GOODHUE COUNTY MINNESOTA
TO EFFECTIVELY PROMOTE THE SAFETY, HEALTH, AND WELL-BEING OF OUR RESIDENTS

BOARD OF COMMISSIONERS
AGENDA

Room 301 (Old Courtroom)
Government Center, Red Wing

May 8, 2018
6:30 p.m.

PLEDGE OF ALLEGIANCE

DISCLOSURES OF INTEREST

REVIEW AND APPROVE THE COUNTY BOARD AGENDA

Land Use Management Director's Report

1. REVIEW: Request for CUP for a Veterinary Clinic
   Request submitted by Nicholas and Krystyna Stoffel for CUP to establish a Veterinary Clinic at 26336 130th Ave Welch, MN 55089. Parcel 46.029.0303. Part of the NW ¼ of NW ¼, SW ¼ of NW ¼, and SE ¼ of NW ¼, Sect 29 Twp 113 Range 16 in Welch Township. A2 Zoned District.

   Documents:

   CBReport_Stoffel.pdf

2. PUBLIC HEARINGS: Request for Map Amendment (Rezone)
   Request for map amendment submitted by Blake Thompson to rezone 38 acres from A3 (Urban Fringe District) to R1 (Suburban Residence District). Parcels 31.001.6100 and 31.001.6200. Part of the SW ¼ of SE ¼ and GOVT Lot 2 in Sect 01 Twp 112 Range 15 in Featherstone Township. A3 Zoned District.

   Documents:

   CBReport_Thompson.pdf

3. PUBLIC HEARING: Request for amendments to Article 11, Section 24 (Preservation of Farming Practices)
   Request submitted by Circle "K" Farms (Michael, Yon, & Jeff Kohlnhofer) to consider proposed text amendments to Goodhue County Zoning Ordinance Article 11, Section 24 (Preservation of Farming Practices).

   Documents:

   CBReport_TextAmend-Art11Sec24.pdf

ADJOURN

Goodhue County Land Use Management

Goodhue County Government Center | 509 West Fifth Street | Red Wing, Minnesota 55066

Lisa M. Hanni, L.S. Director

Building | Planning | Zoning
Telephone: 651.385.3104
Fax: 651.385.3106

County Surveyor / Recorder

Environmental Health | Land Surveying | GIS
Telephone: 651.385.3223
Fax: 651.385.3098

To: County Board of Commissioners
From: Land Use Management
Meeting Date: May 8, 2018
Report date: April 27, 2018

Request for CUP for a Veterinary Clinic

Request submitted by Nicholas and Krystyna Stoffel for CUP to establish a Veterinary Clinic at 26336 130th Ave Welch, MN 55089. Parcel 46.029.0303. Part of the NW ¼ of NW ¼, SW ¼ of NW ¼, and SE ¼ of NW ¼, Sect 29 Twp 113 Range 16 in Welch Township. A2 Zoned District.

Application Information:

Applicant: Nicholas and Krystyna Stoffel (owners)
Address of zoning request: 26336 130th Ave Welch, MN 55089
Parcel(s): Part of the NW ¼ of NW ¼, SW ¼ of NW ¼, and SE ¼ of NW ¼, Sect 29 Twp 113 Range 16 in Welch Township
Township Information: Welch Township endorsed acknowledgment of the applicants' request.
Zoning District: A2 (Agriculture District)

Attachments and links:

Application and submitted project summary
Draft PAC Minutes
Goodhue County Zoning Ordinance: http://www.co.goodhue.mn.us/DocumentCenter/View/2428

Background:

The applicants have owned and operated Stoffel Equine Veterinary Services as a mobile veterinary clinic with a focus on providing horse care and examinations. In 2017 the Stoffel's received approval from Goodhue County to construct a 20,800 sq ft "L"-shaped agricultural accessory building for "hay storage and personal use." The applicants desire CUP approval to utilize this existing structure as a permanent base for their equine veterinary business to provide "in-patient" and "out-patient" veterinary services. The business currently exists as a mobile ambulatory practice.

Goodhue County Zoning Ordinance: Article 4 Conditional/Interim Uses

No CUP/IUP shall be recommended by the County Planning Commission unless said Commission specifies facts in their findings for each case which establish the proposed CUP/IUP will not be injurious to the use and enjoyment of other property in the immediate vicinity for the purposes already permitted, will not substantially diminish and impair property values within the immediate vicinity, will not impede the normal and orderly development and improvement of surrounding vacant property for uses predominant to the area, that adequate measures have been, or will be, taken to provide utilities, access roads, drainage and other necessary facilities, to provide sufficient off-street parking and loading space, to control offensive odor, fumes, dust, noise and vibration so that none of these will constitute a nuisance, and to control lighted signs and other lights in such a manner that no disturbance to neighboring properties will result.

Project Summary:

- The subject property is the site of the applicant's primary residence and consists of a single parcel comprising approximately 23.78 acres.
- Adjacent zoning districts include A2 (Agriculture District) to the north, east, and south; A1 (Agriculture Protection District) to the west.

- Adjacent land uses include agriculture, low-density residential and undeveloped forest-land.
- The Veterinary Clinic will be located in an existing 80 ft by 60 foot and 76 ft by 80 ft (20,800 total sq ft) pole-style detached accessory building. The building was permitted by Goodhue County in October 2016. The structure has capacity to hold up to 6 horses at a time.

  No new structures are proposed with the request.

  A new building permit is required due to the change of use of the facilities.
- The business is operated by the applicants. No Non-resident Employees are proposed with this request.
- Parcel access consists of a "u-shaped" gravel drive located off of 130th Ave on the west side of the property.

  130th Avenue is a gravel surfaced roadway.
- A separate fire number has been assigned to the Veterinary Clinic site.

  Adequate emergency vehicle access is available to service the existing building location.
- Typical equipment utilized for the business includes a utility vehicle, trailers, veterinary implements, and standard office equipment.
- The main activities on-site are the loading and off-loading of trailers with animals and equipment.
- Minimal additional traffic is anticipated to be generated as a result of the request. Business operations will continue to be primarily ambulatory, minimizing traffic to the site.
- Hours of operation are proposed to be year-round, Monday through Friday from 8:00 AM to 6:00 PM and Saturday from 9:00 AM to 1:00 PM (excluding holidays).
- Incidental sale of retail items is made available to customers. The applicant indicated the sale of retail items comprises no more than 5% of total business operations.
- Minimum off-street parking provisions are not specified for Veterinary Clinics. Pursuant to GCZO Article 11, Section 16, minimum off-street parking provisions shall be shall be determined by using the requirements for a closely related use which is listed.

  The Zoning Administrator has determined Veterinarian Clinics to be most similar to "Hospitals" which require a minimum of one parking space for every three guest beds, plus one space for every two employees. The minimum number of parking stalls required for this request is 4.

  Ample room exists on the property to fulfill off-street parking requirements.
- An existing compliant holding tank septic system services the facility.
- Ben Hoyt, Goodhue County Sanitarian, offered the following comments regarding the applicants' wastewater needs:

  "A veterinary Clinic would be required to have a compliant septic system for appropriate wastewater treatment. A business of this nature would also require a septic system operating permit. Any building permits or other subsequent permits associated with the use of the property as a veterinary clinic would require a septic system installation permit and septic system operating permit prior to approval by Environmental Health. Prior records on this property indicate that a holding tank system was allowed for the structure's previous use. Some components of the holding tank system may be utilized for the new system provided that they meet requirements for what is proposed."
- Solid waste disposal services are provided by a P.I.G of Hager City, WI.

  Prompt disposal of any deceased animal carcasses will be provided by a local rendering service.
- The applicants are proposing to install one exterior sign on the front of the building near the main entrance.

  All exterior signage located within property boundaries must follow GCZO Article 11 section 17.

The applicants shall consult the appropriate road authority prior to placing any signage located within road right-of-ways.

- Existing "dusk to dawn" farmyard lights provide exterior lighting for the facility. No additional lighting is proposed.
- Landscaping, grading, and excavating activities were completed with the construction of the facility. No additional landscaping measures are proposed.
- Stormwater is collected via existing roof guttering and directed to existing drainage culverts and natural drainage channels.
- Exterior storage of business materials will be screened from public view via a covered lean-to area located along the east side of the existing building.
- The facility is currently used to stable horses. No additional offensive noise, dust, odors, or fumes are anticipated to be generated as a result of the proposed use.

  Manure generated within the facility is collected and land applied on the property for use as a soil fertilizer.
- Goodhue County Feedlot Officer Virginia Westlie offered the following comments regarding the applicants' request:

  "Goodhue County requires locations to register if they have over 10AU (animal units). This place would be staying under 10AU. They would not be required to register. Being that it is a confinement barn they will also be able to control the manure more as well. It also appears that they have acreage that they would be placing the manure on from the barns. As long as they still follow the setbacks from sensitive features and neighbors while spreading it throughout their acreage they should be fine."
- The Welch Township Board approved a Conditional Use Permit for the applicants' request on 3/22/18; subject to the following conditions:
  - *"No kitchen or living facilities"*
  - *"No transfer of CUP to the third party"*
  - *"A sign identifying the business will be permitted – not to exceed approximately 6'x6'."*

  Welch Township also offered the following comment: *"Request Goodhue County consider annual review of permit."*
- Goodhue County typically reserves annual CUP review requirements for unique uses that have demonstrated the potential for unanticipated land use impacts or intense land uses that warrant a second look once operations have commenced to address issues that could not be anticipated at the time of approval.

<u>Draft Findings of Fact:</u>

1. The proposed Veterinary Clinic does not appear injurious to the use and enjoyment of properties in the immediate vicinity for uses already permitted, nor would it substantially diminish and impair property values in the immediate vicinity. The use would provide a necessary service to the rural community and support the agricultural economy established in the vicinity.
2. The establishment of the proposed Veterinary Clinic is not anticipated to impede the normal and orderly development and improvement of surrounding vacant property for uses predominant to the area. The use is proposed to meet all development standards of the Goodhue County Zoning Ordinance and is an agriculturally-oriented use that appears compatible with adjacent land uses.
3. A review of the applicants submitted project summary indicates adequate utilities, access roads, drainage and other necessary facilities are available to accommodate the proposed use.
4. The submitted plans identify means to provide sufficient off-street parking and loading space to serve the proposed use and meet the Goodhue County Zoning Ordinance's parking requirements.
5. The submitted plans detail adequate measures to prevent or control offensive odor, fumes, dust,

noise, and vibration so that none of these will constitute a nuisance. Furthermore, the applicants' lighting plans appear capable of controlling lights in such a manner that no disturbance to neighboring properties will result.

The application and relevant documents were reviewed by the Planning Advisory Commission (PAC), in addition to holding a public hearing in which they accepted testimony and written comments at their April 16, 2018 meeting. The PAC recommended approval for this request on an 8:0 vote.

Planning Advisory Commission Recommendation:

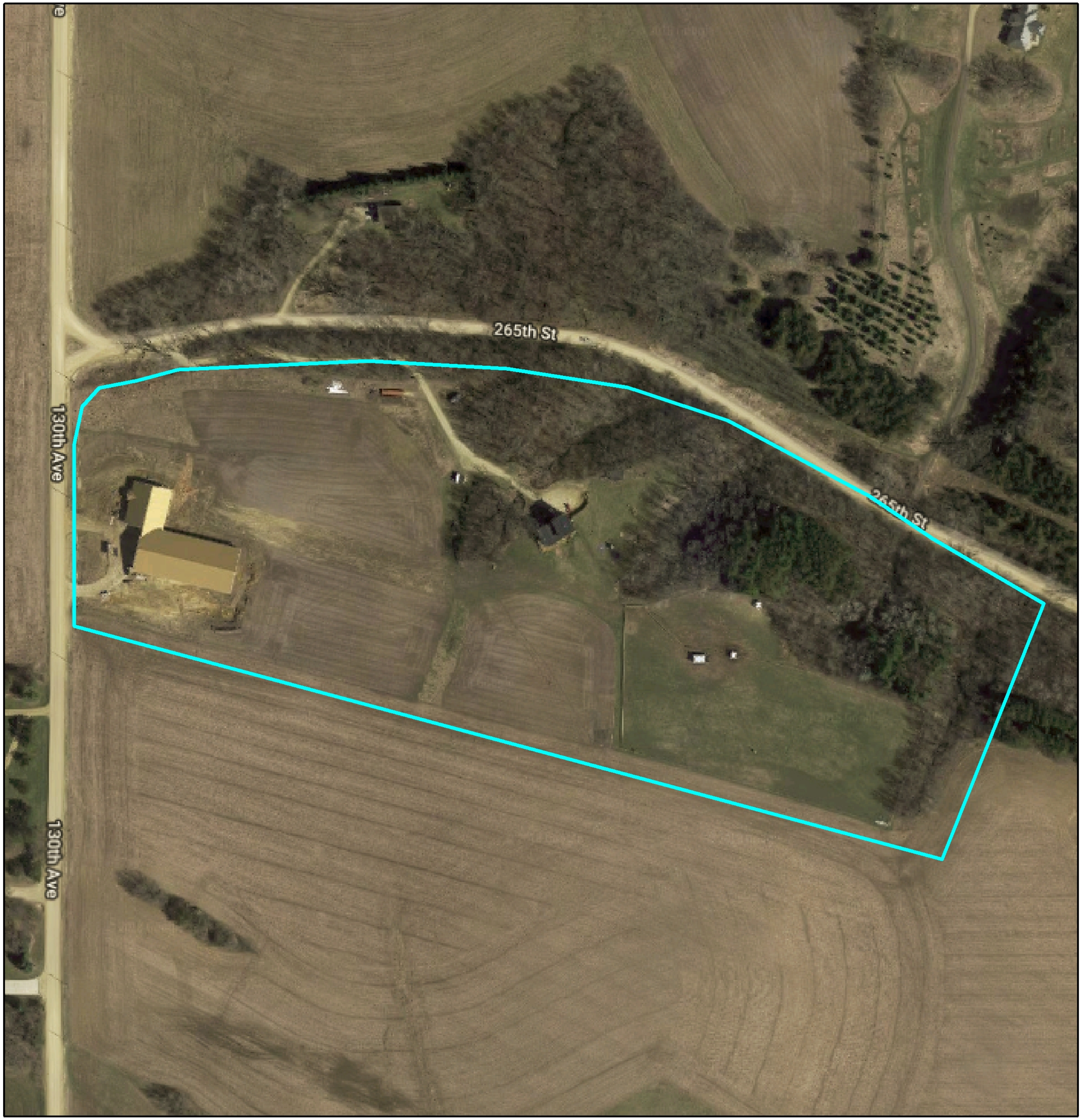
The PAC recommends the County Board

- adopt the staff report into the record;
- adopt the findings of fact;
- accept the application, testimony, exhibits, and other evidence presented into the record; and

APPROVE the request from Nicholas and Krystyna Stoffel for a CUP to establish a Veterinary Clinic at 26336 130th Ave Welch, MN 55089 (Parcel 46.029.0303).

Subject to the following conditions:

1. Activities shall be conducted according to submitted plans, specifications, and narrative unless modified by a condition of this CUP;
2. Hours of operation shall be Monday through Friday, 8:00 AM to 6:00 PM, and Saturdays from 9:00 AM to 1:00 PM (excluding holidays);
3. On-street parking shall be prohibited;
4. On-street loading or off-loading shall be prohibited;
5. Applicants' shall obtain Building Permit approvals for change of use for the existing structure from the Goodhue County Building Permits Department prior to establishing the use;
6. Applicants' shall work with Goodhue County Environmental Health to achieve compliance with the Goodhue County SSTS Ordinance;
7. Compliance with Goodhue County Zoning Ordinance including, but not limited to Article 22 A-2 (Agriculture District);
8. Compliance with all necessary State and Federal registrations, permits, licensing, and regulations.



Planning Advisory Commssion

Public Hearing
April 16, 2018

Nicholas & Krystyna Stoffel
26336 130th Ave
Welch, MN 55089
A2 Zoned District

Parcel # 46.029.0303
NW¼ NW¼, SW¼ NW¼,
and SE¼ NW ¼, Sect 29
Twp 113 Range 16
Welch Township

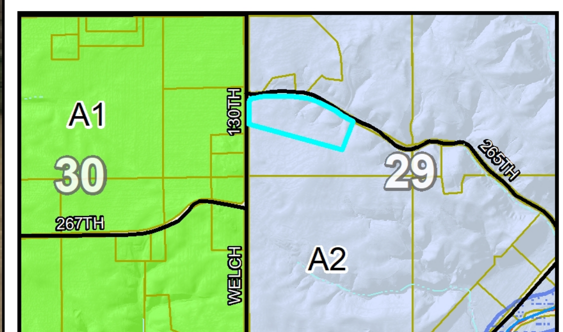
CUP request for a
Veterinary Clinic

Legend

Intermittent Streams
Protected Streams
Lakes & Other Water Bodies
Shoreland
Historic Districts
Parcels
Registered Feedlots
Dwellings
Municipalities

Bluff Impact Zones (% slope)
20
30

FEMA Flood Zones
2% Annual Chance
A
AE
AO
X



2016 Aerial Imagery

Map Created March, 2018, Ryan Bechel

Feet
0 65 130 260 390 520

GOODHUE COUNTY CONDITIONAL/INTERIM USE PERMIT APPLICATION

RECEIVED
MAR 23 2018
Land Use Management

Parcel # 46.029.0303

Permit# Z18-0019

PROPERTY OWNER INFORMATION

Last Name Stoffel

First Nicholas & Krystyna

Email:

Phone

Street Address 13014 265th St

City Welch State MN Zip 55089

Attach Legal Description as Exhibit "A" ☐

Authorized Agent

Phone

Mailing Address of Landowner: same as above

Mailing Address of Agent:

PROJECT INFORMATION

Site Address (if different than above): 26336 130th Ave Welch, MN 55089

Lot Size 23.78 acres

Structure Dimensions (if applicable) 80x60 / 185x80

What is the conditional/interim use permit request for? Veterinary Clinic

Written justification for request including discussion of how any potential conflicts with existing nearby land uses will be minimized

I am proposing to use an already existing structure, therefore, this permit will not be detrimental to the surrounding properties. The building will not obstruct any development of the surrounding farm land, which is the predominant use of land in the area.

DISCLAIMER AND PROPERTY OWNER SIGNATURE

I hereby swear and affirm that the information supplied to Goodhue County Land Use Management Department is accurate and true. I acknowledge that this application is rendered invalid and void should the County determine that information supplied by me, the applicant in applying for this variance is inaccurate or untrue. I hereby give authorization for the above mentioned agent to represent me and my property in the above mentioned matter.

Signature of Landowner: Krystyna Stoffel

Date 2-12-18

Signature of Agent Authorized by Agent:

TOWNSHIP INFORMATION

Township Zoning Permit Attached? ☒ If no please have township complete below:

By signing this form, the Township acknowledges being made aware of the request stated above. In no way does signing this application indicate the Township's official approval or denial of the request.

Signature Ken Shingsby

Title CLERK

Date MAR 22, 2018

Comments:

COUNTY SECTION

COUNTY FEE $350

RECEIPT # 16198

DATE PAID 3/23/18

Applicant requests a CUP/IUP pursuant to Article ____ Section ____ Subdivision ____ of the Goodhue County Zoning Ordinance

What is the formal wording of the request?

Shoreland ______ Lake/Stream Name ______________________ Zoning District ________

Date Received______________ Date of Public Hearing ______________ DNR Notice ______ City Notice ______________

Action Taken: ____Approve ______ Deny Conditions:

TOWNSHIP ZONING APPLICATION **TOWNSHIP NAME** Welch

Goodhue County Parcel #____________

APPLICANT INFORMATION

Last Name	STOFFEL	First	DR. KRYSTYNA	M.I.	
Street Address	13014 265 ST			Phone	
City	WELCH	State	MN	ZIP	55089
Email Address					
Township 113	Range 016			Section	29

PROJECT INFORMATION

Site Address					
Zoning District	CHANGE OF	~~Lot Size~~	USAGE - CUP	Structure Dimensions	
Type of Project	STORAGE BLDG	Proposed Use	VETERINARY CLINIC - HORSES ONLY		
Structure Type	EXISTING	Replacement?	YES ☐	NO ☒	

Variance #__________ Conditional Use Permit #__________

GPS Coordinates

DISCLAIMER AND SIGNATURE

I hereby apply for a zoning permit and I acknowledge that the information above is complete and accurate, that the work will be in conformance with the ordinances and codes of Goodhue County. The applicant also understands by signing this application he / she could be held responsible as representative of this project for any violation of compliance with all applicable laws and ordinances of Goodhue County. This permit may be suspended or revoked if the permit has been issued in error or on the basis of incorrect information supplied or in violation of any ordinance or regulation of Goodhue County. All provisions of law and ordinances governing this type of work will be complied with whether specified herein or not

Signature [signature] Date 3/22/18

TOWNSHIP APPROVALS

I hereby certify by signing that I am authorized to act on the behalf of the Township Board, and the structure and use will meet all Township Codes and Ordinances if constructed as indicated.

Signature	Ken Alingsly	Title CLERK	Date MAR 22, 18
Signature		Title	Date

Application fee__________ **Receipt Number** __________

RESTRICTIONS: 1. NO KITCHEN OR LIVING FACILITIES.
2. NO TRANSFER OF CUP TO THIRD PARTY.
3. A SIGN IDENTIFING THE BUSINESS WILL BE PERMITTED - NOT TO EXCEED APPROXIMATELY 6'x6'.

REQUEST GOODHUE CO. CONSIDER ANNUAL REVIEW OF PERMIT

Conditional Use Permit Application for Veterinary Clinic

in Welch Township PID# 46.029.0303

PROJECT SUMMARY

1. Stoffel Equine Veterinary Services has been in business for almost 11 years as a mobile Veterinary practice for horses. The business address has been linked to by home address since I began operations. I have always had a home office for the business. We recently built a new barn on our property for personal use, and my home office space has expanded to the barn area. Therefore, I am applying for a conditional use permit for a Veterinary clinic. As a Veterinarian I do provide my clients with some retail items. These items are currently tracked, logged, and in compliance with Minnesota state and county sales and use tax. The sale of retail items is not a large part of my practice, making up approximately 5% of total business operations.

2. The planned use of the existing building would be used intermittently for both out-patient and in-patient procedures. However, Stoffel Equine Veterinary Services will remain as a primary ambulatory practice. No new structures are being proposed.

3. There are no proposed new hire of non-resident employees.

4. The hours of operation would consist of Monday-Friday 8am -6 pm, Saturday 9am -1 pm, year round, excluding holidays.

5. The planned maximum occupancy of horses is 6, as this is the number of stalls currently available to house horses in the existing building.

6. The traffic generation will be minimal, since Stoffel Equine Veterinary Services will remain as a primary ambulatory practice. When horses are hauled to the site, the existing gravel driveway for the proposed clinic is a large horseshoe shape that is right off the main road, 130th Ave. This will allow for plenty of off street loading and unloading potential. Therefore, no congestion will be on the main road, and the site is easily accessible.

7. Parking will be made available in the driveway itself and to the west of the building. Currently, the driveway and parking area is gravel, just as the main road, 130th Ave is gravel as well.

8. Solid waste disposal provisions are in place with P.I.G. Furthermore, as a practicing Veterinarian, I have an active relationship with a rendering service that provides prompt disposal of deceased animal carcasses. This service will be utilized if needed at the clinic.

9. The existing building is equipped with optimal utilities such as electric, propane gas, water from our existing well on the property, and sanitary facilities in place with a septic holding tanks already in use.

10. The exterior lighting on the building is already established, and it is in accordance with other properties surrounding the location. This consists of a bright exterior "farm light" which automatically turns on at dusk and off at dawn.

11. An exterior sign stating the name of the business is being proposed. This sign would be located in front of the building with appropriate set backs from the road. If exterior lights would be placed on or near the sign, they will consist of small soft solar lighting pointed directly at the sign.

12. No proposed exterior storage is needed. Existing exterior storage is located off the back of the barn on the east side of the building, as the roof line forms a lean-to. This allows for exterior storage that is still contained and hidden out of plain view.

13. Safety and security measures are currently in place as the existing building is equipped with an ADT security system that provides both fire alarms and burglar alarms. All exterior access doors have locks. In addition, inventory for the operation of the business is further under lock and key with in the building.

14. Accessibility measures for emergency services to the site are in place. The county has already issued a new address/fire number for our barn, since it is located at the end of our property and the entrance is on 130th Avenue. The house address is located on 265th Street. The new barn address makes it easy and convenient to differentiate between the house and the barn locations in case of an emergency.

15. As an already operating horse facility, there is no more potential to generate more noise, odor, or dust for this conditional use permit on the existing building. However, measures are in place to control odors such as manure. This consists of taking the waste from the horses and placing it into a manure spreader. The waste is then spread onto our property. This not only helps to keep odors minimal, but also helps to decrease fly populations, provides an excellent nutrient source for fertilizing our hay fields, and builds soil fertility. There is minimal noise that comes from a horse operation. Furthermore, I cannot foresee any significant increase in dust due to the Veterinary Clinic. The road for the potential clinic is located on 130th Avenue, which is a gravel road, and the driveway to the potential clinic is gravel as well. Therefore, the dust potential is no more than normal traffic traveling by on the road. The township does spray the road with sodium chloride in front of properties to help decrease the dust from the traffic onto buildings/properties.

16. Landscaping, grading, excavating, and filling has been completed on the existing building, therefore, no proposals are necessary.

17. Proper drainage routes, culverts, and gutters are in place on existing building.

18. Not Applicable.

19. The conditional use permit for a Veterinary Clinic will provide a needed service for our region. It will benefit our community horse owners so I can provide a broader range of services to contribute to our horse community.

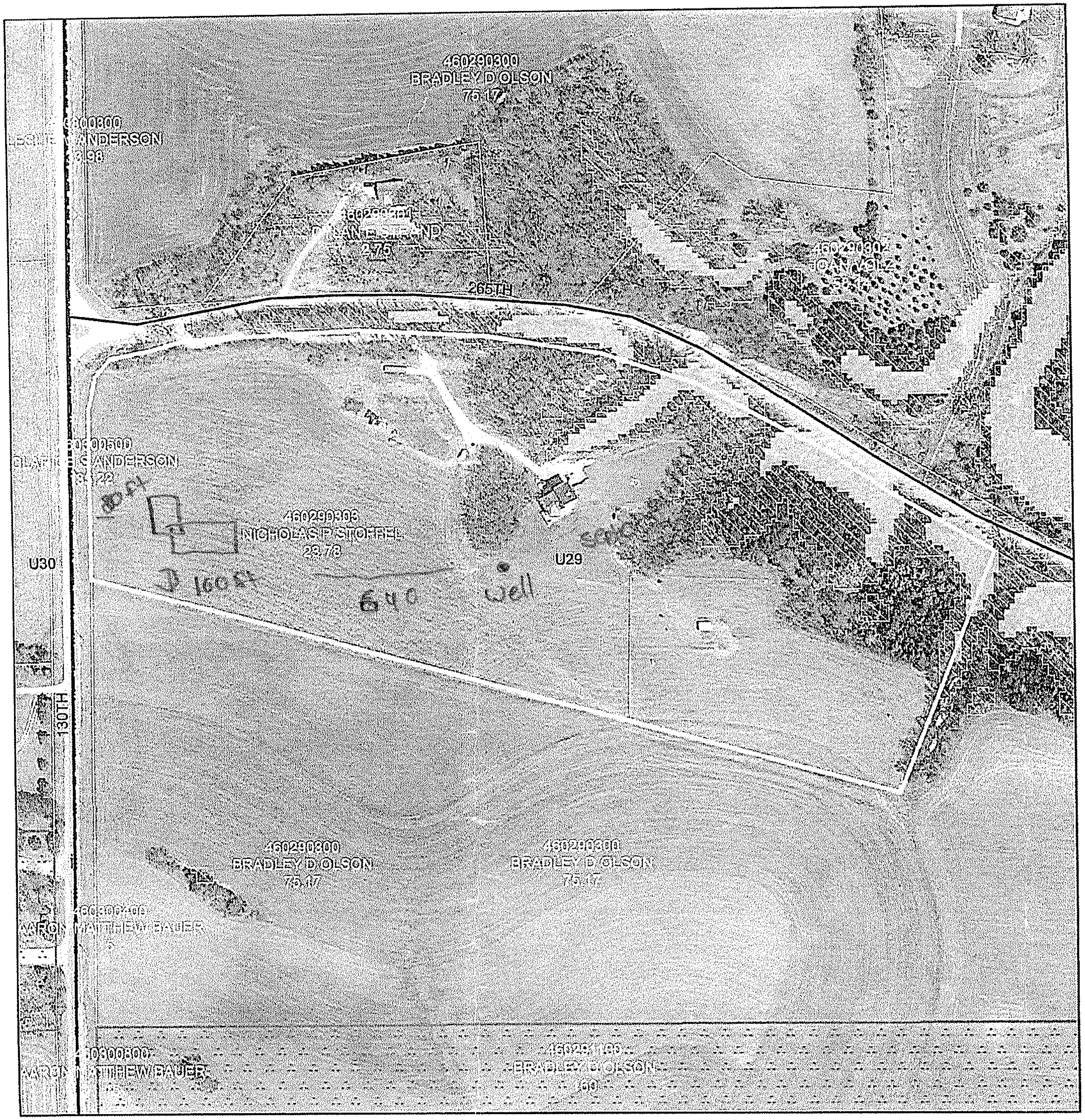
The township has approved this conditional use permit for an Equine Veterinary Clinic with a few reasonable restrictions. However, their request of an annual review of the permit by the county is, what I believe, to be excessive. If this is a stipulation that must be met, I request that the township pays any yearly fees for this process to occur.

An Equine Veterinary Clinic needs to be in a rural, agricultural area. There is already a shortage of Equine Veterinarians in the State. By allowing a new Equine Clinic to emerge, it will help to serve the citizens of the county and many of the surrounding counties as well.

Site Plan

Must include the following information (if applicable):

- [x] North arrow
- [x] Property lines
- [x] Dimensions of parcel
- [x] All buildings with dimensions
- [x] Distance
- [ ] Proposed building(s) with dimensions and distances to property lines
- [ ] Distance from proposed building(s) to well
- [ ] Distance from proposed building(s) to septic system
- [ ] Any natural feature(s) having an influence on the variance



PID # 460290303
Zoning District: A2

The following information is required for a Site Plan:

1. Location, size and shape of any structures Clearly distinguish between existing and proposed;
2. Distances from structures to property lines;
3. Distances between structures, porches and decks;
4. All wells and sanitary sewer systems (including any abandoned) and the distance to nearby structures
5. The existing and intended use of the property;
6. All landscape, screening, and fencing plans;

Upon review, projects may require other information

Legend

- Road
- 2014 Feedlot parcel
- Tax Parcel
- Section Line
- Municipal Boundaries
- Dwelling Point

% Slope

- 20
- 30
- Shoreland

Special Flood Hazard Area

FLD_ZONE

- 0.2 PCT ANNUAL CHANCE FLOOD HAZARD
- A
- AE
- AO
- X

0 100 200 400 600 Feet

DATA DISCLAIMER: Goodhue County assumes NO liability for the accuracy or completeness of this map OR responsibility for any associated direct, indirect, or consequential damages that may result from its use or misuse. Goodhue County Copyright 2015.

2014 Aerial Imagery

Map Created 2015 Land Use Management

Commissioner Nystuen asked if the SWCD has any oversight in the process.

Commissioner Fox responded that the SWCD would need to be involved in the Plat process to review soil erosion and water concerns.

The Applicant added that Featherstone Township has a minimum frontage requirement of 200 feet on a public road. He added that he has had conversations with civil engineers ahead of time to ensure it was physically feasible to negotiate the slopes to create access.

Commissioner Drazkowski commented that if the township is supportive of the area to be zoned R1 it wouldn't make sense for the County to be opposed.

[7]Motion by Commissioner Nystuen seconded by Commissioner Huneke, for the Planning Advisory Commission to:

- adopt the staff report into the record;
- accept the application, testimony, exhibits, and other evidence presented into the record; and

Recommend the County Board of Commissioners **APPROVE** the map amendment request from Blake Thompson to rezone 38 acres from A3 (Urban Fringe District) to R1 (Suburban Residence District).

Motion Carried 7:1

PUBLIC HEARING: Request for CUP for a Veterinary Clinic
Request submitted by Nicholas and Krystyna Stoffel for CUP to establish a Veterinary Clinic at 26336 130th Ave Welch, MN 55089. Parcel 46.029.0303. Part of the NW ¼ of NW ¼, SW ¼ of NW ¼, and SE ¼ of NW ¼, Sect 29 Twp 113 Range 16 in Welch Township. A2 Zoned District.

The Applicants were present to represent their application.

Wozniak presented the staff report and appendixes.

The Applicant stated she has been a mobile equine practitioner for over 11 years. Her clientele has expanded to greater a distance which prompted the desire to allow people to bring horses to her property to reduce their travel time. She added she does not do emergency veterinarian services at this time.

Chair Fox opened the Public Hearing.

Aaron Bauer 26469 130th Ave Welch, MN stated he is the closest neighbor to the Applicants and is supportive of their request. He believes no additional traffic will be created as a result of the request.

[8]After Chair Fox asked three times for comments. It was moved by Commissioner Feuling and seconded by Commissioner Allen to close the public hearing.

Motion carried 8:0

Commissioner Nystuen asked if there was a condition limiting the transfer of the CUP to a third party.

Hanni replied, no, that is the township's requirement.

[9]Motion by Commissioner Allen seconded by Commissioner Pettit, for the Planning Advisory Commission to:

- adopt the staff report into the record;

PLANNING COMMISSION
GOODHUE COUNTY, MN
April 16, 2018 MEETING MINUTES
DRAFT

- adopt the findings of fact;
- accept the application, testimony, exhibits, and other evidence presented into the record; and

Recommend the County Board of Commissioners **APPROVE** the request from Nicholas and Krystyna Stoffel for a CUP to establish a Veterinary Clinic.
Subject to the following conditions:

1. Activities shall be conducted according to submitted plans, specifications, and narrative unless modified by a condition of this CUP;
2. Hours of operation shall be Monday through Friday, 8:00 AM to 6:00 PM, and Saturdays from 9:00 AM to 1:00 PM (excluding holidays);
3. On-street parking shall be prohibited;
4. On-street loading or off-loading shall be prohibited;
5. Applicants' shall obtain Building Permit approvals for change of use for the existing structure from the Goodhue County Building Permits Department prior to establishing the use;
6. Applicants' shall work with Goodhue County Environmental Health to achieve compliance with the Goodhue County SSTS Ordinance;
7. Compliance with Goodhue County Zoning Ordinance including, but not limited to Article 22 A-2 (Agriculture District);
8. Compliance with all necessary State and Federal registrations, permits, licensing, and regulations.

Motion Carried 8:0

PUBLIC HEARINGS: Simanski Metals LLC (Kevin Simanski)
29409 HWY 58 BLVD, Red Wing, MN 55066. Parcels 34.008.1400 and 34.008.1500. Part of the SE ¼ of NW ¼, Sect 08 Twp 112 Range 14 in Hay Creek Township. A2 and B2 Zoned District.

A. Map Amendment (Rezone)
Request for map amendment to rezone part of Parcel 34.008.1500 from B2 to A2.

B. CUP for a Junk/Salvage Reclamation Yard
Request for a conditional use permit (CUP) to establish a Junk/Salvage Reclamation Yard for storage, loading, and processing of recyclable materials.

The applicant was present to represent the application.

Wozniak presented the staff report and attachments. He read an e-mail provided by the Applicants that detailed plans to alter the proposal to remove the transfer facility component (see attachment 11).

Hanni commented that Applicant should clarify what exactly they are requesting and the PAC should determine if they are comfortable with the proposal or if they feel it is necessary to table the item and have the Applicant resubmit their application.

Kevin Simanski (Applicant) stated that the transfer station is secondary to their original purpose of the site so they are removing it given the issues the neighbors have had with it. He stated that removal of the transfer station component should address many of the concerns with traffic, trash, and noise at the site. He stated he would like to move forward with the rezone as requested and the CUP request as amended.

Hanni reviewed the Applicant's application to clarify which components of the application were being struck from the proposal (see attachment 12).

Goodhue County Land Use Management

Goodhue County Government Center | 509 West Fifth Street | Red Wing, Minnesota 55066

Lisa M. Hanni, L.S. Director

Building | Planning | Zoning
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Meeting Date: May 8, 2018
Report date: April 27, 2018

PUBLIC HEARING: Request for Map Amendment (Rezone)
Request for map amendment submitted by Blake Thompson to rezone 38 acres from A3 (Urban Fringe District) to R1 (Suburban Residence District). Parcels 31.001.6100 and 31.001.6200. Part of the SW ¼ of SE ¼ and GOVT Lot 2 in Sect 01 Twp 112 Range 15 in Featherstone Township. A3 Zoned District.

Application Information:
Applicant(s): Blake Thompson
Address of zoning request: 23849 289th ST, Red Wing, MN 55066
Parcel(s): 31.001.6100 and 31.001.6200
Abbreviated Legal Description: Part of the SW ¼ of SE ¼ and GOVT Lot 2 in Sect 01 Twp 112 Range 15 in Featherstone Township
Township Information: Featherstone Township endorsed acknowledgement of the applicant's request.
Zoning District: A3 (Urban Fringe District)

Attachments and links:
Application and submitted Project Summary
Draft PAC Minutes and Attachments
Goodhue County Zoning Ordinance: http://www.co.goodhue.mn.us/DocumentCenter/View/2428

Background:
The applicant owns 2 parcels of land comprising approximately 38 acres in Featherstone Township. The parcels are currently zoned A3 (Urban Fringe District) requiring a minimum of 35 acres per parcel to establish new dwelling sites. The applicant's primary residence currently occupies the eastern most parcel, there is density remaining to establish a second dwelling on the unoccupied parcel. The applicant is requesting the rezone to R1 to allow the property to be subdivided in the future to establish a proposed total of up to 4 dwelling sites.

Project Review:
- The subject property consists of 2 contiguous parcels comprising 38 acres.
- Existing property access is located off of 289th ST in the southwest corner of the property. 289th ST is an existing private drive that may require upgrades to meet the private road standards required by Goodhue County's Subdivision Controls Ordinance.
- The applicant is proposing to establish a second driveway access off of Hay Creek Trail on the west side of the property.
- The proposed future use of the parcels is to subdivide the property to establish a total of four dwelling development sites.

  Future subdivision of the property will require platting.
- The property has significant topographical relief and portions of the northern half of the property may qualify as Blufflands. Future development of these areas would be subject to the

requirements of Goodhue County Zoning Ordinance Article 12 (Bluffland Protection).

- There is no Shoreland District located within property limits. Aerial imagery does indicate the presence of intermittent streams (dry runs) on the property that should be carefully considered with proposed development to prevent erosion and protect downstream water quality.
- The majority of the property is currently undeveloped and is covered by deciduous forest. Future cutting and vegetation removal necessary for development will be required to adhere to the standards and best management practices outlined in GCZO Article 7 Section 7 (Vegetative, Tree, & Woodland Alterations).
- Surrounding land uses include low-density residential to the east, south, and west. A medium density rural residential subdivision is situated less than 1000 feet north of the subject properties. High-density residential subdivisions located within Red Wing city limits are situated less than a half-mile east.
- Adjacent zoning districts include A3 to the north, east, and west; A2 to the south.
- Per GCZO Article 13 (Confined Feedlot Regulations):
    - New residential districts (R1) shall not be located within 1000 feet or 96% OFFSET odor annoyance free rating distance, as determined by the OFFSET odor evaluation model, from any existing feedlot, whichever is greater.
    - New feedlots are not permissible within 1 mile of the city of Red Wing or within A3 and R1 districts.

  The nearest adjacent registered feedlot is located greater than 1 mile south of the subject properties.
- The purpose of the R1 district is to provide a district which will define and protect areas suitable for low to medium density residential development as the principal use of the land and to allow related facilities desirable for a residential environment. It is also intended that this district allow varying densities of development in accordance with the ability to provide water and sewer facilities.
- The Prime Farmland Rating for Agriculture is as follows:

Soil Name	***Slope***	***Amount (acres)***	***% of Total***	***Prime Farmland Rating***
Rasset Fine Sandy Loam	0-6%	1.7	4.5%	Prime Farmland
Newhouse-Valton	12-18%	4.6	12.3%	Not Prime Farmland
Chelsea Loamy Sand	2-6%	6.2	16.5%	Not Prime Farmland
Chelsea Loamy Sand	6-12%	4.3	11.5%	Not Prime Farmland
Chelsea Loamy Sand	12-35%	0.5	1.4%	Not Prime Farmland
Hawick Sandy Loam	18-45%	14.0	37.3%	Not Prime Farmland
Udifluvent Loam	2-12%	6.1	16.2%	Not Prime Farmland
Coloma Loamy Sand	0-6%	0.1	0.4%	Not Prime Farmland

- The property appears to have adequate soils and ample room to accommodate compliant sanitary facilities for proposed future developments consistent with SSTS regulations.
- Staff's review of property records revealed no Condition or Interim Use Permits have been issued to the property.
- The proposed rezone appears compatible with the goals and objectives of the Goodhue County Comprehensive Plan:

  "Direct the location of new or replacement dwelling sites in areas that minimize loss or conversion of prime agricultural soils"

  "If residential development occurs, it should be compact and designed to preserve the prime farmland for agricultural uses or other compatible uses to minimize conflicts between agriculture and non-agricultural uses"

"Soils with Prime Farmland rating shall be protected from non-agricultural development whenever possible"

"Provide more housing choices for rural residents"

- No impacts to historic amenities are anticipated as a result of the proposed rezone.
- Future development near any qualifying bluffs will be required to meet setbacks to areas qualifying as Bluffland on the property as well as meet Bluffland protection standards specified in Goodhue County Zoning Ordinance Article 12 to protect those scenic amenities.
- Dwelling development density in A3 is restricted to 1 dwelling per 35 acres.

  Dwelling density for section 01 is currently at 64 dwellings, 61 of which are located in the E1/2 of the section, and 9 are not located within an existing platted area. The applicants are proposing 2 additional dwellings beyond what is currently allowed, bringing the final density total to 66 for the section.

  Allowing additional dwelling development sites in this location does not appear to negatively affect the surrounding area or the city of Red Wing.
- No substantial negative impacts to adjacent properties are anticipated as a result of the proposed rezone.
- The proposed rezone appears compatible with existing adjacent land uses in the immediate area.

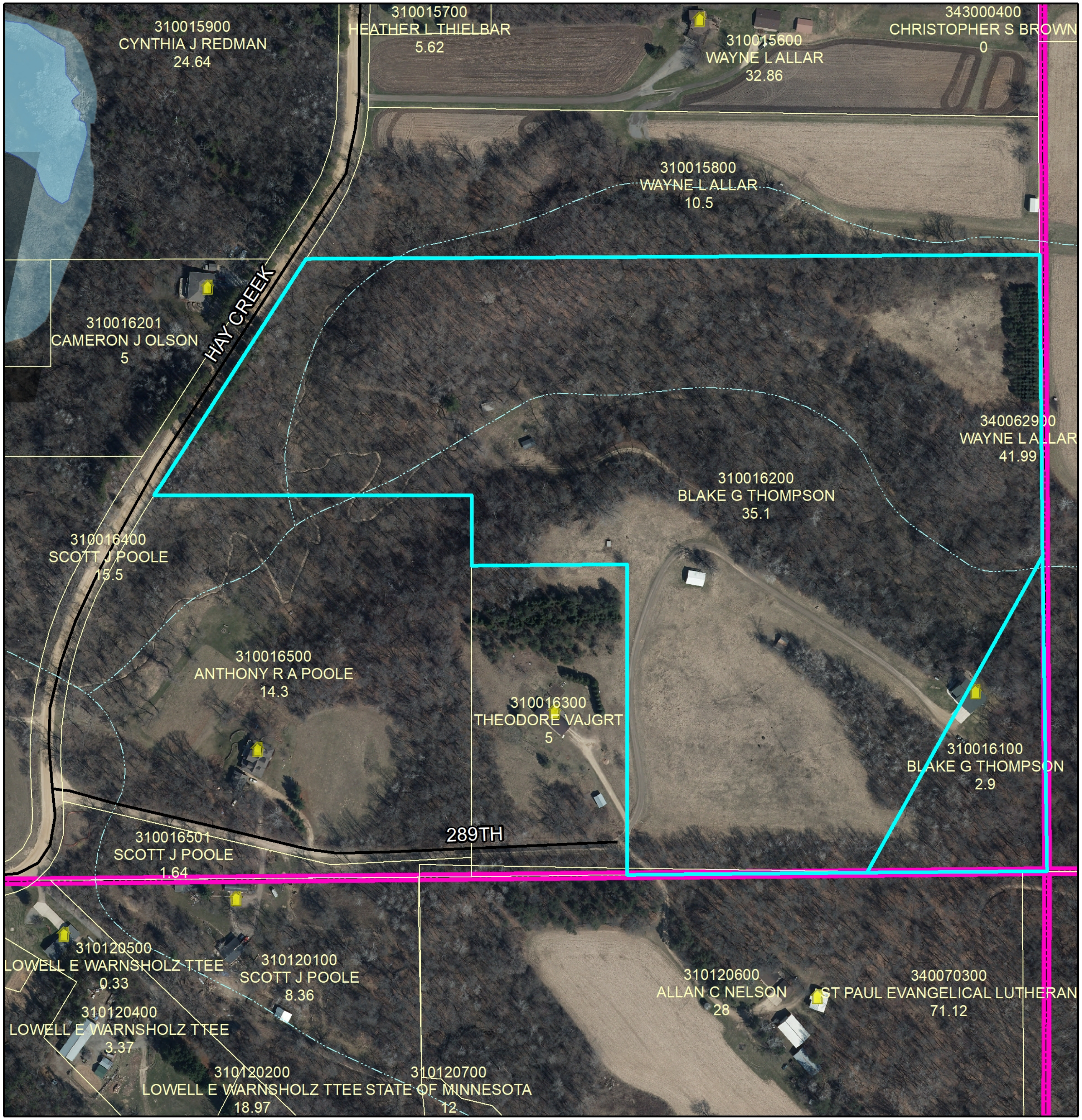
The application and relevant documents were reviewed by the Planning Advisory Commission (PAC), in addition to holding a public hearing in which they accepted testimony and written comments at their April 16, 2018 meeting. The PAC recommended approval for this request with a 7:1 vote.

Planning Advisory Commission Recommendation:

The PAC recommends the County Board

- adopt the staff report into the record;
- accept the application, testimony, exhibits, and other evidence presented into the record; and

APPROVE the map amendment request from Blake Thompson to rezone 38 acres from A3 (Urban Fringe District) to R1 (Suburban Residence District) for parcels 31.001.6100 and 31.001.6200.



Planning Advisory Commssion

Public Hearing
April 16, 2018

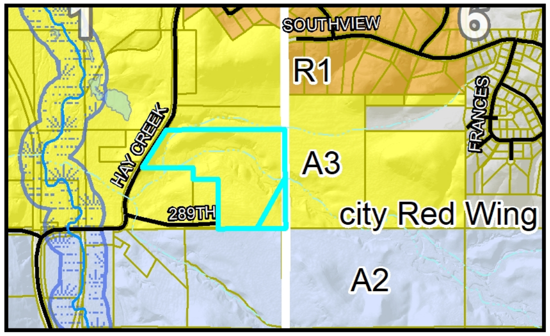
Blake Thompson
A3 Zoned District

Parcels 31.001.6100 & 31.001.6200, Part of the SW ¼ of SE ¼ and GOVT Lot 2 in S01 T112 R15 in Featherstone Township

Map amendment request to rezone property from A3 to R1

Legend

Intermittent Streams	**Bluff Impact Zones (% slope)**
Protected Streams	20
Lakes & Other Water Bodies	30
Shoreland	**FEMA Flood Zones**
Historic Districts	2% Annual Chance
Parcels	A
Registered Feedlots	AE
Dwellings	AO
Municipalities	X



2016 Aerial Imagery

Map Created April, 2018, Ryan Bechel

0 80 160 320 480 640 Feet

1

GOODHUE COUNTY ZONING DISTRICT CHANGE APPLICATION

RECEIVED
MAR 23 2018
Land Use Management

Parcel # 31.001.6100 Permit # Z18-0020

PROPERTY OWNER INFORMATION

Last Name Thompson	First Blake	M.I. G	Date of Birth
Street Address 23849 289th St.			Phone
City Red Wing	State MN	Zip 55066	Attach Legal Description as Exhibit "A" ☒
Authorized Agent n/a			Phone n/a

Mailing Address of Landowner: 23849 289th St. - Red Wing, MN 55066

Mailing Address of Agent: n/a

PROJECT INFORMATION

Site Address (if different than above):

Lot Size 35.1+2.9= 38acre Structure Dimensions (if applicable) 60x40

Existing Zone A3 Proposed Zone R1

Existing Use Residential (two parcels- A3)

Proposed Use: Residential (four parcels- R1)

DISCLAIMER AND PROPERTY OWNER SIGNATURE

I hereby swear and affirm that the information supplied to Goodhue County Land Use Management Department is accurate and true. I acknowledge that this application is rendered invalid and void should the County determine that information supplied by me, the applicant in applying for this variance is inaccurate or untrue. I hereby give authorization for the above mentioned agent to represent me and my property in the above mentioned matter.

Signature of Landowner [signature] Date 3/19/2018

Signature of Agent Authorized by Agent

TOWNSHIP INFORMATION

Township Zoning Permit Attached? ☐ If no please have township complete below:

By signing this form, the Township acknowledges being made aware of the request stated above. In no way does signing this application indicate the Township's official approval or denial of the variance request.

Signature [signature] Title Treasurer Date 3/19/18

Comments:

COUNTY SECTION

COUNTY FEE $500 RECEIPT # 16200 DATE PAID 3/23/18

Applicant requests a variance from Article ___ Section ___ Subdivision ___ of the Goodhue County Zoning Ordinance

What is the formal wording of the request?

Shoreland ______ Lake/Stream Name ______ Zoning District ______

Date Received ______ Date of Public Hearing ______ DNR Notice ______ City Notice ______

Action Taken: ____Approve ____Deny Conditions:

APPLICANT FINDINGS OF FACT
AND SUPPORTING INFORMATION REGARDING ZONING DISTRICT CHANGE APPLICATION

1. How does the requested change compatible with the Goodhue County Comprehensive Plan?

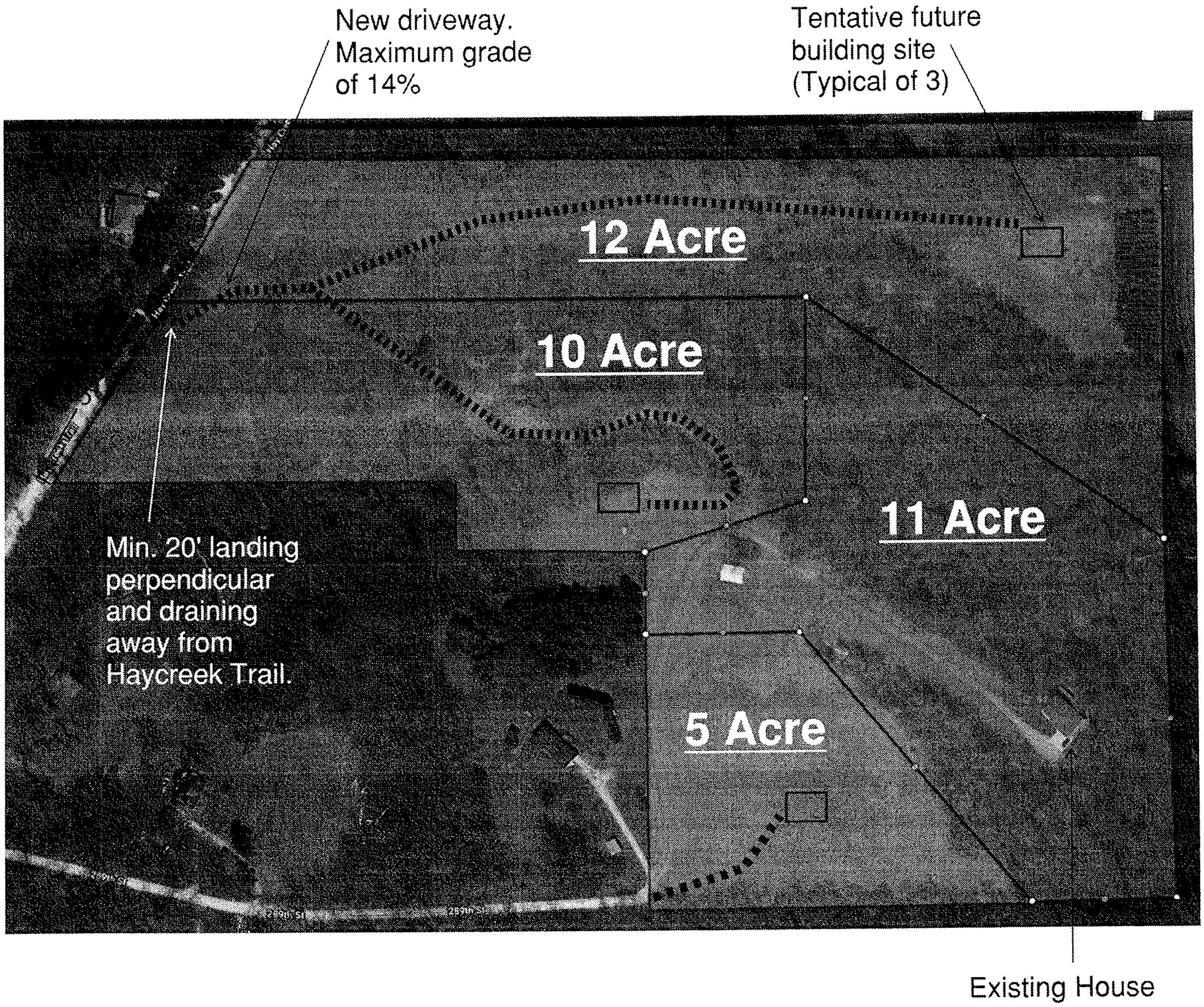
   Convert A3 zoning which could be eliminated from county zoning.

2. What is the cumulative effect of the requested zoning change on the affected Township and any cities located within 2 miles of the proposed parcel?

   One additional residential building site likely. Potentially a total of three additional building sites possible in the future.

3. Is the zoning change compatible with the affected Township and any cities located within 2 miles of the proposed parcel?

   In contact with Featherstone Township they noted that property falls within township designated area for R1 zoning and has a preference for 5 acre minimum lot size.



23849 289th Street - Proposed Layout

2

CERT. OF R. E. VALUE FILED

DOC#: A- 592142

Certified, Filed, and or Recorded on:
February 06, 2012 8:00 AM
Signed ______ Deputy
LISA M HANNI
GOODHUE COUNTY RECORDER
Fee Amount: $96.00

23441

No Delinquent Taxes and transfer entered
this 6th day of February 2012
Carolyn Holmsten Goodhue County Auditor
By Deputy Auditor

OFFICE OF COUNTY RECORDER
GOODHUE COUNTY, MN
WELL CERTIFICATE RECEIVED

Drafted By+
After Recording Return to:
PowerLink
345 Rouser Rd.
Coraopolis PA 15108
Prepared by: Anna Crawley
Pl# 194029
Prepared by signature: Anna Crawley

DEED TAX
$956.67
02/06/12
Goodhue County A/T OR Deputy - Date

Mail Tax Statements to:
BLAKE THOMPSON
23849 289TH ST
RED WING, MN 55066-7142

Property Tax ID#: 31-001-6100 and 31-001-6200

SPECIAL WARRANTY DEED

State Deed Tax Due 956.67

MADE this 29 day of DEC, 2011, by and between DEUTSCHE BANK NATIONAL TRUST COMPANY, AS TRUSTEE FOR ARGENT SECURITIES INC., ASSET-BACKED PASS-THROUGH CERTIFICATES, SERIES 2006-W1, whose post office address is 4600 Regent BLVD STE 200 Irvin TX 75063 Grantor, and BLAKE THOMPSON and REBECCA THOMPSON, MARRIED, whose post office address is 23849 289TH ST RED WING, MN 55066-7142, Grantee;

WITNESSETH, that said Grantor, for and in consideration of the sum of Two hundred eighty nine thousand nine hundred dollars and 00/100 ($289,900.00 DOLLARS), and other good and valuable considerations in hand paid by Grantee, the receipt whereof is hereby acknowledged, this day bargained and sold to the said Grantee forever, all the right, title, interest, claim and demand which the said Grantor has in and to the following described lot, piece or parcel of land, situate, lying and being in Goodhue County, Minnesota, to wit:

The tract of land lying and being in the County of Goodhue, State of Minnesota, described as follows, to-wit:
Government Lot 1 and those parts of Government Lot 2 and the SW 1/4 of the SE 1/4, all in Section 1, Township 112 North, Range 15 West, Goodhue County, Minnesota, described as follows:

Beginning at the SE corner of said Section 1; thence on an assumed bearing of West, along the South line of Government Lots 1 and 2, a distance of 1219.73 feet to SW corner of that certain property as described in Goodhue County Document Number 289316; thence on a bearing of North, along the west line of said document 289316 and its extension, a distance of 810.00 feet; thence on a bearing of West, a distance of 708.80 feet to the centerline of Hay Creek Road; as now located and established; thence northeasterly along said

Order No: 194029

1/5 60545

centerline to the north line of the SW ¼ of the SE ¼ of said Section 1; thence South 89 degrees 43' 56" East, along said North line and along the North line of said Government Lot 2, a distance of 1599.51 feet to the NE corner of said Government Lot 2; thence South 0 degrees 01' 54" East, along the East line of said Government Lots 1 and 2, a distance of 1308.57 feet to the point of beginning.

EXCEPT

That part of Government Lot 2, of Section 1, Township 112, Range 15, Goodhue County, Minnesota, according to the original Government Survey thereof, described as follows:

Commencing at the SE corner of said Section 1; thence on an assumed bearing of West, along the South line of Government Lots 1 and 2, in said Section 1, a distance of 889.73 feet to a placed iron pipe at the point of beginning of the land to be described; thence continue on a bearing of West, along the South line of said Government Lot 2, a distance of 330.00 feet to a placed iron pipe; thence on bearing on North, a distance of 660.00 feet to a placed iron pipe; thence on a bearing of East, a distance of 330.00 feet to a placed iron pipe; thence on a bearing of South, a distance of 660.00 feet to the point of beginning.

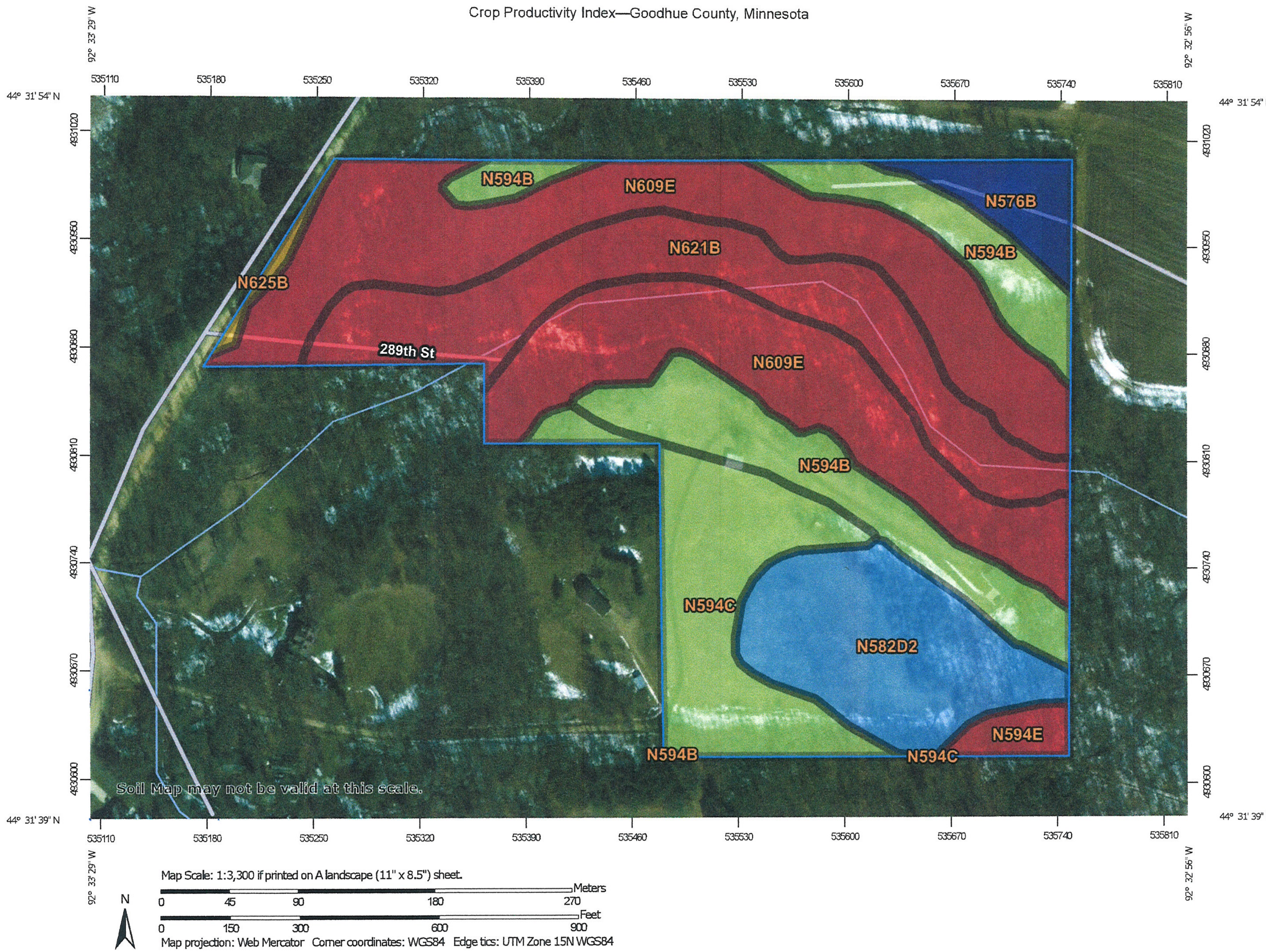
TOGETHER WITH THE FOLLOWING EASEMENT:

An easement for roadway purposes over, under and across the South 81.00 feet of the Theodore Vajgrt and Elisa Vajgry property as described in that certain Warranty Deed dated January 6, 1984 and recorded January 6, 1984 as Document No. 289316.

ALSO, a 66.00 foot wide roadway easement over, under and across that part of Government Lot 2, of Section 1, and that part of the SW ¼ of the SE ¼ of Section 1, all in Township 112, Range 15, Goodhue County, Minnesota, according to the original Government Survey thereof. The centerline of said easement is described as follows:

Commencing at the SE Corner of said Section 1; thence on an assumed bearing of West, along the South line of Government Lot 1 and 2; in said Section 1, a distance of 1219.73 feet to a placed iron pipe; thence on a bearing of North, a distance of 52.85 feet to the point of beginning of the centerline to be described; thence South 89 degrees 07' 35" West, a distance of 327.31 feet thence North 76 degrees 37' 06" West,
to the easterly right of way line of the Township Road, as now located and established and there terminating. The sidelines of said easement are to be prolonged or shortened to

Crop Productivity Index—Goodhue County, Minnesota



Crop Productivity Index

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
N576B	Rasset fine sandy loam, 0 to 6 percent slopes	61	1.2	3.4%
N582D2	Newhouse-Valton complex, 12 to 18 percent slopes, moderately eroded	53	4.6	12.7%
N594B	Chelsea loamy sand, 2 to 6 percent slopes	46	5.6	15.6%
N594C	Chelsea loamy sand, 6 to 12 percent slopes	45	4.5	12.5%
N594E	Chelsea loamy sand, 12 to 35 percent slopes	23	0.6	1.5%
N609E	Hawick sandy loam, 18 to 45 percent slopes	18	13.4	37.3%
N621B	Udifluvents, loamy, 2 to 12 percent slopes, frequently flooded	20	5.9	16.3%
N625B	Coloma loamy sand, 0 to 6 percent slopes	33	0.2	0.7%
Totals for Area of Interest			**36.0**	**100.0%**

Description

Crop productivity index ratings provide a relative ranking of soils based on their potential for intensive crop production. An index can be used to rate the potential yield of one soil against that of another over a period of time. Ratings range from 0 to 100. The higher numbers indicate higher production potential. The rating is not crop specific. Minnesota inquiries must use the 'Map Unit Cropland Productivity Report (MN)' soils report from the Soil Reports tab under 'Vegetative Productivity'.

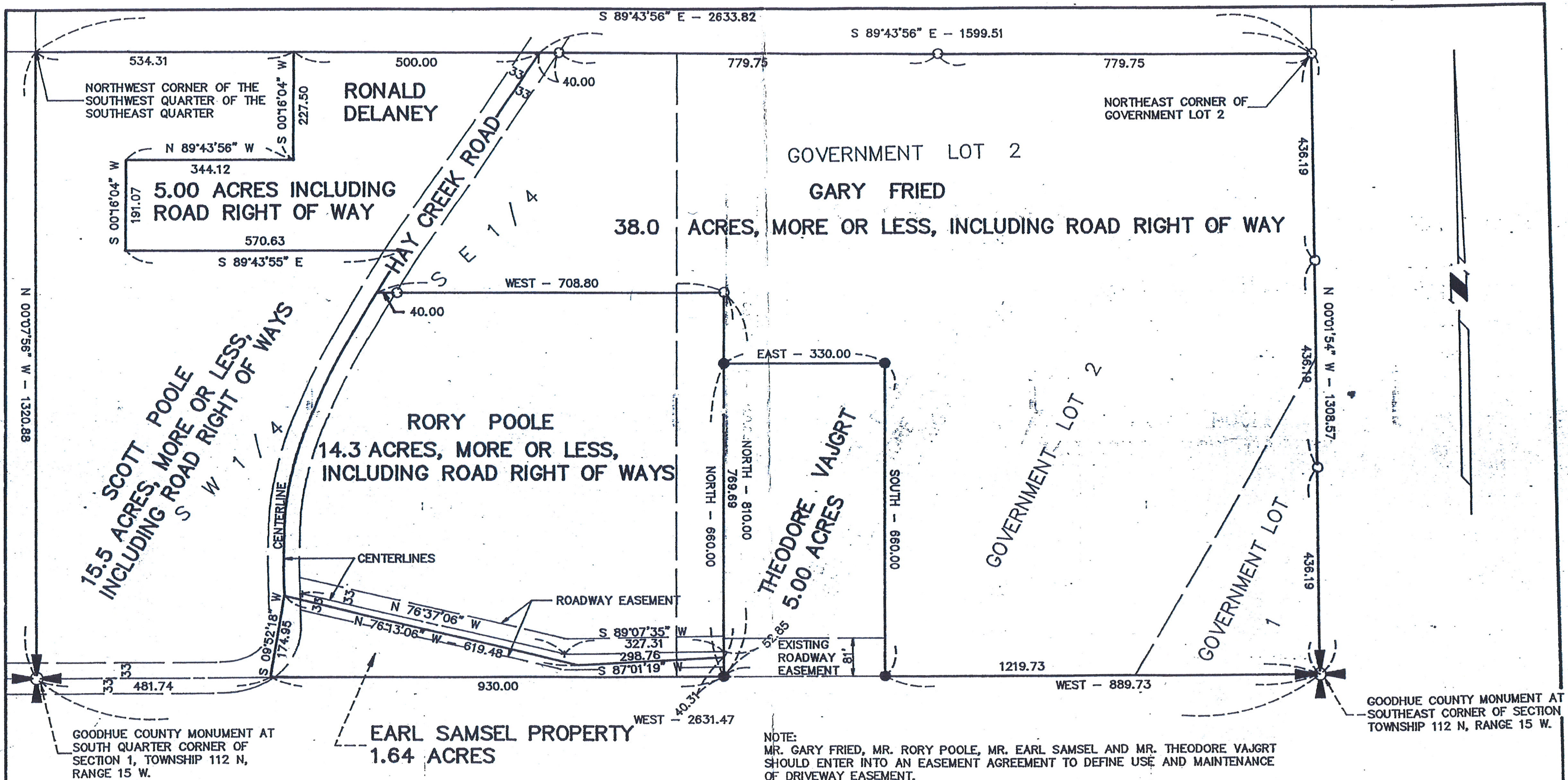
When the soils are rated, the following assumptions are made: a) adequate management, b) natural weather conditions (no irrigation), c) artificial drainage where required, d) no frequent flooding on the lower lying soils, and e) no land leveling or terracing. Even though predicted average yields will change with time, the productivity indices are expected to remain relatively constant in relation to one another over time.

Rating Options

Aggregation Method: Weighted Average

Component Percent Cutoff: None Specified

5369



NOTE:
MR. GARY FRIED, MR. RORY POOLE, MR. EARL SAMSEL AND MR. THEODORE VAJGRT SHOULD ENTER INTO AN EASEMENT AGREEMENT TO DEFINE USE AND MAINTENANCE OF DRIVEWAY EASEMENT.

200 0 200 400 600 Feet

BEARINGS ARE ASSUMED

○ DENOTES A PLACED 1 INCH X 18 INCH IRON PIPE

● DENOTES A FOUND IRON MONUMENT

SURVEY FOR: MR. ALLEN POOLE – MR. GARY FRIED – MR. RORY POOLE – MR. EARL SAMSEL – MR. SCOTT POOLE

JOHNSON, SCOFIELD & REHDER INC.
LAND SURVEYORS
1203 MAIN ST.–RED WING–MN 55066 612 388–1558
WABASHA COUNTY SURVEYOR–WABASHA COUNTY COURTHOUSE
WABASHA–MN 55981 612 565–3244

I hereby certify that this survey, plan or report was prepared by me or under my direct supervision and that I am a duly Registered Land Surveyor under the laws of the State of Minnesota.

NORBERT J. REHDER
MINNESOTA REGISTRATION # 19090
Date: 2/14/1994

BK.	PG.	DRAWING NUMBER
EDS FILE:		R– S–
SHEET 1 OF 5 SHEETS		

Commissioner Pettit stated that Staff's proposed changes cover the items proposed to be struck. She stated that ultimately operators will still be required to follow all the rules but are provided improved clarity with regards to nuisance claims at the county level.

Motion to Deny Failed 3:5

[5]***Motion by Commissioner Pettit seconded by Commissioner Nystuen, for the Planning Advisory Commission to recommend the County Board to***

- adopt the staff report into the record;
- accept the application, testimony, exhibits, and other evidence presented into the record; and;

Recommend the County Board of Commissioners **APPROVE** Staff's recommended wording for the text amendment request and **DENY** the language changes requested by the applicants to the extent they are inconsistent with staff recommendations.

Commissioner Gale asked if the proposed language was going to stop nuisance actions similar to the ones mentioned in Todd County.

Commissioner Fox responded that all it was going to do was stop the County from having to be the mediator in a nuisance complaint.

Commissioner Gale asked if the County would be vulnerable to a lawsuit by not referring the proposed language for further study.

Hanni replied the County cannot know who may bring future actions against it.

Motion Carried 5:3

PUBLIC HEARINGS: Request for Map Amendment (Rezone)

Request for map amendment submitted by Blake Thompson to rezone 38 acres from A3 (Urban Fringe District) to R1 (Suburban Residence District). Parcels 31.001.6100 and 31.001.6200. Part of the SW ¼ of SE ¼ and GOVT Lot 2 in Sect 01 Twp 112 Range 15 in Featherstone Township. A3 Zoned District.

Michael Wozniak (Wozniak) presented the staff report and appendixes.

Blake Thompson (Applicant) commented that he desires to build a house on an available flat spot across a steep ravine on his property. The Applicant added that the township indicated this particular property is one of a few the Township has identified for future residential districts. He added that there is natural gas service currently available in the northwest corner of his property that he would like to utilize. He also added that the ability to sell some property would help to offset the costs necessary to construct the necessary infrastructure to access the site.

Chair Fox opened the Public Hearing.

Jay McClary 2471 Hay Creek Trail, Featherstone Township stated he understands R1 zone means residential only and not future business or commercial traffic moving past his property. He has concerns about the future use of the roads in the vicinity being capable of supporting additional residences.

Wayne Allar 28670 Hay Creek Trail, Featherstone Township is an adjacent landowner and stated he is very concerned about erosion issues with the highly-erodible soils on the property.

He referenced the Crop Productivity Index provided by the Applicant which indicates 24 of the 38 acres have slopes approaching 45%. He added there is a small stream on the property that drains into Hay Creek that is concerning. He is opposed to allowing additional residential sites on the property.

Rebecca Jansen 23700 289th ST Featherstone Township read a statement on behalf of Tony and Sara Poole. She stated they were against the rezone due to County not requesting landowner input prior to the meeting, the soils of the property are not stable enough for development, they are concerned of potential future septic runoff affecting their well water, and have concerns with traffic safety and road maintenance. They added that development should be directed to areas already zoned for such uses rather than rezoning for one landowner.

Ted Vajgrt lives on 289th ST and is a neighbor to the Applicant. He questioned how many lots the Applicant was requesting. Hanni responded "4." Mr. Vagert asked who is responsible for maintenance and repair of the existing private drive along 289th ST. He has concerns that widening of 289th ST in the future could lead to increased traffic through his property.

Wozniak clarified that the development proposal is a 2 step process. If the rezone request were to be granted, the Applicant would be required to Plat the property through a second public process where things like access and road standards as well as lot configurations would be examined. He added that Featherstone Township would be a signatore of any proposed Plat within their jurisdiction.

Hanni read comments received from Eugen Reitmann (see attachment 10)

[6]After Chair Fox asked three times for comments. It was moved by Commissioner Feuling and seconded by Commissioner Huneke to close the public hearing.

Motion carried 8:0

Commissioner Pettit stated she was concerned with changing the zoning just to accommodate an individual wanting to put additional dwellings on a property. She indicated that R1 seemed to be too high of a density for the property and that this property seemed better suited for a "Conservation Subdivision" type of design which is in the initial stages of development.

Hanni commented Staff has encouraged citizens wishing to add density to go through a rezone process to avoid having people request variances. She added that even with a zone change, given the properties topography, setbacks, and access issues, the site will not be able to accommodate more dwelling sites than the applicant has indicated (4).

Wozniak added the only option the County currently has available for higher density non-agricultural development is R1. Staff is currently developing a proposal for a "Conservation Subdivision Design" ordinance which may lend itself to this type of development but is simply not available to the Applicant at this time. He added that many of the conservation type standards could easily still be applied through the Platting process.

Commissioner Allen questioned how the Applicant's proposal fits with annexation activities of the city of Red Wing.

Hanni responded that a review of city planning documents did not reveal any information indicating the city has future annexation plans for the Applicant's property.

Wozniak added that the terrain and topography severely limit annexation potential for the property both from a practical and economic standpoint for the city. A low-density solution such as the Applicants makes sense given the physical constraints of the property.

Commissioner Nystuen asked if the SWCD has any oversight in the process.

Commissioner Fox responded that the SWCD would need to be involved in the Plat process to review soil erosion and water concerns.

The Applicant added that Featherstone Township has a minimum frontage requirement of 200 feet on a public road. He added that he has had conversations with civil engineers ahead of time to ensure it was physically feasible to negotiate the slopes to create access.

Commissioner Drazkowski commented that if the township is supportive of the area to be zoned R1 it wouldn't make sense for the County to be opposed.

[7]**Motion by Commissioner Nystuen seconded by Commissioner Huneke, for the Planning Advisory Commission to:**

- adopt the staff report into the record;
- accept the application, testimony, exhibits, and other evidence presented into the record; and

Recommend the County Board of Commissioners **APPROVE** the map amendment request from Blake Thompson to rezone 38 acres from A3 (Urban Fringe District) to R1 (Suburban Residence District).

Motion Carried 7:1

PUBLIC HEARING: Request for CUP for a Veterinary Clinic
Request submitted by Nicholas and Krystyna Stoffel for CUP to establish a Veterinary Clinic at 26336 130th Ave Welch, MN 55089. Parcel 46.029.0303. Part of the NW ¼ of NW ¼, SW ¼ of NW ¼, and SE ¼ of NW ¼, Sect 29 Twp 113 Range 16 in Welch Township. A2 Zoned District.

The Applicants were present to represent their application.

Wozniak presented the staff report and appendixes.

The Applicant stated she has been a mobile equine practitioner for over 11 years. Her clientele has expanded to greater a distance which prompted the desire to allow people to bring horses to her property to reduce their travel time. She added she does not do emergency veterinarian services at this time.

Chair Fox opened the Public Hearing.

Aaron Bauer 26469 130th Ave Welch, MN stated he is the closest neighbor to the Applicants and is supportive of their request. He believes no additional traffic will be created as a result of the request.

[8]**After Chair Fox asked three times for comments. It was moved by Commissioner Feuling and seconded by Commissioner Allen to close the public hearing.**

Motion carried 8:0

Commissioner Nystuen asked if there was a condition limiting the transfer of the CUP to a third party.

Hanni replied, no, that is the township's requirement.

[9]**Motion by Commissioner Allen seconded by Commissioner Pettit, for the Planning Advisory Commission to:**

- adopt the staff report into the record;

City of RED WING

April 9, 2018

Michael Wozniak
Goodhue County Planner / Zoning Administrator
509 West Fifth Street
Red Wing, MN 55066

RE: Blake Thompson Rezoning Application

Dear Mr. Wozniak:

City staff has reviewed the proposed rezoning request by Blake Thompson, including 38 acres from A3 (Urban Fringe District) to R1 (Suburban Residence District). The city is not supportive of this request based on the following reasons:

1. The purpose of the A3 District is to conserve land for farming and other open space land uses for a period of time until urban services become available. An orderly transition from farm to urban uses shall be achieved by either annexation, or the extension of public or other centralized sewer/water systems. Rezoning from A3 to R1 intensifies the land uses before the orderly transition (with services) is achieved.
2. The Goodhue County Comprehensive Plan supports staged growth for cities that builds upon existing infrastructure. Agricultural zoning (A1 and A2) will continue to surround this property if it is rezoned to R1 (spot zoning), resulting in more urbanized uses that are not contiguous to existing urban development.
3. Planned public street connections and networks are very important as development occurs around the municipal boundaries. What will be the public street connection to and through these 38 acres? Will 289th Street be extended, and will it eventually connect through other property to Southview Ridge? Proper transportation planning is needed if more property is considered for rezoning from A3 to R1.
4. The City of Red Wing has been addressing some (septic) problems that have occurred in existing R1 zoned residential areas northeasterly of this property. It does not make sense to now add even more housing units without municipal services or private centralized services in the Urban Fringe District that surrounds the city.
5. On March 19, 1979, the City Council adopted Resolution No. 1342 that provides for a 2-mile extension of Subdivision Ordinance regulations to guide orderly growth beyond the city's boundary. This may be applied if further subdivision is done on this property.

Sincerely,

Dan Rogness, Community Development Director
651.385.3697 dan.rogness@ci.red-wing.mn.us

Goodhue County Land Use Management

Goodhue County Government Center | 509 West Fifth Street | Red Wing, Minnesota 55066

Lisa M. Hanni, L.S. Director
Building | Planning | Zoning
Telephone: 651.385.3104
Fax: 651.385.3106

County Surveyor / Recorder
Environmental Health | Land Surveying | GIS
Telephone: 651.385.3223
Fax: 651.385.3098

To: Planning Commission
From: Land Use Management
PAC Meeting Date: April 16, 2018

Response to Red Wing's Comments

The County received comments from the City of Red Wing concerning the Blake Thompson rezone request on April 9, 2018.

The property currently has one dwelling and could add another dwelling without changing the zoning district. The request is to reconfigure the property to allow a total of four dwellings on the site.

1. The County has been meeting and discussing the A3 district with the Townships for a number of years. Last year, the Townships reconfirmed their desires to not enact an overall increase to the A1 and A2 district densities and to avoid adding more dwellings through the variance process. If more density was allowed, it was agreed that it should be done through a change of zone process. The purpose statement of the A3 district was also discussed. In most cases, the district was created as a one-mile outline of the existing city boundaries following amendment of the County's Zoning Ordinance to establish the A3 (Urban Fringe) in 1993, with no specific regard to topography or realistic extension of city services.

Some cities have annexed beyond the County's A3 district, and in other cases cities will never annex into the A3 districts for numerous reasons including potential growth and topography. We do not believe the few dwellings planned for these parcels would ever be serviced by city water or sewer due to the topography and distance.

There is an R1 district within 500 feet to the north of this property; A2 and A3 districts adjacent to the property. None of the property is currently being farmed, nor is it considered prime agricultural land.

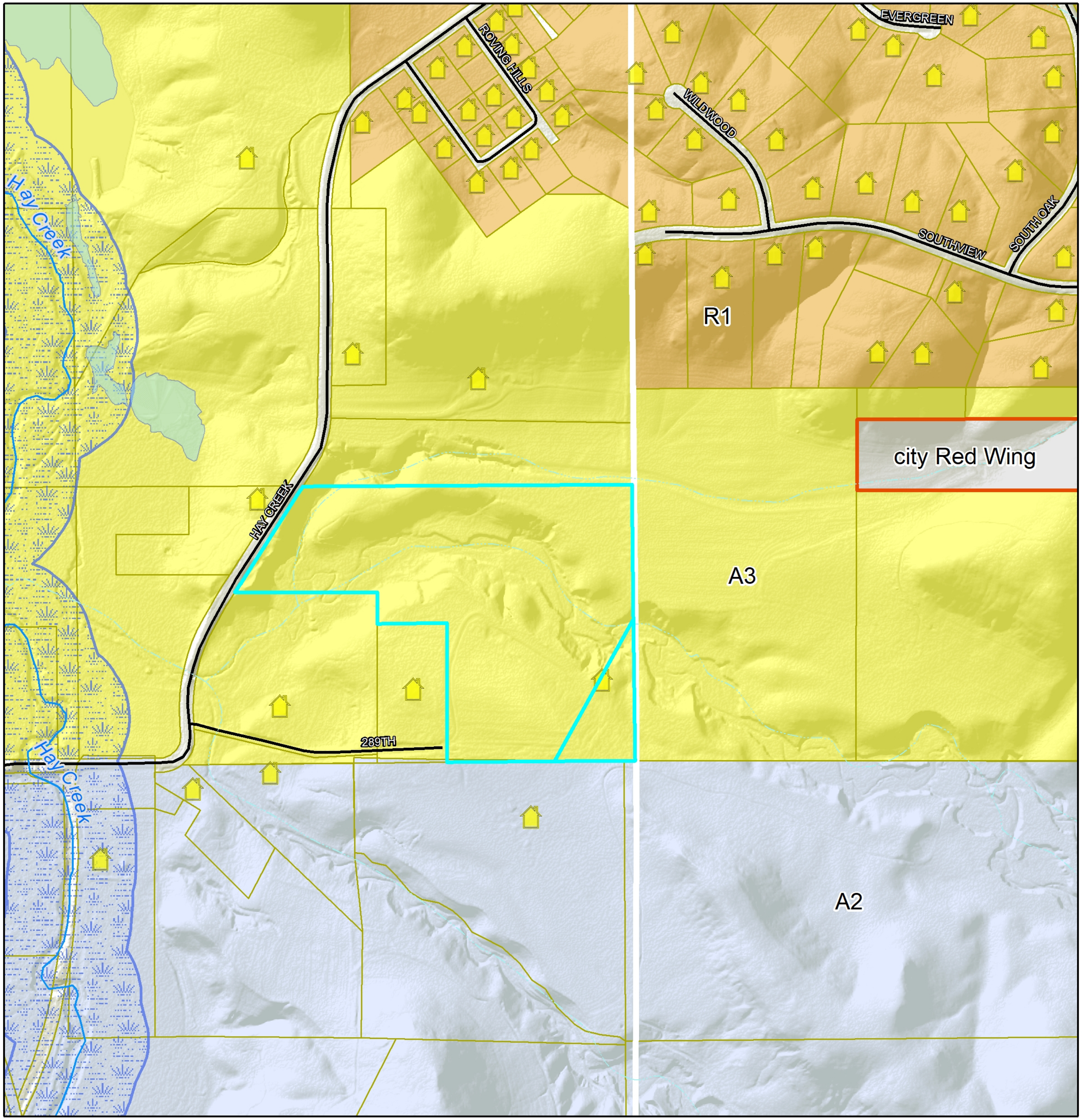
2. The closest city infrastructure to this request is over a half mile to the east. Serving the Blake Thompson property from that direction would involve negotiating a steep bluff and deep ravine bounded by bluffs. The other option of coming down Twin Bluff Road – Haycreek Trail would involve over one mile of infrastructure. We are not aware of any plans from the City showing this as a priority future annexation or extension.

3. There are no plans to extend roads easterly to connect with city cul-de-sacs in the Sunny Meadow Additions or to the South Oaks plat. The proposal is estimating four 5-12 acre lots. The final design will need to take into account two sites per lot for an SSTS, a well, and driveways and building pads that will not require variances to the various setbacks. The topography and soils found on the Thompson property limit development potential. The site is suitable for low-density urban/suburban residential development.

4. The County permits wells and septics throughout the County. If the City is referring to the Roving Hills area, those lots are smaller in size and were established many years ago. They do have challenges with replacing SSTS and wells if need be, however, we are not aware that the City is involved in that process. There are developments within the City that do not have municipal services

that may have priority over parcel development that is a half mile outside its limits.

5. We have requested comments from the City in our review of this request, however, regardless of the City Resolution, we are unaware of any joint zoning/subdivision *authority* the City may have over any area outside the City boundaries. The County and some of the Townships (including Featherstone) have zoning and subdivision controls in place that extend to the municipal boundaries.



Planning Advisory Commssion

Public Hearing
April 16, 2018

Blake Thompson
A3 Zoned District

Parcels 31.001.6100 &
31.001.6200, Part of the
SW ¼ of SE ¼ and GOVT
Lot 2 in S01 T112 R15 in
Featherstone Township

Map amendment request to
rezone property from A3 to R1

Legend

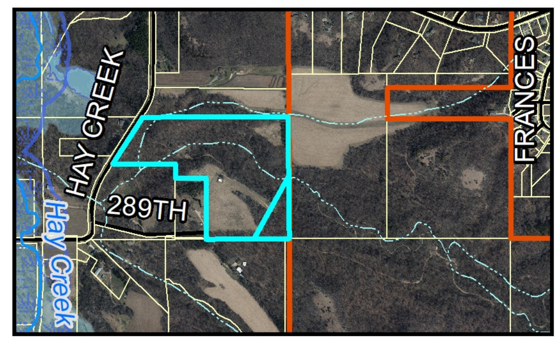
- Intermittent Streams
- Protected Streams
- Lakes & Other Water Bodies
- Shoreland
- Historic Districts
- Parcels
- Registered Feedlots
- Dwellings
- Municipalities

Bluff Impact Zones (% slope)

- 20
- 30

FEMA Flood Zones

- 2% Annual Chance
- A
- AE
- AO
- X



DATA DISCLAIMER: Goodhue County assumes NO liability for the accuracy or completeness of this map OR responsibility for any associated direct, indirect, or consequential damages that may result from its use or misuse. Goodhue County Copyright 2018.

2016 Aerial Imagery

Map Created April, 2018, Ryan Bechel

Feet
0 185 370 740 1,110 1,480

April 13, 2018

To: Goodhue County Planning Advisory Commission

Re: Request for Rezoning in Featherstone Twp.

The Featherstone Township Board of Supervisors would like it entered into the record of this public hearing that they would expect all conditions of Featherstone Township Planning are expected to be met before any development in the Blake Thompson parcels 31.001.6100 and 31.001.6200. This would include concerns for proper road frontage and access grades to any parcels in a sub-division of the property.

Chuck Schwartau

Chuck Schwartau, Clerk

Citizen Comments

RE: Blake Thompson proposed rezone amendment

<u>Eugen Rietmann – 295359 Hay Creek Trail, Red Wing, MN 55066</u>

Eugene would like to state he is concerned that existing infrastructure is insufficient to support additional residential traffic on Hay Creek Trail.

Received via phone by LUM staff on 4/9/18

Lisa M. Hanni, L.S. Director

Building | Planning | Zoning
Telephone: 651.385.3104
Fax: 651.385.3106

County Surveyor / Recorder

Environmental Health | Land Surveying | GIS
Telephone: 651.385.3223
Fax: 651.385.3098

To: County Board of Commissioners
From: Land Use Management
Meeting Date: May 8, 2018
Report date: April 27, 2018

PUBLIC HEARING: Request for Zoning Ordinance Text Amendment

Application Information:
Applicant(s): Yon Kohlnhofer/Jack Perry
Zoning Districts affected by text change: A1, A2, A3

Attachments and links:
Applicant Text Amendment
Staff Recommended Changes
GC Element1:Agriculture (Comp Plan)
Application Document
Draft PAC Minutes
Public Comments
GC Zoning Ordinance: http://www.co.goodhue.mn.us/DocumentCenter/View/2428
GC Comprehensive Plan: https://www.co.goodhue.mn.us/DocumentCenter/View/11368

Background:
Application:
The County has received a request to amend Goodhue County Zoning Ordinance Article 11, Section 24 PRESERVATION OF FARMING PRACTICES.
Staff has added page numbers (center top of page) to the Application Document submitted by the applicant for reference (beginning on page 22 of this pdf document):

Pages 1 -2: Text Amendment application

Pages 3-5: Proposed text amendments

Pages 5-6: Practical Application of the Proposed Ordinance Amendment

Pages 6-7: Legal Authority for such an enactment

Pages 7-9: An Example for such an enactment

Pages9-10: Consistency with the Ordinance

Page 10-12: Consistency with the Plan (Comprehensive Plan)

Pages 14-16: Attachment A- Todd County's Right-to-Farm Ordinance

Pages 17-19: Attachment B- 2/9/16 Order (re: Noise)

Pages 20-24: Attachment C- Dec. 6, 2017 Order (re: Right-to-Farm Ordinance)

Pages 25-27: Attachment D- Todd County's (proposed) Revised Right-to-Farm Ordinance

Staff Review:
Over the years the County has held public meetings to discuss and amend text within the Zoning Ordinance, and in cases such as the Confined Feedlot Regulations (Article 13), the County Board established a citizen committee to review and suggest text modifications, which were subsequently adopted.

The County adopts Minnesota Rules 7020, Rules for the Control of Pollution from Animal Feedlots, in addition to specific additional regulation as outlined in our Confined Feedlot Regulations (Article 13). Some of the additional regulations set by the County include setbacks and the Odor Offset Model for acceptable limits of odor at specific distances.

There is an on-going concern at the Planning Commission that non-agricultural uses in the Agricultural districts may limit the establishment, expansion, or continuation of agricultural operations such as feedlots. This is evidenced by recent conditions to some non-agricultural uses in agricultural zones stated as "The applicant must notify event participants of the local crop and animal agriculture farming practices in the area, which include odors, dust, large farm equipment on the roads and hauling or spreading of agricultural related products."

In 2017, the County worked with the Townships and asked them specifically if they were satisfied with the dwelling density in the County and all but 3 townships were satisfied with the limited amount of additional dwelling sites available. Three Townships wanted more options for a limited amount of dwellings in specific parts of their Township. Overall, the Townships had similar concerns about additional dwellings limiting agricultural practices in the County.

Staff do not believe we have legal authority to deny a party the ability to sue another party and therefore do not agree with the applicant's suggested wording "no property owner shall bring an action(s) of law,…" We do however state that the County will not consider a legally operating or permitted feedlot a nuisance and have suggested additional wording to reinforce the position.

County Land Use staff and the County Attorney have reviewed the proposed changes and suggest alternative wording found in the *Staff Recommended Changes* attachment.

The application and relevant documents were reviewed by the Planning Advisory Commission (PAC), in addition to holding a public hearing in which they accepted testimony and written comments at their April 16, 2018 meeting. After lengthy testimony and consideration, the PAC recommended approval of the Staff's recommended changes.

Planning Advisory Commission Recommendation:

The PAC recommends the County Board

- adopt the staff report into the record;
- accept the application, testimony, exhibits, and other evidence presented into the record; and

DENY the language changes requested by the applicants to the extent they are inconsistent with staff recommendations; and

APPROVE Staff's recommended wording for the text amendment request.

Applicant Text Amendment

BRIGGS

2200 IDS Center
80 South 8th Street,
Minneapolis, MN 55402
OFC 612-977-8400
FAX 612-977-8650
URL Briggs.com

March 6, 2018

Jack Y. Perry
(612) 977-8497
jperry@briggs.com

VIA U.S. MAIL

Lisa M. Hanni
Director, Goodhue County Land Use Management
Goodhue County Government Center
509 West Fifth Street
Red Wing, MN 55066

Re: Petition for an amendment to Article 11 Section 24 ("PRESERVATION OF FARMING PRACTICES") of the Goodhue County Zoning Ordinance

Dear Ms. Hanni:

On behalf of Jeff, Mike and Yon Kohlnhofer (Kohlnhofers) and Circle K Family Farms (Circle K), this Petition, requests an amendment to Article 11 Section 24 ("**PRESERVATION OF FARMING PRACTICES**") of County's Zoning Ordinance (Ordinance). The legal authority underlying, as well as an example for, the requested Ordinance amendment is discussed below.

Besides being consistent with Article 11 Section 24 ("**PRESERVATION OF FARMING PRACTICES**"), the requested Ordinance amendment is, as discussed below, also consistent with County's Ordinance — *i.e.,* Article 13 Section 1 ("**INTENT**") of Article 13 ("**CONFINED FEEDLOT REGULATIONS**") and Article 1 Section 2 ("**PURPOSE**") of Article 1 ("**GENERAL PROVISIONS**"). As likewise discussed below, the requested Ordinance amendment is, as well, consistent with County's Comprehensive Plan (Plan) — *i.e.,* the Plan's "**OVERVIEW**," "**ANIMAL AGRICULTURE OBJECTIVES**," "**ANIMAL AGRICULTURE IMPLEMENTATION STRATEGIES**" and "**AGRICULTURALLY RELATED BUSINESS OBJECTIVE**." In sum, Circle K's requested Ordinance amendment simply asks County to reaffirm its commitment to the protection of regulatorily-compliant agricultural operations from legal action due to their operation.

A. REQUESTED ORDINANCE AMENDMENT

The requested Ordinance amendment is for the passage of the following redlined edits to Article 11 Section 24:

SECTION 24. PRESERVATION OF FARMING PRACTICES
It is the declared policy of this County to enhance and encourage agricultural operations within the County.

Applicant Text Amendment

Where non-agricultural land uses extend into agricultural areas or exist side by side, agricultural operations may be the subject of, among other legal actions, private nuisance or negligence complaints that would result in the cessation or curtailment of operations. Such actions discourage investments in farm improvements to the detriment of adjacent agricultural uses and the economic viability of the County's agricultural industry as a whole.

It is the purpose and intent of this section to reduce the loss to the County of its agricultural resources by limiting the circumstances under which agricultural operations may be ~~considered~~ sued for, among other legal actions, a private nuisance or negligence.

~~Agricultural production that complied with all Goodhue County Ordinances, shall not be considered by this County as constituting a nuisance.~~

~~This Ordinance is not to be construed as in any way modifying or abridging the State law, rather, it is only to be utilized in the interpretation and enforcement of the provisions of this code and County regulations.~~

Subd. 1. **AGRICULTURAL OPERATION.** A facility consisting of real or personal property used for the production of crops including fruit and vegetable production, tree farming, livestock, poultry, dairy products, or poultry products, but not a facility primarily engaged in processing agricultural products. Agricultural operation shall also include certain farm activities and uses as follows: chemical and fertilizer spraying, farm machinery noise, extended hours of operation, manure collection, disposal, spreading or storing, open storage of machinery, feedlots, odors produced from farm animals, crops or products used in farming.

Subd. 2. **ESTABLISHED DATE OF OPERATION.** For the purposes of this section, the established date of operation shall be the date on which the agricultural operation commenced.

~~Subd. 3.~~ ~~**AGRICULTURAL OPERATION NOT A NUISANCE.**~~ ~~An agricultural operation which continues without interruption or change shall not become a private nuisance if the operation was not a nuisance at its established date of operation. The provisions of this subdivision do not apply:~~

~~A.~~ ~~To a condition or injury which results from the negligent or improper operation of an agricultural operation or from~~

~~operations contrary to commonly accepted agricultural practices.~~

~~B. To applicable State or local laws, ordinances, rules or permits.~~

~~C. When an agricultural operation causes injury or direct threat or injury to the health or safety of any person.~~

~~D. To the pollution of, or change in the condition of, waters of the State or the water flow of waters on the lands of any person;~~

~~E. To an animal feedlot facility of one thousand (1,000) or more animal units.~~

Subd. 3. **RIGHT-TO-FARM ORDINANCE**

A. There will be from time to time sights, sounds and smells associated with the operation of farming.

B. No property owner shall bring an action(s) of law, including without limitation claims for private nuisance under Minn. Stat. § 561.01 and common law negligence, against any farming operation, because of such farming activities, as long as such farming activity is complying with the local, County, State and Federal permits, ordinances, rules, statutes and other regulations which both apply to and are enforceable against the farming operation.

B. PRACTICAL APPLICATION OF THE PROPOSED ORDINANCE AMENDMENT

The proposed Right-to-Farm Ordinance simply codifies common sense and County's already existing commitment to the preservation of agricultural operations. The appropriateness of and need for this Ordinance amendment is illustrated by its application to standard "noise" and "odor" nuisance and negligence claims against an agricultural operation.

1. Applied to "noise" claims. A property owner should not be able to bring a § 561.01 "noise" nuisance or "noise" negligence action against a farming operation due to noise levels from the farming activity which comply with the state's objective "maximum levels of noise," particularly when (1) such levels were statutorily-required to be set by the Minnesota Pollution Control Agency (MPCA) so as to avoid being "injurious to human health or welfare . .

Staff Recommended Changes

SECTION 24. PRESERVATION OF FARMING PRACTICES

It is the declared policy of this County to enhance and encourage agricultural operations within the County.

Where non-agricultural land uses extend into agricultural areas or exist side by side, agricultural operations may be the subject of ~~private~~ nuisance complaints that would result in the cessation or curtailment of operations. Such actions discourage investments in farm improvements to the detriment of adjacent agricultural uses and the economic viability of the County's agricultural industry as a whole.

It is the purpose and intent of this section to reduce the loss to the County of its agricultural resources by limiting the circumstances under which agricultural operations may be considered a nuisance.

Agricultural production that complied with all Goodhue County Ordinances, shall not be considered by this County as constituting a nuisance.

This Ordinance is not to be construed as in any way modifying or abridging the State law, rather, it is only to be utilized in the interpretation and enforcement of the provisions of this code and County regulations.

Subd. 1. **AGRICULTURAL OPERATION.** A facility consisting of real or personal property used for the production of crops including fruit and vegetable production, tree farming, livestock, poultry, dairy products, or poultry products, but not a facility primarily engaged in processing agricultural products. Agricultural operation shall also include certain farm activities and uses as follows: chemical and fertilizer spraying, farm machinery noise, extended hours of operation, manure collection, disposal, spreading or storing, open storage of machinery, feedlots, odors produced from farm animals, crops or products used in farming.

Subd. 2. **ESTABLISHED DATE OF OPERATION.** For the purposes of this section, the established date of operation shall be the date on which the agricultural operation commenced or was permitted, whichever is earliest.

Subd. 3. **AGRICULTURAL OPERATION NOT A NUISANCE.** The County will not view ~~A~~an agricultural operation which continues without interruption or change as ~~shall not become~~ a ~~private~~ nuisance if the operation was not a nuisance at its established date of operation, is permitted or conditionally permitted by the County or MPCA, and the activity is complying with the local, County, State, and Federal permits, ordinance, rules, statutes, and other regulations which both apply to and are enforceable against the farming operation~~. The provisions of this subdivision do not apply:~~

~~A. To a condition or injury which results from the negligent or improper operation of an agricultural operation or from operations contrary to commonly accepted agricultural practices.~~

~~B. To applicable State or local laws, ordinances, rules or permits.~~

~~C. When an agricultural operation causes injury or direct threat or injury to the health or safety of any person.~~

~~D. To the pollution of, or change in the condition of, waters of the State or the water flow of waters on the lands of any person;~~

~~E. To an animal feedlot facility of one thousand (1,000) or more animal units.~~

ELEMENT 1: AGRICULTURE

AN ESTIMATED 70% OF THE COUNTY'S 758 SQUARE MILES HAS BEEN IDENTIFIED AS PRIME FARMLAND BY THE USDA AND 92% OF GOODHUE COUNTY'S PRIME FARMLAND IS HARVESTED.
(USDA & NRCS, Web Soil Survey, 2013)

OVERVIEW

Goodhue County has a long history of agricultural priorities: with more than 492 square miles of land in Goodhue County being harvested. Agriculture is highly valued by both urban and rural residents. The preservation of agriculture is valued as a component of the economy, a land resource, a visual feature of the landscape, and a way of life. Desire to protect the County's agricultural and rural landscape also acknowledges the aesthetic and quality of life values of agriculture, as well as the economic benefits to both the famers and the County as a whole.

Agricultural zoning districts have been established to maintain and preserve agricultural land. This Plan classifies agricultural lands into three general categories: plant agriculture, animal agriculture and agricultural related business. This element focuses on assisting the competitiveness of our agricultural enterprises and protecting the farmland base that is key to a thriving agricultural economy.

The success of agriculture in Goodhue County lies in the creativity and drive of our farmers. The nature of agriculture has evolved over the years, but changes have become even more pronounced recently. Farmers are becoming increasingly entrepreneurial and the line between agriculture and manufacturing, tourism, and other business is diminishing.

KEY POINTS

Preserve and protect agricultural land for sustained and long term use

Maintain and promote agricultural infrastructure to enhance and sustain agriculture operations

Encourage best management practices for crop and animal agriculture in order to protect our water and land resources

Encourage farming practices that maintain and improve soil health

Continue to promote Erosion Control and adopt additional controls as farming practices evolve

Continue to allow and support a broad range of agriculturally related businesses within incorporated and unincorporated areas of the County

STRENGTHS

The majority of Goodhue County Soils are rated as prime farmland soils and an estimated 92% of the prime farmland soils are harvested

Goodhue County has a rich history of animal agriculture. The type of animals being reared include but are not limited to chicken, turkey, goats, lamb, alpaca, beef and dairy cattle, and hogs with the latter two being the County's largest animal industries

The limitation of housing through density controls has maintained large tracks of land available for agriculture purposes

The County has a desirable scenic, rural character providing open spaces that contribute to valuable aesthetics and a high quality of life

CHALLENGES

Secession planning for agricultural businesses and agricultural land uses

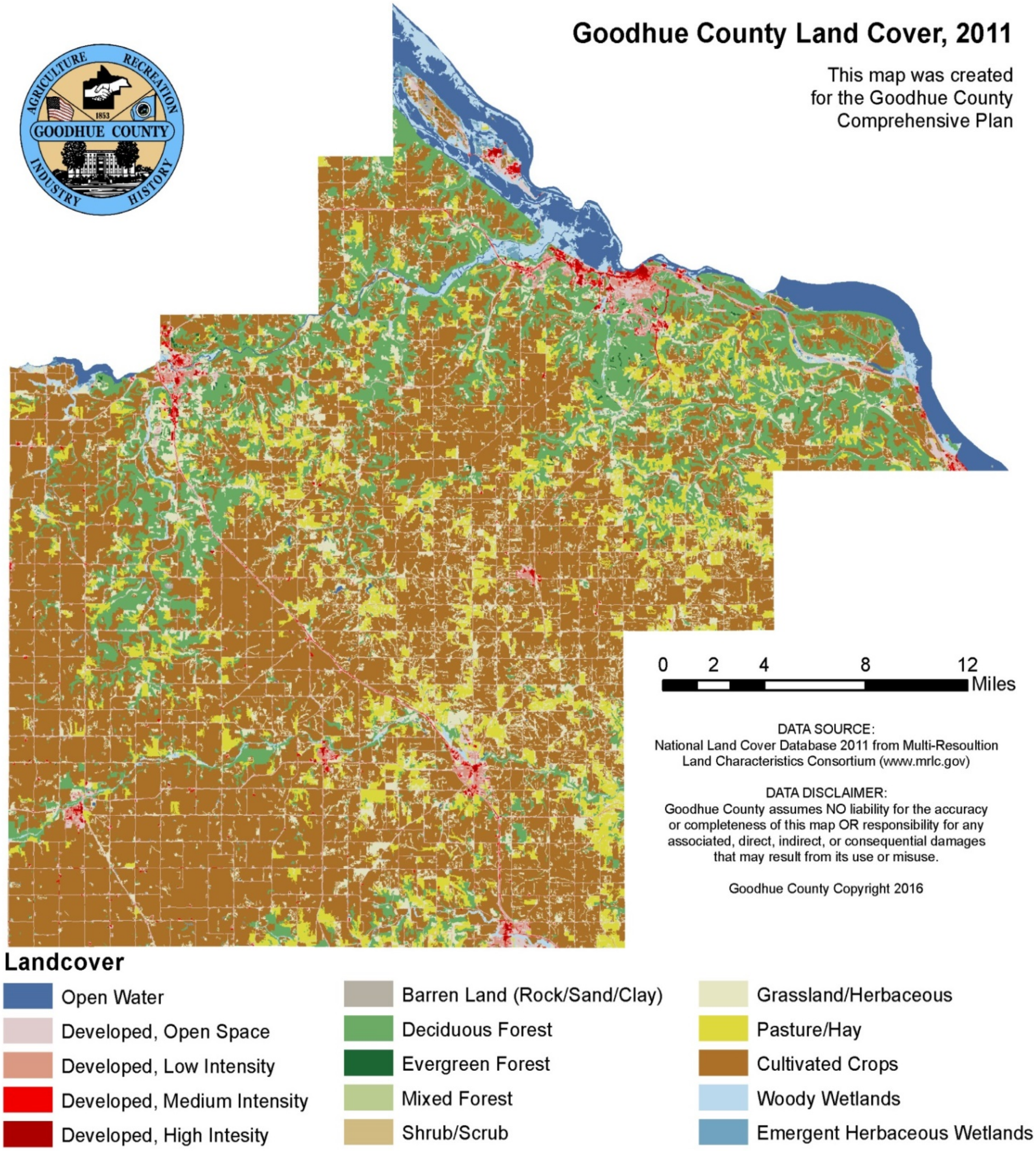
Erosion and sedimentation control is a concern for farmers and adjacent landowners within the County

An increase in housing density within agricultural zones could create potential conflicts between potentially incompatible land uses

It cannot be the goal or the responsibility of local government to regulate and preserve every acre of farmland within its jurisdiction, but it is the intent to create a planning framework that maximizes the possibilities for voluntary farmland protection

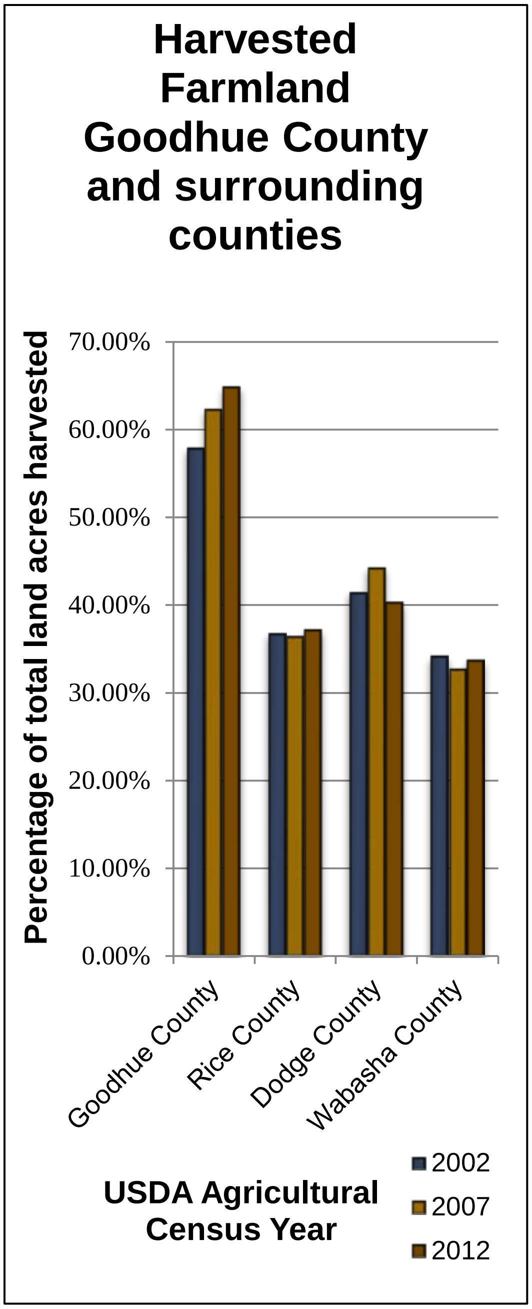
PLANT AGRICULTURE

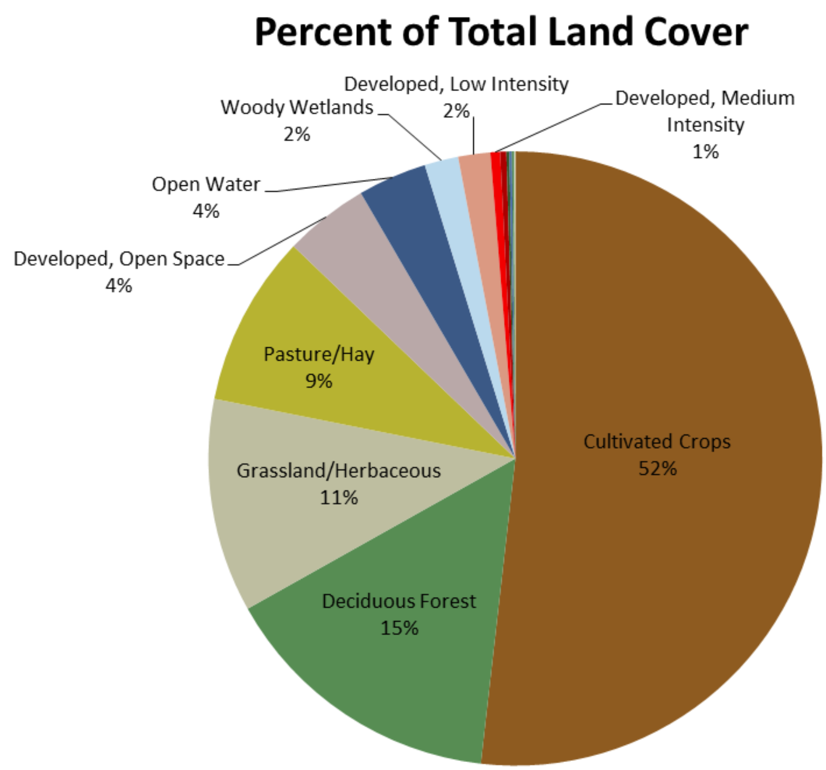
Agriculture joins tourism and manufacturing as a pillar of the County economy. There was a 4% increase of harvested land in the Goodhue County between 2007 and 2012 according to the USDA, Censes of Agriculture.



PLANT AGRICULTURE

Goodhue County has a higher percentage of land area in harvested agriculture than similar abutting Counties. During outreach activities, residents have continued to express the importance of maintaining and preserving agricultural land (Goodhue County, 2015).





National Land Cover Database 2011 from www.mrlc.gov


An example of shares one could receive from a CSA during peak harvest.

PLANT AGRICULTURE

Goodhue County has rich, prime farming soils which have created a strong history in field crop agriculture. The most common field crops in Goodhue County are corn and soybeans. Over 170,000 acres were reported in corn production for grain in 2012, and over 95,000 acres of land was reported in soybean for grain production (USDA, Census of Agriculture, 2012). As shown on the pie chart on the previous page, over half of the land in the County is classified as cultivated cropland. Due to potential conflicts between housing and agricultural production, the County has limited the dwelling densities within the agricultural districts.

COMMUNITY SUPPORTED AGRICULTURE (CSA)

Community Supported Agriculture (CSA) farms are direct-farm marketing and production model farms in which farmers sell shares to members who receive a portion of produce on a weekly schedule. Some CSA's are purely produce, others allow for add-ons such as artisan cheese, bread, meat, eggs, cut flowers, or canned goods. This model of farming allows for the consumers to share in the risks and benefits of the farm. It allows the farmer to get paid before the crop yield, which reduces the risk to the farmer and spreads the risk amongst all shareholders. According to the 2012 Agricultural Census, Goodhue County has nine CSA's, which dropped from twelve in 2007. CSA's can be supported through the same objectives and implementation measures for crop and animal agriculture, perhaps with an emphasis of agricultural tourism.

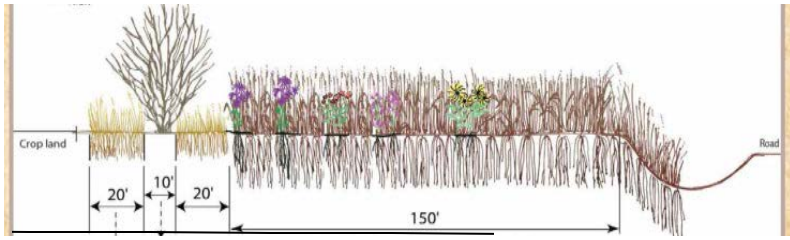
VINEYARDS

The University of Minnesota initiated a breeding program for cold hardy wine grapes in the mid 1980's. Through this research Minnesota has become a contender in the viticulture industry. It was reported in 2012 that Goodhue County was home to 16 vineyards (USDA, Census of Agriculture, 2012). Vineyards have a unique part of recreation and tourism in the County. More information on vineyards in the County is available in the Recreation and Tourism element of this plan.

Photograph courtesy of Cannon Valley Vineyard

ORCHARDS

As of 2012, the County had thirty four farms in orchards which equated to 178 acres. (USDA, Census of Agriculture, 2012). Orchards in Goodhue County typically harvest varieties of apples; however they could contain other fruit trees such as peach, pear, or cherry.



Example of a living snow fence with nesting bird and pollinator components incorporated in. More examples can be found at http://www.dot.state.mn.us/environment/livingsnowfence/index.html

BEE AND POLLINATOR COLONIES

Pollinators include butterflies, moths, wasps, flies, beetles, ants, hummingbirds and bees. There were 17 farms with honey bee colonies reported in 2012 (USDA, Census of Agriculture, 2012). Bees are a vital organism to our environment. Their pollination is a keystone role for the natural habitat and the productivity of agriculture. According to the U.S. Fish and Wildlife Service, honey bee and some pollinator populations are declining (U. S. Fish & Wildlife Service, 2015). Pollinator habitats provide food, shelter, and nesting resources for these species. The Minnesota Department of Agriculture has developed best management practices for pollinator habitat for agricultural landscapes, yards, gardens, and roadside and right of ways. Creating pollinator habitat near roads have multiple benefits such as improved visibility on the road, increased crop yields, and controlled soil erosion.

PLANT AGRICULTURE OBJECTIVES:

1. **Soils with a prime farmland rating shall be protected from non-agricultural development whenever possible.**

2. **Promote sustained, long term, agricultural industry or use as the desired use on agricultural lands.**

3. **Lands outside the cities growth zones will be considered rural and shall be managed to preserve the rural character and be compatible with the continued operation of agricultural uses, their inherent activities, and lifestyle.**

4. **If residential development occurs, it should be compact and designed to preserve the prime farmland for agricultural uses or other compatible uses to minimize conflicts between agricultural and non-agricultural uses.**

5. **Encourage farmers to adopt and maintain sound environmental practices through the utilization of buffer zones to aid in soil erosion prevention practices, chemical application procedures, manure spreading, irrigation, odor control, ensure a sustained agricultural use of the land, and to protect ground water and environmentally sensitive habitats.**

6. **Support and encourage private and public agreements that preserve farmland.**

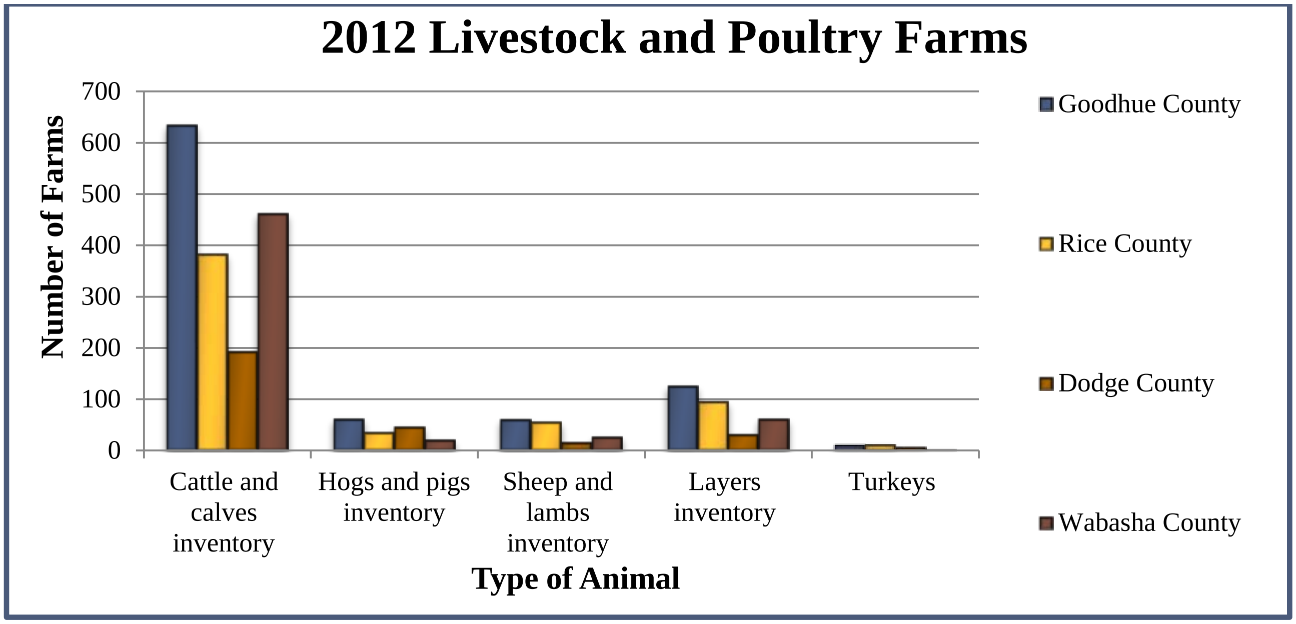
7. **Support new and innovative agricultural products such as vineyards, orchards, bee production, and other innovative practices to enhance emerging agriculture industries..**

PLANT AGRICULTURE IMPLEMENTATION STRATEGIES:

1. **Soils with a prime farmland rating shall be protected from non-agricultural development whenever possible.**
2. **Siting of dwellings or businesses should take into consideration the amount of farmland being used and shall minimize the impact to the greatest extent possible.**
3. **Housing developments shall be directed to incorporated city limits first.**
4. **Educate landowners on the requirements of management of protected waterways and agricultural uses.**
5. **Establish a process for monitoring land applications of manure and processing of wastewater.**
6. **Educational material will be made available to inform landowners the importance of pollinator habitats.**

ANIMAL AGRICULTURE

Goodhue County leads the region in the number of feedlot operations. The chart below shows number of farms with animal inventories for the types of animals listed.



(USDA, Census of Agriculture, 2012)

ANIMAL AGRICULTURE

In 2012, it was reported that there were 636 farms with cattle and calves, equating to over 59,000 animals; and 63 farms with more than 143,000 hogs. Other typical animals in Goodhue County are sheep, chickens, and turkeys (USDA, Census of Agriculture, 2012)

PASTURE AND GRAZING LANDS

Soils that are not rated prime farmland may be better utilized as pasture and grazing lands. Marginal farming soils and topographically challenged areas were historically identified as “goat prairies.” These areas may be ideal for pasture and grazing lands if best management practices are utilized to ensure that land is not over grazed causing soil erosion issues.

EMERGING AGRICULTURE

Goats: Generally goat farming means rearing goats for the purpose of harvesting milk, meat and fiber. Local goat herds have even been used by the Minnesota Department of Resources for controlling invasive species.

Alpaca: Alpaca are docile creatures that are often raised for their soft fleece. They can produce an estimated 10 pounds of fiber each year.

Small farms: Small farms are also known as hobby farms and are on the rise in Minnesota, according to the University of Minnesota Extension data. Small farm needs are slightly different than major farming operations. They require less land and may be secondary to the individuals' main source of income. Small farms could be home to agricultural tourism opportunities such as corn mazes, direct farm markets, and pick your own produce.

ANIMAL AGRICULTURE OBJECTIVES:

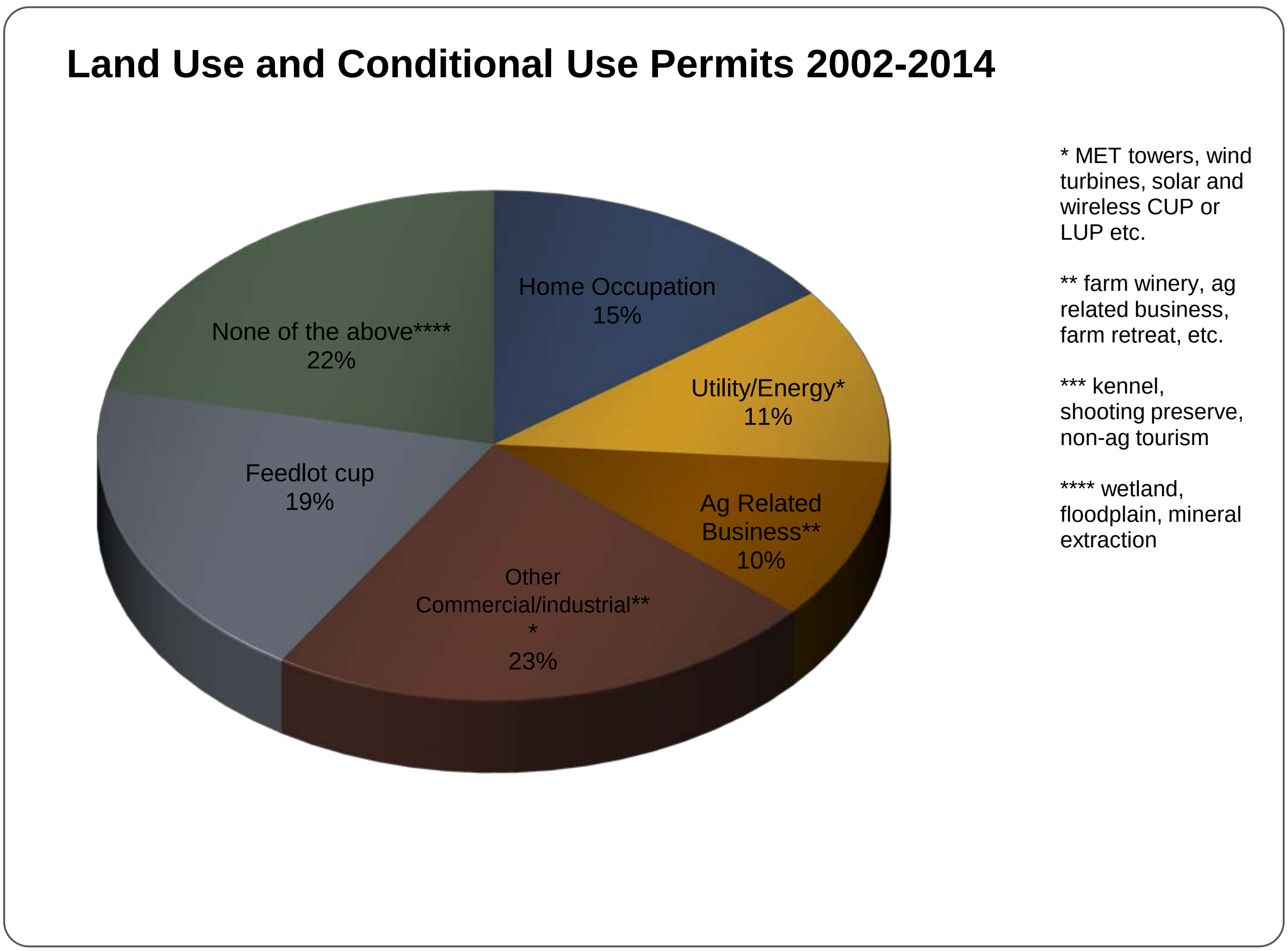
1. **Support and encourage farming activities so farmers can continue to provide an adequate supply of healthy livestock.**
2. **Support agricultural industries that are directly and indirectly related to animal agriculture such as veterinarian services, crop advisory services, livestock sales and auction services.**
3. **Encourage the use of best management practices for animal and crop agricultural practices.**
4. **Continue to allow for agricultural tourism opportunities to allow diversification of the agricultural economy.**
5. **Support the growth of animal agriculture in an environmentally friendly manner.**

ANIMAL AGRICULTURE IMPLEMENTATION STRATEGIES:

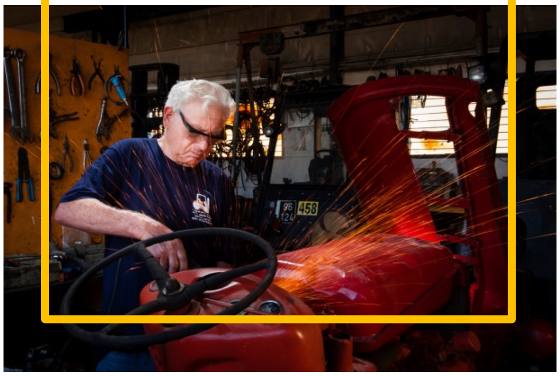
1. **The University of Minnesota's odor OFFSET tool will be used when considering new feedlots and feedlot expansion requests.**
2. **Support and promote best management animal farming practices in order to protect the health, safety, welfare of the operation as well as surrounding properties.**
3. **Work with the Soil and Water Conservation District to enforce the designated feedlot program in accordance with MN Rules 7020.**
4. **Encourage best practices for waste handling, manure spreading, pest control, fertilizer application, and erosion control.**
5. **Evaluate feedlots and feedlot registration requirements to ensure they are addressing health, safety, and welfare concerns for adjacent landowners, water quality, and soil health.**

AGRICULTURAL RELATED BUSINESSES

Goodhue County contains a number of agricultural industries within the agriculturally zoned districts and even within the urban fringe districts. Such industries are vital to economic sustainability of the County. They support and enhance the agricultural products within the County as well as offer alternative income methods to landowners. Such businesses include seed and crop research, fertilizer transfer stations, agricultural cooperatives and grain elevators, turkey manure compost site and transfer stations, hay transfer stations, livestock and agricultural product auctions, and veterinary services. Other businesses have shown to support the agricultural community such as welders, electricians, mechanics, and trucking and transport businesses. As shown in the following chart, 10% of conditional use permit requests since 2002 were requests to establish or expand a commercial or industrial use intended to serve the agricultural community.



AGRICULTURALLY RELATED BUSINESS OBJECTIVES:



1. **Identify agriculturally related businesses and industrial uses that are appropriate for the agricultural districts.**
2. **Support agriculturally related businesses and industrial uses when sited in compatible areas that would not create extraneous nuisances to adjacent landowners.**
3. **Provide appropriate expectations for minimizing impacts between industrial agricultural businesses and the surrounding uses such as landscape buffers and setbacks.**
4. **Consideration for the location, type, and intensity of surrounding existing land uses shall be taken into account during the process of reviewing permits or applications for the establishment of new or expanding land uses.**
5. **Create performance standards for business and industrial uses that primarily serve the agricultural community.**
6. **Allow the use of minimally intrusive signs to advertise and support agriculturally related businesses.**

AGRICULTURALLY RELATED BUSINESS OBJECTIVES:

1. **Create performance standards for business and industrial uses.**
2. **Allow the use of minimally intrusive signs to advertise and support agriculturally related businesses.**

Text Amendment

Land Use Management

509 W 5th Street Suite 103

Red Wing, MN 55066

T: 651-385-3104

F: 651-385-3106

Pursuant to Goodhue County Zoning Ordinance Article 2 Section 3: it shall be unlawful to proceed with the change of use, erection, enlarging or structural alteration of any building without first procuring the Zoning Administrator's approval and the Building Official's approval for a building permit, if applicable.
The first page consists of instructions which should be read carefully before the application form is completed. Land Use Management Department (LUM) staff is available to advise you in the preparation of this application. Call (651) 385-3104 for further information.

The Zoning Ordinance promotes and protects the public health, safety and general welfare of the people of Goodhue County. The Zoning Ordinance will assist in the economic growth of the County by providing a basis for reasonable and orderly residential, commercial and industrial development.; and shall encourage farmers, residents and businesses to protect the land from erosion, loss of wetlands, lost of water quality, and loss of woodlands. To achieve this purpose the Zoning Ordinance shall regulate the use of property, and the size, design, and siting of buildings that may be constructed on a piece of property. Each Zoning District has standards for buildings that govern such features like rear yard setbacks, front yard setbacks, usable open space, height, and parking. No permit shall be issued unless such building or land use is designed and arranged to conform to the provisions of the Goodhue County Zoning Ordinance and the adopted Building Code. Application for a permit shall be signed by the applicant or his authorized agent and filed with the Zoning Administrator's office.

WHAT IS A ZONING TEXT AMENDMENT?

The County Board may issue an amendment to the Zoning District or Zoning Map to reflect changes in conditions in the County or to correct mistakes in the Ordinance or Map.
Any text within the Ordinances governed by the Land Use Management Division can be amended, unless otherwise stated. State and Federal laws may require specific regulations.

WHO MAY INITIATE AMENDMENTS?

The proposal to amend, extend, or add to the regulation of the Zoning Ordinance shall be filed to the Zoning Administrator. The application can be filed by a petition from residents, recommendations from the PAC, or by action from the County Board. (Article 3, Section 2, Subd1.).

INSTRUCTIONS FOR SUBMITTAL:

A complete application shall include the following materials:

1. **Text Amendment Application Form:** Completed application form fulfilling the requirements of Article 3, Section 2: Applications.
2. **Additional Information:** as it pertains to this request.
3. **Application Fees:** Fees for such permits shall be pursuant to fee schedules and amendments, thereto, as established by the County Board. Please refer to the Goodhue County Land Use Management Department Fee Schedule available at **http://www.co.goodhue.mn.us** or at the Land Use Management offices Located in the Government center at 509 West 5th Street Suite 103, Red Wing, MN 55066

Some applications may require additional materials not listed. Upon review, applications may require other information concerning the property or adjoining property as determined by the Zoning Administrator and/or Building Official. All plans and other exhibits submitted with this application will be retained as part of the permanent record in this case.

Applicant or representative is encouraged to attend the scheduled public hearings

To file your Zoning Text Amendment application, please call (651) 385-3104 in advance to schedule an intake appointment. At your scheduled appointment with a staff planner, please bring the application completed to the best of your ability with all required materials. Receipt of this application and required materials by the LUM Department serves to open a Planning file for the proposed project. At that time, the planner assigned will review for completeness to Ordinances and Minnesota Statue 15.99 or whether additional information is required. The necessary County permits shall be issued when they are deemed in compliance with the above items.

Zoning Ordinance Amendment

$500 RECEIPT# DATE

APPLICATION FOR

Text Amendment

APPLICANT OR AUTHORIZED AGENT'S NAME:	
Circle "K" Family Farms and Michael, Yon and Jeff Kohlnhofer	
APPLICANT'S ADDRESS: 35559 Co. 45 Blvd Lake City, MN 55041	TELEPHONE: (651) 764-2282 EMAIL: yonkohl@hotmail.com

CONTACT FOR PROJECT INFORMATION	
Jack Y. Perry	Same as Above ☐
ADDRESS: 2200 IDS Center 80 South 8th Street Minneapolis, MN 55402	TELEPHONE: (612) 977-8497 EMAIL: jperry@briggs.com

☐ Amendment to Subdivision Ordinance Article:________, Section:_______, __________

☒ Amendment to Zoning Ordinance Article: 11, Section: 24, __________

☐ Amendment to Zoning Ordinance Article: ________, Section:_______, __________

☐ Other: ____________________

1. Stated reason for amendment(s) requested:

See March 6, 2018 letter from Jack Y. Perry to Lisa M. Hanni, enclosed herein.

2. Compatibility of proposed ordinance amendment(s) with the Goodhue County Comprehensive Plan:

See March 6, 2018 letter from Jack Y. Perry to Lisa M. Hanni, enclosed herein.

3. Provide proposed amended text and statements outlining any perceived effects the proposed amendment(s) may have on other areas of the Ordinance:

See March 6, 2018 letter from Jack Y. Perry to Lisa M. Hanni, enclosed herein.

4. Provide any additional information that will assist the Planning Advisory Commission and the County Board in reviewing your request:

See March 6, 2018 letter from Jack Y. Perry to Lisa M. Hanni, enclosed herein. The $500 application fee was sent to County on March 6, 2018

Applicant's Affidavit

Under penalty of perjury the following declarations are made:

1. The information presented is true and correct to the best of my knowledge.
2. If I am unable to be present at the meeting where my request is decided, I agree to accept the Notice of Decision by USPS mail.
3. Other information or applications may be required.

Signature: __________ Date: 3/22/18

Print name: Jack Y. Perry owner or authorized agent

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2200 IDS Center
80 South 8th Street,
Minneapolis, MN 55402
OFC 612-977-8400
FAX 612-977-8650
URL Briggs.com

March 6, 2018

Jack Y. Perry
(612) 977-8497
jperry@briggs.com

<u>**VIA U.S. MAIL**</u>

Lisa M. Hanni
Director, Goodhue County Land Use Management
Goodhue County Government Center
509 West Fifth Street
Red Wing, MN 55066

Re: Petition for an amendment to Article 11 Section 24 ("PRESERVATION OF FARMING PRACTICES") of the Goodhue County Zoning Ordinance

Dear Ms. Hanni:

On behalf of Jeff, Mike and Yon Kohlnhofer (Kohlnhofers) and Circle K Family Farms (Circle K), this Petition, requests an amendment to Article 11 Section 24 ("**PRESERVATION OF FARMING PRACTICES**") of County's Zoning Ordinance (Ordinance). The legal authority underlying, as well as an example for, the requested Ordinance amendment is discussed below.

Besides being consistent with Article 11 Section 24 ("**PRESERVATION OF FARMING PRACTICES**"), the requested Ordinance amendment is, as discussed below, also consistent with County's Ordinance — *i.e.*, Article 13 Section 1 ("**INTENT**") of Article 13 ("**CONFINED FEEDLOT REGULATIONS**") and Article 1 Section 2 ("**PURPOSE**") of Article 1 ("**GENERAL PROVISIONS**"). As likewise discussed below, the requested Ordinance amendment is, as well, consistent with County's Comprehensive Plan (Plan) — *i.e.*, the Plan's "**OVERVIEW**," "**ANIMAL AGRICULTURE OBJECTIVES**," "**ANIMAL AGRICULTURE IMPLEMENTATION STRATEGIES**" and "**AGRICULTURALLY RELATED BUSINESS OBJECTIVE**." In sum, Circle K's requested Ordinance amendment simply asks County to reaffirm its commitment to the protection of regulatorily-compliant agricultural operations from legal action due to their operation.

A. <u>REQUESTED ORDINANCE AMENDMENT</u>

The requested Ordinance amendment is for the passage of the following redlined edits to Article 11 Section 24:

SECTION 24. PRESERVATION OF FARMING PRACTICES
It is the declared policy of this County to enhance and encourage agricultural operations within the County.

Where non-agricultural land uses extend into agricultural areas or exist side by side, agricultural operations may be the subject of, among other legal actions, private nuisance or negligence complaints that would result in the cessation or curtailment of operations. Such actions discourage investments in farm improvements to the detriment of adjacent agricultural uses and the economic viability of the County's agricultural industry as a whole.

It is the purpose and intent of this section to reduce the loss to the County of its agricultural resources by limiting the circumstances under which agricultural operations may be ~~considered~~ sued for, among other legal actions, a private nuisance or negligence.

~~Agricultural production that complied with all Goodhue County Ordinances, shall not be considered by this County as constituting a nuisance.~~

~~This Ordinance is not to be construed as in any way modifying or abridging the State law, rather, it is only to be utilized in the interpretation and enforcement of the provisions of this code and County regulations.~~

Subd. 1. **AGRICULTURAL OPERATION.** A facility consisting of real or personal property used for the production of crops including fruit and vegetable production, tree farming, livestock, poultry, dairy products, or poultry products, but not a facility primarily engaged in processing agricultural products. Agricultural operation shall also include certain farm activities and uses as follows: chemical and fertilizer spraying, farm machinery noise, extended hours of operation, manure collection, disposal, spreading or storing, open storage of machinery, feedlots, odors produced from farm animals, crops or products used in farming.

Subd. 2. **ESTABLISHED DATE OF OPERATION.** For the purposes of this section, the established date of operation shall be the date on which the agricultural operation commenced.

~~Subd. 3.~~ ~~**AGRICULTURAL OPERATION NOT A NUISANCE.** An agricultural operation which continues without interruption or change shall not become a private nuisance if the operation was not a nuisance at its established date of operation. The provisions of this subdivision do not apply:~~

~~A. To a condition or injury which results from the negligent or improper operation of an agricultural operation or from~~

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~~operations contrary to commonly accepted agricultural practices.~~

~~B. To applicable State or local laws, ordinances, rules or permits.~~

~~C. When an agricultural operation causes injury or direct threat or injury to the health or safety of any person.~~

~~D. To the pollution of, or change in the condition of, waters of the State or the water flow of waters on the lands of any person;~~

~~E. To an animal feedlot facility of one thousand (1,000) or more animal units.~~

<u>Subd. 3. RIGHT-TO-FARM ORDINANCE</u>

<u>A. There will be from time to time sights, sounds and smells associated with the operation of farming.</u>

<u>B. No property owner shall bring an action(s) of law, including without limitation claims for private nuisance under Minn. Stat. § 561.01 and common law negligence, against any farming operation, because of such farming activities, as long as such farming activity is complying with the local, County, State and Federal permits, ordinances, rules, statutes and other regulations which both apply to and are enforceable against the farming operation</u>.

B. <u>PRACTICAL APPLICATION OF THE PROPOSED ORDINANCE AMENDMENT</u>

The proposed Right-to-Farm Ordinance simply codifies common sense and County's already existing commitment to the preservation of agricultural operations. The appropriateness of and need for this Ordinance amendment is illustrated by its application to standard "noise" and "odor" nuisance and negligence claims against an agricultural operation.

1. **<u>Applied to "noise" claims</u>.** A property owner should <u>not</u> be able to bring a § 561.01 "noise" nuisance or "noise" negligence action against a farming operation due to noise levels from the farming activity which comply with the state's objective "maximum levels of noise," particularly when (1) such levels were statutorily-required to be set by the Minnesota Pollution Control Agency (MPCA) so as to avoid being "injurious to human health or welfare . .

. or could interfere unreasonably with the enjoyment of life or property" and (2) "[n]o local governing unit shall set standards describing the maximum noise levels of sound pressure which are more stringent." To allow otherwise, then, is to allow property owners to insist upon an undefined subjective standard for "noise" that they alone can describe with a six-person jury being asked whether this standard was violated even though the jurors are unlikely to ever get to visit the agricultural operation to hear for themselves the noise at issue. *See, e.g.*, Attach. B.

2. Applied to "odor" claims. A property owner should not be able to bring a § 561.01 "odor" nuisance or "odor" negligence action against a farming operation due to odor levels from the farming activity which comply with the state's "livestock odor" standard for "responding to citizen complaints regarding feedlot odor and its hydrogen sulfide component" — *i.e.*, the state's ambient air quality standards for hydrogen sulfide, particularly when (1) such standards were set by the MPCA to avoid "interfer[ence] with normal activity in healthy and sensitive individuals or . . . interfer[ence] with the enjoyment of life or property" and (2) "[n]o local governing units shall set standards of air quality which are more stringent." To allow otherwise, then, is, like with "noise," to allow property owners to insist upon an undefined subjective standard for "livestock odor" that they alone can describe with a six-person jury being asked whether this standard was violated even though the jurors are unlikely to ever get to visit the agricultural operation to smell for themselves the odor at issue.

C. LEGAL AUTHORITY FOR SUCH AN ENACTMENT

Under Minnesota's private nuisance case law and related jury instruction, a private nuisance is determined by (1) "the degree of discomfort by **the standards** of ordinary people in relation to the area where they reside" (*Citizens for a Safe Grant v. Lone Oak Sportsmen's Club*, 624 N.W.2d 796, 803 (Minn. App. 2001)) or (2) "the **standards** of ordinary people in the area in which the property is located" (Minn. Pract. Series Vol. 4A, 49 (5th. Ed. 2006)). And, under Minnesota's negligence law and related jury instruction, a negligence claim can be proven by nothing more than a private nuisance. *Wendinger v. Forst Farms, Inc.*, 662 N.W.2d 546, 550 (Minn. App. 2003).

Per Merriam-Webster's Dictionary, "standards" means "something set up and established by authority as a rule for the measure of quantity, weight, extent, value, or quality." (Emphasis added). And County is, per Minn. Stat. Chps. 375.51 and 394, the "authority" charged with enacting the applicable "standards of ordinary people in relation to the area where they reside," including such "standards" applicable to private nuisance and negligence claims brought against farming operations within County.

More specifically, County's Ordinance, including without limitation Article 11 Section 24 ("**PRESERVATION OF FARMING PRACTICES**") and Article 13 ("**CONFINED FEEDLOT REGULATIONS**"), can and should define "the standards of ordinary people in relation to the area where they reside" (or "in the area in which the property is located") — *e.g.*, County's "A-1, Agricultural Preservation" and "A-2 Agriculture" zoning districts — in such a way as to protect regulatorily-compliant farming operations from such suits. And, to illustrate its authority to do so, County could undisputedly impose "standards" for its A-1 and A-2 zoning districts which altogether prohibit certain incompatible non-agricultural uses — *e.g.*, retail or non-farm residential uses — in those zoning districts. As such, County has the authority, as well, to enact "standards" in those zoning districts which impose all "lesser included" restrictions therein, including the above proposed Right-to-Farm Ordinance.

Because of County's authority under Minn. Stat. Chps. 375.51 and 394 to enact these "standards" for "agricultural operations," including feedlots, in its A-1 and A-2 zoning districts, these "standards" are clearly not somehow "preempted." Rather, in *Blue Earth County Pork Producers, Inc. v. County of Blue Earth*, 558 N.W.2d 25, 28 (Minn. App. 1997), the Court found that the local manure management ordinance was not preempted by state pollution laws because the state regulatory scheme explicitly delegated enforcement to localities, stating that local governments could impose additional controls upon feedlots. And the above-discussed case law has done this very thing. That is, County was, per Chapter 375.51 and 394, explicitly delegated to enact its "standards" for permitting farming operations in its A-1 and A-2 zoning districts, inclusive of the requested amendment thereto, as "the standards of ordinary people in relation to the area where they reside" (or "in the area in which the property is located").

Moreover, the Legislature clearly knows how to "preempt" local controls, and it does so explicitly. *See, e.g.*, Minn. Stat. § 18B.02 ("Except as specifically provided in this chapter, the provisions of this chapter preempt ordinances by local governments that prohibit or regulate any matter relating to the legislation, labeling, distribution, sale, handling, use, application, or disposal of pesticides" (emphasis added)); Minn. Stat. § 133F.227 ("This section . . . preempts local ordinances that are inconsistent with its terms" (emphasis added)); Minn. Stat. § 216G.02, subd. 4 ("[t]he pipeline routing permit supersedes and preempts all zoning, building, or land use rules, regulations, or ordinances" (emphasis added)); Minn. Stat. § 504B.205, subd. 3 ("This section preempts any inconsistent local ordinance or rule" (emphasis added)). Yet the Legislature failed to so preempt County's enactment of "the standards of ordinary people in relation to the area where they reside" (or "in the area in which the property is located"). To the contrary, the Legislature authorized County under Chapters 375.51 and 394 to enact just such "standards."

D. AN EXAMPLE FOR SUCH AN ENACTMENT

In 2008, Todd County enacted a similar Right-to-Farm Ordinance. Attach. A. Todd County is, however, in the process of slightly amending its Right-to-Farm Ordinance (Attach. D) so that, like Kohlnhofers and Circle K's proposed amendment here, it satisfies the Todd County District Court's very discrete issues with its initial version (Attach. E). And Todd County is amending its Right-to-Farm Ordinance because it saw firsthand the resulting problems which could arise for a state-of-the-art and fully-compliant agricultural operation.

In Todd County, a group of neighbors living in the four closest residences to a new 1,412 AU sow facility filed and prosecuted a baseless multi-year private odor nuisance and negligence case brought against the facility. Built in 2012, this facility cost $10 million, plus $1.6 million in annual local labor and feed thereafter. Sponsored by two national anti-feedlot organizations (*i.e.*, Humane Society of the United States (HSUS) and Socially Responsible Agricultural Project (SRAP)), the neighbors brought this suit even though the facility undisputedly (1) employed the industry's best odor mitigation measures, (2) satisfied MPCA's rigorous environmental review, inclusive of odor modeling, and (3) complied with all regulatory requirements, including compliance with, as shown through odor modeling and air emissions monitoring, both (a) the OFFSET odor evaluation model's requirements and (b) Minn. Stat. § 116.0713's "**LIVESTOCK ODOR**" standards — *i.e.*, the state ambient air quality standards for hydrogen sulfide (H_2S) under Minn. R. 7009.0080 at the property boundaries. And, even though the facility prevailed following a two-week jury trial, Todd County has recognized that no one else would prospectively invest in such a farming operation in Todd County if it does not revise its Right-to-Farm Ordinance to protect animal agriculture from such scenarios.

As proven by this lawsuit, Todd County's concern was, more specifically, that, per Minn. Stat. § 561.01 as interpreted by *Wendinger*, 662 N.W.2d at 550, neighborhood opponents could enforce, through private odor nuisance/negligence claims, an unspecified subjective "livestock odor" standard which is more stringent than that which could be enforced by MPCA or any other local regulatory unit. These neighbors could, for example, enforce this amorphous stricter "livestock odor" standard even though the legislatively-prescribed "livestock odor" standards which MPCA is, per Minn. Stat. § 116.0713(a) (1997), required to (*i.e.*, "must") enforce were, per Minn. R. 7009.0080, "primary standards" for hydrogen sulfide. And "primary standards" are, per Minn. R. 7009.0010, subp. 2, "established to protect the public health from adverse effects . . . that are likely [(1)] to interfere with normal activity in healthy or sensitive individuals or [(2)] to interfere unreasonably with the enjoyment of life or property" (a/k/a nuisance). Not surprisingly, then, this result is contrary to the legislative purpose for the legislatively-prescribed "livestock odor" standard, which was, as advocated by concerned citizens, to establish objective standards which were to be enforced by MPCA. Another concern of Todd County was that these neighbors could enforce, through private odor nuisance/negligence claims, this amorphous stricter "livestock odor" standard even during the feedlots' Minn. Stat. § 116.0713(b)-(d) (2000) and Minn. R. 7020.2002-prescribed 21-day "exemption" from MPCA's enforcement of these "primary standards" for "livestock odor" during their manure "pump out" time period. Strikingly, however, the 21-day "exemption" was enacted in 2000 because no feedlot could otherwise comply with the legislatively-prescribed "livestock odor" standard during the once-a-year manure "pump out." In other words, the statutory purposes for Minn. Stat. § 116.0713(a) (1997) and Minn. Stat. § 116.0713(b)-(d) (2000) were contravened by neighborhood opponents being able to enforce, through private odor nuisance/negligence claims, an unspecified subjective "livestock odor" which is more stringent than that which could be enforced by MPCA.

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In order to encourage agriculture investment within its boundaries, Todd County is revising its Right-to-Farm Ordinance. Yet, in order to simultaneously protect its neighbors from unreasonable impacts, Todd County's proposed revised Right-to-Farm Ordinance only protects regulatorily-compliant farming operations in its agricultural preservation zoning districts from such actions.

E. CONSISTENCY WITH THE ORDINANCE

Beyond Article 11 Section 24 ("**PRESERVATION OF FARMING PRACTICES**"), this requested Ordinance amendment is consistent with Article 13 Section 1 ("**INTENT**"). Article 13 Section 1 provides, in full, as follows:

> **SECTION 1. INTENT**
>
> An adequate supply of healthy livestock, poultry, and other animals is essential to the wellbeing of Goodhue County citizens and the State of Minnesota. These domesticated animals provide our daily source of meat, milk, eggs and fiber. Their efficient, economic production must be the concern of all consumers if we are to have a continued abundance of high-quality, wholesome food and fiber at reasonable prices.
>
> Through this and other ordinances, Goodhue County supports conservation efforts and environmentally safe land use practices. Livestock, poultry and other animals produce manure which may, where improperly stored, transported, or disposed, have a negative affect [sic] on the environment. When animal manure adds to surface water, groundwater, long term air pollution or land pollution in the county, it must be controlled.
>
> The following regulations for the control of livestock, poultry, and other animal feedlot and manure application has been promulgated to provide protection against pollution caused by manure from domesticated animals. However, these rules recognize that animal manure provides beneficial qualities to the soil and to the production of agriculture crops.
>
> These rules comply with the policy and purpose of the state of Minnesota in regard to the control of pollution as set forth in Minnesota Statutes, chapter 115 and 116. It has been our experience that residential and agricultural uses of land can be incompatible. These feedlot controls will regulate the uses and development of land in Goodhue County which may adversely affect the health, safety, and general welfare of the public.
>
> No person shall permit or allow their land or property under their control to be used for any confined feedlots, and no animal manure from any confined feedlot

shall be disposed of within the County of Goodhue, except at an operation which has been approved in accordance with the provisions of this Article.

All feedlots within Goodhue County shall comply with minimum standards set forth within MPCA Chapter 7020 (herein referred to as MPCA 7020) rules of this Ordinance.

OFFSET Odor Modeling references in this Article are based on the model developed or modified by the University of Minnesota Department of Bio systems and Agricultural Engineering.

(Bold in original; underlining added).

The requested Ordinance amendment is also consistent with Article 1, Section 2 ("**PURPOSE**") of the Ordinance. Article 1 Section 2 provides, in full, as follows:

SECTION 2. PURPOSE

The purpose of this Ordinance is to promote and protect the public health, safety and general welfare of the people of Goodhue County. This Ordinance will protect and preserve prime agricultural land by limiting the density of residential development in these areas. This Ordinance will assist in the economic growth of the County by providing a basis for reasonable and orderly residential, commercial and industrial development. At the same time, this Ordinance shall encourage farmers, residents and businesses to protect the land from erosion, loss of wetlands, loss of water quality, and loss of woodlands.

(Bold in original; underlining added).

F. CONSISTENCY WITH THE PLAN

County's recently-enacted Plan provides several protections for animal agriculture. As part of its "**OVERVIEW**," the Plan provides as follows:

Agricultural zoning districts have been established to maintain and preserve agricultural land. This Plan classifies agricultural land into three general categories: plant agriculture, animal agriculture and agricultural related business. This element focuses on assisting the competitiveness of our agricultural enterprises and protecting the farmland base that is key to a thriving agricultural economy.

The success of agriculture in Goodhue County lies in the creativity and drive of our farmers. The nature of agriculture has evolved over the years, but changes

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> have become even more pronounced recently. Farmers are becoming increasingly entrepreneurial and the line between agriculture and manufacturing, tourism, and other business is diminishing.

Plan at 8 (bold in original; underlining added).

More specifically, the Plan's five "**ANIMAL AGRICULTURE OBJECTIVES**" are as follows:

> 1. Support and encourage farming activities so farmers can continue to provide an adequate supply of healthy livestock.
>
> 2. Support agricultural industries that are directly and indirectly related to animal agriculture such as veterinarian services, crop advisory services, livestock sales and auction services.
>
> 3. Encourage the use of best management practices for animal and crop agricultural practices.
>
> 4. Continue to allow for agricultural tourism opportunities to allow diversification of the agricultural economy.
>
> 5. Support the growth of animal agriculture in an environmentally friendly manner.

Id. at 18 (bold in original; underlining added).

The Plan's five "**ANIMAL AGRICULTURE IMPLEMENTATIONS STRATEGIES**" are as follows:

> 1. The University of Minnesota's odor OFFSET tool will be used when considering new feedlots and feedlot expansion requests.
>
> 2. Support and promote best management animal farming practices in order to protect the health, safety, welfare of the operation as well as surrounding properties.
>
> 3. Work with Soil and Water Conservation District to enforce the designated feedlot program in accordance with MN Rules 7020.
>
> 4. Encourage best practices for waste handling, manure spreading, pest control, fertilizer application, and erosion control.

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5. Evaluate feedlots and feedlot registration requirements to ensure they are addressing health, safety, and welfare concerns for adjacent landowners, water quality, and soil health.

Id. at 19 (bold in original; underlining added).

And the Plan's six "**AGRICULTURALLY RELATED BUSINESS OBJECTIVES**" are as follows:

1. Identify agriculturally related businesses and industrial uses that are appropriate for the agricultural districts.

2. Support agriculturally related business and industrial uses when sited in compatible areas that would not create extraneous nuisances to adjacent landowners.

3. Provide appropriate expectations for minimizing impacts between industrial agricultural businesses and the surrounding uses such as landscape buffers and setbacks.

4. Consideration for the location, type and intensity of surrounding existing land uses shall be taken into account during the process of reviewing permits or applications for the establishment of new or expanding land uses.

5. Create performance standards for business and industrial uses that primarily serve the agricultural community.

6. Allow the use of minimally intrusive signs to advertise and support agriculturally related businesses.

Id. at 21 (bold in original; underlining added).

With this requested Ordinance amendment, County has the opportunity to further reinforce its support for regulatory-compliant farming operations. Kohlnhofers and Circle K, together with the rest of County's sizeable animal agriculture industry, respectfully requests that County seize upon this opportunity with the enactment of its Right-to-Farm Ordinance.

Sincerely,

Jack Y. Perry

JYP
Enclosure: $500 application fee
Attachments
Attach. A: 2008 Todd County's Right-to-Farm Ordinance
Attach. B: 2/9/16 Order (re: Noise)
Attach. C: December 6, 2017 Order (re: Right-to-Farm Ordinance)
Attach. D: 2018 Todd County's (proposed) Revised Right-to-Farm Ordinance

cc: Jeff Kohlnhofer, Circle K Family Farms
Mike Kohlnhofer, Circle K Family Farms
Yon Kohlnhofer, Circle K Family Farms
Dr. Mark FitzSimmons, Protein Sources
Dr. Charles Gantzer, Barr Engineering
David Preisler, Minnesota Pork Board
Maren F. Grier, Briggs and Morgan, P.A.

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(xii) All recreational vehicle park projects shall be equipped with at least one (1) central toilet, bathing, and laundry building which meets or exceeds the requirements of the Minnesota Department of Health, except that in primitive tent camping areas, only toilet facilities shall be required as per the Minnesota Department of Health.

Section 9.11 Feedlots.

A. Policy - An efficient and profitable livestock industry is an economic benefit to Todd County and to the State of Minnesota. It provides a value-added opportunity to our crop based agriculture and creates service industries, which provide employment and further economic activity. An efficient industry also produces high quality food and fiber for consumers at reasonable prices. The wastes produced in livestock production have the potential, when improperly stored, transported or disposed, to contribute to air, surface water, and ground water pollution. When properly utilized such wastes contribute to soil fertility and structure and enhance efficient crop production. The following section has been promulgated to reduce risk of pollution of natural resources from feedlots.

B. Todd County is an MPCA delegated Feedlot County.

C. This section regulates feedlots as well as storage and land application of animal waste. All existing and future feedlots in Todd County shall comply with the standards set forth within the Minnesota Pollution Control Agency (MPCA) Chapter 7020 rules and updates, and this Ordinance.

D. Within the agricultural preservation districts, the construction, expansion and operation of feedlots and other agricultural uses are permitted or permitted by conditional uses.

E. There will be from time to time, sights, sounds and smells associated with the operation of farming. No property owner shall bring action of Law against any farming operation, because of such farming activities, as long as such farming activity complies with State, Federal or County regulations.

F. More restrictive standards. Minnesota Rules Chapter 7020 are hereby modified by the following more restrictive standards.

G. The County Board may appoint a Feedlot Officer(s) as are necessary and to designate their power and duties within the limits of this section.

H. A land use permit shall be required for all expansions of buildings of an existing feedlot that does not increase the animal unit numbers.

I. A land use permit with a feedlot inspection is required for all expansions of buildings or lots that increase animal unit numbers of existing registered feedlots of more than 10 animal units but less than 300 animal units. An Interim Permit may be required to correct environment hazards on feedlots.

J. Registration. An animal feedlot capable of holding ten (10) or more animal units, or a manure storage area capable of holding the manure produced by 10 or more animal units is required to register with the County every four (4) years.

K. Conditional Use Permit - Expansion of animal unit numbers to existing feedlots located within 300 feet of any river class or within 1,000 feet of any lake class may be approved if they do not exceed 1,000 animal units and they do not further encroach into the riparian setback or bluff impact zone.

L. The owner of a proposed or existing animal feedlot of over 300 animal units in the Agricultural District shall make an application to the County for a Construction Short Form Permit when any of the following conditions exist:

(i) A new feedlot is proposed where a feedlot did not previously exist;
(ii) Expansion of an existing feedlot beyond registered animal units;
(iii) Any change in species on an existing animal feedlot or facility;
(iv) A feedlot is to be restocked after being abandoned for five (5) or more years;
(v) An inspection reveals that the feedlot is creating a potential pollution hazard and due process is observed by the authorized entity Department and provides the ability to correct the infraction as listed in MPCA regulations;
(vi) Application for conditional use permit;
(vii) A National Pollutant Discharge Elimination System (NPDES) permit application is required under State or Federal rules and regulations (over 1,000 animal units of manure is produced on the farm);
(viii) Other actions as specified in the Ordinance.

M. Feedlot setbacks and separations -feedlot setbacks. All setbacks of this section shall apply within the county and shall not cross county lines. The setback standards of the county where the feedlot is located shall apply. No new feedlot shall hereafter be erected within the following distances:

New Feedlot or Manure Storage Area	**Animal Units**	**Municipal Limits or Municipal Growth Boundaries***	**Public Drainage Ditch***	**School, Church, Park, or Airport***
Tier I	10-100	Half (1/2) mile	300 feet	Quarter (1/4) mile
Tier II	101-300	One (1) mile	300 feet	Half (1/2) mile
Tier III	Over 300	One (1) mile	300 feet	Half (1/2) mile
* All setbacks are reciprocal in nature				

N. All application of animal waste shall comply with all setbacks of Minnesota Statutes Chapter 7020, to minimize odor nuisance, potential point and non-point pollution.

O. Performance Standards:

(i) All new liquid manure storage structures must have a minimum of twelve (12) months of storage capacity.

(ii) All expansions of feedlots with a liquid manure handling system must have a liquid storage capacity to accommodate the increase in animal units. The plans for this expansion must be provided to the Department prior to any construction taking place, and must be completed within two years of the date that the permit was issued. This rule is not intended to be applied to any expansion that utilizes a solid manure handling system.

(iii) No open-air swine or poultry liquid manure storage basins will be allowed.

(iv) All liquid manure storage basins must be fenced to Natural Resources Conservation Service (NRCS) specifications.

(v) Manure application agreements must be for at least four years for all expansions or new construction.

(vi) All new manure storage structures (earthen basins, slurry stores, concrete manure storage, runoff ponds, sediment ponds or other similar structures) shall be a minimum of 300 feet from any property line (including a road right-of-way) unless the manure storage structure is being installed to mitigate a pollution hazard and meeting the 300 foot setback is not feasible or is impractical. In no case shall a new manure storage structure be located within the minimum building setback for the zoning district where it is located.

P. For parcels of land greater than 1 acre in shoreland or "R" zoning.

1. *Limited to up to 25 Chickens (no other fowl) and/ 20 rabbits*
2. Shelter, fencing, cages must be provided – no free range animals.
3. Roosters are prohibited
4. All litter must be garden applied and tilled or removed from property
5. Property owner must maintain a Livestock Registration with Todd County

Q. For parcels located in shoreland zoning that have historic feedlot use.

1. Owner must maintain Livestock Registration with Todd County.
2. May register for up to 9.9 AU maximum animal units on parcel.
3. Todd County will require plans and specifications for review prior to approval of registration verifying setbacks, potential runoff, wetlands, etc..
4. Final determination is made by Planning and Zoning Administrator

R. A violation of this section shall constitute a misdemeanor and be processed according to the procedures established in Article X.

Section 9.12 Mining and Extraction Use.

A. **Mining & extraction permits**. Activities permitted include washing, crushing, screening, and stockpiling of soil, rock, sand, gravel, concrete, and asphalt, removal of barrow material, temporary administrative office structures that will not be present after the permit expires, and equipment maintenance activities under the following conditions:

(i) **Permitee signatures**. Both the landowner and the contractor shall sign the application and be responsible for meeting the conditions of the permit.

STATE OF MINNESOTA | DISTRICT COURT

COUNTY OF TODD | SEVENTH JUDICIAL DISTRICT

Travis Winter, Aimee Goodwin, Corey Goodwin, Joel Walsh, Amy Walsh, Katrina Downes, Russell Anderson,

Plaintiffs,

vs.

Gourley Premium Pork, L.C., d/b/a Gourley Brothers and Gourley Bros. Premium Pork; and Protein Sources, LLP and Protein Sources Milling, LLC; and John Doe,

Defendants.

Court File No. 77-CV-14-933

ORDER

This matter came on for hearing before District Court Judge Douglas P. Anderson on November 20, 2015, at the Todd County Courthouse in Long Prairie, Minnesota, pursuant to Defendants' motion for summary judgment. Appearances were noted in the record.

Based on the files, records and proceedings herein,

IT IS HEREBY ORDERED:

1. Defendants' motion for dismissal of Plaintiff Downes' claims for lack of standing is denied.

2. Plaintiffs Winter's and Goodwin's claims are limited to nuisance and/or negligence damages incurred while they resided at their respective residences.

3. Plaintiffs Winters and Goodwin shall not be allowed to offer evidence of adverse health impacts caused by Defendants operation of the facility.

4. Defendants' motion for summary judgment on Plaintiffs' nuisance claim is granted in part and denied in part. The motion is granted as to claims based on light and noise and denied as to claims based on odors.

5. Defendants' motion for summary judgment on Plaintiffs' negligence claim is granted in part and denied in part. The motion is granted as to claims based on light and noise and denied as to claims based on odors.

6. Defendants' motion for certification is denied.

cited by Defendants are relevant, for all of them deal with the limits of MPCA (or local) actions involving *regulated* (and therefore measurable) standards for noise or air emissions.

Light and noise nuisance

Fourteen 250-watt lights are stationed on fourteen-foot tall poles around the perimeter of the facility to provide illumination for the perimeter road as well as for security. They are light activated, turning on at nightfall and off at daylight.

Light illumination can be objectively measured in foot candles. Defendants conducted such measurements (on the evening of October 13, 2015). *See* Def. Ex. 112. The testing indicated that there is illumination from the lights up to a distance of 120 feet from the facility; at any point further there is no illumination. In other words, the facility's lights cannot cause a shadow at a distance of more than 120 feet. Plaintiffs have presented no facts or expert opinions that dispute this finding. The nearest neighbor is 1,320 feet from the facility.

With respect to Plaintiffs' noise-related nuisance claims, Plaintiffs allege that (1) three feed trucks bring feed to the facility each week; (2) one truck each weeks takes pigs from the facility; (3) exhaust fans at the facility run continuously; (4) a skid steer is operated daily outside the facility from early morning until late evening; (5) when pigs are removed from the facility (once a week), they make squealing noises; and (5) that there is a banging or clanging of the feed trucks as facility workers unload the feed.

None of the noises of which Plaintiffs complain are other than those usually and customarily associated with farming operations, albeit magnified here because of the size of the operation. No evidence has been presented that the noise generated from the facility exceeds what should be expected

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odor to a measured concentration across a diverse population. As a result, it is not possible to adopt a state ambient air quality odor standard. Despite this, *odors can be a source of private or public nuisance*." Def. Ex. 137 (emphasis added).

The "Odor Policy" also states that "*In some limited circumstances*, however, a facility that reduces its emissions of certain chemicals may also reduce neighborhood odor. *In these rare cases*, the MPCA *may* be able to use odor measurement as a surrogate for specific chemical concentrations." Def. Ex. 137 (emphasis added). The MPCA's references to "limited circumstances," "rare cases," and the modal verb "might" indicate that, as a general rule, hydrogen sulfide is a legislatively established surrogate for swine odor.

in an agriculturally zoned area.

The state has established maximum noise levels for various land use activities (*see* Minn. R. 7030.0020, *et. seq.*). Specifically, for agricultural and related activities (noise area classification 3), noise levels may not, day or night, exceed 80 decibels for more than six minutes or 75 decibels for more than 30 minutes of each hour. Minn. R. 7030.0040, 7030.0050. The only testing conducted at the facility (the "Skoglund Report," Def. Ex. 111) indicates that noise levels, projected to the nearest residences, did not exceed 40 decibels—approximately sixteen times less than the state standard for such areas. Therefore, the only evidence before the court is that Defendants' have not come close to exceeding those levels.

In short, there is an objective, scientific means by which to measure sound, and that is in decibels. The sounds of which Plaintiffs complain are regular, consistent and easily measured. Defendants' measurements show compliance with the state-regulated noise standards for agricultural activities. Plaintiffs, on the other hand, have conducting no testing.

For an interference with the enjoyment of life or property to constitute a nuisance, it must be material and substantial, *Citizens for a Safe Grant v. Lone Oak Sportsmen's Club, Inc.*, 624 N.W.2d 796, 803 (Minn. Ct. App. 2001), and a fact finder is to measure the degree of discomfort by the standards of ordinary people in relation to the area where they reside. *Id.* Under the circumstances, the court finds, as a matter of law, that the light and noise emitted from the facility do not cause a *substantial and material* interference with Plaintiffs' enjoyment of their properties and therefore to exclude at trial evidence of excessive light or noise as a basis for Plaintiffs' nuisance claim.

Negligence claim

There is deposition testimony that Defendants left "dead animals laying [sic] out in the hot sun, bloating up, all day long clearly visible from the road," and that on several occasions Defendants garbage blew across the facility' property and ended up on their neighbors' land. *See* Pl. Opp. Mot.

STATE OF MINNESOTA | DISTRICT COURT

COUNTY OF TODD | SEVENTH JUDICIAL DISTRICT

Travis Winter, Aimee Goodwin, Corey Goodwin, Joel Walsh, Amy Walsh, Katrina Downes, Russell Anderson,

Plaintiffs,

vs.

Gourley Premium Pork, L.C., d/b/a Gourley Brothers and Gourley Bros. Premium Pork; and Protein Sources, LLP and Protein Sources Milling, LLC; and John Doe,

Defendants.

Court File No. 77-CV-14-933

ORDER ON FINAL JURY INSTRUCTIONS AND SPECIAL VERDICT FORM

This matter came on for trial before District Court Judge Douglas P. Anderson on December 4, 2017 at the Todd County Courthouse in Long Prairie, Minnesota. Appearances were noted in the record.

Based on the files, records and proceedings herein,

IT IS HEREBY ORDERED:

1. Defendants' requested inclusion of Todd County's Right to Farm Ordinance is DENIED.

2. Defendants' requested revision to this Court's private nuisance instruction is DENIED.

3. Defendants' requested removal of the instruction to determine damages even without a determination of liability is DENIED.

4. Defendants' requested revision to this Court's instruction on allowable items of damages is DENIED.

5. Defendants' requested revisions to the recoverable damage period for (1) Aimee and Corey Goodwin and (2) Russell Anderson, Katrina Downes, and Joel Walsh is GRANTED.

6. Defendants' requested revision of this Court's proposed jury instructions to reflect Minn. Stat. § 116.0713's limitation on claims based upon odor nuisance is DENIED, at this time.

7. Defendants' requested revision to the special verdict form to conform to the requested revised jury instructions is DENIED.

8. Defendants' request to submit one damage question for each of the 2 households, that is, (1) Aimee and Corey Goodwin and (2) Russell Anderson and Katrina Downes is DENIED.

9. The attached Memorandum is made a part of this Order.

Dated December 6, 2017.

BY THE COURT:

Douglas P. Anderson
Judge of District Court

Attachment C

MEMORANDUM

The dates have all been corrected.

Combining (1) Aimee Goodwin and Corey Goodwin and (2) Russell Anderson and Katrina Downes

The court declines to combine spouses or household occupants in the same damage question. The occupants have different factual situations. For example, Corey Goodwin worked out of the home during the daytime hours, and Aimee Goodwin did not. Katrina Downes worked out of the home as well, and Russell Anderson did not. The alleged exposure to the facility is different. Additionally, Downes and Anderson are granddaughter/grandfather and allocating a single damage award between the two of them would not be as simple as allocating a damage award between husband and wife.

The Right to Farm Ordinance

The Right to Farm Ordinance instruction will not be given. Section 9.11 E of the Todd County Ordinance provides that no action of law against a farming operation, because of such farming activities, may be brought as long as such farming activity comply with state, federal or county regulations.

The ordinance is arguably incorrect. The last phrase is written in the disjunctive. No suit can be commenced as long as the farming activity complies with state, federal or county regulations. The way it is written, if a farming operation complied with state regulations but not county regulations, it would still be exempt from litigation (and vice-versa). As the court has stated, an activity can have all the appropriate permits and still be operated negligently or as a nuisance. In fact, the facility in question was granted a conditional use permit (CUP) predicated on the fact that the facility would be operated consistently with the conditions stated at the time the CUP was granted. Additionally, there are periodic compliance checks and reviews as noted by Defendants. Because permits are initially granted, it does not mean that the facility is forever barred from litigation if it ceases to be operated in compliance with the regulations or if it otherwise engages in conduct that can subject it to litigation. The court orally gave the parties 3 examples of why section E is incorrect. First, Todd County has no animal disposal regulations, but defendants must comply with these regulations. Second, Todd County has no hydrogen sulfide standard, yet defendants must comply with these standards set by the state. Third, Todd County has no grace period for exceeding air emissions as does Minnesota statute 116.0713, yet that statute applies to the defendants' facility. Read literally, the Gourley facility would be exempt from suit under section E if it complied with just the Todd County's regulations, and it would not have to comply with state and federal regulations. Besides being written in the conjunctive, Section E should probably require compliance with rules, regulations, and statutes; not just regulations. The term "regulation" is not defined in the Todd County ordinance either.

Defendants can certainly bring forth Section 9.11 of the zoning ordinance to support the underlying premise of the Todd County Ordinance. However, it is a jury question whether or not the facility is being operated in compliance with state, federal, and county regulations. This would include compliance with state and federal laws which include laws which allow for nuisance claims and negligence claims.

Instruction on Livestock Odor under Minn. Stat. § 116.0713

If Plaintiffs claim that Defendants exceed the state ambient air quality standards during manure removal, the court would give, as an instruction, Minn. Stat. § 116.0713(c). Even though there would be no objective evidence that Defendants have exceeded state ambient air quality standards for hydrogen sulfide, they would still be entitled to an instruction that the usual and customary odors affiliated with the operation could be, pursuant to the statute, exceed (or increase) for the cumulative period of 21 days for the removal process under the statute.

D.P.A. DPA

Attachment C

Section 9.11 Feedlots.

A. Policy - An efficient and profitable livestock industry is an economic benefit to Todd County and to the State of Minnesota. It provides a value-added opportunity to our crop based agriculture and creates service industries, which provide employment and further economic activity. An efficient industry also produces high quality food and fiber for consumers at reasonable prices. The wastes produced in livestock production have the potential, when improperly stored, transported or disposed, to contribute to air, surface water, and ground water pollution. When properly utilized such wastes contribute to soil fertility and structure and enhance efficient crop production. The following section has been promulgated to reduce risk of pollution of natural resources from feedlots.

B. Todd County is an MPCA delegated Feedlot County.

C. This section regulates feedlots as well as storage and land application of animal waste. All existing and future feedlots in Todd County shall comply with the standards set forth within the Minnesota Pollution Control Agency (MPCA) Chapter 7020 rules and updates, and this Ordinance.

D. Within the agricultural-preservation districts, the construction, expansion and operation of feedlots and other agricultural uses are permitted or permitted by conditional uses.

E. There will be from time to time, sights, sounds and smells associated with the operation of farming. No property owner shall bring an action(s) of law, including without limitation claims for private nuisance under Minn. Stat. § 561.01 and common law negligence, against any farming operation, because of such farming activities, as long as such farming activity is complying with the local, County, State, and Federal ~~or County~~ permits, ordinances, rules, statutes and other regulations which apply to and are enforceable against the farming operation.

F. More restrictive standards Minnesota Rules Chapter 7020 are hereby modified by the following more restrictive standards.

G. The County Board may appoint a Feedlot Officer(s) as are necessary and to designate their power and duties within the limits of this section.

H. A land use permit shall be required for all expansions of buildings of an existing feedlot that does not increase the animal unit numbers.

I. A land use permit with a feedlot inspection is required for all expansions of buildings or lots that increase animal unit numbers of existing registered feedlots of more than 10 animal units but less than 300 animal units. An Interim Permit may be required to correct environment hazards on feedlots.

J. Registration. An animal feedlot capable of holding ten (10) or more animal units, or a manure storage area capable of holding the manure produced by 10 or more animal units is required to register with the County every four (4) years.

Attachment D

K. Conditional Use Permit - Expansion of animal unit numbers to existing feedlots located within 300 feet of any river class or within 1,000 feet of any lake class may be approved *if they do not exceed 1,000 animal units and they do not further encroach into the* riparian setback or bluff impact zone.

L. The owner of a proposed or existing animal feedlot of over 300 animal units in the Agricultural District shall make an application to the County for a Construction Short Form Permit when any of the following conditions exist:

(i) A new feedlot is proposed where a feedlot did not previously exist;
(ii) Expansion of an existing feedlot beyond registered animal units;
(iii) Any change in species on an existing animal feedlot or facility;
(iv) A feedlot is to be restocked after being abandoned for five (5) or more years;
(v) An inspection reveals that the feedlot is creating a potential pollution hazard and due process is observed by the authorized entity Department and provides the ability to correct the infraction as listed in MPCA regulations;
(vi) Application for conditional use permit;
(vii) A National Pollutant Discharge Elimination System (NPDES) permit application is required under State or Federal rules and regulations (over 1,000 animal units of manure is produced on the farm);
(viii) Other actions as specified in the Ordinance.

M. Feedlot setbacks and separations -feedlot setbacks. All setbacks of this section shall apply within the county and shall not cross county lines. The setback standards of the county where the feedlot is located shall apply. No new feedlot shall hereafter be erected within the following distances:

New Feedlot or Manure Storage Area	**Animal Units**	**Municipal Limits or Municipal Growth Boundaries***	**Public Drainage Ditch***	**School, Church, Park, or Airport***
Tier I	10-100	Half (1/2) mile	300 feet	Quarter (1/4) mile
Tier II	101-300	One (1) mile	300 feet	Half (1/2) mile
Tier III	Over 300	One (1) mile	300 feet	Half (1/2) mile
* All setbacks are reciprocal in nature				

N. All application of animal waste shall comply with all setbacks of Minnesota Statutes Chapter 7020, to minimize odor nuisance, potential point and non-point pollution. 0. Performance Standards:

(i) All new liquid manure storage structures must have a minimum of twelve (12) months of storage capacity.

(ii) All expansions of feedlots with a liquid manure handling system must have a liquid storage capacity to accommodate the increase in animal units. The plans for this expansion must be provided to the Department prior to any construction taking place, and must be completed within two years of the date that the permit was issued. This rule is not intended to be applied to any expansion that utilizes a solid manure handling system.

(iii) No open-air swine or poultry liquid manure storage basins will be allowed.

(iv) All liquid manure storage basins must be fenced to Natural Resources Conservation Service (NRCS) specifications.

(v) Manure application agreements must be for at least four years for all expansions or new construction.

(vi) All new manure storage structures (earthen basins, slurry stores, concrete manure storage, runoff ponds, sediment ponds or other similar structures) shall be a minimum of 300 feet from any property line (including a road right-of-way) unless the manure storage structure is being installed to mitigate a pollution hazard and meeting the 300 foot setback is not feasible or is impractical. In no case shall a new manure storage structure be located within the minimum building setback for the zoning district where it is located.

P. For parcels of land greater than 1 acre in shoreland or "R" zoning.

1.. Limited to up to 25 Chickens (no other fowl) and/ 20 rabbits
2. Shelter, fencing, cages must be provided — no free range animals.
3. Roosters are prohibited
4. All litter must be garden applied and tilled or removed from property
5. Property owner must maintain a Livestock Registration with Todd County

Q. For parcels located in shoreland zoning that have historic feedlot use.

1. Owner must maintain Livestock Registration with Todd County.
2. May register for up to 9.9 AU maximum animal units on parcel.
3. Todd County will require plans and specifications for review prior to approval of registration verifying setbacks, potential runoff, wetlands, etc..
4. Final determination is made by Planning and Zoning Administrator

R. A violation of this section shall constitute a misdemeanor and be processed according to the procedures established in Article X.

PLANNING COMMISSION
GOODHUE COUNTY, MN
April 16, 2018 MEETING MINUTES
DRAFT

The meeting of the Goodhue County Planning Advisory Commission was called to order at 5:30 PM by Chair Darwin Fox at the Goodhue County Government Center 3rd Floor Court Room in Red Wing, Minnesota.

Roll Call

Commissioners Present: Ron Allen, Tom Drazkowski, Len Feuling, Tom Gale, Darwin Fox, Marc Huneke, Richard (Dick) Nystuen, Sarah Pettit

Commissioners Absent: None (Commissioner Huneke arrived at 5:42 PM – see below)

Staff Present: Land Use Management Director Lisa Hanni, Zoning Administrator Mike Wozniak, Zoning Assistant Ryan Bechel

1. Approval of Agenda

[1]Motion by Commissioner Feuling; seconded by Commissioner Drazkowski to approve the meeting agenda. Motion carried 7:0 *(Huneke absent)*

2. Approval of Minutes

[2]Motion by Commissioner Feuling; seconded by Commissioner Nystuen to approve the previous month's meeting minutes. Motion carried 7:0 *(Huneke absent)*

3. Conflict/Disclosure of Interest

There were no reported conflicts of interest.

4. <u>PUBLIC HEARINGS: Request for amendments to Article 11, Section 24 (Preservation of Farming Practices)</u>

Request submitted by Circle "K" Farms (Michael, Yon, & Jeff Kohlnhofer) to consider proposed text amendments to Goodhue County Zoning Ordinance Article 11, Section 24 (Preservation of Farming Practices).

The applicant was present to represent the application.

<u>5:42 PM: Commissioner Huneke enters</u>

Lisa Hanni (Hanni) presented the staff report and attachments. Hanni detailed the County's application process, public noticing requirements and further clarified the request before the PAC was not an amendment to the County's existing Feedlot Ordinance (Article 13).

Jack Perry (Applicant's representative) discussed the importance of agriculture, particularly animal agriculture, citing it accounts for a third of Minnesota's economy. He conveyed concerns with nuisance claims for agricultural uses that are in compliance with all applicable state, local, and federal regulations that are brought on by neighboring parties after significant financial resources have been put into a site. Perry detailed a legal case he was a part of in Todd County, MN and discussed outside interests that have provided financial resources for neighboring parties to bring legal actions against feedlot operators. He feels there is a need for stronger ordinance language, similar to those enacted by Todd County, to protect agricultural operators from nuisance claims lacking proximate cause. Mr. Perry stated that he was in favor of Staff's recommended wording for the proposed amendments. He added that Staff's suggested wording clarified the County's position regarding nuisance claims against agricultural operators that are complying with all specified requirements.

Hanni added clarification of the proposed staff changes stating the wording is to clarify that the County's position: if a feedlot is following all of the rules and requirements placed upon *them by state and local authority, the County will not consider the operation to be a nuisance. Hanni reminded the PAC and attendants of the hearing that the proposed amendments apply to all agricultural operators in the county, not any one specific feedlot.*

Chair Fox opened the Public Hearing.

Beth Slocum 31005 CTY 7 BLVD Welch, MN provided a written statement (see attachment 1) She stated the proposed amendment language doesn't serve the best interests of all Goodhue County residents adding that it removes exemptions to feedlot operators exceeding 1000 animal units. She stated the current ordinance is clear, concise, and adequate to protect the public interest. The proposed ordinance changes are vague and add ambiguity to the language. She conveyed concerns regarding changes to feedlot operations over time that are not present at the initial permit issuance. She further added concerns that the Applicants are attempting to preempt themselves from future air quality nuisance concerns. She suggested the PAC either deny the request or table the item and form a study group to further evaluate the proposal.

Kristi Rosenquist 42883 228th Ave, Mazeppa, MN provided various documentation regarding feedlot air emissions (see attachment 2). She stated she believes the proposed changes are detrimental to property owner rights and may even be unconstitutional. She further added that Jack Perry has submitted similar changes to the legislature which have failed to gain traction and she is worried that he is now working to impose his desired changes at the local level. She stated the Right-to-Farm language was originally intended to protect existing operators from nuisance claims, not newly proposed feedlots moving in near established residences. She feels the existing language has been effective and does not need to be updated and that, statewide, nuisance claims against feedlot operators are a rarity. She added that the Staff's proposed changes are not adequate to protect existing property owner's rights and don't provide enough explanation as to why they are necessary. She cited 3M's recent legal case as an example of a business that was in compliance with regulations but was found to be a nuisance through a lawsuit. She suggested the PAC either deny the request or table the item and form a study group to further evaluate the proposal as has been done with other requests such as wind and mining.

Bob Rosenquist 42883 228th Ave, Mazeppa, MN provided a written summary of comments and documentation regarding air monitoring emissions studies (see attachment 3). He cited various studies that suggest air emissions coming from hog feedlot operations exceed recommended levels and are harmful to public health and safety. He stated the hog industry should face the challenge of odor emissions head-on rather than attempting to modify existing regulations to suit their needs. He stated there is not adequate evidence provided by staff to support agricultural operations have been impacted by nuisance claims and urged the PAC to deny the request and leave the existing language in place.

Keith Allen lives in an A1 zone where he operates a goat dairy farm near Kenyon, MN. He is in full support of the proposed changes. He discussed how the agricultural industry has adapted over time to address issues. He stated he has had the opportunity to visit numerous ag operations during his life and believes the vast majority of agricultural operators are good stewards of the land and are cognizant of the importance of preserving it for future generations.

Marie Mcnamara 35815 165th Ave, Goodhue, MN stated she farms in Goodhue County. She mentioned that the ordinance should protect the interests of all people and avoid unintended consequences. She stated that a lot of time and energy went into developing the feedlot ordinance earlier and that the proposed changes are premature. She questions whether the *proposed changes are protective of all citizens of the County. She submitted documentation regarding the Wendinger family vs Wakefield Pork Inc. (see attachment 4). She stated the case found that compliance with all applicable requirements does not preclude an operator from a negligence lawsuit. She was concerned that the staff recommended wording didn't address potential operational issues after a permit had been issued. She stated the wording proposed to be removed from subd. 3 should not be removed. She further added she was concerned about environmental impacts to the County's Karst features.*

Darwyn Tri of Zumbrota Township grew up on a local dairy farm and is a neighboring landowner to the Kohlnhofer's newest proposed swine facility. He provided a written summary of comments (see attachment 5). He stated he has experience in air quality monitoring and has conducted air quality monitoring of hog feedlots and has serious concerns with feedlot odor emissions and existing data being utilized by the MPCA. He detailed various air emissions studies and contaminants. He recommended that the request is put in front of a committee for further study.

Dan Forsythe of Welch Township state he believes the intent of the Applicant's submitted language is to deny the rights of citizens to due process. He stated the request should be denied because it gives business an unfair advantage over others. He feelsStaff's suggested wording would limit and deny the rights of Goodhue County citizens. He suggested the PAC either deny the request or study it further prior to making a decision.

Sharon Pagel 41567 CTY 42 BLVD Mazeppa, MN provided a written statement and "Explosion of CAFOs" study (see attachment 6). She stated she lives on her family farm that has been established since 1877. She relayed concerns regarding pollutants in odor emissions from hog feedlot operations. She stated that the Kohlnhofers are establishing a new hog operation near her residence and is very concerned about air pollution impacts to the health and well-being of citizens in the vicinity of these types of operations. She recommended the PAC delay amending existing ordinances until the MPCA completes current odor emissions studies. She is opposed to the requested changes.

Josh Betcher County 42 BLVD Mazeppa, MN stated he lives on a 5th generation family farm. He feels the debate needs to be refocused to the proposed amendments as they would apply to all agricultural operators in the County, not specific rules that would apply to one farm or hog operation alone. He feels the proposed changes add clarity to existing rules and allow agricultural operators to have a clearer understanding of regulations when applying for permits and making investments within the County. He noted a lot of work and review had been completed by Staff regarding the proposed amendments and agreed with the proposed language. He added that there are a number of agricultural operations aside from feedlots that this language applies to such as shrimp producers.

Susan Johnson lives in Red Wing city limits. She questioned whether existing language has been problematic for the County. She asked if examples were available of past problems with the existing language. She was concerned that the proposed amendments removed language regarding injury to neighbors and pollution of water resources. She believes the existing ordinance is already working and should be left alone.

Shelly Nygard of Belle Creek Township stated she is a lifelong resident of Goodhue County. She suggested the prepared staff reports provide no account of how changes could affect rural residents. She is concerned the proposed language limits citizen's avenues of redress for future problems with agricultural operations. She feels inadequate explanation has been provided regarding impacts to rural residents. She stated the proposed changes could allow entities to operate uninhibited with no accountability. She noted the Kohlnhofers are going to be studied *for air emissions issues currently. She recommends the request be put in front of a committee for further study or be denied, but either way, she doesn't believe modifications are necessary.*

Dale Post lives on an A1 zoned farm in Zumbrota Township. He is opposed to both the Applicant's wording and Staff's suggested language. He feels the amendments treat residences as if they are intruders in the agricultural area. He feels that residences shouldn't be considered a conflict to farming. He noted that a feedlot of the Kohlnhofers will be subject to air emissions monitoring after testing indicated levels exceeding standards. He stated he would like 3 things included in the record: 1. At risk communities may citizen report hydrogen sulfide emissions in Minnesota; 2. MPCA Commissioner John Stein issued a statement regarding concerns of potential air quality issues at 2 Kohlnhofer hog facilities; 3. The MPCA did not use the air quality monitoring equipment available to them to address emissions concerns at the Kohlnhofers farms. He also mentioned the county Comprehensive Plan has goals regarding feedlots and environmental concerns for adjacent landowners. He recommends no change to the ordinance at this time.

Jack Perry requested a petition including 18 signatures supporting the Applicant's request be included in the record (see attachment 7).

Sonya Trom-Eayrs is from Dodge County, MN. She is a member of Dodge County Concerned Citizens. Her parents are longtime members of the community and have many feedlots surrounding their longtime family farm that have caused odor issues. She stated her parents and pets have suffered health issues in response to hog odor in the area surrounding their property. She fears that the pork has a history of changing local ordinances in response to lawsuits. She asserted that local planning commissions can be biased due to members being involved in the pork industry. She suggested the pork industry is trying to take advantage of the elderly and rural citizens.

Allan Muller of the city of Red Wing submitted written comments (see attachment 8). He stated he felt the proposed changes were an attempt by the Applicant to reduce the rights and powers of people to challenge their operations. The amendments could curtail County efforts to address feedlot issues in the future. Particularly, the removal of the exemption for 1000 animal units is undesirable to the public interest. He also has concerns about public notice requirements not being met. He recommends there be an advisory committee and additional research conducted prior to any decisions being made. He stressed concerns regarding the limitations of regulations to address environmental concerns such as odor emissions. He also mentioned that if higher authorities opt for reduced regulations, that it would also impact permits then at the local level. He is opposed to any amendments being approved.

Douglas Eayrs is from Dodge County, MN. He is a member of Dodge County Concerned Citizens. He provided documentation regarding 2 nitrate monitoring reports (see attachment 9). He conveyed concerns regarding feedlot contamination of groundwater in areas with Karst geography. He reminded the PAC that they have the power to create a standard higher than state standards. He posited that the hog industry wants free water from county aquifers, space to spread untreated animal manure and that they have their own "agenda" which doesn't care for county residents. He is against the proposed amendments and recommends the PAC consider the impacts to rural residents.

Jed Post of Belle Creek Township stated he recently purchased a dairy farm in Goodhue County. He raised concerns regarding the effectiveness of the existing odor offset model. He questioned how many residents of Goodhue County are in favor of the proposed amendments. He would encourage the PAC to take into consideration all rural residents. He also stated he felt the notification process for hog facility public hearings is inadequate.

Melissa Post stated her husband put his retirement into the farm and they have been directly impacted by feedlot odors surrounding their property.

Fredrick Frederickson is a dairy farmer located in Zumbrota Township. He stated he is a neighbor of the Kohlnhofers and is against the proposed changes. He recommends that a more thorough study of the changes be done prior to further consideration.

Sara Freed is a farmer located in southeastern Goodhue County. She is not supportive of the change. She has no issues with the rules and regulations and feels that the ordinance is being changed only as a result of the Kohlnhofer's lawsuit. She believes the amendments are too vague and reduce the ability of citizens to address issues with agricultural operators.

Elvie Day is a new resident of Goodhue County. She stated she no longer eats pork because of the impacts of hog farming to the local environment. She raised concerns about health risks to humans from hog waste. She stressed that the needs of the many should outweigh the wants of a few.

Kristi Rosenquist reappeared to discuss the aforementioned Todd County feedlot facility. She mentioned that the owners of the facility do not live in the vicinity and that locals in the area moved away as a result of its establishment. She feels it is a concerning trend in the industry that owners of the facility no longer live at the facilities and are exposed to the impacts those in the surrounding properties may be subject to. She mentioned the process of drafting the current version of the Goodhue County Feedlot ordinance and stressed not to change it without further study.

Sonya Trom-Eayrs reappeared and encouraged the PAC to visit her website "dodge.cc.org" for additional information regarding "factory farms." She raised concerns regarding the pork industries business model which displaces people for profits.

Josh Betcher reappeared to mention that he feels a lot of effort has been put into this review. He stated he felt that the industry has done a good job of innovating to address problems and would be concerned about increasing regulations that could stifle that innovation.

Brandon Shafer of Belvidere Township stated he was a previous member of the Goodhue County Planning Commission. He made a point of clarification that the proposed changes are not an amendment to the existing feedlot ordinance. He stated that the feedlot ordinance has been a very effective ordinance which has done a good job at balancing the needs of all citizens of the county. He stressed that this amendment request is not about one project but rather public interaction as it relates to agriculture and farming practices. He does not believe the intent is to weaken any existing regulations, but rather clarify how perceived nuisances can be addressed in the future. He stated he is supportive of the amendment.

[3]After Chair Fox asked three times for comments. It was moved by Commissioner Feuling and seconded by Commissioner Pettit to close the public hearing. Motion carried 8:0

Commissioner Allen questioned the Applicant if the existing ordinance has hindered their operations.

Jack Perry responded on behalf of the Applicant. He stated the request is in response to the implications of the Todd County legal case which demonstrated that an operator can be sued for negligence or nuisance despite compliance with all applicable regulations. He also stated feedlot owners are concerned with the financial investments of outside interests to support nuisance lawsuits against feedlot operators. He also stated that if an operator is found liable as a temporary nuisance, the owner can be subjected to perpetual lawsuits. He added there is *a real concern that even if a feedlot operator is in conformance with all imposed requirements they may still be stripped of their ability to operate after investments have been made.*

Commissioner Allen asked Goodhue County Attorney Steve Betcher (Attorney Betcher) if he felt there was a need to amend the existing ordinance language.

Attorney Betcher responded that the request before the PAC was originated by the Applicant based on their perceived need. He stated the Staff's recommended changes are not reflective of the County's feeling that changes are necessary. He clarified that given the request was submitted by an applicant, and not generated by request of the PAC, staff followed the alternative process to propose recommended changes to the language. Staff's proposed language is an attempt to limit the liability of the county in the event that a party was to challenge what did or did not constitute a nuisance as determined by the county. The new language simply states that unless you are violating a requirement, the county will not consider you a nuisance. An aggrieved party still has the opportunity to bring a nuisance action against an operator. We did not agree with the Applicant's language which sought to limit the ability of a party to bring an action against an operator. If there is no violation of any regulation required of the operator, the county will not consider the operation to be a nuisance. If you do violate any terms of a permit or regulations, this language does not preclude the county from pursuing a nuisance claim. The proposed language prevents the county from attempting to mediate nuisance claims amongst neighbors.

Commissioner Drazkowski asked Attorney Betcher for clarification about the language regarding an operation not being a nuisance on the date of establishment or permit issuance. What happens later?

Attorney Betcher replied the date is only used to determine if it may qualify as a nuisance. If you are operating a legal farming operation in Goodhue County and your neighbors decide that they don't like it, the county will not look at it as a nuisance as long as it continues to comply with all the requirements. If the requirements change, the operator will still be required to come into compliance with the new requirements. It simply means that opinions will continue to be private opinions and the county will not insert itself to determine what will be considered a nuisance.

Commissioner Drazkowski questioned Attorney Betcher why he would suggest requiring existing sections "A" through "E" regarding other regulations.

Lisa Hanni responded that those items are still covered in Staff's proposed wording. If an individual causes harm to a person or pollutes, they would not be considered to be following the rules and therefore could still be considered a nuisance.

Attorney Betcher added that there is often disagreement by those opposed to feedlot projects regarding the standards administered by the MPCA. The county has been repeatedly requested to interpret these other agencies regulations. The County does not have expertise or jurisdiction to reinterpret the interpretations of regulations put forth by the other state agencies.

Commissioner Drazkowski asked what the role of the Goodhue County Feedlot Officer is.

Attorney Betcher replied that the County Feedlot Officer is responsible for administering the county feedlot ordinance and the state has delegated the authority to enforce the state feedlot regulations to Goodhue County.

Commissioner Drazkowski questioned if we are opening up Goodhue County citizens to future injury by changing regulations for one specific industry or operator.

Attorney Betcher responded that the commission has the option to recommend the proposal for *further review. He stated that the Staff recommended changes are a result of our experience of how the existing ordinance has been interpreted. He mentioned that the County is currently in a multiple-year lawsuit for a permit that was ultimately reviewed and permitted by the state based on the county interpretation of the state rules. The proposed changes seek to reduce the county's liability in interpreting the rules of other agencies involved in agricultural operations.*

Commissioner Drazkowski questioned the need to amend the ordinance preemptively when it appears the existing ordinance has been effective in serving the public.

Attorney Betcher replied it is the PAC's position to determine what is in the best interests of the county moving forward. Staff proposed the amended language as an alternative to the applicant's proposal that offered the county an opportunity to clarify its legal stance in the event of a future court challenge. There is nothing that requires the PAC to act on it in any such way.

Commissioner Gale asked if an additional public hearing would be needed to decide on Staff's proposed language.

Attorney Betcher responded that due to the "60 Day Rule," the PAC needs to make a decision regarding the proposed language put forth by the Applicant. The PAC may go one step further and make a decision regarding Staff's recommended amendments.

Lisa Hanni added that the Applicant has expressed that they are in agreement with Staff's proposed changes. She also reiterated the language is not about one specific project, this is not the feedlot ordinance, and that this language covers all agricultural operations in the County. This language is a rewording of existing language that clarifies that if you are permitted and following all the rules and regulations required for the operation the County will not view you as a nuisance. If you are not following the rules, the County still has the ability and authority to pursue enforcement action.

[4]Motion by Commissioner Drazkowski seconded by Commissioner Gale, for the Planning Advisory Commission to recommend the County Board to

- adopt the staff report into the record;
- accept the application, testimony, exhibits, and other evidence presented into the record; and;

Recommend the County Board of Commissioners **DENY** Staff's recommended wording for the text amendment request and **DENY** the language changes requested by the applicants to the extent they are inconsistent with staff recommendations.

Commissioner Fueling commented that the language is an opportunity to affirm the County's position as an agricultural community.

Commissioner Allen stated he felt the County has been an agricultural County and that the existing language has been sufficient to support agriculture in the community.

Commissioner Nystuen stated he felt it was important to reinforce the County's position regarding nuisance claims given the amount of investment required in modern agricultural operations.

Commissioner Huneke echoed Commissioner Nystuen's comments and added that it would be good to limit the County's liability as it is not the County's responsibility to be a mediator in nuisance claims. He is supportive of Staff's proposed amendment.

Commissioner Pettit stated that Staff's proposed changes cover the items proposed to be struck. She stated that ultimately operators will still be required to follow all the rules but are provided improved clarity with regards to nuisance claims at the county level.

Motion to Deny Failed 3:5

[5]***Motion by Commissioner Pettit seconded by Commissioner Nystuen, for the Planning Advisory Commission to recommend the County Board to***

- adopt the staff report into the record;
- accept the application, testimony, exhibits, and other evidence presented into the record; and;

Recommend the County Board of Commissioners **APPROVE** Staff's recommended wording for the text amendment request and **DENY** the language changes requested by the applicants to the extent they are inconsistent with staff recommendations.

Commissioner Gale asked if the proposed language was going to stop nuisance actions similar to the ones mentioned in Todd County.

Commissioner Fox responded that all it was going to do was stop the County from having to be the mediator in a nuisance complaint.

Commissioner Gale asked if the County would be vulnerable to a lawsuit by not referring the proposed language for further study.

Hanni replied the County cannot know who may bring future actions against it.

Motion Carried 5:3

PUBLIC HEARINGS: Request for Map Amendment (Rezone)

Request for map amendment submitted by Blake Thompson to rezone 38 acres from A3 (Urban Fringe District) to R1 (Suburban Residence District). Parcels 31.001.6100 and 31.001.6200. Part of the SW ¼ of SE ¼ and GOVT Lot 2 in Sect 01 Twp 112 Range 15 in Featherstone Township. A3 Zoned District.

Michael Wozniak (Wozniak) presented the staff report and appendixes.

Blake Thompson (Applicant) commented that he desires to build a house on an available flat spot across a steep ravine on his property. The Applicant added that the township indicated this particular property is one of a few the Township has identified for future residential districts. He added that there is natural gas service currently available in the northwest corner of his property that he would like to utilize. He also added that the ability to sell some property would help to offset the costs necessary to construct the necessary infrastructure to access the site.

Chair Fox opened the Public Hearing.

Jay McClary 2471 Hay Creek Trail, Featherstone Township stated he understands R1 zone means residential only and not future business or commercial traffic moving past his property. He has concerns about the future use of the roads in the vicinity being capable of supporting additional residences.

Wayne Allar 28670 Hay Creek Trail, Featherstone Township is an adjacent landowner and stated he is very concerned about erosion issues with the highly-erodible soils on the property.

April 11, 2018 **electronic only**

Goodhue County Board Chair, Jason Majerus
John Drotos, Commissioner
Barney Neseth, Commissioner
Ron Allen, Commissioner
Brad Anderson, Commissioner

Re: PUBLIC HEARING: Request for amendments to Article 11, Section 24 (Preservation of Farming Practices): Request submitted by Circle K Farms (Michael, Yon, & Jeff Kohlnhofer) to consider proposed text amendments to Goodhue County Zoning Ordinance Article 11, Section 24 (Preservation of Farming Practices).

Dear County Commissioners,

We request that you withdraw the above referenced item from the Planning Advisory Commission hearing scheduled for April 16, 2018.

Goodhue County Zoning Ordinance, Article 1, Section 7 states in part, "An appeal shall stay all proceedings in furtherance of the action appealed from unless a stay would cause imminent peril to life or property." Kohlnhofer's request constitutes a proceeding in furtherance of their proposed swine finishing operation in Zumbrota Township. The County's processing of Kohlnhofer's March 6, 2018 request prior to the Minnesota Supreme Court's March 20, 2018 denial of further review of proposed project permits, was in violation of County Ordinance requiring a stay of all proceedings in the furtherance of proposed project.

Both the County and Kohlnhofers are co-defendants in a lawsuit currently before the Goodhue County District Court (Court File No. 25-CV-18-259). This case specifically calls on the County to cease violating the stay while the case was under review. The County's processing of co-defendant's proposed ordinance on March 6 and between March 6 and March 20 was in direct violation of County Ordinance.

Also, Minnesota Statute 394.25, Subd. 3c. **Feedlot zoning ordinances** states, (a) "A county proposing to …amend an existing feedlot ordinance must notify the Pollution Control Agency and commissioner of agriculture at the beginning of the process, no later than the notice of the first hearing proposing to adopt or amend an ordinance purporting to address feedlots." We see no evidence that this has happened.

County Zoning Ordinance Article 1, Section 2, Subd. 3 states, "**An application for an amendment not initiated by the Planning Commission <u>shall be referred to the Planning Commission for study</u> and report** and may not be acted upon by the Board until it has received the recommendations of the Planning Commission." (Emphasis added) A public hearing is not a referral for study.

Any change to County feedlot ordinance requires extensive study. In the briefing materials provided to the Planning Advisory Commission ("PAC") late Friday, April 6, 2018, staff provide a counter proposal to Kohlnhofer's proposed amendments. However, the staff provided no analysis of Kohnhofer's proposal explaining how their proposed change would affect county residents. Nor does it explain the meaningful differences between Kohlnhofer's proposal and County staff's proposal. After an entire month of legal analysis by the County Attorney, the PAC and public are provided with no explanation of the legal, property rights and implementation ramifications of either version of these recommended changes. There is no possibility for the PAC to make an informed decision to the County Board, and citizens are asked to provide input at a public hearing without an opportunity to learn before-hand what the proposed changes may mean for them.

In the past, when ordinance changes where controversial, of broad interest and/or had the potential to affect a large number of county residents, the County formed a sub-committee of Planning Advisory Committee members to research and study the issues and make recommendations to the PAC. This happened when the existing feedlot ordinance was created, for the wind energy ordinance update in 2010, and over the frac-sand mining issue. Study by the PAC is not only logical, it is required by the County ordinance.

In addition, if the County chooses to open the feedlot ordinance for amendments, the below signed citizens will be proposing changes and clarifications to the County feedlot and related ordinance sections. Our proposed ordinance changes would be in direct conflict with that proposed by co-defendant Kohlnhofers. We request that the County delay any further proceedings regarding the above referenced proposal, form a study group of selected PAC members, and consider our proposal for feedlot ordinance changes at the same time.

In summary, for the following reasons we call on Goodhue County to suspend all proceedings in the furtherance of co-defendant Kohlnhofer's proposed ordinance: 1) the County has violated the stay in County Ordinance in processing the proposed ordinance, 2) the County and ordinance proposer are co-defendants in a case regarding proposed project and County's previous ongoing violations of the stay, and 3) County is violating its own ordinance by failing to refer Kohnhofer's proposal to the PAC "for study", 4) co-defendant's proposed ordinance should not be heard in a public hearing separate from a full study including our proposed ordinance changes. Please suspend all proceedings in the furtherance of co-defendant Kohlnhofer's proposed ordinance.

Respectfully,

Kristi Rosenquist

Bob Rosenquist

Dale Post

Frederick Fredrickson

Janice Fredrickson

Kathy Bramble

Sharon Pagel

Darwyn Tri

ATTACHMENT 1

Three problems with proposed changes to
Article 11: Performance Standards, Section 24: Preservation of Farming Practices
from the Kohlnhofer Circle K Farms & Goodhue County Land Use Management

1) Nuisance related to date of operation
2) Nuisance related to compliance
3) Burden on neighbors to prove harm

1) Nuisance related to date of operation

The reasoning that the County uses to explain how a farming operation can't ever be a nuisance, if it wasn't a nuisance when it was permitted or when the operation commenced, just doesn't make common sense.

Of course a feedlot of any size can't be a problem/nuisance when it exists only on paper at the permitting stage – it is always perfectly compliant on paper.

And it can't be a problem/nuisance when the livestock initially stock the confinement barn. Nothing has gone wrong yet, everything is new – the concrete manure pit is empty and just beginning to fill, the corrosive and toxic gases have not yet begun corroding metal, plastic & concrete, electrical & plumbing infrastructure are not suffering from corrosion, the wood chip filtration (if this has been installed) for exhaust fans is in perfect condition. Everything is fine.

But that is not how things stay in a large hog confinement barn. The longer animals are housed in confinement, the quicker the building and its systems suffer severe wear and tear. The fuller the pit and the longer the manure is stored, the more toxic gasses it produces. Buildings deteriorate, corroding and rusting from continuous exposure to the toxic gases inside the building, the electrical and plumbing infrastructure suffer from chemical corrosion, concrete manure pits may over time crack and seep. And that's when the facility becomes a problem/nuisance.

Our federal and state governments clearly agree with this assessment – that buildings age and deteriorate as demonstrated by Depreciation Schedules that farmers use all the time for their capital investments in buildings to recognize the wear and tear on facilities as they age.

So common sense would seem clear… an industrial-scale feedlot operation, especially a hog barn over 1000 animal units, can certainly become a problem/nuisance over time. The County should not deny that fact in the proposed ordinance changes.

The County should keep it clear, as it stands in the original ordinance, that an animal feedlot of over 1000 animal units, **can become** a problem/nuisance, no matter how perfect it is to begin with.

2) Nuisance related to compliance

The County's proposal that no animal feedlot operation can be a problem/nuisance if it has been permitted and is complying with all necessary rules and regulations at the local, County, State & Federal level fails to recognize that this compliance is mostly on paper, where it looks perfect, not on the ground, where in reality, it is less than perfect.

The permitting applications for feedlots stocking 1000 animal units or more require all kinds of data in regard to odor, potentially toxic emissions of ammonia and hydrogen sulfide, manure storage and handling, carcass management, soil testing, buffer zones, local geology, local waters, and more. It's a thorough and complex document, prepared by consultants, rarely by the feedlot operator himself. These applications look good on paper, of course, because they are written to comply with the requirements of the MPCA, using modeling for air quality and assurances about manure storage and handling.

But real compliance must insure that all the promises on paper are kept in reality at the industrial hog facility, that the manure pit structure can actually be inspected and tested, that soil tests on land where manure is spread actually meet the requirements, that tile lines are located and assessed for proper manure application, that air emissions pumped out through exhaust fans into the surrounding farming neighborhood actually do not rise above the State standard for air quality, that local waters are protected, that neighbors do not experience continual negative impacts from any of the feedlot activities.

The way the County explains "complies with" in the changes it proposes to the ordinance, does not specify that it is the responsibility of the feedlot operator to demonstrate continuing compliance on the ground – not just on paper – and to make that available to neighbors who worry for their health and safety, especially with the most common complaints about industrial hog operations: odor and toxic air missions.

Though the operator is required to keep records of manure storage, nutrient composition & application, there will be no records on odor, ammonia levels, hydrogen sulfide emissions, volatile organic compounds or total suspended particulates. The feedlot operator is not required to do **any** self-monitoring or reporting of this part of the operation, which is the most immediate danger to human health.

Real compliance means that what appears compliant on paper actually happens in the real world. In these proposed ordinance changes, the County does not guarantee that it will require real, on-the-ground, compliance.

ATTACHMENT 1

3) Burden on neighbors to prove harm

The changes the County suggests to the ordinance abandons the specific language that recognizes the inherent risks over time with an animal feedlot facility of 1000 or more animal units. The changes also abandon the Performance Standards describing serious problems that could be defined as a nuisance:

*injury from negligence or improper agricultural operation
*ignoring State or local laws and ordinances
*injury or threat to health or safety
*pollution of waters

By eliminating these very specific harms, the County abandons its clear statement of what our farming practices must NOT do, and instead substitutes language that is hard to understand and gives no support to neighbors who experience negative impacts from a farming operation.

And the real problem here is that the County's proposed changes create barriers for County residents and leaves **them** to investigate and **prove** any harm, especially in the case of the largest feedlot facilities. In these proposed changes, the County can use the rewriting of Date of Operation & Operation Not a Nuisance as a way to say that they simply cannot acknowledge that a farm operation has become a nuisance. This appears to absolve the County of their most basic responsibility – to protect the health, safety and welfare of the people who live here.

If neighbors notice a problem with manure application, where is the remedy? How will the County help? It seems that now it could be up to neighbors to get access to the manure application records. If they notice manure seepage through runoff, they have to find a way to get the manure storage records. If they see manure being spread poorly or not injected thoroughly, or they are concerned about too much manure per acre or proximity to waterways and local waters, now it is up to them to seek access to the permit application or the farm records or the records of farm fields to be used.

That's a lot of work for citizens who should not have to try to do what the County should be responsible for. Citizens are not agents of the government. Our government should work for all of us.

Right now there is no aggregate data from the permits for liquid manure application, so it is impossible to know how much manure is being spread in our townships and how the manure from the 22 largest feedlots in Goodhue County(over 1000 animal units), 7 of which are owned by the Kohlnhofers Circle K Farms, affects our local watersheds. If our responsible agencies can't accumulate that data, how are neighbors supposed to find remedy for problems they observe?

If neighbors suffer from odor or toxic emissions from a hog barn, where is the remedy? How will the County help? The feedlot operator does **not** self-monitor for these gases outside the barn, so how do neighbors protect themselves from harms to their health and safety?

ATTACHMENT 1

Here's an example of what neighbors had to do to demonstrate their valid concerns that hydrogen sulfide emissions at a proposed Zumbrota Township feedlot could potentially be dangerous. They monitored hydrogen sulfide emissions for 35 days at Kohlnhofer's Circle K Farms facilities. Their results, showing high levels of hydrogen sulfide, convinced the MPCA to begin a continuous monitoring process for the first time in 10 years.

But is this what neighbors should have to do to protect their health, safety and quality of life? Spend considerable time, effort and expense? Ask other neighbors for help? Spend many hours in travel and monitoring to gather real world data rather than depend on promises on paper?

Neighbors should not have to experience the harm AND bear the burden of proof – the feedlot operator should be responsible for protecting neighbors, and not just with models on paper. The County should help by supporting folks who simply want to enjoy their own farming operations and lives. The County should avoid this blanket approval of the largest feedlot operations.

So the burden of proof is on the individuals who are being harmed, at great expense of time and money, in order to seek remedy for problems the County seems to want to deny or not get involved in.

But the role of County government is to protect all its residents – not just the few largest animal feedlot owners. The County should not change the plain English ordinance that is in place now. The proposed changes are so vague and ambiguous that a citizen can't know what they mean without wanting a thorough explanation of how these changes are good for all of us and not just a way for the County to avoid dealing with the potential real problems that are inherent in the largest feedlot operations. If it takes a lawyer to explain the ordinance, it is not a good ordinance.

The existing ordinance is written in Plain Language (MN Rulemaking Manual), anyone can understand it, and it protects all of us. Let it stand.

Thank you.

Beth Slocum
Farna
Welch

ATTACHMENT 2

MINNESOTA POLLUTION CONTROL AGENCY

520 Lafayette Road North | St. Paul, Minnesota 55155-4194 | 651-296-6300

800-657-3864 | Use your preferred relay service | info.pca@state.mn.us | Equal Opportunity Employer

December 8, 2017

Mr. Dale Post
Mr. Frederick Fredrickson
Ms. Kristi Rosenquist
Ms. Kathleen Bramble
Ms. Katie Doody
Land Stewardship Project
821 East 35th Street, # 200
Minneapolis, MN 55407

Re: Minnesota Pollution Control Agency Response to Citizens' Hydrogen Sulfide Monitoring Report of Kohlnhofer Farms in Goodhue County, Minnesota

Dear Mr. Post, Mr. Fredrickson, Ms. Rosenquist, Ms. Bramble, and Ms. Doody:

Thank you for bringing your concerns about hydrogen sulfide emissions in Goodhue County to my attention. In particular, I am grateful for your willingness to invest considerable time and resources to provide the MPCA with data to evaluate and address the issues raised in your September 2017 report: "A Community at Risk: A Report on Citizens' Hydrogen Sulfide Monitoring at Kohlnhofer Factor Hog Farms in Goodhue County, MN" (Report). Your willingness to take action to protect the air quality and public health of Minnesotans is a great example of a partnership that gives my agency the information necessary to prioritize MPCA resources to address issues of concern.

We are concerned about potential violations of the hydrogen sulfide (H_2S) air quality standards and Department of Health Risk Values (HRVs) at two hog facilities in Goodhue County - Holst I Finishing and Jeff Finishing - operated by the Kohlnhofer family. This letter describes what we are doing to address the situation. Governor Dayton has also asked me to respond to your Report, and I have communicated with the Governor and his staff in preparing this letter.

Our Monitoring Plan

Your Report contains several H_2S readings that indicate a potential exceedance of the H_2S air quality standards or the Department of Health's Health Risk Value (HRV) for H_2S. We need to obtain more data to determine if either of the two facilities is in violation of the H_2S standards or the HRV. To get this data, my staff has conducted short term monitoring this fall and will conduct monitoring next spring at the two sites, as explained below.

Short Term Monitoring of H2S Emissions

From October 16, 2017 through October 25, 2017, we measured H_2S readings at the Holst 1 site using similar equipment to the Jerome meter mentioned in your Report. This initial H_2S survey work did not indicate an exceedance of the H_2S standards during the 10-day survey period. The highest 30-minute average H_2S level that we recorded over the 212 hours of monitoring was 15.7 ppb.

The results of our short term monitoring are summarized in Table 1 attached to this letter. However, to determine compliance with H_2S standards, we need to monitor the facilities for a longer period of time and record additional information such as wind direction and temperature.

Our monitoring location for the October 16 – 25, 2017 period was similar but not identical to the location in your report. We located the monitor on the east side of the property at about the same distance from the feedlot as the road boundary used in the Report. We chose this location for two reasons:

1) We intended to locate the monitor to try and capture maximum concentrations of air emissions from the site; and

2) We had concerns about leaving equipment in an unsecured, visible location such as the road ditch directly to the south of the facility for a nine-day period.

The Minnesota Pollution Control Agency (MPCA) recently updated our older Jerome meters with new H_2S monitors called SPM Flex Units. We used a Flex Unit to collect the H_2S readings described above. The Flex Unit may be operated as a survey monitor, in the same manner as a Jerome meter, or deployed at a site as a continuous air monitor (CAM).

When in survey mode, we use the Flex Unit's data to screen facilities to determine if a CAM should be deployed. The CAM will provide the information needed to determine if there is an air quality violation or levels above the state's HRV. Your Report along with our initial screening data supports our decision to locate a CAM at the Holst 1 site. The CAM will collect additional data on wind direction, humidity and temperature to support comparison of the H_2S data with the standard and HRV.

Long Term Monitoring Plan

Our long-term monitoring plan includes both the Holst 1 and Jeff Finishing sites. First, we will install a CAM at the Holst 1 site for the full H_2S monitoring season, typically mid-March until the end of October. We cannot monitor this fall and winter because the CAM does not collect valid data when air temperatures are near or below freezing.

The MPCA monitors for the entirety of March through October time for several reasons:

(1) We need at least 13 weeks of data to determine if levels are above the HRV;

(2) We want to continue monitoring if we find exceedances of the H_2S air standard or the HRV to ensure we don't miss any additional exceedances; and

(3) We want to understand the seasonal H_2S conditions at the feedlot. If we do not see any exceedances in the first 13 weeks, we do not want to miss exceedances that could happen after the first 13 weeks.

Second, the MPCA will conduct survey monitoring at the Jeff Finishing site next spring through fall. If our data indicates that continuous monitoring at the Jeff Finishing site is warranted, we will review all of the data, both continuous and survey monitoring, to determine whether to move the CAM from Holst 1 to Jeff Finishing.

The MPCA has routinely conducted H_2S screening monitoring to evaluate the need for CAM placement at feedlots since the last CAM deployment in 2009. Since screening monitoring has not shown a need for longer term monitoring, the Agency has not deployed a CAM to monitor air quality at a feedlot facility since 2009.

<u>Addressing the Potential Exceedance of the Hydrogen Sulfide Health Risk Value</u>

As I mentioned earlier, we need a full season of monitoring to make sure we address the potential exceedance of the Minnesota Department of Health (MDH) Health Risk Value (HRV), which is 10 ug/m^3, or 7 parts per billion (ppb). This requires a 13-week averaged exposure. The data in the Land Stewardship Report had individual short-term (up to 30 minute) samples collected between June 29 and August 1, 2017. The MPCA has collected data continuously over a 9-day period. Because we do not yet have any samples taken continuously over a 13-week time period, we cannot confirm whether there is an exceedance of the HRV. This is one of the reasons the MPCA will use the CAM to collect data over an entire season starting next spring at the Holst I Finishing site.

The MDH selected a 13-week monitoring period based on available information indicating that a threshold of both dose and duration of exposure must be exceeded before possible health effects would be anticipated. For subchronic HRVs, MDH recommends sampling events that average daily concentrations in air over a period of a few (2-4) months. MDH Rule 4717.8050 states "(S)ubchronic HRVs are compared to a 13-week averaged concentration of a chemical or defined mixture of chemicals in ambient air."

<u>Air Quality Monitoring Concerns Involving Circle K Family Farms – Z Finisher</u>

Finally, I want to address the questions in the Report about the air modeling done for the Circle K site in Zumbrota Township. The Report questions whether the modeling for Circle K is reliable if the smaller Kohlnhofer operations (Holst I and Jeff Finishing) have actual emissions exceeding the modeled emissions for Circle K.

Circle K used a U.S. Environmental Protection Agency (EPA) approved air quality model, known as AERMOD, to evaluate the potential air impacts for the Circle K operation and surrounding area as part of the Circle K Environmental Assessment Worksheet (EAW). AERMOD is currently used throughout the U.S. to model air pollutants from a variety of air emissions sources, including livestock operations, and has been reviewed by EPA and universities for more than a decade. In Minnesota, the MPCA has not observed significant concerns with AERMOD's predictive ability, and we consider it a reliable tool for reviewing the air quality impacts of feedlots and similar projects conducting an EAW. The AERMOD results indicated that the Circle K emissions would not violate the 30 ppb or 50 ppb hydrogen sulfide air standard.

In addition, the emissions used in the Circle K EAW modeling demonstration were from a 2003 publication of air quality emissions from livestock operations in Minnesota and the upper Midwest. Based on the information available at the time of the EAW, the MPCA decided, based on characteristics specific to the Circle K project, that these emission estimates were representative to evaluate the project's air quality impacts.

Survey monitoring offers a useful "snap shot" of air quality conditions for a short time. However, an evaluation of AERMOD's performance requires a significant amount of continuous air quality monitoring at a number of locations, as well as meteorological and facility operation data. While the survey monitoring you conducted helped us decide on placement of a CAM next year and conducting follow-up survey monitoring, we cannot use it to conclude that the Circle K air modeling is flawed.
I thank you for your interest in assuring that feedlot facilities in Minnesota operate in ways that are protective of public health, and for bringing your concerns to my attention. The MPCA's mission is to protect and improve the environment and enhance human health. We are committed to working with the citizens and the Kohlnhofers to assure that their facilities fully comply with environmental regulations and operate in a way that does not adversely impact human health. We will communicate with you as we learn more from our monitoring next year.

Please let me know if you have further questions or concerns.

Sincerely,

John Linc Stine
Commissioner

JLS:bt

Enclosure

Table 1. Maximum H_2S 30 Minute Concentration
Recorded by MPCA from October 16, 2017 through October 25, 2017

Date	Maximum 30-minute Average Concentration (parts per billion)
10/16/2017	1.6
10/17/2017	0.9
10/18/2017	12.4
10/19/2017	8.6
10/20/2017	0.1
10/21/2017	7.0
10/22/2017	15.7
10/23/2017	6.1
10/24/2017	9.6
10/25/2017	14.2

ATTACHMENT 2

From: Kohlasch, Frank (MPCA)
Sent: Monday, October 30, 2017 5:11 PM
To: Lotthammer, Shannon (MPCA); Biewen, Todd (MPCA)
Cc: Strassman, Rick (MPCA)
Subject: FW: MPCA questions

I feel like air monitoring is being setup to take the fall on this one. The story to the Governor's Office seems to be shaping up that we haven't spent or asked for these paltry sums of $15k-$18k for additional H2S monitors, and we haven't assigned staff to conduct the monitoring. The focus is on air monitoring and not on our broader feedlots oversight system. We can't budget or purchase for monitoring that is not requested by a program when the agency has decided that said program will control the decisions on air monitoring deployment.

The Feedlot Program approach has been to respond to complaints with survey monitoring, and if survey monitoring showed a potential issue, then continuous monitoring is conducted. If Feedlots doesn't conduct survey monitoring, we don't have any information on where to place continuous monitors.

The initiation for H2S monitoring feedlots comes from the Feedlots Program, yet nearly all the deficiencies identified are about air monitoring. The inside information is that the survey instruments we provided to regional feedlots staff went unused in most years. We would repair and calibrate the instruments each year, only to find that when we picked them up at the end of the season, they hadn't been used at all. The disuse became so bad it was difficult to keep working units together. The Feedlots Program has not request replacement monitors in the past number of years. The two monitors we have now are because there was FY17 year-end funds made available from the Feedlots Program, and Rick decided it was prudent to begin replacing our obsolete inventory. To our knowledge, the one remaining Jerome meter that could cobbled together was not used until after this report was received.

Also, the agency has explicitly not placed significant focus on air monitoring at feedlots due to the special treatment for this constituency of facility owner/operators. Nowhere do I see a statement that our complaint response system didn't lead to surveys that necessitated continuous monitoring. I only see statements that make it appear we were fiscally irresponsible to not have instruments or staff focused on feedlot air monitoring.

I'm all for helping solve problems, but it feels like the shadow of the bus is getting close here.

Frank L. Kohlasch, Manager
Air Assessment Section
Environmental Analysis & Outcomes Division
(651)757-2500
frank.kohlasch@state.mn.us

ATTACHMENT 2

From: Strassman, Rick (MPCA)
Sent: Monday, October 30, 2017 11:01 AM
To: Hukriede, Randall (MPCA)
Subject: RE:

Basically the same thing. No demand for CAMs from the regulatory programs since Excel Dairy. You and I have discussed the need to upgrade our Jerome and CAM inventory but other higher priority equipment was needed so funding was used elsewhere.

I also delayed making it a higher priority knowing the vendors were upgrading the instruments.

rick

From: Hukriede, Randall (MPCA)
Sent: Monday, October 30, 2017 10:47 AM
To: Strassman, Rick (MPCA) <rick.strassman@state.mn.us>
Subject:
Importance: High

I just talked to Rebecca Flood and she was wondering why we haven't asked to buy additional Flex units if we need more of them? I told her we haven't really had the demand for the Feedlot.Program. What would you like me to say for your program?

ATTACHMENT 2

ATTACHMENT 2

EMISSIONS DATA FROM FOUR SWINE FINISHING ROOMS IN INDIANA

Final Report for Site IN3B

of the

National Air Emissions Monitoring Study

Submitted to

John Thorne, Executive Director
Agricultural Air Research Council
C/O Crowell and Moring, LLP
1001 Pennsylvania Avenue, NW
Washington, DC 20004

and

Bill Schrock, Environmental Engineer
U.S. EPA Office of Air Quality Planning and Standards
Mail Code E143-03, 4930 Page Road
Durham, NC 27703

by

Albert J. Heber, Professor and NAEMS Science Advisor
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July 21, 2010

ATTACHMENT 2

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Acknowledgments

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Citation

Lim, T.T., L. Chen, Y. Jin, C. Ha, J.-Q. Ni, B.W. Bogan, J.C. Ramirez, C. Diehl, C. Xiao, and A.J. Heber. 2010. National Air Emissions Monitoring Study: Emissions Data from Four Swine Finishing Rooms - Site IN3B. Final Report. Purdue University, West Lafayette, IN, July 21.

ATTACHMENT 2

Table of Contents

1. INTRODUCTION AND OBJECTIVES

1.1. Overview of NAEMS

The primary goals of the National Air Emissions Monitoring Study (NAEMS) were to: 1) quantify aerial pollutant emissions from dairy, pork, egg, and broiler production facilities, 2) provide reliable data for developing and validating emissions models for livestock and poultry production and for comparison with government regulatory thresholds, and 3) promote a national consensus on methods and procedures for measuring emissions from livestock operations. Emissions measurements were conducted at a total of 15 different barn monitoring sites and ten open source sites in the continental US.

The NAEMS was managed by Purdue University (Purdue), in its role as Independent Research Contractor for the Agricultural Air Research Council. Purdue selected equipment and methods in consultation with the U.S. EPA, and subcontracted with other universities to operate the monitoring sites. Purdue maintained and calibrated equipment, collected samples, and conducted all other on-site activities. Other researchers at Purdue analyzed the data, and conducted two levels of data analysis and inspection, provided rapid feedback (generally within 2-4 business days) to catch aberrations in the data, and later conducted final processing and review of the data.

The overall objective of this report is to present the quality-assured measurements of ammonia (NH_3), hydrogen sulfide (H_2S), non-methane hydrocarbons (NMHC), particulate matter (PM) and volatile organic compounds (VOCs) from a swine finishing facility in Indiana. The specific objectives of the report are to:

1. Describe the farm, and the monitored buildings,
2. Describe the monitoring methods and quality assurance, and
3. Present tabulated daily averages of emissions.

2. CONFINED ANIMAL FEEDING OPERATION

2.1. Farm

The farm consisted of two "quad" barns constructed in 2003. The farm was located among flat agricultural fields, with some wooded areas about 1.6 km to the south. A 130 m^2 wooded area was located to the north-northeast. There were no other livestock farms within 1.6 km of the site.

The farm had a capacity of 8,000 head, which was divided among two 126 m x 25.5 m barns (east and west barns) that were separated by a distance of 28.7 m (Figure 1).

2.2. Monitored Buildings

Emission monitoring was conducted at the west barn. Each barn consisted of four 1,000-head, 61 m long x 12 m rooms. There was a 3.2-m wide hallway in the center of the barn between rooms 5 and 6 in the SE and SW quadrants and rooms 7 and 8 in the NW and NE quadrants, respectively (Figure 1).

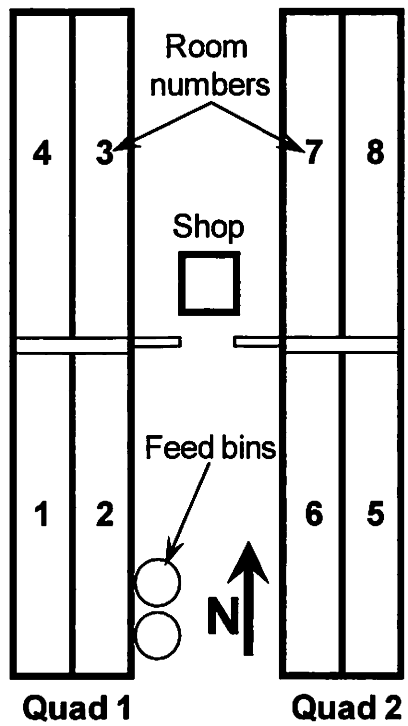

Figure 1. Facility layout. Rooms 5 to 8 in quad 2 were monitored.

Typical practice at the site was that, while rooms 7 and 8 stayed empty, all new weaner pigs were started in rooms 5 and 6, which were equipped with radiant gas heaters. After 3 or 4 weeks, half the pigs were moved to rooms 7 and 8. Rooms 5 and 6 therefore housed twice as many pigs at the beginning of each growth cycle. The producer sometimes practiced double-stocking whereby rooms 5 and 6 would be stocked at about 69 pigs/pen for the first two months, while the hogs in rooms 7 and 8 finished out. After rooms 7 and 8 were emptied and cleaned, half the pigs in rooms 5 and 6 would be moved into rooms 7 and 8. However, during this study, all finished pigs were removed from the rooms before new nursery pigs of the next growth cycle were introduced.

There were two rows of lights within each room, each row had eight lights distributed along the length of the room. The light bulbs were either 60- or 75-W incandescent or fluorescent bulbs. There were also two "always-on" lights installed at the center of the aisle. A diesel-powered generator set was used for backup electricity and it was tested every month. The producer inventoried the contents of the feed bins every week.

The finishing barns were tunnel-ventilated, with each room ventilated separately. Ventilation air entered each room through a 12-m long air inlet curtain that was located on the sidewalls at the end opposite the tunnel ventilation fans. All of the ventilation fans and fan controllers were manufactured by Airstream Ventilation Systems (Assumption, IL). There were five single-speed ventilation fans in the south walls of rooms 5 and 6 and the north walls of rooms 7 and 8. There were also three evenly-spaced variable-speed 0.61-m diameter pit fans (Airstream Model #APP-24F) in the sidewalls of each room. These pit fans constituted the first two stages (Stages 1A and 1B), with the three pit fans running slow as stage 1A and 100% as stage 1B. One single-speed direct-drive 0.91-m diameter fan (Airstream Model # APP-36X), located in the center of the end wall opposite the hallway of each room, was the lone third-stage fan. Four 1.22-m diameter fans (Airstream Model # CS54C1-P) located in the end wall opposite the hallway of each room, made up stages 4 through 6. Fan staging information in each barn is summarized in Table 1.

Table 1. Fan numbers and ventilation stages for rooms 6, 7, and 8 in the finishing barn.

Stage	Quantity	ID of additional fans
1A	3	**1,2,3** at variable speeds lower than 100%
1B	3	**1,2,3** at 100% capacity
2	3+1=4	1,2,3,**6**
3	4+1=5	1,2,3,**5***,6
4	5+1=6	1,2,3,5,6,**7***
5	6+2=8	1,2,3,**4**,5,6,7,**8**

The finishing barns had concrete slatted floors. Each room had two rows of pens on each side of the center walkway. Each row had 16 pens and eight feeders. The manure was stored in a 2.4-m deep pit located underneath the floor. There were reinforced concrete walls separating the pits under each side of the barn, so that there were two distinct pits beneath each barn. At the bottom of the center concrete walls, there were 1.2 m x 0.15 m liquid level equalization ports that ensured all four pits had equal volumes of manure. Manure accumulated in the pit for 180 d before it was pumped out.

2.3. Significant Events and Modifications

There were no significant weather events that affected emissions or the monitoring effort. The site management remained the same, and no changes to the facility were made during the study.

An identical double-quad facility was constructed 305 m north of the monitoring site in the summer of 2008 and was populated with pigs on September 22, 2008.

The ventilation scheme remained the same throughout the study. Site personnel alerted farm personnel when the monitoring system indicated malfunctioning fans.

The rooms were completely empty on 8/27-9/4, 8/20-8/28, 8/27-9/21, and 8/27-9/28 in 2007 for rooms 5 to 8, respectively. After the second group of pigs was removed, the rooms were again empty on 2/18-2/26, 2/19-3/4, 2/12-3/31, and 2/18-3/21 in 2008 for rooms 5 to 8, respectively. The next set of empty room periods were 8/19-8/26, 8/22-9/2, 8/22-9/5, and 8/22-9/9 in 2008 for rooms 5 to 8, respectively. The last empty room periods occurred in 2009, and were 2/16-2/24, 2/16-3/3, 2/16-4/1, and 2/16-3/19 for rooms 5 to 8, respectively. The longer periods for rooms 7 and 8 occurred because new pigs were initially housed in rooms 5 and 6.

Manure was removed from barn 2 on 10/14/07, 4/26/08, 8/22/08, 11/8/08, and 5/9/09. These dates were estimated based on weekly manure depth measurement records because the exact duration and completion of manure removals were not recorded.

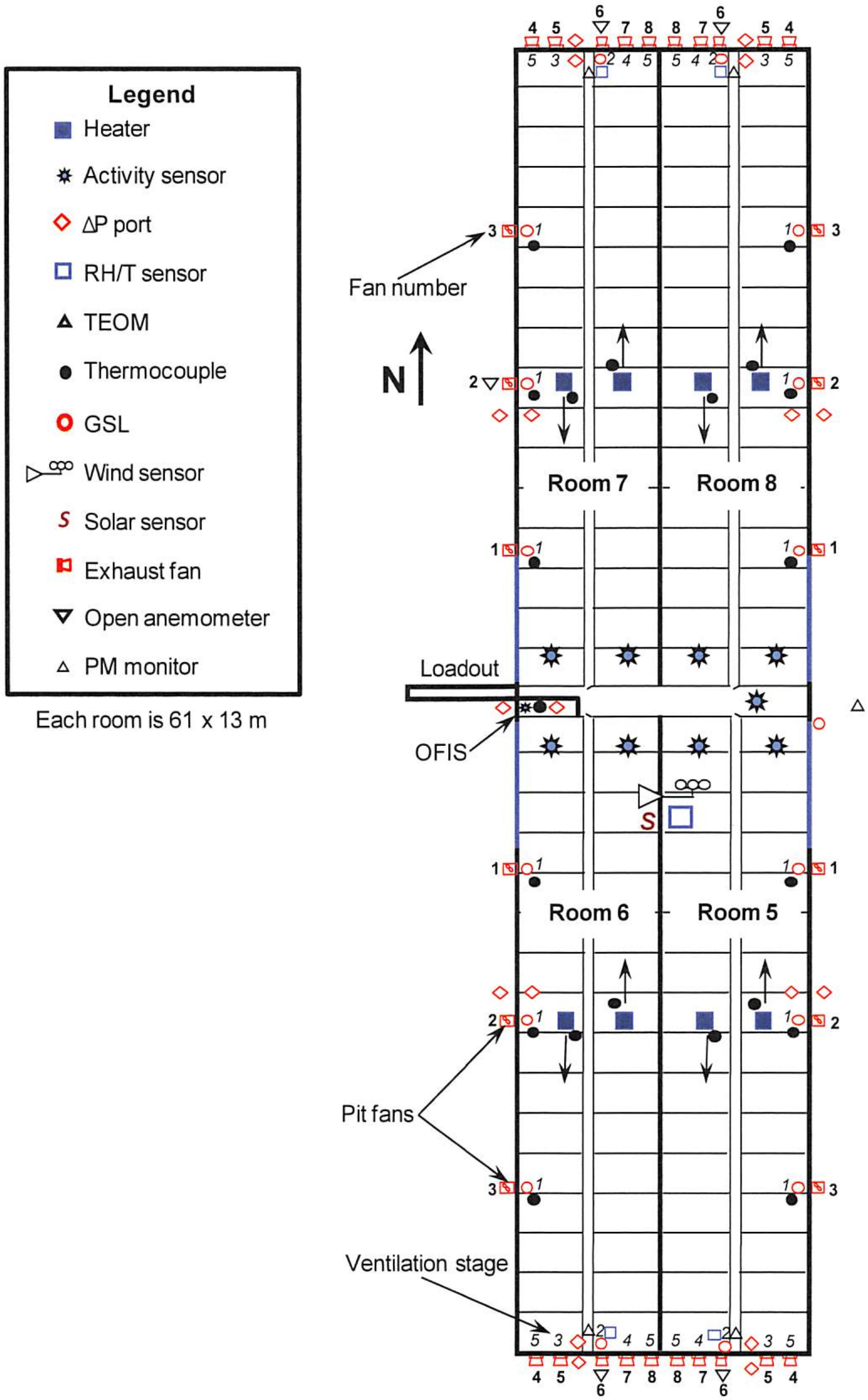

Figure 2. Floor plan of the barns, showing the sampling and measurement locations for barn 2 (rooms 5 to 8).

3. MONITORING AND SAMPLING METHODS

3.1. General Approach

Equipment installation and preliminary testing began on 5/29/07 and was completed on 9/27/07. The site setup and equipment installation followed an approved site monitoring plan, a quality assurance project plan, and instrument or method-specific standard operating procedures.

The monitoring period began on 7/14/07 and concluded on 7/24/09. Target pollutants for this site were NH_3, H_2S, NMHC, PM (PM_{10}, TSP, and $PM_{2.5}$), and VOC. Appendix A lists the target pollutants, and all measured supporting variables and metadata monitored at the site. The monitoring schemes for the two structures are shown in Figures 2 and 3. Table 2 lists the major equipment used at site IN3B, including the models, manufacturers and instrument specifications.

3.2. Instrument Shelter

The on-farm instrument shelter (OFIS) was converted from a 5.4 m x 1.7 m utility room located at the southwest corner of the barn center walkway. Heated raceways were used to connect the OFIS with the monitoring rooms to avoid condensation in sampling lines during cold weather.

The OFIS was supplied with 120 VAC electric power by the farm. The analyzers, computer, GSS, and data acquisition system in the OFIS obtained electrical power from three additional 20-A circuits that were installed for the study. The TEOM vacuum pumps were connected to another additionally-installed power outlet in the hallway outside of the OFIS. An extension cord was connected to a nearby outlet in the hallway, to provide power to the inlet PM monitor (Beta-Gauge).

A 5-kW thru-wall/window air conditioner was installed at the east wall of the OFIS. Heating was provided using an electric 1.5-kW oil-filled heater. The temperature and differential static pressure in the OFIS were monitored with a thermocouple near the instrument rack and a pressure sensor, respectively. One set of gas analyzers (Table 2) in the OFIS measured gas concentrations as the gas sampling system (GSS) sequenced through all the gas sampling locations (GSLs). A personal computer collected all site monitoring data using a data acquisition and control program AirDAC.

Table 2. Major instrumentation.

Analyzer/Instrument	Serial number
INNOVA 1412 Multi-gas analyzer	710-194
TEI 450i H_2S analyzer	0709220685
Environics 4040 dilutor	3917
TEOM 1	263750609
TEOM 2	265130701
TEOM 3	265020701
TEOM 4	265110701
TEI FH 62C14 (Beta Gauge)	E-1304

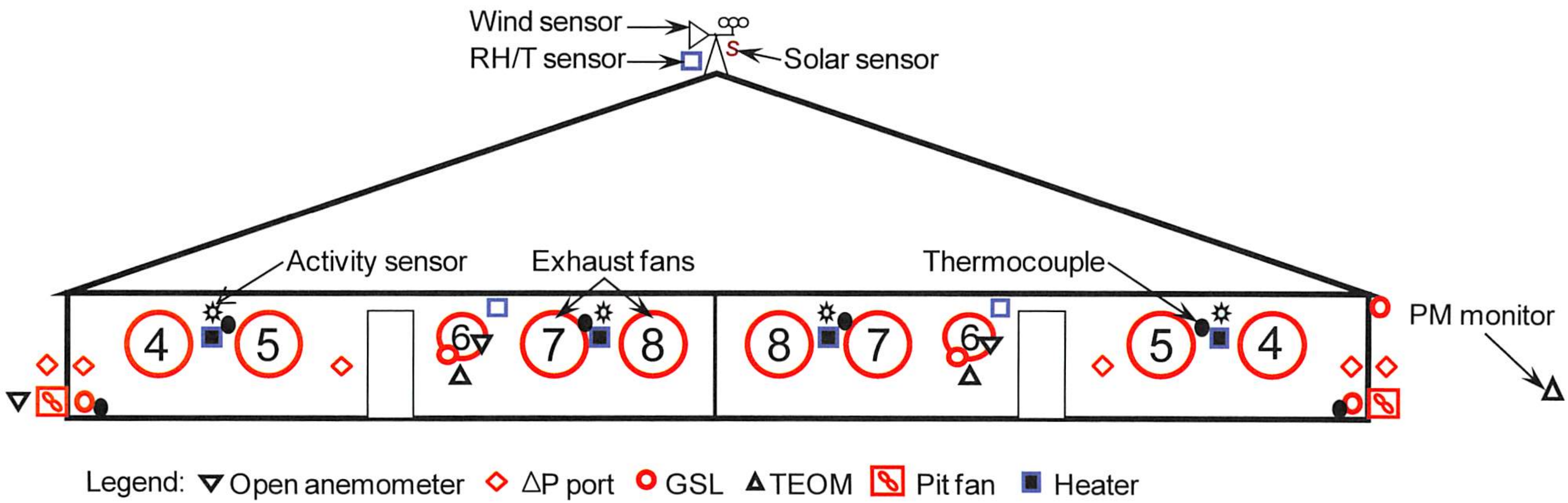

Figure 3. End (south view of barn) monitoring plan for continuous emission testing at barn 2.

3.3. Data Acquisition and Control System

The data acquisition and control system consisted of a personal computer, custom software (AirDAC) written in a commercial programming language (LabVIEW, National Instruments, Austin, TX), distributed I/O hardware (National Instruments FieldPoint modules), and Universal Serial Bus (USB) devices by National Instrument (NI) and Measurement Computing (MC, Norton, MA). The NI FieldPoint (FP) modules and MC USB devices (Table 3) were selected and configured to acquire data for all the on-line measurement variables (Appendix A).

Table 3. Data acquisition hardware configuration for IN3B.

Manufacturer and model	I/O type	# units	# channels	Notes
NI FP-AI-112	Analog input	4	16	Single-ended, 16-bit
NI FP-TC-120	Thermocouple	3	8	
NI FP-DO-401	Digital output	2	16	2 A at 10-30 VDC
MC USB 4303 counter	Count input	4	10	
MC USB DIO 96H	Digital input	1	96	

The 16-channel NI FP-DO-401 digital output module was used to control: 1) sequential switching of multiple gas sampling lines, 2) the raceway heating system, and 3) the gas sampling system cooling fan. Serial communication (RS232) was used to acquire data from the multi-gas monitor and calibration variables (calibration time, gas concentration, etc.) from the gas dilutor. Voltage or current analog signals from various analyzers and sensors were connected to FP-AI-112 modules. Type T thermocouples were connected to FP-TC-120 modules. Digital signals from fan stage relays were connected to the MC USB DIO96H device. Voltage pulses from proximity sensors used to measure fan rotational speed were detected by the MC USB 4303 counters.

AirDAC averaged the signals (after conversion to engineering units) over 15-s and 60-s intervals and recorded the means into two separate computer files. All real-time data were displayed in tabular and graphic forms for on-site or remote (pcAnywhere, Symantec, Mountain View, CA) viewing (Ni et al., 2009; Ni and Heber, 2010). Measurement alarms, data collection notifications, data files, graphs and statistics of the daily data sets, and modified configuration and fieldnote files were automatically emailed to several recipients after midnight.

3.4. Monitoring and Recording Farm and Building Operation

3.4.1. Animal Husbandry and Building Systems

Two infrared motion sensors (activity sensors) were mounted to ceilings of each of the finishing rooms to monitor movements of pigs and workers. An activity sensor was used to monitor researcher presence in the OFIS, and another one was installed in the east end of the center walkway of the barn.

Data on animal inventory and mortalities were recorded manually and on a daily-basis by the producer, and provided to site personnel. Animal inventory was determined by comparing on-farm inventory records and sales reports. The sales reports usually contained information such as the date, packing plant name, number of pigs delivered to the plant, and total weight of each truck load. Average incoming nursery pig weights were also provided by the farm. Each room was divided into sub-groups of pigs according to truck loads, because each had a specific date and average weight. A growth curve was applied to estimate the weight gain per week, for each pig subgroup, following the "standard" growth rate given in the MWPS-8, Swine Housing and Equipment Handbook (MWPS 1983). For each sub-group, the curve was fitted to the beginning and final weights to estimate the weight gain (in percentage with respect to the final weight and age). The average pig weights were estimated based on daily gains of each subgroup, while the total inventory and total weight were the summation of each subgroup within the room. Weekly mortality records were also included in this calculation. The calculated average pig weight within the room was used to estimate unknown weights, because mortalities were not weighed when removed from the rooms.

Relays that controlled lights and feeders were monitored in each room, using auxiliary contacts in 5-VDC circuits in conjunction with the digital inputs of the data acquisition system.

3.4.2. Thermal Environmental

Weather data was collected using a solar radiation shielded capacitance-type relative humidity and temperature probe (RH/T) (Model RHT-WM, Novus Automation, Porto Alegre, Brazil), a pyranometer (Model LI-200SL, LI-COR, Lincoln, NE) and a cup anemometer (Wind Sentry, RM Young, Traverse City, MI), which were mounted on a 1-m aluminum tower located on the ridge of barn 2.

For the room environment conditions, RH/T probes were located at fan 6 of each room. Type T thermocouples (TCs) were used to measure temperatures at the three pit fan exhausts. The TC's were positioned about 15 cm below the concrete slats in the air inlets to the manure pump-out ports.

Thermocouples were also located in the heated raceways between room 7 and the OFIS. Two TCs were located in the OFIS to measure the temperature of the OFIS and the temperature-controlled TEOM tubing bundle. One TC monitored the temperature conditions in the inlet PM monitor enclosure.

3.4.3. Building Airflow

Auxiliary contacts of fan stage relays were monitored with 5-VDC circuits, in conjunction with digital inputs of the data acquisition system, for stages 2 through 5 in each room. Fan rotational speed and operational status was monitored using a magnetic Hall-effect sensor (speed sensor) installed on each fan. The speed sensors were mounted to detect the rotational speed in revolutions per minute (rpm) of either the fan shaft or the fan pulley. The digital signal from the speed sensor was converted into a frequency measurement with a counter module in the data acquisition system.

Static pressure differences were measured across the side and end walls of each room with differential static pressure sensors (Model 260, Setra Systems, Boxborough, MA). The outside port was located against the outside wall near the ventilation fans of the side and end walls. Static pressure in the OFIS was measured with the same type of sensor, to ensure that positive pressure was maintained.

Impeller anemometers (Model 27106RS, RM Young, Traverse City, MI) were installed on the outlet of each of the PREFs of each room and fan 2 of room 7.

In-situ airflow measurements were conducted with either a 122-cm or a 137-cm field-portable fan tester (Fan Assessment Numeration System or FANS, University of Kentucky, Lexington, KY), which was described by Gates et al. (2004). The field data was used to develop equations that would calculate airflow as a function of differential pressure and fan rotational speed, and to assess the uncertainty in airflow predictions. For the smaller pit fans that were inaccessible (much smaller in diameter) to the FANS analyzers, the traversing method was used to test these fans. A three-impeller-anemometer airflow measurement system (TIAMS) was constructed and calibrated in the BESS Laboratory for measuring the pit fan airflow rates.

The TIAMS was custom designed and constructed to fit the exhaust cones of 61-cm diameter pit ventilation fans, and to mount three impeller anemometers (Model 27106R, R.M. Young, Traverse City, MI). The dimensions of the TIAMS was 69 cm x 69 cm x 61 cm. The heights and distances between the anemometers were distributed to allow the anemometers to evenly measure the air speed through the cross-sectional area. A data acquisition module (USB-1208FS, Measurement Computing, Norton, MA) measured the voltage outputs of the anemometers. A custom LabVIEW program was written to receive and log the voltages. The measured airflow rate was calculated with the cross-sectional area of the TIAMS and the mean measured air velocity. The TIAMS was calibrated at the BESS Laboratory twice to develop the calibration factors, and to evaluate its repeatability and linearity. Calibration results of the TIAMS indicated that the measurements were linear (R^2>0.999) and repeatable for airflow rates > 1.0 m^3/s.

A total of four groups of in-situ fan tests with replication were conducted during: 1) August and September of 2007, 2) May to September of 2008, 3) April to June of 2009, and 4) August and September, 2009. Each of the wall fans was tested at least once during the four testing periods, and was tested with the FANS. The pit fans were tested with the traverse method using either the hot-wire anemometer or the TIAMS. However, only the 2008 and 2009 traverses were used in developing the airflow curves because the traverses conducted with the hot-wire anemometer were not calibrated with the fan test chamber.

The airflow curves of the 0.91-m and 1.22-m diameter wall fans and 0.61-m diameter pit fan were obtained from the Bioenvironmental and Structural Systems (BESS) Lab at the University of Illinois at Urbana-Champaign (BESS, 2003; BESS, 2004). Each performance record consisted of airflow (Q1) measured at several static pressures (P1), and at relatively constant speeds (N1 = 822, 598, and 1050 rpm for 0.91-m, 1.22-m, and 0.61-m diameter fans, respectively).

For each fan type, the BESS fan curve was adjusted to the mean speed (N2) of the fan tests. The mean speeds were 572 and 848 rpm for the 0.91-m and 1.22-m diameter wall fans, respectively. Three fan curves were used for the variable speed, 0.61-m diameter pit fans, and the mean speeds were 461, 732, and 1074 rpm. The new, speed-indexed baseline curves were derived using the first ($Q_2 = Q_1(N_2/N_1)$) and second ($\Delta P_2 = \Delta P_1(N_2/N_1)^{0.5}$) fan laws, where Q_2 is the speed-adjusted BESS fan curve at speed N_2. The speed-corrected airflow prediction model is $Q_4 = (a\Delta P_4 + b)\cdot(N_4/N_2)\cdot Q_2$, where ΔP_4 and N_4 are measured fan static pressure and speed. For a given test using the portable tester, the model is $Q_4 = k\cdot(a\cdot\Delta P_3 + b)\cdot(N_3/N_2)\cdot Q_2$, where ΔP_3 and N_3 are the measured fan static pressure and speed during the fan test, and the fan degradation factor $k = a \cdot \Delta P_3 + b$. The values for coefficients a and b were those which minimized the sum of square differences between Q_4 and Q_3 for all the valid fan tests within a speed regime. The resulting fan models are shown in Table 4.

Fans were assigned to a sampling stream based on their proximity to the four sampling locations in each room. For each room, fans 1, 2, and 3 represented streams 1 to 3, respectively, and fans 4 to 8 made up stream 4 (wall fan stream). The airflow rate of stream 4 was calculated by summing the individual airflows of all fans (4 to 8) in the stream.

Table 4. Fan airflow models.

Fan dia, cm	Reference speed (N_2)	Polynomial coefficients of $Q_2=f(\Delta P_2)$ at speed N_2				Coefficients of k	
		a3	a2	a1	a0	b1	b0
122	598	1.88E-05	5.85E-04	6.94E-02	1.08E+01	1.563E-03	0.988
91	822	7.80E-06	3.97E-04	3.77E-02	5.89E+00	1.391E-03	0.967
66	1074	1.00E-05	8.60E-04	3.32E-02	3.58E+00	6.869E-04	0.623
66	732	7.00E-05	2.73E-03	4.87E-02	2.44E+00	2.520E-03	0.622
66	461	1.30E-04	1.74E-03	4.12E-02	1.52E+00	1.702E-03	0.575

3.4.4. Biomaterials Sampling Methods and Schedule

All analyses of biomaterials were performed by an independent laboratory (Midwest Laboratories, Omaha, NE).

Water was evaluated based on analyses of three samples of water provided to the pigs, taken on 11/10/08, 1/5/09, and 2/16/09.

On ten occasions, two composite feed samples were collected from each finishing room and analyzed for nitrogen and solids content by Midwest Labs (Table D1). For each side of the walkway, equal subsamples from each of the eight feeders were collected and combined into a composite sample.

Manure in the barns was sampled 15 times from 4/4/08 to 8/21/09 (Table D2) to determine pH, solids content, and ammoniacal N. Ash content was determined starting in November 2008 for the surface manure samples. During each sampling event, four surface samples were collected from locations along the walkway in each room. The center walkway was divided into four equal areas, and the surface manure samples were collected from the top 31 cm of the pit at the center point of each area. The samples were collected using a 2.7-m long Coliwasa sampler (Southeastern Liquid Analyzers, Inc., York, SC).

One core and two gradient samples were taken from each of the four rooms. The gradient samples were taken from the 1/3 and 2/3 depth sections of the stored manure. The gradient samples were taken when the manure depth was greater than 1 m, and when the manure's solids content was not too high for sampling with the manure sampler. The core and gradient samples were collected from the second or third area sampling locations of each room. The core and gradient samples were analyzed for pH, solids content, and ammoniacal N. Thus there were a total of four core, eight gradient, and 16 surface samples for each sampling event.

Additional core and surface samples were collected from the center pit-access (where second pit fan was located) of each room. These samples were analyzed for the same variables as inside surface samples.

A total of eight core (load-out) samples (two per room) of manure were collected each time before the pits were emptied. The samples were analyzed for solids content, total N, and ash. Each room had north and south composite core samples. Each sample consisted of four subsamples taken from either the north or south barn locations along the walkway.

3.5. Particulate Matter Monitoring

Real-time PM monitors (TEOM Model 1400a, Thermo Fisher Scientific, Waltham, MA) continuously sampled exhaust PM. A TEOM was placed at the end of the walkway of each finishing room, about 2 m in front of the inlet of fan 6, which was the PREF (Figures 2 and 3).

A beta attenuation PM monitor (Beta Gauge Model FH62C-14, Thermo Fisher Scientific, Franklin, MA) continuously measured barn inlet PM concentration. The Beta Gauge was enclosed in a protective outdoor enclosure and located at the inlet gas-sampling location of room 5 (Figure 2). The inlet PM monitor was very near the barn ventilation inlets and more than 13 m away from the pit exhaust fan 1 of room 5. The driveway between the two barns were graveled, and the space surrounding the two barns was grassed and well maintained. Infrequent vehicle traffic, mowing activities, and the machinery in the nearby corn field could have caused "spikes" of measured inlet PM.

At any one time, the sampled PM size class was either PM_{10}, $PM_{2.5}$ or TSP at both TEOMs and the Beta Gauge. The $PM_{2.5}$ size class was monitored for eleven, 1-14 d periods (Table 5). The TSP inlet heads were placed on the TEOMs for nine, 3-12 d periods. The PM_{10} concentration was measured at all other times.

3.6. Continuous Gas Sampling and Monitoring

Air samples for continuous gas measurements were collected from multiple gas sampling probes with a custom-designed gas sampling system (GSS). Each probe was connected to the GSS with Teflon tubing. The sampling lines were heated and wrapped with insulation at locations vulnerable to cold air to prevent condensation inside the tubes.

For each of the finishing rooms, three gas sampling probes were placed 15 cm under the concrete slats, inside the finishing room near the pit exhaust fans (Figure 2). One gas sampling probe was located in front of the inlet of fan 6 (Figure 3). The probe for sampling inlet air was located near the inlet PM measurement location just east of room 5.

Table 5. Sampling schedule for PM_{10}, TSP and $PM_{2.5}$.

Time and day, m/d/y		Test duration, d		
Start	Stop	PM_{10}	TSP	$PM_{2.5}$
7/13/07	10/2/07	81.0		
10/2/07	10/10/07		7.9	
10/10/07	12/11/07	62.0		
12/11/07	12/19/07		8.0	
12/19/07	1/10/08	22.0		
1/10/08	1/24/08			13.9
4/23/08	5/7/08		14.0	
5/7/08	6/30/08	53.9		
6/30/08	7/7/08		7.1	
7/7/08	9/22/08	77.2		
9/22/08	10/8/08			16.0
10/8/08	10/17/08	8.7		
10/17/08	10/21/08			4.0
10/21/08	10/28/08		7.1	
10/28/08	12/8/08	40.9		
10/28/08	10/31/08	2.9		
10/31/08	11/3/08			3.0
11/3/08	11/14/08		10.9	
11/14/08	12/8/08	24.0		
12/8/08	12/11/08		3.0	
12/8/08	12/15/08		6.8	
12/15/08	12/18/08			3.0
12/11/08	2/4/09	55.1		
2/4/09	2/12/09			8.1
2/12/09	3/9/09	24.9		
3/9/09	3/11/09			2.0
3/11/09	3/23/09		12.0	
3/23/09	3/27/09			3.9
3/27/09	6/1/09	66.1		
6/1/09	6/4/09		3.0	
6/4/09	7/1/09	26.8		
7/1/09	7/13/09			12.2
7/13/09	7/14/09	0.7		
7/14/09	7/14/09		0.3	
7/14/09	7/20/09			5.9
7/20/09	7/24/09		4.1	

Each exhaust location was sampled individually for 10 min. The ventilation inlet location was monitored at least twice daily, with a 30-min sampling period.

One set of gas analyzers in the OFIS was used to sequence through all the GSLs. Hydrogen sulfide was measured with a fluorescence H_2S analyzer (Model 450i, Thermo Fisher Scientific, Waltham, MA). Concentrations of NH_3 were measured with a photoacoustic infrared multi-gas monitor (INNOVA Model 1412, LumaSense Technologies, Ballerup, Denmark). Concentrations of NMHC were measured using a chromatography system (Model 55C, Thermo Fisher Scientific).

The INNOVA analyzed non-methane hydrocarbon (NMHC) concentrations by measuring THC and subtracting ethanol (manufacturer error) and methane. The THC data was questionable, however, due to irreconcilable interferences by water vapor and other gases. Therefore, the VOC-related gas emissions measured by the INNOVA are not included in this report.

Table 6. Analyte sampling locations.

Analyte	Room	Sampling location*	Qty
NH_3 H_2S NMHC	5, 6, 7, 8	Three pit fans, and directly in front of fan 6 inlet	16
	5	**INLET:** In front of curtain inlet area of room 5	1
$PM_{2.5}$ PM_{10} TSP	5, 6, 7, 8	TEOM located 2 m in front of fan 6	4
	5	**INLET:** Beta-Gauge in front of the curtain inlet of room 5	1
VOC	5, 6, 7, 8	2 m in front of fan 6	4

*Gas sampling probes were located at fan hub height, suspended from the ceiling.

3.7. VOC Sampling and Analysis

Grab samples of VOC were collected at the PREFs (fan 6 in each room) (Table 6), using methodology based on methods TO-15 and TO-16. Sampling was conducted with 6-L stainless-steel canisters (TO-Can, Restek Corp, Bellefonte, PA), equipped with ¼" bellows valves (Swagelok SS4H) and 207-kPa vacuum gauges. Sampling trains contained flow controllers (Veriflo Model 423XL, Parker-Hannifin Corp., Richmond, CA) with 2- to 4-sccm critical orifices and 7-µm in-line stainless steel filters. Flow controllers were pre-set to a constant flow rate of 3.4 mL/min. Canister sampling was conducted for 24 h, and canister pressures were recorded at the beginning and end of the sampling periods for the calculation of total sample volumes. Sampling was conducted six times between 6/1/09 and 7/23/09, with duplicate samples typically collected at each location. All canisters were cleaned and passed QC before sample collection.

Canister samples were analyzed at Purdue University's Trace Contaminant Laboratory. The canisters were pressurized to +207 kPa with ultrapure N2, and transferred to TDS tubes (Carbotrap 300, Supelco, Bellefonte, PA). The pressurized canisters initially yielded sample flows of 50 mL min^{-1} during sample transfer to tubes. Canister heating was introduced when a canister pressure decreased to 13.8 kPa to ensure maximal transfer of nonvolatile components.

The TDS tubes were analyzed on a thermodesorption-gas chromatograph-mass spectrometer (TDS-GC-MS), consisting of a gas chromatograph (Model 6890, Agilent Technologies, Palo Alto, CA) coupled with a Model 5795 mass spectrometer detector (Agilent Model 5795) and equipped with a thermal desorption system (Model TDS-G, Gerstel, Baltimore, MD) and a cooled injection system (Gerstel CIS). The GC-MS passed a leak check prior to analyzing each set of samples. Compounds were separated on a 60 m x 0.25 mm x 1 μm column. The detector utilized the full scan mode covering masses from 27-270 Daltons in 8 scans/s. The MS quad hold temperature was 150°C, and the MS source hold temperature was 230°C. The analytical results were analyzed by ChemStation, and all integrations were manually checked. This method used an external standard compound for instrument monitoring and QA to avoid losses of low-molecular-weight analytes that would occur when purging solvent used with internal standard(s). All TDS tubes were cleaned with a tube conditioning system (Gerstel TC-2 TDS) for 3.5 h at 350°C prior to each use.

Response curves were generated at both the beginning and the end of the VOC analysis period. The response curves of all chemical standards reached good linearity as 55% of the response curves had $R^2 > 99\%$ and over 98% had $R^2 > 95\%$. Toluene was used as an external standard that was analyzed during each batch of samples to assure quality. The relative bias and standard deviation of 97 toluene checks were -4.3% and 18.8%, respectively. The uncertainty of the mean of duplicate field samples was calculated as 27%, based on the toluene checks.

3.8. Documentation of Quality Assurance

3.8.1. Oversight, Maintenance, and Calibration

Purdue University visited the site frequently during the first few months of the study; that frequency declined as site operation became more routine. A total of 152 and 132 visits were made during years 1 and 2 of the monitoring period. Remote access to the site computer was used to check the site during the majority of the monitoring period. Data files and correspondence were emailed from the site computer on a regular basis.

The NAEMS Science Advisor audited the site on 8/24/07. The Environmental Protection Agency (EPA) conducted site audits on 9/27/07 and 9/1/09.

Various site maintenance and calibration activities were conducted by site personnel (Appendix B). Specific quality assurance tests of the GSS, gas analyzers and other sensors are discussed below.

3.8.2. Gas Sampling System

Two types of GSS leak tests were conducted. The first test examined GSS integrity, by briefly creating a "dead head" against the pump by closing all solenoid valves, while measuring exhaust airflow with a portable rotameter, and recording the leakage flow with the GSS mass flow meter. The second test consisted of monitoring GSS flow and pressure after manually setting AirDAC to sample from a particular GSL and plugging the GSL's gas sampling probe, which created a GSS manifold vacuum of about -70,000 Pa or 0.31 atm. Preliminary tests indicated that GSS flows under dead-head conditions that were 10% or less (<0.45 L/min) of the normal GSS flow rate of 4.5 L/min was indicative of leak-free operation under normal GSS manifold vacuums of -10,000 to -4,000 Pa (0.90-0.96 atm). Leak tests of the GSS were conducted on 2/6/09, 3/18/09, 3/27/09, and 7/18/09. The dead-head leakage flows were always less than the 0.45 L/min threshold. Systematic checking of individual sampling lines was conducted on 9/14/07, 2/19/08, 3/8/08, 4/25/08, 9/8/08, 1/7/09, 3/27/09, and 7/20/09, while checks of some lines were conducted more frequently. Data was only invalidated when leaks occurred away from the sampling location. If gas sampling probe filter maintenance eliminated a leak, no data was invalidated since leakage air would be the same as sampled air.

3.8.3. Gas Analyzers

Gas measurements were evaluated using multipoint calibrations and zero and span checks (Appendix C). The gas concentration data output by the analyzers was adjusted to correct for bias introduced by the gas sampling and measurement system.

3.8.3.1. Correction of Ammonia Concentrations

A multipoint calibration (MPC) was conducted through the challenge line five times using purified air (Cat. # AIO.OCE-T, CEM zero-grade, Praxair, Indianapolis, IN) and three (typical) span concentrations of NH_3 (Cat. # NI-AM5MP-AS, Praxair Primary Standard). Each MPC was conducted with replication (Table 7). The NH_3 was delivered using a 6-port gas dilutor (Model 4040, Environics, Tolland, CT). The R^2 values of each MPC exceeded 0.996, indicating linearity of instrument response to standard gas between 0 and 36 ppm.

Table 7. Multipoint calibration record and results for the NH_3 measurements.

Date	# of points	Span concentration, ppm		R^2
		Minimum	Maximum	
7/11/07	4	12	36	0.9983
1/5/09	4	12	36	0.9960
1/15/09	4	12	36	0.9987
5/15/09	4	12	36	0.9969
7/6/09	4	12	36	0.9967

Precision checks were conducted periodically using zero and span gases (Z/S checks), delivered via the dilutor through the challenge line, and responses were recorded to monitor changes in system performance over time. Span checks were conducted with 36 ppm of NH_3 (Appendix C).

Significant downtime occurred due to factory repair and calibration from 10/16/08 to 1/5/09 and from 6/11/09 to 7/14/09. Another significant downtime that occurred from 1/1/2008 to 2/25/08 and affected all gas concentration measurements was due to a potential GSS pump leakage.

The average response of the analyzer to the zero and span gas applications was assessed, and the results were combined based on changes to the instrument or gas sampling system to create linear correction models (Table 8). The models were used to correct instrument readout data. The measurement accuracy was assessed based on model-corrected zero and span checks (Table 8).

3.8.3.2. Correction of Hydrogen Sulfide Concentration

A MPC was conducted through the challenge line four times using purified air (Cat. # AIO.OCE-T, Praxair CEM zero air) and three span concentrations (Cat. # NI-HSR1E-AS, Praxair EPA Protocol Standard). Except for 9/10/07, each MPC was conducted with replication (Table 9). The H_2S was delivered using a 6-port dilutor (Model 040, Environics, Tolland, CT). The R^2 values of each MPC exceeded 0.9961, indicating excellent linearity of instrument response to standard gas between 0 and 4000 ppb (or 3600 ppb after 10/21/08, and 3000 ppb after 5/22/09).

Table 8. Concentration correction and measurement accuracy for ammonia.

Start/end dates	# of checks		Linear model	Accuracy, % of span			
				Bias		Precision	
	Zero	Span		z	s	z	s
7/13/07-11/30/07	18	16	y =1.098(x–0.724)	0.1	-0.9	1.2	3.5
11/30/07-1/15/09	42	41	y =1.090(x-1.057)	-0.1	-0.5	1.4	2.7
1/15/09-5/22/09	16	14	y =1.055(x-0.968)	-1.5	2.3	0.5	3.9
5/22/09-7/12/09	8	8	y =1.124(x-0.775)	0.0	-0.1	0.7	2.
7/12/09-9/7/09	9	9	y =1.145(x+0.385)	-0.1	-0.1	0.5	1.6
All	93	88					

Table 9. Multipoint calibration record and results for the H_2S measurements.

Date	# of points	Span concentration, ppb		R^2
		Minimum	Maximum	
7/12/07	4	1333	4000	0.9961
9/10/07	4	1333	4000	1.0000
10/21/08	4	1200	3600	0.9986
5/22/09	4	1000	3000	0.9982

Precision checks were conducted periodically (Table 9) using zero and span gases (Z/S checks), delivered via the dilutor through the challenge line, and responses were recorded to monitor changes in system performance over time. Span checks were conducted with 150, 450 or 500 ppb of H_2S (Appendix C).

The average response of the analyzer to the zero and span gas applications was assessed, and the results were combined based on changes to the instrument or GSS to create linear correction models (Table 10). The H_2S/air blend used from 1/29/09 degraded significantly prior to the expiration date and was replaced with H_2S/nitrogen blends by Praxair. However, an expired H_2S/nitrogen blend cylinder (expired 1/9/09) was kept at the site for the calibration checks, and was used until a new span cylinder was delivered on 7/16/09. A comparison test (n=2) indicated that the expired span cylinder did not degrade compared with the new span gas. Therefore all span check data obtained from the expired but stable H_2S/nitrogen blends were included in the development of the gas correction models. The models were used to correct instrument readout data. The measurement accuracy was assessed based on model-corrected zero and span checks (Table 10).

3.8.3.3. Non-Methane Total Hydrocarbons

A MPC was conducted through the challenge line nine times using purified air (Cat. # AIO.OCE-T, CEM zero-grade, Praxair) and three (typical) span concentrations of C_3H_8 (Cat. # NIME50P1E-AS, Praxair Primary Standard), which was a C_3H_8 and CH_4 mixture in nitrogen gas. Each MPC was conducted with replication (Table 12). The C_3H_8 was delivered using a 6-port gas dilutor (Model 4040, Environics, Tolland, CT). The R^2 values of each MPC exceeded 0.9995, indicating linearity of instrument response to standard gas between 0 and 3.0 ppm (4.5 ppm after 8/26/08, and 1.9 ppm after 6/25/09).

Table 10. Concentration correction and measurement accuracy for hydrogen sulfide.

Start/end dates	# of checks		Linear models	Accuracy, % of span			
	Zero	Span		Bias		Precision	
				z	s	z	s
7/13/07-9/12/07	9	9	y =0.942(x–5.406)	0.0	1.9	0.2	3.3
9/12/07-11/23/07	13	13	y =0.801(x–3.160)	0.0	-1.1	0.1	3.9
11/23/07-10/28/08	44	44	y =0.771(x–4.385)	0.0	1.4	0.1	3.3
10/28/08-9/7/09	48	44	y =1.045(x–3.394)	0.0	-0.7	0.1	3.0
All	114	110					

Table 11. Multipoint calibration record and results for the C_3H_8 measurements.

Date	# of points	Span concentration, ppm		R^2
		Minimum	Maximum	
10/18/07	4	1.0	3.0	1.0000
1/9/07	4	1.0	3.0	0.9997
2/4/07	4	1.0	3.0	1.0000
4/11/07	4	1.0	3.0	0.9999
10/8/07	4	1.0	3.0	0.9997
8/26/08	4	1.5	4.5	0.9998
12/11/08	4	1.5	4.5	0.9999
5/12/09	4	1.5	4.5	1.0000
6/25/09	4	0.6	1.9	0.9995

Precision checks were conducted periodically using zero and span gases (Z/S checks), delivered via the dilutor through the challenge line, and responses were recorded to monitor changes in system performance over time. Span checks were conducted with 2.0, 1.5, and 0.6 ppm of C_3H_8 (Appendix C).

Significant downtime occurred due to malfunctioning of the analyzer from 5/9/08 to 8/15/09.

The average response of the analyzer to the zero and span gas applications was assessed, and the results were combined based on changes to the instrument or gas sampling system to create linear correction models (Table 12).

3.8.3.4. Noise Tests

Analyzer noise tests were conducted to assess the minimum detection limit (MDL) of the gas measurements. The analyzers measured CEM zero air (Praxair Cat. # AIO.OCE-T CEM) continuously for 32 to 52 min after equilibrium of the instrument readout was reached. The MDL was defined as three times the standard deviation of the data collected during the equilibrated period (Table 13).

Table 12. Concentration correction and measurement accuracy for C_3H_8.

Start/end dates	# of checks		Linear models	Accuracy, % of span			
				Bias		Precision	
	Zero	Span		z	s	z	s
7/13/07-9/9/08	13	15	y =0.811(x–0.002)	0.0	5.7	1.8	3.0
9/9/08-12/5/08	12	12	y =1.014(x–0.006)	0.7	-0.4	6.0	3.5
12/5/08-5/15/09	20	20	y =1.031(x+0.014)	0.3	-0.2	0.9	1.6
5/15/09-6/25/09	7	7	y =1.089(x+0.021)	-0.1	-0.4	0.2	2.6
6/25/09-7/23/09	6	6	y =1.123(x+0.019)	0.0	0.5	0.0	4.0
All	58	60					

Table 13. Noise tests of gas analyzers with dry air on 9/9/09.

Concentration	Statistical variable				Duration, min	T_{dew},°C
	Min	Max	SD	MDL		
NH3, ppm	0.36	0.51	0.04	0.09	19	-6.97
H2S, ppb	-4.7	-1.7	0.88	2.24	19	N/A

3.8.4. Particulate Matter Monitors

The quality of the exhaust PM data was assessed through periodic mass verifications and flow and leak checks of the TEOMs (Tables 14-17). The TEOMs met or exceeded the mass verification criteria (Ko actual within ±2.5% of Ko audit) except on 10/8/08 for all TEOMs, and 10/31/08 for the room 5 TEOM. The criteria for total and main flows were 16.67±1.0 and 3.0±0.2 L/min, respectively, and were met on all dates except 2/24/07 in rooms 5 and 8, but were retested and passed within one week.. Another flow audit that failed the criteria was 5/4/09 in room 5, caused by a bad signal cable connection.

Leakage criteria were total flow ≤ 0.62 L/min and main flow ≤ 0.15 L/min, respectively. All leak and flow tests of both TEOMs were acceptable on all dates.

Mass verifications and flow calibrations of the inlet and exhaust PM monitors were conducted periodically (Tables 14-17). The TEOMs met or exceeded the mass verification criteria (Ko actual within ±2.5% of Ko audit) for each test period, except on 10/8/08 and 10/31/08. The failure was most likely caused by an old calibration filter and inexperienced site personnel. The subsequent verification tests conducted with a new calibration filter met the criteria.

The criteria for total and main flows were 16.67±1.0 and 3.0±0.2 L/min, respectively, and were met on all dates except 2/24/09 and 5/4/09 for the TEOMs in rooms 5 and 8, respectively. However, the failed flow audits were caused by a malfunctioning flow meter, and measurements within seven or eleven days of these tests indicated acceptable flows with another flow meter. Leakage criteria were total flow ≤ 0.62 L/min and main flow ≤ 0.15 L/min, respectively. All TEOM leakage tests were acceptable on all dates.

Table 14. Quality assurance tests of room 5 TEOM.

Date	Time since last test, d	Mass error, %	TEOM flows, L/min		Leak test flows, L/min	
			Main	Total	Main	Auxiliary
07/16/07		0.38	3.13	16.71	0.03	0.19
01/24/08	192		3.10	16.63	0.03	0.05
07/11/08	169	2.19				
07/24/08	13		3.15	16.93	0.12	0.32
09/15/08	53	2.5	3.05	16.70	0.1	0.38
10/08/08	23	3.25				
10/31/08	23	2.98				
11/03/08	3	2.46				
12/15/08	42	2.38	3.07	16.77	0.11	0.45
02/12/09	59	2.47	3.07	16.77	0.12	0.38
02/24/09	12		2.55	15.50	0.12	0.44
02/27/09	3		2.94	16.23		
03/23/09	24	2.47				
05/04/09	42		3.04	16.70		
05/07/09	3	2.2				
06/01/09	25	2.49				
06/25/09	24				0.08	0.39
07/13/09	18		N/A	17.12		
07/18/09	5	2.04	3.08	16.84	0.08	0.51

Table 15. Quality assurance tests of room 6 TEOM.

Date	Time since last test, d	Mass error, %	TEOM flows, L/min		Leak test flows, L/min	
			Main	Total	Main	Aux.
07/30/07			3.25	17.10	0	-0.01
08/02/07	3	1.16				
01/08/08	159	0.44	3.09	17.06	-0.02	0.03
07/11/08	185	1.98				
07/24/08	13		3.24	16.33	0.09	0.13
09/15/08	53	2.45			0.09	0.3
10/08/08	23	3.71				
10/31/08	23	2.28				
12/18/08	48	2.28	3.08	16.81	0.07	0.21
02/12/09	56	2.11	3.08	16.78	0.09	0.29
02/27/09	15				0.06	0.32
03/03/09	4		3.14	17.14	0.07	0.22
03/23/09	20	1.79				
05/04/09	42		3.10	15.52		
05/07/09	3	1.75				
06/01/09	25	2.21				
06/25/09	24				0.06	0.24
07/06/09	11		N/A	17.39		
07/18/09	12	2.33	3.14	16.75	0.07	0.36

Table 16. Quality assurance tests of room 7 TEOM.

Date	Time since last test, d	Mass error, %	TEOM flows, L/min		Leak test flows, L/min	
			Main	Total	Main	Aux.
07/30/07			3.17	16.86	0.12	0.25
08/02/07	3	0.19				
01/24/08	175		3.01	16.52	0.04	0.43
02/08/08	15	1.1				
07/24/08	167	1.43	3.16	17.51	0.05	0.13
09/15/08	53	2.32	3.08	16.96	0.07	0.14
10/08/08	23	2.8				
11/03/08	26	1.76				
12/18/08	45	2.26	2.95	16.96	0.05	0.17
02/12/09	56	1.78	3.00	16.86	0.05	0.12
03/03/09	19		3.17	17.44	0.08	0.22
03/27/09	24	1.78	3.04	16.89	0.07	0.45
05/04/09	38		3.02	16.80		
05/07/09	3	1.69				
06/01/09	25	1.56				
06/25/09	24				0.06	0.23
07/06/09	11		2.94	16.40		
07/07/09	1		3.05	16.73		
07/18/09	11	1.69	3.03	16.67	0.05	0.25

Table 17. Quality assurance tests of room 8 TEOM.

Date	Time since last test, d	Mass error, %	TEOM flows, L/min		Leak test flows, L/min	
			Main	Total	Main	Aux.
07/30/07			3.18	16.80	0	0.03
08/02/07	3	0.04				
01/03/08	154		2.93	16.39	0.02	0.04
01/08/08	5	0.66				
07/24/08	198	1.95	3.07	16.97	0.05	0.21
09/22/08	60	1.74	3.00	16.35	0.11	0.31
10/08/08	16	3.1				
11/03/08	26	1.65				
12/18/08	45	1.58	3.04	16.61	0.05	0.13
02/12/09	56	1.38	3.02	16.74	0.05	0.12
02/24/09	12		2.62	14.60	0.04	0.07
03/03/09	7		3.13	17.24	0.04	0.11
03/23/09	20	1.61				
05/04/09	42		1.08	7.97		
05/15/09	11		3.08	16.95	0.08	0.11
06/25/09	41				0.05	0.32
07/09/09	14		3.13	16.85	0.01	0.09
07/13/09	4		3.03	16.90		
07/14/09	1		3.10	17.02		
07/18/09	4	0.94	3.19	16.90	0.03	0.12

The quality assurance tests of the inlet PM monitor are summarized in Table 18. Both the calibration and flow rate tests passed the criteria specified by the manufacturer.

Table 18. Quality assurance parameters of the inlet PM monitor.

Date	Time since last test, d	Mass verification, %	Total flow check, L/min
9/13/07		-0.2	16.76
1/31/08	140	-1.7	
8/15/08	197		16.85
2/6/09	175	0.1	
5/22/09	105		16.45

The TEOM measurements were also evaluated based on collocated measurements of all three PM types (Table 19). When the room 7 TEOM was collocated with the room 6 TEOM for 27 h from 7/6/09 to 7/7/09, the differences in average PM_{10}, TSP and $PM_{2.5}$ concentrations over the collocation periods were 4.5, 19.1 and 154.2%, respectively. The differences in average PM_{10}, TSP and $PM_{2.5}$ concentrations between room 8 and room 9 TEOM's over a 29-h collocation period starting 7/13/09 were 1.0, 24.7 and 62.2%, respectively.

Table 19. TEOM collocation tests conducted in room 5.

PM type	Average concentration, $\mu g/m^3$		Difference, %
	Room 5 TEOM	Room 8 TEOM	
PM_{10}	338	323	-4.5
TSP	840	1000	19.1
$PM_{2.5}$	11	27	154.2
TEOM collocation tests conducted in room 6.			
PM type	**Average concentration, $\mu g/m^3$**		**Difference, %**
	Room 6 TEOM	**Room 7 TEOM**	
PM_{10}	166	167	1.0
TSP	471	355	-24.7
$PM_{2.5}$	12	4	-62.2

3.9. Data Analysis

3.9.1. Software

All emission data processing was conducted using custom software (CAPECAB, Fibre Recovery Systems, Inc., Calgary, AB). Data was carefully inspected and validated. If a datum was invalid for a known reason, the datum was marked (flagged) invalid and all calculations dependent on that datum were also invalid unless a substitution datum was identified.

If the QA/QC checks described above indicated a measurement bias, the data was corrected prior to calculating emissions. The CAPECAB program provided a robust method to inspect data, invalidate if necessary, and implement various corrections over specified time periods.

3.9.2. *Data substitution, validation, correction and uncertainty*

3.9.2.1. *Pressure*

All static pressures were corrected based on the zero-pressure check results.

The average static pressures for each room were determined using data from all properly-operating sensors among the north, west, and south ΔP sensors. For calculating airflow, the other functioning sensor in the same room was used whenever the sensor on the fan's actual wall failed.

Calibration offsets were assigned to the different sensors based on time-weighted averages of the zero checks. Two sets of calibration factors were developed for the static pressure sensors based on 26 zero checks. Prior to 12/6/08, calibration offsets were 0.05 Pa (R5 E wall), -0.11 Pa (R5 S wall), 0.57 Pa (R6 S wall), -1.23 Pa (R6 W wall), -0.92 Pa (R7 N wall), 0.16 Pa (R7 W wall), 0.15 Pa (R8 E wall), and -0.05 Pa (R8 N wall). After 12/6/08, calibration offsets were -0.21 Pa (R5 E wall), -0.54 Pa (R5 S wall), -0.01 Pa (R6 S wall), -1.57 Pa (R6 W wall), -1.36 Pa (R7 N wall), -0.20 Pa (R7 W wall), 1.70 Pa (R8 E wall), and -0.36 Pa (R8 N wall).

The atmospheric pressure measurement was unavailable between cycles, as the TEOMs were offline during barn cleaning. To facilitate emission-related calculations, an average atmospheric pressure measurement of 98.6 kPa was substituted in the calculations.

3.9.2.2. *Environmental sensors*

Exhaust air temperatures for each building were defined as the average of the RH/T probe temperature measurement and the thermocouple measurements at fans 1 to 3.

Barn relative humidity (RH) was derived from the OMNI/NOVUS sensor at fan 6. The INNOVA T_{dew} readings for the inlet location were converted to RH, and RH was converted to humidity ratio using the standard conversion equations.

The solar sensor signal was collocated with a reference solar sensor on 10/15/07 and 6/16/09. No calibration offset was applied to correct the raw data.

3.9.2.3. *Fan operation*

The pit fans ran continuously as first-stage fans. The pit fan operation status (percentage of sixty, 1-s readings) was calculated based on the measured fan speed. In the event a pit fan speed sensor signal was invalid due to failure, the operational status was confirmed and substituted with the signals of the other pit fans of the same room.

The operational status and speed of each wall fan were monitored. Similar to the pit fans, the fan operation status was calculated by the fan speed signal, and when the fan speed sensors reported invalid data, the fan operation status signal was first consulted and substituted. Low-level fan speed signal noise was filtered out by setting operational status to "off" (0%) when the average recorded speed was less than 150 rpm.

3.9.2.4. *Gas concentrations*

The first 7 min of the 10-min exhaust gas concentration data were discarded for NH_3 and NMHC, because the system needed that much time to reach equilibrium after switching from one sampling location to another. The first 5 min of the 10-min exhaust gas concentration data were discarded for H_2S. Thus, the last three min of data of each sampling period were validated for NH_3 and NMHC, and the last five min of data of each sampling period were validated for H_2S.

Table 20 describes the time specified in the data processing software for gas concentration measurements to stabilize, based on gas and sampling location, and the maximum interval for interpolating between two valid concentration measurements for a sampling location.

Table 20. Gas concentration data validation and interpolation requirements.

Gas	Exhaust sampling locations		Inlet sampling location	
	Equilibration period, min	Maximum interpolation interval, min	Equilibration period, min	Maximum interpolation interval, min
NH_3	7	300	17	3000
NMHC	7	300	17	3000
H_2S	5	300	10	3000

Gas and water vapor concentrations, and sample relative humidity, temperature, pressure, flow rate, and flow direction were invalidated or automatically excluded during all gas analyzer MPCs and Z/S checks. Airflow rate, and gas and PM emission data were invalidated under conditions of positive barn static pressure, because barn airflow measurements required a negative or underpressure in the barn.

Gas concentration data were invalidated due to problems with the INNOVA 1412. The analyzer sustained chopper motor errors in November 2007, September 2008, and February and March 2009. The analyzer was also returned to the manufacturer for repair and calibration from 10/13/08 to 1/5/09, 3/19/09 to 4/29/09, and 5/12/09 to 7/1/09.

Standard gas concentrations were calculated on dry and moist bases with Eqns. 3-1 and 3-2, respectively.

$$C'' = \frac{C'}{(1-W)} \qquad (3\text{-}1)$$

and

$$C' = \frac{P' \cdot c \cdot M}{R \cdot (273 + T')} \qquad (3\text{-}2)$$

where:

- C'' Dry standard mass concentration, dry basis (mg $d^{-1}sm^3$ or µg $d^{-1}sm^3$)
- C' Standard mass concentration, moist-air basis (mg sm^{-3} or µg sm^{-3})
- P' Standard pressure (1 atm)
- T' Standard temperature (20°C)
- c Volumetric concentration of gas (ppm or ppb)
- M Molecular weight of gas (g mol^{-1})
- R Universal Gas Constant (0.08206 L atm mol^{-1} °K^{-1})
- W Humidity ratio

3.9.2.5. PM concentrations

Prior to 2/21/08, the TEOM flow rates were internally adjusted to 16.7 L min^{-1} for standard conditions (25°C and 1 atm), regardless of the surrounding conditions. The actual flow through the TEOM was verified by correcting for the surrounding conditions and confirming the flow was maintained between 15.7 and 17.7 L min^{-1}. The quality of the PM data was therefore acceptable based on QAQC requirements. The internal TEOM settings were changed on 2/21/08 to adjust the flow to 16.7 L min^{-1} based on actual rather than standard air density.

The TEOMs were configured to output the PM concentration data at the surrounding temperature and atmospheric pressure until 2/21/08, at which time they were reconfigured to output the PM data at standard conditions (20°C, 1 atm). All PM concentration data prior to 2/21/08 was corrected to standard conditions.

Dry standard PM concentrations were obtained by dividing raw concentrations by the air humidity ratio.

PM concentration data was invalidated if the calculated flow was outside the range of 16.67±1.00 L min^{-1}.

3.9.3. Emission calculations

3.9.3.1. Particulate matter

PM emissions were calculated with Eqn. 3-3.

$$E = \left(Q_0 * P_0 * \left(\frac{273+20}{273+T_0}\right)\right) * (C'_0 - C'_i) \qquad (3\text{-}3)$$

Where:

- E Net PM emission rate ($\mu g\ s^{-1}$)
- Q_0 Exhaust airflow rate at To ($m^3\ s^{-1}$)
- P_0 Pressure of exhaust air (atm)
- C_0' PM concentration of exhaust air ($\mu g\ m^{-3}$)
- Ci' Inlet PM concentration ($\mu g\ m^{-3}$)
- T_0 Temperature of exhaust air (°C)

3.9.3.2. Gases

Stream-specific gas emissions were determined as follows:

$$E = Q_O \cdot \frac{P_O \cdot M}{R \cdot (273 + T_O)} \cdot (c_O - c_i) \qquad (3\text{-}4)$$

Where:

- E Stream or barn emission rate (mg s^{-1} or $\mu g\ s^{-1}$)
- Qo Stream or barn outlet moist airflow rate at To ($m^3\ s^{-1}$)

P_O Exhaust air pressure (atm)
M Gas molecular weight (g mol^{-1})
R Universal Gas Constant (0.08206 L atm/mol^{-1} °K^{-1})
T_O Exhaust air temperature (°C)
c_o Exhaust air concentration (ppm or ppb)
c_i Inlet or ventilation air inlet concentration (ppm or ppb)

Building emissions were the summation of the stream emissions. If the interpolated stream concentration was invalid for one stream in a barn, the average of the other two stream concentrations was substituted in the emission calculation. Building emission was divided by variables (barn inventory, feed consumption) or constants (floor area) to normalize emissions to site-specific characteristics.

3.9.3.3. Volatile Organic Compounds

The total VOC concentration was multiplied by building airflow for the 24-h canister sampling period to yield an average emission rate. If two samples were successfully collected for a building at one sampling event, the average concentration was used in the calculation.

4. RESULTS

4.1. Farm Production Information

The farm production information, including inventory, pig mass and density is presented in Table E2.

The monitoring period extended across five growth cycles, while three complete growth cycles occurred within the two-year monitoring period. Based on the three growth cycles, the average growth cycles lasted 172, 171, 151, and 152 d for rooms 5 to 8, respectively. The shorter growth cycle days for rooms 7 and 8 were because the rooms were only stocked with larger pigs from rooms 5 and 6. The time between pig groups averaged 8, 12, 33, and 28 d and ranged from 6 to 25 d.

4.2. Characteristics of Biomaterials

The pH, solids and ash (added to analysis later in the study) content, and Total N and NH_3-N concentrations of the surface manure samples, and the solids, ash (added to analysis later in the study) and total N contents of the feed are presented in Appendix D. The loadout manure and water sample analysis are also presented.

The nitrogen content of the surface manure ranged from 0.20 to 0.86% nitrogen (wet-basis), and the mean was 0.48%. The nitrogen content of the feed ranged from 1.83 to 3.17% nitrogen (wet-basis) and averaged 2.43%.

The nitrogen content of the loadout manure samples averaged 0.48% (wet-basis), and ranged from 0.24 to 0.66% nitrogen.

Water samples showed non-detectable nitrate/nitrite nitrogen, and lower than 1.5 mg/L or non-detectable TKN concentrations, while the total sulfur concentrations ranged from 9.6 to 10.0 mg/L for the three water samples.

4.3. Environmental Conditions

4.3.1. Ambient conditions

The weather conditions monitored at the site are shown in Table E1. According to historical climatic information, daytime average high temperatures ranges from 0°C in the winter to 29°C in the summer. Average overnight lows range from -9°C in winter to 17°C in summer. Typical prevailing winds for the region are from the west-southwest in the winter to early summer, and southwest during the rest of the year.

Table E1 shows the daily average outdoor temperature, relative humidity, wind speed, wind direction, solar radiation and barometric pressure. The ADM outdoor temperature was 12.0°C, while the historical annual average for the area shown in Table 21 was 10.3°C.

Table 21. Monthly averages for weather conditions in the area*.

Month	Temperature*,°C			Wind speed**, km/h	Wind direction**
	High	Low	Mean		
January	0	-9	-4	18	WSW
February	3	-7	-2	18	WSW
March	9	-1	4	19	SW
April	16	4	10	19	SW
May	22	10	16	16	WSW
June	27	15	21	14	WSW
July	29	17	23	13	SW
August	28	16	22	11	SW
September	24	12	18	13	SW
October	18	6	12	14	SW
November	10	1	5	18	SW
December	3	-6	-1	18	SW
Annual Average	16	5	10		

*http://www.weather.com/weather/wxclimatology/monthly/USIN0144
** Data collected at Indianapolis, IN (55 mi. S of the site), NOAA National Climate Data Center.

4.3.2. Barn Conditions

The daily average PREF temperatures are plotted in Figure 4 are presented along with RH in Table E3. The average PREF temperatures for rooms 5 to 8 were 23±5, 23±4, 22±5, and 24±4 °C, respectively. The average PREF RH for rooms 5 to 8 were 68±11, 58±7, 57±7, and 59±8 %, respectively. The average pit exhaust temperatures for rooms 5 to 8 were 22±4, 22±5, 21±6, and 21±5 °C, respectively.

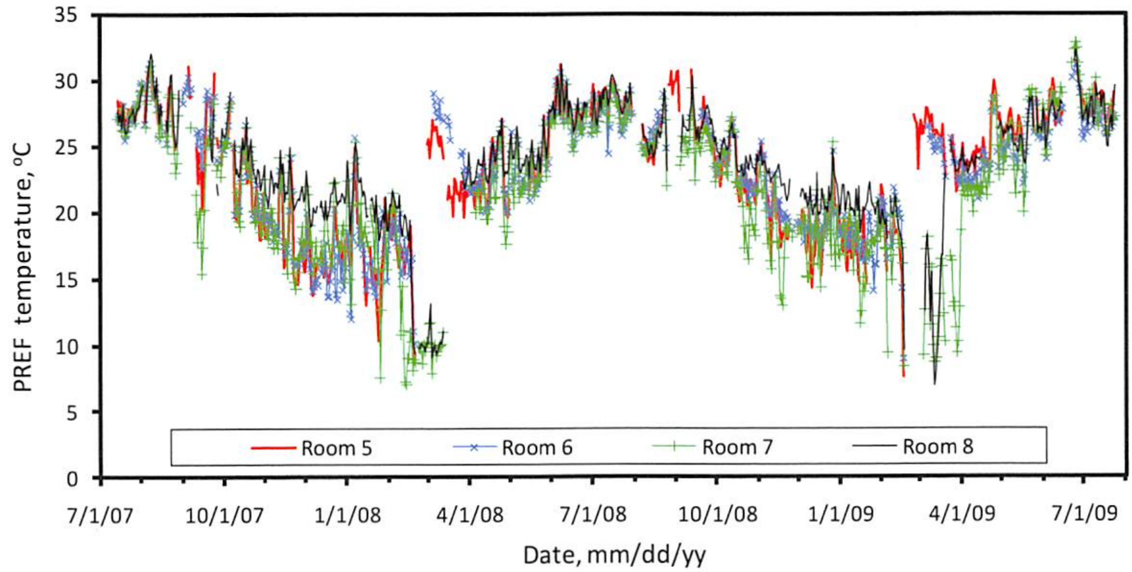

Figure 4. Primary representative exhaust fan temperatures for rooms 5-8.

4.3.3. Ventilation Rates

The median static pressure differential was -15±5 Pa in all cases. The fraction of time that the pressure was positive ranged from 3.5 to 12.3%. Most of the positive pressures were likely wind-induced. Static pressure was greater than -30 Pa over 90% of the time.

The ventilation rate of all four rooms ranged from 0 $m^3\ s^{-1}$ when fans were shut down for cleaning, to 47.1 $dsm^3\ s^{-1}$ during the summer with the room-full of pigs (Figure 5). The overall average ventilation rates were 13.7, 14.1, 14.7, and 13.9 $dsm^3\ s^{-1}$ for rooms 5 to 8, respectively.

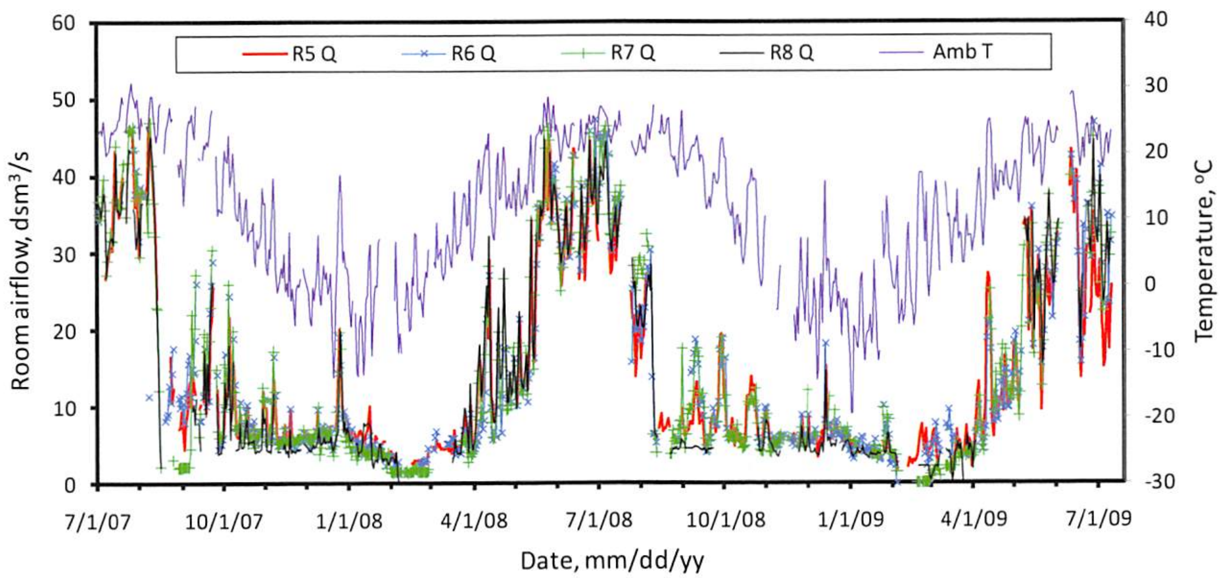

Figure 5. Ambient temperature and dry standard barn airflow rates.

4.4. Particulate Matter Concentration and Emission

4.4.1. PM_{10}

The DM inlet PM_{10} concentration ranged from 4 to 84 µg dsm^{-3} (n=22 d), whereas the DM PM_{10} exhaust concentrations of rooms 5 to 8 ranged from -54 to 1051, -6 to 1228, -54 to 1149, and -46 to 1200 µg dsm^{-3}, respectively (Table E4).

The ADM PM_{10} concentrations of the inlet and rooms 5 to 8 were 274±187, 303±222 and 238±199, and 225±218 µg dsm^{-3}, respectively (Table E4).

The overall mean PM_{10} emission rates were 212±117, 226±134, 185±132, and 172±175 g d^{-1} (235±193, 232±150 and 183±123, and 252±483 mg $d^{-1}pig^{-1}$) for rooms 5 to 8, respectively (Table E5 and Figure 6).

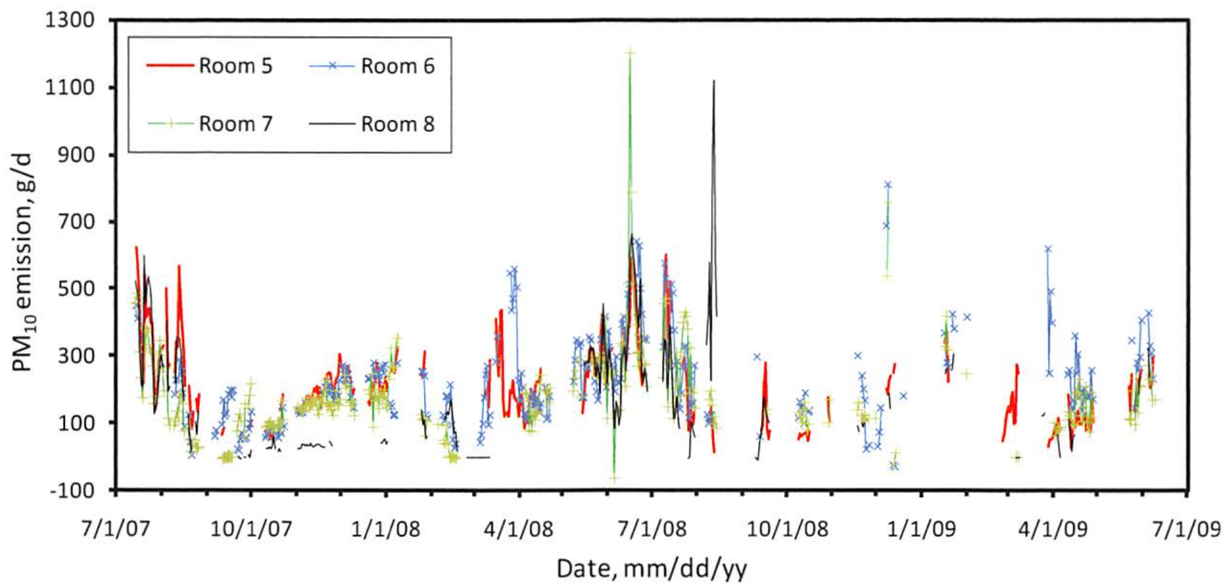

Figure 6. Daily mean PM_{10} emissions.

4.4.2. $PM_{2.5}$

Daily mean concentrations of $PM_{2.5}$ ranged from 2.4 to 31.4 µg dsm^{-3} in the inlet air (n=34 d) . Daily mean concentrations of $PM_{2.5}$ were -34 to 83, -28 to 134, -35 to 69, and -76 to 113 µg dsm^{-3} in the exhaust air of rooms 5 to 8, respectively (Table E4).

The ADM concentrations of the inlet, and exhaust air of rooms 5 to 8 were 13.2±7.1, 17.4±17.9, 26.9±31.1, 15.1±24.8, and 17.8±27.2 µg dsm^{-3}, respectively (Table E4).

The mean $PM_{2.5}$ emission rates during cold weather (1/11/08 to 1/23/08) were 22, 18, 11, and 6 g d^{-1} from rooms 5 (n=12 d), 6 (n=12 d), 7 (n=12 d), and 8 (n=11 d), respectively (Figure 7). The mean $PM_{2.5}$ emission rates during warm weather from rooms 5 to 8 (9/23/08 and 10/17/08) were -1, -5, 36, and -1 g d^{-1} (n=15, 15, 15, and 13 d), respectively.

The overall mean $PM_{2.5}$ emission rates were 9.5±14.4, 5.2±17.0, -14.9±45.9, and 2.4±5.5 g d^{-1} (9.2±14.1, 6.6±17.8, -11.4±44.7, and 2.7±5.8 mg $d^{-1}pig^{-1}$), from rooms 5 to 8, respectively.

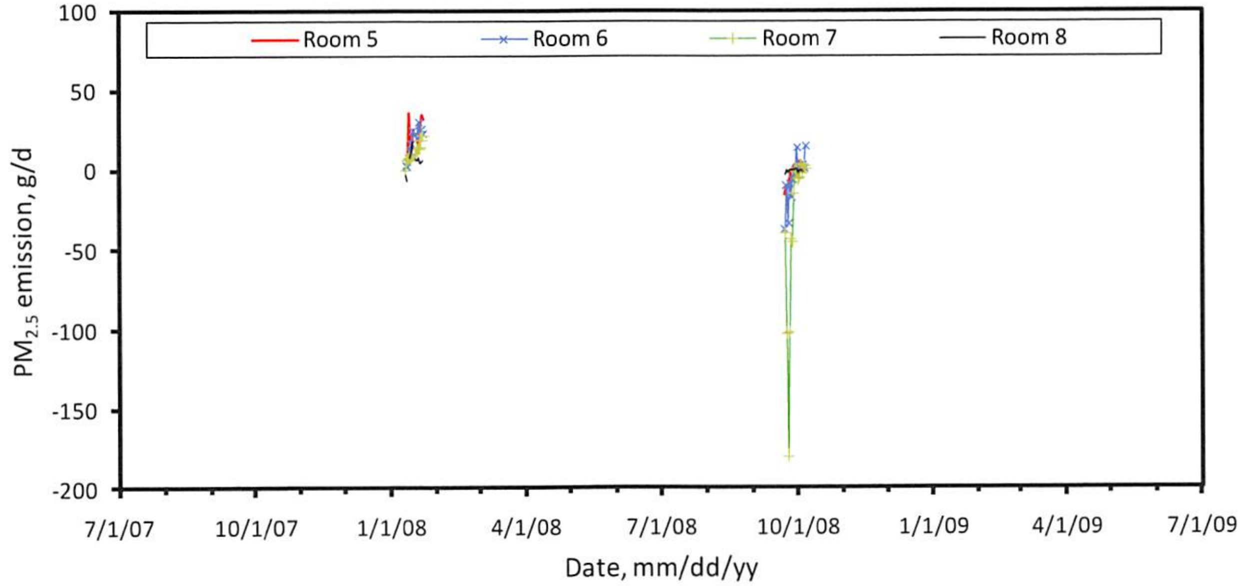

Figure 7. Daily mean $PM_{2.5}$ emissions.

4.4.3. TSP

Daily mean TSP concentrations ranged from 7 to 85 μg dsm^{-3} in the inlet air (n= 72 d), 291 to 2580 μg dsm^{-3} in room 5 exhaust air (n=34 d), 273 to 2075 μg dsm^{-3} in room 6 exhaust air (n=40 d), 202 to 3105 μg dsm^{-3} in room 7 exhaust air (n=44 d), and from 99 to 2762 μg dsm^{-3} in room 8 exhaust air (n=38 d) (Table E4).

The ADM concentrations of the inlet, and exhaust air of rooms 5 to 8 were 28±14, 1147±644, 1109±518, 1015±602, and 826±549 μg dsm^{-3}, respectively (Table E4).

The ADM TSP emissions ranged from 225 to 1699 g d^{-1} (Table E7 and Figure 8**Error! Reference source not found.**). The overall mean TSP emission rates were 899±387 g d^{-1} (853±377 mg $d^{-1}pig^{-1}$) for room 5 (n= 24 d), 1093±281 g d^{-1} (1034±258 mg $d^{-1}pig^{-1}$) for room 978±284 g d^{-1} (852±227 mg $d^{-1}pig^{-1}$) for room 7 (n= 34 d), and 1042±242 g d^{-1} (967±221 mg $d^{-1}pig^{-1}$) for room 8 (n= 22 d), respectively.

4.5. VOC Concentrations and Emissions

The 20 most prevalent VOCs detected in the canister samples accounted for 90% of the total quantified mass (Table 22). The most prevalent compound was pentane, which was 27% of the total mass.

Concentrations of total VOC in exhaust air ranged from 0.29 to 1.23 mg m^{-3} in R5, 0.79 to 4.41 mg m^{-3} in R6, 0.44 to 1.12 mg m^{-3} in R7, and 0.46 to 7.48 mg m^{-3} in R8. The mean total VOC

concentration were 0.77 ± 0.30, 1.56 ± 1.42, 0.77 ± 0.30, and 1.89 ± 2.76 mg m^{-3} in rooms 5-8, respectively.
Total VOC emissions (ng s^{-1}) during each sampling period were determined by multiplying the mean building airflow rate (m^3 s^{-1}) by the total mass (ng m^{-3}) and converting to kg d^{-1}. The VOC emission rates of R5, R6, R7 and R8 ranged from 0.66 to 3.43 kg d^{-1}, 2.43 to 18.2 kg d^{-1}, 1.35 to 4.12 kg d^{-1} and 1.31 to 21.2 kg d^{-1}, respectively. The mean VOC emission rates from R5, R6, R7, and R8 were 2.16 ± 0.96, 5.48 ± 6.24, 2.53± 1.18 and 5.52 ± 7.73 kg d^{-1} or 2.16 ± 0.96, 5.48 ± 6.24, 2.53± 1.18 and 5.52 ± 7.73 g d^{-1} hd^{-1}.

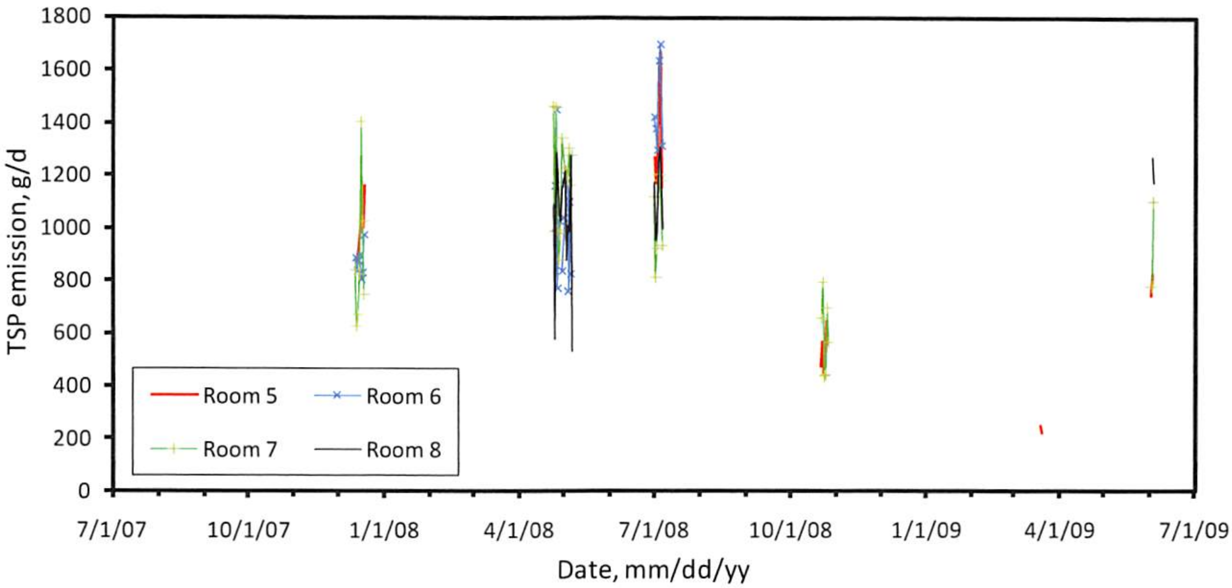

Figure 8. Daily mean TSP emissions.

4.6. Hydrogen Sulfide Concentrations and Emissions

Daily mean inlet and exhaust H_2S concentrations for the entire test are provided in Table E10.

The average daily mean H_2S concentrations were 22±20 (n=608 d) ppb in the inlet air, and 387±399 (n=539 d), 684±770 (n=522 d), 527±693 (n=512 d), and 784±821 (n=499 d) ppb in the exhausts of rooms 5-8, respectively.

Daily mean H_2S emissions from rooms 5-8 are tabulated in Table E11 and plotted in Figure 9 for the entire test period.

The ADM H_2S emission rates from rooms 5-8 were 419±489 (n=500), 618±598 (n=449 d), 401±506 (n=440 d), and 637±627 (n=419 d) mg d^{-1}, respectively.

The ADM pig-specific H_2S emission rates from rooms 5-8 were 525±1032 (n=500 d), 680±1045 (n=449 d), 419±572 (n=440 d), and 855±1186 (n=419 d) mg d^{-1} pig^{-1}, respectively.

Table 22. Average concentration of 20 most prevalent VOC.

Compound	Concentration, ng m^{-3}	% of total	Cumulative %
iso-Propanol	1.38E+05	14.33%	14.3
Propanoic acid	1.13E+05	11.78%	26.1
Acetic acid	9.12E+04	9.49%	35.6
4-Methyl-phenol	8.84E+04	9.20%	44.8
Acetaldehyde	6.09E+04	6.34%	51.1
Pentane	5.67E+04	5.90%	57.0
Phenol	5.14E+04	5.35%	62.4
2-Butanone	3.98E+04	4.14%	66.5
Dimethyl sulfide	3.40E+04	3.54%	70.1
Butanoic acid	3.16E+04	3.29%	73.4
2,3-Butanedione	2.49E+04	2.59%	75.9
Ethyl acetate	1.61E+04	1.67%	77.6
1-Butanol	1.53E+04	1.59%	79.2
Hexanal	1.36E+04	1.41%	80.6
Dimethyl disulfide	1.18E+04	1.23%	81.9
4-Ethyl-phenol	1.17E+04	1.22%	83.1
Dimethyl sulfone	1.02E+04	1.06%	84.1
Nonanal	1.00E+04	1.04%	85.2
Dimethyl trisulfide	9.55E+03	0.99%	86.2
Heptanal	9.05E+03	0.94%	87.1

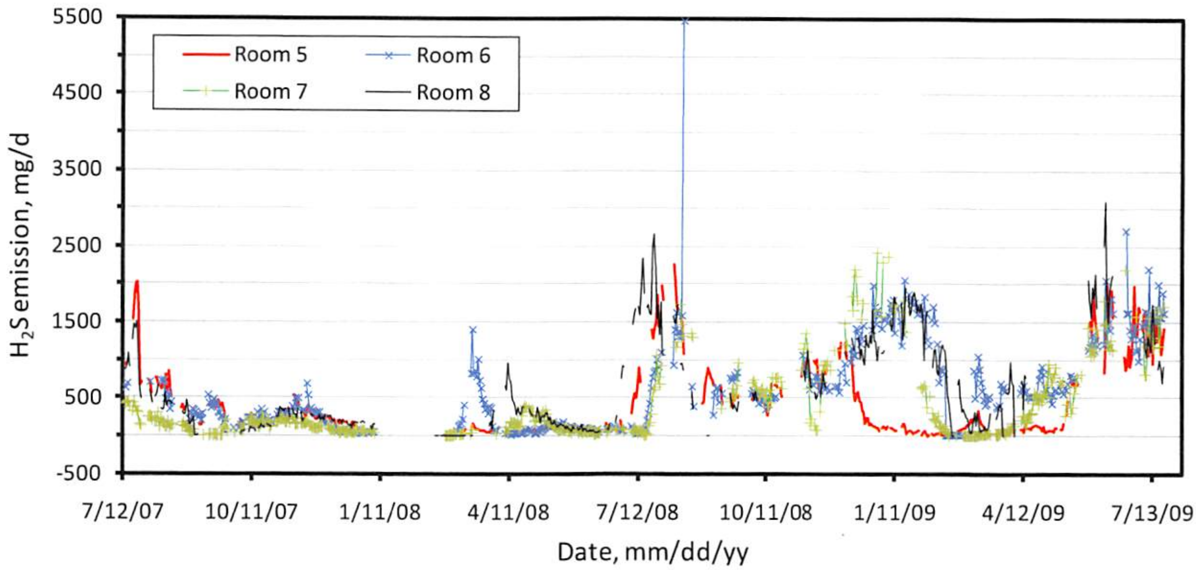

Figure 9. Daily mean H_2S emissions from rooms 5-8.

Table 18. Emission of total VOC (one canister per room per sampling day).

Date	Concentration, mg m^{-3}				Airflow, m^3s^{-1}				Emission, kg d^{-1}			
	R5	R6	R7	R8	R5	R6	R7	R8	R5	R6	R7	R8
06/01/09	1	1	1	1	0.66	0.95	0.95	1.01	34.5	32.4	32.2	32.8
06/08/09	1	1	1	1	0.81	4.06	1.03	0.58	41.7	47.7	42.2	41.2
06/24/09	1	1	1	1	0.81	0.88	0.44	0.52	48.8	48.4	50.5	46.7
07/13/09	1	1	1	1	0.29	0.79	1.12	1.48	26.6	35.8	42.6	33.6
07/22/09	1	1	1	1	1.23	1.49	0.62	0.46	20.9	26.0	26.8	32.9
07/23/09	1	1	1	1	0.80	0.83	0.46	0.81	26.3	36.2	33.8	30.9
Mean	1	1	1	1	0.77	1.50	0.77	0.81	33.1	37.7	38.0	36.3

4.7. Ammonia Concentrations and Emissions

Daily mean inlet and exhaust NH_3 concentrations for the entire test are provided in Table E12.

The average daily mean NH_3 concentrations were 0.2±0.4 (n=451 d) ppm in the inlet air, and 14.6±11.0 (n=405 d), 12.7±7.9 (n=379 d), 12.8±8.8 (n=368 d), and 13.2±9.1 (n=368) ppm in the exhausts of rooms 5-8, respectively.

Daily mean NH_3 emissions from rooms 5-8 are tabulated in Table E13 and plotted in Figure 12 for the entire test period.

The ADM NH_3 emission rates from rooms 5-8 were 7.4±2.7 (n=375 d), 7.7±3.0 (n=340 d), 6.6±3.3 (n=334 d), and 6.2±3.6 (n=337 d) kg d^{-1}, respectively.

The ADM pig-specific NH_3 emission rates from rooms 5-8 were 8.3±6.5 (n=375 d), 8.0±4.5 (n=340 d), 6.7±4.7 (n=334 d), and 7.2±5.6 (n=337 d) g d^{-1} pig^{-1}, respectively.

4.8. NMHC Concentrations and Emissions

Daily mean inlet and exhaust NMHC concentrations for the entire test are provided in Table E8.

The average daily mean NMHC concentrations were -0.009±0.027 (n=488 d) ppm in the inlet air, and 0.21±0.14 (n=442 d), 0.21±0.14 (n=423 d), 0.17±0.13 (n=406 d), and 0.18±0.14 (n=396) ppm in the exhausts of rooms 5-8, respectively.

Daily mean NMHC emissions from rooms 5-8 are tabulated in Table E9 and plotted in Figure 11. The ADM NMHC emission rates from rooms 5-8 were 0.23±0.14 (n=422 d), 0.27±0.16 (n=367 d), 0.21±0.19 (n=349 d), and 0.17±0.15 (n=326 d) kg d^{-1}, respectively.

The ADM pig-specific NMHC emission rates from rooms 5-8 were 213±133 (n=422 d), 257±327 (n=367 d), 217±315 (n=349 d), and 185±175 (n=326 d) mg d^{-1} pig^{-1}, respectively.

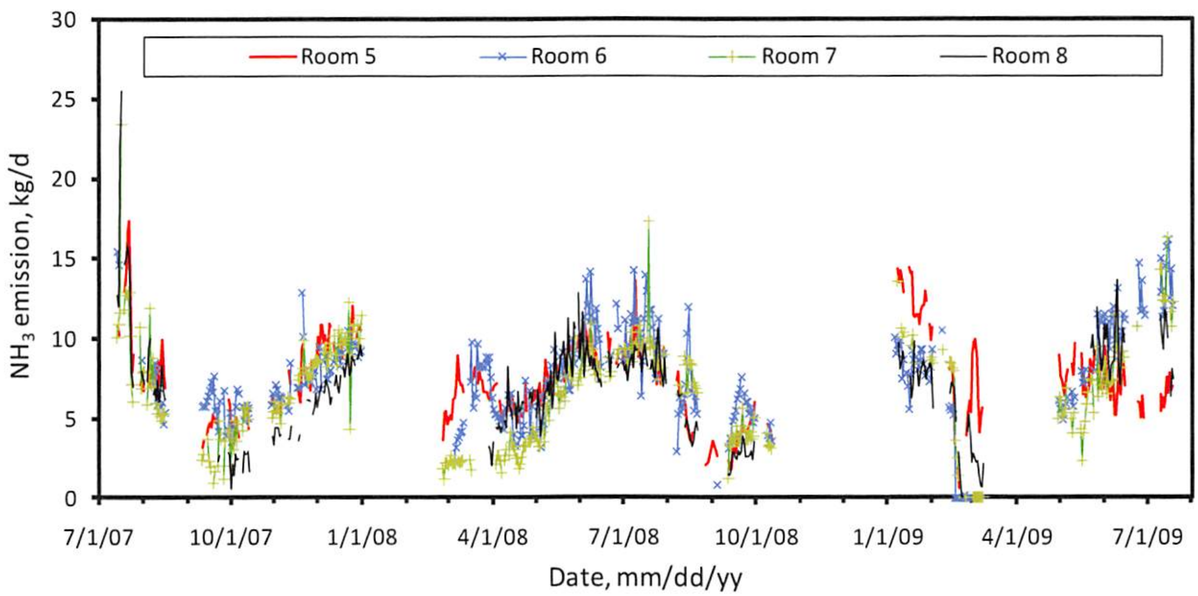

Figure 10. Daily mean NH_3 emissions from rooms 5-8.

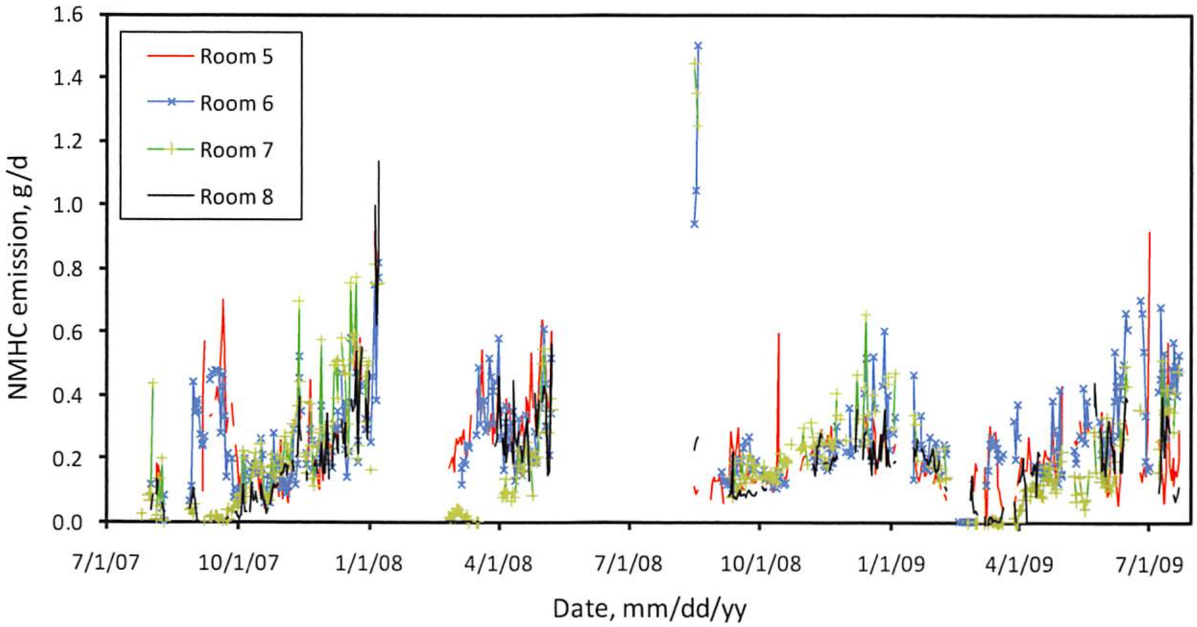

Figure 11. Daily mean NMHC emissions from rooms 5-8.

4.9. Emission Data Completeness

Daily completeness data is given in Table E14. The number of complete data (>75% valid required for reporting a daily mean) were calculated for emission measurements conducted from 7/14/07-7/24/09 (Table 19). The number of daily means of NH_3 emissions was reduced by the INNOVA 1412 recalibrations and maintenance of the instrument. The PM completeness was affected by TEOM failures.

Table 23. Completeness of emissions data (7/14/07-7/24/09).

Location	Days with >75% valid emission data				
	NH_3	H_2S	PM_{10}	$PM_{2.5}$	TSP
Room 5	375	500	303	27	24
Room 6	340	449	271	27	24
Room 7	334	440	296	27	34
Room 8	337	419	230	24	22

4.10. Reconciliation with Data Quality Objectives

The data quality objectives prior to the study were to measure gas and PM emissions from mechanically-ventilated buildings with total relative uncertainties of 27% and 32%, respectively.

4.10.1. Airflow

The overall average airflows for R5, R6, R7 and R8 were 13.7 ± 11.6 dsm^3 s^{-1} (n=604), 14.1 ± 11.9 dsm^3 s^{-1} (n=548), 14.7 ± 13.2 dsm^3 s^{-1} (n=580) and 13.9 ± 13.2 dsm^3 s^{-1} (n=545) respectively.

An average of 6.38 fans operated in all rooms at which condition the airflow measurement uncertainty was 16.7%, based on the fan models.

4.10.2. Gas Emissions

The bias and precision of NH_3 concentration measurements were derived from the NH_3 zero/span checks as compared with the NH_3 correction models (Table 8). The bias and precision of NH_3 measurements were -0.35% and 4.02%, respectively.

The bias and precision of H_2S concentration measurements were derived from the H_2S zero and span checks as compared with the H_2S correction models (Table 10**Error! Reference source not found.**). The bias and precision of H_2S measurements were 0.29% and 3.34%, respectively.

Based on these measurement errors calculated for concentrations and airflows, the uncertainties of NH_3 and H_2S emissions from R5, R6, R7 and R8 were 18.4 and 18.2%, respectively.

4.10.3. PM Emissions

The precision of PM_{10}, TSP and $PM_{2.5}$ concentration measurements were 0.85, 5.41, and 34.05% based on collocation tests of the three TEOMs in inlet air (Table 19). The relative biases of the TEOMs were 1.21, 2.11, 1.23 and -0.05% for R5, R6, R7 and R8 (Tables 14-17). The uncertainties of PM_{10}, TSP and $PM_{2.5}$ emissions from R5 were 17.1, 20.1, and 70.2%, respectively. The uncertainties of PM_{10}, TSP and $PM_{2.5}$ emissions from R6 were 17.1, 20.2, and 70.2%, respectively. The uncertainties of PM_{10}, TSP and $PM_{2.5}$ emissions from R7 were 16.8, 20.1 and 68.1%, respectively. The uncertainties of PM_{10}, TSP and $PM_{2.5}$ emissions from R8 were 16.7, 20.1 and 68.1%, respectively.

5. SUMMARY

The emissions of NH_3, H_2S, NMHC, PM_{10}, TSP, $PM_{2.5}$ and VOCs from four 1,000-hd swine finishing rooms at an 8,000-hd in Indiana were measured during a two-year monitoring study. Manure was accumulated into deep underfloor pits in the barn. The buildings were mechanically-ventilated with variable-speed pit fans and endwall tunnel fans.

The overall average emission rates from finishing room 5 were 7.4 kg d^{-1} of NH_3, 419 mg d^{-1} of H_2S, 0.23 kg d^{-1} of NMHC, 212 g d^{-1} of PM_{10}, 9.5 g d^{-1} of $PM_{2.5}$, 899 g d^{-1} of TSP, and 2.2 kg d^{-1} of total VOC. The overall average emission rates from finishing room 6 were 7.7 kg d^{-1} of NH_3, 618 mg d^{-1} of H_2S, 0.27 kg d^{-1} of NMHC, 226 g d^{-1} of PM_{10}, 5.2 g d^{-1} of $PM_{2.5}$, 1093 g d^{-1} of TSP, and 5.5 kg d^{-1} of total VOC. The overall average emission rates from finishing room 7 were 6.6 kg d^{-1} of NH_3, 401 mg d^{-1} of H_2S, 0.21 kg d^{-1} of NMHC, 185 g d^{-1} of PM_{10}, -14.9 g d^{-1} of $PM_{2.5}$, 978 g d^{-1} of TSP, and 2.5 kg d^{-1} of total VOC. The overall average emission rates from finishing room 8 were 6.2 kg d^{-1} of NH_3, 637 mg d^{-1} of H_2S, 0.17 kg d^{-1} of NMHC, 172 g d^{-1} of PM_{10}, 2.4 g d^{-1} of $PM_{2.5}$, 1042 g d^{-1} of TSP, and 5.5 kg d^{-1} of total VOC.

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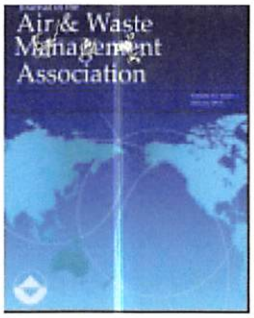

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Emissions of Ammonia, Hydrogen Sulfide, and Odor before, during, and after Slurry Removal from a Deep-Pit Swine Finisher

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ABSTRACT
It is a common practice in the midwestern United States to raise swine in buildings with under-floor slurry storage systems designed to store manure for up to one year. These so-called "deep-pit" systems are a concentrated source for the emissions of ammonia (NH_3), hydrogen sulfide (H_2S), and odors. As part of a larger six-state research effort (U.S. Department of Agriculture-Initiative for Future Agriculture and Food Systems Project, "Aerial Pollutant Emissions from Confined Animal Buildings"), real-time NH_3 and H_2S with incremental odor emission data were collected for two annual slurry removal events. For this study, two 1000-head deep-pit swine finishing facilities in central Iowa were monitored with one-year storage of slurry maintained in a 2.4 m-deep concrete pit (or holding tank) below the animal-occupied zone. Results show that the H_2S emission, measured during four independent slurry removal events over two years, increased by an average of 61.9 times relative to the before-removal H_2S emission levels. This increase persisted during the agitation process of the slurry that on average occurred over an 8-hr time period. At the conclusion of slurry agitation, the H_2S emission decreased by an average of 10.4 times the before-removal emission level. NH_3 emission during agitation increased by an average of 4.6 times the before-removal emission level and increased by an average of 1.5 times the before-removal emission level after slurry removal was completed. Odor emission increased by a factor of 3.4 times the before-removal odor emission level and decreased after the slurry-removal event by a factor of 5.6 times the before-removal emission level. The results indicate that maintaining an adequate barn ventilation rate regardless of animal comfort demand is essential to keeping gas levels inside the barn below hazardous levels.

IMPLICATIONS
Deep-pit slurry removal events lead to elevated H_2S, odor, and NH_3 concentrations inside the pig building and emissions from this facility. H_2S is the gas of most concern and can reach levels dangerous to animals and workers. These results highlight the need for a preplanned protocol that must be established for barn ventilation rate maintenance to ensure that H_2S concentrations do not reach lethal levels.

INTRODUCTION
Many swine raised (reared from 7 or 18 kg to 120 kg) in the midwestern U.S. are grown in structures where year-long storage of manure is present below the occupied zone of the animals. These so-called "deep-pit" systems represent a concentrated source of nutrients that once applied judiciously to the soil provide an excellent source of fertilizer. The standard method for manure removal from buildings using deep-pit manure storage is to provide significant mixing of the slurry before and during slurry removal to suspend solids and to provide a consistent liquid manure fertilizer. This process commonly takes place in the fall after crops have been removed or in early spring before planting begins and generally takes

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from one to three 8-hr work days per 1000-pig building depending upon off-site hauling capacities. This process of slurry removal can represent an acute concentrated emission source for gases and odors. Removal of slurry involves the in situ mixing and agitation of the manure and subsequent application to the field. Significant problems can arise during this process if proper ventilation procedures are not followed. Turbulent activity of the slurry surface can result in very rapid release of odors, ammonia (NH_3), and hydrogen sulfide (H_2S), the latter of which has been linked to several animal and human casualties. Nuisance complaints related to swine production are generally highest during slurry removal and subsequent land application. The objective of this paper is to report on the emission of NH_3, H_2S, and odors before, during, and after slurry removal from two identical deep-pit swine finishing facilities located in the midwestern part of the United States over two annual slurry removal events.

Swine Housing NH_3 Emissions

Several U.S. and northern European studies have investigated the emission of gases from livestock and poultry production systems. Typically, the gases investigated include NH_3, H_2S, and the general class of volatile organic compounds associated with livestock odors.[1] Recently, the need to study the concentrations of these gases in the community surrounding livestock and poultry operations has surfaced because of increasing pressure from regulatory agencies. The following literature review focuses on the emissions from swine housing. A more complete review of the literature on emissions can be found in Hoff et al.[2]

Aarnink et al.[3] studied the NH_3 emission patterns of nursery and finishing pigs raised on partially slatted flooring. They found that for nursery pigs, an average increase of 16 mg NH_3 pig^{-1} day^{-1} was measured, and this increased to 85 mg NH_3 pig^{-1} day^{-1} (4.8 mg NH_3 m^{-2} hr^{-1}) for finishing pigs. The overall average NH_3 emission measured was between 0.70 and 1.20 g NH_3 pig^{-1} day^{-1} for nursery pigs (19–33 g NH_3 animal unit [AU]$^{-1}$ day^{-1}; 1 AU = 500 kg) and between 5.7 and 5.9 g NH_3 pig^{-1} day^{-1} (331 mg NH_3 m^{-2} hr^{-1}) for finishing pigs (42–43 g NH_3 AU^{-1} day^{-1}). They found an increase in NH_3 emission during the summer months for nursery pigs attributed to higher ventilation rates but this same trend was not found for finishing pigs. They also found that removing the under-floor stored slurry reduced the NH_3 emission by ~20% for a period of 10 hr, after which time the NH_3 emission regained the pre-removal emission level.

Demmers et al.[4] investigated the exhausted concentrations and emission rates of NH_3 from mechanically ventilated swine buildings. They reported NH_3 concentrations in a swine finishing house between 12 and 30 mg NH_3 m^{-3} with an average NH_3 emission rate of 46.9 kg NH_3 AU^{-1} yr^{-1} (160 g NH_3 AU^{-1} day^{-1} or 1008 mg NH_3 m^{-2} hr^{-1}).

Burton and Beauchamp[5] studied the relationship between outside temperature, ventilation system response, in-house NH_3 concentration, and the resulting emission of NH_3 from the swine housing unit. They clearly showed the inverse relationship of in-house NH_3 concentration with outside temperature and the direct relationship of NH_3 emission from the swine housing unit with outside temperature. This trend was attributed to the increased ventilation rates required during the summer to control inside climate temperatures for the housed animals. They summarized results over a 1-yr period and reported the monthly averages. February had the highest in-house concentration at 15 mg NH_3-N L^{-1} corresponding to the lowest emission rate at 0.9 kg NH_3-N day^{-1}. August had the lowest in-house concentration of 4 mg NH_3-N L^{-1} and, correspondingly, the highest emission rate of 3.2 kg NH_3-N day^{-1}, on average.

Ni et al.[6] investigated the exhausted concentrations and emission rates of NH_3 in and from a deep-pit swine finishing building with and without the presence of animals and with pits that were roughly half full (1.3 m manure depth; 2.4 m depth capacity). They investigated the gas release rates with and without the effect of heating the building through unit space heaters. Without the presence of animals, they measured NH_3 concentrations between 6 and 15 ppm with emission rates between 40 and 58 mg NH_3 m^{-2} hr^{-1} (5–8 g NH_3 AU^{-1} day^{-1}). When the buildings were restocked with pigs, exhaust air concentrations of NH_3 were, on average, 15.2 ppm with corresponding emission rates of 233 mg NH_3 m^{-2} hr^{-1} (40–50 g NH_3 AU^{-1} day^{-1}).

Groot Koerkamp et al.[7] conducted an extensive study of NH_3 emissions from swine housing facilities. They investigated both indoor NH_3 levels and simultaneous measurements of building ventilation rates and reported the resulting emission rates. In general, NH_3 concentrations varied between 5 and 18 ppm, with average emission rates between 649 and 3751 mg NH_3 AU^{-1} hr^{-1} (16–90 g NH_3 AU^{-1} day^{-1} or between 122–706 mg NH_3 m^{-2} hr^{-1}).

Hinz and Linke[8] investigated the indoor concentrations and emissions of NH_3 from a mechanically ventilated swine finishing facility during a grow-out period where pigs ranged between 25 and 100 kg. Interior NH_3 concentrations during the grow-out varied from 10 to 35 ppm, and these were inversely proportional to outside temperature. Emission rate of NH_3 varied from 70 g NH_3 pig^{-1} hr^{-1} (38 kg average pig wt) to 210 g NH_3 pig^{-1} hr^{-1} (83 kg average pig wt) resulting in an average NH_3 emission rate of 66 g NH_3 AU^{-1} day^{-1} (518 mg NH_3 m^{-2} hr^{-1}).

Zahn et al.[9] studied the NH_3 emission rate from both deep-pit and pull-plug swine finishing facilities during summer periods. They found that the NH_3 emission rates were very similar for these two facility types and grouped the emission data into an overall average of 66 ng NH_3 cm^{-2} sec^{-1} (311 g NH_3 AU^{-1} day^{-1} or 2376 mg NH_3 m^{-2} hr^{-1}).

Zhu et al.[10] studied the daily variations in NH_3 emissions from various mechanically and naturally ventilated swine housing systems. For a mechanically ventilated swine gestation facility, they measured internal NH_3 concentrations between 9 and 15 ppm, with emission rates consistent at ~5 μg NH_3 m^{-2} sec^{-1} (2.2 g NH_3 AU^{-1} day^{-1}). For a mechanically ventilated farrowing facility, they measured internal NH_3 concentrations between 3 and 5 ppm, with emission rates ranging between 20 and 55 μg NH_3 m^{-2} sec^{-1} (15–42 g NH_3 AU^{-1} day^{-1}). For a mechanically ventilated nursery facility, they measured internal NH_3 concentrations between 2 and 5 ppm, with emission rates ranging between 20 and 140 μg NH_3 m^{-2}

sec^{-1} (23–160 g NH_3 AU^{-1} day^{-1}). For a mechanically ventilated finishing facility, they measured internal NH_3 concentrations between 4 and 8 ppm, with emission rates ranging between 20 and 55 μg NH_3 m^{-2} sec^{-1} (10–26 g NH_3 AU^{-1} day^{-1} or between 72–198 mg NH_3 m^{-2} hr^{-1}). For a naturally ventilated finishing facility with pit exhaust fans, they measured internal NH_3 concentrations between 7 and 15 ppm, with emission rates ranging between 60 and 170 μg NH_3 m^{-2} sec^{-1} (28–80 g NH_3 AU^{-1} day^{-1} or between 216–612 mg NH_3 m^{-2} hr^{-1}).

Osada et al.[11] investigated the NH_3 emission from a swine finisher over an 8-week period comparing under-floor stored manure (control) and under-floor manure removed weekly (treatment). They reported only slight differences in NH_3 emission rates with the control at 11.8 kg NH_3 AU^{-1} yr^{-1} (32 g NH_3 AU^{-1} day^{-1} or 255 mg NH_3 m^{-2} hr^{-1}) and the treatment at 11 kg NH_3 AU^{-1} yr^{-1} (30 g NH_3 AU^{-1} day^{-1}).

Swine Housing H_2S Emissions

Ni et al.[6] investigated the exhausted concentrations and emission rates of H_2S in a deep-pit swine finishing building with and without the presence of animals and with pits that were roughly half full (1.3-m depth, 2.4-m depth capacity). They investigated the gas release rates with and without the effect of heating the building through unit space heaters. They measured H_2S concentrations ranging from 221 to 1492 ppb with corresponding emission rates between 1.6 and 3.8 mg H_2S m^{-2} hr^{-1} (0.22–0.49 g H_2S AU^{-1} day^{-1}). When the buildings were restocked with pigs, exhaust air concentration of H_2S averaged 423 ppb with a corresponding emission rate of 9.4 mg H_2S m^{-2} hr^{-1} (1.25 g H_2S AU^{-1} day^{-1}).

Zahn et al.[9] studied the H_2S emission rate from both deep-pit and pull-plug swine finishing facilities during summer periods. They found that the H_2S emission rates were very similar for these two facility types and grouped the emission data into an overall average of 0.37 ng H_2S cm^{-2} sec^{-1} (1.7 g H_2S AU^{-1} day^{-1} or 13.3 mg H_2S m^{-2} hr^{-1}).

Zhu et al.[10] studied the daily variations in H_2S emissions from various mechanically and naturally ventilated swine housing systems. For a mechanically ventilated swine gestation facility, they measured internal H_2S concentrations between 500 and 1200 ppb, with emission rates consistent at ~2 μg H_2S m^{-2} sec^{-1} (1 g H_2S AU^{-1} day^{-1}). For a mechanically ventilated farrowing facility, they measured internal H_2S concentrations between 200 and 500 ppb, with emission rates consistent at ~5 μg H_2S m^{-2} sec^{-1} (4 g H_2S AU^{-1} day^{-1}). For a mechanically ventilated nursery facility, they measured internal H_2S concentrations between 700 and 3400 ppb, with emission rates ranging between 20 and 140 μg H_2S m^{-2} sec^{-1} (23–160 g H_2S AU^{-1} day^{-1}). For a mechanically ventilated finishing facility, they measured internal H_2S concentrations between 300 and 600 ppb, with emission rates consistent at ~10 μg H_2S m^{-2} sec^{-1} (5 g H_2S AU^{-1} day^{-1} or 36 mg H_2S m^{-2} hr^{-1}). For a naturally ventilated finishing facility with pit exhaust fans, they measured internal H_2S concentrations between 200 and 400 ppb, with emission rates ranging between 5 and 15 μg H_2S m^{-2} sec^{-1} (2 and 7 g H_2S AU^{-1} day^{-1} or between 18 and 54 mg H_2S m^{-2} hr^{-1}).

Summary

A large variation in both NH_3 and H_2S emission rates from various swine production buildings has been reported. Considering the literature cited, the range of H_2S emissions expected for finishing pigs is between 1.6 and 54 mg H_2S m^{-2} hr^{-1} from the exhaust ventilation air for swine finishing pigs. The range of NH_3 emissions expected is between 4.8 and 2376 mg NH_3 m^{-2} hr^{-1} from the ventilation air for swine finishing pigs, with the dominating average emission rates in the 300 to 500 mg NH_3 m^{-2} hr^{-1} range. The study by Hinz and Linke[8] also pointed out the changes in emission rates expected as finishing pigs mature, with a reported three-fold increase between 38- and 83-kg average body weight.

FACILITY DESCRIPTION

Two identical deep-pit swine finishing facilities in central Iowa were monitored for this research project; this arrangement represents one of six U.S. sites monitored for a larger six-state emissions study funded by the U.S. Department of Agriculture under the Initiative for Future Agriculture and Food Systems program.[12,13] Each facility monitored, as shown in Figure 1, was designed to house 1000 pigs ranging in weight between ~18 and 120 kg. Slurry was stored in a 2.4-m-deep holding concrete basin below a fully slatted concrete floor and was designed to store manure for one calendar year. Slurry removal and land application was conducted once per year in the fall (October).

Each barn was fan-ventilated for all seasons using a combination of methods. The cold-to-mild weather ventilation was handled with a series of pit (Fans 1, 2), side (Fan 3), and end wall (or tunnel) fans (Fans 4, 5; Figure 1) in combination with a series of 10 rectangular center-ceiling inlets to distribute fresh air within the building. Figure 1 shows the center-ceiling inlet placement and the approximate airflow patterns desired from these inlets. The warm-to-hot weather ventilation was handled with tunnel ventilation, where all fans except Fan 3 were used in combination with an adjustable curtain at the opposing end wall. During this tunnel mode of ventilation, the 10 center-ceiling inlets inside the barn were closed. The barn was controlled for temperature by operation of the end wall exhaust fans and the inlet distribution system controlled via static pressure. As barn temperature demanded airflow rate changes, the inlet distribution system would adjust accordingly to maintain a desired operating static pressure of 20 Pa.

The layout given in Figure 1 includes a mobile emission laboratory (MEL) that housed all instrumentation required to measure gas concentrations and pertinent environmental data and to monitor the barn ventilation rate. NH_3 (Model 17C chemiluminescence; TEI, Inc.), H_2S (Model 45C pulsed fluorescence; TEI, Inc.), and CO_2 (Model 3600 IR, MSA, Inc.) were measured at 12 locations: six from Barn 1 and six from Barn 2. A solenoid switching system enabled gas samples to be delivered to each analyzer simultaneously in 10-min switching increments. Therefore, each location was measured for 10 min every 120 min. The gas concentration measurement at the conclusion of each 10-min sampling interval was used to represent the concentration at that sampling location for

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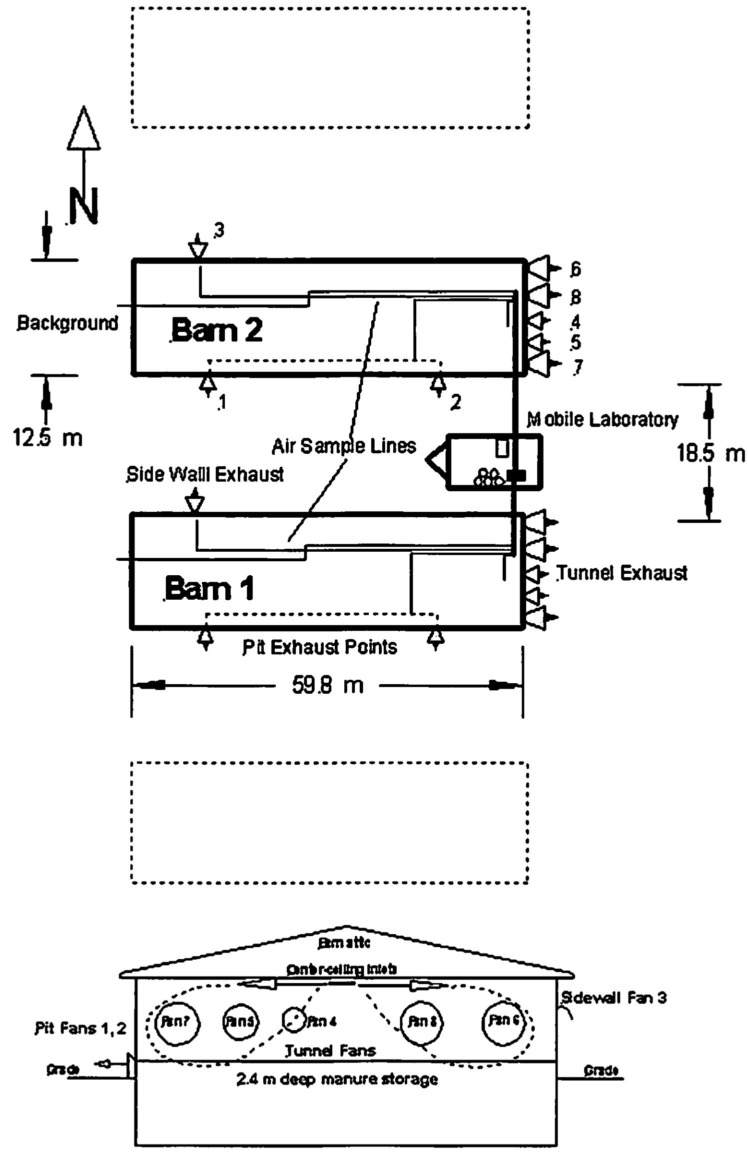

Figure 1. Layout of buildings monitored for this study. Entire site consists of four identical buildings. The monitored buildings shown represent the two center barns of the site. Two pit fans (1,2), one sidewall fan (3), and five end wall tunnel fans (4,5,6,7,8) were present, representing four possible emission zones.

the prior 120 min. This enabled a continuous concentration profile at each sampling location that was used along with continuous airflow data to generate a continuous emissions profile. The analyzers were calibrated before each pump-out event with U.S. Environmental Protection Agency (EPA)-protocol calibration gases. Environmental variables such as temperature, relative humidity, static pressure, and end wall curtain opening level were also measured. Ventilation rate was measured by recording the on/off status of all single-speed fans (Fans 5, 6, 7, 8; Figure 1) and the on/off status along with fan rpm levels for all variable speed fans (Fans 1, 2, 3, 4). Individual fan airflow rates were measured in situ using a FANS unit described in Casey et al.[14] The FANS unit was a device that fit on the intake side of all fans and integrated air velocity across the intake area of the fan with five calibrated anemometers. Airflow rates were measured for a range of expected operating static pressures and fan rpm levels from which a fan calibration equation was developed. By knowing fan status and/or fan rpm level and the current operating static pressure, fan airflow rate could be determined. Specific details related to the MEL setup and quality assurance/quality control procedures can be found in Heber et al.[13] and Jacobson et al.[15]

For emission calculations, the exhausted airflow rate along with the corresponding gas concentration at each emission point was measured. For the barns shown in Figure 1, three emission locations were monitored: the blended pit ventilation air from Fans 1 and 2, the emission at the sidewall Fan 3, and the emission from the combination of Fans 4 to 8 (tunnel end). Concentrations from the other three sampling points were also monitored, but these were not included in the emission calculations. Emission rates were calculated as

$$E = \Sigma(Q_oC_o - Q_iC_i) = \Sigma(Q'_oC'_o - Q'_iC'_i) \quad (1)$$

Table 1. Slurry removal scheduling.

Year	Barn	Date Started	Date Ended	Time Start	Time End
2002	1	October 16	October 16	11:45	18:00
	2	October 18	October 18	10:00	17:00
2003	1[a]	October 21	October 21	18:00	22:00
		October 22	October 22	09:30	14:00
	2	October 20	October 20	10:00	18:30

[a]Barn 1 in 2003 emptied in two separate events over a two-day period.

where C_i is mass concentration at the barn air inlet, mg m^{-3} or $\mu g\ m^{-3}$; E is barn emission rate, mg sec^{-1} or $\mu g\ sec^{-1}$; C_o is mass concentration at the barn air exhaust, mg m^{-3} or $\mu g\ m^{-3}$; C_i' is standardized mass concentration at the barn air inlet (based on standard conditions of temperature and pressure [STP]), mg $(sm)^{-3}$ or $\mu g\ (sm)^{-3}$; C_o' is standardized mass concentration at the barn exhaust (based on STP), mg $(sm)^{-3}$ or $\mu g\ (sm)^{-3}$; Q_o is barn outlet moist airflow rate at T_o, $m^3\ sec^{-1}$; Q_i is barn inlet moist airflow rate at T_i, $m^3\ sec^{-1}$; Q_i' is moist standard ventilation rate at the barn inlet (based on STP), $sm^3\ sec^{-1}$; and Q_o' is moist standard ventilation rate at barn exhaust (based on STP), $sm^3\ sec^{-1}$.

The background concentrations were measured also with one of the sampling locations from a total of six for each monitored barn. The background sampling location was measured within 0.5 m of the end of each barn as shown in Figure 1. The STPs used were 20 °C and 101,325 Pa.

Odor data were also collected for this research project on 2-week intervals. However, during slurry agitation and manure removal, frequent gas samples were collected before, during, and after slurry removal to assess odor concentration and odor emission rate. Odor samples were collected in 10-L Tedlar bags using a vacuum chamber (Model Vac-U-Camber; SKC, Inc.) with a vacuum pump (Model 224–44XR; SKC, Inc.) at a sample flow rate of 3 L min^{-1}. Odor samples were analyzed within 18 hr using a dynamic dilution forced-choice olfactometer (Model AC'SCENT; St. Croix Sensory, Inc.) at the Iowa State University Olfactometry Laboratory.

Table 1 outlines the scheduled slurry removal events for the years 2002 and 2003. The results given in this paper involve the emissions measured for the 24 hr surrounding these slurry removal events. The producer followed a strict protocol before starting each slurry removal event. Before the slurry was agitated, the producer would manually override the ventilation control system by establishing an airflow rate close to 30 fresh-air changes per hour, open all 10 center-ceiling inlet diffusers, and make sure that the end wall curtain used for tunnel ventilation was closed. After these adjustments were made, usually more than 1 hr before agitation, the barn was deemed ready for agitation and slurry removal. The ventilation system was then left alone in manual mode throughout the entire slurry removal event, and no one was allowed in the barn during the slurry removal event. Each slurry removal event for a barn took 6.25–8.5 hr as shown in Table 1.

Table 2. H_2S concentration (ppb) before, during, and after slurry removal.

Year	Barn	Before	Max During	After	Date	Location
2002	1	272	9990[a]	79	October 16, 2002	pit
		592	9833	197	October 16, 2002	sidewall
		473	9990[a]	186	October 16, 2002	tunnel
	2	1084	5455	31	October 18, 2002	pit
		1775	11,990	43	October 18, 2002	sidewall
		857	15,918	30	October 18, 2002	tunnel
2003	1[b]	397	850	467	October 21, 2003	pit
		467	22,245	69	October 22, 2003	pit
		336	3128	678	October 21, 2003	sidewall
		678	12,011	71	October 22, 2003	sidewall
		337	11,957	148	October 21, 2003	tunnel
		148	16,378	71	October 22, 2003	tunnel
	2	2067	35,825	93	October 20, 2003	pit
		460	7840	55	October 20, 2003	sidewall
		1360	8075	69	October 20, 2003	tunnel

[a]Exceeded maximum set range of analyzer, which was 10,000 ppb. Analyzer subsequently changed to a range of 50,000 ppb; [b]Barn slurry emptied over two days; after on October 21, 2003, the same as before on October 23, 2003.

RESULTS AND DISCUSSION

The results presented summarize the H_2S, NH_3, and odor emissions before, during, and after slurry was removed from Barns 1 and 2. The results are intended to characterize the emission changes that occur during and after slurry removal and the potential concentrations reached in the barn during slurry removal.

Table 2 shows the average H_2S concentration (ppb) before the slurry was agitated, the maximum H_2S concentration during slurry removal, and the average concentration after the slurry was removed from each barn for the 2 yr reported. Table 2 summarizes the concentrations associated with each of the three possible emission points (pit, sidewall, and tunnel fans). The averages recorded in Table 2 were for the 6 hr either before or after slurry was removed from the barn.

The overall maximum H_2S concentration reached 35,825 ppb for Barn 2, at the pit exhaust fan location during the 2003 removal event. On average, the H_2S concentration measured at the pit fan exhaust location reached a level that was 18 times higher during agitation as compared with the before-removal level. For the sidewall and tunnel fan exhaust locations, the average H_2S concentration was 27.7 times higher during slurry removal compared with the before-removal concentration.

The characteristics of an emission event experienced during slurry removal are shown in Figure 2. Figure 2a shows the barn temperature, outside temperature, and total barn airflow rate, and Figure 2b shows the total barn H_2S emission rate (mg H_2S $m^{-2}\ hr^{-1}$) and the associated total barn airflow rate ($m^3\ hr^{-1}$) for Barn 1 during the 2003 removal event. As shown in Table 1, this barn was emptied over a two-day period and the multiple elevated emission events are clearly evident. The ambient temperature ranged from a high/low of 23 and 8 °C for October 21, 2003, and a high/low of 24 and 3 °C for October 22, 2003, respectively. The producer routinely bypassed the barn's automatic control system during a slurry removal event to ensure an adequate ventilation rate for the barn

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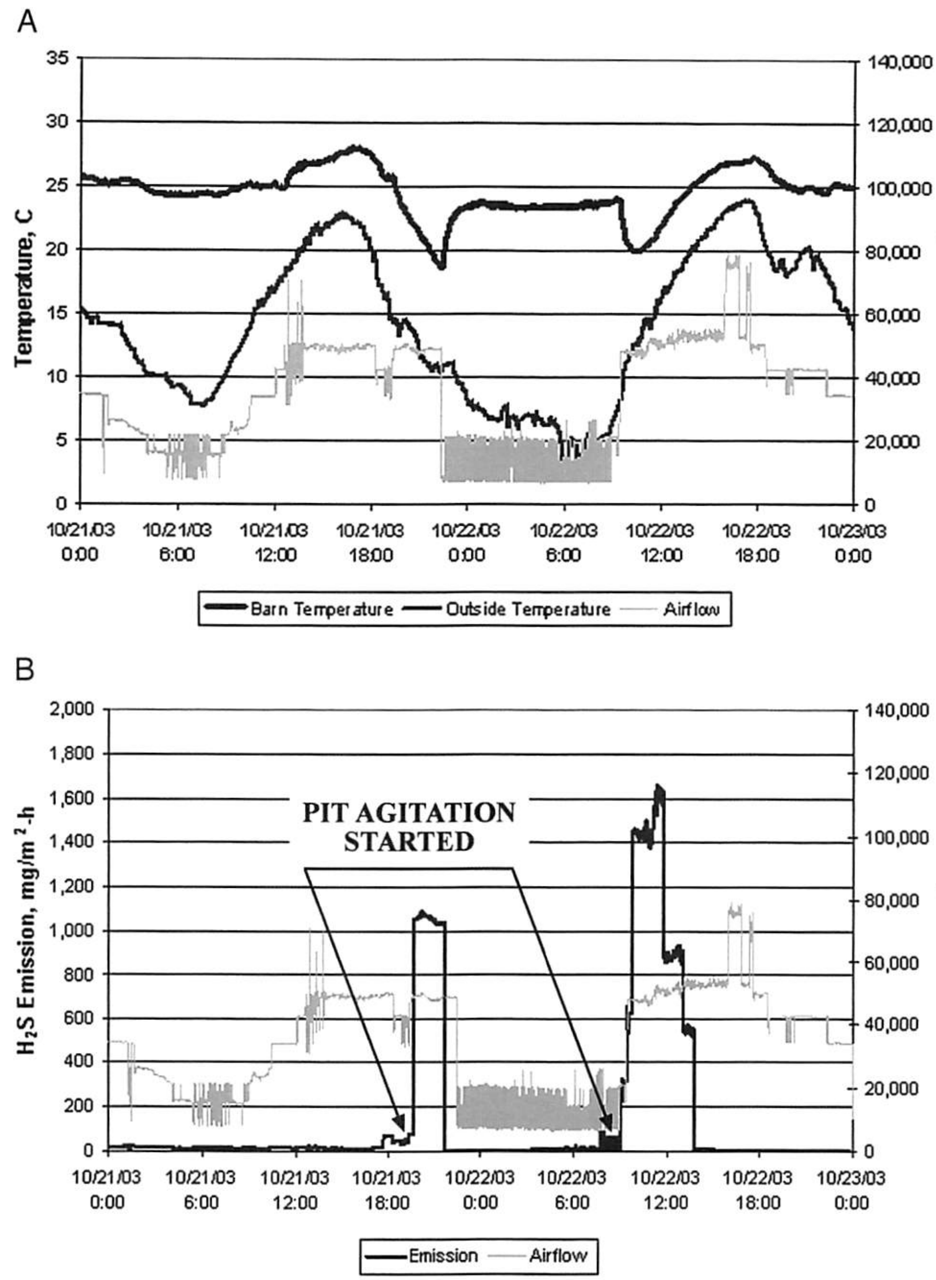

Figure 2. (a) Barn temperature, outside temperature, airflow rate, and (b) H_2S emission before, during, and after a slurry removal event (Barn 1, October 2003, removal event).

by manually turning on selected tunnel fans. The elevated ventilation rate initiated by the producer surrounding both slurry removal events is clearly evident in Figure 2. The elevated H_2S emission rate is clearly evident and dramatic. The emission shown was in direct correlation with slurry agitation, resulting in an elevated H_2S emission rate after the slurry was agitated and fell quickly once slurry agitation stopped. Observing the H_2S analyzer once agitation began showed a definite elevated concentration within minutes after the agitator was started. Figure 3 shows the characteristic H_2S emission for a slurry removal event that occurred over one continuous agitation and removal period. The manual override on the ventilation system resulted in a barn ventilation rate that increased from 13,200 m^3 hr^{-1} to an average of 56,000 m^3 hr^{-1}. The barn, running in automatic control, would have ventilated the space at ~13,200 m^3 hr^{-1} or 6.5 fresh-air changes per hr. With the producer's manual override of the ventilation system, the barn was allowed to ventilate at 56,000 m^3 hr^{-1} or 27.9 fresh-air changes per hr. This characteristic points out the need for the establishment of a ventilation protocol before considering the agitation of slurry, regardless of the depth of slurry in the holding pit. The producer's protocol resulted in no loss of pig life for any of the pit agitation procedures studied with this research project.

The H_2S and NH_3 emissions for the four slurry removal events are summarized in Table 3. The before and after averages were determined by the 24-hr period before the barn was agitated and the 24-hr period after the slurry

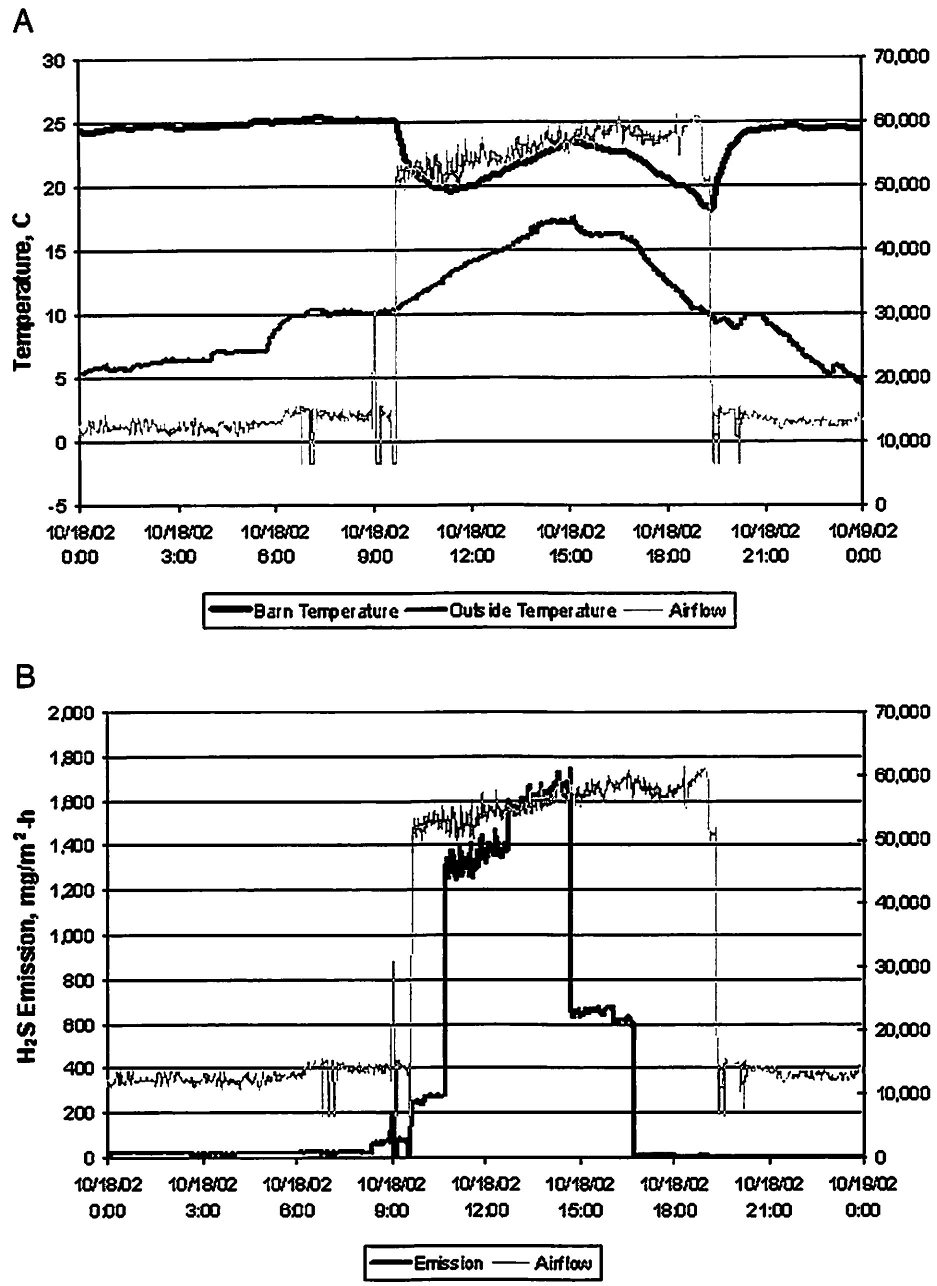

Figure 3. (a) Barn temperature, outside temperature, airflow rate, and (b) H_2S emission before, during, and after a slurry removal event (Barn 2, October 2002, removal event).

was removed from the barn. As shown in Table 3, a very large variation in H_2S emission rates existed before, during, and after slurry removal. The absolute maximum H_2S emission rate measured for the four events was 1,739 mg H_2S m^{-2} hr^{-1}. The average H_2S emission rate for the four slurry removal events was 1,528 ± 201 mg H_2S m^{-2} hr^{-1}. The average before and after H_2S emission rate for the four slurry removal events was 35.1 ± 26 mg H_2S m^{-2} hr^{-1} and 3.8 ± 1.9 mg H_2S m^{-2} hr^{-1}, respectively. If one considers the period of time from just before slurry agitation to the time just after all of the manure was removed from the barn, the cumulative H_2S emission measured for the case shown in Figure 2b was 5.5-kg H_2S and that shown in Figure 3b was 5.7-kg H_2S. The average NH_3 emission rate for the four slurry removal events was 1,836 ± 708 mg NH_3 m^{-2} hr^{-1}. The average before and after NH_3 emission rate for the four slurry removal events was 441 ± 251 mg NH_3 m^{-2} hr^{-1} and 639 ± 369 mg NH_3 m^{-2} hr^{-1}, respectively. Consistently, the after-removal NH_3 emission rate was higher than the before-removal level. A typical NH_3 emission event is shown in Figure 4 for the single continuous slurry removal event shown in Figure 3.

Odor data were collected for this research project at 2-week intervals. However, during the slurry removal event for Barn 2 in 2003, a more detailed odor evaluation procedure was conducted to capture the odor emitted during slurry agitation and manure removal. Odor data for Barn 1 during slurry removal were not collected. Table 4 and Figure 5 summarize the measured

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Table 3. Measured emission levels for H_2S and NH_3 in mg m^{-2} hr^{-1}.[a]

H_2S Emissions, mg H_2S m^{-2} hr^{-1}					Literature ranges (see text) mg m^{-2} hr^{-1} 1.6–54
Year	Barn	Before	Max During	After	
2002	1	13.5 (10.5)	1389.4	3.6 (6.4)	
	2	25.6 (15.1)	1739.1	1.3 (0.8)	
2003	1	28.3 (32.5)	1655.9	4.3 (2.1)	
	2	72.9 (35.5)	1326.2	6.0 (3.1)	
NH_3 Emissions, mg NH_3 m^{-2} hr^{-1}					Literature ranges (see text) mg m^{-2} hr^{-1} 4.8–2376
Year	Barn	Before	Max During	After	
2002	1	264.4 (105.0)	1173.5	324.7 (185.3)	
	2	219.3 (62.5)	1329.3	390.8 (189.5)	
2003	1	516.9 (145.3)	2225.0	708.8 (368.6)	Most commonly reported ranges (mg m^{-2} hr^{-1}) 300–500
	2	761.0 (384.6)	2614.7	1129.8 (468.7)	

Notes: [a]Both barns had a floor area of 747 m^2. Barn 1 had 58,900 kg of pigs, and Barn 2 had 52,500 kg for year 2002 during slurry removal. Barn 1 had 103,530 kg of pigs, and Barn 2 had 83,250 kg for year 2003 during slurry removal. Standard deviation shown in parenthesis.

results. The increase in odor concentration, mgasurgd in odor units (OU) defined as the fesh-air dilution-to-detection (OU m^{-3}) during slurry removal was 4.3 and 2.1 times higher for the pit and tunnel fan exhaust locations, respectively, compared with the before-removal levels. The after-removal odor concentration was 1.3 and 3 times lower than the before-removal levels. The maximum odor strength during slurry removal reached 9,625 OU m^{-3} and 8,228 OU m^{-3} for the pit and tunnel exhaust locations, respectively. During slurry agitation, the odor emission rate (OU m^{-2} sec^{-1}) had maximum levels of 22.2 and 130.6 OU m^{-2} sec^{-1} for the pit and tunnel exhaust fan locations, respectively. The odor concentration measurements indicated that the pit and tunnel exhaust points were relatively similar before, during, and after slurry removal. However, the odor emission was 5.3 times higher from the tunnel exhaust point than the pit exhaust point because of the higher airflow rate from the tunnel exhaust fans during slurry removal.

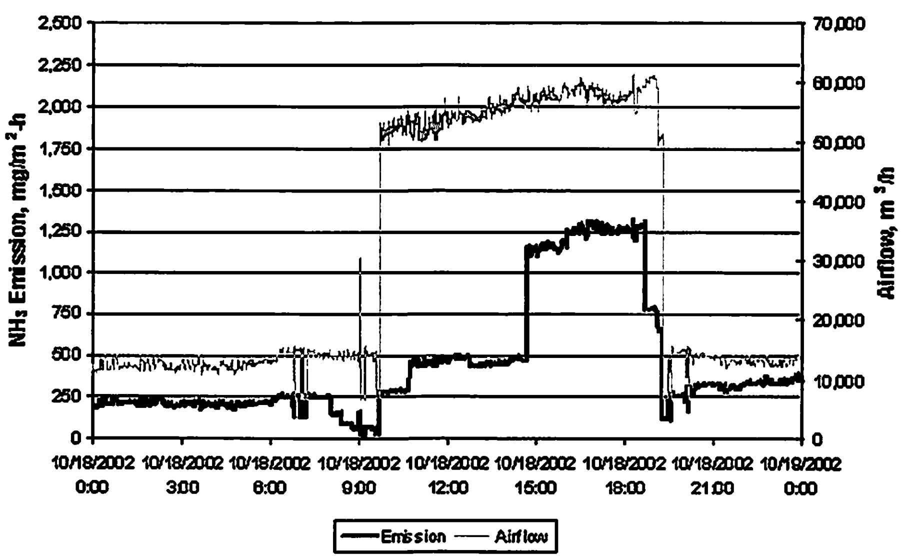

Figure 4. Barn airflow rate and NH_3 emission before, during, and after a slurry removal event (Barn 2, October 2002, removal event).

Table 4. Odor strength (OU m^{-3}) and odor emission rate (OU m^{-2} s) measured for the pit and tunnel exhaust locations before, during, and after slurry removal. Barn 2 for the 2003 slurry removal event shown.

	Odor Strength (OU m^{-3})			Odor Emission Rate (OU m^{-2} s)		
Location	**Before**	**During**	**After**	**Before**	**During**	**After**
Pit	1632 (590)	7022 (1215) [9625]	1258 (513)	3.8 (1.4)	16.2 (2.8) [22.2]	2.9 (1.2)
—	{1.7 m^3 sec^{-1}}	{1.7 m^3 sec^{-1}}	{1.7 m^3 sec^{-1}}			
Tunnel	2611 (468)	5430 (1237) [8228]	868 (622)	26.7 (7.3)	86.2 (19.6) [130.6]	2.5 (1.6)
—	{7.6 m^3 sec^{-1}}	{11.9 m^3 sec^{-1}}	{2.3 m^3 sec^{-1}}			

Notes: The average and standard deviation (in parentheses) shown along with the maximum (in brackets) during slurry removal. The average airflow rate (in {}) is also shown for the measurements before, during, and after slurry removal. These are shown below each odor strength measurement.

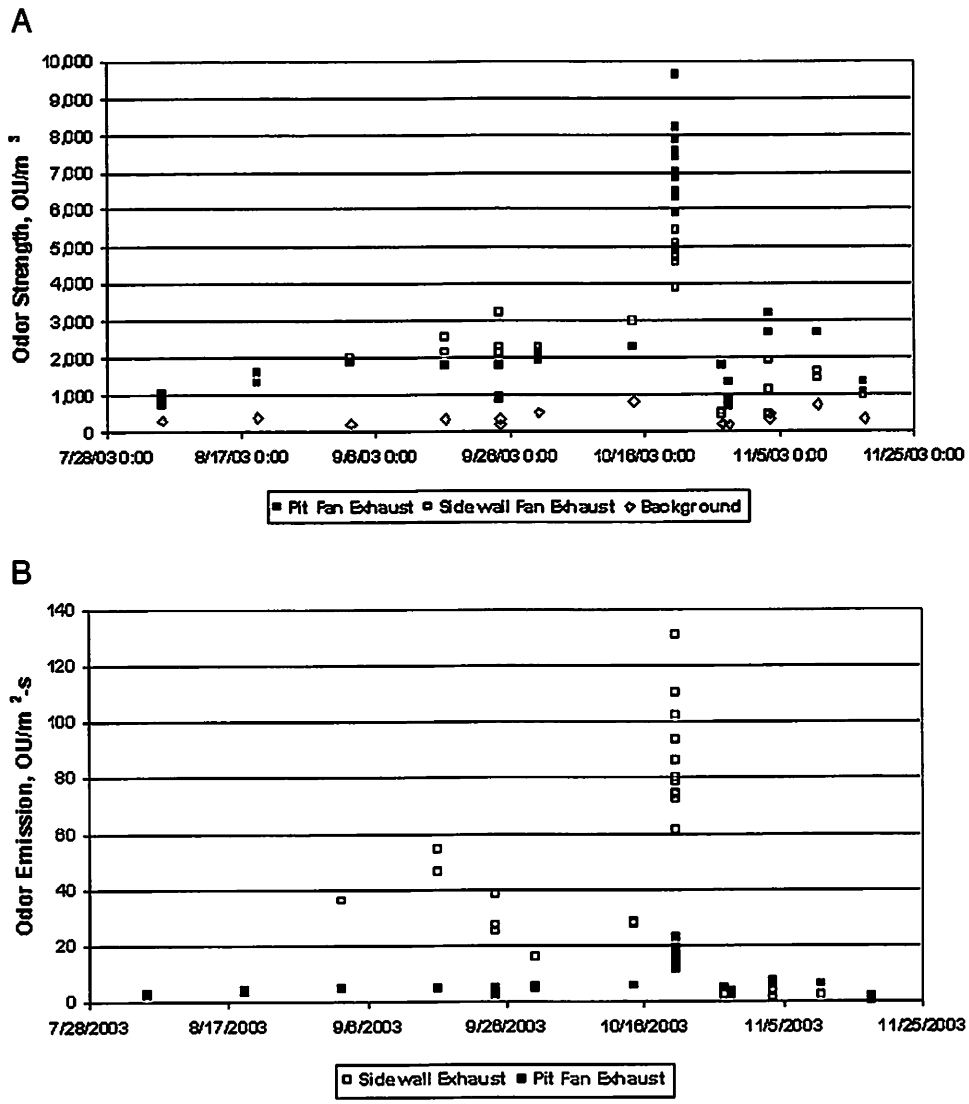

Figure 5. (a) Odor strength and (b) odor emission rate from Barn 2 during the 2003 slurry removal event. Before data measured on October 14, 2003, and after data measured on October 27, 2003.

CONCLUSIONS

The emission of H_2S, NH_3, and odor before, during, and after slurry removal events from two deep-pit swine finishing facilities indicated large increases in concentrations and emission rates during slurry removal, with odor and H_2S emissions lowering to levels well below the pre-removal rates. Although at times the pit exhaust concentrations can be much higher than from non-pit fans, the emission of H_2S, NH_3, and odor from the pit fans is substantially lower than the predominant tunnel fans because of the large differences in ventilation rate capacities when tunnel fans are active. A slurry removal event will result in an acute exposure event for the animals and workers. A protocol establishing a minimum ventilation rate should be established before agitation begins, and all workers should remain outside the facility during agitation. For this research project, the operator established a fixed and minimum ventilation rate of ~27 fresh-air changes per hour with the resulting inside H_2S concentration levels well below lethal levels.

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ATTACHMENT 2

The Explosion of CAFOs in Iowa and Its Impact on Water Quality and Public Health

James Merchant
David Osterberg

January 2018

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January 2018

EXECUTIVE SUMMARY

The Explosion of CAFOs in Iowa and Its Impact on Water Quality and Public Health

By James Merchant and David Osterberg

Iowa has more than four times as many large concentrated animal feeding operations (CAFOs) as it did in 2001, and over the last decade has added nearly 500 new or expanded state-permitted CAFOs annually — now an estimated 10,000 CAFOs of all sizes.

This remarkable expansion is fueled by Iowa's robust export market for slaughtered hogs, nearly $6 billion in 2016, up 7 percent in one year. Exports to Hong Kong/China broke the $1 billion mark for the first time in 2016. Exports are expected to further expand to meet China's insatiable appetite for pork, and with export demand come new pork processing plants and sustained CAFO growth.

Iowa's lax "Master Matrix" process for CAFO siting is broken — 97 percent of requested permits are approved — even in fragile karst topography, over objections of county supervisors in now 20 counties, and despite the protests of neighbors and citizen groups. All have been disenfranchised by the considerable clout of the livestock industry.

A tipping point has been reached. Rural Iowans have every reason to be concerned.

While water quality is a stated priority of Iowa lawmakers, livestock production is an important contributor to water degradation and goes unchecked. Manure leaks and spills are associated with fish kills, nitrate and ammonia pollution, antibiotics, hormones, bacterial contamination, algae blooms, water quality impairments, closed beaches and are a major contributor to the "dead zone" in the Gulf of Mexico.

Continued CAFO expansion will only worsen these documented environmental impacts and must be part of the solution to Iowa's widely recognized water quality problem.

The Explosion of CAFOs in Iowa

In 2001, there were 722 Iowa Department of Natural Resources (DNR) permitted (93 percent hog) large CAFOs. By federal definition, these are 1,000 animal units (AU); smaller animal feeding operations (AFOs) are classified as permitted medium sized (500 AU to 999 AU), or small (below 500 AU in Iowa, but generally below 300 in other states). In this report, all animal feeding operations will be referred to as CAFOs.

The number of large and medium CAFOs in Iowa is not exact. In 2013, EPA Region 7 compelled the DNR to determine the total number of CAFOs of all sizes. DNR reported to EPA in 2016, through the use of satellite imagery, that it had found over 5,000 "new" CAFOs of undetermined size. In its July 31, 2017, report to EPA, DNR reported that it had identified more medium or large CAFOs, only some of which have been added to its database.* The number of animal facilities in the DNR database exceeds 10,000. Accounting for all new CAFOs the total will certainly be more.

* 2017 Annual Report for Work Plan Agreement between the Iowa Department of Natural Resources and the Environmental Protection Agency, Region 7. Iowa DNR. Aug. 1, 2017 http://www.iowadnr.gov/Portals/id

* See also Iowa Concentrated Animal Feeding Operation Air Quality Study, Table 12: https://www.public-health.uiowa.edu/ehsrc/CAFOstudy.htm

Numerous studies in the last decade also have documented the impact of CAFO air emissions on the health of neighbors, finding significant increases in childhood asthma, adult asthma, airway obstruction, and irritant-linked eye and upper airway symptoms.

Other studies have documented negative impacts of CAFO air emissions on mood (more tension, depression, fatigue, confusion and less vigor), other psychosocial measures, and between odor and multiple quality-of-life measures. Several studies now find that property value near animal feeding operations, depending on distance, wind direction and other factors, is depressed 20 to 40 percent.

While one cannot ignore this now extensive scientific evidence, there is every indication that the industry intends business as usual. Not only happy with the Master Matrix, the industry is fortified by a new anti-nuisance suit law that prevents or severely limits real nuisance damages and seeks to eliminate from consideration evidence-based adverse health effects research.

To control and eventually diminish these negative impacts, and sustain long-term farm animal production in Iowa, we suggest six policies for rural Iowans, supervisors and legislators to consider:

- reform and revise the Master Matrix,
- pass a moratorium on new CAFOs,
- consider land covenants and other local legal strategies to limit local CAFO growth,
- challenge the constitutionality of anti-nuisance suit and ag-gag legislation,
- consider renewable energy from animal waste legislation, and
- fund communicable disease and sustainable agriculture programs.

The current industrial model is not sustainable given its high input costs, rising energy demands, fresh water needs, climate change, and adverse environmental and public health impacts. The very real pushback from rural residents and communities will, however, be sustained.

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INTRODUCTION

Iowa has more than four times as many large Concentrated Animal Feeding Operations (CAFOs) as it did in 2001. (See box.) For pork production, this industrial infrastructure has enabled the state to remain the nation's No. 1 producer, not just for the U.S. markets but to meet export demand as well. This has come at a price. There is conflict within the state on the value and cost of such an expansion and the nature of the industry. This report examines data and science to enhance understanding of the issue by Iowans and their policy makers, and presents policy options.

Iowa pork producers set an all-time record of 2.31 metric tons of pork in 2016, up 8 percent year-over-year and over 2 percent higher than the previous record in 2012.[1] Converting metric tons into the number of animals shows how hogs dwarf the human population of roughly 3 million in the state of Iowa. According to the USDA, 21,370,000 of the total of 65,435,000 market hogs nationally came from Iowa.[2]

China: A Booming Market for Iowa Pork

Export value of slaughtered hogs increased 7 percent from the previous year to $5.94 billion and exports accounted for nearly 26 percent of total 2016 pork production. Mexico remains the No. 1 export market for Iowa pork, but exports to Hong Kong/China set a new volume record in 2016 and broke the $1 billion mark for the first time ($1.07 billion), up 53 percent from the previous year.[3]

To understand the extraordinary demand for exported pork to China, which already produces and consumes over half of the world's pork, one need only consider the continued expansion of its population of 1.41 billion combined with the seemingly insatiable appetite of the Chinese people for pork. With an annual growth rate of about 0.45 percent, China's population will grow by over 6 million in the next year.[4] So important is pork to the Chinese diet that in 2007

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* 2017 Annual Report for Work Plan Agreement between the Iowa Department of Natural Resources and the Environmental Protection Agency, Region 7. Iowa DNR. Aug. 1, 2017 http://www.iowadnr.gov/Portals/id
* See also Iowa Concentrated Animal Feeding Operation Air Quality Study, Table 12: https://www.public-health.uiowa.edu/ehsrc/CAFOstudy.htm

China established a National Pork Reserve.[5] While China's Ministry of Agriculture seeks to further expand its national pork production through building U.S.-style very large CAFOs, it has increasingly turned to cheap, nutritious and safe imported pork to meet national demand. In 2011 a Chinese holding company, W.H. Group, bought Smithfield Farms, which remains the largest U.S. pork producer.

The marked growth in pork exports to China is fueling the rapid expansion of CAFOs in Iowa. Pork packing plants are expanding to meet this export demand, with two pork processing plants now open or breaking ground in Iowa. Seaboard Triumph Foods, a $264 million plant in Sioux City, and Prestage, a $240 million plant in Eagle Grove.[6] This news is welcome to the industry, which is concerned that production of hogs could run up against constraints in capacity to process them. This is a real concern since Iowa producers are in an expansionary mood.[7]

WHY RURAL IOWANS SHOULD BE CONCERNED

There has been conflict among neighbors and CAFOs regarding odor, siting policy, size, density, distance to neighboring property or communities, impacts on the rural environment, water quality, the public's health, quality-of-life, property values as well as rural development. The environmental and public health scientific literature underlying this conflict and concern is more substantial than when the industry was the subject of previously widely cited reviews.[8] [9]

An Open Access, industry-sponsored Systematic Review concluded that, apart from Q fever from goats, that MRSA colonization and CAFO proximity was "unclear" and that "there was "inconsistent evidence of a weak association" between respiratory disease and CAFO proximity.[10] A response from several investigators, whose studies had been excluded or misinterpreted, observed that O'Connor et al had "utilized a bias tool not designed for environmental health research, erroneously excluded important studies, and incorrectly interpreted others."[11] The following review seeks to include relevant peer reviewed studies, respects authors' interpretations, and concludes that there is a substantial and growing scientific literature linking adverse health outcomes with living near to animal feeding operations.

IMPACTS ON PUBLIC HEALTH

The Definition of Health

Health, as defined by the World Health Organization, is "a state of complete physical, mental and social well-being."[12] [13] The broad definition of health is widely recognized in the developed world and is increasingly being adopted by American employers as they seek to enhance the health, productivity and well-being of their employees; and by communities as they seek to make decisions about industrial and agricultural development. It is an appropriate definition to apply when considering CAFO emissions and associated adverse health effects among exposed neighbors and communities. When considering adverse effects of CAFOs on nearby neighbors, *health should be defined broadly* because the question of harm involves the nature of home. Any resident associates their family and home life as the center of their well-being, as well as the place there they most need to have — and are entitled to have — a sense of health and security.

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The WHO definition of health is consistent with evaluation and analysis of CAFO peer-review publications by interested scholars from a variety of disciplines including epidemiology, environmental health and behavioral health. While adverse health effect endpoints may not always rise to that of a diagnosable disease or injury, such endpoints are measurable, reproducible and valid for assessing community risk.

Considerations of the Population at Risk

For many reasons, Agency for Toxic Substances and Disease Registry health-based guidelines, U.S. Environmental Protection Agency (EPA) standards, and state-based community health regulations must be stricter for the general public than for those exposed occupationally.[14] Such protection is because CAFO neighbors and nearby communities are composed of susceptible subgroups including children, the elderly, those with pre-existing conditions — such as asthma, chronic obstructive lung disease (COPD), and those with allergies and with compromised immunity. While workers are exposed for only a few hours each day, community residents are exposed continuously. While workers have a choice as to where they work, CAFO neighbors and nearby communities have little or no choice under existing Iowa law and regulations. Therefore, community exposure emissions arising from CAFOs — hydrogen sulfide, ammonia, other airway irritants, volatile organic compounds and inflammatory and infectious bioaerosols — would be expected to have adverse health effects at lower concentrations, and therefore need greater margins of safety, in community settings.

State and local governmental bodies should err on the side of caution when considering permitting strategies. The immediate population at risk is informed by consideration of the demographics, location of susceptible subpopulations such as schools, nursing homes, parks and recreational areas, community residential growth trends, water bodies, and local industry that may emit pollutants that add risk. In addition to these local considerations, the location and size of other CAFOs is important as it is known that, in addition to size and proximity, CAFO density is an important risk factor for airway disease.[15] Some of these factors are included in the currently used DNR Master Matrix, which will be described below.

Asthma and Airway Obstruction

Acute physical responses to airborne CAFO emissions, such as watery eyes, runny nose, coughing and nausea, occur temporarily and typically abate after exposure to gases and odors. Such adverse health effects involve biological (short-term physiological responses to emissions from CAFOs. EPA Human Research Studies for air pollutants noted a distinction between "biological responses" and "clinical responses."[16] While this distinction is important for experimental human exposure studies, biologically this is a continuum of response to environmental agents, ranging from very early physiological responses, such as runny nose, to chronic airway inflammation — manifest by coughing, wheezing, chest tightness, shortness of breath and measurable airway obstruction — which may be diagnosed and classified as asthma, chronic bronchitis and/or chronic obstructive lung disease.

Toxic air emissions from CAFOs often adversely affect immediate neighbors and may adversely affect nearby communities. Those with allergies, asthmatics — especially children in which asthma is more common — and adults with COPD, are at particular risk.

Early studies of typically small deep-pit CAFOs established that farmers working in these independent farm operations were at substantial risk to increased rates of chronic bronchitis, asthma and acute and chronic airway obstruction.[17] [18] The risk of ARDS (acute respiratory disease syndrome) and death from high levels of hydrogen sulfide from manure agitation was similarly documented.[19] These occupational respiratory disease risks persist, but are not the focus of this report.

Toxic air emissions from CAFOs often adversely affect immediate neighbors and may adversely affect nearby communities. As already noted, those with allergies, asthmatics — especially children in whom asthma is more common — and adults with COPD, are at particular risk. Research among neighbors living proximate to CAFOs in Iowa, North Carolina and Germany have established that rates of acute respiratory symptoms, asthma and airway obstruction are increased, especially with proximity to and density of swine CAFOs.

Childhood Asthma

Children are particularly vulnerable — given their growing lungs and the known relatively high rate of asthma — to environmental exposures. Research from the Keokuk County Rural Health Study (KCRHS), a three-round prospective study of over 1,000 Iowa families, provided a particularly rich dataset to examine childhood asthma risk among rural children living on, or close to, farms with CAFOs.[20] Nearly all of these operations were under 500 AU deep-pit CAFOs. The study was able to control for multiple demographic, medical, health care and environmental risk factors in its analysis of 644 Round 1 children (1994-1999). Four "asthma outcomes," doctor-diagnosed asthma, doctor-diagnosed asthma/medication for wheeze, current wheeze, and cough with exercise were measured. Doctor-diagnosed asthma (which is known to be underdiagnosed) prevalence was 12 percent, while a more accurate estimate of asthma prevalence, doctor-diagnosed asthma/medication for wheeze, was 16.7 percent. The prevalence of any asthma outcome among children living on a farm raising swine was significantly elevated at 42.9 percent (compared to 26.6 percent among non-swine farm children) and was 55.8 percent among children living on swine farms that added antibiotics to feed. Multivariable models found three (doctor diagnosed asthma/medication for wheeze, current wheeze and cough with exercise) of the four asthma outcomes were significantly related to farms raising swine that added antibiotics to feed. The high prevalence of asthma among these children was striking, but was likely due in part by children who did farm chores in the CAFOs and thus had some occupational level exposures.

Sigurdarson and Klein studied two rural Iowa elementary schools, one school within a half-mile of a large CAFO housing some 3,800 hogs, while the control school was located more than 10 miles from any CAFO.[21] The prevalence of doctor-diagnosed asthma was 19.7 percent among children in the CAFO-proximate school, while the control school prevalence was a significantly less, 7.3 percent. The adjusted odds ratio for doctor-diagnosed asthma was a highly significant 5.71. Possible confounding risk factors were considered but were not significant in multivariable models.

In 2006, Mirabelli and colleagues published two papers on childhood asthma among North Carolina school children.[22] Based on a sample of public schools, they estimated potential exposure using both record-based and survey-based exposure indices. Of the sample of 226 schools, the nearest swine CAFO ranged from 0.2 to 42 miles. Sixty-six schools were located within 3 miles of any CAFO. Livestock odor was reported outdoors in 47 (21 percent) of the surveyed schools. In 19 schools (8 percent), the odor was noticeable indoors, including in classrooms and hallways. The percentage of schools reporting livestock odor and the ratings of the strength of the odor each decreased with increasing distance to the nearest swine CAFO. An accompanying paper assessed estimated exposure to airborne CAFO effluent and asthma symptoms among adolescents, ages 12-14 years.[23] During the 1999-2000 school year, 58,169 adolescents answered questions about their respiratory symptoms, allergies, medications, socioeconomic status and household environments. Estimates of school-based exposure were calculated from available data from the 265 schools and 2,343 swine operations. The prevalence of wheezing, adjusting for confounders, was slightly higher at schools exposed to airborne effluent from CAFOs. Among students who had reported allergies, the prevalence of wheezing was significantly increased by 5 percent among children in schools within three miles of a CAFO, and 24 percent higher at schools in which livestock odor was noticeable twice per month compared to those with no reported odor. Students with allergies who lived within three miles of a CAFO also reported higher rates of doctor-diagnosed asthma, doctor/emergency room visits, asthma medication, activity-limitation and missed school. The authors concluded that airborne pollution from CAFOs was associated with adolescent wheezing symptoms.

Data from Round 2 (2000-2004) of the KCRHS allowed analysis of the risk to childhood asthma among children (n=565) living in proximity (within 3 miles) to mainly small deep-pit CAFOs.[24] The prevalence of doctor diagnosed asthma (11 percent) did not differ significantly from Round 1, but doctor-diagnosed asthma/mediation for wheeze in Round 2 was increased to 22.7 percent. A metric, based on CAFO footprint, distance to CAFOs, and low wind-speed, was developed to assess relative environmental exposure to CAFO emissions. Children with higher relative exposures to CAFOs had significantly increased odds for both asthma outcomes, while those with doctor-diagnosed asthma/medication for wheeze were found to have a dose-related increase with increasing CAFO exposure metrics.

The Pavilonis study is important as it demonstrated that proximity to even small swine CAFOs was dose-related to childhood asthma risk. Further, this study confirmed Marabelli study findings, again finding that increased risk to childhood asthma symptoms may extend as far as three miles from swine CAFOs.

Airway Disease among Adults

Early cross-sectional surveys of neighbors living proximate to hog CAFOs reported elevated respiratory symptoms, including runny nose, cough and wheeze.[25] [26] These findings were not surprising as they were similar to repeatedly documented increased rates of respiratory symptoms among swine farm exposed workers.

Well-controlled epidemiological studies include a large community-based study of adults (n=6,917) living in four rural German towns with high-density swine CAFOs, and who were surveyed by questionnaire.[27] Exposure was measured by collecting data on a four-point scale of odor annoyance together with geo-coded data on number of CAFOs within 500 meters (1,641 feet) from homes. Analyses were restricted to those not working in farming. The prevalence of wheezing without a cold, doctor-diagnosed asthma and allergic rhinitis were significantly increased with higher levels odor annoyance (none, somewhat, moderately, strongly). Increased CAFO density (dose), as measured by the number of animal houses within 500 meters, was associated with significant increases in wheezing without a cold (27.1 percent with 12 CAFOs) and physician diagnosed asthma (10.4 percent with 12 houses). Importantly, subjects living within 500 meters of 12 CAFOs also had significantly lower levels of forced expiratory volume in one second (FEV1) (-7.4 percent), as compared with age and height adjusted predicted levels. The authors concluded these findings were likely due an "asthma-like syndrome" arising from CAFO emissions.

Wing et al studied 101 nonsmoking volunteers living within 1.5 miles of swine CAFOs in 16 rural neighborhoods of eastern North Carolina.[28] Based on twice-daily odor diaries over a two-week period, objective measures of swine odor were made — hydrogen sulfide, particulate (PM10, PM2.5), and endotoxin. Swine odor was reported in more than half of the 1,655 episode reports. Odor was found to increase in a dose-response fashion with H2S, PM10, temperature and wind speed. The study demonstrated that self-reported measures of odor were objectively related to measures of pollutants well-known to be contained in CAFO emissions. Further analyses of this study population found these repeated measures (hundreds) were related to acute eye irritation (odor, H2S, and PM10).[29] Also, respiratory symptoms in the previous 12 hours were associated with odor and H2S, and difficulty breathing was increased with unit-dose of odor. An increase in wheezing and decrease in FEV1 was associated with increased concentration of PM2.5. Increased sore throat, chest tightness and nausea were dose-related to increases in level of endotoxin. The authors concluded, and an independent invited commentary concurred, that measured emissions within 1.5 miles of swine CAFOs were related to acute physical symptoms and changes in lung function, and that the findings were protected from unmeasured confounding by an innovative study design.[30]

These several studies of adult airway disease (up to 1.5 miles to a swine CAFO) establish that airway symptoms and changes in lung function, indicative of upper airway irritation and asthma, are related in a dose-response fashion to objective measures of environmental exposures from swine CAFOs.

Antibiotic Resistance

Antibiotic resistance is widely acknowledged to be public health crisis, perhaps the most serious of all global health threats.[31] Antibiotic use in both human medicine and animal agriculture are well recognized as drivers of antibiotic resistance, and there is broad agreement (World Health Organization, United Nations, European Medicines Agency, and the Centers for Disease Control) that there is a need to optimize use of antibiotics in people and animals.[32] The CDC estimates that at least 23,000 Americans die each year from antibiotic-infections, but the real number of deaths is acknowledged to be much higher.[33] A major report released in 2016 estimated that globally at least 700,000 people die due to infections that are resistant to currently available antibiotics, and that by 2050 drug-resistant infections will take an estimated 10 million lives each year.[34]

Two recent reviews have addressed this public health challenge using a One Health approach: The Expert Committee on Addressing the Contribution of Livestock to the Antibiotic Resistance Crisis Combating Antibiotic Resistance,[35] and Combating Antimicrobial Resistance: A One Health Approach to a Global Threat: Proceedings of a National Academy of Medicine Workshop.[36]

As was recognized by the Pew Commission on Industrial Farm Animal Production, the use of antibiotics in animal agriculture is a threat to public health,[37] and more recently stated unequivocally by the CDC, "antibiotic use in animal agriculture can harm public health."[38] Poultry and livestock production account for 70 percent of medically important antibiotics (the same class of antibiotics used in human medicine) sold in the U.S. Compared with the rest of the world, the U.S. is among the most intense users of antibiotics in animal agriculture.[39] But, while the U.S. Food and Drug Administration (FDA) Action Plan for Combating Antibiotic-Resistant Bacteria (CARB) has proposed concrete and measurable goals to curb misuse of antibiotics in human medicine, no such goals have been set for curbing misuse of antibiotics in food animal production.[40]

As the Expert Commission and the National Academy of Medicine Workshop agreed, human, animal and environmental ecosystems are interconnected and a One Health approach is therefore needed. Antibiotic resistance is "a numbers game" — the greater the quantity of antibiotic the more resistance and spread; the greater the number of humans and animals given antibiotics, the greater the likelihood that resistance will emerge and spread; and the longer the duration of antibiotic use, the longer period of time over which antibiotic resistance can emerge and spread.[41]

As summarized by the Expert Commission, as early as 1977, the FDA determined that use of certain antibiotics (penicillin and tetracycline) for growth promotion, feed efficiency and disease prevention posed a threat to human health.[42] While the FDA proposed withdrawing approvals for use of these drugs in animal production, it did not proceed; the FDA then provided no meaningful guidance for over 30 years. Prodded by the Pew Commission on Industrial Farm Animal Production (and the subsequent Pew Antibiotic Resistance Project) recommendations — restrict use of antimicrobial in food animal production, phase out and ban use of antimicrobials for nontherapeutic use, clarify antimicrobial definitions, improve monitoring and reporting of antimicrobial use, improve monitoring and surveillance of antimicrobial resistance, increase veterinary oversight in use of antimicrobials for therapeutic and prevention use, implement a national disease monitoring database with 48 hour trace-back.[43] The FDA issued Guidance for Industry #213, which urged drug makers to voluntarily remove growth promotion claims from their medically important antibiotic products.[44] The FDA, however, estimated that only 10-15 percent of antibiotics used in animal agriculture were used only for growth promotion. And, the FDA still approved the use of these drugs at similar levels and durations for disease prevention. The FDA did put antibiotics for use in prevention under the oversight of a veterinarian, but it did not put in place directives to monitor and track antibiotics used in animal production, as has been successfully implemented in Denmark and the Netherlands.

Drawing on successful programs in Denmark and the Netherlands, the Expert Commission made 11 recommendations that refine and extend those made by the Pew Commission. Lessons learned from Danish and Dutch intervention programs, as described in appendices to the Expert Commission report, include:

- The Dutch government and livestock industry have been able to reduce sales and use of antibiotics by more than 60 percent.
- Combined with target setting, Denmark and the Netherlands have phased out antibiotic growth promoters and their use in the absence of disease, resulting in reductions in use of 45-60 percent.
- The Royal Netherlands Veterinary Association has developed a system for classifying and prioritized veterinary antibiotics into three tiers of use in order to reduce antibiotic resistance.
- Stricter veterinary oversight has been implemented in both Denmark and the Netherlands to assure that restrictions on use of antibiotics in growth promotion and disease prevention are followed. Safeguards also include restrictions on veterinarian profits from antibiotic sales and accountability measures, such as use of benchmarks and "yellow card" notifications for misuse.

Antibiotic Resistant Colonization and Disease in Industrial Farm Animal Production

Concern over a new methicillin-resistant *Staphylococcus aureus* (MRSA) was first raised in Europe in 2005 from molecular typing, ST-398, and related strains clonal complex 398 (CC 398) that arose from swine with transmission to humans. Zoonotic MRSA became responsible for more than 20 percent of all MRSA cases in the Netherlands by 2007.[45] Screening of Dutch pigs found that nearly 40 percent of the pigs were colonized with a comparable strain of MRSA (MLST 398) and some 80 percent of pig farms were affected.[46] Since its discovery, MRSA CC398 has been recognized as a common cause of human colonization and disease in Europe — up to 40 percent of new cases of MRSA in Denmark, the Netherlands and parts of Germany, all countries with intensive livestock production.[47]

Whole-genome phylogenetic analyses now show multiple *Staphylococcus auerus* CC398 lineages in circulation in Europe, one of which is found primarily in livestock, CC398-IIa.[48] A study of MRSA CC398-IIa isolates in Denmark between 1999 and 2011 reported an annual increase of 66 percent from 2004-2011.[49] There was clear evidence that those with these MRSA infections had temporal and spatial relationships to both those with and those without livestock exposure. The authors concluded that there had been substantial dissemination of MRSA CC398-IIa from livestock or livestock workers into the Danish population. The isolates demonstrated high levels of resistance to several medically important classes of antibiotics — tetracycline, clindamycin, erythromycin, and norfloxacin, which represent some of the most commonly used antibiotics in Danish swine production.

While much less common in North American than in Europe, MRSA CC398 human infections have been reported in the United States.[50] Some of these infections were reported before recognition of distinct linages for CC398, so weather of human or livestock origin is not clear. However, a recent report confirms repeat infections with CC398-IIa in an Iowa farmer, suggesting these are likely under-diagnosed and reported.[51]

A survey of MRSA ST398 (as well as ST9 and ST5, also common genotypes in U.S. pigs) in 38 swine herds in 11 states in major swine-producing regions found only the positive control farm to have any of these common linages.[52] These findings suggest a relatively low herd prevalence of MRSA in the swine industry, and are supported by a multicenter surveillance study (2011-2013) that collected 2226 *Staphylococcus aureus* isolates around the state of Iowa.[53] Nearly 74 percent were methicillin resistant (MRSA) and 26 percent methicillin susceptible (MSSA). Twenty-five isolates were of the common livestock ST398 and ST9-associated strains. Forty percent of these livestock-associated strains were multi-drug resistant MRSA, compared with 5 percent of the MSSA isolates.

While uncommon in the U.S., two studies suggest that non-livestock strains may spread within areas proximate to swine farms. Independent studies in Iowa and Pennsylvania found an increased risk of MRSA colonization or infection in those living close to farms or in areas where manure had been spread of fields.[54] [55] However, neither study found that increased MRSA were livestock associated strains raising questions about the origin, evolution and genetics of MRSA in the agricultural setting and the spread of the methicillin-resistance gene, *mecA*, from livestock-associated strains to other "human" strains of *Staphyococcus aureus.*[56]

While, based on the European experience, the potential for important transmission and disease to arise from livestock is clear, at present no generalization can be made about MRSA isolate origin or disease risk in the U.S. Nevertheless, the current widespread use of antibiotics that may result in the emergence of a novel pathogen from livestock production is of concern and cause for adoption of the multiple intervention steps recommended by the Expert Commission on Addressing the Contribution of Livestock to the Antibiotic Resistance Crisis.[57]

Influenza

In 2007, a controlled, cross-sectional study of 111 Keokuk County farmers, 97 meatpacking workers, 65 veterinarians and 79 control subjects, demonstrated markedly elevated serology levels for swine influenza virus strains.[58] The odds ratios, indicating exposure to swine influenza, was strongest among farmers (35.3), followed by veterinarians (17.8) and then meat processing workers (2.7). This Iowa study documented that pigs have an important role in interspecies transmission of influenza strains, and that occupational exposure to pigs greatly increases workers' risk of swine influenza. The ease with which these porcine viruses infect man have implications for global influenza transmission and pandemic influenza.

It has long been known that pandemic influenza strains originate in nonhuman species. China has been implicated as the site of origin of the 1957 and 1968 influenza pandemics,[59] and is thought to be the epicenter of future novel influenza virus emergence.[60] With its increasingly dense populations of pigs, poultry and people, coupled with often weak farm and animal market biosecurity, it is not surprising that novel influenza A viruses (IVAs), resulting in increased morbidity and mortality among both livestock and humans, have emerged in China.[61] China is also recognized as the site of the emergent novel pig-only pathogen, porcine reproductive and respiratory syndrome virus in 2006,[62] and porcine epidemic diarrheal (PED) virus in 2014,[63] resulting in hundreds of millions of dollars of agricultural losses in China and the United States. Iowans are very familiar with such costs from the 2015 avian influenza (H5N2) epizootic that resulted in the deaths of 30 million chickens and 1.5 million turkeys. The estimated cost of this epizootic was $1.2 billion, 8,400 lost jobs, $427 million in lost wages and $145 million in lost taxes.[64]

Pigs have an important role in interspecies transmission of influenza strains, and occupational exposure to pigs greatly increases workers' risk of swine influenza. The ease with which these porcine viruses infect man have implications for global influenza transmission and pandemic influenza.

Most recently, these swine "variant" influenza A viruses have been increasingly infecting swine workers, likely family members and those attending agricultural fairs.[65] A recently reported intensive study of swine and swine workers in China documented strong evidence of virus mixing, likely reassorting, and cross-species infections.[66] This study also documented a notable lack of worker protection (personal protective equipment), biosecurity (restricted access and seasonal worker influenza vaccination), and public health pandemic preparedness. The 2018 centennial anniversary of the great influenza pandemic provides an opportunity — indeed an imperative need — to adopt best practice prevention and epizootic preparedness in the poultry and livestock industries.

Studies in North Carolina of the 2009-2010 and 2010-2011 influenza seasons, during which the pandemic 2009 H1N1 influenza virus circulated, documented that in counties with higher numbers of permitted swine operations, influenza-like illnesses peaked earlier than in other counties.[67] The authors concluded that swine CAFOs amplified transmission of influenza and called for influenza vaccination targeting swine workers and enhanced virologic-surveillance in counties where swine CAFOs are located.

These research findings have important implications for both animal and human influenza surveillance and preparedness. Linked One Health virologic-surveillance for novel influenza viruses and influenza vaccination of poultry and swine workers and their families are high preparedness priorities. Also, poultry and livestock industries need to be fully integrated into community, state and national pandemic preparedness efforts. Lawmakers must be made to understand, not only the potential for loss of human and animal life from pandemic and epizootic diseases, but also the potentially catastrophic economic costs to animal agriculture and all who depend on animal agriculture. The risk of devastating epizootic diseases in swine and poultry production, and recommendations for inclusion of prevention measures in the 2018 Farm Bill, were recently addressed in a *Des Moines Register* op-ed by Dr. Patrick Halbur, Professor and interim dean of the Iowa State University College of Veterinary Medicine. [68]

Physiological and Psychological Health Effects

Studies of odor have long been known to affect mood, cognition, physiological responses including heart rate and electroencephalographic (EEG) patterns.[69] Exposure to environmental malodor has been linked to worry, annoyance and physical symptoms.[70] [71] Controlled studies of these health outcomes are remarkably consistent in their findings and conclusions.

Thu and colleagues[72] conducted an Iowa controlled study of neighbors (n=18 living within two miles of a 4,000 sow-swine CAFO, and a comparable control group of neighbors with minimal livestock production. Neighbors living near a CAFO experienced higher levels of several symptoms consistent with exposure to ambient irritants and similar to those found in the occupational setting: burning eyes, runny nose, plugged ears, increased cough and phlegm, shortness of breath, wheezing, chest tightness. But, also described were symptoms more commonly arising from exposure to malodor: headache, nausea, dizziness, weakness and fainting. Questions designed to indicate depression and anxiety revealed no differences between CAFO exposed and control groups. Wing and Wolf [73] surveyed 55 residents living in three eastern North Carolina communities: 23 neighbors living within 2 miles of a 6,000-head swine CAFO, 13 living within two miles of an intensive cattle operation, and 19 living in a rural area without any livestock operation. Residents in the vicinity of the hog CAFO reported increased rates of headaches, runny nose, sore throat, excess coughing, diarrhea and burning of the eyes compared to the control community residents. These two controlled studies from the two most intensive pork producing states closely agree regarding symptom patterns experienced by neighbors living in proximity to swine CAFOs.

In 1995, Schiffman and colleagues reported results of a study of 22 subjects living close to a swine operation and 22 gender, race, age, and years of education matched control subjects without nearby CAFO exposure. All subjects were residents of North Carolina. All subjects completed a Profile of Mood States (POMS) questionnaire, which is known to be sensitive to transient mood shifts. The 65 questions on the POMs allow assessment of six domains: tension/anxiety, depression/dejection, anger/hostility, vigor/activity, fatigue/inertia, and confusion/bewilderment on a scale of 0 (not at all) to 4 (extremely). Results indicated subjects living near a swine CAFO and who experienced odor reported more tension, more depression, more anger, less vigor, more fatigue, and more confusion than control subjects. Those exposed to swine odor also had more total mood disturbance, than did control subjects, based on total POMS ratings. The authors cite numerous studies of odor arising from intensive livestock operations and the impact of environmental odor on population well-being and physiological and psychological health.[74]

Dose-response relationships arising from chronic exposure to animal waste/farming odors in six non-urban Danish regions were developed and reported by Blanes-Vidal et al.[75] Selection of the 12 km by 12 km regions assured a gradient in odor. A total of 1,120 households within the six regions were randomly selected and a standard questionnaire on indoor climate was mailed to each household. The mailing was timed to coincide with the period when application of animal waste to fields was banned per Danish policy. A five-point odor annoyance scale (not annoyed, slightly annoyed, moderately annoyed, very annoyed, and extremely annoyed) measured perceived odor annoyance. While animal waste odor is well known to consist of a complex mixture of irritant gases, volatile organic compounds, and bioaerosols, in this study ammonia (NH_3) concentration was chosen as the proxy for airborne exposures. An objective NH_3 exposure estimate was made via emission/dispersion modeling combining information from two validated methods. An estimated prevalence of odor annoyance (18 percent annoyed 10 percent of the time) exceeded the WHO threshold level (5 percent of the population affected 2 percent of the time).[76] Measures of psychosocial responses were made after controlling for individual covariates. About 45 percent of the respondents reported any annoyance from residential odor. Exposure estimates of NH3 were significantly associated with annoyance, health risk perception and behavioral interference (for each unit increase in NH3 exposure). Annoyance was found to be a strong mediator of exposure-behavioral interference (altering plans to avoid exposure) and exposure-health risk perception. This is the first study to provide quantitative estimation of dose-response associations between ambient NH3 exposures and psychosocial effects arising from odor pollution in a non-urban outdoor environment.

Quality of Life — Well Being

The impact of CAFO exposure on quality-of-life, or well-being, have been described in two reviews by Flora and colleagues, an Iowa Animal Feeding Operations Air Quality Study[77] and an Iowa Policy Project Report.[78] The 2007 Flora study systematically analyzed the impact of swine CAFOs on Iowa communities by examining natural, financial, human and social capital in Iowa's 99 counties. Using multivariate analysis over the decade of the 1990s, when Iowa swine CAFOs grew rapidly, Flora evaluated the various types of community capital change compared to change in CAFO growth. They noted that sociologists generally regard three elements to be essential for community sustainability: social equality and well-being, economic viability, and environmental soundness. Study results found that counties that expanded the number of swine CAFOs also experienced significant regional private-sector employment growth (but not in the county in which swine production increased); also, there was no positive contribution to population retention, in-migration, employment of residents, or school enrollments. The quality-of-life related measure of non-school aged adults found this increase to be true only for adults without a high-school education. In regard to social capital, CAFO growth was not related to changes in civic engagement, but did relate modestly to reduction in crime, to increases in home ownership and the number of religious adherents — unlike other studies that have found that CAFOs depress social capital. Indicators of environmental soundness found that manure from swine CAFOs was strongly and positively related to three of the four contamination measures — manure spills, fish kills, and impaired waterways (lakes, streams and rivers). The authors conclude that these findings raise serious questions as to whether the growth of swine CAFOs has generated sustainable development. They comment further that in certain regions of Iowa, CAFO growth may have hampered rural tourism, recreation and destination retirement development. Whereas CAFO growth in this study contributed modest income growth, they point out that studies of recreational amenity income find growth is more than five times as great, and that recreational amenities and swine CAFOs, given their negative impact on surface water quality in Iowa, cannot co-exist.

Another review cites a Minnesota Generic Environmental Impact Statement (GEIS) for animal agriculture description of quality-of-life as related to perceptions of: 1) having alternatives in what one does on a daily or life cycle basis, and 2) being respected by family and communities of interest and place.[79] Similarly, an important construct of community quality-of-life is social capital, which includes mutual trust, reciprocity, and shared norms and identity.[80] These papers cite numerous studies and policy discussions that document the impact of CAFOs on neighbors and neighboring communities.

The most consistent source of impact on neighbors' quality-of-life is exposure to CAFO odor. Paul Lasley's Iowa Farm and Rural Life Polls in 1992 and 1998[81] reported substantial concern among CAFO neighbors as early as 25 years ago. Three-fourths of the farmers surveyed lived within three quarters of a mile of a neighbor. In the 1998 poll, 14 percent were unwilling to tolerate odor from a neighbor's livestock operation more than two days a year, 34 percent were willing to tolerate only a week or less, and 50 percent would view odor a "major nuisance" if it affected them as many as 10 days a year. Respondents agreed with the following statement: "Increasingly, manure management is a major issue in the livestock industry" 61 percent of the time in 1992 and 85 percent by 1998.

Wing and Wolf (2000) also assessed quality-of-life measures in the previously cited study of two CAFO-exposed rural communities and one control rural community in eastern North Carolina.[82] Quality-of-life, as indicated by the number of times residents could not open their windows or go outside, even in nice weather, was similar between residents near a cattle operation and the control population, but was greatly reduced among residents living within two miles of a swine CAFO. Problems cited by swine CAFO neighbors included limited child and adult recreation, cannot open windows, contaminated well, and decreased property values.

Tajik and colleagues conducted detailed interviews using both open-ended and semi-structured questionnaires designed to assess the impact of CAFO exposure on neighbors' quality-of-life in another eastern North Carolina study.[83] All participants (n=49) were adult non-smokers, nearly 90 percent were black and all lived within 1.5 miles of a swine CAFO. The authors cite recurring themes in almost all interviews. Several descriptors of beneficial use of property were evaluated and frequently cited: cannot sit outside, have guests over, have cookouts, have family reunions; cannot play, garden or work outside; cannot use well water or need to buy bottled water; had to buy air conditioner/dryer; and had a hard time sleeping at night. The authors commented that these findings are notable as the study population was a low-income, predominantly minority rural population known to have higher rates of chronic disease and limited access to health care. Indeed, Wing and colleagues have documented environmental justice as a major issue for people of color who live in proximity, often very close, to swine CAFOs in eastern North Carolina. Many of these black families owned their property, some dating to their ancestors' emancipation from slavery, well before the construction of a swine CAFO in their neighborhood. Many feel tied to the land by history, family, and lack of economic opportunity.[84]

IMPACTS ON WATER QUALITY AND RURAL LIVING

Property Values

> *A year and a half after we bought our home, a hog confinement was built 1,650 feet from our home. If you have ever driven past one of those things, you know what it smells like. Houses don't drive; we have had to live with that odor for five years. Now, Iowa Select has an application filed to double that amount to 5,000 pigs. This county is already saturated with confinements. The DNR has told us there are only four counties with more confinements than ours. Property values are dropping and people are moving out of the area, and Iowa Select wants to build dozens more. The matrix that allows this is outdated and must be fixed now before the smell in this state becomes worse.* [85]

This letter to the editor in *The Des Moines Register* on December 15, 2017, from Donna and Bob Juber of Eldora, Iowa, describes one reason there is a conflict between rural residents and CAFOs. Iowans value their homes. It is the way they save for their retirement and future. Even residents, who may not object to being a neighbor to a CAFO, must wonder about the resale value of their property — and there is a clear effect on the value of property near a CAFO. A recent article by Kilpatrick in the Appraisal Journal demonstrates the extensive devaluation in property caused by proximity to a neighboring CAFO.[86] The article reports that property value decreases are confirmed by actions by county tax assessors. Reductions of the assessed value range from 20 to

ATTACHMENT 2

40 percent of value in counties in farm states including Colorado, Missouri, Michigan, Illinois and Iowa. One study cited finds that "only landfills have a worse effect on adjacent property values."[87]

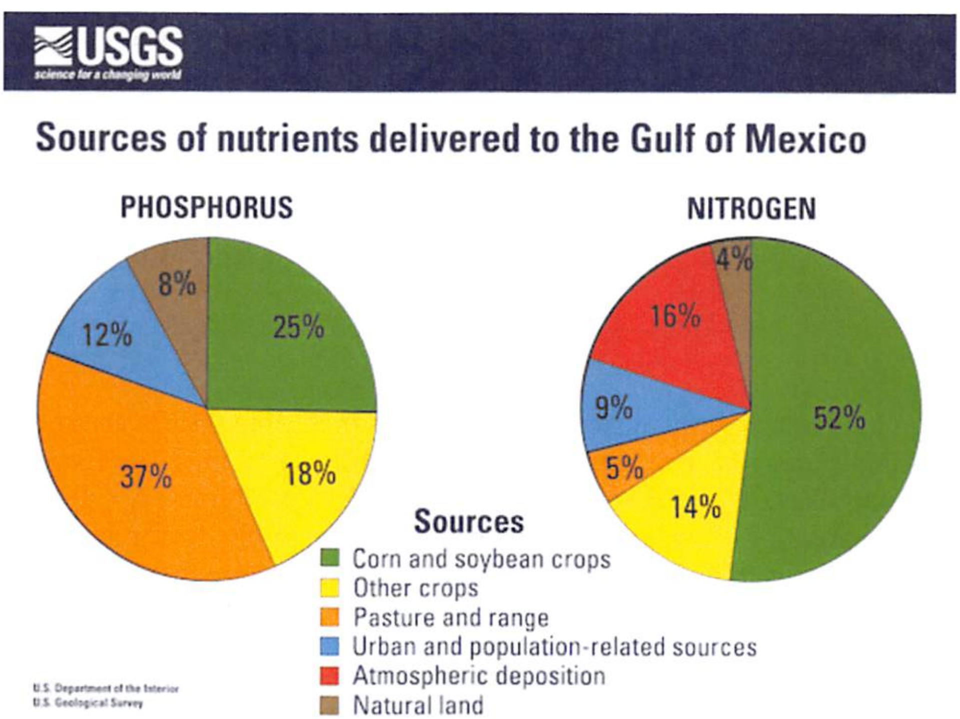
One of the studies cited by Kilpatrick is from Iowa researchers who not only find a decrease in property value, but also suggest that having the ability to bring suit might make the industry more accountable and that nuisance suits may prove to be a powerful incentive for CAFO owners to reduce emissions in Iowa and other states.[88] This potential "incentive" has been largely removed by the Iowa Legislature, as will be explained later in this report.

Distance from the source seems to have a big effect on the amount of the decrease in value according to another survey article that looked at property values near CAFOs.[89] That distance matters and that the decrease in value is significant is made clear by the following quote in the Kilpatrick article that refers to CAFOs as AOs:

> *Overall, the empirical evidence indicates that residences near AOs are significantly affected, and data seems to suggest a valuation impact of up to 26 percent for nearby properties, depending on distance, wind direction, and other factors. Further, there has been some suggestion that properties immediately abutting an AO can be diminished as much as 88 percent. One study estimates the total negative impact to property values in the United States at $26 billion. Mitigation makes a marginal impact. Not only are residences affected, but nearby small farms can be impacted by such factors as water degradation and insects.*[90]

CAFOs and Water Quality

Agriculture in general has been found to cause a decrease in water quality in the Mississippi River Basin watershed as is seen in the following figure from the U.S. Geological Survey. These sources are the primary cause for the hypoxic zone at the mouth of the Mississippi River, or "Dead Zone" that occupies an average of 5,300 square miles each year. The problem is not improving. In fact, the size of the zone in 2017 was a record high of 8,776 square miles.[91]



Source: United States Geological Survey. https://tinyurl.com/yar8hk5g

While agriculture in general cause the bulk of the nutrients contributing to the hypoxia in the Gulf of Mexico, animal agriculture and its manure make up a measurable part of this nutrient contamination. According to University of Iowa researchers, "The high correlation between nitrate concentration and animal unit density suggests that CAFOs produce measurable impacts on water quality."[92] The significance of animal agriculture to total agriculture pollution was earlier described by the U.S. Department of Agriculture's Economic Research Service: "In the Mississippi River's drainage basin, animal manure was estimated to contribute 15 percent of the nitrogen load entering the Gulf of Mexico."[93]

Earlier, Osterberg was co-author of a report published in the American Journal of Public Health on a similar topic to the present report. That paper found that between 1992 and 2002 there were 329 manure spills in Iowa.[94] These data, reprinted in Table 1, show that a limited number of such discharges were deliberate, according to the DNR.

Table 1. Errors, equipment/structure failure main causes of manure spills
Determined causes of 307 major Iowa manure spills, 1992-2002

Identified Causes	No. Spills	Percent of total
Failure or overflow of manure storage structures	74	24
Uncontrolled runoff from open feedlots	56	18
Improper application to cropland	43	14
Equipment failure	73	24
Deliberate spills (pumping manure to ground; deliberate breaches in storage lagoons, etc.	18	6
Other (e.g., transportation accidents)	43	14
Total	**307**	**100**

Source: American Journal of Public Health, October 2004, Vol. 94, No. 10. Merkel M. Data from 3 Iowa Department of Natural Resources (IDNR) databases: IDNR Fish Kill Database; IDNR Enforcement Database/ and IDNR Emergency Response Database.

The number of fish kills continues to grow with the expansion of the industry. A brief submitted to the DNR asking for changes in the Master Matrix in August of 2017 stated. "The state has documented more than 800 manure releases to surface water, groundwater, and land due to improper waste handling, excessive waste application, mechanical failures, and other problems associated with CAFOs since 2000."[95] Clearly there continue to be environmental impacts that may be related to the decreases in water quality.

The 2004 American Journal of Public Health paper referred to above reported that three microbes commonly found in livestock — *Escherichia coli, Campylobacter, and Cryptosporidium* — have caused disease outbreaks. Dairy feedlots in the streams above the intake for the City of Milwaukee water treatment plant were implicated in the famous 1993 Cryptosporidium event that sickened 400,000 people.[96]

Nitrate and Health

Nitrates that originate from several agricultural activities including CAFOs are regulated under the federal Safe Drinking Water Act. The allowed standard (MCL) of 10 mg/L or 10 ppm nitrate nitrogen was originally based on methemoglobinemia, a disease commonly called blue-baby syndrome. While the number of cases of this disease is rare in public water supplies in the United States, well water continues to be a concern for infants who consume formula prepared with private well water.[97]

New research has led researchers to identify other adverse outcomes from consuming water with high levels of nitrate, mainly using research from the Center for Health Effects of Environmental Contamination (CHEEC) at the University of Iowa. A recent report by the Iowa Environmental Council used these data in a report on Nitrate and Health:[98]

> *Many people, however, have not been aware that the health risks of nitrate in drinking water go beyond blue-baby syndrome. Research from Iowa and around the world has associated a number of human health problems, including birth defects and cancers, with elevated levels of nitrate in drinking water.*

The IEC study documents the association between nitrate and birth defects, bladder cancer and thyroid cancer. Many of the studies were of residents in the state of Iowa and, often, effects were seen at nitrate levels lower than the MCL for public drinking water systems.

Phosphorous and Health

Manure runoff into local waterways, especially lakes, can promote the growth of cyanobacterial algal blooms. Some species produce toxins that have forced beach closures in Iowa and other states, compromised sources of drinking water, and caused outbreaks of illness in both animals and humans. According to a recent report, adverse health effects to humans include acute hepatoxicity (liver damage), neurotoxicity, gastrointestinal problems, and a wide range of allergic reactions.[99]

Blue-green algae — or cyanobacteria. Photo credit: Illinois Environmental Protection Agency, http://tinyurl.com/jembwqy

The dangers of cyanobacteria became national news in 2014 when a water treatment plant in Toledo, Ohio, warned its 500,000 customers not to use water from the tap because algae blooms surrounded water intakes at its Lake Erie source. The catastrophic algal bloom prompted the mayor to declare a state of emergency, as the city was forced to find alternative sources of drinking water since boiling the water did not remove the toxin. As noted in a 2014 *Washington Post* story about this incident:

> *"And with these algal blooms predicted to worsen in Lake Erie and other lakes and reservoirs — thanks to a mix of global warming, invasive species and pollution — the issue is expected to pop up more often. Some believe Toledo could be a tipping point."* [100]

Recent scientific papers have demonstrated why potentially toxic cyanobacterial blooms may increase in severity. Warmer temperatures and heavy rainfall events with long dry periods in between will lead to acceleration of the eutrophication* process that the high levels of nitrogen and phosphorus make possible.[101] [102] The EPA has noted these weather patterns are predicted to occur more frequently as the Midwest climate changes.[103] A 2014 statement by 180 scientists and educators at 38 Iowa colleges and universities states that climate conditions will affect public health in several ways including the increased possibility of cyanobacteria outbreaks.[104]

The DNR monitors 39 state park beaches weekly in the summer for microcystin, a toxin produced by at least some forms of blue-green algae. There had been a steady increase in beach closings beginning in 2010 until data was added for 2017. The exceeding low number in that year is surprising and questionable, as it follows a large cut in the DNR budget and the resignation of staff

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* Eutrophication is "The process by which a body of water acquires a high concentration of nutrients, especially phosphates and nitrates. These typically promote excessive growth of algae. As the algae die and decompose, high levels of organic matter and the decomposing organisms deplete the water of available oxygen, causing the death of other organisms, such as fish." (USGS, Website, "Definition of Eutrophication," 2014)

involved in the monitoring. The table below from the Iowa Environmental Council uses DNR data to show the changes in advisories over time.

Table 2. Blue-Green Algae: Steady increase in Iowa beach closings until 2017 cuts and resignations of IDNR monitors

State Park Beaches with Microcystin exceeding 20 ug/L	Year												Total
State Parks (Beach Name)	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	
Beeds Lake State Park (Beeds Lake Beach)			*				1						1
Black Hawk State Park (Black Hawk Lake Campground Beach)			*	1	3	2	1	1	3	7	2	1	21
Black Hawk Lake State Park (Denison Beach)			*					4	7	1	2		14
Big Creek State Park (Big Creek Lake Beach)	1		*		1	2	5			1			10
Brushy Creek State Park (Brushy Creek Lake Beach)			*					1			1		2
Clear Lake State Park (Clear Lake State Park Beach)			*				1						1
Clear Lake, McIntosh Woods State Park (McIntosh Woods Beach)			*				1		3				4
Geode State Park (Geode Lake Beach)		3	*		1			6	1	1	1		13
Green Valley State Park (Green Valley Lake Beach)	12		*				3	2	1	9	7	3	37
Lake Anita State Park (Lake Anita Beach)	1		*				1		1		2		5
Lake Darling State Park (Lake Darling Beach)			*							2		1	3
Lake Keomah State Park (Lake Keomah State Park)			*		1	2					4		7
Lake of Three Fires State Park (Lake of Three Fires Beach)			*		1	4	1	3		2	1		12
Lake Wapello State Park (Lake Wapello Beach)	1		*							2	1		4
Marble Beach State Park (Marble Beach, Spirit Lake)	2		*			1	3						6
near Mini-Wakan State Park (Crandall's Beach, Spirit Lake)			*				2	1		1			4
Pine Lake State Park (Pine Lake Beach)			*							3	6		9
Pleasant Creek State Recreational Area (Pleasant Creek)			*							1	1		2
Prairie Rose State Park (Prairie Rose Lake)			*								2		2
Red Haw State Park (Red Haw Lake Beach)			*							1			1
Rock Creek State Park (Rock Creek Lake Beach)	5		*		1		1	3			1		11
Springbrook State Park (Springbrook Lake)			*							1	1		2
Twin Lakes State Park (Twin Lake West)			*							1			1
Union Grove State Park (Union Grove Lake Beach)	1		*		1			2	6	1	1		12
Viking Lake State Park (Viking Lake Beach)			*			1		1			4		6
Total	**23**	**3**	**0**	**1**	**9**	**12**	**20**	**24**	**22**	**34**	**37**	**5**	**190**

Updated Sept. 5, 2017 — After Monitoring Week 15, data as updated by IDNR.
Source: Iowa Environmental Council

In addition to nutrients, N and P, studies document many other contaminants from animal feeding operations. A report by the National Association of Local Boards of Health identifies new contaminants in water contaminated with manure.

> *Manure emitted by AFOs can contain "nutrients such as nitrogen and phosphorus, pathogens such as E. coli, growth hormones, antibiotics, chemicals used as additives to the manure or to clean equipment, animal blood, silage leachate from corn feed, or copper sulfate used in footbaths for cows."* [105]

The report further states some novel pollutants associated with CAFOs.

> *Water tests have also uncovered hormones in surface waters around CAFOs (Burkholder et al., 2007). Studies show that these hormones alter the reproductive habits of aquatic species living in these waters, including a significant decrease in the fertility of female fish. CAFO runoff can also lead to the presence of fecal bacteria or pathogens in surface water. One study showed that protozoa such as Cryptosporidium parvum and Giardia were found in over 80 percent of surface water sites tested (Spellman & Whiting, 2007). Fecal bacteria pollution in water from manure land application is also responsible for many beach closures and shellfish restrictions.* [106]

Other data from Burkholder, the author cited above, is consistent with other, less exotic contamination. Bacterial contamination surface water including fecal bacteria or protozoa such as

Cryptosporidium parvum and *Giardia*. Many of the pathogens (e.g., *Clostridium perfringens*) present in manure that can contaminate water supplies are concerning because they can cause severe diarrhea, which can be fatal for animals, very young children, and the immunocompromised. "Fecal bacteria and other pathogenic microorganisms typically settle out to the sediments where they can thrive at high densities for weeks to months following CAFO waste effluent spills."[107]

Another more recent review cites articles that show CAFO generated animal waste is associated with pathogens, pharmaceuticals, metals and hormones.[108] The Fry study also reviews articles showing the impact on public health is also related to CAFO air emissions.

FAILURE OF THE MASTER MATRIX AND PUBLIC POLICY IN IOWA

Past Iowa Regulations on Confined Animal Feeding Operations (CAFOs)

When a citizen becomes aggrieved by the actions of a neighbor, such as a CAFO, there are different routes to seek redress. First, there are three levels of legislative/administrative action, (federal, state and local). Second, the courts can intervene on behalf of the aggrieved party either by acting on the constitutionality of actions by the legislative branch or the courts can hear an individual action under nuisance. This section of this report will address all these possible routes for neighbors of CAFOs.

To fully understand why the state of Iowa regulation of its pork industry is weak and that individual nuisance action now has severe limitations, one must know there is something in law called the "right to farm." This is a legal concept that, according to the National Agricultural Law Center, University of Arkansas, is common:

> *All fifty states have enacted right-to-farm laws that seek to protect qualifying farmers and ranchers from nuisance lawsuits filed by individuals who move into a rural area where normal farming operations exist, and who later use nuisance actions to attempt to stop those ongoing operations. While the overall statutory schemes might be similar, each state has noticeably different content in the specific details of the laws...* [109]

While the power of this defense of agricultural production may have severe limits, as enumerated by Drake Law School Professor Neil Hamilton, who states that such laws "are proving to not be such a good idea after all."[110†] Still there is an expectation that agricultural operations have preference in rural areas of Iowa.

This preference for agriculture in rural areas explains much of the interaction of CAFOs, neighbors and the law. These laws arose when farmers were independent operators, but independent livestock farmers have now been largely replaced by contractors for integrated industrial agriculture, which is in the driver's seat and is unwilling to relinquish the wheel.

Regulation by Local and State Government

Calls for new regulation on siting of facilities and treatment of the tons of manure produced by CAFOs have all but gone unheard in the Iowa State Capitol. Individual counties have asked the DNR to reject the location of individual CAFOs.[111] [112] Supervisors in more than 20 of Iowa's 99 counties have called for changes in regulating the industry.[113] Community groups have had their requests for changes turned down by the regulators when they requested changes in how CAFOs are sited. [114]

† The original protection of farming starts with the notion that a landowner should not come to an area that has always had a certain smell and noise and then complain. That notion of fairness has been expanded in states like Iowa, according to Hamilton, to include new industrial swine operations that move into the neighborhood and this is why Right-To-Farm is not such a good idea. (Hamilton, 1998)

State and Local Government Interaction

A series of Iowa Supreme Court cases established that the Iowa Legislature can limit any local government action governing locations of large CAFOs or placing limits on their discharges to water or air. The Iowa Supreme Court held that all agriculture, including an animal feeding operation, is exempt from any county zoning.[‡] Humboldt County later attempted to put controls on CAFOs as a proper application of "home rule" authority but lost in the Iowa Supreme Court.[§] In the face of this state preemption, a Worth County ordinance sought to regulate CAFO operators based, not on home rule, but on the county's ability to protect public health. This ordinance was also struck down as being void and unenforceable as contrary to state law.[**] The opinion of the court was that "We conclude the Worth County ordinance is the type of ordinance expressly preempted by the state statute. Our legislature intended livestock production in Iowa to be governed by statewide regulation, not local regulation. It has left no room for county regulation."[††]

In exchange for eliminating local governmental action, Iowa legislators provided an opening for local advice and limited consent when the Master Matrix went into effect in 2003. This is a scoring system that forces an operation to adopt measures such as greater separation distances and more stringent manure practices and will be examined later in this report.

In exchange for eliminating local governmental action, Iowa legislators provided an opening for local advice and limited consent when the Master Matrix went into effect in 2003.

State and Federal Interaction

Since the state of Iowa has preempted much of the possibility for local government to act on CAFOs, we must ask how well the state, and the administrative organization that takes on enforcement and regulation of these facilities, the DNR, has behaved in the past.

Three environmental groups approached the U.S. EPA's Region 7 office in 2007 to request the agency investigate the DNRs administration of the Clean Water Act. Little came of the request, so in 2011 the groups threatened suit. Region 7 responded this time and in a survey of DNR enforcement of animal agriculture facilities found inadequacies. While EPA Region 7 and the DNR worked out an agreement for improvement, the Iowa Citizens for Community Improvement (ICCI), the Environmental Integrity Project and the Iowa Sierra Club kept up pressure on both agencies. Negotiations centered on five issues. One was easily measured — the number of inspectors. The DNR acknowledged in the official response to Region 7 that there were too few:

> *"Since 2007, the DNR has had a significant reduction in its animal feeding operations staff. To better meet our responsibilities, the DNR needs both an increase in staffing and to reprioritize workloads."* [115]

While the DNR did not explain the extent of the "significant reduction" in agency field staff in the official response, they had answered elsewhere in a 2011 report on manure on frozen and snow-covered ground:

> *"The scope and complexity of confinement program work increased disproportionately beginning with legislation in the late '90s. With this, public awareness of environmental issues also grew, resulting in a significant increase in local demand for education, compliance assistance and compliance assurance. To*

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‡ *Kuehl v. Cass County, 1996*
§ *Goodell v. Humboldt County, 1998*
** *Worth County Friends of Agriculture v. Worth County, 2004*
†† *id*

> *address these needs, animal feeding operations field staffing gradually increased to a high of 23 by SFY 2004. In SFY 2008, four staff people were shifted into a newly established open feedlots program. Then in the fall of 2009, as General Fund expenditures declined, confinement staffing was reduced again. This reduced staff numbers from 19 to 11.5. Further reductions leave the total of field staff for confinement work at 8.75 full time equivalents. This reduction means that the DNR will not be able to maintain an adequate level of compliance and enforcement activity in confinements."* [116]

The EPA Region 7 initial report on DNR shortcomings led to an agreement between the two agencies dedicated to improving how CAFOs and their manure is treated and controlled in the state of Iowa. (See Appendix 1 for a fuller explanation of Region 7 and DNR interaction.) The initial agreement envisioned a 13 staff-person increase, which would only bring numbers back to approximately the 2004 staffing levels — before the addition of many more CAFOs. However, the final agreement only called for seven new staff members.

ICCI, one of the three environmental organizations that caused the EPA to request changes in how DNR regulated CAFOs, described the agreement as a victory although a limited one. After all this organization was instrumental in getting the DNR to go even this far. Still, that the main Iowa environmental agency was forced to enhance its regulation on CAFOs casts doubt on the effectiveness of state regulation and puts into question the preemption of local government involvement.

Individual Action by Neighbors

Neighbors have a second route to proceed when they feel they have been aggrieved — they can also sue under nuisance. The first Iowa legislative action on CAFOs in 1995 (House File 519) included limiting individual action.

Besides limiting the rights of neighbors to seek relief from county government, HF 519 attempted to make it more difficult to successfully sue a livestock operator, by requiring a plaintiff to meet a tough standard of proof. The Iowa House Democratic caucus staff described the limits HF 519 placed on individual plaintiffs:

> *"There is a "rebuttable presumption" that an animal feeding operation is not a public or private nuisance. This rebuttable presumption may be overcome by <u>clear and convincing evidence</u> of <u>both</u> of the following:*
>
> > *the animal feeding operation <u>unreasonably and continuously</u> interferes with another person's comfortable use and enjoyment of life or property; and*
> >
> > *the injury or damage has to be caused by the negligence of the operation.*
>
> *All operations are included in the protection regardless of the established date of the operation or expansion."* [117]

Individuals were also dissuaded from going to court against a CAFO operator because the losing party in a case was made liable for all costs and expenses of the winning party, if the court determined that the claim was frivolous.

The attempt to limit nuisance was voided by the Iowa Supreme Court. The courts determined the Iowa Legislature went too far with this action. Since 2001, three Iowa district court judges have ruled against the attempt to protect CAFOs against nuisance suits.[‡‡] [118] [119] Also, in Iowa a case by neighbors against a CAFO owner was decided with a judgment for the plaintiff of $1 million for actual damages and $32 million for punitive damages.[§§] [120] The case was settled out of court.

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‡‡ (*Weinhold v. Wolff* (Iowa 1996); *Bormann v. Kossuth County Bd of Supervisors* (Iowa 1998); and *Gacke v. Pork Xtra LLC* (Iowa 2004)
§§ (*Blass, et al v. Iowa Select Farms, L.P 2004*)

In the spring of 2017, a new law was passed by the Iowa General Assembly and signed by the Governor revisiting the rights of neighbor to sue a CAFO operator. The new law may well be challenged on grounds of constitutionality, as was the 1995 law. However, as Kristine Tidgren, assistant director of the Center for Agricultural Law and Taxation at Iowa State University, explained in a recent blog:

> *The constitutionality of this legislation, if enacted, would no doubt be challenged as prior legislative attempts to limit nuisance actions against agricultural operations have been rejected by the Iowa Supreme Court. This legislation, however, is very different in that it does not seek to dismiss a nuisance lawsuit, but to limit the types of damages that can be recovered against "responsible" producers. The stated legislative purpose of this bill is to encourage the "expansion of responsible animal agricultural production in this state which provides employment opportunities in and economic growth for rural Iowa, contributes tax revenues to the state and to local communities, and protects our valuable natural resources."* [121]

The new law limits damages that can be awarded to a person who wins a lawsuit against an animal feeding operation, under a claim that the CAFO is a public or private nuisance or an interference with another person's "comfortable use and enjoyment of the person's life or property." The new law limits damages that can be awarded to a person impacted by a CAFO to (a) any actual reduction in property value caused by the facility, (b) past, present, and future adverse health impacts as determined by objectively documented medical evidence and proven to be caused by the facility, and (c) any award for damages due to annoyance and the loss of comfortable use and enjoyment of the property to 1.5 times the sum of property value and objective medical evidence of deterioration of health. By requiring "objectively documented medical evidence and proven to be caused by the facility" in question, this new law seeks to eliminate consideration of the substantial literature on CAFO exposures and causation of adverse health effects, disease and impairment. [122]

Additionally, according to an analysis of the Iowa Environmental Council, if the person suing wins the lawsuit, the facility is classified as a "permanent" nuisance rather than a temporary/ Intermittent nuisance. This means that a person gets one shot at damages — they cannot file additional lawsuits even if the facility causes additional impacts in the future.[123] The constitutionality of the new law has yet to be tested. Analysis of this new law in relation to the real possible public health issues surrounding the location of facilities and their manure application is the subject of a recent IPP report.[124]

HOW THE STATE OF IOWA SHOULD PROCEED

Revise the Master Matrix

The background on CAFOs and neighbors leads us to one of our main questions in this report, the adequacy of the Master Matrix, which — in exchange for preemption of local government action — gave local governments something to do. If a large CAFO operation attains a minimum score on the Master Matrix, it will be approved by the DNR even if there is public opposition to the operation and the county recommends against it. [125]

The Winneshiek County Board of Supervisors does not feel the Master Matrix gives the environment enough protection. That body voted 5-0 and two supervisors appeared before the Iowa Environmental Protection Commission to appeal a DNR approval of a permit for a CAFO in the county in a karst region in October of 2013. They were turned down.[126] This is not an exception.

An earlier Iowa Policy Project report documented that the Master Matrix does not distinguish between types of rivers that are near facilities and could receive pollution from a CAFO. In 2008, the Master Matrix did not treat differently two facilities that could drain into the pollution-impaired Raccoon River above where the City of Des Moines Water Works receives water that must be treated to potable levels for more than half a million Iowans. [127]

In September 2017, ICCI, the same organization that was among the three environmental groups that forced EPA Region 7 to require the DNR to revise its regulations of CAFOs, along with Food and Water Watch, was turned down in its petition to the Environmental Protection Commission (EPC). The EPC, the citizen board that oversees the DNR, followed the recommendations of the DNR to resist any changes to the Iowa's Master Matrix.[128]

The two organizations' brief was thorough. It included sections documenting the failure of the Master Matrix to give counties the authority to protect resources. It demonstrated that the many new animal feeding facilities since the Master Matrix was implemented made the need for changes more necessary. The brief produced data to support changes and requested revisions in the specific scoring criteria. It maintained the DNR has the ability and the duty to make changes.[129]

Included with the brief were resolutions or letters to the legislature signed between November 2016 and the spring of 2017 by 13 counties that requested strengthening of local control and in some cases calling for a moratorium on new facilities until changes were made.[130]*** In addition to this demonstration of support, in 2014 Dickinson County surveyed all Iowa counties and found that more than a third of those county supervisors who responded wanted changes in the Master Matrix.[131] Furthermore, the number of counties have stated their objections to the Master Matrix has now increased to 20.[132]

It is clear that some counties in Iowa see a route to prosperity that puts local limits on the number of animal feeding operations that choose to locate there. This is not surprising since the IPP report by Flora covered earlier in this paper, found that counties who choose to go with hog confinement operations give up other local development possibilities.[133] *The Des Moines Register* pointed out in a February 15, 2015, editorial — *"Livestock confinements need local control"* — that different counties may choose to differ on their desire to add livestock facilities to their suite of economic development opportunities:

> *While Sioux County is apparently comfortable with having the equivalent of 35 hogs for every resident of the county, there is mounting concern in Dickinson County about the growing numbers of livestock confinement operations in one of the state's premier tourism destinations.* [134]

Iowa State Senator David Johnson has introduced a number of bills calling for a moratorium on new, mid and large CAFOs and proposed expanded public participation in CAFO decisions currently captive of the Master Matrix. His bills were supported by a demonstration at the Iowa State Capitol by a coalition of about two dozen state, local and national groups calling itself the Iowa Alliance for Responsible Agriculture. The group rallied in support of all 15 of Senator Johnson's bills to tighten oversight of CAFOs.[135] Senator Johnson is quoted that there will be consequences if nothing is done:

> *"Failure to take legislative action this year could hurt lawmakers when they seek re-election...If not a single one of these bills are passed, legislators will face a real challenge if they're up for election in the fall," he said.*[136]

*** The counties were Adair, Allamakee, Buchanan, Cedar, Cerro Gordo, Dickinson, Floyd Hardin, Howard, Johnson, Pocahontas, Webster and Winneshiek.

Unless his bills or something similar becomes law, DNR has shown it is unwilling to make changes on its own to a 15-year-old law that many find inadequate.

Implement Moratorium on New CAFOs that Do Not Have Superior Waste Handling Technology

An essay by Fred Kirschenmann, on behalf of the Pew Commission on Industrial Farm Animal Production, observed that operation of CAFOs under the current model is unsustainable in the long term. The standard industry production methods externalize the costs and impacts of waste from livestock and poultry production, and rely on cheap energy, abundant fresh water and a relatively stable climate.[137] Add to this long-range sustainability challenge, the degradation of water quality, harmful air pollution, and the public health and rural community impacts reviewed in this report.

North Carolina has developed a state-based model for advancing industrial farm animal production that attempts to make new facilities more sustainable. In 2000, the North Carolina Attorney General entered into an agreement with Smithfield Foods, its subsidiaries and Premium Standard Farms to fund environmentally superior waste management technologies, a $17.5 million development initiative.[138] North Carolina implemented its moratorium new or expanded swine farms in 1997, and made it permanent for swine farms that use anaerobic waste lagoons for primary treatment in 2007. [139] To comply with the moratorium, a new facility must have environmentally superior technology. This is defined as "any technology, or combination of technologies that (1) is permittable by the appropriate governmental authority, (2) is determined to be technically, operationally and economically feasible for an identified category or categories of farms as described in the agreements and (3) meets the following performance standards: 1. Eliminates the discharge of animal waste to surface waters and groundwater through direct discharge, seepage or runoff, 2. Substantially eliminates atmospheric emissions of ammonia; 3. Substantially eliminates the emission of odor that is detectable beyond the boundaries of the parcel or tract of land on which the swine farm is located; 4. Substantially eliminates the release of disease-transmitting vectors and airborne pathogens; and 5. Substantially eliminates nutrient and heavy metal contamination of soil and groundwater."

The director of the North Carolina State Animal and Poultry Waste Management Center was designated to oversee the selection and evaluation of technologies, assisted by an advisory panel composed of individuals representing government, environmental and community interests, agreement member companies, and others with expertise in environmental sciences, public health, animal waste management, economics and business management. A nationwide RFP to research institutions and industry yielded 18 technology candidates that met these goals (See Appendix 2).

> *Under the right conditions, liquid manure will break down into biogas and a low-odor effluent. Biogas can be burned to produce heat, electricity, or both the anaerobically-digested manure, can be stored and applied to fields with significantly less odor than stored, untreated liquid manure. Anaerobic digestion does not reduce the volume or nutrient value of manure. If dilution water is added to the system, the volume of material to handle is increased.*[140]

The term "under the right conditions" applies when harvesting some of the energy contained in manure is proposed as one solution to some of the problems with CAFOs endorsed by the North Carolina law. A 2017 publication from Penn State University describes the benefits of modifying the normal CAFO production process to include energy capture.[141] A 2015 EPA report on the status of anaerobic digesters in the several states lists five in Iowa. [142] The 2016 Iowa Energy Plan estimates there are more than 1,000 potential locations for similar projects.[143] Capturing animal waste to generate renewable energy is potentially a win-win-win — reducing harmful air and water emissions, preserving nutrients and generating renewable energy. Some, but not all CAFO externalities, are necessarily reduced by a policy to require this capture.

In 2007, North Carolina's Renewable Energy & Energy Efficiency Portfolio Standard (REPS) was passed overwhelmingly as part of Senate Bill 3.[144] At the same time, the 2000 moratorium on construction or expanding swine CAFOs was made permanent. The REPS established a clean energy market in the state by directing the state's electric providers (or utilities) to generate a portion of the state's electricity needs both from renewable energy resources and through energy efficiency. The amount, in percentage of total portfolio (natural gas, wind, solar, coal, nuclear) was designated to increase to 12.5 percent by the year 2021. The law also has "set-asides" for energy created from solar, swine waste and poultry waste, the only state to have such a specific carve-out. To meet REPS requirements, utilities must secure Renewable Energy Certificates (RECs), with one REC equal to one megawatt hour (MWh) of electricity. Utilities may purchase swine RECs or develop their own. To comply with the law, they must secure approximately 284,000 swine RECs by 2018.

While the 2015 EPA anaerobic digester report lists only 10 North Carolina projects, the new emphasis on policy in that state is boosting the number (See Appendix 3). In addition, the requirement that expansion of the industry requires new production techniques, like energy production, is an even bigger policy incentive.

An Iowa expansion of anaerobic digestion would address some problems of existing facilities and locating new CAFOs. However, the first line of the Penn State excerpt above begins with "under the right conditions." The "right conditions" would not be met with a 10,000-head cattle feedlot and biogas operation in northern Iowa karst country. The Walz Energy project is currently under construction there. According to neighbors it is too close to Bloody Run Creek, a cold-water trout stream that is one of the designated "Outstanding Iowa Waters."[145] Any leaks from such a large project could endanger the well-developed tourism industry in the area including Spook Cave located on land around Bloody Run. Karst is unusual topography that contains many sinkholes that can direct pollution to the many springs and streams in the region. [146]

Quoted in a long *Des Moines Register* story on the project is Larry Stone, a retired *Register* outdoors writer, reports that the clean, clear waters around the Walz Energy project has been "a hot spot for fishing, picnicking, hiking, bird-watching and leaf-viewing in the fall," and that any problems with this industrial-sized facility will do great damage. He is opposed.[147] Clearly capturing energy from manure, a good thing, does not solve the problems of locating CAFOs if they impose external costs onto neighbors and degrade the local environment. Building a CAFO in the karst region of Northeast Iowa is something that should hardly ever happen.

Challenge the Constitutionality of the 2017 Iowa Anti-Nuisance Suit Legislation and Ag-Gag Law

The nuisance protection for CAFO owners that passed the Iowa Legislature in March of 2017 may or may not be sustained in a court of law. If the law is successfully challenged, it will not be the first time the Iowa Legislature has tried to protect agricultural producers only to find that the Iowa or U.S. Constitution prevents the action. Earlier in this paper it was mentioned that one section of the original 1995 Iowa CAFO law tried to limit neighbors' rights under nuisance only to be struck down by the Iowa Supreme Court.

Another example of the Iowa Legislature probably going too far is the so-called Ag Gag Law. As recently as January 2018 a federal court struck down parts of a law similar to Iowa's law in Idaho.[148] Iowa's law that limits and criminalizes efforts to expose animal cruelty and food safety violations is still on the books. That might change. According to a *Cedar Rapids Gazette* report, "A coalition of public interest groups has filed a federal lawsuit challenging the constitutionality of the Iowa's so-called 'ag gag' law that criminalizes undercover investigative efforts to expose poor conditions for workers, food safety violations, environmental harm and animal cruelty in agricultural facilities."[149] The Iowa law passed in 2012 made it a misdemeanor punishable by up to a year in jail to falsely try to obtain a job in an animal facility in order to publicize what might damage the reputation of the industry.

The lawsuit is another sign — along with calls by Iowa County supervisors for a moratorium on expansion of CAFOs and Senator Johnson's proposed bills — that opposition to industrial farm animal production is brewing.

Citizen Action Not Aimed at the Legislature

Develop Land Covenants and other Local Legal Strategies to Limit CAFO Growth

Some neighbors are uniting to limit the expansion of CAFOs in their county. According to the *Cedar Rapids Gazette*, a group of Howard County landowners, tired of Iowa lawmakers' refusal to tighten rules on confined animal feeding operations, has banded together to outlaw these operations on their properties. Further, these 43 families owning more than 5,000 acres combined won't accept liquid manure from large feeding operations — an unusual move they hope will keep those facilities from opening nearby."[150] While such action is not a state policy suggestion, it demonstrates how citizens might act in the absence of policy.

Community Action to Block a Packing Plant

How do community residents respond to industrial development they find objectionable? A recent Iowa example is the rejection of a pork processing plant, which demonstrates what can happen when local governments are accountable to the communities they serve.

The citizens of Mason City took on the vertically integrated pork industry, specifically the proposed establishment of a Prestage pork processing plant in their community, and against all odds, prevailed. The $240 million proposed facility had already procured vocal support from then Governor Terry Branstad, millions of dollars pledged by the Iowa Economic Development Authority (eventually $11.5 million), and a Mason City incentive package of a 10-year, 5 percent tax rebate on a $100 million minimum valuation.

The City Council initially appeared to be unanimous in its support for building the facility on the outskirts of Mason City. However, local residents had been given little information about this facility that promised to process at least 10,000 hogs daily, employ nearly 1,000 full-time employees with a payroll of nearly $52 million, and a tax benefit to the city of over $1.7 million. Once residents became fully aware of the likelihood of this development, many questions were raised — impact on air quality, impact on water supply and quality, growth of CAFOs in Cerro Gordo County and especially in the Clear Lake watershed, impact on local traffic and worker availability, housing, education, social services and health care. Mason City residents did not just accept the answers offered by Prestage Foods of Iowa, but independently researched environmental, public health and infrastructure impacts and the longer range history of similar packing plant impacts in other Iowa communities. The City Council, after it conducted public hearings rejected the project.[151] The Mason City "No Prestage" movement is a model of citizens taking action through their local government. This is in contrast to the Iowa Legislature taking away the power of local governments to regulate the location of CAFOs.

CONCLUSION

It is impossible to avoid the very substantial scientific evidence showing the impact of livestock production and its rapid growth on the degradation of Iowa water and air, and consequently the health of the people of the state. Despite this mounting scientific evidence, and the mounting opposition to this explosion of CAFOs, there is every indication that industrial livestock production intends business as usual. Meanwhile state policy makers have refused, not only to strengthen state regulation or allow local regulation, but have also prevented those adversely affected by living near animal confinement facilities of opportunity for redress through the courts.

As we stated in a guest opinion in *The Des Moines Register* in September of 2017, the entire process of approving animal confinement facilities needs to be changed. Iowa policy makers are long overdue in reforming and revising the Master Matrix, passing a moratorium on new swine CAFOs that cannot document superior emission and pollution controls, and in providing legal redress for neighbors adversely affected by the virtually unrestricted explosion of CAFOs in Iowa. This degradation of farmland, Iowa's most precious commodity, the rural environment, rural public health, and rural community social and economic welfare, are all interdependent and critical for long-term agricultural sustainability. As industrial agriculture will not, and elected and appointed officials apparently cannot, the outcome of this conflict is very much up to rural Iowans and all who care about sustainable agriculture.

"No Prestage" — an insider's view

The following summary is offered by Deb Lassise, MSPH, as to how the residents of Mason City ultimately defeated Prestage, as the result of a 3-3 vote its city council at its final hearing:

"The 'No Prestage' effort started slow and small. A Facebook page played a big role — it had good oversight and was full of information. It was the beginning of identifying a group of people who did not know each other but shared the same concerns. A petition was started and circulated through Facebook and door-to-door. The door-to-door effort was important — residents had an opportunity for personal interaction. Some residents shared that they did not support Prestage coming to the community, but could not speak out because of their job or employer. Others actively sought the documents, chasing after petitioners and reaching out by phone. A critical part of the strategy was to listen to what Prestage was saying, then research their claims, challenge their language, and share the facts. This included following the money: exploring costs to schools, social services, and community infrastructure as well as the accompanying CAFO expansion in the immediate area. A GO FUND ME site was set up and a bank account opened. Contributions paid for newspaper ads, signs, YouTube videos, a website, billboards, and a forum with guest speakers. Everyone had their own way to contribute — in a public way or an anonymous way — whether it be technical or organizational skills, writing a letter to the editor, speaking at a city council meeting, financially supporting the effort, or talking with others. Residents who initially supported the project changed their minds as facts came out. Many North Iowa and regional neighbors expressed their concerns. Although publicly called racists and kooks, the effort was speaking truth to power and money. The process facilitated meeting new people, learning, accessing valuable national/state/regional resources, keeping a sense of humor, engaging young people, and fostering a strong sense of community."

APPENDIX 1

U.S. EPA vs. Iowa DNR

On July 12, 2012, Region 7 of the U.S. Environmental Protection Agency (EPA) — which covers Iowa, Kansas, Missouri, and Nebraska — found that the Iowa Department of Natural Resources (IDNR) was inadequately enforcing the Clean Water Act (CWA) in regard to Confined Animal Feeding Operations (CAFOs).

In a letter to IDNR Director Chuck Gipp, EPA Regional Administrator Karl Brooks outlined his agency's concerns over the lack of pollution control from the 7,000 animal feeding operations jeopardizing Iowa's waterways and cited that it was a violation of Section 402 of the CWA.[1] Brooks wrote: "Actions are necessary to ensure that Iowa's NPDES [National Pollutant Discharge Elimination System] permitting, compliance and enforcement program for CAFOs complies with the Clean Water Act." EPA gave IDNR 60 days to submit a plan and a schedule for addressing the issues outlined in the letter. EPA also required that IDNR allow the public to provide input on the plan.

EPA and IDNR came to agreement a on plan that outlined six major categories: on-site inspections for all (1) "large" factory farms (more than 1,000 beef cattle or 2,500 hogs) and (2) "medium" factory farms (300-999 beef cattle or 750-2,499 hogs), (3) desktop evaluations for other medium-sized factory farms, (4) issuance of new factory farm permits regulations within one year, (5) stronger manure applications setback requirements with one year, and (6) tougher enforcement protocols.

EPA became involved with the situation after a petition called for IDNR to relinquish its authority for managing the NPDES. The petition was submitted in September 2007 in a collaboration by the Environmental Integrity Project, Iowa Citizens for Community Improvement, and the Sierra Club Iowa Chapter.

Days after EPA's announcement, *The Des Moines Register* — the state's largest newspaper — issued an editorial lambasting state officials for their inability to address the problem.

"Our elected officials enact laws to ensure there is little regulation. They underfund state agencies that oversee agricultural operations. They send a message to go easy on polluters. And the rest of us pay the price with dirty water. That compromises recreational and tourism opportunities, which affects this state's economy."[2]

Water quality was a contentious issue a both the state and federal level at the time. Iowa Governor Terry Branstad claimed that IDNR was "too aggressive already in enforcing pollution regulation against agricultural operations"[3] while U.S. Representatives Leonard Boswell (D), Tom Latham (R), and Steve King (R) voted in 2011 to limit EPA's ability to enforce the Clean Water Act.[4]

One year after EPA issued its indictment against IDNR, another report was released which found that INDR had done little to improve Iowa's water quality. Iowa Citizens for Community Improvement issued a statement critical of IDNR's efforts to address the issue, writing "[i]t has now been almost a full year since the EPA published its report, and no action has been taken. That's 12 more months of degradation to Iowa's water while the DNR stonewalls implementation of the Clean Water Act."[5]

Despite the criticism from activist groups, EPA Region 7 spokesperson Kris Lancaster said "[the] proposed rules are consistent with federal requirements."[6]

1 Noble, Jason. "EPA says DNR is lax on enforcing confinement permits, regulations." *Des Moines Register*, July 13, 2012.
2 *The Des Moines Register*, Editorial: "EPA letter should be a wakeup call." July 1, 2012.
3 *Bleeding Heartland*: "EPA Finds Iowa DNR Not Enforcing Clean Water Act for CAFOs" July 13, 2012
4 *Bleeding Heartland*: "Boswell, Latham and King vote to undermine Clear Water Act." July 15, 2011.
5 Iowa Citizens for Community Improvement. "One Year after EPA Demands Compliance, DNR Continues to Obstruct Clean Water Act Implementation - Iowa CCI," July 8, 2013
6 Eller, Donnelle. "Groups say water rules aren't enough." *Des Moines Register*, Jan. 28, 2014.

APPENDIX 2

Phase 1 and 2 Superior Technology Projects Approved under the Smithfield Agreement

The following are the types of modifications necessary for a new CAFO to be built in North Carolina. Research has demonstrated environmentally better technology.

Phase 1:

- Solids separation/nitrification-denitrification/soluble phosphorus removal/solids processing system (Super Soils Systems USA)
- High solids high temperature anaerobic digester system
- In-ground ambient temperature anaerobic digester/energy recovery/greenhouse vegetable production system
- Solids separation/reciprocating wetland technology system
- Upflow-biofiltration system
- Belt system for manure removal
- Belt manure removal and gasification system to thermally convert dry manure to combustible gas stream for liquid fuel recovery
- Solids separation/combustion for energy and ash recovery centralized system

Phase 2:

- Solids separation/constructed wetlands system
- Sequencing batch reactor (SBR) system
- Manure solids conversion to insect biomass (black soldier fly larvae) for value-added processing into animal feed protein meal and oil system
- ISSUES (innovative Sustainable Systems Utilizing Economical Solutions). This project includes mesophilic digester, permeable lagoon cover, aerobic blanket and microturbine generator

APPENDIX 3

Anerobic Digester Development to Control Swine Waste in North Carolina

Anaerobic digestion is centuries old and varies from simple household digesters used by some 40 million people in China to the 17,000 commercial scale biogas systems in Europe. (North Carolina Bioenergy Council, 2017). According to the American Biogas Council, 2,000 biogas systems are now in operation in the U.S, the majority at sewage treatment plants, and estimates that there are at least 8,700 U.S. dairy and hog operations large enough to profitably produce biogas, but only 265 (12 percent swine) do so. The Smithfield Agreement research, together with incentives provided by REPS legislation, shows progress is being made.

With financing from Duke University, Duke Energy and later Google Inc., the Loyd Ray biogas system generates 600-megawatt hours of energy. Duke takes partial credit for methane capture to offset some on campus pollution and to achieve its aim of zero net greenhouse gas emissions (NC Policy Watch, 2017). Google gets the rest of methane reductions to meet its goal of 100 percent renewable energy. Beyond methane capture, the system meets North Carolina superior technology odor and nutrient pollution standards. Nine other digesters are operating in North Carolina, but none are currently meeting superior technology performance standards, even with state incentive funds and the promise of expansion.

Soon to come on-line is Legacy Farms, one of the state's few integrator independent farms, which will use dry bedding and swine waste to a series of digesters and retaining ponds (NC Policy Watch, 2017). It is expected to meet superior technology standards, will exempt the 560 acre farm from the moratorium and allow it to expand from 5,500 sows to 60,000 finished hogs. Some producers are hosting third-party renewable energy developers on their property. Revolution Energy Systems (RES), a Washington, D.C.-based company, is operating two waste-to-energy systems that generate 17 times the energy as the Lloyd Ray project while using the waste from 70,000 pigs from 10 adjacent CAFOs. The integrator/producer, Murphy Family Ventures, incurred no cost for the biogas system including retrofitting its barns with scrapers. The entire system is owned by RES, as are the benefits: renewable energy credits sold to Duke Energy under REPS, methane credits equal to the pollution of some 7,500 cars sold on the offset market, waste heat to aid digestion, and revenue from electricity sold to the grid. Another project, Vestal Farms in Duplin County, has eliminated burning biogas on-site, an added expense and operational burden, by purifying gas for direct injection — "direct biogas" or "renewable natural gas" — similar to how some utilities allow customers to add renewable energy to the electrical grid. Also in Duplin County, Optima KV is directly injecting biogas, which will be bought and used by Duke Energy to help fuel its gas plants in adjacent counties. It is expected to become the largest biogas project in North Carolina, enough to power more than 800 homes. Five CAFOs, including Vestal, have invested in the system and will benefit.

Duke Energy is expanding its renewable energy output through capturing waste generated methane, which it treats and injects into its pipeline system in four other counties (Waste Management World, 2017). Under a 15-year contract with Carbon Cycle Energy, it is expected to produce about 125,000 MWH of renewable energy per year from biogas — enough to power about 10,000 homes for a year, while at the same time adding RECs to help satisfy the state mandate. While North Carolina is clearly the leader in developing innovative waste-to-energy technology, Roeslein Alternative Energy has reached the halfway point of its $120 million biogas project in partnership with Smithfield Farms in Northern Missouri. The project will inject renewable natural gas (RNG).

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[5] https://www.poi.org/.../hot-stock-inside-china--strategic pork reserve, accessed 11/20/17

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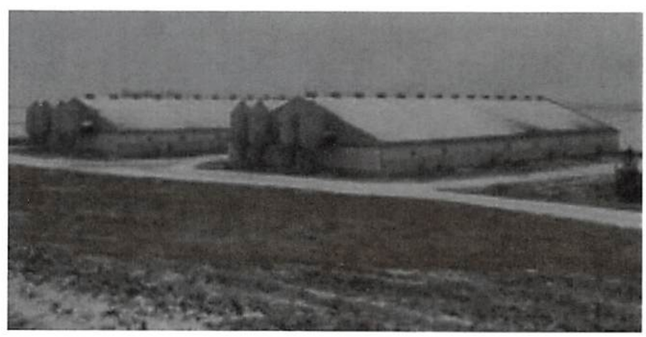
ATTACHMENT 2

A Community at Risk:

A Report on Citizens' Hydrogen Sulfide Monitoring at Kohlnhofer Factory Hog Farms in Goodhue County, Minn.



RELEASED SEPTEMBER 14, 2017

LAND STEWARDSHIP PROJECT

Pictured on the front cover (clockwise from left):

- Zumbrota Township farmers Frederick Fredrickson and Dale Post monitor for hydrogen sulfide.
- Zumbrota Township resident Sharon Pagel and farmer Marilyn Fredrickson record hydrogen sulfide levels.
- Kohlnhofer finishing barns in Goodhue County.
- The Jerome Hydrogen Sulfide Analyzer shows a high reading outside a Kohlnhofer hog facility.

Citizen Hydrogen Sulfide Monitoring Team

Frederick Fredrickson, Dairy Farmer, Zumbrota Township
Marilyn Fredrickson, Dairy Farmer, Zumbrota Township
Dale Post, Farmer, Zumbrota Township
Mary Post, Zumbrota Township
Kristi Rosenquist, Zumbrota Township
Bob Rosenquist, Zumbrota Township
Darwyn Tri, Zumbrota Township
Sharon Pagel, Zumbrota Township
Andrea Lodermeier, Zumbrota Township
Kathy Bramble, Zumbrota Township
Beth Slocum, Farmer, Welch
Winston Kaehler, Red Wing
Linda Walbruch, Mantorville
Marilyn Johnson, Minneapolis
Katie Doody, Policy Organizer, Land Stewardship Project

ATTACHMENT 2

Citizens' Monitoring Shows High Levels of Hydrogen Sulfide at Kohlnhofer Hog Operations

OUR STUDY: As neighbors to a proposed Kohlnhofer 4,700-hog factory farm in Goodhue County's Zumbrota Township in southeastern Minnesota, we have concerns about the impacts this project will have on our air quality, water quality, property values and family farms. To analyze the impact the Kohlnhofers' existing hog facilities are having on air quality in Goodhue County, we monitored for hydrogen sulfide (H_2S) emissions at the property boundaries of Kohlnhofer hog operations. Using a Jerome J605 Hydrogen Sulfide Analyzer and following a scientific protocol, a team of 15 citizens conducted 47 monitoring sessions over a 35-day period.

Citizens set out to find:

1) Are hydrogen sulfide emissions levels exceeding **health risk values** designed by the Minnesota Department of Health (MDH)?
2) Are Kohlnhofer hog operations violating **state ambient air quality standards** set by the Minnesota Pollution Control Agency (MPCA)?

Our data shows:

1) **Hydrogen sulfide emissions from Kohlnhofer hog facilities are likely exceeding health risk values set by the Minnesota Department of Health.**
2) **Two facilities (Jeff Finishing and Holst I Finishing) may be violating state ambient air quality standards set by the MPCA.**

HYDROGEN SULFIDE & FACTORY FARMS: Hydrogen sulfide (H_2S) is a toxic gas emitted when large amounts of liquid animal waste are collected in one place. H_2S has proven negative health impacts, such as nausea, headaches, vomiting and severe diarrhea. Prolonged exposure has been associated with neurologic symptoms, which may be more serious in children.[i] Exposure to extremely high levels of H_2S levels is life threatening.[ii iii]

HEALTH RISK VALUE: According to the Minnesota Department of Health, **H_2S becomes a health risk when levels exceed 7 ppb**[iv] (parts per billion) over a 13-week average (Minn. R. 4717.8150).

- Our study shows **122 readings over 7 ppb** at four operations, with readings up to 56.48 ppb.

STATE HYDROGEN SULFIDE STANDARDS: Minnesota state law mandates ambient air quality standards for feedlots, which creates legal limits for H_2S emissions at the property boundary. This limit is significantly higher than the health risk value, and all operations should stay well below the legal limit. The MPCA mandates that feedlots cannot exceed **30 ppb** of H_2S emissions over a 30-minute period more than two times per week, or **50 ppb** of H_2S emissions over a 30-minute period more than two times per year (Minn. R. 7009.0080).

- At two operations (Jeff Finishing and Holst I Finishing), our study results show:
  - 28 readings over 30 ppb.
  - 3 readings over 50 ppb.
  - 4 monitoring sessions in which the 30-minute average was over 30 ppb.

The Pollution Control Agency and the Department of Health must immediately begin continuous air monitoring at Jeff Finishing and Holst I Finishing to further investigate H_2S exceedances and impacts on public health. Meanwhile, the Kohlnhofers must withdraw their Zumbrota Township proposal. Our public health is at risk.

HOW CITIZENS PREPARED FOR HYDROGEN SULFIDE MONITORING

STEP 1: RESEARCH

Citizens connected with other Land Stewardship Project members who have experienced high hydrogen sulfide levels near factory hog farms. They analyzed the models run by the Minnesota Pollution Control Agency that claim factory hog farms will be safe for neighbors. The models had many flaws, and they set out to research the actual H_2S emissions levels at Kohlnhofer hog facilities.

STEP 2: RENTING A HYDROGEN SULFIDE METER

For decades, the Minnesota Pollution Control Agency has relied on a hand-held hydrogen sulfide meter: the Jerome J605 Hydrogen Sulfide Analyzer. This high-tech machine is easy to use and displays the amount of hydrogen sulfide in parts per billion on the screen.

STEP 3: TRAINING ON THE METER & THE SCIENTIFIC PROTOCOL

In 1996, Land Stewardship Project members in Renville County, Minn., conducted in-depth H_2S monitoring near large hog facilities. The monitoring protocol was designed by the late Paul Homme, who was the past director of the microbiology branch of the U.S. Air Force's epidemiology division and had extensive experience setting up scientific investigations.

Julie Jansen, a Renville County resident who participated in H_2S monitoring with Homme, traveled to Goodhue County to train citizens in the H_2S monitoring protocol. She also trained citizens on how to operate and care for the H_2S meter.

STEP 4: HYDROGEN SULFIDE MONITORING

Citizens began H_2S monitoring on June 29, 2017. They monitored in teams of at least two people and recorded data in a monitoring log. Following the scientific protocol, they recorded the weather conditions and the exact location. If possible, they monitored down-wind from the manure pits.

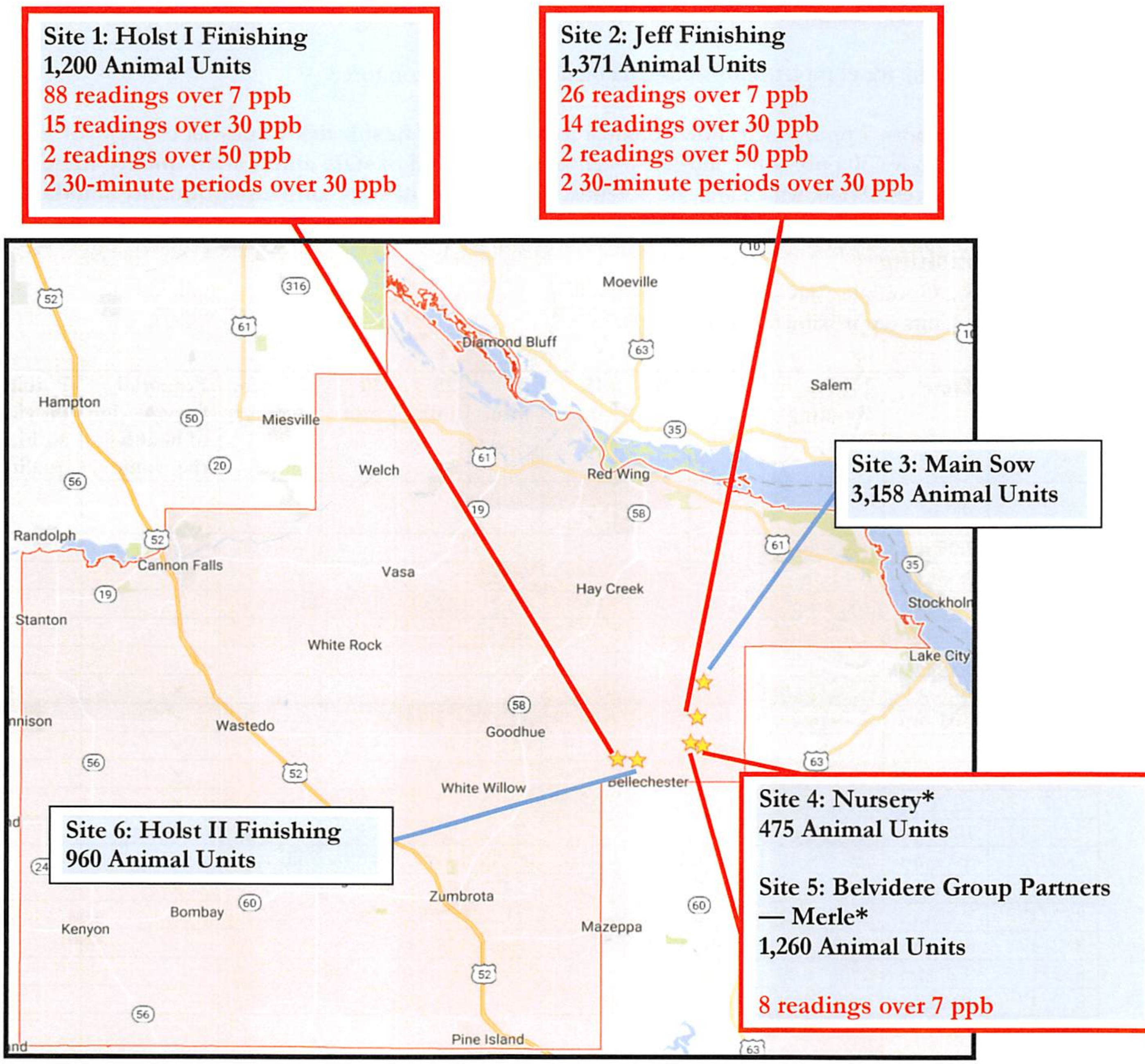
The citizens conducted 47 monitoring sessions throughout a 35-day period, monitoring at the property boundary of 6 Kohlnhofer facilities in Goodhue County. They conducted about 16 hours of monitoring, which is approximately 0.02% of available hours within the 35-day period.

ATTACHMENT 2

Kohlnhofer Factory Farms in Goodhue County and Citizen Hydrogen Sulfide Monitoring

Four Kohlnhofer hog facilities consistently had hydrogen sulfide emissions readings over 7 ppb (parts per billion). The Department of Health indicates that levels above 7 ppb over a sustained period of time pose a threat to public health.

Two Kohlnhofer hog facilities showed hydrogen sulfide readings over 30 ppb and 50 ppb, indicating the potential for violations of state air quality standards.



*Note: Sites 4 and 5 are across the road from each other and were monitored together.

ATTACHMENT 2

Hydrogen Sulfide Data: Readings that Show a Threat to Public Health and Indicate Potential for Violations

The following tables present the complete data for the four Kohlnhofer facilities that recorded high hydrogen sulfide readings. **Holst I Finishing**, **Jeff Finishing**, **Nursery** and **Belvidere Group Partners — Merle.** These facilities consistently showed readings above 7 ppb. The Minnesota Department of Health indicates that sustained hydrogen sulfide levels above 7 ppb pose a risk to public health.

The tables also show the two operations (Holst I Finishing and Jeff Finishing) that recorded readings over 30 ppb and 50 ppb, indicating the potential for violations of our state ambient air quality standards.

Please see appendix for complete emissions data on all 6 facilities monitored.

= Readings above 7 ppb, which show potential for **violation of health risk values** set by Dept. of Health.
= Readings above 30 ppb, which indicate potential for **violation of state ambient air quality standards**.
= Readings over 50 ppb, which indicate potential for **violation of state ambient air quality standards**.

Holst I Finishing

24589 390th St., Goodhue, MN
1,200 Animal Units (approximately 4,000 hogs)

Date	Time	Initial Reading	5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	30-min. average	Potential for violation of health risk value	Potential for violation of ambient air quality standards
6/29/17	7:05 pm	12.29 ppb	0	0						✓	
7/6/17	7:55 pm	6.4 ppb	5.55	10.29	15.26	9.11				✓	
7/7/17	9:14 pm	15.21 ppb	14.79	14.72	23.47	21.35	18.98	17.71	18.03	✓	
7/7/17	9:37 pm	27.67 ppb	28.69	36.83	32.28	22.08	25.65	36.11	29.9	✓	✓
7/10/17	9:05 pm	5.42 ppb	4.11								
7/10/17	9:58 pm	32.69 ppb	29.03	25.45	25.97					✓	✓
7/12/17	9:31 pm	2.40 ppb	3.49	7.78	10.94	11.24	13.94			✓	
7/20/17	7:55 pm	0 ppb	9.3	22.77	3.19	0	0	5.86	5.87	✓	
7/26/17	9:15 pm	29.69 ppb	22.01	24.95	32.89	11.49	7.83	7	19.4	✓	✓
7/27/17	10:20 pm	24.8 ppb	20.81	17.34	24.08	11.69	14.7	12.67	18.01	✓	
7/28/17	10:00 pm	27.1 ppb	17.51	32.18	46.26	40.11	56.48	29.52	35.59	✓	✓
7/30/17	8:45 pm	28.24 ppb	14.02	22.88	32.62	47.49	47.81	37.96	33		✓
8/1/17	9:45 pm	16.27 ppb	13.98	12.05	11.17	5.49				✓	
8/2/17	7:42 pm	10.77 ppb	24.06	24.01	15.55	20.32	17.88	19.45	18.86		
8/2/17	8:17 pm	15.07 ppb	10.91	11.26	22.12	15.27	11.24	13.24	14.16		
8/2/17	9:27 pm	13.77 ppb	14.11	16.09	15.15	20.72	11.84	15.55	15.32		
8/2/17	10:02 pm	10.87 ppb	14.6	37.45	13.77	17.07	22.61	24.41	20.11		✓
8/2/17	10:37 pm	53.34 ppb*									✓

*Note: During the last monitoring session, meter read "Sensor Regeneration Required" and monitoring session was ended prematurely.

ATTACHMENT 2

Jeff Finishing

37112 280th Ave., Goodhue, MN
1,371 Animal Units (approximately 4,570 hogs)

Date	Time	Initial Reading	5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	30-min. average	Potential for violation of health risk value	Potential for violation of ambient air quality standards
6/29/17	7:42 pm	0 ppb									
7/3/17	10:15 pm	40.65 ppb	51.49	50.33	43.75	42.81	36.84	32.58	42.64	✓	✓
7/3/17	10:50 pm	34.18 ppb	39.44	37.41	31.03	30.4	40.63	30.6	33.38	✓	✓
7/5/17	1:09 pm	0 ppb									
7/8/17	7:03 am	4.04 ppb	0								
7/8/17	7:15 am	7.84 ppb	7.34	4.8							
7/15/17	6:06 am	11.25 ppb	11.83	6.55	8.59	6.03	3.28				
7/24/17	9:14 pm	13.27 ppb	12.36	6.29	9.47	10.23	25.89	16.74	13.46	✓	
8/1/17	12:27 am	27.2 ppb	3.84	0						✓	

Nursery & Belvidere Group Partners — Merle*

*Note: These two facilities are across the road from one another and were monitored together.

Nursery:
38448 280th Ave., Goodhue, MN
475 Animal Units
(approximately 9,500 piglets)

Belvidere Group Partners — Merle:
38449 280th Ave., Goodhue, MN
1,260 Animal Units
(approximately 4,200 hogs)

Date	Time	Initial Reading	5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	30-min. average	Potential for violation of health risk value
6/30/17	4:43 am	4.59 ppb	0							
7/1/17	6:29 am	3.23 ppb	6.01	6.4						
7/2/17	6:28 am	4.19 ppb	4.44	8.43	4.85					✓
7/3/17	9:43 pm	5.45 ppb	0	0	5.54	4.02				
7/6/17	8:44 pm	4.88 ppb	6.22							
7/8/17	6:36 pm	0 ppb	8.02							✓
7/10/17	9:15 pm	0 ppb	17.54	15.03						✓
7/10/17	9:44 pm	3.81 ppb	3.3							
7/12/17	8:40 pm	0 ppb	4.17							
7/27/17	9:50 pm	5.7 ppb	5.6	5.93	5.07	5.7	0	4.3	7	
7/29/17	9:40 pm	25.7 ppb	22	16.56	16.84					✓

ATTACHMENT 2

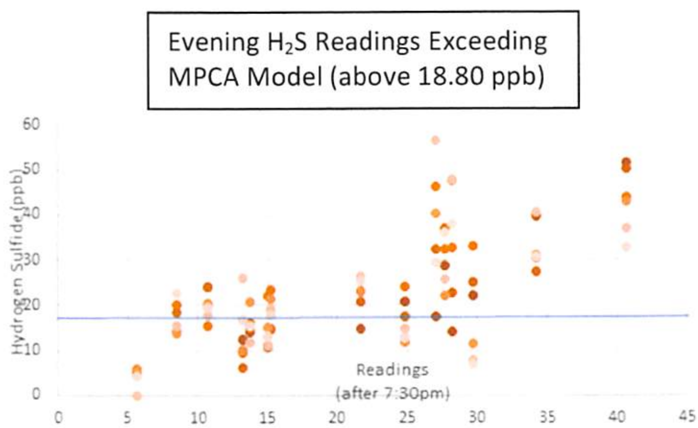
CONCLUSIONS:

Citizen hydrogen sulfide (H_2S) monitoring at Kohlnhofer factory hog farms in Goodhue County, Minn., showed high levels of H_2S emissions at the property boundaries.

H_2S is a toxic gas with proven negative human health impacts. H_2S data gathered over a 35-day period by a team of 15 citizens shows:

- Kohlnhofer hog facilities are likely exceeding health risk values designed by the Minnesota Department of Health, putting our community's health at risk.
- Two Kohlnhofer facilities (Holst I Finishing and Jeff Finishing) may be violating our state air quality standards.

Although citizens were able to monitor for approximately 16 hours, this is only 0.02% of total hours within the 35-day period. Continuous air quality monitoring, conducted by the Minnesota Pollution Control Agency and the Minnesota Department of Health, is needed.



Our data also shows that existing Kohlnhofer facilities are consistently exceeding MPCA H_2S emissions models. The MPCA's H_2S model for the Kohlnhofers' proposed 4,700-hog facility in Zumbrota Township predicts that the project would never exceed 18.80 ppb of H_2S emissions at the property line. Our data shows that smaller Kohlnhofer operations are consistently exceeding this amount, especially in the evening. We do not have confidence that the proposed operation will be safe for our community.

- **To further investigate H_2S emissions exceedances, the MPCA and MDH should immediately begin continuous air quality monitoring at Holst I Finishing and Jeff Finishing. If or when violations are found, the MPCA and MDH should take immediate corrective action to protect the health of the community.**

- **The Kohlnhofers must immediately withdraw their proposal for a 4,700-hog facility in Zumbrota Township. Our community's health is at risk.**

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Appendix

I. Monitoring Protocol

II. Calibration Certificates for Jerome J605 Hydrogen Sulfide Analyzers

III. Complete List of H2S Recordings

Original monitoring sheets are available online at: http://landstewardshipproject.org/repository/1/2251/original_h2s_monitoring_sheets_revised.pdf

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[i] "Medical Management Guidelines for Hydrogen Sulfide," Agency for Toxic Substances & Disease Regulation. https://www.atsdr.cdc.gov/mmg/mmg.asp?id=385&tid=67

[ii] Rapaport, Diane. "Warning: Hydrogen Sulfide," Water Engineering & Management, Jan. 1990, Vol. 137, No. 1, p. 36

[iii] Yale Environmental Protection Clinic. Controlling Odor and Gaseous Emission Problems from Industrial Swine Facilities: A Handbook for All Interested Parties, Kerr Center for Sustainable Agriculture, Poteau, Okla., 1998, 65 pages

[iv] "Environmental Health Information: Excel Dairy, Marshall County, Minnesota," Minnesota Department of Health. http://health.state.mn.us/divs/eh/hazardous/sites/marshall/exceldairy/excelinfo.pdf

ATTACHMENT 2

U.S. ENVIRONMENTAL PROTECTION AGENCY

OFFICE OF INSPECTOR GENERAL

Improving air quality

Eleven Years After Agreement, EPA Has Not Developed Reliable Emission Estimation Methods to Determine Whether Animal Feeding Operations Comply With Clean Air Act and Other Statutes

Report No. 17-P-0396 **September 19, 2017**

ATTACHMENT 2

Report Contributors:

Richard Jones
Erica Hauck
Jim Hatfield
Kevin Good
Julie Narimatsu

Abbreviations

AFO	Animal Feeding Operation
CAA	Clean Air Act
CAFO	Concentrated Animal Feeding Operation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DQO	Data Quality Objective
EEM	Emissions Estimating Methodology
EPA	U.S. Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
GAO	U.S. Government Accountability Office
NAEMS	National Air Emissions Monitoring Study
NAS	National Academy of Sciences
OAQPS	Office of Air Quality Planning and Standards
OIG	Office of Inspector General
PM	Particulate Matter
SAB	Science Advisory Board
USDA	U.S. Department of Agriculture
VOC	Volatile Organic Compound

Cover photos: Hogs (left) and chickens (right) in confined spaces at animal feeding operations. (EPA photos)

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17-P-0396
September 19, 2017

U.S. Environmental Protection Agency
Office of Inspector General

At a Glance

Why We Did This Review

We conducted this review to determine what actions the U.S. Environmental Protection Agency (EPA) has taken to evaluate air emissions from animal feeding operations.

The EPA estimates there are about 18,000 large animal feeding operations nationwide, which can potentially emit air pollutants in high-enough quantities to subject these facilities to Clean Air Act and other statutory requirements. A lack of reliable methods for estimating these emissions prevented the EPA and state and local agencies from determining whether these operations are subject to statutory requirements.

In 2005, the EPA and the animal feeding operations industry entered into a compliance agreement to address this challenge. As part of this agreement, the industry agreed to fund an air emissions monitoring study that the EPA would use to develop improved emission estimating methodologies for the industry.

This report addresses the following:

- *Improving air quality.*

Send all inquiries to our public affairs office at (202) 566-2391 or visit www.epa.gov/oig.

Listing of OIG reports.

Eleven Years After Agreement, EPA Has Not Developed Reliable Emission Estimation Methods to Determine Whether Animal Feeding Operations Comply With Clean Air Act and Other Statutes

What We Found

Until the EPA develops sound methods to estimate emissions, the agency cannot reliably determine whether animal feeding operations comply with applicable Clean Air Act requirements.

The industry-funded National Air Emissions Monitoring Study (NAEMS) and the EPA's analyses of the study's results comprised the agency's primary actions to evaluate air emissions from animal feeding operations over the past decade. The NAEMS monitoring was completed more than 7 years ago at a cost of about $15 million, but the EPA had not finalized any emission estimating methodologies for animal feeding operations. In addition, the EPA had only drafted methodologies for about one-fourth of the emission source and pollutant combinations studied in the NAEMS. The EPA expected to develop and begin publishing emission estimating methodologies by 2009, so the methodologies could be used by the EPA, state and local agencies, and industry operators to determine the applicability of Clean Air Act and other statutory requirements.

Delays in developing the emission estimating methodologies stemmed from limitations with NAEMS data, uncertainty about how to address significant feedback from the EPA's Science Advisory Board, and a lack of EPA agricultural air expertise and committed resources. The EPA had not finalized its work plan or established timeframes to finish the methodologies. As a result, the applicability of requirements to control emissions from individual animal feeding operations remained undetermined, enforcement protections for consent agreement participants remained in effect longer than anticipated, and a number of agency actions on animal feeding operation emissions continued to be on hold. Further, because the EPA had not conducted systematic planning, the agency was at risk of developing emission estimating methodologies that cannot be widely applied to animal feeding operations.

Recommendations and Planned Corrective Actions

We recommend that the EPA conduct systematic planning for future development of emission estimating methodologies. Based on the results of this planning, the EPA should determine whether it can develop emission estimating methodologies of appropriate quality for each of the emission source and pollutant combinations studied. If the EPA determines that it cannot develop certain emission estimating methodologies, it should notify agreement participants and end civil enforcement protections. For the emission estimating methodologies that can be developed, the EPA should establish public milestones for issuing the draft methodologies. The EPA agreed with our recommendations, and we accepted the agency's planned corrective actions.

ATTACHMENT 2

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

THE INSPECTOR GENERAL

September 19, 2017

MEMORANDUM

SUBJECT: Eleven Years After Agreement, EPA Has Not Developed Reliable Emission Estimation Methods to Determine Whether Animal Feeding Operations Comply With Clean Air Act and Other Statutes
Report No. 17-P-0396

FROM: Arthur A. Elkins Jr.

TO: Sarah Dunham, Acting Assistant Administrator
Office of Air and Radiation

Lawrence Starfield, Acting Assistant Administrator
Office of Enforcement and Compliance Assurance

This is our report on the subject evaluation conducted by the Office of Inspector General (OIG) of the U.S. Environmental Protection Agency (EPA). The project number for this evaluation was OPE-FY16-0018. This report contains findings that describe the problems the OIG has identified and corrective actions the OIG recommends. This report represents the opinion of the OIG and does not necessarily represent the final EPA position. Final determinations on matters in this report will be made by EPA managers in accordance with established audit resolution procedures.

Action Required

In accordance with EPA Manual 2750, your office provided planned corrective actions in response to the OIG recommendations. We consider the planned corrective actions for all recommendations to be acceptable. Therefore, you are not required to provide a written response to this final report. The OIG may make periodic inquiries on your progress in implementing these corrective actions. Please update the EPA's Management Audit Tracking System as you complete planned corrective actions.

We will post this report to our website at www.epa.gov/oig.

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Chapters

- continued -

Appendices

Chapter 1
Introduction

Purpose

We conducted this evaluation to determine what actions the U.S. Environmental Protection Agency (EPA) has taken to evaluate air emissions from animal feeding operations (AFOs), including the status of the National Air Emissions Monitoring Study (NAEMS).

Background

AFOs are agriculture operations where animals are kept and raised in confined areas. The U.S. Department of Agriculture (USDA) has estimated that there are about 450,000 AFOs nationwide. While the majority of these are small operations with fewer than 300 animals, the EPA has estimated there are more than 18,000 large AFOs[1] that may raise thousands of animals. For more than two decades, movements to improve profitability within the agriculture industry have resulted in larger AFO facilities that often are geographically concentrated. As facility size has increased and greater numbers of animals are housed in confined spaces, concerns have arisen regarding these facilities' impacts on the environment and public health.

The EPA regulates certain larger AFOs under the Clean Water Act's National Pollutant Discharge Elimination System permit program, which regulates the discharge of pollutants to the waters of the United States. AFO air emissions are not regulated by any AFO-specific standards under the Clean Air Act (CAA), but AFOs that emit air pollutants in sufficient quantities can trigger CAA permit requirements. In the late 1990s, the EPA recognized that it did not have sufficient AFO air emissions data to develop reliable emission estimating methodologies (EEMs) for determining whether individual AFOs are subject to CAA permit requirements or emission reporting requirements under two other statutes: the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Emergency Planning and Community Right-to-Know Act (EPCRA).[2] Both CAA permitting requirements and CERCLA/EPCRA release

---

[1] EPA water regulations define AFOs and a subset of larger AFOs called concentrated animal feeding operations (CAFOs), and the Clean Water Act includes CAFOs as a type of point source. The CAA does not define or reference these terms, and the EPA's Office of Air and Radiation does not distinguish between an AFO and a CAFO. Thus, we use the term "AFO" throughout our report, even when referring to a facility that would meet the definition of a CAFO under the Clean Water Act.

[2] EPCRA and CERCLA require facilities to report emissions of certain hazardous substances if they are released in quantities at or above certain thresholds. This includes two hazardous substances commonly released by AFOs: ammonia and hydrogen sulfide.

reporting requirements are triggered only if a facility emits certain pollutants at or above specific regulatory thresholds.

The agency began discussions with representatives of the AFO industry in 2001 to address uncertainty in determining the applicability of statutory requirements for air emissions. As a result, the EPA and certain sectors of the AFO industry[3] (e.g., pork and broiler producers, egg layers, and dairy) negotiated a consent agreement, which was published in 2005[4] and entered into by AFO owners/operators who elected to participate. Under this agreement, participating AFO owners/operators agreed to pay a civil penalty, comply with all applicable requirements of the agreement, and participate (if selected) in a national monitoring study. The AFO sectors agreed to fund the monitoring study to provide data the EPA would use to develop EEMs for various AFO pollutants and emission sources.

Air Emissions From AFOs

AFOs can release several pollutants, including but not limited to: ammonia, hydrogen sulfide, particulate matter (PM), volatile organic compounds (VOCs) and hazardous air pollutants. AFO air emissions come from lagoons, barns and other structures, and manure spread on fields. Table 1 lists the key pollutants emitted from AFOs, along with their common emission sources and associated health and air quality effects.

Table 1: Emission sources and health effects of key pollutants from AFOs

Pollutant	Common emission sources	Health and air quality effects
Ammonia (NH_3)	Decomposition of animal manure.	Can cause severe cough and chronic lung disease. It also contributes directly to the formation of $PM_{2.5}$, and deposition can impact sensitive ecosystems.
Volatile organic compounds (VOCs)	Animal feed and waste.	Can cause eye, nose and throat irritation; damage to liver, kidney and central nervous system; and cancer. VOCs also contribute to the formation of ground-level ozone.
Particulate matter (PM)*	Dry manure, bedding and feed materials, and dirt feed lots.	Exposure is linked to a variety of problems, including decreased lung function, increased respiratory symptoms, and premature death in people with heart or lung disease.
Hydrogen Sulfide (H_2S)	Decomposition of animal manure stored in wet conditions such as lagoons.	Can cause eye and respiratory irritation at lower concentrations. At higher concentrations, paralysis of the respiratory center can lead to rapid death. Excess emissions can contribute to the formation of $PM_{2.5}$ and acid rain.

Source: EPA Office of Inspector General (OIG) analysis.

* PM includes both fine particles ($PM_{2.5}$,) and coarser particles (PM_{10}).

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[3] According to the EPA, state and local agencies, and an environmental organization also participated in initial discussions on the agreement.

[4] Animal Feeding Operations Consent Agreement and Final Order, 70 Fed. Reg. 4958-4977 (Jan. 31, 2005).

AFOs can be located near residences, and some communities have multiple AFOs nearby. For example, several counties in eastern North Carolina have the highest concentration of swine AFOs in the United States. Some studies have raised concerns that lower-income and minority communities are disproportionately impacted by air emissions from AFOs. Studies conducted in North Carolina found that residents living near swine AFOs were disproportionately low-income people of color. Air pollution from these AFOs is associated with the potential health impacts listed in Table 1 above, as well as a reduced quality of life due to persistent odors[5] and declining property values.[6]

Highlights from external studies on impacts from AFO air emissions:

- **Residential property values were reduced by an average of almost 23 percent within 1.25 miles of a large swine AFO.[a]**
- **The closer children go to school near a large AFO, the greater the risk of asthma symptoms.[b]**
- **Living in close proximity to large swine AFOs may result in impaired mental health and negative mood states, such as tension, depression or anger.[c, d]**

[a] Simons, R.A. et al., 2014. The Effect of a Large Hog Barn Operation on Residential Sales Prices in Marshall County, KY. JOSRE. 6(1).
[b] Mirabelli, M. C. et al., 2006. Asthma Symptoms Among Adolescents Who Attend Public Schools That Are Located Near Confined Swine Feeding Operations. Pediatrics. 118;66-75.
[c] Bullers, S., 2005. Environmental Stressors, Perceived Control, and Health: The Case of Residents Near Large-Scale Hog Farms in Eastern North Carolina. Human Ecology. 33(1).
[d] Schiffman, S. S. et al., 1995. The Effect of Environmental Odors Emanating From Commercial Swine Operations on the Mood of Nearby Residents. Brain Research Bulletin. 37(4): 369-375.

Characterizing air emissions from AFOs is difficult due to a number of factors. AFOs can have many and varied sources of air emissions, including barns, houses, feedlots, pits, lagoons, basins and manure spray fields. Each of these emission sources can emit a variety of air pollutants, and emission rates can fluctuate depending on climate and geographical conditions, among other factors. Further, characterizing AFO air emissions requires expertise in multiple scientific disciplines, including animal nutrition, AFO practices and atmospheric chemistry.

The EPA and the USDA have been collaborating on a manual of voluntary best management practices to provide AFO owner/operators and state and local governments with options to reduce AFO air emissions. The manual contains best management practices for reducing particulate matter, ammonia, hydrogen sulfide, and other air emissions through various aspects of AFO management, including feed management, manure management, land application, and other areas. The EPA plans to publish the manual before the end of 2017, pending agency administration approval.

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[5] Odors are not regulated by the EPA, but may be addressed under some state and local laws.
[6] Simons, R.A. et al., 2014. The Effect of a Large Hog Barn Operation on Residential Sales Prices in Marshall County, KY. JOSRE. 6(1).
Kim, J. et al., 2009. A Spatial Hedonic Approach to Assess the Impact of Swine Production on Residential Property Values. Environ Resource Econ. 42: 509-534.

National Academy of Sciences Report on AFO Air Emissions

In 2001, the EPA and USDA jointly requested that the National Academy of Sciences (NAS) evaluate the body of scientific information used for estimating various kinds of air emissions from AFOs. In 2003, the NAS reported[7] that accurate emissions estimates were needed to determine AFOs' potential impacts and to assess the implementation of measures to control emissions. The NAS also reported that the EPA had not dedicated the necessary resources to estimate AFO air emissions, and that the agency's approach to estimating emissions was inadequate. That approach involved deriving emission factors from published emissions data, as well as gathering emission factors from existing literature. These emission factors were then applied to representative farms to estimate annual mass emissions. The NAS reported that this approach did not account for the variability among AFOs (e.g., differences in geography and climate) and thus cannot adequately estimate air emissions from an individual AFO.

The NAS recommended that the EPA develop a "process-based" approach to estimate AFO air emissions. The NAS favored such an approach for most types of emissions as the primary focus for both short- and long-term research,[8] but also stated that short-term research should focus on providing "defensible estimates of air emissions that could be used to support responsible regulation."[9] The NAS described process-based models as mathematical models "that describe the movement of various substances of interest at each major stage of the process of producing livestock products: movement into the next stage, movement in various forms to the environment, and ultimately movement into products used by humans."[10]

Air Compliance Agreement With AFO Industries

In 2002, spurred in part by uncertainty about emission levels from AFOs and concerns about applicability of CAA requirements, representatives of the pork, egg producers, and other AFO sectors proposed a plan to EPA officials to produce air emissions monitoring data from AFOs. Negotiations between the EPA and AFO sectors[11] lasted for more than 2 years before an agreement was finalized in 2005. As a condition of the 2005 Air Compliance Agreement (henceforth, the "Agreement"), the industry agreed to fund a large-scale emissions monitoring study. The EPA was to use the emissions monitoring data to develop EEMs that

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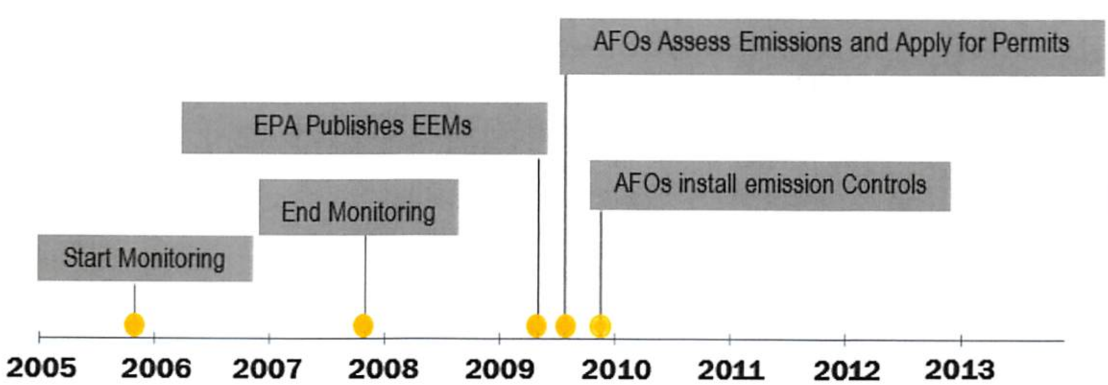
[7] *Air Emissions from Animal Feeding Operations: Current Knowledge, Future Needs*, NAS National Research Council (2003).
[8] 2003 NAS report, pp. 152-153.
[9] 2003 NAS report, p. 25.
[10] 2003 NAS report, p. 9.
[11] Participating AFO sectors included egg layers, broiler chickens, dairy cattle and swine. The turkey sector was a part of the negotiations as well, but not enough turkey AFO owners/operators signed up to fund monitoring. The Agreement did not cover beef cattle.

AFOs could apply to estimate their emissions and determine the applicability of CAA permitting and CERCLA/EPCRA release reporting requirements. Once a facility applied the EEMs to determine its emissions, the facility was to submit all required CAA permit applications and/or report any hazardous substance releases requiring notice under CERCLA/EPCRA.[12]

The Federal Register Notice (henceforth, the "Notice") that published the Agreement included the EPA's expectation that the emissions monitoring study would begin in 2005 and last 2 years. The Notice also described the EPA's expected timeframes for completing the tasks subsequent to the study. Based on these original expectations, the EPA would begin publishing final EEMs in 2009, and AFOs would have obtained any necessary permits and installed emission controls by 2010. Figure 1 shows the timing for these different activities.

Figure 1: Expected timeframes for monitoring study and EEM development



Source: OIG analysis of the Notice publishing the Agreement. 70 Fed. Reg. 4958-4977 (Jan. 31, 2005).

[12] In a 2008 rule, the EPA exempted from CERCLA Section 103 reporting requirements all releases of hazardous substances to the air from animal waste at AFOs. The rule also exempted such releases from EPCRA Section 304 reporting requirements, except when AFOs confine a number of animals at or above the large CAFO threshold, as defined under Clean Water Act regulations. However, on April 11, 2017, the U.S. Court of Appeals for the District of Columbia Circuit ruled in favor of a group of environmental organizations that challenged the exemption and ordered that the 2008 rule be vacated (*Waterkeeper Alliance et al. v. EPA*). On July 17, 2017, the EPA filed a motion requesting the Court grant a stay of the ruling for six months to allow the EPA time to develop guidance for farms on reporting requirements. On August 16, 2017, the Court ordered a stay of the ruling through November 14, 2017. The EPA has 75 days from August 16, 2017, to request an extension of the stay if needed.

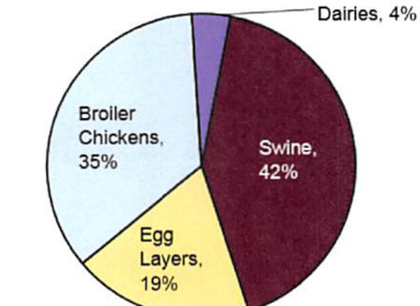
Primary provisions for AFOs participating in the Air Compliance Agreement include:

- **Pay up to $2,500 per farm to fund a 2-year emissions study.**
- **Agree to make their property available for emissions monitoring if selected as a monitoring site for the study.**
- **Pay a civil penalty ranging from $200 to $1,000, depending on the size and number of AFOs covered by the participant's Air Compliance Agreement.**
- **Receive protection from enforcement actions for civil violations of the CAA, CERCLA and EPCRA, to last until either (1) the EPA finalizes EEMs, or (2) the EPA notifies the facility that it was unable to finalize EEMs.**

Under the Agreement, participating AFOs were granted a release and covenant not to sue for potential CAA, CERCLA and EPCRA violations alleged in the Agreement (henceforth, "civil enforcement protections") until the EEMs are developed and AFOs apply for applicable CAA permits and report qualifying releases under CERCLA and EPCRA, or the EPA determines it cannot develop EEMs and notifies Agreement participants accordingly.

The EPA entered into 2,568 separate agreements with AFO owners and operators, which covered about 13,900 AFOs in 42 states. According to the EPA, these 13,900 AFOs comprise more than 90 percent of the largest AFOs in the United States. Figure 2 illustrates the percentage of all Agreement participants by type of animal raised.

Figure 2: Agreement participants by type of animal raised



Source: EPA

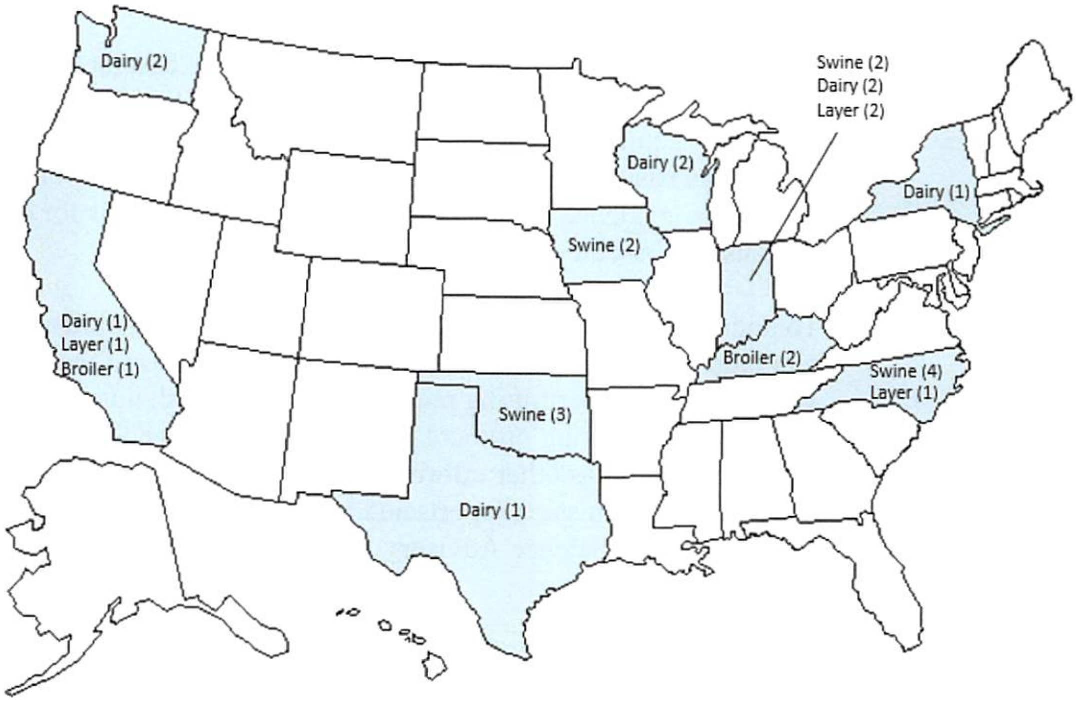
Monitoring Study Methodology

About $15 million was collected from the AFO sectors participating in the Agreement to fund the NAEMS emissions study. The NAEMS protocol provided the framework for the field sampling plan, and was developed through a collaborative effort of industry experts, university scientists, EPA and other government scientists, and other stakeholders knowledgeable in the field. The Agricultural Air Research Council—a nonprofit organization established by industry—was responsible for managing and disbursing funds for the study.

The Agricultural Air Research Council was also responsible for selecting a Science Advisor to develop a detailed study design and quality assurance plan, and to oversee the emissions monitoring work, including work conducted by the contracted principal investigators. The principal investigators—most of whom were researchers at land grant universities with expertise in animal agriculture and/or emissions measurement—carried out the monitoring at selected sites. EPA staff did not collect monitoring data, but conducted audits at monitoring sites to ensure that proper techniques and protocols were followed.

Monitoring was conducted at 27 total sites (i.e., specific sources of emissions such as a barn or a lagoon).[13] Measurements of ammonia, particulate matter (PM_{10} and $PM_{2.5}$),[14] total suspended particulates, VOCs, hydrogen sulfide, and carbon dioxide[15] were taken at broiler chicken, egg layer, swine, and dairy confinement sites (e.g., houses and barns). Measurements of ammonia, hydrogen sulfide, and VOCs were taken at swine and dairy open-source sites (e.g., lagoons and basins). Figure 3 shows the location of monitoring sites across the country.

Figure 3: NAEMS monitoring site locations



Source: OIG analysis of NAEMS site reports.

Other types of measurements were also taken at monitoring sites to help characterize emissions. These measurements included meteorological data (such as temperature and wind speed), and information on the number of animals at AFO monitoring locations, how the animals were housed, and how their waste was managed. The Agreement stated that the EPA would use data from the NAEMS and any other relevant data to develop EEMs.

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[13] The 27 monitoring sites were located at 23 AFOs. Monitoring was conducted at two sites (emission sources) for four of the 23 participating AFOs.

[14] PM_{10} describes inhalable particles with diameters that are generally 10 micrometers and smaller. $PM_{2.5}$ describes fine inhalable particles with diameters that are generally 2.5 micrometers and smaller.

[15] While carbon dioxide was measured at confinement sites as part of the NAEMS, the EPA never intended to create EEMs for carbon dioxide emissions.

Responsible Offices

The EPA office primarily responsible for development of the Agreement was the Office of Enforcement and Compliance Assurance. The EPA office responsible for developing EEMs from the NAEMS data is the Office of Air Quality Planning and Standards within the EPA's Office of Air and Radiation, while the Office of Research and Development plays a supporting role.

Scope and Methodology

We conducted our performance audit from April 2016 through May 2017, in accordance with generally accepted government auditing standards. Those standards require that we obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our objective. We believe the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objective.

To address our objective, we identified and reviewed applicable statutes, regulations, policies and guidance, including sections of the CAA and the Clean Water Act, CAA permitting requirements and thresholds, and the Agreement and associated monitoring protocol. To help us determine the status of the EPA's NAEMS, as well as other efforts to evaluate AFO air emissions, we obtained and reviewed EPA emission reports and analyses, NAEMS-related reports and studies, an EPA Science Advisory Board (SAB) report, and documents related to EPA legal proceedings.

To determine state efforts to address AFO air emissions, we reviewed state regulations and programs for a selected number of states. We also reviewed petitions requesting that the EPA regulate AFO air emissions, and an administrative complaint alleging discrimination against minorities in North Carolina in permitting AFOs. In addition, we reviewed academic studies and reports to determine AFO air emissions and health impacts, and potential disparate impacts in overburdened communities.

We interviewed EPA staff and managers in the Office of Air Quality Planning and Standards, the Office of Enforcement and Compliance Assurance, the Office of Research and Development, the Office of Civil Rights, the Office of Water, and EPA Region 4 (which covers North Carolina), to gain an understanding of EPA actions to evaluate and address AFO air emissions. We also interviewed the following stakeholders to discuss the Agreement and the history and status of the NAEMS:

- USDA's Natural Resources Conservation Service staff.
- SAB members who reviewed the EPA's draft EEMs.
- An AFO industry advisor.
- AFO academic researchers at Purdue University, North Carolina State University, and University of North Carolina-Chapel Hill.

In addition, we interviewed organizations (Sierra Club, Food & Water Watch, EarthJustice, Waterkeeper Alliance) that submitted CAA petitions to regulate AFO emissions. We also interviewed organizations that submitted a Title VI administrative complaint (the North Carolina Environmental Justice Network and the Rural Empowerment Association for Community Help) alleging discrimination in AFO permitting in North Carolina.

To assess internal controls, we reviewed EPA policies and guidance on quality assurance, including the following:

- The EPA's Quality Policy.
- The EPA's Procedure for Quality Policy.
- The EPA's *Guidance on Systematic Planning Using the Data Quality Objectives Process.*
- The EPA's Office of Air Quality Planning and Standards' Quality Management Plan.

We also reviewed the quality assurance project plans developed for the NAEMS and early draft EEM development.

Prior Report

In September 2008, the U.S. Government Accountability Office (GAO) issued a report on AFOs titled *Concentrated Animal Feeding Operations: EPA Needs More Information and a Clearly Defined Strategy to Protect Air and Water Quality from Pollutants of Concern* (GAO-08-944). GAO reported that the EPA did not have the data needed to effectively regulate CAFO air emissions; specifically, the EPA lacked data on air emission from CAFOs, which the EPA is trying to address through the NAEMS. GAO found that the EPA lacked consistent and accurate data for CAFOs regulated under the Clean Water Act, and that such data—like the locations of the CAFOs—could assist with an assessment of CAFO air emissions. GAO reported that two, then-recent decisions by the EPA suggest that the agency had not yet determined how it intended to regulate air emissions from CAFOs:

- The EPA proposed to exempt releases to the air of hazardous substances from farm manure from both CERCLA and EPCRA notification requirements.

- The EPA stated it will not make key regulatory decisions on how federal air regulations apply to CAFOs until after the NAEMS is completed.

GAO recommended that the EPA (1) reassess the data collection efforts of the NAEMS, and (2) establish a strategy and timetable for developing process-based emission estimating protocols for CAFOs. GAO determined that the EPA has implemented the first recommendation but has not completed the second one.

Chapter 2
EPA Plans for Finalizing EEMs Were Not Accomplished and Potential Air Quality Impacts Continue

The EPA had not published any final EEMs for AFOs, and had not finalized its workplan or established timeframes for completing them. Moreover, progress had been limited since 2013, when the EPA's SAB concluded that draft EEMs developed by the EPA should not be applied on a national scale as intended, and made several recommendations to improve the EPA's statistical analyses. At the time of the Agreement in 2005, the EPA expected that it would begin publishing final EEMs in 2009. Further, the EPA expected that by 2010 the AFO industry would have used the EEMs to assess their emissions, apply for any applicable CAA permits, and install any necessary emission reduction controls.

The EPA collaborated with a committee of external stakeholders to develop a protocol they believed would provide sufficient, representative data for the EPA's EEM development efforts. However, public comments submitted to the EPA on the planned NAEMS protocol, and the 2008 GAO report, questioned whether the NAEMS would provide enough data to produce scientifically and statistically valid EEMs. As a result of the delays, individual AFOs have not applied EEMs to determine whether their air emissions were significant enough to require CAA permits and related emissions controls, while civil enforcement protections for Agreement participants remained in effect.

Development of EEMs Is Years Behind Schedule

Based on the original expectations for completion of the tasks in the Notice, the NAEMS monitoring would have been completed in 2007, and the EPA would have begun publishing EEMs in 2009. By 2010 all facilities would have done the following:

1. Applied the EEMs to determine whether they met or exceeded CAA permitting and/or CERCLA/EPCRA release reporting thresholds, and whether permitting and reporting were required.

2. Submitted any required CAA permit applications and CERCLA/EPCRA release notifications.

3. Implemented the mitigation and emission control requirements described in their permits. At this point, the protections from civil enforcement actions under the Agreement would have ended for participating AFOs.

However, EPA staff told us that this timeline did not account for time required for the EPA's Environmental Appeals Board to approve individual agreements, which took longer than anticipated and was not completed until December 2006. Further, it did not account for monitoring that occurred on a rolling basis, and thus took more than 2 years to complete.

The NAEMS monitoring was completed in early 2010, about 2 years later than originally expected. The EPA began developing draft EEMs after monitoring was completed. In 2012, the EPA placed its draft EEMs on its public website for public comment. Draft EEMs covered eight[16] of the 36[17] emission source and pollutant combinations described in the Agreement. The EPA's Office of Air and Radiation also submitted the draft EEMs to the SAB to obtain feedback on EEM development and related questions. The SAB conducted its review of draft EEMs in 2012 and issued its final report[18] on April 19, 2013.

At the time we finished our review in May 2017, the EPA had not finalized any draft EEMs, or developed any additional draft EEMs. According to the 2005 Agreement, the EPA expected to begin publishing final EEMs within 18 months after completion of the NAEMS monitoring.

Figure 4 shows a timeline of expected and actual NAEMS and EEM development activities up to the 2013 SAB final report.

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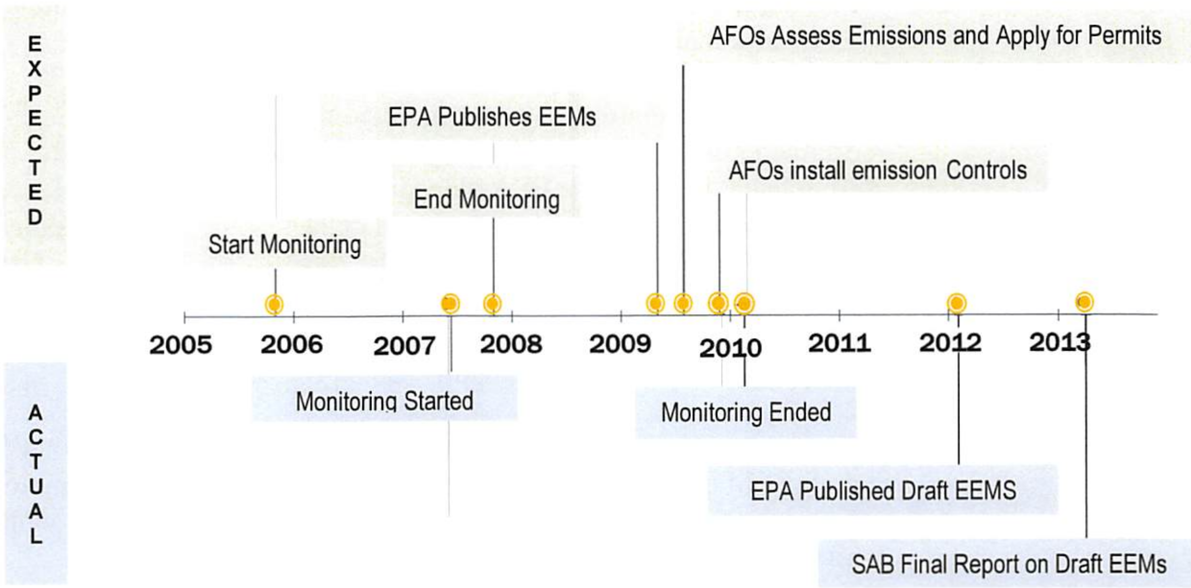
[16] These included EEMs to estimate six different types of emissions from broiler chicken houses, and EEMs to estimate ammonia emissions from dairy and swine lagoons/basins. Also, see Table 2.
[17] According to the Office of Air and Radiation, the number of EEMs that will ultimately be developed will be influenced by factors such as differences in production, management and building conditions, as well as availability of sufficient data.
[18] *SAB Review of Emissions-Estimating Methodologies for Broiler Animal Feeding Operations and for Lagoons and Basins at Swine and Dairy Animal Feeding Operations*, EPA-SAB-13-003 (2013).

Figure 4: Expected and actual NAEMS/EEM development timeline



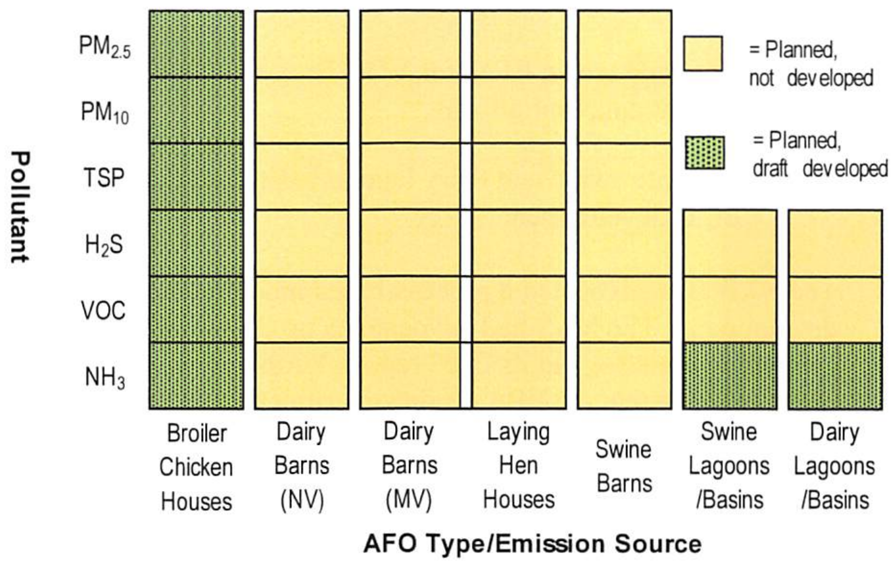
Source: OIG analysis of EPA documents.

Responding to SAB Concerns and a Lack of Resources Slowed Development of EEMs

The SAB identified several concerns with the draft EEMs, and the Office of Air and Radiation did not agree with some of the concerns. Since that time, EEM development slowed considerably, as the EPA decided how to address the SAB's concerns. The EPA also encountered resource constraints and a lack of available technical expertise.

Table 2 shows all emission source and pollutant combinations from the Agreement,[19] and the draft EEMs that were developed and submitted to the SAB for review.

Table 2: Status of EEM development



Source: OIG analysis.

$PM_{2.5}$:	Particulate matter < 2.5 micrometers	H_2S:	Hydrogen Sulfide
PM_{10}:	Particulate matter < 10 micrometers	VOC:	Volatile organic compounds
TSP:	Total suspended particulates	NH_3:	Ammonia

SAB Review of Draft EEMs and EPA Response

The SAB concluded that the data and methodology used to develop the draft EEMs limited the ability of the models to estimate emissions beyond the small number of AFOs in the NAEMS data set. Specifically, the SAB concluded that the number of sites monitored was too small relative to the size of the industry; the models were based on variables that did not accurately predict emissions; the EPA should not have combined swine and dairy lagoon/basin data; and there were significant limitations with the VOC data for broiler houses. Thus, the SAB recommended that the EPA not apply the current version of the EEMs beyond the AFOs in the EPA's dataset.

[19] This included EEMs for both naturally ventilated (NV) and mechanically ventilated (MV) dairy barns, as discussed in the Agreement.

The SAB made a number of other recommendations, including having the EPA do the following:

- Expand its dataset by collecting data from monitoring efforts outside of the NAEMS, and using NAEMS data that were initially excluded due to the EPA's data completeness criteria.
- Not generate an EEM for VOC emissions from broiler operations based on current data limitations.
- Separate swine and dairy lagoon/basin data that had been combined for EEM development.

The SAB also advocated a process-based modeling approach to EEM development. The NAS had advocated a process-based modeling approach to estimating emissions in its 2003 report. Further, in its 2008 report, GAO recommended that the EPA establish a strategy and timetable for developing process-based emission estimating protocols for CAFOs. The SAB noted the following:

> Process-based models would be more likely to be successful in representing a broad range of conditions than the current models because process-based models represent the chemical, biological and physical processes and constraints associated with emissions.

According to the Notice publishing the Agreement, the EPA believed process-based modeling to be a large and complex, multiyear research effort. Therefore, the EPA planned to develop an interim modeling approach, which would be a critical first step to developing a process-based modeling approach. The modeling approach the EPA ultimately selected for the draft EEMs used a statistical software program to analyze the various measurements taken during the NAEMS and identify those variables that predict emissions. The SAB recognized that the EPA may need to apply statistical approaches to assess emissions while it was developing and evaluating process-based models, and thus made recommendations to improve the EPA's chosen approach, as discussed above.

Prior Stakeholder Feedback Questioned the NAEMS Monitoring Approach

The SAB's concerns about the number of monitoring sites being able to support statistically based EEMs was raised in public comments on the Agreement and protocol before the EPA began developing EEMs, and was also raised by GAO in its 2008 report on the EPA's efforts to characterize AFO pollution.

After the NAEMS protocol was made available for public comment in 2005, a number of external groups expressed concerns about the study design and whether it would lead to credible scientific data. Some commenters noted that the number of sites was too limited to account for all the differences in types of manure management systems, building types, ventilation rates, feeding practices, animal type/age, animal management practices, geography and climate. The commenters noted that even for the types of AFOs monitored, there may not be a sufficient number of samples to establish statistically valid EEMs. Similarly, in its 2008 report, GAO cautioned that the NAEMS may not supply the data needed for the EPA to develop comprehensive EEMs. Further, the GAO report stated that members of the USDA Agricultural Air Quality Task Force had raised concerns about the quality and quantity of data collected, and had pushed for the EPA to review the first 6 months of monitoring data to determine whether the study needed to be revised to yield more useful information.

According to the NAEMS Science Advisor, the NAEMS protocol could be viewed as a compromise between compliance-minded EPA, budget-minded industry, and publication-minded universities. The protocol developers decided on an approach that focused on collecting a comprehensive set of monitoring data (i.e., 2 years of monitoring many different AFO conditions and parameters) at a smaller number of sites, as opposed to collecting a smaller set of data at more sites. According to the EPA, costs were a factor in this decision because mobilizing and demobilizing equipment and then re-deploying at new sites would have depleted funds that could be used for monitoring. The protocol developers believed the chosen monitoring plan would produce sufficient data for EEM development if the selected monitoring sites represented how the majority of animals are raised in the different AFO sectors.

Although the monitoring protocol was developed as a joint effort of researchers knowledgeable about AFO operations and/or monitoring techniques, there was no comprehensive internal or external assessment to determine the amount of data needed to produce scientifically and statistically sound EEMs that could be extrapolated nationwide. The EPA did not perform such an assessment prior to the NAEMS, in part, because it did not know which variables would most impact air emissions at AFOs, and the agency wanted to see the data before selecting a modeling approach for EEM development. Also, the NAEMS protocol and detailed monitoring plans were not peer reviewed to ensure that the NAEMS would provide sufficient data for the EPA to produce a comprehensive suite of EEMs.

EPA's EEM Development Activities Since 2013 Have Been Limited

The EPA planned to continue EEM development using its statistically based approach, and had addressed some of the SAB's recommendations by acquiring additional data sets from other external studies, and reassessing data completeness criteria for the NAEMS. However, the draft EEMs that were submitted to the SAB for review had not been revised, and the EPA had not begun developing EEMs for the remaining 28 emission source and pollutant combinations.

A lack of expertise and resources slowed the agency's work on the EEMs in recent years. According to EPA managers, the agency in recent years did not have staff with combined expertise in agricultural emissions, air quality and statistical analysis. At the time the NAEMS protocol was developed, the EPA had more applicable expertise, but the key staff involved in the NAEMS protocol development retired. Further, competing priorities resulted in the EPA's Office of Air and Radiation putting the EEM effort largely on hold. The EPA had dedicated few agency resources to develop EEMs since the SAB's 2013 final report. The few remaining agency staff who worked on the NAEMS and subsequent data analysis were reassigned to other work, and the EPA stopped funding the contract for NAEMS analysis.

The EPA's most recent draft EEM development work plan, dated March 2016, provided a general framework for how the EPA intended to finish all planned EEMs. The draft plan stated that a new staff person with appropriate expertise, along with student contractor support, would complete the EEMs. The EPA hired the new staff person and a student contractor in January 2017 but had not yet finalized timeframes for completing EEM development.

AFO Air Emissions Remain Largely Uncharacterized and Important Agency Actions Are on Hold

Eleven years after the Agreement was entered, and 7 years after NAEMS monitoring was completed, the EPA, state, local and tribal permitting authorities, and AFO owners/operators, did not have scientifically defensible EEMs needed to make CAA and CERCLA/EPCRA compliance determinations. In addition, the civil enforcement protections for the approximately 14,000 AFOs that participated in the Agreement remained in effect more than 6 years after intended expiration, and several important EPA actions were on hold pending development of the EEMs.

CAA Permit and CERCLA/EPCRA Reporting Determinations Have Not Been Made

Per the Agreement, facilities were not required to determine whether CAA permitting and CERCLA/EPCRA reporting requirements apply to them until the EPA publishes final EEMs. However, once final EEMs are published, participating AFOs are required to use the EEMs to estimate their emissions and come into compliance with applicable CAA and CERCLA/EPCRA requirements.

The Agreement states that a source with emissions exceeding CAA major source permitting thresholds[20] would have to do one of the following:

1. Apply for and obtain a permit that contains a federally enforceable limitation or condition that limits the potential emissions to less than the applicable major source threshold for the area where the source is located.

2. Install either best available control technology in attainment areas,[21] or lowest achievable emission rate technology in nonattainment areas;[22] and then obtain a federally enforceable permit that incorporates the appropriate best available control technology or lowest achievable emission rate limit.

Delays in issuing the EEMs resulted in facilities continuing to have civil enforcement protections even if their emissions were exceeding CAA permit or CERCLA/EPCRA reporting thresholds. Given the lack of reliable EEMs, it was difficult to estimate how many facilities could be exceeding these thresholds. However, monitoring conducted as part of an EPA enforcement case in 2003 demonstrated that some large AFOs can exceed the 250-tons-per-year permitting threshold for PM emissions. That monitoring showed total PM emissions of 550 and 700 tons per year at two large egg-layer AFOs.

The NAEMS Science Advisor analyzed NAEMS data for the pork and egg-layer industries, which indicated that pork and egg-layer AFOs could frequently exceed the EPCRA reporting threshold for ammonia of 100 pounds per day. This analysis indicated that pork and egg layer AFOs were unlikely to exceed 250 tons per year of PM_{10} or VOC emissions. However, the Science Advisor's analysis did not address whether pork or egg-layer AFOs would trigger permitting requirements in poor air quality areas where regulatory thresholds are lower.

Paragraph 38 of the Agreement required the EPA to end civil enforcement protections for those emission sources/types for which the EPA determined it was unable to develop EEMs. As described earlier, the SAB concluded in its 2013 report that the EPA did not have sufficient data to develop an EEM for VOC emissions from broiler houses. Further, more than 7 years since completion of the NAEMS, the EPA had only developed draft EEMs for eight of a possible 36 emission source and pollutant combinations. However, the EPA had not yet determined that it could not develop any of the EEMs, and thus has not waived enforcement protections for any of the emissions sources covered under the 2005 Agreement.

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[20] Applicable regulatory thresholds range from 10 tons per year in areas with very poor air quality (called extreme nonattainment areas) to 250 tons per year in areas with adequate air quality (called attainment areas).
[21] A geographic area is generally designated as being in attainment for a particular criteria air pollutant if the concentration of that pollutant is found to be at or below the regulated or "threshold" level for the associated National Ambient Air Quality Standard.
[22] A geographic area is generally designated as being in nonattainment for a particular criteria air pollutant if the concentration of that pollutant is found to exceed the regulated or "threshold" level for the associated National Ambient Air Quality Standard.

Agency Actions on Hold

Delays in completing EEMs have also caused important agency efforts to address or mitigate AFO air emissions to remain on hold. The EPA stated it would not take the following actions until the EEMs are finalized because they are needed to inform the agency's decision-making:

Responding to citizen petitions to regulate AFOs. The EPA has received petitions to address AFO emissions in regulations beyond the current permitting CAA provisions, which include a 2009 petition to list and regulate AFOs as a source category under CAA Section 111, and a 2011 petition to regulate ammonia as a criteria pollutant under CAA Sections 108 and 109. EPA staff told us they did not plan to evaluate the need for additional regulations as laid out in these petitions until the EEMs are finalized.

Defining "source" for aggregation purposes. The aggregation of sources pertains to how many individual emission sources are counted together to determine whether a facility exceeds CAA major source status, and thus impacts how many facilities could exceed permitting thresholds. For example, if a barn at an AFO rather than the entire AFO is a "source," fewer AFOs could be impacted by CAA permitting requirements. The EPA had not issued guidance on this issue, and said it planned to do so after developing the EEMs.

In our view, final EEMs are also necessary for the EPA to develop compliance and enforcement strategies for Agreement non-participants, and to assess whether AFO emissions may contribute to disproportionate health risks to certain communities.

Conclusion

The EPA's ability to characterize and address AFO air emissions is unchanged since its 2005 Agreement with the AFO industry intended to produce reliable emissions estimation methods. As a result, individual AFOs have not estimated their emissions to determine whether they are required to implement controls to reduce emissions and/or report their emissions to the appropriate emergency responders. Additionally, other important agency actions pertaining to AFO air emission estimates continue to be on hold.

Timeframes for completing EEM development were uncertain, as staffing and contract support needed to finish EEMs only recently became available and the EPA had not yet finalized its work plan at the time we completed our review. Further, SAB concerns about the EPA's EEM development methodology have not been resolved. Despite these uncertainties, parties to the 2005 Agreement continue to receive protections from civil enforcement actions. We make recommendations in Chapters 3 and 4 of this report.

Chapter 3
EPA Needs to Implement Systematic Planning to Assure That EEMs Have Sufficient Quality

The EPA's planning for EEM development did not describe the desired level of quality needed for the EEMs' intended purpose of estimating individual AFO air emissions nationwide. The establishment of such criteria is a key component of systematic planning for agency projects. In accordance with the agency's data quality policies, EPA organizations should conduct systematic planning to ensure that projects will result in scientific products that are defensible and useful for their intended purpose. The agency's most recent EEM development draft work plan used the terms "appropriate" and "meaningful" to describe final EEM products, but did not explain how those terms would be used to evaluate the quality or acceptability of the final EEMs.

As noted in Chapter 2, the agency's SAB concluded that the EPA's 2012 draft EEMs were not suitable for their intended purpose. Consequently, if the agency does not fully implement systematic planning for future EEM development, the EPA is at risk of producing additional draft EEMs that are not sufficient for estimating air emissions at individual AFOs across the United States.

EPA Quality System

The EPA's Procedure for its Quality Policy[23] establishes management principles and responsibilities for ensuring that EPA products and services meet agency quality-related requirements, and are of sufficient quality for their intended use and support the EPA's mission to protect human health and the environment. The policy applies to agency products and services developed for external distribution or dissemination. Each EPA organization is responsible for implementing the EPA Quality Policy and Program within its organization. Requirements for implementing the program include conforming to the minimum specifications of the American National Standards Institute and the American Society for Quality Control standard, ANSI/ASQC E4-1994.[24]

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[23] EPA Chief Information Officer's CIO Order 2106-P-01.0 (October 20, 2008).

[24] *Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs,* the American National Standards Institute and the American Society for Quality Control (1994). This standard is the basis for the EPA's Quality System.

At the project level, these minimum specifications include the following:

- Using a systematic planning approach (e.g., the data quality objectives process) to develop acceptance or performance criteria covered by the EPA Quality Policy.

- Having approved quality assurance project plans, or equivalent documents, for all applicable tasks involving environmental data.

To implement the EPA's Quality Policy, each EPA organization must develop a quality management plan that describes its quality system, documents its quality policies, and identifies the environmental programs to which the quality system applies. The EPA's Office of Air Quality Planning and Standards (OAQPS) developed a quality management plan that describes options for ensuring that OAQPS projects are of appropriate quality for their intended purpose. These options include elements of systematic planning to ensure that quality considerations are built into a product at the beginning, and consist of (1) developing a quality assurance project plan or similar document, and/or (2) conducting pre-dissemination review (e.g., peer review) of information.

According to the OAQPS quality management plan, quality documentation describes in detail the activities that must be implemented to assure that the results of work will satisfy the stated performance criteria. The performance criteria may be stated in the form of data quality objectives (DQOs). DQOs are qualitative or quantitative statements that clarify project technical and quality objectives, define the appropriate type of data, and specify tolerable levels of potential decision errors (e.g., uncertainty) that will be used as the basis for identifying the data needed to support decisions. EPA quality assurance guidance[25] recommends that systematic planning include DQOs when data are to be used to make a regulatory decision or emission estimations.

The DQO process is the agency's recommendation when data are to be used to make some type of decision (e.g., compliance or noncompliance with a standard) or estimation (e.g., ascertain the mean concentration level of a contaminant).

***Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA QA/G-4, February 2006**

Further, DQOs should be specified for a project before the agency develops its plan for collecting the data, since the DQOs will drive key data collection decisions. For estimation, the guidance states that DQOs are typically expressed in terms of acceptable uncertainty (e.g., width of an uncertainty band or interval) associated with a point estimate at a desired level of statistical confidence.

[25] The EPA's *Guidance on Systematic Planning Using the Data Quality Objectives Process* (2006).

The OAQPS quality management plan also provides for the pre-dissemination review of OAQPS information as a way to provide assurance that quality has been built into the information that the office disseminates. The quality management plan cites peer review as an example of pre-dissemination review, and notes that it can be appropriate to incorporate the pre-dissemination review for project planning documents, such as the quality assurance project plan, prior to beginning the project.

EPA Has Not Fully Implemented a Systematic Planning Process to Assure a Desired Level of Quality for EEMs

The EPA's planning process for EEM development had yet to establish data quality objectives describing the performance or acceptance criteria for the final EEMs. While extensive planning went into assuring the quality of the monitoring data collected during the NAEMS, this planning did not describe the desired quality of the end products resulting from EPA analysis of the NAEMS data (i.e., the EEMs), or the type and extent of emissions monitoring data needed to produce EEMs of desired quality.

Planning for Draft Development of EEMs Was Not Systematic

Ideally, under a systematic planning process, a methodology for producing a final product at the desired quality is determined up front. This methodology then drives the data collection efforts. When data are to be used to make some type of decision or estimation, the EPA recommends that the desired level of quality be expressed in the form of DQOs. As noted in Chapters 1 and 2, the EPA collaborated with external scientists to develop the monitoring protocol. However, several factors influenced the scope of the NAEMS, and that effort was not specifically designed to produce data to satisfy acceptance criteria for the EEMs. Among these factors was that, prior to the study, the EPA did not know which variables most impact air emissions at AFOs. Thus, the EPA tried to create an EEM development methodology using the data that was available from the NAEMS.

Unless some form of planning is conducted prior to investing the necessary time and resources to collect data, the chances can be unacceptably high that these data will not meet specific project needs.

Guidance on Systematic Planning Using the Data Quality Objectives Process, **EPA QA/G-4, February 2006**

The NAEMS protocol stated that the NAEMS and subsequent data analyses and interpretation would allow the EPA and livestock and poultry producers to "reasonably determine" which AFOs were subject to CAA regulatory provisions and CERCLA/EPCRA reporting requirements. However, as part of its planning, the EPA did not define what was meant by "reasonably determine." The EPA developed a quality assurance project plan for its efforts to develop the draft EEMs that were published in 2012, but it focused on assessing the quality of incoming data from the NAEMS and other sources. The quality assurance project plan did not include DQOs or other performance criteria defining the acceptable level of uncertainty for EEM predictions, or the quality control measures the EPA would use to assure its statistical models were scientifically and statistically sound.

The EPA had its draft EEMs peer reviewed by the SAB, but the agency did not involve the SAB in its planning process to ensure that the NAEMS would provide sufficient data for EEM development. As discussed in Chapter 2, the SAB concluded that the EPA's draft EEMs were not useful for making compliance determinations nationwide due to problems with the underlying data and analysis.

Plans for Completing Development of EEMs Can Be Strengthened

The EPA had not yet conducted systematic planning for the EEM completion effort, but had developed a draft work plan. That draft work plan contained little information about systematic planning to assure the quality of future EEMs. The plan did not address whether a quality assurance project plan would be developed, or commit to peer review of the planned methodology or the draft or final EEMs.[26]

The draft work plan described a future scoping study that would allow the EPA to plan activities and resources for developing "appropriate" EEMs, and stated that EEMs developed in the future would be tested to determine whether they can reproduce "meaningful" emissions estimates. However, the work plan did not define or establish acceptance criteria for "appropriate" or "meaningful" EEMs. Staff from OAQPS stated that they planned to make quality planning decisions once the new staff person had been hired to conduct the scoping study and subsequent EEM development.

Conclusion

As explained in the EPA's quality assurance guidance, systematic planning that defines the level of quality required for an end product should be conducted prior to data collection efforts, to reduce the risk that the data collected is not sufficient. Such planning for the EEMs was not conducted prior to the NAEMS or draft EEM development efforts, in part, because the EPA did not have a full understanding of the factors that influence AFO air emissions. Further, the NAEMS protocol and monitoring plans were not developed exclusively to provide data needed for EEM development. Based on its experience and peer review feedback in developing the initial set of draft EEMs, the EPA should be in a better position to conduct systematic planning for the EEM completion effort.

[26] In the draft plan, the EPA stated it will provide developed EEMs to "appropriate stakeholders and possibly the Science Advisory Board" for review, and then modify the EEMs based on comments received. However, the plan does not commit to obtaining independent, external peer review of the EEMs or the planned methodology that will be used to develop the EEMs.

Without adequate systematic planning, the EPA is at risk of spending additional time and resources to develop EEMs that still are not sufficient for estimating AFO emissions nationwide.

Recommendations

We recommend that the Assistant Administrator for Air and Radiation:

1. In accordance with EPA quality assurance guidance, conduct comprehensive systematic planning for future emission estimating methodology development through either the quality assurance project plan or pre-dissemination review processes.

    - If the EPA chooses to develop a quality assurance project plan, it should first develop data quality objectives for the emission estimating methodologies.

    - If the EPA chooses to conduct a pre-dissemination review, it should obtain independent, external feedback on the adequacy of its emission estimating methodologies development and plans prior to beginning the project.

2. Based on the results of systematic planning, determine and document the decision as to whether the EPA is able to develop scientifically and statistically sound emission estimating methodologies for each originally planned emission source and pollutant combination.

3. For the emission source and pollutant combinations for which the Office of Air and Radiation determines it can develop scientifically and statistically sound emission estimating methodologies, establish public milestone dates for issuing each draft emission estimating methodology. For any emission source and pollutant combinations for which the Office of Air and Radiation determines that it cannot develop scientifically and statistically sound emission estimating methodologies, notify the Office of Enforcement and Compliance Assurance of that determination.

We recommend that the Assistant Administrator for Enforcement Compliance and Assurance:

4. For any emission source and pollutant combinations for which the Office of Air and Radiation determines it cannot develop emission estimating methodologies, notify Air Compliance Agreement participants of this determination, and that the release and covenant not to sue for those emission sources and pollutant types will expire in accordance with paragraph 38 of the 2005 Air Compliance Agreement.

Agency Response and OIG Evaluation

The Office of Air and Radiation agreed with Recommendations 1, 2 and 3, and provided acceptable planned corrective actions and completion dates. The Office of Enforcement and Compliance Assurance agreed with Recommendation 4 and provided an acceptable corrective action plan.

The agency also provided technical comments that were incorporated into our final report as appropriate. Appendices A and B contain the responses to our report from the Office of Air and Radiation, and the Office of Enforcement and Compliance Assurance, respectively.

Chapter 4
EPA Has Not Updated Some Stakeholders and Public on Current Status of EEM Efforts

The 2005 Air Compliance Agreement between the AFO industry and the EPA generated significant stakeholder and public interest in AFO air emissions, and any actions the agency would take to address those emissions. Leading up to the monitoring study, and for 2 years after monitoring data was available, the EPA provided frequent public updates related to the NAEMS and EEMs. However, since the SAB's 2013 final report, the agency had provided only high-level updates to selected stakeholders. This left many stakeholders and the public uninformed about the current status of the work, the reasons for delays, and current timelines for finalizing the EEMs. The EPA should resume providing public updates on the status of EEM development through its website or other public means, to ensure the transparency of its process and accountability in setting completion dates.

EPA Provided Extensive Public Outreach During Early Stages

The EPA issued four press releases in 2006 announcing individual agreements entered into between the EPA and AFOs. Further, in the years after it received all monitoring data in 2010, the EPA provided frequent updates on EEM development efforts and the SAB's review of draft EEMs. In 2011, the EPA published data from the NAEMS monitoring, issued a Call for Information to collect information to supplement the NAEMS data, and updated the public on processes related to the planned SAB review. In 2012, the EPA released its draft EEMs for public comment.

EPA Has Not Publicly Communicated on EEM Development Efforts Since 2013

Since the EPA posted the SAB's 2013 final report on its public website, the EPA had not updated some stakeholders and the public on recent aspects of its NAEMS data analysis and EEM development efforts. An OAQPS manager told us that the agency planned to post final EEMs on its public webpage, but used other mechanisms to provide updates on the status of EEM development. Such updates were provided only upon request, and typically to groups with which the agency had regular contact, such as the USDA's Agricultural Air Quality Task Force. Numerous interested parties—including the SAB Chair, a SAB panel member, and three external groups—told us that they had no information about the ongoing NAEMS data analysis, the reasons for delays, or how long it might take the EPA to publish final EEMs.

Further, staff at the USDA told us that while they periodically received high-level updates from the EPA at Agricultural Air Quality Task Force and intra-agency workgroup meetings, they were not aware of the EPA's current plans for completing EEM development. The EPA's 2016 update to the Agricultural Air Quality Task Force provided the SAB's recommendations regarding the draft EEMs, as previous updates had done, and stated that the EPA will continue developing EEMs to account for air emissions from AFOs.

Conclusion

Despite being years behind schedule in finalizing the EEMs, the EPA has not provided public updates since 2013 on the NAEMS data analysis and the agency's current efforts to finalize the EEMs. Thus, stakeholders and the public do not know where the EPA currently stands with respect to EEM development. To ensure transparency and accountability in completing EEMs for the $15 million investment in the NAEMS study, the EPA should provide public updates on the status of EEM development and establish public milestones for completion of each draft EEM.

Recommendation

We recommend that the Assistant Administrator for Air and Radiation:

5. Provide the public with the status of emission estimating methodology development and the agency's planned next steps for analyzing the National Air Emissions Monitoring Study data and finalizing the emission estimating methodologies, including the completion of milestone dates for each draft emission estimating methodology it plans to develop.

Agency Response and OIG Evaluation

The Office of Air and Radiation agreed with Recommendation 5, and provided an acceptable corrective action plan and completion date. The Office of Air and Radiation also provided technical comments that were incorporated into our final report as appropriate. Appendix A contains the Office of Air and Radiation's response to our report.

ATTACHMENT 2

Status of Recommendations and Potential Monetary Benefits

RECOMMENDATIONS

Rec. No.	Page No.	Subject	Status[1]	Action Official	Planned Completion Date	Potential Monetary Benefits (in $000s)
1	23	In accordance with EPA quality assurance guidance, conduct comprehensive systematic planning for future emission estimating methodology development through either the quality assurance project plan or pre-dissemination review processes. o If the EPA chooses to develop a quality assurance project plan, it should first develop data quality objectives for the emission estimating methodologies. o If the EPA chooses to conduct a pre-dissemination review, it should obtain independent, external feedback on the adequacy of its emission estimating methodologies development and plans prior to beginning the project.	R	Assistant Administrator for Air and Radiation	3/31/18	
2	23	Based on the results of systematic planning, determine and document the decision as to whether the EPA is able to develop scientifically and statistically sound emission estimating methodologies for each originally planned emission source and pollutant combination.	R	Assistant Administrator for Air and Radiation	6/30/18	
3	23	For the emission source and pollutant combinations for which the Office of Air and Radiation determines it can develop scientifically and statistically sound emission estimating methodologies, establish public milestone dates for issuing each draft emission estimating methodology. For any emission source and pollutant combinations for which the Office of Air and Radiation determines that it cannot develop scientifically and statistically sound emission estimating methodologies, notify the Office of Enforcement and Compliance Assurance of that determination.	R	Assistant Administrator for Air and Radiation	6/30/18	
4	23	For any emission source and pollutant combinations for which the Office of Air and Radiation determines it cannot develop emission estimating methodologies, notify Air Compliance Agreement participants of this determination, and that the release and covenant not to sue for those emission sources and pollutant types will expire in accordance with paragraph 38 of the 2005 Air Compliance Agreement.	R	Assistant Administrator for Enforcement and Compliance Assurance	9/30/18[2]	
5	26	Provide the public with the status of emission estimating methodology development and the agency's planned next steps for analyzing the National Air Emissions Monitoring Study data and finalizing the emission estimating methodologies, including the completion of milestone dates for each draft emission estimating methodology it plans to develop.	R	Assistant Administrator for Air and Radiation	6/30/18	

[1] C = Corrective action completed.
R = Recommendation resolved with corrective action pending.
U = Recommendation unresolved with resolution efforts in progress.

[2] If applicable, based on the Office of Air and Radiation's determination in response to Recommendation 3.

Office of Air and Radiation Response to Draft Report

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

JUN 2 3 2017

OFFICE OF
AIR AND RADIATION

MEMORANDUM

SUBJECT: Response to the Office of Inspector General's Draft Report, *Emissions From Animal Feeding Operations Remain Largely Uncharacterized More Than 7 Years After Study Completed* (Project No. OPE-FY16-0018)

FROM: Sarah Dunham
Acting Assistant Administrator

TO: Carolyn Copper
Assistant Inspector General
Office of Program Evaluation
Office of Inspector General

The EPA's Office of Air and Radiation (OAR) appreciates the opportunity to review and comment on the Office of Inspector General (OIG) draft report titled "*Emissions From Animal Feeding Operations Remain Largely Uncharacterized More Than 7 Years After Study Completed.*" OAR agrees in general with the OIG's recommendations.

OAR's current task is the development of Emissions Estimating Methodologies (EEMs) for animal feeding operations (AFOs), using statistically-based methodologies to develop emissions factors for select types of AFOs from data collected through the National Air Emissions Monitoring Study (NAEMS). In partnership with the Office of Research and Development (ORD), we are undertaking this effort and incorporating a National Academy of Sciences (NAS) recommendation that the EPA develop an interim method for estimating emissions while we participate in a longer-term effort to develop process-based EEMs. In addition, our work will include objectives outlined in the 2005 Air Compliance Agreement (Agreement) the EPA entered into with participating AFOs. The AFO sectors represented in the Agreement covered the monitoring study costs. Individual participating AFOs did not directly pay monitoring study funds. The EPA remains committed to fulfilling this goal of developing EEMs for AFOs based on scientifically and statistically sound methods. The statistically-based EEMs must also be easily implemented by the agricultural community and other users, and be based on non-proprietary inputs.

While we generally agree with your characterizations of the Agreement and the associated NAEMS, there are a few places where information in the draft report is slightly unclear where the information differs from our understanding of specific facts. Please refer to the attached list of these instances and suggested revisions intended to help clarify and improve the draft report's accuracy.

Below are OAR's responses to the OIG's specific recommendations (recommendation numbers 1, 2, 3 and 5), which we developed in consultation with ORD. On June 9, 2017, OECA provided a separate response to recommendation number 4 as it is assigned to their office. In the attached technical comments, we provide suggested additional detailed changes in the form of a markup.

Recommendation 1: In accordance with EPA quality assurance guidance, conduct comprehensive systematic planning for future emission estimating methodology development through either the quality assurance project plan or pre-dissemination review processes.

- **If the EPA chooses to develop a quality assurance project plan, it should first develop data quality objectives for the emission estimating methodologies.**
- **If the EPA chooses to conduct a pre-dissemination review, it should obtain independent, external feedback on the adequacy of its emission estimating methodologies development and plans prior to beginning the project.**

Response 1: OAR and ORD agree with this recommendation and have initiated development of a quality assurance project plan (QAPP) for evaluation of the data and completion of the EEMs. As part of the QAPP development, appropriate data quality objectives will be defined. We intend to make this document publicly available on our website (see below).

Planned completion date: FY 2018, Q2 (March).

Recommendation 2: Based on the results of systematic planning, determine and document the decision as to whether the EPA is able to develop scientifically and statistically sound emission estimating methodologies for each originally planned emission source and pollutant combination.

Response 2: OAR agrees with this recommendation. As noted, completion of this task is contingent upon the results and decisions made during the QAPP development. Upon completion of the QAPP, OAR and ORD will determine which EEMs can be completed and the appropriate schedules for their completion. We intend to make the schedules publicly available on our website (see below).

Planned Completion Date: As stated above, development of the QAPP is ongoing with completion anticipated in the second quarter of FY 2018. Upon completion of the QAPP, decisions on EEM development and schedules will be determined and transmitted to the Office of Enforcement and Compliance Assurance (OECA). We anticipate that the schedules will be established in third quarter of FY 2018.

Recommendation 3: For the emission source and pollutant combinations for which the Office of Air and Radiation determines it can develop scientifically and statistically sound emission estimating methodologies, establish public milestone dates for issuing each draft emission estimating methodology. For any emission source and pollutant combinations for which the Office of Air and Radiation determines that it cannot develop scientifically and statistically sound emission estimating methodologies, notify the Office of Enforcement and Compliance Assurance of that determination.

Response 3: OAR agrees with this recommendation and will develop a schedule for completion of the EEMs after completion of data review and QAPP development, which is currently planned for completion in the second quarter of FY 2018.

Planned Completion Date: As stated above, development of the QAPP is ongoing with completion anticipated in the second quarter of FY 2018. Upon completion of the QAPP, decisions on EEM development and schedules will be determined and transmitted to OECA and made available to the public. We anticipate that the schedules will be established in the third quarter of FY 2018.

Recommendation 5: Provide the public with the status of emission estimating methodology development and the agency's planned next steps for analyzing the National Air Emissions Monitoring Study data and finalizing the emission estimating methodologies, including the completion milestone dates for each draft emission estimating methodology it plans to develop.

Response 5: OAR agrees with this recommendation and will post the schedule on our website for completion of the EEMs after completion of data review and QAPP development, which is currently planned for completion in the second quarter of FY 2018. We anticipate providing updates on our progress with subsequent website postings.

Planned Completion Date: As stated above, development of the QAPP is ongoing with completion anticipated in the second quarter of FY 2018. Upon completion of the QAPP, decisions on EEM development and schedules will be determined and milestones will be made available to the public. We anticipate that the schedules will be established in the third quarter of FY 2018.

If you have any questions regarding this response, please contact Mike Jones, Office of Air Quality Planning and Standards (OAQPS) Audit Liaison, at (919) 541-0528.

Attachment

ATTACHMENT 2

Appendix B

Office of Enforcement and Compliance Assurance Response to Draft Report

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

JUN - 9 2017

OFFICE OF
ENFORCEMENT AND
COMPLIANCE ASSURANCE

MEMORANDUM

SUBJECT: Response to the Office of Inspector General Draft Report: "Emissions from Animal Feeding Operations Remain Largely Uncharacterized More Than 7 Years After Study Completed," Project No. OPE-FY16-0018 (May 12, 2017)

FROM: Lawrence E. Starfield
Acting Assistant Administrator
Office of Enforcement and Compliance Assurance

TO: Carolyn Copper
Assistant Inspector General
Office of Program Evaluation
Office of Inspector General

Thank you for the opportunity to respond to the Office of Inspector General (OIG) Draft Report, "Emissions from Animal Feeding Operations Remain Largely Uncharacterized More Than 7 Years After Study Completed" (Draft Report). The Office of Enforcement and Compliance Assurance (OECA) appreciates OIG's careful examination of this issue, and we are committed to following the terms of the Animal Feeding Operations (AFO) Air Compliance Agreement (Agreement) and OIG's recommendation for OECA – Recommendation Number 4. We concur with Recommendation Number 4, and we provide a high-level intended corrective action with an estimated completion date below.

While we generally agree with your characterizations of the Agreement and its associated National Air Emissions Monitoring Study (NAEMS), there are a few places where the Draft Report is slightly unclear or where the information differs from our understanding of specific facts. Enclosed for your consideration, we include a list of these instances and suggested revisions intended to help clarify and improve the Draft Report's accuracy.

OECA has discussed the Draft Report with the Office of Air and Radiation (OAR) and we understand that OAR will be providing a separate response addressing the Draft Report's findings and recommendations for OAR – Recommendation Numbers 1, 2, 3, and 5.

OECA Response to Recommendation Number 4 – Concur

No.	Recommendation	High-Level Intended Corrective Action	Planned Completion Date
4	For any emission source and pollutant combinations for which the Office of Air and Radiation determines it cannot develop emission estimating methodologies, notify Air Compliance Agreement participants of this determination and that the release and covenant not to sue for those emission sources and pollutant types will expire in accordance with paragraph 38 of the 2005 Air Compliance Agreement.	If the EPA determines it cannot develop emission estimating methodologies for any emission source and pollutant combinations, OECA will notify Agreement participants in writing that the EPA has made such a determination and that the release and covenant not to sue will expire in accordance with paragraph 38 of the Agreement.	If necessary, OECA will complete the intended corrective action within 60 days of OAR finalizing its determination.

We concur with OIG's recommendation that OECA notify Agreement participants if OAR determines that it cannot develop emission estimating methodologies for any emission source and pollutant combinations. OECA notes that this recommendation will only require a corrective action if OAR determines it cannot develop emission estimating methodologies for any source and pollutant combinations. Paragraph 38 of the Agreement requires the EPA to notify Agreement participants in writing if the Agency makes such a determination. OECA intends to continue abiding by the Agreement's terms, and we will notify Agreement participants if the Agency determines it cannot develop emission estimating methodologies for any emission source and pollutant combinations.

If you have any questions regarding this response, please contact OECA Audit Liaison, Gwendolyn Spriggs, at 202.564.2439.

Attachment

cc: Susan Shinkman, OECA/OCE
Rosemarie Kelley, OECA/OCE
Lauren Kabler, OECA/OCE
Apple Chapman, OECA/OCE
Tim Sullivan, OECA/OCE

Gwendolyn Spriggs, OECA/OAP
Sarah Dunham, OAR
Robin Dunkins, OAR/OAQPS
Mike Jones, OAR/OAQPS

Appendix C

Distribution

The Administrator
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Deputy Chief of Staff for Operations
Assistant Administrator for Air and Radiation
Assistant Administrator for Enforcement and Compliance Assurance
Agency Follow-Up Official (the CFO)
Agency Follow-Up Coordinator
General Counsel
Associate Administrator for Congressional and Intergovernmental Relations
Associate Administrator for Public Affairs
Career Deputy Assistant Administrator, Office of Air and Radiation
Deputy Assistant Administrator, Office of Enforcement and Compliance Assurance
Audit Follow-Up Coordinator, Office of the Administrator
Audit Follow-Up Coordinator, Office of Air and Radiation
Audit Follow-Up Coordinator, Office of Enforcement and Compliance Assurance

ATTACHMENT 3

Testimony to Goodhue County PAC 4-16-18
RE: Circle K and County proposal to change County Ordinance

I'm Bob Rosenquist. I live and farm part-time in the A-1 zoned part of Goodhue County.

The proposed ordinance change relies on the Minnesota Pollution Control Agency to perform EAWs for CAFO's over 1000 animal units that are complete and accurate and to determine regulatory compliance of the largest feedlots. In the last six months the MPCA has admitted their EAW reviews are only as good as the information they had at the time; that they have performed no continuous air monitoring at any feedlot in the last decade; and, never during agitation and pump out of manure pits.

During pump out and agitation the U.S. Department of Agriculture reports that hydrogen sulfide emissions have exceeded 35,000 parts per billion which is more than 1000 times over the Minnesota State standard. I would like to enter into the record the, "Emissions of Ammonia, Hydrogen Sulfide, and Odor before, during, and after Slurry Removal from a Deep-Pit Swine Finisher." This included two deep-pit swine finishing facilities in central Iowa as part of a six-state study.

In addition to hydrogen sulfide, the University of Purdue measured the 20 most prevalent (by mass) volatile organic compounds emitted from a deep pit hog finishing facility similar to, though smaller than, Kohlnhofer's most recently proposed facility. The Purdue study also measured large amounts of particulate matter in both the PM2.5 and PM10 size. Charlie Peterson, MPCA contact for feedlot air issues, said he could not recall that the MPCA had ever studied these environmental pollutants – volatile organic compounds and particulate matter.

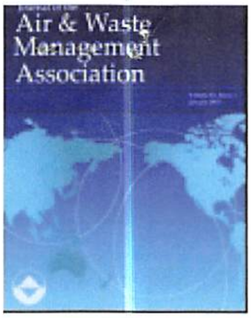
Using an emission rate from a University of Iowa controlled study, Kohlnhofer's proposed finishing facility could discharge nearly 3 tons of hydrogen sulfide per year. In 2018 the national hog producers successfully lobbied the federal government for an exemption from reporting their annual hydrogen sulfide emissions to the EPA.

The hog industry is an incredible innovative industry in terms of economic and labor efficiency. Rather than lobbying for special exemptions and changes to state law and county ordinance, they should face the challenge head-on with innovation to reduce their manure air emissions.

I've driven Highway 56 through Dodge County quite a few nights. On numerous nights this is 20-miles of hog stench – even in the winter with the truck closed up. That is not the condition of rural Goodhue County, or most of the numerous counties I drive through in southern Minnesota and the northern half of Iowa.

While staff does well to state the importance of agriculture to Goodhue County, it does not provide any explanation of what is wrong with the existing ordinance. Neither the Kohlnhofers nor County staff provide any evidence that agricultural growth in the county is limited by nuisance claims. Have there been **any**?

I urge you Do Not change our Zoning Ordinance. Or form a study group and do this right.



Journal of the Air & Waste Management Association

ATTACHMENT 3

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Emissions of Ammonia, Hydrogen Sulfide, and Odor before, during, and after Slurry Removal from a Deep-Pit Swine Finisher

Steven J. Hoff , Dwaine S. Bundy , Minda A. Nelson , Brian C. Zelle , Larry D. Jacobson , Albert J. Heber , Jinqin Ni , Yuanhui Zhang , Jacek A. Koziel & David B. Beasley

TECHNICAL PAPER

ISSN 1047-3289 *J. Air & Waste Manage. Assoc.* 56:581–590 ATTACHMENT 3

Emissions of Ammonia, Hydrogen Sulfide, and Odor before, during, and after Slurry Removal from a Deep-Pit Swine Finisher

Steven J. Hoff, Dwaine S. Bundy, Minda A. Nelson, and Brian C. Zelle
Agricultural and Biosystems Engineering Department, Iowa State University, Ames, IA

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Yuanhui Zhang
Agricultural and Biological Engineering Department, University of Illinois, Urbana, IL

Jacek A. Koziel
Agricultural and Biosystems Engineering Department, Iowa State University, Ames, IA

David B. Beasley
Biological and Agricultural Engineering Department, North Carolina State University, Raleigh, NC

ABSTRACT
It is a common practice in the midwestern United States to raise swine in buildings with under-floor slurry storage systems designed to store manure for up to one year. These so-called "deep-pit" systems are a concentrated source for the emissions of ammonia (NH_3), hydrogen sulfide (H_2S), and odors. As part of a larger six-state research effort (U.S. Department of Agriculture-Initiative for Future Agriculture and Food Systems Project, "Aerial Pollutant Emissions from Confined Animal Buildings"), real-time NH_3 and H_2S with incremental odor emission data were collected for two annual slurry removal events. For this study, two 1000-head deep-pit swine finishing facilities in central Iowa were monitored with one-year storage of slurry maintained in a 2.4 m-deep concrete pit (or holding tank) below the animal-occupied zone. Results show that the H_2S emission, measured during four independent slurry removal events over two years, increased by an average of 61.9 times relative to the before-removal H_2S emission levels. This increase persisted during the agitation process of the slurry that on average occurred over an 8-hr time period. At the conclusion of slurry agitation, the H_2S emission decreased by an average of 10.4 times the before-removal emission level. NH_3 emission during agitation increased by an average of 4.6 times the before-removal emission level and increased by an average of 1.5 times the before-removal emission level after slurry removal was completed. Odor emission increased by a factor of 3.4 times the before-removal odor emission level and decreased after the slurry-removal event by a factor of 5.6 times the before-removal emission level. The results indicate that maintaining an adequate barn ventilation rate regardless of animal comfort demand is essential to keeping gas levels inside the barn below hazardous levels.

IMPLICATIONS
Deep-pit slurry removal events lead to elevated H_2S, odor, and NH_3 concentrations inside the pig building and emissions from this facility. H_2S is the gas of most concern and can reach levels dangerous to animals and workers. These results highlight the need for a preplanned protocol that must be established for barn ventilation rate maintenance to ensure that H_2S concentrations do not reach lethal levels.

INTRODUCTION

Many swine raised (reared from 7 or 18 kg to 120 kg) in the midwestern U.S. are grown in structures where year-long storage of manure is present below the occupied zone of the animals. These so-called "deep-pit" systems represent a concentrated source of nutrients that once applied judiciously to the soil provide an excellent source of fertilizer. The standard method for manure removal from buildings using deep-pit manure storage is to provide significant mixing of the slurry before and during slurry removal to suspend solids and to provide a consistent liquid manure fertilizer. This process commonly takes place in the fall after crops have been removed or in early spring before planting begins and generally takes from one to three 8-hr work days per 1000-pig building depending upon off-site hauling capacities. This process of slurry removal can represent an acute concentrated emission source for gases and odors. Removal of slurry involves the in situ mixing and agitation of the manure and subsequent application to the field. Significant problems can arise during this process if proper ventilation procedures are not followed. Turbulent activity of the slurry surface can result in very rapid release of odors, ammonia (NH_3), and hydrogen sulfide (H_2S), the latter of which has been linked to several animal and human casualties. Nuisance complaints related to swine production are generally highest during slurry removal and subsequent land application. The objective of this paper is to report on the emission of NH_3, H_2S, and odors before, during, and after slurry removal from two identical deep-pit swine finishing facilities located in the midwestern part of the United States over two annual slurry removal events.

Swine Housing NH_3 Emissions

Several U.S. and northern European studies have investigated the emission of gases from livestock and poultry production systems. Typically, the gases investigated include NH_3, H_2S, and the general class of volatile organic compounds associated with livestock odors.[1] Recently, the need to study the concentrations of these gases in the community surrounding livestock and poultry operations has surfaced because of increasing pressure from regulatory agencies. The following literature review focuses on the emissions from swine housing. A more complete review of the literature on emissions can be found in Hoff et al.[2]

Aarnink et al.[3] studied the NH_3 emission patterns of nursery and finishing pigs raised on partially slatted flooring. They found that for nursery pigs, an average increase of 16 mg NH_3 pig^{-1} day^{-1} was measured, and this increased to 85 mg NH_3 pig^{-1} day^{-1} (4.8 mg NH_3 m^{-2} hr^{-1}) for finishing pigs. The overall average NH_3 emission measured was between 0.70 and 1.20 g NH_3 pig^{-1} day^{-1} for nursery pigs (19–33 g NH_3 animal unit [AU]$^{-1}$ day^{-1}; 1 AU = 500 kg) and between 5.7 and 5.9 g NH_3 pig^{-1} day^{-1} (331 mg NH_3 m^{-2} hr^{-1}) for finishing pigs (42–43 g NH_3 AU^{-1} day^{-1}). They found an increase in NH_3 emission during the summer months for nursery pigs attributed to higher ventilation rates but this same trend was not found for finishing pigs. They also found that removing the under-floor stored slurry reduced the NH_3 emission by ~20% for a period of 10 hr, after which time the NH_3 emission regained the pre-removal emission level.

Demmers et al.[4] investigated the exhausted concentrations and emission rates of NH_3 from mechanically ventilated swine buildings. They reported NH_3 concentrations in a swine finishing house between 12 and 30 mg NH_3 m^{-3} with an average NH_3 emission rate of 46.9 kg NH_3 AU^{-1} yr^{-1} (160 g NH_3 AU^{-1} day^{-1} or 1008 mg NH_3 m^{-2} hr^{-1}).

Burton and Beauchamp[5] studied the relationship between outside temperature, ventilation system response, in-house NH_3 concentration, and the resulting emission of NH_3 from the swine housing unit. They clearly showed the inverse relationship of in-house NH_3 concentration with outside temperature and the direct relationship of NH_3 emission from the swine housing unit with outside temperature. This trend was attributed to the increased ventilation rates required during the summer to control inside climate temperatures for the housed animals. They summarized results over a 1-yr period and reported the monthly averages. February had the highest in-house concentration at 15 mg NH_3-N L^{-1} corresponding to the lowest emission rate at 0.9 kg NH_3-N day^{-1}. August had the lowest in-house concentration of 4 mg NH_3-N L^{-1} and, correspondingly, the highest emission rate of 3.2 kg NH_3-N day^{-1}, on average.

Ni et al.[6] investigated the exhausted concentrations and emission rates of NH_3 in and from a deep-pit swine finishing building with and without the presence of animals and with pits that were roughly half full (1.3 m manure depth; 2.4 m depth capacity). They investigated the gas release rates with and without the effect of heating the building through unit space heaters. Without the presence of animals, they measured NH_3 concentrations between 6 and 15 ppm with emission rates between 40 and 58 mg NH_3 m^{-2} hr^{-1} (5–8 g NH_3 AU^{-1} day^{-1}). When the buildings were restocked with pigs, exhaust air concentrations of NH_3 were, on average, 15.2 ppm with corresponding emission rates of 233 mg NH_3 m^{-2} hr^{-1} (40–50 g NH_3 AU^{-1} day^{-1}).

Groot Koerkamp et al.[7] conducted an extensive study of NH_3 emissions from swine housing facilities. They investigated both indoor NH_3 levels and simultaneous measurements of building ventilation rates and reported the resulting emission rates. In general, NH_3 concentrations varied between 5 and 18 ppm, with average emission rates between 649 and 3751 mg NH_3 AU^{-1} hr^{-1} (16–90 g NH_3 AU^{-1} day^{-1} or between 122–706 mg NH_3 m^{-2} hr^{-1}).

Hinz and Linke[8] investigated the indoor concentrations and emissions of NH_3 from a mechanically ventilated swine finishing facility during a grow-out period where pigs ranged between 25 and 100 kg. Interior NH_3 concentrations during the grow-out varied from 10 to 35 ppm, and these were inversely proportional to outside temperature. Emission rate of NH_3 varied from 70 g NH_3 pig^{-1} hr^{-1} (38 kg average pig wt) to 210 g NH_3 pig^{-1} hr^{-1} (83 kg average pig wt) resulting in an average NH_3 emission rate of 66 g NH_3 AU^{-1} day^{-1} (518 mg NH_3 m^{-2} hr^{-1}).

Zahn et al.[9] studied the NH_3 emission rate from both deep-pit and pull-plug swine finishing facilities during summer periods. They found that the NH_3 emission rates were very similar for these two facility types and grouped the emission data into an overall average of 66 ng NH_3 cm^{-2} sec^{-1} (311 g NH_3 AU^{-1} day^{-1} or 2376 mg NH_3 m^{-2} hr^{-1}).

Zhu et al.[10] studied the daily variations in NH_3 emissions from various mechanically and naturally ventilated swine housing systems. For a mechanically ventilated swine gestation facility, they measured internal NH_3 concentrations between 9 and 15 ppm, with emission rates consistent at ~5 µg NH_3 m^{-2} sec^{-1} (2.2 g NH_3 AU^{-1} day^{-1}). For a mechanically ventilated farrowing facility, they measured internal NH_3 concentrations between 3 and 5 ppm, with emission rates ranging between 20 and 55 µg NH_3 m^{-2} sec^{-1} (15–42 g NH_3 AU^{-1} day^{-1}). For a mechanically ventilated nursery facility, they measured internal NH_3 concentrations between 2 and 5 ppm, with emission rates ranging between 20 and 140 µg NH_3 m^{-2}

sec^{-1} (23–160 g NH_3 AU^{-1} day^{-1}). For a mechanically ventilated finishing facility, they measured internal NH_3 concentrations between 4 and 8 ppm, with emission rates ranging between 20 and 55 μg NH_3 m^{-2} sec^{-1} (10–26 g NH_3 AU^{-1} day^{-1} or between 72–198 mg NH_3 m^{-2} hr^{-1}). For a naturally ventilated finishing facility with pit exhaust fans, they measured internal NH_3 concentrations between 7 and 15 ppm, with emission rates ranging between 60 and 170 μg NH_3 m^{-2} sec^{-1} (28–80 g NH_3 AU^{-1} day^{-1} or between 216–612 mg NH_3 m^{-2} hr^{-1}).

Osada et al.[11] investigated the NH_3 emission from a swine finisher over an 8-week period comparing under-floor stored manure (control) and under-floor manure removed weekly (treatment). They reported only slight differences in NH_3 emission rates with the control at 11.8 kg NH_3 AU^{-1} yr^{-1} (32 g NH_3 AU^{-1} day^{-1} or 255 mg NH_3 m^{-2} hr^{-1}) and the treatment at 11 kg NH_3 AU^{-1} yr^{-1} (30 g NH_3 AU^{-1} day^{-1}).

Swine Housing H_2S Emissions

Ni et al.[6] investigated the exhausted concentrations and emission rates of H_2S in a deep-pit swine finishing building with and without the presence of animals and with pits that were roughly half full (1.3-m depth, 2.4-m depth capacity). They investigated the gas release rates with and without the effect of heating the building through unit space heaters. They measured H_2S concentrations ranging from 221 to 1492 ppb with corresponding emission rates between 1.6 and 3.8 mg H_2S m^{-2} hr^{-1} (0.22–0.49 g H_2S AU^{-1} day^{-1}). When the buildings were restocked with pigs, exhaust air concentration of H_2S averaged 423 ppb with a corresponding emission rate of 9.4 mg H_2S m^{-2} hr^{-1} (1.25 g H_2S AU^{-1} day^{-1}).

Zahn et al.[9] studied the H_2S emission rate from both deep-pit and pull-plug swine finishing facilities during summer periods. They found that the H_2S emission rates were very similar for these two facility types and grouped the emission data into an overall average of 0.37 ng H_2S cm^{-2} sec^{-1} (1.7 g H_2S AU^{-1} day^{-1} or 13.3 mg H_2S m^{-2} hr^{-1}).

Zhu et al.[10] studied the daily variations in H_2S emissions from various mechanically and naturally ventilated swine housing systems. For a mechanically ventilated swine gestation facility, they measured internal H_2S concentrations between 500 and 1200 ppb, with emission rates consistent at ~2 μg H_2S m^{-2} sec^{-1} (1 g H_2S AU^{-1} day^{-1}). For a mechanically ventilated farrowing facility, they measured internal H_2S concentrations between 200 and 500 ppb, with emission rates consistent at ~5 μg H_2S m^{-2} sec^{-1} (4 g H_2S AU^{-1} day^{-1}). For a mechanically ventilated nursery facility, they measured internal H_2S concentrations between 700 and 3400 ppb, with emission rates ranging between 20 and 140 μg H_2S m^{-2} sec^{-1} (23–160 g H_2S AU^{-1} day^{-1}). For a mechanically ventilated finishing facility, they measured internal H_2S concentrations between 300 and 600 ppb, with emission rates consistent at ~10 μg H_2S m^{-2} sec^{-1} (5 g H_2S AU^{-1} day^{-1} or 36 mg H_2S m^{-2} hr^{-1}). For a naturally ventilated finishing facility with pit exhaust fans, they measured internal H_2S concentrations between 200 and 400 ppb, with emission rates ranging between 5 and 15 μg H_2S m^{-2} sec^{-1} (2 and 7 g H_2S AU^{-1} day^{-1} or between 18 and 54 mg H_2S m^{-2} hr^{-1}).

Summary

A large variation in both NH_3 and H_2S emission rates from various swine production buildings has been reported. Considering the literature cited, the range of H_2S emissions expected for finishing pigs is between 1.6 and 54 mg H_2S m^{-2} hr^{-1} from the exhaust ventilation air for swine finishing pigs. The range of NH_3 emissions expected is between 4.8 and 2376 mg NH_3 m^{-2} hr^{-1} from the ventilation air for swine finishing pigs, with the dominating average emission rates in the 300 to 500 mg NH_3 m^{-2} hr^{-1} range. The study by Hinz and Linke[8] also pointed out the changes in emission rates expected as finishing pigs mature, with a reported three-fold increase between 38- and 83-kg average body weight.

FACILITY DESCRIPTION

Two identical deep-pit swine finishing facilities in central Iowa were monitored for this research project; this arrangement represents one of six U.S. sites monitored for a larger six-state emissions study funded by the U.S. Department of Agriculture under the Initiative for Future Agriculture and Food Systems program.[12,13] Each facility monitored, as shown in Figure 1, was designed to house 1000 pigs ranging in weight between ~18 and 120 kg. Slurry was stored in a 2.4-m-deep holding concrete basin below a fully slatted concrete floor and was designed to store manure for one calendar year. Slurry removal and land application was conducted once per year in the fall (October).

Each barn was fan-ventilated for all seasons using a combination of methods. The cold-to-mild weather ventilation was handled with a series of pit (Fans 1, 2), side (Fan 3), and end wall (or tunnel) fans (Fans 4, 5; Figure 1) in combination with a series of 10 rectangular center-ceiling inlets to distribute fresh air within the building. Figure 1 shows the center-ceiling inlet placement and the approximate airflow patterns desired from these inlets. The warm-to-hot weather ventilation was handled with tunnel ventilation, where all fans except Fan 3 were used in combination with an adjustable curtain at the opposing end wall. During this tunnel mode of ventilation, the 10 center-ceiling inlets inside the barn were closed. The barn was controlled for temperature by operation of the end wall exhaust fans and the inlet distribution system controlled via static pressure. As barn temperature demanded airflow rate changes, the inlet distribution system would adjust accordingly to maintain a desired operating static pressure of 20 Pa.

The layout given in Figure 1 includes a mobile emission laboratory (MEL) that housed all instrumentation required to measure gas concentrations and pertinent environmental data and to monitor the barn ventilation rate. NH_3 (Model 17C chemiluminescence; TEI, Inc.), H_2S (Model 45C pulsed fluorescence; TEI, Inc.), and CO_2 (Model 3600 IR, MSA, Inc.) were measured at 12 locations: six from Barn 1 and six from Barn 2. A solenoid switching system enabled gas samples to be delivered to each analyzer simultaneously in 10-min switching increments. Therefore, each location was measured for 10 min every 120 min. The gas concentration measurement at the conclusion of each 10-min sampling interval was used to represent the concentration at that sampling location for

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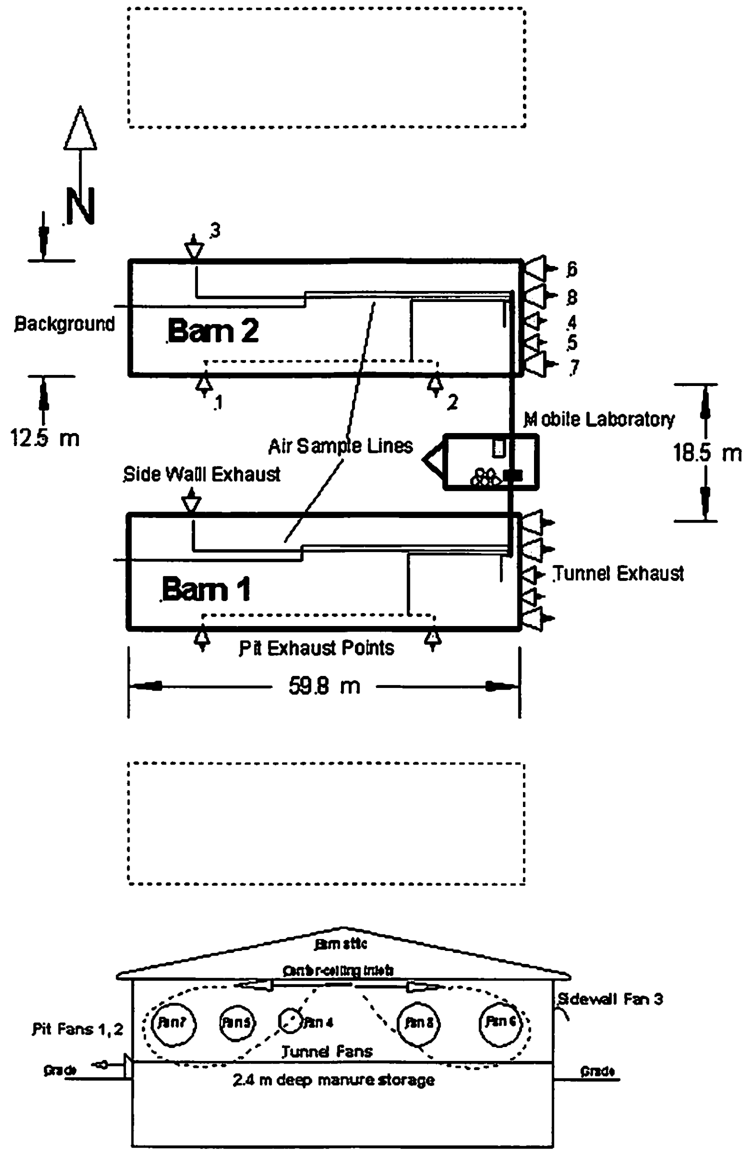

Figure 1. Layout of buildings monitored for this study. Entire site consists of four identical buildings. The monitored buildings shown represent the two center barns of the site. Two pit fans (1,2), one sidewall fan (3), and five end wall tunnel fans (4,5,6,7,8) were present, representing four possible emission zones.

the prior 120 min. This enabled a continuous concentration profile at each sampling location that was used along with continuous airflow data to generate a continuous emissions profile. The analyzers were calibrated before each pump-out event with U.S. Environmental Protection Agency (EPA)-protocol calibration gases. Environmental variables such as temperature, relative humidity, static pressure, and end wall curtain opening level were also measured. Ventilation rate was measured by recording the on/off status of all single-speed fans (Fans 5, 6, 7, 8; Figure 1) and the on/off status along with fan rpm levels for all variable speed fans (Fans 1, 2, 3, 4). Individual fan airflow rates were measured in situ using a FANS unit described in Casey et al.[14] The FANS unit was a device that fit on the intake side of all fans and integrated air velocity across the intake area of the fan with five calibrated anemometers. Airflow rates were measured for a range of expected operating static pressures and fan rpm levels from which a fan calibration equation was developed. By knowing fan status and/or fan rpm level and the current operating static pressure, fan airflow rate could be determined. Specific details related to the MEL setup and quality assurance/quality control procedures can be found in Heber et al.[13] and Jacobson et al.[15]

For emission calculations, the exhausted airflow rate along with the corresponding gas concentration at each emission point was measured. For the barns shown in Figure 1, three emission locations were monitored: the blended pit ventilation air from Fans 1 and 2, the emission at the sidewall Fan 3, and the emission from the combination of Fans 4 to 8 (tunnel end). Concentrations from the other three sampling points were also monitored, but these were not included in the emission calculations. Emission rates were calculated as

$$E = \Sigma(Q_o C_o - Q_i C_i) = \Sigma(Q'_o C'_o - Q'_i C'_i) \qquad (1)$$

Table 1. Slurry removal scheduling.

Year	Barn	Date Started	Date Ended	Time Start	Time End
2002	1	October 16	October 16	11:45	18:00
	2	October 18	October 18	10:00	17:00
2003	1[a]	October 21	October 21	18:00	22:00
		October 22	October 22	09:30	14:00
	2	October 20	October 20	10:00	18:30

[a]Barn 1 in 2003 emptied in two separate events over a two-day period.

where C_i is mass concentration at the barn air inlet, mg m^{-3} or $\mu g\ m^{-3}$; E is barn emission rate, mg sec^{-1} or $\mu g\ sec^{-1}$; C_o is mass concentration at the barn air exhaust, mg m^{-3} or $\mu g\ m^{-3}$; C_i' is standardized mass concentration at the barn air inlet (based on standard conditions of temperature and pressure [STP]), mg $(sm)^{-3}$ or $\mu g\ (sm)^{-3}$; C_o' is standardized mass concentration at the barn exhaust (based on STP), mg $(sm)^{-3}$ or $\mu g\ (sm)^{-3}$; Q_o is barn outlet moist airflow rate at T_o, $m^3\ sec^{-1}$; Q_i is barn inlet moist airflow rate at T_i, $m^3\ sec^{-1}$; Q_i' is moist standard ventilation rate at the barn inlet (based on STP), $sm^3\ sec^{-1}$; and Q_o' is moist standard ventilation rate at barn exhaust (based on STP), $sm^3\ sec^{-1}$.

The background concentrations were measured also with one of the sampling locations from a total of six for each monitored barn. The background sampling location was measured within 0.5 m of the end of each barn as shown in Figure 1. The STPs used were 20 °C and 101,325 Pa.

Odor data were also collected for this research project on 2-week intervals. However, during slurry agitation and manure removal, frequent gas samples were collected before, during, and after slurry removal to assess odor concentration and odor emission rate. Odor samples were collected in 10-L Tedlar bags using a vacuum chamber (Model Vac-U-Camber; SKC, Inc.) with a vacuum pump (Model 224–44XR; SKC, Inc.) at a sample flow rate of 3 L min^{-1}. Odor samples were analyzed within 18 hr using a dynamic dilution forced-choice olfactometer (Model AC'SCENT; St. Croix Sensory, Inc.) at the Iowa State University Olfactometry Laboratory.

Table 1 outlines the scheduled slurry removal events for the years 2002 and 2003. The results given in this paper involve the emissions measured for the 24 hr surrounding these slurry removal events. The producer followed a strict protocol before starting each slurry removal event. Before the slurry was agitated, the producer would manually override the ventilation control system by establishing an airflow rate close to 30 fresh-air changes per hour, open all 10 center-ceiling inlet diffusers, and make sure that the end wall curtain used for tunnel ventilation was closed. After these adjustments were made, usually more than 1 hr before agitation, the barn was deemed ready for agitation and slurry removal. The ventilation system was then left alone in manual mode throughout the entire slurry removal event, and no one was allowed in the barn during the slurry removal event. Each slurry removal event for a barn took 6.25–8.5 hr as shown in Table 1.

Table 2. H_2S concentration (ppb) before, during, and after slurry removal.

Year	Barn	Before	Max During	After	Date	Location
2002	1	272	9990[a]	79	October 16, 2002	pit
		592	9833	197	October 16, 2002	sidewall
		473	9990[a]	186	October 16, 2002	tunnel
	2	1084	5455	31	October 18, 2002	pit
		1775	11,990	43	October 18, 2002	sidewall
		857	15,918	30	October 18, 2002	tunnel
2003	1[b]	397	850	467	October 21, 2003	pit
		467	22,245	69	October 22, 2003	pit
		336	3128	678	October 21, 2003	sidewall
		678	12,011	71	October 22, 2003	sidewall
		337	11,957	148	October 21, 2003	tunnel
		148	16,378	71	October 22, 2003	tunnel
	2	2067	35,825	93	October 20, 2003	pit
		460	7840	55	October 20, 2003	sidewall
		1360	8075	69	October 20, 2003	tunnel

[a]Exceeded maximum set range of analyzer, which was 10,000 ppb. Analyzer subsequently changed to a range of 50,000 ppb; [b]Barn slurry emptied over two days; after on October 21, 2003, the same as before on October 23, 2003.

RESULTS AND DISCUSSION

The results presented summarize the H_2S, NH_3, and odor emissions before, during, and after slurry was removed from Barns 1 and 2. The results are intended to characterize the emission changes that occur during and after slurry removal and the potential concentrations reached in the barn during slurry removal.

Table 2 shows the average H_2S concentration (ppb) before the slurry was agitated, the maximum H_2S concentration during slurry removal, and the average concentration after the slurry was removed from each barn for the 2 yr reported. Table 2 summarizes the concentrations associated with each of the three possible emission points (pit, sidewall, and tunnel fans). The averages recorded in Table 2 were for the 6 hr either before or after slurry was removed from the barn.

The overall maximum H_2S concentration reached 35,825 ppb for Barn 2, at the pit exhaust fan location during the 2003 removal event. On average, the H_2S concentration measured at the pit fan exhaust location reached a level that was 18 times higher during agitation as compared with the before-removal level. For the sidewall and tunnel fan exhaust locations, the average H_2S concentration was 27.7 times higher during slurry removal compared with the before-removal concentration.

The characteristics of an emission event experienced during slurry removal are shown in Figure 2. Figure 2a shows the barn temperature, outside temperature, and total barn airflow rate, and Figure 2b shows the total barn H_2S emission rate (mg $H_2S\ m^{-2}\ hr^{-1}$) and the associated total barn airflow rate ($m^3\ hr^{-1}$) for Barn 1 during the 2003 removal event. As shown in Table 1, this barn was emptied over a two-day period and the multiple elevated emission events are clearly evident. The ambient temperature ranged from a high/low of 23 and 8 °C for October 21, 2003, and a high/low of 24 and 3 °C for October 22, 2003, respectively. The producer routinely bypassed the barn's automatic control system during a slurry removal event to ensure an adequate ventilation rate for the barn

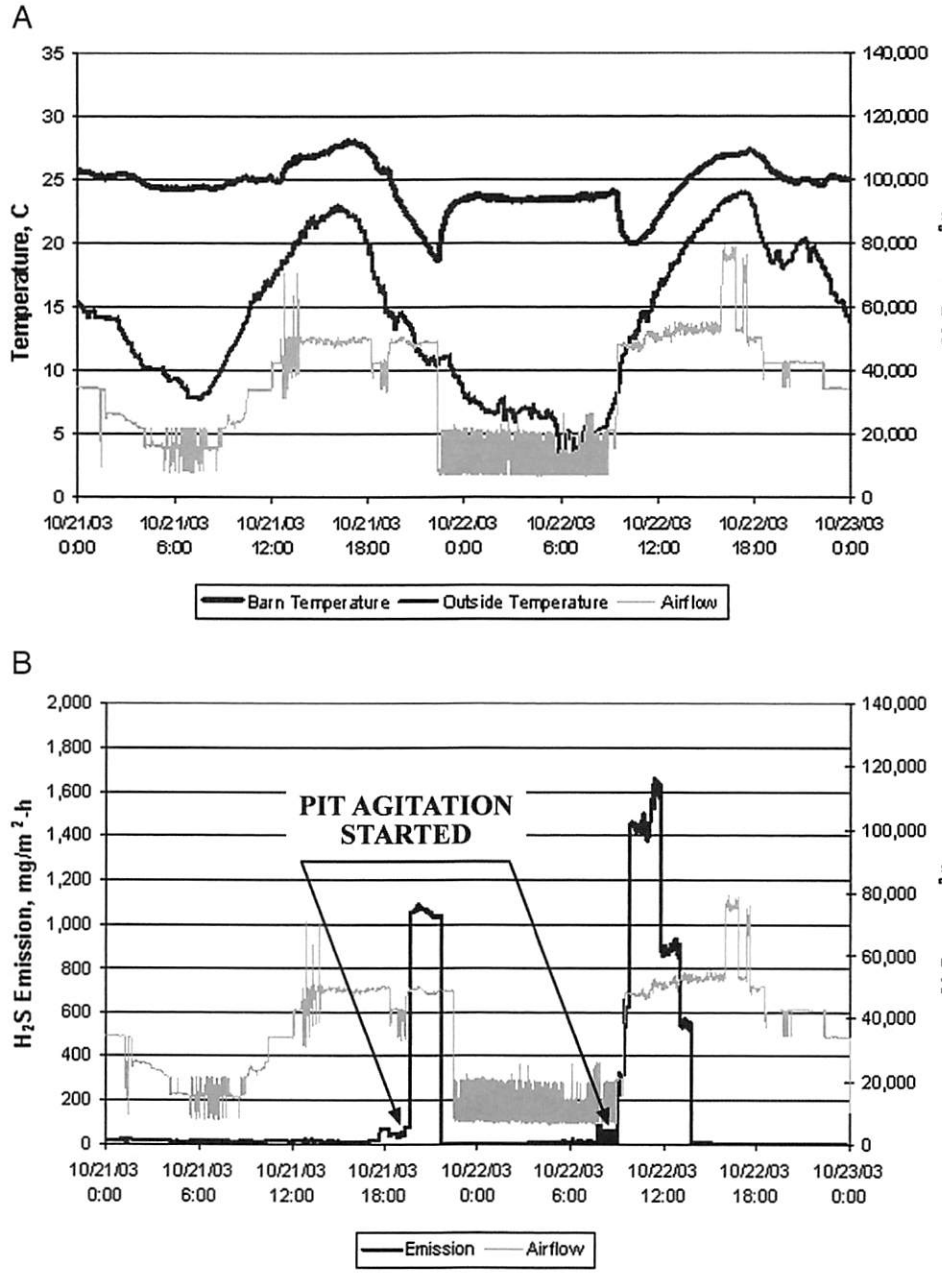

Figure 2. (a) Barn temperature, outside temperature, airflow rate, and (b) H_2S emission before, during, and after a slurry removal event (Barn 1, October 2003, removal event).

by manually turning on selected tunnel fans. The elevated ventilation rate initiated by the producer surrounding both slurry removal events is clearly evident in Figure 2. The elevated H_2S emission rate is clearly evident and dramatic. The emission shown was in direct correlation with slurry agitation, resulting in an elevated H_2S emission rate after the slurry was agitated and fell quickly once slurry agitation stopped. Observing the H_2S analyzer once agitation began showed a definite elevated concentration within minutes after the agitator was started. Figure 3 shows the characteristic H_2S emission for a slurry removal event that occurred over one continuous agitation and removal period. The manual override on the ventilation system resulted in a barn ventilation rate that increased from 13,200 $m^3\ hr^{-1}$ to an average of 56,000 $m^3\ hr^{-1}$. The barn, running in automatic control, would have ventilated the space at ~13,200 $m^3\ hr^{-1}$ or 6.5 fresh-air changes per hr. With the producer's manual override of the ventilation system, the barn was allowed to ventilate at 56,000 $m^3\ hr^{-1}$ or 27.9 fresh-air changes per hr. This characteristic points out the need for the establishment of a ventilation protocol before considering the agitation of slurry, regardless of the depth of slurry in the holding pit. The producer's protocol resulted in no loss of pig life for any of the pit agitation procedures studied with this research project.

The H_2S and NH_3 emissions for the four slurry removal events are summarized in Table 3. The before and after averages were determined by the 24-hr period before the barn was agitated and the 24-hr period after the slurry

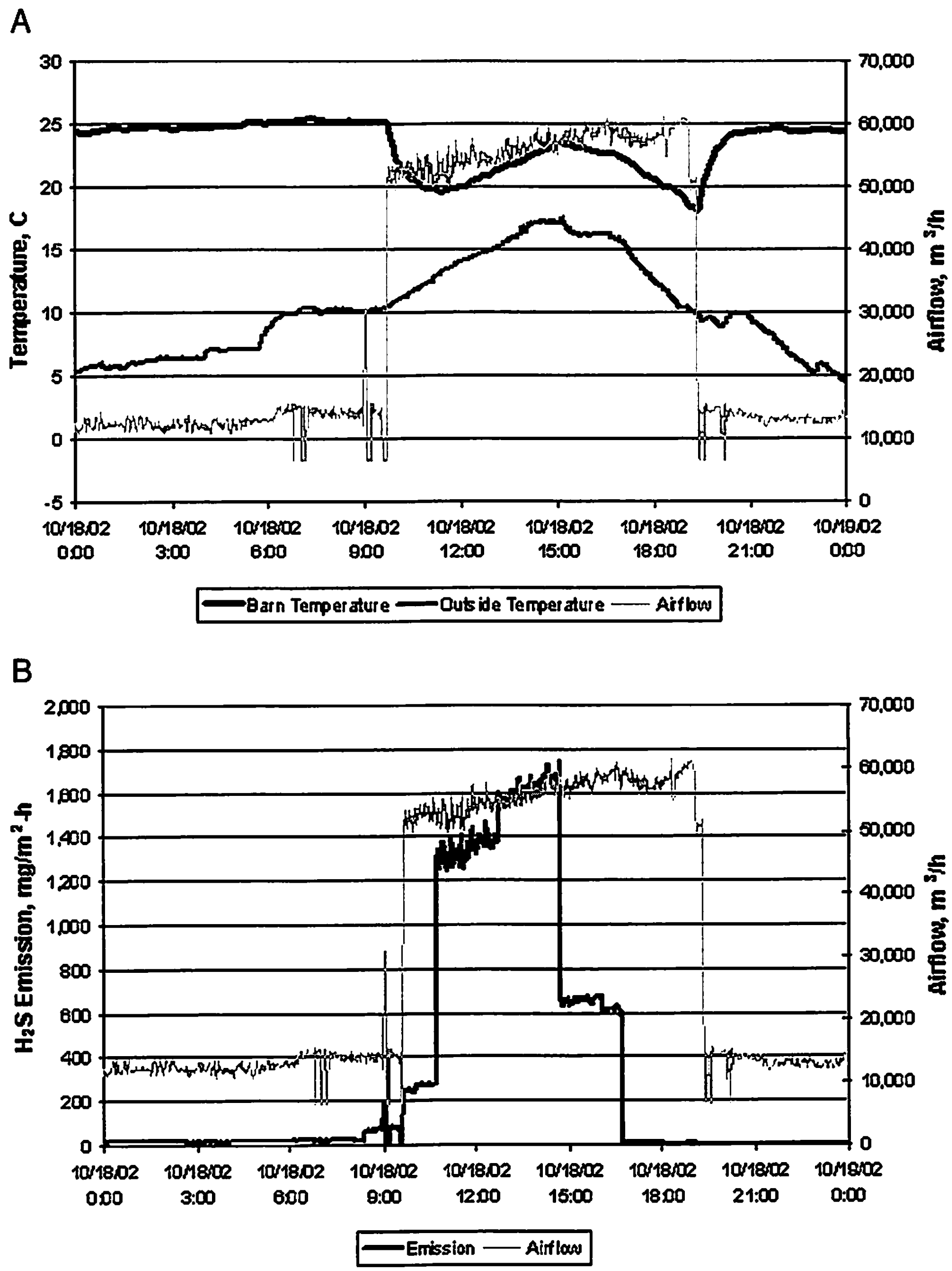

Figure 3. (a) Barn temperature, outside temperature, airflow rate, and (b) H_2S emission before, during, and after a slurry removal event (Barn 2, October 2002, removal event).

was removed from the barn. As shown in Table 3, a very large variation in H_2S emission rates existed before, during, and after slurry removal. The absolute maximum H_2S emission rate measured for the four events was 1,739 mg H_2S m^{-2} hr^{-1}. The average H_2S emission rate for the four slurry removal events was 1,528 ± 201 mg H_2S m^{-2} hr^{-1}. The average before and after H_2S emission rate for the four slurry removal events was 35.1 ± 26 mg H_2S m^{-2} hr^{-1} and 3.8 ± 1.9 mg H_2S m^{-2} hr^{-1}, respectively. If one considers the period of time from just before slurry agitation to the time just after all of the manure was removed from the barn, the cumulative H_2S emission measured for the case shown in Figure 2b was 5.5-kg H_2S and that shown in Figure 3b was 5.7-kg H_2S. The average NH_3 emission rate for the four slurry removal events was 1,836 ± 708 mg NH_3 m^{-2} hr^{-1}. The average before and after NH_3 emission rate for the four slurry removal events was 441 ± 251 mg NH_3 m^{-2} hr^{-1} and 639 ± 369 mg NH_3 m^{-2} hr^{-1}, respectively. Consistently, the after-removal NH_3 emission rate was higher than the before-removal level. A typical NH_3 emission event is shown in Figure 4 for the single continuous slurry removal event shown in Figure 3.

Odor data were collected for this research project at 2-week intervals. However, during the slurry removal event for Barn 2 in 2003, a more detailed odor evaluation procedure was conducted to capture the odor emitted during slurry agitation and manure removal. Odor data for Barn 1 during slurry removal were not collected. Table 4 and Figure 5 summarize the measured

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Table 3. Measured emission levels for H_2S and NH_3 in mg m^{-2} hr^{-1}.[a]

H_2S Emissions, mg H_2S m^{-2} hr^{-1}					Literature ranges (see text) mg m^{-2} hr^{-1} 1.6–54
Year	Barn	Before	Max During	After	
2002	1	13.5 (10.5)	1389.4	3.6 (6.4)	
	2	25.6 (15.1)	1739.1	1.3 (0.8)	
2003	1	28.3 (32.5)	1655.9	4.3 (2.1)	
	2	72.9 (35.5)	1326.2	6.0 (3.1)	
NH_3 Emissions, mg NH_3 m^{-2} hr^{-1}					Literature ranges (see text) mg m^{-2} hr^{-1} 4.8–2376
Year	Barn	Before	Max During	After	
2002	1	264.4 (105.0)	1173.5	324.7 (185.3)	
	2	219.3 (62.5)	1329.3	390.8 (189.5)	
2003	1	516.9 (145.3)	2225.0	708.8 (368.6)	Most commonly reported ranges (mg m^{-2} hr^{-1}) 300–500
	2	761.0 (384.6)	2614.7	1129.8 (468.7)	

Notes: [a]Both barns had a floor area of 747 m^2. Barn 1 had 58,900 kg of pigs, and Barn 2 had 52,500 kg for year 2002 during slurry removal. Barn 1 had 103,530 kg of pigs, and Barn 2 had 83,250 kg for year 2003 during slurry removal. Standard deviation shown in parenthesis.

results. The increase in odor concentration, mgasurgd in odor units (OU) defined as the fesh-air dilution-to-detection (OU m^{-3}) during slurry removal was 4.3 and 2.1 times higher for the pit and tunnel fan exhaust locations, respectively, compared with the before-removal levels. The after-removal odor concentration was 1.3 and 3 times lower than the before-removal levels. The maximum odor strength during slurry removal reached 9,625 OU m^{-3} and 8,228 OU m^{-3} for the pit and tunnel exhaust locations, respectively. During slurry agitation, the odor emission rate (OU m^{-2} sec^{-1}) had maximum levels of 22.2 and 130.6 OU m^{-2} sec^{-1} for the pit and tunnel exhaust fan locations, respectively. The odor concentration measurements indicated that the pit and tunnel exhaust points were relatively similar before, during, and after slurry removal. However, the odor emission was 5.3 times higher from the tunnel exhaust point than the pit exhaust point because of the higher airflow rate from the tunnel exhaust fans during slurry removal.

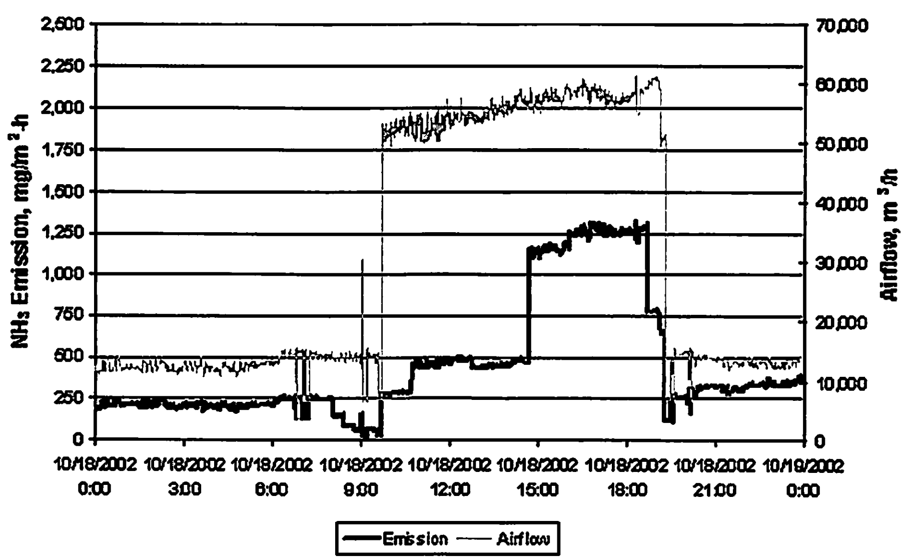

Figure 4. Barn airflow rate and NH_3 emission before, during, and after a slurry removal event (Barn 2, October 2002, removal event).

Table 4. Odor strength (OU m^{-3}) and odor emission rate (OU m^{-2} s) measured for the pit and tunnel exhaust locations before, during, and after slurry removal. Barn 2 for the 2003 slurry removal event shown.

	Odor Strength (OU m^{-3})			Odor Emission Rate (OU m^{-2} s)		
Location	**Before**	**During**	**After**	**Before**	**During**	**After**
Pit	1632 (590)	7022 (1215) [9625]	1258 (513)	3.8 (1.4)	16.2 (2.8) [22.2]	2.9 (1.2)
—	{1.7 m^3 sec^{-1}}	{1.7 m^3 sec^{-1}}	{1.7 m^3 sec^{-1}}			
Tunnel	2611 (468)	5430 (1237) [8228]	868 (622)	26.7 (7.3)	86.2 (19.6) [130.6]	2.5 (1.6)
—	{7.6 m^3 sec^{-1}}	{11.9 m^3 sec^{-1}}	{2.3 m^3 sec^{-1}}			

Notes: The average and standard deviation (in parentheses) shown along with the maximum (in brackets) during slurry removal. The average airflow rate (in {}) is also shown for the measurements before, during, and after slurry removal. These are shown below each odor strength measurement.

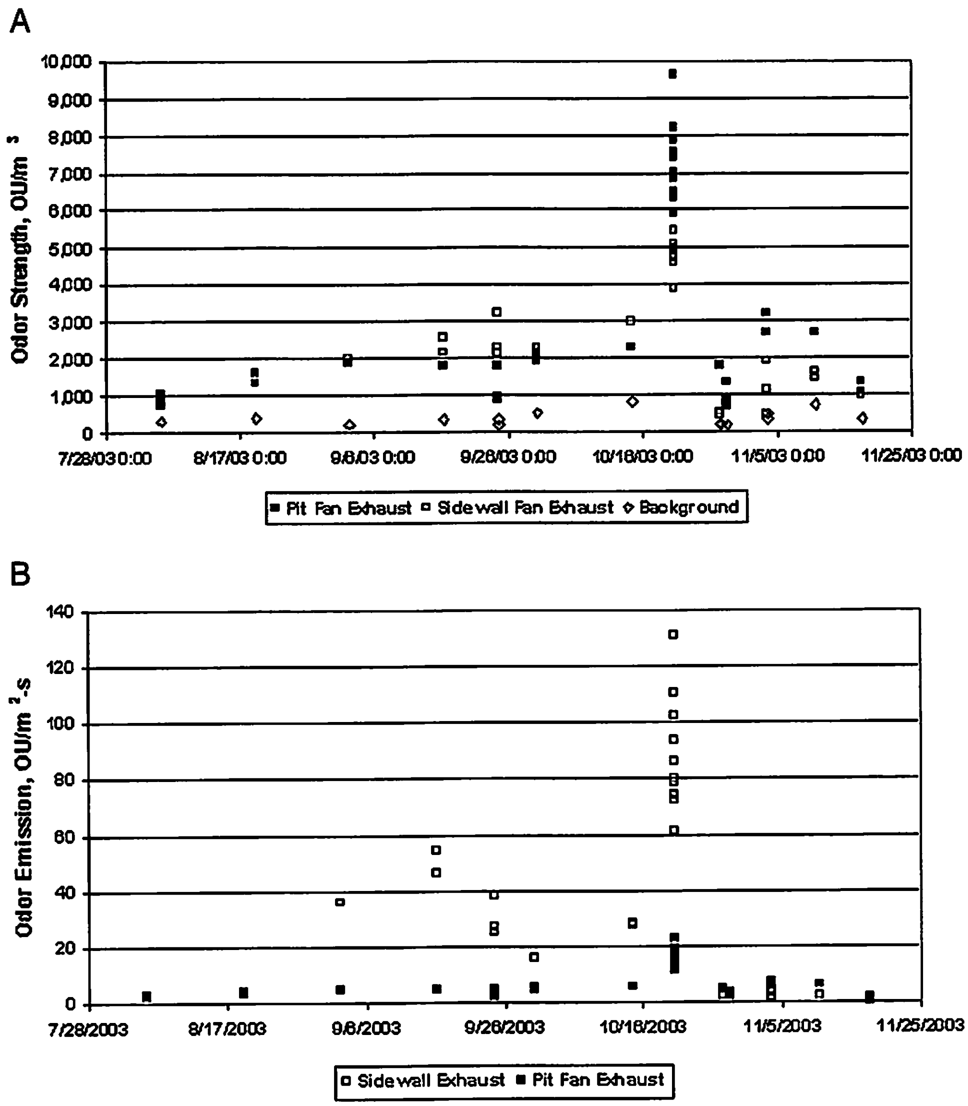

Figure 5. (a) Odor strength and (b) odor emission rate from Barn 2 during the 2003 slurry removal event. Before data measured on October 14, 2003, and after data measured on October 27, 2003.

CONCLUSIONS

The emission of H_2S, NH_3, and odor before, during, and after slurry removal events from two deep-pit swine finishing facilities indicated large increases in concentrations and emission rates during slurry removal, with odor and H_2S emissions lowering to levels well below the pre-removal rates. Although at times the pit exhaust concentrations can be much higher than from non-pit fans, the emission of H_2S, NH_3, and odor from the pit fans is substantially lower than the predominant tunnel fans because of the large differences in ventilation rate capacities when tunnel fans are active. A slurry removal event will result in an acute exposure event for the animals and workers. A protocol establishing a minimum ventilation rate should be established before agitation begins, and all workers should remain outside the facility during agitation. For this research project, the operator established a fixed and minimum ventilation rate of ~27 fresh-air changes per hour with the resulting inside H_2S concentration levels well below lethal levels.

ACKNOWLEDGMENTS

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MN ATTACHMENT 4

STATE OF MINNESOTA
IN COURT OF APPEALS
CX-02-1603

pg. 12
Hog feed lot operation's "compliance with generally accepted Ag practices" does not preclude a finding of negligence.
pg. 12

Gerald Wendinger, et al.,
Appellants,

vs.

Forst Farms, Inc., et al.,
Respondents,

Wakefield Pork, Inc.,
Respondent

Filed June 10, 2003
Affirmed in part and reversed in part, and remanded
Lansing, Judge

Nicollet County District Court
File No. C101440

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mn.gov/law-library-stat/archive/ctappub/0306/op021603-0610.htm

Considered and decided by Lansing, Presiding Judge, Klaphake, Judge, and Hudson, Judge.

SYLLABUS

I. A plaintiff states an actionable claim in nuisance by presenting evidence that the defendant has intentionally maintained a condition causing nuisance harm. A claim of private nuisance does not require proof that the nuisance harm resulted from a "wrongful" act except to the extent the plaintiff must prove fault on the part of the defendant.

II. Minn. Stat. § 561.19, subd. 2(a) (2002), does not impose an absolute two-year limitation on nuisance claims against agricultural operations.

III. Minn. Stat. § 561.19, subd. 2(b) (2002), does not provide agricultural operations an affirmative defense against nuisance claims based on compliance with "generally accepted agricultural practices."

OPINION

LANSING, Judge

On cross-motions for summary judgment in a dispute involving allegations of nuisance, negligence, and trespass against a confined-animal feeding operation, the district court granted summary judgment for Jerome, Alma, and James Forst, Forst Farms, Inc., and Wakefield Pork, Inc. The district court did not decide the summary judgment motion of Gerald and Julie Wendinger on the issue of agency. The Wendingers appeal, and we affirm in part, reverse in part, and remand.

FACTS

Julie and Gerald Wendinger own land in rural Nicollet County near a confined-animal feeding operation run by the Forst family (the Forsts), as Forst Farms, Inc. (Forst Farms). The Wendingers and Forsts are long-time residents of the area. The Forsts have farmed their land since the 1960s, and Gerald Wendinger was born on and farmed the Wendinger land until the 1970s. The Wendingers built a new home on that land in 1984.

In 1994, the Forsts entered into an agreement with Wakefield Pork, Inc., (Wakefield) under which the Forsts agreed to construct and operate a confined-animal feeding operation for housing and feeding pigs owned by Wakefield. The operation stores the liquid animal waste in a two-stage outdoor concrete manure lagoon from which it is pumped and spread on area fields each autumn. The Forsts had previously used a "scrape and haul" system with their livestock in which the waste and straw used in the stalls is hauled away in solid form. The new feeding facility was put into operation in 1994.

The manure lagoon was pumped out for the first time in the fall of 1995 and around that time the Wendingers complained about odors they believed to be emanating from the Forst operation. Between late 1995 and 2000, the Wendingers filed scores of further odor complaints with various state and local authorities. State and local environmental officials conducted a series of investigations in response to the complaints.

In the summer of 2001, the Wendingers sued the Forsts, Forst Farms, and Wakefield, stating claims in negligence, nuisance, and trespass and seeking injunctive and compensatory relief. The district court dismissed the trespass claim for failure to state a legally sufficient claim and dismissed the negligence and nuisance claims after granting summary judgment for the defendants. The court did not rule on the Wendingers' motion for summary judgment recognizing Wakefield's agency over the Forst Farms confined-feeding operation. The Wendingers now appeal.

ISSUES

I. Do invasive odors give rise to an action in trespass?

II. Must a plaintiff alleging nuisance prove that the nuisance harm is the result of a wrongful act?

III. Does Minn. Stat. § 561.19, subd. 2(a) (2002), impose an absolute two-year limitation on nuisance claims against agricultural operations or provide an affirmative defense against such claims for an agricultural operation in compliance with "generally accepted agricultural practices"?

IV. Does Minn. Stat. § 561.19, subd. 2(b) (2002), provide the standard of care governing negligence claims against agricultural operations?

V. Is Forst Farms, Inc., an agent of Wakefield Pork, Inc., as a matter of law?

ANALYSIS

I

The district court dismissed the Wendingers' trespass claim on grounds that invasive odors can give rise only to an action for nuisance, not trespass. When reviewing a district court's dismissal of an action for failure to state a claim on which relief can be granted, we determine only whether the complaint sets forth a legally sufficient claim for relief. *Barton v. Moore*, 558 N.W.2d 746, 749 (Minn. 1997).

"Trespass encompasses any unlawful interference with one's person, property, or rights, and requires only two essential elements: a rightful possession in the plaintiff and unlawful entry upon such possession by the defendant." *Special Force Ministries v.*

WCCO Television, 584 N.W.2d 789, 792-93 (Minn. App. 1998) (citations omitted), *review denied* (Minn. Dec. 15, 1998). The Wendingers argue that the odors from the feeding operation physically invaded their land because the odors migrated onto the property in the form of airborne particulate matter. A claim of trespass by airborne particles, they contend, should be treated the same as claims of trespass by errant bullets, which have been upheld by Minnesota appellate courts. *See Whittaker v. Stangvick*, 100 Minn. 386, 111 N.W. 295 (1907); *Citizens for a Safe Grant v. Lone Oak Sportsmen's Club, Inc.*, 624 N.W.2d 796, (Minn. App. 2001).

A number of jurisdictions have abandoned the historical distinction between direct and indirect invasions separating nuisance and trespass claims and have applied principles of trespass to cases in which a plaintiff claims invasion by particulate matter. *See, e.g., Borland v. Sanders Lead Co.*, 369 S.2d 523 (Ala. 1979); *Martin v. Reynolds Metals Co.*, 342 P.2d 790 (Or. 1959); *Bradley v. Am. Smelting& Refining Co.*, 709 P.2d 782 (Wash. 1985). Minnesota, however, has not recognized trespass by particulate matter. Current Minnesota law was summarized in a 1989 case involving allegations of nuisance and trespass caused by noxious fumes from a waste-water treatment plant: "[a]lthough some of the traditional distinctions between nuisance and trespass have become blurred and uncertain, the distinction now accepted is that trespass is an invasion of the plaintiff's right to exercise exclusive possession of the land and nuisance is an interference with the plaintiff's use and enjoyment of the land." *Fagerlie v. City of Willmar*, 435 N.W.2d 641, 644 n.2 (Minn. App. 1989) (citing D. Dobbs, *Prosser and Keeton on Torts* at 622 (5th ed. 1984)).

Like the fumes in *Fagerlie*, the odors of which the Wendingers complain interfere with the use and enjoyment of their land, not with their exclusive possession of it. We accordingly conclude that the district court did not err in dismissing the Wendingers' trespass claim for failure to state a legally sufficient claim.

II

The Wendingers also challenge the district court's grant of summary judgment on their nuisance claim. Specifically, they contend that the district court erred as a matter of law in holding that a claim of private nuisance requires proof of "wrongful conduct" by the defendant. As a legal question, we review de novo the district court's determination of the necessary elements of a cause of action. *See Frost-Benco Elec. Ass'n v. Minnesota Pub. Utils. Comm'n*, 358 N.W.2d 639, 642 (Minn. 1984) (explaining that a reviewing court exercises independent review on a purely legal issue).

Nuisance is defined by statute as "[a]nything which is injurious to health, or indecent or offensive to the senses, or an obstruction to the free use of property, so as to interfere with the comfortable enjoyment of life or property." Minn. Stat. § 561.01 (2002). An action in nuisance "may be brought by any person whose property is injuriously affected or whose personal enjoyment is lessened by the nuisance." *Id.* In applying the statute in this case, the district court read into it an additional requirement of "wrongful conduct," drawn from language in *Highview N. Apartments v. County of Ramsey*, 323 N.W.2d 65, 70-71 (Minn. 1982).

Highview involved a municipal drainage system that diverted a watershed into a storm sewer system and caused the flooding of the plaintiffs' basements. The municipalities, held liable for damages under a nuisance theory, argued on appeal that the district court erred in assigning liability on the basis they had "maintained something which is clearly an unreasonable thing in view of the surroundings." *Id.* at 73. The municipalities contended that without proof of negligence, unlawful conduct, or the creation of a dangerous situation, there could be no nuisance. *Id.* at 70.

The supreme court rejected the municipalities' argument and held that the nuisance statute "defines a nuisance in terms of the resultant harm rather than in terms of the kind of conduct by a defendant which causes the harm." *Id.* The court went on to explain that "there must be some kind of conduct causing the nuisance harm which is 'wrongful'." *Id.* at 70-71 (citing *Randall v. Vill. of Excelsior*, 103 N.W.2d 131, 134, 258 Minn. 81, 85 (1960)). By enclosing the word "wrongful" in quotation marks preceding the *Randall* citation, the court signaled that the word was to have the same meaning it had in *Randall*. In *Randall* the supreme court used the word "wrongful" to describe the type of injury involved in a nuisance claim: "It is elementary that 'nuisance' denotes the wrongful invasion or infringement of a legal right or interest * * * and includes intentional harms and harms caused by negligence, reckless or ultrahazardous conduct." *Randall*, 103 N.W.2d at 134, 258 Minn. at 85 (citation omitted). Used in this way, the word "wrongful" is meant simply to limit the scope of nuisance liability to situations in which the defendant can be said to be at fault. *See* Bryan A. Garner, *A Dictionary of Modern Legal Usage* 72 (1987) (defining "at fault" to include "responsible for a wrong committed"). The holding in *Highview* confirms this use of wrongful because thedefendants were held liable for nuisance harm without proof that the harm resulted from unlawful conduct by them. Rather, nuisance liability was premised solely on the municipalities' fault under the reasonable-use doctrine governing the drainage of surface waters.

Applying the principles of *Randall* and *Highview* to this case, we believe that a plaintiff who presents evidence that the defendant intentionally maintains a condition that is injurious to health, or indecent or offensive to the senses, or which obstructs free use of property, states an actionable claim in nuisance. The Wendingers supported their nuisance claim with evidence that the Forsts were aware of their operation's alleged impact on the Wendingers' use and enjoyment of their land as early as 1996. The Forsts do not contest this point. That evidence is sufficient to demonstrate intentional conduct. *See* Dan B. Dobbs, *The Law of Torts* § 464 at 1325 (2000) (explaining that a defendant intentionally causes nuisance harm when he maintains the condition causing the harm after having been apprised of its effect upon the plaintiff's use and enjoyment of his land). We therefore conclude that the district court erred as a matter of law in holding that an allegation of nuisance must be supported by evidence that the defendant caused the nuisance harm by an independent wrongful act.

III

The legislature has shielded agricultural operations from nuisance liability in certain circumstances. This protection is set forth in Minn. Stat. § 561.19, subd. 2, which reads:

> Subd. 2. Agricultural operation not a nuisance.
> (a)An agricultural operation is not and shall not become a private or public nuisance after two years from its established date of operation if the operation was not a nuisance at its established date of operation.

> (b)An agricultural operation is operating according to generally accepted agricultural practices if it is located in an agriculturally zoned area and complies with the provisions of all applicable federal and state statutes and rules or any issued permits for the operation.
>
> (c)The provisions of this subdivision do not apply:
>
> (1) to a condition or injury which results from the negligent or improper operation of an agricultural operation or from operations contrary to commonly accepted agricultural practices or to applicable state or local laws, ordinances, rules, or permits;
>
> (2) when an agricultural operation causes injury or direct threat of injury to the health or safety of any person;
>
> * * * .

Minn. Stat. § 561.19, subd. 2 (2002). The district court interpreted these provisions to impose a two-year limitation on nuisance suits against agricultural operations and to bar nuisance claims against operations that are conducted according to "generally accepted agricultural practices."

Because it presents a question of law, we review the district court's construction of Minn. Stat. § 561.19 de novo. *Brookfield Trade Ctr., Inc. v. County of Ramsey*, 584 N.W.2d 390, 393 (Minn. 1998). To determine whether a statute has been correctly applied, we focus on the words of the statute to "ascertain and effectuate the intention of the legislature." Minn. Stat. § 645.16 (2002). If the meaning is plain and unambiguous we apply that meaning as a manifestation of legislative intent. *Kersten v. Minn. Mut. Life Ins. Co.*, 608 N.W.2d 869, 874-75 (Minn. 2000). Plain meaning embodies ordinary use of the language in the context of the whole-act structure, applying the usual conventions of grammar and syntax. *Occhino v. Grover*, 640 N.W.2d 357, 359-60 (Minn. App. 2002), *review denied* (Minn. May 28, 2002). If the meaning of statutory language is not plain, we resolve ambiguity by looking to other factors that evince legislative intent and, when applicable, agency interpretation and extrinsic-source canons. *Id.* at 360; Minn. Stat. § 645.16 (listing factors for ascertaining legislative intent).

Timeliness of nuisance claim

Minn. Stat. § 561.19, subd. 2(a), states that an agricultural operation shall not become a nuisance once it has been established for two years "*if the operation was not a nuisance at its established date of operation.*" Minn. Stat. § 561.19, subd. 2(a) (emphasis added). Thus, under the plain meaning of the act, a court considering the timeliness of a nuisance claim against a facility that has been in operation for more than two years must determine whether the complaint alleges the operation was a nuisance when established. The Wendingers alleged in their complaint that the Forst operation produced extremely noxious odors and gases "from the beginning." The district court made no finding on this allegation. Without a determination that the allegation is unsupported by evidence, the district court did not have a basis to conclude that the Wendingers' nuisance claim was barred under subdivision 2(a).

"Generally accepted agricultural practices"

The district court explained in its summary judgment memorandum that when applying Minn. Stat. § 561.19, subd. 2, the "focus is to be upon whether the operation is operating according to generally accepted agricultural practices, defined to be an operation located in an agriculturally zoned area which complies with the provisions of all applicable federal and state statutes and rules or any issued permits for the operation." The court then went on to suggest that compliance with generally accepted agricultural practices provides an agricultural operation with an affirmative defense to a nuisance claim. Based on the language in its memorandum, the court apparently read subdivision 2(b) as the source of this affirmative defense.

Subdivision 2(b), however, only provides a definition of the phrase "operating according to generally accepted agricultural principles;" it does not connect that definition to any operative section. Neither subdivision 2(b) nor any other part of the statute explains the purpose of the definition, and, indeed, the phrase "generally accepted agricultural practices" appears in no other Minnesota law or regulation. A possible explanation is that subdivision 2(b) was intended to provide a definition for "*commonly* accepted agricultural practices" in subdivision 2(c). (Emphasis added.) Even if that were the case, however, subdivision 2(c) states *exceptions* to the limitations on nuisance action and therefore would provide no support for construing the definition to give rise to an affirmative defense.

Although we are unable to discern the legal significance of subdivision 2(b), the plain language of the provision creates no affirmative defense for operations in compliance with generally accepted agriculture practices. We therefore reject the district court's conclusion that the Wendingers' nuisance claim may be considered only to the extent that it alleges nuisance harm caused by negligence.

IV

The district court held that Minn. Stat. § 561.19, subd. 2(b), states a duty of care applicable to a hog-confinement operator and concluded that the Wendingers' claim in negligence failed as a matter of law because the Wendingers offered no evidence that the

Forst facility deviated from generally accepted agricultural practices. The determination of the proper standard of care presents a question of law, which we review de novo. *Bondy v. Allen*, 635 N.W.2d 244, 250 (Minn. App. 2001).

A legal duty of care is imposed either by the common law rule requiring exercise of ordinary care not to injure another, or by a statute designed for the protection of others. *Lynghaug v. Payte*, 247 Minn. 186, 194, 76 N.W.2d 660, 665-66 (1956). While violation of a statutory duty may in certain circumstances constitute negligence per se, *see, e.g., Scott v. Indep. Sch. Dist. 709, Duluth*, 256 N.W.2d 485, 488-89 (Minn. 1977), the inverse proposition—that compliance with a statute precludes a finding of negligence—is not the law. A statutory standard "is no more than a minimum, and it does not necessarily preclude a finding that the actor was negligent in failing to take additional precautions." *Blasing v. P.R.L. Hardenbergh Co.*, 303 Minn. 41, 49, 226 N.W.2d 110, 115 (1975) (quoting William L. Prosser, *Handbook of the Law of Torts* (4th ed. 1971) § 36 at 203); *see also Blatz v. Allina Health Sys.*, 622 N.W.2d 376, 386 (Minn. App. 2001) (noting that compliance with statute regulating conduct does not provide conclusive proof that person exercised due care). We therefore conclude that the district court erred as a matter of law in dismissing the Wendingers' claim without determining whether it alleged a legally sufficient cause of action in negligence.

V

The Wendingers sought summary judgment on the question of whether the Forsts and Forst Farms are agents of Wakefield Pork, so that Wakefield would be liable for any negligence in the operation of the Forst facility or resulting nuisance harm under a theory of respondeat superior. The district court did not rule on the Wendingers' motion, apparently because of its determination that the Wendingers' substantive claims were insufficient as a matter of law.

Wakefield contends that the lack of a district court ruling on the agency question places that issue beyond the scope of this appeal. But the scope of appellate review is not strictly limited to the judgment or order appealed from; it also includes "any other matter as the interest of justice may require." Minn. R. App. P. 103.04. Determining the agency question in this appeal would serve the interests of justice by resolving an important question of liability, thereby possibly saving one of the defendants the time and cost of defending this action, at least with respect to certain claims. Nevertheless, we are prevented from considering the question by the lack of factual findings on the relationship between Forst Farms and Wakefield. *See Vacura v. Haar's Equip., Inc.*, 364 N.W.2d 387, 391 (Minn. 1985) (stating that existence of agency relationship is question of fact). The parties' appellate briefs make clear that the factual basis of the Forst Farms-Wakefield relationship is contested and must therefore be subject to further fact-finding.

DECISION

Because odors do not interfere with the exclusive possession of land, an allegation that a confined-animal feeding operation emits invasive odors does not state a claim for trespass. Invasive odors may support a claim in nuisance, however, if they rise to the level of nuisance harm and are caused by a condition intentionally maintained by the defendant. The plain meaning of Minn. Stat. § 561.19, subd. 2, supports neither the imposition of an absolute two-year limitation on nuisance claims against agricultural operations nor the creation of an affirmative defense against such claims for operations that comply with "generally accepted agricultural practices." **Finally, an agricultural operation's compliance with generally accepted agricultural practices does not preclude a finding of negligence.**

Affirmed in part, reversed in part, and remanded.

Intent of this law held up in court: "compliance with generally accepted Ag practices" - does not preclude findings of negligence.

ATTACHMENT 4

561.19 NUISANCE LIABILITY OF AGRICULTURAL OPERATIONS.

Subdivision 1. **Definitions.** For the purposes of this section, the following terms have the meanings given them:

(a) "Agricultural operation" means a facility and its appurtenances for the production of crops, livestock, poultry, dairy products or poultry products, but not a facility primarily engaged in processing agricultural products.

(b) "Established date of operation" means the date on which the agricultural operation commenced. If the agricultural operation is subsequently expanded or significantly altered, the established date of operation for each expansion or alteration is deemed to be the date of commencement of the expanded or altered operation. As used in this paragraph, "expanded" means an expansion by at least 25 percent in the number of a particular kind of animal or livestock located on an agricultural operation.

"Significantly altered" does not mean:

(1) a transfer of an ownership interest to and held by persons or the spouses of persons related to each other within the third degree of kindred according to the rules of civil law to the person making the transfer so long as at least one of the related persons is actively operating the farm, or to a family farm trust under section 500.24;

(2) temporary cessation or interruption of cropping activities;

(3) adoption of new technologies; or

(4) a change in the crop product produced.

(c) "Generally accepted agricultural practices" means those practices commonly used by other farmers in the county or a contiguous county in which a nuisance claim is asserted.

Subd. 2. **Agricultural operation not a nuisance.** (a) An agricultural operation is not and shall not become a private or public nuisance after two years from its established date of operation as a matter of law if the operation:

(1) is located in an agriculturally zoned area;

(2) complies with the provisions of all applicable federal, state, or county laws, regulations, rules, and ordinances and any permits issued for the agricultural operation; and

(3) operates according to generally accepted agricultural practices.

(b) For a period of two years from its established date of operation, there is a rebuttable presumption that an agricultural operation in compliance with the requirements of paragraph (a), clauses (1) to (3), is not a public or private nuisance.

(c) The provisions of this subdivision do not apply:

(1) to an animal feedlot facility with a swine capacity of 1,000 or more animal units as defined in the rules of the Pollution Control Agency for control of pollution from animal feedlots, or a cattle capacity of 2,500 animals or more;

(2) to any prosecution for the crime of public nuisance as provided in section 609.74 or to an action by a public authority to abate a particular condition which is a public nuisance; or

ATTACHMENT 4

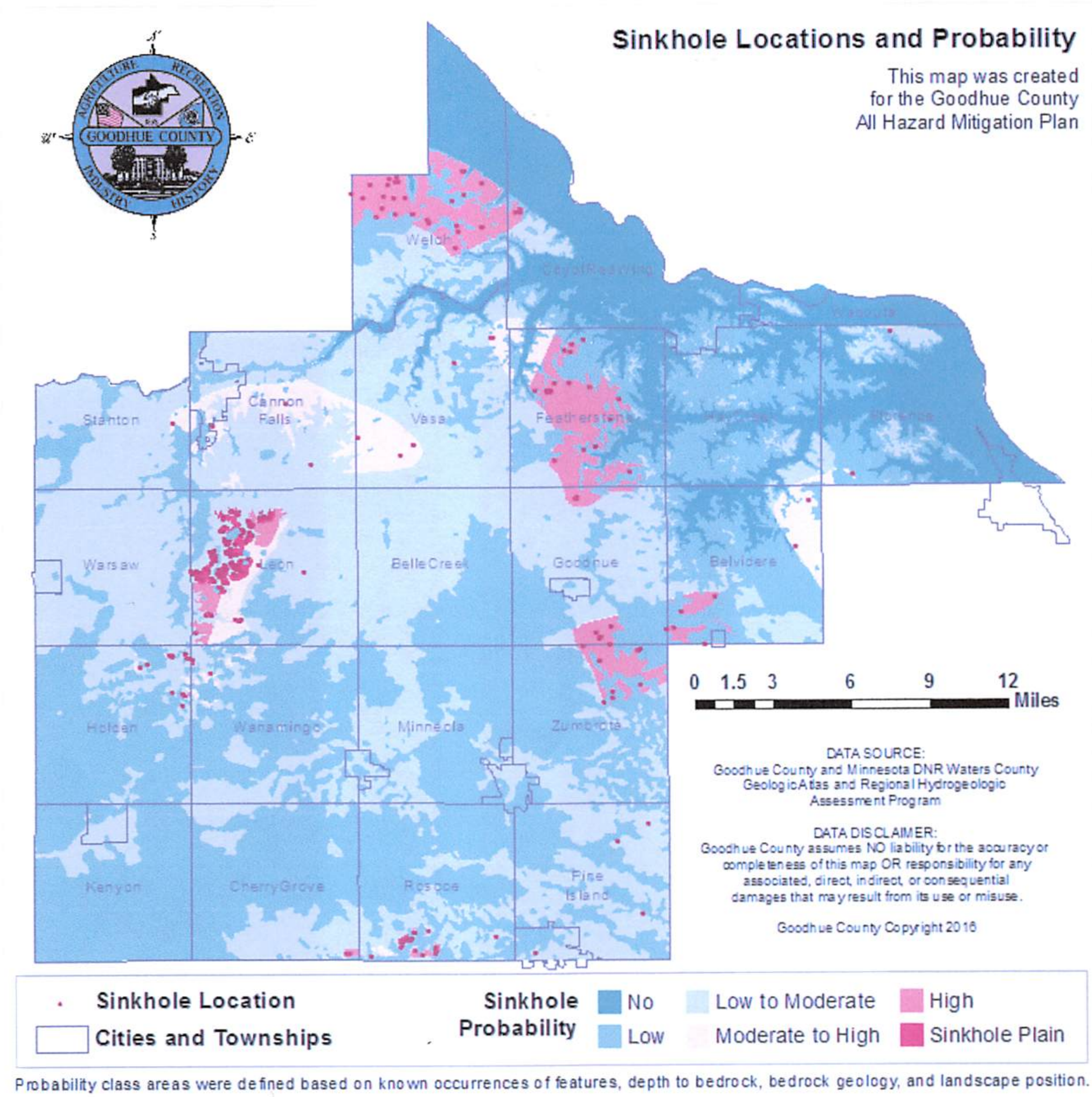
(3) to any enforcement action brought by a local unit of government related to zoning under chapter 394 or 462.

Subd. 3. **Existing contracts.** This section shall not be construed to invalidate any contracts or commitments made before January 1, 1983.

Subd. 4. **Severability.** If a provision of this section, or application thereof to any person or set of circumstances, is held invalid or unconstitutional, the invalidity shall not affect other provisions or applications of this section which can be given effect without the invalid provision or application. To that end, the provisions of this section are declared to be severable.

Subd. 5. [Repealed, 1983 c 182 s 2]

History: *1982 c 533 s 1; 1983 c 182 s 1; 1994 c 619 s 9,10; 1994 c 622 s 4,5; 2001 c 128 s 4; 2004 c 254 s 43,44*

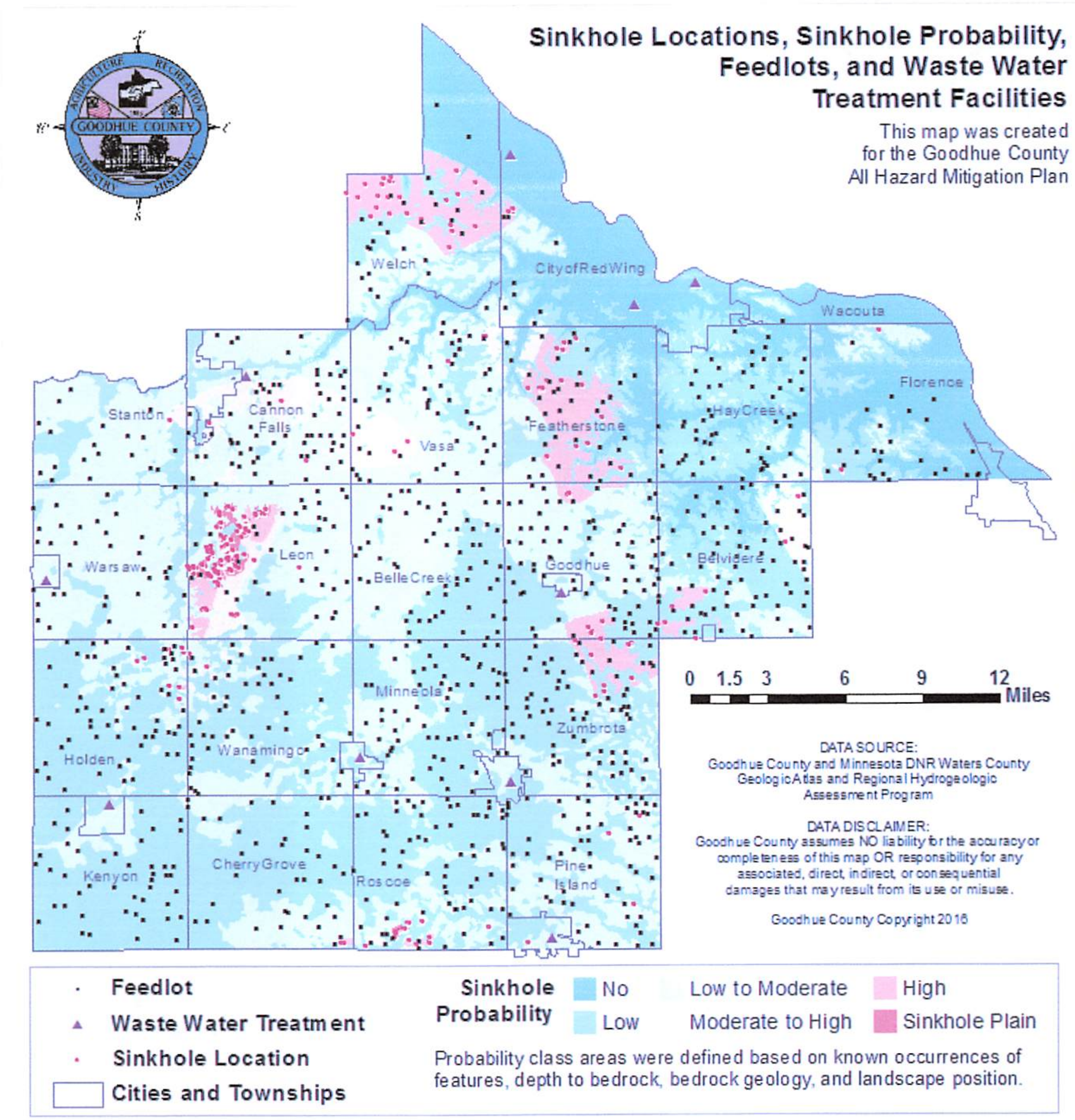


Map 26. Sinkhole Probability in Goodhue County [23]

Rapid flow of water through karst features such as sinkholes can be indicative of little filtration. Polluted surface water can quickly move into a groundwater aquifer or well. Besides affecting drinking water for humans, water pollution can travel further more quickly underground. When the polluted water emerges as a spring, stream, or lake, the pollution can endanger aquatic plants and animals. Dissolved bedrock can also lead to a collapse of the earth's surface. If this occurs beneath a sewage lagoon, waste water can be released into the groundwater system. Erosion can not only degrade streams, wetland, ponds, and rivers but can also cause damage to structures such as home, roads, and bridges.

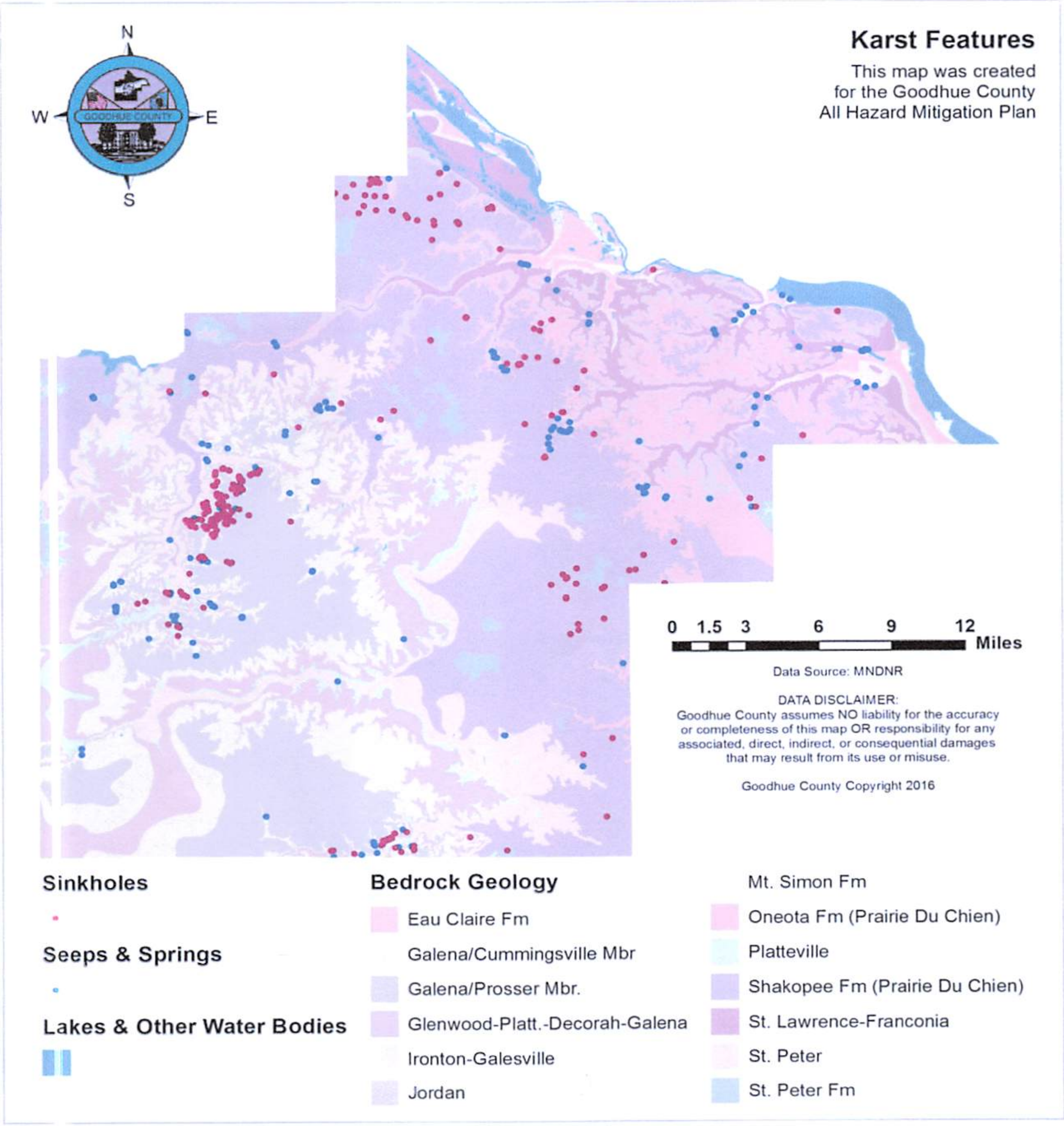
Sinkhole probability is high in Leon Township, Welch Township, Featherstone Township, Belvidere Township, Goodhue Township, and Zumbrota Township. Sinkhole probability is Moderate to High for

One notable incident of groundwater contamination occurred in the City of Bellechester in 1992. A sinkhole formed in one of the sewage lagoons, releasing close to 2 million gallons of sewage. The Goodhue County Environmental Health Department tested all wells that were known within a three mile radius for potential contamination. Of the wells that were tested, only a few had elevated chemical levels. It could not be confirmed that the contamination of these wells was caused by the sewage release.



Map 32. Sinkhole Locations, Sinkhole Probability, Feedlots, and Waste Water Treatment Facilities. [50]

du Chien formations are the first bedrock. Known karst features in Goodhue County include 160 seeps and springs and 376 sinkholes. Much of the County is underlain by active karst as shown on the maps below, which contributes to the scenic variety of the areas.



Map 6. Karst Features

Soils

Goodhue County's soil is based on clay subsoil in all places except on the terrace plains that skirt the main streams. This clay is generally fine and loamy, but in the high prairies of the western towns it is mingled with some pebbles. No matter how frequent the stones are on the surface or in the immediate subsoil, the real soil, which sustains the annual crops of the farmers, is invariably of fine grain that is usually black and is from a few inches to several feet thick. Stones in the subsoil appear in the western part of the county but gradually disappear towards the east, and they are wholly wanting in the extreme eastern part of the county. The subsoil clay, which, in the western towns seems to be a true till at no great depth, passes through an intermediate,

ATTACHMENT 5

My name is Darwyn Tri. I live in rural Zumbrota Township. I grew up on a dairy farm and raised hogs , and in the past I've worked at the local sales barn for 15 years - so I've had some exposure to hogs. I'm also a neighboring landowner to Kohlnhofer's proposed newest and largest swine finishing facility.

I use air monitors on my current job to test the atmosphere for confined space entry. In other words, the atmosphere must be tested, verified and documented that it is safe before a colleague enters an enclosed space that is not intended for use. I was also one of the citizens doing the air monitoring for the hydrogen sulfide report that was made public. I'm comfortable that we were following the proper procedures with the Jerome meters, and the report results speak for themselves. It was a stark reminder of how heavy of a film you would get on, and in you, from being around a high concentration of hogs. Not only the odor, but the heavy / sticky film you'd get in your nostrils and lungs resulting in irritated eyes, throats and sometimes resulting in a headache.

While we were testing for hydrogen sulfide at several Kohlnhofer barns last summer there were times when our breathing was affected and we began to cough even when the hydrogen sulfide was not very high. While we were pondering what could be causing the coughing, the federal EPA Inspector General issued a scathing report. It turns out the National Academy of Science had been warning since 2003 of the complete lack of information on the emissions coming out of deep manure pits. After 15 years and 15 million dollars, the EPA study has not established valid emissions rates for air modeling that the MPCA and other governmental bodies use when making decisions about issuing permits to hog CAFOs, short for concentrated animal feeding operations. However, some EPA data collection was completed that measured actual emission rates for hydrogen sulfide and odor-causing Volatile Organic Compounds. In the case of the most recently permitted Kohlnhofer facility, our Minnesota Pollution Control Agency allowed modelling using an emission factor from a non-controlled study that the study's authors warned would not be appropriate for all locations.

I would like to enter into the record EPA Inspector General's report 17-P-0396 dated September 19, 2017. I also wish to enter the EPA *Emissions Data from Four Swine Finishing Rooms in Indiana Final Report for Site IN3B* of the National Air Emissions Monitoring Study. Purdue University staff recommended we look at the Indiana data since that barn would be most like the Kohlnhofer brothers' proposed facility.

The data explains why we were coughing! Volatile organic compounds (VOCs) and Total Suspended Particulate or TSP's.

The top twenty volatile organic compounds from the Indiana deep pit finishing barn that Purdue University studied for the EPA, found some nasty chemicals like 2, 3-BUTANEDIONE. This volatile organic compound is a Class 3 hazardous chemical. The Center for Disease Control gives the following advice: Personal protection, including a filter respirator for organic gases and particulates, should be adapted to the airborne concentration of the substance, and worn for protection. Remove all ignition sources. **Do NOT let this chemical enter the environment. This is on record from a credible government agency!**

Another interesting volatile organic compound was Dimethyl trisulfide (DMTS). This is an organic chemical compound with a foul odor, which is detectable at levels as low as 1 part per trillion... It is a product of decomposing bacteria and contributes to the odor of human and hog feces.

Based on the Indiana data, the amount of total suspended particulate from a mechanical ventilated barn, like the Kohlnhofer's proposed facility, could emit suspended particulates that exceed Minnesota's health standard in Minnesota Rules 4717.8000 to 4717.8600. This health standard is intended as one set of criteria in evaluating risks to human health by chemical emissions to the ambient air.

We contacted Charlie Peterson, the air expert in the Feedlot division of the MPCA. Charlie confirmed that to his knowledge the MPCA has never ever studied the volatile organic compounds or total suspended particulates emitted by deep pit swine finishing barns. A review of emails obtained in a Data Practices request appears to show that MPCA staff have questions and doubts that proper protocol and emphasis have been used in preparation of feedlot environmental assessment. We look forward to working with the MPCA to ensure they study this issue at existing deep pit hog barns.

This makes our point that changing County Ordinance to provide additional special exemption from nuisance accountability would be premature until actual air emissions have been studied and fully understood.

Testimony to Goodhue County PAC 4-16-18
RE: Circle K and County proposal to change County Ordinance

I'm Sharon Pagel and I've lived in rural Goodhue County my whole life. I now live on an 80 acre farm in Zumbrota Township. This is a Century Farm that has been a family farm since 1877. So we have roots in Goodhue County.
This review was done by 2 University of Iowa Professors and was just released in January 2018. I would like to enter into the record: "The Explosion of CAFO's in Iowa and Its Impact on Water Quality and Public Health."
One of the studies in this review showed that hog barn emissions of odor, hydrogen sulfide, particulate matter and endotoxins, "were related to eye and nasal irritation, respiratory symptoms, difficulty breathing, wheezing, chest tightness [and] nausea." Further, "These findings are highly consistent with well-documented adverse health effects" among people who work near CAFOs and those who live near CAFOs.
This matches what I and my neighbors personally experienced while testing for hydrogen sulfide near Kohlnhofer's existing hog CAFO's. When the Kohlnhofers predicted an odor-free hog facility with almost no hydrogen sulfide and other air emissions, citizens knew that made no sense. Kohlnhofers assured us that the new hog-finishing facility they plan to build near my family's farm will be like their existing facilities. So we monitored the air near their existing facilities. After a relatively short time in the emission plume it felt like the odor was clinging to us and our cloths and we would be coughing and experiencing eye irritation. The combination of suspended particulate matter, hydrogen sulfide and whatever else was coming out of Kohlnhofer's facilities was horrible. This is not a normal thing that happens at our century farm or at the other places I've lived in rural Goodhue County. Living in that nasty air would definitely ruin our quality of life and it seems like it would ruin our health. I'm also concerned what multiple large CAFOs would do to our water quantity and quality.
The house I live in may not be an "agricultural operation" as defined by county ordinance, but it is my home and part of our farm. I'm concerned that the air emissions from huge hog CAFOs will impact my grandchildren when they visit. I urge the Goodhue County PAC to not change the ordinance for the financial benefit of Kohlnhofer's hog facilities, especially now - while the Minnesota Pollution Control Agency is investigating

hydrogen sulfide levels at their existing facilities.

ATTACHMENT 6

Farm practices that put the health and quality of life of residents of Goodhue County at risk should not be promoted. The Goodhue County letter-head says, **"To effectively promote the safety, health, and well-being of our residents."** I urge you - Do Not change our Zoning Ordinance.

ATTACHMENT 6

The Explosion of CAFOs in Iowa and Its Impact on Water Quality and Public Health

James Merchant
David Osterberg

January 2018

The Iowa Policy Project
20 E. Market Street • Iowa City, Iowa 52245
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Authors and Acknowledgments

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We gratefully acknowledge the support of the **McKnight Foundation** and the **Fred and Charlotte Hubbell Foundation**. Views expressed are solely the perspective of the authors and the Iowa Policy Project.

The Iowa Policy Project

Formed in 2001, the Iowa Policy Project is a nonpartisan, nonprofit organization located at 20 E. Market Street, Iowa City, IA 52245.

The Iowa Policy Project promotes public policy that fosters economic opportunity while safeguarding the health and well-being of Iowa's people and the environment. By providing a foundation of fact-based, objective research and engaging the public in an informed discussion of policy alternatives, the Iowa Policy Project advances accountable, effective and fair government.

All reports produced by the Iowa Policy Project are made available to the public, free of charge, via the organization's website at http://www.iowapolicyproject.org.

The Iowa Policy Project is a 501(c)3 organization. Contributions to support our work may be tax-deductible. We may be reached at the address above, by phone at (319) 338-0773, by email at ipp@Lcom.net, or through other contacts available on our website.

ATTACHMENT 6

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January 2018

EXECUTIVE SUMMARY

The Explosion of CAFOs in Iowa and Its Impact on Water Quality and Public Health

By James Merchant and David Osterberg

Iowa has more than four times as many large concentrated animal feeding operations (CAFOs) as it did in 2001, and over the last decade has added nearly 500 new or expanded state-permitted CAFOs annually — now an estimated 10,000 CAFOs of all sizes.

This remarkable expansion is fueled by Iowa's robust export market for slaughtered hogs, nearly $6 billion in 2016, up 7 percent in one year. Exports to Hong Kong/China broke the $1 billion mark for the first time in 2016. Exports are expected to further expand to meet China's insatiable appetite for pork, and with export demand come new pork processing plants and sustained CAFO growth.

Iowa's lax "Master Matrix" process for CAFO siting is broken — 97 percent of requested permits are approved — even in fragile karst topography, over objections of county supervisors in now 20 counties, and despite the protests of neighbors and citizen groups. All have been disenfranchised by the considerable clout of the livestock industry.

A tipping point has been reached. Rural Iowans have every reason to be concerned.

While water quality is a stated priority of Iowa lawmakers, livestock production is an important contributor to water degradation and goes unchecked. Manure leaks and spills are associated with fish kills, nitrate and ammonia pollution, antibiotics, hormones, bacterial contamination, algae blooms, water quality impairments, closed beaches and are a major contributor to the "dead zone" in the Gulf of Mexico.

Continued CAFO expansion will only worsen these documented environmental impacts and must be part of the solution to Iowa's widely recognized water quality problem.

The Explosion of CAFOs in Iowa

In 2001, there were 722 Iowa Department of Natural Resources (DNR) permitted (93 percent hog) large CAFOs. By federal definition, these are 1,000 animal units (AU); smaller animal feeding operations (AFOs) are classified as permitted medium sized (500 AU to 999 AU), or small (below 500 AU in Iowa, but generally below 300 in other states). In this report, all animal feeding operations will be referred to as CAFOs.

The number of large and medium CAFOs in Iowa is not exact. In 2013, EPA Region 7 compelled the DNR to determine the total number of CAFOs of all sizes. DNR reported to EPA in 2016, through the use of satellite imagery, that it had found over 5,000 "new" CAFOs of undetermined size. In its July 31, 2017, report to EPA, DNR reported that it had identified more medium or large CAFOs, only some of which have been added to its database.* The number of animal facilities in the DNR database exceeds 10,000. Accounting for all new CAFOs the total will certainly be more.

* 2017 Annual Report for Work Plan Agreement between the Iowa Department of Natural Resources and the Environmental Protection Agency, Region 7. Iowa DNR. Aug. 1, 2017 http://www.iowadnr.gov/Portals/id
* See also Iowa Concentrated Animal Feeding Operation Air Quality Study, Table 12: https://www.public-health.uiowa.edu/ehsrc/CAFOstudy.htm

Numerous studies in the last decade also have documented the impact of CAFO air emissions on the health of neighbors, finding significant increases in childhood asthma, adult asthma, airway obstruction, and irritant-linked eye and upper airway symptoms.

Other studies have documented negative impacts of CAFO air emissions on mood (more tension, depression, fatigue, confusion and less vigor), other psychosocial measures, and between odor and multiple quality-of-life measures. Several studies now find that property value near animal feeding operations, depending on distance, wind direction and other factors, is depressed 20 to 40 percent.

While one cannot ignore this now extensive scientific evidence, there is every indication that the industry intends business as usual. Not only happy with the Master Matrix, the industry is fortified by a new anti-nuisance suit law that prevents or severely limits real nuisance damages and seeks to eliminate from consideration evidence-based adverse health effects research.

To control and eventually diminish these negative impacts, and sustain long-term farm animal production in Iowa, we suggest six policies for rural Iowans, supervisors and legislators to consider:

- reform and revise the Master Matrix,
- pass a moratorium on new CAFOs,
- consider land covenants and other local legal strategies to limit local CAFO growth,
- challenge the constitutionality of anti-nuisance suit and ag-gag legislation,
- consider renewable energy from animal waste legislation, and
- fund communicable disease and sustainable agriculture programs.

The current industrial model is not sustainable given its high input costs, rising energy demands, fresh water needs, climate change, and adverse environmental and public health impacts. The very real pushback from rural residents and communities will, however, be sustained.

James Merchant is Professor Emeritus of Public Health and Medicine, and Founding Dean Emeritus, College of Public Health, at the University of Iowa. David Osterberg is Professor Emeritus of Occupational and Environmental Health at the University of Iowa, and co-founder of the nonpartisan Iowa Policy Project in Iowa City.

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The Explosion of CAFOs in Iowa and Its Impact on Water Quality and Public Health

By James Merchant and David Osterberg

INTRODUCTION

Iowa has more than four times as many large Concentrated Animal Feeding Operations (CAFOs) as it did in 2001. (See box.) For pork production, this industrial infrastructure has enabled the state to remain the nation's No. 1 producer, not just for the U.S. markets but to meet export demand as well. This has come at a price. There is conflict within the state on the value and cost of such an expansion and the nature of the industry. This report examines data and science to enhance understanding of the issue by Iowans and their policy makers, and presents policy options.

Iowa pork producers set an all-time record of 2.31 metric tons of pork in 2016, up 8 percent year-over-year and over 2 percent higher than the previous record in 2012.[1] Converting metric tons into the number of animals shows how hogs dwarf the human population of roughly 3 million in the state of Iowa. According to the USDA, 21,370,000 of the total of 65,435,000 market hogs nationally came from Iowa.[2]

China: A Booming Market for Iowa Pork

Export value of slaughtered hogs increased 7 percent from the previous year to $5.94 billion and exports accounted for nearly 26 percent of total 2016 pork production. Mexico remains the No. 1 export market for Iowa pork, but exports to Hong Kong/China set a new volume record in 2016 and broke the $1 billion mark for the first time ($1.07 billion), up 53 percent from the previous year.[3]

To understand the extraordinary demand for exported pork to China, which already produces and consumes over half of the world's pork, one need only consider the continued expansion of its population of 1.41 billion combined with the seemingly insatiable appetite of the Chinese people for pork. With an annual growth rate of about 0.45 percent, China's population will grow by over 6 million in the next year.[4] So important is pork to the Chinese diet that in 2007

The Explosion of CAFOs in Iowa

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China established a National Pork Reserve.[5] While China's Ministry of Agriculture seeks to further expand its national pork production through building U.S.-style very large CAFOs, it has increasingly turned to cheap, nutritious and safe imported pork to meet national demand. In 2011 a Chinese holding company, W.H. Group, bought Smithfield Farms, which remains the largest U.S. pork producer.

The marked growth in pork exports to China is fueling the rapid expansion of CAFOs in Iowa. Pork packing plants are expanding to meet this export demand, with two pork processing plants now open or breaking ground in Iowa. Seaboard Triumph Foods, a $264 million plant in Sioux City, and Prestage, a $240 million plant in Eagle Grove.[6] This news is welcome to the industry, which is concerned that production of hogs could run up against constraints in capacity to process them. This is a real concern since Iowa producers are in an expansionary mood.[7]

WHY RURAL IOWANS SHOULD BE CONCERNED

There has been conflict among neighbors and CAFOs regarding odor, siting policy, size, density, distance to neighboring property or communities, impacts on the rural environment, water quality, the public's health, quality-of-life, property values as well as rural development. The environmental and public health scientific literature underlying this conflict and concern is more substantial than when the industry was the subject of previously widely cited reviews.[8] [9]

An Open Access, industry-sponsored Systematic Review concluded that, apart from Q fever from goats, that MRSA colonization and CAFO proximity was "unclear" and that "there was "inconsistent evidence of a weak association" between respiratory disease and CAFO proximity.[10] A response from several investigators, whose studies had been excluded or misinterpreted, observed that O'Connor et al had "utilized a bias tool not designed for environmental health research, erroneously excluded important studies, and incorrectly interpreted others."[11] The following review seeks to include relevant peer reviewed studies, respects authors' interpretations, and concludes that there is a substantial and growing scientific literature linking adverse health outcomes with living near to animal feeding operations.

IMPACTS ON PUBLIC HEALTH

The Definition of Health

Health, as defined by the World Health Organization, is "a state of complete physical, mental and social well-being."[12] [13] The broad definition of health is widely recognized in the developed world and is increasingly being adopted by American employers as they seek to enhance the health, productivity and well-being of their employees; and by communities as they seek to make decisions about industrial and agricultural development. It is an appropriate definition to apply when considering CAFO emissions and associated adverse health effects among exposed neighbors and communities. When considering adverse effects of CAFOs on nearby neighbors, *health should be defined broadly* because the question of harm involves the nature of home. Any resident associates their family and home life as the center of their well-being, as well as the place there they most need to have — and are entitled to have — a sense of health and security.

When considering adverse effects of CAFOs on nearby neighbors, health should be defined broadly because the question of harm involves the nature of home. Any resident associates their family and home life as the center of their well-being.

The WHO definition of health is consistent with evaluation and analysis of CAFO peer-review publications by interested scholars from a variety of disciplines including epidemiology, environmental health and behavioral health. While adverse health effect endpoints may not always rise to that of a diagnosable disease or injury, such endpoints are measurable, reproducible and valid for assessing community risk.

Considerations of the Population at Risk

For many reasons, Agency for Toxic Substances and Disease Registry health-based guidelines, U.S. Environmental Protection Agency (EPA) standards, and state-based community health regulations must be stricter for the general public than for those exposed occupationally.[14] Such protection is because CAFO neighbors and nearby communities are composed of susceptible subgroups including children, the elderly, those with pre-existing conditions — such as asthma, chronic obstructive lung disease (COPD), and those with allergies and with compromised immunity. While workers are exposed for only a few hours each day, community residents are exposed continuously. While workers have a choice as to where they work, CAFO neighbors and nearby communities have little or no choice under existing Iowa law and regulations. Therefore, community exposure emissions arising from CAFOs — hydrogen sulfide, ammonia, other airway irritants, volatile organic compounds and inflammatory and infectious bioaerosols — would be expected to have adverse health effects at lower concentrations, and therefore need greater margins of safety, in community settings.

State and local governmental bodies should err on the side of caution when considering permitting strategies. The immediate population at risk is informed by consideration of the demographics, location of susceptible subpopulations such as schools, nursing homes, parks and recreational areas, community residential growth trends, water bodies, and local industry that may emit pollutants that add risk. In addition to these local considerations, the location and size of other CAFOs is important as it is known that, in addition to size and proximity, CAFO density is an important risk factor for airway disease.[15] Some of these factors are included in the currently used DNR Master Matrix, which will be described below.

Asthma and Airway Obstruction

Acute physical responses to airborne CAFO emissions, such as watery eyes, runny nose, coughing and nausea, occur temporarily and typically abate after exposure to gases and odors. Such adverse health effects involve biological (short-term physiological responses to emissions from CAFOs. EPA Human Research Studies for air pollutants noted a distinction between "biological responses" and "clinical responses."[16] While this distinction is important for experimental human exposure studies, biologically this is a continuum of response to environmental agents, ranging from very early physiological responses, such as runny nose, to chronic airway inflammation — manifest by coughing, wheezing, chest tightness, shortness of breath and measurable airway obstruction — which may be diagnosed and classified as asthma, chronic bronchitis and/or chronic obstructive lung disease.

Toxic air emissions from CAFOs often adversely affect immediate neighbors and may adversely affect nearby communities. Those with allergies, asthmatics — especially children in which asthma is more common — and adults with COPD, are at particular risk.

Early studies of typically small deep-pit CAFOs established that farmers working in these independent farm operations were at substantial risk to increased rates of chronic bronchitis, asthma and acute and chronic airway obstruction.[17] [18] The risk of ARDS (acute respiratory disease syndrome) and death from high levels of hydrogen sulfide from manure agitation was similarly documented.[19] These occupational respiratory disease risks persist, but are not the focus of this report.

Toxic air emissions from CAFOs often adversely affect immediate neighbors and may adversely affect nearby communities. As already noted, those with allergies, asthmatics — especially children in whom asthma is more common — and adults with COPD, are at particular risk. Research among neighbors living proximate to CAFOs in Iowa, North Carolina and Germany have established that rates of acute respiratory symptoms, asthma and airway obstruction are increased, especially with proximity to and density of swine CAFOs.

Childhood Asthma

Children are particularly vulnerable — given their growing lungs and the known relatively high rate of asthma — to environmental exposures. Research from the Keokuk County Rural Health Study (KCRHS), a three-round prospective study of over 1,000 Iowa families, provided a particularly rich dataset to examine childhood asthma risk among rural children living on, or close to, farms with CAFOs.[20] Nearly all of these operations were under 500 AU deep-pit CAFOs. The study was able to control for multiple demographic, medical, health care and environmental risk factors in its analysis of 644 Round 1 children (1994-1999). Four "asthma outcomes," doctor-diagnosed asthma, doctor-diagnosed asthma/medication for wheeze, current wheeze, and cough with exercise were measured. Doctor-diagnosed asthma (which is known to be underdiagnosed) prevalence was 12 percent, while a more accurate estimate of asthma prevalence, doctor-diagnosed asthma/medication for wheeze, was 16.7 percent. The prevalence of any asthma outcome among children living on a farm raising swine was significantly elevated at 42.9 percent (compared to 26.6 percent among non-swine farm children) and was 55.8 percent among children living on swine farms that added antibiotics to feed. Multivariable models found three (doctor diagnosed asthma/medication for wheeze, current wheeze and cough with exercise) of the four asthma outcomes were significantly related to farms raising swine that added antibiotics to feed. The high prevalence of asthma among these children was striking, but was likely due in part by children who did farm chores in the CAFOs and thus had some occupational level exposures.

Sigurdarson and Klein studied two rural Iowa elementary schools, one school within a half-mile of a large CAFO housing some 3,800 hogs, while the control school was located more than 10 miles from any CAFO.[21] The prevalence of doctor-diagnosed asthma was 19.7 percent among children in the CAFO-proximate school, while the control school prevalence was a significantly less, 7.3 percent. The adjusted odds ratio for doctor-diagnosed asthma was a highly significant 5.71. Possible confounding risk factors were considered but were not significant in multivariable models.

In 2006, Mirabelli and colleagues published two papers on childhood asthma among North Carolina school children.[22] Based on a sample of public schools, they estimated potential exposure using both record-based and survey-based exposure indices. Of the sample of 226 schools, the nearest swine CAFO ranged from 0.2 to 42 miles. Sixty-six schools were located within 3 miles of any CAFO. Livestock odor was reported outdoors in 47 (21 percent) of the surveyed schools. In 19 schools (8 percent), the odor was noticeable indoors, including in classrooms and hallways. The percentage of schools reporting livestock odor and the ratings of the strength of the odor each decreased with increasing distance to the nearest swine CAFO. An accompanying paper assessed estimated exposure to airborne CAFO effluent and asthma symptoms among adolescents, ages 12-14 years.[23] During the 1999-2000 school year, 58,169 adolescents answered questions about their respiratory symptoms, allergies, medications, socioeconomic status and household environments. Estimates of school-based exposure were calculated from available data from the 265 schools and 2,343 swine operations. The prevalence of wheezing, adjusting for confounders, was slightly higher at schools exposed to airborne effluent from CAFOs. Among students who had reported allergies, the prevalence of wheezing was significantly increased by 5 percent among children in schools within three miles of a CAFO, and 24 percent higher at schools in which livestock odor was noticeable twice per month compared to those with no reported odor. Students with allergies who lived within three miles of a CAFO also reported higher rates of doctor-diagnosed asthma, doctor/emergency room visits, asthma medication, activity-limitation and missed school. The authors concluded that airborne pollution from CAFOs was associated with adolescent wheezing symptoms.

Data from Round 2 (2000-2004) of the KCRHS allowed analysis of the risk to childhood asthma among children (n=565) living in proximity (within 3 miles) to mainly small deep-pit CAFOs.[24] The prevalence of doctor diagnosed asthma (11 percent) did not differ significantly from Round 1, but doctor-diagnosed asthma/mediation for wheeze in Round 2 was increased to 22.7 percent. A metric, based on CAFO footprint, distance to CAFOs, and low wind-speed, was developed to assess relative environmental exposure to CAFO emissions. Children with higher relative exposures to CAFOs had significantly increased odds for both asthma outcomes, while those with doctor-diagnosed asthma/medication for wheeze were found to have a dose-related increase with increasing CAFO exposure metrics.

The Pavilonis study is important as it demonstrated that proximity to even small swine CAFOs was dose-related to childhood asthma risk. Further, this study confirmed Marabelli study findings, again finding that increased risk to childhood asthma symptoms may extend as far as three miles from swine CAFOs.

Airway Disease among Adults

Early cross-sectional surveys of neighbors living proximate to hog CAFOs reported elevated respiratory symptoms, including runny nose, cough and wheeze.[25] [26] These findings were not surprising as they were similar to repeatedly documented increased rates of respiratory symptoms among swine farm exposed workers.

Well-controlled epidemiological studies include a large community-based study of adults (n=6,917) living in four rural German towns with high-density swine CAFOs, and who were surveyed by questionnaire.[27] Exposure was measured by collecting data on a four-point scale of odor annoyance together with geo-coded data on number of CAFOs within 500 meters (1,641 feet) from homes. Analyses were restricted to those not working in farming. The prevalence of wheezing without a cold, doctor-diagnosed asthma and allergic rhinitis were significantly increased with higher levels odor annoyance (none, somewhat, moderately, strongly). Increased CAFO density (dose), as measured by the number of animal houses within 500 meters, was associated with significant increases in wheezing without a cold (27.1 percent with 12 CAFOs) and physician diagnosed asthma (10.4 percent with 12 houses). Importantly, subjects living within 500 meters of 12 CAFOs also had significantly lower levels of forced expiratory volume in one second (FEV1) (-7.4 percent), as compared with age and height adjusted predicted levels. The authors concluded these findings were likely due an "asthma-like syndrome" arising from CAFO emissions.

Wing et al studied 101 nonsmoking volunteers living within 1.5 miles of swine CAFOs in 16 rural neighborhoods of eastern North Carolina.[28] Based on twice-daily odor diaries over a two-week period, objective measures of swine odor were made — hydrogen sulfide, particulate (PM10, PM2.5), and endotoxin. Swine odor was reported in more than half of the 1,655 episode reports. Odor was found to increase in a dose-response fashion with H2S, PM10, temperature and wind speed. The study demonstrated that self-reported measures of odor were objectively related to measures of pollutants well-known to be contained in CAFO emissions. Further analyses of this study population found these repeated measures (hundreds) were related to acute eye irritation (odor, H2S, and PM10).[29] Also, respiratory symptoms in the previous 12 hours were associated with odor and H2S, and difficulty breathing was increased with unit-dose of odor. An increase in wheezing and decrease in FEV1 was associated with increased concentration of PM2.5. Increased sore throat, chest tightness and nausea were dose-related to increases in level of endotoxin. The authors concluded, and an independent invited commentary concurred, that measured emissions within 1.5 miles of swine CAFOs were related to acute physical symptoms and changes in lung function, and that the findings were protected from unmeasured confounding by an innovative study design.[30]

These several studies of adult airway disease (up to 1.5 miles to a swine CAFO) establish that airway symptoms and changes in lung function, indicative of upper airway irritation and asthma, are related in a dose-response fashion to objective measures of environmental exposures from swine CAFOs.

Antibiotic Resistance

Antibiotic resistance is widely acknowledged to be public health crisis, perhaps the most serious of all global health threats.[31] Antibiotic use in both human medicine and animal agriculture are well recognized as drivers of antibiotic resistance, and there is broad agreement (World Health Organization, United Nations, European Medicines Agency, and the Centers for Disease Control) that there is a need to optimize use of antibiotics in people and animals.[32] The CDC estimates that at least 23,000 Americans die each year from antibiotic-infections, but the real number of deaths is acknowledged to be much higher.[33] A major report released in 2016 estimated that globally at least 700,000 people die due to infections that are resistant to currently available antibiotics, and that by 2050 drug-resistant infections will take an estimated 10 million lives each year.[34]

Two recent reviews have addressed this public health challenge using a One Health approach: The Expert Committee on Addressing the Contribution of Livestock to the Antibiotic Resistance Crisis Combating Antibiotic Resistance,[35] and Combating Antimicrobial Resistance: A One Health Approach to a Global Threat: Proceedings of a National Academy of Medicine Workshop.[36]

As was recognized by the Pew Commission on Industrial Farm Animal Production, the use of antibiotics in animal agriculture is a threat to public health,[37] and more recently stated unequivocally by the CDC, "antibiotic use in animal agriculture can harm public health."[38] Poultry and livestock production account for 70 percent of medically important antibiotics (the same class of antibiotics used in human medicine) sold in the U.S. Compared with the rest of the world, the U.S. is among the most intense users of antibiotics in animal agriculture.[39] But, while the U.S. Food and Drug Administration (FDA) Action Plan for Combating Antibiotic-Resistant Bacteria (CARB) has proposed concrete and measurable goals to curb misuse of antibiotics in human medicine, no such goals have been set for curbing misuse of antibiotics in food animal production.[40]

As the Expert Commission and the National Academy of Medicine Workshop agreed, human, animal and environmental ecosystems are interconnected and a One Health approach is therefore needed. Antibiotic resistance is "a numbers game" — the greater the quantity of antibiotic the more resistance and spread; the greater the number of humans and animals given antibiotics, the greater the likelihood that resistance will emerge and spread; and the longer the duration of antibiotic use, the longer period of time over which antibiotic resistance can emerge and spread.[41]

As summarized by the Expert Commission, as early as 1977, the FDA determined that use of certain antibiotics (penicillin and tetracycline) for growth promotion, feed efficiency and disease prevention posed a threat to human health.[42] While the FDA proposed withdrawing approvals for use of these drugs in animal production, it did not proceed; the FDA then provided no meaningful guidance for over 30 years. Prodded by the Pew Commission on Industrial Farm Animal Production (and the subsequent Pew Antibiotic Resistance Project) recommendations — restrict use of antimicrobial in food animal production, phase out and ban use of antimicrobials for nontherapeutic use, clarify antimicrobial definitions, improve monitoring and reporting of antimicrobial use, improve monitoring and surveillance of antimicrobial resistance, increase veterinary oversight in use of antimicrobials for therapeutic and prevention use, implement a national disease monitoring database with 48 hour trace-back.[43] The FDA issued Guidance for Industry #213, which urged drug makers to voluntarily remove growth promotion claims from their medically important antibiotic products.[44] The FDA, however, estimated that only 10-15 percent of antibiotics used in animal agriculture were used only for growth promotion. And, the FDA still approved the use of these drugs at similar levels and durations for disease prevention. The FDA did put antibiotics for use in prevention under the oversight of a veterinarian, but it did not put in place directives to monitor and track antibiotics used in animal production, as has been successfully implemented in Denmark and the Netherlands.

Drawing on successful programs in Denmark and the Netherlands, the Expert Commission made 11 recommendations that refine and extend those made by the Pew Commission. Lessons learned from Danish and Dutch intervention programs, as described in appendices to the Expert Commission report, include:

- The Dutch government and livestock industry have been able to reduce sales and use of antibiotics by more than 60 percent.
- Combined with target setting, Denmark and the Netherlands have phased out antibiotic growth promoters and their use in the absence of disease, resulting in reductions in use of 45-60 percent.
- The Royal Netherlands Veterinary Association has developed a system for classifying and prioritized veterinary antibiotics into three tiers of use in order to reduce antibiotic resistance.
- Stricter veterinary oversight has been implemented in both Denmark and the Netherlands to assure that restrictions on use of antibiotics in growth promotion and disease prevention are followed. Safeguards also include restrictions on veterinarian profits from antibiotic sales and accountability measures, such as use of benchmarks and "yellow card" notifications for misuse.

Antibiotic Resistant Colonization and Disease in Industrial Farm Animal Production

Concern over a new methicillin-resistant *Staphylococcus aureus* (MRSA) was first raised in Europe in 2005 from molecular typing, ST-398, and related strains clonal complex 398 (CC 398) that arose from swine with transmission to humans. Zoonotic MRSA became responsible for more than 20 percent of all MRSA cases in the Netherlands by 2007.[45] Screening of Dutch pigs found that nearly 40 percent of the pigs were colonized with a comparable strain of MRSA (MLST 398) and some 80 percent of pig farms were affected.[46] Since its discovery, MRSA CC398 has been recognized as a common cause of human colonization and disease in Europe — up to 40 percent of new cases of MRSA in Denmark, the Netherlands and parts of Germany, all countries with intensive livestock production.[47]

Whole-genome phylogenetic analyses now show multiple *Staphylococcus auerus* CC398 lineages in circulation in Europe, one of which is found primarily in livestock, CC398-IIa.[48] A study of MRSA CC398-IIa isolates in Denmark between 1999 and 2011 reported an annual increase of 66 percent from 2004-2011.[49] There was clear evidence that those with these MRSA infections had temporal and spatial relationships to both those with and those without livestock exposure. The authors concluded that there had been substantial dissemination of MRSA CC398-IIa from livestock or livestock workers into the Danish population. The isolates demonstrated high levels of resistance to several medically important classes of antibiotics — tetracycline, clindamycin, erythromycin, and norfloxacin, which represent some of the most commonly used antibiotics in Danish swine production.

While much less common in North American than in Europe, MRSA CC398 human infections have been reported in the United States.[50] Some of these infections were reported before recognition of distinct linages for CC398, so weather of human or livestock origin is not clear. However, a recent report confirms repeat infections with CC398-IIa in an Iowa farmer, suggesting these are likely under-diagnosed and reported.[51]

A survey of MRSA ST398 (as well as ST9 and ST5, also common genotypes in U.S. pigs) in 38 swine herds in 11 states in major swine-producing regions found only the positive control farm to have any of these common linages.[52] These findings suggest a relatively low herd prevalence of MRSA in the swine industry, and are supported by a multicenter surveillance study (2011-2013) that collected 2226 *Staphylococcus aureus* isolates around the state of Iowa.[53] Nearly 74 percent were methicillin resistant (MRSA) and 26 percent methicillin susceptible (MSSA). Twenty-five isolates were of the common livestock ST398 and ST9-associated strains. Forty percent of these livestock-associated strains were multi-drug resistant MRSA, compared with 5 percent of the MSSA isolates.

While uncommon in the U.S., two studies suggest that non-livestock strains may spread within areas proximate to swine farms. Independent studies in Iowa and Pennsylvania found an increased risk of MRSA colonization or infection in those living close to farms or in areas where manure had been spread of fields.[54] [55] However, neither study found that increased MRSA were livestock associated strains raising questions about the origin, evolution and genetics of MRSA in the agricultural setting and the spread of the methicillin-resistance gene, *mecA*, from livestock-associated strains to other "human" strains of *Staphyococcus aureus.*[56]

While, based on the European experience, the potential for important transmission and disease to arise from livestock is clear, at present no generalization can be made about MRSA isolate origin or disease risk in the U.S. Nevertheless, the current widespread use of antibiotics that may result in the emergence of a novel pathogen from livestock production is of concern and cause for adoption of the multiple intervention steps recommended by the Expert Commission on Addressing the Contribution of Livestock to the Antibiotic Resistance Crisis.[57]

Influenza

In 2007, a controlled, cross-sectional study of 111 Keokuk County farmers, 97 meatpacking workers, 65 veterinarians and 79 control subjects, demonstrated markedly elevated serology levels for swine influenza virus strains.[58] The odds ratios, indicating exposure to swine influenza, was strongest among farmers (35.3), followed by veterinarians (17.8) and then meat processing workers (2.7). This Iowa study documented that pigs have an important role in interspecies transmission of influenza strains, and that occupational exposure to pigs greatly increases workers' risk of swine influenza. The ease with which these porcine viruses infect man have implications for global influenza transmission and pandemic influenza.

It has long been known that pandemic influenza strains originate in nonhuman species. China has been implicated as the site of origin of the 1957 and 1968 influenza pandemics,[59] and is thought to be the epicenter of future novel influenza virus emergence.[60] With its increasingly dense populations of pigs, poultry and people, coupled with often weak farm and animal market biosecurity, it is not surprising that novel influenza A viruses (IVAs), resulting in increased morbidity and mortality among both livestock and humans, have emerged in China.[61] China is also recognized as the site of the emergent novel pig-only pathogen, porcine reproductive and respiratory syndrome virus in 2006,[62] and porcine epidemic diarrheal (PED) virus in 2014,[63] resulting in hundreds of millions of dollars of agricultural losses in China and the United States. Iowans are very familiar with such costs from the 2015 avian influenza (H5N2) epizootic that resulted in the deaths of 30 million chickens and 1.5 million turkeys. The estimated cost of this epizootic was $1.2 billion, 8,400 lost jobs, $427 million in lost wages and $145 million in lost taxes.[64]

Pigs have an important role in interspecies transmission of influenza strains, and occupational exposure to pigs greatly increases workers' risk of swine influenza. The ease with which these porcine viruses infect man have implications for global influenza transmission and pandemic influenza.

Most recently, these swine "variant" influenza A viruses have been increasingly infecting swine workers, likely family members and those attending agricultural fairs.[65] A recently reported intensive study of swine and swine workers in China documented strong evidence of virus mixing, likely reassorting, and cross-species infections.[66] This study also documented a notable lack of worker protection (personal protective equipment), biosecurity (restricted access and seasonal worker influenza vaccination), and public health pandemic preparedness. The 2018 centennial anniversary of the great influenza pandemic provides an opportunity — indeed an imperative need — to adopt best practice prevention and epizootic preparedness in the poultry and livestock industries.

Studies in North Carolina of the 2009-2010 and 2010-2011 influenza seasons, during which the pandemic 2009 H1N1 influenza virus circulated, documented that in counties with higher numbers of permitted swine operations, influenza-like illnesses peaked earlier than in other counties.[67] The authors concluded that swine CAFOs amplified transmission of influenza and called for influenza vaccination targeting swine workers and enhanced virologic-surveillance in counties where swine CAFOs are located.

These research findings have important implications for both animal and human influenza surveillance and preparedness. Linked One Health virologic-surveillance for novel influenza viruses and influenza vaccination of poultry and swine workers and their families are high preparedness priorities. Also, poultry and livestock industries need to be fully integrated into community, state and national pandemic preparedness efforts. Lawmakers must be made to understand, not only the potential for loss of human and animal life from pandemic and epizootic diseases, but also the potentially catastrophic economic costs to animal agriculture and all who depend on animal agriculture. The risk of devastating epizootic diseases in swine and poultry production, and recommendations for inclusion of prevention measures in the 2018 Farm Bill, were recently addressed in a *Des Moines Register* op-ed by Dr. Patrick Halbur, Professor and interim dean of the Iowa State University College of Veterinary Medicine. [68]

Physiological and Psychological Health Effects

Studies of odor have long been known to affect mood, cognition, physiological responses including heart rate and electroencephalographic (EEG) patterns.[69] Exposure to environmental malodor has been linked to worry, annoyance and physical symptoms.[70] [71] Controlled studies of these health outcomes are remarkably consistent in their findings and conclusions.

Thu and colleagues[72] conducted an Iowa controlled study of neighbors (n=18 living within two miles of a 4,000 sow-swine CAFO, and a comparable control group of neighbors with minimal livestock production. Neighbors living near a CAFO experienced higher levels of several symptoms consistent with exposure to ambient irritants and similar to those found in the occupational setting: burning eyes, runny nose, plugged ears, increased cough and phlegm, shortness of breath, wheezing, chest tightness. But, also described were symptoms more commonly arising from exposure to malodor: headache, nausea, dizziness, weakness and fainting. Questions designed to indicate depression and anxiety revealed no differences between CAFO exposed and control groups. Wing and Wolf [73] surveyed 55 residents living in three eastern North Carolina communities: 23 neighbors living within 2 miles of a 6,000-head swine CAFO, 13 living within two miles of an intensive cattle operation, and 19 living in a rural area without any livestock operation. Residents in the vicinity of the hog CAFO reported increased rates of headaches, runny nose, sore throat, excess coughing, diarrhea and burning of the eyes compared to the control community residents. These two controlled studies from the two most intensive pork producing states closely agree regarding symptom patterns experienced by neighbors living in proximity to swine CAFOs.

In 1995, Schiffman and colleagues reported results of a study of 22 subjects living close to a swine operation and 22 gender, race, age, and years of education matched control subjects without nearby CAFO exposure. All subjects were residents of North Carolina. All subjects completed a Profile of Mood States (POMS) questionnaire, which is known to be sensitive to transient mood shifts. The 65 questions on the POMs allow assessment of six domains: tension/anxiety, depression/dejection, anger/hostility, vigor/activity, fatigue/inertia, and confusion/bewilderment on a scale of 0 (not at all) to 4 (extremely). Results indicated subjects living near a swine CAFO and who experienced odor reported more tension, more depression, more anger, less vigor, more fatigue, and more confusion than control subjects. Those exposed to swine odor also had more total mood disturbance, than did control subjects, based on total POMS ratings. The authors cite numerous studies of odor arising from intensive livestock operations and the impact of environmental odor on population well-being and physiological and psychological health.[74]

Dose-response relationships arising from chronic exposure to animal waste/farming odors in six non-urban Danish regions were developed and reported by Blanes-Vidal et al.[75] Selection of the 12 km by 12 km regions assured a gradient in odor. A total of 1,120 households within the six regions were randomly selected and a standard questionnaire on indoor climate was mailed to each household. The mailing was timed to coincide with the period when application of animal waste to fields was banned per Danish policy. A five-point odor annoyance scale (not annoyed, slightly annoyed, moderately annoyed, very annoyed, and extremely annoyed) measured perceived odor annoyance. While animal waste odor is well known to consist of a complex mixture of irritant gases, volatile organic compounds, and bioaerosols, in this study ammonia (NH_3) concentration was chosen as the proxy for airborne exposures. An objective NH_3 exposure estimate was made via emission/dispersion modeling combining information from two validated methods. An estimated prevalence of odor annoyance (18 percent annoyed 10 percent of the time) exceeded the WHO threshold level (5 percent of the population affected 2 percent of the time).[76] Measures of psychosocial responses were made after controlling for individual covariates. About 45 percent of the respondents reported any annoyance from residential odor. Exposure estimates of NH3 were significantly associated with annoyance, health risk perception and behavioral interference (for each unit increase in NH3 exposure). Annoyance was found to be a strong mediator of exposure-behavioral interference (altering plans to avoid exposure) and exposure-health risk perception. This is the first study to provide quantitative estimation of dose-response associations between ambient NH3 exposures and psychosocial effects arising from odor pollution in a non-urban outdoor environment.

Quality of Life — Well Being

The impact of CAFO exposure on quality-of-life, or well-being, have been described in two reviews by Flora and colleagues, an Iowa Animal Feeding Operations Air Quality Study[77] and an Iowa Policy Project Report.[78] The 2007 Flora study systematically analyzed the impact of swine CAFOs on Iowa communities by examining natural, financial, human and social capital in Iowa's 99 counties. Using multivariate analysis over the decade of the 1990s, when Iowa swine CAFOs grew rapidly, Flora evaluated the various types of community capital change compared to change in CAFO growth. They noted that sociologists generally regard three elements to be essential for community sustainability: social equality and well-being, economic viability, and environmental soundness. Study results found that counties that expanded the number of swine CAFOs also experienced significant regional private-sector employment growth (but not in the county in which swine production increased); also, there was no positive contribution to population retention, in-migration, employment of residents, or school enrollments. The quality-of-life related measure of non-school aged adults found this increase to be true only for adults without a high-school education. In regard to social capital, CAFO growth was not related to changes in civic engagement, but did relate modestly to reduction in crime, to increases in home ownership and the number of religious adherents — unlike other studies that have found that CAFOs depress social capital. Indicators of environmental soundness found that manure from swine CAFOs was strongly and positively related to three of the four contamination measures — manure spills, fish kills, and impaired waterways (lakes, streams and rivers). The authors conclude that these findings raise serious questions as to whether the growth of swine CAFOs has generated sustainable development. They comment further that in certain regions of Iowa, CAFO growth may have hampered rural tourism, recreation and destination retirement development. Whereas CAFO growth in this study contributed modest income growth, they point out that studies of recreational amenity income find growth is more than five times as great, and that recreational amenities and swine CAFOs, given their negative impact on surface water quality in Iowa, cannot co-exist.

Another review cites a Minnesota Generic Environmental Impact Statement (GEIS) for animal agriculture description of quality-of-life as related to perceptions of: 1) having alternatives in what one does on a daily or life cycle basis, and 2) being respected by family and communities of interest and place.[79] Similarly, an important construct of community quality-of-life is social capital, which includes mutual trust, reciprocity, and shared norms and identity.[80] These papers cite numerous studies and policy discussions that document the impact of CAFOs on neighbors and neighboring communities.

The most consistent source of impact on neighbors' quality-of-life is exposure to CAFO odor. Paul Lasley's Iowa Farm and Rural Life Polls in 1992 and 1998[81] reported substantial concern among CAFO neighbors as early as 25 years ago. Three-fourths of the farmers surveyed lived within three quarters of a mile of a neighbor. In the 1998 poll, 14 percent were unwilling to tolerate odor from a neighbor's livestock operation more than two days a year, 34 percent were willing to tolerate only a week or less, and 50 percent would view odor a "major nuisance" if it affected them as many as 10 days a year. Respondents agreed with the following statement: "Increasingly, manure management is a major issue in the livestock industry" 61 percent of the time in 1992 and 85 percent by 1998.

Wing and Wolf (2000) also assessed quality-of-life measures in the previously cited study of two CAFO-exposed rural communities and one control rural community in eastern North Carolina.[82] Quality-of-life, as indicated by the number of times residents could not open their windows or go outside, even in nice weather, was similar between residents near a cattle operation and the control population, but was greatly reduced among residents living within two miles of a swine CAFO. Problems cited by swine CAFO neighbors included limited child and adult recreation, cannot open windows, contaminated well, and decreased property values.

Tajik and colleagues conducted detailed interviews using both open-ended and semi-structured questionnaires designed to assess the impact of CAFO exposure on neighbors' quality-of-life in another eastern North Carolina study.[83] All participants (n=49) were adult non-smokers, nearly 90 percent were black and all lived within 1.5 miles of a swine CAFO. The authors cite recurring themes in almost all interviews. Several descriptors of beneficial use of property were evaluated and frequently cited: cannot sit outside, have guests over, have cookouts, have family reunions; cannot play, garden or work outside; cannot use well water or need to buy bottled water; had to buy air conditioner/dryer; and had a hard time sleeping at night. The authors commented that these findings are notable as the study population was a low-income, predominantly minority rural population known to have higher rates of chronic disease and limited access to health care. Indeed, Wing and colleagues have documented environmental justice as a major issue for people of color who live in proximity, often very close, to swine CAFOs in eastern North Carolina. Many of these black families owned their property, some dating to their ancestors' emancipation from slavery, well before the construction of a swine CAFO in their neighborhood. Many feel tied to the land by history, family, and lack of economic opportunity.[84]

IMPACTS ON WATER QUALITY AND RURAL LIVING

Property Values

> *A year and a half after we bought our home, a hog confinement was built 1,650 feet from our home. If you have ever driven past one of those things, you know what it smells like. Houses don't drive; we have had to live with that odor for five years. Now, Iowa Select has an application filed to double that amount to 5,000 pigs. This county is already saturated with confinements. The DNR has told us there are only four counties with more confinements than ours. Property values are dropping and people are moving out of the area, and Iowa Select wants to build dozens more. The matrix that allows this is outdated and must be fixed now before the smell in this state becomes worse.* [85]

This letter to the editor in *The Des Moines Register* on December 15, 2017, from Donna and Bob Juber of Eldora, Iowa, describes one reason there is a conflict between rural residents and CAFOs. Iowans value their homes. It is the way they save for their retirement and future. Even residents, who may not object to being a neighbor to a CAFO, must wonder about the resale value of their property — and there is a clear effect on the value of property near a CAFO. A recent article by Kilpatrick in the Appraisal Journal demonstrates the extensive devaluation in property caused by proximity to a neighboring CAFO.[86] The article reports that property value decreases are confirmed by actions by county tax assessors. Reductions of the assessed value range from 20 to

40 percent of value in counties in farm states including Colorado, Missouri, Michigan, Illinois and Iowa. One study cited finds that "only landfills have a worse effect on adjacent property values."[87]

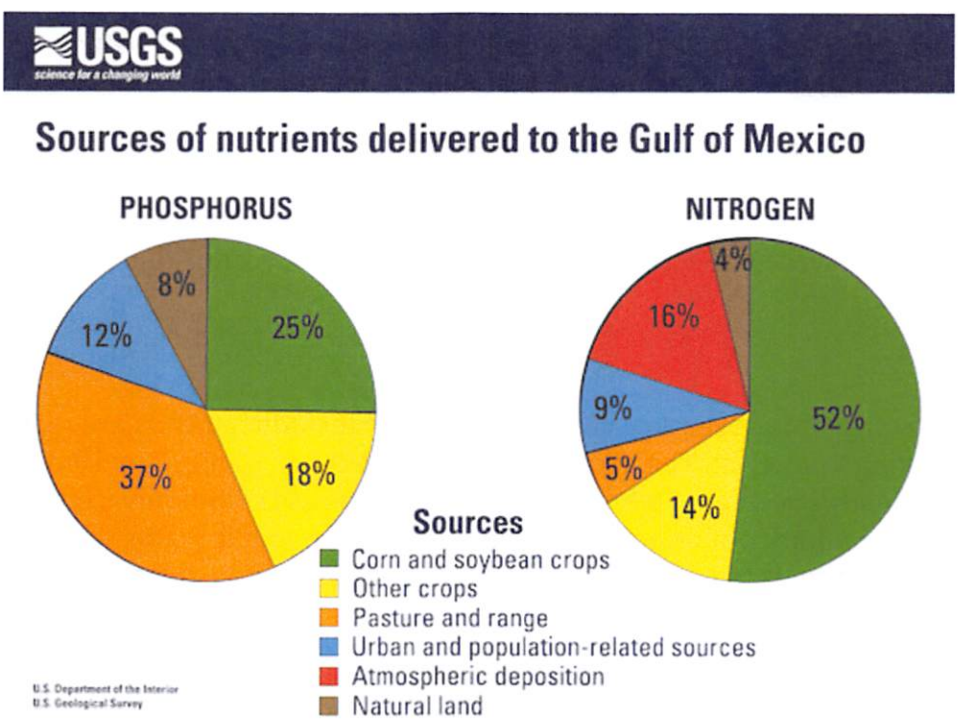
One of the studies cited by Kilpatrick is from Iowa researchers who not only find a decrease in property value, but also suggest that having the ability to bring suit might make the industry more accountable and that nuisance suits may prove to be a powerful incentive for CAFO owners to reduce emissions in Iowa and other states.[88] This potential "incentive" has been largely removed by the Iowa Legislature, as will be explained later in this report.

Distance from the source seems to have a big effect on the amount of the decrease in value according to another survey article that looked at property values near CAFOs.[89] That distance matters and that the decrease in value is significant is made clear by the following quote in the Kilpatrick article that refers to CAFOs as AOs:

> *Overall, the empirical evidence indicates that residences near AOs are significantly affected, and data seems to suggest a valuation impact of up to 26 percent for nearby properties, depending on distance, wind direction, and other factors. Further, there has been some suggestion that properties immediately abutting an AO can be diminished as much as 88 percent. One study estimates the total negative impact to property values in the United States at $26 billion. Mitigation makes a marginal impact. Not only are residences affected, but nearby small farms can be impacted by such factors as water degradation and insects.*[90]

CAFOs and Water Quality

Agriculture in general has been found to cause a decrease in water quality in the Mississippi River Basin watershed as is seen in the following figure from the U.S. Geological Survey. These sources are the primary cause for the hypoxic zone at the mouth of the Mississippi River, or "Dead Zone" that occupies an average of 5,300 square miles each year. The problem is not improving. In fact, the size of the zone in 2017 was a record high of 8,776 square miles.[91]



Source: United States Geological Survey. https://tinyurl.com/yar8hk5g

While agriculture in general cause the bulk of the nutrients contributing to the hypoxia in the Gulf of Mexico, animal agriculture and its manure make up a measurable part of this nutrient contamination. According to University of Iowa researchers, "The high correlation between nitrate concentration and animal unit density suggests that CAFOs produce measurable impacts on water quality."[92] The significance of animal agriculture to total agriculture pollution was earlier described by the U.S. Department of Agriculture's Economic Research Service: "In the Mississippi River's drainage basin, animal manure was estimated to contribute 15 percent of the nitrogen load entering the Gulf of Mexico."[93]

Earlier, Osterberg was co-author of a report published in the American Journal of Public Health on a similar topic to the present report. That paper found that between 1992 and 2002 there were 329 manure spills in Iowa.[94] These data, reprinted in Table 1, show that a limited number of such discharges were deliberate, according to the DNR.

Table 1. Errors, equipment/structure failure main causes of manure spills

Determined causes of 307 major Iowa manure spills, 1992-2002

Identified Causes	No. Spills	Percent of total
Failure or overflow of manure storage structures	74	24
Uncontrolled runoff from open feedlots	56	18
Improper application to cropland	43	14
Equipment failure	73	24
Deliberate spills (pumping manure to ground; deliberate breaches in storage lagoons, etc.	18	6
Other (e.g., transportation accidents)	43	14
Total	**307**	**100**

Source: American Journal of Public Health, October 2004, Vol. 94, No. 10. Merkel M. Data from 3 Iowa Department of Natural Resources (IDNR) databases: IDNR Fish Kill Database; IDNR Enforcement Database/ and IDNR Emergency Response Database.

The number of fish kills continues to grow with the expansion of the industry. A brief submitted to the DNR asking for changes in the Master Matrix in August of 2017 stated. "The state has documented more than 800 manure releases to surface water, groundwater, and land due to improper waste handling, excessive waste application, mechanical failures, and other problems associated with CAFOs since 2000."[95] Clearly there continue to be environmental impacts that may be related to the decreases in water quality.

The 2004 American Journal of Public Health paper referred to above reported that three microbes commonly found in livestock — *Escherichia coli, Campylobacter, and Cryptosporidium* — have caused disease outbreaks. Dairy feedlots in the streams above the intake for the City of Milwaukee water treatment plant were implicated in the famous 1993 Cryptosporidium event that sickened 400,000 people.[96]

Nitrate and Health

Nitrates that originate from several agricultural activities including CAFOs are regulated under the federal Safe Drinking Water Act. The allowed standard (MCL) of 10 mg/L or 10 ppm nitrate nitrogen was originally based on methemoglobinemia, a disease commonly called blue-baby syndrome. While the number of cases of this disease is rare in public water supplies in the United States, well water continues to be a concern for infants who consume formula prepared with private well water.[97]

New research has led researchers to identify other adverse outcomes from consuming water with high levels of nitrate, mainly using research from the Center for Health Effects of Environmental Contamination (CHEEC) at the University of Iowa. A recent report by the Iowa Environmental Council used these data in a report on Nitrate and Health:[98]

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> *Many people, however, have not been aware that the health risks of nitrate in drinking water go beyond blue-baby syndrome. Research from Iowa and around the world has associated a number of human health problems, including birth defects and cancers, with elevated levels of nitrate in drinking water.*

The IEC study documents the association between nitrate and birth defects, bladder cancer and thyroid cancer. Many of the studies were of residents in the state of Iowa and, often, effects were seen at nitrate levels lower than the MCL for public drinking water systems.

Phosphorous and Health

Manure runoff into local waterways, especially lakes, can promote the growth of cyanobacterial algal blooms. Some species produce toxins that have forced beach closures in Iowa and other states, compromised sources of drinking water, and caused outbreaks of illness in both animals and humans. According to a recent report, adverse health effects to humans include acute hepatoxicity (liver damage), neurotoxicity, gastrointestinal problems, and a wide range of allergic reactions.[99]

Blue-green algae — or cyanobacteria. Photo credit: Illinois Environmental Protection Agency, http://tinyurl.com/jembwqy

The dangers of cyanobacteria became national news in 2014 when a water treatment plant in Toledo, Ohio, warned its 500,000 customers not to use water from the tap because algae blooms surrounded water intakes at its Lake Erie source. The catastrophic algal bloom prompted the mayor to declare a state of emergency, as the city was forced to find alternative sources of drinking water since boiling the water did not remove the toxin. As noted in a 2014 *Washington Post* story about this incident:

> *"And with these algal blooms predicted to worsen in Lake Erie and other lakes and reservoirs — thanks to a mix of global warming, invasive species and pollution — the issue is expected to pop up more often. Some believe Toledo could be a tipping point."* [100]

Recent scientific papers have demonstrated why potentially toxic cyanobacterial blooms may increase in severity. Warmer temperatures and heavy rainfall events with long dry periods in between will lead to acceleration of the eutrophication* process that the high levels of nitrogen and phosphorus make possible.[101] [102] The EPA has noted these weather patterns are predicted to occur more frequently as the Midwest climate changes.[103] A 2014 statement by 180 scientists and educators at 38 Iowa colleges and universities states that climate conditions will affect public health in several ways including the increased possibility of cyanobacteria outbreaks.[104]

The DNR monitors 39 state park beaches weekly in the summer for microcystin, a toxin produced by at least some forms of blue-green algae. There had been a steady increase in beach closings beginning in 2010 until data was added for 2017. The exceeding low number in that year is surprising and questionable, as it follows a large cut in the DNR budget and the resignation of staff

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* Eutrophication is "The process by which a body of water acquires a high concentration of nutrients, especially phosphates and nitrates. These typically promote excessive growth of algae. As the algae die and decompose, high levels of organic matter and the decomposing organisms deplete the water of available oxygen, causing the death of other organisms, such as fish." (USGS, Website, "Definition of Eutrophication," 2014)

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involved in the monitoring. The table below from the Iowa Environmental Council uses DNR data to show the changes in advisories over time.

Table 2. Blue-Green Algae: Steady increase in Iowa beach closings until 2017 cuts and resignations of IDNR monitors

State Park Beaches with Microcystin exceeding 20 ug/L	Year												Total
State Parks (Beach Name)	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	
Beeds Lake State Park (Beeds Lake Beach)			*				1						1
Black Hawk State Park (Black Hawk Lake Campground Beach)			*	1	3	2	1	1	3	7	2	1	21
Black Hawk Lake State Park (Denison Beach)			*					4	7	1	2		14
Big Creek State Park (Big Creek Lake Beach)	1		*		1	2	5			1			10
Brushy Creek State Park (Brushy Creek Lake Beach)			*					1			1		2
Clear Lake State Park (Clear Lake State Park Beach)			*				1						1
Clear Lake, McIntosh Woods State Park (McIntosh Woods Beach)			*				1		3				4
Geode State Park (Geode Lake Beach)		3	*		1			6	1	1	1		13
Green Valley State Park (Green Valley Lake Beach)	12		*				3	2	1	9	7	3	37
Lake Anita State Park (Lake Anita Beach)	1		*				1		1		2		5
Lake Darling State Park (Lake Darling Beach)			*							2		1	3
Lake Keomah State Park (Lake Keomah State Park)			*		1	2					4		7
Lake of Three Fires State Park (Lake of Three Fires Beach)			*		1	4	1	3		2	1		12
Lake Wapello State Park (Lake Wapello Beach)	1		*							2	1		4
Marble Beach State Park (Marble Beach, Spirit Lake)	2		*			1	3						6
near Mini-Wakan State Park (Crandall's Beach, Spirit Lake)			*				2	1		1			4
Pine Lake State Park (Pine Lake Beach)			*							3	6		9
Pleasant Creek State Recreational Area (Pleasant Creek)			*							1	1		2
Prairie Rose State Park (Prairie Rose Lake)			*								2		2
Red Haw State Park (Red Haw Lake Beach)			*							1			1
Rock Creek State Park (Rock Creek Lake Beach)	5		*		1		1	3			1		11
Springbrook State Park (Springbrook Lake)			*							1	1		2
Twin Lakes State Park (Twin Lake West)			*							1			1
Union Grove State Park (Union Grove Lake Beach)	1		*		1			2	6	1	1		12
Viking Lake State Park (Viking Lake Beach)			*			1		1			4		6
Total	23	3	0	1	9	12	20	24	22	34	37	5	190

Updated Sept. 5, 2017 — After Monitoring Week 15, data as updated by IDNR.
Source: Iowa Environmental Council

In addition to nutrients, N and P, studies document many other contaminants from animal feeding operations. A report by the National Association of Local Boards of Health identifies new contaminants in water contaminated with manure.

> *Manure emitted by AFOs can contain "nutrients such as nitrogen and phosphorus, pathogens such as E. coli, growth hormones, antibiotics, chemicals used as additives to the manure or to clean equipment, animal blood, silage leachate from corn feed, or copper sulfate used in footbaths for cows."* [105]

The report further states some novel pollutants associated with CAFOs.

> *Water tests have also uncovered hormones in surface waters around CAFOs (Burkholder et al., 2007). Studies show that these hormones alter the reproductive habits of aquatic species living in these waters, including a significant decrease in the fertility of female fish. CAFO runoff can also lead to the presence of fecal bacteria or pathogens in surface water. One study showed that protozoa such as Cryptosporidium parvum and Giardia were found in over 80 percent of surface water sites tested (Spellman & Whiting, 2007). Fecal bacteria pollution in water from manure land application is also responsible for many beach closures and shellfish restrictions.* [106]

Other data from Burkholder, the author cited above, is consistent with other, less exotic contamination. Bacterial contamination surface water including fecal bacteria or protozoa such as

Cryptosporidium parvum and *Giardia*. Many of the pathogens (e.g., *Clostridium perfringens*) present in manure that can contaminate water supplies are concerning because they can cause severe diarrhea, which can be fatal for animals, very young children, and the immunocompromised. "Fecal bacteria and other pathogenic microorganisms typically settle out to the sediments where they can thrive at high densities for weeks to months following CAFO waste effluent spills."[107]

Another more recent review cites articles that show CAFO generated animal waste is associated with pathogens, pharmaceuticals, metals and hormones.[108] The Fry study also reviews articles showing the impact on public health is also related to CAFO air emissions.

FAILURE OF THE MASTER MATRIX AND PUBLIC POLICY IN IOWA

Past Iowa Regulations on Confined Animal Feeding Operations (CAFOs)

When a citizen becomes aggrieved by the actions of a neighbor, such as a CAFO, there are different routes to seek redress. First, there are three levels of legislative/administrative action, (federal, state and local). Second, the courts can intervene on behalf of the aggrieved party either by acting on the constitutionality of actions by the legislative branch or the courts can hear an individual action under nuisance. This section of this report will address all these possible routes for neighbors of CAFOs.

To fully understand why the state of Iowa regulation of its pork industry is weak and that individual nuisance action now has severe limitations, one must know there is something in law called the "right to farm." This is a legal concept that, according to the National Agricultural Law Center, University of Arkansas, is common:

> *All fifty states have enacted right-to-farm laws that seek to protect qualifying farmers and ranchers from nuisance lawsuits filed by individuals who move into a rural area where normal farming operations exist, and who later use nuisance actions to attempt to stop those ongoing operations. While the overall statutory schemes might be similar, each state has noticeably different content in the specific details of the laws...* [109]

While the power of this defense of agricultural production may have severe limits, as enumerated by Drake Law School Professor Neil Hamilton, who states that such laws "are proving to not be such a good idea after all."[110†] Still there is an expectation that agricultural operations have preference in rural areas of Iowa.

This preference for agriculture in rural areas explains much of the interaction of CAFOs, neighbors and the law. These laws arose when farmers were independent operators, but independent livestock farmers have now been largely replaced by contractors for integrated industrial agriculture, which is in the driver's seat and is unwilling to relinquish the wheel.

Regulation by Local and State Government

Calls for new regulation on siting of facilities and treatment of the tons of manure produced by CAFOs have all but gone unheard in the Iowa State Capitol. Individual counties have asked the DNR to reject the location of individual CAFOs.[111] [112] Supervisors in more than 20 of Iowa's 99 counties have called for changes in regulating the industry.[113] Community groups have had their requests for changes turned down by the regulators when they requested changes in how CAFOs are sited. [114]

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† The original protection of farming starts with the notion that a landowner should not come to an area that has always had a certain smell and noise and then complain. That notion of fairness has been expanded in states like Iowa, according to Hamilton, to include new industrial swine operations that move into the neighborhood and this is why Right-To-Farm is not such a good idea. (Hamilton, 1998)

State and Local Government Interaction

A series of Iowa Supreme Court cases established that the Iowa Legislature can limit any local government action governing locations of large CAFOs or placing limits on their discharges to water or air. The Iowa Supreme Court held that all agriculture, including an animal feeding operation, is exempt from any county zoning.[‡] Humboldt County later attempted to put controls on CAFOs as a proper application of "home rule" authority but lost in the Iowa Supreme Court.[§] In the face of this state preemption, a Worth County ordinance sought to regulate CAFO operators based, not on home rule, but on the county's ability to protect public health. This ordinance was also struck down as being void and unenforceable as contrary to state law.[**] The opinion of the court was that "We conclude the Worth County ordinance is the type of ordinance expressly preempted by the state statute. Our legislature intended livestock production in Iowa to be governed by statewide regulation, not local regulation. It has left no room for county regulation."[††]

In exchange for eliminating local governmental action, Iowa legislators provided an opening for local advice and limited consent when the Master Matrix went into effect in 2003. This is a scoring system that forces an operation to adopt measures such as greater separation distances and more stringent manure practices and will be examined later in this report.

In exchange for eliminating local governmental action, Iowa legislators provided an opening for local advice and limited consent when the Master Matrix went into effect in 2003.

State and Federal Interaction

Since the state of Iowa has preempted much of the possibility for local government to act on CAFOs, we must ask how well the state, and the administrative organization that takes on enforcement and regulation of these facilities, the DNR, has behaved in the past.

Three environmental groups approached the U.S. EPA's Region 7 office in 2007 to request the agency investigate the DNRs administration of the Clean Water Act. Little came of the request, so in 2011 the groups threatened suit. Region 7 responded this time and in a survey of DNR enforcement of animal agriculture facilities found inadequacies. While EPA Region 7 and the DNR worked out an agreement for improvement, the Iowa Citizens for Community Improvement (ICCI), the Environmental Integrity Project and the Iowa Sierra Club kept up pressure on both agencies. Negotiations centered on five issues. One was easily measured — the number of inspectors. The DNR acknowledged in the official response to Region 7 that there were too few:

> *"Since 2007, the DNR has had a significant reduction in its animal feeding operations staff. To better meet our responsibilities, the DNR needs both an increase in staffing and to reprioritize workloads."* [115]

While the DNR did not explain the extent of the "significant reduction" in agency field staff in the official response, they had answered elsewhere in a 2011 report on manure on frozen and snow-covered ground:

> *"The scope and complexity of confinement program work increased disproportionately beginning with legislation in the late '90s. With this, public awareness of environmental issues also grew, resulting in a significant increase in local demand for education, compliance assistance and compliance assurance. To*

‡ *Kuehl v. Cass County, 1996*
§ *Goodell v. Humboldt County, 1998*
** *Worth County Friends of Agriculture v. Worth County, 2004*
†† *id*

ATTACHMENT 6

> *address these needs, animal feeding operations field staffing gradually increased to a high of 23 by SFY 2004. In SFY 2008, four staff people were shifted into a newly established open feedlots program. Then in the fall of 2009, as General Fund expenditures declined, confinement staffing was reduced again. This reduced staff numbers from 19 to 11.5. Further reductions leave the total of field staff for confinement work at 8.75 full time equivalents. This reduction means that the DNR will not be able to maintain an adequate level of compliance and enforcement activity in confinements."* [116]

The EPA Region 7 initial report on DNR shortcomings led to an agreement between the two agencies dedicated to improving how CAFOs and their manure is treated and controlled in the state of Iowa. (See Appendix 1 for a fuller explanation of Region 7 and DNR interaction.) The initial agreement envisioned a 13 staff-person increase, which would only bring numbers back to approximately the 2004 staffing levels — before the addition of many more CAFOs. However, the final agreement only called for seven new staff members.

ICCI, one of the three environmental organizations that caused the EPA to request changes in how DNR regulated CAFOs, described the agreement as a victory although a limited one. After all this organization was instrumental in getting the DNR to go even this far. Still, that the main Iowa environmental agency was forced to enhance its regulation on CAFOs casts doubt on the effectiveness of state regulation and puts into question the preemption of local government involvement.

Individual Action by Neighbors

Neighbors have a second route to proceed when they feel they have been aggrieved — they can also sue under nuisance. The first Iowa legislative action on CAFOs in 1995 (House File 519) included limiting individual action.

Besides limiting the rights of neighbors to seek relief from county government, HF 519 attempted to make it more difficult to successfully sue a livestock operator, by requiring a plaintiff to meet a tough standard of proof. The Iowa House Democratic caucus staff described the limits HF 519 placed on individual plaintiffs:

> *"There is a "rebuttable presumption" that an animal feeding operation is not a public or private nuisance. This rebuttable presumption may be overcome by <u>clear and convincing evidence</u> of <u>both</u> of the following:*
>
> > *the animal feeding operation <u>unreasonably and continuously</u> interferes with another person's comfortable use and enjoyment of life or property; and*
> >
> > *the injury or damage has to be caused by the negligence of the operation.*
>
> *All operations are included in the protection regardless of the established date of the operation or expansion."* [117]

Individuals were also dissuaded from going to court against a CAFO operator because the losing party in a case was made liable for all costs and expenses of the winning party, if the court determined that the claim was frivolous.

The attempt to limit nuisance was voided by the Iowa Supreme Court. The courts determined the Iowa Legislature went too far with this action. Since 2001, three Iowa district court judges have ruled against the attempt to protect CAFOs against nuisance suits.[‡‡] [118] [119] Also, in Iowa a case by neighbors against a CAFO owner was decided with a judgment for the plaintiff of $1 million for actual damages and $32 million for punitive damages.[§§] [120] The case was settled out of court.

‡‡ (*Weinhold v. Wolff* (Iowa 1996); *Bormann v. Kossuth County Bd of Supervisors* (Iowa 1998); and *Gacke v. Pork Xtra LLC* (Iowa 2004)
§§ (*Blass, et al v. Iowa Select Farms, L.P 2004*)

In the spring of 2017, a new law was passed by the Iowa General Assembly and signed by the Governor revisiting the rights of neighbor to sue a CAFO operator. The new law may well be challenged on grounds of constitutionality, as was the 1995 law. However, as Kristine Tidgren, assistant director of the Center for Agricultural Law and Taxation at Iowa State University, explained in a recent blog:

> *The constitutionality of this legislation, if enacted, would no doubt be challenged as prior legislative attempts to limit nuisance actions against agricultural operations have been rejected by the Iowa Supreme Court. This legislation, however, is very different in that it does not seek to dismiss a nuisance lawsuit, but to limit the types of damages that can be recovered against "responsible" producers. The stated legislative purpose of this bill is to encourage the "expansion of responsible animal agricultural production in this state which provides employment opportunities in and economic growth for rural Iowa, contributes tax revenues to the state and to local communities, and protects our valuable natural resources."* [121]

The new law limits damages that can be awarded to a person who wins a lawsuit against an animal feeding operation, under a claim that the CAFO is a public or private nuisance or an interference with another person's "comfortable use and enjoyment of the person's life or property." The new law limits damages that can be awarded to a person impacted by a CAFO to (a) any actual reduction in property value caused by the facility, (b) past, present, and future adverse health impacts as determined by objectively documented medical evidence and proven to be caused by the facility, and (c) any award for damages due to annoyance and the loss of comfortable use and enjoyment of the property to 1.5 times the sum of property value and objective medical evidence of deterioration of health. By requiring "objectively documented medical evidence and proven to be caused by the facility" in question, this new law seeks to eliminate consideration of the substantial literature on CAFO exposures and causation of adverse health effects, disease and impairment. [122]

Additionally, according to an analysis of the Iowa Environmental Council, if the person suing wins the lawsuit, the facility is classified as a "permanent" nuisance rather than a temporary/ Intermittent nuisance. This means that a person gets one shot at damages — they cannot file additional lawsuits even if the facility causes additional impacts in the future.[123] The constitutionality of the new law has yet to be tested. Analysis of this new law in relation to the real possible public health issues surrounding the location of facilities and their manure application is the subject of a recent IPP report.[124]

HOW THE STATE OF IOWA SHOULD PROCEED

Revise the Master Matrix

The background on CAFOs and neighbors leads us to one of our main questions in this report, the adequacy of the Master Matrix, which — in exchange for preemption of local government action — gave local governments something to do. If a large CAFO operation attains a minimum score on the Master Matrix, it will be approved by the DNR even if there is public opposition to the operation and the county recommends against it. [125]

The Winneshiek County Board of Supervisors does not feel the Master Matrix gives the environment enough protection. That body voted 5-0 and two supervisors appeared before the Iowa Environmental Protection Commission to appeal a DNR approval of a permit for a CAFO in the county in a karst region in October of 2013. They were turned down.[126] This is not an exception.

An earlier Iowa Policy Project report documented that the Master Matrix does not distinguish between types of rivers that are near facilities and could receive pollution from a CAFO. In 2008, the Master Matrix did not treat differently two facilities that could drain into the pollution-impaired Raccoon River above where the City of Des Moines Water Works receives water that must be treated to potable levels for more than half a million Iowans. [127]

In September 2017, ICCI, the same organization that was among the three environmental groups that forced EPA Region 7 to require the DNR to revise its regulations of CAFOs, along with Food and Water Watch, was turned down in its petition to the Environmental Protection Commission (EPC). The EPC, the citizen board that oversees the DNR, followed the recommendations of the DNR to resist any changes to the Iowa's Master Matrix.[128]

The two organizations' brief was thorough. It included sections documenting the failure of the Master Matrix to give counties the authority to protect resources. It demonstrated that the many new animal feeding facilities since the Master Matrix was implemented made the need for changes more necessary. The brief produced data to support changes and requested revisions in the specific scoring criteria. It maintained the DNR has the ability and the duty to make changes.[129]

Included with the brief were resolutions or letters to the legislature signed between November 2016 and the spring of 2017 by 13 counties that requested strengthening of local control and in some cases calling for a moratorium on new facilities until changes were made.[130***] In addition to this demonstration of support, in 2014 Dickinson County surveyed all Iowa counties and found that more than a third of those county supervisors who responded wanted changes in the Master Matrix.[131] Furthermore, the number of counties have stated their objections to the Master Matrix has now increased to 20.[132]

It is clear that some counties in Iowa see a route to prosperity that puts local limits on the number of animal feeding operations that choose to locate there. This is not surprising since the IPP report by Flora covered earlier in this paper, found that counties who choose to go with hog confinement operations give up other local development possibilities.[133] *The Des Moines Register* pointed out in a February 15, 2015, editorial — *"Livestock confinements need local control"* — that different counties may choose to differ on their desire to add livestock facilities to their suite of economic development opportunities:

> *While Sioux County is apparently comfortable with having the equivalent of 35 hogs for every resident of the county, there is mounting concern in Dickinson County about the growing numbers of livestock confinement operations in one of the state's premier tourism destinations.* [134]

Iowa State Senator David Johnson has introduced a number of bills calling for a moratorium on new, mid and large CAFOs and proposed expanded public participation in CAFO decisions currently captive of the Master Matrix. His bills were supported by a demonstration at the Iowa State Capitol by a coalition of about two dozen state, local and national groups calling itself the Iowa Alliance for Responsible Agriculture. The group rallied in support of all 15 of Senator Johnson's bills to tighten oversight of CAFOs.[135] Senator Johnson is quoted that there will be consequences if nothing is done:

> *"Failure to take legislative action this year could hurt lawmakers when they seek re-election...If not a single one of these bills are passed, legislators will face a real challenge if they're up for election in the fall," he said.*[136]

*** The counties were Adair, Allamakee, Buchanan, Cedar, Cerro Gordo, Dickinson, Floyd Hardin, Howard, Johnson, Pocahontas, Webster and Winneshiek.

Unless his bills or something similar becomes law, DNR has shown it is unwilling to make changes on its own to a 15-year-old law that many find inadequate.

Implement Moratorium on New CAFOs that Do Not Have Superior Waste Handling Technology

An essay by Fred Kirschenmann, on behalf of the Pew Commission on Industrial Farm Animal Production, observed that operation of CAFOs under the current model is unsustainable in the long term. The standard industry production methods externalize the costs and impacts of waste from livestock and poultry production, and rely on cheap energy, abundant fresh water and a relatively stable climate.[137] Add to this long-range sustainability challenge, the degradation of water quality, harmful air pollution, and the public health and rural community impacts reviewed in this report.

North Carolina has developed a state-based model for advancing industrial farm animal production that attempts to make new facilities more sustainable. In 2000, the North Carolina Attorney General entered into an agreement with Smithfield Foods, its subsidiaries and Premium Standard Farms to fund environmentally superior waste management technologies, a $17.5 million development initiative.[138] North Carolina implemented its moratorium new or expanded swine farms in 1997, and made it permanent for swine farms that use anaerobic waste lagoons for primary treatment in 2007. [139] To comply with the moratorium, a new facility must have environmentally superior technology. This is defined as "any technology, or combination of technologies that (1) is permittable by the appropriate governmental authority, (2) is determined to be technically, operationally and economically feasible for an identified category or categories of farms as described in the agreements and (3) meets the following performance standards: 1. Eliminates the discharge of animal waste to surface waters and groundwater through direct discharge, seepage or runoff, 2. Substantially eliminates atmospheric emissions of ammonia; 3. Substantially eliminates the emission of odor that is detectable beyond the boundaries of the parcel or tract of land on which the swine farm is located; 4. Substantially eliminates the release of disease-transmitting vectors and airborne pathogens; and 5. Substantially eliminates nutrient and heavy metal contamination of soil and groundwater."

The director of the North Carolina State Animal and Poultry Waste Management Center was designated to oversee the selection and evaluation of technologies, assisted by an advisory panel composed of individuals representing government, environmental and community interests, agreement member companies, and others with expertise in environmental sciences, public health, animal waste management, economics and business management. A nationwide RFP to research institutions and industry yielded 18 technology candidates that met these goals (See Appendix 2).

> *Under the right conditions, liquid manure will break down into biogas and a low-odor effluent. Biogas can be burned to produce heat, electricity, or both the anaerobically-digested manure, can be stored and applied to fields with significantly less odor than stored, untreated liquid manure. Anaerobic digestion does not reduce the volume or nutrient value of manure. If dilution water is added to the system, the volume of material to handle is increased.*[140]

The term "under the right conditions" applies when harvesting some of the energy contained in manure is proposed as one solution to some of the problems with CAFOs endorsed by the North Carolina law. A 2017 publication from Penn State University describes the benefits of modifying the normal CAFO production process to include energy capture.[141] A 2015 EPA report on the status of anaerobic digesters in the several states lists five in Iowa. [142] The 2016 Iowa Energy Plan estimates there are more than 1,000 potential locations for similar projects.[143] Capturing animal waste to generate renewable energy is potentially a win-win-win — reducing harmful air and water emissions, preserving nutrients and generating renewable energy. Some, but not all CAFO externalities, are necessarily reduced by a policy to require this capture.

In 2007, North Carolina's Renewable Energy & Energy Efficiency Portfolio Standard (REPS) was passed overwhelmingly as part of Senate Bill 3.[144] At the same time, the 2000 moratorium on construction or expanding swine CAFOs was made permanent. The REPS established a clean energy market in the state by directing the state's electric providers (or utilities) to generate a portion of the state's electricity needs both from renewable energy resources and through energy efficiency. The amount, in percentage of total portfolio (natural gas, wind, solar, coal, nuclear) was designated to increase to 12.5 percent by the year 2021. The law also has "set-asides" for energy created from solar, swine waste and poultry waste, the only state to have such a specific carve-out. To meet REPS requirements, utilities must secure Renewable Energy Certificates (RECs), with one REC equal to one megawatt hour (MWh) of electricity. Utilities may purchase swine RECs or develop their own. To comply with the law, they must secure approximately 284,000 swine RECs by 2018.

While the 2015 EPA anaerobic digester report lists only 10 North Carolina projects, the new emphasis on policy in that state is boosting the number (See Appendix 3). In addition, the requirement that expansion of the industry requires new production techniques, like energy production, is an even bigger policy incentive.

An Iowa expansion of anaerobic digestion would address some problems of existing facilities and locating new CAFOs. However, the first line of the Penn State excerpt above begins with "under the right conditions." The "right conditions" would not be met with a 10,000-head cattle feedlot and biogas operation in northern Iowa karst country. The Walz Energy project is currently under construction there. According to neighbors it is too close to Bloody Run Creek, a cold-water trout stream that is one of the designated "Outstanding Iowa Waters."[145] Any leaks from such a large project could endanger the well-developed tourism industry in the area including Spook Cave located on land around Bloody Run. Karst is unusual topography that contains many sinkholes that can direct pollution to the many springs and streams in the region. [146]

Quoted in a long *Des Moines Register* story on the project is Larry Stone, a retired *Register* outdoors writer, reports that the clean, clear waters around the Walz Energy project has been "a hot spot for fishing, picnicking, hiking, bird-watching and leaf-viewing in the fall," and that any problems with this industrial-sized facility will do great damage. He is opposed.[147] Clearly capturing energy from manure, a good thing, does not solve the problems of locating CAFOs if they impose external costs onto neighbors and degrade the local environment. Building a CAFO in the karst region of Northeast Iowa is something that should hardly ever happen.

Challenge the Constitutionality of the 2017 Iowa Anti-Nuisance Suit Legislation and Ag-Gag Law

The nuisance protection for CAFO owners that passed the Iowa Legislature in March of 2017 may or may not be sustained in a court of law. If the law is successfully challenged, it will not be the first time the Iowa Legislature has tried to protect agricultural producers only to find that the Iowa or U.S. Constitution prevents the action. Earlier in this paper it was mentioned that one section of the original 1995 Iowa CAFO law tried to limit neighbors' rights under nuisance only to be struck down by the Iowa Supreme Court.

Another example of the Iowa Legislature probably going too far is the so-called Ag Gag Law. As recently as January 2018 a federal court struck down parts of a law similar to Iowa's law in Idaho.[148] Iowa's law that limits and criminalizes efforts to expose animal cruelty and food safety violations is still on the books. That might change. According to a *Cedar Rapids Gazette* report, "A coalition of public interest groups has filed a federal lawsuit challenging the constitutionality of the Iowa's so-called 'ag gag' law that criminalizes undercover investigative efforts to expose poor conditions for workers, food safety violations, environmental harm and animal cruelty in agricultural facilities."[149] The Iowa law passed in 2012 made it a misdemeanor punishable by up to a year in jail to falsely try to obtain a job in an animal facility in order to publicize what might damage the reputation of the industry.

The lawsuit is another sign — along with calls by Iowa County supervisors for a moratorium on expansion of CAFOs and Senator Johnson's proposed bills — that opposition to industrial farm animal production is brewing.

Citizen Action Not Aimed at the Legislature

Develop Land Covenants and other Local Legal Strategies to Limit CAFO Growth

Some neighbors are uniting to limit the expansion of CAFOs in their county. According to the *Cedar Rapids Gazette*, a group of Howard County landowners, tired of Iowa lawmakers' refusal to tighten rules on confined animal feeding operations, has banded together to outlaw these operations on their properties. Further, these 43 families owning more than 5,000 acres combined won't accept liquid manure from large feeding operations — an unusual move they hope will keep those facilities from opening nearby."[150] While such action is not a state policy suggestion, it demonstrates how citizens might act in the absence of policy.

Community Action to Block a Packing Plant

How do community residents respond to industrial development they find objectionable? A recent Iowa example is the rejection of a pork processing plant, which demonstrates what can happen when local governments are accountable to the communities they serve.

The citizens of Mason City took on the vertically integrated pork industry, specifically the proposed establishment of a Prestage pork processing plant in their community, and against all odds, prevailed. The $240 million proposed facility had already procured vocal support from then Governor Terry Branstad, millions of dollars pledged by the Iowa Economic Development Authority (eventually $11.5 million), and a Mason City incentive package of a 10-year, 5 percent tax rebate on a $100 million minimum valuation.

The City Council initially appeared to be unanimous in its support for building the facility on the outskirts of Mason City. However, local residents had been given little information about this facility that promised to process at least 10,000 hogs daily, employ nearly 1,000 full-time employees with a payroll of nearly $52 million, and a tax benefit to the city of over $1.7 million. Once residents became fully aware of the likelihood of this development, many questions were raised — impact on air quality, impact on water supply and quality, growth of CAFOs in Cerro Gordo County and especially in the Clear Lake watershed, impact on local traffic and worker availability, housing, education, social services and health care. Mason City residents did not just accept the answers offered by Prestage Foods of Iowa, but independently researched environmental, public health and infrastructure impacts and the longer range history of similar packing plant impacts in other Iowa communities. The City Council, after it conducted public hearings rejected the project.[151] The Mason City "No Prestage" movement is a model of citizens taking action through their local government. This is in contrast to the Iowa Legislature taking away the power of local governments to regulate the location of CAFOs.

CONCLUSION

It is impossible to avoid the very substantial scientific evidence showing the impact of livestock production and its rapid growth on the degradation of Iowa water and air, and consequently the health of the people of the state. Despite this mounting scientific evidence, and the mounting opposition to this explosion of CAFOs, there is every indication that industrial livestock production intends business as usual. Meanwhile state policy makers have refused, not only to strengthen state regulation or allow local regulation, but have also prevented those adversely affected by living near animal confinement facilities of opportunity for redress through the courts.

As we stated in a guest opinion in *The Des Moines Register* in September of 2017, the entire process of approving animal confinement facilities needs to be changed. Iowa policy makers are long overdue in reforming and revising the Master Matrix, passing a moratorium on new swine CAFOs that cannot document superior emission and pollution controls, and in providing legal redress for neighbors adversely affected by the virtually unrestricted explosion of CAFOs in Iowa. This degradation of farmland, Iowa's most precious commodity, the rural environment, rural public health, and rural community social and economic welfare, are all interdependent and critical for long-term agricultural sustainability. As industrial agriculture will not, and elected and appointed officials apparently cannot, the outcome of this conflict is very much up to rural Iowans and all who care about sustainable agriculture.

> ***"No Prestage" — an insider's view***
>
> The following summary is offered by Deb Lassise, MSPH, as to how the residents of Mason City ultimately defeated Prestage, as the result of a 3-3 vote its city council at its final hearing:
>
> "The 'No Prestage' effort started slow and small. A Facebook page played a big role — it had good oversight and was full of information. It was the beginning of identifying a group of people who did not know each other but shared the same concerns. A petition was started and circulated through Facebook and door-to-door. The door-to-door effort was important — residents had an opportunity for personal interaction. Some residents shared that they did not support Prestage coming to the community, but could not speak out because of their job or employer. Others actively sought the documents, chasing after petitioners and reaching out by phone. A critical part of the strategy was to listen to what Prestage was saying, then research their claims, challenge their language, and share the facts. This included following the money: exploring costs to schools, social services, and community infrastructure as well as the accompanying CAFO expansion in the immediate area. A GO FUND ME site was set up and a bank account opened. Contributions paid for newspaper ads, signs, YouTube videos, a website, billboards, and a forum with guest speakers. Everyone had their own way to contribute — in a public way or an anonymous way — whether it be technical or organizational skills, writing a letter to the editor, speaking at a city council meeting, financially supporting the effort, or talking with others. Residents who initially supported the project changed their minds as facts came out. Many North Iowa and regional neighbors expressed their concerns. Although publicly called racists and kooks, the effort was speaking truth to power and money. The process facilitated meeting new people, learning, accessing valuable national/state/regional resources, keeping a sense of humor, engaging young people, and fostering a strong sense of community."

ATTACHMENT 6

APPENDIX 1

U.S. EPA vs. Iowa DNR

On July 12, 2012, Region 7 of the U.S. Environmental Protection Agency (EPA) — which covers Iowa, Kansas, Missouri, and Nebraska — found that the Iowa Department of Natural Resources (IDNR) was inadequately enforcing the Clean Water Act (CWA) in regard to Confined Animal Feeding Operations (CAFOs).

In a letter to IDNR Director Chuck Gipp, EPA Regional Administrator Karl Brooks outlined his agency's concerns over the lack of pollution control from the 7,000 animal feeding operations jeopardizing Iowa's waterways and cited that it was a violation of Section 402 of the CWA.[1] Brooks wrote: "Actions are necessary to ensure that Iowa's NPDES [National Pollutant Discharge Elimination System] permitting, compliance and enforcement program for CAFOs complies with the Clean Water Act." EPA gave IDNR 60 days to submit a plan and a schedule for addressing the issues outlined in the letter. EPA also required that IDNR allow the public to provide input on the plan.

EPA and IDNR came to agreement a on plan that outlined six major categories: on-site inspections for all (1) "large" factory farms (more than 1,000 beef cattle or 2,500 hogs) and (2) "medium" factory farms (300-999 beef cattle or 750-2,499 hogs), (3) desktop evaluations for other medium-sized factory farms, (4) issuance of new factory farm permits regulations within one year, (5) stronger manure applications setback requirements with one year, and (6) tougher enforcement protocols.

EPA became involved with the situation after a petition called for IDNR to relinquish its authority for managing the NPDES. The petition was submitted in September 2007 in a collaboration by the Environmental Integrity Project, Iowa Citizens for Community Improvement, and the Sierra Club Iowa Chapter.

Days after EPA's announcement, *The Des Moines Register* — the state's largest newspaper — issued an editorial lambasting state officials for their inability to address the problem.

"Our elected officials enact laws to ensure there is little regulation. They underfund state agencies that oversee agricultural operations. They send a message to go easy on polluters. And the rest of us pay the price with dirty water. That compromises recreational and tourism opportunities, which affects this state's economy."[2]

Water quality was a contentious issue a both the state and federal level at the time. Iowa Governor Terry Branstad claimed that IDNR was "too aggressive already in enforcing pollution regulation against agricultural operations"[3] while U.S. Representatives Leonard Boswell (D), Tom Latham (R), and Steve King (R) voted in 2011 to limit EPA's ability to enforce the Clean Water Act.[4]

One year after EPA issued its indictment against IDNR, another report was released which found that INDR had done little to improve Iowa's water quality. Iowa Citizens for Community Improvement issued a statement critical of IDNR's efforts to address the issue, writing "[i]t has now been almost a full year since the EPA published its report, and no action has been taken. That's 12 more months of degradation to Iowa's water while the DNR stonewalls implementation of the Clean Water Act."[5]

Despite the criticism from activist groups, EPA Region 7 spokesperson Kris Lancaster said "[the] proposed rules are consistent with federal requirements."[6]

1 Noble, Jason. "EPA says DNR is lax on enforcing confinement permits, regulations." *Des Moines Register*, July 13, 2012.
2 *The Des Moines Register*, Editorial: "EPA letter should be a wakeup call." July 1, 2012.
3 *Bleeding Heartland*: "EPA Finds Iowa DNR Not Enforcing Clean Water Act for CAFOs" July 13, 2012
4 *Bleeding Heartland*: "Boswell, Latham and King vote to undermine Clear Water Act." July 15, 2011.
5 Iowa Citizens for Community Improvement. "One Year after EPA Demands Compliance, DNR Continues to Obstruct Clean Water Act Implementation - Iowa CCI," July 8, 2013
6 Eller, Donnelle. "Groups say water rules aren't enough." *Des Moines Register*, Jan. 28, 2014.

APPENDIX 2

Phase 1 and 2 Superior Technology Projects Approved under the Smithfield Agreement

The following are the types of modifications necessary for a new CAFO to be built in North Carolina. Research has demonstrated environmentally better technology.

Phase 1:

- Solids separation/nitrification-denitrification/soluble phosphorus removal/solids processing system (Super Soils Systems USA)
- High solids high temperature anaerobic digester system
- In-ground ambient temperature anaerobic digester/energy recovery/greenhouse vegetable production system
- Solids separation/reciprocating wetland technology system
- Upflow-biofiltration system
- Belt system for manure removal
- Belt manure removal and gasification system to thermally convert dry manure to combustible gas stream for liquid fuel recovery
- Solids separation/combustion for energy and ash recovery centralized system

Phase 2:

- Solids separation/constructed wetlands system
- Sequencing batch reactor (SBR) system
- Manure solids conversion to insect biomass (black soldier fly larvae) for value-added processing into animal feed protein meal and oil system
- ISSUES (innovative Sustainable Systems Utilizing Economical Solutions). This project includes mesophilic digester, permeable lagoon cover, aerobic blanket and microturbine generator

APPENDIX 3

Anerobic Digester Development to Control Swine Waste in North Carolina

Anaerobic digestion is centuries old and varies from simple household digesters used by some 40 million people in China to the 17,000 commercial scale biogas systems in Europe. (North Carolina Bioenergy Council, 2017). According to the American Biogas Council, 2,000 biogas systems are now in operation in the U.S, the majority at sewage treatment plants, and estimates that there are at least 8,700 U.S. dairy and hog operations large enough to profitably produce biogas, but only 265 (12 percent swine) do so. The Smithfield Agreement research, together with incentives provided by REPS legislation, shows progress is being made.

With financing from Duke University, Duke Energy and later Google Inc., the Loyd Ray biogas system generates 600-megawatt hours of energy. Duke takes partial credit for methane capture to offset some on campus pollution and to achieve its aim of zero net greenhouse gas emissions (NC Policy Watch, 2017). Google gets the rest of methane reductions to meet its goal of 100 percent renewable energy. Beyond methane capture, the system meets North Carolina superior technology odor and nutrient pollution standards. Nine other digesters are operating in North Carolina, but none are currently meeting superior technology performance standards, even with state incentive funds and the promise of expansion.

Soon to come on-line is Legacy Farms, one of the state's few integrator independent farms, which will use dry bedding and swine waste to a series of digesters and retaining ponds (NC Policy Watch, 2017). It is expected to meet superior technology standards, will exempt the 560 acre farm from the moratorium and allow it to expand from 5,500 sows to 60,000 finished hogs. Some producers are hosting third-party renewable energy developers on their property. Revolution Energy Systems (RES), a Washington, D.C.-based company, is operating two waste-to-energy systems that generate 17 times the energy as the Lloyd Ray project while using the waste from 70,000 pigs from 10 adjacent CAFOs. The integrator/producer, Murphy Family Ventures, incurred no cost for the biogas system including retrofitting its barns with scrapers. The entire system is owned by RES, as are the benefits: renewable energy credits sold to Duke Energy under REPS, methane credits equal to the pollution of some 7,500 cars sold on the offset market, waste heat to aid digestion, and revenue from electricity sold to the grid. Another project, Vestal Farms in Duplin County, has eliminated burning biogas on-site, an added expense and operational burden, by purifying gas for direct injection — "direct biogas" or "renewable natural gas" — similar to how some utilities allow customers to add renewable energy to the electrical grid. Also in Duplin County, Optima KV is directly injecting biogas, which will be bought and used by Duke Energy to help fuel its gas plants in adjacent counties. It is expected to become the largest biogas project in North Carolina, enough to power more than 800 homes. Five CAFOs, including Vestal, have invested in the system and will benefit.

Duke Energy is expanding its renewable energy output through capturing waste generated methane, which it treats and injects into its pipeline system in four other counties (Waste Management World, 2017). Under a 15-year contract with Carbon Cycle Energy, it is expected to produce about 125,000 MWH of renewable energy per year from biogas — enough to power about 10,000 homes for a year, while at the same time adding RECs to help satisfy the state mandate. While North Carolina is clearly the leader in developing innovative waste-to-energy technology, Roeslein Alternative Energy has reached the halfway point of its $120 million biogas project in partnership with Smithfield Farms in Northern Missouri. The project will inject renewable natural gas (RNG).

ATTACHMENT 6

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ATTACHMENT 6

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ATTACHMENT 7

Goodhue County Crop & Livestock Farmers

We, the undersigned, agree with the changes the county is recommending to Preservation of Farming Practices to enhance the ability of livestock farmers to continue in Goodhue County.

Signed:

[illegible]	Kohlnhofer Farms
[illegible]	Kohlnhofer Farm
[illegible]	Kohlnhofer Farms
Patty Kehren	Kehren Farms
[illegible]	Huneke Dairy
Paul Huneke	Huneke Dairy
Jerome B[illegible]	Bartholome Farms
Robert [illegible]	Robert [illegible] Farm
Glen Brinkman	Brinkman Sheep Farm
Kevin Voth	Voth Farms
[illegible]	Dillon Dresser
[illegible]	Brinkman Sheep Farm
Craig Breuer	Craig Breuer
Alan Breuer	Alan Breuer
[illegible]	Pine View Dairy Inc
[illegible]	Brady Meyer
Henry Thomforde	HENRY + KATHY THOMFORDE
Matt [illegible]	Kehne Ind

Wozniak, Michael

From: Alan Muller <alan@greendel.org>
Sent: Monday, April 16, 2018 2:02 PM
To: Ronald.clifford.allen@gmail.com; Allen, Ron (COUNTY); Majerus, Jason (County); Anderson, Brad; Nesseth, Byron; Drotos, Paul
Cc: Wozniak, Michael
Subject: Proposed text amendments to "performance standards" related to feedlots

Dear Commissioners:

There are important procedural and substantive concerns with the proposed text amendment.

It appears that a "petition" for an amendment, on behalf of Circle K farms and the Kohlnhofers, dated March 6, 2018, was addressed to Lisa Hanni by Jack Perry, a Minneapolis attorney.

A Text Amendment application form dated March 22, 2018 , is also in the file.

It appears that no public notice was given until April 6, 2018, one month after the petition was received.

The matter appears on the Planning Advisory Commission meeting agenda for April 16, 2018, apparently as a decision item, only tend days after the first and only public notice.

This gives little public notice and no advisory committee has been convened.

County Staff have prepared their own "Staff Recommended Changes," (undated) apparently in response to the March 6th letter. This appears to mean "recommended changes" to the present Zoning Ordinance.

Either proposal would have the effect of significantly reducing the recourse available to residents in the event of problems caused by feedlots. The proposed limitation, if not elimination, of nuisance and negligence claims suggests that Mr. Perry's clients fear that they will create problems for their neighbors.

Neither Mr. Perry nor the Staff have offered any evidence that the proposed changes would be in the public interest.

At this time the County should reject the proposed text amendment language. If the County wishes to proceed further with this, it should do so in a deliberate and transparent manner, with adequate public participation including an advisory committee. We request that an advisory committee be established, as has been done with other types of land use issues with potential for significant impact.

Yours very truly,

Alan Muller and Carol Overland
1110 West Avenue
Red Wing, 55066

Copy: Planning Advisory Commission members (please include in meeting packet)

Dodge County ATTACHMENT 9
Environmental Services
721 Main St. N. • Dept. 391 • Mantorville, MN 55955-2230
Phone: 507-635-6273 • Fax: 507-635-6265
dean.schrandt@co.dodge.mn.us
In-County Toll Free: 888-600-5169

4/6/17

Greetings, Nitrate Monitoring Network Volunteers,

Thanks again for participating in the nitrate monitoring network here in Dodge County. With your help we continue to learn more about how nitrate levels are changing in our county's drinking water.

The sample of your well water, which you recently mailed back to us, has been tested for the presence of nitrate. The results are listed below:

25.1 mg/l ("mg/l" stands for milligrams per liter)

The state standard for nitrate in drinking water is 10 mg/l – levels beyond that are linked to serious health effects in infants and expectant mothers, and the presence of nitrate may be an indicator of other contaminants in the water. If your nitrate level is near, or over, 10 mg/l, and you wish to learn more about what can be done about it, feel free to contact me, or visit the MN Department of Health website (http://www.health.state.mn.us/) for more information.

On the back of this letter is a graph showing nitrate results, including your samples, for the entire network over the last 6 ½ years. Each of the four lines represents a sub-group set up to study certain situations that may, or may not, increase your chances of having a high nitrate well:

1) **Grid & Baseline** – These wells were chosen to achieve complete coverage of the county. They can be deep or shallow, and often have low nitrate levels. However, they're very important as they serve as an early warning system, as protecting our deep aquifers is a high priority.

2) **Decorah Edge** - The Decorah Shale is a very hard layer of rock which sometimes allows nitrate to wick around and underneath it's edge. These wells are located near the edge of the Decorah Shale.

3) **Near Other High Nitrate Wells** – We know that nitrate tends to move sideways through a rock layer, and can impact other, nearby wells. These wells are within 1.5 miles of a neighbor with a high nitrate well.

4) **Sinkhole Vicinity** – Sinkholes, and other karst features like springs and seeps, provide a direct conduit by which nitrate can move from the surface to an underground rock layer. These wells are located within 1.5 miles of a karst feature and tend to have high nitrate levels, though, readings can fluctuate often.

Your well belongs to sub-group 3

Your next sampling bottle will arrive by mail in the fall of 2017, and will arrive directly from the Southern MN Analysis Laboratory, as has been the case for the last few years. It is most helpful for testing purposes if you can return it promptly.

Thanks, again for your time in this effort. Please direct all future questions to me – contact information is contained in the header above.

Dean Schrandt – Dodge County Nitrate Monitoring Network Coordinator

ATTACHMENT 9

Dodge County
Environmental Services
721 Main St. N. • Dept. 391 • Mantorville, MN 55955-2230
Phone: 507-635-6273 • Fax: 507-635-6265
dean.schrandt@co.dodge.mn.us
In-County Toll Free: 888-600-5169

11-28-17

Greetings, Nitrate Monitoring Network Volunteers,

Thanks again for participating in the nitrate monitoring network here in Dodge County. With your help we continue to learn more about how nitrate levels are changing in our county's drinking water.

The sample of your well water, which you recently mailed back to us, has been tested for the presence of nitrate. The results are listed below:

16.2 mg/l ("mg/l" stands for milligrams per liter)

All results are measured in mg/l (milligrams per liter).

The state standard for nitrate in drinking water is 10 mg/l – levels beyond that are linked to serious health effects in infants and expectant mothers, and the presence of nitrate may be an indicator of other contaminants in the water. If your nitrate level is near, or over, 10 mg/l, and you wish to learn more about what can be done about it, feel free to contact me, or visit the MN Department of Health website (http://www.health.state.mn.us/) for more information.

Interest in private well nitrate levels continues to grow – Our local Dodge County monitoring network has recently increased to approx. 125 households.

That means that many new monitors are receiving test results for the first time. Several of you will have very low nitrate readings, meaning that your well is likely fairly deep (> 200 ft.), and/or protected by a thick layer of soil and clay.

Please don't stop sampling yet! – Changes in nitrate levels occur slowly over time, and watching for changes in low nitrate levels is as important to us as changes in wells with high nitrate levels, as it helps us determine where, and how quickly, nitrate changes are occurring.

Your next sampling bottle will arrive by mail in February/March of 2017, but I will be sharing some summary data, graphs, and tables with you before then.

Thanks, again for your time in this effort. Please direct all future questions to me – contact information is contained in the header above.

Dean Schrandt – Dodge County Nitrate Monitoring Network Coordinator