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August 13, 2010

Via U.S. Mail and Electronic Mail

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Re: Proposed Surface Water and Ground Water Monitoring Rules for Animal Feeding Operations (15A N.C. Admin. Code 02T.1310-1311)

Dear Mr. Larick,

Thank you for the opportunity to comment on the proposed surface water and ground water monitoring rules for animal feeding operations (hereinafter proposed rules). These comments are submitted on behalf of Clean Water for NC, Catawba Riverkeeper, French Broad Riverkeeper, Lower Neuse Riverkeeper, Pamlico-Tar Riverkeeper, Waccamaw Riverkeeper, White Oak-New Riverkeeper, Yadkin Riverkeeper, and Waterkeeper Alliance (Waterkeepers). Waterkeepers and Clean Water for NC support the implementation of monitoring rules capable of efficiently and effectively determining if and when animal waste is being discharged from animal feeding operations in North Carolina.

We believe these proposed rules can capably support a zero discharge goal upon the incorporation of the following three improvements:

1. An expansion in the number of sampling sites required at each operation;
2. An increase in the number of targeted sampling events; and
3. A re-expansion of the surface water monitoring plan monitoring parameters to include a true fecal indicator organism, such as fecal coliform, and 5-day biochemical oxygen demand (BOD).

I. UNDER BOTH STATE AND FEDERAL ENVIRONMENTAL LAWS, ANIMAL FEEDING OPERATIONS MUST COMPLY WITH A ZERO DISCHARGE STANDARD

Animal feeding operations, especially large concentrated animal feeding operations (CAFOs), can negatively impact water quality and human health through the discharge of pollutants into water resources.[1] As evidenced in the following statement by Senator Robert Dole during the

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[1] *See* U.S. EPA, *National Pollution Discharge Elimination System Permit Regulation and Effluent Limitation Guidelines and Standards for Concentrated Animal Feeding Operations (CAFOs); Final Rule [*hereinafter 2003 Rule*]*, 68 Fed. Reg. 7176, 7179 (Feb. 12, 2003)("[d]espite more than 25 years of regulation of CAFOs, reports of discharge and runoff of manure and manure nutrients from these operations persists.").

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passage of the Clean Water Act in 1972, this potential for discharge has been publicly recognized for quite some time.

> Animal and poultry waste, until recent years, has not been considered a major pollutant .... The picture has dramatically changed, however, as development of intensive livestock and poultry production on feedlots and in modern buildings has created massive concentrations of manure in small areas. The recycling capacity of the soil and plant cover has been surpassed .... Precipitation runoff from these areas picks up high concentrations of pollutants which reduce oxygen levels in receiving streams and lakes and accelerate the eutrophication process.... [W]aste management systems are required to prevent waste generation in concentrated production areas from causing serious harm to surface and groundwaters.[2]

The substance of this statement remains true today. For, as the "recycling capacity" for soil and plant cover has "been surpassed," as the already deficient waste management systems utilized at these operations have aged and deteriorated, and as the Industry has further consolidated, the threat of discharge from these operations has only become worse.[3]

To counter this known discharge potential, the federal Clean Water Act prohibits CAFOs from discharging any pollutants into jurisdictional waters without a tailored National Pollution Discharge Elimination System (NPDES) permit.[4] Discharge in this case means all discharge, whether continuous, intermittent, sporadic or even as the result of a 25-year, 24-hour storm or

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[2] Statement of Senator Robert Dole, S. Rep. No. 92-414, at 100 (1972), reprinted in 1972 U.S.C.C.A.N. 3668, 3761.

[3] *See* 2003 Rule at 7180 ("[]the continued trend towards fewer but larger operations, coupled with greater emphasis on more intensive production methods and specialization, is concentrating more manure nutrients and other animal waste constituents within some geographic areas. These large operations often do not have sufficient land to effectively use manure as fertilizer. Furthermore, there is limited land acreage near the CAFO to effectively use the manure. This trend has coincided with increased reports of large-scale discharges from CAFOs, as well as continued runoff that is contributing to the significant increase in nutrients and resulting impairment of many U.S. water bodies.").

[4] *See* 33 U.S.C. §§ 1311(a), 1342, 1362(7) & (12). *See also* U.S. EPA, *Revised National Pollution Discharge Elimination System Permit Regulation and Effluent Limitation Guidelines for Concentrated Animal Feeding Operations in Response to the Waterkeeper Decision; Final Rule* [hereinafter 2008 Rule], 73 Fed. Reg. 70417, 70424 (Nov. 20, 2008)("EPA disagrees that CAFOs designated for the 25-year, 24-hour storm should be categorically excluded from the requirement to apply for a permit simply based on their design standard. EPA also believes that it is reasonable to expect unpermitted CAFOs to meet a zero discharge standard. The [Clean Water Act] is very clear that point source discharges from CAFOs are illegal unless the operator has applied for and obtained an NPDES permit. Thus 'zero discharge' is the only standard to which EPA can hold unpermitted CAFOs under the [Clean Water Act].... [A] violation of the prohibition against discharging without a permit occurs even if the discharge was not planned or intended.").

greater. [5] Likewise, North Carolina prohibits the discharge of pollutants from animal feeding operations through its "non-discharge" permitting system.[6]

To promote compliance with state and federal zero discharge standards, each statute provides broad regulatory authority to implement compliance conditions and programs, such as monitoring programs.[7] However, despite this strong language, there is no true system in place to require this extensive industry to show that they are in fact complying with the laws and not discharging pollutants into North Carolina waters.

II. SUMMARY - AN ADEQUATELY TAILORED MONITORING PROGRAM IS NECESSARY TO SHOW COMPLIANCE WITH THE LAW AND TO PROTECT HUMAN HEALTH AND THE ENVIRONMENT

Despite federal and North Carolina zero discharge standards, discharge from animal feeding operations occurs in a number of ways, including through direct discharge, runoff, waste mismanagement and deposition.[8] In fact, studies show that discharges from animal feeding

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[5] *Id. See also Id.* at 70423 ("[i]t is well established that 'discharge' is not limited to continuous discharges of pollutants from a point source to waters of the U.S., but also includes intermittent and sporadic discharge"); *Chesapeake Bay Foundation v. Gwaltney of Smithfield*, 890 F.2d 690, 693 (4th Cir. 1989) ("[i]ntermittent or sporadic violations do not cease to be ongoing until the date when there is no real likelihood of repetition.").

[6] *See* N.C. Gen. Stat. § 143-215.10C(b) ("[a]n animal waste management system shall be designed, constructed, and operated so that the animal operation served by the animal waste management system does not cause pollution in the waters of the State" except as allowable under the Clean Water Act and during specified storm periods). *See also, e.g.,* N.C. Swine Waste Management System General Permit, General Permit Number AWG100000 (2009) ("[a]ny discharge of waste that reaches surface waters or wetlands ... except as otherwise provided in this General Permit and associated statutory and regulatory provisions.").

[7] See 33 U.S.C. § 1342(b)(2) ("[t]he Administrator shall prescribe conditions for such permits to assure compliance with the requirements of [the NPDES program], including conditions on data and information collection, reporting, and such other requirements as he deems appropriate."); 15A NCAC 02B.0505 ("[e]very person subject to this Section shall be required to establish, operate and maintain a monitoring program consistent with their National Pollution Discharge Elimination System (NPDES) permit or as required by the Director.").

[8] *See, e.g.,* EPA, Environmental Assessment of Proposed Revisions to the NPDES Regulation and Effluent Guidelines for CAFOs, EPA-HQ-OW-2002-0025-0022 (Jan. 2001), *available at* www.regulations.gov (last visited August 10, 2010)(summarizing known discharge routes of animal waste from CAFOs); Gurian-Sherman, D. (2008). *CAFOs Uncovered: The Untold Costs of Confined Animal Feeding Operations.* Union of Concerned Scientists Publications: Cambridge, MA, *available at* http://www.ucsusa.org (last visited August 10, 2010); Halden, R.U., Schwab, K.J. (2007). *Environmental Impacts of Industrial Farm Animal Production* [hereinafter PEW Environmental Impacts]. PEW Commission on Industrial Farm Animal Production, *available at* http://www.ncifap.org/reports (last visited August 10, 2010); Hodne, C.J. (2005). *Concentrating on Clean Water: The Challenge of Concentrated Animal Feeding Operations.* Prepared for the Iowa Policy Project, April 2005, *available at* http://www.iowapolicyproject.org (last visited August 10, 2010); Jongbloed, A.W., Lenis, N.P. (1998). Environmental concerns about animal manure. *Journal of Animal Science*, 76: 2641-2648; Mitloehner, F.M., Schenker, M.B. (2007). Environmental exposure and health effects from concentrated animal feeding operations. *Epidemiology*, 18: 309-311; PEW Commission on Industrial Farm Animal Production (2008). *Putting Meat on the Table: Industrial Farm Animal Production in America* [hereinafter Putting Meat on the Table], *available at* http://www.ncifap.org/reports (last visited August 10, 2010); U.S. Government Accountability Office (GAO)(2008). *EPA Needs More Information and a Clearly Defined Strategy to Protect Air and Water Quality from Pollutants of*

operations in North Carolina to surface and ground waters do occur, and that they result in impairment to the State's rivers, streams and estuaries.[9] Although most of the routes for the discharge of pollutants to water resources are directly land-based, one method for discharge, deposition, is a bit more diffuse. Due to its difficulty to monitor at the surface water level, deposition is not addressed though these proposed rules. Yet, it must be highlighted as an issue of concern because it does present a very real threat to water quality and environmental health.[10]

In short, the primary reason that deposition is a danger to water quality is, quite simply, nitrification. Deposition is a process by which the nitrogen emitted from an animal feeding operation, usually in the form of ammonia, either enters the atmosphere, binds with water

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Concern [hereinafter GAO Report 08-944]. Report No. GAO-08-944, *available at* http://www.gao.gov/ (last visited August 10, 2010).

[9] *See, e.g.,* Burkholder, et al. (2007). Impacts of waste from concentrated animal feeding operations on water quality. *Environmental Health Perspectives*, 115(2): 308-312; Burkholder, et al. (1997). Impacts to a coastal river and estuary from rupture of a large swine waste holding lagoon. *Journal of Environmental Quality*, 26:1451-1466; Evans, R.O. (1984). Subsurface drainage water quality from land application of swine lagoon effluent. *Transactions of American Society of Agricultural Engineers*, 27: 473-480; Cooperband, L.R., Good, L.W. (2002) Biogenic phosphate minerals in manure: Implications for phosphorus loss to surface waters. *Environmental Science & Technology*, 36(23): 5075-5082; Donham, K.J. (2000). The concentration of swine production – Effects on swine health, productivity, human health, and the environment. *Veterinary Clinics of North America: Food Animal Practice*, 16: 559-597; Huffman, R.L., Westerman, P.W. Estimated seepage losses from established swine waste lagoons in the lower coastal plain of North Carolina. *Transactions of American Society of Agricultural Engineers*, 38:449-453; Mallin, et al. (1996). Effects of animal waste spills on receiving waters. In *Solutions: Proceedings of Technical Conference on Water Quality*, North Carolina State University, Raleigh, NC, March 19-21, 1996; Mallin, M.A. (2000). Impacts of animal production on rivers and estuaries. *American Scientist*, 88:26-37; Mallin, M.A., Cahoon, L.B. (2003). Industrialized animal production: A major source of nutrient and microbial pollution in aquatic ecosystems. *Population and the Environment*, 24(5): 369-385; Stone, et al. (1998). Impact of swine waste application on ground and stream water quality in an eastern coastal plain watershed. *American Society of Agricultural Engineers*, 41(6): 1665-1670; U.S. Geological Society (USGS)(2004). *Geochemistry and Characteristics of Nitrogen Transport at a CAFO in a Coastal Plain Agricultural Watershed, and Implications for Nutrient Loading in the Neuse River Basin. N.C.* USGS File Report 2994-5283.

[10] See, e.g., Cure, W., et al. (1999). *Status Report on Emissions and Deposition of Atmospheric Nitrogen Compounds from Animal Production in North Carolina* [hereinafter NC Status Report]. North Carolina Department of Environment and Natural Resources, Division of Air Quality, at 7, *available at* http://daq.state.nc.us/monitor/projects/ (last visited August 10, 2010) ("EPA's Second Great Waters Report to Congress reports that more than 40% of the nitrogen(N) entering the Albemarle-Pamlico Sounds is estimated to come from the atmosphere. Comparisons between current and historical levels of N inputs are difficult but if atmospheric inputs are on the rise, then atmospheric depositions could be a major factor contributing to the over-enrichment, or eutrophication, of coastal waters and estuaries."). *See also* Bajwa, K.S., Arya, S.P, Aneja, V.P. (2008). Modeling studies of ammonia dispersion and dry deposition at some hog farms in North Carolina. *Journal of the Air & Waste Management Association*, 58: 1198-1207 at 1198 ("[o]n a global basis, the amount of nitrogen that enters the biosphere has nearly doubled when compared with the preindustrial times, and a significant component of this increase has been in the form of [ammonia]-nitrogen. In continents with intensive agriculture, atmospheric inputs of reduced nitrogen as [ammonia] and [ammonium] by dry and wet deposition may represent a substantial contribution to the acidification of seminatural ecosystems." (citing Galloway, et al. (2001). Optimizing Nitrogen Management in Food and Energy Production and Environmental Protection. In *Proceedings of the Second International Nitrogen Conference*, A.A. Balkema: Potomac, MD)); Fowler, et al. (1989). Deposition of Atmospheric Pollutants on Forests. *Philosophical Transactions of the Royal Society*, 324:247-265; Grennfelt, P., Thornelof, E. (Eds.)(1992). *Critical Loads for Nitrogen: a Workshop Report.* Nord 19912:40. Nordic Council of Ministers: Copenhagen.

molecules, and is transported back to surface water resources via rain (also known as "wet deposition") or binds directly with surface water resources (known as "dry deposition").[11] Both methods of deposition are hazardous to water quality because they lead to an increase in the nitrogen content of the impact water resources.[12] As discussed below, the over-nitrification of surface waters can cause a number of adverse environmental and human health impacts, including eutrophication.[13] Deposition is often linked to emissions from poultry animal feeding operations, but it is also caused by other animal feeding operations, including swine operations.[14]

Fortunately, while deposition can be difficult to monitor at the surface water level, direct discharge, waste mismanagement, and runoff are comparatively not. The reasons for this are numerous, but the most direct reason is because these discharge routes can often be sited and targeted by a suitable surface water monitoring plan.[15] Additionally, because confined animal waste contains a number of known pollutants[16], the necessary sampling parameters can be

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[11] *See, e.g.,* Aneja, et al. (2003). Agricultural ammonia emissions and ammonium concentrations associated with aerosols and precipitation in the southeast United States. *Journal of Geophysical Research,* 108(D4): 4152-4163; Aneja, et al. (2000). Characterization of atmospheric ammonia emissions from swine waste storage and treatment lagoons. *Journal of Geophysical Research,* 105(D9): 11,535-11,545; Asman, W.A., et al. (1998). Ammonia: emissions, atmospheric transport and deposition. *New Phytologist,* 139: 27-48; Baek, B.H., Aneja, V.P., Tong, Q. (2004). Chemical coupling between ammonia, acid gas, and fine particles. *Environmental Pollution,* 129: 89-98; Costanza, et al. (2008). Potential geographic distribution of atmospheric nitrogen deposition from intensive livestock production in North Carolina, USA. *Science of the Total Environment,* 398: 76-86.

[12] *Id. See also* Bajwa, K.S., Arya, S.P, Aneja, V.P. (2008). Modeling studies of ammonia dispersion and dry deposition at some hog farms in North Carolina. *Journal of the Air & Waste Management Association,* 58: 1198-1207 at 1198 ("[a]ir mass trajectories suggest that wet and dry deposition of NH3 and NH4 emitted from agricultural operations in eastern North Carolina could potentially affect all river basins in the coastal plain region, as well as sensitive coastal ecosystems and estuaries. High nitrogen loading can have detrimental effects on terrestrial ecosystems, effects that can result in the greater export of nitrogen to the surface and groundwater. Adverse effects on sensitive ecosystems caused by nitrogen deposition can be reduced by lowering the emissions and, to a limited extent, also by removing sources close to the ecosystem to be protected.").

[13] *See, e.g.,* NC Status Report at 22-23 ("[m]uch of the concern over atmospheric deposition of N compounds has focused on the effects of nutrient over-enrichment, or eutrophication, in aquatic systems. Added nitrogen, regardless of the source, stimulates algae growth in the nitrogen-limited estuaries and shallow coastal waters of North Carolina.... Estimates of the proportion of the total N that enters these coastal waters from the atmosphere vary substantially, but for the Albemarle-Pamlico Estuary they range between 38% and 44%.").

[14] *See* NC Status Report at 73 ("[numerous studies have] found that nitrogen deposition by precipitation is higher in the region of North Carolina where animal production is most concentrated. They also found that the increases in ammonium concentration in rainfall and increases in ammonium deposition were statistically correlated with growth in hog population in the region."). *See also* Bajwa, K.S., Arya, S.P, Aneja, V.P. (2008). Modeling studies of ammonia dispersion and dry deposition at some hog farms in North Carolina. *Journal of the Air & Waste Management Association,* 58: 1198-1207 at 1198("[m]easurements made at National Atmospheric Deposition Program/National Trends Network sites in North Carolina show an increasing trend in [ammonium] concentration in precipitation since 1990. This increase has been linked with the increasing number of hogs in North Carolina.").

[15] For example, wastes are often transported off of the property through channelized ditches, grassed waterways, or other confined conveyances.

[16] Pollutants are nutrients (including nitrogen and phosphorus), fecal bacteria and pathogens, other solids and organic matter, antibiotics, hormones, and pesticides.

appropriately tailored once the goals of the program are established. An appropriately targeted plan will provide an adequate evaluation of the pollutants exiting an operation and entering surface waters.

But, incontrovertibly, in limiting the parameters, the regulatory authority should be very sensitive to the economic, environmental and human health trade-offs that accompany each change. In effect, the more parameters removed from the monitoring program, the easier implementation of the plan becomes for the permittee, but the weaker the information becomes on the types and origins of the pollutants being discharged from these operations. Therefore, it stands to reason that a decrease in testing events and parameters will correlate with a decrease in discharge comprehension, and, consequently, a higher risk to human health[17] and the environment. This problem is particularly apparent with regards to fecal contamination, which can cause a range of human health ailments including *Campylobacter, Cryptosporidium, Escherichia coli* (*E. coli*), and *Salmonella.*[18]

In light of these significant concerns, the regulatory authorities should implement a monitoring program capable of providing sufficient information for itself and the operator to evaluate if, when, and to what extent discharge is occurring. A capable monitoring program will fit nicely into the state and federal permitting programs while also augmenting the State's goals and strategies for reducing nutrient and fecal coliform impairment and improving the biological integrity of public waters.[19] In addition, rather than being considered punitive by permittees, this program, if suitably configured, will be beneficial because it will provide each permittee with the necessary information to discontinue any continuing discharges and to bring the operation into compliance with both state and federal laws, thus averting personal liability and financial penalty under those laws.

Accordingly, to stave against any unnecessary loss in program functionality, we respectfully recommend that the following improvement be made to the proposed rules: 1. an expansion in the number of sampling sites required at each operation; 2. an increase in the number of targeted sampling events; and 3. a re-expansion of the surface water monitoring plan monitoring

[17] Including the health of humans who recreate in, consume, or otherwise interact with impacted waters.

[18] *See* GAO Report 08-944, at 22 ("[a]ccording to North Carolina agricultural experts, excessive manure production has contributed to the contamination of some of the surface and well water in these counties [of eastern North Carolina] and the surrounding areas."); see also, Penn Future, *Pollutants and Health Risks Associated with Concentrated Animal Feeding Operations*, *available at* https://www.pennfuture.org/UserFiles/hogfarmtoxicchart.pdf (last visited August 05, 2010).

[19] *See* North Carolina Nutrient Criteria Implementation Plan, Revised – October 25, 2005 [hereinafter Nutrient Criteria Implementation Plan], *available at* http://h2o.enr.state.nc.us/csu/documents/NCIP10-27-2005.pdf (last visited August 09, 2010) ("North Carolina firmly believes that a proactive management strategy based on adaptive management techniques is the most viable method to control excessive nutrients from point and non-point sources."); North Carolina "Redbook," Surface Waters and Wetlands Standards [hereinafter Redbook], May 2007, *available at*: http://portal.ncdenr.org/c/document_library/get_file?folderId=285750&name=DLFE-8513.pdf (last visited August 09, 2010); North Carolina Water Quality Assessment and Impaired Waters List (2006 Integrated 305(b) and 303(d) Report); Final [hereinafter 2007 Integrated Report], May 2007, *available at* http://h2o.enr.state.nc.us/tmdl/documents/2006IR_FINAL_000.pdf (last visited August 09, 2010).

parameters to include a true fecal indicator organism, such as fecal coliform, and 5-day biochemical oxygen demand (BOD). These amendments will support an unobtrusive and cost effective plan that will provide the accountability, prevention, water quality improvements and human health protections currently needed in North Carolina.

III. RESEARCH CLEARLY SHOWS THAT ANIMAL FEEDING OPERATIONS CAN DISCHARGE A VARIETY OF POLLUTANTS INTO SURFACE AND GROUNDWATERS

To understand the universe of pollutants that can be evaluated through an appropriately targeted monitoring plan, it is necessary to understand the types of pollutants that are generated at animal feeding operations. In a nutshell, concentrated animal waste contains a number of pollutants that can impact human health and water quality.[20] As referenced in Section II, these pollutants can originate from aerial-based emissions or land-based discharges. Since the aerial-based pollutants are beyond the scope of the current rulemaking, this comment focuses on the land-based pollutants and their impacts to water quality and human health. Within that class, even taking into consideration the fact that each operation (depending on animal type, feed type and feed additives[21]) is likely to produce a distinct percentage of each pollutant, there remain a few categories of pollutants that are known to exist in some form in all concentrated animal waste. Those pollutants are: nutrients (particularly nitrogen and phosphorus), fecal contaminants (including bacteria and pathogens), antibiotics, hormones and pesticides.

A. Nutrients

As discussed in our previous comments[22], concentrated animal waste contains significant quantities of nutrients that, if discharged into water resources, can cause considerable water quality impairment.[23] As a result, nationally nutrients are the leading stressor of impaired lakes,

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[20] *See* Ft. Nt. 8, 9. *See also* 2003 Rule at 7181 ("EPA's *2000 Inventory* data indicate that the agricultural sector including crop production, pasture and range grazing, concentrated and confined animal feeding operations, and aquaculture is the leading contributor of pollutants to identified water quality impairment in the Nation's rivers and streams.... The inventory does not allow a comprehensive brakeout of water quality impairment attributable to CAFOs, but EPA's data show that water quality concerns tend to be greatest in regions where crops are intensively cultivated and where livestock operations are concentrated.").

[21] As stated by the PEW Commission on Industrial Farm Animal Production, "[f]eed formulation influences [pollutant and] pathogen risks because the feed supplied to confined animal populations are significantly different from the unsupplemented foraged feeds of grain and grasses traditionally available to poultry, swine, or cattle." Silbergeld, et al. (2008). *Industrial Farm Animal Production, Antimicrobial Resistance, and Human Health* [hereinafter Pew Antimicrobial Resistance], available at www.ncifap.org/reports (last visited August 10, 2010).

[22] Previous written comments on the proposed surface water and ground water monitoring rules for animal feeding operations were submitted to Keith Larick on July 14, 2009.

[23] *See, e.g.,* Barker, J.C., Zublena, J.P. (1995). Livestock manure nutrient assessment in North Carolina, In *Proc. 7th International Symposium on Agricultural Waste*, 98-106. American Society of Agricultural Engineers, Chicago, Ill, June 18-20; Diesel, et al. (2007). Nutrient loading patterns on an agriculturally impacted stream system in Huntingdon County Pennsylvania over three summers. *Northeastern Geology & Environmental Sciences*, 29(1): 25-33; Geohring, L, et al. (2005). *Drainage Water Quality Response to Liquid Manure Application.* Presentation at the 2005 American Society for Agricultural Engineers Annual International Meeting, Report No. 05-2065; Goodrich,

ponds and reservoirs, and, as of 2000, the fifth leading stressor of impaired rivers and streams.[24] In North Carolina, nutrient impairment of waters is of vital concern.[25] For example, "[n]utrient impairment presents a major challenge to the restoration of the Albemarle-Pamlico Estuary in North Carolina. Three major tributaries of Pamlico Sound - the Neuse River, the Tar-Pamlico River and the Chowan River - suffer from nutrient over enrichment[, and t]he historically important fisheries of the region cannot be fully restored until these problems are solved."[26]

Nutrients occur in manure in many forms, but the two forms in which they are the most prevalent are nitrogen and phosphorus.[27] While both nitrogen[28] and phosphorus can have value as fertilizers, the discharge, overuse or mismanagement of these nutrients can cause severe environmental impairment.[29] The discharge of nitrogen into waters is an environmental concern because, for example, in the form of ammonia, "it is toxic to aquatic life and it exerts a direct BOD on the receiving waters, thereby reducing dissolved oxygen levels and the ability of the water body to support aquatic life," and in the form of nitrate it can cause numerous human

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J.A., et al. (1991). Drinking water from agriculturally contaminated groundwater. *Journal of Environmental Quality*, 20(4): 707-717; Hill, et al. (2005). Impact of animal application on runoff water quality in field experiment plots. *International Journal of Environmental Research and Public Health*, 2(2): 314-321; Jackson, et al. (2000). Swine manure management plans in north-central Iowa: Nutrient loading and policy implications. *Journal of Soil and Water Conservation*, 55(2): 205-212; Stone, et al. (1998). Impact of swine waste application on ground and stream water quality in an eastern coastal plain watershed. *American Society of Agricultural Engineers*, 41(6):1665-1670; Van Es, H.M., et al. (2004). Effect of manure application, timing, crop, and soil type on phosphorus leaching. *Journal of Environmental Quality*, 33: 1070-1080.

[24] See 2003 Rule at 7235.

[25] *See* Nutrient Criteria Implementation Plan; Redbook; and 2007 Integrated Report. *See also* Raquet, M, Williams, M., Kucken, D. (2007). *Supplemental Guide to North Carolina's Basinwide Planning: Support Document for Basinwide Water Quality Plans, Second Revision* [hereinafter Supplemental Guide], *at* 93-94, *available at* http://h2o.enr.state.nc.us/basinwide/documents/SupportDocument.pdf (last visited August 09, 2010) ("[i]n North Carolina, Nutrient Management Strategies have been implemented in the Tar-Pamlico and Neuse River basins. The Chowan River basin, the New River watershed in the White Oak River basin and the Jordan Lake watershed in the Cape Fear River basin are also designated NSW. BMPs must be implemented to prevent nutrient impacts to surface water quality.").

[26] Rader, D., Rudek, J. *Evaluation of Alternative Approaches to Restoring Nutrient Impaired Watersheds in the Albemarle-Pamlico Estuary*. Presented at Coastal & Estuarine Research Federation Conference, available at http://www.erf.org/cgi-bin/conference_abstract.pl?conference=erf2001&id=733 (last visited August 09, 2010).

[27] *See* 2003 Rule at 7180 ("[b]y sector, USDA estimates that operations that confine poultry account for the majority of on-farm excess nitrogen and phosphorus. Poultry operations account for nearly one-half of the total recoverable nitrogen, but on-farm use is able to absorb less than 10 percent of that amount.... This is attributable to not only the limited land area for manure application but also the generally higher nutrient content of poultry manure compared to manure of most other farm animals.... Dairies and hog operations are the other dominant livestock types shown to contribute to excess on-farm nutrients, particularly phosphorus.").

[28] "Manure nitrogen occurs in several forms, including ammonia and nitrate. Ammonia and nitrate have fertilizer value for crop growth, but these forms of nitrogen can also produce adverse environmental impacts when they are transported in excess quantities to the environment." 2003 Rule at 7235.

[29] *See* Ft. Nt. 23, 25.

health issues, including methemoglobinemia (also known as "blue baby syndrome").[30] Similarly, the discharge of phosphorus is of concern because it can lead to the eutrophication of waters, which can in turn cause "fish kills, reduce biodiversity, [cause] objectionable tastes and odors, increase drinking water treatment costs, and [promote the] growth of toxic organisms."[31] Eutrophication can also be caused by excess nitrogen pollution.[32]

When EPA and USDA analyzed the issue of excess nutrient production at confined animal feeding operations,[33] they determined that:

> a considerable portion of the manure nutrients generated at larger animal production facilities exceeds the crop nutrient needs, both at the farm and local county levels. Given consolidation trends in the industry towards larger-sized operations that tend to have less available land on which to spread manure, the amount of excess manure nutrients being produced has been rising. Among the principle reasons for the farm-level excess of nutrients generated is inadequate land for utilizing manure. USDA data show that the amount of nutrients, and the amount of excess nutrients, produced by confined animal operations rose about 20 percent from 1982 to 1997. During that same period, cropland and pastureland controlled by these farms declined from an average of 3.6 acres in 1982 to 2.2 acres per 1,000 pounds live weight of animals in 1997. The combination of these factors has contributed to an increase in the amount of excess nutrients produced at these operations. Larger-sized operations with 1,000 or more animals exceeding 1,000 pounds accounted for the largest share of excess nutrients in 1997. Roughly 60 percent of the nitrogen and 70 percent of the phosphorus generated by these operations must be transported off-site.[34]

USDA went on to find that by sector confined poultry operations generate the majority of on-farm nitrogen and phosphorus, but that dairies and hog operations follow at a close second.[35]

[30] 2003 Rule at 7235.

[31] 2003 Rule at 7235.

[32] *Id.*

[33] "USDA defines 'excess manure nutrients' on a confined livestock farm as manure nutrient production that exceeds the capacity of the crop to assimilate the nutrients." 2003 Rule at 7180.

[34] 2003 Rule at 7180. *See also* GAO Report 08-944 at 20 ("[a] USDA report identified this concern as early as 2000 when it found that between 1982 and 1997 as livestock production became more spatially concentrated that when manure was applied to cropland, crops were not fully using the manure and this could result in ground and surface water pollution from excess nutrients. According to the report, the number of counties where farms produced more manure nutrients, primarily nitrogen and phosphorus, than could be applied to the land without accumulating nutrients in the soil increased.... As a result, the potential for runoff and leaching of these nutrients from the soil was high, and water quality could be impaired, according to USDA. Agricultural experts and government officials who we spoke to during our review echoed the findings of USDA." (citing R.L. Kellogg, et al. (2000). *Manure Nutrients Relative to the Capacity of Cropland and Pastureland to Assimilate Nutrients: Spatial and Temporal Trends for the United States.* Washington, D.C.)).

[35] 2003 Rule at 7180 ("Poultry operations account for nearly one-half of the total recoverable nitrogen, but on-farm use is able to absorb less than 10 percent of that amount.... This is attributable to not only the limited land area for

Nutrient pollution and eutrophication are a major issue for many North Carolina waterbodies. For example, according to a 2004 USGS study,[36] nutrient pollution, particularly nitrogen pollution, "has been the primary contributing factor for fish kills and algal blooms in the Neuse estuary,"[37] and CAFOs "appear to have a significant effect on nitrogen and phosphorus loading in streams."[38] In fact, the study found that "[t]he use of sprayed swine wastes on fields planted in crops at the Lizzie Research Station study site resulted in increased concentrations of nitrate and other chemical constituents in ground water beneath spray fields compared to ground water beneath crops treated with chemical fertilizers," leading to an increase in ground water nitrate concentrations by a factor of 3.5 after 4 years of spraying, and that nitrogen and phosphorus loads were also being transported to surface waters.[39] Research indicates that similar links can, and in many cases have, been made in other estuaries in the state with high concentrations of animal feeding operations.

B. Fecal Contaminants, Including Bacteria and Pathogens

By virtue of its colonic origins, most fecal matter produced at animal feeding operations can contain a large amount of bacteria and infectious pathogens.[40] If discharged into water resources, pathogens and other fecal contaminants can be extremely hazardous to human health[41]

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manure application but also the generally higher nutrient content of poultry manure compared to manure of most other farm animals.... Dairies and hog operations are the other dominant livestock types shown to contribute to excess on-farm nutrients, particularly phosphorus.").

[36] Spruill, et al. (2004). *Geochemistry and Characteristic of Nitrogen Transport at a Confined Animal Feeding Operation in a Coastal Plain Agricultural Watershed, and Implications for Nutrient Loading in the Neuse River Basin, North Carolina, 1999-2002.* U.S. Geological Society (USGS), report number 2994-5283.

[37] *Id.* (citing Stow, C.A., Borsuk, M.E. (2003). Assessing TMDL effectiveness using flow-adjusted concentrations – A case study of the Neuse River, North Carolina. *Environmental Science and Technology*, 37: 2043-2050).

[38] *Id.* (citing Glasgow, H.B., Burkholder, J.M. (2000). Water quality trends and management implications from a five-year study of a eutrophic estuary. *Ecological Applications*, 10: 1024-1046).

[39] *Id.*

[40] *See* Rosen, B.H. (2000). *Waterborne Pathogens in Agricultural Watersheds.* At 1. The Watershed Science Institute, Natural Resources Conservation Service, United States Department of Agriculture. ("[a] pathogen is any agent that causes disease in animals or plants. Pathogens may be a bacterium, protozoan, virus, or worm. *Waterborne zoonotic disease* is a term used to describe that is transmitted among animals and humans by water.... Most waterborne pathogens are in human and animal feces.); Gerba, C.P., Smith Jr., J.E. (2005). Source of pathogenic microorganisms and their fate during land application of wastes. *Journal of Environmental Quality*, 34(1): 42-48.

[41] For example, "[w]hen humans are exposed to and infected by waterborne enteric pathogens, the pathogens become capable of reproducing in the gastrointestinal tract. As a result, healthy humans shed pathogens in their feces for a period ranging from days to weeks. This shedding of pathogens often occurs in the absence of any signs of clinical illness. Regardless of whether a pathogen causes clinical illness in the person who sheds it in his or her feces, the pathogen being shed may infect other people directly by person-to-person spread, contact with contaminated surfaces, and other means which are referred to as secondary spread. As a result, waterborne pathogens that are initially waterborne may subsequently infect other people through a variety of routes. Sensitive subpopulations are at greater risk from waterborne disease than the general population." U.S. EPA, *National*

and can negatively affect, among other things, the tourism and shellfish industries.[42] Indeed, livestock manure contains more than 150 pathogens that are associated with risks to human beings, "including six human pathogens that account for more than 90% of food and waterborne diseases in humans."[43] Those six organisms, *Campylobacter spp., Salmonella spp., Listeria monocytogenes, Escherichia coli (E. coli), Cryptosporidium parvum* and *Giardia lamblia*, are rapidly transmissible, and can cause anywhere from acute gastrointestinal illness and abdominal discomfort to vomiting and possibly death[44].[45]

Further, if a person is infected by a waterborne pathogen, he or she can experience "chronic disease such as irritable bowel syndrome, reduced kidney function, hypertension, and reactive arthritis."[46] Because these pathogens are easily transmissible through water resources, the mere presence of fecal pathogens in rural surface and groundwater resources "may pose health risks to people who either recreate in contaminated surface waters or use the groundwater as a drinking water source."[47] This is particularly true in eastern North Carolina where communities are heavily reliant on groundwater resources.[48]

Due to the formidable risk of fecal exposure to human health and safety, "[t]he EPA standard for maximum allowable limits for fecal coliform bacteria (FC) in recreational waters is 200 colony forming units (CFU)/100mL, while finished (potable) drinking water is expected to have zero bacterial contamination."[49] EPA also recognizes that stopping fecal contamination should be preventative instead of reactive. To re-enforce this position, EPA is currently in the process of revising and strengthening the Total Coliform Rule under the Safe Drinking Water Act.[50] In this

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Primary Drinking Water Regulations: Revisions to the Total Coliform Rule; Proposed Rule [hereinafter Total Coliform Rule], 75 Fed. Reg. 40925, 40928-29 (July 14, 2010).

[42] See Supplemental Guide at 149 ("[l]ike many states, the livelihood of North Carolina communities that cater to water related activities can be severely impacted if bacteria levels are above the water quality standards because the high levels often result in closed swimming areas and/or restricted and even prohibited shellfish harvesting.").

[43] 2003 Rule at 7236.

[44] Death usually only occurs in sensitive subpopulations such as children and the elderly. See *Total Coliform Rule* at 40928.

[45] *See* 2003 Rule at 7236; Total Coliform Rule at 40928.

[46] Total Coliform Rule at 40928.

[47] Sapkota, et al. (2007). Antibiotic-resistance *Enterococci* and fecal indicators in surface water and groundwater impacted by concentrated swine feeding operation. *Environmental Health Perspectives*, 115(7): 1040-1045 at 1044.

[48] *See generally* North Carolina Department of Environment and Natural Resources, Division of Water Resources, Central Coastal Plain Capacity Use Area, *available at* http://www.ncwater.org/Permits_and_Registration/Capacity_Use/Central_Coastal_Plain/index.php?menu=Home (last visited August 09, 2010).

[49] Cook, M.J., Baker, J.L. (2001). Bacterial and nutrient transport to tile lines shortly after application of large volumes of liquid swine manure. *American Society of Agricultural Engineers*, 44(3): 95-503.

[50] *See* Total Coliform Rule.

revised rule, which will apply to human waste treatment plants, EPA supports a "preventative approach to identifying and fixing problems that affect or may affect public health."[51]

It is important to note that even though the appropriate use, treatment and management of animal waste can be useful in preventing the movement of fecal contaminants into ground and surface waters, that fecal contaminants can be very resilient.[52] They can be so resilient in fact, that "[p]athogens, including bacteria and viruses, survive in animal waste for extensive periods of time and can be recovered in soils that have been 'amended' by these wastes."[53] Due to this resiliency and the considerable threat of fecal contaminants to human health, it is important that fecal application and runoff is adequately monitored and prevented.

The need for adequate monitoring and prevention is particularly important in concentrated animal production because of the vulnerability of open-air waste management systems to spills and other discharges, and because of the lean treatment-process for the animal waste produced at these operations. As described by the Pew Commission on Industrial Farm Animal Production:

> According to the US Department of Agriculture, confined animals produce roughly 335 million tons (dry wt.) of waste per year, which is more than 40 times the mass of human biosolids generated by publicly owned treatment works (7.6 million tons in 2005). In contrast to human biosolids, no treatment-process control requirements or prescribed criteria for pathogens have been established for animal waste, although the level of pathogens, as well as antibiotic-resistant bacteria, are often higher than levels found in human feces. For swine and cattle (i.e., beef feedlots and dairy cows), an estimated 95% to 99% of the waste is applied to land, and for poultry litter (i.e., excreta, spilled feed, feathers, soil, and bedding material), over 90% is applied to land.[54]

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[51] *Id.* at 40930.

[52] *See* Rosen, B.H. (2000). *Waterborne Pathogens in Agricultural Watersheds*, at 24. The Watershed Science Institute, Natural Resources Conservation Service, United States Department of Agriculture (the human wastewater treatment process is much more stringent then the animal waste treatment process. However, even with conventional sewage treatment, many pathogens are able to survive, and it is recommended that "uses of water downstream of sewage discharges must be carefully controlled and the water treated appropriately to avoid infection by such organisms").; Liu, X, et al. (2009). *Evaluation of Waterborne Pathogens Associated with a Concentrated Swine Feeding Operation in North Carolina.* Presented at the 2010 National Water Quality Conference, *available at* http://www.usawaterquality.org/conferences/2010/abstract_index.html (last visited August 11, 2010); PEW Antimicrobial Resistance at 7 (citing Gerba, C.P., Smith, J.E. (2005). Sources of pathogenic microorganisms and their fate during land application of wastes. *Journal of Environmental Quality*, 34(1): 42-48); Gerba, C.P., Wallis, C., Melnick, J.L. (1975). Fate of waterwater bacteria and viruses in soil. *The Journal of the Irrigation and Drainage Division* (September, 1975): 157-174.

[53] *Id.*

[54] PEW Antimicrobial Resistance at 31 (citing United States Department of Agriculture (USDA) (2005). USDA National Program Annual Report, *available at* www.ars.usda.gov/research/programs/programs.htm?np_code=206&docid=13337(last visited August 10, 2010); USDA/APHIS (1995). *Part I: Feedlot Management Practices*. United States Department of Agriculture, National Health Monitoring System; Walton, T.E. (2002). *Swine 2000-Part III: Reference of Swine Health & Environmental Management in the United States*. APHIS United States Department of Agriculture, National Health Monitoring

Since the primary source of the pollutants in question is animal urine and feces, any discharge of waste from these operations often results in the discharge of fecal matter to water resources. For example, in a study conducted by the Johns Hopkins Bloomberg School of Public Health that compared, among other things, the concentrations of fecal indicators in groundwater and surface water impacted by swine CAFOs to unaffected waters, researchers found that "surface waters and groundwaters located down gradient of the swine CAFO are contaminated with significantly higher *Enterococcus spp., E. coli,* and fecal coliforms compared with surface water and groundwater located up gradient of the swine CAFO."[55]

C. Antibiotics and Antibiotic Resistance

A subset to the issue of fecal contamination is the generation and transmission of antibiotics and antibiotic resistant bacteria through animal waste. Among the pollutants discharged by CAFOs, antibiotics and antibiotic-resistant bacteria threaten to be the most prospectively dangerous. It is estimated that more than 70 percent of antibiotics used in the United States are utilized in animal agriculture,[56] and, in fact, that "estimated antimicrobial use in animal feeds in North Carolina alone exceeds total human clinical use for the entire United States population."[57] As an example, most large-scale swine production facilities apply a broad-spectrum of antibiotics for nontherapeutic or subtherapeutic[58] reasons to each animal in their feed as a way to prevent disease, maintain production yields, promote growth, and improve efficiency of feed conversion. [59] In total, that multiplies out to an estimated 10.3 million pounds of antibiotics used annually in

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System; Moore, P.A., et al. (1995). Poultry manure management: Environmentally sound options. *Journal of Soil and Water Conservation*, 50(3); 321-327).

[55] Sapkota, et al. (2007). Antibiotic-resistance *Enterococci* and fecal indicators in surface water and groundwater impacted by concentrated swine feeding operation. *Environmental Health Perspectives*, 115: 1040-1045 at 1043.

[56] *See* Melon, M., Benbrook, C., Benbrook, K.L. (2001). *Hogging it: Estimates of Antimicrobial Abuse in Livestock* [hereinafter Hogging It]. Union of Concerned Scientists Publications: Cambridge, MA, *available at* www.uscusa.org (last visited August 10, 2010).

[57] Silbergeld, et al. (2008). One reservoir: redefining the community origins of antimicrobial-resistant infections. *Medical Clinics of North America*, 92: 1391-1407, at 1394.

[58] Both the "nontherapeutic" use of antibiotics and the "subtherapeutic" use of antibiotics are prophylactic in nature, and are not used for the direct treatment of a diseased animal. *See* PEW Antimicrobial Resistance at 47; U.S. Food and Drug Administration (FDA). *Draft Guidance: The Judicious Use of Medically Important Antimicrobial Drugs in Food-Producing Animals*, at 4, *available at* http://www.fda.gov/downloads/AnimalVeterinary/GuidanceComplianceEnforcement/GuidanceforIndustry/UCM216936.pdf (last visited August 11, 2010).

[59] *See* Davies, R., Roberts, T.A. (1999). Antimicrobial susceptibility of enterococci recovered from commercial swine carcasses: effect of feed additives. *Letters in Applied Microbiology*, 29(5): 327-333; Witte, W. (1998). Medical consequences of antibiotic use in agriculture. *Science*, 279: 996-997.

the production of swine in the United States.[60] Such a high use of antibiotics in food animal production can be hazardous to environmental and human health.[61]

The use of antibiotics in food animal production can breed antibiotic resistance in those animals.[62] Such antibiotic resistance can be passed on to humans in a number of ways, including through direct contact, secondary contact (contact with air, water, dust or soils contaminated with antibiotic resistant bacteria) and consumption.[63] Specifically, as it pertains to water quality, antibiotic resistant bacteria "can be released into the general environment from animal houses through ventilation and waste disposal. Because confinement of thousands of animals requires controls to reduce heat and regulate humidity, poultry and swine houses are ventilated with high-volume fans that result in considerable movement of materials into the external environment" and into water resources.[64] Numerous studies link aerosolized dust to the spread of antibiotic resistant bacteria.[65] However, "[t]he major route of transfer of [antibiotic resistant bacteria] to the environment is via waste generation and disposal on land."[66] Once antibiotic resistant bacteria enter the environment, there can be numerous significant human health and societal impacts.

For example, as antibiotics are the leading treatment method for many bacterial diseases, produced resistance to these pharmaceuticals makes it more difficult to treat disease and results in a greater spread of infectious disease and a higher resultant mortality rate.[67] "From an ecological perspective, the greater selection pressure for resistance generated by agricultural uses

[60] *See generally* Hogging It.

[61] *See* Ft. Nt. 60, 63, 67, 69.

[62] *See* Burriel, A.R. (1997). Resistance to coagulase-negative staphylococci isolated from sheep to various antimicrobial agents. *Research in Veterinary Science*, 63: 189-190; Nijsten, et al. (1996). Antibiotic resistance among *Escherichia coli* isolated from fecal samples of swine farmers and swine. *Journal of Antimicrobial Chemotherapy*, 37: 1131-1140.

[63] *See* Witte, W. (1998). Medical consequences of antibiotic use in agriculture. *Science*, 279: 996-997; PEW Antimicrobial Resistance at 7.

[63] Sapkota, et al. (2007). Antibiotic-resistance *Enterococci* and fecal indicators in surface water and groundwater impacted by concentrated swine feeding operation. *Environmental Health Perspectives*, 115: 1040-1045 at 1043.

[64] PEW Antimicrobial Resistance at 29.

[65] *Id.*

[66] *Id.* at 31.

[67] *See* Okeke, I.N, et al. (2005). Antimicrobial resistance in developing countries. Part I: recent trends and current status. *Lancet Infectious Diseases*, 5(7): 481-493; Velge, et al. (2005). Emergence of Salmonella epidemics: the problem of *Salmonella* enteric serotype Enteritidis and multiple antibiotic resistances in other major serotypes. *Veterinary Resources*, 36(3): 267-288; Seybold, et al. (2006). Emergence of community-associated methicillin-resistant *Staphylococcus* aureus USA 300 genotype as a major cause of health care-associated blood stream infections. *Clinical Infectious Diseases*, 42(5):647-656; Travers, K., Barza, M. (2002). Morbidity of infections caused by antimicrobial-resistant bacteria. *Clinical Infectious Diseases*, 34 Supp. 3:S131-134.

may result in carriage of [antibiotic resistant] bacteria, both pathogenic and commensal, by persons in the nonhospitalized population. When these people enter the hospital, they may be a major source of transmitted infections in the hospital environment." [68] This can result in human vulnerability to many of the bacterial diseases often treated by antibiotics, such as *Salmonella* and *Campylobacter*.[69]

Additionally, due to the metabolic process of most animals, antibiotics may not be fully broken down by the animal before being expelled through the animal's waste,[70] and since there is nothing in the treating process geared towards digesting those antibiotics, they are often spread onto the land with the other waste during the land application process.[71] As a result, any discharge of waste from a CAFO property can include a certain percentage of antibiotics and antibiotic derivatives. Once they enter the water, those antibiotics can have a number of impacts on water quality and human health.[72] Some of the issues are exactly the same as above, human resistance to infections because of ingestions of antibiotic-resistant microbials, and some result because humans and wildlife can be highly impacted by the ingestion of antibiotics that they were not intended to ingest. Consequently, the unintentional ingestion of un-prescribed pharmaceuticals can lead to sickness and even death. It can also lead to human-generated strains of antibiotic resistant bacteria.[73]

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[68] PEW Antimicrobial Resistance at 35.

[69] *See generally* U.S. Government Accountability Office (2004). *Antibiotic Resistance: Federal Agencies Need to Better Focus Efforts to Address Risk to Humans from Antibiotic Use in Animals.* GAO-04-490 (April 2004); Hogging It.

[70] *See* Batt, A., Snow, D., Aga, D. (2006). Occurrence of sulfonamide antimicrobials in private water wells in Washington County, Idaho, USA. *Chemosphere*, 64(11): 1963-1971 ("[a] significant portion of the administered antibiotics in animals is excreted in an un-metabolized form and could result in the contamination of soil and water through cropland application of animal wastes."); Schorzman, K., Baldwin, J., Bokor, J. (2009). *Possible Sources of Nitrate to the Springs of Southern Gooding County, Eastern Snake River Plain, Idaho*. Idaho Department of Environmental Quality, Ground Water Quality Technical Report No. 38 (December 2009); *Prescription drugs found in drinking water across U.S* [hereinafter AP Report], Associated Press, April 4, 2008 *available at* www.cnn.com/2008/HEALTH/03/10/pharma.water1 (last visited May 15, 2008).

[71] *Id. See also* Christian, et al. (2003). Determination of antibiotic residues in manure, soil, and surface waters. *Acta Hydrochim. Hydrobiology*, 31:36-44; Halling-Sorenson, et al. (1998). Occurrence, fate and effects of pharmaceutical substances in the environment – A review. *Chemosphere*, 36:357-393; Kolpin, et al. (2002). Pharmaceuticals, hormones, and other organic wastewater contaminants in US Streams. *Enviro. Sci. Technol.*, 36:1202-1211.

[72] *See* Batt, A., Snow, D., Aga, D. (2006). Occurrence of sulfonamide antimicrobials in private water wells in Washington County, Idaho, USA. *Chemosphere*, 64(11): 1963-1971 (even "low levels of antibiotics [in water resources] can favor the proliferation of antibiotic resistant bacteria."). *See also* Lathers, C.M. (2002). Clinical pharmacology of antimicrobial use in humans and animals. *Journal of Clinical Pharmacology*, 42: 587-600 (in addition to antibiotic resistance to antibiotics used in humans, "bacteria can develop cross-resistance between antibiotics used in veterinary medicine with those of similar structures that are used exclusively in human medicine.")

[73] *See* Ft. Nt. 63, 64, 67.

D. Hormones

Hormones can enter the environment and affect human health in many of the same ways as antibiotics. For example, much like antibiotics, hormones fed to confined animals can be wholly or partially evacuated from the animal through their waste products.[74] This is because hormones, sometime even more so than antibiotics, can be difficult for the host animal to fully metabolize and synthesize.[75] As a result, excreted hormones are integrated into the animal waste treatment system, and are subject to the same discharge pathways discussed above, including through direct discharge, runoff, soil retention and waste product mismanagement.[76]

Expelled hormones can have a negative effect on the persons or wildlife that unintentionally come into contact with them. Moreover, due to their bioreactive design, hormones often affect non-target species in unpredictable, and sometimes volatile, ways.[77] For example, since hormones are a type of endocrine disrupting compound, unintentional ingestion might disrupt the natural synthesis, transport, or metabolism of hormones in the body.[78] Further, since endocrine disruption "may occur as a result of exposure to very low levels of hormonally active chemicals," it is strongly considered by the United States Geological Society (USGS) as an "adverse health effect of concern." [79]

Numerous direct pathways between the use of hormones in animal production and the resultant impacts on wildlife have been documented. For example, beef cattle CAFOs frequently use the anabolic steroid androgen mimic, trebolone acetate, to promote the growth of muscle.[80] During

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[74] *See, e.g.*, Kjaer, et al. (2007). Leaching of estrogenic hormones from manure-treated structured soils. *Environmental Science & Technology*, 41(11): 3911-3917; Orlando, et al. (2004). Endocrine-disrupting effects of cattle feedlot effluent on an aquatic sentinel species, the fathead minnow. *Environmental Health Perspectives*, 112.

[75] *See* Kolpin, et al. (2002). Pharmaceuticals, hormones, and other organic wastewater contaminants in US Streams. *Enviro. Sci. Technol.*, 36:1202-1211; Daughton (2004). *PPCPs as Environmental Pollutants*. U.S. Environmental Protection Agency: Office of Research and Development; AP Report (physiologically, animals such as swine are very similar to humans in the way they use and excrete hormones.).

[76] *Id.*

[77] *See* Daughton (2004). *PPCPs as Environmental Pollutants*. U.S. Environmental Protection Agency: Office of Research and Development (eco-toxicity data is available for less than one percent of human pharmaceuticals.); Goodman (2008). *Sedatives and sex hormones in our water supply*. Democracy Now!, April 4, 2008 at www.alternet.org/water/80505/?page=1 (for many PPCPs, the specific modes of action and interaction with other substances are not fully understood.); Lee, B., Reckhow, K.H., Kullman, S.W. *Bayesian Network Development for Natural Estrogen Compounds from Swine Concentrated Animal Feeding Operations, available at* http://www.nicholas.duke.edu/people/faculty/reckhow/KHR%20PDF%20publications/CAFO.pdf (last visited August 11, 2010).

[78] *Id.*

[79] Hirsch, R (2008). Associate Director for Water USGS, Statement before the Committee on Environment and Public Works Subcommittee on Transportation Safety, Infrastructure Security and Water Quality, April 15, 2008.

[80] *See* Durhan EJ, et al. (2006). Identification of metabolites of trebolone acetate in androgenic runoff from a beef feedlot, *Environmental Health Perspectives*, 114 Suppl 1:65-8.

degradation this steroid creates a product that is both stable in water and highly capable of binding to androgen receptors in fish.[81] Exposure to this compound causes the masculinization of female fish and results in reduced fertility at even low concentrations.[82] The results in fish indicate what can be anticipated in human beings.

E. Pesticides and Herbicides

Pesticides are also used by animal feeding operations in a number of ways. Pesticides can be sprayed over the herds and in the barns to prevent the infestation of insects, mites, and rodents. Further, they can be used as a means to delouse the animals themselves. For example, in poultry, pesticides are often used because ectoparasites such as mites, lice, fleas, chiggers, and biting flies will suck the birds' blood or chew on their skin, scales or feathers, thereby impacting the animals' health and welfare. As a result, in many cases applied pesticides will end up in the process wastewater and often in the waste treatment system. Once the pesticides enter the waste treatment system, they can be discharged in the same way as the pollutants discussed above. In addition, pesticides and herbicides are often sprayed around the waste storage structures, in the production area, and over crops to prevent the proliferation of insects and weeds.

Pesticides can impact human health. For example, as EPA notes, some pesticides, "such as the organophosphates and carbamates, affect the nervous system. Others may irritate the skin or eyes. Some pesticides may be carcinogens."[83] Therefore, since pesticides "[b]y their nature [are] substances that in many cases are designed to kill pests, [they] can pose risks to humans and to the environment,"[84] and they must be appropriately regulated. In North Carolina, pesticides are regulated by the North Carolina Pesticide Law of 1971.[85]

F. Land-Based Discharge Routes

In summary, after being combined in the animal waste management system, these primary pollutants and a number of secondary pollutants, including organic matter, solids, salts, and trace elements, can be discharged into water resources in a number of ways. "If improperly managed, manure and wastewater from animal feeding operations can adversely impact water quality through surface runoff and erosion, direct discharges to surface water, spills and other dry-

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[81] *Id. See also* Hotchkiss, et al. (2008). *Fifteen years after "Wingspread" – Environmental Endocrine Disruptors and human and wildlife health: Where are we today and where we need to go.* Toxicological Science Advance Access published Feb 16, 2008.

[82] *Id.*

[83] U.S. EPA, *Pesticides: Health and Safety, available at* www.epa.gov/pesticides/health/human.htm (last visited August 10, 2010).

[84] U.S. EPA, Reducing Pesticide Risk. *Pesticides: Health and Safety, available at* http://www.epa.gov/pesticides/health/reducing.htm (last visited August 10, 2010).

[85] *See* North Carolina General Statute 143-434, et seq., *available at* http://www.ncga.state.nc.us/EnactedLegislation/Statutes/HTML/ByArticle/Chapter_143/Article_52.html (last visited August 09, 2010).

weather discharges, and leaching into soils and groundwater."[86] Within this, one of the leading causes of discharge is the improper or excessive land application of wastes, which can result in surface runoff and direct discharges to surface water.[87] In addition to occurring as the result of improper operation and management, discharges can also occur if the operation is designed, constructed or maintained such that a discharge will occur.[88] As a result, discharges can be intentional or they can be accidental.[89] However, any discharge, whether intentional or not, is considered a violation of both the Clean Water Act[90] and North Carolina state law.[91]

IV. THE FINAL MONITORING RULE SHOULD EXPAND THE NUMBER OF TESTING SITES AND EPISODES, IMPROVE QUALITY CONTROL AND SPECIFY HOW RELEVANT SAMPLING DATA WILL BE TRANSLATED INTO PRODUCTIVE IMPROVEMENTS TO DISCHARGING ANIMAL FEEDING OPERATIONS

We request that our previous comments on this issue[92] in their entirety be incorporated by reference into this comment letter. Furthermore, we would like to re-emphasize a few of our substantive points from those comments. First, the final rules should not set a maximum limit on the number of representative sampling locations for an individual operation. Setting such a limit is unnecessary, and it may unduly limit the ability of the program to adequately monitor for the discharge of pollutants from an operation. As a substitute, the final rule should require at least a minimum of two sampling locations, and this requirement should apply regardless of whether the permittee samples his or her property individually or as part of a monitoring coalition.

Second, for this rule to be effective the number of testing episodes performed each year should be expanded. Without an expansion, it will be difficult for the rule to adequately reflect an operation's discharge potential, especially with regards to the impacts of annual weather variability on the operation's waste management practices. In addition, the proposed rules

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[86] GAO Report 08-944 at 5.

[87] *Id.* ("while manure is a valuable resource often used as fertilizer, agricultural experts and government officials have raised concerns about the large amounts of manure produced by animal feeding operations that are increasing clustered within specific geographic areas within a state. For example, five contiguous North Carolina counties had an estimated hog population of over 7.5 million hogs in 2002 and the hog operations in these counties could have produced as much as 15.5 million tons of manure that year. According to agricultural experts and government officials that we spoke to, such clustering of operations raises concerns that the amount of manure produced could result in the overapplication of manure to croplands in these areas and the release of excessive levels of some pollutants that could potentially damage water quality.").

[88] *See* 2008 Rule at 70423.

[89] *Id.*

[90] The Clean Water Act is triggered if the discharge originates at a CAFO or other point source.

[91] See Ft. Nt. 4, 6.

[92] *See* Ft. Nt. 22.

should expand the number of testing episodes performed during significant land application periods and during times, such as the winter, when runoff is more likely to occur.

Further, there should be an improvement in the program's quality assurance and control (QA/QC) measures. For example, to ensure that sampling is accurate and systematically meaningful, the regulatory authorities could provide sampling trainings, could require all sampling be done by a certified scientist, could generate a site-specific sampling schedule (this could be generated at the same time DWQ determines the operation's sampling locations), and/or could generate a universally applicable sampling form to streamline the process. Finally, we support the inclusion of focused language regarding the intended methods for compiling sampling information as well as a detailed description of how relevant sampling data will be translated into productive improvements at discharging operations.

V. WATER QUALITY, PUBLIC HEALTH AND UTILITY REQUIRE THAT THE CONSTITUTENTS SELECTED FOR THE SURFACE WATER MONITORING PLAN ARE CAPABLE OF MONITORING FOR POLLUTANTS OF CONCERN

In light of the universe of pollutants generated at animal feeding operations and the impacts of those pollutants on human health and the environment,[93] the constituents selected for the surface water monitoring program must be capable of indicating whether, what type and to what extent discharge is occurring at permitted animal feeding operations. At the same time, the proposed rules are sensitive to the economic considerations of the regulated community. As a result, in attempting to distill these pollutants into an actionable monitoring program, the proposed rules necessarily include nutrient indicators, and they acceptably exempt antibiotics, hormones and pesticides. The omission of antibiotics and hormones is acceptable despite numerous peer-reviewed studies on the harmful impacts of and the known evaluation methods for these pollutants[94] because an application of the cost-benefit analysis shows that a fecal indicator is likely to provide sufficient notice to indicate (and ultimately discontinue) discharge without expanding cost.[95] Yet, that is only true if a fecal indicator is included in the monitoring analysis.

Regarding the inclusion of the nitrogen parameters, because we previously commented on the necessary inclusion of nitrogen due to its high concentration in confined animal waste as well as its sizeable impact to water quality,[96] and since the proposed rules, by continuing to include

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[93] *See* Section III.

[94] *See, eg.*, Sapkota, et al. (2007). Antibiotic-resistance *Enterococci* and fecal indicators in surface water and groundwater impacted by concentrated swine feeding operation. *Environmental Health Perspectives*, 115(7): 1040-1045 at 1044; Davies, R., Roberts, T.A. (1999). Antimicrobial susceptibility of *Enterococci* recovered from commercial swine carcasses: effect of feed additives. *Letters in Applied Microbiology*, 29(5): 327-333; Witte, W. (1998). Medical consequences of antibiotic use in agriculture. *Science*, 279: 996-997; Burriel, A.R. (1997). Resistance to coagulase-negative staphylococci isolated from sheep to various antimicrobial agents. *Research in Veterinary Science*, 63: 189-190; Nijsten, et al. (1996). Antibiotic resistance among *Escherichia coli* isolated from fecal samples of swine farmers and swine. *Journal of Antimicrobial Chemotherapy*, 37: 1131-1140.

[95] In short, a fecal constituent should be sufficient because it can indicate and eliminate the discharge of excretia, often the source of hormones and antibiotics, to waterways.

[96] *See* Ft. Nt. 22.

ammonia nitrogen and nitrate nitrogen[97], appear to agree with that position, we will not unnecessarily duplicate those remarks in these comments. We will only state that the inclusion of both nitrogen parameters is necessary, and that knowledge and discontinuation of nutrient discharges will aid in improvements to water quality and human health, especially with regards to eutrophication, algae growth, and methemoglobinemia. In addition, as discussed below, we believe that the inclusion of BOD in the monitoring regime will further improve nutrient monitoring.

On the other hand, what these rules unacceptably exempt is a true fecal indicator. Therefore, this section will discuss the continuing question of what parameters are necessary to target and stop the discharge of pollutants from permitted animal feeding operations. Specifically, we will analyze which parameters are necessary to accurately detect, and thereafter discontinue, the discharge of fecal contaminants, especially hazardous pathogens, as required by state and federal law. Before we get into specifics, however, it stands to note that one reasonable and appropriate fix would be to have the parameters in the surface water monitoring plan mirror the parameters in proposed section 15A NCAC 02T.1310(a). Those parameters are 5-day biochemical oxygen demand (BOD), total Kjeldahl nitrogen (TKN), ammonia nitrogen, nitrate nitrogen, fecal coliform and chloride.

A. Fecal Contamination Must be Discontinued

Nationally, animal agriculture is often considered one of the leading causes of fecal impairment to rivers and streams,[98] and its discharge into water resources poses a severe threat to human health and the environment.[99] However, as proposed, the monitoring rules do not include a true fecal indicator. Instead, the proposed rules appear to rely on the constituent chloride to indicate the presence of fecal contaminants.

Relying on chloride alone is inadequate and unnecessary. For example, while fecal coliform (or another primary fecal indicator) is indistinct from fecal contamination, chloride can originate

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[97] In a groundwater study, it was found that the "δ^{15}N of nitrate is very useful in distinguishing animal sources from the two major environmental sources of N, soil organic N, and fertilizer N." Spruill, T.B., Showers, W.J., Howe, S.S. (2002). Application of classification-tree methods to identify nitrate sources in ground water. *Journal of Environmental Quality*, 31: 1538-1549.

[98] *See* Crane, et al. (1983). Bacterial pollution from agricultural sources: a review. *Transactions of the ASAE*, 26(5): 858-866; Landry, M.S., et al. (1999). *Fecal Bacteria Contamination of Surface Waters Associated with Land Application of Animal Waste.* Presented at the 1999 ASAE/CSAE-SCGR Annual International Meeting, Toronto, Canada (July 18-21, 1999); Lee, F., Jones-Lee, A. (1993) *Public Health Significance of Waterborne Pathogens.* A report to the California Environmental Protection Agency Comparative Risk Project, *available at* http://www.gfredlee.com/phealthsig_080801.pdf (last visited August 11, 2010); Liu, X, et al. (2009). *Evaluation of Waterborne Pathogens Associated with a Concentrated Swine Feeding Operation in North Carolina.* Presented at the 2010 National Water Quality Conference, *available at* http://www.usawaterquality.org/conferences/2010/abstract_index.html (last visited August 11, 2010); Mallin (2000). Impacts of industrial animal production on rivers and estuaries. *American Scientist*, 88: 26-37; Mallin, M.A., Cahoon, L.B. (2003). Industrialized animal production: A major source of nutrient and microbial pollution to aquatic ecosystems. *Population and Environment*, 24(5): 369-385

[99] *Id.; see also*, Ft. Nt. 40, 41.

from a large number of distinct sources. In addition, unlike with chloride, knowledge regarding the presence of fecal coliform will provide fundamental public health and safety information. Therefore, chloride may be an adequate supplemental fecal indicator (secondary to a primary fecal indicator such as fecal coliform), and we support it as such, but it should not, and cannot, exist in this monitoring program as the sole fecal indicator.

i. The presence of fecal coliform can indicate that fecal discharge is occurring

As discussed above, animal feces contains a large amount of bacteria.[100] The bacteria can be harmless, some can even be beneficial, or they can be harmful.[101] Harmful bacteria that are disease producing are referred to as "pathogenic."[102] Often, because there are so many types of fecal bacteria and because "[t]rying to detect [every] disease-causing bacteria and other pathogens in water is expensive," testers will use a "surrogate" or "indicator" organism to determine whether fecal bacteria are present in a sample.[103]

For these rules, the fecal "indicator" organism was fecal coliform. Fecal coliform is a subset of the total coliform family that can directly tie bacterial pollution to animal wastes without the exorbitant costs associated with testing for every potential fecal contaminant.[104] While it does not directly show the precise pathogens that are present in the water, the presence of fecal coliform can indicate that impacted waters may pose threat to human health as well as water quality. [105] Further, fecal coliform is an accepted and well-tested fecal indicator. In fact, "[i]n North Carolina, fecal coliform and *Enterococci* serve as bacterial indicators of water quality."[106] As such, the testing protocol for fecal coliform has been thoroughly peer-reviewed, and most laboratories are trained in its testing protocol.

[100] *See* Ft. Nt. 40.

[101] Bruhn, L. Wolfson, L. (2007). *Citizens Monitoring Bacteria: A Training Manual for Monitoring E. coli, 2nd Edition*, at 7, *available at* www.uwex.edu/ces/csreesvolmon/EColi/ (last visited July 8, 2010). *See also Id.*

[102] *Id.*

[103] *Id. See also* Landry, M.S., et al. (1999). *Fecal Bacteria Contamination of Surface Waters Associated with Land Application of Animal Waste*, at 2-3, Presented at the 1999 ASAE/CSAE-SCGR Annual International Meeting, Toronto, Canada (July 18-21, 1999).

[104] *See* Total Coliform Rule at 40929("[f]ecal coliform bacteria are a subgroup of total coliforms that traditionally have been associated with fecal contamination.").

[105] See Total Coliform Rule at 40929 ("EPA considers total coliforms to be a useful indicator that a potential pathway exists through which fecal contamination can enter the distribution system. The absence (versus the presence) of total coliforms in the distribution system indicates a reduced likelihood that fecal contamination and/or waterborne pathogens are occurring in the distribution system.").

[106] Supplemental Guide at 149.

ii. The presence of chloride can indicate that the water is salty

Chloride, on the other hand, is a "salt-related" constituent.[107] There are a number of natural and anthropogenic sources of chloride in the environment, including ocean water; weathered bedrock, surficial materials and soils; geological deposits containing halite or brines; wet deposition from oceanic sources; industrial uses such as the chloralkali industry; deicing practices; agriculture; food processing; metal processing; paper production; landfills; municipal wastes, septic tank discharge and more.[108] With regards to animal agriculture, "[s]alt [(chloride)] is used as a feed additive, and may be used in other agricultural products such as pesticides and fertilizers."[109] With conventional fertilizers, chloride is often found because, for example, "the potassium in most [agricultural] fertilizers is in the form of potassium chloride."[110] In sum, chloride is both commonly used and pervasive.

iii. Chloride is not a sufficient indicator of fecal discharge because it cannot isolate the presence of fecal contaminants, and because it does not aid in the protection of human health and welfare

Two of the principal reasons that chloride is not an adequate substitute for fecal coliform are that chloride is unable to specifically target the discharge of animal wastes, and that chloride does not provide sufficient protections for human health. As identified above, chloride is both pervasive and potential. It is potential because while salt from animal feeds "may" be present in waste materials and "may" discharge to surface waters,[111] the presence of chloride in waste depends in large part on diet and metabolism. Fecal coliform, on the other hand, must be present in all animal waste discharges because animal waste is, at its core, feces. In addition, chloride is pervasive because it could originate from a number of sources, including pesticides and commercial fertilizers. Fecal contaminants, in contrast, originate from fecal material.

Secondly, the US EPA has only a secondary standard for chloride under the Safe Drinking Water Act.[112] Contaminants receive a voluntary secondary standard if they are seen as a nuisance but not as a threat to human health and safety.[113] Specifically, the listed noticeable effect of chloride

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[107] Mullaney, J.R., Lorenz, D.L., Arntson, A.D. (2009). Chloride in Groundwater and Surface Water in Areas Underlain by the Glacial Aquifer System, Northern United States. U.S. Geological Society, Scientific Investigation Report 2009-5086, *available at* http://pubs.usgs.gov/sir/2009/5086/pdf/sir2009-5086.pdf (last visited August 09, 2010).

[108] *Id.*

[109] *Id.*

[110] *Id.*

[111] Mullaney, J.R., Lorenz, D.L., Arntson, A.D. (2009). Chloride in Groundwater and Surface Water in Areas Underlain by the Glacial Aquifer System, Northern United States. U.S. Geological Society, Scientific Investigation Report 2009-5086, *available at* http://pubs.usgs.gov/sir/2009/5086/pdf/sir2009-5086.pdf (last visited August 09, 2010).

[112] *See* U.S. EPA, Secondary Drinking Water Regulations: Guidance for Nuisance Chemicals, *available at* http://www.epa.gov/ogwdw000/consumer/2ndstandards.html (last visited August 09, 2010).

[113] *Id.*

is that the water has a "salty taste."[114] Indicating the presence of fecal coliform, on the other hand, can warn of the potential presence of pathogens and other bacteria that are harmful to human health. As such, monitoring for fecal coliform can indispensably inform permittees as to their potential impacts to human health and welfare, whereas monitoring for chloride will merely inform permittees that they are causing the waterbody to have a "salty taste."[115] Because we believe that human health and safety is extremely important, we do not think that it should not be overlooked. [116]

For these reasons, while chloride can appropriately supplement a fecal indicator, it alone is not a suitable indicator for fecal contamination.

iv. Fecal coliform is not the only suitable fecal indicator

Even though chloride is not a sufficient indicator for fecal contamination, there are a few options available that can adequately substitute for fecal coliform. These other options are viable, in part, because of the structure of the *Enterobacteriaceae* family, and in particular, the coliform bacteria branch of the family.

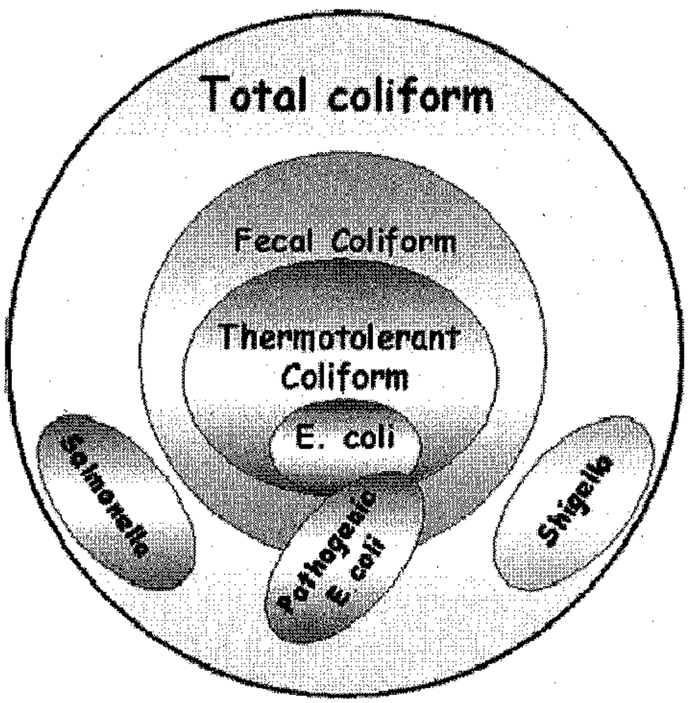

Figure 1. *E. coli* is a subdivision of Fecal Coliform, which is a subdivision of total coliform.[117]

[114] *Id.*

[115] *Id.*

[116] In generating these comments, Waterkeepers requested to review the draft and/or final Hearing Officers' Report created for these rules to gain an appreciation of why fecal coliform was removed from the proposed rules. However, as of the closing date for this commenting period, no documents were made available.

[117] *From* University of California, Agriculture and Natural Resources, "Eliminate Fecal Coliforms," *available at* http://groups.ucanr.org/UC_GAPs/Elimanate_Fecal_Coliforms/ (last visited August 11, 2010).

As Figure 1 indicates, "total coliform" is the encompassing title for coliform bacteria. As such, total coliform is a broad and minimally specific indicator of fecal contamination. As a subset of total coliform, fecal coliform is a narrowed indicator for fecal contamination. However, it also cannot claim to be the most targeted indicator of fecal contamination, especially as it relates to pathogenic impacts to human health. Therefore, it is in the third subset of coliform bacteria that we locate the more narrowly targeted indicators *Enterococcus* spp. and *E. coli. A*s discussed below, both of these indicators have the potential to replace fecal coliform in these proposed rules.[118]

"Like fecal coliform bacteria, *enterococci* are passed through the fecal excrement of humans, livestock and wildlife. The bacteria can be found in the digestive tract of warm-blooded animals and aid in the digestion of food. EPA approves the use of *enterococci* as an indicator of water quality in recreation bathing waters."[119] Comparably, *E. coli* bacteria are good indicator organisms for fecal contamination because they are specific, "they generally live longer than pathogens, are found in greater numbers, and are less risky to collect or culture in a laboratory."[120] In addition, since both *E. coli* and e*nterococci* represent a smaller subset of total coliforms, some circles believe that they are a better indicator for hazardous fecal contamination than fecal coliform.[121] As such, both *E. coli* and e*nterococcus* spp. are considered to be very good indicators of fecal contamination.

We additionally recognize that there are forms of bacterial source tracking currently in development.[122] From studies, we believe that bacterial source tracking could present itself as a

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[118] *Id. See also* Sapkota, et al. (2007). Antibiotic-resistance Enterococci and Fecal indicators in surface water and groundwater impacted by concentrated swine feeding operation. *Environmental Health Perspectives*, 115(7): 1040-1045 at 1043.

[119] Supplemental Guide at 150. *See also* Sapkota, et al. (2007). Antibiotic-resistance Enterococci and Fecal indicators in surface water and groundwater impacted by concentrated swine feeding operation. *Environmental Health Perspectives*, 115(7): 1040-1045 at 1043; Jin, G., et al. (2005). Comparison of *E. coli, Enterococci*, and fecal coliform as indicators for brackish water quality assessment. *Water Environ. Res.*, 77(5): 433.

[120] Bruhn, L. Wolfson, L. (2007). *Citizens Monitoring Bacteria: A Training Manual for Monitoring E. coli, 2nd Edition*, at 7-8, *available at* www.uwex.edu/ces/csreesvolmon/EColi/ (last visited July 8, 2010).

[121] *See* Gronewold, et al. (2008). An assessment of fecal indicator bacteria-based water quality standards. *Environmental Science & Technology*, 42(13): 4676-4682; Total Coliform Rule at 40929; Francy, D.S., et al. (1993). *Escherichia coli and fecal-coliform bacteria indicators of recreational water quality*. USGS Water Resources Investigation Report 93-4083. Columbus, Ohio; Pope, L.M. (1995) *Surface-water quality assessment of the lower Kansas River Basin, Kansas and Nebraska: dissolved oxygen and Escherichia coli bacteria in streams during low flow, July 1988 through July 1989*. USGS Water Resources Investigation Report 94-4077. Lawrence, KS.

[122] *See, e.g.,* Baertsch, et al. (2007). Source tracking aerosols released from land-applied class B biosolids during high-wind events. *Applied Environmental Microbiology*, 73(14): 4522-4531; Bernhard, A.E., Field, K.G. (2000). A PCR assay to discriminate human and animal feces on the basis of host differences in Bacteroides-Prevotella genes encoding 16S RNA. *Journal of Applied Microbiology*, 66, 4571-4574; Caldwell, et al. (2007). Mitochondrial multiplex real-time PCR as a source tracking method in fecal-contaminated effluents. *Environmental Science Technology*, 41(9): 3277-3283; Cotta, M.A., Whitehead, T.R., Zeltwanger, R.L. (2003). Isolation, characterization

very feasible option for determining whether and from what source fecal contamination is occurring. "Bacterial Source Tracking (BST) is a collective group of new methodologies being developed to determine sources of fecal pollution in environmental samples.... BST methodologies represent the best tools available for determining sources of fecal pollution in water."[123] However, unlike the other testing methodologies, BST is new and many of its methods are still under development. In addition, the precision of this test comes with a higher price tag than previously discussed fecal indicator tests.

Therefore, while chloride is not a proper primary indicator of fecal contamination, numerous substitutes, including fecal coliform, *Enterococcus* spp. and *E. coli,* are viable options for measuring fecal contamination through this monitoring program. We do, however, support the continued inclusion of chloride as a supplementary parameter.

B. Biochemical Oxygen Demand Is a Reasonable Monitoring Constituent

As stated above, it is necessary and appropriate for this rule to measure for the discharge of nutrients from animal feeding operations, and monitoring for ammonia nitrogen and nitrate nitrogen is a good first step in indicating nutrient pollution. However, we additionally think that the inclusion of BOD in this monitoring regime is likely to provide a useful and distinct set of information regarding nutrient impact beyond the information provided by nitrogen sampling alone. BOD is a measure of the amount of dissolved oxygen necessary to break down organic matter, such as algae, in a water resource.[124] Therefore, a larger BOD indicates a greater

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and comparison of bacteria from swine feces and manure storage pits. *Environmental Microbiology*, 5(9): 737-745; Dombek, et al. (2000). Use of repetitive DNA sequences and the PCR to differentiate *Escherichia coli* isolates from human and animal sources. *Applied and Environmental Microbiology*, 66(6): 2572-2577; Field, K.G., Samadpour, M. (2007). Fecal source tracking, the indicator paradigm, and managing water quality. *Journal of Water Resources*, 41(16): 3517-3538; Gourmelon, et al. (2007). Evaluation of two library-independent microbial source tracking methods to identify sources of fecal contamination in French estuaries. *Applied Environmental Microbiology*, 73(15): 4857-4866; Gourmelon, et al. (2002). Determining the genetic structure of the natural population of Staphylococcus aureas: a comparison of multilocus sequence typing with pulsed-field gel electrophoresis, randomly amplified polymorphic DNA analysis, and phage typing. *Journal of Clinical Microbiology*, 40(12): 4544-4546; Koike, et al. (2007). Monitoring and source tracking of tetracycline resistance genes in lagoons and groundwater adjacent to swine production facilities over a 3-year period. *Applied Environmental Microbiology*, 73(15): 4813-4823; Mieszkin, et al. (2009). Estimation of pig fecal contamination in a river catchment by real-time PCR using two pig-specific Bacteroidales 16S rRNA genetic markers. *Applied Environmental Microbiology*, 75(10): 3045-3054; Miller, et al. (2008). In situ-synthesized virulence and marker gene biochip for detection of bacterial pathogens in water. *Applied Environmental Microbiology*, 74(7): 2200-2209; Okabe, et al. (2007). Quantification of host-specific Bacteroides-Prevotella 16S rRNA genetic markers for assessment of fecal pollution in freshwater. *Applied Microbiological Technology*, 74(4): 890-901; Stedfeld, et al. (2007). Multiplex approach for screening genetic markers of microbial indicators. Water and Environmental Resources, 79(3): 260-269; Stewart, et al. (2003). Recommendations for microbial source tracking: lessons from a methods comparison study. *Journal of Water Health*, 1(4): 225-31; U.S. EPA (2005). *Microbial Source Tracking Guide Document.* EPA Report number EPA/600/R-05/064, *available at* http://www.epa.gov/nrmrl/pubs/600r05064/600r05064.pdf (last visited August 11, 2010).

[123] Bruhn, L. Wolfson, L. (2007). *Citizens Monitoring Bacteria: A Training Manual for Monitoring E. coli, 2nd Edition*, at 30, *available at* www.uwex.edu/ces/csreesvolmon/EColi/ (last visited July 8, 2010).

[124] *See* U.S. EPA, Volunteer Stream Monitoring: A Methods Manual, at 145, *available at* http://www.epa.gov/volunteer/stream/vms52.html (last visited August 09, 2010).

presence of organic matter in the water resource and a decreased availability of oxygen for other forms of aquatic life, such as fish.[125]

As it relates to discharges from animal feeding operations, since the monitoring rule currently does not monitor for phosphorus (a nutrient which, along with nitrogen, is contained in large amounts in animal waste); since increased phosphorus levels in a water body can stimulate excess plant growth; and since the eventual decomposition of excess plant growth can deplete oxygen levels in surface water, testing for BOD can provide a good indication of nutrient pollution and, therefore, total waterbody and ecosystem health. For those reasons, inclusion of BOD is a reasonable monitoring constituent.

VI. WATERKEEPERS AND CLEAN WATER FOR NC SUPPORT THE ADDITIONAL CHANGES TO THE PROPOSED RULES

Finally, we support the restructuring of the first sentence of section .1310 (a)(3). However, the sentence is still unnecessarily duplicative with regards to its reference to two visual monitoring events per year. Therefore, we suggest that you remove the first clause of the sentence ("twice per year") so that the sentence reads:

> "~~At least twice per year, f~~ Facilities with known subsurface drains shall make visual observations of subsurface drain outlets within forty-eight hours after a land application event and after a rainfall event subsequent to a land application event for a minimum of two visual inspections per year for each field with subsurface drains."

VII. WATERKEEPERS AND CLEAN WATER FOR NC SUPPORT THE IMPLEMENTATION OF MONITORING RULES CAPABLE OF EFFICIENTLY AND EFFECTIVELY DETERMINING IF AND WHEN ANIMAL WASTE IS BEING DISCHARGED FROM ANIMAL FEEDING OPERATIONS IN NORTH CAROLINA

An appropriately targeted monitoring program will provide the accountability, substance, and pollution abatement needed to protect human health and welfare, improve water quality, and promote compliance with governing laws. However, the current draft of the proposed rules has been so channelized that it has gone from being targeted to being constrained. Fortunately, transitioning these rules into an acceptably functional form will not require much change to the face of the rule. Rather, three minor changes (the addition of more sampling sites, an increase in targeted sampling events, and the re-expansion of monitoring parameters to include a primary fecal indicator and BOD) should sufficiently enhance the proposed rules, thereby permitting the ultimate goals of the rules to be met. We would additionally support changes to the proposed rules that would increase the rules' QA/QC measures and provide more focused language regarding when sampling should take place, how sampling information will be compiled, and

[125] *Id.* ("[t]he consequences of high BOD are the same as those for low dissolved oxygen: aquatic organisms become stressed, suffocate, and die."). See also, Supplemental Guide at 167-168 ("[a]lgal growth and the depletion of dissolved oxygen caused by nutrient enrichment ... can result in supersaturation – a condition that occurs when dissolved oxygen levels are greater than the saturation value for a given temperature and atmospheric pressure. High dissolved gas levels can be lethal to fish populations by inhibiting respiratory processes.").

how relevant sampling data will be translated into productive improvements to discharging animal feeding operations.

In conclusion, we strongly support the incorporation of the suggested improvements into the final version of the surface and ground water quality monitoring rules for animal feeding operations. If these suggestions are not incorporated into the final rule, we respectfully request for the administrative authorities, through either a Hearing Officers' Report or through another written medium, to respond to these concerns and suggestions.

Thank you for your time and consideration. If you have any questions or would like to discuss these comments further, please contact Hannah Connor at 914-674-0622.

Sincerely,

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Waccamaw Riverkeeper
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