General CAFO Questions:

1. **Are any CAFOs in Jefferson County a significant threat to public health water and air, based on all available data on local landscape and scientific evidence regarding pollutants considered consequential to CAFO operations?**

   DNR Response: Agricultural operations in general have the potential to impact water quality, air quality, and public health. Since CAFOs are larger agricultural operations, the potential for impact is heightened due to the increased generation of manure and process wastewater. Hence CAFOs are classified as point source dischargers and require Wisconsin Pollutant Discharge Elimination System (WPDES) permit coverage. Risk for potential impacts is also heightened during instances of permit noncompliance. View the attached environmental assessment for the Large Dairy CAFO General Permit. This document contains information pertaining to potential water environmental impacts from CAFOs. Here is a link: https://dnr.wi.gov/topic/CAFO/documents/LargeDairyCAFOGP-EnvironmentalAssessment.pdf. The department is not aware of any significant CAFO permit noncompliance in Jefferson County. Since finalization of the Large Dairy CAFO General permit, a new air pollution law was promulgated that says, the department may not regulate the emission of hazardous air contaminants associated with agricultural waste except to the extent required by federal law. [s. 285.28, Wis. Stats.]

   In 2020, Air Management assisted the CAFO program with an environmental review which included a comprehensive summary of air-related information applicable to most concentrated animal feeding operations, along with excerpts from a 2018 air permit analysis for Daybreak Eggs, located in Jefferson County. A copy is attached here for your convenience.

   The Air Management Program does not track whether a regulated air pollution source is a CAFO or have regulations specifically applicable to CAFOs. Based on Standard Industrial Classification codes, three farms in Jefferson County are covered under air pollution control permits and one farm has been determined to be exempt from permitting requirements. Records indicate the facilities are currently operating in compliance with air pollution regulations.

   Land and Water Conservation Department Comment: The three farms covered under air pollution control permits are Cold Spring Egg Farm, Daybreak Foods, and Jones Dairy Farm. Dean's Eggs (also known as Nature Link) is the farm that was determined to be exempt. Please note that Jones Dairy Farm is not a CAFO and has an air permit based on their use of boilers, cookers, and broiling ovens used to smoke meats.

2. **Are current state regulations in alignment with what is known *now* about CAFOs and their impact? In other words, are current state regulations considered outdated, or too exclusionary to comprehensively identify and address significant risks to public health?**

   DNR Response: Regulatory requirements for CAFOs originate from the National Pollutant Discharge Elimination System (NPDES) permitting program under the Clean Water Act. Wisconsin is delegated CAFO permitting authority from EPA to administer the Wisconsin Pollutant Discharge Elimination System (WPDES) permitting program. Delegation only occurs if state requirements are at least as stringent as federal requirements. Wisconsin has more stringent requirements in the instance of regulating groundwater quality impacts. The NPDES permitting system does not consider groundwater impacts from CAFOs unless there is a clear connection between groundwater and surface waters.

   The department has revised standards as we learn more information about potential agricultural impacts. For instance, NR 151, Wis. Adm. Code, was revised in 2017 to add a targeted performance standard to prevent impacts to groundwater quality within the Silurian bedrock region of the state (see https://www.co.door.wi.gov/DocumentCenter/View/560/Summary-of-Silurian-Bedrock-Standards-PDF?bidId=). The department also attempted to revise NR 151 again in 2021 to add a nitrate targeted performance standard. The statutory process and associated firm timelines established by the Legislature for rule-making did not allow adequate time for the department to complete the proposed nitrate targeted performance standard.

The Air Management Program does not have any regulations specifically covering CAFOs. However, air pollution from CAFOs is regulated under ch. 285, Wis. Statutes, and chs. NR 400-499 Wis. Adm. Code, like other industrial sources of air pollution.

The 2020 environmental review previously mentioned includes a comprehensive summary of air-related information applicable to most concentrated animal feeding operations and discusses the potential risks associated with pollutants commonly associated with agricultural activities, including CAFOs.

Land and Water Conservation Department Comment: Please note that the standard referencing Silurian bedrock does not impact Jefferson County as that type of bedrock is not located in the county.

3. How can we better assess the impact, if any exists, of CAFOs in Jefferson County, on water and air?

DNR Response: Self-reporting is key component of the federal NPDES permit program that serves as a basis for Wisconsin's WPDES permit program. The permit requires the agricultural operation complete ongoing self-monitoring and reporting of its production area and nutrient management activities. The permittee is required to report certain types of non-compliance within 24 hours to the DNR. In addition to self-monitoring/reporting by the permittee, the DNR (1) reviews annual reports summarizing self-monitoring activities and Nutrient Management Plan updates, (2) responds to citizen complaints, (3) may conduct a manure hauling audit on an operation's land application practices, (4) conducts a compliance inspection at least once every five-year permit term, typically during the last year of the permit term, (5) conducts more frequent inspections where warranted based on compliance issues or constructions activities and (6) responds to spills should they occur. Documented noncompliance is subject to DNR compliance and/or enforcement measures. The CAFO program is continually working to find ways to increase the amount of time staff can spend on compliance and enforcement activities.

Members of the public are welcome to monitor surface water quality. WDNR and University of Wisconsin - Extension (UWEX) work with citizens through the Water Action Volunteers program. Please visit the DNR web page pertaining to citizen based monitoring (see https://dnr.wisconsin.gov/topic/WildlifeHabitat/citizenMonitoring) and the Water Action Volunteers website for additional information (see https://wateractionvolunteers.org). Baseline water quality data is useful for detecting trends in water quality within an area. Typically, it is not used for pursuing enforcement related to CAFO permits.

The citizens of Wisconsin are considered one of the most important assessment tools of environmental impact. Department staff are available during work hours to receive feedback and information about environmental impacts being observed by the community, as it may relate to any source, including CAFOs. Air Management responds to input from communities by collaborating with regulated sources of emissions and adjusting operational requirements, where appropriate and within the limits of the department's regulatory authorities.
Land and Water Conservation Department Comment: The LWCD often is invited on the DNR compliance inspections referenced in item 4 of the 1st paragraph. The LWCD roll is to determine if there are any requirements that a farm needs to take to be in compliance with any County ordinances (including Manure Storage Ordinance and the Livestock Facility Siting rules).

The LWCD often collaborates with the DNR when it comes to spill response and manure spreading concerns. The LWCD assists the DNR by performing site visits and gathering information related to an incident or citizen complaint. This information is shared with the DNR who keep the LWCD appraised of their next steps.

The LWCD and the Rock River Coalition work in partnership to recruit, train, and equip citizens who want to do stream monitoring of wadable streams. The sampling protocols used are from the Water Action Volunteer Program referenced by the DNR. It is important to understand that the sampling performed does not have anything to do with pollutant source tracking. The sampling provides information on in-stream conditions including flow, temperature, dissolved oxygen, water clarity, and an index score based on the mix of aquatic insects found in the stream. In some cases, phosphorus samples are taken. In no circumstances would a citizen be asked to investigate whether any farm could be a source of pollution. The data is not used to assess the impact of CAFOs (or any other industry or activity) on the stream. Long term data could indicate changes in the quality of stream, but it will not identify any pollutant source.

The LWCD investigates every citizen communication we receive having to do with manure spreading concerns. We take the opportunity to educate the citizen about the rules of manure spreading and we communicate to the landowner and work with them on next steps if the rules were not followed properly.

Any spills of manure on roads are handled by the Sheriff's Department.

4. What should the local health jurisdiction need to be aware of regarding the impact of CAFOs?

DNR Response: Please view the above referenced environmental analysis for the Large Dairy CAFO GP and the environmental review document included in this packet. These documents contain details about potential health impacts of CAFOs.

5. What are evidence based practices to assess and address any issues related to CAFO facilities?

DNR Response: When instances of permit noncompliance are discovered at CAFOs the DNR's stepped enforcement process is followed to resolve the issues. This could include a series of informal contacts, a notice of noncompliance, a notice of violation, and/or a referral to the Department of Justice for prosecution.

6. As we go forward on educating County Committees on the information provided by the DNR, is there anyone with the DNR that can attend a future meeting?

DNR Response: We welcome the opportunity to discuss CAFO and Air regulations with the County Health Department at any time during normal business hours. For in-person attendance, additional information (participants, an agenda, etc.) about the particular meeting would be necessary, to help ensure appropriate staff are involved.

7. The Daybreak Memo provided is a document that is difficult for public health professionals to digest due to the lack of subject matter expertise. Can DNR provide a more succinct summary of relevant findings?

DNR Response: The Overview of Air Pollutant Health Effects, found at the bottom of page 2 of that memo, provides succinct and conclusive statements related to your inquiries on health impacts from agricultural-based emissions.

8. Have any cases of noncompliance from CAFO facilities in Jefferson County been referred to the Department of Justice?

DNR Response: Review of available records show no instance of any enforcement cases related to noncompliance with air pollution or CAFO regulations at a Jefferson County farm, being referred to the Department of Justice by the Air Management or CAFO Programs.

9. Can DNR provide a list of facilities in Jefferson County which have a:

   a. WPDES CAFO permit
   b. Air Permit

DNR Response a.: All facilities with CAFO Permits can be found by searching the CAFO permittees database. The one exception is the S&R Egg Farm facility near Palmyra, which does not appear if you filter for Jefferson County, since the facility's main farm is located in Walworth County.

DNR Response b.: All facilities with Air Permits, or other air regulatory determinations, can be found by searching Jefferson County using DNR's Air Permit Search Tool.

Water Quality Questions:

10. Related to water, can DNR provide historical data that shows local (Jefferson County) levels of contaminants associated with CAFOs?

DNR Response: Permitted CAFOs are required to implement a Monitoring and Inspection Program to ensure production area facilities are meeting discharge limitations. Permittees are also responsible for implementing and updating a nutrient management plan to ensure land application activities meet effluent limitations. Copies of annual reports and nutrient management plan updates reflect these activities and can be accessed through the ePermitting database.

Surface water quality data can be accessed utilizing the Surface Water Integrated Monitoring System (SWIMS) database. Groundwater quality data can be accessed utilizing the Groundwater Retrieval Network (GRN). This data was not collected with the intent of measuring impacts from CAFOs.

11. Does DNR perform any investigation of complaints from the public related to impact on groundwater from CAFOs?

DNR Response: DNR investigates complaints related to groundwater contamination from any source. Complaints can be confidentially reported using the DNR tip line (1-800-847-9367). Spills should also be reported to the 24-hour spill emergency hotline (1-800-943-0003).

12. Do any statutory barriers exist that would prevent counties from passing regulations related to surface water or groundwater contaminants, similar to those that exist for air contaminants?

DNR Response: Please visit this webpage for additional information on water quality standards.

13. "Wisconsin has more stringent requirements in the instance of regulating groundwater quality impacts. The NPDES permitting system does not consider groundwater impacts from CAFOs unless there is a clear connection between groundwater and surface waters."

a. Can DNR elaborate on these statements?

DNR Response: The Clean Water Act regulates discharges to surface water and does not address discharges to groundwater. However, the Wisconsin WPDES program is more expansive than the federal law in that it regulates both discharges to surface water and groundwater.

14. What would the impact be of an addition of a nitrate targeted performance standard in NR 151?

DNR Response: The department has concluded work on the proposed NR 151 nitrate targeted performance standard without promulgating any new or revised rules. Please visit this webpage for additional information.

Air Quality Questions:

15. In terms of process, how do the DNR CAFO and air programs work together if a farm needs both a CAFO and an air permit?

DNR Response: The permitting processes for the CAFO and Air programs are completely separate from one another. CAFOs do have to comply with air quality standards. However, it is rare for a CAFO to meet the federally-established emissions thresholds such that an air permit would be required. For additional information on odor and air quality concerns related to agricultural facilities, visit DNR's web page on Air Toxics and Mercury (see https://dnr.wisconsin.gov/topic/AirQuality/Toxics.html). Toward the bottom of the page there is a tab dedicated to "Ag waste BMPs." For additional information about the CAFO permitting program in general, visit the CAFO web page (https://dnr.wisconsin.gov/topic/CAFO/WPDESNR243.html). The equipment that may require air permit coverage at a CAFO includes mechanical driers, digesters with engine generators or a flare, and digester gas compression systems.

16. Does the DNR have any regulations or guidelines in the CAFO permits that have to do with reducing air emissions and odor such as paving of gravel roads, covers on manure storage?

DNR Response: CAFO WPDES permits are water quality based and focus on preventing impacts to surface water quality, groundwater quality, and wetland functional value. Covers on manure storage facilities is not a permit requirement, although some CAFOs do voluntarily install covers to reduce odors and prevent collection and storage of precipitation.

Although WPDES permit requirements do not focus on air or odor issues, there are rules that are applicable to CAFOs regarding air quality and odor. Section NR 415.04, Wis. Adm. Code, focuses on fugitive dust. Odor control requirements are identified in s. NR 429.03, Wis. Adm. Code. Both regulations require the implementation of preventative measures to avoid problematic releases, and both regulations apply to all air emission sources across the state, regardless of whether a source is subject to air permitting requirements or not.

17. What specifically is regulated in a CAFO air permit?

DNR Response: Air Management does not issue a general CAFO air permit. An air permit issued to a CAFO would address emissions of the same air pollutants as any other air permit, except that hazardous air contaminants associated with agricultural waste are not regulated per s. 285.28, Wis. Stats. The fugitive and intermittent nature of the remaining emissions usually lead to the CAFO being below air permitting requirements.

In cases where farms do require air permits, it is usually because they have operations beyond housing animals such as installation of manure digesters to produce biogas and associated activities including operations that clean and compress biogas for injection into the natural gas pipeline system and biogas combustion operations such as flares or engine driven electrical generators. Air permitting may also be required at farms that dry manure and sell it as fertilizer.

18. How would you classify the quality of the air in Jefferson County? And what are the trends – it is improving, staying the same, or reducing? And how much of our air quality problems are from sources that are local versus regional or even multi state?

DNR Response: Jefferson County is in attainment of all federal air quality standards. The most recent Air Quality Trends report, released in Fall of 2021 shows Wisconsin's air quality continues to improve, building on a nearly 20 year-trend.

19. What are the air pollutants of concern for Jefferson County? What are the major/leading sources of the air pollutants of concern for Jefferson County?

DNR Response: Jefferson County is in attainment with all ambient air quality standards. These standards are set to be protective of public health.

County level estimates of emissions is available in the 2017 and past National Emission Inventories (NEIs) at:
https://www.epa.gov/air-emissions-inventories/2017-national-emissions-inventory-nei-data
The data can be queried in order to generate custom data files, and the results will be displayed on screen with various options (file types) to download.

Since 2013, Air Management has monitored ozone in Jefferson County, as required by the Clean Air Act, near the elementary school grounds at N440 Laatsch Lane in Jefferson. Prior to 2013 monitoring took place at Jefferson high school. Monitor data for both locations can be found on page 27 of the 2021 Trends by County report.

20. What air pollutants are currently monitored in Jefferson County? Should there be other parameters monitored that currently aren't? If so, what would the costs be to monitoring those parameters?

DNR Response: Since 2013, Air Management has monitored ozone in Jefferson County near the elementary school grounds at N440 Laatsch Lane in Jefferson.

The statewide monitoring network is spatially distributed to provide air quality information based on geographic coverage and population density. As required by the Clean Air Act, the U.S. EPA sets National Ambient Air Quality Standards (NAAQS) for criteria pollutants, which include particulate matter, NO2, ozone, CO, SO2 and lead. The DNR conducts ambient air monitoring in locations directed by federal requirements to measure concentrations of criteria pollutants for comparison to the appropriate NAAQS.

The Wisconsin Department of Natural Resources Annual Monitoring Network Plan is an annual process that details that the siting and operation of each monitor meets the requirements of 40 CFR Part 58 and certifies that the state has met all federal ambient air monitoring requirements. The plan also proposes recommended changes to the air monitoring network.

The DNR does not have funding to support monitoring beyond what is federally required. Depending on the pollutant, one regulatory monitoring site measuring one pollutant typically costs $30,000 - $120,000 to install and approximately $20,000 - 30,000 annually to maintain and meet federal requirements.

21. What is your opinion of using purple air monitors?

DNR Response: Comparability studies found that the data associated with the PurpleAir sensors can compare more accurately with federal reference method samplers by applying a predetermined, local correction factor. The DNR conducted a study to develop a correction factor for PurpleAir Sensors with a goal of improving the accuracy and utility of these sensors for citizens in Wisconsin interested in local air quality. For further details on the PurpleAir comparison study and correction factors see the Wisconsin DNR PurpleAir Study Summary.

When used with the correction factor, PurpleAir data can help fill the gaps of regulatory monitors. This can be especially helpful during events like wildfires.

22. Do other Counties get involved in air pollutant monitoring, air permitting, and source control?

DNR Response: The DNR is not aware of any counties in Wisconsin conducting these activities, except in as much as may be included as laws in local ordinances, such as motor vehicle idling ordinances.

23. How does DNR regulate Air Quality? Both farm related and in general.

DNR Response: Air Management operates a statewide network of air monitors to measure ambient concentrations of several air pollutants throughout the state including ground-level ozone (O3), particle pollution, sulfur dioxide (SO2), nitrogen dioxide (NO2) and carbon monoxide (CO). These pollutants are called criteria pollutants and are regulated by the U.S. Environmental Protection Agency (EPA) as part of the Clean Air Act (CAA). Monitored levels of criteria pollutants are compared against the National Ambient Air Quality Standards (NAAQS), set by EPA at levels protective of public health, to determine whether the standards are met. All of the monitors in Wisconsin use federally approved methods for measuring air quality.

Air Management implements the Clean Air Act and statutory and code requirements primarily through air pollution control permitting and compliance assurance of stationary sources in Wisconsin.

24. Does a County have any ability to regulate Air Quality? Again, farm related and in general.

DNR Response: The existence of state or federal regulations does not preclude any county from pursuing development of their own air quality regulations. Chapter NR 403, Wis. Adm. Code, contains the provisions for establishing local air pollution control programs. However, implementation of such regulations at the county level may face logistic and economic challenges.

25. We understand there is an air quality monitor in Jefferson County. Can you provide information on the monitor?

DNR Response: Since 2013, Air Management has monitored ozone in Jefferson County near the elementary school grounds at N440 Laatsch Lane in Jefferson. Prior to 2013 monitoring took place at Jefferson high school. Monitor data for both locations can be found on page 27 of the 2021 Trends by County report.

26. How/Who purchased and installed it? How is the data used collected?

DNR Response: The DNR air monitoring program purchased, maintains and operates the shelter and instrumentation at the Jefferson monitoring site. A proprietary data acquisition system is used to share data internally and with the public in real time. https://airquality.wi.gov/home/map

27. Depending on the answer above, could the County and DNR partner to create additional air monitors? Would this be beneficial in anyway?

DNR Response: The DNR does not have funding to conduct monitoring beyond what is federally required.

28. How many air permits are there in Jefferson County and how many of those are for CAFOs?

DNR Response: Department tracking indicates there are 36 sources operating under active air permits in Jefferson County. Three of them are farms. The Air Management Program does not track CAFO status.

Land and Water Conservation Department Comment: The three farms referenced are Cold Spring Egg Farm, Daybreak Foods, and Jones Dairy Farm. Please note that Jones Dairy Farm is not a CAFO and has an air permit based on their use of boilers, cookers, and broiling ovens used to smoke meats.

29. How many farms in Jefferson County that have CAFO permits also have air permits?

DNR Response: There are three farms in Jefferson County with air permits, Facility ID Number (FID) 128002820 Jones Dairy Farm, FID 128003370 Cold Spring Egg Farm, and FID 128027350 Daybreak Foods Creekwood Complex - Egg Pkg Plant. A fourth farm, FID 128121290 Dean Eggs Dba Nature Link Farms, has been identified as exempt from air permitting requirements.

30. Related to air, can DNR provide historical data that shows local (Jefferson County) levels of contaminants associated with CAFOs?

DNR Response: The DNR does not have monitoring equipment designed to gather air quality data directly from CAFOs. The purpose of DNR's monitoring program is to meet Clean Air Act requirements. The U.S. EPA sets National Ambient Air Quality Standards (NAAQS) for criteria pollutants, which include particulate matter (PM), nitrogen oxides (NO_2), ozone, carbon monoxide (CO), sulfur dioxide (SO_2) and lead. The statewide monitoring network is spatially distributed to provide air quality information based on geographic coverage and population density. The DNR conducts ambient air monitoring in locations directed by federal requirements to measure concentrations of criteria pollutants for comparison to the appropriate NAAQS. The DNR does not have funding to monitor beyond what is federally required.

31. If the County chooses to invest in a Purple Air monitor, could we potentially have it installed at the same location of the DNR's ozone monitor at Laatsch Lane in Jefferson?

DNR Response: While this is possible, installing at the Laatsch Lane monitoring site would not be ideal for your study. Due to strict state IT cybersecurity rules, a Wi-Fi connection could not be provided. To understand how to best use sensor data, we have many good resources on the DNR's Air Monitoring Sensors webpage, including a comprehensive roadmap for setting up an air monitoring project, data evaluation and interpretation tools.

32. Do you know of any grants that can pay for the installation and maintenance of Purple Air monitors and analysis of data?

DNR Response: The department is not aware of any grants available for this type of monitoring at this time. EPA does offer a sensor loan program that can be found here: https://www.epa.gov/air-sensor-toolbox/air-sensor-loan-programs

33. Would DNR use any of the PurpleAir data in any way including for regulatory reasons?

DNR Response: No, the Clean Air Act only allows for Federal Reference Method (FRM) or Federal Equivalent Method (FEM) instruments to be used for regulatory purposes. PurpleAir is neither an FRM nor an FEM. There are extensive federal requirements related to the collection, quality control and quality assurance of that data for FRMs and FEMs.

34. If Jefferson County is adjacent to a County that is in nonattainment for any air quality standard, then should we be concerned or take any type of action?

DNR Response: Wisconsin currently meets all national ambient air quality standards except for the 2015 ozone standard. Ozone is a regional pollutant which primarily impacts areas along eastern Wisconsin's shoreline of Lake Michigan. Ozone monitors are located in Jefferson County and neighboring Dane, Dodge, Rock, Walworth and Waukesha Counties, all of which have design values below the 2015 ozone standard of 70 parts per billion. Waukesha County, despite having monitored air quality meeting the standard, is associated with the greater Milwaukee nonattainment area for this standard. For this reason, EPA included Waukesha County in the ozone nonattainment area.

35. The monitored and modeled annual average concentrations of PM2.5 included on this website (https://dhsgis.wi.gov/DHS/EPHTracker/#/map/Air%20Quality/airQualityIndex), shows an overall decreasing trend in particulate matter for Jefferson County. The last data point is from 2018 with an increase in modeled particulate matter. Is this increase a concern? Is it a concern that the particulate matter amount in Jefferson County is in the highest range of data (8.68 ug/m^3 to 9.8 ug/m^3)?

DNR Response: Per DNR's most recent trends report, there is a similar statewide increase in 3-year design values around this time. During this timeframe, DNR transitioned to a FEM new measurement technique which may be responsible for this apparent increase. This is a trend that has been recognized nationwide for these instruments and continues to be assessed. The modeled concentrations for Jefferson County meet the current NAAQS for annual concentrations of 12 ug/m^3. In fact, the entire state of Wisconsin is meeting the NAAQS for PM2.5.

36. Data shows Wisconsin air quality nearly 19 % reduction over a 20-year period in particulate matter. From the perspective of the Air program, do they feel comfortable with us stating that we are reasonably confident there is a negligible impact on air quality from CAFOs?

DNR Response: Since the early 2000s average statewide PM2.5 concentrations have decreased by 35%. PM2.5 is a regional pollutant formed predominantly from reactions that form sulfates and nitrates in the atmosphere, as such the monitoring network is designed to allow for the most spatial and population coverage as required by the PM2.5 NAAQS. It is fairly well-documented that reductions in PM2.5 over the past two decades can be attributed to regulations on tailpipe emissions standards and sulfur content limitations on diesel fuel. Currently, Wisconsin fully meets all NAAQS for PM.

The primary fine particulate related pollutant emitted at animal feeding operations (AFOs) is ammonia, which may convert to ammonium nitrate through complex atmospheric chemical reactions. More information about an air emissions monitoring study performed by EPA at some AFOs, nationally, may be found at: Agriculture and Air Quality | US EPA

The Air Program would not be able to refute or support that statement, except to again point out that Wisconsin is currently in compliance with all NAAQS for PM.

37. Related to Odor control requirements are identified in s. NR 429.03, Wis. Adm. Code., if there is a persistent issue related to odor, is there a mechanism for assessment/enforcement?

DNR Response: Yes. The Air Program will confirm that the source has been made aware of the ongoing odor issue. The Air Program works with the source on the results of investigations conducted, the origins and nature of the odors, and the extent of measures being implemented to minimize odors. If necessary, the department may require that additional odor abatement measures be implemented, or that an application for additional air permitting actions be submitted.

State of Wisconsin

CORRESPONDENCE/MEMORANDUM

DATE: June 19, 2020

TO: Mark Cain – Wastewater Engineer, Bureau of Watershed Management

FROM: David Panofsky, P.E. – Air Management Engineer, Bureau of Air Management

SUBJECT: Air Quality Environmental Review for Daybreak Foods Inc.; 3 million layers and pullets egg production farm located in Lake Mills

The Air Management Program (AM) reviewed the air quality emissions of Daybreak Foods Inc. (Daybreak) in Lake Mills as part of its construction permit preliminary determination and this information is contained within this document. The initial part of this document includes general air-related information applicable to most concentrated animal feeding operations. This document represents the Air Management Program's review of the proposed Daybreak facility from the air quality perspective for the integrated environmental analysis associated with water quality permitting.

The Department of Natural Resources has the following authorities regarding this operation and air quality:

- Air emission limitations from s. NR 415.04, Wis. Adm. Code, covering fugitive dust sources
- 2011 Wisconsin Act 122 (creating s. 285.28, Stats.), signed into law March 7, 2012 and published March 21, 2012, exempts state hazardous air contaminants associated with "agricultural waste" from requirements of ch. NR 445, Wis. Adm. Code. Specifically, s. 285.28, Stats. reads as follows: "The department may not regulate the emission of hazardous air contaminants associated with agricultural waste except to the extent required by federal law."
- Applicable permitting thresholds contained in s. NR 406.04(2)(c), Wis. Adm. Code (construction permits); s. NR 407.02(4), Wis. Adm. Code (operation permits), s. NR 405.02(22)(a)2, s. NR 405.02 (27) and s. NR 405.07 (9), Wis. Adm. Code (PSD or prevention of significant deterioration).
- Chs. NR 406 and 407, Wis. Adm. Code, contain provisions that allow a source to exclude emissions of state hazardous air contaminants (including ammonia and hydrogen sulfide) from requirements of ch. NR 445, Wis. Adm. Code associated with agricultural waste in accordance with s. 285.28, Stats., signed into law March 7, 2012. These provisions apply to state hazardous air contaminants only and do not apply to criteria pollutants such as PM or VOCs, or to federal hazardous air pollutants or to PSD major source permitting thresholds contained in Ch. NR 405, Wis. Adm. Code.
- Hazardous contaminant emissions reporting requirements contained in Ch. NR 438, Wis. Adm. Code are also not applicable per s. 285.28, Stats.
- Odor control requirements may be imposed if the Department determines an objectionable odor exists per s. NR 429.03 – Malodorous Emissions, Wis. Adm. Code.

Daybreak, as with any source of air pollution, is required to evaluate existing information, determine its air emissions, and comply with any air regulatory requirements that apply. Daybreak received construction permit 18-JJW-054 on October 17, 2018. This memo includes general information on air-quality and animal agricultural operations and also includes findings from the air quality permit analysis.

Air Quality:

Animal agricultural operations generate odors and emit air pollutants. Depending upon the composition, concentration, frequency, and total mass of these emissions, these emissions may impact local or regional air quality.

Air Pollutants and Odor

Airborne pollutant emissions from concentrated animal feeding operations (CAFO), and other types of animal agricultural operations, include gases and particles. Air quality concerns are focused primarily on ammonia (NH_3), hydrogen sulfide (H_2S), odors, particulate matter (PM), volatile organic compounds (VOC), and greenhouse gases (GHG) including methane.

Odors are produced by a number of different air pollutants associated with animal agriculture. Some of the most objectionable compounds produced are: organic acids including acetic acid, butyric acids, valeric acids, caproic acids, and propanoic acid; sulfur containing compounds such as hydrogen sulfide and dimethyl sulfide; and nitrogen-containing compounds including ammonia, methyl amines, methyl pyrazines, putrescine, skatole and indoles.

Diesel exhaust particulate matter emissions from semi-trucks, manure spreaders and other miscellaneous farm equipment could also be generated by animal agricultural operations. Emergency generators, other stationary diesel or biogas engines and other combustion sources will emit pollutants, too. The combustion of diesel, biogas or other fuels emits and forms pollutants such as oxides of nitrogen (NOx); sulfur dioxide (SO_2); carbon monoxide (CO);) and other products of incomplete combustion.

In addition to primary emissions, certain air pollutants are formed through chemical processes in the atmosphere known as secondary formation processes. The secondary pollutants can have significant health and environmental effects. Ammonia reacts with sulfur dioxide and nitrogen oxides (NOx), driving the formation, through chemical condensation, of fine atmospheric particulates (PM2.5). VOC and NOx react to form ozone. Nitrogen containing compounds such as ammonia and NOx can result in increased nutrient loading and acidification of soils and waters upon deposition from the atmosphere.

Overview of Air Pollutant Health Effects

Air pollutants, including hydrogen sulfide, ammonia and organic dust, can produce unhealthy air quality situations. Even when using beneficial management systems and mitigation techniques, some airborne contaminants may be generated. Concentrations of airborne contaminants may build up inside livestock buildings resulting in animal and human health concerns. Most concerns are associated with chronic or long-term exposure. However, some human and animal health concerns or safety hazards can result from acute or short-term exposures. Below is a summary table of air pollutants, sources, and health effects.

Pollutant	Sources	Health Effects
Particulate Matter and Particulate Matter up to 2.5 micrometers (PM2.5)	Grain & Feed storage and handling; animals; windblown dust	Effects vary with composition of particulates, size, concentration, and exposure frequency. For example, mineral dusts can cause obstructive respiratory disease. Particulates from combustion and atmospheric condensations with reactive components (often fine particulates or PM 2.5)cause vascular disease associated with chronic or acute inflammation. Chronic exposure to bioaerosols can result in immune hypersensitivity reactions in the form of atopic allergy or hypersensitivity pneumonitis. It has been estimated that animal agricultural operations in the upper Midwest can contribute a significant portion of the ambient PM2.5 in winter.
Ammonia (NH_3)	Animal manures and urine	Ammonia may be associated with increased respiratory symptoms. Eye and respiratory irritation are most likely effects when ammonia is present immediately around livestock facilities. Ammonia also contributes to regional air quality including the formation of $PM_{2.5}$ and associated health effects of fine-particle pollution. Ammonia gas and particulates can impact human and animal health and cause environmental degradation. If inhaled, the fine particulate (PM2.5) forms of ammonia pose a risk to human and animal health. These particles can travel into the deepest part of the lungs and into the vasculature. Chronic exposure, from collective sources, causes a variety of ailments related to irritation and inflammation of cardio-vascular tissues.
Hydrogen sulfide and other sulfur compounds.	Animal manures	Offensive odor at low concentrations. High concentrations above 100ppm cause nervous system depression including reversible respiratory paralysis leading to loss of consciousness and death. Intensity of odor is not a good indicator of danger, due to rapid olfactory paralysis at high concentration.
Volatile Organic Compounds (VOCs)	Animals, feeds and waste treatment	This is a general class of carbon-based chemicals that are small enough to evaporate and form part of the air mixture. Individual chemicals vary in odor and toxicity, but are typically regarded as nuisances at the concentrations typically found around livestock operations. Compounds include volatile fatty acids (butyric and caproic acid), that have distinct and offensive odors. In addition to health effects of individual compounds, VOCs

		participate in atmospheric reactions to create ozone, a reactive form of oxygen and a respiratory irritant.

Particulate matter, fugitive dust emissions, bioaerosols

Wisconsin defines particles, particulates or particulate matter as any airborne finely divided solid or liquid material with an aerodynamic diameter smaller than 100 µm (micrometers). In general, particles are identified according to their aerodynamic diameter, with the particles most relevant for human health as either PM10 (particles with an aerodynamic diameter smaller than 10 µm) and PM2.5 (aerodynamic diameter smaller than 2.5 µm). Even low concentrations of particulates have been related to a range of adverse health effects. Fine particulate matter (PM2.5) is considered more dangerous than PM10 since, when inhaled, PM2.5, though tiny, are mixtures of reactive chemicals. They are small enough to reach the deepest part of the lungs, where the smallest particles can enter the blood and cause inflammation in the lungs and heart[*]. The tiny particles classified as PM2.5 are primarily formed by reactions in the atmosphere, or may be emitted directly to the atmosphere during combustion. Key precursor pollutants include, ammonia (principally from agricultural operations), SO_2 (principally from coal burning), NOx (principally from combustion processes) and organic carbon. The nature and sources of organic carbon vary widely and include combustion as well as secondary formation. Together, ammonium nitrate and ammonium sulfate represent about 60% of the total mass of PM2.5. On average, organic carbon represents about 30% of the mass of PM2.5. Black carbon and crustal material together are about 10% of the mass of PM2.5.

Sometimes called coarse particles, the particles in the PM10 size range are generally created by mechanical action such as crushing, grinding or wind-blown dust. Organic carbon content of particles will vary with the source material and method of formation. For example, the carbon content of PM varies inversely with the fineness of particles (Li et al, 2003).

Bioaerosols are a major component of the particulate matter from concentrated animal feeding operations (CAFOs). Bioaerosols are particles of biological origin that are suspended in air and include bacteria, fungi, fungal and bacterial spores, viruses, mammalian cell debris, products of microorganisms, pollens, and aeroallergens. Studies provide evidence that airborne biological contaminants (such as cow allergens[†]) are present in airborne particulate matter up to three miles from dairy operations (Williams et al, 2011). Another study (Dungan, 2010) provides a review of fate and transport of bioaerosols associated with a variety of livestock operations and manures.

Some microorganisms associated with bioaerosols are pathogenic; that is, capable of causing disease in animals and/or humans. The amount and variety of pathogens present in animal waste are dependent on a variety of factors including the health status of the animals and the characteristics of the manure and manure storage facilities (Spiehs and Goyal, 2007). While most environmental effects from manure-containing pathogens occur when introduced into surface and ground water, there is also potential for pathogens to become airborne during the process of land application (Saunders and Harrison, 2012).

Ammonia

Ammonia (NH_3) is an atmospheric pollutant of concern that readily reacts with acids and precursor pollutants in the atmosphere to form particulate ammonium sulfates [NH_4HSO_4 and $(NH_4)_2SO_4$], and ammonium nitrate (NH_4NO_3). These are contributors to ambient fine particulates (PM2.5), regional haze and decreased visibility, as well as to soil and water acidification. Another secondary effect of ammonia is increased nitrogen deposition from airborne

[*] As a point of reference, a human hair is 60 micrometers in diameter.

[†] A cow-specific allergen, studied by Williams et al, 2011, "include Bos d 2, a member of the family of lipocalins, allergic proteins,…associated with cow dander, sweat and urine."

ammonia, ammonium sulfates and ammonium nitrates on surface water and soils which may result in eutrophication and a tendency within an ecosystem towards degraded plant communities.

Agricultural livestock operations were estimated to account for 84 percent of ammonia emissions, based on a 2005 statewide inventory. Ammonia is primarily generated from animal waste and is released from buildings, infrastructure or other areas where animal waste is transported, processed, stored or land-applied. This includes confinement buildings, open lots, stockpiles, manure handling and storage facilities, and land application from both wet and dry manure handling systems.

The potential for ammonia emissions exists wherever manure is present. Nitrogen in animal wastes occurs as unabsorbed nutrients in animal feces and as either urea (mammals) or uric acid (poultry) in urine. Ammonia is produced when the urea contained in urine is enzymatically hydrolyzed by bacterial urease in feces (or e.g., on barn floors and in soil). Smaller amounts of ammonia are produced during the decomposition of feces.

The volatilization of ammonia from any manure management operation is highly variable depending on total ammonia/ammonium concentration, temperature, pH and storage time. Ammonia is highly soluble in water and can also readily volatilize from water solution to enter the air. However, when the pH of an ammonia solution is sufficiently low, ammonia exists in the form of ammonium ion (NH_4^+), which is much less volatile than ammonia (NH_3). High pH and high temperature favor a higher concentration of ammonia and, thus, greater ammonia emissions. The pH of both liquid and solid manures is influenced by the characteristics of the manure and environmental conditions. Manure pH can range from 7 to 8.5, which may result in fairly rapid ammonia volatilization. The surface pH for manure in housing facilities and manure storages is higher (from 0.5 to 1.0 pH units) than the average bulk pH of the excreted manure and is critical in determining ammonia emission rates. The pH of manure in storage is a function of solids content, with low solids having a pH around 7 and high solids around pH 8.5 (Rotz, 2014).

Atmospheric ammonia concentrations in the Midwest. Ammonia emissions are not constant throughout the year. They demonstrate seasonal and daily variations. The degree of seasonal variation depends on the geographic region, animal sector, and type of animal production practices used. For example, high temperature increases ammonia volatilization. Precipitation and humidity can increase or decrease emissions depending on how manure is managed. High wind speeds can increase emissions from open manure storage facilities and land application. The population of animals on a farm also may vary throughout the year, thereby changing ammonia emissions from housing and manure storage facilities.

The Midwest Regional Planning Organization (MRPO) has been collecting and analyzing data on ambient ammonia concentrations in order to evaluate the potential impacts of ammonia emission reductions on levels of ambient PM2.5 and regional haze. The MRPO found that reducing ammonia emissions would be an effective strategy to reduce PM2.5 concentrations and improve visibility in the Great Lakes region (LADCO, 2009 http://www.ladco.org/reports/pm25/).

The National Atmospheric Deposition Program (NADP) has been measuring nitrogen species and concentration in precipitation since the late 70's. Their results show the upper Midwest as a relative hotspot for ammonium and overall nitrogen deposition. Ammonium deposition hotspots have also been identified in North Carolina after the introduction of a significant number of CAFOs to the region (National Deposition Program, 2014 http://nadp.sws.uiuc.edu/data/animaps.aspx).

Regulatory perspective. Ammonia is a state hazardous air pollutant under Ch. NR 445, Wis. Adm. Code. Wisconsin has an ambient air quality standard for ammonia of 418 $\mu g/m^3$ averaged over a 24-hour period. Agricultural wastes are currently exempt from the requirements of Chs. NR 445 and reporting of ammonia from agricultural waste would not be required under NR 438, Wis. Adm. Code. Ch. NR 438, Wis. Adm. Code contains reporting requirements when emissions exceed 2,097 lb/yr of ammonia. The Clean Air Act lists ammonia in section 112(r)(3).

Ammonia is listed as a toxic air contaminant in chapter NR 445 because it can cause adverse health effects at ambient concentrations. Ammonia's toxicity is based upon its caustic properties. At low concentrations, ammonia is irritating to wet tissues of the lungs, airways, and eyes. At sufficiently high concentrations, ammonia begins to dissolve those tissues, causing more severe damage.

Ammonia Toxicity Progression

Property	Concentration in Air (ppm)
Detectable Odor	0.04-53
Eye, Nose Irritation	50-100
Strong Cough	50-100
Airway Dysfunction	150
Lethal in 30 Minutes	2,500-4,500
Lethal Immediately	5,000-10,000

Few monitoring studies have been completed in Wisconsin to document ambient ammonia concentration changes with respect to distance and time from a source. However, there are 2 sites in Wisconsin which participate in NADP's Ammonia Monitoring Network (AMoN) - Perkinstown (located inside of the Chequamegon-Nicolet National forest in Taylor County) and Horicon Marsh (at the southern end of the Wildlife Refuge in Dodge County). Both sites show concentrations of ammonia that are somewhat above the national average.

Hydrogen Sulfide

There are several biotic, abiotic, and industrial sources of hydrogen sulfide (H_2S) release into the atmosphere. Hydrogen sulfide releases associated with livestock operations typically result from the anaerobic decomposition of sulfur-containing organic matter (primarily manure). Hydrogen sulfide is a colorless gas that is heavier than air and highly soluble in water, with odor and health implications. Fundamental gas laws ultimately dictate the equilibrium behavior of a gas. In the case of hydrogen sulfide, its slightly higher molecular weight relative to air, combined with its slow rate of release from the aqueous phase, result in it initially staying near the ground. Hydrogen sulfide will eventually mix thoroughly in an enclosed space at equilibrium. Liquid manure storage pits (inside buildings) or basins (near barns) are the primary sources of hydrogen sulfide in animal production. Significant quantities of hydrogen sulfide can be released during agitation of stored liquid manure, during the flushing of animal housing and from sand separation channels prior to storage lagoons. In addition, mechanical solids separation and biogas processing can release significant concentrations of the gas.

There are limited studies in Wisconsin on the unhealthy levels of hydrogen sulfide beyond the property boundary of large animal agricultural operations. These studies have not documented hydrogen sulfide concentrations associated with dairy operations in Wisconsin as a health hazard. Problems with hydrogen sulfide were documented in 2008 in Minnesota, where air emissions from the Excel Dairy in Thief River Falls were deemed a public health hazard. Note: Minnesota has a different hydrogen sulfide standard than Wisconsin[‡]. In 2009, The Wisconsin Division of Public Health in cooperation with the Agency for Toxic Substances and Disease Registry and U.S. EPA studied one feeder pig operation in southwest Wisconsin and concluded that exposure to hydrogen sulfide in air locations near that particular operation was not expected to harm people's health, although hydrogen sulfide was at times detected as an odor.

Regulatory perspective: Hydrogen sulfide is a state hazardous air pollutant under Ch. NR 445, Wis. Adm. Code. Wisconsin has an ambient air quality standard for H_2S which is 335 $\mu g/m^3$ (about 238 ppb) averaged over a 24-hour

[‡] Minnesota has established air quality standards for H_2S that are more restrictive than Wisconsin's. Minnesota's ambient air quality standards for H_2S are measured concentrations of 30 ppb no more than twice in 5 days, averaged over 30-minute periods, and no more than 50 ppb in any two 30-minute periods over those same 5 days.

period. Hydrogen sulfide from agricultural wastes is currently exempt from the requirements of Chs. NR 445 and NR 438, Wis. Adm. Code.

Ch. NR 438, Wis. Adm. Code, contains reporting requirements when emissions exceed 3,279 lb/yr of H_2S. The Clean Air Act lists hydrogen sulfide in section 112(n) and (r). Total reduced sulfur and hydrogen sulfide each have a PSD significance threshold of 10 tpy as defined in Table A in s. NR 405.02 (27), Wis. Adm. Code.

The toxic mechanism of hydrogen sulfide is similar to cyanide, though much less potent. Of the several ways in which hydrogen sulfide can affect human health, the most dangerous is when H_2S is concentrated enough to cause respiratory paralysis through the nervous system, leading to collapse and loss of consciousness while in a dangerous air environment such as a sewer or enclosed manure pit. NIOSH lists 100ppm H_2S as *immediately dangerous*, although the actual concentration during incidents of loss of consciousness are usually unknown[§]. Manure gas safety is outlined in an interagency (DATCP, NRCS, and DHSF) November 2008 report, "Manure Gas Safety; Review of Practices and Recommendations for Wisconsin Livestock Farms."

Hydrogen Sulfide Toxicity Progression

Property	Concentration in Air (ppm)
Offensive odor, headache (chronic exposure)	0.3
Very Offensive (chronic)	3-5
Asthmatics affected (acute)	2
Olfactory paralysis (acute)	150
Central Nervous System Depression/Loss of Consciousness	>500
Lung Paralysis, Collapse, Death	600-1,000

Greenhouse Gases

Agriculture in general, and livestock operations in particular, are anthropogenic sources of greenhouse gas emissions (GHG). The primary GHGs associated with animal agriculture include methane (CH_4) and nitrous oxide (N_2O). The July 2008 report of the Wisconsin Governor's Task Force on Global Warming includes several recommended policies for the animal agriculture sector to reduce GHG emissions. Among the recommendations to reduce emissions are nutrient and manure management changes (*i.e.* to reduce nitrous oxides and methane) and the production, capture and combustion of waste-derived methane. While enteric emissions appear to be the majority of GHG emitted by livestock, GHG associated with manure management can be significant.

US EPA has finalized a rule (40 CFR part 98, subpart JJ) which contains reporting requirements for GHGs for animal agricultural sources emitting over 25,000 metric tons annually of carbon dioxide equivalents ($mtCo_2e$) from manure management activities. In 2009, US EPA estimated that 25 dairy operations in the US exceeded the 25,000 $mtCo_2e$ for manure management systems. In addition, the federal and state Prevention of Significant Deterioration (PSD) permitting programs require consideration of GHG emissions from sources already required to undergo PSD permitting for any other regulated pollutant.

Volatile Organic Compounds & Other Hazardous Air Contaminants

Volatile organic compounds (VOCs), which contribute to odor and air quality problems, have been identified and associated with CAFOs. Research in the U.S. has focused primarily on dairy CAFOs. VOCs are associated with fermented feeds and both enteric fermentation and with fresh and stored manure. Researchers have identified 113 VOC compounds, including 82 VOCs coming from a lactating cow open stall and 73 coming from a slurry lagoon.

[§] U.S. Department of Health, Agency for Toxic Substances and Disease Registry (ASTDR) 2014

These compounds include: alcohols, aldehydes, ketones, esters, aromatic hydrocarbons, halogenated hydrocarbons, terpenes, other hydrocarbons, amines, other nitrogen containing compounds and sulfur-containing compounds.

On a mass basis, ethanol (EtOH), methanol (MeOH), acetic acid, acetaldehyde, and acetone are the major VOC compounds generated on dairy animal agricultural operations (from silage and manure sources). Both methanol and acetaldehyde are federal hazardous air pollutants under Sec. 112 (b). To the Department's knowledge, no state has made a regulatory decision at animal agricultural operations based on methanol or acetaldehyde emissions, nor has the US EPA published or cited information to suggest these pollutants could individually exceed 10 tons/year or together exceed 25 tons/year which are the thresholds for developing a MACT (maximum achievable control technology) under s. 112(d), or determining a case-by-case MACT under s. 112(g)(2) of the Clean Air Act.

VOCs are defined in s. NR 400.02(162), Wis. Adm. Code as "any organic compound which participate in atmospheric photochemical reactions." This definition excludes a number of compounds determined to have negligible photochemical reactivity, such as methane. VOCs are a precursor pollutant to ozone, a criteria pollutant, and have permitting thresholds and general control requirements in Chs. NR 405, 406, 407, 408, 419 and 424, Wis. Adm. Code. Many VOCs are also classified as federal hazardous air pollutants (HAPs), such as methanol or acetaldehyde.

Odors

Odor is a very real and often highly charged issue for farmers, neighbors and local government in terms of health risks, both perceived and real, and nuisance lawsuits. In fact, the issue of air emissions and odors are often talked about as being one-and-in-the-same. However, it is important to note that not all air pollutants have odors, just as not all odor-causing agents are regulated air pollutants. Additionally, many compounds have very strong odors at extremely low concentrations which can result from emissions far below any regulatory limits. Differentiating between emissions of air pollutants and odors is important, both in terms of mitigation practices and the effectiveness of those practices.

Odorous gases emitted from CAFOs are primarily generated from the microbial breakdown of feed in the gut of animals and in the stored manure. Feed, particularly silage under certain conditions, can also be a significant odor source. While there are numerous odorous compounds associated with manure, odors can also result from a combination of dozens, if not hundreds, of airborne compounds. These compounds can act synergistically to produce an odor that is actually more intense than would be expected from the sum of the individual compounds present.

Most of the odorous compounds that are emitted from animal production operations are byproducts of anaerobic decomposition/transformation of livestock wastes by microorganisms. Animal wastes include manure (feces and urine), spilled feed and water, bedding materials (*e.g.,.* straw, sunflower hulls, wood shavings), wash water, and other wastes. DATCP (and NRCS standards) define manure as containing all these things (feces, urine, bedding, spilled water, etc.). This highly organic mixture includes carbohydrates, fats, proteins, and other nutrients that are readily degradable by microorganisms in a wide variety of suitable environments. The by-products of microbial transformations depend, in major part, on whether it is done aerobically (*i.e.* with oxygen) or anaerobically (*i.e.* without oxygen). Microbial transformations done under aerobic conditions generally produce fewer odorous by-products than those done under anaerobic conditions. However, compounds such as alcohols and acids which are produced by aerobic decomposition may have strong odors as well. Moisture content and temperature affect the rate of microbial decomposition.

A large number of volatile compounds have been identified as by-products of animal waste decomposition. The compounds are often listed in groups based on their chemical structure. Some of the principal odorous compounds and compound groups are: ammonia, amines, hydrogen sulfide, volatile fatty acids, indoles, phenols, mercaptans, alcohols, and carbonyls. Carbon dioxide and methane are odorless.

All sources of air emissions are subject to s. NR 429.03, Wis. Adm. Code. This rule establishes general limitations on objectionable odor, defines the tests for what constitutes objectionable odor, and requires that preventive measures satisfactory to the department be taken. Ch NR 429, Wis. Adm. Code includes a procedure for determining objectionable odors based on conditions at the facility once it has been constructed and is operating.

The Livestock Facility Siting rule consists of s. 93.90, Wis. Stats. and Ch. ATCP 51, Wis. Adm. Code and establishes state standards (including provisions for addressing odors) and procedures local governments must follow **if** they choose to require conditional use or other permits for siting new and expanded livestock operations. Facilities covered by the Livestock Facility Siting Law must comply with an odor standard that uses a predictive model to determine acceptable odor levels from the farm areas, including manure storage, animal housing and open lots.

The predictive model used with ATCP 51 has several features. For example, the model:

- requires practices described in ATCP 51, if a proposed facility does not have adequate separation distance from neighbors

- provides a range of practices to choose from (including low cost options to manage odor)

- protects future expansions by fixing the closest neighbor at the time of the original application, yet does not allow for continuous odor monitoring for enforcement purposes

Identifying and Quantifying Air Pollutants

Both the quantity and the types of air contaminant emissions from animal agricultural operations are challenging to estimate, making off-site air quality impacts difficult to predict. This is due to hourly, daily, and seasonal temperature variation; the varying number and type of animals present (which may change over time); the type of housing and manure handling system; the feed type; and the chosen management practices.

Emissions estimating methodologies have been used by other states and in some cases the Department has provided estimates using the best available science and professional judgment to provide annualized total mass emissions (and some daily maximum emissions for ammonia) for a number of air pollutants. “High” or “low” mass emissions (flux) of air pollutants on an annualized basis do not necessarily predict ambient (or indoor) air concentrations of those pollutants. There is little dispute that large animal agricultural operations have the potential to emit substantial quantities of air pollutants.

Federal Study

In the late 1990s, US EPA realized that it did not have sufficient air emissions data to implement federal Clean Air Act requirements for animal feeding operations. To resolve the situation, US EPA began discussions with animal feeding operation owners in 2001. These discussions led to a January 31, 2005 EPA Federal Register notice offering individual animal feeding operations an opportunity to voluntarily sign a consent agreement committing them to participate in a nationwide air emission monitoring study and establishing a timeline for them to achieve compliance with federal air permit, air emission control, and air emission reporting requirements. In return, EPA provided limited amnesty from enforcement action during the term of the agreement.

Data collection was completed in mid-2009 (including one dairy operation located in Wisconsin) with final data reported to US EPA during the summer of 2010. On January 13, 2011, US EPA made National Air Emissions Monitoring Study (NAEMS) data available to the public. US EPA is presently evaluating this and other data and intends to publish air emissions estimating methods for animal feeding operations in the future. In February 2012 US EPA published two draft Federal emissions estimating methodologies for animal agricultural operations – one for “broiler operations” and the other for “lagoon emissions” from dairy (and swine) operations, based on NAEMS-derived data. The dairy-related draft report was reviewed by the US EPA Science Advisory Board (SAB) formed in mid-March 2012. The SAB produced a final report to EPA on April 19, 2013 (EPA-SAB-13-003) recommending a process-based methodology for estimating emissions from animal agricultural operations.

How Air Pollutants Are Emitted

After contaminants are generated, they are emitted through animal housing ventilation systems or emitted from other sources including animal holding and production areas, feed preparation and storage, manure management/storage facilities, mortality management, and land application sites. From these sources, air pollutants are dispersed by atmospheric processes. Air contaminant travel distance varies due to different phases (gaseous, liquid or particulate), size of particles, air contaminant reactivity, weather conditions, surrounding topography and vegetation, as well as other factors. These variations make it challenging to form a clear picture of the expected emissions and emission-related effects from animal agricultural operations. This is especially true for air pollutant concentrations (indoor or outdoor ambient air quality measurements) as opposed to an average annualized emissions flux.

Dispersion Models and Ambient Air

Regulatory dispersion modeling is predicated on the steady-state nature of the release. Gaussian plume models have been developed to replicate monitored concentrations attributed to industrial or commercial operations, for example a large industrial boiler for generating steam and/or electricity. The release of farm emissions comes from locations (i.e. housing, waste storage facilities) that are unlike a smoke stack. These emissions are able to be modeled, but there is more uncertainty associated with establishing release parameters. The time-varying nature of farm emissions is even more difficult to model. Regulatory models generally assume steady-state emission generation. This implies that over the course of one hour, the emission rate will not significantly change, and that any changes from hour-to-hour are under the control of the operator. Farm emissions vary between hours, within a given hour, and more importantly, this variation is difficult to predict because of the large number of factors which must be considered.

Despite the variability of emissions from animal agricultural operations, the nitrogen balance including ammonia has been studied extensively in dairy operations which have integrated cropping systems. In this context, integrated cropping systems involve coordinating the management of individual crops in order to benefit from the interaction of other crops, pasture, and farm-derived nutrients (manure) to produce feed or feedstocks for livestock or other valuable agricultural commodities. Nitrogen excretion from animals varies based on nitrogen feed rates, the nutritional needs of the dry or lactating cows, and how much nitrogen ends up in milk. In Wisconsin and elsewhere, research points to an average annualized total nitrogen loss of 15 percent from freestall housing and 10 to 30 percent loss of nitrogen as ammonia from incoming nitrogen in uncovered manure storage (Satter et al, 2002; Powell et al, 2013).

Nitrogen Deposition

Many studies have shown that the majority of gaseous ammonia is deposited close to the emission source (within a half mile), while other studies have shown trace amounts measured more than six miles away (Lupis, et al 2010). So, ammonia, before it has a chance to react to form other ammoniated particles, may be deposited close to the source and create a hotspot for nitrogen deposition. Gaseous ammonia can travel much further and last longer in the atmosphere if it reacts with other chemicals (as described in the ammonia section) and is transformed into a particle. Gaseous ammonia can react with other ambient gases and particles, including nitric and sulfuric acids (formed from NOx and SOx, respectively), contributed by combustion processes. These reactions result in the formation of solid ammoniated particles, such as ammonium nitrate and ammonium sulfate, that contribute to fine particulate matter, or PM2.5. Due to its small diameter and increased atmospheric lifetime (from several days to weeks), PM2.5 may travel nearly 100 times further than gas phase ammonia before settling or falling out of the air (Klaasen et al, 1992; Sommer et al, 2008; Lupis, et al 2010; Walker et al 2014).

Transport and deposition of ammonia gas and ammoniated particles into pristine areas has been documented to result in ecosystem changes. These effects can include soil acidification, plant community changes (e.g., promoting grasses, sedges, and weedy plants while choking out native plants and wildflowers) and water eutrophication (i.e., an increase in aquatic plant production, harmful because it can lead to a lack of oxygen). These negative environmental impacts can have a cascading effect throughout the entire ecosystem (Baron et al, 2000; Porter et al, 2007; Doering et al 2011Nanus et al, 2012).

Nitrogen inputs have also been studied in several east and Gulf Coast estuaries due to concerns about eutrophication. Nitrogen from atmospheric deposition is estimated to be as high as 10% to 40% of the total input of nitrogen to some of these estuaries and perhaps higher in a few cases (Kerchner et al, 2000; Alexander et al, 2001).

There is scientific evidence that nitrogen deposition can impact specific plant communities and eventually leads to "nitrogen saturation" of soils. The National Parks Conservation Association states that atmospheric nitrogen deposition in Indiana Dunes National Lakeshore is of concern because the park's sand dunes and bogs are nitrogen-limited ecosystems— places where nitrogen naturally occurs in limited quantities, thereby limiting plant growth. Atmospheric deposition increases the amount of nitrogen that is available to plants and can unnaturally accelerate succession to later stages, alter species composition, and reduce species richness. Acid deposition is also of concern at Indiana Dunes because changes in soil pH can lead to changes in vegetation. One study suggests that "…the addition of nitrogen may lead to a decline in the wild lupine population…The decline in biomass production [of wild lupine]…may suggest that the wild lupine seedlings were not able to adapt to the drastic change of nitrogen enrichment in the soil." (Avans, 2012). Other studies on nitrogen deposition and critical loads of nitrogen have been published in the U.S. and in Europe (Erisman, et al, 2007; Stevens et al, 2010; Pardo, et al 2011;Sullivan, et al 2011;Zhang et al, 2012; Davidson, 2012; Establishment of Threshold Effects for the Forest County Potawatomi Community Class 1 Air Quality Related Values, 2012).

<u>Air Emissions Mitigation</u>

There are ways to minimize, although not eliminate, air pollutant emissions from animal agricultural operations, including dairy or swine operations. Specifically, beneficial management practices (BMPs) are defined as production methods, technologies and waste management practices used to prevent or control air emissions from livestock facilities. Even with a number of practices put in place, significant air emissions reductions can be challenging to attain.

Wisconsin DNR in coordination with an advisory group which included animal agriculture producers, academics, NRCS and DATCP, published a report in December 2010 (BMP report) which included a list of beneficial management practices that reduce ammonia and hydrogen sulfide air emissions.

The BMP report presented the following general concepts:

- Not every BMP will be appropriate for every animal agricultural operation, nor will every BMP be technically or economically feasible for a given farm. Animal agricultural operations generally choose a number of individual practices or a combination of practices based on farm-specific features and other factors.

- In some cases, a specific BMP focusing on one air pollutant may actually contribute to an increase in other air emissions or to environmental problems in other media (e.g. ground water or surface water).

- In general, practices which reduce odor tend to reduce ammonia and/or hydrogen sulfide, but not always.

- Different production methods, animal types, and manure management systems have the potential to create different types and quantities of air emissions. In order to successfully mitigate emissions, different practices, or a combination of practices and technologies, may be required.

- Many of the BMPs, which prevent or mitigate air emissions, often make common and economic sense. For example, mixed operations that integrate optimal cropping systems with animal production typically retain nitrogen for crops (minimizing ammonia losses), resulting in decreased need for fertilizer nitrogen.

- Successful reduction of ammonia and hydrogen sulfide losses from animal agriculture requires an integrative, whole-farm emissions approach for effective evaluation and selection of practices or technologies.

- While certain practices or technologies may be quite effective for controlling emissions from one part of a farm, it is important to understand the fate of those controlled emissions elsewhere. For example, while an impermeable cover is one of the most effective ways of controlling emissions from manure storage facilities, liquid manure still has potential to release contaminants during subsequent land application activity.

There are practices and technologies which prevent or reduce the formation of ammonia or hydrogen sulfide. For example, the benefits of not over-feeding nitrogen to animals through dietary and nutrition practices are reductions in nitrogen excretion (and, hence, ammonia) which will be realized throughout all farm components (e.g., animal housing, manure management systems including manure storage, and land application.

Technologies which capture and treat air (e.g., biofilters) can also significantly reduce air emissions (for ammonia, hydrogen sulfide, VOCs) from any mechanically ventilated space. Production methods and practices which keep manure in an aerobic state will greatly reduce the emissions of hydrogen sulfide.

Air Quality Regulations Overview

Existing Federal Regulations

Under the federal Clean Air Act, new and existing major stationary sources of federally regulated criteria air pollutant emissions are subject to federal air permit requirements. Included are permit requirements under the federal "Prevention of Significant Deterioration (PSD)" and "Non-Attainment Area" New Source Review programs, along with the applicable requirements for "Best Available Control Technology", and "Lowest Achievable Emission Rate" technology and offsets, respectively. Emissions associated with animal feeding operations (AFOs) are not categorically exempt from these requirements.

Under Section 112(b) of the federal Clean Air Act, hazardous air pollutants are regulated through National Emission Standards for Hazardous Air Pollutants (NESHAPs) established by industry sector. No such standards have been established specifically for AFOs. Ammonia and hydrogen sulfide, two air pollutants associated with AFOs, are not regulated as federal hazardous air pollutants under section 112(b).

The Clean Air Act lists ammonia and hydrogen sulfide in section 112(r)(3).

On June 4, 2019, US EPA Administrator Wheeler signed a final rule to amend the emergency release notification regulations under EPCRA. This amendment adds a reporting exemption for air emissions from animal waste at farms.

Methanol and acetaldehyde are federal hazardous air pollutants with emission limitations covered under section 112(b) of the Clean Air Act. Any stationary source which emits, or has the potential to emit, 10 tons per year of methanol or acetaldehyde, or 25 tons/year combined, would be a "major source" under the Clean Air Act.

Existing State Regulations

The federal air permit requirements described above are incorporated into state air permit rules in chs. NR 405, 406, and 407. In addition, chs. NR 406 and 407 include air permit requirements for minor sources. Emissions associated with animal feeding operations are not categorically exempt from these requirements.

Ch. NR 445, Wis. Adm. Code, addresses the control of state hazardous air contaminants. This rule establishes ambient air standards for specific contaminants in the ambient air. The acceptable 24-hour average ambient concentrations for ammonia and hydrogen sulfide, the two primary contaminants associated with agricultural waste, are 418 and 335 micrograms per cubic meter, respectively.

2011 Wisconsin Act 122 (creating s. 285.28, Stats.), signed into law March 7, 2012 and published March 21, 2012, exempts state hazardous air contaminants associated with "agricultural waste" from state regulations. Specifically, s. 285.28, Stats. reads as follows: "The department may not regulate the emission of hazardous air contaminants associated with agricultural waste except to the extent required by federal law." The exemption applies to only state hazardous air contaminants (such as ammonia, hydrogen sulfide, or acetic acid) and does not apply to criteria pollutants such as PM, or VOCs, or to federal hazardous air pollutants.

Odors are addressed in ch. NR 429 (Malodorous Emissions). Ch. ATCP 51 (Livestock Facility Siting) consists of a state statute (s. 93.90) and rule (ATCP 51) that establish state standards and procedures local governments must follow if they choose to require conditional use or other permits for siting new and expanded livestock operations.

In addition to Livestock Siting and NR 429, there is a statute (s. 823.08, Wis. Stats) also referred to as the "Right-to-Farm Law" which could address how odors generated at animal agricultural operations are to be addressed. According to the Wisconsin Legislative Council, the purpose of this statute is to "provide a measure of protection for farmers from lawsuits, in which the normal consequences of an agricultural activity such as odors, noise, dust, flies or slow-moving vehicles are claimed to be a nuisance."

Similar to federal reporting requirements, state reporting requirements include requirements in ch. NR 445 and the annual air emission reporting requirements of ch. NR 438, Wis. Adm. Code. Hazardous air emissions from animal feeding operations ("agricultural waste") are exempt from these state reporting requirements though.

The following site-specific air-related information is pulled directly from the department's air quality construction permit preliminary determination.

GENERAL APPLICATION INFORMATION

Owner/Operator:	Daybreak Foods, Inc. N5344 Crossman Road Lake Mills, Jefferson County, WI 53551-9653
Responsible Official:	Mr. Keith Kulow, Regional Manager keith@daybreakfoods.com
Application Contact Person:	Mr. Rick Roedl, Capital Projects Manager (920) 648-7017 rroedl@daybreakfoods.com
Application Submitted By:	Mr. Jim Fleischman, Pollution Technology (608) 831-2730 Jimf@pollutiontechnology.com
Application Submittal Date:	April 10, 2018
Date of Complete Application:	May 14, 2018

PROJECT DESCRIPTION

Daybreak Foods, Inc., proposes to increase egg production at their Lake Mills location. The facility intends to accomplish this increase through a substantial rebuild of their existing facility. The facility proposes to construct 3 pullet houses and 5-layer barns with a goal of reaching a total of nearly 3 million layers and pullets across existing and proposed houses and barns. The project will also involve the installation of a number of support operations, including feed storage bins, heating units, boilers, emergency generators, animal incinerators, processing plant and feed mill operations.

This project requires a construction permit under ch. NR 406, Wis. Adm. Code, because no exemptions are applicable to this project, and the maximum theoretical emissions from the project exceed the thresholds under s. NR 406.04(2), Wis. Adm. Code.

SOURCE DESCRIPTION

Daybreak Foods is located in a mostly rural area south of Lake Mills, Wisconsin. This is an area with rolling hills and mixed wooded land and agricultural land use. Jefferson County is designated as attainment or unclassified for all criteria pollutants.

Description of New or Modified Units:

Barns
Fugitive F01 – Pullet House 1
Fugitive F02 – Pullet House 2
Fugitive F04 – Pullet House 4
Fugitive F11 – Layer Barn 1
Fugitive F12 – Layer Barn 2
Fugitive F13 – Layer Barn 3
Fugitive F14 – Layer Barn 4
Fugitive F15 – Layer Barn 5

Feed Storage
Process P01A-B, Stack S01A-B – Pullet House 1 – Two Feed Storage Bins
Process P02A-B, Stack S02A-B – Pullet House 2 – Two Feed Storage Bins
Process P03A, Stack S03A – Pullet House 3 – One Feed Storage Bin
Process P04A-B, Stack S04A-B – Pullet House 4 – Two Feed Storage Bins
Process P11A-D, Stack S11A-D – Layer Barn 1 – Four Feed Storage Bins
Process P12A-D, Stack S12A-D – Layer Barn 2 – Four Feed Storage Bins
Process P13A-D, Stack S13A-D – Layer Barn 3 – Four Feed Storage Bins
Process P14A-D, Stack S14A-D – Layer Barn 4 – Four Feed Storage Bins
Process P15A-D, Stack S15A-D – Layer Barn 5 – Four Feed Storage Bins

Heating Units
Process P21A-H, Stack S21A-H – Pullet House 1 Heating Units – 8 Natural Gas Heaters @ 0.225 MMBtu/hr Each
Process P22A-H, Stack S22A-H – Pullet House 2 Heating Units – 8 Natural Gas Heaters @ 0.225 MMBtu/hr Each
Process P24A-H, Stack S24A-H – Pullet House 4 Heating Units – 8 Natural Gas Heaters @ 0.225 MMBtu/hr Each
Process P31A-L, Stack S31A-L – Layer Barn 1 Heating Units – 12 Natural Gas Heaters @ 0.225 MMBtu/hr Each
Process P32A-L, Stack S32A-L – Layer Barn 2 Heating Units – 12 Natural Gas Heaters @ 0.225 MMBtu/hr Each
Process P33A-L, Stack S33A-L – Layer Barn 3 Heating Units – 12 Natural Gas Heaters @ 0.225 MMBtu/hr Each
Process P34A-L, Stack S34A-L – Layer Barn 4 Heating Units – 12 Natural Gas Heaters @ 0.225 MMBtu/hr Each
Process P35A-L, Stack S35A-L – Layer Barn 5 Heating Units – 12 Natural Gas Heaters @ 0.225 MMBtu/hr Each
Boiler B40, Stack S40 – Processing Plant Low Pressure Steam Natural Gas Boiler – 4.0 MMBtu/hr
Boiler B41, Stack S41 – Egg Wash Natural Gas Boiler 1 – 2.0 MMBtu/hr
Boiler B42, Stack S42 – Egg Wash Natural Gas Boiler 2 – 2.0 MMBtu/hr
Boiler B43, Stack S43 – Process Plant Natural Gas HVAC System 1 – 2.0 MMBtu/hr
Boiler B44, Stack S44 – Process Plant Natural Gas HVAC System 2 – 2.0 MMBtu/hr

Feed Mill
Process P60, Stack S60 – 250,000 Bushel Feed Mill Surge Corn Storage Bin
Process P61, Stacks S61, Control C61 – Feed Mill Operations (16 Ingredient Bins, 6 Loadout Bins, 8 Micro Ingredient Bins, 2 Indoor Receiving Pits)

Emergency Generators
Process P81, Stack S81 – Pullet House 1: 3.4 MMBtu per Hour Diesel-Fired Emergency Generator
Process P82, Stack S82 – Pullet House 2: 3.4 MMBtu per Hour Diesel-Fired Emergency Generator
Process P84, Stack S84 – Pullet House 4: 3.4 MMBtu per Hour Diesel-Fired Emergency Generator
Process P89, Stack S89 – Processing Plant 5.2 MMBtu per Hour Diesel-Fired Emergency Generator
Process P91, Stack S91 – Layer Barn 1: 5.2 MMBtu per Hour Diesel-Fired Emergency Generator
Process P92, Stack S92 – Layer Barn 2: 5.2 MMBtu per Hour Diesel-Fired Emergency Generator
Process P93, Stack S93 – Layer Barn 3: 5.2 MMBtu per Hour Diesel-Fired Emergency Generator
Process P94, Stack S94 – Layer Barn 4: 5.2 MMBtu per Hour Diesel-Fired Emergency Generator
Process P95, Stack S95 – Layer Barn 5: 5.2 MMBtu per Hour Diesel-Fired Emergency Generator

Crematories
Incinerator I02, Stack S02 – Layer Barn Crematory 2
Incinerator I03, Stack S03 – Pullet House Crematory 1

EMISSION CALCULATIONS.

This section provides information describing how air pollution emissions from the source have been determined. It describes the source of the emission estimates, references emission factors and equations used and/or describes the engineering judgement used to determine emissions. This information provides the department's legal and factual basis for how the emission estimates support the draft permit conditions. As required by 40 CFR s. 70.5(c)(3)i., these emission estimates are sufficient to verify which requirements are applicable to the source. Refer to the Applicable Requirements and Compliance Demonstration section for details regarding how the emission estimates are used to determine the applicable requirements for the source.

Fugitive F01 – Pullet House 1
Fugitive F02 – Pullet House 2
Fugitive F04 – Pullet House 4
Fugitive F11 – Layer Barn 1
Fugitive F12 – Layer Barn 2
Fugitive F13 – Layer Barn 3
Fugitive F14 – Layer Barn 4
Fugitive F15 – Layer Barn 5

The emissions from the pullet houses and layer barns are based on the results of the National Air Emissions Monitoring Study entitled "Emissions Data From Two Manure-Belt Layer Barns in Indiana". Of the three poultry CAFO emission studies performed for the US EPA, this study most represents the operations at this facility. While the results of these US EPA studies are in question, these studies are the best information available at this time for estimating emissions from these sources. Each of the pullet houses has a maximum capacity of 200,000 pullets. Each of the layer barns has a maximum capacity of 400,000 layers.

PM and PM_{10} emissions are not calculated for the pullet houses because pullets produce comparatively little manure and these houses are essentially sealed. PM and PM_{10} emissions for the layer barns do not account for the advanced air handling systems used in this cage free facility which may result in lower potential emissions.

Pollutant	Emission Factor	Units
PM	60.1	mg/day/bird
PM_{10}	16.6	mg/day/bird
VOC	40.9	mg/day/bird
Ammonia	274	mg/day/bird
Hydrogen Sulfide	1.92	mg/day/bird

Process P01A-B, Stack S01A-B – Pullet House 1 – Two Feed Storage Bins
Process P02A-B, Stack S02A-B – Pullet House 2 – Two Feed Storage Bins
Process P03A, Stack S03A – Pullet House 3 – One Feed Storage Bin
Process P04A-B, Stack S04A-B – Pullet House 4 – Two Feed Storage Bins
Process P11A-D, Stack S11A-D – Layer Barn 1 – Four Feed Storage Bins
Process P12A-D, Stack S12A-D – Layer Barn 2 – Four Feed Storage Bins
Process P13A-D, Stack S13A-D – Layer Barn 3 – Four Feed Storage Bins

Process P14A-D, Stack S14A-D – Layer Barn 4 – Four Feed Storage Bins
Process P15A-D, Stack S15A-D – Layer Barn 5 – Four Feed Storage Bins
Each storage silo has a daily maximum throughput of 11 tons of feed per day. The layer barn storage bins are filled by an enclosed conveyor from the existing feed mill which crosses over each layer barn silo. The production capacity of the feed mill is 60 tons per hour. The maximum annual rate assumes each storage silo is filled once per day. The Pullet House storage bins are filled by truck via auger. The maximum hourly particulate emission rates are based on the emission factors from US EPA, AP-42, Section 9.9.1 – Grain Elevators and Processes as listed below. Silos exhaust small amounts of particulate matter only when they are being loaded as the air in the silo is displaced. The particulate matter emissions from these silos are exhausted uncontrolled through mesh screens.

Pollutant	Emission Factor	Units
Particulate Matter (PM)	0.017	Lb/ton of grain
PM_{10}	0.0025	Lb/ton of grain

These silos are not a source of hazardous air pollutants.

Process P81, Stack S81 – Pullet House 1: 3.4 MMBtu per Hour Diesel-Fired Emergency Generator
Process P82, Stack S82 – Pullet House 2: 3.4 MMBtu per Hour Diesel-Fired Emergency Generator
Process P84, Stack S84 – Pullet House 4: 3.4 MMBtu per Hour Diesel-Fired Emergency Generator
Process P89, Stack S89 – Processing Plant 5.2 MMBtu per Hour Diesel-Fired Emergency Generator
Process P91, Stack S91 – Layer Barn 1: 5.2 MMBtu per Hour Diesel-Fired Emergency Generator
Process P92, Stack S92 – Layer Barn 2: 5.2 MMBtu per Hour Diesel-Fired Emergency Generator
Process P93, Stack S93 – Layer Barn 3: 5.2 MMBtu per Hour Diesel-Fired Emergency Generator
Process P94, Stack S94 – Layer Barn 4: 5.2 MMBtu per Hour Diesel-Fired Emergency Generator
Process P95, Stack S95 – Layer Barn 5: 5.2 MMBtu per Hour Diesel-Fired Emergency Generator
Processes P81-P84 are diesel-fired emergency generators rated at 3.4 MMBtu per hour and 300 KW. Processes P89-P95 are diesel fired emergency generators rated at 5.2 MMBtu per hour and 500 KW. The emissions resulting from the diesel engines are based on emission factors listed under US EPA AP-42, Section 3.3 – Gasoline and Industrial Engines and assume 200 hours per year of total operation for each emergency generator based on the definition of a "restricted use reciprocating internal combustion engine" contained in s. NR 400.02(136m), Wis. Adm. Code. These diesel-fired emergency generators also emit hazardous air pollutants. However, because these generators are for emergency purposes only, the total HAP emissions from this equipment is not significant. Greenhouse gas emissions from these emergency generators are calculated using the emission factors in 40 CFR 98, Tables C-1 and C-2 and the global warming potentials in 40 CFR 98, Table A-1.

Process P21A-H, Stack S21A-H – Pullet House 1 Heating Units – 8 Natural Gas Heaters @ 0.225 MMBtu/hr Each
Process P22A-H, Stack S22A-H – Pullet House 2 Heating Units – 8 Natural Gas Heaters @ 0.225 MMBtu/hr Each
Process P24A-H, Stack S24A-H – Pullet House 4 Heating Units – 8 Natural Gas Heaters @ 0.225 MMBtu/hr Each
Process P31A-L, Stack S31A-L – Layer Barn 1 Heating Units – 12 Natural Gas Heaters @ 0.225 MMBtu/hr Each
Process P32A-L, Stack S32A-L – Layer Barn 2 Heating Units – 12 Natural Gas Heaters @ 0.225 MMBtu/hr Each
Process P33A-L, Stack S33A-L – Layer Barn 3 Heating Units – 12 Natural Gas Heaters @ 0.225 MMBtu/hr Each
Process P34A-L, Stack S34A-L – Layer Barn 4 Heating Units – 12 Natural Gas Heaters @ 0.225 MMBtu/hr Each
Process P35A-L, Stack S35A-L – Layer Barn 5 Heating Units – 12 Natural Gas Heaters @ 0.225 MMBtu/hr Each
Boiler B40, Stack S40 – Processing Plant Low Pressure Steam Natural Gas Boiler – 4.0 MMBtu/hr
Boiler B41, Stack S41 – Egg Wash Natural Gas Boiler 1 – 2.0 MMBtu/hr
Boiler B42, Stack S42 – Egg Wash Natural Gas Boiler 2 – 2.0 MMBtu/hr
Boiler B43, Stack S43 – Process Plant Natural Gas HVAC System 1 – 2.0 MMBtu/hr
Boiler B44, Stack S44 – Process Plant Natural Gas HVAC System 2 – 2.0 MMBtu/hr
The emissions from natural gas combustion in these emission units are based on emission factors from US EPA, AP-42, Section 1.4, except for PM_{10} and $PM_{2.5}$ emissions. PM_{10} and $PM_{2.5}$ emissions are calculated using emission factors of 0.52 lb/mmcf and 0.43 lb/mmcf, respectively, provided by Mr. Ron Myers from US EPA. These emission units also emit hazardous air pollutants. However, due to the relatively small total maximum heat input rating of these emission units, the total HAP emissions from this equipment is not significant. Greenhouse gas emissions from these emission units are calculated using the emission factors in 40 CFR 98, Tables C-1 and C-2 and the global warming potentials in 40 CFR 98, Table A-1.

Incinerator I02, Stack S02 – Layer Barn Crematory 2
Incinerator I03, Stack S03 – Pullet House Crematory 1
I02 is a Firelake Model A600 agricultural incinerator with natural gas burners rated at 0.613 MMBtu per hour and an incineration rate of 600 pounds per hour. I03 is a Firelake Model A400 agricultural incinerator with natural gas burners rated at 0.358 MMBtu per hour and an incineration rate of 400 pounds per hour. Particulate matter emissions are based on the highest

emission rate of 0.08 grains/dscf listed on the Firelake Certificate of Stack Air Quality for A & X series incineration/cremation systems. For these emission units, PM_{10} and $PM_{2.5}$ emissions are assumed to be equivalent to total particulate matter emissions. The air flow of 187 scfm for the A400 series is based upon a 2001 stack test report provided by the equipment distributor. The air flow of 230 scfm for the A600 series is based upon an interpolation of stack test data for A400 series and the A850 series. Carbon monoxide emissions are based on the highest concentration of 50 ppmv listed on the Firelake Certificate of Stack Air Quality for A & X series incineration/cremation systems. NOx, VOC, and SO_2 emissions are based on emission factors from US EPA, AP-42, Section 1.4. Greenhouse gas emissions are based on the highest percentage of 9% by volume dry for carbon dioxide from the Firelake Certificate of Stack Air Quality for A & X series incineration/cremation systems. Dioxin emissions as equivalents are based on “Characterization of Emissions from an Animal Crematorium Shenandoah A850” for poultry. The emission rate has been adjusted to the A600 and A400 based on chamber capacity.

Process P60, Stack S60 – 250,000 Bushel Feed Mill Surge Corn Storage Bin
The corn storage bin has a maximum throughput of 26 tons of feed per hour. The maximum hourly particulate emission rates are based on the emission factors from US EPA, AP-42, Section 9.9.1 – Grain Elevators and Processes as listed below. The corn storage bin exhausts small amounts of particulate matter only when it is being loaded as the air in the bin is displaced. The particulate matter emissions from this bin are exhausted uncontrolled through mesh screens.

Pollutant	Emission Factor	Units
Particulate Matter (PM)	0.017	Lb/ton of grain
PM_{10}	0.0025	Lb/ton of grain

Process P61, Stacks S61, Control C61 – Feed Mill Operations (16 Ingredient Bins, 6 Loadout Bins, 8 Micro Ingredient Bins, 2 Indoor Receiving Pits)
Based upon the application, the maximum throughput of the unloading operation and the throughput of all bins is approximately 104 tons of feed per hour. The maximum hourly particulate emission rates are based on the emission factors from US EPA, AP-42, Section 9.9.1 – Grain Elevators and Processes as listed below. These operations are controlled by a baghouse. The permittee has conservatively assumed a baghouse control efficiency for particulate matter of 98%.

Pollutant	Emission Factor	Units
Particulate Matter (PM)	0.017	Lb/ton of grain
PM_{10}	0.0025	Lb/ton of grain

APPLICABLE REQUIREMENTS

This section describes the requirements that are applicable to the source. It includes emission unit and pollutant specific applicable requirements and associated compliance demonstration methods. Emission summary tables are included with references to supporting calculations and/or the source of emission information. As required by 40 CFR s. 70.5(c)(3)i., emission estimates sufficient to verify which requirements are applicable to the source are included in this analysis. Some pollutants subject to regulation under the Act do not currently have specific applicable emission limitations or standards, however they are considered when determining source status under programs, such as Part 70 and PSD, and when determining the applicability of requirements that are based on source status, such as CAM. One such pollutant is $PM_{2.5}$. Based on definitions in ss. NR 400.02(123m) and (124), Wis. Adm. Code, direct $PM_{2.5}$ emissions cannot exceed PM_{10} emissions. Since PM_{10} and $PM_{2.5}$ have the same major source thresholds, emission estimates of PM_{10} are sufficient for determining Part 70 and PSD source status and CAM applicability with respect to both $PM_{2.5}$ and PM_{10}. When determining Part 70 source status for particulate matter, a stationary facility is a Part 70 major source if it emits or has the potential to emit, 100 tpy or more of PM_{10} per s. NR 407.01(4)(a), Wis. Adm. Code.

Fugitive F01 – Pullet House 1
Fugitive F02 – Pullet House 2
Fugitive F04 – Pullet House 4
Fugitive F11 – Layer Barn 1
Fugitive F12 – Layer Barn 2
Fugitive F13 – Layer Barn 3
Fugitive F14 – Layer Barn 4
Fugitive F15 – Layer Barn 5
NR 404 – Ambient Air Quality
Fugitive emissions are defined under s. NR 400.02(71), Wis. Adm. Code, as any emission point within a facility other than a flue or stack. It is the Department’s policy that fugitive emissions not be included in a minor source air quality modeling analysis. For the purposes of air quality modeling, the Department considers the particulate matter emissions resulting from the

layer barns to be fugitive emissions which are accounted for in the background concentration of the modeling analysis.

NR 415 – Control of Particulate Emissions
Because these processes are considered fugitive emission source, they are subject to s. NR 415.04, Wis. Adm. Code. The permittee may not cause, allow or permit any materials to be handled, transported or stored without taking precautions to prevent particulate matter from becoming airborne under s. NR 415.04, Wis. Adm. Code. Compliance demonstration will be based on compliance with the facility-wide Fugitive Dust Control Plan.

NR 424 – Control of Organic Compound Emissions from Process Lines
Because no applicable emission limitation applies under chs. NR 419-423, Wis. Adm. Code, the applicability of ch. NR 424, Wis. Adm. Code, shall be examined. Under s. NR 424.03, Wis. Adm. Code, process lines emitting organic compounds shall control volatile organic compound emissions by at least 85% or latest available control techniques and operating practices demonstrating best current technology, as approved by the Department. Under s. NR 400.02(128), Wis. Adm. Code, a process line is defined as one or more actions or unit operations which must function simultaneously or in sequence in order to manufacture or modify a product. The Department does not believe that s. NR 424.03, Wis. Adm. Code, applies to pullet houses because no product is produced in these operations. The Department does not believe that s. NR 424.03, Wis. Adm. Code, applies to layer barns because the products produced in a layer barn – eggs – are produced through a biological process that does not involve a one or more actions or unit operations in order to manufacture or modify the product. In addition, The American Heritage College Dictionary defines manufacture as “to make or process (a raw material) into a finished product, esp. by a large scale industrial operation”, “to make or process (a product), esp. with industrial machines”, and “to create, produce, or turn out in a mechanical manner”. The product produced in the layer barns is a natural bodily function of the birds which does not require raw materials to finish into a product other than food and water for the bird. Nor are industrial machines used to directly make or process the product. In addition, the waste materials generated by the birds in the pullet houses and layer barns are not considered a product or part of actions or unit operations to produce fertilizer at this stage of the waste handling operations.

NR 429.03 – Malodorous Emissions.
These processes are subject to the requirements of s. NR 429.03, Wis. Adm. Code. Compliance demonstration will be based on compliance with the facility-wide Malodorous Emissions Control Plan.

NR 431 – Control of Visible Emissions
Any emission unit installed after 1972 may not cause or allow emissions of shade or density greater than number 1 of the Ringlemann chart or 20% opacity. The exceptions under s. NR 431.05, Wis. Adm. Code, may apply to these emission units. Compliance demonstration will be based on compliance with the facility-wide Fugitive Dust Control Plan.

Process P01A-B, Stack S01A-B – Pullet House 1 – Two Feed Storage Bins
Process P02A-B, Stack S02A-B – Pullet House 2 – Two Feed Storage Bins
Process P03A, Stack S03A – Pullet House 3 – One Feed Storage Bin
Process P04A-B, Stack S04A-B – Pullet House 4 – Two Feed Storage Bins
Process P11A-D, Stack S11A-D – Layer Barn 1 – Four Feed Storage Bins
Process P12A-D, Stack S12A-D – Layer Barn 2 – Four Feed Storage Bins
Process P13A-D, Stack S13A-D – Layer Barn 3 – Four Feed Storage Bins
Process P14A-D, Stack S14A-D – Layer Barn 4 – Four Feed Storage Bins
Process P15A-D, Stack S15A-D – Layer Barn 5 – Four Feed Storage Bins
Process P60, Stack S60 – 250,000 Bushel Feed Mill Surge Corn Storage Bin

NR 404 – Ambient Air Quality
To ensure compliance with the applicable National Ambient Air Quality Standards under s. NR 404.04(8), Wis. Adm. Code, or increment under s. NR 404.05(3)(a), Wis. Adm. Code, the PM_{10} emissions from these emission units were limited to the emission rates contained in the draft permit based on refined air quality modeling. See the Air Quality Review section for more information. Compliance demonstration will be based on a calculation of the maximum hourly emissions from each of these processes and compliance with the facility-wide Fugitive Dust Control Plan.

NR 415 – Control of Particulate Emissions
Because these processes will be constructed after April 1, 1972, the applicable particulate matter emission limit is the more restrictive of the process weight rate equation under s. NR 415.05(2), Wis. Adm. Code and the direct source limit of 0.40

pounds of particulate matter per 1,000 pounds of exhaust gas under s. NR 415.05(1)(n), Wis. Adm. Code. Compliance demonstration will be based on a calculation of the maximum hourly emissions from each of these processes and compliance with the facility-wide Fugitive Dust Control Plan.

NR 431 – Control of Visible Emissions
Each of these processes will be constructed or last modified after April 1, 1972, so they are each subject to a visible emission limit of 20% opacity under s. NR 431.05, Wis. Adm. Code. Compliance demonstration will be based on the use of a Fugitive Dust Control Plan.

40 CFR 60, Subpart DD & NR 440.47 – Standards of Performance for Grain Elevator
The permanent grain storage capacity for this facility is approximately 0.815 million bushels. The facility does not qualify as a grain terminal elevator under this regulation because the permanent storage capacity does not exceed 88,100 m^3 (ca. 2.5 million U.S. bushels). The facility is also not considered to be a grain storage elevator because while the permanent storage capacity of the facility is equal to or greater than 35,200 m^3 (ca. 1 million bushels), the facility is not considered to be a wheat flour mill, a wet corn mill, a dry corn mill (human consumption), a rice mill, or a soybean oil extraction plant.

Process P61, Stacks S61, Control C61 – Feed Mill Operations (16 Ingredient Bins, 6 Loadout Bins, 8 Micro Ingredient Bins, 2 Indoor Receiving Pits)
NR 404 – Ambient Air Quality
To ensure compliance with the applicable National Ambient Air Quality Standards under s. NR 404.04(8), Wis. Adm. Code, or increment under s. NR 404.05(3)(a), Wis. Adm. Code, the PM_{10} emissions from these emission units were limited to the emission rates contained in the draft permit based on refined air quality modeling. See the Air Quality Review section for more information. Compliance demonstration will be based on the use of a baghouse to control particulate matter emissions.

NR 415 – Control of Particulate Emissions
Because these processes will be constructed after April 1, 1972, the applicable particulate matter emission limit is the more restrictive of the process weight rate equation under s. NR 415.05(2), Wis. Adm. Code and the direct source limit of 0.40 pounds of particulate matter per 1,000 pounds of exhaust gas under s. NR 415.05(1)(n), Wis. Adm. Code. Compliance demonstration will be based on the use of a baghouse to control particulate matter emissions.

NR 431 – Control of Visible Emissions
Each of these processes will be constructed or last modified after April 1, 1972, so they are each subject to a visible emission limit of 20% opacity under s. NR 431.05, Wis. Adm. Code. Compliance demonstration will be based on the use of a baghouse to control particulate matter emissions.

40 CFR 60, Subpart DD & NR 440.47 – Standards of Performance for Grain Elevator
The permanent grain storage capacity for this facility is approximately 0.815 million bushels. The facility does not qualify as a grain terminal elevator under this regulation because the permanent storage capacity does not exceed 88,100 m^3 (ca. 2.5 million U.S. bushels). The facility is also not considered to be a grain storage elevator because while the permanent storage capacity of the facility is equal to or greater than 35,200 m^3 (ca. 1 million bushels), the facility is not considered to be a wheat flour mill, a wet corn mill, a dry corn mill (human consumption), a rice mill, or a soybean oil extraction plant.

Process P81, Stack S81 – Pullet House 1: 3.4 MMBtu per Hour Diesel-Fired Emergency Generator
Process P82, Stack S82 – Pullet House 2: 3.4 MMBtu per Hour Diesel-Fired Emergency Generator
Process P84, Stack S84 – Pullet House 4: 3.4 MMBtu per Hour Diesel-Fired Emergency Generator
Process P89, Stack S89 – Processing Plant 5.2 MMBtu per Hour Diesel-Fired Emergency Generator
Process P91, Stack S91 – Layer Barn 1: 5.2 MMBtu per Hour Diesel-Fired Emergency Generator
Process P92, Stack S92 – Layer Barn 2: 5.2 MMBtu per Hour Diesel-Fired Emergency Generator
Process P93, Stack S93 – Layer Barn 3: 5.2 MMBtu per Hour Diesel-Fired Emergency Generator
Process P94, Stack S94 – Layer Barn 4: 5.2 MMBtu per Hour Diesel-Fired Emergency Generator
Process P95, Stack S95 – Layer Barn 5: 5.2 MMBtu per Hour Diesel-Fired Emergency Generator
All Pollutants
Each of these emission units is limited to 200 hours of total operation per year (testing and emergency operation combined) based on the definition of a "restricted use reciprocating internal combustion engine" contained in s. NR 400.02(136m), Wis. Adm. Code.

NR 485.055 - Particulate emission limit for gasoline and diesel internal combustion engines
Each of these emission units is subject to particulate matter restrictions under s. NR 485.055, Wis. Adm. Code. No person may cause, allow or permit the emissions of particulate matter to the ambient air from stationary or semistationary gasoline or diesel powered internal combustion reciprocating engines in excess of 0.50 pound of

particulate per million Btu heat input. Based on AP-42 emission factors, emission calculations demonstrate that each of these emergency diesel generators will be in compliance at all times with this requirement. Compliance demonstration will be based on fuel use restrictions.

NR 431 – Visible Emissions
Any emission unit installed after 1972 may not cause or allow emissions of shade or density greater than number 1 of the Ringlemann chart or 20% opacity. The exceptions under s. NR 431.05, Wis. Adm. Code, may apply to these emissions units. These emission units are not expected to exceed this standard because they only combust diesel, which is considered a clean burning fuel. Compliance demonstration will be based on fuel use restrictions.

40 CFR 60, Subpart IIII - Standards of Performance for Stationary Compression Ignition Internal Combustion Engines
Each of these engine generators is subject to this rule. The rule requires that owner or operators of 2007 model year or later emergency stationary compression ignition (CI) internal combustion engines (ICE) with a maximum engine power greater than 37 kW (50 HP) and a displacement of less than 10 liters per cylinder that are not fire pump engines comply with the following certification emission standards for new nonroad CI engines for the same model year and maximum engine power in 40 CFR 89.112:

- Nitrogen Oxides and Non-methane Hydrocarbons (combined): 4.0 g/KW-hr;
- Carbon Monoxide: 3.5 g/KW-hr; and
- Particulate matter: 0.20 g/KW-hr.

Additionally, exhaust opacity from the engine may not exceed the following limitations in 40 CFR 89.113:

- 20% during acceleration mode;
- 15% during the lugging mode; and
- 50% during peaks in either acceleration or lugging modes.

Compliance demonstration will be based on the requirements under the federal regulation.

40 CFR 60, Subpart ZZZZ – National Emission Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines
An affected source that is a new or reconstructed stationary RICE located at an area source or a new or reconstructed emergency stationary RICE with a site rating of less than or equal to 500 brake HP located at an area source of HAP emissions must meet the requirements in 40 CFR part 63, subpart ZZZZ by meeting the requirements of 40 CFR part 60, subpart IIII for compression ignition engines. No further requirements apply for such engines under 40 CFR part 63, subpart ZZZZ.

Process P21A-H, Stack S21A-H – Pullet House 1 Heating Units – 8 Natural Gas Heaters @ 0.225 MMBtu/hr Each
Process P22A-H, Stack S22A-H – Pullet House 2 Heating Units – 8 Natural Gas Heaters @ 0.225 MMBtu/hr Each
Process P24A-H, Stack S24A-H – Pullet House 4 Heating Units – 8 Natural Gas Heaters @ 0.225 MMBtu/hr Each
Process P31A-L, Stack S31A-L – Layer Barn 1 Heating Units – 12 Natural Gas Heaters @ 0.225 MMBtu/hr Each
Process P32A-L, Stack S32A-L – Layer Barn 2 Heating Units – 12 Natural Gas Heaters @ 0.225 MMBtu/hr Each
Process P33A-L, Stack S33A-L – Layer Barn 3 Heating Units – 12 Natural Gas Heaters @ 0.225 MMBtu/hr Each
Process P34A-L, Stack S34A-L – Layer Barn 4 Heating Units – 12 Natural Gas Heaters @ 0.225 MMBtu/hr Each
Process P35A-L, Stack S35A-L – Layer Barn 5 Heating Units – 12 Natural Gas Heaters @ 0.225 MMBtu/hr Each
Boiler B40, Stack S40 – Processing Plant Low Pressure Steam Natural Gas Boiler – 4.0 MMBtu/hr
Boiler B41, Stack S41 – Egg Wash Natural Gas Boiler 1 – 2.0 MMBtu/hr
Boiler B42, Stack S42 – Egg Wash Natural Gas Boiler 2 – 2.0 MMBtu/hr
Boiler B43, Stack S43 – Process Plant Natural Gas HVAC System 1 – 2.0 MMBtu/hr
Boiler B44, Stack S44 – Process Plant Natural Gas HVAC System 2 – 2.0 MMBtu/hr

NR 404 – Ambient Air Quality
These processes, other than Boilers B40, B41, and B42, are considered insignificant emission units under s. NR 407.05(4)(c)9.k., Wis. Adm. Code, as they are convenience space heating units with heat input capacity of less than 5 million Btu per hour that burn gaseous fuels. It is Department policy not to include insignificant emission units in

any refined air quality modeling analysis. The construction permit will not contain any specific requirements for these emission units in order to meet increment or NAAQS, as applicable.

To ensure compliance with the applicable National Ambient Air Quality Standards under s. NR 404.04(8), Wis. Adm. Code, or increment under s. NR 404.05(3)(a), Wis. Adm. Code, the PM_{10} emissions from Boilers B40, B41, and B42 were limited to the emission rates contained in the draft permit based on refined air quality modeling. See the Air Quality Review section for more information. Compliance demonstration will be based on fuel use restrictions.

NR 415 - Control of Particulate Emissions

Boilers B40 to B44 are subject to particulate matter restrictions under s. NR 415.06(2)(a), Wis. Adm. Code. Any fuel-burning installation of 250 MMBtu per hour or less installed after 1972, shall have a maximum emission from any stack of 0.15 pounds of particulate matter per MMBtu heat input. Compliance demonstration for Boilers B40, B41, and B42, which will be included as significant emission units in the permit, will be based on fuel use restrictions.

NR 431 – Control of Visible Emissions

Any emission unit installed after 1972 may not cause or allow emissions of shade or density greater than number 1 of the Ringlemann chart or 20% opacity. The exceptions under s. NR 431.05, Wis. Adm. Code, apply to these emission units. Compliance demonstration for Boilers B40, B41, and B42 will be based on fuel use restrictions.

40 CFR 60 – New Source Performance Standards

Boilers B40, B41 and B42 are not subject to 40 CFR 60, Subpart Dc – Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units (s. NR 440.207, Wis. Adm. Code) because the maximum heat input capacity of each boiler is less than 10 MMBtu per hour. The other processes listed in this section do not meet the definition of a steam generating unit.

40 CFR 63 – National Emission Standards for Hazardous Air Pollutants

Because Boilers B40, B41 and B42 only combust natural gas and the facility is considered an area source of federal HAPs, 40 CFR 63 subpart JJJJJJ – National Emission Standards for Hazardous Air Pollutants for Industrial Commercial, and Institutional Boilers Area Sources is not applicable to these boilers. The other processes listed in this section do not meet the definition of a boiler.

Incinerator I02, Stack S02 – Layer Barn Crematory 2

Incinerator I03, Stack S03 – Pullet House Crematory 1

NR 404 – Ambient Air Quality

To ensure compliance with the applicable National Ambient Air Quality Standards under s. NR 404.04(8), Wis. Adm. Code, or increment under s. NR 404.05(3)(a), Wis. Adm. Code, the PM_{10} emissions from these processes were limited to the emission rates contained in the draft permit based on refined air quality modeling. See the Air Quality Review section for more information. Compliance demonstration will be based on fuel use restrictions.

NR 415 - Control of Particulate Emissions

These emission units are subject to particulate matter restrictions under s. NR 415.07(2), Wis. Adm. Code. The A600 incinerator, which is rated at over 500 pounds of waste per hour and less than 4,000 pounds of waste per hour is subject to a particulate matter emission limitation of 0.20 pounds of particulate per 1,000 pounds of exhaust gas. The A400 incinerator, which is rated at 500 pounds of waste per hour or less is subject to a particulate matter emission limitation of 0.30 pounds of particulate per 1,000 pounds of exhaust gas.

NR 419.03 – Control of Organic Compound Emissions

These processes are subject to the requirements of s. NR 419.03, Wis. Adm. Code. Compliance demonstration will be based on the monitoring and recording of the secondary chamber temperature and records of operation and maintenance of the incinerators in compliance with the manufacturer’s recommendations.

NR 429.03 – Malodorous Emissions.

These processes are subject to the requirements of s. NR 429.03, Wis. Adm. Code. Compliance demonstration will be based on the monitoring and recording of the secondary chamber temperature and records of operation and maintenance of the incinerators in compliance with the manufacturer’s recommendations.

NR 431 – Control of Visible Emissions

Any emission unit installed after 1972 may not cause or allow emissions of shade or density greater than number 1 of the Ringlemann chart or 20% opacity. The exceptions under s. NR 431.05, Wis. Adm. Code, apply to these emission units.

40 CFR 60 – New Source Performance Standards
These emission units are not subject to 40 CFR 60, Subpart CCCC – Standards of Performance for Commercial and Industrial Solid Waste Incineration Units. Incineration units burning 90 percent or more by weight (on a calendar quarter basis and excluding the weight of auxiliary fuel and combustion air) of pathological waste as defined in 40 CFR §60.2265 are not subject to this subpart if the facility meets the two requirements specified below:
(1) Notify the Administrator of US EPA that the unit meets these criteria; and
(2) Keep records on a calendar quarter basis of the weight of pathological waste and the weight of all other fuels and wastes burned in the unit.
Under 40 CFR 60.2265, pathological waste is defined as waste material consisting of only human or animal remains, anatomical parts, and/or tissue, the bags/containers used to collect and transport the waste material, and animal bedding (if applicable).

These emission units are not subject to 40 CFR 60, Subpart EEEE – Standards of Performance for Other Solid Waste Incineration Units. Institutional waste incineration units or very small municipal waste combustion units are excluded from this regulation if they burn 90 percent or more by weight (on a calendar quarter basis and excluding the weight of auxiliary fuel and combustion air) of pathological waste as defined in 40 CFR §60.3078 and the owner/operator of the unit notifies the Administrator of US EPA that the unit meets these criteria. Under 40 CFR 60.3078, pathological waste is defined as waste material consisting of only human or animal remains, anatomical parts, and/or tissue, the bags/containers used to collect and transport the waste material, and animal bedding (if applicable).

HAZARDOUS AIR POLLUTANT REVIEW

A. State HAPs (NR 445):

There are several state hazardous air pollutants expected to be emitted from the operation of the facility. The state hazardous air pollutants emitted from the following processes are exempt from regulation under ch. NR 445, Wis. Adm. Code:

The state HAPs resulting from the combustion of group 1 virgin fossil fuels, such as natural gas, propane, or distillate fuel oil, are exempt from regulation by ch. NR 445, Wis. Adm. Code, under s. NR 445.07(1), Wis. Adm. Code. This exemption affects fuel combusting emission units, such as the boilers, heaters, HVAC units, and the emergency generators.

Under s. 285.28, Wis. Stats., the Department may not regulate the emission of hazardous air contaminants associated with agricultural waste except to the extent required by federal law. This statute was originally promulgated by 2011 Senate Bill 138. A review of the documents supporting 2011 Senate Bill 138 indicates that the Joint Committee for Review of Administrative Rules (JCRAR) was concerned about the application of ch. NR 445, Wis. Adm. Code, to agricultural operations. They believed that "chapter NR 445 was created in the 1980s to regulate emissions from smoke stacks" and that it was "not appropriate to regulate something that cannot be effectively measured" (meaning fugitive agricultural emissions). Thus, the Department does not regulate the emissions of any ch. NR 445, Wis. Adm. Code, Table A, B, or C pollutants that may be directly related to agricultural waste. This exemption affects the state hazardous air pollutant emission that may result from manure generation in the pullet houses and layer barns. The total non-exempt potential emissions of HAPs from the facility are summarized in the table below. This table also lists the thresholds (annual and/or 1-hour/24-hour average) for each HAP for each stack height category. The table also indicates which pollutants are exempt from ch. NR 445, Wis. Adm. Code, review because they are directly associated with agricultural waste.

Pollutant	Stack Height Class	$E_{Unobstructed}$		4×($E_{obstructed}$ + $E_{Fugitive}$)		E_{Total}		Ch. NR 445 Thresholds (lb/hr or lb/yr)	
		lb/hr	lb/yr	lb/hr	lb/yr	lb/hr	lb/yr	1-hr/24-hr avg.	Annual
Ammonia (7664-41-7) s EXEMPT	<25	--	--	302	2,645,809	302	2,645,809	0.935	17,769
Benzene (71-43-2) sf	<25	--	2.99	--	--	--	2.99	--	228
Hydrogen Sulfide (7783-06-4) s EXEMPT	<25	--	--	2.12	--	2.12	--	0.749	--
TCDD (2,3,7,8-Tetrachlorodibenzo-p-dioxin), as equivalents (17446-01-6) sf	<25	--	2.3E-06	--	--	--	2.3E-06	--	1.0E-04

s = state hazardous air pollutant; f = Federal hazardous air pollutant

To demonstrate the source is in compliance for a HAP regulated by ch. NR 445, Wis. Adm. Code, the total non-exempt potential emissions of the HAP (or air toxic) for the entire facility must either be less than stack thresholds listed in Tables A, B or C in the chapter or meet applicable emissions limitations. To check to see if emissions are less than stack thresholds, first emissions for each stack height category is calculated. The calculated values are then compared to the corresponding values listed in Tables A, B or C of ch. NR 445, Wis. Adm. Code, for the pollutant and the particular stack height category. If the total for each stack height category is less than the amount listed in the table for each stack height category, then the source is in compliance with the ch. NR 445, Wis. Adm. Code, requirements. If the calculated emissions exceed the threshold for one or more of the stack categories then **all emissions** must be included in a determination to see if applicable emission limitations are being met. There are 4 stack height categories in the rule — stacks < 25 ft, 25 ft < stack < 40 ft, 40 ft < stack < 75 ft, and stacks > 75 ft.

Comparing the total non-exempt potential emission rates for each HAP to its corresponding ch. NR 445, Wis. Adm. Code, threshold values, it appears the threshold values will not be exceeded for any state HAPs that are not considered exempt from regulation under ch. NR 445, Wis. Adm. Code. Thus, this facility is in compliance with ch. NR 445, Wis. Adm. Code.

B. Federal HAPs (MACT, GACT, NESHAP):

40 CFR 63 Subpart ZZZZ – National Emissions Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines (NESHAP)
Because the compression ignition emergency generators are subject to regulation under 40 CFR 60, an affected source must meet the requirements of 40 CFR 63 subpart ZZZZ by meeting the requirements of 40 CFR 60 subpart IIII.

AIR QUALITY REVIEW

Section 285.63(1)(b), Wis. Stats. allows the department to approve a permit application if it finds the source will not cause or exacerbate a violation of any ambient air quality standard or ambient air increment. See the Criteria for Permit Approval section for additional information and other criteria for permit approval. This section describes the department's finding under s. 285.63(1)(b), Wis. Stats.

Processes P81, P82, P84, P89, and P91-P95 (Emergency Generators) are intermittent sources because they do not have a set operating schedule, operate for short periods of time during the year (generally outside of the facilities' control) and do not contribute to the normal operation of the facility. These intermittent emissions units are not included in the dispersion modeling analysis described below.

The combustion units, pullet houses, and layer barns at this facility emit volatile organic compounds. Volatile organic compounds are precursors to ozone. Ozone is a regional pollutant which is formed in the atmosphere through complex chemical reactions. There is no approved dispersion model for predicting the impact VOC emissions from direct stationary sources will have on ozone concentrations. There are no ambient air quality standards specifically for VOCs. Therefore, dispersion modeling of VOC emissions from direct stationary sources is not performed.

The combustion units at this facility emit $PM_{2.5}$. For the reasons described in Appendix B of the "Wisconsin Air Dispersion Modeling Guidelines", dated March 2018, the Department has concluded that direct $PM_{2.5}$ emissions from existing sources, minor new sources, and minor modifications of sources do not cause or exacerbate violation of the $PM_{2.5}$ air quality standard or increment. This conclusion and the information contained in Appendix B of the "Wisconsin Air Dispersion Modeling Guidelines" serves as the Department's finding pursuant to s. 285.63(1)(b), Wis. Stats for the $PM_{2.5}$ air quality standard and increment and sets forth the legal and factual basis for the draft permit conditions.

The combustion units at this facility emit nitrogen oxides (NOx). For the reasons described in Appendix C of the "Wisconsin Air Dispersion Modeling Guidelines", dated March 2018, the Department has concluded that direct NO_x emissions from stationary sources that are not large and comparatively steady sources of direct NOx emissions, do not cause or exacerbate violation of the 1-hour NO2 ambient air quality standard. This conclusion and the information contained in Appendix C of the "Wisconsin Air Dispersion Modeling Guidelines" serves as the Department's finding pursuant to s. 285.63(1)(b), Wis. Stats for the 1-hour NO2 air quality standard and sets forth the legal and factual basis for the draft permit conditions. Large and comparatively steady sources of NO_x emissions, include sources with one or more individual combustion units with a maximum heat input rating of 250

MMBtu/hr or more. This facility does not include individual combustion units with a maximum heat input of 250 MMBtu/hr or more and the dispersion modeling analysis described below does not assess the impact of these emissions units on 1-hour NO_2 concentrations.

Dispersion modeling of annual NOx emissions is an effective tool for predicting a source's impact on ambient annual NOx emissions as explained in Appendix C of the "Wisconsin Air Dispersion Modeling Guidelines". The dispersion modeling analysis described below assesses the impact of the combustion units at this facility on annual NO_2 concentrations.

The results of the dispersion modeling are summarized in a memo dated September 6, 2018 and are shown below. The dispersion modeling predicts that the source impact will not cause or exacerbate a violation of the ambient air quality standards/ambient air increments, taking into consideration background concentrations. The assumptions used in the dispersion modeling, including emission rates and stack parameters are summarized below. In addition to the applicable limits the following additional requirements were assumed in the dispersion modeling and are included in the draft permit to assure the ambient air quality standards and increments will be protected.

Introduction

A dispersion modeling analysis was completed to assess the impact to ambient air of criteria pollutants. The analysis was performed in support of a construction permit. The facility has a physical location of: N5505 Crossman Road, City of Lake Mills, Jefferson County, Wisconsin. PSD baselines HAVE been set in Jefferson County.

Modeling Analysis

- Jonathan Wright supplied the emission parameters used in this analysis. Building dimensions were determined using BPIP-PRIME with measurements taken on plot plans provided with the application. Please refer to the source tables for details.
- Five years (2011-2015) of preprocessed meteorological data was used in this analysis. The surface data was collected in Madison (MSN), and the upper air meteorological data originated in Green Bay.
- The AERMIC (AMS/EPA Regulatory Model Improvement Committee) Model (AERMOD) was also used in the analysis. The model used rural dispersion coefficients with the regulatory default options. These allow for calm wind and missing data correction, buoyancy induced dispersion, and building downwash including recirculation cavity effects.
- The receptors used in this analysis consisted of a rectangular grid of 3,077 points with 25+-meter resolution extending 900 + meters from the emission sources. Points on top of facility buildings or inside fenced areas were not considered. Receptor elevations were derived from AERMAP using the National Elevation Dataset.
- Each Layer Barn facilitates one or more storage bins. However, only one storage bin can be filled at any one time. The modeling analysis reflects all storage bins being loaded simultaneously resulting in an overly conservative analysis.
- Regional background concentrations included in the analysis can be found at the following link: **http://dnr.wi.gov/topic/AirPermits/documents/AQBackgroundConcentrationGuidance.pdf**

Model Results

The results of the dispersion modeling analysis indicate that all air quality standards will be met assuming the emission rates and stack parameters listed in the source tables.

Modeling Analysis Results (All Concentrations in $\mu g/m^3$)			
	PM_{10} – 24 Hour	PM_{10} – Annual	NO_2 – Annual
Impact of Increment consuming sources	25	7	2
PSD Increment	30	17	25
% Increment Consumed	83	41	8
Total Concentration (Modeled plus Background)	51	-	13

NAAQS	150	-	100
% NAAQS	34	-	13

Conclusion

The results of the modeling analysis demonstrate that the applicable air quality standards will be satisfied assuming the emissions rates and stack parameters listed in the source tables.

Daybreak Point Source Stack Parameters[**]						
Source ID	LOCATION (UTM83)	HEIGHT (M)	HEIGHT (FT)	DIAMETER (M)	VELOCITY (M/S)	TEMP (K)
I01A	342035, 4766910	10.67	35.2	0.51	1.63	949.77
I01B	342035, 4767108	7.16	23.6	2.54	0.00	949.77
I01C	341512, 4767330	7.16	23.6	2.54	0.00	949.77
S01A1	341811.3, 4767119.63	7.16	23.6	2.54	0.00	294.21
S01A2	341811.3, 4767118.63	7.16	23.6	2.54	0.00	294.21
S01A3	341812.317, 4767100.92	7.16	23.6	2.54	0.00	294.21
S01A4	341812.366, 4767098.35	7.16	23.6	2.54	0.00	294.21
S01B1	341811.66, 4767069.65	7.16	23.6	2.54	0.00	294.21
S01B2	341811.66, 4767067.65	7.16	23.6	2.54	0.00	294.21
S01B3	341811.66, 4767049.65	7.16	23.6	2.54	0.00	294.21
S01B4	341811.66, 4767047.65	7.16	23.6	2.54	0.00	294.21
S01C1	341810.59, 4767020.72	7.16	23.6	2.54	0.00	294.21
S01C2	341810.59, 4767018.72	7.16	23.6	2.54	0.00	294.21
S01C3	341810.59, 4767010.72	7.16	23.6	2.54	0.00	294.21
S01C4	341810.59, 4767008.72	7.16	23.6	2.54	0.00	294.21
S01D1	341805.63, 4766975.7	7.16	23.6	2.54	0.00	294.21
S01D2	341805.63, 4766973.7	7.16	23.6	2.54	0.00	294.21
S01D3	341805.63, 4766965.7	7.16	23.6	2.54	0.00	294.21
S01D4	341805.63, 4766963.7	7.16	23.6	2.54	0.00	294.21
S01E1	341804.57, 4766928.9	7.16	23.6	2.54	0.00	294.21
S01E2	341804.57, 4766926.9	7.16	23.6	2.54	0.00	294.21
S01E3	341804.57, 4766918.9	7.16	23.6	2.54	0.00	294.21
S01E4	341804.57, 4766916.9	7.16	23.6	2.54	0.00	294.21
S01F1	341031.338, 4767237.04	5.18	17.1	2.54	0.00	294.21
S01F2	341042.75, 4767236.51	5.18	17.1	2.54	0.00	294.21
S01G1	341106.563, 4767238.88	5.18	17.1	2.54	0.00	294.21
S01G2	341108.563, 4767238.88	5.18	17.1	2.54	0.00	294.21
S01H1	341190.962, 4767292.09	5.18	17.1	2.54	0.00	294.21
S01H2	341189.601, 4767297.51	5.18	17.1	2.54	0.00	294.21
S01I1	341216.648, 4767393	6.10	20.1	2.54	0.00	294.21
S01I2	341211.889, 4767390.29	6.10	20.1	2.54	0.00	294.21

[**] The source parameters in the table were used for modeling purposes, based on conversion from English units. Refer to the permit application forms or submittals in support of the application for the original English unit parameters.

S02A	342014.727, 4766910.85	8.23	27.2	0.51	1.63	421.99
S02B	342014.252, 4767109.3	8.23	27.2	0.51	1.16	421.99
S03	341501.036, 4767354.47	14.63	48.3	0.51	1.16	449.77
S06A	341530, 4767164	20.42	67.4	0.51	1.16	294.21
S06B	341584, 4767164	12.2	40	1.7	1.16	294.21
S08	342019, 4766900	7.16	23.6	2.54	0.00	294.21
S09A	341560, 4767578	14.63	48.3	0.51	1.16	294.21

Daybreak Point Source Stack Parameters		
Source ID	NO_x Rate (lbs/hr)	PM_{10} Rate (lbs/hr)
I01A	0.06	0.16
I01B	0.06	0.16
I01C	0.04	0.13
S01A1	0.00	0.03
S01A2	0.00	0.03
S01A3	0.00	0.03
S01A4	0.00	0.03
S01B1	0.00	0.03
S01B2	0.00	0.03
S01B3	0.00	0.03
S01B4	0.00	0.03
S01C1	0.00	0.03
S01C2	0.00	0.03
S01C3	0.00	0.03
S01C4	0.00	0.03
S01D1	0.00	0.03
S01D2	0.00	0.03
S01D3	0.00	0.03
S01D4	0.00	0.03
S01E1	0.00	0.03
S01E2	0.00	0.03
S01E3	0.00	0.03
S01E4	0.00	0.03
S01F1	0.00	0.03
S01F2	0.00	0.03
S01G1	0.00	0.03
S01G2	0.00	0.03
S01H1	0.00	0.03
S01H2	0.00	0.03
S01I1	0.00	0.03
S01I2	0.00	0.03
S02A	0.40	0.00
S02B	0.20	0.01
S03	0.55	0.68
S06A	0.00	0.06
S06B	0.00	0.50
S08	0.00	0.04

S09A	0.00	0.01

$NO_X \rightarrow NO_2$ via ARM2

DAY Stack/Process Descriptions					
Source ID	Release Type	Description	Source ID	Release Type	Description
I01A	DEFAULT	Cremator/Incinerator	S01C1	HORIZONTAL	Layer Barn Storage Bin
I01B	DEFAULT	Cremator/Incinerator	S01C2	HORIZONTAL	Layer Barn Storage Bin
I01C	DEFAULT	Cremator/Incinerator	S01C3	HORIZONTAL	Layer Barn Storage Bin
S01A1	HORIZONTAL	Layer Barn Storage Bin	S01C4	HORIZONTAL	Layer Barn Storage Bin
S01A2	HORIZONTAL	Layer Barn Storage Bin	S01D1	HORIZONTAL	Layer Barn Storage Bin
S01A3	HORIZONTAL	Layer Barn Storage Bin	S01D2	HORIZONTAL	Layer Barn Storage Bin
S01A4	HORIZONTAL	Layer Barn Storage Bin	S01D3	HORIZONTAL	Layer Barn Storage Bin
S01B1	HORIZONTAL	Layer Barn Storage Bin	S01D4	HORIZONTAL	Layer Barn Storage Bin
S01B2	HORIZONTAL	Layer Barn Storage Bin	S01E1	HORIZONTAL	Layer Barn Storage Bin
S01B3	HORIZONTAL	Layer Barn Storage Bin	S01E2	HORIZONTAL	Layer Barn Storage Bin
S01B4	HORIZONTAL	Layer Barn Storage Bin	S01E3	HORIZONTAL	Layer Barn Storage Bin
S01E4	HORIZONTAL	Layer Barn Storage Bin	S03	DEFAULT	Corn Dryer
S01F1	HORIZONTAL	Layer Barn Storage Bin	S06A	HORIZONTAL	Feed Mill Bin
S01F2	HORIZONTAL	Layer Barn Storage Bin	S06B	DEFAULT	Feed Mill Bin
S01G1	HORIZONTAL	Layer Barn Storage Bin	S08	HORIZONTAL	Manure Transfer
S01G2	HORIZONTAL	Layer Barn Storage Bin	S09A	DEFAULT	Feed Transfer
S01H1	HORIZONTAL	Layer Barn Storage Bin			
S01H2	HORIZONTAL	Layer Barn Storage Bin			
S01I1	HORIZONTAL	Layer Barn Storage Bin			
S01I2	HORIZONTAL	Layer Barn Storage Bin			
S02A	DEFAULT	Steam Boiler			
S02B	DEFAULT	Egg wash boiler			

EMISSIONS FROM NEW (OR MODIFIED) EQUIPMENT.

A. Emissions From New Equipment or Modification - Criteria Pollutants.

Process		PM		PM_{10}		$PM_{2.5}$		NOx		CO		SO_2		VOC		GHG
		lb/hr	TPY	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY	TPY
P	F01	--	--	--	--	--	--	--	--	--	--	--	--	0.75	3.29	--

A. Emissions From New Equipment or Modification - Criteria Pollutants.

	Process	PM		PM_{10}		$PM_{2.5}$		NOx		CO		SO_2		VOC		GHG
		lb/hr	TPY	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY	TPY
	F02	--	--	--	--	--	--	--	--	--	--	--	--	0.75	3.29	--
	F04	--	--	--	--	--	--	--	--	--	--	--	--	0.75	3.29	--
	F11	2.21	9.67	0.61	2.67	--	--	--	--	--	--	--	--	1.50	6.57	--
	F12	2.21	9.67	0.61	2.67	--	--	--	--	--	--	--	--	1.50	6.57	--
	F13	2.21	9.67	0.61	2.67	--	--	--	--	--	--	--	--	1.50	6.57	--
	F14	2.21	9.67	0.61	2.67	--	--	--	--	--	--	--	--	1.50	6.57	--
	F15	2.21	9.67	0.61	2.67	--	--	--	--	--	--	--	--	1.50	6.57	--
	I02	0.16	0.69	0.16	0.69	0.16	0.69	0.06	0.27	0.05	0.23	3.7E-04	1.6E-03	3.4E-03	1.5E-02	620
	I03	0.13	0.56	0.13	0.56	0.13	0.56	0.04	0.16	0.04	0.18	2.1E-04	9.4E-04	2.0E-03	8.6E-03	504
	P01	0.37	6.8E-02	5.5E-02	1.0E-02	--	--	--	--	--	--	--	--	--	--	--
	P02	0.37	6.8E-02	5.5E-02	1.0E-02	--	--	--	--	--	--	--	--	--	--	--
	P03	0.19	6.8E-02	2.8E-02	5.0E-03	--	--	--	--	--	--	--	--	--	--	--
	P04	0.37	6.8E-02	5.5E-02	1.0E-02	--	--	--	--	--	--	--	--	--	--	--
	P11	0.75	0.14	0.11	2.0E-02	--	--	--	--	--	--	--	--	--	--	--
	P12	0.75	0.14	0.11	2.0E-02	--	--	--	--	--	--	--	--	--	--	--
	P13	0.75	0.14	0.11	2.0E-02	--	--	--	--	--	--	--	--	--	--	--
	P14	0.75	0.14	0.11	2.0E-02	--	--	--	--	--	--	--	--	--	--	--
	P15	0.75	0.14	0.11	2.0E-02	--	--	--	--	--	--	--	--	--	--	--
	P21	1.4E-02	6.0E-02	9.4E-04	4.1E-03	7.7E-04	3.4E-03	0.18	0.79	0.15	0.66	1.1E-03	4.7E-03	9.9E-03	4.3E-02	952
	P22	1.4E-02	6.0E-02	9.4E-04	4.1E-03	7.7E-04	3.4E-03	0.18	0.79	0.15	0.66	1.1E-03	4.7E-03	9.9E-03	4.3E-02	952
	P24	1.4E-02	6.0E-02	9.4E-04	4.1E-03	7.7E-04	3.4E-03	0.18	0.79	0.15	0.66	1.1E-03	4.7E-03	9.9E-03	4.3E-02	952
	P31	2.1E-02	9.0E-02	1.4E-03	6.1E-03	1.2E-03	5.1E-03	0.27	1.18	0.23	0.99	1.6E-03	7.1E-03	1.5E-02	6.5E-02	1,428
	P32	2.1E-02	9.0E-02	1.4E-03	6.1E-03	1.2E-03	5.1E-03	0.27	1.18	0.23	0.99	1.6E-03	7.1E-03	1.5E-02	6.5E-02	1,428
	P33	2.1E-02	9.0E-02	1.4E-03	6.1E-03	1.2E-03	5.1E-03	0.27	1.18	0.23	0.99	1.6E-03	7.1E-03	1.5E-02	6.5E-02	1,428
	P34	2.1E-02	9.0E-02	1.4E-03	6.1E-03	1.2E-03	5.1E-03	0.27	1.18	0.23	0.99	1.6E-03	7.1E-03	1.5E-02	6.5E-02	1,428
	P35	2.1E-02	9.0E-02	1.4E-03	6.1E-03	1.2E-03	5.1E-03	0.27	1.18	0.23	0.99	1.6E-03	7.1E-03	1.5E-02	6.5E-02	1,428
	B40	3.0E-02	0.13	2.1E-03	9.1E-03	1.7E-03	7.5E-03	0.40	1.75	0.34	1.47	2.4E-03	1.1E-02	2.2E-02	9.6E-02	2,115
	B41	1.5E-02	6.7E-02	1.0E-03	4.6E-03	8.6E-04	3.8E-03	0.20	0.88	0.17	0.74	1.2E-03	5.3E-03	1.1E-02	4.8E-02	1,058
	B42	1.5E-02	6.7E-02	1.0E-03	4.6E-03	8.6E-04	3.8E-03	0.20	0.88	0.17	0.74	1.2E-03	5.3E-03	1.1E-02	4.8E-02	1,058
	B43	1.5E-02	6.7E-02	1.0E-03	4.6E-03	8.6E-04	3.8E-03	0.20	0.88	0.17	0.74	1.2E-03	5.3E-03	1.1E-02	4.8E-02	1,058
	B44	1.5E-02	6.7E-02	1.0E-03	4.6E-03	8.6E-04	3.8E-03	0.20	0.88	0.17	0.74	1.2E-03	5.3E-03	1.1E-02	4.8E-02	1,058
	P60	0.44	1.94	0.07	0.28	--	--	--	--	--	--	--	--	--	--	--
	P61*	0.50	2.19	0.50	2.19	--	--	--	--	--	--	--	--	--	--	--
	P81	1.05	0.11	1.05	0.11	1.05	0.11	15.0	1.50	3.23	0.32	0.99	0.10	1.22	0.12	56
	P82	1.05	0.11	1.05	0.11	1.05	0.11	15.0	1.50	3.23	0.32	0.99	0.10	1.22	0.12	56
	P84	1.05	0.11	1.05	0.11	1.05	0.11	15.0	1.50	3.23	0.32	0.99	0.10	1.22	0.12	56
	P89	1.61	0.16	1.61	0.16	1.61	0.16	22.9	2.29	4.94	0.49	1.51	0.15	1.87	0.19	85
	P91	1.61	0.16	1.61	0.16	1.61	0.16	22.9	2.29	4.94	0.49	1.51	0.15	1.87	0.19	85
	P92	1.61	0.16	1.61	0.16	1.61	0.16	22.9	2.29	4.94	0.49	1.51	0.15	1.87	0.19	85
	P93	1.61	0.16	1.61	0.16	1.61	0.16	22.9	2.29	4.94	0.49	1.51	0.15	1.87	0.19	85
	P94	1.61	0.16	1.61	0.16	1.61	0.16	22.9	2.29	4.94	0.49	1.51	0.15	1.87	0.19	85
	P95	1.61	0.16	1.61	0.16	1.61	0.16	22.9	2.29	4.94	0.49	1.51	0.15	1.87	0.19	85
	Total	30.4	57.0	17.5	18.5	13.1	2.60	186	32.2	42.0	15.7	12.0	1.28	24.8	45.0	18,145
MTE	F01	--	--	--	--	--	--	--	--	--	--	--	--	0.75	3.29	--
MTE	F02	--	--	--	--	--	--	--	--	--	--	--	--	0.75	3.29	--
MTE	F04	--	--	--	--	--	--	--	--	--	--	--	--	0.75	3.29	--
MTE	F11	2.21	9.67	0.61	2.67	--	--	--	--	--	--	--	--	1.50	6.57	--
MTE	F12	2.21	9.67	0.61	2.67	--	--	--	--	--	--	--	--	1.50	6.57	--
MTE	F13	2.21	9.67	0.61	2.67	--	--	--	--	--	--	--	--	1.50	6.57	--
MTE	F14	2.21	9.67	0.61	2.67	--	--	--	--	--	--	--	--	1.50	6.57	--
MTE	F15	2.21	9.67	0.61	2.67	--	--	--	--	--	--	--	--	1.50	6.57	--

A. Emissions From New Equipment or Modification - Criteria Pollutants.

Process	PM		PM_{10}		$PM_{2.5}$		NOx		CO		SO_2		VOC		GHG
	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY	lb/hr	TPY	TPY
I02	0.16	0.69	0.16	0.69	0.16	0.69	0.06	0.27	0.05	0.23	3.7E-04	1.6E-03	3.4E-03	1.5E-02	620
I03	0.13	0.56	0.13	0.56	0.13	0.56	0.04	0.16	0.04	0.18	2.1E-04	9.4E-04	2.0E-03	8.6E-03	504
P01	0.37	6.8E-02	5.5E-02	1.0E-02	--	--	--	--	--	--	--	--	--	--	--
P02	0.37	6.8E-02	5.5E-02	1.0E-02	--	--	--	--	--	--	--	--	--	--	--
P03	0.19	6.8E-02	2.8E-02	5.0E-03	--	--	--	--	--	--	--	--	--	--	--
P04	0.37	6.8E-02	5.5E-02	1.0E-02	--	--	--	--	--	--	--	--	--	--	--
P11	0.75	0.14	0.11	2.0E-02	--	--	--	--	--	--	--	--	--	--	--
P12	0.75	0.14	0.11	2.0E-02	--	--	--	--	--	--	--	--	--	--	--
P13	0.75	0.14	0.11	2.0E-02	--	--	--	--	--	--	--	--	--	--	--
P14	0.75	0.14	0.11	2.0E-02	--	--	--	--	--	--	--	--	--	--	--
P15	0.75	0.14	0.11	2.0E-02	--	--	--	--	--	--	--	--	--	--	--
P21	1.4E-02	6.0E-02	9.4E-04	4.1E-03	7.7E-04	3.4E-03	0.18	0.79	0.15	0.66	1.1E-03	4.7E-03	9.9E-03	4.3E-02	952
P22	1.4E-02	6.0E-02	9.4E-04	4.1E-03	7.7E-04	3.4E-03	0.18	0.79	0.15	0.66	1.1E-03	4.7E-03	9.9E-03	4.3E-02	952
P24	1.4E-02	6.0E-02	9.4E-04	4.1E-03	7.7E-04	3.4E-03	0.18	0.79	0.15	0.66	1.1E-03	4.7E-03	9.9E-03	4.3E-02	952
P31	2.1E-02	9.0E-02	1.4E-03	6.1E-03	1.2E-03	5.1E-03	0.27	1.18	0.23	0.99	1.6E-03	7.1E-03	1.5E-02	6.5E-02	1,428
P32	2.1E-02	9.0E-02	1.4E-03	6.1E-03	1.2E-03	5.1E-03	0.27	1.18	0.23	0.99	1.6E-03	7.1E-03	1.5E-02	6.5E-02	1,428
P33	2.1E-02	9.0E-02	1.4E-03	6.1E-03	1.2E-03	5.1E-03	0.27	1.18	0.23	0.99	1.6E-03	7.1E-03	1.5E-02	6.5E-02	1,428
P34	2.1E-02	9.0E-02	1.4E-03	6.1E-03	1.2E-03	5.1E-03	0.27	1.18	0.23	0.99	1.6E-03	7.1E-03	1.5E-02	6.5E-02	1,428
P35	2.1E-02	9.0E-02	1.4E-03	6.1E-03	1.2E-03	5.1E-03	0.27	1.18	0.23	0.99	1.6E-03	7.1E-03	1.5E-02	6.5E-02	1,428
B40	3.0E-02	0.13	2.1E-03	9.1E-03	1.7E-03	7.5E-03	0.40	1.75	0.34	1.47	2.4E-03	1.1E-02	2.2E-02	9.6E-02	2,115
B41	1.5E-02	6.7E-02	1.0E-03	4.6E-03	8.6E-04	3.8E-03	0.20	0.88	0.17	0.74	1.2E-03	5.3E-03	1.1E-02	4.8E-02	1,058
B42	1.5E-02	6.7E-02	1.0E-03	4.6E-03	8.6E-04	3.8E-03	0.20	0.88	0.17	0.74	1.2E-03	5.3E-03	1.1E-02	4.8E-02	1,058
B43	1.5E-02	6.7E-02	1.0E-03	4.6E-03	8.6E-04	3.8E-03	0.20	0.88	0.17	0.74	1.2E-03	5.3E-03	1.1E-02	4.8E-02	1,058
B44	1.5E-02	6.7E-02	1.0E-03	4.6E-03	8.6E-04	3.8E-03	0.20	0.88	0.17	0.74	1.2E-03	5.3E-03	1.1E-02	4.8E-02	1,058
P60	0.44	1.94	0.07	0.28	--	--	--	--	--	--	--	--	--	--	--
P61	1.76	7.74	0.26	1.14	--	--	--	--	--	--	--	--	--	--	--
P81	1.05	0.11	1.05	0.11	1.05	0.11	15.0	1.50	3.23	0.32	0.99	0.10	1.22	0.12	56
P82	1.05	0.11	1.05	0.11	1.05	0.11	15.0	1.50	3.23	0.32	0.99	0.10	1.22	0.12	56
P84	1.05	0.11	1.05	0.11	1.05	0.11	15.0	1.50	3.23	0.32	0.99	0.10	1.22	0.12	56
P89	1.61	0.16	1.61	0.16	1.61	0.16	22.9	2.29	4.94	0.49	1.51	0.15	1.87	0.19	85
P91	1.61	0.16	1.61	0.16	1.61	0.16	22.9	2.29	4.94	0.49	1.51	0.15	1.87	0.19	85
P92	1.61	0.16	1.61	0.16	1.61	0.16	22.9	2.29	4.94	0.49	1.51	0.15	1.87	0.19	85
P93	1.61	0.16	1.61	0.16	1.61	0.16	22.9	2.29	4.94	0.49	1.51	0.15	1.87	0.19	85
P94	1.61	0.16	1.61	0.16	1.61	0.16	22.9	2.29	4.94	0.49	1.51	0.15	1.87	0.19	85
P95	1.61	0.16	1.61	0.16	1.61	0.16	22.9	2.29	4.94	0.49	1.51	0.15	1.87	0.19	85
Total	31.6	62.6	17.2	17.5	13.1	2.60	186	32.2	42.0	15.7	12.0	1.28	24.8	45.0	18,145

*Note: For P61, the potential PM/PM_{10} emission rate is based upon the emission rate used in the air quality modeling analysis which is higher than the calculated potential emission rate.

B. Emissions From New Equipment or Modification - Hazardous Air Pollutants (HAPs):

Pollutant	Type (F, S)*	Process Number	Potential to Emit (PTE)			Maximum Theoretical Emissions (MTE)		
			Lb/hr	Lb/yr	TPY	Lb/hr	Lb/yr	TPY
TCDD (2,3,7,8-Tetrachlorodibenzo-p-dioxin), as equivalents (17446-01-6)	FS	I02, I03	1.7E-10	1.5E-06	7.4E-10	1.7E-10	1.5E-06	7.4E-10
Hexane (110-54-0)	FS	P21-P24, P31-P35, B40-B44	5.7E-02	503	0.25	5.7E-02	503	0.25
Formaldehyde (50-00-0)	FS	P21-P35, B40-B44, P81-P95	5.2E-02	30.8	1.5E-02	5.2E-02	30.8	1.5E-02
Benzene (71-43-2)	FS	P21-P35, B40-B44, P81-P95, I02-I03	3.9E-02	10.2	5.2E-3	3.9E-02	10.2	5.2E-3
Total of all federal HAPs (individual / cumulative) =					<10 / <25			<10 / <25

* F = Federal HAP; S = State HAP (NR 445)

SOURCE CLASSIFICATION

Existing Facility Status

The existing facility is not located in an area designated as nonattainment for any pollutant. The existing facility is not a major source under Part 70 because the potential emissions of each criteria pollutant are less than the major source threshold of 100 tons per year. The facility is an area (minor) source of hazardous air pollutants regulated by the Clean Air Act (federal HAPs) because the potential emissions of any single federal HAP to less than 10 tons per year and the potential emissions of all federal HAPs combined to less than 25 tons per year. The facility is a minor source for Prevention of Significant Deterioration (PSD) purposes because the source is not one of the stationary source types listed in s. NR 405.02(22)(a), Wis. Adm. Code and the potential emissions of each air contaminant subject to regulation under the Act are less than 250 tons per year.

Project Status

The proposed project is a minor modification to a PSD minor source. The proposed project is a minor source of federal HAPs.

Facility Status After Issuance of Permit(s)

The facility status will not change as a result of this permit.

Source Status Summary

Facility Classification[a]						
Program[b]	Existing Facility			After Permit Issuance		
	Major[c]	Synthetic Minor[d]	Minor	Major	Synthetic Minor	Minor
PSD			X			X
NAA NSR			NA			NA
Part 70 [e]			X			X
Federal HAPs			X			X
EPA Class Code[f]			B			B

[a] *A facility can only have one overall classification for each program. If a facility has potential emissions of a single pollutant which exceed the major source thresholds for Part 70, the facility is a Part 70 source. The same applies for the EPA class code and the source status for PSD. The exception is for CAA HAPs. A facility can be a Part 70 source for criteria pollutants and an area (i.e. minor) source of HAPs. If a facility is a major source of HAPs, it is a Part 70 source.*

[b] *As required by 40 CFR s. 70.5(c)(3)i., emission estimates sufficient to verify which requirements are applicable to the source are included in this analysis. Based on the definitions in ss. NR 400.02(123m) and (124), Wis. Adm. Code, direct PM2.5 emissions cannot exceed PM10 emissions. Since PM10 and PM 2.5 have the same major source thresholds, emission estimates of PM10 are sufficient for determining Part 70 and PSD source status with respect to both PM2.5 and PM10.*

[c] *For PSD, major stationary source has the meaning given in s. NR 405.02(22), Wis. Adm. Code. For nonattainment areas (NAA), major stationary source has the meaning given in s. NR 408.02(21), Wis. Adm. Code. For Part 70, major source has the meaning given in s. NR 407.02(4), Wis. Adm. Code.*

[d] *A source classified as synthetic minor is a stationary source that has maximum theoretical emissions greater than the major source threshold and has its potential to emit limited by practicably enforceable permit conditions so that it is not a major source. There are two categories of synthetic minor sources for EPA Class Code, SM80 and SM. f*

[e] *A stationary source that directly emits, or has the potential to emit, 100 tpy or more of any air contaminant subject to regulation under the Act other than particulate matter is defined as a major source for Part 70. For particulate matter, a stationary source is a Part 70 major source if it emits or has the potential to emit, 100 tpy or more of PM10 per s. NR 407.01(4)(a), Wis. Adm. Code.*

[f] *EPA Class Codes: "A" means the source's maximum theoretical emissions and potential to emit for one or more pollutants are greater than Part 70 major source thresholds. "SM80" means the source's maximum theoretical emissions of one or more pollutants are greater than Part 70 major source thresholds and potential to emit is at least 80% but less than 100% of Part 70 major source thresholds. "SM" means the source's maximum theoretical emissions of one or more pollutants are greater than Part 70 major source thresholds but potential to emit for all pollutants is less than 80% of Part 70 major source thresholds. "B" means the source's maximum theoretical emissions and potential to emit for all pollutants are less than major source thresholds.*

Pollutant Specific EPA Class Code

Pollutant specific classifications are used for compliance purposes. A facility can only have one overall EPA class code. The facility's EPA class code is shown in the previous section.

Pollutant	Pollutant Specific EPA Class Code After Permit Issuance			
	A	SM80	SM	B
PM				X
PM_{10}				X
$PM_{2.5}$				X
SO_2				X
NO_x				X
CO				X
VOC				X
Pb				X
Individual CAA HAPs				X
Total CAA HAPs				X

EPA Class Codes:

***A** means the source's maximum theoretical emissions and potential to emit for one or more pollutants are greater than Part 70 major source thresholds.*

***SM80** means the source's maximum theoretical emissions of one or more pollutants are greater than Part 70 major source thresholds and potential to emit is at least 80% but less than 100% of Part 70 major source thresholds.*

***SM** means the source's maximum theoretical emissions of one or more pollutants are greater than Part 70 major source thresholds but potential to emit for all pollutants is less than 80% of Part 70 major source thresholds.*

***B** means the source's maximum theoretical emissions and potential to emit for all pollutants are less than major source thresholds.*

STATUS UNDER WISCONSIN ENVIRONMENTAL POLICY ACT (WEPA)

An air pollution control construction permit that does not require review under chs. NR 405 or 408, Wis. Adm. Code, is considered a minor action under s. NR 150.20(1m)(o), Wis. Adm. Code and as such, is compliant with WEPA and does not require a determination prior to permit issuance.

NEW SOURCE PERFORMANCE STANDARDS (NSPS) AND NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS (NESHAPS)APPLICABILITY

		Yes	No	NA	Explanation
NSPS	**For proposed construction of a source:**				
	1. Is the proposed source in a source category for which there is an existing or proposed NSPS?	☒	☐	☐	Processes P81, P82, P84, P89, P91-P95 are subject to 40 CFR 60 subpart IIII
	2. Is the proposed source an affected facility?	☒	☐	☐	
	For the proposed modification of an existing source:				
	1. Is the existing source, which is being modified, in a source category for which there is an existing or proposed NSPS?	☐	☐	☒	
	2. Is the existing source, which is being modified, an affected facility (prior to modification)?	☐	☐	☒	
	3. Does the proposed modification constitute a modification ***under NSPS*** to the existing source?	☐	☐	☒	
	4. Will the existing source be an affected facility after modification?	☐	☐	☒	
N	**Part 61 NESHAPS:**				

NEW SOURCE PERFORMANCE STANDARDS (NSPS) AND NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS (NESHAPS)APPLICABILITY

		Yes	No	
	1. Is the source subject to a Part 61 NESHAPS?	☐	☒	
	Part 63 NESHAPS:			
	1. Is the source subject to an existing Part 63 NESHAPS?	☒	☐	Processes P81, P82, P84, P89, P91-P95 are subject to 40 CFR 63 subpart ZZZZ
	2. Is the proposed project subject to s. 112(g) of the Clean Air Act?	☐	☒	
	The section 112(g) rules only apply to case-by-case MACT standards that are developed for new construction or reconstruction of sources that (by themselves) constitutes a new major source of federal hazardous air pollutants (for source categories not covered under an existing Part 63 MACT standard).			

CRITERIA FOR CONSTRUCTION PERMIT APPROVAL

Section 285.63, Wis. Stats., sets forth the specific language for permit approval criteria. The Department finds that:

1. The source will meet emission limitations.
2. The source will not cause nor exacerbate a violation of an air quality standard or ambient air increment.
3. The source is operating or seeks to operate under an emission reduction option. Not Applicable.
4. The source will not preclude the construction or operation of another source for which an air pollution control permit application has been received.

PRELIMINARY DETERMINATIONS FOR 18-JJW-054

The Wisconsin Department of Natural Resources has reviewed application and other materials submitted by Daybreak Foods, Inc., for 18-JJW-054 and hereby makes a preliminary determination that this project, when constructed and operated consistent with the application and subsequent information submitted, will be able to meet the emission limits and conditions included in the attached draft permit. Furthermore, the Department hereby makes a preliminary determination that an operation permit may be issued with the following draft applicable limits and draft permit conditions. A final decision regarding emission limits and conditions will be made after the Department has reviewed and evaluated all comments received during the public comment period. The proposed emission limits and other proposed conditions in the draft permit are written as they will appear in the final permit. These proposed conditions may be changed as a result of public comments or further evaluation by the Department.

COMMONLY USED ACRONYMS AND ABBREVIATIONS:

acfm	Actual cubic feet per minute	MTE	Maximum Theoretical Emissions
AP-42	Compilation of Air Pollutant Emission Factors	MW	Megawatts
BACT	Best Available Control Technology	n/a	Not Applicable
BTU or btu	British Thermal Unit	N_2O	Nitrous Oxide
°C	Degrees Celsius	NAA	Non-Attainment Area
CAA	Federal Clean Air Act	NAAQS	National Ambient Air Quality Standards
CAMS	Compliance Assurance Monitoring System	NESHAP	National Emission Standard for Hazardous Air Pollutants
CEM	Continuous Emission Monitoring	NMOC	Non-methane Organic Compounds
CFR	Code of Federal Regulations	NO_2	Nitrogen Dioxide
CH_4	Methane	NOx	Oxides of Nitrogen
CI	Compression Ignition	NSCR	Non-Selective Catalytic Reduction
CO	Carbon Monoxide	NSPS	New Source Performance Standards
CO_2	Carbon Dioxide	NSR	New Source Review
CO_2e	Carbon Dioxide Equivalents	Pb	Lead
COMS	Continuous Opacity Monitoring System	PHAP	Hazardous Air Pollutant Emitted as a Particulate
Department	Wisconsin Department of Natural Resources	PM	Particulate Matter
dscf	Dry standard cubic foot	PM_{10}	Particulate Matter less than 10 microns in diameter
dscm	Dry standard cubic meter	$PM_{2.5}$	Particulate Matter less than 2.5 microns in diameter
EPA	United States Environmental Protection Agency	ppm	Parts per million
ESP	Electrostatic Precipitator	ppmdv	Parts per million dry volume
°F	Degrees Fahrenheit	ppmv	Parts per million by volume
FESOP	Federal Enforceable State Operating Permit	ppmw	Parts per million by weight
FID	Facility Identification Number	PSD	Prevention of Significant Deterioration
FOP	Federal Operating Permit	psia	Pounds per square inch absolute
ft	Feet	psig	Pounds per square inch gauge
g	Grams	PTE	Potential to Emit
GACT	Generally Available Control Technology	RACT	Reasonable Available Control Technology
GCP	General Construction Permit	RCP	Registration Construction Permit

COMMONLY USED ACRONYMS AND ABBREVIATIONS:

GHG	Greenhouse Gas	RICE	Reciprocating Internal Combustion Engine
GOP	General Operation Permit	ROG	Reactive Organic Gases
gr	Grains	ROP	Registration Operating Permit
GWP	Global Warming Potential	s.	Section
HAP	Hazardous Air Pollutant	scf	Standard cubic feet
Hg	Mercury	sec	Seconds
hr	Hour	SCR	Selective Catalytic Reduction
hp	Horsepower	SDS	Safety Data Sheet
H_2S	Hydrogen Sulfide	SI	Spark Ignition
HVLP	High Volume Low Pressure	SNCR	Selective Non-Catalytic Reduction
Kg	Kilogram	SO_2	Sulfur Dioxide
kW	Kilowatt	SOP	State Operating Permit
LACT	Latest Available Control Techniques	Temp	Temperature
LAER	Lowest Achievable Emission Rate	THC	Total Hydrocarbons
lb	Pound	TPY	Tons per year
m	Meter	µg	Microgram
MACT	Maximum Achievable Control Technology	VE	Visible Emissions
MPAP	Malfunction, Prevention, and Abatement Plan	VHAP	Hazardous Pollutant Emitted as a Vapor
mg	Milligram	VOC	Volatile Organic Compounds
mm	Millimeter	Wis. Adm. Code	Wisconsin Administrative Code
MM	Million	Wis. Stats.	Wisconsin Statutes
MMBtu/hr	Million British Thermal Units Per Hour	yr	Year

Impacts of Waste from Concentrated Animal Feeding Operations on Water Quality

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Waste from agricultural livestock operations has been a long-standing concern with respect to contamination of water resources, particularly in terms of nutrient pollution. However, the recent growth of concentrated animal feeding operations (CAFOs) presents a greater risk to water quality because of both the increased volume of waste and to contaminants that may be present (e.g., antibiotics and other veterinary drugs) that may have both environmental and public health importance. Based on available data, generally accepted livestock waste management practices do not adequately or effectively protect water resources from contamination with excessive nutrients, microbial pathogens, and pharmaceuticals present in the waste. Impacts on surface water sources and wildlife have been documented in many agricultural areas in the United States. Potential impacts on human and environmental health from long-term inadvertent exposure to water contaminated with pharmaceuticals and other compounds are a growing public concern. This workgroup, which is part of the Conference on Environmental Health Impacts of Concentrated Animal Feeding Operations: Anticipating Hazards—Searching for Solutions, identified needs for rigorous ecosystem monitoring in the vicinity of CAFOs and for improved characterization of major toxicants affecting the environment and human health. Last, there is a need to promote and enforce best practices to minimize inputs of nutrients and toxicants from CAFOs into freshwater and marine ecosystems. *Key words:* ecology, human health, poultry, swine, water contaminants, wildlife. ***Environ Health Perspect*** **115:308–312 (2007). doi:10.1289/ehp.8839 available via *http://dx.doi.org/*** [Online 14 November 2006]

Background and Recent Developments

Concentrated animal feed operations and water quality. Animal cultivation in the United States produces 133 million tons of manure per year (on a dry weight basis) representing 13-fold more solid waste than human sanitary waste production [U.S. Environmental Protection Agency (U.S. EPA) 1998]. Since the 1950s (poultry) and the 1970s–1980s (cattle, swine), most animals are now produced for human consumption in concentrated animal feeding operations (CAFOs). In these industrialized operations, the animals are held throughout their lives at high densities in indoor stalls until they are transported to processing plants for slaughter. There is substantial documentation of major, ongoing impacts on aquatic resources from CAFOs, but many gaps in understanding remain.

Contaminants detected in waste and risk of water contamination. Contaminants from animal wastes can enter the environment through pathways such as through leakage from poorly constructed manure lagoons, or during major precipitation events resulting in either overflow of lagoons and runoff from recent applications of waste to farm fields, or atmospheric deposition followed by dry or wet fallout (Aneja 2003). The magnitude and direction of transport depend on factors such as soil properties, contaminant properties, hydraulic loading characteristics, and crop management practices (Huddleston 1996). Many contaminants are present in livestock wastes, including nutrients (Jongbloed and Lenis 1998), pathogens (Gerba and Smith 2005; Schets et al. 2005), veterinary pharmaceuticals (Boxall et al. 2003; Campagnolo et al. 2002; Meyer 2004), heavy metals [especially zinc and copper; e.g., Barker and Zublena (1995); University of Iowa and Iowa State Study Group (2002)], and naturally excreted hormones (Hanselman et al. 2003; Raman et al. 2004). Antibiotics are used extensively not only to treat or prevent microbial infection in animals (Kummerer 2004), but are also commonly used to promote more rapid growth in livestock (Cromwell 2002; Gaskins et al. 2002; Liu et al. 2005). In addition, pesticides such as dithiocarbamates are applied to sprayfields (Extension Toxicology Network 2003). Although anaerobic digestion of wastes in surface storage lagoons can effectively reduce or destroy many pathogens, substantial remaining densities of microbial pathogens in waste spills and seepage can contaminate receiving surface- and groundwaters (e.g., Burkholder et al. 1997; Mallin 2000). Pharmaceuticals can remain present as parent compounds or degradates in manure and leachates even during prolonged storage. Improper disposal of animal carcasses and abandoned livestock facilities can also contribute to water quality problems. Siting of livestock operations in areas prone to flooding or where there is a shallow water table increases the potential for environmental contamination.

The nutrient content of the wastes can be a desirable factor for land application as fertilizer for row crops, but overapplication of livestock wastes can overload soils with both macronutrients such as nitrogen (N) and phosphorous (P), and heavy metals added to feed as micronutrients (e.g., Barker and Zublena 1995). Overapplication of animal wastes or application of animal wastes to saturated soils can also cause contaminants to move into receiving waters through runoff and to leach through permeable soils to vulnerable aquifers. Importantly, this may happen even at recommended application rates. As examples, Westerman et al. (1995) found 3–6 mg nitrate (NO_3)/L in surface runoff from sprayfields that received swine effluent at recommended rates; Stone et al. (1995) measured 6–8 mg total inorganic N/L and 0.7–1.3 mg P/L in a stream adjacent to swine effluent sprayfields. Evans et al. (1984) reported 7–30 mg NO_3/L in subsurface flow draining a sprayfield for swine wastes, applied at recommended rates. Ham and DeSutter (2000) described export rates of up to 0.52 kg ammonium m^{-2} $year^{-1}$ from lagoon seepage; Huffman and Westerman (1995) reported that groundwater near swine waste lagoons averaged 143 mg inorganic N/L, and estimated export rates at 4.5 kg inorganic N/day. Thus, nutrient losses into receiving waters can be excessive relative to levels (~ 100–200 µg inorganic N or P/L)

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known to support noxious algal blooms (Mallin 2000). In addition to contaminant chemical properties, soil properties and climatic conditions can affect transport of contaminants. For example, sandy, well-drained soils are most vulnerable to transport of nutrients to underlying groundwater (Mueller et al. 1995). Nutrients can also readily move through soils under wet conditions (McGechan et al. 2005).

Presence of contaminants in water sources. The presence of many contaminants from livestock waste has been documented in both surface water and groundwater supplies in agricultural areas within the United States (e.g., Campagnolo et al. 2002; Kolpin et al. 2002; Meyer 2004). Urban wastewater streams also contain these contaminants, and efforts to accurately determine sources of contamination are under way (Barnes et al. 2004; Cordy et al. 2004; Kolpin DW, unpublished data). The U.S. Geological Survey (USGS) began pilot surveillance programs for organic wastewater contaminants in 1999 and expanded that effort to a national scale over the past 5 years (Kolpin et al. 2002). Recent USGS efforts have focused specifically on water quality in agricultural locations (Kolpin DW, unpublished data). Nutrient levels have been detected in high parts per million (milligrams per liter) levels; pharmaceuticals and other compounds are generally measured in low levels (ppb [micrograms per liter]). In Europe, surveillance efforts conducted in Germany documented the presence of veterinary pharmaceuticals in water resources (Hirsch et al. 1999).

Animal wastes are also rich in organics and high in biochemical oxygen-demanding materials (BOD); for example, treated human sewage contains 20–60 mg BOD/L, raw sewage contains 300–400 mg BOD/L, and swine waste slurry contains 20,000–30,000 mg BOD/L (Webb and Archer 1994). Animal wastes also carry parasites, viruses, and bacteria as high as 1 billion/g (U.S. EPA 1998). Swine wastes contain > 100 microbial pathogens that can cause human illness and disease [see review in Burkholder et al. (1997)]. About one-third of the antibiotics used in the United States each year is routinely added to animal feed to increase growth (Mellon et al. 2001). This practice is promoting increased antibiotic resistance among the microbial populations present and, potentially, increased resistance of naturally occurring pathogens in surface waters that receive a portion of the wastes.

Contaminant impacts. Some contaminants pose risks for adverse health impacts in wildlife or humans. The effects of numerous waterborne pathogens on humans are well known, although little is known about potential impacts of such microorganisms on aquatic life. With respect to nutrients, excessive phosphorus levels can contribute to algal blooms and cyanobacterial growth in surface waters used for recreation and as sources of drinking water. Research is beginning to investigate the environmental effects, including endocrine disruption and antibiotic resistance issues (Burnison et al. 2003; Delepee et al. 2004; Fernandez et al. 2004; Halling-Sorensen et al. 2003; Sengelov et al. 2003; Soto et al. 2004; Wollenberger et al. 2000). However, knowledge is limited in several crucial areas. These areas include information on metabolites or environmental degradates of some parent compounds; the environmental persistence, fate, and transport and toxicity of metabolites or degradates (Boxall et al. 2004); the potential synergistic effects of various mixtures of contaminants on target organisms (Sumpter and Johnson 2005); and the potential transport and effects from natural and synthetic hormones (Hanselman et al. 2003; Soto et al. 2004). Further, limited monitoring has been conducted of ecosystem health in proximity to CAFOs, including monitoring the effects on habitats from lagoon spills during catastrophic flooding (Burkholder et al. 1997; Mallin et al. 1997; Mallin et al. 2000).

Ecologic and wildlife impacts. Anoxic conditions and extremely high concentrations of ammonium, total phosphorus, suspended solids, and fecal coliform bacteria throughout the water column for approximately 30 km downstream from the point of entry have been documented as impacts of waste effluent spills from CAFOs (Burkholder et al. 1997; Mallin et al. 2000). Pathogenic microorganisms such as *Clostridium perfringens* have been documented at high densities in receiving surface waters following CAFO waste spills (Burkholder et al. 1997). These degraded conditions, especially the associated hypoxia/anoxia and high ammonia, have caused major kills of freshwater fish of all species in the affected areas, from minnows and gar to largemouth bass, and estuarine fish, including striped bass and flounder (Burkholder et al. 1997). Waste effluent spills also stimulated blooms of toxic and noxious algae. In freshwaters, these blooms include toxic and noxious cyanobacteria while in estuaries, harmful haptophytes and toxic dinoflagellates arise. Most states monitor only water-column fecal coliform densities to assess whether waterways are safe for human contact. World Health Organization (WHO) guidelines for cyanobacteria in recreational water are 20,000 cyanobacterial cells/mL, which indicates low probability of adverse health effects, and 100,000 cyanobacterial cells/mL, which indicates moderate probability of adverse health effects (WHO 2003). Yet 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 (Burkholder et al. 1997).

The impacts from CAFO pollutant loadings to direct runoff are more substantial after such major effluent spills or when CAFOs are flooded and in direct contact with surface waters (Wing et al. 2002). Although the acute impacts are often clearly visible—dead fish floating on the water surface, or algal overgrowth and rotting biomass—the chronic, insidious, long-term impacts of commonly accepted practices of CAFO waste management on receiving aquatic ecosystems are also significant (U.S. EPA 1998). One purpose of manure storage basins is to reduce the N content of the manure through volatilization of ammonia and other N-containing molecules. Many studies have shown, for example, that high nutrient concentrations (e.g., ammonia from swine CAFOs, or ammonia oxidized to NO_3, or phosphorus from poultry CAFOs) commonly move off-site to contaminate the overlying air and/or adjacent surface and subsurface waters (Aneja et al. 2003; Evans et al. 1984; Sharpe and Harper 1997; Sharpley and Moyer 2000; Stone et al. 1995; U.S. EPA 1998; Webb and Archer 1994; Westerman et al. 1995; Zahn et al. 1997). Inorganic N forms are added to the atmosphere during spray practices, and both ammonia and phosphate can also adsorb to fine particles (dust) that can be airborne. The atmospheric depositions are noteworthy, considering that a significant proportion of the total ammonium from uncovered swine effluent lagoons and effluent spraying (an accepted practice in some states) reenters surface waters as local precipitation or through dry fallout (Aneja et al. 2003; U.S. EPA 1998, 2000). The contributed nutrient concentrations from the effluent greatly exceed the minimal levels that have been shown to promote noxious algal blooms (Mallin 2000) and depress the growth of desirable aquatic habitat species (Burkholder et al. 1992). The resulting chronically degraded conditions of nutrient overenrichment, while not as extreme as during a major waste spill, stimulate algal blooms and long-term shifts in phytoplankton community structure from desirable species (e.g., diatoms) to noxious species.

A summary of the findings from a national workshop on environmental impacts of CAFOs a decade ago stated that there was "a surprising lack of information about environmental impacts of CAFOs to adjacent lands and receiving waters" (Thu K, Donham K, unpublished data). Although the knowledge base has expanded since that time, especially regarding adverse effects of inorganic N and P overenrichment and anoxia, impacts of many CAFO pollutants on receiving aquatic ecosystems remain poorly understood. As examples, there is poor understanding of the impacts of fecal bacteria and other microbial pathogens from CAFO waste effluent contamination on aquatic communities; impacts of antibiotic-resistant bacteria created from CAFO wastes on aquatic life; impacts of organic nutrient forms preferred by certain noxious plankton; impacts from the contributed pesticides and heavy metals; and impacts from these pollutants acting in concert, additively or synergistically. This lack of information represents a critical gap in our present ability to assess the full extent of CAFO impacts on aquatic natural resources.

Despite their widespread use, antibiotics have only recently received attention as environmental contaminants. Most antibiotics are designed to be quickly excreted from the treated organism. Thus, it is not surprising that antibiotics are commonly found in human and animal waste (Christian et al. 2003; Dietze et al. 2005; Glassmeyer et al. 2005; Meyer 2004) and in water resources affected by sources of waste (Glassmeyer et al. 2005; Kolpin et al. 2002). Although some research has been conducted on the environmental effects from antibiotics (e.g., Brain et al. 2005; Jensen et al. 2003), much is yet to be understood pertaining to long-term exposures to low levels of antibiotics (both individually and as part of complex mixtures of organic contaminants in the environment). The greatest risks appear to be related to antibiotic resistance (Khachatourians 1998; Kummerer 2004) and natural ecosystem functions such as soil microbial activity and bacterial denitrification (Costanzo et al. 2005; Thiele-Bruhn and Beck 2005).

Human health impacts. Exposure to waterborne contaminants can result from both recreational use of affected surface water and from ingestion of drinking water derived from either contaminated surface water or groundwater. High-risk populations are generally the very young, the elderly, pregnant women, and immunocompromised individuals. Recreational exposures and illnesses include accidental ingestion of contaminated water that may result in diarrhea or other gastrointestinal tract distress from waterborne pathogens, and dermal contact during swimming that may cause skin, eye, or ear infections. Drinking water exposures to pathogens could occur in vulnerable private wells; under normal circumstances community water utilities disinfect water sufficiently before distribution to customers. Cyanobacteria (blue–green algae) in surface water can produce toxins (e.g., microcystins) that are known neurotoxins and hepatotoxins. Acute and chronic health impacts from these toxins can occur from exposures to both raw water and treated water (Carmichael et al. 2001; Rao et al. 2002). Removal of cyanotoxins during drinking water treatment is a high priority for the drinking water industry (Hitzfield et al. 2000; Rapala et al. 2002). The WHO has set a provisional drinking water guideline of 1 µg microcystin-LR/L (Chorus and Bartram 1999). While there are no drinking water standards in the United States for cyanobacteria, they are on the U.S. EPA Unregulated Contaminant Monitoring Rule List 3 (U.S. EPA 2006).

Exposure to chemical contaminants can occur in both private wells and community water supplies, and may present health risks. High nitrate levels in water used in mixing infant formula have been associated with risk for methemoglobinemia (blue-baby syndrome) in infants under 6 months of age, although other health factors such as diarrhea and respiratory disease have also been implicated (Ward et al. 2005). The U.S. EPA drinking water standard of 10 mg/L NO_3–N and the WHO guideline of 11 mg/L NO_3–N were set because of concerns about methemoglobinemia. (Note: "nitrate" refers to nitrate–nitrogen). Epidemiologic studies of noncancer health outcomes and high nitrate levels in drinking water have reported an increased risk of hyperthyroidism (Seffner 1995) from long-term exposure to levels between 11–61 mg/L (Tajtakova et al. 2006). Drinking water nitrate at levels < 10 mg/L has been associated with insulin-dependent diabetes (IDDM; Kostraba et al. 1992), whereas other studies have shown an association with IDDM at nitrate levels > 15 mg/L (Parslow et al. 1997) and > 25 mg/L (van Maanen et al. 2000). Increased risks for adverse reproductive outcomes, including central nervous system malformations (Arbuckle et al. 1988) and neural tube defects (Brender et al. 2004; Croen et al. 2001), have been reported for drinking water nitrate levels < 10 mg/L.

Anecdotal reports of reproductive effects of nitrate in drinking water include a case study of spontaneous abortions in women consuming high nitrate water (19–26 mg/L) from private wells (Morbidity and Mortality Weekly Report 1996).

While amassing experimental data suggest a role for nitrate in the formation of carcinogenic *N*-nitroso compounds, clear epidemiologic findings are lacking on the possible association of nitrate in drinking water with cancer risk. Ecologic studies have reported mixed results for cancers of the stomach, bladder, and esophagus (Barrett et al. 1998; Cantor 1997; Eicholzer and Gutzwiller 1990; Morales-Suarez-Varela et al. 1993, 1995) and non-Hodgkin lymphoma (Jensen 1982; Weisenburger 1993), positive findings for cancers of the nasopharynx (Cantor 1997), prostate (Cantor 1997), uterus (Jensen 1982; Thouez et al. 1981), and brain (Barrett et al. 1998), and negative findings for ovarian cancer (Jensen 1982; Thouez et al. 1981). Positive findings have generally been for long-term exposures at > 10 mg/L nitrate. Case–control studies have reported mixed results for stomach cancer (Cuello et al. 1976; Rademacher et al. 1992; Yang et al. 1998); positive results for non-Hodgkin lymphoma at > 4 mg/L nitrate (Ward et al. 1996) and colon cancer at > 5 mg/L (De Roos et al. 2003); and negative results for cancers of the brain (Mueller et al. 2001; Steindorf et al. 1994), bladder (Ward et al. 2003), and rectum (De Roos et al. 2003), all at < 10 mg/L. Cohort studies have reported no association between nitrate in drinking water and stomach cancer (Van Loon et al. 1998); positive associations with cancers of the bladder and ovary at long-term exposures > 2.5 mg/L (Weyer et al. 2001); and inverse associations with cancers of the rectum and uterus, again at > 2.5 mg/L (Weyer et al. 2001).

Exposure to low levels of antibiotics and other pharmaceuticals in drinking water (generally at micrograms per liter or nanograms per liter) represent unintentional doses of substances generally used for medical purposes to treat active disease or prevent disease. The concern is more related to possible cumulative effects of long-term low-dose exposures than on acute health effects (Daughton and Ternes 1999). A recent study conducted in Germany found that the margin between indirect daily exposure via drinking water and daily therapeutic dose was at least three orders of magnitude, concluding that exposure to pharmaceuticals via drinking water is not a major health concern (Webb et al. 2003). It should be noted that when prescribing medications, providers ensure patients are not taking incompatible drugs, but exposure via drinking water is beyond their control.

Endocrine-disrupting compounds are chemicals that exhibit biological hormonal activity, either by mimicking natural estrogens, by canceling or blocking hormonal actions, or by altering how natural hormones and their protein receptors are made (McLachlan and Korach 1995). Although very low levels of estrogenic compounds can stimulate cell activity, the potential for human health effects, such as breast and prostate cancers, and reproductive effects from exposure to endocrine disruptors, is in debate (Weyer and Riley 2001).

Workshop Recommendations

Priority research needs.

- Ecosystems monitoring: Systematic sustained studies of ecosystem health in proximity to large CAFOs are needed, including effects of input spikes during spills or flooding events.
- Toxicologic assessment of contaminants: Identification and prioritization of contaminants are needed to identify those that are most significant to environmental and public health. Toxicity studies need to be conducted to identify and quantify contaminants

(including metabolites), and to investigate interactions (synergistic, additive, and antagonistic effects).

- Fate and transport: Studies of parent compounds and metabolites in soil and water must be conducted, and the role of sediment as a carrier and reservoir of contaminants must be evaluated.
- Surveillance programs: Programs should be instituted to assess private well water quality in high-risk areas. Biomonitoring programs should be designed and implemented to assess actual dose from environmental exposures.

Translation of science to policy.

- Wastewater and drinking water treatment: Processes for water treatment must be monitored to ensure adequate removal or inactivation of emerging contaminants.
- Pollution prevention: Best management practices should be implemented to prevent or minimize release of contaminants into the environment.
- Education: Educational materials should be continued to be developed and distributed to agricultural producers.

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Understanding Local and State Regulations for New and Expanding Livestock Facilities

This overview outlines key local and state regulations beyond the permits issued by local governments under the Livestock Facility Siting Law (Siting Law), ATCP 51 Wis. Admin. Code, and Department of Natural Resources (DNR) permits for concentrated animal feeding operations (CAFO) under NR 243 Wis. Admin. Code. Local and state officials can provide more detailed regulatory information, including copies of applicable plans and ordinances.

Local planning

Comprehensive land use plans define future land uses, including delineation of areas slated for development and transition out of agriculture. County farmland preservation plans define areas for agricultural preservation. Zoning and other land use regulation must be consistent with these plans.

Local zoning

Towns and counties have the authority to regulate rural land use through zoning. In addition, cities and villages can exercise extraterritorial zoning in areas surrounding their incorporated boundaries. Locally-established zoning districts specify what uses are allowed. Livestock facilities can be prohibited, or allowed as a permitted or a conditional use. Conditional use permits (CUPs) must be issued in accordance with the Siting Law, and cannot be used to exclude a proposed facility. To prohibit or limit the size of livestock farms within agriculturally zoned districts, the Siting Law requires that a local ordinance include reasonable public health and safety justifications backed by scientifically defensible findings of fact. Also, at least one other agriculturally-zoned district must allow for livestock operations of any size. Zoning designations can change. For example if a dairy is located on land that is re-zoned to a non-agricultural use, it becomes a non-conforming use and restrictions on the ability to modernize or expand the farm can be imposed.

Development restrictions near lakes, rivers, wetlands and floodplains

Locally enforced shoreland-wetland zoning ordinances and floodplain ordinance implement minimum state standards for development in these areas. Farmers cannot construct stream crossings or other structures within navigable waterways without a DNR Chapter 30 Permit. DNR approval is needed for filling and grading wetlands, and an Army Corps of Engineers wetlands permit may also be necessary.

Setbacks

Farm structures must meet minimum setback distances specified in zoning or other local ordinances. These ordinances establish property lines and road setbacks for structures, subject to limits imposed by the Siting Law. A variance to the setback requirement may be granted by a local board of adjustments or similar body. Referenced in local ordinances, Natural Resources Conservation Services (NRCS) technical standards require that practices be constructed and operated according to standards, including setback distances. For example, manure storage structures must be located 400 feet from a sinkhole, and manure cannot be applied within 50 feet of a well.

Air quality regulation

Certain facilities covered by the Livestock Facility Siting Law must comply with an odor standard that uses a predictive model to determine acceptable odor levels from the farm structures. The Siting Law does not provide authority to monitor and regulate air pollutants. In the future, livestock farms may be required to meet air emission standards for hydrogen sulfide and ammonia under the DNR air toxics rule NR 445, Wis. Admin.

Road access and vehicle weight limits

The Department of Transportation and local governments can restrict highway access points and impose road weight limits to prevent damage, including seasonal weight restrictions. Local requirements are determined by the authority responsible for maintaining the road.

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Water-Related Regulations

State runoff management rules

State runoff rules require all livestock operations to properly store manure, divert clean water from animal lots, prevent overgrazing of streambanks, and apply manure and other fertilizers to croplands according to a nutrient management plan. In the northeastern part of the state, farms must meet targeted standards design to protect groundwater against pathogens. Most farms must be offered cost-share funding to be required to meet state standards. Farmers may have to comply with standards without cost-sharing as a condition for receiving a permit or a tax credit though the farmland preservation program.

County land and water conservation departments (LCDs) are primarily responsible for implementing the runoff rules. Generally local regulations must implement state runoff standards, with limited options to address additional resource concerns. Under s. 92.15 Wis. Stats, counties and towns can impose more stringent local standards for livestock operations if the local standards are supported by water quality justifications, and have been approved by DNR and DATCP. For more information go to http://runoffinfo.uwex.edu/

Local manure storage and management permits

County ordinances require a permit to ensure that new or modified manure storage structures are designed and constructed according to NRCS technical standards. A nutrient management plan must be developed to ensure that stored manure is properly land applied. County LCDs help farmers identify special design considerations for sensitive sites, as well as explain other local requirements such as winter manure spreading plans. LCD contact information can be found at, https://wisconsinlandwater.org/files/pdf/WILandWaterDirectory.pdf

Towns and counties can adopt an ordinance under the Siting Law that requires a permit for new or expanding livestock facilities with 500 or more animal units (a few local ordinances can require a permit for smaller facilities). Siting permits are issued under a licensing ordinance or as a conditional use permit under a zoning ordinance. Through a siting permit a local government can enforce state water quality standards for manure storage, runoff and nutrient management, and also an odor management standard (see prior page). A siting ordinance can include a more stringent local standard if it is based on defensible findings of fact justifying that the local requirement is necessary to protect public health and safety. To determine where siting

State permits for large livestock operations

Livestock farms with 1,000 or more animal units, about 700 milking cows, must obtain a Wisconsin Pollution Discharge Elimination System (WPDES) permit from the DNR. Permit requirements exceed the manure management standards in the state runoff rules. State permits do not restrict the number of animals at a facility; however, permits can impose additional requirements to adequately protect water quality. For information, go to http://dnr.wi.gov

Stormwater and erosion control

Prior to construction activities disturbing one acre or more, landowners must obtain a DNR storm water construction site general permit, which includes post-construction stormwater management requirements. Local stormwater and erosion control approvals may also be necessary.

High capacity well permit

DNR approval is required when the combined pumping capacity of all private wells on a farm exceed 70 gallons per minute. Capacity certification may be required if a farm well serves 25 or more people daily.

Local groundwater protection

Local governments have adopted requirements designed to protect groundwater including manure spreading restrictions.

ENVIRONMENTAL HEALTH

Understanding Concentrated Animal Feeding Operations and Their Impact on Communities

NALBOH
National Association of Local Boards of Health

Understanding Concentrated Animal Feeding Operations and Their Impact on Communities

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Foreword

The National Association of Local Boards of Health (NALBOH) is pleased to provide *Understanding Concentrated Animal Feeding Operations and Their Impact on Communities* to assist local boards of health who have concerns about concentrated animal feeding operations (CAFOs) or large industrial animal farms in their communities. The Environmental Health Services Branch of the Centers for Disease Control and Prevention (CDC), National Center for Environmental Health (NCEH) encouraged the development of this product and provided technical oversight and financial support. This publication was supported by Cooperative Agreement Number 5U38HM000512. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the CDC.

The mission of NALBOH is to strengthen boards of health, enabling them to promote and protect the health of their communities, through education, technical assistance, and advocacy. Boards of health are responsible for fulfilling three public health core functions: assessment, policy development, and assurance. For a health agency, this includes overseeing and ensuring that there are sufficient resources, effective policies and procedures, partnerships with other organizations and agencies, and regular evaluation of an agency's services.

NALBOH is confident that *Understanding Concentrated Animal Feeding Operations and Their Impact on Communities* will help local board of health members understand their role in developing ways to mitigate potential problems associated with CAFOs. We trust that the information provided in this guide will enable board of health members to develop and sustain monitoring programs, investigate developing policy related to CAFOs, and create partnerships with other local and state agencies and officials to improve the health and well-being of communities everywhere.

A special thanks to Jeffrey Neistadt (NALBOH's Director – Education and Training), NALBOH's Environmental Health subcommittee, and any local board of health members and health department staff who were contacted during the development of this document for their contributions and support.

Notes

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Introduction

Livestock farming has undergone a significant transformation in the past few decades. Production has shifted from smaller, family-owned farms to large farms that often have corporate contracts. Most meat and dairy products now are produced on large farms with single species buildings or open-air pens (MacDonald & McBride, 2009). Modern farms have also become much more efficient. Since 1960, milk production has doubled, meat production has tripled, and egg production has quadrupled (Pew Commission on Industrial Animal Farm Production, 2009). Improvements to animal breeding, mechanical innovations, and the introduction of specially formulated feeds and animal pharmaceuticals have all increased the efficiency and productivity of animal agriculture. It also takes much less time to raise a fully grown animal. For example, in 1920, a chicken took approximately 16 weeks to reach 2.2 lbs., whereas now they can reach 5 lbs. in 7 weeks (Pew, 2009).

New technologies have allowed farmers to reduce costs, which mean bigger profits on less land and capital. The current agricultural system rewards larger farms with lower costs, which results in greater profit and more incentive to increase farm size.

AFO vs. CAFO

A CAFO is a specific type of large-scale industrial agricultural facility that raises animals, usually at high-density, for the consumption of meat, eggs, or milk. To be considered a CAFO, a farm must first be categorized as an animal feeding operation (AFO). An AFO is a lot or facility where animals are kept confined and fed or maintained for 45 or more days per year, and crops, vegetation, or forage growth are not sustained over a normal growing period (Environmental Protection Agency [EPA], 2009). CAFOs are classified by the type and number of animals they contain, and the way they discharge waste into the water supply. CAFOs are AFOs that contain at least a certain number of animals, or have a number of animals that fall within a range and have waste materials that come into contact with the water supply. This contact can either be through a pipe that carries manure or wastewater to surface water, or by animal contact with surface water that runs through their confined area. (See Appendix A)

History

AFOs were first identified as potential pollutants in the 1972 Clean Water Act. Section 502 identified "feedlots" as "point sources" for pollution along with other industries, such as fertilizer manufacturing. Consequently, a permit program entitled the National Pollutant Discharge Elimination System (NPDES) was created which set effluent limitation guidelines and standards (ELGs) for CAFOs. CAFOs have since been regulated by NPDES or a state equivalent since the mid-1970s. The definitions of what was considered an AFO or CAFO were created by the EPA for the NPDES process in 1976. These regulations remained in effect for more than 25 years, but increases and changes to farm size and production methods required an update to the permit system.

The regulations guiding CAFO permits and operations were revised in 2003. New inclusions in the 2003 regulations were that all CAFOs had to apply for a NPDES permit even if they only discharged in the event of a large storm. Large poultry operations were included in the regulations, regardless of their waste disposal system, and all CAFOs that held a NPDES permit were required to develop and implement a nutrient management plan. These plans had CAFOs identify ways to treat or process waste in a way that maintained nutrient levels at the appropriate amount.

The 2003 CAFO rule was subsequently challenged in court. A Second Circuit Court of Appeals decision required alteration to the CAFO permitting system. In *Water Keeper et al. vs. the EPA*, the court directed the EPA to remove the requirement for all CAFOs to apply for NPDES. Instead, the court required that nutrient management plans be submitted with the permit application, reviewed by officials and the public, and the terms of the plan be incorporated into the permit.

As a result of this court decision, the CAFO rule was again updated. The current final CAFO rule, which was revised in 2008, requires that only CAFOs which discharge or propose to discharge waste apply for permits. The EPA has also provided clarification in the discussion surrounding the rule on how CAFOs should assess whether they discharge or propose to discharge. There is also the opportunity to receive a no discharge certification for CAFOs that do not discharge or propose to discharge. This certification demonstrates that the CAFO is not required to acquire a permit. And while CAFOs were required to create nutrient management plans under the 2003 rule, these plans were now included with permit applications, and had a built-in time period for public review and comment.

Benefits of CAFOs

When properly managed, located, and monitored, CAFOs can provide a low-cost source of meat, milk, and eggs, due to efficient feeding and housing of animals, increased facility size, and animal specialization. When CAFOs are proposed in a local area, it is usually argued that they will enhance the local economy and increase employment. The effects of using local materials, feed, and livestock are argued to ripple throughout the economy, and increased tax expenditures will lead to increase funds for schools and infrastructure.

Environmental Health Effects

The most pressing public health issue associated with CAFOs stems from the amount of manure they produce. CAFO manure contains a variety of potential contaminants. It can contain plant 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.

Depending on the type and number of animals in the farm, manure production can range between 2,800 tons and 1.6 million tons a year (Government Accountability Office [GAO], 2008). Large farms can produce more waste than some U.S. cities—a feeding operation with 800,000 pigs could produce over 1.6 million tons of waste a year. That amount is one and a half times more than the annual sanitary waste produced by the city of Philadelphia, Pennsylvania (GAO, 2008). Annually, it is estimated that livestock animals in the U.S. produce each year somewhere between 3 and 20 times more manure than people in the U.S. produce, or as much as 1.2–1.37 billion tons of waste (EPA, 2005). Though sewage treatment plants are required for human waste, no such treatment facility exists for livestock waste.

While manure is valuable to the farming industry, in quantities this large it becomes problematic. Many farms no longer grow their own feed, so they cannot use all the manure they produce as fertilizer. CAFOs must find a way to manage the amount of manure produced by their animals. Ground application of untreated manure is one of the most common disposal methods due to its low cost. It has limitations, however, such as the inability to apply manure while the ground is frozen. There are also limits as to how many nutrients from manure a land area can handle. Over application of livestock wastes can overload soil with macronutrients like nitrogen and phosphorous and micronutrients that have been added to animal feed like heavy metals (Burkholder et al., 2007). Other manure management strategies include pumping liquefied manure onto spray fields, trucking it off-site, or storing it until it can be used or treated. Manure can be stored in deep pits under the buildings that hold animals, in clay or concrete pits, treatment lagoons, or holding ponds.

Animal feeding operations are developing in close proximity in some states, and fields where manure is applied have become clustered. When manure is applied too frequently or in too large a quantity to an area, nutrients overwhelm the absorptive capacity of the soil, and either run off or are leached into the groundwater. Storage units can break or become faulty, or rainwater can cause holding lagoons to overflow. While CAFOs are required to have permits that limit the levels of manure discharge, handling the large amounts of manure inevitably causes accidental releases which have the ability to potentially impact humans.

The increased clustering and growth of CAFOs has led to growing environmental problems in many communities. The excess production of manure and problems with storage or manure management can affect ground and surface water quality. Emissions from degrading manure and livestock digestive processes produce air pollutants that often affect ambient air quality in communities surrounding CAFOs. CAFOs can also be the source of greenhouse gases, which contribute to global climate change.

All of the environmental problems with CAFOs have direct impact on human health and welfare for communities that contain large industrial farms. As the following sections demonstrate, human health can suffer because of contaminated air and degraded water quality, or from diseases spread from farms. Quality of life can suffer because of odors or insect vectors surrounding farms, and property values can drop, affecting the financial stability of a community. One study found that 82.8% of those living near and 89.5% of those living far from CAFOs believed that their property values decreased, and 92.2% of those living near and 78.9% of those living far from CAFOs believed the odor from manure was a problem. The study found that real estate values had not dropped and odor infestations were not validated by local governmental staff in the areas. However, the concerns show that CAFOs remain contentious in communities (Schmalzried and Fallon, 2007). CAFOs are an excellent example of how environmental problems can directly impact human and community well-being.

Groundwater

Groundwater can be contaminated by CAFOs through runoff from land application of manure, leaching from manure that has been improperly spread on land, or through leaks or breaks in storage or containment units. The EPA's 2000 National Water Quality Inventory found that 29 states specifically identified animal feeding operations, not just concentrated animal feeding operations, as contributing to water quality impairment (Congressional Research Service, 2008). A study of private water wells in Idaho detected levels of veterinary antibiotics, as well as elevated levels of nitrates (Batt, Snow, & Alga, 2006). Groundwater is a major source of drinking water in the United States. The EPA estimates that 53% of the population relies on groundwater for drinking water, often at much higher rates in rural areas (EPA, 2004). Unlike surface water, groundwater contamination sources are more difficult to monitor. The extent and source of contamination are often harder to pinpoint in groundwater than surface water contamination. Regular testing of household water wells for total and fecal coliform bacteria is a crucial element in monitoring groundwater quality, and can be the first step in discovering contamination issues related to CAFO discharge. Groundwater contamination can also affect surface water (Spellman &

Whiting, 2007). Contaminated groundwater can move laterally and eventually enter surface water, such as rivers or streams.

When groundwater is contaminated by pathogenic organisms, a serious threat to drinking water can occur. Pathogens survive longer in groundwater than surface water due to lower temperatures and protection from the sun. Even if the contamination appears to be a single episode, viruses could become attached to sediment near groundwater and continue to leach slowly into groundwater. One pollution event by a CAFO could become a lingering source of viral contamination for groundwater (EPA, 2005).

Groundwater can still be at risk for contamination after a CAFO has closed and its lagoons are empty. When given increased air exposure, ammonia in soil transforms into nitrates. Nitrates are highly mobile in soil, and will reach groundwater quicker than ammonia. It can be dangerous to ignore contaminated soil. The amount of pollution found in groundwater after contamination depends on the proximity of the aquifer to the CAFO, the size of the CAFO, whether storage units or pits are lined, the type of subsoil, and the depth of the groundwater.

If a CAFO has contaminated a water system, community members should be concerned about nitrates and nitrate poisoning. Elevated nitrates in drinking water can be especially harmful to infants, leading to blue baby syndrome and possible death. Nitrates oxidize iron in hemoglobin in red blood cells to methemoglobin. Most people convert methemoglobin back to hemoglobin fairly quickly, but infants do not convert back as fast. This hinders the ability of the infant's blood to carry oxygen, leading to a blue or purple appearance in affected infants. However, infants are not the only ones who can be affected by excess nitrates in water. Low blood oxygen in adults can lead to birth defects, miscarriages, and poor general health. Nitrates have also been speculated to be linked to higher rates of stomach and esophageal cancer (Bowman, Mueller, & Smith, 2000). In general, private water wells are at higher risk of nitrate contamination than public water supplies.

Surface Water

The agriculture sector, including CAFOs, is the leading contributor of pollutants to lakes, rivers, and reservoirs. It has been found that states with high concentrations of CAFOs experience on average 20 to 30 serious water quality problems per year as a result of manure management problems (EPA, 2001). This pollution can be caused by surface discharges or other types of discharges. Surface discharges can be caused by heavy storms or floods that cause storage lagoons to overfill, running off into nearby bodies of water. Pollutants can also travel over land or through surface drainage systems to nearby bodies of water, be discharged through manmade ditches or flushing systems found in CAFOs, or come into contact with surface water that passes directly through the farming area. Soil erosion can contribute to water pollution, as some pollutants can bond to eroded soil and travel to watersheds (EPA, 2001). Other types of discharges occur when pollutants travel to surface water through other mediums, such as groundwater or air.

Contamination in surface water can cause nitrates and other nutrients to build up. Ammonia is often found in surface waters surrounding CAFOs. Ammonia causes oxygen depletion from water, which itself can kill aquatic life. Ammonia also converts into nitrates, which can cause nutrient overloads in surface waters (EPA, 1998). Excessive nutrient concentrations, such as nitrogen or phosphorus, can lead to eutrophication and make water inhabitable to fish or indigenous aquatic life (Sierra Club Michigan Chapter, n.d.). Nutrient over-enrichment causes algal blooms, or a rapid increase of algae growth in an aquatic environment (Science Daily, n.d.). Algal blooms can cause a spiral of environmental problems to an aquatic system. Large groups of algae can block sunlight from underwater plant life, which are habitats for much aquatic life. When algae growth increases in surface water, it can also dominate other resources and cause plants to die. The dead plants provide fuel for bacteria to grow and increased bacteria use more of the water's oxygen supply. Oxygen depletion once again causes indigenous aquatic life to die. Some algal blooms can contain toxic algae and other microorganisms, including *Pfiesteria*, which has caused large fish kills in North Carolina, Maryland, and the Chesapeake Bay area (Spellman & Whiting, 2007). Eutrophication can cause serious problems in surface waters and disrupt the ecological balance.

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% 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.

Air Quality

In addition to polluting ground and surface water, CAFOs also contribute to the reduction of air quality in areas surrounding industrial farms. Animal feeding operations produce several types of air emissions, including gaseous and particulate substances, and CAFOs produce even more emissions due to their size. The primary cause of gaseous emissions is the decomposition of animal manure, while particulate substances are caused by the movement of animals. The type, amount, and rate of emissions created depends on what state the manure is in (solid, slurry, or liquid), and how it is treated or contained after it is excreted. Sometimes manure is "stabilized" in anaerobic lagoons, which reduces volatile solids and controls odor before land application.

The most typical pollutants found in air surrounding CAFOs are ammonia, hydrogen sulfide, methane, and particulate matter, all of which have varying human health risks. Table 1 on page 6 provides information on these pollutants.

Most manure produced by CAFOs is applied to land eventually and this land application can result in air emissions (Merkel, 2002). The primary cause of emission through land application is the volatilization of ammonia when the manure is applied to land. However, nitrous oxide is also created when nitrogen that has been applied to land undergoes nitrification and denitrification. Emissions caused by land application occur in two phases: one immediately following land application and one that occurs later and over a longer period as substances in the soil break down. Land application is not the only way CAFOs can emit harmful air emissions—ventilation systems in CAFO buildings can also release dangerous contaminants. A study by Iowa State University, which was a result of a lawsuit settlement between the Sierra Club and Tyson Chicken, found that two chicken houses in western Kentucky emitted over 10 tons of ammonia in the year they were monitored (Burns et al., 2007).

Most studies that examine the health effects of CAFO air emissions focus on farm workers, however some have studied the effect on area schools and children. While all community members are at risk from lowered air quality, children take in 20-50% more air than adults, making them more susceptible to lung disease and health effects (Kleinman, 2000). Researchers in North Carolina found that the closer children live to a CAFO, the greater the risk of asthma symptoms (Barrett, 2006). Of the 226 schools that were included in the study, 26% stated that there were noticeable odors from CAFOs outdoors, while 8% stated

Table 1 Typical pollutants found in air surrounding CAFOs.

CAFO Emissions	Source	Traits	Health Risks
Ammonia	Formed when microbes decompose undigested organic nitrogen compounds in manure	Colorless, sharp pungent odor	Respiratory irritant, chemical burns to the respiratory tract, skin, and eyes, severe cough, chronic lung disease
Hydrogen Sulfide	Anaerobic bacterial decomposition of protein and other sulfur containing organic matter	Odor of rotten eggs	Inflammation of the moist membranes of eye and respiratory tract, olfactory neuron loss, death
Methane	Microbial degradation of organic matter under anaerobic conditions	Colorless, odorless, highly flammable	No health risks. Is a greenhouse gas and contributes to climate change.
Particulate Matter	Feed, bedding materials, dry manure, unpaved soil surfaces, animal dander, poultry feathers	Comprised of fecal matter, feed materials, pollen, bacteria, fungi, skin cells, silicates	Chronic bronchitis, chronic respiratory symptoms, declines in lung function, organic dust toxic syndrome

they experience odors from CAFOs inside the schools. Schools that were closer to CAFOs were often attended by students of lower socioeconomic status (Mirabelli, Wing, Marshall, & Wilcosky, 2006).

There is consistent evidence suggesting that factory farms increase asthma in neighboring communities, as indicated by children having higher rates of asthma (Sigurdarson & Kline, 2006; Mirabelli et al., 2006). CAFOs emit particulate matter and suspended dust, which is linked to asthma and bronchitis. Smaller particles can actually be absorbed by the body and can have systemic effects, including cardiac arrest. If people are exposed to particulate matter over a long time, it can lead to decreased lung function (Michigan Department of Environmental Quality [MDEQ] Toxics Steering Group [TSG], 2006). CAFOs also emit ammonia, which is rapidly absorbed by the upper airways in the body. This can cause severe coughing and mucous build-up, and if severe enough, scarring of the airways. Particulate matter may lead to more severe health consequences for those exposed by their occupation. Farm workers can develop acute and chronic bronchitis, chronic obstructive airways disease, and interstitial lung disease. Repeated exposure to CAFO emissions can increase the likelihood of respiratory diseases. Occupational asthma, acute and chronic bronchitis, and organic dust toxic syndrome can be as high as 30% in factory farm workers

(Horrigan, Lawrence, & Walker, 2002). Other health effects of CAFO air emissions can be headaches, respiratory problems, eye irritation, nausea, weakness, and chest tightness.

There is evidence that CAFOs affect the ambient air quality of a community. There are three laws that potentially govern CAFO air emissions—the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, also known as the Superfund Act), the Emergency Planning & Community Right to Know Act (EPCRA), and the Clean Air Act (CAA). However, the EPA passed a rule that exempts all CAFOs from reporting emissions under CERCLA. Only CAFOs that are classified as large are required to report any emission event of 100 pounds of ammonia or hydrogen sulfide or more during a 24-hour period locally or to the state under EPCRA (Michigan State University Extension, n.d.). The EPA has also instituted a voluntary Air Quality Compliance Agreement in which they will monitor some CAFO air emissions, and will not sue offenders but instead charge a small civil penalty. These changes have attracted criticism from environmental and community leaders who state that the EPA has yielded to influence from the livestock industry. The changes also leave ambiguity as to whether emission standards and air quality near CAFOs are being monitored.

Greenhouse Gas and Climate Change

Aside from the possibility of lowering air quality in the areas around them, CAFOs also emit greenhouse gases, and therefore contribute to climate change. Globally, livestock operations are responsible for approximately 18% of greenhouse gas production and over 7% of U.S. greenhouse gas emissions (Massey & Ulmer, 2008). While carbon dioxide is often considered the primary greenhouse gas of concern, manure emits methane and nitrous oxide which are 23 and 300 times more potent as greenhouse gases than carbon dioxide, respectively. The EPA attributes manure management as the fourth leading source of nitrous oxide emissions and the fifth leading source of methane emissions (EPA, 2009).

The type of manure storage system used contributes to the production of greenhouse gases. Many CAFOs store their excess manure in lagoons or pits, where they break down anaerobically (in the absence of oxygen), which exacerbates methane production. Manure that is applied to land or soil has more exposure to oxygen and therefore does not produce as much methane. Ruminant livestock, such as cows, sheep, or goats, also contribute to methane production through their digestive processes. These livestock have a special stomach called a rumen that allows them to digest tough grains or plants that would otherwise be unusable. It is during this process, called enteric fermentation, that methane is produced. The U.S. cattle industry is one of the primary methane producers. Livestock production and meat and dairy consumption has been increasing in the United States, so it can only be assumed that these greenhouse gas emissions will also rise and continue to contribute to climate change.

Odors

One of the most common complaints associated with CAFOs are the odors produced. The odors that CAFOs emit are a complex mixture of ammonia, hydrogen sulfide, and carbon dioxide, as well as volatile and semi-volatile organic compounds (Heederik et al., 2007). These odors are worse than smells formerly associated with smaller livestock farms. The anaerobic reaction that occurs when manure is stored in pits or lagoons for long amounts of time is the primary cause of the smells. Odors from waste are carried away from farm areas on dust and other air particles. Depending on things like weather conditions and farming techniques, CAFO odors can be smelled from as much as 5 or 6 miles away, although 3 miles is a more common distance (State Environmental Resource Center, 2004).

Because CAFOs typically produce malodors, many communities want to monitor emissions and odors. Quantifying odor from industrial farming can be challenging because it is a mixture of free and particle-bound compounds, which can make it hard to identify what specifically is causing the odor. Collecting data on specific gases, such as hydrogen sulfide, can be used as a proxy for odor levels.

CAFO odors can cause severe lifestyle changes for individuals in the surrounding communities and can alter many daily activities. When odors are severe, people may choose to keep their windows closed, even in high temperatures when there is no air conditioning. People also may choose to not let their children play outside and may even keep them home from school. Mental health deterioration and an increased sensitization to smells can also result from living in close proximity to odors from CAFOs. Odor can cause negative mood states, such as tension, depression, or anger, and possibly neurophysciatric abnormalities, such as impaired balance or memory. People who live close to factory farms can develop CAFO-related post traumatic stress disorder, including anxiety about declining quality of life (Donham et al., 2007).

Ten states use direct regulations to control odors emitted by CAFOs. They prohibit odor emissions greater than a set standard. States with direct regulations use scentometers, which measure how many times an odor has to be doused with clean air before the smell is undetectable. An additional 34 states have indirect methods to reduce CAFO odors. These include: setbacks, which specify how far CAFO structures have to be from other buildings; permits, which are the most typical way of regulating CAFOs; public comment or involvement periods; and operator or manure placement training.

Insect Vectors

CAFOs and their waste can be breeding grounds for insect vectors. Houseflies, stable flies, and mosquitoes are the most common insects associated with CAFOs. Houseflies breed in manure, while stable and other flies breed in decaying organic material, such as livestock bedding. Mosquitoes breed in standing water, and water on the edges of manure lagoons can cause mosquito infestations to rise. Flies can change from eggs to adults in only 10 days, which means that substances in which flies breed need to be cleaned up regularly.

Flies are typically considered only nuisances, although insects can agitate livestock and decrease animal health. The John Hopkins Bloomberg School of Public Health found evidence that houseflies near poultry operations may contribute to the dispersion of drug-resistant bacteria (Center for Livable Future, 2009). Since flies are attracted to and eat human food, there is a potential for spreading bacteria or pathogens to humans, including microbes that can cause dysentery and diarrhea (Bowman et al., 2000). Mosquitoes spread zoonotic diseases, such as West Nile virus, St. Louis encephalitis, and equine encephalitis.

Residences closest to the feeding operations experience a much higher fly population than average homes. To lower the rates of insects and any accompanying disease threats, standing water should we cleaned or emptied weekly, and manure or decaying organic matter should be removed twice weekly (Purdue Extension, 2007). For more specific insect vector information, please refer to NALBOH's vector guide (*Vector Control Strategies for Local Boards of Health*).

Pathogens

Pathogens are parasites, bacterium, or viruses that are capable of causing disease or infection in animals or humans. The major source of pathogens from CAFOs is in animal manure. There are over 150 pathogens in manure that could impact human health. Many of these pathogens are concerning because they can cause severe diarrhea. Healthy people who are exposed to pathogens can generally recover quickly, but those who have weakened immune systems are at increased risk for severe illness or death. Those at higher risk include infants or young children, pregnant women, the elderly, and those who are immunosuppressed, HIV positive, or have had chemotherapy. This risk group now roughly compromises 20% of the U.S. population.

Table 2 Select pathogens found in animal manure.

Pathogen	Disease	Symptoms
Bacillus anthracis	Anthrax	Skin sores, headache, fever, chills, nausea, vomiting
Escherichia coli	Colibacilosis, Coliform mastitis-metris	Diarrhea, abdominal gas
Leptospira pomona	Leptospirosis	Abdominal pain, muscle pain, vomiting, fever
Listeria monocytogenes	Listerosis	Fever, fatigue, nausea, vomiting, diarrhea
Salmonella species	Salmonellosis	Abdominal pain, diarrhea, nausea, chills, fever, headache
Clostirdum tetani	Tetanus	Violent muscle spasms, lockjaw, difficulty breathing
Histoplasma capsulatum	Histoplasmosis	Fever, chills, muscle ache, cough rash, joint pain and stiffness
Microsporum and *Trichophyton*	Ringworm	Itching, rash
Giardia lamblia	Giardiasis	Diarrhea, abdominal pain, abdominal gas, nausea, vomiting, fever
Cryptosporidium species	Cryptosporidosis	Diarrhea, dehydration, weakness, abdominal cramping

Sources of infection from pathogens include fecal-oral transmission, inhalation, drinking water, or incidental water consumption during recreational water activities. The potential for transfer of pathogens among animals is higher in confinement, as there are more animals in a smaller amount of space. Healthy or asymptomatic animals may carry microbial agents that can infect humans, who can then spread that infection throughout a community, before the infection is discovered among animals.

When water is contaminated by pathogens, it can lead to widespread outbreaks of illness. Salmonellosis, cryptosporidiosis, and giardiasis can cause nausea, vomiting, fever, diarrhea, muscle pain, and death, among other symptoms. *E.coli* is another serious pathogen, and can be life-threatening for the young, elderly, and immunocompromised. It can cause bloody diarrhea and kidney failure. Since many CAFO use sub-therapeutic antibiotics with their animals, there is also the possibility that disease-resistant bacteria can emerge in areas surrounding CAFOs. Bacteria that cannot be treated by antibiotics can have very serious effects on human health, potentially even causing death (Pew Charitable Trusts, n.d.).

There is also the possibility of novel (or new) viruses developing. These viruses generate through mutation or recombinant events that can result in more efficient human-to-human transmission. There has been some speculation that the novel H1N1 virus outbreak in 2009 originated in swine CAFOs in Mexico. However, that claim has never been substantiated. CAFOs are not required to test for novel viruses, since they are not on the list of mandatory reportable illness to the World Organization for Animal Health.

Antibiotics

Antibiotics are commonly administered in animal feed in the United States. Antibiotics are included at low levels in animal feed to reduce the chance for infection and to eliminate the need for animals to expend energy fighting off bacteria, with the assumption that saved energy will be translated into growth. The main purposes of using non-therapeutic doses of antimicrobials in animal feed is so that animals will grow faster, produce more meat, and avoid illnesses. Supporters of antibiotic use say that it allows animals to digest their food more efficiently, get the most benefit from it, and grow into strong and healthy animals.

The trend of using antibiotics in feed has increased with the greater numbers of animals held in confinement. The more animals that are kept in close quarters, the more likely it is that infection or bacteria can spread among the animals. Seventy percent of all antibiotics and related drugs used in the U.S. each year are given to beef cattle, hogs, and chickens as feed additives. Nearly half of the antibiotics used are nearly identical to ones given to humans (Kaufman, 2000).

There is strong evidence that the use of antibiotics in animal feed is contributing to an increase in antibiotic-resistant microbes and causing antibiotics to be less effective for humans (Kaufman, 2000). Resistant strains of pathogenic bacteria in animals, which can be transferred to humans thought the handling or eating of meat, have increased recently. This is a serious threat to human health because fewer options exist to help people overcome disease when infected with antibiotic-resistant pathogens. The antibiotics often are not fully metabolized by animals, and can be present in their manure. If manure pollutes a water supply, antibiotics can also leech into groundwater or surface water.

Because of this concern for human health, there is a growing movement to eliminate the non-therapeutic use of antibiotics with animals. In 2001, the American Medical Association approved a resolution to ban all low-level use of antibiotics. The USDA has developed guidelines to limit low-level use, and some major meat buyers (such as McDonald's) have stopped using meat that was given antibiotics that are also used for humans. The World Health Organization is also widely opposed to the use of antibiotics, calling for a cease of their low-level use in 2003. Some U.S. legislators are seeking to ban the routine use of antibiotics with livestock, and there has been legislation proposed to solidify a ban. The Preservation of Antibiotics for Medical Treatment Act (PAMTA), which was introduced in 2009, has the support of over 350 health, consumer, and environmental groups (H.R. 1549/S. 619). The act, if passed, would ban seven classes of antibiotics important to human health from being used in animals, and would restrict other antibiotics to therapeutic and some preventive uses.

Other Effects – Property Values

Most landowners fear that when CAFOs move into their community their property values will drop significantly. There is evidence that CAFOs do affect property values. The reasons for this are many: the fear of loss of amenities, the risk of air or water pollution, and the increased possibility of nuisances related to odors or insects. CAFOs are typically viewed as a negative externality that can't be solved or cured. There may be stigma that is attached to living by a CAFO.

The most certain fact regarding CAFOs and property values are that the closer a property is to a CAFO, the more likely it will be that the value of the property will drop. The exact impact of CAFOs fluctuates depending on location and local specifics. Studies have found differing results of rates of property value decrease. One study shows that property value declines can range from a decrease of 6.6% within a 3-mile radius of a CAFO to an 88% decrease within 1/10 of a mile from a CAFO (Dakota Rural Action, 2006). Another study found that property value decreases are negligible beyond 2 miles away from a CAFO (Purdue Extension, 2008). A third study found that negative effects are largest for properties that are downwind and closest to livestock (Herriges, Secchi, & Babcock, 2005). The size and type of the feeding operation can affect property value as well. Decreases in property values can also cause property tax rates to drop, which can place stress on local government budgets.

Considerations for Boards of Health

Right-to-Farm Laws

With all of the potential environmental and public health effects from CAFOs, community members and health officials often resort to taking legal action against these industrial animal farms. However, there are some protections for farms in place that can make lawsuits hard to navigate. Right-to-farm laws were created to address conflicts between farmers and non-farming neighbors. They seek to override common laws of nuisance, which forbid people to use their property in ways that are harmful to others, and protect farmers from unreasonable controls on farming.

All 50 states have some form of right-to-farm laws, but most only offer legal protections to farms if they meet certain specifications. Generally, they must be in compliance with all environmental regulations, be properly run, and be present in a region first before suburban developments, often a year before the plaintiff moves to that area. These right-to-farm laws were originally created in the late 1970s and early 1980s to protect family farms from suburban sprawl, at a time when large industrial farms were not the norm. As industrial farms grew in size and number, the agribusiness industry lobbied for and achieved the passage of stricter laws in the 1990s, many of which are now being challenged in court by homeowners and small family farmers. Opponents to these laws argue that they deprive them of their use of property and therefore violate the Fifth Amendment to the Constitution.

Some state courts have overturned their strict right-to-farm laws, such as Iowa, Michigan, Minnesota, and Kansas. Others such as Vermont have rewritten their laws. Vermont's updated right-to-farm bill protects established farm practices as long as there is not a substantial adverse effect on health, safety, or welfare.

Boards of health need to be aware of what legal protection their state offers farms. Right-to-farm laws can hinder nuisance complaints brought about by community members. State laws can prevent local government or health officials from regulating industrial farms.

Board of Health Involvement with CAFOs

Boards of health are responsible for fulfilling the three public health core functions: assessment, policy development, and assurance. Boards of health can fulfill these functions through addressing problems stemming from CAFOs in their communities. Specific public health services that can tackled regarding CAFOs include monitoring health status, investigating health problems, developing policies, enforcing regulations, informing and educating people about CAFOs, and mobilizing community partnerships to spread awareness about environmental health issues related to CAFOs.

Assessment: Board of health members should ensure that there is an effective method in place for collecting and tracking public complaints about CAFOs and large animal farms. Since environmental health specialists at local health departments are often responsible for investigating complaints, the board of health must take measures to ensure that they are properly trained and educated about CAFOs. It is possible that the board of health may be responsible or choose to do some investigations itself. Schmalzried and Fallon (2008) advocate that local health districts adopt a proactive approach for addressing public concerns about CAFOs, stating that health districts can offer some services that may help ease public frustration with CAFOs. A fly trapping program can establish a baseline for the average number of flies present prior to the start-up of CAFOs or large animal farms, which can then establish if a fly nuisance exists in the area. Testing for water quality and quantity can provide evidence if CAFOs are suspected of affecting private water supplies. Boards of health can also monitor exposure incidences that occur in emergency rooms to determine if migrant or farm workers are developing any adverse health conditions as a result of their work environments. Establishing these programs benefit both members of the community and provide information to future animal farm operators, and local boards of health should recommend them if they've been receiving complaints about CAFOs.

Policy Development: Boards of health in many states can adopt health-based regulations about CAFOs, however, they may be met with some resistance. Humbolt County, Iowa, adopted four health-based ordinances concerning CAFOs that became models for regulations in other states, but the Iowa Supreme Court ruled the ordinances were irreconcilable with state laws. Boards of health that choose to regulate CAFOs can also be subject to pressure from outside forces, including possible lawsuits or withdrawal of funding. Boards of health should also consider working with other local officials to institute regulations on CAFOs, such as zoning ordinances.

Assurance: Boards of health can execute the assurance function by advocating for or educating about better environmental practices with CAFOs. Board members may receive complaints from the public about CAFOs, and boards can hold public meetings to receive complaints and hear public testimony about farms. If boards of health are not capable of regulating industrial farms in their communities, they can still try to collaborate with other local agencies that have jurisdiction. Board of health members can educate other local agencies and public officials about CAFOs and spread awareness about the environmental and health hazards. They can request a public hearing with the permitting agency of the

CAFO to express their concerns about the potential health effects. They can also work with agricultural and farm representatives to teach better environmental practices and pollution reduction techniques.

In many states, boards of health are empowered to adopt more stringent rules than the state law if it is necessary to protect public health. Board of health members should examine their state laws before they take any action regarding CAFOs to determine the most appropriate course of action. Any process should include an investigative period to gather evidence, public hearings, and a time for public review of draft policies.

Board of Health Case Studies

Tewksbury Board of Health, Massachusetts

Locals have complained about Krochmal Farms, a pig farm, for many years, but complaints have increased recently. The addition of a hog finishing facility to the farm coincided with the time that community member complaints grew. Most complaints are centered on the odor coming from the farm. The complaints were originally just logged when phone calls were received; however, the health department added a data tracking system as the number of complaints increased. After a complaint is received, the sanitarian or health director does a site visit to investigate.

The health director in Tewksbury filed an order of prohibition against the farm, which is allowed under Massachusetts law 111, section 143, for anything that threatens public health. The order of prohibition was appealed and the matter was taken to the board of health for a grievance hearing. The board of health hearing included months of testimony about the pig farm. The board of health is also doing a site assignment, which determines if a location is appropriate for treating, storing, or disposing of waste, including agricultural waste. The site assignment process includes both the Department of Environmental Protection (DEP) and the local board of health. The board of health holds a public hearing process, while the DEP reviews the site assignment application. The board of health grants the site assignment only if it is concurrently approved by the DEP.

The health director in Tewksbury points out that the only laws the board of health is able to regulate the farm under are nuisance laws. There have been efforts by the community to do a home rule petition to address the air quality and pest management complaints. The home rule petition is currently working its way through the Massachusetts state house. The status of the petition is unknown.

The board of health has tried to work directly with the pig farm to manage complaints. The farm contains manure composting facilities and the health district has requested advance notice to warn the community before manure is treated or applied to the soil. The farm has adopted a new manure management system. This system uses Rapp technology to control odors and reduce ammonia and hydrogen sulfide levels. However, questions still remain as to whether this addition will fully solve the odor issue. Typically, systems using Rapp technology include an oil cap that floats on manure holding pools and helps seal odors inside. These techniques have been researched and proven to reduce odors. However, the Tewksbury farm did not install the oil cap, and it is unknown whether the exclusion of the cap will hinder the technology's ability to reduce odors.

The complaints about the farm primarily concern the odor that emanates from the farm. The complaints do include mention of health side effects, including nausea and burning eyes. The health director has also heard concerns about potential environmental effects from the pig manure. Community members are worried the manure runoff is entering and contaminating Sutton Brook, since there has been flooding in that area. There has been no confirmation of this occurring. The board of health is aware that the farm has a nutrient management plan, but they are not allowed to request and find out what is incorporated in that plan.

The Tewksbury piggery is technically not classified as a CAFO, though it is believed to be the largest pig farm in the commonwealth of Massachusetts. The area around it has become densely populated and the community members state that they just want to live peacefully with the farm. The board of health has submitted multiple grant applications to study the health effects associated with the farm. After the site assignment process is complete, the board of health will decide how it will regulate the farm. At the beginning of 2010, the board of health was still working on drafting regulations for the pig farms.

Wood County Board of Health, Ohio

Wood County, Ohio, contains two existing large dairy farms, both of which were proposed in 2001 to be expanded to over 1500 cows each. It is also the site for three other proposed dairy farms. There is a large community effort that supports restricting the operation and expansion of these farms, mainly represented by the community group Wood County Citizens Opposed to Factory Farms. The Wood County Board of Health became involved in investigating these dairy farms through this community group and other local officials. The Trustees of Liberty Township requested assistance from the Wood County Board of Health in supporting a moratorium on factory farm operations until local regulations were in effect. The trustees believed that manure runoff from the farms could contaminate local waterways, lower the ground water table, increase the presence of insect vectors, and devalue local properties.

The Wood County Health Director, in cooperation with the board of health, contacted nearby counties to determine what actions they had taken against farms in their communities. While the health director and board of health investigated action in the form of a nuisance regulation against the farms, they were advised that nuisance lawsuits filed against farms in Ohio were held to a tough standard, and they would be forced to demonstrate with scientific proof that the farms have a substantial adverse effect on health. They found that no other board of health in Ohio had opted to regulate farming operations and relied on the enforcement of existing state laws.

The board of health held a public forum to hear public opinion regarding the industrial farms. Ultimately, the Wood County Board of Health took actions other than regulations to help protect the health and environment of its community. They helped community members protect the safety of their water wells by offering free and low cost water well testing and inspections. They tested area ditch and water ways for fecal coliform bacteria, phosphorous, and nitrates to monitor the impact of farm runoff. They also purchased fly traps to monitor and count fly types to determine if the farms have caused an increase in insect vectors. Board of health members also met with state officials from the Ohio EPA in an effort to facilitate cooperation regarding the factory farms. While the Wood County Board of Health and Health Department chose not to institute any local regulations, they continue to monitor the situation and respond to community complaints.

Cerro Gordo County Board of Health, Iowa

Officials in Cerro Gordo County, Iowa, began looking into regulating animal feeding operations after the number of hog farms in Iowa started to grow. Floods in North Carolina and new regulations in Colorado meant that many hog farms began relocating to Iowa. Many citizens had concerns over the effects of

CAFOs, and the Iowa State Association of Counties wanted to review air quality issues. Officials in Cerro Gordo County originally began working on a regulation that required inspections and was based on public health concerns, since farms were already exempt from any regulations related to zoning. However, Iowa state senators soon introduced legislation that passed and prevented any animal feeding operations from being regulated from a public health angle as well.

As Iowans were now prevented from regulating animal feeding operations in terms of zoning or public health, officials in Cerro Gordo County decided to place a moratorium on the construction of new animal feeding operations in that county. They wanted to temporarily stop the growth of animal feeding operations until they could get better science about their effects. Cerro Gordo County Ordinance #40, the "Animal Confinement Moratorium Ordinance," went into effect on May 14, 2002. Since the moratorium did not address public health or zoning, officials were able to get around the rules and still have a way to temporarily control animal feeding operation growth in their county. The ordinance placed "a 1-year moratorium on any new construction, expansion, or activity occurring on land used for the production, care, feeding, or housing of animals." The ordinance also afforded "local public health officials adequate time to appropriately assess health and environmental concerns that may be related to confined animal feeding operations and concentration of animals; establish objective measurable standards of enforcement; exercise the Board of Health's responsibility to protect and improve the health of the public; refrain from impacting farm operators unfairly; and provide penalties for violations of the provisions hereof pursuant to Chapter 137, Code of Iowa" (Cerro Gordo County, 2002).

The moratorium was first adopted by the Cerro Gordo County Board of Health. It was then presented to the county board of supervisors by the health director on behalf of the board of health. Before the board of health adopted the moratorium, they held an investigative meeting in which representatives from the Iowa Farm Bureau and other industry spokespeople exchanged opinions on the issue of animal feeding operations. The moratorium was created through a collaboration between local and county officials—health department staff, the board of health, and the board of supervisors. The moratorium did not receive any help or backing from state officials, who were concerned about the political nature of the ordinance. However it did receive backing from a *Globe Gazette* editorial.

The moratorium was immediately met with resistance from state officials. The Cerro Gordo County Board of Supervisors was contacted by a local legislator, and the Iowa Farm Bureau stated they would challenge the county budget. The Iowa Farm Bureau threatened to take the county to court. There were concerns over the cost of a court trial, which was estimated to be as high as $60,000. The county attorney doubted the legality of the moratorium and ultimately recommended removing it. The moratorium was in effect until June of 2005, when it was repealed by the county board of supervisors.

Since the moratorium was repealed there have been a few hog farms built in Cerro Gordo County, but the decline in pork prices has prevented any large growth of hog farms. Health officials believe that if the county had not implemented the animal confinement moratorium, there would have been many more farms built in their county, since many hog farms were built in counties south of Cerro Gordo County. There is now a process for siting new animal confinement operations in Iowa that uses a Master Matrix scoring system. The Cerro Gordo County Board of Supervisors tracks the Master Matrix system, but so far no animal feeding operations in Iowa who have applied using this system have been denied the right to build.

Conclusion

Concentrated animal feeding operations or large industrial animal farms can cause a myriad of environmental and public health problems. While they can be maintained and operated properly, it is important to ensure that they are routinely monitored to avoid harm to the surrounding community. While states have differing abilities to regulate CAFOs, there are still actions that boards of health can and should take. These actions can be as complex as passing ordinances or regulations directed at CAFOs or can be simply increasing water and air quality testing in the areas surrounding CAFOs. Since CAFOs have such an impact locally, boards of health are an appropriate means for action. Boards of health should take an active role with CAFOs, including collaboration with other state and local agencies, to mitigate the impact that CAFOs or large industrial farms have on the public health of their communities.

Appendix A: Regulatory Definitions of Large CAFOs, Medium CAFOs, and Small CAFOs

Animal Sector	Size Thresholds (number of animals)		
	Large CAFOs	Medium CAFOs[1]	Small CAFOs[2]
Cattle or cow/calf pairs	1,000 or more	300-999	Less than 300
Mature dairy cattle	700 or more	200-699	Less than 200
Veal calves	1,000 or more	300-999	Less than 300
Swine (over 55 pounds)	2,500 or more	750-2,500	Less than 750
Swine (under 55 pounds)	10,000 or more	3,000-9,999	Less than 3,000
Horses	500 or more	150-499	Less than 150
Sheep or lambs	10,000 or more	3,000-9,999	Less than 3,000
Turkeys	55,000 or more	16,500-54,999	Less than 16,500
Laying hens or broilers[3]	30,000 or more	9,000-29,999	Less than 9,000
Chickens other than laying hens[4]	125,000 or more	37.500-124,999	Less than 37,500
Laying hens[4]	82,000 or more	25,000-81,999	Less than 25,000
Ducks[4]	30,000 or more	10,000-29,999	Less than 10,000
Ducks[3]	5,000 or more	1,500-4,999	Less than 1,500

Data: Environmental Protection Agency

1 Must also meet one of two “method of discharge” criteria to be defined as a CAFO or must be designated.

2 Never a CAFO by regulatory definition, but may be designated as a CAFO on a case-by-case basis.

3 Liquid manure handling system

4 Other than a liquid manure handling system

Appendix B: Additional Resources

American Public Health Association. *Precautionary moratorium on new concentrated animal feed operations*. http://www.apha.org/advocacy/policy/policysearch/default.htm?id=1243

Center for a Livable Future. http://www.livablefutureblog.com/

Environmental Health Sciences Research Center. *Iowa concentrated animal feeding operation air quality study*. http://www.public-health.uiowa.edu/ehsrc/CAFOstudy.htm

Environmental Protection Agency. *Animal feeding operations*. http://cfpub.epa.gov/npdes/home.cfm?program_id=7

Food and Water Watch. http://www.foodandwaterwatch.org/

Impacts of CAFOs on Rural Communities. http://web.missouri.edu/ikerdj/papers/Indiana%20--%20CAFOs%20%20Communities.htm#_ftn1

Land Stewardship Project. http://www.landstewardshipproject.org/index.html

Midwest Environmental Advocates. http://www.midwestadvocates.org/

National Agriculture Law Center. *Animal feeding operations reading room*. http://www.nationalaglawcenter.org/readingrooms/afos

National Association of Local Boards of Health. *Vector control strategies for local boards of health*. http://www.nalboh.org/publications.htm

Pew Charitable Trusts. *Human health and industrial farming*. http://www.saveantibiotics.org/index.html

Pew Commission on Industrial Animal Farm Production. http://www.ncifap.org/

Purdue Extension. *Concentrated animal feeding operations*. http://www.ansc.purdue.edu/CAFO/

State Environmental Resource Center. http://serconline.org

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Center for Livable Future. (2009). *Flies may spread drug-resistant bacteria from poultry operations*. Retrieved from http://www.livablefutureblog.com/2009/03/flies-may-spread-drug-resistant-bacteria-from-poultry-operations/

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