

TABLE 7.1.—ANNUALIZED BENEFITS OF ELG REQUIREMENTS FOR LARGE CAFOS—Continued
[Millions of 2001\$]

Types of benefits	Total for all CAFOs
Reduced nitrate contamination of private wells	\$30.9 to \$45.7.
Reduced eutrophication & pathogen contamination of coastal & estuarine waters (Case study of potential fishing benefits to the Albemarle-Pamlico estuary)	Not monetized [\$0.2].
Reduced public water treatment costs	\$1.1 to \$1.7.
Reduced livestock mortality from nitrate and pathogen contamination of livestock drinking water	\$5.3.
Reduced pathogen contamination of private & public underground sources of drinking water	Not monetized.
Reduced human & ecological risks from antibiotics, hormones, metals, salts	Not monetized.
Improved soil properties	Not monetized.
Reduced cost of commercial fertilizers for non-CAFO operations	Not monetized.
Total benefits	\$204.1 + [B] to \$355.0 + [B].

[B] represents non-monetized benefits of the rule.

B. What Pollutants Are Present in Manure and Other CAFO Wastes, and How Do They Affect Human Health and the Environment?

1. What Pollutants Are Present in Animal Waste?

The primary pollutants associated with animal wastes are nutrients (particularly nitrogen and phosphorus), organic matter, solids, pathogens, and odorous/volatile compounds. Animal waste is also a source of salts and trace elements and, to a lesser extent, antibiotics, pesticides, and hormones. The composition of manure at a particular operation depends on the animal species, size, maturity, and health, as well as on the composition (e.g., protein content) of animal feed. The sections below introduce the main constituents in animal manure and include information from the *National Water Quality Inventory: 2000 Report* (hereinafter the “2000 Inventory”). This report is prepared every 2 years under section 305(b) of the Clean Water Act, and it summarizes State reports of impairment to their water bodies and the suspected sources of those impairments.

a. Nutrients. Animal wastes contain significant quantities of nutrients, particularly nitrogen and phosphorus. The 2000 Inventory lists nutrients as the leading stressor of impaired lakes, ponds, and reservoirs. Nutrients are also ranked as the fifth leading stressor for impaired rivers and streams, are among the top 10 stressors of impaired estuaries, and are the second leading stressor reported for the Great Lakes. 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. Ammonia is of environmental concern because it is

toxic to aquatic life and it exerts a direct BOD on the receiving water, thereby reducing dissolved oxygen levels and the ability of a water body to support aquatic life. Excessive amounts of ammonia can lead to eutrophication, or nutrient overenrichment, of surface waters. Nitrate is a valuable fertilizer because it is biologically available to plants. Excessive levels of nitrate in drinking water, however, can produce adverse human health impacts.

Phosphorus is of concern in surface waters because it is a nutrient that can lead to eutrophication and the resulting adverse impacts—fish kills, reduced biodiversity, objectionable tastes and odors, increased drinking water treatment costs, and growth of toxic organisms. At concentrations greater than 1.0 milligrams per liter, phosphorus can interfere with the coagulation process in drinking water treatment plants thus reducing treatment efficiency. Phosphorus is of particular concern in fresh waters, where plant growth is typically limited by phosphorus levels. Under high pollutant loads, however, fresh water may become nitrogen-limited. Thus, both nitrogen and phosphorus loads can contribute to eutrophication.

b. Organic matter. Livestock manures contain many carbon-based, biodegradable compounds. Once these compounds reach surface water, they are decomposed by aquatic bacteria and other microorganisms. During this process dissolved oxygen is consumed, which in turn reduces the amount of oxygen available for aquatic animals. The 2000 Inventory indicates that low dissolved oxygen levels caused by organic enrichment (oxygen-depleting substances) are the third leading stressor in impaired estuaries. They are the fourth greatest stressor in impaired rivers and streams, and the fifth leading stressor in impaired lakes, ponds, and reservoirs. Severe reductions in dissolved oxygen levels can lead to fish

kills. Even moderate decreases in oxygen levels can adversely affect water bodies through decreases in biodiversity characterized by the loss of fish and other aquatic animal populations, and a dominance of species that can tolerate low levels of dissolved oxygen.

c. Solids. The 2000 Inventory indicates that dissolved solids are the fourth leading stressor in impaired lakes, ponds, and reservoirs. Solids from animal manure include the manure itself and any other elements that have been mixed with it. These elements can include spilled feed, bedding and litter materials, hair, and feathers. In general, the impacts of solids include increasing the turbidity of surface waters, physically hindering the functioning of aquatic plants and animals, and providing a protected environment for pathogens. Increased turbidity reduces penetration of light through the water column, thereby limiting the growth of desirable aquatic plants that serve as a critical habitat for fish, shellfish, and other aquatic organisms. Solids that settle out as bottom deposits can alter or destroy habitat for fish and benthic organisms. Solids also provide a medium for the accumulation, transport, and storage of other pollutants, including nutrients, pathogens, and trace elements.

d. Pathogens. Pathogens are defined as disease-causing microorganisms. A subset of microorganisms, including species of bacteria, viruses, and parasites, can cause sickness and disease in humans and are known as human pathogens. The 2000 Inventory indicates that pathogens (specifically bacteria) are the leading stressor in impaired rivers and streams and the fourth leading stressor in impaired estuaries. Livestock manure may contain a variety of microorganism species, some of which are human pathogens. Multiple species of pathogens can be transmitted directly from a host animal's manure to surface