

not include estuaries, coastal areas or other marine water bodies, and fish kills are noted to occur in these areas as well. Parts of the Eastern Shore of the United States have been plagued with problems related to *Pfiesteria*, a dinoflagellate algae that exist in rivers at all times, but is known to cause fish kills in estuarine and coastal environments under certain conditions. Fish attacked by *Pfiesteria* have lesions or large, gaping holes on them as their skin tissue is broken down; the lesions often result in death. The conditions under which *Pfiesteria* can harm fish are believed to be related to high levels of nutrients. Fish kills related to *Pfiesteria* in the Neuse River in North Carolina have been blamed on the booming hog industry and the associated waste spills and runoff from the hog farms. Preliminary evidence suggests that human health problems might also be associated with exposure to *Pfiesteria*. As a result, people most likely would limit or avoid recreational activities in coastal waters with *Pfiesteria*-related fish kills. The town of New Bern, a popular summer vacation spot along the Neuse River in North Carolina, experienced several major fish kills in the summer of 1995. During this event, people became ill after swimming and fishing in the impacted areas, and there were reports that people swimming in the waters reported welts and sores on their bodies. Summer camps canceled boating classes, children were urged to stay out of the water, and warnings were issued about swimming and eating fish that were diseased. Many blame the heavy rainfall, which pumped pollutants from overflowing sewage plants and hog lagoons into the river, creating algae blooms, low oxygen, and *Pfiesteria* outbreaks as the cause of the fish kills.

EPA obtained reports on fish kill events in the United States, with data for nineteen States showing historical and current fish kills. Using these data, EPA estimates the benefits of reducing fish kills through implementation of the ELG requirements in today's rule for Large CAFOs at \$0.1 million annually.

*d. Reduced public water treatment costs.* Total suspended solids (TSS) entering the surface waters from CAFOs can hinder effective drinking water treatment by interfering with coagulation, filtration, and disinfection processes. EPA used the NWPCAM model to predict how pollutant reductions from Large CAFOs would affect the ambient concentration of TSS in the source waters of public water supply systems. To measure the value of reductions in TSS concentrations, EPA estimated the extent to which lower TSS concentrations reduce the operation and

maintenance (O&M) costs associated with the conventional treatment technique of gravity filtration. EPA estimates reduced drinking water treatment costs of \$1.1 to \$1.7 million annually due to reduced discharges of pollutants at Large CAFOs.

#### 4. Benefits From Improved Ground Water Quality

*a. Human health benefits.* CAFO wastes can contaminate ground water and thereby cause health risks and welfare losses to people relying on ground water sources for their potable supplies or other uses. Of particular concern are nitrogen and other constituents that leach through the soils and the unsaturated zone and ultimately reach ground waters. Nitrogen loadings convert to elevated nitrate concentrations at household and community system wells, and elevated nitrate levels in turn pose a risk to human health in households with private wells. (Nitrate levels in community wells are regulated to protect human health.)

This rule is expected to reduce nitrate levels in private drinking wells by reducing the rate at which manure is spread on cropland, thus reducing the rate at which pollutants will leach through soils and reach ground water. The federal health-based National Primary Drinking Water Standard for nitrate is 10 milligrams per liter (mg/L), and this Maximum Contaminant Level (MCL) applies to all community water supply systems. Households relying on private wells are not subject to the federal MCL for nitrate, but levels above 10 mg/L are considered unsafe for sensitive subpopulations (e.g., infants). Several economic studies indicate a considerable willingness-to-pay by households to reduce the likelihood of nitrate levels exceeding 10 mg/L, and to reduce nitrate levels even when baseline concentrations are considerably below the MCL.

EPA used U.S. Geological Survey data on nitrate levels in wells throughout the country to predict how nitrate concentrations in private drinking wells would be reduced by this rule. Based on these data, EPA estimates that 9.2 percent of households that currently rely on private wells with nitrate concentrations exceeding the MCL will have these concentrations reduced to levels below the MCL because of the ELG requirements for Large CAFOs. EPA estimates the value of these reductions based on willingness-to-pay studies to be \$583 annually per household (2001\$) resulting in benefit estimates of \$30.2 to \$44.6 million nationally on an annual basis for this

component of ground water improvements. Another 5.8 million households that currently have nitrate levels in their private wells below the MCL will experience further reductions in nitrate levels because of the ELG requirements for Large CAFOs. Studies also show that people are willing to pay \$2.09 per mg/L reduced annually (2001\$) to get these additional reductions once they are already below the MCL for nitrate. This gives benefits estimates of \$0.7 million to \$1.1 million annually for the nation for this component of ground water improvements. The total benefits of reduced nitrate contamination of private drinking wells as a result of reducing pollutant discharges at Large CAFOs are estimated to range from approximately \$30.9 to \$45.7 million annually (2001\$).

Research documented in the record and summarized in the *Benefits Analysis* shows that CAFO wastes affect the environment and human health in ways beyond those for which benefits have been monetized. Additional ground water benefits that may result from this rule include reduced pathogen contamination of private drinking water wells and community drinking water supplies. EPA's *Benefits Analysis* does not include monetary values for these additional ground water improvements because data limitations preclude quantifiable estimates of the magnitude of improvement or because it is difficult to ascribe an economic value to these benefits. EPA also recognizes that CAFO operators have strong private incentives to avoid contaminating their own private drinking water sources.

*b. Animal health benefits.* Land application of manure can result in leaching of nitrates and enteric pathogens to ground water, which in many cases is used as the source of drinking water for livestock in rural communities. Excessive nitrate in livestock watering sources, particularly in conjunction with feeds containing nitrogen such as alfalfa, can contribute to increased morbidity and mortality due to acute and chronic nitrate poisoning in cattle which would have the ability to convert nitrate to toxic nitrite. In addition, studies have found that nearly 20% of rural water wells are contaminated with enteric pathogens such as fecal coliform and fecal streptococcus, common indicators of enteric pathogens, at ratios which suggest the source of contamination may be animal waste. Consumption of water by livestock contaminated with enteric pathogens could result in increased morbidity and mortality due to waterborne illness, particularly gastrointestinal disorders.