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Economic and Environmental Benefits Analysis of the Final Meat and Poultry Products Rule

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CHAPTER 7
ENVIRONMENTAL IMPACTS AND POTENTIAL BENEFITS

7.1 MPP POLLUTANTS

The primary pollutants associated with MPP wastes are nutrients (particularly nitrogen and phosphorus), organic matter, solids, and pathogens. EPA identified 30 pollutants of concern for the meat processing segment of the industry and 27 pollutants of concern for the poultry processing segment of the industry. This list includes ammonia (as nitrogen), carbonaceous five-day biochemical oxygen demand (BOD_5), chemical oxygen demand (COD), nitrate and nitrite (as nitrogen), oil and grease, pH, temperature, total nitrogen, and total phosphorus (as PO_4). The following sections include information from the *National Water Quality Inventory: 2000 Report*, (U.S. EPA 2000) or the *"2000 Inventory*," and introduce the main constituents of MPP industry waste streams. Prepared every two years under § 305(b) of the Clean Water Act, the *Inventory* summarizes state reports on the impairment of water bodies and suspected stressors.

7.1.1 Nutrients

The *2000 Inventory* lists nutrients as the leading stressor of impaired lakes, ponds, and reservoirs. Nutrients are also the fifth leading stressor of impaired rivers and streams, among the top 10 stressors of impaired estuaries, and the second leading stressor reported for the Great Lakes.

Nitrogen occurs in several forms, including ammonia and nitrate. These forms of nitrogen can 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 exerts a direct oxygen demand on the receiving water as it is broken down, thereby reducing dissolved oxygen levels and the ability of a water body to support aquatic life. Excessive amounts of ammonia and other forms of nitrogen can lead to eutrophication, or nutrient overenrichment, of surface waters. Eutrophication is the

most documented impact of nutrient pollution. Excess nutrients in surface water can also cause algal blooms, which depress oxygen levels and contribute further to eutrophication.

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

7.1.2 Organic matter

BOD_5 and COD are important measures of the organic content of an effluent. 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 could lead to fish kills. Even moderate decreases in oxygen levels could adversely affect water bodies through decreases in biodiversity characterized by the loss of fish and other aquatic animals and a dominance of species that can tolerate low levels of dissolved oxygen.

7.1.3 Solids

The *2000 Inventory* indicates that dissolved solids are the fourth leading stressor in impaired lakes, ponds, and reservoirs. In general, solids can increase cloudiness of surface waters, physically damage aquatic plants and animals, and provide a protected environment for pathogens. Increased cloudiness reduces penetration of light through the water column and limits the growth of desirable aquatic plants that are critical habitat for fish, shellfish, and other aquatic organisms. Solids that settle out as bottom deposits can alter or destroy habitat for fish and organisms that live at the bottom.

7.1.4 Oil and Grease

Oil and grease could have toxic effects on aquatic organisms (i.e., fish, Crustacea, larvae and eggs, gastropods, bivalves, invertebrates, and flora). Marine larvae and benthic invertebrates appear to be the most intolerant of oil and grease, particularly water-soluble compounds, at concentrations ranging from 0.1 parts per million to 25 parts per million and 1 part per million to 6,100 parts per million, respectively. The oil and grease designation includes many organic compounds with varying physical, chemical, and toxicological properties, and EPA has not established a numerical criterion applicable to all types of oil and grease. Water quality standards and some permit limits, therefore, are described as requiring "no visible sheen." For this assessment, EPA did not model the effects of oil and grease on the environment.

7.1.5 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. 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. Water-born pathogens are known to impact aquatic life, drinking water supplies, and human activities such as fishing (Docket No. W-01-06, Record No. 10024 - Pathogen TMDL report). There are numerous reports associating *E. coli* 0157-caused illness with consumption of contaminated beef (Valcour et al., 2002; Michino et al., 1999; Tuttle et al., 1999), wild meats (Gagliardi et al., 1999), or under-processed fruit juice (Kudva et al., 1998). Additional cases of illness have been caused by drinking water contaminated with the pathogen (Novello, 1999; Bruce-Grey Owen Sound Health Unit, 2000; Jackson, et al., 1998). In most of these reports, animal feces, particularly bovine feces, were the probable vehicle for transmitting *E. coli* 0157:H7 to other animals, food, and the environment. Epidemiological investigations have demonstrated that cattle, particularly young animals, are a principal reservoir of *E. coli* 0157:H7 (Wang et al., 1996).

7.1.6 Other potential contaminants

Surfactants have been identified as an emerging issue related to water quality from waste effluent. Alkylphenol polyethoxylates (AP) are nonionic industrial surfactants used globally in detergents, paints, herbicides, and cosmetics. All categories and subcategories of the MPP industry addressed in this final rule conduct relatively thorough sanitation processes, involving large amounts of chemical cleansers. Alkylphenols such as octylphenol, nonylphenol, and nonylphenol diethoxylate are commonly found in sewage treatment plant effluents and river waters as microbial breakdown products of these surfactants. Researchers have shown that these degradation products inadvertently mimic the biological activity of the female hormone estrogen in *in vitro* fish, avian, and mammalian assays. They are estrogenic as their molecular action is mediated through the estrogen receptor (White et al., 1994). Findings of AP estrogenicity *in vitro* have been substantiated by reports of inhibited testicular growth after AP exposure of rats (Sharpe et al., 1995) and fish (Jobling et al., 1996) *in vivo*. The potential impacts of estrogen receptor binding chemicals include altered protein expression on the cellular level, changes in hormone levels in the ova and testis, expression of secondary sex characteristics, and altered reproductive capability of individuals. These impacts could lead to skewed genders within a population and ultimately impact the long-term efficacy of the population. While these chemicals are relatively weak estrogen receptor binders, they could be of concern due to their hydrophobic tendency and potential to bioaccumulate. (Schmeider et al., 2000). Tighter discharge limits and effluent treatment processes to reduce the concentration of AP and its degradation products have been shown to reduce the estrogenic activity of the watercourses into which the effluents are discharged. (Sheehan et al., 2002)

Growth promoters (e.g., trenbolone acetate—a synthetic anabolic steroid used to promote growth in cattle) are extensively used in the United States. Researchers have shown that these steroids, and more importantly their metabolites (e.g. 17-beta-trenbolone from trenbolone acetate), are comparatively stable in animal waste, suggesting the potential for exposure to aquatic animals via direct discharge, runoff, or both. Reproductive alterations have been reported in fish living in waters receiving cattle feedlot effluent (Jegou et al., 2001). In addition, feedlot effluent samples have displayed androgenic activity *in vitro* (Gray et al., 2001). Little is known of the toxicity of these promoters and metabolites. Recent studies, however, on one such chemical—17- beta-trenbolone—indicate the potential for androgenic activity in *in vitro* and *in vivo* assays and induction of developmental abnormalities (Wilson et al., 2002). Furthermore, 17-beta-trenbolone researchers observed androgenic activity in the fathead minnow as evidenced by

secondary sex characteristics in females (production of dorsal nuptial tubercles, structures normally present only on the heads of males) and altered reproductive physiology of males (Ankley et al., 2003). The presence of these chemicals in the environment and their potential toxicity are the subject of further study.

7.2 WATER QUALITY IMPAIRMENT AND MPP DISCHARGE LOCATIONS

EPA identified 10 articles documenting the environmental impacts of meat and poultry processing facilities. Documented impacts include four reaches with nutrient loadings, two sites with contaminated well water, one site with contaminated groundwater, and one lake threatened by nutrient loadings. See Appendix 7-A of this document for a summary of the articles.

EPA has made significant progress in implementing Clean Water Act programs and in reducing water pollution. Despite such progress, however, serious water quality problems persist throughout the country. The *2000 Inventory* data identify the leading pollutants impairing surface water quality in the United States to include nutrients, pathogens, sediment/siltation, and oxygen-depleting substances. These pollutants originate from many different sources, including the animal production industry.

More than 40 percent of our assessed waters still do not meet the applicable water quality standards, amounting to more than 20,000 individual river segments, lakes, and estuaries. These impaired waters include approximately 300,000 miles of rivers and shorelines and approximately 5 million acres of lakes. An overwhelming majority of the population—218 million—live within 10 miles of the impaired waters.

Under section 303(d) of the 1972 Clean Water Act, states, territories, and authorized tribes are required to assess and develop lists of waters that do not meet water quality standards after point sources of pollution have installed the minimum required levels of pollution control technology. The law requires that these jurisdictions establish priority rankings for waters and develop total maximum daily loads (TMDLs) for them. A TMDL specifies the maximum amount of a single pollutant that a water body can receive and still attain its applicable standard. The calculation of the TMDL must include a margin of

safety to ensure that the water body can be used for the purposes the jurisdiction has designated. The calculation must also account for seasonal variation in water quality.

MPP facilities primarily discharge pollutants to rivers and streams. For those MPP facilities for which EPA had location information, 66 of the 112 water bodies to which they discharge are listed as impaired. MPP facilities discharging to an impaired water body could be subject to requirements to reduce their discharges. Of the 66 impaired water bodies, 19 have proposed or promulgated TMDLs; 11 of the 19 are impaired by nutrients. Eight water bodies are scheduled for TMDLs; 5 of the 8 are impaired by nutrients. Eighteen of the remaining 39 water bodies are impaired because of nutrients. The TMDLs for some of these water bodies are not scheduled. TMDL schedules are not available for all of the impaired water bodies.

7.3 WATER QUALITY AND HUMAN HEALTH IMPROVEMENTS FROM THIS RULE

7.3.1 Reductions in pollutant discharges from this rule

The pollutant reductions achieved by the final rule will reflect the additional wastewater treatment at MPP facilities. See Section VIII A of the preamble of the final rule for discussion of pollutant loading reduction. The pollutant reductions are used in the water quality models and environmental benefit assessment models to estimate the human health and environmental benefits accruing from the rule.

EPA quantified the reduction of nitrogen loads associated with the rule. Reductions of discharges of the metals barium, chromium, copper, manganese, molybdenum, nickel, titanium, vanadium, and zinc were also analyzed for the final rule. Fecal coliform served as a surrogate measure of pathogen reductions that would be achieved by this rule. EPA expects that other pathogens (e.g., *E. coli*) will be reduced to a similar degree due to disinfection requirements. Table 7-1 presents the pollutant reductions expected to result from the rule.

Table 7-1
Pollutant reductions: Combined total for all MPP Facilities

Parameter	Baseline Pollutant Loading (Pre-regulation)	Post-regulation Pollutant Loading	Pollutant Reduction
Nitrogen (million lb)	48.4	20.0	28.5
Pathogens (10^{18} cfu)	1,340.2	249.0	1,091.2
Sediment (million lb)	8.5	6.1	2.4

The following chapters describe the methods EPA used to estimate the effect of pollutant reductions and other environmental improvements on human health and the ecosystem. They also describe how EPA assigned a monetary value to these benefits. In some cases, EPA could identify an improvement that would result from the rule, but could not estimate the monetary value of the improvement or quantify the amount of improvement to expect. Chapters 9 through 12 illustrate some of these non-monetized and/or non-quantified benefits.

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CHAPTER 7: APPENDIX A
DOCUMENTED ENVIRONMENTAL IMPACTS AND PERMIT VIOLATIONS

In addition to modeling environmental effects of MPP facilities using the NWPCAM model, EPA performed a literature search to document cases where MPP facilities have been identified as sources of water quality impairment. The results of this literature search are published in the Administrative Record as part of the public docket (DCN 317,601).

While the literature search was not comprehensive and was limited mostly to newspaper articles and government press releases covering the last five years, EPA found 19 cases in which plant operators were cited for a variety of permit violations. One meat processing facility was cited for more than 5,000 permit violations, which led to degradation of water quality in the affected river. In fact, this facility received the highest fine ever issued under the Clean Water Act. Other documented impacts cited in the articles included 10 stream reaches with nutrient loadings, two sites with contaminated well water, one site with contaminated groundwater, and one lake threatened by nutrient loadings. In all cases, the identified source of contamination or perceived threat was an MPP facility. In cases in which permit levels were violated or alleged to be violated, ammonia (NH_3-N), phosphate (PO_4), fecal coliform bacteria, and total suspended solids (TSS) were the most common contaminants of concern.

Eighteen of the articles document legal action in criminal cases taken against MPP facility owners or operators. Documented legal action targeted: (1) the conspiracy of five facilities to violate the Clean Water Act; (2) illegal dumping of waste (one case); and (3) falsifying records, diluting waste samples, and/or destroying records (five cases). These legal actions resulted in possible incarceration and fines ranging from $0.25 million to $12.6 million. Table 7-A summarizes the environmental impacts identified and type of legal action pursued.

Table 7-A
Documented Environmental Effects of MPP Wastes on Water Quality

	Identified Impacts
Case #1	High concentrations of fecal coliform, an indicator of the presence of animal intestinal waste, found in receiving waters. Also excessive discharges of phosphorus, ammonia, cyanide, oil, and grease. Plant was fined $12.6 million, the largest Clean Water Act fine ever assessed (1997).
Case #2	Operators of five poultry processing facilities were indicted for actions leading to more than 5,000 permit violations during a 20-year period (from 1975-1995). Indictment (01/2000) alleged one of the plants discharged pollutants, including ammonia, fecal coliform, oil and grease, suspended solids, and other rotting materials, directly into receiving waters.
Case #3	Poultry processing plant agreed to pay $500,000 (1998) for permit violations. Parameters on the discharge of phosphorus were also established for the first time for this facility.
Case #4	Meat processing facility operators agreed to pay fine of $250,000 for permit violations. Permit violations included falsification of discharge monitoring reports, exceedances of effluent limitations, and inadequate record-keeping practices (1998).
Case #5	Turkey processor agreed to make improvements in wastewater treatment system and pay $300,000 fine for permit violations. Violations included exceeding limitations for phosphorus and ammonia (1997). High levels of these pollutants were found downstream of the plant. Biologists also found a dearth of aquatic insects.
Case #6	Rendering facility officials agreed to pay $600,000 in fines for polluting river with dead animal parts and falsifying sewer discharge records (2000).
Case #7	Chicken processing plant was fined $10,800 for permit violations. Wastewater exceeded fecal coliform limits and volume limits. During 1998, a fish kill caused by oxygen depleted water was tied to facility's treatment plant.
Case #8	Two poultry plants were fined more than $46,000 for 206 water quality violations that took place during 1998 and 1999. Waste with high bacteria levels was running off sprayed fields.
Case #9	A poultry plant was fined $6 million for allowing excessive runoff from its farms and processing plants.
Case #10	Pork processing plant cited 20 times since 1994 for permit violations. Tests of receiving water body indicated high levels of several pollutants, including ammonia and fecal bacteria.

Table 7-A continued

	Identified Impacts
Case #11	High levels of phosphorous were detected downstream from poultry processing plant. In addition, state alleged that high levels of ammonia and high temperatures resulted from plant's discharges.
Case #12	State Conservation Commission study indicated that waste from poultry processing plants threatened viability of lake due to discharges of phosphorous and nitrogen.
Case #13	Water quality data collected by EPA indicated marked increase in phosphorous in many areas downstream from chicken plants**.**
Case #14	State Department of Natural Resources obtained a court order to compel poultry processor to adhere to state water quality laws. The plant will reduce its discharge by approximately 50 percent under the court order.
Case #15	State environmental official filed suit against poultry processor for willfully contaminating groundwater in the vicinity of fields where the plant had sprayed wastewater. Wastewater was laden with nitrates (1998).
Case #16	Owner of meat slaughter house indicted for allegedly dumping blood and other animal waste products into nearby water bodies (2000).
Case #17	State issued an order containing a $25,000 fine for violating permit limits for ammonia, solids, and other pollutants.
Case #18	Operator of rendering plant sentenced to one month in prison for illegally discharging pollutants into river (1998). Ammonia and other pollutants were discharged and monitoring reports falsified.
Case #19	Meat processing firm was fined $28,000 for failing to file proper forms for discharge of oil, grease, TSS, and BOD (1998). Consent agreement also required company to install pollution control equipment.