

estimated using an environmental model (Groundwater Loading Effects of Agricultural Management Systems, or GLEAMS) that simulates hydrologic transport, erosion, and biochemical processes such as chemical transformation and plant uptake. The GLEAMS model uses information on soil characteristics and climate, along with characteristics of the applied manure and commercial fertilizers, to model losses of nutrients, metals, pathogens, and sediment in surface runoff, sediment, and ground water leachate. EPA's analysis also developed estimates of changes in pollutant discharges occurring at the production area.

The pollutant reduction estimates were developed for each type of model farm included in EPA's cost models. The model farms were developed to represent the various animal types, farm sizes, and geographic regions. Model farms were developed for each animal type across a range of size classes, and model farms were located in each geographic region. The pollutant estimates for the model farms were combined with published data from USDA's 1997 *Census of Agriculture* and then refined into national, regional, State, and county level pollutant loading estimates that were used to determine in-stream surface water and ground water concentrations. These

values were then used in the water quality models and other environmental benefits assessment models to estimate the human health and environmental benefits accruing from this rule.

EPA quantified the reduction of nitrogen and phosphorus loads associated with this rule. Reductions of discharges of the metals zinc, copper, cadmium, nickel, lead, and arsenic were also analyzed for the final rule. Fecal coliform and fecal streptococcus were used as surrogates to estimate pathogen reductions that would be achieved by this rule. Other pathogens would likely be reduced to a similar degree. Table 7.2 presents the pollutant reductions expected to result from this rule.

TABLE 7.2.—POLLUTANT REDUCTIONS: COMBINED TOTAL FOR ALL ANIMAL SECTORS

Parameter	Baseline pollutant loading (Pre-regulation)	Post-regulation pollutant loading	Pollutant reduction
Large CAFOs:			
Nutrients (million lb)	658	503	155 (24%)
Metals (million lb)	20	19	1 (5%)
Pathogens (10 ¹⁹ cfu)	5,784	3,129	2,655 (46%)
Sediment (million lb)	35,493	33,434	2,059 (6%)
Medium CAFOs:			
Nutrients (million lb)	65	54	11 (17%)
Metals (million lb)	2.0	1.9	0.1 (5%)
Pathogens (10 ¹⁹ cfu)	1,456	779	677 (46%)
Sediment (million lb)	3,119	3,015	104 (3%)

2. Approach for Determining the Benefits of This Rule

EPA has analyzed the water quality improvements expected to result from the new requirements being promulgated today and has estimated the environmental and human health benefits of the pollutant reductions that will result. The benefits described in this section are primarily associated with direct improvements in water quality (both surface water and ground water), but this new rule will also create certain non-water quality environmental effects, such as improved soil conditions, changes in energy consumption, and changes in emissions of air pollutants.

For this rule, EPA conducted seven benefit studies to estimate the impacts of reductions in pollutant discharges from CAFOs. The first study used a national water quality model (National Water Pollution Control Assessment Model, or NWPCAM) that estimates runoff from land application areas to rivers, streams, and, to a lesser extent, lakes in the U.S. This study estimated the value society places on improvements in surface water quality associated with today's rule. The second study examined the expected

improvements in shellfish harvesting resulting from the new CAFO rule. A third study looked at incidences of fish kills that are attributed to AFOs and estimated the cost of replacing the lost fish stocks. The fourth study estimated the benefits associated with reduced ground water contamination. Reduced public water treatment costs were evaluated in the fifth study, and reduced livestock mortality from nitrate and pathogen contamination of livestock drinking water was evaluated in the sixth study. In the seventh study, a case study of potential fishing benefits for the Albemarle-Pamlico estuary is presented to provide some insight to the potential benefits for estuaries and coastal waters. Each of the seven studies, as well as benefits results, are briefly described in the following sections. Benefits results associated with reduced pollutant discharges from Large CAFOs are also summarized in Table 7.1. The benefit value estimates presented in this section reflect only those pollutant reductions and water quality improvements attributable to Large CAFOs. EPA also developed estimates of the pollutant reductions that will occur due to the revised requirements for Small and Medium

CAFOs, but analysis of the monetized value of the associated water quality improvements was not completed in time for benefits estimates to be presented here.

In this analysis, EPA estimates the effect of pollutant reductions and other environmental improvements on human health and the ecosystem and assigns a monetary value to these benefits to the extent possible. In some cases, EPA was able to identify certain types of improvements that will result from this rule, but was unable to either estimate the monetary value of the improvement or quantify the amount of improvement that will occur. These non-monetized and non-quantified benefits are included in the discussion below. Given the limitations in assigning monetary values to some of the improvements, the economic benefit values described below and in the *Benefits Analysis* should be considered a subset of the total benefits of this rule. These monetized benefits should be evaluated along with descriptive qualitative assessments of the non-monetized benefits. For example, the economic valuation used for this rule assigns monetary values to the water quality improvements due to reductions of the