

2972–2974) and in the record for this rulemaking.

4. What Ecological and Human Health Impacts Have Been Caused by CAFO Wastes?

Among the reported environmental problems associated with animal manure are surface and ground water quality degradation, adverse effects on estuarine water quality and resources in coastal areas, and effects on soil and air quality. The scientific literature, which spans more than 30 years, documents how these problems can contribute to increased risk to aquatic and wildlife ecosystems, for example, the large number of fish kills in recent years. Human health might also be affected, for example, by high nitrate levels in drinking water and exposure to waterborne human pathogens and other pollutants in manure. The record for this rule provides more detailed information on the scientific and technical research to support these findings.

a. Ecological impacts. Manure pollutants in surface waters contribute to eutrophication, the disruption of a water body due to overenrichment. Eutrophication is the most documented impact of nutrient pollution and is a serious concern for coastal and estuarine resources. Another negative impact generated by excess nutrients in surface water is algae blooms, which also result from overenrichment from nutrients. Such blooms depress oxygen levels and contribute further to eutrophication. Many lake and coastal problems are linked to eutrophication, including red tides, fish kills, outbreaks of shellfish poisonings, loss of habitat, coral reef destruction, and hypoxia.

Many of the constituents in manure, especially organic matter, also decrease the oxygen concentrations in surface waters, sometimes below the levels fish and invertebrates require to survive. Nitrites and pathogens in manure can also pose risks to aquatic life. If sediments are enriched by nutrients, the concentrations of nitrites in the overlying water may be raised enough to cause nitrite poisoning in fish. There is substantial information in the record for this rule that describes local, regional, and national evaluations indicating that animal manure is a significant source of pollutants that contribute to water quality degradation. Many of these evaluations note a high incidence of fish kills. EPA's analysis shows that between 1981 and 1999, 19 States reported 4 million fish killed from both runoff and spills at CAFOs.

In addition, excess nitrogen can contribute to water quality decline by

increasing the acidity of surface waters. Pathogens can accumulate in fish and shellfish, resulting in a pathway for transmission to higher trophic organisms; they can also contribute to avian botulism and avian cholera. Additional information on fish kills and other adverse impacts is presented in the 2001 proposal (66 FR 2972–2974) and in the record for this rulemaking.

b. Human health impacts from affected drinking water. Pollution originating from an animal production facility can have multiple impacts on drinking water. Nitrogen in manure is easily transformed into the nitrate form, which can be transported to drinking water sources and present a range of health risks. These health risks include methemoglobinemia in infants, spontaneous abortions, and increased incidence of stomach and esophageal cancers. Nitrate is not removed by conventional drinking water treatment processes but requires additional, relatively expensive treatment units. California's Chino Basin estimates a cost of more than \$1 million per year to remove nitrates from drinking water due to loadings from local dairies. Generally, people drawing water from domestic wells are at greater risk of nitrate poisoning than those drawing from public water sources, because domestic wells are typically shallower and not subject to wellhead protection monitoring or treatment requirements.

Salts in animal wastes can also pose a health hazard. At low levels, salts can increase blood pressure in salt-sensitive individuals, increasing their risk of stroke and heart attacks. The salt load into the Chino Basin from local dairies is more than 1,500 tons per year, which costs the drinking water treatment system between \$320 and \$690 per ton to remove.

To the extent that nutrients contribute to algae blooms in surface water through accelerated eutrophication, algae can affect drinking water by clogging treatment plant intakes, producing objectionable tastes and odors, and increasing production of harmful chlorinated by-products (e.g., trihalomethanes) by reacting with chlorine used to disinfect drinking water. In Wisconsin, the City of Oshkosh has spent an extra \$30,000 per year on copper sulfate treatment to kill the algae in the waters from Lake Winnebago, which is attributed to excess nutrients from animal manure, commercial fertilizers, and soil. In Tulsa, Oklahoma, excessive algae growth in Lake Eucha, associated with poultry farming, costs the city \$100,000 per year to address taste and odor problems in the drinking water.

c. Other human health impacts. In addition to threats to human health through drinking water exposures, pathogens from animal manure can also threaten human health through shellfish consumption and recreational contact such as swimming in contaminated waters. Relatively low-dose exposures to *Cryptosporidium parvum* and *Giardia* spp. can cause infection in humans. Other bacteria found in livestock manure have also been associated with waterborne disease. Pathogens from animal wastes can readily enter water sources, resulting in contamination of surface waters. Some pathogens are able to survive and remain infectious in the environment for relatively long periods of time. U.S. federal agencies and other independent researchers have recognized the potential public health risks from pathogens originating from CAFOs. At this time, however, the magnitude of the human health risk from pathogenic organisms that directly originate from CAFOs and are transported through U.S. waters has not been established.

According to a United Nations report, the use of antibiotics in food-producing animals has the potential to affect human health because of the presence of drug residues in foods and also because of the selection of resistant bacteria in animals. However, the impact of antimicrobial metabolic products and nonmetabolized drugs in animal wastes that are released into the environment remains unclear. The emergence of resistant bacteria is of particular concern because such infections are more difficult to treat and require drugs that are often less readily available, more expensive, and more toxic. In the U.S., pilot studies coordinated by EPA, USDA, and the Centers for Disease Control have been initiated to assess the extent of environmental contamination by antimicrobial drug residues and drug-resistant organisms that enter the soil or water from human and animal waste.

C. How Will Water Quality and Human Health Be Improved by This Rule?

1. What Reductions in Pollutant Discharges Will Result From This Rule?

EPA's pollutant reductions for this rule focus to a large degree on estimating the amount of pollutants in the runoff from land where manure has been applied. These estimates of pollutant discharges, referred to as the "edge-of-field" loadings, were made for nutrients, metals, pathogens, and sediment for both pre-rule conditions (baseline) and post-rule conditions. The reductions in pollutant discharges were