgradient wells, in some cases the concentrations decreased downgradient of the dairies, and some were found in wells without nitrate. *Id.* ¶ 117.

Third, Defendants dispute that the wells analyzed by Plaintiffs are most representative or that they show any "significant contribution" from the Dairy. *Id.* ¶¶ 121-24. Regarding upgradient monitoring wells, Plaintiffs assert YVD-02 is the most appropriate upgradient well, whereas Defendants contend DC-01, which is immediately upgradient to the Dairy, is more appropriate. ECF Nos. 211-1 ¶ 121;

256-1 ¶ 121; *see* ECF No. 223 ¶ 65 (map depicting well locations). Plaintiffs chose YVD-02 because it has not been impacted by human-influenced sources; DC-01, on the other hand, is not fully hydrologically upgradient from Cow Palace Dairy and other sources of nitrogen loading. ECF Nos. 211-1 ¶¶ 121-122; 223 ¶ 61 (noting that although DC-01 is also identified as an upgradient monitoring well, that well is "approximately 220 feet lower in surface topographical elevation than YVD-02, and is likely influenced by some of the agricultural fields located above and upgradient of it"). Defendants' expert Mr. Trainor maintains that DC-01 is more representative because it provides contaminant inputs to the site from other upgradient sources. ECF No. 256-6.

Regarding downgradient monitoring wells, Plaintiffs provide data from a number of downgradient wells, YVD-09, YVD-10, YVD-14, YVD-15, DC-03, DC-03D, evidencing high nitrate levels from the Dairy's operations, as well as the other cluster dairies not party to this litigation. ECF No. 211-1 ¶ 124. Plaintiffs acknowledge that some downgradient wells show low nitrate levels, such as DC-07, but assert that these wells are influenced and diluted by cleaner water sources, such as excess irrigation water. *See* ECF No. 237-2 ¶¶ 222-23.

Finally, Defendants fault Plaintiffs for not demonstrating preferential pathways and for not establishing the time it would take for nitrate to reach groundwater from the Dairy. ECF No. 256-1 ¶ 126. Plaintiffs concede that the amount of time it would take for excess nitrate to reach groundwater is "highly variable." ECF No. 211-1 ¶ 125. That being said, they maintain that preferential pathways exist because of the differing densities of subsurface soils, which indicates nitrates may travel to groundwater via a shorter path in one location than it would in another. Thus, considering that conditions underneath Cow Palace are not conducive to denitrification, it is a "virtual certainty" that nitrate observed in the subsurface will reach groundwater. ECF Nos. 211-1 ¶ 125; 223 ¶ 48. Importantly, Defendants' experts do not dispute that nitrates may reach the groundwater, given sufficient water to help transport nitrates through the vadose zone; rather, they harp on the possibility that migration could take decades and that Plaintiffs have failed to establish the timeframe it would take. ECF Nos. 256-1 ¶ 126; 256-3, ex. 1 at 1. It is worth noting that Cow Palace Dairy has operated on this site for about 40 years. ECF No. 223 ¶ 105.

Regarding nitrate movement, Plaintiffs note, and Defendants do not dispute, that nitrate movement is determined by the rate of water movement, which in turn is influenced by the soil texture and amount of water escaping the root zone. As a result, the amount of water moving through the vadose zone of the agricultural fields is largely dependent on irrigation management; thus, Cow Palace's irrigation practices have a strong effect on the rate that water, and with it, nitrates, will move through the soil. ECF No. 211-1 ¶ 126; *see* 256-1 (failing to contest).

According to data obtained by both Defendants and the EPA, groundwater recharge can occur fairly rapidly.[19] First, water table elevation monitoring demonstrates that the water table fluctuates widely, in some instances by upwards of three feet over a ten-day period. ECF Nos. 211-1 ¶ 127; 223 ¶ 102. According to Plaintiffs' expert Dr. Shaw, these types of fluctuations would not be present if groundwater recharge were taking many decades. ECF Nos. 211-1 ¶ 127; 223 ¶ 102. Defendants' experts agreed that such water table variability means a seventy-year recharge estimate is probably not accurate, and that seasonal fluctuations in water table are evidence that seasonal surface activities are influencing groundwater. *See* ECF Nos. 228-1; 229-2.

Second, wide variability in groundwater temperature indicates that groundwater recharge is occurring fairly rapidly. According to Plaintiffs' expert Dr. Shaw, this variability in water temperatures would not be occurring if recharge were taking decades. ECF Nos. 211-1 ¶ 128; 223 ¶ 103. Defendants' expert, Dr.

---

[19] The EPA report opined that of the "approximately 312 to 367 tons of nitrate . . . at the three-foot depth . . . past the root zone," in the application fields of various dairies, including Cow Palace, "much of this nitrate will eventually end up in groundwater." ECF No. 229-2 (DAIRIES019335-336) (also noting that implementation of the consent order can help mitigate this issue).

Melvin, agrees that these temperature changes indicate that groundwater recharge is "probably" occurring more quickly than seventy years.[20] ECF No. 228-1.

Third, the presence of modern dairy-related pharmaceuticals such as those used at Cow Palace Dairy in downgradient groundwater provides further evidence that groundwater recharge can and is occurring rapidly. ECF Nos. 211-1 ¶ 129; 223 ¶ 104. Defendants' expert, Dr. Melvin, concedes that the presence of pharmaceuticals in groundwater is a "possible" indication that groundwater is younger than seventy years. ECF No. 228-1.

Fourth, EPA's age-dating of wells showed that the average age of groundwater was 31.6 years, age-dating that Dr. Melvin does not dispute. According to Plaintiffs' expert, Mr. Shaw, this is the average age of the water itself, not the date the water became contaminated. ECF Nos. 211-1 ¶ 130; 223 ¶ 105.

In sum, Plaintiffs suggest the contamination found in the groundwater, as evidenced by the well testing, along with evidence of relatively rapid recharging groundwater, demonstrates the Dairy's operations contribute to the current levels of contamination.

---

[20] Mr. Melvin's opinion that if could take up to seventy years for groundwater recharge is an estimate based on a model from his 1969 dissertation. ECF No. 228-1 (Melvin deposition discussing expert report and dissertation model).

Defendants overarching response to this evidence is that such groundwater recharge cannot quantify the Dairy's contribution to the contamination, so the significance of the Dairy's contribution remains a disputed issue of fact. ECF No. 256-1 ¶¶ 127-30. That being said, Defendants' experts concede that there is a "potential" that Cow Palace Dairy has some impact on groundwater and that it is "certainly possible" that the Dairy's manure applications could be the source of contaminants observed in nearby well water. ECF Nos. 211-1 ¶ 131; 229-2; *see* ECF No. 228-1 ("Q: "[I]s it more likely than not that Cow Palace could be the cause of this contamination? . . . A: Yes.").

7. Evidence of Surface Water Contamination

Plaintiffs also contend that the Dairy's operations are contributing to surface water contamination. In support, Plaintiffs highlight soil and area topography maps which show a strong drainage pattern running from northeast to southwest through the application fields with several intermittent or ephemeral streams present. ECF No. 211-1 ¶ 36. According to Plaintiffs, this creates a significant potential for runoff and pollution of downstream surface waters. *Id*. Further, Plaintiffs point to the interconnectedness of the contaminated shallow groundwater and nearby surface waters and cite to expert reports that agree the groundwater underlying the Dairy will eventually reach the Yakima River. ECF No. 286 (citing ECF No. 286-9). In response, Defendants dispute that there is any evidence of surface water runoff, but rather contend Cow Palace is specifically designed to prevent such occurrence, with catch basins to prevent any contaminated runoff from leaving the field. ECF Nos. 190-1 ¶¶ 94-100; 256-1 ¶ 36.

8. Adverse Health Effects

Plaintiffs' suit asserts that the Dairy's manure management practices present an imminent and substantial endangerment to public health because of the nitrate contamination in the groundwater. To help prevent adverse health effects, the EPA has set the maximum contaminant level for nitrates in drinking water at 10 mg/L. ECF No. 211-1 ¶¶ 133-34; 213 ¶ 6. Plaintiffs point to a number of health risks associated with exposure to nitrate, including both chronic exposure and exposure below the MCL, such as increased risk of various types of cancer, as well as hyperthyroidism and increased mortality from strokes and heart disease. ECF Nos. 211-1 ¶¶ 134-36; 213 ¶¶ 6-8. Exposure primarily occurs from consuming drinking water, cooking with water, brushing teeth, and ingesting water while bathing, showering, or using pools. ECF No. 211-1 ¶ 137.

The wells of some of Plaintiffs' members who live near the Dairy have levels of nitrate in excess of the EPA's MCL. ECF Nos. 211-1 ¶ 139; 213 ¶ 13 (noting that one standees' well showed nitrate levels as high as 64.6 mg/L). Further, Defendants' samples of 115 residences in the area, pursuant to the AOC, showed 66 residences exceeding the MCL. ECF Nos. 211-1 ¶ 140; 213 ¶ 15 (noting that two of these residences had nitrate levels which exceeded 50 mg/L).

In response, Defendants contend that Plaintiffs overstate the threat of nitrate exposure, that the MCL is set for the most sensitive members of the population, and that Plaintiffs fail to take into account dosage and sensitivity. ECF No. 256-1 ¶¶ 135-39. Most alarmingly, Defendants seem to suggest that because young infants in the area, the most sensitive population, are not currently suffering from methemoglobinemia, the risk of nitrate contamination in the groundwater is not great. *Id.* ¶¶ 134, 141.

Whether or not Plaintiffs have overstated the risk of nitrate contamination, it is worth noting that Defendants recently installed reverse osmosis units in all Dairy employee housing from which the employees would obtain their drinking water. ECF No. 211-1 ¶ 14 (citing deposition of Vern Carson, safety director for the Dolsen Companies, ECF No. 229-2).

9. Administrative Order on Consent

In response to a series in a local Yakima Valley newspaper, *Yakima Herald Republic*, discussing the issue of groundwater contamination in the region, the EPA sampled drinking water wells and potential sources of excess nitrate contamination in the area. ECF No. 200 at 2. From February through April 2010, the EPA collected samples from three possible sources—dairies, irrigated croplands, and residential septic systems—to investigate the contribution of various land uses to the high nitrate levels in groundwater. ECF No. 204-2. At the conclusion of its study, the EPA, acknowledging the study's limitations, ultimately determined that the cluster dairies, of which Cow Palace Dairy is a part, are the likely source of excess nitrate levels in the downgradient drinking-water wells, estimating that the dairies account for approximately 65 percent of the contamination. *Id.* (attributing 30 percent of the contamination to the irrigated croplands and 3 percent to the residential septic systems). The EPA published its final, revised report in March 2013. *Id.*

Around this time, Cow Palace Dairy entered into an Administrative Order on Consent ("AOC") with the EPA. ECF No. 190-1 ¶ 83; *see* ECF No. 38-1. The AOC sets forth a series of actions that the Dairy must take, including the following: (1) provide a permanent, safe alternative drinking water supply to residents with wells that exceed maximum contaminant levels within a one-mile radius (MCLs), (2) take specific actions to further control potential sources of nitrogen at the Dairy, (3) establish a network of monitoring wells to measure the effectiveness of the nitrogen source reduction actions, and (4) ensure effective nutrient management at the Dairy to reduce the introduction of nitrate to an underground source of drinking water. ECF No. 190-1 ¶ 85.[21]

The EPA recently issued an update in December 2014 to its AOC, concluding that data collected under the AOC supports its previous finding that the dairies, including Cow Palace Dairy, are the chief source of nitrate contamination in the area. ECF No. 305-4 at 8 ("Comparison of the nitrate levels in the upgradient monitoring wells with those along the downgradient edge of the Dairies properties indicate that there is heavy nitrate loading of the drinking water aquifer occurring within the Dairies' footprint."). Specifically regarding the level of contribution from the residential septic systems compared to the dairies, the EPA's update includes the following excerpt:

> Based on available information, the contribution from residential septic systems to nitrate contamination in the monitoring and residential drinking water wells downgradient of the Dairies is negligible. Livestock generate significantly more waste than humans. The amount of nitrogen generated by the 224 residential septic systems on and within one mile downgradient of these Dairies is insignificant relative to the amount of nitrogen produced by the Dairies. **A three-person residence generates about 30 pounds of nitrogen per year**. By comparison, the USDA Agricultural Waste Management Field Handbook estimates that **a single lactating cow produces about 1 pound of nitrogen per day or 365 pounds of nitrogen per year**. In 2009, the Dairies reported having more than 24,000 animals, not all of which are lactating cows. The total amount

---

[21] Plaintiffs contest whether these actions are sufficient to protect human health and the environment. ECF No. 286-1 ¶ 85.

> of nitrogen generated by these 224 residential septic systems is **less than one-tenth of one percent** of the total amount generated by these Dairies.

Id. (emphasis added). Cow Palace Dairy alone has more than 7,000 milking cows. ECF No. 220-1 (COWPAL002097).

B. Parties

Plaintiffs are two non-profit corporations, bringing suit on behalf of their organizations and individual members. Community Association for Restoration of the Environment ("CARE") is a public interest corporation dedicated to informing Washington state residents about activities that endanger the health, welfare, and quality of life for current and future residents. In furtherance of its mission, CARE serves as an advocate to protect and restore the economic, social, and environmental resources of the region. ECF No. 52 at 2-23. Center for Food Safety ("CFS") is also a public interest corporation, organized under the laws of Washington D.C., whose mission is to protect the environment and human health from harmful food production technologies, including the negative impacts of industrial agricultural technologies. ECF No. 49 at 3.

Plaintiffs are suing the following seemingly separate, but factually interrelated entities: Cow Palace, LLC, a Washington limited liability company, ECF No. 220 at 24; Three D Properties, LLC, a Washington limited liability company, ECF No. 220-1; and The Dolsen Companies, a Washington corporation, *id.*

Cow Palace has one member, The Dolsen Companies, and Bill Dolsen serves as the registered agent. ECF Nos. 181 at 4; 220 at 24. The Dairy's DNMP lists The Dolsen Companies as the owner/operator of the Dairy. ECF No. 226-1 (COWPAL000459). Bill Dolsen serves as the President, Chairman, and Director of The Dolsen Companies; Adam Dolsen serves as Vice President and Director. ECF No. 220-1. Three D Properties has one manager: Bill Dolsen. *Id.*

On November 7, 2013, several months after Plaintiffs commenced this action, Dolsen Companies transferred sixteen parcels to Cow Palace, parcels on which the Dairy operates. ECF No. 229-4. Cow Palace did not pay any money for this land, and neither company made any tax payments as a result of the transfer. ECF No. 281-1 ¶ 2. Three D owns approximately 50 percent of the land on which Cow Palace operates, including parcels previously owned by Adam Dolsen but also transferred on November 7, 2013. ECF Nos. 229-2; 229-4.

Upon careful review, it becomes readily apparent that these three entities are interconnected, with the Dolsens serving as the core and common link. Bill Dolsen, as manager of Three D and registered agent for Cow Palace, has primary authority for decisions involving real property acquisitions by Cow Palace and Three D. ECF No. 229-4. Although Mr. Boivin is the manager of the Dairy and "top person in charge" of operations, he "ultimately reports" to Bill Dolsen. ECF Nos. 281-2, ex.3, ex.6. For instance, shortly after there was a breach in one of the Dairy's lagoons from nearby drilling, Mr. Boivin contacted Bill Dolsen, who instructed Mr. Boivin to stop drilling. ECF No. 281-2, ex.3.[22] Employees at the Dairy understand Mr. Boivin to be one of their supervisors, and Bill Dolsen to be the "boss" of Mr. Boivin. ECF No. 281-2, ex. 7.

Both Dolsens met or spoke with Washington State Department of Agriculture and Secretary of Agriculture representatives on behalf of the Dairy. ECF Nos. 281-1 ¶ 14; 309 ¶ 14. Specifically regarding the Dairy's manure management practices, Adam and Bill Dolsen represented the Dairy in negotiations with the EPA. ECF No. 281-2, ex. 3, ex. 8. In fact, it was the Dolsens, along with Mr. Boivin, who made the final decision to accept the AOC the Dairy entered into with the EPA. ECF No. 281-2, ex. 8 ("Q: Who from Cow Palace was the principal who gave authorization to make settlement proposals to EPA? A: It was between myself and my father and Jeff Boivin. Q: Was it a collaboration among the three of you? A: Yes."). Adam Dolsen testified that he allowed EPA access to the Cow

---

[22] Similarly, Mr. Boivin contacted Adam Dolsen when there was a breach in one of the lagoons. ECF No. 281-2, ex. 8.

Palace site and worked with other dairies in implementing the AOC's requirements. ECF Nos. 281-1 at 6; 309 at 10.

Adam Dolsen has authority to fire managers of Cow Palace, authority which he shares with his father. ECF No. 281-2, ex. 8. Indeed, in his deposition, Adam Dolsen referred to these employees as "our employees."[23] *Id.* Defendants maintain that any actions that Adam Dolsen has taken with respect to the Dairy have been done in his capacity as President of Cow Palace, a position to which Bill Dolsen, as Manager of Cow Palace, appointed him. ECF Nos. 308 ¶ 4; 309 ¶ 18. However, Adam Dolsen's deposition reveals the following:

> Q: What is your title in the Dolsen Companies?
>
> A: Vice president.
>
> Q: As Vice president what are your decision-making powers?
>
> A: Just, I guess, depends on what the decision is.
>
> Q: What types of decisions are you involved in?
>
> A: Mostly employee-related decisions.
>
> Q: Hiring and firing?
>
> A. To some extent.
>
> Q: When you say employee, please define what you mean by that.

---

[23] Bill Dolsen similarly referred to the dairy employees as "work[ing] for us." ECF Nos. 281-2, ex. 3

A: Employee.

Q: Employee decisions, you said.

A: I make decisions that are relevant to the employees that are employed at Dolsen Companies.

Q: So does that include the Cow Palace?

A: Yes.

Q: Do you hire and fire at the Cow Palace?

A: I have hired people at the Cow Palace.

Q: Are you responsible for determining whether to fire someone at the Cow Palace?

A: Yes, but I guess it depends on who it is.

Q: If it’s a management person - -

A: Yes.

Q: -- is that your responsibility?

A: Yes.

Q: Do you share that responsibility with anyone else?

A: Yes.

Q: Who?

A: My father, HR, and depending on if there is a manager above them.

ECF No. 281-2, ex 8.

Dolsen Companies receives and maintains a number of records regarding the Dairy, including manure transfers, offsite manure applications, compost transfers, laboratory analyses of liquid manure samples, annual yields of crops grown on the Dairy's agricultural fields, as well as records of safety meetings, inspections, and incident reports involving injuries at the Dairy. ECF Nos. 229-2; 229-3. Mr. Boivin travels to the Dolsen Companies office once a month for these records. ECF No. 281-2. Further, several Dolsen Companies employees, including Bill and Adam Dolsen, perform numerous functions for the Dairy, including conducting meetings for the Dairy's employees focusing on OSHA compliance, equipment safety, and animal safety; overseeing corporate records, such as annual reports and tax returns; performing annual review and renewal of the Dairy's insurance policy; discussing financial implications of purchases and sales of major assets; reviewing monthly financial statements for the Dairy; making "employee-related decisions" such as hiring and firing Dairy employees; and meeting with management one or two times per month. ECF Nos. 229-2; 229-4. Finally, it was Adam and Bill Dolsen, along with Vern Carson, safety director for the Dolsen Companies, who made the decision to install reverse osmosis units in all Dairy employee housing around 2011 or 2012, from which the employees would obtain their drinking water. ECF No. 211-1 ¶¶ 14-15 (citing Carson deposition, ECF No. 229-2).

//

DISCUSSION

I. Standards of Review

A. Rule 12(b)(1) Dismissal

When addressing a motion to dismiss for lack of subject matter jurisdiction, the court is not bound by the plaintiff's factual allegations. Pursuant to Rule 12(b)(1), the Court "may 'hear evidence regarding jurisdiction' and 'resolv[e] factual disputes where necessary.'" *Robinson v. United States*, 586 F.3d 683, 685 (9th Cir. 2009) (quoting *Augustine v. United States*, 704 F.2d 1074, 1077 (9th Cir. 1983)). A Rule 12(b)(1) motion may be either facial, where the court's inquiry is limited to the allegations in the complaint; or factual, where the court may look beyond the complaint to consider extrinsic evidence. *Safe Air for Everyone v. Meyer*, 373 F.3d 1035, 1039 (9th Cir. 2004). "If the moving party converts 'the motion to dismiss into a factual motion by presenting affidavits or other evidence properly brought before the court, the party opposing the motion must furnish affidavits or other evidence necessary to satisfy its burden of establishing subject matter jurisdiction.'" *Wolfe v. Strankman*, 392 F.3d 358, 362 (9th Cir. 2004) (quoting *Safe Air*, 373 F.3d at 1039). Accordingly, in deciding jurisdictional issues, the court is not bound by the factual allegations within the complaint. *Augustine*, 704 F.2d at 1077.

//

B. Summary Judgment

Summary judgment may be granted to a moving party who demonstrates "that there is no genuine dispute as to any material fact and that the movant is entitled to judgment as a matter of law." Fed. R. Civ. P. 56(a). The moving party bears the initial burden of demonstrating the absence of any genuine issues of material fact. *Celotex Corp. v. Catrett*, 477 U.S. 317, 323 (1986). The burden then shifts to the non-moving party to identify specific facts showing there is a genuine issue of material fact. *See Anderson v. Liberty Lobby, Inc.*, 477 U.S. 242, 256 (1986). "The mere existence of a scintilla of evidence in support of the plaintiff's position will be insufficient; there must be evidence on which the [trier-of-fact] could reasonably find for the plaintiff." *Id.* at 252.

For purposes of summary judgment, a fact is "material" if it might affect the outcome of the suit under the governing law. *Id.* at 248. A dispute concerning any such fact is "genuine" only where the evidence is such that the trier-of-fact could find in favor of the non-moving party. *Id.* "[A] party opposing a properly supported motion for summary judgment " 'may not rest upon the mere allegations of denials of his pleading, but . . . must set forth specific facts showing that there is a genuine issue for trial.'" *Id.* at 248 (internal quotation marks and citation omitted); *see also First Nat'l Bank of Ariz. v. Cities Serv. Co.*, 391 U.S. 253, 288-89 (1968) (holding that a party is only entitled to proceed to trial if it presents sufficient, probative evidence supporting the claimed factual dispute, rather than resting on mere allegations). Moreover, "[c]onclusory, speculative testimony in affidavits and moving papers is insufficient to raise genuine issues of fact and defeat summary judgment. *Soremekun v. Thrify Payless, Inc.*, 509 F.3d 978, 984 (9th Cir. 2007). In ruling upon a summary judgment motion, a court must construe the facts, as well as all rational inferences therefrom, in the light most favorable to the non-moving party, *Scott v. Harris*, 550 U.S. 372, 378 (2007), and only evidence which would be admissible at trial may be considered. *Orr v. Bank of Am., NT & SA*, 285 F.3d 764, 773 (9th Cir. 2002).

II. Motion to Dismiss Pursuant to 12(b)(1)

Defendant Cow Palace moves to dismiss this action, pursuant to Rule 12(b)(1), asserting that Plaintiffs have failed to establish standing. ECF No. 209. Plaintiffs, asserting that there is no genuine dispute as to their standing, move this Court to grant summary judgment as to this issue. ECF No. 211.

To satisfy Article III's standing requirements, the plaintiff must show the following three elements: (1) the "plaintiff must have suffered an injury in fact—an invasion of a legally protected interest which is (a) concrete and particularized and (b) actual or imminent, not conjectural or hypothetical;" (2) there must be a "causal connection between the injury and the conduct complained of—the injury has to be "fairly traceable" to the challenged action of the defendant, and not the result of the independent action of some third party not before the court;" and (3) "it must be likely, as opposed to speculative, that the injury will be redressed by a favorable decision." *Lujan v. Defenders of Wildlife*, 504 U.S. 555, 560–61 (1992) (internal quotation marks and citations omitted). "An association has standing to bring suit on behalf of its members when its members would otherwise have standing to sue in their own right, the interests at stake are germane to the organization's purpose, and neither the claim asserted nor the relief requested requires the participation of individual members on the lawsuit." *Friends of the Earth, Inc. v. Laidlaw Envtl. Servs.*, 528 U.S. 167, 181 (2000).

Here, Defendant Cow Palace does not dispute that the interests at stake are germane to Plaintiffs' organizational interests, nor that personal participation by individual standees is unnecessary. Rather, the core of Defendant Cow Palace's challenge is whether any standee can establish individual standing.

This Court concludes that at least CARE has organizational standing to proceed.[24] First, considering CARE's organizational mission, the interests at stake in the action are germane to its organizational goals. Second, this case does not require the individual participation by each standee. Finally, CARE's individual members have standing to sue. Although Defendant Cow Palace greatly disputes

---

[24] Because CARE has standing, this Court need not address whether CFS also has Article III standing. *See Sierra Club v. EPA*, 762 F.3d 971, 978 (9th Cir. 2014).

that Plaintiffs have established the causation and redressability requirements of the standing doctrine, this Court is unconvinced.

First, Plaintiffs have sufficiently established that one or more of its members has suffered an injury in fact. Although Defendant Cow Palace states that "CARE fails to establish all three factors of the standing test," it fails to brief why the standees' purported harm does not satisfy the injury-in-fact requirement. ECF No. 209 at 11-12. To demonstrate that its individual members have suffered an injury-in-fact, Plaintiffs highlight the declarations of its members whose recreational and aesthetic interests in the Yakima River watershed are being adversely affected by manure pollution and whose health and property interests are adversely affected by nitrate contamination of their homes' well water. ECF No. 257 at 809; *see* ECF Nos. 50, 52, 53, 216, 218. For example, Helen Reddout, a member of CARE, declares that her recreational, aesthetic, health, and property interests are adversely affected by the Dairy's manure mismanagement. ECF No. 52. Ms. Reddout lives 1.5 miles downgradient from Cow Palace Dairy, obtains her drinking water from groundwater which is contaminated with levels of nitrate that exceed the MCL, has had to purchase bottled water as a result of the contamination, and is concerned about the health impacts from nitrate consumption. *Id.* at 7-8. Further, Ms. Reddout asserts that, because of the Dairy's alleged impact to the water quality of the Yakima River, she no longer swims or wades in the Yakima River, no longer gathers edible plants near the River, and no longer engages in bird watching. *Id.* at 4-7.

As demonstrated by the numerous statements presented by Plaintiffs, its members' recreational, aesthetic, health, and property interests present cognizable injuries for purposes of standing. Because Plaintiffs have sufficiently demonstrated that its members "use the affected area and are persons 'for whom the aesthetic and recreational values of the area will be lessened' by the challenged activity," *Laidlaw*, 528 U.S. at 183 (quoting *Sierra Club v. Morton*, 405 U.S. 727, 735 (1972)), they have documented injury in fact.

Second, with regards to causation, this Court finds that the standees' injuries are "fairly traceable" to the Dairy's operations. Defendant Cow Palace asserts that Plaintiffs have failed to support a causal connection between Cow Palace's management and handling of manure and the standees' injury. ECF No. 209 at 14-15 (asserting that standees neither state "with any degree of certainty that any of his or her alleged health problems was attributable to Cow Palace's conduct" nor can they trace their aesthetic and recreational injuries to Cow Palace's conduct). To support their contention that their members' injuries are fairly traceable to the Dairy's conduct, Plaintiffs cite to the upgradient, onsite, and downgradient nitrate sampling demonstrating that Cow Palace Dairy's manure application, storage, and management practices have contributed to nitrate contamination in the groundwater. ECF No. 257 at 11; *see* ECF No. 211-1 ¶¶ 116-124 (noting wells upgradient of Cow Palace Dairy had very little nitrate but wells downgradient showed high levels of nitrate and other tracers associated with cow manure). Plaintiffs contend they are not required to show the "particular manure pollution molecules" that are affecting standees originated from Cow Palace Dairy, a showing that is more demanding than that required to establish liability under RCRA; rather, they assert they have satisfied their burden by merely demonstrating there is manure leaking from the Dairy's operations into the groundwater and such manure pollution is causing or contributing to groundwater contamination and relatedly the standees' injuries. ECF No. 257 at 11.

Defendant Cow Palace's opening brief heavily relied on *Washington Environmental Council v. Bellon*, 732 F.3d 1131(9th Cir. 2013), in which standees were seeking to compel the state to regulate greenhouse gas emissions from several Washington oil refineries. As the Ninth Circuit held, the "chain of causality between Defendants' alleged misconduct and [plaintiff's] injuries is too attenuated" as it merely "consists of a series of links strung together by conclusory, generalized statements of contribution, without any plausible scientific or other evidentiary basis that the refineries' emissions are the source of their injuries." 732 F.3d at 1141-42. However, unlike in *Bellon* where the standees merely provided "vague, conclusory" statements about how the refineries' emissions would cause them injury, *id.* at 1142, Plaintiffs' standees provide specific statements of current and imminent harm to their recreational, aesthetic, health, and property interests. Further, unlike in *Bellon* where the standees attempted to show localized harm in the global climate change context, *id.* at 1143, Plaintiffs' standees are attributing harm to a confined valley of finite polluters with localized water pollution. Finally, unlike in *Bellon* where the Washington refineries' contributions to greenhouse gases was not meaningful in relation to worldwide emissions, *id.* at 1143-44, Plaintiffs' standees have presented convincing evidence demonstrating that the Dairy is a meaningful, although not sole, contributor to nitrate contamination in the area.

Plaintiffs here are not required to prove that the exact nitrate molecules from Cow Palace Dairy are contributing or causing the standees' injuries. As the Ninth Circuit has stated, "the threshold requirement of traceability does not mean that plaintiffs must show to a scientific certainty that defendant's effluent caused the precise harm suffered by the plaintiffs in order to establish standing." *Nat. Res. Def. Council v. Sw. Marine, Inc.*, 236 F.3d 985, 995 (9th Cir. 2000) (internal quotation marks and citations omitted). "[R]ather than pinpointing the origins of particular molecules, a plaintiff must merely show that a defendant discharges a pollutant that causes or contributes to the kinds of injuries alleged in the specific geographic area of concern." *Id.* (internal quotation marks and citations omitted).

As Plaintiffs aptly note, the underlying cause of action merely requires Plaintiffs to demonstrate that Defendants' practices have or are "contributing" to the pollution; not that Defendants conduct is the only cause or that, as established by a degree of certainty, the standees' injuries stem from Defendants' conduct. ECF No. 257 at 13. Courts cannot "raise the standing hurdle higher than necessary showing for success on the merits in an action." *Laidlaw*, 528 U.S. at 181. Thus, Defendant Cow Palace's contention, suggesting that Plaintiffs must demonstrate causation to a degree of certainty, a showing greater than required to establish liability under RCRA, is a threshold not mandated by the standing doctrine and one this Court declines to impose. Further, as previously stated by this District, the fact that other sources also contribute to pollution offers "no shield" to a defendant polluter; that is, a plaintiff need not sue every polluter but merely must show that the defendant caused a part of the injury. *CARE v. Bosma*, 65 F.Supp.2d 1129, 1141 (E.D. Wash. 1999), *aff'd*, 305 F.3d 943 (9th Cir. 2002).

Finally, with regards to redressability, this Court finds that a favorable ruling by this Court would surely provide at least some "incremental benefit," if not more, in addition to the measures already provided for in the AOC. Defendants assert that the AOC is already addressing any injuries alleged and even if the AOC provides narrower relief, Plaintiffs' have failed to establish how any "incremental benefit" from its additional demands for relief would address its members' injuries.

ECF No. 209 at 17. Plaintiffs assert that the relief they are seeking is broader than the AOC; thus, a ruling in their favor would likely help alleviate the alleged injury. ECF No. 257 at 16-20.

As previously stated in this Court's past Order Denying Defendant Cow Palace's Motion to Dismiss,[25] the relief "sought by CARE . . . differs from the requirements of the Consent Order in multiple areas," including immediately lining the lagoons and providing drinking water to residents within a more expansive, three-mile, down-gradient radius. ECF No. 72 at 18, 23. Thus, if Plaintiffs prevail and Cow Palace Dairy is ordered to line its lagoons, among other measures, contamination will decrease and Plaintiffs' injuries will be, at the very least, incrementally redressed.

This Court finds there is no genuine issue of material dispute as to Plaintiffs' standing; accordingly, Defendant Cow Palace's Motion to Dismiss (ECF No. 209) is **DENIED** and Plaintiffs' Motion for Summary Judgment (ECF No. 211), as to this issue, is **GRANTED**.

---

[25] This Court notes that Defendant Cow Palace already raised the issue of Plaintiffs' standing, as it relates to redressability, in a previous motion filed over one year ago. ECF No. 38 at 17-20 (contending that because Plaintiffs are seeking relief that has already been granted by the AOC, they fail to state a claim and, for the same reason, lack standing).

III. Evidentiary Issues

A. Daubert Motions

Expert witness testimony is governed by Federal Rule of Evidence 702, which provides:

> A witness who is qualified as an expert by knowledge, skill, experience, training, or education may testify in the form of an opinion or otherwise if: (a) the expert's scientific, technical, or other specialized knowledge will help the trier of fact to understand the evidence or to determine a fact in issue; (b) the testimony is based on sufficient facts or data; (c) the testimony is the product of reliable principles and methods; and (d) the expert has reliably applied the principles and methods to the facts of the case.

Fed. R. Evid. 702.

In Daubert v. Merrell Dow Pharmaceuticals, 509 U.S. 579, 597 (1993), the Supreme Court directed trial courts to perform a "gatekeeping" function to ensure that expert testimony conforms to Rule 702's admissibility requirements. The district court has "broad discretion in determining the admissibility of evidence and considerable leeway in determining the reliability of particular expert testimony." *Id.* When considering the admissibility of expert testimony, the court first determines whether the witness is "qualified as an expert by knowledge, skill, experience, training, or education," Fed. R. Evid. 702, and then examines whether the proffered testimony is both relevant and reliable, *Daubert*, 509 U.S. at 583.

Daubert identifies four non-exclusive factors a court may consider in assessing the relevance and reliability of expert testimony: (1) whether a theory or technique has been tested; (2) whether the theory or technique has been subjected to peer review and publication; (3) the known or potential error rate and the existence and maintenance of standards controlling the theory or technique's operation; and (4) the extent to which a known technique or theory has gained general acceptance within a relevant scientific community. *Id.* at 593-94. These factors are not to be applied as a "definitive checklist or test," but rather as guideposts which "may or may not be pertinent in assessing reliability, depending on the nature of the issue, the expert's particular expertise, and the subject of his testimony." *Kumho Tire Co., Ltd. v. Carmichael*, 526 U.S. 137, 150 (1999). The ultimate objective is to "make certain that an expert, whether basing testimony upon professional studies or personal experience, employs in the courtroom the same level of intellectual rigor that characterizes the practice of an expert in the relevant field." *Id.* at 152.

Plaintiffs move this Court to limit or exclude the testimony of Defendant Cow Palace's experts Mr. Stephen, Mr. Maul, and Mr. Backe. ECF Nos. 193, 202, 206. Defendant Cow Palace moves this Court to exclude any expert testimony that relies on the EPA's report, "Relation Between Nitrate in Water Wells in the Lower Yakima Valley, Washington." ECF No. 200.

i. Scott Stephen

Plaintiffs first move to exclude the testimony of Defendant Cow Palace's expert, Scott Stephen, a soil scientist. ECF No. 193.

First, Plaintiffs contest Mr. Stephen's qualification to testify in fields of hydrology, hydrogeology, or toxicology. Plaintiffs contend that Mr. Stephen, who holds only an undergraduate degree in soil science and no education, training, or experience in the fields of hydrology, hydrogeology, of toxicology, should not be permitted to offer opinions in these areas. *Id.* at 4. Specifically, Plaintiffs challenge Mr. Stephen's ability to opine as to "whether higher nitrates in subsoils cause higher nitrates in area water and wells, whether nitrates found below the root zone have the ability to leach further, whether there is water movement in Cow Palace fields below the root zone, the impact of manure on water quality, the extent of groundwater contamination, or the various pathways that nitrate can reach human populations" or to challenge a myriad of Dr. Shaw's conclusions. *Id.* at 5. Rather, according to Plaintiffs, Mr. Stephen's expertise is limited to "understanding the dynamics of soil as a medium for growing crops" and "[a]nything to do with soil and the cropping system." *Id.* at 4 (citing ECF No. 194-2).

Second, Plaintiffs challenge whether Mr. Stephen's opinions in the area of soil science are reliable. *Id.* at 6. Plaintiffs assert that Mr. Stephen's testimony should be limited to that of a fact witness, regarding the tasks he has been hired to perform for the Dairy, rather than as an expert on soil science. *Id.* at 9. In support, Plaintiffs assert the following:

- Mr. Stephen did not review all relevant records to reach his conclusion that the Dairy's manure should be characterized as a fertilizer, rather than a discarded material, *id.* at 7; *see* ECF No. 195-1 at 2 ("In my opinion, nothing within the Shaw report proves that Cow Palace was applying manure for any other purpose than for use as a fertilizer.");

- Mr. Stephen opined that there is no agreed-upon definition of "agronomic rate" but rather that each Dairy must make its own interpretations as how to implement its DNMP, an opinion Plaintiffs find particularly troubling considering Mr. Stephen was hired to help the Dairy implement its DNMP, ECF No. 193 at 7; *see* ECF No. 195-2 ("I think the guidance is there, but there's a lot of information to go through that can be complicated . . .");

- Although Mr. Stephen was retained to opine as to whether the Dairy's manure applications were agronomic, his knowledge of the manure applications only go back to the beginning of his tenure, which began in 2013, ECF No. 193 at 8;

- Mr. Stephen's opinions as to whether the Dairy agronomically applied manure do not account for residual nitrate in the soil, *id.*;

- Mr. Stephen has minimal experience, which primarily includes sampling-related responsibilities, has never authored any publications, has either never testified or has not testified within the last four years, and bases his opinions on reading materials, rather than experience, training, or education, *id.* at 8-9.

In defense of Mr. Stephen, Defendant Cow Palace maintains that Mr. Stephen is a university-educated and locally-trained soil scientist and thus a qualified expert.

First, Defendants assert that Plaintiffs have not objected to anything in Mr. Stephen's original report; thus, Mr. Stephen should be free to testify about opinions in his original report. ECF No. 244 at 5-6. Second, Defendants maintain that Mr. Stephen's report did not reach an opinion as to whether Cow Palace's past manure applications were agronomic, but when pushed to opine as to past practices in his deposition, he stated, based on his review of data only as far back as 2011, it would be "fair to say" Cow Palace's applications since that time have been agronomic. *Id.* at 6-7. Third, Defendants maintain that Mr. Stephen's opinions are admissible as a rebuttal to the opinions of Plaintiffs' expert, Dr. Shaw, rather than affirmative opinions that are designed to meet any relevant standard of scientific rigor. *Id.* at 7-9. Finally, Defendants contend that Mr. Stephen's education in soil science, soil physics, soil biology, environmental science, soil chemistry, and soil microbiology render him qualified to opine about nitrate migration below the root zone. *Id.* at 9-11.

This Court finds Mr. Stephen sufficiently qualified to testify as a soil expert in order to survive the Court's gatekeeping function pursuant to *Daubert*. As Defendant Cow Palace notes, Rule 702 is "broadly phrased and intended to embrace more than a narrow definition of qualified expert." *Hangarter v. Provident Life & Acc. Ins. Co*, 373 F.3d 998, 1015 (9th Cir. 2004) (quoting *Thomas v. Newton Int'l Enters.*, 42 F.3d 1266, 1269 (9th Cir. 1994)). Mr. Stephen's training and education is in soil physics, soil biology, environmental science, soil chemistry, and soil microbiology. ECF No. 195-2 at 10-11. Regarding his professional experience, Mr. Stephen has over 18 years of experience working as a Professional Consultant in his role as a soil scientist. ECF No. 194-2 at 2. He has years of practical experience "helping dairies use agronomic principles to achieve nutrient management goals" in the Yakima Valley. *Id.* Accordingly, Mr. Stephen is sufficiently qualified—given his knowledge, skill, and practical experience—to provide expert testimony about the nature of the nitrogen cycle, the use of manure as a fertilizer and soil conditioner, manure applications to soil, crop rotation, and nutrient management in regards to agronomic rate, and the current management of the Dairy under the AOC. *Id.* That being said, although Mr. Stephen is qualified to testify as a soil scientist, his opinions are limited to those that are within his relevant area of expertise; that is, although this Court recognizes that there may be some overlap in the soil science and hydrology/hydrogeologist disciplines, it appears Mr. Stephen is not qualified to testify about water movement through the vadose zone, the impact of manure constituents on water quality, the extent of groundwater contamination, or the various pathways that nitrate can reach human populations. *See* ECF No. 195-2.

This Court also finds Mr. Stephen's opinions sufficiently reliable and relevant that they are admissible in these proceedings. *See* Fed. R. Evid. 702 (allow scientific knowledge by a qualified expert if it will "assist the trier of fact to understand the evidence or to determine a fact in issue"). Mr. Stephen's opinions regarding agronomic application of manure are relevant to this case and Mr. Stephen's opinions are helpful given his practical training and experience in the Yakima area. Further, Mr. Stephen's opinions on whether the Dairy has agronomically applied manure since 2011, based on his review of relevant records and his personal knowledge of the Dairy's application since his tenure started in 2013, are relevant and will assist the Court. That being said, Plaintiff is free to examine and critique the accuracy of Mr. Stephen's opinions and the bases therefor to aid this Court's determination of what weight to give to his opinions.

ii. James Maul

Plaintiffs also move to exclude the testimony of Defendant Cow Palace's expert, James Maul, a hydrogeoloist and licensed geologist. ECF No. 202.

First, Plaintiffs challenge Mr. Maul's opinions as unreliable regarding his critiques of the EPA Report, Dr. Shaw's report, and Mr. Erickson's report. *Id.* at 3. In support, Plaintiffs assert that Mr. Maul failed to consider all available data before forming his opinions. *Id.* For instance, Mr. Maul admitted that he had only reviewed some of the available data—such as results of groundwater monitoring wells around the Dairy, U.S. Geological Survey information about the depth of the aquifer underlying the Dairy, and the first two phases of the EPA's investigation upon which its final report was predicated—when determining whether the Dairy was contributing to nitrate contamination. *Id.* at 4-6.

Second, Plaintiffs challenge Mr. Maul's qualification to opine as to certain topics. Specifically, Plaintiffs challenge whether Mr. Maul is qualified to opine as to whether historical agricultural practices are the source of current contamination. *Id.* at 7-8. Further, Plaintiffs challenge Mr. Maul's qualification to opine about the public health impacts of nitrate exposure. *Id.* at 9.

In defense, Defendant Cow Palace maintains that Mr. Maul is a qualified expert whose opinion is based on sufficient facts and data. Given his experience and specialized knowledge, Defendant Cow Palace asserts that Mr. Maul is qualified to examine the reliability of the EPA's report and the expert testimony that relies upon its data and findings. ECF No. 277 at 4-5. Further, Defendant Cow Palace maintains that Mr. Maul's testimony is based on his education and training, extensive experience, and review of relevant documents. *Id.* at 6. Defendant Cow Palace maintains that Mr. Maul's task was merely to determine whether the EPA collected sufficient data to support its conclusions, not to independently review all of the data himself, develop his own site model, and affirmatively disprove each of EPA's conclusions. *Id.* at 6-7. As such, Defendant Cow Palace asserts that Mr. Maul should be permitted to refute the EPA report and, relatedly, the basis for Plaintiffs' conclusions. *Id.* at 8.

This Court finds that Mr. Maul is sufficiently qualified to testify as an expert hydrogeologist in order to pass through the Court's gatekeeping function. Mr. Maul was educated as a geologist, has thirty years of practical experience as a hydrogeologist, and is currently licensed in the state of Washington. ECF No. 278 at 1-2. Throughout this tenure, Mr. Maul has participated and overseen numerous "projects designed to identify sources of particular contaminants." *Id.* at 2. Specifically, he has worked on a number of projects with EPA oversight and is thus familiar with the standard procedures that should be followed and data collected. *Id.* Accordingly, Mr. Maul is sufficiently qualified to opine as to the reliability and sufficiency of the EPA report. ECF No. 203-1 at 1. That being said, Mr. Maul is not a toxicologist and thus is not qualified to assess the accuracy of the EPA report, as it touches on public health impacts of nitrate contamination. Although Mr. Maul may opine that the Report is scientifically unreliable, in general, he is not qualified to assess its reliability in areas outside of his expertise, such as toxicology.

This Court also finds Mr. Maul's opinions sufficiently reliable and relevant to these proceedings. *See* Fed. R. Evid. 702 (permitting scientific knowledge by a qualified expert if it will "assist the trier of fact to understand the evidence or to determine a fact in issue"). Defendant Cow Palace hired Mr. Maul specifically to assess the reliability of the EPA report and determine whether sufficient data supports its conclusions. Although Plaintiff faults Mr. Maul for not reviewing and independently verifying all the available data underlying EPA's report, Rule 702 does not espouse such a high standard. Moreover, Plaintiffs' objection loses sight of Mr. Maul's limited expert role in critiquing the overall reliability of the Report based on methods used and data supporting its conclusions. This Court recognizes the limited bases for Mr. Maul's opinions, such as the fact that "[d]ata collected after the EPA drafted the Report is not relevant to Mr. Maul's task," ECF No. 277 at 6, and so will consider that limited bases when weighing his testimony with the other available and relevant evidence.

iii. Michael Backe

Plaintiff also seeks to exclude testimony of Defendant Cow Palace's expert, Michael Backe, a hydrogeologist. ECF No. 206. Specifically, Plaintiffs seek to exclude testimony critiquing Mr. Erickson's estimation of the amount of waste leaking from the Dairy's lagoons and reporting results of soil and water testing conducted at the two neighboring properties of Plaintiffs' standees. *Id.* at 2.

First, Plaintiffs challenge Mr. Backe's analysis as lacking rigor and failing to comport with scientific method. *Id.* at 4. Plaintiffs fault Mr. Backe for failing to review all relevant data before offering his rebuttal opinion as to Mr. Erickson's seepage estimates. *Id.* at 4-6. For instance, although Mr. Backe criticized Mr. Erickson's assumptions regarding the thickness of the lagoon liners, he acknowledged that he did not look at data relevant to determine the liner thickness, data relevant to conductivity for soils in the region, data relevant to determining soil permeability, or information about the impacts of well drilling. ECF No. 282 at 2-3. Further, although Mr. Backe opined that a "water balance method" would be a more reliable way to determine seepage, neither Mr. Backe or any other expert performed any water balancing testing. ECF No. 206 at 7.

Second, Plaintiffs challenge Mr. Backe's "observations" of the standees' properties as irrelevant and unhelpful. *Id.* Specifically, Mr. Backe reported the results of nitrate detected in sampling at the standees' properties but failed to offer any perspective on what the sampling indicates. *Id.* at 8; *see* ECF No. 208 ("I did not make any evaluation as to what they mean other than just reporting what we found.").

In response, Defendant Cow Palace maintains Mr. Backe's opinions are sufficiently reliable and relevant to this matter. Regarding Plaintiffs' argument that Mr. Backe failed to review all available data, as well as gather his own data to support the assertion that a water balance method is more reliable, Defendant Cow Palace asserts that Mr. Backe's role as a rebuttal expert is merely to disprove Plaintiffs' conclusions. ECF No. 236 at 4-6. Regarding the relevance of Mr. Backe's testimony about the results of his inspections of the standees' properties, Defendant Cow Palace asserts that such testimony is relevant to show the existence of nitrates from sources other than the Dairy. *Id.* at 8-10.

This Court finds Mr. Backe's opinions are sufficiently reliable and relevant to this matter in order to pass through the gatekeeping function this Court must apply. Again, Plaintiffs fault Defendants' expert for not reviewing all available data or coming to conclusions based on their own data, but Rule 702 does not set such a demanding standard. As one of Defendants' experts, Mr. Backe was assigned to rebut the assumptions, data, and findings of Plaintiffs' expert Mr. Erickson. ECF No. 207-1. Although Mr. Backe must be sufficiently qualified to provide this testimony and his testimony must be relevant and helpful to the trier of fact, he need not develop alternative, affirmative opinions in order to adequately rebut the evidence presented by Plaintiffs—that is not Defendants' burden. That being said, this Court recognizes the limited bases for Mr. Backe's rebuttal opinions regarding Mr. Erickson's findings and so considers that limited bases when weighing his testimony with the other available and relevant evidence.

Regarding Mr. Backe's testimony about the results of soil samples taken from the standees' nearby properties, this Court determines Mr. Backe's findings are relevant to whether the Dairy is or has contributed to the nitrate contamination in the groundwater. Although Plaintiffs suggest that Mr. Backe did not opine as to the meaning of these results, his expert rebuttal report explicitly states that "[t]he presence of [nitrate and other chemicals at the standees' properties] are likely the result of both individual and regional agricultural historical practices throughout the Lower Yakima Valley." *Id.* at 20. As such, although the evidence may have limited value considering RCRA's standard, the testimony helps rebut Plaintiffs assertion that the Dairy is contributing to the nitrate contamination in the area.

Accordingly, this Court declines to categorically exclude the testimony of Messrs. Stephen, Maul, or Backe; however, their testimony may be of limited value, as indicated above.

iv. Expert Testimony Relying on EPA Report

Defendant Cow Palace moves to exclude all expert testimony that relies on the EPA Report, "Relation Between Nitrate in Water Wells in the Lower Yakima Valley, Washington." ECF No. 200. Generally, Defendant Cow Palace challenges the report as not meeting *Daubert's* reliability standards because the techniques and methods used are not scientifically sound, cannot be independently verified, were not subject to meaningful peer review, and have an unknown error rate. *Id.* at 6-15.

In defense, Plaintiffs maintain that the report, upon which Dr. Shaw's, Dr. Lawrence's, and Mr. Erickson's testimony relies, should not be excluded. ECF No. 250. First, Defendant Cow Palace failed to identify the testimony it seeks to exclude; instead, it attacks the reliability of the report in general and asks the Court to sift through the hundreds of pages of expert report materials to determine which testimony should be excluded. *Id.* at 4. Second, Plaintiffs reassert their previous *Daubert* Motion contending that Mr. Maul's opinions, opinions upon which Defendant Cow Palace's motion primarily relies, are unreliable. *Id.* at 5. Third, Plaintiffs contend that this Court should give the EPA report deference given that it is a scientific determination of a federal agency within its expertise. *Id.* at 8-9. Finally, Plaintiffs contend that the *Daubert* reliability factors are inapplicable to the Report. *Id.* at 10-12.

This Court finds Plaintiffs' experts' testimony, which relies in part on the EPA report, is reliable. As an initial matter, Rule 702 and *Daubert's* flexible checklist of reliability factors provide guidance to the court when assessing whether, in general, the reasoning or methodology underlying the testimony is reliable. Specific to experts Erickson, Lawrence, and Shaw, the Court acknowledges that the EPA report is only one publication and data set upon which these experts rely. *Id.* at 10 (noting that these experts also relied on the well data provided under the AOC). Further, the *Daubert* factors are meant to provide a helpful, not definitive, checklist when determining the reliability of expert testimony. *See Kumho Tire Co.*, 526 U.S. at 151. Even so, the EPA report expressly qualifies its findings based on the assumptions made; like other government reports, the EPA Report's verification process is aided by agency review and public comment; and finally, considering the report is a compilation of the EPA's technical analysis, judgments, and findings "based on an evaluation of complex scientific data within the agency's technical expertise," *see Envtl. Def. Ctr., Inc. v. EPA*, 344 F.3d 832, 869 (9th Cir. 2003), this Court finds some level of deference to its reliability is warranted. *See Chem. Mfrs. Ass'n v. EPA*, 919 F.2d 158, 167 (D.C. Cir. 1990) ("It is not the role of courts to second-guess the scientific judgments of the EPA, and [courts] give considerable latitude to the EPA in drawing conclusions from scientific and technological research, even where it is imperfect or preliminary.") (internal quotation marks and citations omitted). Accordingly, this Court declines to exclude the expert testimony of Plaintiffs' experts who rely, in part, upon some of the underlying data from the EPA report.

B. EPA Report

Defendant Cow Palace seeks to exclude the EPA report itself, in addition to any expert testimony that relies on it, as unfairly prejudicial under the evidentiary rules. ECF No. 200 at 16. Pursuant to Federal Rule of Evidence 403, a "court may exclude relevant evidence if its probative value is substantially outweighed by a danger of . . . unfair prejudice. . . ." Fed. R. Evid. 403. In support of its motion, Defendant Cow Palace contends that, because the science underlying the report is so flawed, its admission would prejudice an inquiry into whether the Dairy is a likely source of contamination in the groundwater. ECF No. 200 at 16. In response, Plaintiffs highlight that Rule 403 maintains a limited role in a bench trial, Defendant Cow Palace's criticisms of the Report are unfounded, and Defendant Cow Palace has failed to explain what unfair prejudice it will suffer.

As Plaintiffs aptly note, Rule 403 has a limited role, if any, in a bench trial. *See E.E.O.C. v. Farmer Bros. Co.*, 31 F.3d 891, 898 (9th Cir. 1994) (citing *Gulf States Utils. Co. v. Ecodyne Corp.*, 635 F.2d 517, 519 (5th Cir. 1981) (noting that excluding relevant evidence in a bench trial is an illogical and "useless procedure" because a judge in a bench trial can exclude any improper inferences from certain evidence in reaching a decision). Although this Court acknowledges the possibility of bias that the EPA report might represent, it is only a portion of what Plaintiffs rely on to demonstrate that the Dairy is contributing to the nitrate contamination in the groundwater. Accordingly, this Court does not find that its probative value is substantially outweighed by the danger of unfair prejudice.

C. Motion to Strike Undisclosed Testimony

In the final evidentiary motion before the Court, Defendant Cow Palace moves to strike certain testimony of Dr. Shaw, Mr. Erickson, and Dr. Lawrence, which it asserts were not timely disclosed. ECF No. 237. Pursuant to Federal Rule of Civil Procedure 26(a)(2), an expert's written report must contain "a complete statement of all opinions the witness will express and the basis and reasons for them." Fed. R. Civ. P. 26(a)(2)(B)(i). Further, "[a] party must make these disclosures at the times and in the sequence that the court orders." *Id.* at 26(a)(2)(D). "If a party fails to provide information or identify a witness as required by Rule 26(a) or (e), the party is not allowed to use that information or witness to supply evidence on a motion, at a hearing, or at a trial, unless the failure was substantially justified or harmless." *Id.* at 37(c)(1).

Defendant Cow Palace faults Plaintiffs for offering new and previously undisclosed expert testimony for the first time in their Motion for Summary Judgment. ECF No. 237 at 4. Although the deadlines to submit expert reports and rebuttal reports was, respectively, September 22, 2014, and October 20, 2014, Plaintiffs filed new declarations from Dr. Shaw, Mr. Erickson, and Dr. Lawrence on November 17 and 18 in support of their Motion for Summary Judgment. *Id.* at 3.

The Court has thoroughly reviewed the submissions by both parties and cannot conclude that Defendant Cow Palace was in any way harmed or prejudiced by these allegedly undisclosed opinions. The opinions expressed in the declarations contain similar, sometimes verbatim, recitations of what was expressed in the original expert reports. *Compare* ECF No. 237-2 ¶ 180 ("These studies indicate that the likely source of high nitrates is most closely tied to recent agricultural activities."), *with* ECF No. 241 ¶ 52 ("These studies indicate that the likely source of high nitrates is most closely tied to recent agricultural activities.").

However, even when the declaration varied the wording of the opinion, there can be no doubt that Defendants were on notice of the experts' opinions and the basis for each. *Compare* ECF No. 237-2 ¶ 20 (Dr. Shaw characterized the Dairy's manure applications as exceeding "agronomic rates"), *with* ECF No. 240 ¶ 19 (Dr. Shaw characterized the Dairy's manure applications as done "without regard to crop fertilization needs"). Although the Court acknowledges there were a few instances in which the material cited in the declarations could not be found in the original expert report, this information either came from Cow Palace's own records or was discussed in the experts' depositions and thus Cow Palace had the opportunity to question the witnesses on these issues. Because Defendant Cow Palace has failed to show how it has suffered any harm or prejudice because of the purportedly new opinions presented in Plaintiff's experts' declarations, Fed. R. Civ. P. 37(c)(1), this Court declines to strike any of this testimony.

IV. Cross Motions for Summary Judgment

Defendants move for summary judgment on all Plaintiffs' claims as against all Defendants. ECF Nos. 190, 191. Plaintiffs move for summary judgment on the following RCRA issues: (1) animal waste that is over-applied onto soil and that leaks into groundwater is a "solid waste" under RCRA; (2) conditions at Cow Palace Dairy exist that may cause or contribute to an imminent and substantial endangerment; (3) conditions at Cow Palace Dairy exist that violate RCRA's ban on open dumping; and (4) all named Defendants are responsible parties under RCRA. ECF No. 211 at 3.

A. Resource Conservation and Recovery Act

"[The Resource Conservation and Recovery Act] is a comprehensive statute that governs the treatment, storage, and disposal of solid and hazardous waste… so as to minimize the present and future threat to human health and the environment." *Meghrig v. KFC Western, Inc.*, 516 U.S. 479, 483 (1996) (internal quotation marks and citation omitted). Congress enacted RCRA to, in part, ensure that waste that is unavoidably generated is "treated, stored, or disposed of so as to minimize the present and future threat to human health and the environment." 42 U.S.C. § 6902(b). Although the EPA maintains primary responsibility for enforcing the provisions of RCRA, the statute provides for "citizen suits" against persons who allegedly violate its requirements. *Id.* § 6972.

Plaintiffs are seeking to hold Defendants liable under two of RCRA's provisions.[26] First, RCRA outlaws the disposal of solid waste in a manner that constitutes "open dumping." *Id.* § 6945(a). Second, RCRA prohibits any person

---

[26] The parties do not contest that Plaintiffs have satisfied RCRA's pre-suit requirements under 42 U.S.C. § 6972(b)(2)(A), and that there is no state or federal RCRA proceedings that would preclude Plaintiffs' action under 42 U.S.C. § 6972(b)(1)(B), (b)(2)(B), (b)(2)(C).

from causing or contributing to the creation of an imminent and substantial endangerment to human health or the environment. *Id.* § 6972(a)(1)(B). Plaintiffs contend that Defendants' handling, storage, and disposal of manure has contributed to an imminent and substantial endangerment to human health and the environment and violated RCRA's ban on "open dumping."

1. Imminent and Substantial Endangerment

The imminent and substantial endangerment provision of RCRA provides that a civil action may be commenced against "any person . . . who has contributed or who is contributing to the past or present handling, storage, treatment, transportation, or disposal of any solid or hazardous waste which may present an imminent and substantial endangerment to health or the environment." *Id.* § 6972(a)(1)(B). To establish liability, Plaintiffs must demonstrate the following: (1) a "person," as defined under RCRA, has "contributed" or "is contributing" to, (2) the "past or present handling, storage, treatment, transportation, or disposal of" any "solid or hazardous waste," and (3) the waste in question "may present an imminent and substantial endangerment to health or the environment." *See Ecol. Rights Found. v. Pac. Gas & Elec. Co.*, 713 F.3d 502, 514 (9th Cir. 2013) (citation omitted).

//

//

2. Open Dumping

A civil action may also be brought against "any person . . . who is alleged to be in violation of any permit, standard, regulation, condition, requirement, prohibition, or order which has become effective" under RCRA. 42 U.S.C. § 6972(a)(1)(A). RCRA prohibits "any solid waste management practice or disposal of solid waste . . . which constitutes the open dumping of solid waste." *Id.* § 6945(a). In turn, RCRA defines "open dump" as "any facility or site where solid waste is disposed of which is not a sanitary landfill which meets the criteria promulgated under section 6944 of this title and which is not a facility for disposal of hazardous waste." *Id.* § 6903(14). Further, "disposal" is defined as "the discharge, deposit, injection, dumping, spilling, leaking, or placing of any solid waste or hazardous waste into or on any land or water so that such solid waste . . . or any constituent thereof may enter the environment or be emitted into the air or discharged into any waters, including ground waters." *Id.* § 6903(3).

The EPA promulgated criteria to clarify what practices may violate RCRA's open dumping prohibition. 40 C.F.R. pt. 257. The regulations state that a facility cannot "contaminate an underground drinking water source beyond the solid waste boundary." *Id.* § 257.3-4(a). In turn, EPA defines "contaminate" to mean introducing a substance that would cause a substance in the groundwater to exceed the maximum contaminant level ("MCL") or increase existing MCL exceedance.

Id. § 257.3-4(c)(2)(i)-(ii). The EPA has set the MCL for nitrates at 10 mg/L. *Id.* § 141.62.

The parties do not dispute that the Dairy is neither a qualified landfill nor a facility for the disposal of hazardous waste. Thus, to prevail on their open dumping claim, Plaintiffs must establish the following: (1) a solid waste is managed or disposed at the Dairy (2) that "contaminates" an "underground drinking water source"[27] (3) beyond the solid waste boundary. *See S. Road Assocs. v. Int'l Bus. Machines Corp.*, 216 F.3d 251, 257 (2d. Cir. 2000); *see also Parker v. Scrap Metal Processors, Inc.*, 386 F.3d 993, 1012 (11th Cir. 2004).

Accordingly, because of the substantial overlap in these two claims, this Court's analysis will proceed as follows: (1) whether the manure at the Dairy, when over-applied to land, stored in lagoons that leak, and managed on unlined, permeable soil surfaces, constitutes the "handling, storage, treatment, transportation, or disposal of . . . solid waste;" (2) whether the manure

---

[27] There is no dispute that groundwater is an "underground drinking water source." 40 C.F.R. § 257.3-4(c)(4), nor that the MCL for nitrate is 10 mg/L, *id.* § 141.62. Plaintiffs' brief does not address whether the Dairy's practices also contaminate surface water, as defined under EPA regulations, *see* ECF No. 211 at 11-13, 27-28; therefore, this Court's analysis of their open dumping claim is limited to an analysis of the Dairy's alleged contamination of groundwater.

"contaminates" the groundwater or surface water, and relatedly whether this water is "beyond the solid waste boundary;" (3) whether, if the nitrates are reaching water, this contamination is posing an "imminent and substantial endangerment" to human health or the environment; and (4) whether the Defendants are all responsible parties under RCRA.

3. Whether Defendants' Manure Can be Characterized as a "Solid Waste" Under RCRA

Under RCRA, the definition of "solid waste" includes "any garbage, refuse, . . . and other *discarded material*, including solid, liquid, semisolid or contained gaseous material resulting from … agricultural operations…." 42 U.S.C. § 6903(27) (emphasis added). Although RCRA does not define "discarded material," the Ninth Circuit has interpreted the term according to its ordinary meaning, as "to cast aside; reject; abandon; give up." *Safe Air*, 373 F.3d at 1041.[28]

---

[28] Further, the court in *Safe Air* found the reasoning of several extra-circuit cases persuasive in identifying whether a material qualifies as "solid waste," particularly "(1) whether the material is 'destined for beneficial reuse or recycling in a continuous process by the generating industry itself;' (2) whether the materials are being actively reused, or whether they merely have the potential of being reused; (3) whether the materials are reused by its original owner, as opposed to use by a salvager or reclaimer." *Id*. at 1043 (internal citations omitted).

As the Ninth Circuit has recently articulated, in reference to RCRA's legislative history, "[t]he key to whether a manufactured product is a 'solid waste,' then, is whether that product 'has served its intended purpose and is no longer wanted by the consumer.'" *Ecological Rights*, 713 F.3d at 515 (*citing* H.R. Rep. No. 94-1491(I) at 2 (1976)). Specifically with regards to manure, both RCRA's legislative history and EPA's supporting regulations explicitly state that RCRA's provisions do not apply to agricultural wastes, but only to the extent the wastes are "returned to the soil as fertilizers or soil conditions." 40 C.F.R. § 257.1(c)(1) (EPA regulations stating that RCRA provisions "do not apply to agricultural wastes, including manure and crop residues, returned to the soil as fertilizers or soil conditions"); *see Safe Air*, 373 F.3d at 1045-46 (noting that RCRA's legislative history explicitly states that "[a]gricultural wastes which are returned to the soil as fertilizers or soil conditioners are not considered discarded materials") (citing H.R. Rep. No. 94-1491(I) at 2 (1976), reprinted in 1976 U.S.C.C.A.N. 6238, 6240).

In its July 2013 Order Denying Defendants' Motion to Dismiss, this Court found that manure could plausibly be considered "solid waste"—as a legal matter—when it is over-applied to fields and managed and stored in ways that allow it to leak into the soil because at that point, the manure is no longer "useful" or "beneficial" as a fertilizer. ECF No. 72 at 11. In so finding, this Court declined to adopt Defendants' blanket interpretation that manure, used as a fertilizer, can *never* be considered a "solid waste" under RCRA. Rather, this Court determined that the issue of whether manure can be considered a solid waste hinges, factually, on whether the manure is handled and used in such a manner that its usefulness as a fertilizer is eliminated. In so deciding, this Court acknowledged the practical ramifications of determining when manure becomes "discarded" or ceases to be "useful or beneficial," *see Safe Air*, 373 F.3d at 1042; *Ecological Rights*, 713 F.3d at 515, as well as the express declarations of Congress and the EPA that RCRA does not apply to agricultural wastes "returned to the soil as fertilizers," *see Safe Air*, 373 F.3d at 1045-46.

At that early stage in the proceedings, considering Plaintiffs' allegations that Defendants applied manure in amounts well beyond what the crop would use as a fertilizer, this Court could envision circumstances that manure, although generally a useful fertilizer, could be used or handled in a way that its otherwise useful purpose as a fertilizer was eliminated or disregarded and thus transformed into a discarded material. As aptly stated by the court in *Water Keeper Alliance, Inc. v. Smithfield Foods, Inc.*, "no blanket animal waste exception excludes animal waste from the 'solid waste' definition. Instead, the determination of whether defendants 'return' animal waste to the soil as [fertilizer] is a functional inquiry focusing on defendants' use of the animal waste products rather than the agricultural waste definition." 2001 WL 1715730, at *4-5 (E.D.N.C. Sept. 20, 2001) ("The question of whether defendants return animal waste to the soil for fertilization purposes or instead apply waste in such large quantities that its usefulness as organic fertilizer is eliminated is a question of fact."). ECF No. 72 at 11-13. After all, if Congress intended to exclude *all* agricultural wastes from RCRA's provisions, it would not have qualified its exception with the phrase, "which are *returned to the soils as fertilizers* or soil conditioners," *see Safe Air*, 373 F.3d at 1045-46, nor allowed for the possibility that "solid waste" originate from "agricultural operations," *see* 42 U.S.C. § 6903 (27).

Plaintiffs acknowledge that manure can generally be a useful product when stored and subsequently used as fertilizer and sold to third parties; rather, they assert that the facts here demonstrate Defendants discarded manure by applying it to agricultural fields without regard to crop fertilization needs, and abandoned the manure when storing it in lagoons that leak and managing it on unlined, native soils. ECF No. 211 at 15-25.

In response to the contentious issue of whether manure can ever be characterized as a solid waste, Defendants' again cite to sundry precedent, previously identified in their Motion to Dismiss, to establish the following principles: (1) using a material is not waste under RCRA even if some portion escapes into the environment; (2) in determining whether a material is waste, courts do not engage in a "rigorous, point-by-point determination of whether every portion of the material actually serves its intended purpose on every occasion it is used, and then declare one portion waste and the other not;" (3) RCRA does not require that fertilizer be used at some "theoretical minimum effective rate" or "perfect rate" in order to guarantee no escapement or over-application; and (4) RCRA was not intended to regulate farmers' storage or use of fertilizer. ECF Nos. 190 at 7-10; 191 at 8. On the contrary, Defendants maintain that the manure generated, stored, and used at the Dairy is a useful product, sold and gifted to third parties, and eventually applied to agricultural fields to fertilize crops. ECF No. 190 at 11-19.

This Court now turns to the evidence submitted regarding Defendants' land application, storage, and composting of manure.[29]

i. Land Application

Plaintiffs assert excess manure applied onto agricultural fields constitutes "discarded material" because such waste cannot effectively be used by crops as fertilizer and therefore has no beneficial use nor is it used as it was intended to be used. ECF No. 211 at 16. Defendants maintain, *inter alia*, that manure was applied with reference to the DNMP with the purpose to fertilize crops and any

---

[29] This Court finds insufficient briefing on the issue of whether the manure excreted from the cows in the confinement pens is a solid waste. As such, this issue is reserved for trial.

failure in interpreting the DNMP's requirements does not establish that the Dairy's applications constituted discard. ECF No. 256 at 11-13.

This Court finds there is no triable issue that when Defendants excessively over-apply manure to their agricultural fields—application that is untethered to the DNMP and made without regard to the fertilization needs of their crops—they are discarding the manure and thus transforming it to a solid waste under RCRA. Because the excess manure is not "returned to the soil as fertilizers," it is not exempt from RCRA's provisions. *See Safe Air*, 373 F.3d at 1045-46. Although Defendants' failure to adhere to the DNMP and implement its Best Management Practices is not actionable under RCRA, it provides strong evidence that the Dairy's application of manure was not "useful" or "beneficial" but rather constituted discard. *Id.* at 1042; *Ecological Rights*, 713 F.3d at 515

First, the evidence presented demonstrates Defendants failed to use manure nutrient analyses or consider average crop yields when determining manure applications. Although they may have taken samples of the manure, samples from the main lagoon only, the analyses obtained were not actually taken into account when determining application rates. Rather, Mr. Boivin admitted that the Dairy merely referenced the estimates as listed in the DNMP when determining how much manure to apply. ECF No. 211-1 ¶ 68.a (citing ECF No. 228-1); *see also* ECF Nos. 190-3 ¶ 58; 256-1 ¶ 68.a. For instance, when determining how much manure to apply based on nitrate concentration, Mr. Boivin admitted to merely referencing the DNMP's *estimated* concentration of 1.5 lbs/1000 gallons, as opposed to *actual* concentrations of the Dairy's manure, which ranged from 1.67 lbs/1000 gallons to 33.7 lbs/gallons. ECF No. 211-1 ¶ 68.a.

Second, the uncontroverted evidence presented demonstrates that Defendants failed to account for residual manure already present in the soil when determining how much manure to apply. As Mr. Boivin admitted in his deposition, Defendants applied manure, millions of gallons of manure, to fields that were already sufficiently saturated with nitrates from previous applications. *Id.* ¶ 68.d (citing Boivin deposition, ECF No. 228-1). As such, any additional applications could not be used as fertilizer by the crops.[30] For instance, Mr. Boivin

---

[30] Although Plaintiffs highlight Defendants' application of manure to bare ground where no crop was planted, ECF No. 211-1 ¶ 72 (citing ECF No. 228-1), this Court recognizes that the DNMP, although it suggests avoiding applications to bare ground, also notes that there is a lag time between when the manure is applied and when the constituents break down into beneficial fertilization nutrients. ECF No. 226-1 (COWPAL000477). Plaintiffs also highlight that Defendants applied manure on numerous occasions until the lagoons were empty, ECF No. 211-1 ¶ 71; however, this Court questions how dispositive this particular evidence is,

acknowledged that on one particular occasion, although samples from the top two feet of the soil column showed nitrate levels in excess of what the alfalfa crop could use as fertilizer, the Dairy proceeded to apply *7,680,000* gallons of manure onto the already sufficiently fertilized field. ECF No. 304 at 3. Plaintiffs' expert Dr. Shaw cited numerous similar examples of non-agronomic applications, which alone resulted in tens of millions of gallons of manure applied to fields requiring no fertilization. *See* ECF No. 237-2 ¶¶ 76-78, 83-84, 101, 107, 109, 133, 144, 145, 149, 155, 157. This provides further uncontroverted evidence that Defendants' manure was not "returned to the soil as fertilizer," considering the crop could not possibly use the manure constituents as fertilizer.

Defendants do not rebut this compelling evidence with anything more than a conclusory allegation that Cow Palace calculated its manure applications with reference to the DNMP. ECF No. 256-1, ¶ 55. The uncontroverted evidence shows otherwise— that none of the parameters for that application algorithm were calculated or followed in practice.

Finally, the excessively high levels of manure constituents in the Dairy's agricultural fields, based on post-harvest soil sampling by both parties, indicate that Defendants had applied manure at rates in excess of what the crop actually

---

considering, in theory, the lagoons could have been pumped empty before the fields were completely fertilized.

could or did use. Specifically, samples taken below crop root zones—that is, the soil depth where no crop roots are present to use manure constituents as fertilizer—showed very high nitrate and phosphorous levels.[31] ECF No. 211-1 ¶ 77.

Accordingly, because Defendants manure applications were not only untethered to DNMP's Best Management Practices but done without regard to crop fertilization needs, presumably in an effort to discard their excess supply, the otherwise beneficial purpose of manure as fertilizer was eliminated and the manure discarded.

ii. Lagoons

Plaintiffs also assert that the otherwise beneficial manure stored in the Dairy's several lagoons is transformed into "solid waste" under RCRA when it leaks into the soil and accumulates in the environment, losing all beneficial fertilization and commodity purposes. ECF No. 211 at 21. Defendants maintain

---

[31] The EPA's most recent update to its AOC—which directs the dairies, including Cow Palace, to maintain soil nitrate in to the top two feet of soil below 45 parts per million—found three of Cow Palace Dairy's fields in excess of this concentration based on 2013 post-harvest soil sampling. ECF No. 305-4 at 4-5. Spring 2014 sampling showed similar results. *Id.* at 5; *see also id.* at 6 (noting that the hundreds of tons of nitrate found in the third foot of soil, which cannot be effectively used by most crops, "has effectively been lost to the environment.").

that the lagoons are constructed, maintained, and operated to NRCS standards, which allow for permeability, and merely serve as temporary storage until the manure can be applied as useful fertilizer. ECF No. 256 at 7-8, 14-15.

The Ninth Circuit recently addressed a similar problem of whether a non-hazardous material was transformed into a solid waste when it escapes into the environment as an expected consequence of its intended use. In *Ecological Rights*, an environmental group asserted that PCP-based wood preservative that leaked, spilled, and dripped from utility poles constituted a solid waste under RCRA. 713 F.3d at 514. In concluding that is it not, the Ninth Circuit held that the "PCP-based wood preservative that is released into the environment as a natural, expected consequence of its intended use—as a preservative for wooden utility poles—is not *automatically* 'solid waste' under RCRA's definition of that term.'" *Id.* at 518 (emphasis added).

That being said, the Ninth Circuit expressly emphasized that it was *not* deciding "whether or under what circumstances PCP, wood preservative, *or another material* becomes a RCRA 'solid waste' when it accumulates in the environment as a natural, expected consequence of the material's intended use." *Id.* (emphasis added). Referencing persuasive authority, the Ninth Circuit indicated that there could be circumstances in which a material that accumulates in the environment, long after it had served its intended purpose, could meet RCRA's statutory definition of "solid waste." *Id.* (citing, among other precedent, *Conn. Coastal Fishermen's Ass'n*, 989 F.2d 1305, 1316 (2d. Cir. 1993)) (holding that "materials left to accumulate long after they had served their intended purpose"—specifically, five million pounds of lead bullets and 11 million pounds of clay target debris accumulated for nearly 70 years at a firing range—met RCRA's statutory definition of solid waste") (internal quotation marks omitted). Thus, the Ninth Circuit left open the possibility that such accumulated material could properly be characterized as a solid waste.

Here, the manure leaking from Defendants' lagoons is not a natural, expected consequence of the manure's use or intended use but rather a consequence of the poorly designed temporary storage features of the lagoons. The consequence of such permeable storage techniques, thus, converts what would otherwise be a beneficial product (the stored manure) into a solid waste (the discarded, leaching constituents of manure) under RCRA because the manure is knowingly abandoned to the underlying soil. *Ecological Rights*, 713 F.3d at 515 (noting the plain meaning of "discarded" includes "abandon"). Save for one lagoon, Defendants possess limited documentation to evidence that lagoons were actually constructed to meet NRCS standards. However, even assuming the lagoons were constructed pursuant to NRCS standards, these standards specifically allow for permeability and, thus, the lagoons are designed to leak. ECF Nos. 190-1

¶ 70; 286-1 ¶¶ 69-70.

Moreover, considering the specific circumstances regarding Defendants' lagoons, which allow manure to leak and accumulate into the soil, potentially at the rate of millions of gallons annually, this Court also finds such dangerous accumulations to be the type contemplated by the Ninth Circuit in *Ecological Rights*; thus, this manure is discarded and properly characterized as a solid waste under RCRA. Plaintiffs have presented indisputable evidence that such leaking is leading to dangerous accumulations of nitrates in the deep soil between the lagoons that eventually will reach the underlying aquifer. Although there is a genuine dispute as to the magnitude of the leaking, there can be no dispute that the lagoons are leaking and thus allowing nitrate to accumulate in the soil at rates possibly higher than three million gallons per year. ECF No. 212 ¶¶ 28, 34, 39, 43, 48, 64, 69, 74. As evidenced by sampling between impoundments, nitrates were found at depths as great as 47 feet, evidencing horizontal seepage between the lagoons. *Id.* ¶ 57. Further, although Plaintiffs were not permitted to take samples beneath the Dairy's lagoons, samples beneath a nearby abandoned lagoon—a lagoon of similar design and construction and overlying similar soil type—evidence concentrations of nitrate, phosphorus, and ammonium. *Id.* ¶¶ 77- 78, 82-83. Because the soils underlying the Dairy are not conducive to denitrification, the nitrate that accumulates as a result of the leaking lagoons will continue to leach into the soil and migrate toward the underlying aquifer. Accordingly, because the manure stored in the Dairy's lagoons is accumulating in the environment—possibly at accumulation rates of millions of gallons per year—as a consequence of the lagoons' storage design, it is properly characterized as a discarded material and thus a "solid waste" under RCRA.

iii. Composting

Finally, Plaintiffs assert that Defendants knowingly discard manure when they compost manure on unlined, native soils, which allow for leaching and accumulation of nitrate below the surface. ECF No. 211 at 24-25. Plaintiffs' sampling showed manure nutrients had leached deep into the soil underlying the composting operation, and once leached, Defendants could no longer put the substance to its beneficial use. *Id.* at 25. Defendants maintain that they do not discard manure simply by composting it on the bare ground. ECF No. 256 at 9-10.

Here, this Court finds that the manure in the unlined composting area is both knowingly abandoned and accumulating in dangerous quantities and thus a solid waste. As with the lagoons, this Court finds that leaching into the soil is a natural and intended consequence of preparing (on unlined soil) the manure for later use as compost, not while *actually using* it for its beneficial purpose as a fertilizer. The consequence of such unlined composting surfaces converts what would otherwise be a beneficial product (the composted manure) into a solid waste (the discarded, leaching constituents of manure) under RCRA because the manure is knowingly abandoned to the underlying soil. *Ecological Rights*, 713 F.3d at 515 (noting the plain meaning of "discarded" includes "abandon"). Moreover, sampling of the soil beneath the composting area indicates that manure constituents are accumulating in the underlying soils without the possibility of denitrification or crop uptake to help mitigate these accumulations. As such, these dangerous accumulations of nitrate will continue to migrate toward the underlying aquifer. By purposefully composting wet manure on open, native soil which causes manure constituents to leach into and accumulate in the soil, Defendants have discarded those constituents as a solid waste under RCRA.

Accordingly, because Plaintiffs have demonstrated that no reasonable trier of fact, upon reviewing the record here, could dispute that Defendants' excessive application of manure onto agricultural fields, untethered to the DNMP or the fertilization needs of the crops; and storage and composting of manure in ways that result in dangerous accumulations of nitrate in the environment, transformed its manure, an otherwise beneficial and useful product, into a discarded material and thus a RCRA solid waste.

This Court now turns to the issue of whether Defendants' handling, storage, and disposal of the manure contaminated the environment.

//

4. Whether the Dairy's Operations May be Contaminating the Environment

i. Groundwater

Plaintiffs assert that nitrate from the manure, over-applied and leaking from the impoundments and compost area, is reaching groundwater. ECF No. 211 at 26. Defendants fault Plaintiffs for failing to provide any opinion regarding the time it would take for nitrates to migrate through the relatively thick vadose zone and reach the aquifer, as well as failing to quantify the Dairy's contribution. ECF No. 256 at 15-16. Defendants maintain that the groundwater testing is merely detecting an historic nitrate plume, considering the agricultural history of the Yakima Valley, or otherwise affected by other sources, such as septic systems and irrigated croplands. *Id.* at 15-17.

There is no triable issue as to whether the Dairy's operations are contributing to the high nitrate levels in the groundwater. Although the parties dispute the significance of the Dairy's contribution and the time it will take for the nitrates in soils underlying Cow Palace to reach the groundwater, there can be no genuine dispute that the nitrates beneath the crop root zones at the Dairy will continue to migrate through the vadose zone to the underlying aquifer. *See* ECF Nos. 211-1 ¶ 131; 229-2; *see also* ECF No. 228-1 ("Q: "[I]s it more likely than not that Cow Palace could be the cause of this contamination? . . . A: Yes.").

First, sampling by Plaintiffs, the EPA, and Defendants all demonstrate excess levels of nitrate in the groundwater, with concentrations as high as 234 mg/L in one monitoring well. *See* ECF Nos. 213-1, ex. C; 223 ¶¶ 67-94. Although Defendants fault Plaintiffs for "cherry-picking" the well data, AOC monitoring wells downgradient of the Dairy evidence high nitrate levels frequently in excess of the MCL. On the other hand, upgradient well data that has not been impacted by human-influenced nitrogen sources, evidences small amounts of nitrates. ECF No. 223 ¶ 121. Further, the presence of tracer chemicals and dairy pharmaceuticals, the same pharmaceuticals detected at the Dairy, in downgradient wells also indicates that the Dairy's operations are contributing to the high nitrate levels in the groundwater. ECF No. 211-1 ¶ 117.

Second, besides the purely hypothetical musings of Defendants' soil expert, Scott Stephen, the soils underlying the Dairy are not conducive to denitrification considering the predominant soils present little potential for any loss of nitrate through denitrification. ECF Nos. 211-1 ¶ 35; 223 ¶ 49. As such, given the highly mobile nitrates found below the crop root zones as well as the highly permeable soils underlying the Dairy, the nitrates will migrate to the aquifer with water, be it from rainfall, snowmelt, irrigation practices, or more liquid manure to help transport it. Even Defendants' expert Dr. Melvin has conceded this eventuality. ECF No. 228-1.

Finally, Plaintiffs have presented ample evidence that groundwater recharge is occurring relatively rapidly. Frequent temperature and water table level fluctuations, along with EPA's age-dating of wells and the presence of modern-day dairy pharmaceuticals, corroborate the assertion that surface activities are rapidly impacting groundwater activities and that groundwater recharge is most likely nowhere near the 70-year timeline previously opined by Dr. Melvin.[32] ECF No. 211-1 ¶ 127-28. Even if Defendants contend such contamination could take "decades," Cow Palace Dairy has operated at its site for approximately 40 years. ECF No. 223 ¶ 105. Accordingly, Defendants activities are contributing to the contamination of the groundwater.

Although Defendants attempt to minimize their contribution by pointing to other nitrogen-loading sources, such as residential septic systems, the EPA's most recent data set under the AOC demonstrates just how significant the Dairy's contribution is. "Whereas a three-person residence generates about 30 pounds of nitrogen per year . . . a single lactating cow produces about 1 pound of nitrogen per day or 365 pounds of nitrogen per year." ECF No. 305-4 at 8. While there are 224 residential septic systems within one mile downgradient of the cluster Dairies,

---

[32] It is worth noting that Dr. Melvin, upon being presented evidence of the fairly rapid rate of groundwater recharge, conceded that his 70-year recharge timeline was probably not accurate. ECF No. 228-1.

Cow Palace Dairy has more than 7,000 milking cows alone. *Id.* Its entire herd produces over 100 million gallons of manure per year, with millions of those gallons leaking from its lagoons and compost area, and being applied to fields that cannot possibly use the substance as fertilizer. Given these numbers, any attempt to diminish the Dairy's contribution to the nitrate contamination is disingenuous, at best.

That being said, the statutory standard does not require that Plaintiffs quantify Defendants' contribution or demonstrate that Defendants are the sole cause of the contamination; rather, Plaintiffs need only show that the Dairy's operations "contributed" or are "contributing" to disposal of solid waste which "may" be posing a serious threat to public health. *See* 42 U.S.C. §§ 6903(3), 6972(a)(1)(B); *see also* 40 C.F.R. § 257.3-4(a) (defining contaminating to mean causing that groundwater to exceed the MCL *or cause a further increase* in groundwater that already exceeds the MCL).

Accordingly, a reasonable trier-of-fact, given the evidence presented, could come to no other conclusion than that the Dairy's operations are contributing to the high levels of nitrate that are currently contaminating—and will continue to contaminate as nitrate present below the root zone continues to migrate—the underlying groundwater.

//

ii. *Surface Water*

Plaintiffs also assert that Defendants' activities are contaminating surface water, both through the interconnectedness of contaminated shallow groundwater and nearby surface waters, and directly from surface runoff. ECF No. 286 at 20. Defendants question what evidence Plaintiffs have produced to demonstrate any surface water discharge and whether surface waters have been affected by the Dairy's operations. ECF No. 190 at 19.

Because of disputed issues of material fact regarding whether the Dairy's operations are affecting surface water in the area, this Court reserves this issue for determination at trial.

iii. Contamination "Beyond the Solid Waste Boundary"

Plaintiffs assert that contamination from the Dairy extends beyond the "solid waste boundary," which is defined as the "outermost perimeter" of where waste is disposed. ECF No. 211 at 28 (citing 40 C.F.R. § 257.3-4(c)(5)). Because it is undisputed that groundwater beneath the Dairy generally flows to the south and southwest, any nitrates that migrate into the underlying aquifer will either be extracted from a well or eventually discharged to surface water. *Id.* As discussed above, well data downgradient of the Dairy evidences high nitrate concentrations, concentrations to which the Dairy's operations may be contributing. Accordingly, nitrate contamination extends beyond the "outermost perimeter" of where the Dairy discards its manure and thus, there is no genuine dispute that the Dairy's activities are contaminating an area "beyond the solid waste boundary."

5. Whether Contamination Poses a Substantial and Imminent Endangerment to Health or the Environment

Plaintiffs assert that the excess nitrate levels found in the groundwater, a result of contamination from the Dairy's operations, may present an imminent and substantial endangerment to health or the environment.[33] First, "courts have emphasized the preeminence of the word 'may' in defining the degree of risk needed to support" liability under RCRA. *Me. People's Alliance v. Mallinckrodt, Inc.*, 471 F.3d 277, 288 (1st Cir. 2006). Second, the term imminent "does not require a showing that actual harm will occur immediately so long as the risk of threatened harm is present." *Price v. U.S. Navy*, 39 F.3d 1011, 1019 (9th Cir. 1994). Third, an endangerment is "substantial" when it is "serious." *Burlington N. & Santa Fe Ry. Co. v. Grant*, 505 F.3d 1013, 1021 (10th Cir. 2007). Finally, a substantial endangerment does not require proof of actual harm but rather "a threatened or potential harm." *Price,* 39 F.3d at 1019. "[I]f an error is to be made

---

[33] Plaintiffs also assert that Dairy's operations are creating a risk of harm to the environment—that is, the groundwater and surface water—although the full extent of contamination and migration is unknown. ECF No. 211 at 31-32.

in applying the endangerment standard, the error must be made in favor of protecting public health, welfare, and the environment." *Burlington N.*, 505 F.3d at 1021 (internal quotation marks and citation omitted).

The EPA set the nitrate MCL at 10 mg/L because of the serious health risks, such as various types of cancer, that arise when water is consumed at or above this level. *See* 56 Fed. Reg. 3526 (Jan. 30, 1991). Plaintiffs contend that there is evidence that exposure even below this level may present a risk to public health. ECF No. 211 at 29. As evidenced by Defendants' own testing pursuant to the AOC of residences within one-mile of the Dairy, 66 of the 115 residences tested exceeded the MCL for nitrates, with some residences exceeding 50 mg/L. ECF No. 213 ¶ 14. Further, Dolsen Companies' independent testing of dairy employee housing confirmed the presence of high concentrations of nitrates in the drinking water in the area; seven of the eight residences exceeded the MCL, the highest having nitrate concentrations at 72.8 mg/L, and the one non-exceeding residence having nitrate concentrations at 9.18 mg/L. *Id.* ¶ 15.

Alarmingly, Defendant Cow Palace's briefing seems to suggest that this Court wait to act until a young infant in the area is first diagnosed with methemoglobinemia, a health effect that occurs at the lowest dose of nitrate consumption. ECF No. 256 at 17 (asserting that because "effects on the most sensitive endpoint in the most sensitive population is not occurring in the Yakima

Valley," whether nitrates in the groundwater present an imminent and substantial endangerment is in dispute). Or alternatively, the steps the Dairy has already taken "reduce" any threat that nitrate contamination may pose because of the reverse osmosis filter systems the Dairy has offered to provide or maintain for nearby residents. *Id.* at 17-18.

Defendants again misstate the requirements of RCRA. Congress provided that a party violates RCRA when its actions "may" be endangering public health, welfare, or the environment. *Me. People's Alliance*, 471 F.3d at 288. Further, proof of actual or immediate harm is not necessary; rather, Plaintiffs need only present evidence that the contamination currently poses "threatened or potential harm." *Price*, 39 F.3d at 1019. The undisputed facts are that residential wells downgradient of the Dairy exceed the maximum contaminant level, as established by the EPA, and even if the Dairy's AOC obligations are helping to "reduce" the risk of the adverse health effects of the nitrate-contaminated water to nearby residents, the risk still remains to these residents, as well as to those beyond this limited one-mile downgradient zone. Considering their installation of reverse osmosis units in all Dairy employee housing, this Court questions whether Defendants truly believe the risk of nitrate contamination to be overstated. ECF No. 211-1 ¶¶ 14-15 14. Accordingly, there can be no dispute that the Dairy's operations may present an imminent and substantial endangerment to the public who is consuming the contaminated water.[34]

6. Defendants' Liability

A private party may bring suit under RCRA "against any person . . . including any past or present generator, past or present transporter, or past or present owner or operator of a treatment, storage, or disposal facility, who has *contributed or who is contributing* to the past or present handling, storage, treatment, transportation, or disposal of any solid or hazardous waste which may present any imminent and substantial endangerment to health or the environment."[35] 42 U.S.C. § 6972(a)(1)(B) (emphasis added). The Ninth Circuit has defined "contribute" to mean "lend assistance or aid to a common purpose," "have a share in any act or effect," "be an important factor in," or "help to cause."

---

[34] Because the Court finds the Dairy's manure presents a risk of harm to human health, it may also necessarily present a risk of harm to the environment.

[35] RCRA defines the term "person" as "an individual, trust, firm, joint stock company, corporation (including a government corporation), partnership, association, State, municipality, commission, political subdivision of a State, or any interstate body and shall include each department, agency, and instrumentality of the United States." 42 U.S.C. § 6903(15). The parties do not dispute that each Defendant meets the definition of "person" under RCRA.

Hinds Invs., L.P. v. Angioli, 654 F.3d 846, 850 (9th Cir. 2011). "[T]o state a claim predicated on RCRA liability for 'contributing to' the disposal of hazardous waste, a plaintiff must allege that the defendant had a measure of control over the waste at the time of its disposal or was otherwise actively involved in the waste disposal process." *Id.* at 852. Congress intended that the term "contribution" be "liberally construed," and such term includes "a share in any act or effect" giving rise to disposal of the wastes that may present an endangerment. *United States v. Aceto Agric. Chems. Corp*., 872 F.2d 1373, 1383-84 (2d Cir. 1989).

As an initial matter, Cow Palace, Dolsen Companies, and Three D Properties are all past or present owners of the land on which the Dairy operates. Dolsen Companies previously owned 425 acres of land on which the Dairy operates but transferred those parcels—which included cow pens, milking barns, composting area, the majority of the lagoons, and almost half of the agricultural fields—to Cow Palace after this litigation commenced. Three D and Cow Palace are current owners, with Three D owning approximately fifty percent of the land used by the Dairy, some of which Adam Dolsen transferred to Three D after this litigation commenced. Thus, all three Defendants are "past or present owners" of the land under RCRA. *See* 42 U.S.C. § 6972(a)(1)(B).

Although Three D and Dolsen Companies hold themselves out as mere "passive landowners," with no involvement in or control of the Dairy's operational practices, ECF No. 191 at 12-13, there is no genuine issue surrounding whether all three entities had some "measure of control" over the Dairy's manure management. Most telling, Mr. Boivin testified that although he is "the top person in charge at Cow Palace Diary" he "*ultimately reports*" to Bill Dolsen. Such evidence strongly indicates that Bill Dolsen—as President, Chairman, and Director of The Dolsen Companies, sole manager of Three D Properties, and registered agent for Cow Palace—exercises "some measure of control" of the Dairy on behalf of all three entities. Further uncontroverted evidence showing the interconnected relationship of these three entities, with the Dolsens at the core, includes the following:

- The Dolsen Companies is listed as the owner/operator of the Dairy on its DNMP;
- Bill Dolsen, has primary authority for decisions involving real property acquisitions by Cow Palace and Three D;
- Both Dolsens used their authority to accept the AOC affecting Dairy's operations and either met or spoke with other state and federal regulatory representatives;
- Both Dolsens were contacted when there was a breach in one of the lagoons;
- Adam Dolsen, as Vice President of Dolsen Companies, had the authority to fire and hire management at the Dairy and met with management one or two times per month;
- The Dolsen Companies receives and maintains numerous records regarding the Dairy, including manure transfers, offsite manure

applications, compost transfers, laboratory analyses of liquid manure samples, annual yields of crops, and various safety and inspection records.

- Adam and Bill Dolsen, along with Vern Carson, safety director for the Dolsen Companies, made the decision to install reverse osmosis units in all Dairy employee housing around 2011 or 2012, from which the employees would obtain their drinking water.

Taken as a whole, there can be no doubt that each of these entities, although legally separate, maintain or maintained some "measure of control" over the Dairy's operations or "share[d] in any act or effect" of the Dairy's management practices. *Hinds*, 654 F.3d at 850; *Aceto*, 872 F.2d at 1383-84. Although Defendants seek to hide behind the legally separate entities, Defendants' abject failure to respect the corporate divisions when managing the Dairy's operations necessarily results in all three forms being held responsible. Accordingly, Defendants The Dolsen Companies, Three D, and Cow Palace are all responsible parties under RCRA.[36]

---

[36] As this stage in the proceedings, this Court need not determine, generally, what remedies are available under RCRA to Plaintiffs here and, specifically, for which actions each Defendant, as past and current owners of the site, are responsible. 42 U.S.C. § 6972(a) (empowering courts to "restrain any person who has contributed or who is contributing to the past or present handling, storage, treatment, transportation, or disposal of any solid or hazardous waste . . ., to order such

7. Conclusion

In conclusion, this Court finds no genuine issue of material fact that Defendants' application, storage, and management of manure at Cow Palace Dairy violated RCRA's substantial and imminent endangerment and open dumping provisions and that all Defendants are responsible parties under RCRA. This Court reserves remedial issues, as well as the other remaining issues as discussed above, for trial.

//

---

person to take such other action as may be necessary, or both . . ., and to apply any appropriate civil penalties" available under RCRA); *see Meghrig*, 516 U.S. at 483 (holding that "RCRA is not principally designed to effectuate the cleanup of toxic waste sites or to compensate those who have attended to the remediation of environmental hazards"); *but see Express Car Wash Corp. v. Irinago Bros., Inc.*, 967 F.Supp. 1188, 1192 (D. Or. 1997) ("The Supreme Court's decision in *Meghrig* thus defines the two endpoints of the RCRA citizen suit continuum: a plaintiff facing an imminent threat from hazardous waste, when no remediation has yet taken place, clearly can sue RCRA for an injunction to force appropriate parties to clean up the contamination."); *see also Tanglewood E. Homeowners v. Charles-Thomas, Inc.*, 849 F.2d 1568, 1574 (5th Cir. 1988) ("The remedies package of [RCRA] includes civil penalties, injunctive relief, and attorney's fees.").

ACCORDINGLY, IT IS HEREBY ORDERED:

1. Defendant Cow Palace, LLC's Motion for Summary Judgment (ECF No. 190) is **DENIED**.

2. Defendants The Dolsen Companies' and Three D Properties' Motion for Summary Judgment (ECF No. 191) is **DENIED**.

3. Plaintiffs' Motion to Exclude Expert Testimony of Scott Stephen (ECF No. 193) is **DENIED**.

4. Defendant Cow Palace, LLC's *Daubert* Motion to Exclude Testimony in Reliance on the EPA Report and to Exclude EPA Report Under Rule 403 (ECF No. 200) is **DENIED**.

5. Plaintiffs' Motion to Exclude Expert Testimony of James Maul (ECF No. 202) is **DENIED**.

6. Plaintiffs' Motion to Exclude Expert Testimony of Michael Backe (ECF No. 206) is **DENIED**.

7. Defendant Cow Palace LLC's Motion to Dismiss (ECF No. 209) is **DENIED**.

8. Plaintiffs' Motion for, and Memorandum in Support of, Summary Judgment (ECF No. 211; *see* ECF No. 234-1 (praecipe)) is **GRANTED in part**.

9. Cow Palace, LLC'S Motion to Strike Undisclosed Expert Testimony (ECF No. 237) is **DENIED**.

The District Court Executive is hereby directed to enter this Order and provide copies to counsel.

DATED January 14, 2015.

UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF WASHINGTON

Thomas O. Rice

THOMAS O. RICE
United States District Judge