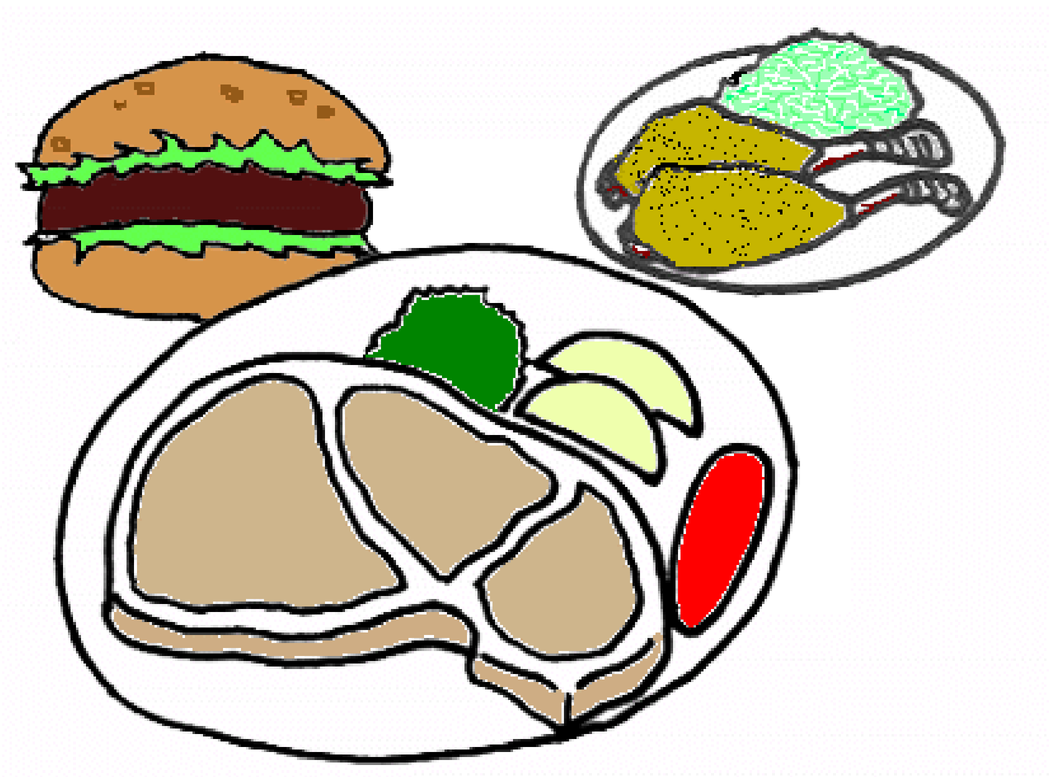
United States Environmental Protection Agency
Office of Water
Mail Code 4303T
Washington, DC 20460
EPA-821-B-01-007
January 2002

EPA

Development Document for the Proposed Effluent Limitations Guidelines and Standards for the Meat and Poultry Products Industry Point Source Category (40 CFR 432)



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ACKNOWLEDGMENTS AND DISCLAIMER

The Agency would like to acknowledge the contributions of Marvin Rubin, Janet Goodwin, Samantha Lewis, Carey A. Johnston, William Wheeler, Jade Lee-Freeman, and Beverly Randolph for the development of this technical document. In addition, EPA acknowledges the contribution of TetraTech Inc., Eastern Research Group, Westat, and Science Applications International Corporation.

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SECTION 1

PURPOSE AND SUMMARY OF THE REGULATION

This section describes the purpose of the regulation and summarizes proposed requirements. Section 1.1 describes the purpose of the rulemaking. Section 1.2 presents an overview of the Meat and Poultry Products (MPP) Point Source Category. Section 1.3 summarizes the proposed MPP rulemaking.

1.1 PURPOSE OF THIS RULEMAKING

Pursuant to the Clean Water Act (CWA), EPA is proposing effluent limitations guidelines and standards (ELGs) for the Meat and Poultry Products Point Source Category (40 CFR 432). These proposed ELGs apply to existing and new meat and poultry products (MPP) facilities that are direct dischargers. Direct discharging facilities directly discharge wastewater to surface waters of the United States (e.g., lake, river, ocean). This document and the administrative record for this rulemaking provide the technical basis for these proposed limitations and standards.

1.2 OVERVIEW OF THE MPP POINT SOURCE CATEGORY

The meat and poultry products industry includes facilities that slaughter livestock and/or poultry or that process meat and/or poultry into products for further processing or sale to consumers[1]. The industry is often divided into three categories: (1) meat slaughtering and processing; (2) poultry slaughtering and processing; and (3) rendering. Facilities may perform slaughtering operations, processing operations from carcasses slaughtered at other or their own facilities, or both. Companies that own meat or poultry product facilities may also own facilities that raise the animals. These other enterprises (e.g., feedlots) are not covered by the MPP ELGs.

The meat and poultry products industry encompasses primarily four North American Industry Classification System (NAICS) codes which are developed by the Department of

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[1]Meat products include all animal products from cattle, calves, hogs, sheep and lambs, and any meat that is not listed under the definition of poultry. Poultry includes broilers, other young chickens, hens, fowl, mature chickens, turkeys, capons, geese, ducks, exotic poultry (e.g., ostriches), and smallgame such as quail, pheasants, and rabbits. This category may include species not classified as “poultry” by USDA Food Safety and Inspection Service (FSIS) and that may or may not be under USDA FSIS voluntary inspection.

Commerce. These NAICS codes include: Animal Slaughtering (Except Poultry) (NAICS 311611); Meat Processed from Carcasses (NAICS 311612); Poultry Processing (NAICS 311615); and Rendering and Meat Byproduct Processing (NAICS 311613).

The MPP industry includes almost 6,770 facilities, of which an estimated 5,657 discharge process wastewater. (See Table 1-1.) Of these facilities discharging process wastewater, EPA estimates that 94 percent are indirect dischargers and 6 percent are direct dischargers. The Agency estimates that approximately 1,113 facilities either discharge no process wastewater or use contract haulers. See Section 5 for a description of how EPA subcategorized MPP facilities.

EPA estimated engineering compliance costs for each of the technology options for a set of model sites, and then used these sites to estimate compliance costs for the entire MPP industry. The Agency also estimated pollutant loadings and removals associated with each of the technology options. EPA then used the loadings and removals to assess the effectiveness of each technology option. The Agency used the costs to estimate the financial impact on the industry of implementing the various technology options. (See "Economic Analysis of Proposed Effluent Limitations Guidelines and Standards for the Meat and Poultry Products Industry Point Source Category" [EPA-821-B-01-006].) Details on the cost-effectiveness analysis can be found in the same document. EPA also estimated the water quality impacts and potential benefits for each technology option. (See "Environmental Assessment of Proposed Effluent Limitations Guidelines and Standards for the Meat and Poultry Products Industry Point Source Category" [EPA-821-B-01-008].)

Table 1-1. Profile and Subcategorization of MPP Facilities

40 CFR 432 Category	Description	Facility Size			
		Small		M, L, VL	
		Direct	Indirect	Direct	Indirect
A, B, C, D	Meat First Processors	59 †	1,003	82 †	70
E, F, G, H, I	Meat Further Processors	48 †	2,940	19 †	234
J	Independent Renderers	6 †	17	21 †	75
K	Poultry First Processors	0	39	104	143
L	Poultry Further Processors	4	568	16	209

Source: EPA Screener Survey
† Covered under current MPP ELGs (40 CFR 432)

1.3 SUMMARY OF THE PROPOSED MPP EFFLUENT LIMITATIONS AND GUIDELINES

EPA is proposing regulations for the MPP direct dischargers based on the "best practicable control technology currently available" (BPT), the "best conventional pollutant control technology" (BCT), the "best available technology economically achievable" (BAT), and the best available demonstrated control technology for new source performance standards (NSPS).

The Agency is proposing revised ELGs for nine of the ten existing subcategories of the meat products industry, including: simple slaughterhouse, complex slaughterhouse, low processing packinghouse, high processing packinghouse, meat cutter, sausage and luncheon meats processor, ham processor, canned meats processor, and renderer. The Agency is also proposing two new MPP subcategories with effluent guidelines and source performance standards for the poultry first processing (i.e., slaughtering) and further processing categories. EPA is not proposing any new or revised effluent limitations guidelines or pretreatment standards for the small processor category.

Table 1-2 summarizes the proposed technology options that serve as the basis for the effluent limitations guidelines and standards being proposed today for the meat and poultry products industry. For descriptions and discussion of the subcategories, see Section 5; for the technologies, Section 8; for a discussion of the process wastewater generated by these subcategories see Section 6; and for a discussion of the proposed limits, see Section 13.

Table 1-2. Summary of Technologies for Proposed Options for MPP Facilities

Subcategory	**Regulatory Level**	**Technology Option**	**Technical Components**
Subpart A: Simple Slaughterhouse; **Subpart B:** Complex Slaughterhouse; **Subpart C:** Low-Processing Packinghouse; and **Subpart D:** High-Processing Packinghouse	BPT	2	Equalization, dissolved air flotation, secondary biological treatment with nitrification.
	BAT; NSPS	3	Equalization, dissolved air flotation, secondary biological treatment with nitrification and denitrification.
	BCT	No Action	No revised limitations are proposed.
	PSES; PSNS	No Action	No pretreatment standards are proposed.
Subpart E: Small Processors	BPT; BCT; BAT; NSPS	No Action	No revised limitations or standards are proposed.
	PSES; PSNS	No Action	No pretreatment standards are proposed.
Subpart F: Meat Cutter; **Subpart G:** Sausage and Luncheon Meats Processor; **Subpart H:** Ham Processor; and **Subpart I:** Canned Meats Processor	BPT	2	Equalization, dissolved air flotation, secondary biological treatment with nitrification.
	BAT; NSPS	3	Equalization, dissolved air flotation, secondary biological treatment with nitrification and denitrification.
	BCT	No Action	No revised limitations are proposed.
	PSES; PSNS	No Action	No pretreatment standards are proposed.
Subpart J: Renderer	BPT; BCT	2	Equalization, dissolved air flotation, secondary biological treatment with nitrification.
	BAT; NSPS	2	Equalization, dissolved air flotation, secondary biological treatment with nitrification.
	PSES; PSNS	No Action	No pretreatment standards are proposed.
Subpart K: Poultry First Processing *(facilities which slaughter up to 10 million pounds per year)*; and, **Subpart L:** Poultry Further Processing *(facilities which produce up to 7,000 pounds per year of finished product)*	BPT; BCT	1	Equalization, dissolved air flotation, secondary biological treatment with less efficient nitrification.
	BAT; NSPS	1	Equalization, dissolved air flotation, secondary biological treatment with less efficient nitrification.
	PSES; PSNS	No Action	No pretreatment standards are proposed.

Subcategory	Regulatory Level	Technology Option	Technical Components
Subpart K: Poultry First Processing *(facilities which slaughter more than 10 million pounds per year)*; and, **Subpart L:** Poultry Further Processing *(facilities which produce more than 7,000 pounds per year of finished product)*	BPT; BCT	3	Equalization, dissolved air flotation, secondary biological treatment with nitrification and denitrification.
	BAT; NSPS	3	Equalization, dissolved air flotation, secondary biological treatment with nitrification and denitrification.
	PSES; PSNS	No Action	No pretreatment standards are proposed.

SECTION 2

LEGAL AUTHORITY AND BACKGROUND

This section presents background information supporting the development of effluent limitations guidelines and standards for the Meat and Poultry Products (MPP) Point Source Category. Section 2.1 presents the legal authority to regulate the MPP industry. Section 2.2 discusses the Clean Water Act, the Pollution Prevention Act, the Regulatory Flexibility Act (as amended by the Small Business Regulatory Enforcement Fairness Act of 1996), and prior regulation of the MPP industry. Section 2.3 discusses the scope and applicability of the MPP proposal.

2.1 LEGAL AUTHORITY

The Agency proposes these regulations under the authority of Sections 301, 304, 306, 307, 308, 402, and 501 of the Clean Water Act, 33 U.S.C.1311, 1314, 1316, 1317, 1318, 1342, and 1361.

2.2 REGULATORY BACKGROUND

2.2.1 Clean Water Act

Congress adopted the Clean Water Act (CWA) to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (Section 101(a), 33 U.S.C. 1251(a)). To achieve this goal, the CWA prohibits the discharge of pollutants into navigable waters except in compliance with the statute. The Clean Water Act addresses the problem of water pollution on a number of different fronts. It relies primarily, however, on establishing restrictions on the types and amounts of pollutants discharged from various industrial, commercial, and public sources of wastewater.

Direct dischargers (i.e., those that discharge effluent directly into navigable waters) must comply with effluent limitation guidelines and new source performance standards in National Pollutant Discharge Elimination System (NPDES) permits; indirect dischargers (i.e., those that discharge to publicly owned treatment works must comply with pretreatment standards. These limitations and standards are established by regulation for categories of industrial dischargers based on the degree of control that can be achieved using various levels of pollution control technology. The limitations and standards are summarized below.

2.2.1.1 Best Practicable Control Technology Currently Available (BPT)—Section 304(b)(1) of the CWA

EPA defines BPT limitations for discharges of conventional, toxic, and non-conventional pollutants[2] from existing sources. In specifying BPT, EPA considers the cost of achieving effluent reductions in relation to the effluent reduction benefits, the age of equipment and facilities, the processes employed, process changes required, engineering aspects of the control technologies, non-water quality environmental impacts (including energy requirements), and other factors the EPA Administrator deems appropriate (CWA §304(b)(1)(B)). Traditionally, EPA establishes BPT effluent limitations based on the average of the best performances of facilities within the industry, grouped to reflect various ages, sizes, processes or other common characteristics. Where existing performance is uniformly inadequate, however, EPA may establish BPT limitations based on higher levels of control than currently in place in an industrial category if the Agency determines that the technology is available in another category or subcategory and can be practically applied.

2.2.1.2 Best Conventional Pollutant Control Technology (BCT)—Section 304(b)(4) of the CWA

The 1977 amendments to the CWA established BCT as an additional level of control for discharges of conventional pollutants from existing industrial point sources. In addition to other factors specified in section 304(b)(4)(B), the CWA requires that BCT limitations be established in light of a two-part "cost-reasonableness" test. EPA published a methodology for the development of BCT limitations in July. (51 FR 24974, July 9, 1986).

[2] Conventional pollutants are biochemical oxygen demand (BOD_5), total suspended solids (TSS), fecal coliform, pH, and oil and grease; toxic pollutants are those pollutants listed by the Administrator under CWA Section 307(a); nonconventional pollutants are those that are neither toxic nor listed as conventional.

Section 304(a)(4) designates the following as conventional pollutants: biochemical oxygen demanding pollutants (measured as BOD_5), total suspended solids (TSS), fecal coliform, pH and any additional pollutants defined by the Administrator as conventional. The Administrator designated oil and grease as an additional conventional pollutants on July 30, 1979 (44 FR 44501).

2.2.1.3 Best Available Technology Economically Achievable (BAT)—Section 304(b)(2)(B) of the CWA

In general, BAT effluent limitation guidelines represent the best existing economically achievable performance of direct discharging facilities in the industrial subcategory or category. The factors considered in assessing BAT include the cost of achieving BAT effluent reductions, the age of equipment and facilities involved, the processes employed, engineering aspects of the control technology, potential process changes, non-water quality environmental impacts (including energy requirements), and such other factors as the Administrator deems appropriate. The Agency retains considerable discretion in assigning the weight to be accorded to these factors. An additional statutory factor considered in setting BAT is economic achievability. Generally, the achievability is determined on the basis of the total cost to the industry and the effect of compliance with the BAT limitations on overall industry and subcategory financial conditions. Unlike BPT, BAT limitations may be based upon effluent reductions attainable through changes in a facility's processes and operations. As with BPT, where existing performance is uniformly inadequate, BAT limitations may be based upon technology transferred from a different subcategory within an industry or from another industrial category. BAT also may be based upon process changes or internal controls, even when these technologies are not common industry practice.

2.2.1.4 New Source Performance Standards (NSPS)—Section 306 of the CWA

NSPS reflect effluent reductions that are achievable based on the best available demonstrated control technology. New facilities have the opportunity to install the best and most efficient production processes and wastewater treatment technologies. As a result, NSPS should represent the greatest degree of effluent reduction attainable through the application of the best available demonstrated control technology for all pollutants (i.e., conventional, non-conventional, and priority pollutants). In establishing NSPS, EPA is directed to take into consideration the cost of achieving the effluent reduction and any non-water quality environmental impacts and energy requirements.

2.2.1.5 Pretreatment Standards For Existing Sources (PSES)—Section 307(b) of the CWA

PSES are designed to prevent the discharge of pollutants that pass through, interfere with, or are otherwise incompatible with the operation of POTW. The CWA authorizes EPA to establish pretreatment standards for pollutants that pass though POTWs or interfere with treatment processes or sludge disposal methods. The pretreatment standards are to be technology-based and analogous to the BAT effluent limitations guidelines.

The General Pretreatment Regulations, which set forth the framework for implementing categorical pretreatment standards, are found in 40 CFR Part 403. These regulations provide a definition of pass-through that addresses local rather than national instances of pass-through and establish pretreatment standards that apply to all non-domestic dischargers (52 FR 1586, January 14, 1987).

2.2.1.6 Pretreatment Standards For New Sources (PSNS)—Section 307(b) of the CWA

Like PSES, PSNS are designed to prevent the discharges of pollutants that pass through, interfere with, or are otherwise incompatible with the operation of POTWs. PSNS are to be issued at the same time as NSPS. New indirect dischargers have the opportunity to incorporate into their facilities the best available demonstrated technologies. The Agency considers the same factors in promulgating PSNS as in promulgating NSPS.

2.2.1.7 Best Management Practices (BMPs)

Sections 304(e), 308(a), 402(a), and 501(a) of the CWA authorize the Administrator to prescribe BMPs as part of effluent limitations guidelines and standards or as part of a permit. EPA's BMP regulations are found at 40 CFR 122.44(k). Section 304(e) of the CWA authorizes EPA to include BMPs in effluent limitations guidelines for certain toxic or hazardous pollutants for the purpose of controlling "plant site runoff, spillage or leaks, sludge or waste disposal, and drainage from raw material storage." Section 402(a)(1) and NPDES regulations (40 CFR 122.44(k)) also provide for best management practices to control or abate the discharge of pollutants when numeric limitations and standards are infeasible. In addition, Section 402(a)(2), read in concert with Section 501(a), authorizes EPA to prescribe as wide a range of permit conditions as the Administrator deems appropriate in order to ensure compliance with applicable effluent limitation and standards and such other requirements as the Administrator deems appropriate. Table 2-1 summarizes these regulatory levels of control and the pollutants controlled.

Table 2-1. Summary of Regulatory Levels of Control

Type of Site Regulated	**BPT**	**BAT**	**BCT**	**NSPS**	**PSES**	**PSNS**
Existing Direct Dischargers	X	X	X			
New Direct Dischargers				X		
Existing Indirect Dischargers					X	
New Indirect Dischargers						X
Type of Pollutant Regulated	**BPT**	**BAT**	**BCT**	**NSPS**	**PSES**	**PSNS**
Priority Toxic Pollutants	X	X		X	X	X
Nonconventional Pollutants	X	X		X	X	X
Conventional Pollutants	X		X	X	X	X

Source: Clean Water Act

2.2.2 Section 304(m) Requirements

Section 304(m) requires EPA to establish schedules for; reviewing and revising existing effluent limitations guidelines and standards; promulgates new effluent limitations guidelines and standards. Section 304(m) does not apply to pretreatment standards for indirect dischargers, which EPA promulgates pursuant to Sections 307(b) and 307(c) of the Clean Water Act.

On October 30, 1989, Natural Resources Defense Council, Inc., and Public Citizen, Inc., filed an action against EPA in which they alleged, among other things, that EPA had failed to comply with CWA section 304(m) (see NRDC v. Browner, civ. no. 89-2980(D.DC.)). Plaintiffs and EPA agreed to a settlement of that action in a consent decree entered on January 31, 1992. The consent decree, which has been modified several times, established a schedule by which EPA is to propose and take final action for eleven point source categories identified by name in the decree and for eight other point source categories identified only as new or revised rules, numbered five through 12. EPA selected the meat and poultry products industry as the subject for New or Revised Rule #11. Under the decree, as modified, the Administrator was required to sign a proposed rule for the meat and poultry products industry no later than January 30, 2002, and must take final action on that proposal no later than December 31, 2003.

2.2.3 Total Maximum Daily Load (TMDL) program

The CWA requires states to identify waters not meeting water quality standards and to develop Total Maximum Daily Loads (TMDLs) for those waters (Section 303(d) of the CWA). A TMDL is essentially a prescription designed to restore the health of the polluted body of water by indicating the amount of pollutants that may be present in the water and still meet water quality standards. More than 20,000 bodies of water across America have been identified as impaired . These waters include more than 300,000 river and shoreline miles and five million acres of lakes. EPA estimates that more than 40,000 TMDLs must be established.

EPA promulgated a final rule in July 2000 to amend and clarify existing regulations at 40 CFR 130.7 implementing Section 303(d) of the CWA. Those rules require States to identify waters that are not meeting State water quality standards and to establish TMDLs to restore the quality of those waters. The July 2000 revisions of the rule established specific time frames under which EPA will assure TMDLs are completed, and that necessary point and nonpoint source controls are implemented to meet TMDLs.

On October 18, 2001 (66 FR 53044), EPA established April 30, 2003 as the new effective date of the July 2000 TMDL rule revisions. EPA believes that this delay of the effective date is necessary for the Agency to be able to conduct a meaningful consultation with the public, analyze recommendations of various stakeholders, reconcile concerns about the scope, complexity, and cost of the TMDL program, and structure a flexible yet effective TMDL program, including a revised TMDL rule, to meet Clean Water Act goals of restoring the nation's impaired waters. During this delay, the program will continue to operate under the 1985 TMDL regulations, as amended in 1992 at 40 CFR Part 130, and EPA and the States and Territories will continue to develop TMDLs to work towards cleaning up the nation's waters and meeting water quality standards. The Agency plans to propose a new, revised TMDL rule during the summer of 2002 and issue a new final rule sometime in 2003.

A TMDL must be developed for waters that do not attain water quality standards. A TMDL identifies the loading capacity of a waterbody for the applicable pollutant, which is the greatest amount of a pollutant that a water can receive without exceeding water quality standards. The TMDL also identifies the load reduction needed to attain standards and allocates such reductions to point source dischargers (a wasteload allocation(s)) and nonpoint sources (a load allocation(s)). Thus, the TMDL is actually a "pollution budget" or water-quality based approach that will allow the waterbody to achieve water quality standards. Wasteload allocations are reflected in the NPDES permits written for point sources discharging into the waterbody.

Effluent guidelines are technology-based controls for point source dischargers and are part of the NPDES permits that point sources must obtain prior to discharging pollutants to waters of the U.S. EPA is not required to demonstrate environmental benefits of its technology-based effluent guidelines. It is well established that EPA is not required to consider receiving water quality in setting technology-based effluent limitations guidelines and standards. Weyerhaeuser v. Costle, 590 F. 2nd 1011, 1043 (D.C. Cir. 1978) ("The Senate Committee declared that '[t]he use of any river, lake, stream or ocean as a waste treatment system is unacceptable"– regardless of the measurable impact of the waste on the body of water in question. Legislative History at 1425 (Senate Report). The Conference Report states that the Act 'specifically bans pollution dilution as an alternative to treatment.'" Id. at 284."). The purpose of such technology-based limits is to "result in reasonable further progress toward the national goal of eliminating the discharge of all pollutants." See NRDC, 863 F.2d at 1433 (9th Cir. 1988). In short, the CWA set up both TMDLs and effluent guidelines as complementary regulatory programs as both are necessary for restoring the quality of the Nation's waters and for striving towards the national goal of eliminating the discharge of all pollutants.

2.2.4 Pollution Prevention Act

The Pollution Prevention Act of 1990 (42 U.S.C. 13101 et seq., Pub.L. 101-508, November 5, 1990), makes pollution prevention the national policy of the United States. This act identifies an environmental management hierarchy in which pollution "should be prevented or reduced whenever feasible; pollution that cannot be prevented or recycled should be reused in an environmentally safe manner whenever feasible; pollution that cannot be prevented or recycled should be treated in an environmentally safe manner whenever feasible; and disposal or release into the environment should be employed only as a last resort..." (Sec. 6602; 42 U.S.C. 13103).

According to the Pollution Prevention Act, source reduction reduces the generation and release of hazardous substances, pollutants, wastes, contaminants, or residuals at the source, usually within a process. The term source reduction "includes equipment or technology modifications, process or procedure modifications, reformulation or redesign of products, substitution of raw materials, and improvements in housekeeping, maintenance, training, or inventory control. The term source reduction does not include any practice which alters the physical, chemical, or biological characteristics or the volume of a hazardous substance, pollutant, or contaminant through a process or activity which itself is not integral to or necessary for the production of a product or the providing of a service." In effect, source reduction means reducing the amount of a pollutant that enters a waste stream or that is otherwise released into the environment prior to out-of-process recycling, treatment, or disposal. The Pollution Prevention Act directs the Agency to, among other things, "review regulations of the Agency prior and subsequent to their proposal to determine their effect on source reduction" (Sec. 6604; 42 U.S.C. 13103). This proposed regulation for the MPP industry was reviewed for its incorporation of pollution prevention as part of the Agency effort. Chapter 8 outlines pollution prevention practices applicable to the MPP industry.

2.2.5 Regulatory Flexibility Act (RFA) as Amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA)

The RFA generally requires an agency to prepare a regulatory flexibility analysis for any rule subject to notice and comment rulemaking requirements under the Administrative Procedure Act or any other statute, unless the agency certifies that the rule will not have a significant economic impact on a substantial number of small entities. Small entities include small businesses, small organizations, and small governmental jurisdictions.

For the purpose of assessing the impact of today's rule on small entities, a small entity is defined as: (1) a small business based on full time employees (FTEs) or annual revenues established by SBA; (2) a small governmental jurisdiction that is a government of a city, county, town, school district, or special district with a population of less than 50,000; and (3) a small organization that is any not-for-profit enterprise which is independently owned and operated and is not dominant in its field.

The definitions of small business for the meat products industries are in SBA's regulations at 13 CFR 121.201. These size standards were updated effective October 1, 2000. SBA size standards for the meat and poultry products industry (that is, for NAICS codes 311611, 311612, 311613, and 311615) define a "small business" as one with 500 or fewer employees.

EPA estimates that small businesses own 71 out of 246 facilities that would be regulated under the rule as proposed. The EPA based this estimate on information from screener survey and SBA. The Agency assumes that it is unlikely that any small business owns more than one facility. EPA has fully evaluated the economic impact of the proposed rule on the affected small companies. None of the facilities owned by small companies have a cost/sales ratio greater than one percent. For this proposal, EPA is using the ratio of annualized compliance costs to net income as its central measure of economic achievability. (See Section IV.E of the MPP Preamble for a definition of this measure.) EPA estimates that, based on its model facilities, 38 of the 71 facilities owned by small companies have cost/net income ratios between five and nine percent, eight facilities have cost/net income ratios between two and three percent, while the other 25 facilities owned by small companies have cost/net income ratios less than one percent. EPA also calculated the ratio of cost to sales as a supplement to the cost/net income ration. None of the facilities owned by small companies has a cost/sales ratio greater than 0.52 percent. More detail on these estimates is provided in the MPP Economic Analysis (EPA-821-B-01-006). After considering the economic impact of the proposed rule on small entities, including consideration of alternative regulatory approaches being proposed, EPA is certifying that this action will not have significant economic impact on a substantial number of small entities. No small governments are regulated by this action.

Although this proposed rule will not have a significant economic impact on a substantial number of small entities, EPA nonetheless has tried to reduce the impact of this rule on them. EPA is not proposing any new requirements on 5,411 facilities (the vast majority of facilities). Most of these are owned by small businesses, and many of the smallest could likely experience serious economic impacts if requirements were imposed. EPA considered regulating the 731 largest indirect discharging facilities in this group of 5,411 facilities (462 of which are owned by small businesses). If the costs of Option 1 for PSES standards were imposed on these indirect discharging facilities, EPA estimates that 235 of the 462 facilities owned by small companies would have a cost/net income ratio between 1 and 2 percent while the other 227 facilities owned by small companies would have a cost/net income ratio of less than 1 percent. Thus, even if EPA had proposed Option 1 PSES standards for the 731 largest indirect dischargers the combined proposal would not have had a significant impact on a substantial number of small entities.

EPA has held several teleconferences with representatives of the American Association of Meat Processors (AAMP) which has almost a third of its association members with less than 10 FTE at the company level. EPA will continue to evaluate the potential impacts of the proposed rule on small entities and issues related to such impacts.

2.2.6 Regulatory History of the MPP Industry

In 1974, EPA promulgated effluent guidelines for meat slaughterhouses and packinghouse facilities (40 CFR 432 Subcategories A through D), and in 1975, EPA promulgated effluent guidelines for meat further processing facilities (40 CFR 432 Subcategories E through I) and independent rendering facilities (40 CFR 432 Subcategory J) in 1975. The Agency proposed regulations for the poultry industry in 1974, but the rule was never finalized. The following describes the current regulatory framework for the MPP industry.

2.2.6.1 Meat Facilities

The effluent limitations guidelines and standards for the meat products industry were developed and promulgated in the 1970's. As described above, there are existing regulations for the meat slaughtering and processing subcategories and for independent rendering. These regulations were issued in phases and are grouped together under 40 CFR 432. Although there is no definition of "red meat" or "meat" in the existing MPP effluent guidelines, EPA defined these terms in the previous technical development documents associated with these prior rules as all animal products from cattle, calves, hogs, sheep and lambs, and from any meat that is not listed under the definition of poultry. EPA is using the term "meat" as synonymous with the term "red meat." EPA proposes to include the same definition in the revised regulations. The current regulations for meat cover all aspects of producing meat products from the slaughter of the animal to the production of final consumer products (e.g., cooked, seasoned, or smoked products, such as luncheon meat or hams.)

EPA promulgated BPT, BAT, NSPS limitations and standards for existing and new meat slaughterhouses and packinghouses on February 28, 1974 (39 FR 7894). EPA established separate effluent limitations and standards for existing and new sources for various types of meat slaughterhouses and packinghouses: Simple Slaughterhouse, Complex Slaughterhouse, Low Processing Packinghouse, and High Processing Packinghouse (40 CFR 432, Subcategories A through D).

The Agency promulgated BPT, BAT, NSPS limitations and standards for existing and new meat further processing subcategories and the independent rendering subcategory on January 3, 1975 (40 FR 902). EPA promulgated no PSNS for this segment of the industry in the January 3, 1975 notice. EPA established separate effluent limitations and standards for existing and new sources for various types of meat further processors and independent renderers: Small Processor, Meat Cutter, Sausage and Luncheon Meats Processor, Ham Processor, Canned Meats Processor, and Independent Renderer (40 CFR 432, Subcategories E through J).

EPA did not establish any pretreatment standards in the 1974 or 1975 regulations.

The BPT and BAT limitations established in the February 28, 1974 notice were the subject of litigation in American Meat Institute v. EPA, 526 F.2d 442 (7th Cir. 1975). The Seventh Circuit Court of Appeals reviewed the effluent limitations and remanded selected portions of those regulations. The BPT and BAT regulations remanded by the court were subsequently revised or withdrawn. (See 44 FR 50732, August 29, 1979; 45 FR 82253, December 15, 1980.)

The regulations in the independent rendering subcategory were also the subject of litigation in National Renderers Association et al., v. EPA, et al., 541 F. 2d 1281 (8th Cir. 1976). The Court remanded the regulations to the Agency to reconsider the economic impact of the costs associated with these requirements. The BAT limitations for independent renderers were not remanded, but EPA reevaluated these limitations nonetheless. On October 6, 1977 (42 FR 54417), EPA promulgated a final rule which revised the BAT limitations and new source performance standards for this subcategory. In that final rule, the BAT limitations for ammonia, BOD5, and TSS are less stringent than the original BAT limitations; however, the October 6, 1977 NSPS are more stringent than the original NSPS standards. In the final rule, EPA retained an exclusion for small facilities (less than 75,000 pounds of raw material per day) from BPT, BAT, and NSPS

2.2.6.2 Poultry Facilities

EPA proposed BPT, BAT, NSPS, PSNS limitations and standards for existing and new poultry slaughterers and processors on April 24, 1975 (40 FR 18150). EPA proposed to subcategorize the poultry processing sector into five subcategories, distinguished by the animal or bird being processed and an additional subcategory which applied to further processing. These regulations were never finalized, since the 1977 amendments to the Clean Water Act refocused the Agency's attention on establishing effluent limitations guidelines for industry sectors with effluents containing toxic metals and organics.

2.3 SCOPE/APPLICABILITY OF PROPOSED REGULATION

EPA is proposing new or revised effluent limitations guidelines and standards for nine of the ten subcategories of the (MPP) point source category (40 CFR 432) including: simple slaughterhouse, complex slaughterhouse, low processing packinghouse, high processing packinghouse, meat cutter, sausage and luncheon meats processor, ham processor, canned meats processor, and renderer. The Agency is proposing no new or revised effluent limitations guidelines or pretreatment standards for the small processor category. EPA is also proposing two new MPP subcategories with effluent limitations guidelines and new source performance standards for the poultry first processing (i.e., slaughtering) and further processing subcategories.

Section 1, table 1-2 summarizes the proposed technology options which serve as the basis for the effluent limitations guidelines and standards being proposed for the meat and poultry products industry. For descriptions and discussion of the subcategories, see Section 5; for the technologies, Section 8; and for a discussion of the process wastewater generated by these subcategories, Section 6.

2.3.1 Meat Facilities

2.3.1.1 Meat Slaughtering and Further Processing Facilities

In 1974, EPA established regulations that apply to the meat slaughterhouses and packinghouses (40 CFR 432, Subcategories A through D). EPA established regulations in 1975 which apply to meat further processing facilities (40 CFR 432, Subcategories E through I). The current regulations for meat cover all aspects of producing meat products from slaughtering the animal to producing final consumer products (e.g., cooked, seasoned or smoked products, such as luncheon meat or hams). For Subparts F, G, H and I of the existing regulations, EPA established a production rate threshold of greater than 6,000 pounds of finished product per day, below which the regulations do not apply. Subpart E of the existing regulations applies to meat further processors that produce up to 6,000 pounds of finished product per day.

EPA is not proposing to change the existing production rate thresholds in Subparts E through I in this proposed rule for existing limitations and standards. Also, EPA is proposing new production rate thresholds in Subparts A through D and F through I for the proposed limitations and standards based on current data collected for this rulemaking (see Section 3). These new production rate thresholds do not affect Subpart E (Small Processors) meat facilities, as these proposed new production rate thresholds are all higher than the Subpart E production rate threshold (i.e., 6,000 pounds of finished product per day).

Based on current survey data, EPA defines small facilities based on their annual production. EPA defines the following facilities which are currently covered under 40 CFR 432 as small:

- Facilities in Subcategories A, B, C and D that slaughter less than 50 million pounds (LWK) per year;
- All facilities in Subcategory E;
- Facilities in Subcategories F, G, H and I that produce less than 50 million pounds of finished product per year; and
- Facilities in Subcategory J that render less than 10 million pounds per year of raw material.

Most smaller MPP facilities are excluded from the scope of today's proposal for a number of reasons: (1) small MPP facilities as a group discharge less than 3 percent of the conventional pollutants (or 35 million pounds/year), 1 percent of the toxic pollutants (or 1.3 million pounds/year), 4 percent of the nutrients (or 7.5 million pounds/per year), and less than 1.5 percent of the pathogens (or 47 x 10^9 CFU/year) as compared to all discharges from the entire MPP industry;(2) EPA determined that only a limited amount of loadings removal would be accomplished by improved treatment and small facilities; and (3) EPA determined that "small" MPP facilities would discharge a very small portion of the total industry discharge. Therefore, EPA is not revising current limitations and standards for small meat facilities. The existing regulations, however, will continue to apply to those facilities. EPA is, however, setting limitations and standards for small poultry direct discharging facilities (for whom there are no existing standards) based on current performance.

The existing regulations apply to all sizes of meat direct dischargers (except for renderers processing less than 75,000 pounds of raw material per day). The proposed revisions to 40 CFR 432 apply to meat facilities above the new production based thresholds and all poultry facilities that discharge directly to a receiving stream or other waters of the United States.

2.3.1.2 Independent Rendering Facilities

In 1975, EPA established regulations (40 CFR 432, Subcategory J) that apply to independent renderers, defined as independent or off-site operations that manufacture meat meal, dried animal by-product residues (tankage), animal fats or oils, grease, and tallow, perhaps including hide curing, by a renderer. The existing regulations establish a size threshold of 75,000 pounds of raw material per day processed. Facilities that process less than this amount are not subject to the existing regulations.

EPA is proposing to lower this production threshold in these revisions to include all facilities that render more than 10 million pounds per year of raw material (or approximately 27,000 pounds per day for a facility that operates 365 days per year). EPA is lowering this production threshold based on data collected for this rulemaking. See the "Economic Analysis of Proposed Effluent Limitation Guidelines and Standards for the meat and Poultry Products Industry Point Source Category" (EPA-821-B-01-006) for a description of EPA's reasons for setting production thresholds and exempting most small MPP facilities (including all small rendering facilities that render less than 10 million pounds per year of raw material) from the proposed revisions to 40 CFR 432. Subpart J applies to the rendering of any meat or poultry raw material. When rendering is done in conjunction with a meat slaughterhouse or packinghouse, the rendering wastewater generated is regulated under the limitations for the appropriate meat slaughtering or packinghouse subcategory (i.e., under Subparts A, B, C, or D).

2.3.2 Poultry Slaughtering and Further Processing Facilities

EPA is proposing to establish effluent limitations guidelines and new source performance standards for the poultry first processing (i.e., slaughtering) and further processing subcategories. Poultry includes broilers, other young chickens, hens, fowl, mature chickens, turkeys, capons, geese, ducks, and small game such as quail, pheasants, and rabbits.

EPA proposed regulations for this segment of the meat and poultry products industry in 1975, but did not finalize them. EPA has reanalyzed this segment of the meat and poultry products industry and is proposing today to establish BPT, BCT, and BAT limitations and standards for existing facilities and new source performance standards for direct dischargers.

EPA proposes to create two new subcategories which would apply to poultry processing facilities. The first new poultry subcategory is the "poultry first processing" subcategory which includes the slaughtering and evisceration of the bird or animal and dressing the carcass for shipment either whole or in parts, such as leg, quarters, breasts, and boneless pieces. These facilities are commonly known as "ice pack facilities." The second new poultry subcategory is the "poultry further processing" subcategory which includes additional preparation of the meat including further cutting, cooking, seasoning, and smoking to produce ready-to-be eaten or reheated servings. The additions to 40 CFR 432 for poultry being proposed apply to facilities that discharge directly to a receiving stream and to other waters of the United States.

EPA is proposing to set less stringent effluent limitations guidelines for direct dischargers slaughtering up to 10 million pounds of poultry per year and for further processors producing up to 7 million pounds of poultry per year. See the “Economic Analysis of Proposed Effluent Limitation Guidelines and Standards for the meat and Poultry Products Industry Point Source Category” (EPA-821-B-01-006) for a description of EPA's reasons for setting production thresholds. The treatment options proposed for larger poultry slaughtering and further processing facilities are economically unachievable for small poultry slaughtering and further processing facilities. Rendering performed in conjunction with a poultry first processing facility would be subject to the appropriate regulations under the poultry slaughtering (Subpart K).

SECTION 3

DATA COLLECTION ACTIVITIES

EPA conducted a number of data collection activities in support of these proposed regulations. Section 3.1 describes EPA's site visit and sampling program. Section 3.2 describes EPA's industry surveys. Section 3.3 describes other information collection activities, including: literature searches, National Pollutant Discharge Elimination System (NPDES) permits, and NPDES discharge monitoring report (DMR) reports. Section 3.4 describes EPA stakeholder meetings.

3.1 SUMMARY OF EPA'S SITE VISIT AND SAMPLING PROGRAM

3.1.1 EPA Site Visits

During 2000 and 2001, EPA conducted site visits at 15 meat and poultry products (MPP) processing facilities. Six of these site visits were conducted at meat facilities, seven at poultry facilities, and two at rendering-only facilities. The purposes of these site visits were to: (1) collect information on meat and poultry processing operations; (2) collect information on wastewater generation and waste management practices used by the MPP facilities; and (3) evaluate each facility as a candidate for multi-day sampling. In addition, EPA conducted limited sampling during several of the site visits to screen for potential contaminants that may be found in wastewaters from the different types of meat and poultry processing operations.

In selecting candidates for site visits, EPA attempted to identify facilities representative of various MPP processing operations, as well as of both direct and indirect dischargers. EPA specifically considered the type of meat and poultry processing operations, age of the facility, size of facility (in terms of production), wastewater treatment processes employed, and best management practices/pollution prevention techniques used. EPA also solicited recommendations for good-performing facilities (e.g., facilities with advanced wastewater treatment technologies) from EPA Regional offices and State agencies. The site-specific selection criteria are discussed in site visit reports prepared for each site visited by EPA (and can be found in Section 6.1.4.2 of the Administrative Record for the proposed rule).

During each site visit, EPA collected information on the facility and its operations, including: (1) general production data and information; (2) the types of meat and poultry processing wastewaters generated and treated on-site; (3) water source and use; (4) wastewater treatment and disposal operations; (5) potential sampling locations for wastewater (raw influent, within the treatment system, and final effluent); and (6) other information necessary for developing a sampling plan for possible multi-day sampling episodes. EPA also collected wastewater samples of influent and effluent at seven of the 15 facilities for screening purposes only.

3.1.2 EPA Sampling

3.1.2.1 Overview

Based on data collected from the site visits, EPA selected 11 facilities for multi-day sampling. The purpose of the multi-day sampling was to characterize pollutants in raw wastewaters prior to treatment, as well as to document wastewater treatment plant performance (including selected unit processes). Selection of facilities for multi-day sampling was based on an analysis of information collected during the site visits, as well as the following criteria:

- The facility performed meat and/or poultry slaughtering and/or further processing operations representative of MPP facilities.
- The facility utilized in-process treatment and/or end-of-pipe treatment technologies that EPA was considering for technology option selection.
- Compliance monitoring data for the facility indicated that it was among the better performing treatment systems, or that it employed wastewater treatment process for which EPA sought data for option selection.

Multi-day sampling occurred at six meat facilities and five poultry facilities. EPA performed multi-day sampling at two facilities, and nine facilities performed the multi-day sampling on behalf of EPA. For the nine facilities that performed the sampling, EPA developed sampling plans that detailed the procedures for sample collection, including the pollutants to be sampled, location of sampling points, and sample collection, preservation, and shipment techniques. EPA assisted the nine facilities as necessary (e.g., provided sample bottle labels, provided assistance in shipping, and in one instance, provided on-site contractor support during the sampling event).

3.1.1.2 Description of Sampling Episodes

During each multi-day sampling episode, EPA sampled facility influent and effluent wastestreams. EPA did not collect source water information but will collect additional source water data after proposal. EPA will use the post-proposal source water data to better characterize wastewater characteristics for each of the facilities sampled. At some facilities, the Agency also collected samples at intermediate points throughout the wastewater treatment system to assess the performance of individual treatment units. Some of the facilities chosen for sampling perform rendering and/or further processing operations in addition to meat and/or poultry processing. For facilities that also performed rendering operations or further processing, EPA sampled wastewater from the rendering and/or further processing operations separately, when possible.

Sampling episodes were conducted over either a 3-day or 5-day period. EPA obtained samples using a combination of 24-hour composite and grab samples, depending upon the pollutant parameter to be analyzed. Depending on the type of wastewater processed and the treatment technology being evaluated, EPA analyzed wastewater for up to 53 parameters including conventional (BOD_5, TSS, oil and grease, fecal coliforms, and pH), toxic (selected metals and pesticides), and nonconventional (e.g., nutrients, microbiologicals) pollutants. When possible for a given parameter, EPA collected 24-hour composite samples in order to capture the variability in the waste streams generated throughout the day (e.g., production wastewater versus clean-up wastewater).

Data collected from the influent samples contributed to characterization of the industry, development of the list of pollutants of concern and of raw wastewater characteristics. EPA used the data collected from the influent, intermediate, and effluent points to analyze the efficacy of treatment at the facilities, and to develop current discharge concentrations, loadings, and the treatment technology options for the meat and poultry products industry. EPA used effluent data to calculate the long-term averages (LTAs) and limitations for each of the proposed regulatory options. EPA also used industry-provided data from the MPP detailed survey to complement the sampling data for these calculations. During each sampling episode, EPA also collected flow rate data corresponding to each sample collected and production information from each associated manufacturing operation for use in calculating pollutant loadings and production-normalized flow rates. EPA has included in the public record all information collected for which the facility has not asserted a claim of Confidential Business Information (CBI) or which would indirectly reveal information claimed to be CBI.

3.1.2.3 Sampling Episode Reports

EPA used the site visit reports to prepare multi-day sampling and analysis plans (SAPs) for each facility that would undergo multi-day sampling. The Agency collected the following types of information during each sampling episode:

- Dates and times of sample collection.
- Flow data corresponding to each sample.
- Production data corresponding to each sample.
- Design and operating parameters for source reduction, recycling, and treatment technologies characterized during sampling.
- Information about site operations that had changed since the site visit or that were not included in the site visit report.
- Temperature, pH, and dissolved oxygen (DO) of the sampled wastestreams.

After the conclusion of the sampling episodes, EPA prepared sampling episode reports for each facility which included descriptions of the wastewater treatment processes, sampling procedures, and analytical results. EPA documented all data collected during sampling episodes in the sampling episode report for each sampled site and has included them in the MPP Administrative Record. Non-confidential business information from these reports is available in the public record for this proposal. For detailed information on sampling and preservation procedures, analytical methods, and quality assurance/quality control procedures, see the various sampling episode reports in the rulemaking record (see Section 6 of the Administrative Record).

3.1.2.4 Pollutants Sampled

The Agency (or facilities, as directed by the Agency) collected, preserved, and transported all samples according to EPA protocols, as specified in EPA's "Sampling and Analysis Procedures for Screening of Industrial Effluents for Priority Pollutants" and in the MPP Quality Assurance Project Plan (QAPP).

EPA collected composite samples for most parameters, because the Agency expected the wastewater composition to vary over the course of a day. The Agency collected grab samples from unit operations for oil and grease and microbiologicals. EPA gathered composite samples either manually or by using an automated sampler. The Agency collected individual aliquots for the composite samples at a minimum of once every 4 hours over each 24-hour period. Oil and grease samples were collected every 4 hours, and microbiologicals were collected once a day.

Table 3-1 lists the parameters sampled at the majority of the facilities, some of which have not been identified as pollutants of concern.

EPA contract laboratories completed all wastewater sample analyses, except for the field measurements of temperature, dissolved oxygen, and pH. EPA or facility staff collected field measurements of temperature, dissolved oxygen, and pH at the sampling site. The analytical chemistry methods used, as well as the sample volume requirements, detection limits, and holding times, were consistent with the individual laboratory's quality assurance and quality control plan. Laboratories contracted for MPP sample analysis followed EPA approved analysis methods for all parameters.

The EPA contract laboratories reported data on their standard report sheet and submitted them to EPA's sample control center (SCC). The SCC reviewed the report sheets for completeness and reasonableness. EPA reviewed all reports from the laboratory to verify that the data were consistent with requirements, reported in the proper units, and that the data were in compliance with the applicable protocol. Appendix A provides brief descriptions of each of the analytical methods.

Table 3-1. MPP Sampled Parameters

Biochemical oxygen demand (BOD_5)	Oil and grease
Carbonaceous biochemical oxygen demand ($CBOD_5$)	Metals (e.g., arsenic, chromium, copper, mercury, zinc)
Dissolved biochemical oxygen demand ($DBOD_5$)	Carbamate pesticide (carbaryl)
Chemical oxygen demand (COD)	Permethrin (cis- and trans-)
Total organic carbon (TOC)	Malathion
Total suspended solids (TSS)	Stirofos
Total dissolved solids (TDS)	Dichlorvos
Total volatile solids (TVS)	Total coliform
Chloride	Fecal coliform
Total residual chlorine (TRC)	Escherichia coli
Ammonia as nitrogen	Fecal streptococci
Nitrate/nitrite	Salmonella
Total Kjeldahl nitrogen (TKN)	Aeromonas
Total phosphorus (TP)	Cryptosporidium (meat facilities only)
Total dissolved phosphorus (TDP)	
Orthophosphate	

Quality control measures used in performing all analyses complied with the guidelines specified in the analytical methods and in the MPP QAPP. EPA reviewed all analytical data to ensure that these measures were followed and that the resulting data were within the QAPP-specified acceptance criteria for accuracy and precision. SCC's review is summarized in Data Review Narratives that are available in Section 6.1.4.2 of the Administrative Record.

3.2 EPA MPP INDUSTRY SURVEYS

3.2.1 Overview of Industry Surveys

EPA did not have the site-specific technical and economic information required for the development of technologically achievable regulatory options for the meat and poultry products industry. Therefore, EPA used two survey questionnaires to collect site-specific technical and economic information.

EPA published a notice in the Federal Register on May 1, 2000 (65 FR 25325) announcing the Agency's intent to submit the meat and poultry products industry survey Information Collection Request (ICR) to the Office of Management and Budget (OMB). The May 1, 2000 notice requested comment on the draft ICR and the survey questionnaires. EPA received five sets of comments during the 60 day public comment period. Commentors on the ICR included: National Chicken Council, National Renderers Association, American Meat Institute, BCR Foods, and the U.S. Poultry and Egg Association. EPA made minor clarifying revisions to the survey methodology and questionnaires as a result of public comments.

EPA made every reasonable attempt to ensure that the meat and poultry products industry ICR did not request data and information currently available through less burdensome mechanisms. Prior to publishing the May 1, 2000 notice, EPA met with and distributed draft copies of the survey questionnaires to three trade associations representing the meat and poultry products industry (American Meat Institute, National Chicken Council, and National Renderers Association). EPA obtained approval from OMB for the use and distribution of two survey questionnaires: a short screener survey and a more detailed survey.

3.2.2 Description of the Survey Instruments

In February 2001, EPA mailed a short screener survey entitled “2001 Meat Products Industry Screener Survey” to 1,650 meat and poultry products facilities. The screener survey consisted of seven questions that elicited site-specific information such as type of animal processed and processing operation, wastewater disposal method, and the number of full-time employees at the site and company. EPA used the information collected from the screener survey to describe industry operations, wastewater generation rates, and wastewater disposal practices. EPA also used the responses to the site employment question for classifying each facility as small or not-small according to the Small Business Administration regulations at 13 CFR Part 121.

EPA designed the second survey to collect detailed site-specific technical and financial information. In March 2001, EPA mailed the second survey, entitled "2001 Meat Products Industry Survey," to 350 meat and poultry products facilities. The detailed survey is divided into five parts. The first four parts collect general facility and technical data. The first set of questions request general facility site information. The general facility information questions asked the site to identify itself, characterize itself by certain parameters (including meat and poultry products operations, age, and location), and confirm that it was engaged in meat and/or poultry processing operations. Respondents also indicated whether they use trisodium phosphate (TSP) as a biocide. Substituting other non-phosphorus based biocides with TSP has the potential to lower overall phosphorus concentrations in the raw wastewater and treated effluent. The second set of questions requested analytical and production data including: (1) detailed daily analytical and flow rate data for selected sampling points; (2) monthly production data; and (3) operating hours for selected manufacturing operations. Survey respondents were required to provide existing sampling data and information. The Agency used the analytical data to estimate baseline pollutant loadings and pollutant removals from facilities with treatment-in-place resembling projected regulatory options and to evaluate the variability associated with meat and poultry products industry discharges. The Agency used the production data collected to evaluate the production basis for applying the MPP proposal in NPDES permits.

The next two sections of the survey focused on wastewater characteristics and current treatment practices, respectively. Questions regarding wastewater and treatment were designed to gather: (1) information on the wastewater treatment systems (including diagrams) and discharge flow rates; (2) analytical monitoring data; and (3) operating and maintenance cost data (including treatment chemical usage). The outfall information questions covered permit information such as: (1) discharge location; (2) wastewater sources to the outfall; (3) flow rates; (4) regulated parameters and limits; and (5) permit monitoring data. The Agency used this information to calculate the effluent limitations guidelines and standards and pollutant loadings associated with the regulatory options that EPA considered for this proposal. The Agency also used data received in response to these questions to identify treatment technologies in place, to determine the feasibility of regulatory options and potential revision of the subcategorization scheme of the meat and poultry products industry, and to estimate compliance costs, the pollutant reductions associated with the likely technology-based options, and potential environmental impacts associated with the regulatory options EPA considered for this proposal.

The fifth part of the detailed survey elicited site-specific financial and economic data. EPA used this information to characterize the economic status of the industry and to estimate potential economic impacts of wastewater regulations. The financial and economic information collected in the survey was necessary to complete the economic analysis of the proposed effluent limitations guidelines and standards for the meat and poultry products industry. EPA requested financial and economic information for the fiscal years ending 1997, 1998, and 1999, the most recent years for which data are available.

3.2.3 Development of Survey Mailing List

EPA sent the two meat and poultry products industry survey questionnaires to a random sample of facilities included in the USDA Food Safety and Inspection Service (FSIS) Hazard Analysis and Critical Control Points (HACCP) database, and a list of renderers provided by the National Renderers Association (NRA). The HACCP database provided a list of 7,891 federally- and state-inspected meat and poultry processing facilities. The HACCP database is dated March 9, 2000 for the federally inspected facilities and May 10, 2000 for the state-inspected facilities. The entire HACCP database is classified into Large, Small, and Very Small facilities, corresponding to more than 500 employees, 10-500 employees, and fewer than 10 employees at the facility level, respectively. The 231 renderers from the NRA list were not classified by size. The Urner Barry Meat and Poultry Directory 2000 identified production information (i.e., whether a facility was a slaughterer or further processor) for at least 242 of the 292 large facilities (82 percent) and 1,236 of the 2,381 small facilities (52 percent). No such information was available for the remaining large and small facilities or for any of the 5,308 very small facilities.

3.2.4 Sample Selection

EPA grouped the facilities into seven strata by the size and the type of meat and poultry processing operation that takes place in each facility, so that each stratum would encompass facilities with similar operations. This grouping (also known as stratification) increases precision (reducing one source of uncertainty) for estimates of costs, benefits and other quantities. Table 3-2 lists the stratification of the meat and poultry products industry based on employment and other information from USDA's HACCP program, the Urner Barry Meat and Poultry Directory 2000, and the National Renders Association.

Various meat and poultry processors were randomly selected within each grouping. EPA weighted each survey response to account for facilities not surveyed and to develop national estimates from the survey responses. EPA deliberately selected the 65 "certainty" facilities to obtain site-specific information on the top producers for all types of meat and poultry products as well as facilities identified as good performers by state and regional environmental personnel.

Table 3-2. Meat and Poultry Products Industry Strata

Stratum (No. of Employees)	Number of Facilities in Stratum	Screener Survey Sample Size	Detailed Survey Sample Size
Certainty	65	0	65
Large Processor ($\geq$500)	43	31	3
Large Slaughterer ($\geq$500)	190	100	52
Small Processor (10-499)	1,878	688	62
Small Slaughterer (10-499)	498	130	69
Very Small Processor (<10)	5,308	649	57
Renderer	235	52	42
Total	8,217	1,650	350

EPA focused much of its analysis on the characteristics of larger facilities since small facilities as a group discharge fewer than 3 percent of the conventional pollutants, 1 percent of the toxic pollutants, 4 percent of the nutrients, and less than 1.5 percent of the pathogens as compared to all discharges from the entire MPP industry. Moreover, most of these small facilities are discharging small volumes of wastewater into large urban publicly owned treatment works (POTW) systems, which helps minimize impacts. Thus there is minimal impact on POTW operations or the passing of MPP pollutants of concern through POTWs into waters of the United States. Consequently, larger facilities were oversampled in the sample design. The oversampling rate is approximately 6:3:1, meaning that the large facilities were sampled at six times the rate of the very small facilities, and the small facilities at three times the rate of the very small. In addition, many of the very small facilities were not eligible for the survey, as they were no longer in operation. Appendix B provides additional information on how the Agency designed the survey, developed sample size and extrapolated survey results

3.2.5 Survey Response

Of the 8,217 meat and poultry products industry facilities generating wastewater, 2,000 facilities were mailed either a detailed survey or a screener survey questionnaire. As of October 4, 2001, 1,365 of the 1,650 screener surveys and 300 of the 350 detailed surveys were returned to EPA. EPA used 962 of the screener surveys and 241 of the detailed surveys which were received before April 24, 2001 for screener survey and May 29, 2001 for detailed survey, for the development of various regulatory options. EPA used the cut-off dates in order to process, synthesize, and analyze the collected data and to develop regulatory options in a timely fashion. EPA will use all surveys collected after the deadlines in upcoming analyses for the forthcoming Notice of Data Availability (NODA) and final rule.

3.3 OTHER INFORMATION COLLECTION ACTIVITIES

EPA conducted a number of other data collection efforts to supplement information gathered through the survey process, facility sampling activities, site visits, and meetings with industry experts and the general public. The main purpose of these other data collection efforts was to obtain information on documented environmental impacts of meat and poultry processing industry facilities, additional data on animal processing waste characteristics, pollution prevention practices, wastewater treatment technology innovation, and facility management practices. These other data collection activities included a literature search, a review of current NPDES permits, and NPDES DMRs.

3.3.1 Literature Search on Environmental Impacts

EPA conducted a literature search to obtain information on various aspects of the animal processing industry, including documented environmental impacts, wastewater treatment technologies, waste generation and facility management, and pollution prevention. EPA performed extensive internet and library searches for applicable information. The Agency used the resources of its own environmental library and of the United States Department of Agriculture's (USDA) National Research Library to obtain technical articles on environmental issues relating to the animal processing industry. Researchers also consulted several university libraries and industry experts during the literature search. As a result, EPA was able to compile a list environmental impacts associated with the meat and poultry processing industry. The scope of the literature search included government reports of permit violations and any associated environmental impacts. EPA has included a summary of the case studies in the Administrative Record associated with the MPP proposal. The primary sources for the case studies include newspaper and technical journal articles, government reports, and papers included in industry and academic conference proceedings.

3.3.2 Current NPDES Permits

EPA extracted information from the Agency's Permit Compliance System (PCS) to identify meat and poultry processing industry point source dischargers with NPDES permits. This initial extraction was performed by searching the PCS using reported Standard Industrial Classification (SIC) codes used to describe the primary activities occurring at the site. Specifically, the following SIC Codes were used:

- 2011—Meat Packing Facilities
- 2013—Sausages and Other Prepared Meats
- 2015—Poultry Slaughtering and Processing
- 2077—Animal and Marine Fats and Oils.

EPA identified 359 active meat and poultry product facilities with NPDES permits in the PCS database. The PCS estimate of MPP direct dischargers is approximately equivalent to the screener survey estimate of direct dischargers. For the final rule, EPA will refine its estimates of direct dischargers to incorporate information from both the PCS database and the screener survey.

EPA selected a sample from this universe of direct dischargers in the PCS database. The Agency then reviewed NPDES permits and permit applications to obtain information on treatment technologies and wastewater characteristics for each of the respective animal processing and rendering sectors. EPA used this information as part of its initial screening process to identify the universe of processing facilities that would be covered under the proposal. In addition, the Agency used this information to better define the scope of the information collection requests and to supplement other information collected on meat and poultry processing waste management practices.

3.3.3 Discharge Monitoring Reports

In addition, the Agency collected long-term effluent data from facility DMRs via the PCS database in an effort to perform a "real world" check on the achievability of the MPP proposal limits. DMRs summarize the quality and volume of wastewater discharged from a facility under a NPDES permit. DMRs are critical for monitoring compliance with NPDES permit provisions and for generating national trends on Clean Water Act compliance. DMRs may be submitted monthly, quarterly, or annually depending on the requirements of the NPDES permit.

EPA extracted discharge data and permit limits from these DMRs (via the PCS database) to help identify pollutants of concern (i.e., which pollutants are currently being regulated) and to identify better performing facilities. Specifically, EPA identified the amount of discharged ammonia in relation to the respective permit limits. EPA conducted this analysis in part to identify potential facilities for future sampling, as well as to assist in identifying a selection of facilities for the certainty component of the detailed survey exercise.

EPA was able to collect DMR information on a total of 176 facilities from four MPP sectors: 77 meat packing facilities; 17 facilities producing sausages and other prepared meat products; 65 poultry slaughtering and processing facilities; and 17 animal and marine fat and oils facilities. EPA collected 31,311 data points on 83 separate pollutant parameters.

Indirect dischargers file compliance monitoring reports with their control authority (e.g., POTW) at least twice per year as required under the General Pretreatment Standards (40 CFR 403), while direct dischargers file discharge monitoring reports with their permitting authority at least once per year. EPA did not collect compliance monitoring reports for MPP facilities that are indirect dischargers, as: (1) a vast majority of MPP indirect dischargers are small facilities (i.e., small volumes of wastewater); and (2) this information is less centralized and harder to collect.

Because DMR and indirect discharger compliance monitoring reports do not provide information about processes and production, EPA was not able to use these data directly in calculating the limitations and standards Instead, in the detailed survey, EPA requested that facilities provide the individual daily measurements from their monitoring (for DMR or the control authority) with detailed information about their treatment systems and processes. After further evaluation of the detailed surveys, EPA intends to use the self-monitoring data corresponding to the proposed treatment options to calculate the final limits and to reassess the achievability of the limits by well-operated BAT systems. In cases where EPA determines that improved system operation will allow the limits to be consistently achieved, it will include additional treatment costs for the facility in its cost estimations for the final rule where it has not already done so. In following the approach described above, EPA concludes that it will address issues related to the achievability of the numerical limits by well-operated and economically achievable treatment systems.

3.4 STAKEHOLDER MEETINGS

EPA encouraged the participation of all interested parties throughout the development of the MPP proposal. EPA conducted outreach to the following trade associations (which represent the vast majority of the facilities that will be affected by this guideline): American Meat Institute (AMI), American Association of Meat Processors (AAMP), National Renderers Association (NRA), U.S. Poultry and Egg Association, and the National Chicken Council. EPA met on several occasions with various industry representatives to discuss aspects of the regulation development. EPA also participated in industry meetings and gave presentations on the status of the regulation development. Summaries of these meetings are in the rulemaking Administrative Record.

In the development of the surveys used to gather facility specific information on this industry, EPA consulted with the industry groups and several of their members to ensure that the information was being requested in an intelligible manner, and that they would provide it in the form requested.

EPA also met with representatives from USDA to discuss this regulation and how it might either be affected by or affect requirements on the meat and poultry processing industry implemented by the Food Safety and Inspection Service of USDA. EPA has met with representatives from state and local governments to discuss their concerns with meat and poultry processing facilities and how EPA should approach these facilities in regulation. Summaries of these meetings are in the Administrative Record. Additionally, EPA Regional and State pretreatment coordinators were contacted to identify MPP indirect dischargers that were causing POTW interference or pass through. The results of this limited search is summarized in Section 13 and in the rulemaking Administrative Record. EPA plans to conduct a more systematic and thorough study of POTWs accepting MPP indirect discharges to better characterize interference and pass through issues. EPA will present the results of the findings in the forthcoming NODA.

SECTION 4

MEAT AND POULTRY PRODUCTS INDUSTRY OVERVIEW

This section provides an overview of the meat and poultry products (MPP) industry. Section 4.2 provides a general overview of the MPP industry. Sections 4.3, 4.4, and 4.5 provide more detailed information related meat, poultry, and rendering operations, respectively.

4.1 INTRODUCTION

The meat and poultry products industry includes facilities that slaughter livestock (e.g., cattle, calves, hogs, sheep, and lambs) and/or poultry or process meat and/or poultry into products for further processing or sale to consumers. In some facilities, slaughter and further processing activities are combined. The industry is often described in terms of three categories: (1) meat slaughtering and processing; (2) poultry slaughtering and processing; and (3) rendering. A facility may perform slaughtering operations, processing operations from carcasses slaughtered at the facility or other facilities, or both. Companies that own meat or poultry product facilities may also own facilities that raise the animals or further process the meat or poultry products into final consumer goods. Raising of animals, however, is not covered by the meat and poultry products industry effluent limitations guidelines.

Since the 1970s when EPA issued the existing regulations for the meat and rendering industry sectors, the meat and poultry products industry has become increasingly concentrated and vertically integrated through alliances, acquisitions, mergers, and other relationships. This vertical integration is particularly pronounced in the broiler sector of the poultry industry. Most of the broiler and other chicken products that reach the consumer have been under the control of the same company from the hatching through the processing of the birds. Vertical integration is not seen to the same extent in the meat sector, although there is increasing vertical integration, particularly in the hog sector.

The meat and poultry products industry encompasses four North American Industry Classification System (NAICS) codes developed by the Department of Commerce. These

NAICS codes include Animal Slaughtering (Except Poultry), NAICS 311611; Meat Processed from Carcasses, NAICS 311612; Poultry Processing, NAICS 311615; and Rendering and Meat Byproduct Processing, NAICS 311613.

4.2 MEAT PRODUCTS INDUSTRY DESCRIPTION

4.2.1 Animal Slaughtering (Except Poultry)

Animal Slaughtering (Except Poultry) (NAICS 311611) includes meat first processing facilities that slaughter cattle, hogs, sheep, lambs, calves, horses, goats, and exotic livestock (e.g., elk, deer, buffalo) for human consumption. Slaughtering (first processing) is the first step in the processing of meat animals into consumer products. Slaughterhouse operations typically encompass the following steps: (1) receiving and holding of live animals for slaughter; (2) stunning prior to slaughter; (3) slaughter (bleeding); and (4) initial processing of animals. Slaughterhouse facilities are designed to accommodate this multistep process of first processing. In most slaughterhouses, the major steps are carried out in separate rooms.

In addition, many first processing facilities further process carcasses on-site to produce products such as hams, sausages, and canned meat. Otherwise, carcasses may be shipped to other facilities for further processing. Also, many first processing facilities include rendering operations that produce edible products, such as lard, and inedible products, including ingredients for animal feeds and products for industrial use.

Based on the 1997 U.S. Census of Manufacturers, the animal first processing industry sector includes 1,300 companies, which operate approximately 1,400 facilities. The industry sector employs 142,000 people and generates a total value of shipments of $54 billion. Twelve states reported shipments in excess of $1 billion; Texas, California, Illinois, Iowa, and Wisconsin contain the largest number of first processing establishments (at least 60 establishments in each state). Nebraska ranks seventh in the number of facilities located in the state, but it has the highest number of employees engaged in animal first processing of any state. Nebraska accounts for almost 17 percent of the value added and 16 percent of total shipments in this industry sector. Industry activity is most heavily concentrated in Nebraska, Kansas, Iowa, and Texas.

The Animal First Processing sector comprises a large number of facilities (72 percent of the sector) that have fewer than 20 employees. These facilities employ less than 5 percent of the sector workforce and contribute an even smaller percentage of value added and value of shipments to this sector. Thirty-nine facilities employ between 1,000 and 2,500 employees and while constituting 3 percent of the total number of establishments, provide 43 percent of the industry employment and 46 percent of the value of shipments.

Revised production rate thresholds exclude most smaller meat product processing facilities from the January 31, 2002, proposed revisions to 40 CFR Part 432. Based on the current screener survey data, EPA is defining small meat facilities as those that produce fewer than 50 million pounds live weight kill (LWK) per year. See Figures 4-1 and 4-2 for the distribution of small and non-small (facilities producing more than 50 million pounds (LWK) per year) meat first and further processing facilities, also, categorized by discharge type, throughout the United States.

4.2.2 Meat Processed from Carcasses

Meat Processed from Carcasses (NAICS 311612) includes facilities engaged in processing or preserving meat and meat by-products (but not poultry or small game) from purchased meats. These facilities do not slaughter animals or perform any initial processing (e.g., defleshing, defeathering).

The meat further processing industry sector includes 1,164 companies, which own and operate about 1,300 facilities. This sector employs about 88,000 people, and the value of shipments is more than $25 billion, of which $9 billion is value added by manufacture.

California, Illinois, New York, and Texas have the highest concentration of meat further processing facilities, each with more than 90 meat further processing facilities. The highest levels of employment, however, are found in Illinois, Pennsylvania, Texas, and Wisconsin, which together generate one-third of the meat further processing employment. In Wisconsin more than half of the meat further processing facilities employ more than 20 workers, and the state also accounts for the largest share of both total shipments and value added in the industry.

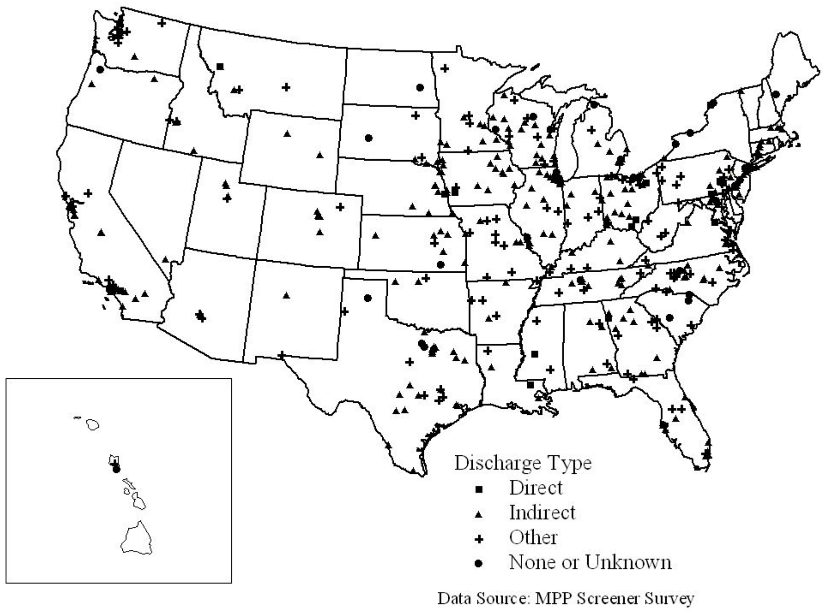

Figure 4-1. Location of Small Meat Facilities in the United States (Based on MPP Screener Survey Data).

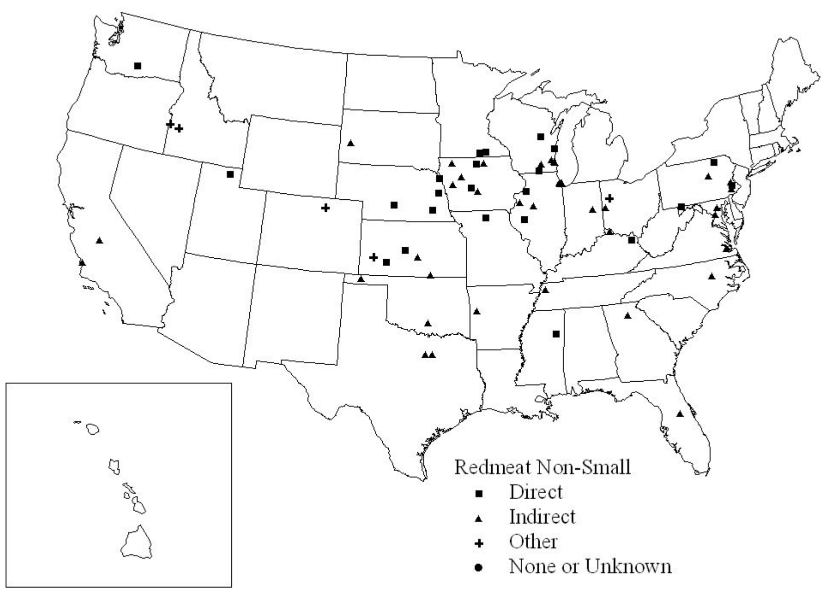

Figure 4-2. Location of Non-Small Meat Facilities in the United States (Based on MPP Screener Survey Data).

As with the animal first processing sector, more than half of the meat further processing facilities employ fewer than 20 workers. The bulk of the employment (54 percent), value added (55 percent), and total shipments (57 percent) is accounted for by meat further processing facilities employing between 100 and 500 workers. The difference between the animal first processing sector and the meat further processing sector is that while the value of shipments in the animal first processing industry sector is heavily concentrated in the largest facilities, the value of shipments in the meat further processing sector is more evenly distributed across meat further processing facilities of all different sizes.

See Figures 4-1 and 4-2 for the locations of small and non-small meat and mixed meat first and further processing facilities throughout the United States that have been further classified by discharge type. EPA defines small meat facilities as those producing fewer than 50 million pounds per year (LWK).

4.3 DESCRIPTION OF MEAT FIRST AND FURTHER PROCESSING OPERATIONS

The meat processing industry produces meat products and by-products from cattle, calves, hogs, sheep, lambs, horses, and all other animal species except poultry, other birds, rabbits, and small game. Equine meat production has declined in the United States in the past 5 years. Total annual production of equine meat was 47,134 head in the year 2000 (USDA, 2001). Most horse meat is exported to Europe for consumption because of the cultural aversion to horse meat consumption in the United States. It is not known whether European demand for horse meat will increase in the future, given concerns about transmissible bovine spongiform encephalopathy in cattle.

The processing of animal species other than cattle and hogs accounts for only a small fraction of total production. The live weight of cattle and hogs slaughtered annually is consistently more than 90 percent of the total live weight of meat animals slaughtered for the production of meat products and by-products. Given that there is little difference in the processing of cattle, calves, sheep, lambs, and horses, only the processing of cattle is described in the sections that follow; parallel discussions are provided where cattle and hog processing procedures differ.

Meat processing begins with the assembly and slaughter of live animals and may end with the shipping of dressed carcasses or continue with a variety of additional activities. Meat processing operations are classified as slaughter (first processing) or further processing operations or an integrated combination of both. First processing operations include those operations which receive live meat animals and produce a raw or dressed meat product, either whole or in parts. In this classification system, first processing operations simply produce dressed whole or split carcasses or smaller segments for sale to wholesale meat distributors or directly to retailers. These operations are often prerequisites to further processing activities such as cutting, deboning, grinding, sausage production, curing, pickling, smoking, cooking, or canning. Demand for whole or split carcasses gradually has declined since the mid-1970s with a concurrent increase in demand for a greater degree of carcass cut-up ranging from separation of whole or split carcasses into front and hind quarters or smaller sections (e.g., "boxed beef"), to the preparation of packaged, case-ready, fresh cuts of meat. Most first processing operations today perform some cutting, deboning, and grinding operations. Further processing operations such as sausage production, curing, pickling, smoking, cooking, and canning can occur on-site or at off-site facilities.

Therefore, EPA considers the reduction of whole or split carcasses into quarters or smaller segments (including case-ready cuts, which may be with or without bone and may be ground) to be part of first processing operations when performed at first processing facilities. Conversely, EPA considers the cutting, boning, and grinding operations to be further processing operations when performed at facilities not also engaged in first processing activities. The reduction of whole or split carcasses or smaller carcass segments (e.g., "boxed beef") into case-ready cuts at the retail level is an example of a case in which cutting, boning, or grinding would be further processing.

4.3.1 Meat Slaughter and Packing Operations

Common to all meat first processing operations are the series of steps necessary to transform live animals into either whole or split carcasses. These steps include the assembly and holding of animals for slaughter; killing, which involves stunning before and bleeding after killing; hide or hair removal in the case of hogs, evisceration and variety meat (organ) harvest; carcass washing; trimming; and carcass cooling. Depending on the market served, cutting, deboning, and grinding and other further processing operations may occur at the same location.

Most meat facilities for which site visits were conducted slaughtered animals 5 days per week, Monday through Friday. Slaughtering may also be performed on Saturdays during peak production periods. Employees of meat facilities generally work 8 to 9.5 hours per day, Monday through Friday, and when necessary 4 to 5 hours on Saturday. Meat facilities generally have two slaughter shifts per day, one starting at approximately 6 a.m. and the other starting at approximately 3 p.m.

Generally, larger meat first processing operations specialize in the processing of one type of animal (e.g., cattle, calves, sheep, lambs, hogs, or horses). Differences in animal size and some processing steps preclude the design of processing equipment for multiple animal types. If a single facility does slaughter different types of meat animals, separate lines, if not buildings, are used (Warriss, 2000). However, very small meat first processing operations may process several types of meat animals in a single building. Figure 4-3 shows the general sequence of steps in the process of transforming live meat animals into carcasses. Detailed descriptions of each of these steps are given in the following sections.

4.3.1.1 Live Animal Receiving and Holding

Meat processors schedule receipt of live animals for slaughter from producers not only to provide a continuous supply of animals for processing but also to minimize holding time to no more than 1 day. This practice eliminates the need for feeding and reduces manure accumulation in holding pens. However, processors provide water to minimize weight loss. With the

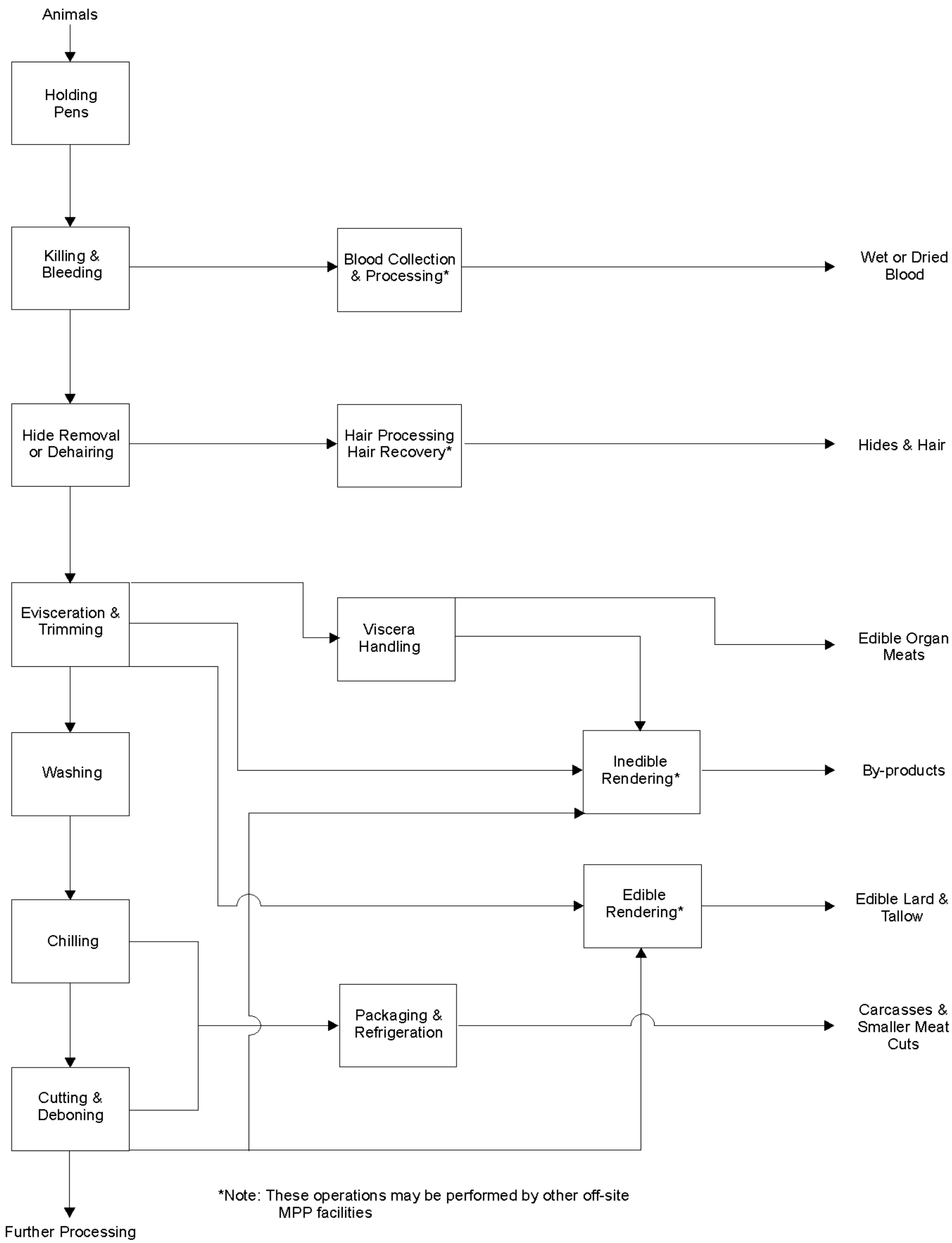

Figure 4-3: Process Flow in a Meat Slaughtering and Packing Facility. (USEPA, 1974)

relocation of first processing operations to areas of animal production, movement by truck has replaced rail transportation of live animals.

Holding pens, which allow recovery from shipping-related stress, may be covered or totally enclosed, especially in cold climates, to provide some protection from extreme weather conditions but primarily to reduce contaminated runoff from precipitation events. Holding pens are, however, sources of wastewater resulting from pen washing and drinking water spillage. Water pollutant concentrations depend on whether pens are scraped (dry cleaned) prior to wash-down to remove accumulated manure. Animals are herded from the holding pens to the killing area of the processing plant through connecting alleys. These alleys also are sources of wastewater generated during precipitation events (if uncovered) as well as from cleaning.

4.3.1.2 Methods Used to Stun Animals

Humane slaughter legislation requires that animals be stunned to produce an unconscious state before killing to reduce pain and suffering. Some exemptions are made for religious meat processing (e.g., kosher, halal). Cattle typically are stunned by mechanical means using a captive bolt pistol, percussion stunner, or free bullet to inflict brain trauma and the immediate loss of consciousness. Electric shock is most commonly used to stun hogs because mechanical stunning can result in convulsions, making subsequent shackling difficult. Electric shock also is commonly used to stun sheep, lambs, and calves before killing.

A less commonly used alternative to electric shock for stunning hogs is exposure to a 70 to 90 percent carbon dioxide environment in a pit or tunnel. Inhalation of a high concentration of carbon dioxide causes a drop in brain fluid pH and loss of consciousness. Current research is being performed to evaluate argon as a substitute for carbon dioxide. While stunning with argon is believed to be less stressful to the animal than using carbon dioxide, use of argon requires longer exposure periods to achieve unconsciousness (Warriss, 2000).

4.3.1.3 Killing and Bleeding

Immediately after stunning, shackles are attached to the animal's rear legs for suspension from an overhead rail conveyor used to move the carcass through the processing plant. After hanging the animals, processors kill them within seconds by severing main arteries and veins in the neck region to cause death by massive and rapid blood loss (exsanguination). This process is generally known as "sticking," and somewhat different techniques are used for cattle, hogs, sheep, and horses.

Troughs or gutters collect blood lost following sticking for recovery in the form of various by-products. If blood is collected for subsequent human consumption in products such as blood sausage, a hollow knife connected to a special tank under partial vacuum is used. While approximately 40 to 60 percent of the blood exits the body during bleeding, about 3 to 5 percent remains in the muscles and the remainder is in held in the viscera (Wilson, 1998).

Certain religious practices require an alternative slaughter process for cattle. In these cases, the animal is not stunned prior to slaughter. Instead, the animal is restrained while the slaughterer makes a transverse cut that severs the major vessels in the throat (Warriss, 2000). The Jewish slaughter practice, called Shechita, requires a single cut without pause, pressure, stabbing, slanting, or tearing. The cut severs the skin, muscles, trachea, esophagus, jugular veins, and carotid arteries. After bleeding ceases, the slaughterer searches for lung adhesions. The meat is unfit for consumption if the sores are believed to have been detrimental to the animal while alive. Next, the removal of blood vessels and sinews, called porging, completes the slaughter ritual. Halal, the Muslim slaughter practice, is similar to Shechita; the main difference is that searching and porging do not take place (Wilson, 1998).

Although not common, the slaughtering process may include electric stimulation of the carcasses to improve meat quality and to facilitate removal of the hide. Typically, this process calls for a skull probe, which is inserted into the skull of the carcass through the hole from the captive bolt for 30 seconds (Wilson, 1998). One of the primary goals of electric stimulation is to prevent cold shortening, which makes the meat less tender. Plants use both high-voltage (>500 volts) and low-voltage (30 to 90 volts) electric stimulation systems (USEPA, 1997).

4.3.1.4 Hide Removal from Cattle and Sheep and Hair Removal from Hogs

Before evisceration, slaughterers remove hides from cattle and sheep, and hair from hog carcasses to reduce the potential for contamination of the carcasses after evisceration from hair, dirt, and manure. Hides usually are removed from cattle and sheep mechanically after the removal of the head, tail, and hooves. The process of hide removal begins with some initial separation from the carcass manually, using either conventional or air-driven knives, to enable attachment of mechanical pullers. The pullers then remove the hide by either pulling up from the neck to the tail or pulling in the reverse direction, which is less common.

On-site hide processing can consist of salting for preservation before shipment to leather tanning operations, or it can involve washing, defleshing, and salting before shipment. However, on-site hide processing options also may include curing before shipment for off-site tanning or complete processing followed by the marketing of tanned hides.

Hogs typically are not skinned. Rather, they are scalded by immersion for about 4 to 5 minutes in hot water having a temperature of about 54 to 60 ˚C (130 to 140 ˚F). The objective of scalding to relax hair follicles is to facilitate subsequent mechanical hair removal by passing the carcass between rotating drums with rubber fins or fingers. A constant flow of water washes away the hair removed from the carcass. Any remaining hair is removed by singeing by passing the carcass through a gas flame followed by passing the carcass through a water spray for cooling and washing, and then by manual shaving.

Meat processing facilities usually collect hog hair and other particulate matter from processing wastewater by screening for rendering before any subsequent on-site or off-site wastewater treatment. Hog hair also may be recovered, washed, and baled for sale for various uses, but demand for this material has become quite limited. Also limited is the demand for pigskin leather, which is why most hogs are not skinned.

4.3.1.5 Evisceration

After hide or hair removal from hogs, the carcasses are washed with water sprays to remove any manure, soil, and hair present to retard microbial growth and spoilage. This step is followed by evisceration to remove internal organs. Evisceration begins with a ventral incision made manually that spans the length of the carcass, followed by removal of the gastrointestinal tract (stomach, intestines, and rectum). Then, an incision is made through the diaphragm to allow removal of the remaining organs (trachea, lungs, heart, kidneys, liver, and spleen).

After evisceration, carcasses are federally or state-inspected for indicators of disease and suitability for human consumption. Condemned carcasses are segregated with salvage of usable parts when possible. Following evisceration and inspection, with the possible exception of calf and lamb carcasses, carcasses usually are split into two halves by sawing them down the middle of the spinal column.

After evisceration, different organs may be separated for sale as variety meats or pet food ingredients prior to the removal of viscera from the processing plant; otherwise, viscera are generally disposed of through rendering. Liver and kidneys are the organs most commonly harvested from cattle, calf, and lamb viscera; some stomach tissue is harvested from cattle for sale as tripe. Less common is the harvesting of the thymus from calves for sale as sweet breads. Lung tissue also may be harvested for sale as food for mink.

Variety meat harvesting from hogs is more extensive than from cattle and sheep and includes not only liver and kidneys, but also the small and large intestine. The former is sold as chitterlings while the latter is sold as natural casing for sausage. In addition, hog ears and feet, jowls, and the sphincter muscle may be harvested for sale.

4.3.1.6 Washing

After carcass inspection and splitting, a second washing takes place to remove blood released during evisceration, bone dust from carcass splitting, and any other foreign matter present. Processors may add bactericide such as an organic acid, chlorine, or potassium chloride to the wash water to reduce microbial populations and the potential for growth and spoilage. Acetic and lactic acids in very dilute concentrations (2 to 3 percent) are the organic acids used as bactericides. Large operations often use automated carcass washing equipment to maintain appropriate pressure to maximize efficiency of water use (USEPA, 1997). The time from stunning to the second and final carcass wash varies to some degree, but it is less than 1 hour.

Before refrigeration or freezing, all variety meats are washed to remove blood and any other contaminants. The washing of the small and large intestines of hogs is a very labor-intensive process requiring substantial amounts of water to completely removal fecal material.

4.3.1.7 Chilling

The next step in the meat slaughtering process is carcass chilling to remove residual body heat to inhibit microbial growth and reduce evaporative weight loss. Carcasses are chilled for at least a 24-hour period but are chilled for 48 hours over weekends and during weeks with holidays. Typically, carcass chilling is a two-step process beginning with snap (flash) chilling at temperatures substantially below freezing to effect a rapid initial rate of reduction in carcass temperature (USEPA, 1997). After snap chilling, carcasses are moved into chill rooms for the remainder of the chilling process. Chill room temperatures are maintained at a temperature of 1 ˚C (34 ˚F) to reduce carcass temperature to no higher than 7 ˚C (45 ˚F) before further handling (Warriss, 2000). Chilling facilities separate the "dirty" and "clean" sides of meat processing plants.

4.3.1.8 Packaging and Refrigeration or Freezing

Larger carcass sections usually are packaged in heavy plastic bags, which then may be placed in cardboard boxes (e.g., "boxed beef") for shipping. Large quantities of ground meat also are packaged in heavy plastic bags. Smaller cuts sold as case-ready are placed on Styrofoam trays, wrapped with thin plastic film, and boxed for shipment. Case-ready cuts also may be weighed and labeled showing weight and price. The packaging of case-ready cuts usually is a completely automated process.

Packaged meats then are refrigerated until and during shipment. Freezing of meats that have not been further processed is rare given consumer food safety concerns about refreezing previously frozen meats. However, some meat is frozen before shipment, especially for commercial use and export markets.

4.3.1.9 Cleaning Operations

Federal and state regulations require that equipment and facilities used for the first processing of all animals for human consumption be completely cleaned at least after every 8 hours of operation to maintain sanitary conditions. Therefore, the daily schedule for meat processing facilities consists of one or two 8-hour production shifts followed by a 6- to 8-hour cleanup shift. During cleanup, first all equipment, walls, and floors are rinsed to remove easily detachable particulate matter. Then they are scrubbed and rinsed again to remove detached particulate matter, detergents, and sanitizing agents used during the scrubbing phase of cleanup activities. In states where phosphorus-based detergents are banned, phosphorus-based detergent use in food processing plants is generally exempted, so phosphorus-based detergents are commonly used. Chlorine solutions and other bactericidal compounds are also commonly used.

4.3.2 Meat Further Processing

As previously discussed, EPA considers the reduction of whole or split carcasses into quarter or smaller segments as further processing operations when they do not occur in conjunction with first processing operations. The segments produced include case-ready cuts with or without bone and ground meat. Other activities, including sausage production, curing, pickling, smoking, marinating, cooking, and canning, also are considered further processing operations.

In the meat industry, further processing activities may be combined with first processing activities at the same site or they may be stand-alone operations. Where first and further processing activities occur at the same site, usually some fraction of the carcasses produced is marketed as fresh meat and the remainder is transformed into processed products. Stand-alone further processing operations may receive carcasses, or more commonly carcass parts, from first processing operations for further processing.

4.3.2.1 Raw Material Thawing

The frozen raw materials received by a meat processing plant are handled in one of three different ways:

- Wet thawing
- Dry thawing
- Chipping

Materials that are wet thawed are submerged in tanks or vats containing warm water for the time required to thaw the particular pieces of meat. The devices used for wet thawing include simple carts with water covering the meat, vats with water flowing in and out with the exit temperature of the water controlled at 10 to 16 ˚C (50 to 60 ˚F) to avoid heating the outer surfaces of the meat, and equipment where the meat pieces are suspended in a tank of water and moved by some conveyance through that tank for a time sufficient to thaw the meat (USEPA, 1974).

Dry thawing involves placing the frozen meat pieces in a refrigerated room at a temperature above freezing and allowing sufficient time for the particular pieces of meat to fully thaw (USEPA, 1974).

Chipping involves size-reduction equipment designed to handle frozen pieces of meat and to produce small particles of meat that readily thaw and can be used directly in subsequent mixing or grinding operations. This type of thawing is usually associated with the production of comminuted (flaked) meat products (USEPA, 1974).

Both wet and dry thawing generally are used when the entire piece of meat, or a substantial portion of it, is required for a finished product, such as hams or bacon (USEPA, 1974).

Wet thawing of raw materials generates the largest quantity of contaminated wastewater. The water used to thaw the materials is in contact with the meat and thereby extracts water-soluble salts and accumulates particles of meat and fat. The water used in thawing is dumped into the sewer after thawing is complete. The waste load generated in dry thawing is from the thawing materials dripping onto the floor and from the washing of these drippings into the sewer. The waste from the chipping of frozen meat materials includes the meat and fat particles remaining on the chipping equipment that are washed into the sewer during cleanup. Juices extruded from the meat product in the chipping process are wasted to the sewer, although it is not a large wasteload (USEPA, 1974).

4.3.2.2 Carcass/Meat Handling and Preparation

This operation includes seven different operations that may be involved in handling and preparing meat materials for subsequent processing, depending on the processing plant. Each of the seven operations is described separately. All seven operations are usually not required to produce a processed meat product (USEPA, 1974). These operations are also illustrated in Figure 4-4.

4.3.2.2.1 Breaking

Beef is frequently received by meat processors as carcass halves or quarters. Breaking involves the cutting of these half and quarter carcasses into more manageable sizes for further handling and preparation following this operation. The waste load originates from the cutting and sawing and includes small meat and fat particles and relatively little liquid, all of which fall to the floor and are washed into the sewer during cleanup (USEPA, 1974).

4.3.2.2.2 Trimming

The removal of excess or unwanted fat and of specific cuts from larger pieces of meat is done in the trimming operation. The unwanted fat trimmed from meat products is usually disposed of through rendering. The materials for disposal are collected and stored in drums, which are picked up by renderers. The waste load generated in trimming might be greater than that generated by the breaking operation. Trimming requires a greater number of cuts on a specific piece of meat to obtain the required quality or particular cut desired from the raw

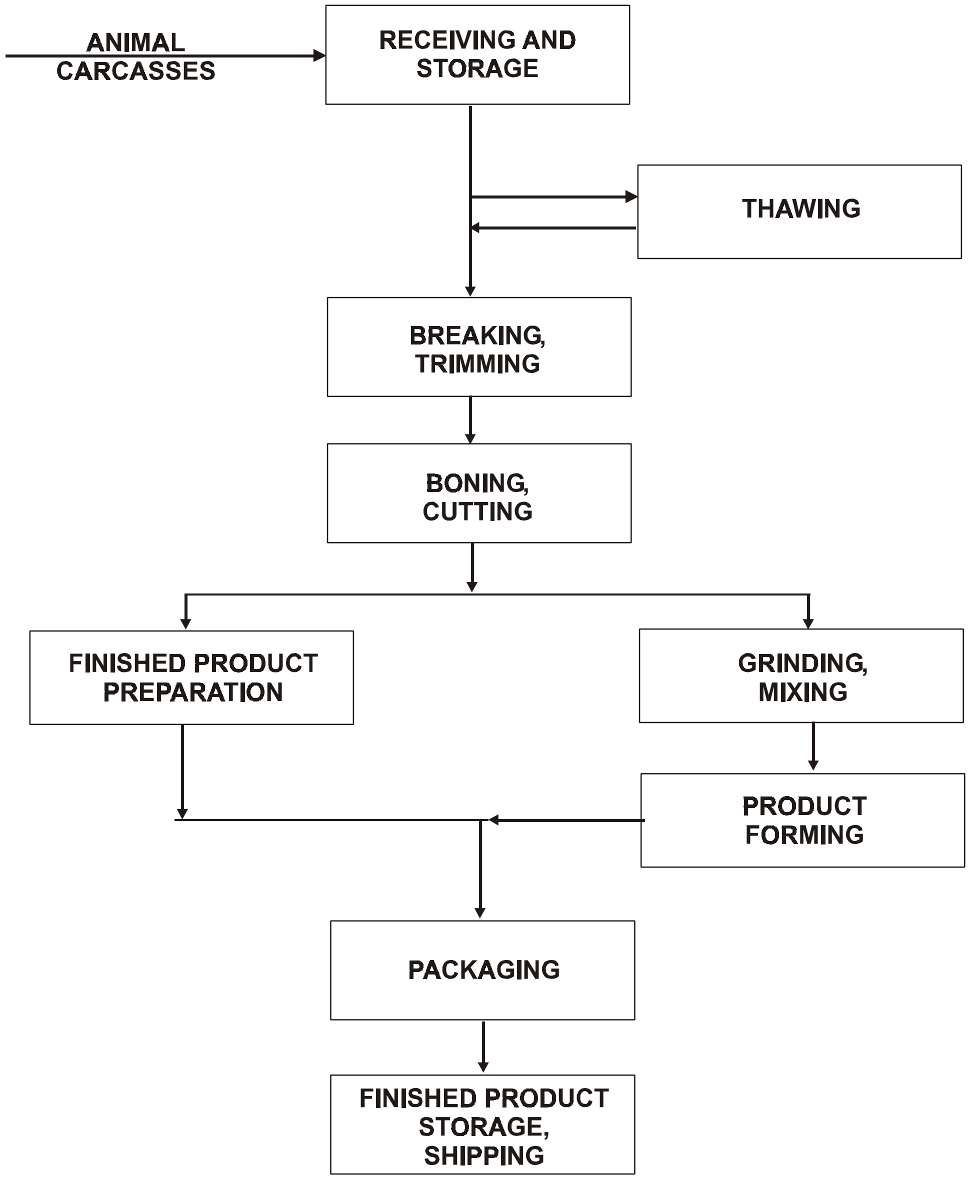

Figure 4-4. General Process for Meat Cuts and Portion Control Procedures (USEPA, 1974).

material. The wastewater generated by this operation results from the use of water by the personnel involved in the operation during the operating day and water required to clean the equipment and floor of the trimming operation (USEPA, 1974).

4.3.2.2.3 Cutting

In the cutting operation, the larger pieces of meat are cut or sawed for the direct marketing of the smaller sections or individual cuts, or for further processing in the production of processed meat products. The solid waste materials generated in cutting are similar to those produced in trimming, plus the bone dust from sawing the bones. The large pieces are useful in sausages or canned meats or can be rendered for edible fats and tallows. The waste materials from the equipment and floor washdown contribute to the waste load of the meat processing plant (USEPA, 1974).

4.3.2.2.4 Deboning

Some raw materials are prepared for the consumer by the removal of internal bones prior to manufacturing particular products such as hams and Canadian bacon. Deboning might also be performed at the same location as trimming, prior to the production of various meat cuts. The bones removed in this operation are disposed of through rendering channels. Meat and fat particles produced from this operation are normally washed into the sewer of a meat processing plant (USEPA, 1974).

4.3.2.2.5 Skinning

The removal of the pork skin from a piece of meat can be done by machine or by hand. Skinning is most frequently used in the preparation of pork bellies for processing into bacon and in ham production. The common practice in the industry is to use machines for the skinning process. The skins removed are disposed of through rendering channels. Other products that require skinning, such as picnic hams, are manually skinned, frequently at the same time that the raw hams are deboned. In either type of skinning operation, meat and fat particles are generated and wasted by falling on the floor or by becoming attached to the skinning equipment. The subsequent cleanup washes these particles into the sewer. In addition, tempering frequently precedes pork belly skinning, generating a waste load comparable to that generated by wet thawing of frozen meat materials by direct meat contact with water (USEPA, 1974).

4.3.2.2.6 Comminution (Mincing, Bowl Chopping, Flaking)

Comminution is the process of reducing large pieces of meat into small pieces for products such as sausage and hamburger patties. There are three general methods of comminution: mincing, bowl chopping, and flaking. Each method affects the size and shape of meat differently, influencing other meat properties. The general processes for comminuted meat products are illustrated in Figure 4-5.

Meat is minced by being pushed through a perforated plate positioned against a rotating knife with a screw auger. The size of perforation varies, depending on the desired meat particle size. The meat is then broken into very small pieces through bowl chopping. Meat is bowl chopped by being placed into a rotating bowl and carried by conveyor belt through a set of vertically rotating knives. Comminuted (flaked) meat is produced when a sharp blade cuts frozen meat blocks into small flakes.

Hamburger patties are formed of minced or flaked beef traditionally, although other meats can be used. Reformed steaks are made from comminuted meat that is shaped to resemble a natural steak. Sausages are made from chopped or comminuted meat and additional ingredients, which are filled into a casing. The casing can be made from the collagen layer of animal intestines or from the reconstituted collagen from other animal parts (Warriss, 2000).

4.3.2.2.7 Grinding, Mixing, and Emulsifying

All processed meat products that are not marketed as cuts or as specific items such as bacon or ham, or used in large pieces, are processed at least through a grinding step to produce a finished product. Grinding is the first step in reducing the size of meat pieces for use in processed meat products such as hamburger, or in preparation for further mixing, blending, or additional size reduction. Grinders are frequently equipped with plates through which meat is forced or extruded. Grinder plates with holes measuring 1/8 to 3/8 inch are most commonly used. In addition to size reduction, grinding equipment may be used to prepare a mixture of various ingredients such as meat products from different types of animals or lean and fatty meat products. The particle size of the meat ingredients in a product is critical. Larger particle size is

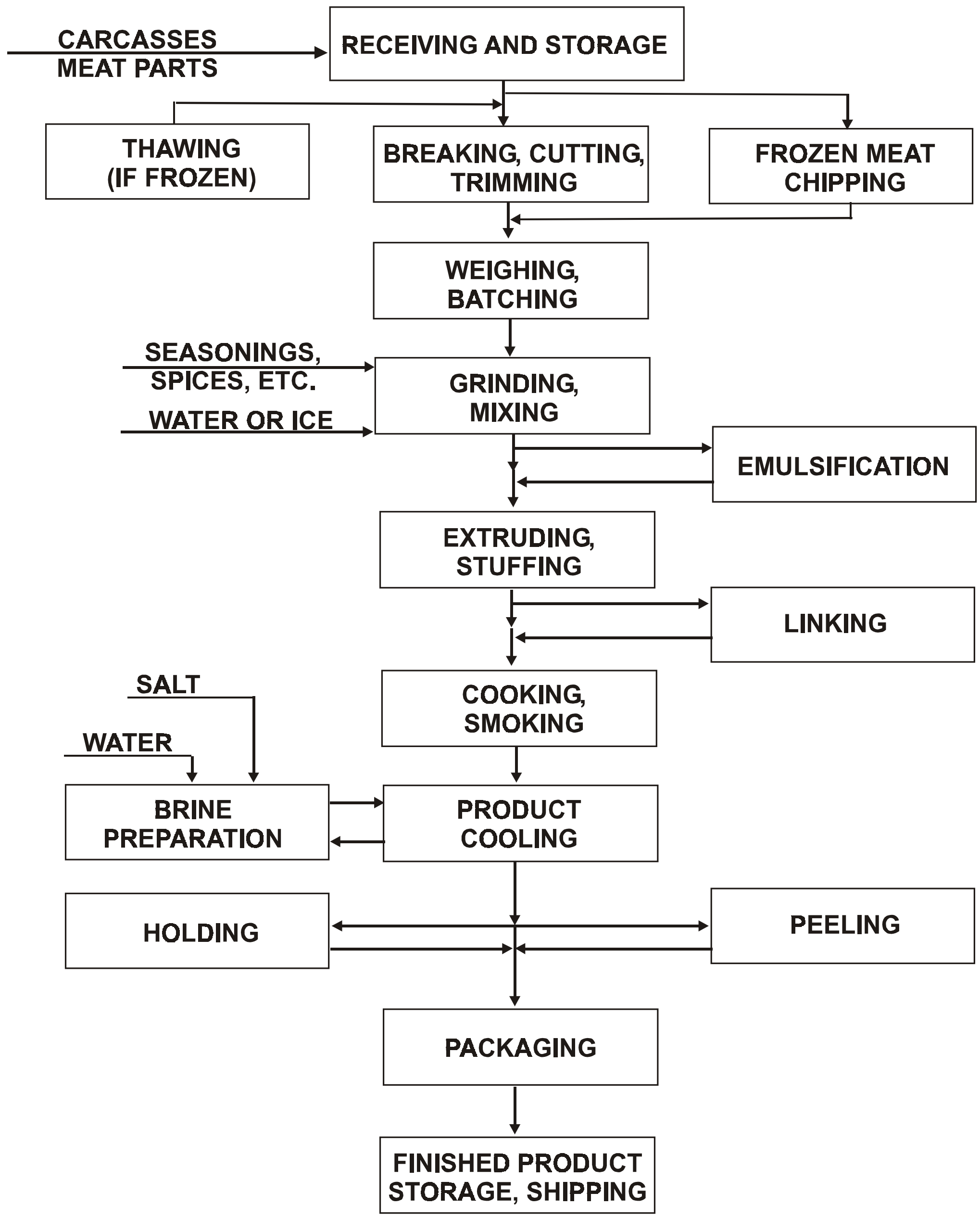

Figure 4-5. General Process for Comminuted Meat Products (Sausage, Wieners, Luncheon Meats, etc.) USEPA, 1974).

required for hamburger or fresh pork sausage products. A slightly smaller particle size is required for manufacturing dry or semi-dry sausages. Various sausages, including wieners and some luncheon meats, are prepared by a substantial size reduction or comminution of the meat raw materials. These products involve a stable sausage emulsion whereby the fat droplets or globules are uniformly dispersed throughout the mixture so that it will take on a homogenous appearance (USEPA, 1974).

Equipment is available to the meat processor that blends or mixes the various ingredients, including the meat materials, to produce stable emulsions. One type of equipment—the "silent cutter"— uses numerous knife blades spinning at a high velocity to reduce the particle size and to produce a stable emulsion. The other type of equipment used to produce an emulsion has the appearance of a common type of dry blender comparable to the ribbon blender (USEPA, 1974).

Control of the type of raw materials used, the sequence of addition, and the time and intensity of grinding, blending, or emulsifying are all critical to the quality of the finished product. Some movement of materials is usually involved in these operations because stepwise processing is required for each batch. This movement is accomplished by pumping or manually using portable containers (USEPA, 1974).

Solid waste materials are generated from these operations by spillage in handling and movement of materials and in cleanup and preparation of equipment for different types of products (USEPA, 1974).

These manufacturing operations are among the major contributors to the waste load in a meat processing plant as a result of equipment cleanup. Because the processing step involves size reduction of lean and fatty materials and the preparation of stable mixtures of meat and other ingredients, these materials tend to coat equipment surfaces and collect in crevices, recesses, and dead spaces in equipment. All of these materials are removed in cleanup and washed into the sewer. This is in contrast to larger particles that can be readily dry-cleaned off a floor prior to washdown, thereby reducing the raw waste load in the wastewater stream. Any piece of equipment that is used in any of these operations is cleaned at least once per processing day and may be rinsed off periodically throughout the day, thereby generating a fairly substantial quantity of wastewater and contributing to the raw waste load (USEPA, 1974).

4.3.2.3 Tenderizing and Tempering

Meat can be tenderized either by marinating or by being injected with salt solutions or acids. Meats have been traditionally marinated in vinegar or wine because their acidic properties break down the muscle structure. Also, the myofibrils swell and hold water, improving tenderness and juiciness. More recently, solutions, especially calcium chloride solutions, have been injected into the meat to achieve the same results (Warriss, 2000).

The processing of some meat products can be enhanced by adjusting the temperature or moisture content prior to a specific processing step. This is particularly true in the production of bacon from pork bellies. If the pork bellies are to be skinned, tempering in a water-filled vat is frequently used to improve skin removal. Hams and bacon are frequently tempered following cooking and smoking by being kept in refrigerated storage long enough for the desired temperature to develop within the particular product. See Figure 4-6 for the general processes for hams and bacon. Some meat processors also find it advantageous to allow the cooked bacon slab to temper in refrigerated storage, following pressing and forming of the slab into the rectangular shape used in the bacon-slicing machines. The holding of essentially finished products generates very little, if any, waste load. However, the water-soaking tempering technique employed prior to skinning pork bellies does generate a waste load comparable to that generated by wet thawing of frozen meat materials by the direct meat contact and subsequent dumping of this water into the sewer (USEPA, 1974).

4.3.2.4 Curing

Curing employs salt compounds to preserve meat and develop a characteristic appearance and flavor. There are two methods of curing meats—dry curing, which entails rubbing solid salts into the meat surface, and immersion, a much more common method wherein meat is submersed into a liquid solution of salts. Injecting brine into the meat and tumbling the meat with rotating drums often aid in distribution. Other salts, such as potassium nitrate, sodium nitrate, and sodium nitrite, often substitute for common table salt (sodium chloride) in the brine solution. The curing brine typically contains additional substances, including sugars to enhance flavor,

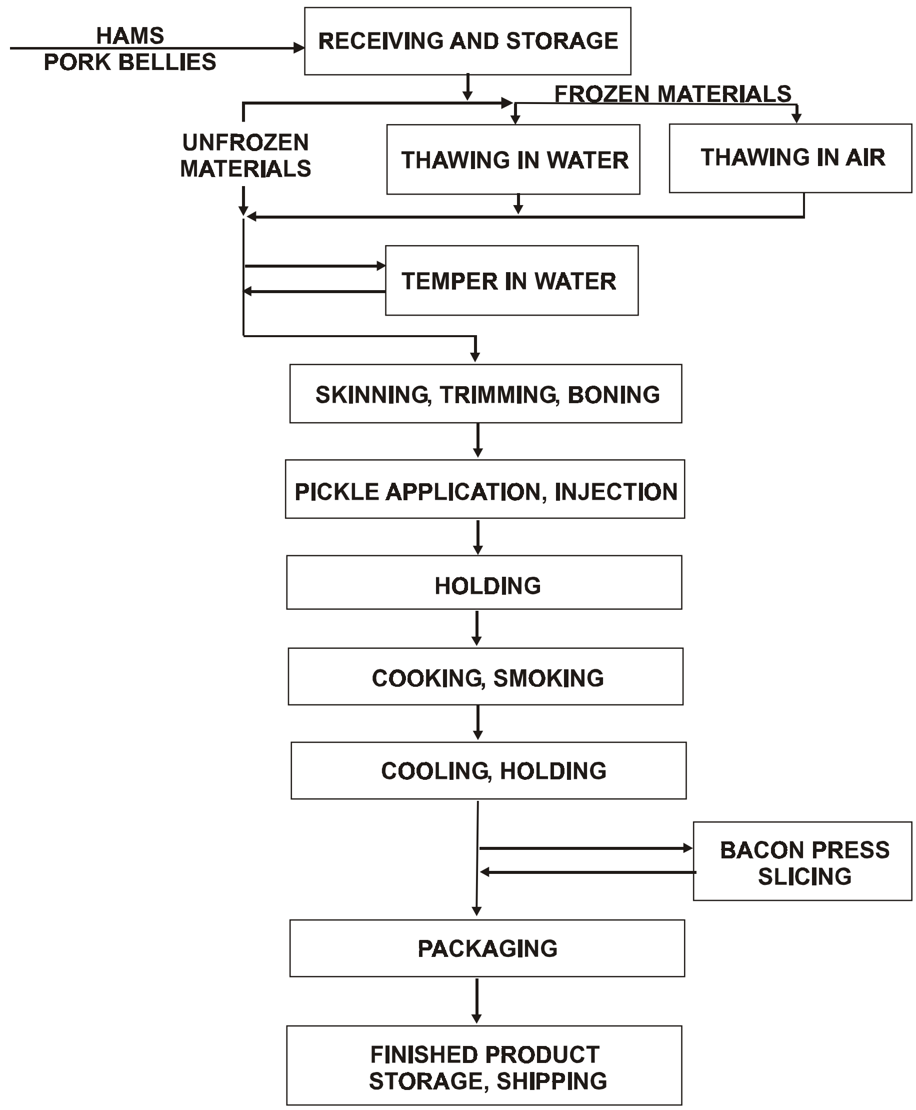

Figure 4-6. General Process for Hams and Bacon. (USEPA, 1974).

ascorbic acid to prevent discoloration, and polyphosphates to improve the water-holding capacity of the meat (Warriss, 2000).

4.3.2.5 Pickle Application/Injection

A pickle or curing solution is prepared with sugar, sodium nitrite, sodium nitrate, and salt as the main ingredients in water. The pickle solution preparation area frequently is separated physically within the plant from the actual point of use. Various types of injection are used to introduce the pickle solution into the interior of a meat product. Pickle solution may also be applied by holding the meat product in a curing brine long enough for the pickle to be absorbed. Or the pickle may be injected or pumped into hams or similar products by introducing the brine through an artery or the vascular system, if it is relatively intact. The product may be injected through numerous needles that penetrate the ham over a large area. Hams, for example, are usually pumped to 110 or 120 percent of their green (or starting) weight. The injection may also be done on both sides to ensure thorough and uniform pickling. Following the pickle injection or application, it is common practice to store the product in tubs with a covering of pickle solution for some time (USEPA, 1974).

Pickling solutions are high in sugar and salt content, particularly the latter. The large amount of spillage in this operation comes from runoff from the pickle injection, from pickle oozing out of the meat after injection, from dumping of cover pickle, and from dumping of residual pickle from the injection machine at the end of each operating day. These practices contribute substantially to the wastewater and waste load from a meat processing plant. Many of the ingredients of pickle solutions represent pollutional material in high concentrations and add significantly to the raw waste load from the pickle operation. Cleanup of the tubs or vats holding the product in brine solutions and cleanup of the pickle injection machines is required at least once per day, or after each use in the case of the vats. This necessity generates additional waste load and wastewater from a meat processing plant (USEPA, 1974).

4.3.2.6 Cooking, Smoking, and Cooling

Although smoking has traditionally functioned as a method of preservation by drying the meat and preventing fat oxidation, it now primarily serves to flavor the meat. Liquid smokes that contain liquid extract of smoke commonly substitute for real smoke (Warriss, 2000).

Most of the meat products are cooked as part of the standard manufacturing procedure. Notable exceptions are fresh pork sausage, bratwurst, and bockwurst. Processed meat products may be cooked with moist or dry heat. Cooking sausages coagulates the proteins and reduces the moisture content, thereby firming up the product and fixing the desired color of the finished product. Large walk-in ovens or smokehouses are in general use throughout the industry. These smokehouses are equipped with temperature controls, humidity controls, water showers, and facilities to provide smoke for smoking products (USEPA, 1974).

The smoking of meat products gives the finished meat product a characteristic and desirable flavor, some protection against oxidation, and an inhibiting effect on bacterial growth in the finished product. Smoke is most commonly generated from hardwood sawdust or small-size wood chips. Smoke is generated outside the oven and is carried into the oven through ductwork. A small stream of water quenches the burned hardwood sawdust before dumping the sawdust to waste. Water overflow from this quenching section is commonly wasted into the sewer. One plant slurried the char from the smoke generator, piped it to a static screen for separation of the char from the water, and then wasted the water (USEPA, 1974).

The actual cooking operation generates wastewater when steam or hot water is used as the cooking medium, such as in cooking luncheon meats in stainless steel molds. The steam condensate and hot water are wasted to the sewer from the cooking equipment. It is standard practice to shower the finished product immediately after cooking to cool it. This practice also generates a wastewater stream containing a waste load primarily of grease (USEPA, 1974).

Cleanup of the cooking ovens is not done every day, but at the discretion of the plant management. The typical practice is to clean each oven and the ductwork for the heated air and smoke circulation at least once a week. This cleaning includes the use of highly caustic cleaning solutions to cut grease and deposits from the smoking operation that have been deposited on the walls, ceiling, and ductwork in the ovens. The effluent from such a cleaning operation is noticeably dark-colored. This color is thought to be the result of creosote-type deposits and fatty acids from the smoke. The other waste load generated in oven cleanup is the grease from the walls and floors resulting from cooking the various products (USEPA, 1974).

In total quantity, the waste load and wastewater generated in this cleanup is not particularly significant. However, there is the noticeable coloration of the wastewater during cleanup and, depending on the extent of the use of caustic, an increase in the pH of the wastewater (USEPA, 1974).

Facilities cool processed meat products in different ways, depending on the type of product. Sausage products may be cooled while still in the oven or smokehouse with a spray of cold water or brine solution. Alternatively, they may be cooled in the aisle immediately outside the smokehouse to save heat and increase productivity. The brine solution is used to achieve a lower spray temperature and thereby a more rapid cooling of the product. The brine is recirculated until it is judged to be excessively contaminated to permit efficient use, at which point it is usually discharged into the sewer (USEPA, 1974).

Hams and bacon products (Figure 4-8) are not exposed to water but instead are moved quickly from the smokehouse to a refrigerated room with a very low temperature (-35 ˚C, or -31 ˚F) and higher-than-normal air circulation to achieve rapid cool-down. The hams and bacon may drip a small quantity of juice or grease onto the floor of the cold room before the surface temperature of the product reaches a point that precludes any further dripping. Cleanup of the floor results in wasting of these drippings into the sewer (USEPA, 1974).

Canned meat products and products prepared in stainless steel molds are usually cooled by submersion in cold water. The water is usually contained in a tank or raceway, where it may flow at a very low speed in a direction countercurrent to the movement of the cans or molds. Depending on the type of installation and product, it was found that the water used in cooling need not be dumped and in fact can be continually recirculated with only a nominal amount of blow-down to remove accumulated solids, just as would be done in operating a boiler. In other situations, usually where smaller quantities of water are involved and luncheon meat molds are being cooled, the water is dumped more frequently (up to once a day). This dumping is necessary because the seal on the molds is not tight enough to prevent leakage of juices and grease to the exterior of the molds (USEPA, 1974).

The only cleanup of cooling equipment that would generate a waste load is cleanup of the floors in the cold rooms where hams and bacon are cooled. This load is small in comparison to others from the plants (USEPA, 1974).

4.3.2.7 Mechanically Recovered Meat

Mechanically recovered meat (MRM) is meat separated from bone by first grinding it to produce a paste. The paste is then forced through a perforated stainless steel drum to separate meat and bone particles. High-pressure air also can be used to remove meat from bone (Warriss, 2000).

4.3.2.8 Canning and Retorting

Canning is another method of preserving and packaging meat for convenient consumption. After meat is sealed in a container, it is heated using steam under pressure at a temperatures of at least 116 ˚C (240 ˚F) to achieve adequate sterilization. However, lower temperatures are used in the canning of cured ham because sterilization by heat is not necessary because of the bactericidal effect of curing agents. Containers used for meat canning usually are steel, which may be coated with tin or a temperature-resistant plastic polymer (Warriss, 2000). See Figure 4-7 for the general processes used for canning meat products.

The containers used to hold the canned meat products must be prepared before filling and covering. The cans are thoroughly cleaned and sterilized. The wet cans are transported from the preparation area to the processing area for filling and covering. Water is present all along the can lines from preparation to filling and covering. The cans go through one last steaming just before they enter the can filling machine (USEPA, 1974).

Can filling is a highly mechanized high-speed operation. It requires moving the meat product to the canning equipment and delivering that product into a container. The high speed and the design of the equipment result in an appreciable amount of spillage of the meat product as the cans are filled and conveyed to the covering equipment. At the can covering station, a small amount of steam is introduced under the cover just before the cover is sealed to create a vacuum within the can when it cools. This steam use also generates a quantity of condensate, which drains off the cans and equipment onto the floor.

The operation of the filling and covering equipment results in a substantial quantity of wastewater containing product spills that is wasted to the sewer. Canning plants that have more

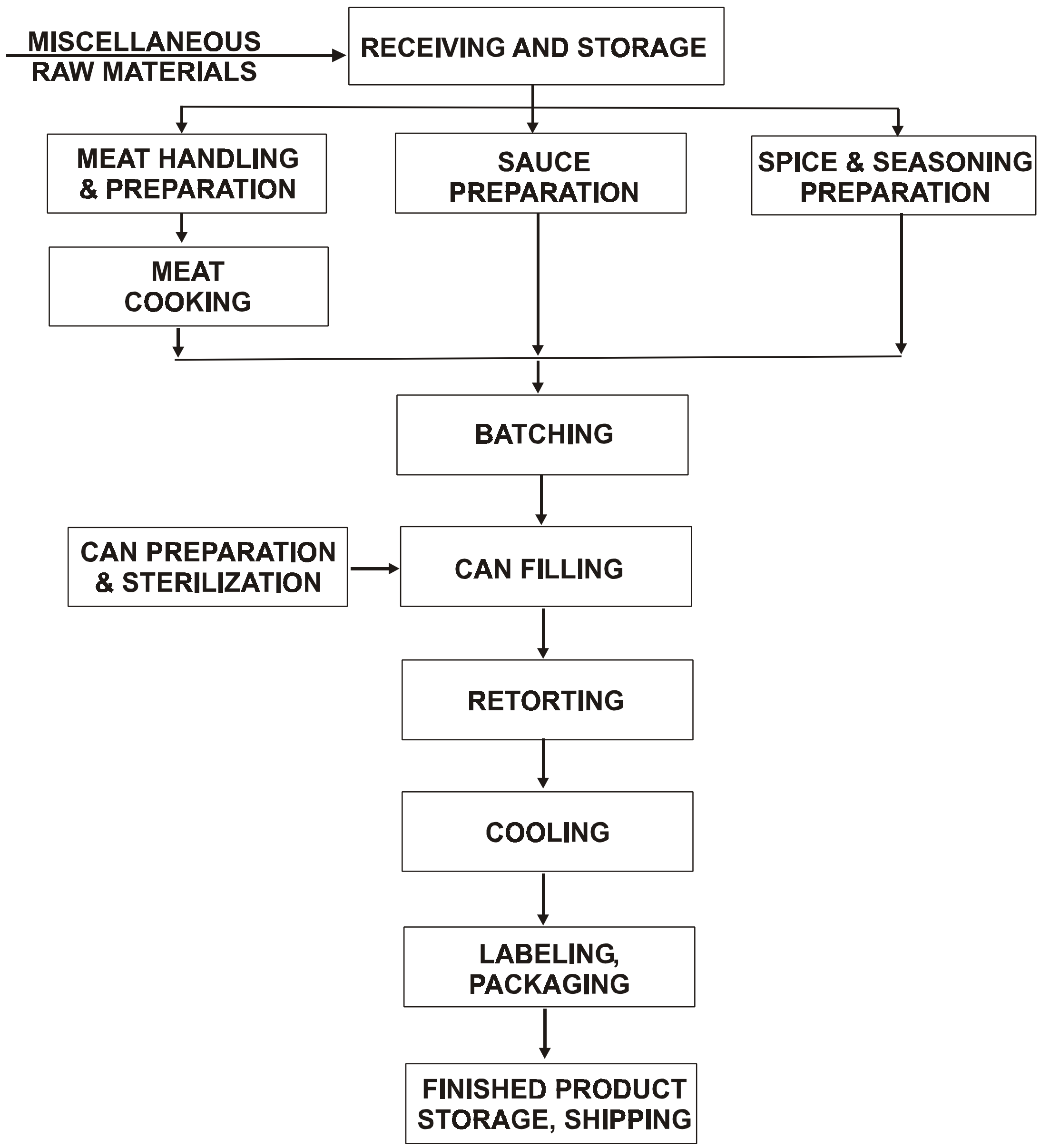

Figure 4-7. General Process for Canned Meat Products (USEPA, 1974).

than one filling and covering line have a waste load that is roughly proportional to the number of such lines in use (USEPA, 1974).

All of the equipment is washed at least once per day at the end of the processing period. If a can filling machine is to be used for different products during the day, it is usually cleaned between product runs. Meat products are frequently canned with gravy-type sauces, or the meat product itself has been comminuted to a small particle size and mixed to produce a flowable mixture. This type of canned product results in a greater contamination of equipment wash water because of the tendency of the product mixture to coat surfaces it comes in contact with and to fill all dead spaces and crevices in the equipment. The equipment is highly mechanized with many moving parts and is designed to be cleaned intact rather than being dismantled first, as is grinding and mixing equipment. Cleaning the equipment while it is intact requires a high-velocity water stream or steam to remove all food particles from the equipment. The tendency of operating personnel is to use greater quantities of water than necessary to clean the equipment. This practice results in large quantities of wastewater with substantial waste loads from canning operations (USEPA, 1974).

The equipment used in transporting the meat product to the can filling equipment also must be cleaned after it has been used on a specific product, and it is always cleaned at the end of the processing day. This equipment is usually broken down, and the product characteristics that contribute to large waste loads, as described above, also generate large waste loads in cleanup of the transport equipment (USEPA, 1974).

Some ham products are canned by manually placing ham pieces in cans. Manpower is used in place of mechanical equipment because the pieces are randomly sized and the packer is able to create a full, uniform appearance for the canned product. A small amount of gelatin is added to provide moisture to the product. The quantity of waste generated from this type of operation probably is somewhat less than that from high-speed canning equipment (USEPA, 1974).

4.3.2.9 Freezing

Blast, belt, plate, and cryogenic freezers are used for freezing meat. The specific type used depends on the type of product being frozen. Blast freezers blow frigid air (-40 ˚C, or -40 ˚F) over the meats in a tunnel. Belt freezers freeze small meats such as burgers that are carried on a conveyor belt. Plate freezers consist of cold metal plates that are pressed onto the meat surface. Finally, cryogenic freezing freezes items through immersion into liquid nitrogen (-196 ˚C, or -321 ˚F) (Warriss, 2000).

4.3.2.10 Packaging

Packaging for transport, distribution, and sale is the final step in further meat processing. Appropriate packaging fulfills three purposes. The first is to protect meat from contamination and inhibit microbial growth, the second is to reduce evaporative weight loss and surface drying, and the last is to enhance the appearance of the meat. Plastic film and antioxidants play an important role in successful packaging (Warriss, 2000).

Various packaging techniques are used in the meat processing industry. These techniques include use of the standard treated cardboard package, the Cry-O-Vac (plastic film sealed under vacuum) type of package, and the bubble enclosure package used for sliced luncheon meats and wieners, and the boxing of smaller containers of pieces of finished product for shipment. In some packaging techniques a substantial amount of product handling is involved, which may result in some wasted product. The size of the pieces of wasted finished product, however, are such that there is little reason for it to be wasted to the sewer. Instead, it should be returned for subsequent use in another processed product or directed to a rendering channel (USEPA, 1974).

The only time water is generated by the packaging operation is during cleanup of the equipment. Small quantities of water are adequate for cleanup of this equipment, and only small quantities of wastewater are generated (USEPA, 1974).

4.3.2.11 Seasonings, Spices, and Sauce Preparation

A wide variety of chemicals is used by meat processing to improve product characteristics such as taste, color, texture, appearance, shelf-life, and other characteristics important to the industry. These chemicals include salt, sugar, sodium nitrate, sodium nitrite, sodium erythrobate, ascorbic acid, and spices like pepper, mustard, and paprika. Other common materials added in the preparation of processed meat products are dry milk solids, corn syrup, and water, either as a liquid or as ice (USEPA, 1974).

Other than water, most of these materials are solids and are handled in the solid state. The product formulations for the various finished products produced by a meat processor call for specific quantities of chemicals and seasonings. These spices and chemicals are preweighed and prepared for use in a specific batch in a dry spice preparation area. They are weighed into containers and added to batches in the grinding or mixing operation. Very little waste of either a dry or wet nature is generated by the specific operation of seasoning and spice formulation. Sauces are prepared for use in canned meat products particularly. Sauces are wet mixtures of seasonings, spices, and other additives described above, as well as meat extracts and juices, and are used to prepare a gravy-type of product. Significant quantities of waste are generated in the preparation and handling of sauces and in kettle cleaning. The residual materials are washed out of the kettles directly into the sewer and contribute significantly to the raw waste load of a meat processor that prepares a canned meat product (USEPA, 1974).

4.3.2.12 Weighing and Batching

The meat processing industry uses batch-type manufacturing operations in all but a few instances. The type and quantity of materials that go into each unit of production, or batch, are controlled according to specifications established by the individual meat processing companies in accordance with government standards for the finished product. The lean and raw materials that go into each batch are weighed and placed in portable tubs. The portable tubs of weighed raw material are identified for a specific product and moved to the next manufacturing operation (USEPA, 1974).

The weighing and batching area is frequently located in one of the refrigerated raw material storage areas. The operation involves considerable manual handling of meat products and pieces of trim fat. Liquids, including meat juices and water, frequently drip from the raw materials onto the floor of the batching area. Particles also drop off in the handling process. The tubs used to hold the raw materials and the batches of raw material contain liquids and solids that are wasted to the sewer after batches have been dumped into subsequent processing equipment. The tubs and handling equipment are cleaned as needed during the production period and at least once a day (USEPA, 1974).

4.3.2.13 Extrusion, Stuffing, and Molding

Following the preparation of a stable emulsion or mixture of ingredients for a processed meat product such as wieners or sausage, the mixture is again transported by pump or in a container to a manufacturing operation where the mixtures are formed or molded into the finished product. Sausage casings and stainless steel molds are commonly used as containers in this operation. Either natural casings, which are the intestines from some types of animals, or synthetic casings, which are used only in the formation of the products and then peeled and disposed of before the product goes to the consumer, may be used in producing sausages and wieners and in some kinds of luncheon meats. The stainless steel molds are most commonly used to obtain the square shape characteristic of some luncheon meats (USEPA, 1974).

In the casing, stuffing, or mold-filling operation a product mixture is placed in a piece of equipment from which the product mixture is either forced by air pressure or pumped into the container to form a uniform, completely filled container resembling the shape of the finished product (USEPA, 1974).

Water is used to prepare the natural casings for use in the stuffing operation, and the stainless steel molds are cleaned and sterilized after every use. The primary source of waste load and wastewater is the cleanup of the equipment used in this operation. As in the previous operation, the residual emulsions and mixtures contribute significantly to the waste load because of their propensity to stick to most surfaces with which they come in contact and to fill crevices and voids. All equipment used in this operation is broken down at least once a day for a thorough cleaning. This cleanup is designed to remove all remnants of the mixtures handled by the equipment, and this material is wasted with the wastewater into the sewer, thereby contributing to the waste load (USEPA, 1974).

Some spillage of material occurs in this operation. Spillage occurs during transport of the material from grinding and emulsifying to the extrusion operation, and particularly in the extrusion or stuffing of the container and overflows (USEPA, 1974).

4.3.2.14 Linking

This manufacturing operation is simply the formation of links or specific-sized lengths of product in a casing. Linking is done by twisting or pinching the casing at the desired length for the specific finished product, mechanically or manually. A small stream of water is used to lubricate the casing to avoid breakage or splitting. When the full length of each casing has been linked, the product is hung on a rail hanger, called a "tree," in preparation for the next manufacturing operation (usually cooking and smoking) (USEPA, 1974).

Unless a casing splits or breaks, no significant amount of raw waste load should be contributed by this operation. The equipment used is thoroughly washed after use. The hangers that hold the products through the cooking and smoking step become coated with greasy substances, which are washed off and into the sewer after each use. In addition, a standard maintenance practice is to coat the hangers with a thin film of edible oil to protect them from rusting. This oil is ultimately washed off in the overshowering or in the washing of the hangers following each use. Some large operations use automated spray cabinets for "tree" washing (USEPA, 1974).

4.3.2.15 Casing Peeling

Synthetic casings made from a plastic material are used in the production of a large number of wieners in the meat processing industry. These casings are not edible and therefore must be removed from the wieners after cooking and cooling but prior to packaging for sale to the consumer. The peeling equipment includes a sharp knife that slits the casing material, a small spray of steam to part the casing from the finished wiener, and a mechanism to peel the casing away from the wiener. Casing material is solid waste that results from this operation; it is collected and disposed of as part of the plant refuse. The slitting mechanism occasionally penetrates the wiener in addition to the casing and cuts the wiener, rendering it useless as a finished product. However, these pieces of wiener are not wasted but are used in other products prepared in the plant. The steam used in the casing peeling results in a small water stream from this operation, but it is so small that it is of no real consequence (USEPA, 1974).

The equipment is cleaned at the end of every processing day and may contribute a small quantity of waste load as a result of wiener particles that may be attached to various parts of the mechanism and are subsequently washed into the sewer during cleanup. The volume of waste-water and the waste load are relatively insignificant in comparison with other waste sources (USEPA, 1974).

4.3.2.16 Product Holding/Aging

Some processed meat products require holding or aging as part of the production process. Hams, dry sausage, and some bacon, for example, require intermediate or finished holding periods before the product is shipped out of the meat processing plant. The holding operation requires space and some means of storing the particular meat product in the holding area. These holding areas are refrigerated, and some drippings accumulate on the floor. The floor area, like other processing floors, is cleaned once every processing day. The quantity of wastewater and the waste load from the cleanup of these holding areas is minimal compared to that of many other sources within meat processing plants (USEPA, 1974).

4.3.2.17 Bacon Pressing and Slicing

After the bacon has been smoked, cooled, and held for the required time, two processing steps are required before the product is ready for packaging (Figure 4-6). Bacon slabs are irregular in shape after smoking and cooling, and bacon slicing equipment is designed to handle a slab with a fairly rectangular shape. This design facilitates the production of the typical uniform bacon slice expected by the consumer. The bacon slabs are placed in a molding press, which forms the slabs into the desired rectangular shape (USEPA, 1974).

Two different slicing procedures are used in the processing industry after the slabs have been made rectangular. Some plants slice the bacon slabs immediately after pressing. Others prefer to return the molded bacon slabs to a refrigerated holding area to allow the temperature of the slab to cool down. Each approach is successful, and the method actually used appears to depend only on individual preference for a given operation (USEPA, 1974).

Bacon slicing is usually a high-speed operation in which slabs are rapidly cut, the strips of bacon are placed on a cardboard or similar receptacle until a specified weight is reached, and then the bacon is fed onto a conveying system that delivers the bacon to packaging (USEPA, 1974).

There is little waste generated in bacon pressing and slicing except for random pieces of bacon that fall on the floor. These pieces are of sufficient size to be readily picked up by dry cleaning the floors before washdown. The equipment is cleaned at the end of every processing day. There are some particles, as well as a fairly complete covering of grease, on all parts of the equipment that come in contact with the bacon slabs. All of this material is washed off in the cleanup operation. The quantity of wastewater generated in cleanup and the waste load from this cleanup is again relatively small in comparison to other sources (USEPA, 1974).

4.3.2.18 Receiving, Storage, and Shipping

The meat-type raw materials and virtually all the finished product in a meat processing plant require refrigerated storage. Some of the raw materials and finished products are frozen and require freezer storage. The meat-type raw materials are brought into meat processing plants as carcasses, quarters, primal cuts, and specific cuts or parts packaged in boxes. The seasonings, spices, and chemicals are usually purchased in the dry form and are stored in dry areas convenient to the sauce and spice formulation area (USEPA, 1974).

The meat processing plants of companies with nationwide sales and plants located throughout the country also use the storage facilities of meat processing plants as distribution centers for products not manufactured at each plant (USEPA, 1974).

The cleaning of freezers is always a dry process and only on rare occasions does it generate a wastewater load. Refrigerated storage space does require daily washdown, particularly of the floors, where juices and particles have accumulated from the materials stored in the refrigerated area. The general policy of the industry is to encourage dry cleaning of all floors, including storage areas, before the final washdown of the floors. Frequently, actual practices do not include dry cleaning of the floors before washdown (USEPA, 1974).

Shipping and receiving always involve truck transportation. The primary source of waste material in this operation is the transport of carcasses, quarters, and large cuts of meat from the trucks to the storage area within the meat processing plant (USEPA, 1974).

Meat and fat particles falling from the raw material are the primary source of waste material in this operation. The receipt and transport of other raw materials and finished products essentially generate no waste load (USEPA, 1974).

4.4 POULTRY PROCESSING INDUSTRY DESCRIPTION

Poultry Processing (NAICS 311615) includes the slaughter of poultry and small game animals (e.g., quails, pheasants, and rabbits) and exotic poultry (e.g., ostriches) and the processing and preparing of these products and their by-products. Slaughtering is the first step in processing poultry into consumer products. Poultry slaughtering (first processing) operations typically encompass the following steps:

- Receiving and holding of live animals
- Stunning prior to slaughter
- Slaughter
- Initial processing

Poultry first processing facilities are designed to accommodate this multistep process. In most facilities, the major steps are carried out in separate rooms.

In addition, many first processing facilities further process carcasses, producing products that may be breaded, marinated, or partially or fully cooked. Also, many first processing facilities include rendering operations that produce edible products such as fat and inedible products, primarily ingredients for animal feeds, including pet foods.

The 1997 U.S. Census of Manufacturers reported 260 companies engaged in poultry slaughtering. These companies own or operate 470 facilities, employ 224,000 employees, and produce about $32 billion in value of shipments. The poultry slaughtering sector has relatively few facilities with fewer than 20 employees; as in the meat sectors, however, a few very large facilities dominate the sector. Almost 50 percent of the sector employment and over 40 percent of the value of shipments were accounted for by 75 facilities, which employ more than 1,000 workers each. Eighty percent of employment and 74 percent of total shipments are produced by facilities that employ more than 500 workers. Yet these facilities compose only 36 percent of the poultry processing industry.

Products of the poultry processing sector can be divided into two major categories: broilers and turkeys. Broilers account for more than half of the industry's shipments; processed poultry accounts for about 30 percent of the shipments; and turkeys account for about 12 percent.

Poultry processing is largely concentrated in the southeastern states. Arkansas and Georgia have the largest number of facilities, employment, and value of shipments. Alabama and North Carolina rank third and fourth in all of these measures. California is the only state in the top 10 poultry-producing states that is not in the Southeast. California ranks 10^{th} in terms of employment and value of shipments and 8^{th} in number of facilities.

EPA is using revised production rate thresholds to exclude most smaller poultry product processing facilities from the proposed revisions to 40 CFR Part 432 because the technologies on which the options were based are not cost-effective for facilities with the lowest production threshold. Based on the current screener survey data, EPA defines small poultry first and further processing facilities as those that produce fewer than 10 million pounds (LWK) and 7 million pounds (LWK) per year, respectively. See to Figures 4-8 and 4-9 for the distribution of small and non-small (facilities producing more than 50 million pounds (LWK) per year) poultry first and further processing facilities, also categorized by discharge type, throughout the United States.

4.5 DESCRIPTION OF POULTRY FIRST AND FURTHER PROCESSING OPERATIONS

Poultry processing plants are highly automated facilities designed for the slaughter of live birds with whole carcasses as the end product. The operations of these plants differ significantly from their meat counterparts in several respects. For example, poultry slaughtering (first processing) operations typically involve more steps than do meat first processing operations. A poultry processing plant can encompass up to 10 steps, including unloading, stunning, killing, bleeding, scalding, defeathering, eviscerating, chilling, freezing, and packaging (Sams, 2001). Each of these operations occurs in a separate section of the processing plant and involves the use of different types of equipment. Because broiler chickens constitute most of the poultry industry's annual production, and the same sequence of operations is used in the processing of

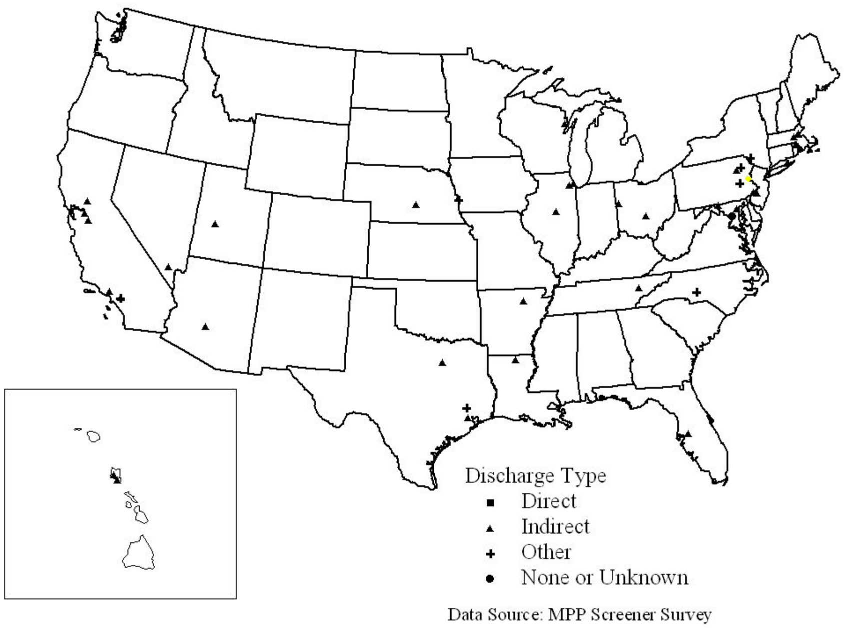

Figure 4-8. Location of Small Poultry Facilities in the United States (Based on Screener Survey Data).

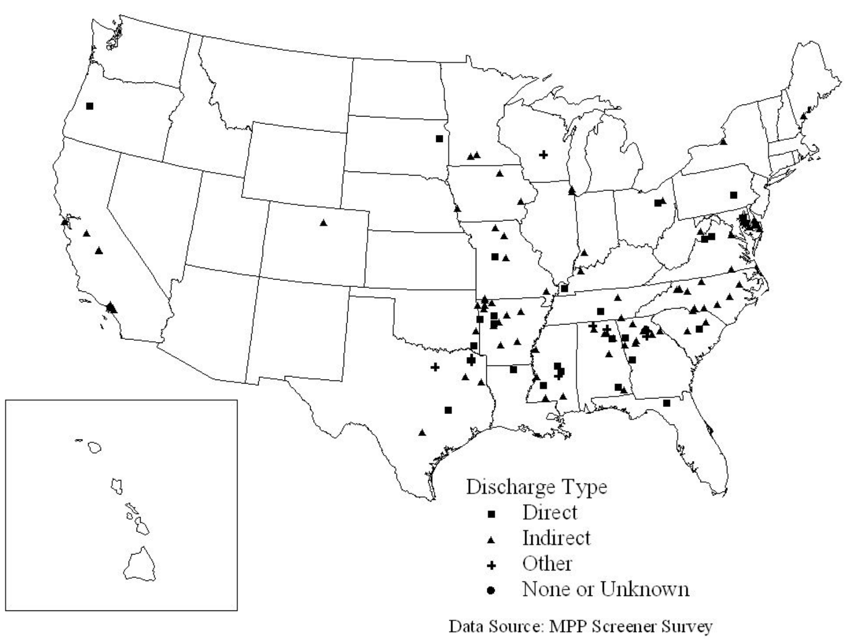

Figure 4-9. Location of Non-Small Poultry Facilities in the United States (Based on Screener Survey Data).

turkeys and other birds, the following sections describe only broiler processing operations unless otherwise noted.

Poultry processing begins with the assembly and slaughter of live birds and may end with the shipment of dressed carcasses or continue with a variety of additional activities. Poultry processing operations are also classified as first or further processing operations or as an integrated combination. First processing operations include those operations which receive live poultry and produce a dressed carcass, either whole or in parts. In this classifications system, first processing operations simply produce dressed whole or split carcasses or smaller segments for sale to wholesale distributors or directly to retailers. First processing operations offer supply products for further processing activities such as breading, marinating, and partial or complete cooking, which may occur on- or off-site.

Following the same logic applied to the meat processing industry, EPA considers the reduction of whole poultry carcasses into halves, quarters, or smaller pieces, which may be with or without bone and may be ground as part of first processing when performed at first processing facilities. Consequently, EPA also considers cutting, boning, and grinding operations to be further processing operations when performed at facilities not also engaged in first processing activities.

4.5.1 Poultry First Processing Operations

Common to all poultry first processing operations is a series of operations necessary to transform live birds into dressed carcasses. Figure 4-10 illustrates this series of operations, and the following sections describe these operations.

4.5.1.1 Receiving Areas

Birds are transported to processing plants with delivery scheduled so that all birds are processed on the day they are received. Live bird holding areas are usually covered and have cooling fans to reduce bird weight loss and mortality during hot weather conditions (Sams, 2001).

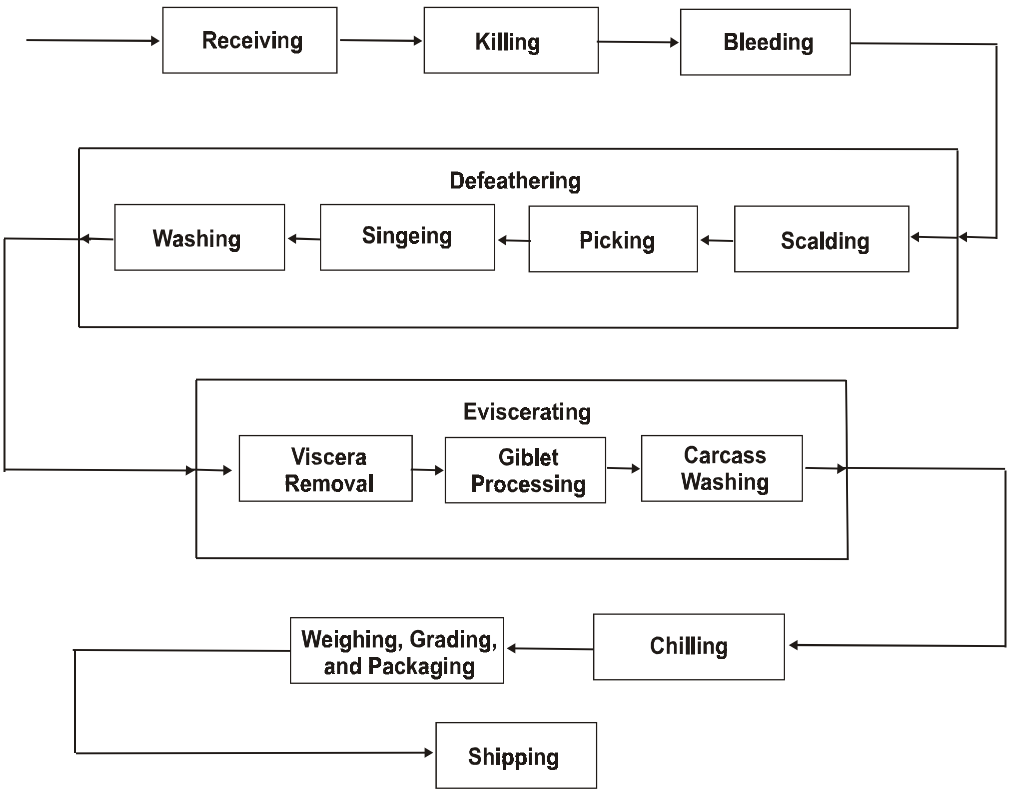

Figure 4-10. General Process for Poultry First Processing Operations (USEPA, 1975).

Broiler chickens are typically transported to processing plants in cage modules stacked on flatbed trailers. These cage modules can hold about 20 average-size broiler chickens. The cage modules are removed from the transport trailer and tilted using a folklift truck to empty the cage. Alternatively, tilting platforms can be used to empty the cage modules after they have been removed from the transport trailer. When the cage module tilts, the lower side of the cage opens and the birds slide onto a conveyor belt, which moves them into the hanging area inside the plant. In the hanging area, the live birds are hung by their feet on shackles attached to an overhead conveyer system, commonly referred to as the killing line, that moves the birds into the killing area. The killing-line moves at a constant speed, and up to 8,000 birds per hour (133 birds per minute) can be shackled in a modern plant, although in practice this number is much lower because workers cannot unload broilers fast enough to fill every shackle (Wilson, 1998). Cage modules also are used to transport ducks, geese, and fowl.

Turkeys are generally transported in cages permanently attached to flatbed trailers. The cages are emptied manually into a live bird receiving area located outside the confines of the processing plant. Turkeys are unloaded manually to minimize bruising. They are more susceptible than broilers to bruising from automatic unloading because of their heavier weight and irregular body shape. Turkeys are then immediately hung on shackles attached to an overhead conveyer system that passes from the unloading area into the processing plant (Sams, 2001).

Following the unloading process, cages and transport trucks may be washed and sanitized to prevent disease transmission among grower operations. The washing and sanitizing of cages and trucks is common in the turkey industry but not in the broiler chicken industry (USEPA, 1975).

4.5.1.2 Killing and Bleeding

Almost all birds are rendered unconscious through stunning just prior to killing. Some exemptions are made for religious meat processing (e.g., kosher, halal). Stunning immobilizes the birds to increase killing efficiency, cause greater blood loss, and increase defeathering efficiency. Stunning is performed by applying a current of 10 to 20 milliamps (mA) per broiler and 20 to 40 mA per turkey for approximately 10 to 12 seconds (Sams, 2001). Poultry are killed by severing the jugular vein and carotid artery or less typically by debraining. Usually a rotating circular blade is used to kill broilers, while manual killing is often required for turkeys because of their varying size and body shape. Decapitation is not performed, because it decreases blood loss following death (Stadelman, 1988).

Immediately after being killed, broilers are bled as they pass through a “blood tunnel” designed to collect blood to reduce wastewater biochemical oxygen demand and total nitrogen concentrations. The blood tunnel is a walled area designed to confine and capture blood splattered by muscle contractions following the severing of the jugular vein and corotid artery. The blood collected is processed with recovered feathers in the production of feather meal, a by-product feedstuff used in livestock and poultry feeds as a source of protein. On average, broilers are held in the tunnel from 45 to 125 seconds for bleeding, with an average time of 80 seconds;

turkeys are held in the tunnel from 90 to 210 seconds, with an average time of 131 seconds. Blood loss approaches 70 percent in some plants, but generally speaking only 30 to 50 percent of a broiler's blood is lost in the killing area. Depending on plant operating conditions, blood is collected in troughs and transported to a rendering facility by vacuum, gravity, or pump systems, or it is allowed to congeal on the plant floor and collected manually. Virtually all plants collect blood for rendering either on- or off-site and thereby limit the amount of blood present in their wastewater (USEPA, 1975).

4.5.1.3 Scalding and Defeathering

After killing and bleeding, birds are scalded by immersion in a scalding tank or by spraying with scalding water. Scalding is performed to relax feather follicles prior to defeathering. Virtually all plants use scald tanks because of the high water usage and inconsistent feather removal associated with spray scalding. Scalding tanks are relatively long troughs of hot water into which the bled birds are immersed to loosen their feathers. Depending on the intended market of the broilers, either soft (semi-scald) or hard scalding is used. Soft scalding is used for the fresh, chilled market, whereas hard scalding is preferred for the frozen sector (Mead, 1989). The difference between these two types of scalding techniques lies in the scalding temperature used. Soft scalding is performed at about 53 ˚C (127 ˚F) for 120 seconds; it loosens feathers without subsequent skin damage. Hard scalding is performed at 62 to 64 ˚C (144 to 147 ˚F) for 45 seconds; it loosens both feathers and the first layer of skin. Sometimes chemicals are added to scald tanks to aid in defeathering by reducing surface tension and increasing feather wetting. The USDA requires that all scald tanks have a minimum overflow of 1 liter (0.26 gallon) per bird (FSIS, 2001) to reduce the potential for microbial contamination (Sams, 2001).

Because scalding and mechanical defeathering do not completely remove duck and goose feathers, immersion in a mixture of hot wax and rosin follows. After this mixture partially solidifies, it is removed with the remaining feathers (Stadelman et al., 1988).

The next stage is automated defeathering, which is done by machines with multiple rows of flexible, ribbed, rubber fingers on cylinders that rotate rapidly across the birds. The abrasion caused by this contact removes the feathers and occasionally the heads of the birds. At the same time, a continuous spray of warm water is used to lubricate the bird and flush away feathers as they are removed. Feathers are flumed to a screening area using scalding overflow for dewatering prior to processing for feather meal production. Different defeathering machines may be used for different types of birds (USEPA, 1975).

Following defeathering, pinfeathers may be removed manually because they are still encased within the feather shaft and thus are resistant to mechanical abrasion. After pinfeather removal, birds pass through a gas flame that singes the remaining feathers and fine hairs. Next, feet and heads are removed. Feet are removed by passing them through a cutting blade, and heads are removed by clamps that pull upward on the necks. Removing the head from a bird is advantageous because the esophagus and trachea are removed with it. Removing the head also loosens the crop and lungs for easier automatic removal during evisceration (Mead, 1989). At this point, blood, feathers, feet, and the heads of broilers are collected and sent to a rendering facility, where they are transformed into by-product meal (Sams, 2001). Chicken feet also may be collected for sale primarily in export markets.

After removal of the feet, the carcasses are rehung on shackles attached to an overhead conveyer, known as an evisceration line, and washed in enclosures using high-pressure cold water sprays prior to evisceration. The purpose of this washing step is to sanitize the outside of the bird before evisceration to reduce microbial contamination of the body cavity. This transfer point is often referred to as the point separating the “dirty” and “clean” sections of the processing plant (Wilson, 1998). The killing-line conveyor then circles back, and the shackles are cleaned before returning to the unloading bay (USEPA, 1975).

4.5.1.4 Evisceration

Evisceration is a multistep process that begins with removing the neck and opening the body cavity. Then, the viscera are extracted but remain attached to the birds until they are inspected for evidence of disease. Next, the viscera are separated from the bird, and edible components (hearts, livers, and gizzards) are harvested. The inedible viscera, known as offal, are collected and combined with heads and feet for subsequent rendering. Entrails are sometimes left attached for religious meat processing (e.g., Buddhist, Confucius). Depending on the plant design, a wet or dry collection system is used. Wet systems use water to transport the offal by fluming it to a screening area for dewatering before rendering. Dry systems, which are not common, may use a series of conveyor belts or vacuum or compressed air stations for offal transport (USEPA, 1975).

Automation of the evisceration process varies depending on plant size and operation. A fully automated line can eviscerate approximately 6,000 broilers per hour (Mead, 1989). The type of equipment available for plant use varies by location and manufacturer. Many parts of the process can be performed manually, especially for turkeys. Though a fully automated evisceration line may be used for broilers, the variation in size among turkeys makes automation more difficult. Female turkeys (hens) are significantly smaller than male turkeys (toms) (USEPA, 1975).

When broilers first enter the evisceration area, they are rehung on shackles by their hocks to a conveyor line that runs directly above a wet or dry offal collection system (Wilson, 1998). The birds' necks are disconnected by breaking the spine with a blade that applies force just above the shoulders. As the blade retracts the neck falls downward and hangs by the remaining skin while another blade removes the preen gland from the tail. The preen gland produces oil that is used by birds for grooming and has an unpleasant taste to humans (Sams, 2001). Next, a venting machine cuts a hole with a circular blade around the anus for extraction of the viscera. Great care must be taken not to penetrate the intestinal lining of a broiler because the resulting fecal contamination will result in condemnation during inspection (USEPA, 1975).

Following venting, the opening of the abdominal wall is enlarged to aid in viscera removal. At this point all viscera are drawn out of the broiler by hand, with the aid of scooping spoons, or more commonly by an evisceration machine. The evisceration machine immobilizes the broiler and passes a clamp through the abdominal opening to grip the visceral package. Once removed, this package is allowed to hang freely to aid in the inspection process. Every bird must be inspected by a USDA inspector or a USDA-supervised plant worker for evidence of disease or contamination before being packaged and sold. The inspector checks the carcass, viscera, and body cavity to determine wholesomeness with three possible outcomes: pass, conditional, and fail. If the bird is deemed conditional, it is hung on a different line for further inspection or to be trimmed of unwholesome portions. Failed birds are removed from the line and disposed of, usually by rendering (Stadelman, 1988).

The viscera are removed from the birds that have passed inspection and are pumped to a harvesting area where edible viscera are separated from inedible viscera. A giblet harvester is used to collect the edible viscera, including heart, liver, neck, and gizzard, and to prepare each appropriately. The heart and liver are stripped of connective tissue and washed. The gizzard is split, its contents are washed away, its hard lining is peeled off, and it is given a final wash. The minimum giblet washer flow rate required by USDA is 1 gallon of water for every 20 birds processed (25 CFR 61.144). Meanwhile, the inedible viscera, including intestines, proventriculus, lower esophagus, spleen, and reproductive organs, are extracted and sent to a rendering facility. Finally, the crop and lungs are mechanically removed from each bird. The crop is pushed up through the neck by a probe, and the lungs are removed by vacuum. A final inspection is required to ensure the carcass is not heavily bruised or contaminated, and then the carcass is cleaned (USEPA, 1975). Bruised birds are diverted to salvage lines for recovery of parts.

The second carcass washing of the broilers is very thorough. Nozzles are used to spray water both inside and outside the carcass. These high-pressure nozzles are designed to eliminate the majority of remaining contaminants on both carcass and conveyor line, and the water is often mixed with chlorine or other antimicrobiological chemicals. From here, the conveyor system travels to the chilling area (USEPA, 1975).

Kosher and halal poultry producers pack the birds (inside and out) in salt for 1 hour to absorb any residual blood or juices. The birds are then rinsed and shipped to kosher/halal meat distributers. On an average day a typical kosher poultry facility (generating approximately 2 million gallons wastewater per day) would use approximately 80,000 pounds of salt in its operations (Thorne, 2001). Industry has stated that most kosher operations (meat and poultry) are located in urban areas with sewer connections.

4.5.1.5 Chilling

After birds have been eviscerated and washed, they are chilled rapidly to slow the growth of any microorganisms present to extend shelf life and to protect quality (Sams, 2001). USDA regulations require that broilers be chilled to 4 ˚C (40 ˚F) within 4 hours of death and turkeys within 8 hours of death (9 CFR 381.66). Most poultry processing plants use large chilling tanks containing ice water; very few use air chilling. Several types of chilling tanks are used, including (1) a large enclosed drum that rotates about a central axis, (2) a perforated cylinder mounted within a chilling vat, and (3) a large open chilling tank containing a mechanical rocker to provide agitation. In all cases, birds are cascaded forward with the flow of water at a minimum overflow rate per bird specified by the USDA (FSIS, 2001).

Most poultry plants use two chilling tanks in series, a pre-chiller and a main chiller. The direction of water flow is from the main chiller to the pre-chiller, which is opposite to the direction of carcass movement. Because water and ice are added to only the main chiller, the water in the pre-chiller is somewhat warmer than that in the main chiller. Most plants chlorinate chiller makeup water to reduce potential carcass microbial contamination. The USDA requires 0.5 gallon (2 liters) of overflow per bird in the chillers (FSIS, 2001); the flow typically is about 0.75 gallon (3 liters) per bird (Sams, 2001). The effluent from the first chiller usually is used for fluming offal to the offal screening area (USEPA, 1975).

USDA requires pre-chiller water temperature to be less than 18.3 ˚C (65 ˚F) (9 CFR 381.66), and temperature values typically range between 7 and 12 ˚C (45 and 54 ˚F) (Stadelman, 1988). Agitation makes the water a very effective washer, and the pre-chiller often cleans off any remaining contaminants. Most broiler carcasses enter the pre-chiller at about 38 ˚C (100 ˚F) and leave at a temperature between 30 and 35 ˚C (86 and 95 ˚F). The cycle lasts 10 to 15 minutes, and water rapidly penetrates the carcass skin during this time period (Sams, 2001). Water weight gained in the pre-chiller is strictly regulated and monitored according to poultry classification and final destination of the product by the USDA. Cut-up and ice-packed products are allowed to retain more water than their whole carcass pack or whole frozen counterparts (FSIS, 2001).

The main chill tank's water temperature is approximately 4 ˚C (39 ˚F) at the entrance and 1 ˚C (34 ˚F) at the exit because of the countercurrent flow system. Broiler carcasses stay in this chiller between 45 and 60 minutes and leave the chill tank at about 2 to 4 ˚C (36 to 39 ˚F). Air bubbles are added to the main chill tanks to enhance heat exchange. The bubbles agitate the water and prevent a thermal layer from forming around the carcass. If not agitated, water around the carcass would reach thermal equilibrium with the carcass and retard heat transfer (Sams, 2001).

If air chilling is used, it normally involves passing the conveyor of carcasses through rooms of air circulating at between -7 and 2 ˚C for 1 to 3 hours. In some cases water is sprayed on the carcasses, increasing heat transfer by evaporative cooling (Sams, 2001). Giblets, consisting of hearts, livers, gizzards, and necks, are chilled similarly to carcasses, though the chilling systems are separate and smaller (USEPA, 1975).

4.5.1.6 Packaging and Freezing

After the birds are chilled, they are either packed as whole birds or processed further. Whole birds are sold in both fresh and frozen forms. Chickens are primarily sold as fresh birds and turkeys are primarily sold as frozen birds. Fresh birds not sold in case-ready packaging are packed in ice for shipment to maintain a temperature of 0 ˚C (32 ˚F). Poultry sold frozen is cooled to approximately -18 ˚C (0 ˚F) (Wilson, 1998).

4.5.2 Poultry Further Processing Operations

Further processing can be as simple as splitting a carcass into two halves or as complex as producing a breaded or marinated, partially or fully cooked product. Therefore, further processing may involve receiving, storage, thawing, cutting, deboning, dicing, grinding, chopping, canning, and final product preparation. Final product preparation includes freezing, packaging, and shipping. Further processing may be performed after first processing in an integrated operation, or it may be performed at a separate facility. Further processing is a highly automated process designed to transform eviscerated broiler carcasses into a wide variety of consumer products. Depending on the type of product being produced, plant production lines may overlap, especially for producing cooked, finished products (USEPA, 1975). The following sections describe poultry first processing operations. Figure 4-11 illustrates these series of operations.

4.5.2.1 Receiving and Storage

If further processing takes place at a location separate from first processing, carcasses, cut-up parts, and deboned meat are usually transported by truck. The vast majority of first processing products received for further processing are whole carcasses. Further processing operations separate from first processing or killing operations may receive poultry that already has been further processed to some degree, typically cut-up or deboned. Further processing plants that are separate from killing operations usually process poultry received packed in ice or frozen, whereas further processing operations combined with killing operations usually process whole carcasses directly following chilling. Thus, further processing plants separate from killing operations require refrigerated or freezer storage facilities before further processing, whereas further processing operations combined with killing operations do not require these facilities except for the preservation of final products. Seasonings, spices, and chemicals are usually received in dry form and stored in dry areas conveniently located near sauce, spice, butter, and breading formulation areas (USEPA, 1975).

4.5.2.2 Thawing

Frozen poultry carcasses and components thereof received by further processing plants can be thawed by immersing in water, by spraying with water, or by thawing in air with adequate protection against contamination. In immersion, poultry is submerged in tanks or vats of lukewarm potable water for the time required to thaw the poultry throughout. To prevent spoilage, the USDA does not permit the continuous running tap water temperature to exceed 21 ˚C (70 ˚F) (9 CFR 381.65). Ice or other cooling agents may be used to keep the thawing water within the acceptable temperature range. The vats used for thawing range from pushcarts of 10 to 20 cubic feet in volume to substantially larger permanently installed tanks. Agitation may be induced to enhance thawing by adding water continuously or by pumping filtered air through flexible hoses into the immersion tank (USEPA, 1975). In thawing units that have no

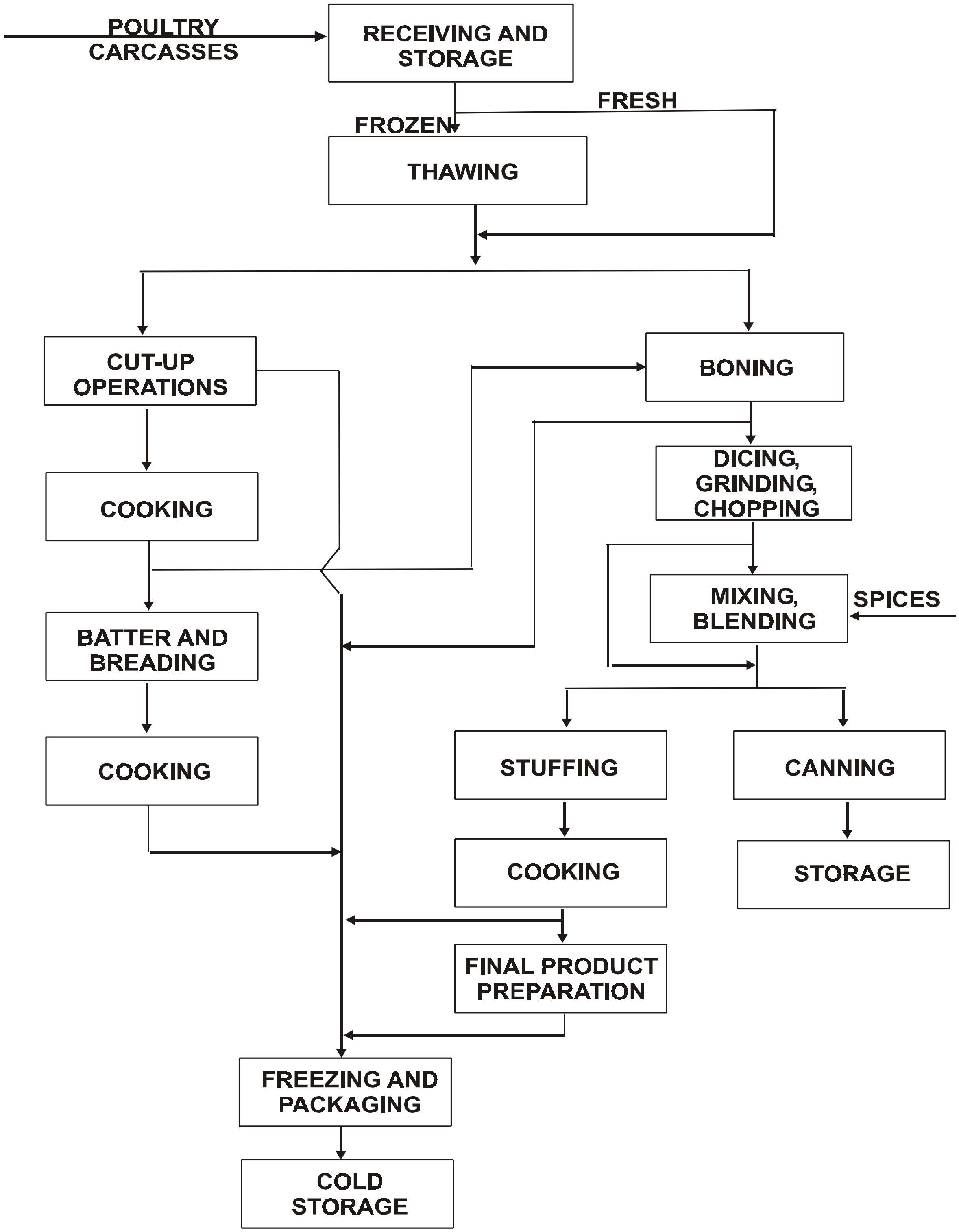

Figure 4-11. General Process Flowsheet for Poultry Further Processing Operations (USEPA, 1975)

freshwater added (no overflow) or where the thawing water leaves the unit for reconditioning prior to returning to the thawing unit, the water is not allowed to exceed 10 ˚C (50 ˚F), as required by the USDA (9 CFR 381.65).

Complete thawing is necessary to permit thorough examination of poultry prior to any further processing. When the poultry has adequately thawed for reinspection, the product is removed from the water and drained. Some plants prefer to place frozen poultry directly into cooking kettles prior to thawing. This practice is permitted only when representative samples of the entire lot have been thawed and found to be in sound and wholesome condition. In this case, cookers filled with water are heated to enable the cooking process to begin immediately following completion of thawing. USDA requires that thawing practices and procedures result in no net gain in weight over the frozen weight (9 CFR 381.65).

If the only further processing operation is repackaging whole carcasses or parts for shipment to market, USDA regulations prohibit recooling the thawed parts in slush ice. Mechanical refrigeration is required; however, the whole carcasses or parts may be held in tanks of crushed ice with open drains, pending further processing or packaging (9 CFR 381.65).

4.5.2.3 Cutting

Cutting of poultry is normally the first further processing step for fresh ice-packed and just-thawed poultry. Cutting involves disjointing and sawing of poultry into various parts. The specifics of these parts became regulated by the government in 1986, when the Food Safety Inspection Service (FSIS) of the USDA published guidelines for cuts of poultry (FSIS, 2001). Using these guidelines as the standard, further processing plants cut poultry into parts manually or automatically. Mechanized equipment that processes entire carcasses into various cut portions is available. The following parts are removed in descending order: neck skin, wings, breasts, backbone, and finally thighs (which can be separated from the drumsticks, if desired). Manual cuts can be made or a machine can be used to make horizontal and vertical cuts, if further portion uniformity is desired. Up to 2,000 birds an hour can be processed this way. The only manual labor required is feeding carcasses into the machine (Mead, 1989).

4.5.2.4 Deboning

After poultry has been cut into parts, the parts may be deboned (separation of meat from bone). Both raw and cooked poultry can be deboned. Frequently turkeys, because of their size, are deboned raw, while chickens and similarly sized poultry can be deboned either raw or cooked (USEPA, 1995). Chicken cooked before deboning will retain its characteristic chicken flavor, while chicken cooked after deboning tastes like meat; therefore, cooked chicken is deboned for products for which chicken flavor is desired, and raw chicken is deboned for products for which a meat flavor is desired. Additional seasonings can be added to the raw chicken after it has been deboned to further enhance its flavor (Mead, 1995). Deboning is usually performed with specially designed machines, but it may be done manually. Bones are collected for rendering (USEPA, 1975).

When deboning is mechanized, the meat either retains its original shape or is ground into a thick paste. If the original shape is desired, the portions are fed into machines where a specially designed mold fits over the poultry cut. As the mold compresses the portions, the meat slides away from the bone. If cooked meat is to be used in other food products, it is placed into a machine that acts much like a hydraulic press, compacting the meat and bone against several different screens. The meat passes through these screens while the bone remains behind, creating a thick paste of condensed poultry meat (Mead, 1989).

4.5.2.5 Grinding, Chopping, and Dicing

Many poultry products such as patties, rolls, and luncheon meats require size reduction of boned meat. Grinding, chopping, and dicing vary the degree of size reduction, with grinding producing the greatest degree of size reduction, chopping the next, and dicing the least. Each of these operations is accomplished by mechanical equipment. In grinding, the meat is forced past a cutting blade and then extruded through orifice plates with holes between 1/8 and 3/8 inch. Chopping likewise is usually accomplished by forcing the meat past a cutter and through an orifice plate; however, the holes are greater than 3/8 inch in diameter (the specific orifice size is chosen based on the desired nature of the final product). Dicing is more like a cutting operation in that it makes distinct cuts in the meat to produce square-shaped chunks (USEPA, 1975).

4.5.2.6 Cooking

Some further processed poultry products are cooked at some point in processing. This step is done in preparation of a final product or in preparing whole birds for subsequent deboning, the latter applying particularly to processing chickens. Partially and fully cooked poultry products are frequently prepared in further processing operations, especially for the hotel, restaurant, institutional and fast-food markets (USEPA, 1975).

Most poultry products are cooked by immersion in water in steam-jacketed open vats. Gas-fired ovens are used for some products, such as breasts that are not breaded. A small number of microwave ovens are used in place of immersion cookers, and deep fat frying is used for breaded products (USEPA, 1975).

Chicken parts, whole birds, and products such as rolls and loaves may be cooked by immersion in hot water cookers. Overflow wires are used in these cookers to collect edible chicken or turkey fat during the actual cooking operation. At the end of the processing day, the contents of cooking vats are dumped into the wastewater collection system (USEPA, 1975).

Gas-fired ovens require essentially no water for operation. A small quantity of steam may be added for humidity control, but it is usually vented through the facility's stack system (USEPA, 1975).

The use of microwave ovens frequently requires a preliminary injection of spices and preservatives using multiple-needle injection equipment similar to the equipment used in ham and bacon processing. The solution remaining at the end of the operating day is discarded into the into the wastewater collection system (USEPA, 1975).

All cooked products are cooled before any further processing. The most common cooling technique for cooked products is immersion into a cold-water tank with continuous overflow (USEPA, 1975).

4.5.2.7 Batter and Breading

Fully cooked poultry parts or fresh fabricated products may be battered and breaded to produce a desired finished product. The batter is a water-based pumpable mixture, usually containing milk and egg solids, flour, spices, and preservatives. A new batch of batter is prepared each operating day. The batter is pumped through the application equipment, and the excess flows back to the small holding tank. Some of the batter clings to the application equipment; this is cleaned off during the day (USEPA, 1975).

The breading is a mixture of solids deposited on the poultry product after the batter is applied. There is no liquid used in breading the products, and the residual solids are not disposed of into the wastewater collection system. The breading is "set," "browned," or cooked by deep fat frying in vegetable oil. Breaded products are conveyed through a deep-fat fryer that is heated directly by gas flame or is heated by the circulation of hot oil from a heater separate from the fryer. The vegetable oil in the fryer is reused repeatedly. When vegetable oil disposal is necessary (after the end of each production shift), it is shipped to a renderer (USEPA, 1975).

4.5.2.8 Mixing and Blending

Some of the further processed products require mixing of several ingredients, including ground or chopped meat, dry solids, spices, and water. The required intermixing speed and intensity of these ingredients varies, depending on the product, from a gentle blending action to an intense high-shear mixing action. Gravies and sauces are prepared in mixers that usually are steam jacketed for heating. The ingredients are pumped or manually transported to the mixing equipment for the preparation of batches of the product mix (USEPA, 1975).

4.5.2.9 Stuffing and Injecting

Following the preparation of a mixture of ingredients for a processed poultry product, the mixture is pumped or transported manually in a container to a manufacturing operation, where the mixtures are formed into the finished products. Either natural or synthetic sausage casings are commonly used as containers in this operation (USEPA, 1975).

To stuff cases, a product mixture is placed in a piece of equipment from which the product mixture is either forced by air pressure or pumped to fill the casing uniformly and completely to form the finished product. Water is used to lubricate casings for use in the stuffing operation (USEPA, 1975).

Whole bird stuffing, which is performed primarily with turkeys, involves pumping a stuffing mixture into the body cavity of a dressed bird at a stuffing station, followed by trussing and freezing of the stuffed bird (USEPA, 1975).

Whole birds are often injected with edible fats and oils, such as butter, margarine, corn oil, and cottonseed oil, to enhance their palatability. Again, this is primarily done with turkey carcasses. This step is normally accomplished by inserting small, perforated needles into the carcass in such a manner as to direct the injected fat or oil between the tissue fibers. The preferred method is to inject longitudinally into the carcass without penetrating the skin of the carcass, so the intact overlying skin will retard escape of the injected materials. The injection material can be used for 1 day after preparation, but it must be discarded at the end of the second processing day. Most plants minimize or avoid any disposal of this high-cost material by preparing only the quantity needed (USEPA, 1975).

4.5.2.10 Canning

The containers used to hold canned poultry products must be prepared before filling and covering. The cans must be cleaned and sterilized before being filled. The sterilized cans are transported from the preparation area to the processing area for filling and closure. Water is frequently present all along the can lines from preparation to filling and covering to remove any spilled product from equipment used, from outer can surfaces, and from condensed steam. The cans go through one last steaming just before entering the can filling area. Can filling can be done by hand or mechanically. However, canning of whole birds or disjointed parts necessitates hand filling (USEPA, 1975).

Can filling by machine is a high-speed operation. It requires moving the poultry food products to the canning equipment, and it provides the automated delivery of those products into a container. The high speed and the design of the equipment result in an appreciable amount of spillage of product as the cans are filled and conveyed to the closure equipment. At the can closure station, a small amount of steam is introduced under the cover just before the cover is sealed to create a vacuum in the can when it cools. Steam use also generates a quantity of condensate that drains off the cans and equipment onto the floor. The operation of the filling and covering equipment results in a substantial quantity of wastewater containing product spills, which is wasted to the wastewater collection system. Filling cans by hand does not appear to generate as much spillage. Canning plants that have more than one filling and covering line have a waste load that is generally proportional to the number of such lines in use (USEPA, 1975).

Canned poultry food products are preserved by heating to destroy any bacteria present. This is accomplished by cooking or by retorting (the pressurized cooking of canned products). Steam is used as the heating medium in retorting, and it is common practice to bleed or vent steam from the retort vessels to maintain a constant cooking pressure. Cooking without pressure is used for cured boneless canned poultry products; the products are considered perishable and must be kept refrigerated. Virtually no wastewater or solid waste is generated by retorting or cooking operations unless a can in a particular batch accidentally opens and spills its contents. This event requires wasting of the contents of that can and cleanup of the cooking vessel. Such accidents rarely happen; thus the retorts or cooking vessels, as a matter of normal practice, are not cleaned (USEPA, 1975).

4.5.2.11 Final Product Preparation

Many of the final products from a poultry plant are ready to serve after heating and are prepared for the hotel, restaurant, and institutional markets. These products are portion-controlled, may have gravy or a sauce added, and are packaged in containers of an appropriate size and design for immediate heating and serving. Poultry meat patties, slices of turkey loaf, and chicken parts are examples of the types of poultry products prepared in this manner. Equipment is used to convey and slice the meat product and deposit it into containers. The same equipment delivers and adds the sauce or gravy to the meat in the container, as required for specific products. As the final operation, this equipment closes the individual containers (USEPA, 1975).

4.5.2.12 Freezing

The first step in the freezing of further processed poultry products is usually accomplished by blast freezing, in which the product is frozen by high-velocity air within the range of -40 to -29 ˚C (-40 to –20 ˚F) or by first passing the product through a carbon dioxide or nitrogen tunnel in which the change in phase of carbon dioxide or nitrogen from liquid to gas causes rapid surface freezing. The products are then placed in holding freezers in which the temperature is maintained at between -29 and -18 ˚C (-20 and 0 ˚F) (USEPA, 1975).

4.5.2.13 Packaging

Packing protects products against damage, contamination, and dessication. Packaging also can extend the shelf-life of fresh poultry and improves product presentation (Mead, 1995). A variety of packaging techniques are used for further processed poultry products. These techniques include the use of plastic film sealed under vacuum (Cry-O-Vac packaging), the bubble enclosure packages used for sliced luncheon meats, and the boxing of smaller containers or pieces of finished product for shipment (USEPA, 1975).

In some techniques of packaging, a substantial amount of product handling is involved, which may result in some wasted finished product. However, pieces of wasted finished product are usually returned for subsequent use in another processed product or directed to a renderer (USEPA, 1975).

4.5.2.14 Shipping

Shipping involves the transportation of finished products and material collected for rendering. Truck transportation is the primary mode of shipping, and products are distributed according to market orders (USEPA, 1975).

Trucks must be pre-chilled prior to loading to maintain the shelf-life of fresh poultry products. Fresh poultry must be maintained at temperatures near freezing with 90 to 100 percent humidity during transport to maintain a shelf-life of 1 to 4 weeks (USDA, 1997). Trucks are loaded through overhead doors leading directly from inside the facility into the truck. Therefore, there typically is no loading dock exposed to the elements, so that pollutants in any runoff from truck loading areas are only those commonly associated with vehicle parking areas. The pollutant load is wastewater concentrated by cleanup of inside loading areas, and it is variable depending on the method of packaging. Ice pack products generate a higher pollutant load from icemelt than do packaged products. However, loading areas are not a significant source of wastewater pollutant loads.

4.6 DESCRIPTION OF RENDERING OPERATIONS

This section provides an overview of the U.S. rendering industry for the preparation of edible and inedible rendered products. This section is divided into three subsections: industry characterization, process description, and emerging technologies.

4.6.1 Industry Characterization

The Rendering and Meat Byproduct Processing (NAICS 311613) sector includes facilities engaged in the rendering of inedible (i.e., not suitable for human consumption) stearin, grease, and tallow from animal fat bones and meat scraps, and the manufacturing of animal oils, including fish oil, and fish and animal meal. The edible (i.e., suitable for human consumption) rendering industry is included in Standard Industrial Classification (SIC) Code 2011. Many facilities not classified as rendering facilities perform rendering operations but are not classified as such because they are also engaged in slaughtering (first processing). These facilities are often on-site (or "integrated") rendering facilities that are part of an animal or poultry slaughtering facility. Integrated rendering plants normally process only one type of raw material, whereas independent rendering plants often handle several types of raw material that require either multiple rendering systems or significant modifications in the operating conditions for a single system.

The rendering sector consists of 137 companies that own or operate 240 facilities. The sector employs 8,800 workers and generates $2.6 billion in shipments. Texas and California have the largest number of rendering facilities. Unlike the meat or poultry industry sectors, the rendering industry sector includes few large facilities; only 11 rendering facilities employed more than 100 workers per facility in 1997. Rendering facilities tend to collect most of their raw material from farms, animal feeding operations, first processors, further processors, and restaurants (e.g., grease from traps and fryers). Rendering collection areas for raw material are limited by cost of transportation and travel time for the raw material to reach the rendering facility. Many rendering facilities have limited overlap of collection areas with other rendering facilities. The 132 rendering facilities that employ between 20 and 99 workers account for the largest share of the industry shipments (66 percent).

As with the meat and mixed meat animal first and further processing sectors, EPA is using revised production rate thresholds to exclude most smaller rendering facilities from the January 31, 2002, proposed revisions to 40 CFR Part 432. Based on the current screener survey data, EPA is defining small rendering facilities as those which produce less than 10 million pounds of rendered product per year. See to Figures 4-12 and 4-13 for the distribution of small and non-small rendering facilities further categorized by discharge type throughout the United States.

4.6.2 Rendering (Meat and Poultry By-product Processing) Description

Rendering processes are processes used to convert the by-products of meat and poultry processing into marketable products, including edible and inedible fats and proteins for agricultural and industrial use. Materials rendered include viscera, meat scraps including fat, bone, blood, feathers, hatchery by-products (infertile eggs, dead embryos, etc.), and dead animals. Lard and foodgrade tallow are examples of edible rendering products. Inedible rendering products include industrial and animal feedgrade fats, meat and poultry by-product meals, feather meal, dried blood, and hydrolyzed hair.

Rendering plants that operate in conjunction with animal slaughterhouses or poultry processing plants are called integrated rendering plants. Plants that collect their raw materials from a variety of off-site sources are called independent rendering plants. Independent plants

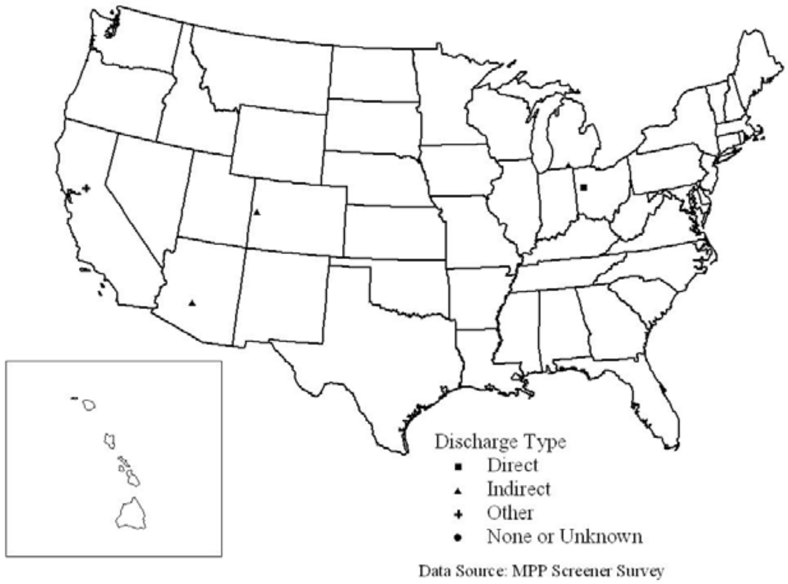

Figure 4-12. Location of Small Rendering Facilities in the United States (Based on Screener Survey Data)**.**

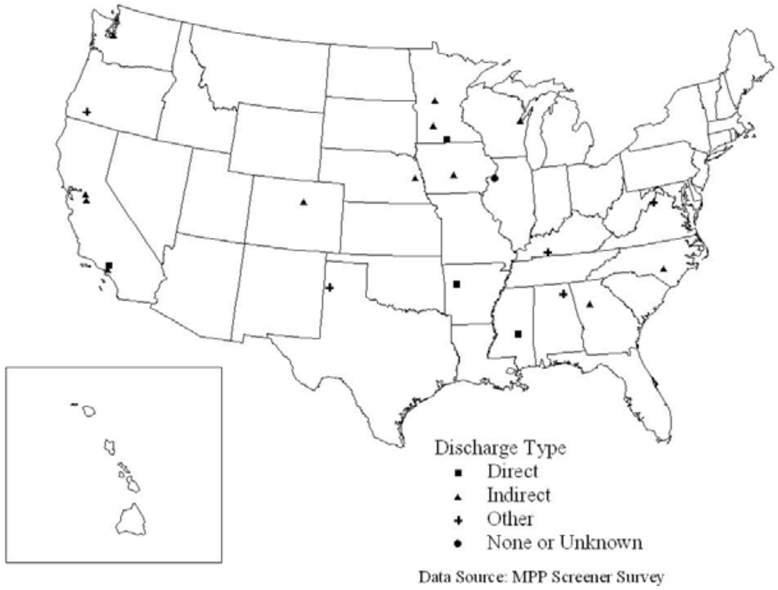

Figure 4-13. Location of Non-Small Rendering Facilities in the United States (Based on Screener Survey Data).

obtain animal by-product materials from a variety of sources, including butcher shops, supermarkets, restaurants, fast-food chains, poultry processors, slaughterhouses, farms, ranches, feedlots, and animal shelters (USEPA, 1995).

Edible rendering plants separate fatty animal tissue into edible fats and proteins. The edible rendering plants are normally operated in conjunction with meat packing plants. The USDA Food Safety and Inspection Service (FSIS) is responsible for regulating and inspecting meat and poultry first and further processing facilities and facilities engaged in edible rendering (i.e., suitable for human consumption) to ensure food safety. The U.S. Food and Drug Administration (FDA) covers inedible rendering operations. Inedible rendering plants are operated by independent renderers or are part of integrated rendering operations. These plants produce inedible tallow and grease, which are used in livestock and poultry feed, pet food, soap, chemical products such as fatty acids, and fuel blending agents.

4.6.2.1 Edible Rendering

A typical edible rendering process is shown in Figure 4-14. Fat trimmings, usually consisting of 14 to 16 percent fat, 60 to 64 percent moisture, and 22 to 24 percent protein, are ground and then belt conveyed to a melt tank. The melt tank heats the materials to about 43 ˚C (110 ˚F), and the melted fatty tissue is pumped to a disintegrator, which ruptures the fat cells.

The proteinaceous solids are separated from the melted fat and water by a centrifuge. The melted fat and water are then heated with steam to about 93 ˚C (200 ˚F) by a shell and tube heat exchanger. A second-stage centrifuge then separates the edible fat from the water, which also contains any remaining protein fines. The water is discharged as sludge, and the "polished" fat is pumped to storage. Throughout the process, direct heat contact with the edible fat is minimal, and no cooking vapors are directly emitted (USEPA, 1995).

Edible lard and tallow are the main foodstuffs produced from continuous edible rendering of animal fatty tissue. Either the low temperature option or the high temperature option edible rendering processes may be used to render edible fat. The low temperature option uses temperatures below 49 ˚C (120 ˚F) and the high temperature option uses temperatures between

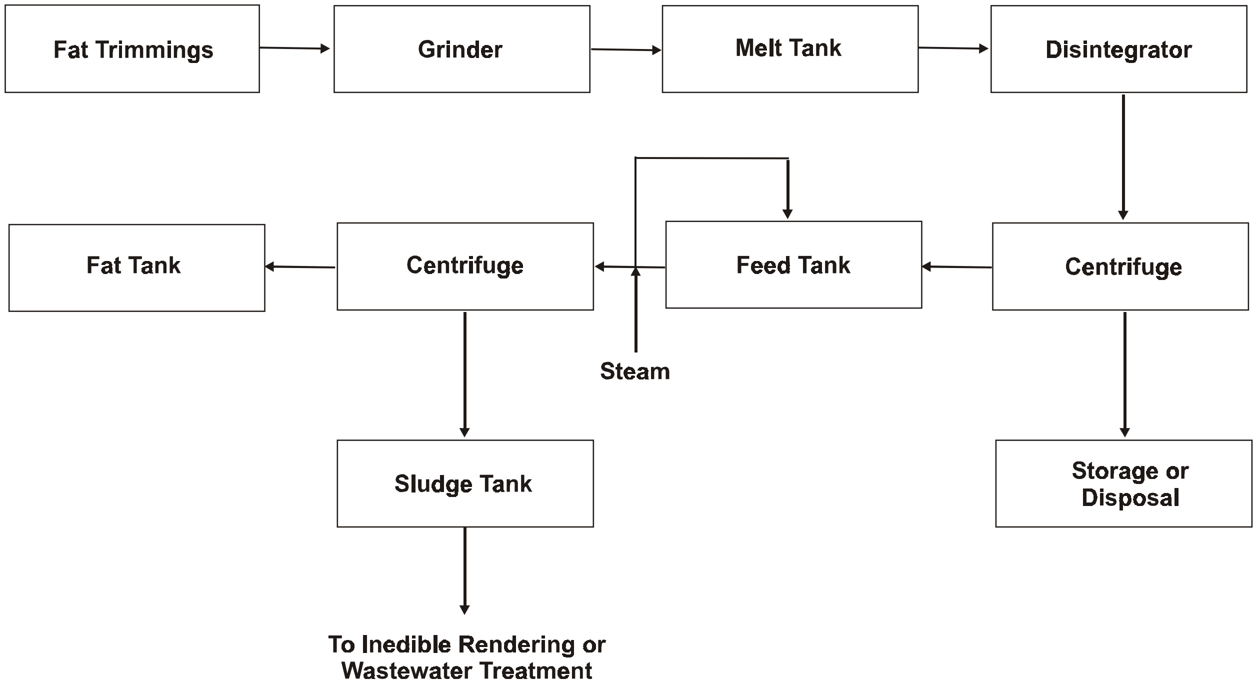

Figure 4-14. General Process for Edible Rendering (USEPA, 1995).

82 and 100 ˚C (180 and 210 ˚F) to melt animal fatty tissue and to separate the fat from the protein. A better separation of fat from protein can be achieved with the high temperature option; however, the protein obtained from the low temperature option is of acceptable quality, wheras the protein obtained from the high temperature option cannot be sold as an edible product (Prokop, 1985).

4.6.2.2 Inedible Rendering

Table 4-1 shows the fat, protein, and moisture contents for several raw materials processed by inedible rendering plants. There are two processes for inedible rendering: the wet process and the dry process. Wet rendering separates fat from raw material by boiling in water. The process involves adding water to the raw material and using live steam to cook the raw material and separate the fat. Dry rendering is a batch or continuous process in which the material being rendered is cooked in its own moisture and grease with dry heat in open steam-jacketed drums until the moisture has evaporated. Following dehydration, as much fat as possible is removed by draining, and the residue is passed through a screw press to remove some

Table 4-1. Composition of Raw Materials for Inedible Rendering

Source	Tallow/grease Wt %	Protein Solids Wt %	Moisture Wt %
Packing house offal[a] and bone			
Steers	30-35	15-20	45-55
Cows	10-20	20-30	50-70
Calves	10-15	15-20	65-75
Sheep	25-30	20-25	45-55
Hogs	25-30	10-15	55-65
Poultry offal	10	25	65
Poultry feathers	None	33	67
Dead stock (whole animals)			
Calves	10	22	68
Sheep	22	25	53
Hogs	30	28	42
Butcher shop fat and bone	31	32	37
Blood	None	16-18	82-84
Restaurant grease	65	10	25

[a] Waste parts; especially the viscera and similar parts from a butchered animal.
Source: USEPA, 1995.

of the remaining fat and moisture. Then the residue is granulated or ground into a meal. At present, only dry rendering is used in the United States. The wet rendering process is no longer used because of the high cost of energy and because of its adverse effect on the fat quality (USEPA, 1995).

Inedible rendering can be divided into two subcategories: feed grade and pet food grade rendering. In addition, the poultry industry uses a third subcategory of inedible rendering called glomerate rendering. Glomerate rendering is the oldest rendering process, dating back to the beginnings of slaughterhouses when all animal by-products were rendered and fed back to animals as a feed. The glomerate process involves combining meat and feathers and cooking them together to produce feed for poultry. Because more plants further process poultry than they did in the past, a greater amount of bones, backs, and necks are included in the rendering process. The ratio of meat to feathers varies throughout the day, generally resulting in increased protein concentrations toward the end of the day. Glomerate rendering is not widely used today because of the highly variable protein concentrations of the final products (Christensen, 1996).

Feed grade rendering has the largest market because livestock and poultry feed manufacturers purchase the products produced in bulk to use as feed ingredients. This process requires that fat and protein and hog hair or poultry feathers be separated, though crude techniques are used. The meat is cooked down into meal and the feathers or hair are hydrolyzed before they are sold to the livestock and poultry feed manufacturers (Christensen, 1996).

Pet food grade rendering is the most profitable type of rendering and has an $8 billion market worldwide each year. Strict separation of materials is required because purchasers are very concerned with texture, color, ash content, and quality of the final product. Blood and feathers or hair cannot be included in pet food (Christensen, 1996).

The following sections describe the two typical inedible rendering processes, batch rendering and continuous rendering. Both can be used to produce either feed grade or pet food grade protein meal and fat. As discussed previously, the grade of the rendered products depends on the types of raw materials included and excluded. Since the 1960s continuous rendering systems have been installed to replace batch systems at most plants. Currently, only a few batch cooker plants remain in operation in North America (Lehmann, 2001).

4.6.2.2.1 Batch Rendering Process

Figure 4-15 shows the basic inedible rendering process using multiple batch cookers. In the batch process, the raw material from the receiving bin is screw conveyed to a crusher, where it is reduced to 2.5 to 5 centimeters (1 to 2 inches) in size to improve cooking efficiency. Cooking normally requires 1.5 to 2.5 hours, but adjustments in the cooking time and temperature may be required to process the various materials. A typical batch cooker is a horizontal, cylindrical vessel equipped with a steam jacket and an agitator. To initiate the cooking process, the cooker is charged with raw material and the material is heated to a final temperature ranging from 121 to 135 ˚C (250 to 275 ˚F). Following the cooking cycle, the contents are discharged to

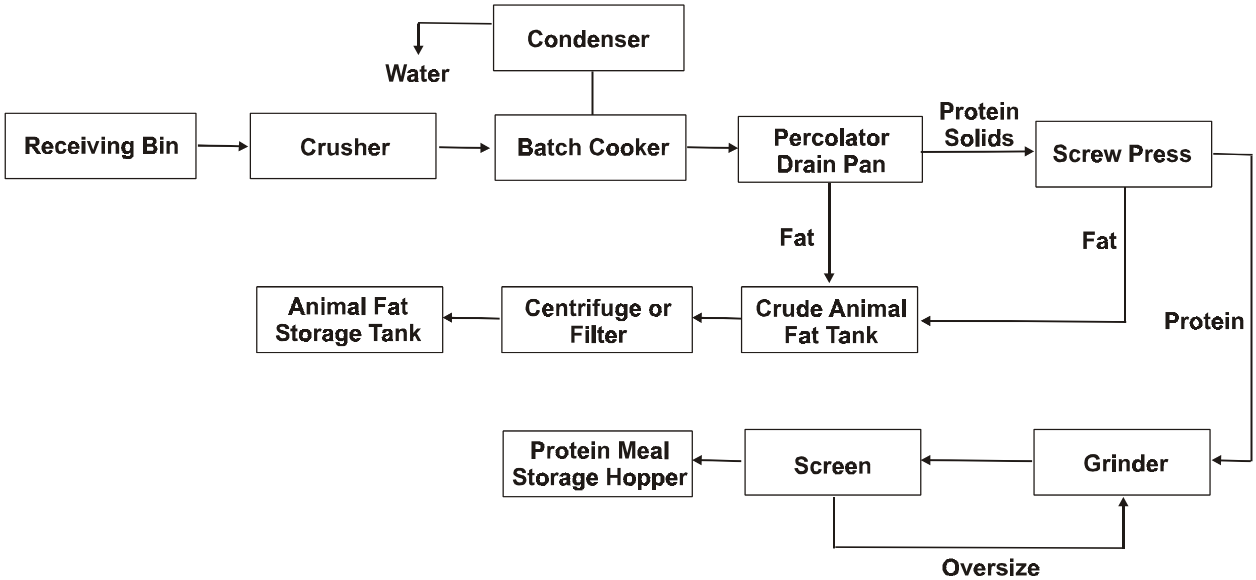

Figure 4-15. General Process for Inedible Batch Cooking Rendering (USEPA, 1995).

the percolator drain pan. Vapor emissions from the cooker pass through a condenser, which condenses the water vapor and emits the noncondensibles as volatile organic compound (VOC) emissions (USEPA, 1995).

The percolator drain pan contains a screen that separates the liquid fat from the protein solids. From the percolator drain pan, the protein solids, which still contain about 25 percent fat, are conveyed to a screw press. The screw press completes the separation of fat from solids and yields protein solids that have a residual fat content of about 10 percent. These solids, called cracklings, are then ground and screened to produce protein meal. The fat from both the screw press and the percolator drain pan is pumped to the crude animal fat tank, centrifuged or filtered to remove any remaining protein solids, and stored in the animal fat storage tank (USEPA, 1995).

4.6.2.2.2 Continuous Rendering Process

A typical continuous rendering process is shown in Figure 4-16. The system is similar to a batch system, except that a single, continuous cooker is used rather than several parallel batch cookers. A typical continuous cooker is a horizontal, steam-jacketed cylindrical vessel equipped with a mechanism that continuously moves the material horizontally through the cooker.

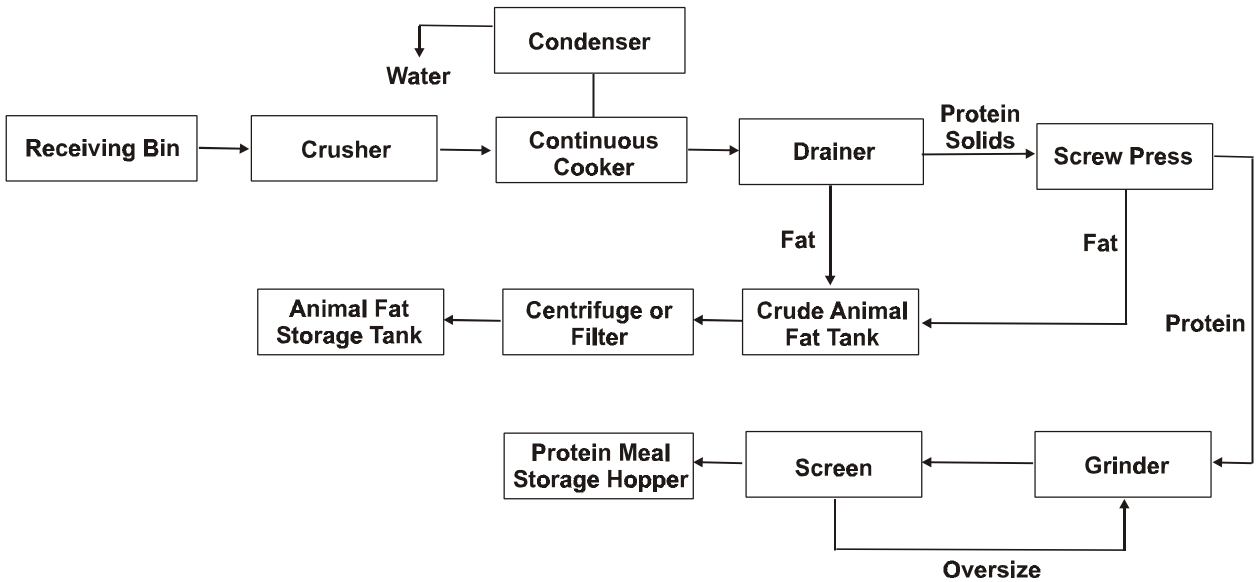

Figure 4-16. General Process for Inedible Continuous Rendering (USEPA, 1995).

Continuous cookers process the material faster than batch cookers and typically produce a higher quality fat product. From the cooker, the material is discharged to the drainer, which serves the same function as the percolator drain pan in the batch process. The remaining operations are generally the same as the batch process operations (USEPA, 1995).

In the 1980s newer continuous rendering systems were developed to precook the raw material and to remove moisture from the liquid fat prior to the cooker/drier stage. These systems use an evaporator operated under vacuum and heated by the vapors from the cooker/drier. One system, termed waste-heat dewatering (WHD), consists of treating the raw material in a preheater followed by a twin-screw press. The solids from the press are directed to the cooker/drier. The liquid fat is sent to an evaporator operated under a vacuum and heated by the hot vapors from the cooker/drier to a temperature of 70 to 90 ˚C (160 to 200 ˚F). In the evaporator, the moisture evaporates from the liquid fat and passes to a water-cooled condenser. The dewatered fat is recombined with the solids from the screw press prior to entry into the cooker/drier. These pretreatment systems may reduce fuel costs by 30 to 40 percent and increase production throughput by up to 75 percent (USEPA, 1995). Several inedible continuous rendering systems exist, including the Duke System, the Anderson C-G (Carver-Greenfield) System, and the Atlas Stord Waste Heat Dewatering System.

Duke Continuous Rendering System (Inedible Rendering)

The process of the Duke system is similar to that of the batch cooker described earlier. The main difference is that it operates on a continuous basis. The cooker portion of the system, called the Equacooker, is a horizontal steam-jacketed cylindrical vessel equipped with a rotating shaft. Paddles, which are attached to the rotating shaft, lift the material and move it horizontally through the cooker. The rotating shaft also has steam-heated coils to provide increased heat transfer. The Equacooker is divided into three separate compartments that are equipped with baffles to restrict and control the flow of materials through the cooker. Adjusting the speed of the variable-speed drive for the twin-screw feeder controls the feed rate to the Equacooker, while the discharge rate is controlled by the control wheel rotation speed. The control wheel has buckets that collect the cooked material from the Equacooker and discharge it into the Drainor. A site glass column, located adjacent to the control wheel, shows the operating level in the cooker; a photoelectric cell unit shuts off the twin-screw feeder when the upper level limit is reached. The Drainor is an enclosed screw conveyor that contains a section of perforated troughs, which allow the free melted fat to drain through as the solids are conveyed to the Pressor or screw press for additional separation of tallow. Similar to any other screw press used with a batch cooker, the Pressor reduces the grease level of the crackling (Prokop, 1985).

The central control panel, which consolidates the process controls for the system, houses a temperature recorder, stream pressure indicators, equipment speed settings, motor load gauges, and stop and start buttons. This design facilitates operation of the controls so that only one person is needed to operate the Equacooker portion of the Duke system (Prokop, 1985).

Anderson C-G (Carver-Greenfield) System (Inedible Rendering)

The Anderson C-G system differs from most other systems in several aspects. Instead of using screw conveyors, recycled fat carries the raw material as a pumpable slurry. An additional grinding step is included to further reduce the size of the particles. Also, the conventional evaporator system with a vacuum is powered by an electrical motor, rather than by steam injectors, to remove moisture from the slurry (Prokop, 1985).

The process begins with a triple-screw feeder that feeds the partially ground raw material continuously, and at a controlled rate, to a fluidizing tank. In the tank, fat that has been recycled through the system at a temperature of 104 ˚C (22 ˚F) suspends the material and carries it to a disintegrator to further reduce the particle size. The final particle size ranges from 0.25 to 1 inch. The slurry is next pumped to an evaporator, which can be either a single or a double-stage unit, and is held under vacuum. Because the vacuum facilitates moisture removal, the C-G system can operate at a lower temperature than other processes. The evaporator consists of a vertical shell and tube heat exchanger connected to a vacuum system. Gravity aids the flow of the slurry through the tubes of the heat exchanger while steam is injected into the shell. Next, the water vapor is separated from the slurry in the vapor chamber, which is under a vacuum pressure of 660 to 710 mm (26 to 28 inches) of mercury. Water vapor then travels through a shell and tube condenser that is connected to a steam-injection vacuum system. Once the vapors are condensed, they exit the condenser through a barometric leg, allowing the vacuum to be maintained. In a two-stage evaporator system, the vapor from the second stage functions as a heating medium for the first stage. Providing steam economy, the two-stage evaporator is especially useful for materials that have a high moisture content. The remaining dry slurry of fat and cracklings is then pumped from the evaporator to a centrifuge that separates the solids from the liquid. A portion of the fat is recycled back to the fluidizing tank, while the remainder is removed from the system. Discharged solids from the centrifuge are screw-conveyed to expellers (screw presses), which reduce the fat content of solids from 26 percent by weight to 6 to 10 percent (Prokop, 1985).

As in the Duke process, the central control panel allows a single person to operate the cooking process. The panel includes level indicators and controls to stabilize the flow through the fluidizing and other process tanks in addition to the vacuum chamber. It also monitors evaporator vacuum and temperature measurements. The panel also has equipment speed settings, motor current readings, and start/stop push buttons (Prokop, 1985).

Atlas Stord Waste Heat Dewatering (WHD) System /(Inedible Rendering)

The Atlas Stord system, formerly called the Stord Bartz WHD System, consists of a preheater, twin-screw press, and evaporator system. It is typically installed with an existing rendering system. As with other processes, the raw material is screw-conveyed from the raw material bin over an electromagnet and is fed to either a prebreaker or hogor for course grinding. The ground material travels through a preheater to melt the fat and condition the animal fibrous tissue properly for the subsequent pressing operation. The preheater is a horizontal, steam-jacketed, cylindrical vessel that has an agitator and rotating shaft to ensure continuous flow and adequate heat transfer. The temperature of the material is controlled within the preheater at 60 to 82 ˚C (140 to 180 ˚F), depending on the type of raw material.

After it is heated, the material is then subjected to the twin-screw press, where it is separated into a solid phase and a liquid phase. The press consists of intermeshing, counter-rotating screws that move inside a press cage assembly. A perforated screen, through which the liquid is pressed, is secured by vertical support plates. The shape of the screen follows the contour of the rotating flights of the twin screws. The material fills the space between the screws and the press cage. The twin screws have a lower diameter shaft and deeper flights at the feed end, providing a larger volume of space. As the screws rotate, the volume of space decreases, creating an increased pressure to the material to squeeze out the liquid through the perforated screen.

After the liquid, consisting of melted fat and water, is squeezed out, a presscake of solids of fat and moisture remains. The solids are screw-conveyed to the existing cooker or dryer, where the moisture is removed. The screw press completes the final separation of fats from the solids. The liquid extracted by the screw press is pumped from the feed tank to the evaporator, which is a tubular heat exchanger that is mounted vertically and is integral with the vapor chamber. Vapors from the existing cooker or drier serve as the heating medium for evaporation. The liquid enters the evaporator at the top and flows by gravity downward through the tubes, then discharges into the vapor chamber maintained under a vacuum of 24 to 26 inches of mercury. A shell and tube condenser with circulating cooling water condenses the vapor. Because the system makes use of vapors from the existing cooker, fuel costs are reduced by 30 to 40 percent (Prokop, 1985).

4.5.3 Blood Processing and Drying

Blood processing and drying is an auxiliary process in meat rendering operations. At the present time, less than 10 percent of the independent rendering plants in the United States process whole animal blood. Whole blood from animal slaughterhouses, containing 16 to 18 percent total protein solids, is processed and dried to recover protein as blood meal. The blood meal is a valuable ingredient in animal feed because it has a high lysine content. Continuous cookers have replaced the batch cookers originally used in the industry because of the improved energy efficiency and product quality provided by continuous cookers. In the continuous process, whole blood is introduced into a steam-injected, inclined tubular vessel in which the blood solids coagulate. The coagulated blood solids and liquid (serum water) are then separated in a centrifuge, and the blood solids are dried in either a continuous gas-fired, direct-contact ring dryer or a steam tube, rotary dryer (USEPA, 1995). Blood from poultry processing usually is processed with feathers to increase the available protein content of feather meal.

4.5.4 Poultry Feathers and Hog Hair Processing.

The raw material is introduced into a batch cooker and is processed for 30 to 45 minutes at temperatures ranging from 138 to 149 ˚C (280 to 300 ˚F) and pressures ranging from 40 to 50 pounds per square inch. This process converts keratin, the principal component of feathers and hog hair, into amino acids. The moist meal product, containing the amino acids, is passed either through a hot air, ring-type dryer or over steam-heated tubes to remove the moisture from the meal. If the hot air dryer is used, the dried product is separated from the exhaust by cyclone collectors. In the steam-heated tube system, fresh air is passed countercurrent to the flow of the meal to remove the moisture. The dried meal is then transferred to storage. The exhaust gases are passed through controls prior to discharge to the atmosphere (USEPA, 1995).

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SECTION 5

SUBCATEGORIZATION

This section presents the proposed subcategorization for the meat and poultry products (MPP) effluent limitations guidelines and pretreatment standards. Section 5.1 presents EPA's subcategorization criteria. Section 5.2 presents each proposed subcategory in detail and discusses the differences between the existing subcategorization and the proposed subcategorization.

5.1 SUBCATEGORIZATION PROCESS

Section 304(b)(2)(B) of the CWA (33 U.S.C. 1314(b)(2)(B)) requires EPA to consider a number of different factors when developing effluent limitations guidelines and pretreatment standards. For example, when developing limitations that represent the best available technology economically achievable (BAT) for a particular industry category, EPA must consider, among other factors:

- Age of the equipment and facilities
- Location
- Manufacturing processes employed
- Types of treatment technology to reduce effluent discharges
- Cost of effluent reductions
- Non-water quality environmental impacts

The statute also authorizes EPA to take into account other factors that the Administrator deems appropriate. In addition, it requires BAT model technology chosen by EPA to be economically achievable, which generally involves considering both compliance costs and the overall financial condition of the industry.

EPA took these factors into account in considering whether different effluent limitations guidelines and pretreatment standards were appropriate for subcategories within the industry. For this industry, EPA broke down the industry into subcategories with similar characteristics. This breakdown recognized the major differences among companies within the industr, which might reflect, for example, different processes, economies of scale, or other factors. Subdividing an industry into subcategories results in more tailored regulatory standards, thereby increasing regulatory predictability and diminishing the need to address variations among facilities through a variance process. See *Weyerhaeuser Co.* v. *Costle*, 590 F. 2d 1011, 1053 (D.C. Cir. 1978).

For this proposed MPP rulemaking, EPA used industry survey data and EPA sampling data for the subcategorization analysis. Various subcategorization criteria were analyzed for trends in discharge flow rates, pollutant concentrations, and treatability to determine where subcategorization was warranted. Equipment and facility age and facility location were not found to affect wastewater generation or wastewater characteristics; therefore, age and location were not used as a basis for subcategorization. An analysis of non-water quality environmental characteristics (e.g., solid waste and air emission effects) also showed that these characteristics did not constitute a basis for subcategorization. See Section 10 of this document for more information on non-water quality environmental impacts.

Even though size (e.g., acreage, number of employees, production rates) of a facility does not influence production-normalized wastewater flow rates or pollutant loadings, size was used as a basis for subcategorization because more stringent limitations would not be cost- effective for smaller meat, poultry, and rendering facilities. In addition, smaller facilities discharge a very small portion of the total industry discharge. Therefore, this proposal does not revise the existing limitations and standard for smaller facilities in Subcategories A through J and proposes less stringent requirements for smaller facilities in Subcategories K and L. See Section 12 of this document for definition of "small" and "non-small" facilities for each subcategory. See the "Economic Analysis of Proposed Effluent Limitations Guidelines and Standards for the Meat and Poultry Products Industry Point Source Category" (EPA 821-B-01-006) for a description of why EPA established standards for small poultry facilities.

EPA also identified both the types of meat products (e.g., meat or poultry) and the manufacturing processes (e.g., slaughtering, further processing, rendering) as a determinative factor for subcategorization because of differences in median production-normalized wastewater flow rates (PNFs) and estimated pollutant loadings. For meat facilities, the PNF for slaughtering is 322 gallons per 1000 pounds (gal/1000 lb) live weight killed, the PNF for further processing is

555 gal/1000 lb finished product, the PNF for meat cutters in subcategory F only is 130 gal/1000 lb finished product, and the PNF for rendering is 346 gal/1000 lb raw material. For poultry facilities, the PNF for slaughtering is 1,289 gal/1000 lb live weight killed, the PNF for further processing is 315 gal/1000 lb finished product, and the PNF for rendering is 346 gal/1000 lb raw material.

Slaughtering operations use substantial amounts of water for initial processing (kill through carcass shipping or cut-up). Slaughtering or first processing operations generally involve taking the live animal and producing whole or cut-up meat carcasses (which then may be further processed). Wastewaters from first processing operations are generated from a variety of sources that generally include the areas where animals are killed and bled; hides, hair, or feathers are removed; animals are eviscerated; carcasses are washed and chilled; and carcasses are trimmed and cut to produce the whole carcasses or carcass parts. As a result of these operations, wastewaters that contain varying levels of blood, animal parts, viscera, fats, bones, and the like are generated. In addition, federal food safety concerns require frequent and extensive cleanup of slaughtering operations, which also contributes to wastewater generation. These cleanup wastewaters contain not only slaughtering residues and particulate matter but also products used for cleaning and disinfection (e.g., detergents and sanitizing agents).

Alternatively, most further processing operations generate wastewaters from sources different from slaughtering operations. These sources, and the resulting wastewater characteristics, are highly dependent on the type of finished product desired. Further operations can include, but are not limited to, cutting and deboning, cooking, seasoning, smoking, canning, grinding, chopping, dicing, forming, and breading. Unlike slaughtering operations, most further processing operations do not use significant amounts of water, except for cleanup. Wastewaters generated from further processing operations contain some soft and hard tissue (e.g., muscle, fat, and bone), blood, and other substances used in final product preparation (e.g., breading, spices), as well as products used for cleaning and disinfection (detergents and sanitizing agents).

Rendering operations primarily process slaughtering by-products (e.g., animal fat, bone, blood, hair, feathers, dead animals). The amount of water used and the characteristics of wastewater generated by rendering operations are highly dependent on a number of factors, including the type of product produced (e.g., edible vs. inedible), the rendering process used (batch vs. continuous, wet process vs. dry process), and the source and type of raw materials used (e.g., poultry processors, slaughterhouses, butcher shops, supermarkets, restaurants, fast-food chains, farms, ranches, feedlots, animal shelters). In general, rendering operations involve cooking the raw materials to recover fats, oil, and grease; remaining residue is dried and then granulated or ground into a meal using a continuous dry rendering process. A significant portion of wastewater pollutant loadings generated from rendering operations is condensed steam from cooking operations. Unlike slaughtering and further processing operations, rendering cleanup operations are generally less rigorous, generating a smaller proportion of the total expected wastewater flow.

5.2 PROPOSED SUBCATEGORIES

EPA proposes to keep the current subcategorization scheme for small facilities, but for larger facilities the Agency is proposing new limitations and collapsing the existing subcategories. Specifically, EPA proposes new limitations and standards that are the same for larger facilities in the following MPP subcategories: Simple Slaughterhouses (Subpart A), Complex Slaughterhouses (Subpart B), Low-Processing Packinghouses (Subpart C), and High-Processing Packinghouses (Subpart D). Also, EPA proposes new limitations and standards that are the same for facilities in the following MPP subcategories: Meat Cutters (Subpart F), Sausage and Luncheon Meats Processors (Subpart G), Ham Processors (Subpart H), and Canned Meats Processors (Subpart I).

EPA is also retaining the Renderer (Subpart J) subcategory and proposing new limitations and standards for facilities in this subcategory. This proposal does not revise the existing limitations and standards for smaller facilities in Subparts A through J (which would include by definition all Subpart E [Small Processor] facilities). Finally, EPA proposes adding two MPP subcategories in 40 CFR Part 432: Poultry First Processing (Subpart K) and Poultry Further Processing (Subpart L). These two new subcategories will cover both small and large poultry processing facilities, although the smaller facilities in each of the subcategories are required to meet less stringent requirements than the larger poultry facilities. EPA chose less stringent limitations for smaller poultry processing facilities because more stringent limits would not be cost-effective for such facilities.

EPA believes that the similarities among Simple Slaughterhouses, Complex Slaughterhouse, Low-Processing Packinghouses, and Complex Packinghouses (Subcategories A through D), including but not limited to the commonality of slaughter of live animals, represents a rational basis for proposing new limitations and standards that are the same for all four subcategories. This approach allows the use of production-normalized wastewater flow and pollutant generation on a common live weight killed (LWK) basis for all four subcategories, with possible additional allowances reflecting the degree of further processing and rendering.

The proposal for new limitations and standards that are the same for meat cutters, sausage and luncheon meat processors, ham processors, and canned meat processors is also based on the similarities among these four subcategories. These similarities include, but are not limited to, the absence of slaughtering and on-site rendering activities and the ability to characterize wastewater flow and pollutant generation on a finished product basis.

The rationale that EPA used for proposing two new subcategories for poultry, first processing and further processing, with separate limitations and standards, is essentially the same as that used for grouping Subcategories A through D and F through I for meat. Included were the presence (Subcategory K) or absence (Subcategory L) of slaughtering. Immediately following, each subcategory is described in more detail in terms of its manufacturing processes and wastewater characteristics.

5.2.1 Meat Slaughterhouses and Packinghouses—Subparts A, B, C and D

EPA is proposing to retain the existing subcategories. EPA is not proposing to revise the existing BPT requirements for facilities that slaughter 50 million pounds per year or less. Because the existing limitations for smaller meat facilities (which EPA believes should be maintained) are different for each of the subcategories, the subcategories themselves are being maintained. EPA believes that retaining the existing subcategorization scheme will simplify implementation for the permit writers, as well as generate appropriate limitations and standards for the facilities.

The proposed regulation would require all meat direct dischargers that slaughter more than 50 million pounds live weight per year to achieve the same production-based effluent limitations. EPA finds that the slaughtering and initial processing operations used in all four of these subcategories are the key factors in determining wastewater characteristics and treatability. Moreover, EPA believes there are no significant differences between these four subcategories in terms of age, location, and size of facilities. In addition to slaughtering and initial processing, EPA is proposing to establish allowances to account for the additional processes that might also occur on-site. The proposed effluent limitations guidelines would provide allowances for discharges from each of the following processes: slaughtering (which includes initial processing), further processing, and rendering. These allowances would be the same for all four subcategories and are related to the volume of production as follows: the amount of live weight killed for the slaughtering process, the amount of finished product that is further processed on-site, and the amount of raw material that is rendered on-site.

5.2.2 Meat Further Processing—Subparts F, G, H and I

The proposed subcategorization scheme requires all facilities that generate more than 50 million pounds per year of meat finished products without performing slaughtering to be regulated by the same production-based effluent limitations guidelines. Subpart E (Small Processor) facilities are excluded from these new proposed requirements by definition. The limitations guidelines allow discharges based on the amount of finished product that is further processed on-site. The wastewater characteristics and treatability for three of the four subcategories are sufficiently similar to group them together for the purpose of revising or setting new limitations and standards. However, subpart F limitations will be based on a lower production-normalized flow than Subpart G, H, and I limitations because Subpart F facilities generate substantially less water per pound of finished product than the other three subparts. Moreover, EPA believes there are no significant differences between these four subcategories in terms of age, location, and size of these MPP facilities. EPA believes that this subcategorization scheme will simplify implementation for the permit writers, as well as generate appropriate limitations and standards for the facilities.

5.2.3 Renderer—Subpart J

Subpart J applies to independent rendering facilities, which are facilities that only render raw materials and process hides and do no first or further processing. The proposed subcategorization scheme requires all independent rendering facilities that render more than 10 million pounds per year of raw material to be regulated by the same production-based effluent limitations guidelines. This scheme is a change from the current guidelines, which apply only to independent renderers that render more than approximately 27.4 million pounds raw material per year (or 75,000 pounds raw material per day for a facility that operates 365 days per year). The limitations and standards allow discharges based on the amount of raw material rendered on-site.

5.2.4 Poultry First Processing—Subpart K

EPA divided the poultry first processors into two segments, small and non-small. Small poultry first processors slaughter 10 million pounds of poultry per year or less; non-small poultry first processors slaughter more than 10 million pounds of poultry per year. EPA is proposing that the technology-based effluent limitations guidelines for small poultry first processors (both new and existing) be based on the less efficient nitrification technology option (Option 1). EPA is proposing that the technology-based effluent limitations guidelines for non-small poultry first processors (both new and existing) be based on the nitrification/denitrification technology option (Option 3). See Section 11 of this document for a discussion of the technology options, and see Section 12 of this document for more details on how EPA developed the two segments and specific requirements for each segment.

The effluent limitations guidelines allow discharges for all activities that may be performed on-site, including further processing and rendering, based on (1) the amount of live weight killed, (2) the amount of finished product that is further processed on-site, and (3) the amount of raw material that is rendered on-site.

5.2.5 Poultry Further Processing—Subpart L

EPA divided the poultry further processors into two segments, small and non-small. Small poultry further processors generate 7 million pounds of finished product per year or less; non-small poultry further processors generate more than 7 million pounds of finished product per year. EPA is proposing that the technology-based effluent limitations guidelines for small poultry further processors (both new and existing) be based on a less efficient nitrification technology option (Option 1). EPA is proposing that the technology-based effluent limitations guidelines for non-small poultry further processors (both new and existing) be based on the nitrification/denitrification technology option (Option 3). See Section 11 of this document for a discussion of the technology options, and see Section 12 of this document for more details on how EPA developed the two segments and specific requirements for each segment. The effluent limitations guidelines allow discharges based on the amount of finished product that is produced on-site.

5.3 REFERENCES

U.S. Environmental Protection Agency. 1974. Development document for effluent limitation guidelines and new source performance standards—red meat processing segments of the meat products point source category. EPA-440/1-74-012a. Effluent Guidelines Division, Office of Air and Water Programs, Washington, DC. (DCN 00162)

U.S. Environmental Protection Agency. 1975. Development document for proposed effluent limitation guidelines and new source performance standards for the poultry processing point source category. EPA-440/1-75-031b. Effluent Guidelines Division, Office of Water and Hazardous Materials, Washington, DC. (DCN 00140)

SECTION 6

WASTEWATER CHARACTERIZATION

This section describes the characteristics of wastewater generated by meat and poultry product (MPP) operations. Section 6.1 describes wastewater characteristics of meat processing wastes, Section 6.2 describes wastewater characteristics of poultry processing wastes, and Section 6.3 describes wastewater characteristics of rendering wastes.

6.1 MEAT PROCESSING WASTES

6.1.1 Volume of Wastewater Generated

In meat processing, water is used primarily for carcass washing after hide removal from cattle, calves, and sheep or hair removal from hogs and again after evisceration, for cleaning, and sanitizing of equipment and facilities, and for cooling of mechanical equipment such as compressors and pumps. A large quantity of water is used for scalding in the process of hair removal for hogs. Since most meat-processing facilities operate on a round-the-clock schedule with the killing cycle followed by processing and cleaning operations, the rate of water use and wastewater generation varies with both time of day and day of the week. In order to comply with Federal requirements for complete cleaning and sanitation of equipment after each processing shift, a regular processing shift, usually of 8- or 10-hour duration, is followed by one 6- to 8-hour cleanup shift every day. During processing, water use and wastewater generation are relatively constant and low compared to the cleanup period that follows. Water use and wastewater generation essentially cease after the cleanup period until processing begins the next day. In addition, there is little water use or wastewater generation on non-processing days, which usually are Saturdays and Sundays. Thus, meat processing wastewater flow rates can be highly variable, especially on an hourly basis.

A number of studies also have shown that the volume of water used and wastewater generated on a per unit of production basis, such as live weight killed (LWK) or finished product produced also can vary substantially among processing plants. Some of this variation is a reflection of different levels of effort among plants to minimize water use to reduce the cost of wastewater treatment. For example, Johns (1995) reported water use ranging from 312 to 601 gallons per 1,000 pounds live weight for processing of beef cattle. In an earlier analysis of data from 24 simple slaughterhouses (operations producing fresh meat ranging from whole carcasses to smaller cuts of meat with two or fewer by-product recovery activities, such as rendering and hide processing), wastewater flows ranged from 160 to 1,755 gallons per 1,000 lb LWK with a mean value of 639 gallons per 1,000 lb LWK (USEPA, 1974). About one-half of these operations slaughtered beef cattle, with the remainder evenly divided between hogs and mixed kill. Two facilities were small operations with less than 95,000 lb LWK per day, and the remainder were classified as medium size, handling between 95,000 and 758,000 lb LWK per day. For 19 medium and large complex slaughterhouses (operations with three or more byproduct recovery activities), wastewater flows ranged from 435 to 1,500 gallons per 1,000 lb LWK with a mean value of 885 gallons per 1,000 lb LWK.

As part of the data collection for the proposed rule, EPA collected data related to the volumes of wastewater flow generated at meat processing facilities. Table 6-1 presents typical wastewater volumes generated per unit of production from meat industries as reported during site visits by EPA. Table 6-2 presents median wastewater volumes generated per unit of production as reported in the MPP detailed surveys.

Table 6-1. Wastewater Generated in Meat Processing

Meat Type	First Processing and Rendering [a]			Further Processing [b]		
	Average	Range	n	Average	Range	n
Hogs	462	243-613	3	681	NA	1
Cattle (first processing and rendering)	390	NA	1	NA		
Cattle (first processing, rendering and hide processing)	345	304-386	2			

LWK = Live weight killed; n = number of observations; NA = not available.
[a] Units are gallons per 1,000 lb LWK.
[b] Units are gallons per 1,000 lb of finished product.

Table 6-2. Wastewater Volumes Produced by Meat Facilities per Unit of Production

	Process Wastewater Generated (gallons per 1,000 lbs of production unit)	
	First Processing[a]	**Further Processing[b]**
Small facilities	348	672
Non-small facilities	323	555

[a] Production unit for first processing operations is 1,000 lb of live weight killed (LWK). These numbers include facilities that may also generate wastewater from cutting operations.
[b] Production unit for further processing operations is 1,000 lb of finished product.
Data source: MPP detailed surveys

6.1.2 Description of Waste Constituents and Concentrations

The principal sources of wastes in meat processing are from live animal holding, killing, hide or hair removal, eviscerating, carcass washing, trimming, and cleanup operations. When present, further processing, rendering, and hide processing operations[1] also are significant sources of wastes. Meat processing wastes include blood not collected, viscera, soft tissue removed during trimming and cutting, bone, urine and feces, soil from hides and hooves, and various cleaning and sanitizing compounds. Further processing, rendering, and hide processing produce additional sources of fat and other soft tissues, as well as substances including brines, cooking oils, and tanning solutions. Wastewater characteristics of rendering operations are discussed in Section 6.3.

The principal constituents of meat processing wastewaters are a variety of readily biodegradable organic compounds, primarily fats and proteins, present in both particulate and dissolved forms. Screening of meat processing wastewaters is usually performed in most facilities to reduce concentrations of particulate matter before effecting pre-treatment.

Meat processing wastewaters remain high strength wastes, even after screening, in comparison to domestic wastewaters, based on concentrations of biochemical oxygen demand

[1]Note that although not part of meat processing operations, hide processing wastewaters are often commingled with meat processing wastewaters prior to treatment. The existing regulations at 40 CFR Part 432, as well as the proposed regulations, address wastewaters from hide processing operations when discharged with meat processing wastewaters.

(BOD), chemical oxygen demand (COD), total suspended solids (TSS), nitrogen, and phosphorus.

Blood not collected, solubilized fat, urine, and feces are the primary sources of BOD in meat processing wastewaters. For example, blood from beef cattle has a reported BOD_5 of 156,500 mg/L with an average of 32.5 pounds of blood produced per 1,000 pounds LWK (Grady and Lim, 1980). Thus, the efficacy of blood collection is a significant factor in determining the amount of BOD in meat processing wastewater.

Another significant factor in determining the BOD of meat processing wastewaters is the manner in which manure (urine and feces) is handled at the facility. Generally, manure is separated from the main waste stream and treated as a solid waste. Beef cattle manure has a BOD_5 of approximately 27,000 mg/kg on an as excreted basis, and the BOD_5 of swine manure is approximately 37,000 mg/kg of manure (American Society of Agricultural Engineers, 1999).

The efficiency of fat separation and removal from the waste stream is an important factor in determining the BOD concentration in meat processing wastewaters. Fat removed from wastewater can be handled as a solid waste or by-product. The high BOD of animal fats is directly attributable to their rapid biodegradability and high-energy yield for microbial cell maintenance and growth, especially under aerobic conditions. The significance of fat as a component of BOD in meat processing wastewaters generally is determined indirectly as the concentration of oil and grease (Standard Methods APHA 1995). In the determination of oil and grease, the concentration of a specific substance is not determined. Instead, groups of compounds with similar physical characteristics are determined quantitatively based on their common solubility in an organic extracting solvent. Over time, petroleum ether has been replaced by trichlorotrifluoroethane (Freon) and most recently by n-hexane as the preferred extracting solvent. Thus, oil and grease concentrations in meat processing wastewaters may be reported as Freon or n-hexane extractable material (HEM).

Blood and manure are also are significant sources of nitrogen in meat processing wastewaters. The principal form of nitrogen in these wastewaters before treatment is organic nitrogen with some ammonia nitrogen. During collection of wastewater samples, some ammonia nitrogen is produced by the microbially mediated mineralization of organic nitrogen. Nitrite and nitrate nitrogen generally are present only in trace concentrations (less than 1 mg/L) in meat processing wastewaters; however, these nitrate and nitrite concentrations are increased when nitrites are used in processes such as the curing of bacon and ham. The phosphorus in meat processing wastewaters is primarily from blood, manure, and cleaning and sanitizing compounds, which can contain trisodium phosphate (sodium phosphate, tribasic).

Due to the presence of manure in meat processing wastewaters, densities of total coliform, fecal coliform, and fecal streptococcus groups of bacteria generally are on the order of several million colony forming units (cfu) per 100 mL. Although members of these groups of microorganisms generally are not pathogenic, they do indicate the possible presence of pathogens of enteric origin such as *Salmonella ssp.* and *Campylobacter jejuni*. They also indicate the possible presence of gastrointestinal parasites including *Ascaris sp*., *Giardia lamblia*, and *Cryptosporidium parvum* and enteric viruses.

Meat processing wastewaters also contain a variety of mineral elements, some of which are present in the water that is used for processing meat. In addition, water supply systems and mechanical equipment may be significant sources of metals, including copper, chromium, molybdenum, nickel, titanium, and vanadium. Manure, especially hog manure, may be significant sources of copper, arsenic, and zinc, because these constituents are commonly added to hog feed. Although pesticides such as Dichcorvos, malathion, and Carbaryl are commonly used in the production of meat animals to control external parasites, label-specified withdrawal periods before slaughter typically should limit concentrations to non-detectable or trace levels. Failure to observe specified withdrawal periods is an unlawful act (*7 U.S.C 136 Et. Seq*).

Tables 6-3 and 6-4, respectively, present typical wastewater characteristics and pollutants generated per unit of production from hog and cattle processing facilities, as reported during sampling visits by EPA. Average effluent concentrations for all pollutants of concern evaluated by EPA for potential regulation are provided in Section 9.

Table 6-3. Typical Characteristics of Hog and Cattle Processing Wastewaters[a]

Parameter	Hog		Cattle	
	First Processing and Rendering	Further Processing[b]	First Processing and Rendering	Further Processing[b]
	Average	Average	Average	Average
Flow (MGD)	1.95	0.30	1.87	1.46
Live weight killed (1,000 lb/day)	3,639	435	3,942	4,044
BOD_5 (mg/L)	2,220	1,492	7,237	5,038
Total suspended solids (mg/L)	3,314	363	1,153	2,421
Hexane Extractables (mg/L)	674	162	146	1,820
Total Kjeldahl nitrogen (mg/L)	229	24	306	72
Total phosphorus (mg/L)	72	82	35	44
Fecal coliform bacteria (CFU/100 mL)	$1.6x10^6$	$1.4x10^6$	$7.3x10^5$	$1.4x10^6$

MGD = Million gallons per day; CFU = Colony forming units.

[a] Data generated during EPA sampling of MPP facilities.
[b] Finished product, 1,000 lb/day

Table 6-4. Typical Pollutant Generation per Unit of Production in Hog and Cattle Processing[a]

Parameter	Hog		Cattle	
	First Processing and Rendering	Further Processing	First Processing and Rendering	Further Processing
	Average	Average[b]	Average	Average[b]
BOD_5 (lb/1,000 lb LWK)	8.34	8.48	23.55	14.97
Total suspended solids (lb/1,000 lb LWK)	11.20	2.06	3.75	7.28
Hexane extractables (lb/1,000 lb LWK)	2.82	0.92	0.48	5.65
Total Kjeldahl nitrogen (lb/1,000 lb LWK)	1.17	0.14	1.00	0.21
Total phosphorus (lb/1,000 lb LWK)	0.25	0.47	0.11	0.12
Fecal coliform bacteria (CFU/1,000 lb LWK)	$2.6x10^{10}$	$3.6x10^{10}$	$1.1x10^{10}$	$1.8x10^{10}$

LWK = Live weight killed; CFU = Colony forming units.

[a] Data generated during EPA sampling of MPP facilities.
[b] Per 1,000 lb of finished product

6.2 POULTRY PROCESSING WASTES

6.2.1 Volume of Wastewater Generated

In poultry processing, water is used primarily for scalding in the process of feather removal, bird washing before and after evisceration, chilling, cleaning and sanitizing of equipment and facilities, and for cooling of mechanical equipment such as compressors and pumps. Although water also is typically used to remove feathers and viscera from production areas, overflow from scalding and chiller tanks is used.

A number of studies also have shown that the volume of water used and wastewater generated by poultry processing on a per unit of production basis (such as per bird killed) can vary substantially among processing plants. Again, some of this variation is a reflection of different levels of effort among plants to reduce their wastewater treatment costs by minimizing their water use. One study of 88 chicken processing plants found wastewater flows ranged from 4.2 to 23 gallon per bird with a mean value of 9.3 gallon per bird (USEPA, 1975). No standard deviation values were reported; therefore, the distribution of individual values could not be determined. Using the reported mean live weight per bird of 3.83 pounds, 9.3 gallon per bird translates into 2,428 gallon per 1,000 lb LWK, which is significantly higher than the mean flow of 639 gallon per 1,000 lb LWK used for meat processing. For 34 turkey processing plants, the mean wastewater flow was 31.2 gallon per bird with individual plant values ranging from 9.6 to 71.4 gallon per bird. Again, no standard deviation was reported. Based on the reported mean live weight per bird of 18.2 pounds, the mean flow of 31.2 gallon per bird translates into 1,714 gallon per 1,000 lb LWK. Again, this value is substantially higher than that for meat processing, but also substantially lower than the value calculated for chickens. Two of the factors that contribute to the higher rate of wastewater generation for poultry processing are the 1) required continuous overflow from scalding tanks, and 2) use of carcass immersion in ice bath chillers with a required continuous overflow for removal of body heat after evisceration. As discussed elsewhere, meat carcasses are chilled using mechanical refrigeration.

As part of the data collection for the proposed rule, EPA collected data related to the volumes of wastewater flow generated at poultry processing facilities. Table 6-5 shows typical wastewater volumes generated per unit of production from poultry facilities, as reported during site visits by EPA. Table 6-6 shows median wastewater volumes generated per unit of production from poultry facilities as reported in the MPP detailed surveys.

Table 6-5. Wastewater Generation in Poultry First and Further Processing[a]

Parameter	First Processing[b]	Further Processing[c]
	Average	Average
Broiler	1,075	1,926
Turkey	634	NA

NA = not available.
[a] Data generated during EPA sampling of MPP facilities.
[b] Units in gallons per 1,000 lb LWK
[c] Units in gallons per 1,000 lb of finished product

Table 6-6. Wastewater Volumes Produced by Poultry Facilities per Unit of Production

	Process Wastewater Generated (gallons per 1,000 lbs of production unit)	
	First Processing[a]	Further Processing[b]
Small Facilities	1,167	606
Non-small Facilities	1,289	316

[a] Production unit for first processing operations is 1,000 lb of live weight killed (LWK). These numbers include facilities that may also generate wastewater from cutting operations.
[b] Production unit for further processing operations is 1,000 lb of finished product.
Data source: MPP detailed surveys

6.2.2 Description of Waste Constituents and Concentrations

The principal sources of wastes in poultry processing are live bird holding and receiving, killing, defeathering, eviscerating, carcass washing, chilling, cut-up, and cleanup operations. Further processing and rendering operations are also major sources of wastes. These wastes include blood not collected, feathers, viscera, soft tissue removed during trimming and cutting, bone, soil from feathers, and various cleaning and sanitizing compounds. Further processing and rendering can produce additional sources of animal fat and other soft tissue, in addition to other substances such as cooking oils.

Thus, the principal constituents of poultry processing wastewaters are a variety of readily biodegradable organic compounds, primarily fats and proteins, present in both particulate and dissolved forms. To reduce wastewater treatment requirements, poultry processing wastewaters also are screened to reduce concentrations of particulate matter before treatment. An added benefit of screening is increased collection of materials and subsequent increased production of rendered by-products. Because feathers are not rendered with soft tissue, wastewater containing feathers is not commingled with other wastewater. Instead, it is screened separately and then combined with unscreened wastewater to recover soft tissue before treatment during the screening process of these mixed wastewaters.

However, poultry processing wastewaters also remain high strength wastes even after screening in comparison to domestic wastewaters based on concentrations of BOD, COD, TSS, nitrogen, and phosphorus after screening. Blood not collected, solubilized fat, and feces are principal sources of BOD in poultry processing wastewaters. As with meat processing wastewaters, the efficacy of blood collection is a significant factor in determining BOD concentration in poultry processing wastewaters.

Another significant factor in determining the BOD of poultry processing wastewaters is the degree to which manure (urine and feces), especially from receiving areas, is handled separately as a solid waste. Chicken and turkey manures have BOD concentrations in excess of 40,000 mg/kg on an as excreted basis (American Society of Agricultural Engineers, 1999). Although the cages and trucks used to transport broilers to processing plants usually are not washed, cages and trucks used to transport live turkeys to processing plants are washed to prevent transmission of disease from farm to farm. Thus, manure probably is a more significant source of wastewater BOD for turkey processing operations than for broiler processing operations.

Primarily because of immersion chilling, fat is a more significant source of BOD in poultry processing wastewaters than in meat processing wastewaters. Additional sources of BOD in poultry processing wastewaters are feather and skin oils desorbed during scalding for feather removal. Thus, the oil and grease content of poultry processing wastewaters typically is higher than that in meat processing wastewaters.

Blood not collected, as well as urine and feces, also are significant sources of nitrogen in poultry processing wastewaters. Again, the principal form of nitrogen in these wastewaters before treatment is as organic nitrogen with some ammonia nitrogen produced by the microbially mediated mineralization of organic nitrogen during collection. Nitrite and nitrate nitrogen generally are present only in trace concentrations, less than 1 mg/L. The phosphorus in poultry processing wastewaters is primarily from blood, manure, and cleaning and sanitizing compounds such as trisodium phosphate (trisodium phosphate tribasic), and trisodium phosphate in detergents.

Due to the presence of manure in poultry processing wastewaters and commingling of processing and sanitary wastewaters after screening, and dissolved air flotation of the former, densities of the total and fecal coliform and fecal streptococcus groups of bacteria generally are on the order of several million cfu/100 mL. As discussed earlier, members of these groups of microorganisms generally are not pathogenic. They do, however, indicate the possible presence of pathogens of enteric origin, such as *Salmonella sp*. and *Campylobacter jejuni*, gastrointestinal parasites, and pathogenic enteric viruses. *Giardia lamblia*, and *Cryptosporidium parvum* are not of concern in poultry processing wastewaters.

Poultry processing wastewaters also contain a variety of mineral elements, some of which are present in the potable water used for processing poultry. Again, water supply systems and mechanical equipment may be significant sources of metals including copper, chromium, molybdenum, nickel, titanium, and vanadium. In addition, manure is a significant source of arsenic and zinc. Although pesticides such as carbaryl, also are commonly used in the production of poultry to control external parasites, label-specified withdrawal periods before slaughter typically should limit concentrations to non-detectable or trace levels. Failure to observe specified withdrawal periods is an unlawful act (7 U.S.C. 136 et seq.).

Tables 6-7 and 6-8, respectively, present typical wastewater characteristics and pollutant generated from broiler and turkey processing facilities as reported during site visits by EPA.

Average effluent concentrations for all pollutants of concern evaluated by EPA for potential regulation are provided in Section 9.

Table 6-7. Typical Characteristics of Broiler First and Further Processing and Turkey First Processing Wastewaters[a]

Parameter	Broiler		Turkey
	First Processing	Further Processing	First Processing
	Average	Average[b]	Average
Flow (MGD)	0.89	1.10	0.58
Live weight kill (1,000 lb/day)	880	573	909
BOD_5 (mg/L)	1,662	3,293	2,192
Total suspended solids (mg/L)	760	1,657	981
Hexane extractables (mg/L)	665	793	156
Total Kjeldahl nitrogen (mg/L)	54	80	90
Total phosphorus (mg/L)	12	72	21
Fecal coliform bacteria (CFU/100 mL)	$9.8x10^5$	$8.6x10^5$	not determined

MGD = Million gallons per day; CFU = colony forming units.
[a] Data generated during EPA sampling of MPP facilities.
[b] Per 1,000 lb of finished product

Table 6-8. Pollutant Generation per Unit of Production in Broiler First and Further Processing[a]

Parameter	Broiler		Turkey
	First Processing	Further Processing	First Processing
	Average	Average[b]	Average
BOD_5 (lb/1,000 lb LWK)	13.84	52.94	11.58
Total suspended solids (lb/1,000 lb LWK)	6.69	26.64	5.18
Hexane Extractables (lb/1,000 lb LWK)	7.22	12.75	0.82
Total Kjeldahl nitrogen (lb/1,000 lb LWK)	0.44	1.29	0.48
Total phosphorus (lb/1,000 lb LWK)	0.10	0.65	0.11
Fecal coliform bacteria (CFU/1,000 lb LWK)	$3.4x10^{10}$	$6.3x10^{10}$	not determined

LWK = Live weight killed; CFU = Colony forming units.
[a] Data generated during EPA sampling of MPP facilities.
[b] Per 1,000 lb of finished product

6.3 RENDERING WASTEWATER GENERATION AND CHARACTERISTICS

The slaughter of livestock and poultry produces a considerable amount of inedible viscera and other solid wastes, including feathers from poultry and hair from hogs. Inedible viscera and other soft tissue, fat, and bone, which are collected as solid wastes and removed from wastewater by screening, are converted by rendering into valuable byproducts such as meat meal and meat and bone meal. In the rendering process, these materials are cooked in their own moisture and fat in vented steam-jacketed vessels until the moisture has evaporated. Then, as much fat as possible is removed and the solid residue is passed through a screw press, dried, and granulated or ground into a meal for sale as a livestock or poultry or pet food ingredient. In some situations, dissolved air flotation (DAF) solids are disposed of by rendering, although DAF solids reduce the quality of rendered products, especially if metal salts are used for flocculation/coagulation prior to DAF.

Rendering operations also may include blood drying to produce blood meal for sale as a feed ingredient or fertilizer. They also may include the hydrolysis of hair or feathers for the production of livestock and poultry feed ingredients. Typically, blood from poultry processing operations is combined with feathers to increase the value of the resulting feather meal as a source of protein.

Rendering may be performed at the same site as other meat or poultry processing operations or at a separate location, usually by an independent entity. When rendering is performed in conjunction with other meat or poultry processing operations, wastes from locations without on-site rendering also may be processed.

6.3.1 Volume of Wastewater Generated

Rendering operations are intensive users of water and significant generators of wastewater. Water is used throughout the rendering process, including for raw material cooking and sterilization, condensing cooking vapors, plant cleanup, truck and barrel washing when materials from off-site locations are being processed, odor control, and steam generation (USEPA, 1975). Most of these activities also generate wastewater. According to the National Rendering Association (2000), rendering plants produce approximately one-half ton (120 gallons) of water for each ton of rendered material. Variations in wastewater flow per unit of raw material processed are largely attributable to the type of condensers used for condensing the cooking vapors and, to a lesser extent, to the initial moisture content of the raw material.

Based on a survey of National Rendering Association (NRA) members, an average size rendering plant generates about of 215,000 gallons/day process wastewater and an average of 34,000 gallons/day from other sources (National Rendering Association, 2000). The NRA estimates that the average plant discharges about 243,300 gallons/day or 169 gallons per minute.

The major sources of wastewater at rendering plants are produced from raw material receiving operations (especially when materials from off-site locations are being processed), condensing cooking vapors, drying, plant cleanup, and truck and barrel washing (USEPA, 1975). Condensates formed during raw material sterilization and drying are the largest contributors to the total wastewater in terms of volume and pollutant load (Metzner and Temper, 1990). At those rendering plants where hide curing is also performed as an ancillary operation, additional volumes of raw waste are generated, although those operations are not covered by this proposal. (USEPA, 1975). Note, however, that hide processing wastewaters may be commingled with other wastewaters prior to treatment.

Condensates recovered from cooking and drying processes contain high concentrations of volatile organic acids, amines, mercaptans, and other odorous compounds. Thus, rendering plant condensers can be sources of significant emissions of noxious odors to the atmosphere if water scrubbing is not used for emissions control. There is little increase in final effluent volume when water scrubbing is used, because recycled final effluent is used for scrubber operation.

Liquid drainage from raw materials receiving areas can contribute significantly to the total raw waste load (USEPA, 1975). Large amounts of raw materials commonly accumulate in receiving areas (in bins or on floors). Fluids from these raw materials drain off and enter the internal plant sewers (USEPA, 1975). At rendering plants that process poultry, drainage of liquids can be significant because of the use of fluming to transport feathers and viscera in the processing plant. In such plants, liquid drainage may account for approximately 20 percent of the original raw material weight.

The other important source of wastewater from rendering operations is water used for cleaning equipment and facilities, the cleanup of spills, and trucks when materials are received from off-site locations for rendering. Cleanup of rendering equipment and facilities is less intensive than that in processing facilities and usually occurs only once per day, even though rendering usually is a 24-hour operation and commonly occurs on a seven day per week schedule. The wastewater generated during cleanup operations usually accounts for about 30 percent of total rendering plant wastewater flow (USEPA, 1975).

Approximately 30 percent of the total raw BOD waste load originates in the cooking and drying process (USEPA, 1975). Factors such as rate of cooking, speed of agitation, cooker overloading, foaming, and presence of traps can result in volume and composition differences among different rendering plants.

Although the water used in air scrubbers that are commonly used to control odor can contribute up to 75 percent of a plant’s total effluent volume, they contribute little to the final effluent discharge, since most of this air scrubber wastewater is recycled (USEPA, 1975). Other important sources of process wastewater include plant and truck washdown activities, and the cleanup of spills.

As part of the data collection for the proposed rule, EPA collected data related to the volumes of wastewater flow generated at rendering operations. Table 6-9 presents typical wastewater volumes generated per unit of production from broiler rendering facilities as reported during site visits by EPA. Table 6-10 presents median wastewater volumes generated per unit of production as reported in the MPP detailed survey.

Table 6-9. Wastewater Generation in Broiler Rendering[a]

Parameter	Average
Broiler	200

[a] Data generated during EPA sampling of MPP facilities. Units are gallons per 1,000 pounds of live weight killed.

Table 6-10. Wastewater Volumes Produced by Rendering Operations per Unit of Production

	Process Wastewater Generated (gallons per 1,000 lbs of raw material)
	Rendering[a]
Small facilities	134
Non-small facilities	346

[a] These estimates reflects wastewater generated by on-site and off-site (independent) renderers.
Data source: MPP detailed surveys

6.3.2 Description of Waste Constituents and Concentrations

The principal constituents in wastewaters from rendering operations are the same as those in meat and poultry processing wastewaters. In addition, it appears that there is little difference in rendering wastewater constituents or concentrations attributable to the source of materials being processed. A 1975 survey found that the range and average of BOD_5 wastewater values for plants processing more than 50 percent poultry by-products could not be differentiated from those plants processing less than 50 percent poultry by-products (USEPA, 1975). Additionally, the study found that plant size does not affect the levels of pollutants in the waste stream. However, management and operating variables, such as rate of cooking, speed of agitation, cooker overloading, foaming, and presence or absence of traps, were found to influence both wastewater volume and the concentrations of various wastewater constituents, as would be expected.

Another factor affecting the composition of rendering process wastewaters is the degree of decomposition that has occurred before rendering (USEPA, 1975). In warm weather, significant decomposition can occur, especially with materials from off-site sources. One result is increased wastewater ammonia nitrogen concentrations during summer months.

Table 6-11 provides a sense of the significance of various sources of wastewater from rendering operations relative to typical analyte composition before treatment. In this table, concentrations found in samples collected from a continuous dry rendering plant in Columbus, Ohio are presented (Hansen and West, 1992). Samples from blood, cooker condensate, and wash-up water were analyzed. The cooker condensate was mostly composed of condensed volatile fats and oils with some ammonia. The wash-up water consisted of plant cleanup water mixed with drainage from the raw product storage hopper. (The relative proportions were not measured.) Although the blood accounted for only a small percentage of the total volume of wastewater, it clearly is a highly significant source of COD, TKN, ammonia nitrogen, and grease in rendering plant wastewater.

Table 6-12 shows typical wastewater characteristics generated from broiler rendering facilities as reported during site visits by EPA. Average effluent concentrations for all pollutants of concern evaluated by EPA for potential regulation are provided in Section 9.

In 2000, the NRA collected data from its membership to provide a general characterization of rendering process wastewaters. Table 6-13 presents the results of this survey. The data are only for wastewater generated and final effluent characteristics, and do not cover specific sources of generated wastewater. The final effluent data indicate pollutant loads after treatment has been applied. The NRA did not report data on metals in generated wastewater or on nutrients in generated or discharged wastewater.

Table 6-14 shows pollutant generated from broiler rendering facilities per unit of production, as reported during site visits by EPA.

Table 6-11. Pollutant Concentrations for a Dry Continuous Rendering Plant

Parameter	Raw Blood[a] (mg/L)	Condensate Batch 1[a,b] (mg/L)	Condensate Batch 2[a,b] (mg/L)	Wash-up water[c] (mg/L)
Total COD	150,000	6,000	2,400	7,600
Soluble COD	136,000	6,000	2,400	3,200
Total Kjeldahl nitrogen (TKN-N)	16,500	740	430	270
Ammonia nitrogen	3,500	740	430	40
*COD: TKN	9.1	8.1	5.6	28.1
Total Phosphorus (P)	183	<4	<4	15.1
*COD: P	820	>1500	>600	503
Freon extractables (FOG)	620	260	110	35
Potassium	793	<6	<6	20.9
Calcium	55	<1	<1	26.4
Magnesium	27	<1	<1	7.3
Iron	164	2	2	9.4
Sodium	818	0.1	0.1	37.1
Copper	0.7	<0.2	<0.2	0.1
Zinc	1.3	<0.15	<0.15	0.46
Manganese	0.05	0.05	0.05	0.01
Lead	<0.6	<3	<3	<1.3
Chromium	0.3	<0.2	<0.2	0.12
Cadmium	0.05	<0.01	<0.01	<0.04
Nickel	<0.2	<1	<1	<0.4
Cobalt	<0.02	<0.01	<0.01	<0.04
Sulfate (SO_4-S)	300	<2	<2	4.6
Total Chloride	1700	<2	<2	86

[a] Each value is the mean of three samples analyzed in duplicate.
[b] The strength of condensate varied from winter to summer; however, only condensate collected during the summer was used in these studies. Cold ambient temperatures around the forced air condensers affected the COD strength of the cooker condensate. The COD strength of the blood and wash-up water was similar for both batches; therefore, data for each batch is not included separately.
[c] Each point is the mean of duplicate analyses of one sample.
[d] < and > symbols both indicate the limits of the analyses were exceeded.
* These parameters are ratios and have no units.

Source: Hansen and West, 1992

Table 6-12. Typical Characteristics of Broiler Rendering Wastewaters[a]

Parameter	Average
Flow (MGD)	0.29
Raw product rendered (1,000 lb/day)	1,442[a]
BOD_5 (mg/L)	1,984
Total suspended solids (mg/L)	3,248
Hexane extractables (mg/L)	1,615
Total Kjeldahl nitrogen (mg/L)	180
Total Phosphorus (mg/L)	38
Fecal coliform bacteria CFU/100 mL	$1.2x10^6$

MGD = million gallons per day; CFU = colony forming units.
[a] Data generated during EPA sampling of MPP facilities.

Table 6-13. Wastewater Characterization of "Typical" National Rendering Association (NRA) Member Render Plant

Parameter	Generated Wastewater Concentration (mg/L)	Discharged Wastewater Concentration (mg/L)
Chemical oxygen demand (COD)	123,000	8,000
Biochemical oxygen demand (BOD)	80,000	5,100
Total suspended solids (TSS)	8,400	268
Fat and other greases (FOG)	3,200	116
Metals (average zinc)	NA	0.68
Fecal coliform bacteria	$2.5x10^8$ cfu/mL	$4.5x10^4$ cfu/mL

CFU = colony forming units; NA = not available.
Source: NRA, 2000

Table 6-14. Typical Wastewater and Pollutant Generation per Unit of Production in Broiler Rendering

Parameter	Average[a]
BOD_5 (lb/1,000 lb RPR)	3.31
Total suspended solids (lb/1,000 lb RPR)	5.42
Hexane extractables (lb/1,000 lb RPR)	2.70
Total Kjeldahl nitrogen (lb/1,000 lb RPR)	0.30
Total phosphorus (lb/1,000 lb RPR)	0.06
Fecal coliform bacteria (CFU/1,000 lb RPR)	$9.1x10^9$

RPR = raw product rendered; CFU = colony forming units.
[a] Per 1,000 lb of raw product rendered.

6.5 REFERENCES

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SECTION 7

SELECTION OF POLLUTANTS AND POLLUTANT PARAMETERS FOR REGULATION

7.1 INTRODUCTION

EPA conducted a study of meat and poultry products wastewater to determine the presence of priority, conventional, and nonconventional pollutant parameters. The Agency defines priority pollutant parameters in Section 307(a)(1) of the CWA. In Table 7-1, EPA lists the 126 specific priority pollutants listed in 40 CFR Part 423, Appendix A. Section 301(b)(2) of the CWA requires EPA to regulate priority pollutants, if EPA determines them to be present at significant concentrations. Most of the priority pollutants listed in Table 7-1 were not further considered for regulation, because EPA's technical evaluation of the industry did not identify them as significant contributors to MPP wastewaters. Section 304(a)(4) of the CWA defines which conventional pollutant parameters include biochemical oxygen demand, total suspended solids, oil and grease, pH, and fecal coliform bacteria. These pollutant parameters are subject to regulation, as specified in Sections 304(a)(4), 304(b)(1)(a), 301(b)(2)(e), and 306 of the CWA. Nonconventional pollutant parameters are those that are neither priority nor conventional pollutant parameters. This group includes nonconventional metal pollutants, nonconventional organic pollutants, and other nonconventional pollutant parameters. Sections 301(b)(2)(f) and 301(g) of the CWA give EPA the authority to regulate nonconventional pollutant parameters, as appropriate, based on technical and economic considerations.

This section identifies and discusses the pollutants in meat and poultry processing wastewaters considered for regulation by EPA. It then presents the criteria used for the identification of the pollutants of concern and the selection of the pollutants proposed for regulation.

7.2 POLLUTANTS CONSIDERED FOR REGULATION

Table 7-1 identifies, the pollutants considered for regulation in meat and poultry processing wastewaters by EPA. The rationale for their consideration is summarized in the discussion that follows. For meat processing wastewaters, EPA considered 52 pollutants (24 classicals and biologicals, 22 metals, and six pesticides) were considered. For poultry processing wastewaters, the Agency considered 51 pollutants (23 classicals and biologicals, 22 metals, and six pesticides).

Not included as pollutants considered for regulation are antibiotics and other animal drugs. Although a number of pharmaceutical agents are used in the production of livestock and poultry therapeutically and at sub-therapeutic levels to increase rate of weight gain and feed conversion efficiency, antibiotics and other drugs were not considered as pollutants for possible regulation based on the following rationale.

Table 7-1. Priority Pollutant List[a]

1 Acenaphthene	66 Bis(2-ethylhexyl) phthalate
2 Acrolein	67 Butyl benzyl phthalate
3 Acrylonitrile	68 Di-n-butyl phthalate
4 Benzene	69 Di-n-octyl phthalate
5 Benzidine	70 Diethyl phthalate
6 Carbon tetrachloride (tetrachloromethane)	71 Dimethyl phthalate
7 Chlorobenzene	72 Benzo(a)anthracene (1,2-benzanthracene)
8 1,2,4-Trichlorobenzene	73 Benzo(a)pyrene (3,4-benzopyrene)
9 Hexachlorobenzene	74 Benzo(b)fluoranthene (3,4-benzo fluoranthene)
10 1,2-Dichloroethane	75 Benzo(k)fluoranthene (11,12-benzofluoranthene)
11 1,1,1-Trichloroethane	76 Chrysene
12 Hexachloroethane	77 Acenaphthylene
13 1,1-Dichloroethane	78 Anthracene
14 1,1,2-Trichloroethane	79 Benzo(ghi)perylene (1,12-benzoperylene)
15 1,1,2,2-Tetrachloroethane	80 Fluorene
16 Chloroethane	81 Phenanthrene
17 Removed	82 Dibenzo(a,h)anthracene (1,2,5,6-dibenzanthracene)
18 Bis(2-chloroethyl) ether	83 Indeno(1,2,3-cd)pyrene (2,3-o-phenylenepyrene)
19 2-Chloroethyl vinyl ether (mixed)	84 Pyrene
20 2-Chloronaphthalene	85 Tetrachloroethylene (tetrachloroethene)
21 2,4,6-Trichlorophenol	86 Toluene
22 Parachlorometa cresol (4-chloro-3-methylphenol)	87 Trichloroethylene (trichloroethene)
23 Chloroform (trichloromethane)	88 Vinyl chloride (chloroethylene)
24 2-Chlorophenol	89 Aldrin
25 1,2-Dichlorobenzene	90 Dieldrin
26 1,3-Dichlorobenzene	91 Chlordane (technical mixture & metabolites)
27 1,4-Dichlorobenzene	

28 3,3'-Dichlorobenzidine	92 4,4'-DDT (p,p'-DDT)
29 1,1-Dichloroethylene	93 4,4'-DDE (p,p'-DDX)
30 1,2-Trans-Dichloroethylene	94 4,4'-DDD (p,p'-TDE)
31 2,4-Dichlorophenol	95 Alpha-endosulfan
32 1,2-Dichloropropane	96 Beta-endosulfan
33 1,3-Dichloropropylene (trans-1,3-dichloropropene)	97 Endosulfan sulfate
34 2,4-Dimethylphenol	98 Endrin
35 2,4-Dinitrotoluene	99 Endrin aldehyde
36 2,6-Dinitrotoluene	100 Heptachlor
37 1,2-Diphenylhydrazine	101 Heptachlor epoxide
38 Ethylbenzene	102 Alpha-BHC
39 Fluoranthene	103 Beta-BHC
40 4-Chlorophenyl phenyl ether	104 Gamma-BHC (lindane)
41 4-Bromophenyl phenyl ether	105 Delta-BHC
42 Bis(2-Chloroisopropyl) ether	106 PCB-1242 (Arochlor 1242)
43 Bis(2-Chloroethoxy) methane	107 PCB-1254 (Arochlor 1254)
44 Methylene chloride (dichloromethane)	108 PCB-1221 (Arochlor 1221)
45 Methyl chloride (chloromethane)	109 PCB-1232 (Arochlor 1232)
46 Methyl bromide (bromomethane)	110 PCB-1248 (Arochlor 1248)
47 Bromoform (tribromomethane)	111 PCB-1260 (Arochlor 1260)
48 Dichlorobromomethane (bromodichloromethane)	112 PCB-1016 (Arochlor 1016)
49 Removed	113 Toxaphene
50 Removed	114 Antimony (total)
51 Chlorodibromomethane (dibromochloromethane)	115 Arsenic (total)
52 Hexachlorobutadiene	116 Asbestos (fibrous)
53 Hexachlorocyclopentadiene	117 Beryllium (total)
54 Isophorone	118 Cadmium (total)
55 Naphthalene	119 Chromium (total)
56 Nitrobenzene	120 Copper (total)
57 2-Nitrophenol	121 Cyanide (total)
58 4-Nitrophenol	122 Lead (total)
59 2,4-Dinitrophenol	123 Mercury (total)
60 4,6-Dinitro-o-cresol (phenol, 2-methyl-4,6-dinitro)	124 Nickel (total)
61 N-Nitrosodimethylamine	125 Selenium (total)
62 N-Nitrosodiphenylamine	126 Silver (total)
63 N-Nitrosodi-n-propylamine (di-n-propylnitrosamine)	127 Thallium (total)
64 Pentachlorophenol	128 Zinc (total)
65 Phenol	129 2,3,7,8-Tetrachloro-dibenzo-p-dioxin (TCDD)

Source: 40 CFR Part 423, Appendix A.

[a] Priority pollutants are numbered 1 through 129 but include 126 pollutants, since EPA removed three pollutants from the list (Numbers 17, 49, and 50).

All use of antibiotics and other animal drugs in the production of livestock and poultry for human consumption is regulated under the authority of the Federal Food, Drug, and Cosmetic Act (9 U.S.C. 301 et seq.) by the Food and Drug Administration (FDA), U.S. Department of Health and Human Services. In addition, routine monitoring to ensure that residues or specific metabolites, when appropriate, in meat and poultry do not exceed established tolerances is part of the U.S. Department of Agriculture's Food Safety Inspection Service's (FSIS) meat and poultry inspection process. Any meat or poultry found to have drug or pesticide residues exceeding established tolerance limits is considered to be adulterated and condemned as not fit for human consumption. Because condemnation results in a significant financial loss, livestock and poultry producers and processors have a significant incentive to prevent the presence of drug and pesticide residues at time of slaughter. Monitoring for drug and pesticide residues by the FSIS is under the authorities of the Federal Meat Inspection Act, as amended by the Wholesome Meat Act (21U.S.C.601 et seq.) and the Poultry Products Inspection Act, as amended by the Wholesome Poultry Products Act (21 U.S.C 451 et seq.).

In the FDA drug approval process, all new drugs marketed for veterinary use must be approved. There are two types of approval for veterinary drugs, including those routinely used in animal feeds (21 CFR 558.3). Category I drugs require no withdrawal period before slaughter at the lowest use level for each species for which they are approved. Category II drugs require a special withdrawal period at the lowest use level for each species for which they are approved or are regulated on a "no residue" basis or with a "zero" tolerance, because of a carcinogenic concern regardless of whether or not a withdrawal period is required. The basis for establishing minimum withdrawal periods and tolerances of new animal drugs in edible products of food-producing animals by FDA is set forth in 21 CFR 556.1. If there is an expectation of, or uncertainty about, the presence of residues, a withdrawal period or a maximum concentration in specified tissue will be established. Withdrawal periods and tolerances or the absence thereof for all animal drugs approved for use in food-producing animals are set forth from 21 CFR 556.20 through 21 CFR 556.770. For example, Bacitracin zinc has no required withdrawal period but a limit of 0.5 parts per million (ppm) in un-cooked edible tissue of cattle, swine, and poultry (21 CFR 556.70). Virginiamycin also has no required withdrawal period before slaughter but limits of 0.4 ppm in uncooked edible kidney, skin, and fat; 0.3 ppm in liver, and 0.1 ppm in muscle. There are no residue tolerance limits for broiler chickens and cattle. Generally residue concentration limits are no more than 1 ppm.

As noted above, all livestock and poultry slaughtered at federally inspected facilities is inspected by the FSIS under the authority of the Federal Meat Inspection Act as amended and the

Poultry Products Inspection Act as amended. Condemnation, as unfit for human use, of all meat and poultry found to be adulterated is required. In the Federal Meat Inspection Act, the definition of the term adulterated includes the presence of any poisonous or deleterious substance that may render the carcass or any part thereof injurious to health.

Regulations promulgated under the authority of Poultry Products Inspection Act are more specific and require that all carcasses, organs, or other parts of carcasses be condemned, if it is determined on the basis of a sound statistical sample that they are adulterated because of the presence of any biological residue (9 CFR 381.80). Biological residue is defined as any substance, including metabolites, remaining in poultry at the time of slaughter or in any of its tissues after slaughter, as the result of treatment or exposure of the live poultry to a pesticide, organic compound, metallic or inorganic compound, hormone, hormone-like substance, growth promoter, antibiotic, anthelmintic, tranquilizer, or other agent that leaves a residue (9 CFR 381.1).

Given the statutory and regulatory barriers in place to prevent residues of antibiotics and other animal drugs, as well as pesticides in food for human consumption above established tolerance limits, EPA assumes that it is highly improbable that antibiotics, other animal drugs, or pesticides are present routinely in detectable concentrations in the treated effluent of livestock or poultry processing plants. Obviously, the possibility of the slaughter of livestock or poultry containing drug or pesticide residues above tolerance limits exists. However, the financial self-interest of livestock and poultry producers suggests that such occurrences would be infrequent and highly random. Thus, the probability of detection would be low especially when pre-treatment processes, such as anaerobic lagoons with relatively long hydraulic detention time, are used. Therefore, EPA has concluded that establishing effluent standards for antibiotics and other animal drugs and pesticides and requiring routine monitoring may impose an unnecessary burden on livestock and poultry processors.

7.2.1 Classical and Biological Pollutants

Aeromonas

Aeromonas is a member of the family Vibrionaceae, which also includes Vibrios such as *Vibrio cholerae*, the cause of cholera in humans. *Aeromonas* is not a common inhabitant of the intestinal tract of warm-blooded animals and normally is found in aquatic habitants. Its presence in meat and poultry processing wastewaters probably is the result of colonization in wastewater collection and treatment systems.

Biochemical Oxygen Demand

Biochemical oxygen demand (BOD) is an estimate of the oxygen-consuming requirements of organic matter decomposition under aerobic conditions. When meat and poultry processing wastewaters are discharged to surface waters, the microorganisms present in the naturally occurring microbial ecosystem decompose the organic matter contained therein. This decomposition of organic matter consumes oxygen and reduces the amount available for aquatic animals. Severe reductions in dissolved oxygen concentrations can lead to fish kills. Even moderate decreases in dissolved oxygen concentrations can adversely affect water bodies through decreases in biodiversity, as manifested by the loss of some species of fish and other aquatic animals. Loss of biodiversity in aquatic plant communities due to anoxic conditions also can occur.

BOD is determined by measuring the depletion of dissolved oxygen resulting from aerobic microbial activity in a suitably diluted sample during incubation at 20 ˚C over a fixed period of time. Normally, this fixed period of time is five days and the results are reported as 5-day BOD or BOD_5. If the bacteria responsible for nitrification are present in the sample, BOD_5 is a combined estimate of the oxygen required for organic matter oxidation and the oxidation of ammonia to nitrate nitrogen (nitrification). Thus, BOD_5 includes both carbonaceous oxygen demand ($CBOD_5$) and nitrogenous oxygen demand (NOD). However, $CBOD_5$ can be determined separately by adding an agent that inhibits nitrification prior to incubation.

BOD_5 determinations include estimates of oxygen requirements for the degradation of both particulate and dissolved organic matter. First filtering the sample to remove particulate organic matter and then determining the BOD_5 of the filtrate, dissolved BOD_5, can separate these estimates. The difference between BOD_5 and dissolved BOD_5 is an estimate of the contribution of particulate matter to total BOD.

Chemical Oxygen Demand

Chemical oxygen demand (COD) is an estimator of the total organic matter content of both wastewaters and natural waters. It is the measure, using a strong oxidizing agent in an acidic medium, of the oxygen equivalent of the oxidizable organic matter present. COD generally is higher than BOD, because COD includes slowly biodegradable and recalcitrant organic compounds not degraded microbially during the duration of the BOD test. For many types of wastewaters, the ratio between BOD and COD is relatively constant. When such a relatively constant ratio exists, COD can be used as a surrogate to estimate the impact of wastewater discharges on natural wastewaters. However, COD is most useful as a control parameter for wastewater treatment plant operation, because it can be determined in three hours as opposed to BOD, which requires a minimum of five days. Thus, COD can be used to rapidly recognize deterioration in wastewater treatment plant performance and the need for corrective action.

Chloride

Chloride (Cl^-) is a common anion in both wastewaters and natural waters. However, excessively high chloride concentrations in wastewater discharges can be harmful to both animals and plants in non-marine surface waters and disrupt ecosystem structure. Also, it can adversely affect biological waste-water treatment processes. Further, excessively high chloride concentrations in surface waters can impair their use as source waters for potable water supplies due to taste, if sodium is the predominant cation present, because of the corrosive action of chloride ions.

There are numerous sources of chloride in meat and poultry processing wastewaters. However, salt used in meat curing processes probably is the most significant single source.

Cryptosporidium

Cryptosporidium parvum is an intestinal protozoan parasite responsible for the infectious disease cryptosporidiosis, which predominantly occurs in ruminants, particularly young calves. However, other mammals, including pigs and humans, also can be infected. The mechanism of transmission is via oocysts shed in the feces of infected individuals. Clinical infection is most common in young animals and usually is self-limiting, with surviving individuals becoming carriers as adults. Other species of *Cryptosporidium* are responsible for infection in poultry but are not causative agents of cryptosporidiosis in mammals, including humans. Thus, consideration of *Cryptosporidium* as a pollutant for possible regulation was limited to cattle, and especially veal processing wastewaters.

Hexane Extractable Materials (Oil and Grease)

In meat and poultry processing wastewaters, oil and grease (primarily) is an estimate of the concentration of animal fats and oils lost during processing activities, but also may include lubricating oils and greases. Oil and grease is not a specific substance. Rather, it is a group of substances determined on the basis of their common solubility in an organic extraction agent. Although a variety of extraction agents have been used for the estimation of oil and grease concentrations in wastewaters, including trichlorotrifluoroethane, n-hexane or a mixture of n-hexane and methyl-tert-butyl ether commonly is used, and oil and grease may be alternatively described as hexane extractable materials (American Public Health Association, 1995).

Oil and grease in discharges of meat and poultry processing wastewaters are of concern for several reasons. One is the high BOD of animal fats and oils, which are readily biodegradable, and the impact on the dissolved oxygen status of receiving waters and related impacts on aquatic biota. In addition, a film of oil and grease on the surface of receiving waters can be unsightly and reduce natural re-aeration processes. Furthermore, soluble and emulsified oil and grease can inhibit oxygen and other gas transport processes necessary for plant and animal survival, also resulting in aquatic ecosystem disruption.

Indicator Organisms

The total coliform, fecal coliform, and fecal streptococcus groups of bacteria share the common characteristic of containing species which normally are present in the enteric tract of all warm-blooded animals, including humans. Thus, these groups of bacteria commonly are used as indicators of fecal contamination of natural waters and the possible presence of enteric pathogenic bacteria, viruses, and parasites of enteric origin. They are used as indicators of the possible presence of enteric pathogens, because of their normal presence in generally high densities in comparison to enteric pathogens, such as *Salmonella* and *Shigella*, and their relative ease of enumeration.

The total coliform group of bacteria consists of several genera of bacteria belonging to the family Enterobacteriaceae, but also contains organisms not typical of enteric organisms, such as the species *Enterobacter aerogenes*. Thus, the presence of total coliforms only is an indicator of possible fecal contamination, whereas members of the fecal coliform group are limited to those genera of the family Enterobacteriaceae limited to the enteric tract of warm-blooded animals with the species *Escherichia coli* typically being the principal component of the fecal coliform group. Because fecal streptococci also are normally present in the enteric tract of warm-blooded animals in relatively high numbers, the fecal streptococcus group of bacteria also is an indicator of fecal contamination of natural waters.

Because of the presence of manure and the common combination of processing and sanitary wastewaters for treatment, total coliforms, fecal coliforms, *E. coli*, and fecal streptococcus were considered as pollutants for possible regulation in meat and poultry processing wastewaters as indicators of inadequate disinfection and the possible presence of pathogens in discharged effluents. In addition to potential human health impacts through use of receiving surface waters as source waters for public and private water supplies and contact recreation, pathogens possibly present in meat and poultry processing wastewaters can be infectious to wildlife.

Nitrogen

Several forms of nitrogen are pollutants of concern in meat and poultry processing wastewaters. Included are total Kjeldahl nitrogen (TKN), ammonia nitrogen (NH_4-N) and nitrite plus nitrate nitrogen (NO_2 + NO_3-N). Because protein is the principal component of meat and blood, meat, and poultry processing, wastewaters can contain relatively high concentrations of nitrogen. Another source of nitrogen in these wastewaters is in fecal material in the forms primarily of unabsorbed feed proteins and products of protein degradation.

Total Kjeldahl nitrogen (TKN) is an estimate of the sum of organic nitrogen and ammonia nitrogen and provides an estimate of organic nitrogen by difference when ammonia nitrogen is concurrently determined. Under both anaerobic and aerobic conditions, the readily biodegradable fraction of organic nitrogen is mineralized readily by microbial activity with the nitrogen not used for cell synthesis accumulating as ammonia nitrogen. The water quality impacts associated with organic nitrogen are related to this process of mineralization to ammonia nitrogen in natural waters and are discussed below.

As noted above, ammonia nitrogen in meat and poultry processing wastewaters is the product primarily of organic nitrogen mineralization. However, cleaning and sanitizing agents also are possible sources. Ammonia nitrogen is present in aqueous solutions in both as ionized (ammonium) and un-ionized (ammonia) species. Ammonia nitrogen is a pollutant considered for regulation in meat and poultry processing wastewaters, because its presence in wastewater discharges to surface waters has several negative environmental impacts. Both ammonia and ammonium nitrogen can be directly toxic to fish and other aquatic organisms, with ammonia nitrogen being more toxic. In addition, discharges of ammonia nitrogen can reduce ambient dissolved oxygen concentrations in receiving surface waters because of the microbially mediated oxidation of ammonia nitrogen to nitrite and nitrate nitrogen. This demand is known as nitrogenous oxygen demand (NOD).

Ammonia nitrogen in wastewater discharges also can be responsible for the development of eutrophic conditions and the associated adverse impacts on ambient dissolved oxygen concentrations, if nitrogen is the nutrient limiting primary productivity. While phosphorus typically is the nutrient limiting primary productivity in fresh surface waters, nitrogen typically is the limiting nutrient in marine waters and the more saline segments of estuaries. Eutrophic conditions, an excess of primary productivity, are characterized by algae blooms, which cause shifts in ambient dissolved oxygen concentrations from super saturation during sunny days to substantial deficits at night and on cloudy days, when photo-synthesis is not occurring. The decay of the biomass generated by excessive primary productivity also exerts a demand on ambient dissolved oxygen concentrations. With the depression of ambient dissolved oxygen concentrations, populations of fish and other aquatic organisms are adversely affected, with the possible change in ecosystem composition and loss of biodiversity.

Nitrite and nitrate nitrogen is rarely present in meat and poultry processing wastewaters before aerobic biological treatment, due to the lack of oxygen necessary for microbially mediated nitrification. However, nitrite and nitrate salts used in further processing are potential sources. Thus, the principal source of nitrite and nitrate nitrogen following treatment is nitrification during aerobic biological treatment, which often is required, at least seasonally, to satisfy effluent limitations for the discharge of ammonia nitrogen to surface waters. Usually, nitrate nitrogen is the predominate form of oxidized nitrogen in these discharges, with nitrite nitrogen present only in trace amounts. High concentrations of nitrite nitrogen usually are indicative of incomplete nitrification and are accompanied by more than trace ammonia nitrogen concentrations.

Although nitrite nitrogen will exert an NOD in surface waters, the principal concern about oxidized forms of nitrogen in wastewater discharges is related to their role in the development of eutrophic conditions. The impacts of such conditions on fish populations, biodiversity, recreation, and potable water supply treatment costs were discussed above. An additional concern is their potential for increasing ambient surface water nitrate nitrogen concentrations above the national maximum contaminant level (MCL) of 10 mg per L in source waters used for public drinking water supplies.

Phosphorus

Total phosphorus and total orthophosphate phosphorus: phosphorus is a pollutant considered for regulation in meat and poultry processing wastewaters, because of the role of phosphorus as the nutrient typically limiting primary productivity in freshwater ecosystems. In such aquatic ecosystems, an increase in ambient phosphorus concentration due to wastewater discharges above naturally occurring levels results in the excessive growth of algae and other phytoplankton, with the development of eutrophic conditions as the consequence. In turn, eutrophic conditions can cause fish kills, disruption of natural aquatic ecosystem structure, and loss of biodiversity. Additional impacts of eutrophication in fresh waters include impairment of recreational use and additional treatment cost for use of these waters as a source of potable water. In marine waters, phosphorus is not a pollutant of concern due to relatively high naturally occurring phosphorus concentrations. The impact of phosphorus in wastewater discharges into estuaries varies with impacts generally decreasing as salinity levels increase.

There are numerous sources of phosphorus in meat and poultry processing wastewaters, including bone, soft tissue, blood, manure, detergents and sanitizers, and boiler water additives to control corrosion. Both organic and inorganic forms of phosphorus are present, with inorganic forms present as both ortho- and polyphosphate phosphorus. Total orthophosphate phosphorus, also known as total reactive phosphorus, can be directly used by phytoplankton and higher adequate plants and are immediately available sources of phosphorus. Although polyphosphate forms of phosphorus undergo hydrolysis in aqueous solutions, hydrolysis usually is quite slow, as is mineralization of organically bound phosphorus. Thus, orthophosphate phosphorus is a potential pollutant of concern because of its immediate biological availability, whereas polyphosphates and organically bound phosphorus, which comprise the difference between total phosphorus and orthophosphate phosphorus, are pollutants of concern as sources of slowly released orthophosphate phosphorus.

Dissolved total phosphorus simply is the sum of ortho-and-polyphosphate phosphorus in solution by excluding suspended forms of phosphorus by filtration.

Salmonella

A number of pathogenic species of Salmonella, including *Salmonella enteritidis*, are common inhabitants of the enteric tracts of livestock and poultry and may be present in meat and poultry processing wastewaters. Because of its potential risk to public health through public and private water supplies, contact forms of recreation, and wild life exposure to effluents discharged to natural waters, *Salmonella* was considered as a pollutant for possible regulation in these wastewaters.

Solids

Meat and poultry processing wastewaters before and after treatment contain both suspended and dissolved solids, which also are known as non-filterable and filterable residue. Suspended and dissolved solids concentrations are determined by filtering the solids with a standard glass fiber filter, then drying them to a constant weight. Those solids retained on the filter are considered to be suspended solids, and those solids passing through the filter are considered to be dissolved solids. Dissolved solids concentrations also can be estimated indirectly by determining their conductance, the ability to carry an electric current. This ability depends on the presence and dissociation of inorganic compounds. Organic compounds in aqueous solutions generally do not dissociate and are poor conductors of electricity.

The principal constituents of suspended solids in treated meat and poultry processing wastewaters are soft and hard tissue particles not removed during treatment and biomass synthesized during treatment. Thus, suspended solids have both organic (volatile) and inorganic fractions. Dissolved solids consist primarily of dissolved inorganic compounds (primarily calcium, magnesium, iron, manganese, sulfur compounds) but also may contain colloidal organic material. The principal sources of dissolved solids in meat and poultry processing wastewaters are potable water supplies used for process-ing, salts used in processing such as sodium chloride, and cleaning and sanitizing agents. Generally, the organic, and therefore potentially biodegradable, fraction of suspended solids is substantially higher than the inorganic fraction, with the reverse typically characteristic of dissolved solids. Total solids are the sum of suspended and dissolved solids with total volatile solids or total volatile residue representing an estimate of the organic fraction of total solids.

Both suspended and dissolved solids in meat and poultry processing wastewater effluents were pollutants considered for several reasons. Suspended solids that settle to form bottom deposits can create anaerobic conditions because of the oxygen demand exerted by microbial decomposition. They can alter habitat for fish, shellfish, and benthic organisms. Suspended solids also provide a medium for the transport of other sorbed pollutants including nutrients, pathogens, metals, and toxic organic compounds, such as pesticides with accumulation and storage in settled deposits. Settled, suspended solids and other associated pollutants often have extended interaction with the water column through cycles of deposition, resuspension, and redeposition.

Suspended solids in wastewater discharges also can clog fish gills, reducing oxygen transport and increasing turbidity. In severe situations, clogging of fish gills can result in asphyxiation, and in less severe situations can result in an increase in susceptibility to infection. In addition, suspended solids increase turbidity in receiving waters and reduce penetration of light through the water column, thereby limiting the growth of rooted aquatic vegetation that serves as a critical habitat for fish, shellfish, and other aquatic organisms.

Dissolved solids were considered as pollutants for possible regulation, primarily because of their potential impact on the subsequent use of receiving waters as source waters for public and industrial water supplies. Reduction of dissolved solids concentrations in source waters to acceptable levels for public and industrial water supply use can be a costly process. However, dissolved solids also have the potential to alter the chemistry of natural waters to a degree that adversely impacts indigenous aquatic biota, especially in the immediate vicinity of the effluent discharge. An example is the possible influence on the toxicity of heavy metals and organic compounds to fish and other aquatic organisms, primarily because of the antagonistic effect of hardness.

Possible regulation of total volatile residue (total volatile solids) in meat and poultry processing wastewaters was considered, because this parameter also is an estimator of organic matter and potentially exerted oxygen demand in receiving waters after treated effluent discharge.

Total Residual Chlorine

Chlorine in the form of chlorine gas (Cl_2), calcium hypochlorite [$Ca(OCl)_2$], sodium hypochlorite (NaOCl), or chlorine dioxide (ClO_2), is commonly used for the disinfection of meat and poultry processing wastewaters before direct discharge to surface waters. Because free chlorine is directly toxic to aquatic organisms and can react with naturally occurring organic compounds in natural waters to form toxic compounds such as trihalomethane, total residual chlorine in meat and poultry processing wastewater effluents was considered as a pollutant for possible regulation.

Total Organic Carbon

Total organic carbon (TOC) is a measure of a variety of organic compounds in various oxidation states in water and wastewater. Some of these compounds can be oxidized further by biological or chemical processes and are captured in BOD or COD determinations. However, these tests also may not oxidize some organic carbon compounds. Thus, TOC may provide the most accurate estimate of organic matter content; it provides no information relative to potentially exerted oxygen demand. However, TOC can be used to estimate BOD and COD in a wastewater with a relatively constant composition, once correlations between TOC and BOD and COD are established. Like COD, TOC can be determined rapidly in contrast to BOD, which requires a five-day incubation period.

7.2.2 Non-conventional Pollutants

Metals

A number of metals from a range of possible sources have the potential to be present in meat and poultry processing wastewaters. These possible sources include water supplies and distribution systems, processing equipment, cleaning and sanitizing agents, and wastewater collection systems and treatment equipment. In addition, metals including arsenic, copper, and zinc commonly are added to livestock and poultry feeds as trace mineral supplements or growth stimulants, and may be present in manures.

The following metals were considered as pollutants for possible regulation in meat and poultry processing wastewaters: antimony, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, lead, manganese, mercury, molybdenum, nickel, selenium, silver, thallium, tin, titanium, vanadium, yttrium, and zinc. These metals were considered as pollutants for possible regulation in meat and poultry processing wastewaters, because of their potential toxicity to phytoplankton and zooplankton and to higher aquatic plant and animal species, including fish. They also are pollutants of concern, given the potential for bioaccumulation and biomagnification in aquatic food chains and presence downstream in effluent receiving waters used as source waters for potable water supplies. Although removal of metals from wastewaters during conventional physicochemical and biological treatment processes occurs through adsorption to biosolids removed by settling and filtration before discharge, these processes are not intentionally engineered to remove metals before effluent discharge.

Pesticides

Pesticides, with the exception of rodenticides in enclosed bait stations, are not used in meat and poultry processing facilities to prevent the risk of product contamination. They are, however, commonly topically applied to livestock and poultry in animal feeding operations for the control of ectoparasites. Although withdrawal periods are required before slaughter, residues may remain on feathers, hair, and skin at slaughter. Thus, the following pesticides were considered as pollutants for possible regulation in meat processing wastewaters: carbaryl, cis-permethrin, dichlorvos, Malathion, and tetrachlorvinphos. Transpermithrin and carbaryl were considered as a pollutant for possible regulation in poultry processing wastewaters.

These pesticides were considered as pollutants for possible regulation because of their toxicity to aquatic ecosystems and their potential for bioaccumulation and biomagnification in aquatic food chains and presence downstream in effluent receiving waters used as source waters for potable water supplies. Although removal of pesticides from wastewaters during conventional physicochemical and biological treatment processes occurs through adsorption to biosolids removed by settling and filtration before discharge, these processes are not intentionally engineered to remove metals before effluent discharge. For some pesticides, biodegradation also may occur during wastewater treatment.

7.3 SELECTION OF POLLUTANTS OF CONCERN

EPA determined pollutants of concern for the meat and poultry products industry by assessing Agency sampling data. To establish the pollutants of concern, EPA reviewed the analytical data from influent wastewater samples to determine the pollutants, which were detected at treatable levels. EPA set treatable levels at five times the baseline value to ensure that pollutants detected at only trace amounts would not be selected.

EPA obtained the pollutants of concern by establishing which parameters were detected at treatable levels in at least 10 percent of all the influent wastewater samples. Tables 7-2 and 7-3 detail the list of meat and poultry products industry pollutants of concern. EPA did not sample at independent rendering facilities and transferred data from on-site rendering facilities. Consequently, EPA is using all the pollutants of concern from Tables 7-1 and 7-2 for independent rendering facilities. EPA is planning further sampling at independent rendering facilities after proposal to better develop a list of pollutants of concern for this segment of the industry.

Table 7-2. Pollutants of Concern for Meat Processing Facilities

Pollutant Group	Pollutant	CAS Number
Classicals or biologicals	Aeromonas	C2101
	Ammonia as nitrogen	7664417
	Biochemical oxygen demand	C003
	BOD 5-day (carbonaceous)	C002
	Chemical oxygen demand (COD)	C004
	Chloride	16887006
	Cryptosporidium	137259508
	Dissolved biochemical Oxygen demand	C003D
	Dissolved phosphorus	14265442D
	E. Coli	C050
	Fecal coliform	C2106
	Fecal streptococcus	C2107
	Hexane extractable material	C036
	Nitrate/nitrite	C005
	Total coliform	E10606
	Total dissolved solids	C010
	Total Kjeldahl nitrogen	C021
	Total organic carbon (TOC)	C012
	Total orthophosphate	C034
	Total phosphorus	14265442
	Total suspended solids	C009
	Volatile residue	C030
Metals	Chromium	7440473
	Copper	7440508
	Manganese	7439965
	Titanium	7440326
	Zinc	7440666
Pesticides	Carbaryl	63252
	Cis-permethrin	61949766
	Trans-permethrin	61949777

Table 7–3. Pollutants of Concern for Poultry Processing Facilities

Pollutant Group	Pollutant	CAS Number
Classicals or Biologicals	Aeromonas	C2101
	Ammonia as nitrogen	7664417
	Biochemical oxygen demand	C003
	BOD 5-day (carbonaceous)	C002
	Chemical oxygen demand (COD)	C004
	Chloride	16887006
	Dissolved biochemical Oxygen demand	C003D
	Dissolved phosphorus	14265442D
	E. Coli	C050
	Fecal coliform	C2106
	Fecal streptococcus	C2107
	Hexane extractable material	C036
	Nitrate/nitrite	C005
	Salmonella	68583357
	Total coliform	E10606
	Total dissolved solids	C010
	Total Kjeldahl nitrogen	C021
	Total organic carbon (TOC)	C012
	Total orthophosphate	C034
	Total phosphorus	14265442
	Total residual chlorine	7782505
	Total suspended solids	C009
	Volatile residue	C030
Metals	Copper	7440508
	Manganese	7439965
	Zinc	7440666
Pesticides	Carbaryl	63252

7.4 SELECTION OF POLLUTANTS FOR REGULATION

7.4.1 Methodology for Selection of Regulated Pollutants

EPA selects the pollutants for regulation based on applicable Clean Water Act provisions regarding the pollutants subject to each statutory level and the pollutants of concern (POCs) identified for each subcategory.

As presented above, EPA selected a subset of pollutants for which to establish numerical effluent limitations from the list of POCs for each regulated subcategory. Generally, a chemical is considered a POC if it is detected in the untreated process wastewater at five times the minimum level (ML) in more than 10 percent of samples.

Monitoring for all POCs is not necessary to ensure that meat and poultry products wastewater pollution is adequately controlled, since many of the pollutants originate from similar sources, have similar treatabilities, are removed by similar mechanisms, and are treated to similar levels. Therefore, it may be sufficient to monitor for one pollutant as a surrogate or indicator of several others.

Regulated pollutants are pollutants for which the EPA would establish numerical effluent limitations and standards. EPA selected a POC for regulation in a subcategory if it meets all the following criteria:

- Chemical is not used as a treatment chemical in the selected technology option.
- Chemical is not considered a nonconventional bulk parameter.
- Chemical is not considered a volatile compound.
- Chemical is effectively treated by the selected treatment technology option.
- Chemical is detected in the untreated wastewater at treatable levels in a significant number of samples, generally five times the minimum level at more than 10 percent of the raw wastewater samples.
- Chemicals whose control through treatment processes would lead to control of a wide range of pollutants with similar properties; these chemicals are generally good indicators of overall wastewater treatment performance.

Based on the methodology described above, EPA proposes to regulate pollutants in each subcategory that will ensure adequate control of a range of pollutants.

7.4.2 Selection of Regulated Pollutants for Existing and New Direct Dischargers

The current regulation requires facilities to maintain the pH between 6.0 and 9.0 at all times. EPA intends to retain this limitation and proposes to codify identical pH limitations for previously unregulated subcategories. The pH shall be monitored at the point of discharge from the wastewater treatment facility to which effluent limitations derived from this part apply.

In addition, EPA is proposing to establish effluent limitations for MPP facilities for the following pollutants of concern: BOD, COD, TSS, hexane extractable materials (oil and grease), fecal coliforms, ammonia, total nitrogen (total Kjeldahl nitrogen plus nitrite and nitrate nitrogen), and total phosphorus. The specific justifications for the pollutants to be regulated for each subcategory are provided below. In general, EPA selected these pollutants because they are representative of the characteristics of meat processing wastewaters generated in the industry, and are key indicators of the performance of treatment processes that serve as the basis for the effluent limitations.

A number of POCs evaluated by EPA are parameters that identify the quantity of material in an effluent that is likely to consume oxygen as it breaks down in surface waters after it has been discharged. These parameters include total organic carbon, BOD, carbonaceous BOD, COD, and dissolved BOD. Values for these POCs in meat poultry processing wastes are typically very high due to the wastewaters generated from killing, evisceration, further processing, and rendering processes. EPA is proposing to regulate BOD and COD, which will be used as indicators of the performance of biological treatment systems to remove all oxygen-demanding pollutants and impact of treated effluent discharges to surface waters on dissolved oxygen concentrations.

Total suspended solids (TSS), total dissolved solids (TDS), and total volatile residue are parameters that measure the quantity of solids in a wastewater. Meat processing facilities typically produce wastewaters high in organic solids, including blood, carcass, feathers, and feces. These solids cause a high oxygen demand (both chemical and biochemical) and are high in nitrogen content. Because some nutrients bind to solids, and solids often include oxygen-demanding organic material, limiting the loading of solids will prevent degradation of surface waters. EPA proposes to regulate TSS as an indicator of performance of biological treatment systems to remove solids. EPA considered regulation of TDS, however, because as organic matter is broken down in a biological wastewater treatment system, levels of TDS may increase, which makes regulation of TDS not feasible.

Wastewaters from meat processing facilities have high concentrations of the nutrients nitrogen and phosphorus associated primarily with blood, soft tissue, fecal material, and cleaning and sanitizing agents. In addition, those facilities employing advanced biological treatment systems to remove ammonia by biological nitrification, convert ammonia nitrogen to nitrite and nitrate nitrogen through microbially mediated oxidation. Due to the potential degrading impacts to surface waters associated with the discharge of nitrogen and phosphorus (e.g., eutrophication), EPA proposes to regulate total nitrogen and total phosphorus. In regulating total nitrogen and total phosphorus, EPA will ensure that biological treatment systems used by facilities are effectively removing all forms of these nutrients, including total Kkjeldahl nitrogen, nitrate/nitrite, ammonia nitrogen, orthophosphate, and dissolved phosphorus. EPA is also proposing to specifically regulate ammonia nitrogen, because of the significant oxygen demand it exerts, as well as its relatively high toxicity to aquatic life.

Oil and grease (as n-hexane-extractable material) is a parameter that measures oil and grease concentrations in effluents. Oil and grease, primarily in the form of animal fat, is present in relatively high concentrations in meat and poultry processing wastewaters. EPA is proposing that the control of oil and grease is necessary to ensure that treatment systems are effective in removing oil and grease. Excessive oil and grease concentrations can be associated with high BOD demand in a surface water. They present other nuisance problems, as well.

Chlorides measure the quantity of chloride ion dissolved in solution. In the meat processing industry, salts may be used in further processing and for cleaning and sanitizing purposes. The presence of chloride in discharges to surface waters may impact aquatic organisms, because of their sensitivity to concentrations of salt. Although EPA determined that chlorides are a pollutant of concern, EPA is not proposing to regulate chlorides because biological systems are not specifically designed and operated to treat chlorides. In fact, EPA observed in some instances an increase in chlorides within the biological treatment system (i.e., from the influent to the effluent) at several facilities. As a result, EPA believes that a facility will not be able to manage a biological treatment process to consistently achieve effluent limitations for chlorides.

Total coliforms, fecal coliforms, E. coli, fecal streptococcus, *Salmonella*, and *Aeromonas* were considered POCs, because they provide information on the potential presence bacterial and other pathogens in meat processing wastewaters. Pathogens typically are present in meat and poultry processing wastewaters due to the presence of fecal material. The reduction of pathogens is important to prevent impairment of surface water uses, such as a drinking water source or as a recreation water. EPA is proposing to regulate fecal coliforms as an indicator of the efficacy of treatment processes to control pathogens.

In many instances, EPA found meat processing facilities using chlorine to disinfect treated wastewaters. As a disinfectant, chlorine is highly toxic to aquatic life. Therefore, EPA is also considering regulating total residual chlorine in the final rule as a means to control the amount of chlorine that is discharged to surface waters. EPA is requesting comment on this issue in the preamble for the proposed rule.

Metals may be present in meat processing wastewaters for a variety of reasons. They are used as feed additives they may be contained in sanitation products or they may result from deterioration of meat processing machinery and equipment. Many metals are toxic to algae, aquatic invertebrates, and/or fish. Although metals may serve useful purposes in meat processing operations, most metals retain their toxicity once they are discharged into receiving waters. Although EPA observed that many of the biological treatment systems used within the meat processing industry provide substantial reductions of most metals, biological systems are not specifically engineered to remove metals. As a result, EPA believes that a facility will not be able to manage a biological treatment process to consistently achieve effluent limitations. Therefore, EPA is not proposing to regulate metals.

Pesticides are used for controlling animal ectoparasites and may be present in wastewaters from initial animal wash and processing operations. Some pesticides are bioaccumulative and retain their toxicity once they are discharged into receiving waters. Although EPA observed that many of the biological treatment systems used within the meat processing industry provide adequate reductions of pesticides, most biological systems are not specifically engineered to remove pesticides. As a result, EPA believes that a facility will not be able to manage a biological treatment process to consistently achieve effluent limitations for pesticides. Therefore, EPA is not proposing to regulate pesticides.

7.5 REFERENCES

American Public Health Association (APHA). 1995. Standard methods for the examination of water and wastewater, 19th edition, American Public Health Association, Washington, DC.

S.E. Aiello, ed., 1998. The Merck veterinary manual, 8th edition, Merck and Company, Inc., Whitehouse Station, New Jersey.

SECTION 8

WASTEWATER TREATMENT TECHNOLOGIES AND POLLUTION PREVENTION PRACTICES

8.1 INTRODUCTION

This section describes unit processes that are currently in use or may be used to treat meat and poultry products (MPP) wastewaters. A variety of unit processes are used to provide primary, secondary, and tertiary wastewater treatment; however, because of the similarities in the physical and chemical characteristics of meat and poultry products wastewaters, EPA identified no practical difference in the types of treatment technologies between meat and poultry products facilities (e.g., primary treatment for removal of solids, biological treatment for removal of organic and nutrient pollutants). In addition, the unit processes that are used in the treatment of MPP wastewaters are similar to those normally used in the treatment of domestic wastewaters (Eremektar et al., 1999; Johnston, 2001). In this section, those unit processes most commonly used or potentially transferable from other industries for the treatment of MPP wastewaters are described and typical combinations of unit processes are outlined.

Wastewater treatment falls into three main categories: (1) primary treatment (e.g., removal of floating and settleable solids); (2) secondary treatment (e.g., removal of most organic matter); and (3) tertiary treatment (e.g., removal of nitrogen or phosphorus or suspended solids or some combination thereof). MPP facilities that discharge to a publicly owned treatment works (POTW), typically employ only primary treatment; however, some facilities may also provide secondary treatment, as demonstrated in the data provided in the MPP detailed survey. MPP facilities that discharge directly to navigable waters under the authority of a National Pollutant Discharge Elimination System (NPDES) typically both primary and secondary treatment to generated wastewaters. As also described in the MPP detailed surveys, many direct dischargers also apply tertiary treatment to wastewater discharged under the NPDES permit system. Table 8-1 identifies the types of wastewater treatment commonly found in the MPP industry.

Table 8–1. Distribution of Wastewater Treatment Units In MPP Industry

Treatment Category	Treatment Unit	Percent of Direct/Indirect Discharging Facilities Having The Treatment Unit In Place	
		Direct Discharger	Indirect Discharger
Primary treatment	Screen	98 percent	64 percent
	Oil and Grease Removal	83 percent	77 percent
	Dissolved Air Floatation	81 percent	46 percent
	Flow Equalization	75 percent	34 percent
Secondary and tertiary treatment	Biological Treatment [a]	100 percent	13 percent
	Filtration	23 percent	0 percent
	Disinfection	92 percent	0 percent

[a] Biological treatment includes any combination of the following: aerobic lagoon, anaerobic lagoon, facultative lagoon, any activated sludge process, and/or other biological treatment processes (e.g., trickling filter).
Source: EPA Detailed Survey Data.

8.2 PRIMARY TREATMENT

As noted above, primary treatment involves removal of floating and settleable solids. In MPP wastewaters, the typical unit processes used for primary treatment are screening, catch basin, dissolved air flotation (DAF), and flow equalization. Chemicals are often added to improve the performance of the treatment units (e.g., flocculant or polymer addition to DAF units). Primary treatment has two objectives in the MPP industry: (1) reduction of suspended solids and biochemical oxygen demand (BOD) loads to subsequent unit processes; and (2) the recovery of materials that can be converted into marketable products through rendering.

8.2.1 Screening

Screening is typically the first and most inexpensive form of primary treatment. Screening removes large solid particles from the waste stream that could otherwise damage or interfere with downstream equipment and treatment processes, including pumps, pump inlets, and pipelines (Nielsen, 1996). There are several types of screens used in wastewater treatment including: (1) static or stationary, (2) rotary drum, (3) brushed, and (4) vibrating. Static, vibrating, or rotary drum screens are most commonly used as primary treatment (USEPA, 1974, 1975). These screens use stainless steel wedge wire as the screen material and remove medium and coarse particles between 0.01 to 0.06 inches in diameter. Generally, all wastewater generated in MPP facilities is screened before discharge to subsequent treatment processes. Use of screens aids in recovery of valuable by-products that are sometimes used as a raw material for the rendering industry and subsequent industries (Banks and Adebowale, 1991; USEPA, 1974; USEPA, 1975). The use of secondary screens is becoming more prevalent in the industry. Secondary screening has the advantage of by-product recovery prior to adulteration by coagulants and reduces the volume of solids to be recovered in subsequent unit processes, such as the dissolved air flotation (Starkey and Wright, 1997).

The following describes the main types of screens used at MPP facilities.

8.2.1.1 Static Screens

The primary function of a static screen is to remove large solid particles (USEPA, 1974; USEPA, 1975). For example, the physical nature of slaughterhouse raw wastewater can include coarse, suspended matter (larger than 1 mm mesh) which is insoluble, slowly biodegradable, and 40 to 50 percent of the raw wastewater COD (Johns, 1995). Screening can be accomplished in several ways, and in older versions, only gravity drainage is involved. A concavely curved screen design using high-velocity pressure feeding originally developed for mineral classification has been adapted to meet MPP wastewater treatment needs. This design employs bar interference to the slurry, which knives off thin layers of the flow over the curved surface. The screen material usually is 316 stainless steel although harder, wear-resistant stainless alloys may also be used for special purposes. Openings of 0.025 to 0.15 cm (0.01 to 0.06 inch) meet normal screening needs (USEPA, 1974; USEPA, 1975). Figure 8-1 shows a general schematic of a static screen.

In some poultry products facilities, “follow-up” stationary screens, consisting of two, three, and four units placed vertically in the effluent sewer before discharge to the municipal sewer, have successfully prevented escape of feathers and solids from the drains in the flow-away screen room and other drains on the premises. These stationary “channel” screens are framed and are usually constructed of mesh or perforated stainless steel with ¼- to ½ -inch openings. The series arrangement permits removal of a single screen for cleaning and improves efficiency. The three-slope static screen is being used in a few poultry products facilities as primary treatment (USEPA, 1975). Static screens can be used in series to remove of coarse particles first before further screening by finer mesh screens.

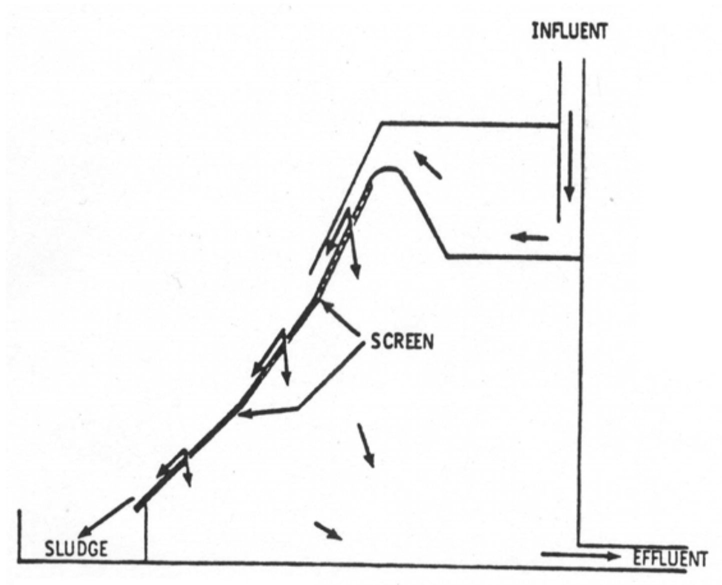

Figure 8-1. General schematic of a static screen (U.S. EPA,1980)

8.2.1.2 Rotary Drum Screens

Rotary drum screens typically are constructed of stainless steel mesh or wedge wire and are designed in one of two ways. The first, driven by external rollers, receives the wastewater at one open end and discharges the solids at the other open end. The screen is inclined toward the exit end to facilitate movement of solids. The liquid passes outward through the screen (usually stainless steel screen cloth or perforated sheet) to a receiver and then to the sewer. To prevent clogging, the screen is usually sprayed continuously from a line of external spray nozzles (USEPA, 1974; USEPA, 1975).

The second type of rotary screen is driven with an external pinion gear. Raw wastewater discharges into the interior of the screen, below the center, and solids are removed in a trough that is mounted lengthwise with a screw conveyor. The liquid exits from the screen into a box where the screen is partially submerged. The screen itself is typically 40 by 40 mesh, with openings of 0.4 mm. To assist lifting the solids to the conveyor trough, perforated lift paddles are mounted lengthwise on the inside surface of the screen. Externally spraying the screen helps reduce blinding, and teflon coated screens reduce clogging by grease. Solid removals up to 82 percent have been reported (USEPA, 1974; USEPA, 1975).

Figure 8-2 shows a general schematic of a rotating drum screen.

8.2.1.3 Brushed Screens

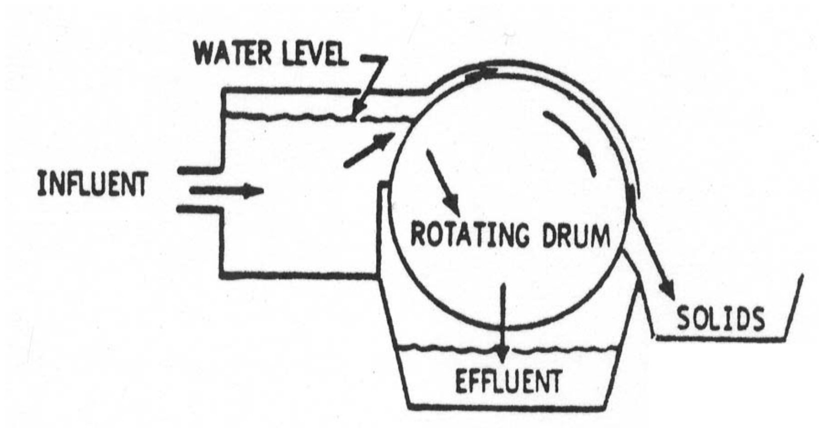

Figure 8-2. General schematic of a rotary drum screen. (U.S. EPA, 1980)

Although most commonly used in sewage treatment, brushed screens can be adapted to remove solids from MPP wastewater. Brushed screens are constructed of a half-circular drum with a stainless steel perforated screen. Mesh size varies according to the type of solid being screened. As influent passes through the screen, rotary brushes sweep across, pushing solids off the screen and into a collection trough. If required, this design can be doubled to dry solid matter further by pushing solids onto a second screen that is pressed and then brushed into the collection trough (Nielsen, 1996).

8.2.1.4 Vibrating Screens

The effectiveness of a vibrating screen depends on a rapid motion. Vibrating screens operate between 99 and 1,800 rpm; the motion can be either circular or straight line, varying from 0.08 to 1.27 cm (1/32 to ½ inch) total travel. Speed and motion are selected by the screen manufacturer for the particular application (USEPA, 1974; USEPA, 1975). Usually made of stainless steel, the vibrating action allows effluent to pass through while propelling solids toward a collection outlet with the aid of gravity (Nielsen, 1996).

Of prime importance in the selection of a proper vibrating screen is the application of the proper cloth. The liquid capacities of vibrating screens are based on the percent of open area of the cloth. The cloth is selected with the proper combination of strength of wire and percent of open area. If the waste solids to be handled are heavy and abrasive, wire of greater thickness should be used to assure long life. However, if the material is light or sticky in nature, the durability of the screening surface may be the least important factor. In such a case, a light wire may be desired to provide an increased percent of open area (USEPA, 1974; USEPA, 1975).

Poultry products facilities may employ two types of vibrating screens. For offal recovery, vibratory screens usually have 20-mesh screening; for feather removal, as well as for in-plant primary treatment of combined wastewater, a 36- by 40-mesh screen cloth is used. On most applications a double-crimped, square-weave cloth is used because of its inherent strength and resistance to wire shifting. Vibratory screens with straight-line action are largely used for byproduct recovery, while those with circular motion are frequently used for in-plant primary treatment (USEPA, 1975).

8.2.2 Catch Basins

Catch basins separate grease and finely suspended solids from wastewater by the process of gravity separation. The basic setup employs a minimum turbulence flowthrough tank where solids heavier than water sink to the bottom, and grease and fine solids rise to the surface. Basins are equipped with a skimmer to remove grease and scum off the top and a scraper to remove sludge at the bottom. The skimmer moves scum into collecting troughs and the scraper moves sludge into a hopper from where both are pumped to byproduct recovery systems. Key factors affecting basin efficiency are detention time and the rate of solid removal from the basin. Depending on influent concentration, recovery rates between 60 and 70 percent can be achieved with a detention time of 20 to 40 minutes (Nielsen, 1996).

Typically, catch basins are rectangular in shape and relatively shallow (1.8 meters or 6 feet is the preferred length). The flow rate is the most important criterion for the design, and the most common sizing factor is determined by measuring the volume of flow during one peak hour with 30 to 40 minutes of detention. An equalization tank before the catch basin reduces size requirements significantly (USEPA, 1974; USEPA, 1975). Depending on the influent characteristics, treatment costs range from 50 to 500 dollars per million gallons treated (FMCITT, 2002).

Tanks can be constructed of concrete or steel; usually two tanks with a common wall are built, in case one becomes unavailable due to maintenance or repairs. Concrete tanks have the inherent advantages of lower overall maintenance and more permanence of structure. However, some facilities prefer to be able to modify their operation for future expansion, alterations, or even relocation. All-steel tanks have the advantage of being semi-portable, more easily field-erected, and more easily modified than concrete tanks. The all-steel tanks, however, require additional maintenance as a result of wear from abrasion and corrosion (USEPA, 1974; USEPA, 1975).

A tank using all-steel walls and a concrete bottom is the best compromise between the all-steel tank and the all-concrete tank. The advantages are the same as for steel; however, the all-steel tank requires a footing underneath and supporting members, whereas the concrete bottom forms the floor and supporting footings for the steel-wall tank (USEPA, 1974; USEPA, 1975).

8.2.3 Dissolved Air Flotation

Dissolved air flotation (DAF) is used extensively in the primary treatment of MPP wastewaters to remove suspended solids. The principal advantage of DAF over gravity settling is its ability to remove very small or light particles (including grease) more completely and in a shorter period of time. Once particles have been to the surface, they are removed by skimming (Metcalf and Eddy, 1991).

In DAF, either the entire influent, some fraction of the influent, or some fraction of the recycled DAF effluent is saturated with air at a pressure of 40 to 50 psi (250 to 300 kPa), and then introduced into the flotation tank (Martin and Martin, 1991). The method of operation may cause operating costs to differ slightly, but process performances are essentially equal among the three modes of operation (USEPA, 1974; USEPA, 1975). With larger wastewater flows, only a fraction of the DAF effluent is saturated and recycled by introduction through a pressure control valve into the influent feed line. From 15 to 120 percent of the influent flow may be recycled in larger units (Metcalf and Eddy, 1991). Under atmospheric pressure in the flotation tank, the air desorbs from solution and forms a cloud of fine bubbles, which transport fine particulate matter to the surface of the liquid in the tank. A skimmer mechanism continually removes the floating solids, and a bottom sludge collector removes any solids that settle. Although unit shape is not important, a more even distribution of air bubbles allows for a shallower flotation tank. Optimum depth settings are between 4 and 9 feet (1.2 to 2.7 meters) (Martin and Martin, 1991).

Chemicals (e.g., polymers and flocculants) are often added prior to the DAF to improve the DAF performance. Typical removals of suspended solids by DAFs vary between 40 to 65 percent without chemical addition and between 80 to 93 percent with chemical addition. Likewise, oil and grease removals by DAF improve from 60 to 80 percent without chemical addition to 85 to 99 percent with chemical addition (Martin and Martin, 1991). There are many advantages to a DAF system, including its low installation costs, compact design, ability to accept variable loading rates, and low level of maintenance (Nielsen, 1996). The mechanical equipment involved in the DAF system is fairly simple, requiring limited maintenance attention for such things as pumps and mechanical drives (USEPA, 1974; USEPA, 1975).

Although alternatives to DAF do exist, including electro flotation, reverse osmosis, and ion exchange, these processes have not been widely adopted by MPP facilities. Cost considerations and technical difficulties associated with these alternatives have prevented ready incorporation of such technologies (Johns, 1995). However, Cowan et al., (1992) summarized treatment and costs for extended trials, using a variety of ultrafiltration and reverse osmosis membranes at a number of slaughterhouses in South Africa. They report that ultrafiltration and reverse osmosis treatment may be the method of choice for treating slaughterhouse wastewaters, both as a pretreatment step prior to discharge to POTW and as a means of reclaiming high quality reusable water from the treated effluent.

8.2.4 Flow Equalization

Since most MPP facilities operate on a five-day per week schedule, weekly variation of wastewater flow is common. In addition, each facility must be thoroughly cleaned and sanitized every 24 hours. Although wastewater flow is relatively constant during processing, a significant difference in flow occurs between processing and cleanup periods, producing a substantial diurnal variation in flow and organic load on days of processing. To avoid the necessity of sizing subsequent treatment units to handle peak flows and loads, in-line flow equalization tanks are installed (Reynolds, 1982; Metcalf and Eddy, 1991). Flow equalization tanks may also be installed to store the effluent from the wastewater treatment plant before discharge to a POTW or other effluent disposal destinations. The end-of-treatment equalization ensures reduced variation in flow and waste load.

Equalization facilities consist of a holding tank and pumping equipment designed to reduce the fluctuations of waste stream. They can be economically advantageous, whether the industry is treating its own wastes or discharging into a city sewer after some pretreatment. The tank is characterized by a varying flow into the tank and a constant flow out. For MPP facilities, flow equalization basins usually are sized to provide a constant 24-hour flow rate on processing days, but also may be sized to provide a constant daily flow rate, including non-processing days. The major advantages of equalization basins are that the subsequent treatment units are smaller, since they can be designed for the 24-hour average flow rather than peak flows, and secondary waste treatment systems operate much better when not subjected to shockloads or variations on feed (USEPA, 1974; USEPA, 1975). To prevent settling of solids and to control odors, aeration and mixing of flow equalization basins are required. Methods of aeration and mixing include diffused air, diffused air with mechanical mixing, and mechanical aeration (Reynolds, 1982; Metcalf and Eddy, 1991).

8.2.5 Chemical Addition

Chemicals are often added to remove pollutants from wastewater. According to the MPP detailed survey responses, chemicals (e.g., polymers, coagulants, and flocculants such as aluminum or iron salts or synthetic organic polymers) are often added to MPP wastewaters prior to DAF or clarifier to aggregate colloidal particles through destabilization by coagulation and flocculation to improve process performance. Essentially all of the chemicals added are removed with the separated solids. When the solids are disposed of by rendering, the use of organic polymers is preferred to avoid high aluminum or iron concentrations in the rendered product produced. EPA noted during site visits to two independent rendering operations that sludges from dissolved air floatation units which use chemical additions to promote solids separation are rendered; however, the chemical bond between the organic matter and the polymers requires that the sludges be processed (rendered) at higher temperatures (260 ^{o}F) and longer retention times. Because the efficacy of aluminum and iron salts and organic polymers is pH dependent, pH adjustment normally precedes the addition of these compounds to minimize chemical use (Ross et. al., 1992; USEPA, 1974; USEPA, 1975).

8.3 SECONDARY BIOLOGICAL TREATMENT

MPP facilities that discharge directly to navigable waters under the authority of a NPDES permit at a minimum apply both primary and secondary treatment to generated wastewaters (see Table 8-1). The objective of secondary treatment is the reduction of BOD through the removal of organic matter, primarily in the form of soluble organic compounds, remaining after primary treatment. Although secondary treatment of wastewater can be performed using a combination of physical and chemical unit processes, use of biological processes has remained the preferred approach (Peavy, 1986). Greater than 90 percent wastewater pollutant removal efficiencies can be achieved with biological treatment (Kiepper, 2001). According to responses to the MPP detailed survey, common systems used for biological treatment of MPP wastewater include lagoons, activated sludge systems, extended aeration, oxidation ditches, and sequencing batch reactors. A sequence of anaerobic biological processes followed by aerobic biological processes is commonly employed by MPP facilities which have biological treatment. Kiepper (2001) suggests that approximately 25 percent of U.S. poultry facilities use biological treatment systems consisting of an anaerobic lagoon followed by an activated sludge system.

8.3.1 Anaerobic Treatment

Anaerobic wastewater treatment processes use the microbially-mediated reduction of complex organic compounds to methane and carbon dioxide as the mechanism for organic matter and BOD reduction. Because methane and carbon dioxide are essentially insoluble in water, both desorb rapidly. This combination of gases, predominantly methane, is commonly referred to as biogas and may be released directly to the atmosphere, collected and flared, or used as a boiler fuel (Clanton, 1997). EPA (1997) provides estimates of the emission factors (e.g., gram-CH_4/head of cattle) for these gases. The BOD removal efficiency by anaerobic treatment can be very high. Anaerobic wastewater treatment processes are more sensitive to temperature and loading rate changes than those of aerobic wastewater treatment processes.

The production of biogas generally occurs as a two-step process. In the first step, complex organic compounds are reduced microbially to simpler compounds, including hydrogen, short-chained volatile acids, alcohols, and carbon dioxide. Carbon dioxide is generated from the reduction of compounds containing oxygen. A wide variety of facultative and anaerobic microorganisms are responsible for these transformations that occur to obtain energy for maintenance, growth, and nutrients, including carbon for cell synthesis (Metcalf and Eddy, 1991; Nielsen, 1996; Peavy, 1986).

In the second step, the short-chained volatile acids, and alcohols are reduced further to methane and carbon dioxide by a group of obligate anaerobic microorganisms referred to collectively as methanogens. This group of microorganisms includes a number of species of methane-forming bacteria with growth rates significantly lower than the facultative and anaerobic microorganisms responsible for the initial reduction of complex compounds into the substrates that are reduced to methane. The biogas produced by the microbial activity typically contains between 30 and 40 percent carbon dioxide and between 60 and 70 percent methane with trace amounts of hydrogen sulfide and other gases (Metcalf and Eddy, 1991; Nielsen, 1996; Peavy, 1986; Clanton 1997).

Due to negligible energy requirements, anaerobic wastewater treatment processes are particularly attractive for the treatment of high strength wastewaters such as MPP wastewaters. Even though anaerobic processes are not capable of producing dischargeable effluents, they can significantly reduce energy requirements for subsequent aerobic treatment to produce dischargeable effluents (Metcalf and Eddy, 1991; Nielsen, 1996; Peavy, 1986; Clanton 1997). Anaerobic treatment can also digest organic solid fractions of animal by-products from slaughterhouse facilities (Banks, 1994; Banks and Wang, 1999).

According to the MPP detailed survey, anaerobic lagoons are the most commonly used anaerobic unit process for treatment of MPP wastewaters. In addition to secondary treatment, anaerobic lagoons provide flow equalization. As noted above, MPP operations normally occur on a 5-day per week schedule, and lagoons reduce variation in daily flows to subsequent secondary and tertiary treatment processes. However, high rate anaerobic processes have continued to attract attention as alternatives to anaerobic lagoons. Included are the anaerobic contact (AC), up-flow anaerobic sludge blanket (UASB), and anaerobic filter processes (AF) (Johns, 1995). These alternatives are especially appealing in situations where land for lagoon construction or expansion is not available.

8.3.1.1 Anaerobic Lagoons

A typical anaerobic lagoon is relatively deep, between 10 and 17 feet (3 to 5 meters) with a detention time of 5 to 10 days. Many treatment systems comprise of at least two lagoons in parallel or series; typical loading rates are between 15 to 20 pounds BOD_5 per 1,000 per cubic feet. The influent wastewater flow is usually near the bottom of the lagoon and has a pH between 7.0 and 8.5. Anaerobic lagoons are not mixed, although some gas mixing occurs. A scum usually develops at the surface, serving several purposes: retarding heat loss, ensuring anaerobic conditions, and reducing emissions of odorous compounds (USEPA, 1974; USEPA, 1975). Depending on the operating conditions, the BOD reductions by anaerobic lagoons can vary widely. Reductions up to 97 percent in BOD_5, up to 95 percent of suspended solids, and up to 96 percent of COD from the influent have been reported (USEPA, 1974; USEPA, 1975, John, 1995).

Wastewater organic carbon anaerobic degradation products emitted from anaerobic lagoons include methane and carbon dioxide. Also, ammonium and hydrogen sulfide are produced from the degradation of sulfur and nitrogen containing compounds found in meat products wastewater. Ammonium can be converted to ammonia in wastewater. The pH of the wastewater determines what emissions are produced in the anaerobic lagoons. A pH of 8 or greater causes more ammonia to be emitted while a pH of 6 or lower produces more hydrogen sulfide and carbon dioxide emissions (Zhang, 2001).

Because odors emitted from anaerobic lagoons can be quite offensive, much effort has been put into maintaining oil and grease caps or developing covers for these ponds. Many operators maintain a cap of oil and grease on the anaerobic lagoons or anaerobic equalization tanks to reduce odors and inhibit oxygen transfer (i.e., promoting anaerobic conditions). This oil and grease cap can be broken up and made ineffective with the influx of storm water or other highly variable flows to the anaerobic lagoons or anaerobic equalization tanks. Synthetic floating or biogas-inflated covers are used to prevent odors from escaping the lagoons, while simultaneously trapping biogas for collection and use as a fuel source. Covering lagoons also reduces heat losses with the result of higher microbial reaction rates. Surface area loading rates can thus be increased and lagoon volume can be reduced (Morris et al., 1998).

8.3.1.2 Alternate Anaerobic Treatment Technologies

Anaerobic Contact Systems

Anaerobic contact systems are very similar to the activated sludge process in concept. Mixed liquor solids from the completely mixed anaerobic reactor vessel are separated in a clarifier and returned to the reactor to maintain a high concentration of biomass (Stebor et al., 1990). The high biomass enables the system to maintains a long solids residence time (SRT) at a relatively short hydraulic retention time (HRT). The completely mixed, sealed reactors are normally heated to maintain a temperature of 35 °C (95 °F).

To provide a relatively short HRT, influent wastewater is mixed with solids removed from the effluent, usually by gravitational settling. Because of the low growth rates of anaerobic microorganisms, as much as 90 percent of the effluent solids may be recycled to maintain an adequate solids residence time. A degasifier that vents methane and carbon dioxide is usually included to minimize floating solids in the separation step (Eckenfelder, 1989). BOD loadings and HRTs range from 2.4 to 3.2 kg/m^3 and from 3 to 12 hours, respectively (USEPA, 1974). Anaerobic contact systems are not common because of high capital cost. Nonetheless, these systems have several advantages over anaerobic lagoons, including the ability to reduce odor problems and reduced land requirements. Biogas produced may be used to maintain reactor temperature.

Up-flow Anaerobic Sludge-Blanket (UASB)

The UASB is another anaerobic wastewater treatment process. Influent wastewater flows upward through a sludge blanket of biologically formed granules, with treatment occurring when the wastewater comes in contact with the granules. The methane and carbon dioxide produced generate internal circulation and serve to maintain the floating sludge blanket. Biogas collection in a gas collection dome occurs above the floating sludge blanket. Particles attached to gas bubbles that rise to the surface of the sludge blanket strike the bottom of degassing baffles, and the degassed particles drop down to the surface of the sludge blanket (Metcalf and Eddy, 1991). Residual solids and granules in the effluent are separated using gravity settling and returned to the sludge blanket. Settling may occur within the reactor or in a separate settling unit. Critical to this operation is the formation and maintenance of granules. Calcium has been used to promote granulation and iron to reduce unwanted filamentous growth (Eckenfelder, 1989).

The application of the UASB process to MPP wastewater has been a less successful endeavor, thus far, compared to other anaerobic processes. For example in treating a slaughterhouse wastewater, it was difficult to generate the sludge granules, thereby significantly lowering the level of BOD removal. High fat concentrations led to the loss of sludge (Johns, 1995).

Anaerobic Filters (AF)

The AF is a column filled with various types of media operating as an attached growth or fixed film reactor. Wastewater flows upward through the column. Because the microbial population is primarily attached to the media, mean cell residence times on the order of 100 days are possible. Thus, it provides an ability to treat very high strength wastewaters with COD concentrations as high as 20,000 mg/L as well as resistance to shock loads. Several studies have shown that AFs operated at short hydraulic retention times can greatly reduce the organic content of process wastewater (Harper et al., 1999). Most development work on the AF has involved high-strength industrial and food-processing wastewaters.

For the MPP industry, removals of COD are reported from 80 to 85 percent when COD loadings are 2 to 3 kg/m^3/day. When loadings are higher, performance suffers. Gas tends to have a relatively high methane content (72 to 85 percent). One facility reported BOD concentrations below 500 mg/L, at 33°C, with a COD loading of 2 to 3 kg/m^3/day. It is important to have effective pretreatment to remove oil and grease and suspended solids, as a high oil and grease concentration can cause unstable operation of the system (Harper et al., 1999; Johns, 1995).

Based on pilot-scale experiments, anaerobic-packed bed treatment has proven to be an effective alternative to DAF for pretreatment of poultry processing wastewater (Harper et al., 1999).

Anaerobic Sequence Batch Reactor (ASBR)

The ASBR is a variation of the anaerobic contact process that eliminates the need for complete mixing. This treatment is particularly applicable for MPP wastewaters, because high protein concentrations eliminate the need for supplemental alkalinity. In addition, ASBR easily addresses high levels of solids that are typically found in MPP wastewaters. One study that used an ASBR system on process wastewater achieved BOD_5 removals ranging from 37 to 77 percent and COD removals ranging from 27 to 63 percent. The resulting biogas was 73 to 81 percent methane, although the high concentration of hydrogen sulfide (~1,800 ppm) in the biogas may make at least partial removal of hydrogen sulfide prior to use as a fuel (Morris et al., 1998).

8.3.2 Aerobic Treatment

In the treatment of MPP wastewaters, aerobic treatment may directly follow primary treatment, or more typically follow some form of anaerobic treatment to reduce BOD and suspended solids concentrations to levels required for discharge. Reduction of ammonia also is a typical role of aerobic processes in the treatment of MPP wastewaters. Many NPDES permits are written with seasonal limits for ammonia, because the lower pH and lower temperature of the receiving waters during winter reduce the toxicity of ammonia by converting it to ammonium (Ohio EPA, 1999). Advantages of using aerobic wastewater treatment processes include low odor production, fast biological growth rate, no elevated operation temperature requirements; and quick adjustments to temperature and loading rate changes. However, the operating costs of aerobic systems are higher than the costs of anaerobic systems for processing livestock wastewater, because of the relatively high space, maintenance, management, and energy required for artificial oxygenation. The microorganisms involved in aerobic treatment process require free dissolved oxygen to reduce the biomass in the wastewater (Clanton, 1997).

Aerobic wastewater treatment processes can be broadly divided into suspended and attached growth processes. Aerobic lagoons and various forms of activated sludge process like conventional, extended aeration, oxidation ditches, and sequencing batch reactors (SBRs) are examples of suspended growth processes; trickling filters and rotating biological contactors (RBCs) are examples of attached growth processes. Both utilize a diverse population of heterotrophic microorganisms using molecular oxygen in the process of obtaining energy for cell maintenance and growth (Metcalf and Eddy, 1991).

Aerobic wastewater treatment processes have the primary objective of transforming soluble and colloidal organic compounds into microbial biomass, with subsequent removal of the biomass formed by settling or mechanical separation as the primary mechanism for organic matter and BOD removal. Some oxidation of organic carbon to carbon dioxide also occurs to provide energy for cell maintenance and growth. The degree of carbon oxidation depends on the solids retention time (SRT), also referred to as the mean cell residence time of the process, which determines the age of the microbial population. Processes with long SRTs operate in the endogenous respiration phase of the microbial growth curve and generate less settleable solids per unit BOD removed. Attached growth processes generally operate at long SRTs (Metcalf and Eddy, 1991).

At SRTs sufficiently long to maintain an active population of nitrifying bacteria, oxidation of ammonia nitrogen to nitrate nitrogen (nitrification) also occurs. However, the rates of growth of the autotrophic bacteria responsible for nitrification, *Nitrosomas* and *Nitrobacter*, are substantially slower than the growth rates of the microorganisms responsible for BOD reduction (Metcalf and Eddy, 1991). Therefore, the amount of nitrification during aerobic treatment will depend on the type of treatment system used and its operating conditions.

8.3.2.1 Activated Sludge

The activated sludge process (see Figure 8-3) is one of the most commonly used biological wastewater treatment processes in the United States (Metcalf and Eddy, 1991). According to the MPP detailed survey, various forms of activated sludge process used in the

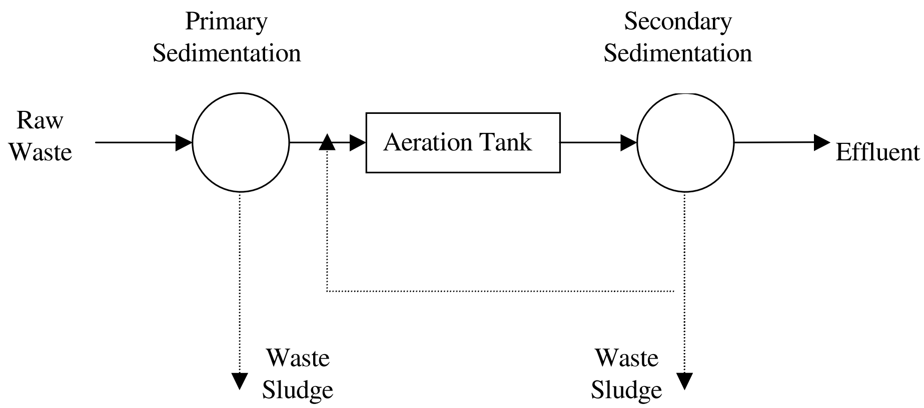

Figure 8-3. Activated Sludge Process (USEPA, 1974).

MPP industry include conventional, complete mix, extended aeration, oxidation ditch, and sequencing batch reactor. Other forms of activated sludge include tapered aeration, step-feed aeration, modified aeration, contact stabilization, Kraus process, and high-purity oxygen. All of these forms share the common characteristics of short HRTs, usually no more than several hours, and SRTs on the order of 5 to 15 days. This differential is maintained by continually recycling a fraction of the settleable solids separated after aeration by clarification back to the aeration basin. These settled solids contain an active, adapted microbial population and are the source of the term "activated sludge." The microbial population is comprised primarily of bacteria and protozoa, which aggregate to form flocs.

Floc formation is a critical factor in determining the efficacy of settling after aeration, which is the primary mechanism of BOD and suspended solids reduction. The fraction of activated sludge returned, known as the recycle ratio, determines the SRT of the process and serves the basis for controlling process performance. Typically, about 20 percent of the settled solids are recycled to maintain the desired concentration of mixed liquor suspended solids (MLSS). The remaining sludge is removed from the system and may be stabilized using aerobic or anaerobic digestion or by chemical addition (lime stabilization), which may be followed by dewatering by filtration or centrifugation (USEPA, 1974; USEPA, 1975).

The activated sludge process is capable of 95 percent reductions in BOD_5 and suspended solids (USEPA, 1974; USEPA, 1975). In addition, reductions in ammonia nitrogen in excess of

95 percent are possible at temperatures above 10°C and dissolved oxygen concentrations above 2 mg/L (Johns, 1995). Performance depends on maintaining an adequate SRT and mixed liquor suspended solids with good settling characteristics, which depends on floc formation. Excessive growth of filamentous organisms can impair activated sludge settleability. Excessive mixing can lead to the formation of pin flocs, which also have poor settling characteristics. Diffused air used for achieving the required aeration and mechanical systems used for obtaining necessary mixing result in significant energy use (Metcalf and Eddy, 1991).

Conventional

In the conventional activated sludge process, the aeration tank is a plug flow reactor. Plug flow regime may be made with baffles in aeration tanks. Settled wastewater and recycled activated sludge enter the head end of the aeration tank and are mixed by diffused-air or mechanical aeration. Air application is generally uniform throughout tank length. During the aeration period, adsorption, flocculation, and oxidation of organic matter occurs. Activated-sludge solids are separated in a secondary settling tank (Metcalf and Eddy, 1991).

Complete-mix

Complete mix activated sludge process uses a complete mix tank as an aeration basin. The process is an application of the flow regime of a continuous-flow stirred tank reactor. Settled wastewater and recycled activated sludge are introduced typically at several at several points in the aeration tank. The organic load on the aeration tank and the oxygen demand are uniform throughout the tank length (Metcalf and Eddy, 1991).

Extended Aeration

Extended aeration is another variant of the activated sludge process. The principal difference between extended aeration and the other variants of the activated sludge process is that extended aeration operates in the endogenous respiration phase of the microbial growth curve. Thus, lower organic loading rates and longer HRTs are required. Because of longer HRTs, typically 18 to 36 hours, extended aeration has the ability to absorb shock loads. Other advantages include its generation of less excess solids from endogenous respiration and greater overall process stability (USEPA, 1974). However, poor settling characteristics of aeration basin effluent is a frequently encountered problem with extended aeration. Generally, extended aeration treatment facilities are prefabricated package unit operations used for treating relatively low volume wastewater flows for small communities (Metcalf and Eddy, 1991). Extended aeration can be designed to provide high degree of nitrification.

Oxidation Ditches

An oxidation ditch system represents a modification of the activated sludge process in terms of its reactor configuration. The oxidation ditch consists of a ring- or oval-shaped channel and is equipped with mechanical aeration devices (Metcalf and Eddy, 1991). Aerators in the form of brush rotors, disc aerators, surface aerators, draft tune aerators, or fine pore diffusers with submersible pumps provide oxygen transfer, mixing and circulation in the oxidation ditch. Wastewater enters the ditch, is aerated, and circulates at about 0.8 to 1.2 ft/s. Oxidation ditches typically operate in an extended aeration mode with HRT greater than 10 hours and SRT of 10 to 50 days (USEPA, 1993). Oxidation ditches provide high removal of BOD and can be designed for nitrification and nitrogen and phosphorous removal (Sen et al., 1990).

Sequencing Batch Reactor

The sequencing batch reactor (SBR) is a fill-and-draw type reactor system using one or more complete mix tanks in which all steps of activated sludge process occur. SBR systems have four basic periods: Fill (the receiving of raw wastewater), React (the time to complete desired reaction), Settle (the time to separate the microorganisms from treated effluent), and Idle (the time after discharging the tank and before refilling). However, these periods may be modified or eliminated depending on effluent requirements. The time for a complete cycle is the total time between the beginning of Fell and the end of Idle (Martin and Martin, 1991). SBR systems provides high removal of BOD and suspended solids. In addition, SBR systems can be designed for nitrification and to remove nitrogen and phosphorous. Lo and Liao (1990) report that SBR technology can be used successfully in the treatment of poultry processing wastewaters for the removal of BOD^5 and nitrogen. SBR offers the advantages of operational and loading flexibility, high removal efficiency, competitive capital costs, and reduced operator maintenance (Glenn et al., 1990).

8.3.2.2 Lagoons

Lagoons are widely used in the treatment of MPP wastewater. They are comparatively cheaper than other treatment processes, although they require larger land area. Lagoons can be anaerobic, aerobic, aerated, or facultative. Anaerobic lagoons are discussed in Section 8.3.1.1. Other types of lagoons are discussed in this section.

Aerobic lagoons

Aerobic lagoons, which are also known as aerobic stabilization ponds, are large shallow earthen basins that use algae in combination with other microorganisms for wastewater treatment. Low-rate ponds, which are designed to maintain aerobic conditions throughout the liquid column, may be up to five feet deep. High-rate ponds are usually shallower, with a maximum depth of no greater than 1.5 feet. They are designed to optimize the production of algal biomass as a mechanism for nutrient removal. In aerobic stabilization ponds, oxygen is supplied by a combination of natural surface aeration and photosynthesis. In the symbiotic relationship between the algae and other microorganisms present, the oxygen released by the algae during photosynthesis is used by the non photosynthetic microorganisms present in the aerobic degradation of organic matter, while the nutrients and carbon dioxide released by the nonphotosynthetic microorganisms are used by the algae (Martin and Martin, 1991).

Loading rates of aerobic stabilization ponds are in the range of 10 to 300 pounds of BOD per acre per day with an HRT of 3 to 10 days. Soluble BOD_5 reductions of up to 95 percent are possible with aerobic stabilization ponds (Martin and Martin, 1991). Aerobic stabilization ponds may be operated in parallel or series. To maximize performance, intermittent mixing is necessary. Without supplemental aeration, dissolved oxygen concentrations will vary from super saturation due to photosynthesis during day light hours, to values at or approaching zero at night, especially with high-rate ponds. Also, settled solids will create an anaerobic zone at the bottom of the pond (Reynolds, 1982). Thus, nitrogen removal is achieved by the combined processes of nitrification and denitrification.

The low cost of aerobic stabilization ponds is offset, especially in colder climates, by seasonal variation in performance. In winter, limited sunlight due to shorter day length and cloud cover limits photosynthetic activity and oxygen release, as well as algae growth. In addition, ice cover limits natural surface aeration. Thus, aerobic stabilization ponds in colder climates may become anaerobic lagoons in winter months with a concurrent deterioration in effluent quality and a source of noxious odors in the following spring before predominately aerobic conditions become reestablished (Martin and Martin, 1991). Scaief (1975), however, reports no difference in overall treatment efficiency across all seasons for anaerobic-aerobic lagoon systems or anaerobic contact process followed by aerobic lagoons.

Aerated Lagoons

Aerated lagoons are earthen basins used in place of concrete or steel tanks for suspended growth biological treatment of wastewater. Aerated lagoons typically are about 8 feet (2.4 m) deep, but can be as much as 15 feet (4.6 m) deep and may be lined to prevent seepage of wastewater to ground water. Although diffused air systems are used for aeration and mixing, fixed and floating mechanical aerators are more common.

Natural aeration occurs in diffused air systems by air diffusion at the water surface by wind- or thermal-induced mixing and by photosynthesis. Algae and cyanobacteria (blue-green algae) are the microorganisms responsible most of the photosynthetic activity in a naturally-aerated lagoon. Naturally aerated lagoons are approximately 1 to 2 feet deep, so that sunlight can penetrate the full lagoon depth to maintain photosynthetic activity throughout the day. Mechanically aerated lagoons do not have a depth requirement, because oxygen is supplied artificially instead of by algal photosynthesis (Zhang, 2001).

Aerated lagoons can be operated as activated sludge units with the recycle of settled solids with relatively short HRTs, or as complete mix systems without settled solids recycle. Systems operated as activated sludge units have a conventional clarifier for recovery of settled solids for recycle. Aerated lagoons operated as complete mix systems without solids recycle may use a large, shallow earthen basin in place of a more conventional clarifier for removal of suspended solids. Typically, these basins also are used for the storage and stabilization of the settled solids. Usually a detention time of no less than 6 to 12 hours is required.

One of the principal advantages of aerated lagoons is relatively low capital cost. However, more land is required. With earthen settling basins, algae growth and odors can be problems, along with consistent effluent quality.

Facultative Lagoons

The facultative lagoons are deeper than aerobic lagoons, varying in depth from 5 to 8 ft. Waste is treated by bacterial action occurring in an upper aerobic layer, a facultative middle layer, and a lower anaerobic layer. Aerobic bacteria degrade the waste in the upper layer, where oxygen is provided by natural surface aeration and algal photosynthesis. Settleable solids are deposited on the lagoon bottom and degraded by anaerobic bacteria. The facultative bacteria in the middle layer degrade the waste aerobically, whenever dissolved oxygen is present and anaerobically otherwise. The facultative lagoons have more depth and smaller surface areas aerated or aerobic lagoons but still have good odor control capabilities, because of the presence of the upper aerobic layer, where odorous compounds such as sulfides produced by anaerobic degradation in the lower layer, are oxidized before emission into the atmosphere. Biochemical reactions in the facultative lagoons are a combination of aerobic and anaerobic degradation reactions (Zhang, 2001).

8.3.2.3 Alternate Aerobic Treatment Technologies

Trickling Filters

A trickling filter consists of a bed of highly permeable media to which a microbial flora becomes attached, a distribution system to spread wastewater uniformly over the bed surface, and an under-drain system for collection of the treated wastewater and any microbial solids that have become detached from the media. As the wastewater percolates or trickles down through the media bed, the organic material present is absorbed onto the film or slime layer of attached microorganisms. Within 0.1 to 0.2 mm of the surface of the slime layer, the organic matter absorbed is metabolized aerobically, providing energy and nutrients for cell maintenance and growth. As cell growth occurs, the thickness of the slime layer increases and oxygen diffusing into the slime layer is consumed before penetration to the media surface occurs and anaerobic conditions develop near the media surface. In addition, organic matter and nutrients necessary for cell maintenance and growth are lacking due to utilization near the surface of the slime layer. Thus, endogenous conditions develop near the media surface and detachment occurs from hydraulic shear forces as the microorganisms at and near the media surface die. This process is known as “sloughing” and may be a periodic or continual process depending on organic and hydraulic loading rates. Hydraulic loading rate usually is adjusted to maintain continual sloughing and a constant slime layer thickness (Metcalf and Eddy, 1991).

The biological community in the trickling filter process includes aerobic, facultative, and anaerobic bacteria, fungi, and protozoans. The aerobic microbial population may include the nitrifying bacteria *Nitrosomonas* and *Nitrobacter*. It also may include algae and higher organisms such as worms, insect larvae, and snails, unlike activated sludge processes. Variations in these biological communities occur according to individual filter and operating conditions (Metcalf and Eddy, 1991).

Trickling filters have been classified as low-rate, intermediate-rate, high-rate, super high-rate, roughing, and two-stage, based on filter medium, hydraulic and BOD_5 loading rates, recirculation ratio, and depth (Metcalf and Eddy, 1991). Hydraulic loading rates range from 0.02 to 0.06 gallon per ft^2-day for low-rate filters to 0.8 to 3.2 gallon per ft^2-day for roughing filters. Organic loading rates range from 5 to 25 pounds BOD_5 per 10^3 ft^2-day to 100 to 500 pounds BOD_5 per 10^3 ft^2-day. Both low-rate and two-stage trickling filters can produce a nitrified effluent while roughing filters provide no nitrification. Others may provide some degree of nitrification. Low-rate and intermediate-rate trickling filters traditionally have used rock or blast furnace slag as filter media while high-rate filters only employ rock. Super high-rate filters use plastic media, while roughing filters may be constructed using either plastic or redwood media; two-stage filters may use plastic or rock media (Metcalf and Eddy, 1991).

Trickling filters are secondary wastewater treatment unit processes and require primary treatment for removal of settleable solids and oil and grease to reduce the organic load and prevent plugging. Secondary clarification also is necessary. Lower energy requirements make trickling filters attractive alternatives to activated sludge processes. However, mass-transfer limitations limit the ability of trickling filters to treat high strength wastewaters. To successfully treat such wastewaters, a two- or three-stage system is necessary. When staging of filters is used, a clarifier usually follows each stage. The overall BOD_5 removal efficiency of can be as great as 95 percent (USEPA, 1974).

Rotating Biological Contactors

Rotating biological contactors (RBCs) also employ an attached film or slime layer of microorganisms to adsorb and metabolize wastewater organic matter, providing energy and nutrients for cell maintenance and growth. RBCs consist of a series of closely spaced circular disks of polystyrene or polyvinyl chloride mounted on a longitudinal shaft. The disks are rotated alternately, exposing the attached microbial mass to the wastewater being treated for adsorption of organic matter and nutrients and then the atmosphere for adsorption of oxygen. The rate of rotation controls oxygen diffusion into the attached microbial film and provides the sheer force necessary for continual biomass sloughing (Metcalf and Eddy, 1991). Mass transfer limitations limit the ability of RBCs to treat high strength wastewaters, such as MPP wastewaters. RBCs can be operated in series like multi-stage trickling filter systems, a tapered feed arrangement is possible. An example of such an arrangement would be three RBCs in parallel in stage one, followed by two RBCs in parallel in stage two, and one RBC in stage three.

As with trickling filters, hydraulic and organic loading rates are criteria used for design. Design values may be derived from pilot plant or full-scale performance evaluations or using the theoretical or empirical approaches (Metcalf and Eddy, 1991). Typical hydraulic and organic loading rate design values for secondary treatment are 2 to 4 gallon/ft^2-day and 2.0 to 3.5 pounds total $BOD_5/10^3$ ft^2-day, respectively with effluent BOD_5 concentrations ranging from 15 to 30 mg/L. For secondary treatment combined with nitrification, typical hydraulic and organic loading rate design values for are 0.75 to 2 gallon/ft^2-day and 1.5 to 3.0 pounds $BOD_5/10^3$ ft^2-day, respectively producing effluent BOD_5 concentrations between 7 and 15 mg/L and NH_3 concentrations of less than 2 mg/L (Metcalf and Eddy, 1991).

The major advantages of RBCs are: (1) relatively low installation cost, (2) ability to combine secondary treatment with ammonia removal by nitrification, especially in multi-stage systems, and (3) resistance to shock loads. The major disadvantage is the need to enclose them, especially in cold climates to maintain high removal efficiencies, control odors, and minimize problems with temperature sensitivities (USEPA, 1974). Early RBC units experienced operating problems, including shaft and bearing failures, disk breakage, and odors. Design modifications have been made to address these problems, including increased submergence to reduce shaft and bearing loads (Metcalf and Eddy, 1991).

Although RBCs are used in both the United States and Canada for secondary treatment of domestic wastewaters, use for secondary treatment of high strength industrial wastewaters such as MPP wastewaters has been limited. Energy requirements associated with activated sludge processes may make RBCs more attractive for treating MPP wastewaters, especially following physical/chemical and anaerobic pretreatment. A BOD_5 reduction of 98 percent is achievable with a four-stage RBC (USEPA, 1974).

8.4 TERTIARY TREATMENT

Tertiary or advanced wastewater treatment generally is considered to be any treatment beyond conventional secondary treatment to remove suspended or dissolved substances. Tertiary wastewater treatment can have one or several objectives. One common objective is further reduction in suspended solids concentration after secondary clarification. Nitrogen and phosphorus removal also are common tertiary wastewaters treatment objectives. Existing wastewater treatment plants may be retrofit without the addition of new tanks or lagoons to incorporate biological nutrient removal (Randall et al., 1999). In addition, tertiary wastewater treatment may be used to remove soluble refractory, toxic, and dissolved inorganic substances. In the treatment of MPP wastewaters, tertiary wastewater treatment most commonly is used for further reductions in nutrients and suspended solids.

8.4.1 Nutrient Removal

In primary and secondary wastewater treatment processes, some reduction of nitrogen and phosphorus occurs by the separation of particulate matter during settling or cell synthesis. However, limited assimilative capacity of receiving waters may require additional reductions in nitrogen and phosphorus concentrations before discharge. Both biological and physicochemical unit processes can be used to reduce nitrogen and phosphorous concentration in wastewater. Biological processes are generally more cost effective than physicochemical processes. Moreover, retrofit existing secondary treatment systems for biological nutrient removal may lead to reduced costs given their lower requirements for energy use and chemical addition (Randall and Mitta, 1998; Randall et al., 1999).

8.4.1.1 Nitrogen Removal

The removal of nitrogen from wastewaters biologically is a two-step process, beginning with nitrification and followed by denitrification. Nitrification, a microbially-mediated process, also is a two-step process, beginning with the oxidation of ammonia to nitrite and followed by the oxidation of nitrite to nitrate. Bacteria of the genus *Nitrosomonas* are responsible for the oxidation of ammonia to nitrite; bacteria of the genus *Nitrobacter* are responsible for the subsequent oxidation of nitrite to nitrate (Metcalf and Eddy, 1991).

Following the nitrification process under anaerobic conditions, nitrite and nitrate are reduced microbially by denitrification producing nitrogen gas as the principal end product. Small amounts of nitrous oxide and nitric oxide also may be produced, depending on environmental conditions. Because nitrogen, nitrous oxide, and nitric oxide are essentially insoluble in water, desorption occurs immediately. Although nitrification can occur in combination with secondary biological treatment, denitrification generally is a separate unit process following secondary clarification. Because the facultative and anaerobic microorganisms responsible for denitrification are heterotrophs, denitrification after secondary clarification requires the addition of a source of organic carbon for cell maintenance and growth. Methanol probably is the most commonly added source of organic carbon for denitrification, although raw wastewater (by-passed to the denitrification treatment tank), biosolids, and a variety of other substances also can be used (USEPA, 1993, Metcalf and Eddy, 1991).

The chemical transformations that occur during nitrification and denitrification are outlined below (Metcalf and Eddy, 1991):

Nitrification*:*

$NH_4^+ + 1.5\ O_2 \longrightarrow NO_2^- + 2H^+ + H_2O$ (*Nitrosomonas*)

$NO_2^- + 0.5\ O_2 \longrightarrow 2NO_3^-$ (*Nitrobacter*)

Denitrification (using methanol as carbon source):

$$NO_3^- + 1.08\ CH_3OH + H^+ \longrightarrow 0.065\ C_5H_7O_2N + 0.47\ N_2 + 0.76\ CO_2 + 3 + 2.44\ H_2O$$

Nitrification unit processes can be classified based on the degree of separation of the oxidation of carbonaceous and nitrogenous compounds respectively to carbon dioxide and nitrate (Metcalf and Eddy, 1991). Combined carbon oxidation and nitrification can be achieved in all suspended growth secondary wastewater treatment processes and with all attached growth processes except roughing filters. Carbon oxidation and nitrification processes may also be separated, with carbon oxidation occurring first, using both suspended and attached growth processes in a variety of combinations. Both suspended and attached growth processes are used for denitrification, following combined carbon oxidation and nitrification.

Nitrification and denitrification can be combined in a single process. With this approach, wastewater organic matter serves as the source of organic carbon for denitrification. Thus, the cost of adding a supplemental source of organic carbon and providing re-aeration after denitrification is eliminated. Also eliminated is the need for intermediate clarifiers and return sludge systems. The proprietary four-stage Bardenpho process (Metcalf and Eddy, 1991) is a combined nitrification-denitrification process using both organic carbon in untreated wastewater and organic carbon released during endogenous respiration for denitrification. Separate aerobic and anoxic zones provide for nitrification and then denitrification.

Other processes include the Modified Ludzack-Ettinger (MLE) process, A^2/O, University of Capetown (UCT) (USEPA, 1993). The A^2/O, and University of Capetown (UCT) process was developed to remove both nitrogen and phosphorous. Sequencing batch reactors (SBR) can also be used to achieve nitrification and denitrification (USEPA, 1993). Biological nitrogen and phosphorus removals can be enhanced in oxidation ditch systems by controlling aeration to maintain reliable aerobic, anoxic, and anaerobic volumes. For example, a BNR oxidation ditch process developed by Virginia Tech for retro-fitting a domestic wastewater treatment facility was capable of: (1) maintaining less than 0.5 mg/L total phosphorus and between 3 and 4 mg/L for total nitrogen in the discharged effluent all year round and (2) significantly reducing operational costs by reducing electrical energy, aeration, and chemical addition (Sen et al., 1990).

Nitrification is easily inhibited by a number of factors including toxic organic and inorganic compounds, pH, and temperature. In poorly buffered systems, the hydrogen ions released when ammonia is oxidized to nitrite/nitrate can reduce pH to an inhibitory level without the addition of a buffering agent.

A pH of at least 7.2 is generally recognized as necessary to maintain a maximum rate of nitrification (Grady and Lim, 1980). Based on the following theoretical stoichiometric relationships for the growth of *Nitrosomonas* and *Nitrobacter,* the alkalinity (HCO_3^-) utilized is 8.64 mg HCO_3^- per mg of ammonia nitrogen oxidized to nitrate nitrogen. For *Nitrosomonas*, the equation is:

$$55\ NH_4^+ + 76\ O_2 + 109\ HCO_3^- \rightarrow C_5H_7O_2N + 54\ NO_2^- + 57\ H_2O + 104\ H_2CO_3$$

For *Nitrobacter*, the equation is:

$$400\ NO_2^- + NH_4^+ + 4\ H_2CO_3 + HCO_3^- + 195\ O_2 \rightarrow C_5H_7O_2N + 3\ H_2O + 400\ NO_3^-$$

As noted above, one of the advantages of using wastewater organic matter as the source of organic carbon for denitrification is the elimination of the cost of an organic carbon source such as methanol. A second advantage is elimination of the need to add a source of bicarbonate alkalinity in poorly buffered systems to compensate for the utilization of alkalinity resulting from nitrification and the associated reduction in pH. As shown in the overall energy reaction for nitrification, two hydrogen ions are released for every ammonium ion oxidized to nitrate.

$$NH_4^+ + 2\ O_2 \rightarrow NO_3^-\ 2\ H^+\ H_2O$$

However, denitrification releases one hydroxyl ion for each nitrate ion reduced to nitrogen gas, as shown in the following overall energy reaction for denitrification using methanol as the source of organic carbon.

$$6\ NO_3^- + 5\ CH_3OH \rightarrow 5\ CO_2 + 3\ N_2 + 7\ H_2O + 6\ OH^-$$

In addition, hydrogen ions are required for cell synthesis during denitrification, as shown by the following relationship:

$$3\ NO_3^- + 14\ CH_3OH + CO_2 + 3\ H^+ \rightarrow 3\ C_5H_7O_2N + H_2O$$

Therefore, using wastewater organic matter as the source of organic carbon for denitrification in a combined nitrification denitrification system generally eliminates the need for adding a source of alkalinity to prevent pH inhibition of nitrification. Very poorly buffered systems are the exception.

Using wastewater organic matter as the source of organic carbon for denitrification also reduces aeration requirements for BOD removal in suspended growth systems. Based on half reactions for electron acceptors, 1/5 mole of NO_3^- is equivalent to 1/4 mole of O_2. Therefore, each unit mass of NO_3^- - N is equivalent to 2.86 units of O_2 in its ability to oxidize organic matter, if cell synthesis is ignored. However, some organic matter must be converted into cellular material and is not completely oxidized. It does, however, represent the removal of BOD through removal of excess suspended solids and an additional reduction in aeration requirements for BOD removal. Therefore, the actual reduction in BOD realized by using wastewater organic matter as the source of organic carbon for denitrification is marginally higher that 2.86 mass units of BOD per unit NO_3^- - N denitrified. The magnitude of this marginal increase depends on the SRT in the denitrification reactor with the magnitude decreasing as SRT increases. Assuming a

SRT of 7.5 days, a ratio of BOD_5 in wastewater used as an organic carbon source for denitrification to NO_3^- - N of 3.5 should provide for essentially complete denitrification.

An added positive consequence of using wastewater organic matter as the source of organic carbon for denitrification is that sludge production per unit BOD removed is lower, because denitrification is an anoxic process occurring under anaerobic conditions. Typical cell yield under anaerobic conditions is 0.05 mg volatile suspended solids (VSS) per mg BOD removed versus 0.6 mg VSS per mg BOD removed under aerobic conditions (Metcalf and Eddy, 1991).

Both *Nitrosomonas* and *Nitrobacter* are autotrophic mesophilic microorganisms with relatively low growth rates in comparison to heterotrophs, even under optimal conditions. Thus, maintaining an actively nitrifying microbial population may become harder and require excessively long SRTs in cold weather (Metcalf and Eddy, 1991; USEPA, 1993).

8.4.1.2 Phosphorus Removal

To achieve low effluent discharge limits, phosphorous may be removed from wastewater biologically and/or by physicochemical methods. Biological treatment is cheaper than physicochemical methods and is particularly suitable for facilities with high flows.

Biological Treatment

Microorganisms used in secondary wastewater treatment require phosphorus for cell synthesis and energy transport. In the treatment of typical domestic wastewater, between 10 and 30 percent of influent phosphorus is removed by microbial assimilation, followed by clarification or filtration. However, phosphorus assimilation in excess of requirements for cell maintenance and growth, known as luxury uptake, can be induced by a sequence of anaerobic and aerobic conditions (Metcalf and Eddy, 1991).

Acinetobacter is one of the organisms primarily responsible for the luxury uptake of phosphorus in wastewater treatment. In response to volatile fatty acids present under anaerobic conditions, stored phosphorus is released. However, luxury uptake and storage for subsequent use of phosphorus occurs when anaerobic conditions are followed by aerobic conditions. Thus, removal of phosphorus by clarification or filtration following secondary treatment is increased, because biosolids are already wasted (USEPA, 1987, Metcalf and Eddy, 1991; Reddy, 1998).

Currently, several proprietary processes use luxury uptake for removal of phosphorus from wastewater during suspended growth secondary treatment. Included are the A/O, PhoStrip, and Bardenpho processes. In addition, sequencing batch reactors (SBRs) can be operated to remove phosphorus. In the PhoStrip process, phosphorus is stripped from the biosolids generated using anaerobic conditions to stimulate release. The soluble phosphorus generated then is precipitated using lime. Both the A/O and PhoStrip processes are capable of producing final effluent total phosphorus concentrations of less than 2 mg/L. A modified version of the A/O process, the A^2/O process, along with the Bardnepho process and SBRs are capable of combined biological removal of nitrogen and phosphorus (USEPA, 1987; Metcalf and Eddy, 1991; Reddy, 1998).

Physicochemical Process

Phosphorus can be removed from wastewater by precipitation using metal salts or lime. The metal salts most commonly used are aluminum sulfate (alum) and ferric chloride. However, ferrous sulfate and ferrous chloride also can be used. Use of lime is less common due to operating and maintenance problems associated with its use and the large volume of sludge produced. Polymers often are used in conjunction with metal salts to improve the degree of phosphorus removal. Ion exchange, discussed in Section 8.4.3.3, also is an option for phosphate phosphorus removal, but is rarely used in wastewater treatment. (Metcalf and Eddy, 1991).

Chemicals can be added to remove phosphorus in: (1) raw wastewater prior to primary settling, (2) primary clarifier effluent, (3) mixed liquor with suspended growth treatment processes, (4) effluent from biological treatment processes prior to secondary clarification, or (5) after secondary clarification (Metcalf and Eddy, 1991). In Option 1 (pre-precipitation), precipitated phosphorus is removed with primary clarifier solids, whereas removal is with secondary clarifier solids for Options 2 through 4 (co-precipitation). In Option 5, additional clarification or filtering facilities are required. In the treatment of MPP wastewaters, the addition of chemicals for phosphorus removal prior to dissolved air flotation is a possible option (Metcalf and Eddy, 1991).

With alum addition, phosphorus is precipitated as aluminum phosphate ($AlPO_4$), and aluminum hydroxide ($Al(OH)_3$). With the addition of ferric chloride, the chemical species produced are ferric phosphate ($FePO_4$) and ferric hydroxide ($Fe[OH]_3$). Lime addition produces calcium phosphate ($Ca_5[PO_4]_3[OH]$), magnesium hydroxide ($Mg[OH]_2$), and calcium carbonate ($CaCO_3$). In the case of alum and iron, one mole theoretically will precipitate one mole of phosphate. However, competing reactions and the effects alkalinity, pH, trace elements, and ligands found in wastewater make bench-scale or full-scale tests necessary to determine dosage rates. Due to coagulation and flocculation, removal of suspended solids also occurs with the precipitated phosphorus species. With the addition of aluminum and iron salts, the addition of a base to maintain a pH in the range of 5 to 7 to optimize the efficacy of phosphorus precipitation may be necessary depending on wastewater buffer capacity. (USEPA, 1987; Metcalf and Eddy, 1991; Reddy, 1998).

When lime is used, it usually is calcium hydroxide ($Ca(OH)_2$). Due to reaction with natural bicarbonate alkalinity forming $CaCO_3$ as a precipitate, an increase to a pH of 10 or higher is necessary for the formation of $Ca_5(PO_4)_3(OH)$. After lime is used to precipitate phosphorus, recarbonation with carbon dioxide is necessary to lower pH (USEPA, 1987; Metcalf and Eddy, 1991; Reddy, 1998).

When chemical addition is used for phosphorus removal, additional benefits are realized. Due to coagulation and flocculation, effluent BOD and suspended solids concentrations also are reduced, especially when chemical addition occurs after secondary clarification (USEPA, 1987; Metcalf and Eddy, 1991; Reddy, 1998).

8.4.2 Residual Suspended Solids Removal

Simple clarification after secondary wastewater treatment may not reduce the concentration of suspended solids to the level necessary to comply with concentration or mass discharge permit limits or both. Granular-medium filtration usually is used to achieve further reductions in suspended solids concentrations. This practice also provides further reductions in BOD. Filtration is a solid-liquid separation in which the liquid passes through a porous material to remove as much fine material as possible (Reynolds, 1982).

Granular Medium Filters

Metcalf and Eddy (1991) lists nine different types of commonly used granular-medium filters. They are classified as either semi-continuous or continuous, depending on whether back washing is a batch or a semi continuous or continuous operation. Within each classification, there are several different types, depending on bed depth, type of filtering medium, and stratification or lack thereof of the filtering medium. Shallow, conventional, and deep bed filters respectively are typically about 11 to 16, 30 to 36, and 72 inches in depth. Sand or anthracite is used singularly in mono-medium filter beds. Dual-medium beds may be comprised of anthracite and sand, activated carbon and sand, resin beads and sand, or resin beads and anthracite. In multi-medium beds some combination of anthracites, sand, garnet or ilmenite, activated carbon, and resin beads are used. In stratified filter beds, the effective size of the filter medium increases with the direction of wastewater flow. Flow through the filter medium can be either accomplished by gravity alone under pressure with the sometimes later described as rapid filters.

Several mechanisms are responsible for the removal of suspended solids in granular-medium filters. Included are straining, sedimentation, impaction, and interception. Chemical adsorption, physical adsorption, flocculation, and biological growth also may contribute to suspended solids removal. (Metcalf and Eddy, 1991).

The operation of granular-medium filters has two phases, filtration and cleaning or re-generation. The second phase, commonly called backwashing, involves the removal of captured suspended solids when effluent suspended solids begin to increase or when head loss across the filter bed reaches an acceptable maximum value. With semi-continuous filtration, filtration and backwashing occur sequentially, while with continuous filtration, the filtration and backwashing phases occur simultaneously. Usually backwashing is accomplished by reversing flow through the filter medium with sufficient velocity to expand or fluidize the medium to dislodge and transport accumulated suspended solids to the surface of the filter bed. Compressed air may be used in conjunction with the backwashing water to enhance removal of accumulated suspended solids. The backwashing water with the removed suspended solids typically is returned to a primary clarifier or a secondary biological treatment process unit (Metcalf and Eddy, 1991).

Filtration and backwashing occur simultaneously with continuous processes, and there is no suspended solids breakthrough or terminal head loss value. One type of continuous filter is the traveling bridge filter, which comprises a series of cells operated in parallel. Backwashing of individual cells occurs sequentially, while the other cells continue to filter influent. Deep bed filters, which are upflow filters, are continually backwashed by continually pumping sand from the bottom of the filter through a sand washing located at the top of the filter with the clean sand distributed on the top of the filter bed. Thus, sand flow is counter-current to the flow of the wastewater being filtered (Metcalf and Eddy, 1991). Generally, all types of granular-medium filter produce effluent with an average turbidity of two nephelometric turbidity units (NTUs) or less from high quality filter influent having turbidity of seven to nine NTUs. This level translates into a suspended solids concentration of 16 to 23 mg/L (Metcalf and Eddy, 1991). Lower quality filter influent requires chemical addition to achieve an effluent turbidity of two NTUs or less. Chemicals commonly used include a variety of organic polymers, alum, and ferric chloride. They produce removal of specific contaminants, including phosphorous, metal ions, and humic substances (Metcalf and Eddy, 1991).

Problems with the use of granular-medium filtration include turbidity breakthrough with semi-continuous filters, even though terminal head loss has not been reached. Problems with both semi-continuous and continuous filters include: buildup of emulsified grease; loss of filter medium, agglomeration of biological floc, dirt, and filter medium or media forming mud balls and reducing the effectiveness of filtration and backwashing, and the development of cracks in the filter bed (Metcalf and Eddy, 1991).

8.4.3 Alternate Tertiary Treatment Technologies

8.4.3.1 Nitrogen Removal

Besides the biological treatment discussed in Section 8.4.1.1, various physicochemical processes are used for nitrogen removal. The principal physical and chemical processes used for nitrogen removal are air stripping, breakpoint chlorination, and selective ion exchange. However, all these technologies are reported to have limited use due to cost, inconsistent performance, and operating and maintenance problems (Metcalf and Eddy, 1991; Johns, 1995). Air stripping and breakpoint chlorination is discussed in this section, while ion exchange is discussed in Section 8.4.3.3. Note that these three technologies remove nitrogen when the nitrogen is in the form of ammonia (air stripping, breakpoint chlorination, and ion exchange) or nitrate ions (ion exchange). Since, raw meat-processing wastewater contains nitrogen primarily in organic form, the technologies may require additional upstream treatment to convert the organic nitrogen into ammonia and/or nitrate.

Air Stripping

Air stripping of ammonia is a physical process of transferring ammonia from wastewater into air by injection of wastewater into air in a packed tower. To achieve a high degree of ammonia reduction, elevation of wastewater pH to at least 10.5 usually by the addition of lime, is necessary. The removal efficiencies of ammonia nitrogen can be as high as 98 percent with effluent ammonia concentrations of less than 1 mg/L (USEPA, 1974; USEPA, 1975). Because of the high operating and maintenance costs associated with air stripping, the practical application of air stripping of ammonia is limited to special cases, such as the need for a high pH for other reasons (Metcalf and Eddy, 1991).

High operation and maintenance costs for air stripping of ammonia can be attributed in part to the formation of calcium carbonate scale within stripping tower and feed lines. Absorption of carbon dioxide from the air stream used for stripping leads to calcium carbonate scale formation, which varies in nature from soft to very hard. Because the solubility of ammonia increases as temperature decreases, the amount of air required for stripping ammonia increases significantly as temperature decreases for the same degree of removal. If ice formation occurs in the stripping tower, a further reduction in removal efficiency occurs (Metcalf and Eddy, 1991, Johns, 1995).

There are secondary environmental impacts also because air stripping of ammonia without subsequent scrubbing in an acid solution results in the emission of ammonia to the atmosphere. This emission may lead to bad odor and air pollution. Particulate matter is also formed in the atmosphere, following the reaction of ammonia with sulfate. In addition, stripping towers can be sources of emissions of volatile organic compounds and noise (Peavy, 1986; Metcalf and Eddy, 1991).

Breakpoint Chlorination

Breakpoint chlorination involves the addition of chlorine to wastewater to oxidize ammonia to nitrogen gas and other stable compounds. Breakpoint chlorination has been successfully used as a second, stand-by ammonia removal process for ammonia concentrations up to 50 mg/L (Green et al., 1981). Before chlorine reacts with ammonia, it first reacts with oxidizable substances present, such as Fe^{+2}, Mn^{+2}, H_2S, and organic matter to produce chloride ions. After meeting the immediate demand of the oxidizable compounds, excess chlorine react with ammonia to form chloramines. With increased chlorine dosage, the chloramines formed will be converted to nitrogen trichloride, nitrous oxide, and nitrogen gas. The destruction of chloramines occurs until the breakpoint chlorination point is achieved. After this point, free residual chlorine becomes available (Metcalf and Eddy, 1991). Therefore, the required chlorine dosage to destroy ammonia is achieved when breakpoint chlorination is reached. The overall reaction between chlorine and ammonia can be described by the following equation:

$$2NH_3 + 3HOCl \longrightarrow N_2 + 3H_2O + 3HCl$$

Stoichiometrically, the breakpoint reaction requires a weight ratio of 7.6 CL_2 to 1 NH_4^+-N, but in actual practice ratios of from 8:1 to 10:1 are common (Green et al., 1981). Process efficiencies consistently range between 95 and 99 percent. The process is easily adapted to complete automation, which helps assure quality and operational control (Reynolds, 1982). The optimal pH for breakpoint chlorination is between 6 and 7. Because chlorine reacts with water, forming hydrochloric acid, a pH depression to below 6 may occur with poorly buffered wastewaters. This drop increases chlorine requirements and slows the rate of reaction.

One advantage of breakpoint chlorination for ammonia removal is its relative insensitivity to temperature. Also, capital costs are small relative to other ammonia removal processes, such as ammonia stripping and ion exchange (Green et al., 1981). However, many organic compounds react with chlorine to form toxic compounds, including trihalomethanes and other disinfection by-products, which can interfere with beneficial uses of receiving waters. Thus, dechlorination is necessary. Both sulfur dioxide and carbon adsorption are used with dechorination, with sulfur dioxide being more common due to lower cost. Another disadvantage of breakpoint chlorination for nitrogen removal may be an undesirable increase in total dissolved solids (Metcalf and Eddy, 1991).

8.4.3.2 Residual Suspended Solids Removal

Besides granular-medium filtration systems microscreens may be used to achieve supplemental removals of suspended solids. This practice also provides further reduction in BOD. Microscreens involve solid-liquid separation a process in which liquid passes through a filter fabric to remove as much fine material as possible.

Microscreens

Microscreens are a surface filtration device used to remove a portion of the residual suspended solids from secondary effluents and from stabilization pond effluents. Microscreens are low speed, continually backwashed, rotating drum filters operating under gravity conditions. Typical filtering fabrics have openings of 23 or 35 μm and cover the periphery of the drum. Wastewater enters the open end of the drum and flows outward through the rotating screening cloth. The collected solids are backwashed into a trough located at the highest point within the drum and returned to primary or secondary treatment processes (Metcalf and Eddy, 1991).

Typical suspended solids removal is about 55 percent with a range of 10 to 80 percent. Some problems with microscreens include incomplete solids removal and an inability to handle fluctuations in suspended solids concentrations. Reducing drum rotational speed and decreasing frequency of backwashing can increase removal efficiency, but screening capacity is thereby reduced. Typical hydraulic loading rates and drums speeds respectively are 75 to 150 gallon/ft^2-min and 15 ft/min at 3-in. head loss to 115 to 150 ft/min at a 6-in. head loss (Metcalf and Eddy, 1991).

8.4.3.3 Removal of Organic Compounds and Specific Ions

Various advanced wastewater treatment processes are used for removing organic compounds and target ions from wastewater. Carbon adsorption process has been widely used to remove organic compounds from different types of wastewater. To remove target ions from wastewater, ion exchange process have been used. To prevent filter plugging and to ensure proper operation, granular activated carbon columns and ion exchange columns are usually preceded by filtration units.

Carbon Adsorption

Both granular and powdered activated carbon can be used to further reduce concentrations of organic compounds, including refractory compounds after secondary biological treatment. With granulated activated carbon (GAC), the adsorption process occurs in steps. Initially, organic matter moves from the bulk liquid phase to the liquid-solid interface by advection and diffusion. Next, diffusion of the organic matter through the macropore system of the granulated activated carbon occurs at adsorption sites in micropores and submicropores. Although adsorption also occurs on the surface and in the macro- and mesopores of activated carbon granules, the surface area of the micro- and submicropores greatly exceeds the surface areas of the granule and the macro- and mesopores. With powdered activated carbon (PAC), adsorption occurs primarily on the surface of the carbon particles (Weber, 1972; Metcalf and Eddy, 1991).

When the rate of adsorption equals the rate of desorption, the adsorptive capacity of the carbon has been reached and regeneration is necessary. GAC is regenerated easily by oxidizing the adsorbed organic matter in a furnace. About 5 to 10 percent of GAC is destroyed in the regeneration process and must be replaced (Metcalf and Eddy, 1991). Also, the adsorptive capacity of regenerated GAC is slightly less than that of virgin GAC. A major problem with the use of PAC is that regeneration methodology is not well defined.

A fixed bed reactor often is used for wastewater treatment using GAC. Flow is downward through the carbon column, which is supported by an under-drain system. There may be provision for backwashing and surface washing to limit head-loss due to the accumulation of particulate matter. Upflow and expanded bed columns also are used (Metcalf and Eddy, 1991). With biological wastewater treatment, PAC usually is added either to the basin or to the secondary clarifier effluent. In the "PACT' process, the PAC is added directly to the aeration basin (Metcalf and Eddy, 1991).

Tertiary treatment using activated carbon can remove up to 98 percent of colloidal and dissolved organics measured as BOD_5 and COD in a wastewater stream. Effluent BOD_5 concentrations may be as low as 2 to 7 mg/L with effluent COD concentrations in the range of 10 to 20 mg/L (Metcalf and Eddy, 1991).

Use of activated carbon is common in water treatment to remove organic compounds from raw water supplies responsible for color, taste, and odor problems. In the treatment of MPP wastewaters, the use of carbon adsorption is generally limited to tertiary treatment prior to wastewater reuse as potable water.

Ion Exchange

Ion exchange is a unit process in which ions of a given species are displaced from an insoluble exchange material (resin) by ions of a different species in solution. This process is most commonly used to soften water by removing calcium and magnesium ions. It is also used in industrial wastewater treatment for the recovery of valuable constituents, including precious metals and radioactive materials. It may be operated in batch or continuous mode. In a batch process, the resin is stirred with the water to be treated in a the reactor until reaction is complete. The spent acid is removed by settling, and subsequently is regenerated and reused. In a continuous process, the exchange material is placed in a bed or a packed column, and the water to be treated is passed through it. When the resin capacity is exhausted, the column is backwashed to remove trapped solids and then regenerated (Metcalf and Eddy, 1991). To maintain continuous operation, typically, two or more columns are used, so that when one of the columns is off-line (backwashing or regenerating) other column(s) are on-line (operational).

Although ion exchange is known to occur with a number of natural materials, there is a broad spectrum of synthetic exchange resins available. Synthetic resins consist of networks of hydrocarbon radicals with attached soluble ionic functional groups. The hydrocarbon radicals are cross-linked in a three dimensional matrix, with the degree of cross-linking imparting the ability to exclude ions larger than a given size. The nature of the attached functional groups largely determines resin behavior. There are four major classes of ion exchange resins: strongly acidic and weakly acidic cation exchange resins, and strongly basic and weakly basic anion resins. Strongly acidic resins contain functional groups derived from strong acids such as sulfuric acid (H_2SO_4), whereas functional groups of weakly acidic resins are derived from weak acids such as carbonic acid (H_2CO_3). Similarly, strongly basic resins contain functional groups derived from quaternary ammonium compounds, whereas functional groups of weekly basic resins are derived from weak base amines. The exchangeable counter ion of an acidic cation resin may be the hydrogen ion or some other monovalent cation, such as sodium. For a basic anion resin, the exchangeable counter ion may be the hydroxide ion or some other monovalent anion. The regenerant will be the corresponding acid, base, or simple salt (Weber, 1972).

The use of ion exchange in the treatment of MPP wastewaters is less common. The ion exchange technology may be used to remove ammonium ions from wastewater, nitrate ions from the nitrified wastewater, phosphorous, and/or to remove total dissolved solids from wastewater. The functional group to be used depends on the target ions (NH_4^+, NO_3^- , or other ions) to be removed.

To minimize head loss through ion exchange columns and possible resin fouling, ion exchange usually follows granular medium filtration and possibly carbon adsorption. In addition, special provisions are necessary for regeneration waste. Another waste stream requiring disposal is exhausted resin. Regeneration efficiency decreases with time and replacement becomes necessary to maintain process performance.

8.5 DISINFECTION

Disinfection destroys remaining pathogenic microorganisms and is generally required for all MPP wastewaters being discharged to surface waters. Chlorine injection is the most commonly used method for wastewater disinfection; however, use of ultraviolet light for disinfection is not uncommon (USEPA, 2001). Ozone injection and combinations of UV and ozonation are also attractive alternatives for disinfection.

8.5.1 Chlorination

The chemical reactions that occur when chlorine is added to wastewater have been described above in the discussion of breakpoint chlorination for ammonia removal. For disinfection, the objective is to add chlorine at a rate that results in a free chlorine residual to ensure that pathogen kill occurs. As discussed above, a free chlorine residual occurs only after reactions with readily oxidizable ions, organic matter, and ammonia are complete. Thus, chlorine requirements for disinfection depend on wastewater characteristics at the time of disinfection. The degree of mixing and contact time in a chlorine contact chamber are critical factors in the process of disinfection using chlorine. The most commonly used chlorine compounds used for wastewater disinfection are chlorine gas, calcium hypochlorite, sodium hypochlorite, and chlorine dioxide (Metcalf and Eddy, 1991). Chlorine dioxide is an unstable and explosive gas that requires special precautions.

As also was noted above in the discussion of breakpoint chlorination for ammonia removal (Section 8.4.3.1), dechlorination often is necessary to reduce effluent toxicity with sulfur dioxide addition being the most commonly used approach. Sulfur dioxide reacts with both free chlorine and chloramines with chloride ions, resulting primarily in the end production of chloride ions (Metcalf and Eddy, 1991).

8.5.2 Ozonation

Since ozone is chemically unstable, it decomposes to oxygen very rapidly after generation, and thus must be generated on site. The most efficient method of producing ozone is by electrical discharge. Ozone is generated either from air or pure oxygen, when a high voltage is applied across the gap of narrowly spaced electrodes. It is an extremely reactive oxidant, and it is generally believed that bacterial kill through ozonation occurs directly because of cell wall disintegration. Ozone is a more effective virucide than chlorine. Ozone does not produce dissolved solids and is not affected by ammonia concentrations or pH. In addition, there is no chemical residue produce from using ozone, because it decomposes rapidly to oxygen and water. Use of ozone increases the dissolved oxygen concentration, control odor, and provides removal of soluble refractory organics. One disadvantage to using ozone is that it is necessary to generate it on site, because of its chemical instability (Metcalf and Eddy, 1991).

8.5.3 Ultraviolet Light

Suspended or submerged lamps producing ultraviolet (UV) light are another option for wastewater disinfection, especially for the inactivation of the parasites of *Cryptosporidium* parvum and *Giardia lamblia*. It is known that chlorine does not have an effect on Cryptosporidium and that ozone requires higher doses to complete inactivation (Stone and Brooks, 2001). Radiation emitted from the ultraviolet light is an effective bateriocide and virucide while generating any toxic compound. Low-pressure mercury arc lamps are the principal means of generating UV energy used for disinfection. Operationally the lamps are either suspended outside of the liquid to be treated or submerged in the liquid. Where the lamps are submerged, they are encased in quartz tubes to prevent cooling effects on the lamps. Radiation from low-pressure lamps with a wavelength of around 254 nm penetrates the cell wall of the microorganisms and is absorbed by cellular materials a process which either prevents replication or causes death of the cell to occur (Stone and Brooks, 2001). Since turbidity will absorb UV energy and shield the microorganism, turbidity in the water should be kept low for better results (Metcalf and Eddy, 1991). UV irradiation, whether at low- or medium-pressure, performs similarly in achieving 4 log inactivation of Cryptosporidium (Stone and Brooks, 2001). UV irradiation in combination with ozonation can also be applied for the reuse of chiller water in poultry operations (Diaz and Law, 1997).

8.6 EFFLUENT DISPOSAL

The most common disposal methods of treated MPP wastewaters are by discharge to adjacent surface waters under the authority of a NPDES permit or discharge to POTWs. However, disposal by land application is an alternative method that can eliminate the need for tertiary treatment of wastewater (Johns, 1995; Uhlman, 2001).

Land application by sprinkler or flood irrigation can be a feasible alternative to surface water discharge, if the appropriate land is available and other prerequisites can be satisfied. These prerequisites include soils with moderately slow to moderately rapid permeability and soils with the ability to collect any surface runoff that occurs. In addition, the production of a marketable crop is a necessity to provide a mechanism for the removal of nitrogen, phosphorus, and other nutrients from soils applied with wastewater by sprinkler or flood irrigation (Uhlman, 2001).

In land application, wastewater disposal is performed using a combination of percolation and evapotranspiration with microbial degradation of organic compounds occurring in the soil profile. Both crop uptake and nitrification-denitrification serve as mechanisms for nitrogen reduction. Crop uptake, chemical precipitation, and adsorption to soil particles are mechanisms of phosphorus reduction. Water balances are managed to match crop water use and salt leaching needs with irrigation to maintain water percolation to groundwater within the system design (Uhlman, 2001). Nitrogen balances are also developed to match estimated nitrogen losses and crop uptake (removal) to minimize percolate nitrate losses to groundwater. Spray and flood irrigation systems for wastewater disposal (Figure 8-4) may be designed with the objective of either wastewater disposal or wastewater reuse. If disposal is the objective, application or hydraulic loading rate is not controlled by crop requirements, but by the limiting design parameter, soil permeability or constituent loading. In many situations, nitrogen loading rate is the limiting design parameter to minimize leaching of nitrate nitrogen to ground water. Phosphorus loading rate generally is not a limiting design parameter, due to the ability of soils to immobilize phosphorus. However, the ability of soils to adsorb phosphorus is finite, and saturation of the upper zone of the soil profile can occur (US EPA, 1974).

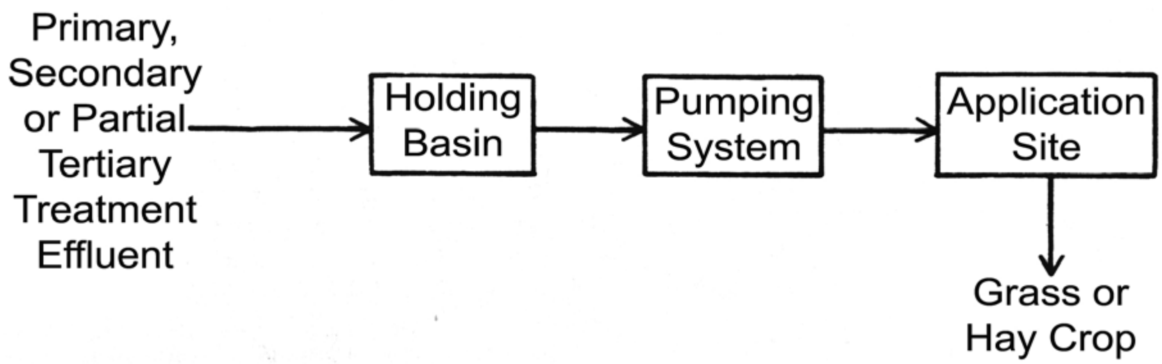

Figure 8-4. Spray/Flood Irrigation System (USEPA, 1974)

Wastewater can be applied to crops using solid set or center pivot sprinkler or flood irrigation. With flood irrigation, also known as ridge-and-furrow irrigation, wastewater is released into furrows between rows of growing crops. Fields irrigated using flood irrigation are graded to allow uniform irrigation of the entire field by gravity flow, with provision for capture and containment of any return flow. Intermittent application cycles, usually ranging from every four to ten days, maintain aerobic conditions in the soil. In arid and semi-arid areas, land application, as a method for wastewater disposal, is especially attractive, given the low rates of precipitation allowing higher hydraulic loading rates than in more humid regions. However, the accumulation of soluble salts (total dissolved solids) in the root zone of the soil profile can be problematic in arid and semi-arid regions because of the lack of precipitation, resulting in reduced leaching of these salts from the soil profile. These salt accumulations are toxic to many plant species. Salt accumulations in the soil profile also occur when conventional irrigation practices are used in arid and semi-arid climates. The typical approach used to deal with accumulations of soluble salts from irrigation is periodic hydraulic loadings to leach accumulated soluble salts from the root zone of the soil. However, some ground water contamination may result from using periodic hydraulic loadings. Reduction of total dissolved solids concentrations in MPP wastewaters prior to land application is another option, but the associated cost may make direct discharge to surface waters a more attractive option in arid and semi-arid climates.

Wastewater treatment systems using sprinkler or flood irrigation as a method for MPP wastewater disposal should provide a minimum of secondary treatment before use of wastewater for irrigation. Secondary treatment of wastewater reduces BOD and suspended solids loading rates and consequently, it reduces the potential of these parameters to act as limiting design factors. Secondary treatment also reduces the odor and vermin problems associated with flood irrigation or sprinkler application of lesser treated wastewater. A holding basin is a necessary element to allow intermittent wastewater applications and to provide storage when climatic or soil conditions do not allow irrigation. Ideally, storage should be adequate to limit wastewater application to the active plant growth period of the year. Thus, storage of wastewater for at least six months in cold climates is desirable (Loehr et al., 1979). For a more complete discussion of wastewater disposal by land application, Loehr et al. (1979) and Overcash and Pal (1979).

In the absence of proper system design and operation, land application as a method of wastewater disposal can adversely affect surface and ground water quality. Excessive organic loading rates can result in reduced soil permeability and the generation of noxious odors due to the development of anaerobic conditions. Excessive nitrogen application rates can lead to nitrate leaching to ground water. Excessive phosphorus application rates can lead to surface or ground water contamination, or both, if the irrigated soils become saturated with phosphorus.(Metcalf and Eddy, 1991)

Exposure to pathogens also is a concern, especially with spray irrigation systems given the potential for pathogen transport in aerosols. Virus transmission through aerosols is the most serious concern, because a single virus can cause infection. In contrast, infectious doses of bacterial pathogens range from at least 10^1 for *Shigella* to as high as 10^8 organisms for enteropathogenic *E. coli* (Loehr *et al*., 1979). However, using one or more of several recommended practices can reduce the transmission of pathogens in aerosols. Recommended practices include: (1) creating buffer zones with or without hedgerows (2) using low pressure nozzles aimed downward (3) avoiding wastewater spraying windy conditions and (4) restricting irrigation to daylight hours (Johns, 1995).

Especially in colder climates, wastewater land application systems require storage facilities to avoid application to frozen, snow-covered, or saturated soil. Wastewater application under these conditions can result in surface runoff transporting pollutants to adjacent surface waters. See Loehr et al (1979) for a detailed discussion of storage requirements for wastewater land application systems in various climates.

8.7 SOLIDS DISPOSAL

Typically, biosolids generated during the treatment of MPP wastewaters are aerobically digested before disposal by land application. Biosolids may be de-watered prior to land application. Rendering is a common disposal method for wastewater solids recovered by dissolved air flotation (DAF) before secondary treatment. Generally, the use of metal salts prior to DAF is avoided if rendering is used for the disposal of recovered solids, to unacceptably high concentrations of aluminum or iron in rendering products. Alternatives to rendering for the disposal of DAF solids are land application and land filling. High quality by-products (e.g., blood) are often segregated from DAF solids and other MPP WWTP sludges as some rendering operations (e.g., pet food manufacturing) require high quality input by-products.

EPA noted during site visits to two independent rendering operations that sludges from dissolved air floatation units which use chemical additions to promote solids separation are rendered; however, the chemical bond between the organic matter and the polymers requires that the sludges be processed (rendered) at higher temperatures (260 ^{o}F) and longer retention times. EPA also observed during site visits that some independent renderers reject raw materials that have (1) a pH below 4 SU (with 3 SU being a general cut-off), (2) ferric chloride due to its corrosive nature, and (3) other contamination (e.g., pesticides).

8.8 POLLUTION PREVENTION AND WASTEWATER REDUCTION PRACTICES

8.8.1 Wastewater Minimization and Waste Load Reduction Practices at MPP Facilities

For many MPP facilities, wastewater flow minimization and waste load reduction practices have been incorporated into normal business practices in order to reduce production costs and maximize profits. As with other competitive industries, unessential consumption of water and energy, and the additional costs of waste treatment can mean the difference between profitability and operational losses. While water reuse and by-products recovery are standard approaches for wastewater flow minimization and waste load reduction at MPP facilities, the extent of these practices and their effectiveness, varies widely among individual facilities. Some large facilities have installed onsite advanced wastewater treatment systems which treat facility effluent allowing this water to be reused for some applications within the facility. Other facilities have changed sanitation practices to reduce water use and effluence in general. For example, one independent renderer noted during an EPA site visit that his facility fully converted from a wet cleaning method to a dry cleaning method in the product shipment area in order to minimize water pollution.

Industry sources have estimated that the implementation of the U.S. Department of Agriculture Food Safety and Inspection Service's (USDA FSIS) Hazard Analysis and Critical Control Points (HACCP) program has increased water usage by 20 to 25 percent. USDA FSIS disagrees with industry's assertion that implementation of HACCP has necessarily required greater use of water. Furthermore, USDA FSIS asserts that its regulatory performance standards provide for numerous water reuse opportunities (see 9 CFR 416.2(g)).

The USDA FSIS promulgated the HACCP program on July 25, 1996 (61 FR 38806). The HACCP rule requires all MPP facilities to develop and implement a system of preventative controls to improve the safety of their products with an emphasis on reducing microbial contamination from fecal material. The Sanitation Requirements for Official Meat and Poultry

Establishments Rule (USDA, 1996; 64 FR 56400) also mandates all MPP facilities to develop and implement written standard operating procedures for sanitation.

As described below, opportunities remain for reducing potable water use and wastewater flow in MPP through water conservation techniques and multiple use and reuse of water. In addition, opportunities exist to reduce waste loads to wastewater treatment facilities by physically collected solid materials before using water to clean equipment and facilities. Gelman et al. (1989) and Berthouex et al. (1977) provide case studies for minimizing waste and water use at poultry processing and hog processing facilities, respectively. Both conclude that facilities can save costs through readily available process modifications that can significantly reduce water use and wastewater flow and loadings.

8.8.2 General Water Conservation and Waste Load Reduction Techniques

Reducing water use is important as facilities that institute a water use reduction program also reduce their raw wastewater load (Scaief, 1975). Numerous studies have demonstrated the water use in MPP can be reduced significantly. For example, Carawan and Clemens (1994) reported a reduction in water use of 75 gallons per pig processed, a reduction of 33 percent, following implementation of a water conservation program at a hog slaughtering and rendering operation. In addition, it has been demonstrated that substantial reductions in wastewater pollutant concentrations also can be achieved through implementation of waste load reduction practices. Reductions in 5-day biochemical oxygen demand (BOD_5) in hog processing wastewater of 40 percent have been reported (Carawan and Clemens, 1994). However, both goals can be achieved only when management recognizes that a reduction in processing costs and an increase in profitability can be realized by reducing the costs of potable water and wastewater treatment. Thus, a management commitment to water conservation logically depends on the cost of potable water, and a management commitment to waste load reduction depends on the cost of wastewater treatment. If potable water is being obtained from private on-site wells, there obviously is a reduced economic incentive to conserve water than when water is being purchased from a public utility or private water purveyor. Also, the incentive for waste load reduction generally is greater for indirect dischargers because wastewater treatment costs are readily identifiable and surcharges for excessive pollutant concentrations can rapidly escalate wastewater treatment costs. Conversely, wastewater treatment costs can be less visible for direct dischargers and less sensitive to pollutant concentrations.

The development of water conservation and waste load reduction programs in the MPP as well as in other industries begins with the development of general profiles of water use and wastewater pollutant concentrations over one or preferably several 24 hour periods to determine the relative significance of processing and cleanup activities. Generally this step is accompanied or followed by measuring water use in individual phases of the processing process to identify opportunities for water use reduction. For example, measuring water flow to scalders and chillers in poultry processing to determine overflow rates can identify overflow rates in excess of FSIS requirements. Measuring and regulating water pressure for carcass washing to insure that FSIS requirements are not being exceeded is another example of how water use can be reduced in MPP operations. Measuring and regulating small flows such as from hand washing operations also can significantly reduce water use and wastewater volume.

The daily cleanup and sanitation of processing facilities and equipment contributes substantially to water use and wastewater pollutant load and probably presents the greatest opportunity for reductions. Typically, both water use and wastewater pollutant load can be reduced substantially by initially “dry cleaning” processing areas and equipment to collect meat scraps and other materials for disposal by rendering instead of the common practice of using “water as a broom.” Although subsequent screening before wastewater treatment provides for recovery of larger particles, fine particulate matter and soluble proteins, fats, and carbohydrates are not recovered and are manifested as an increased pollutant load to the wastewater treatment plant. Gelman *et al.* (1989) have shown that biochemical oxygen demand (BOD) in cleanup wastewater in poultry processing can be reduced from 20 to 50 percent by initially dry cleaning processing areas and equipment. Concurrently, dry cleaning can increase the production of inedible rendered products. Dry cleaning of live animal holding areas also can reduce water required for the cleaning of these facilities and the pollutant load in the wastewater generated. However, responses to the MPP detailed survey indicate that dry cleaning is a much more common practice at meat as compared to poultry processing facilities (47 percent for meat processing respondents versus 17 percent for poultry processing respondents).

To be successful, water conservation and waste load reduction plans must be implemented and performance monitored. Implementation requires employee training that should be continual and possibly the installation of new equipment such as hose nozzles and foot valves at hand wash stations that automatically shut off when not in use. Conversion to high pressure, low volume systems for carcass washing and general sanitation also can reduce water consumption. However, continual monitoring of water use and waste loads also is a necessity to avoid slippage in performance.

8.8.3 Multiple Use and Reuse of Water

USDA FSIS guidelines do not preclude the multiple use and reuse of water in MPP as practices to reduce potable water consumption and the discharge of treated wastewater. While it is obvious that acceptable multiple use and reuse strategies must avoid contact with products intended for human consumption, a significant fraction of the water used in MPP does not involve such contact.

The multiple use of water most commonly occurs in poultry processing. Witherow et al. (1978) report that water conservation through multiple reuse in poultry processing will be rewarded by savings in processing cost and reduced requirements for wastewater treatment. Examples include the use of scalder overflow to flume feathers from mechanical de-feathering equipment and the use of chiller overflow to flume inedible viscera to screens for recovery prior to rendering. Combination UV irradiation and ozonation can be effective treatment for this re-used poultry chiller overflow (Diaz and Law, 1997). These are examples of countercurrent recycling where water reuse is countercurrent to product flow.

In contrast to multiple use, water reuse requires treatment as a prerequisite with the degree of treatment determining how water can be reused. For example, reuse of wastewater after tertiary treatment to remove suspended solids and double disinfection, such as chlorination followed by ultraviolet light, is permissible for purposes where no contact with such as evaporative condenser cooling and holding lot, parking lot, and wastewater treatment plant cleaning.

With further treatment to meet drinking water standards using unit processes such as coagulation and flocculation followed by settling and then filtration and disinfection, reuse of wastewater treatment plant secondary effluent expands the potential for reuse. Examples of permissible uses in hog processing include use on the kill floor up to the first carcass wash, flushing of large intestines (chitterlings), cleaning of receiving pens, and rendering facilities. Other possible uses of wastewater treated to meet drinking water standards include use for equipment such as pump cooling and as boiler makeup water.

In the poultry processing industry, a number of unit process level reuse strategies also have been explored. One example is the reuse of final chiller overflow following diatomaceous earth filtration and disinfection as scalder makeup water or for fluming of harvested giblets. As noted by Carawan (1994), it also was demonstrated in the late 1970s that poultry processing wastewater treated to meet primary drinking water standards can be safe, when mixed with an equal amount of potable water, for use in poultry processing.

Based on data provided by the MPP detailed survey, EPA estimates that reuse of water in MPP facilities is relatively rare. About 8 percent of the poultry processing respondents to the survey indicated reuse of water from the wastewater treatment plant to defeathering or evisceration areas. Other water reuse practices such as reusing effluent for screen washing or cleanup of outside areas are even less common as indicated by detailed survey response.

8.8.4 Specific Pollution Control Practices Identified by EPA in Previous Regulatory Proposals

The following relevant Best Available Technology Economically Achievable (BAT) in-plant pollution control practices were listed in EPA's "Development Document for Proposed Effluent Limitations Guidelines for the Poultry Segment of the Meat Product and Rendering Process Point Source Category" (USEPA, 1975):

- Control and minimize flow of freshwater at major outlets by installing properly sized spray nozzles and by regulating pressure on supply lines. Hand washers may require installation of press-to-operate valves. This also implies that screened waste waters are recycled for feather fluming.
- Confine bleeding and provide for sufficient bleed time. Recover all collectable blood and transport to rendering in tanks rather than by dumping on top of feathers or offal.
- Use minimum USDA-approved quantities of water in the scalder and chillers.
- Shut off all unnecessary flow during worm breaks.
- Consider the reuse of chiller water as makeup water for the scalder. This may require preheating the chiller water with the scalder overflow water by using a simple heat exchanger.
- Use pretreated poultry processing waste waters for condensing all cooking vapors in onsite rendering operations.
- Consider dry offal handling as an alternative to fluming. A number of plants have demonstrated the feasibility of dry offal handling in modern high-production poultry slaughtering operations.
- Consider steam scalding as an alternative to immersion scalding.
- Control water use in gizzard splitting and washing equipment.
- Provide for frequent and regular maintenance attention to byproduct screening and handling systems. A back-up screen may be required to prevent byproduct from entering municipal or private waste treatment systems.
- Dry clean all floors and tables prior to washdown to reduce the waste load. This is particularly important in the bleeding, cutting, and further processing areas and all other areas where there tend to be material spills.

- Use high-pressure, low-volume spray nozzles or steam-augmented systems for plant washdown.
- Minimize the amount of chemicals and detergents to prevent emulsification or solubilization of solids in the waste waters. For example, determine the minimum effective amount of chemical for use in the scald tank.
- Control inventories of raw materials used in further processing so that none of these materials are ever wasted to the sewer. Spent raw materials should be routed to rendering.
- Treat separately all overflow of cooking broth for grease and solids recovery.
- Reduce the waste water from thawing operations.
- Make all employees aware of good water management practices and encourage them to apply these practices.
- Treat offal truck drainage before sewering. One method is to steam sparge the collected drainage and then screen.
- In-plant primary systems—catch basins, skimming tanks, air flotation, etc.—should provide for at least a 30-minute detention time of the waste water. Frequent, regular maintenance attention should be provided.

The following BAT in-plant pollution control practices were listed in EPA's "Development Document for Proposed Effluent Limitations Guidelines and New Source Performance Standards for the Processor Segment of the Meat Products Point Source Category" (USEPA, 1974):

- Use water control systems and procedures to reduce water use considerable below that of Best Practicable Control Technology Currently Available (BPT) except for small processors.
- Reduce the waste water from thawing operations.

- Provide for improved collection and greater reuse of cure and pickle solutions.
- Prepackage products (e.g., hams) before cooking to reduce grease contamination of smokehouse floors and walls.
- Revise equipment cleaning procedures to collect and reuse wasted materials, or to dispose of them through channels other than the sewer.
- Reuse or recycle noncontaminated water whenever possible.
- Initiate and continually enforce meticulous dry cleanup of floors before washing.
- Install properly designed catch basins and maintain them with frequent regular grease and solids removal.

It should be noted that the in-plant controls and modifications required to achieve the July 1, 1983, effluent limitations included water control systems and procedures to reduce water use to about 50 percent of the water used to meet BPT (USEPA, 1974).

8.8.5 Non-Regulatory Approaches to Pollution Prevention

EPA is using non-regulatory approaches to facilitate reduction of wastewater generation in the MPP industry. Specifically, the Agency has formed partnerships with industry and state agencies to develop guidance materials and implement innovative practices for reducing waste.

Participants in developing this program include the American Meat Institute (AMI), the American Association of Meat Processors (AAMP), the U.S. Department of Agriculture (USDA), several State agencies, EPA programs and regions, and other interested constituent groups. For example, EPA and its partners are developing BMP guidance materials for handling and disposal of rendering materials, and for chloride, nitrogen, and phosphorus discharges. The project team will evaluate these management practices and develop measures of their effectiveness. Long-term deployment of the final tools will occur through the active leadership of the industry's trade associations. In addition, EPA is partnering with the Iowa Waste Reduction Center (IWRC) and the Iowa Department of Natural Resources (IDNR) to pilot test the Guide with five companies. IWRC and IDNR are providing technical assistance and implementation consulting to the five companies. The pilot will be completed in July 2002, and then EPA will evaluate the pilot and incorporate lessons learned into the final draft of the "EMS Guide for Meat and Poultry Processors." The final guide is expected to be completed by September 2002, at which point this tool will be widely marketed throughout the meat and poultry processing industry.

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SECTION 9

POLLUTANT LOADINGS

This section presents annual pollutant loading estimates for the meat and poultry products (MPP) industry. EPA estimated the pollutant loadings for the MPP industry to evaluate the effectiveness of the treatment technologies, to estimate benefits gained from removing pollutants discharged from each of the industry model facility groupings, and to evaluate the cost-effectiveness of the technology options in reducing the pollutant loadings. EPA defined baseline loadings, technology option loadings, and pollutant removals as follows:

- Baseline loadings - Pollutant loadings in meat and poultry processing wastewater being discharged to surface water or through publicly owned treatment works (POTWs) to surface water.

- Technology option loadings - Estimated pollutant loadings in meat and poultry processing wastewater after implementation of technology option, also referred to as post-compliance or treated pollutant loadings. In calculating these loadings EPA assumed that all MPP facilities would operate wastewater treatment and pollution prevention technologies equivalent to the technology option for which they have been costed. Costing methodology and estimates are discussed in detail in Section 11.

- Pollutant removals - The difference between baseline loadings and technology option loadings.

EPA estimated baseline loadings, technology option loadings, and pollutant removals for every model facility grouping (facility groupings are described further in Section 11). This section discusses the methodology that EPA used to estimate pollutant loadings and removals, and presents the resultant estimated pollutant loadings and expected removals as follows:

- Sections 9.1.1 through 9.1.4 discusses the data sources and methodology that EPA used to estimate baseline pollutant loadings,

- Sections 9.2.1 through 9.2.4 present the data sources and methodology that EPA used to estimate technology option pollutant loadings, and

- Section 9.3 discusses the method to estimate pollutant removals.

9.1 BASELINE POLLUTANT LOADINGS

This section presents baseline pollutant loadings for the meat and poultry products industry. EPA estimated the baseline pollutant loadings for each model facility grouping based on wastewater discharges to surface waters or through publicly owned treatment works (POTWs) to surface waters.

The following is a summary of methods used by EPA to select data sources and compute baseline loads:

- Section 9.1.1 presents sources used by EPA to compute baseline concentrations for the pollutants of concern

- Section 9.1.2 outlines the methods used by EPA to compute average concentrations from detailed survey analytical data and from EPA sampling episodes

- Section 9.1.3 presents the hierarchy used by EPA to impute baseline concentrations for all 37 pollutants of concern for the 151 (48 direct and 103 indirect discharge) facilities

- Section 9.1.4 describes the methodology used to estimate pollutant loadings for the various pollutants of concern.

9.1.1 Sources and Use of Available Data

EPA used analytical data provided by the industry in the detailed surveys and analytical data from facilities sampled to compute baseline pollutant concentrations. The analysis includes a total of 48 direct and 103 indirect discharge facility detailed surveys. For the 151 direct and indirect discharge facilities, EPA used baseline concentrations reported for 1999, the base year of the MPP detailed survey. In addition to the analytical data from the 151 facilities, EPA used sampling data from 11 facilities, including two facilities sampled by EPA. Nine facilities carried out self-sampling with technical oversight provided by EPA.

9.1.2 Calculation of Average Concentrations from Analytical Data

For each facility and for each pollutant of concern (POC) in the baseline loading analysis, EPA used average concentrations provided in the detailed survey. When a facility did not provide average concentrations, but un-averaged, self-monitoring data instead, EPA calculated an average value to use as the baseline concentration. In computing average baseline concentrations for use in the proposal, the Agency did not edit any analytical data provided in the detailed survey. In addition, EPA did not use sample detection limits or the maximum and minimum concentration values, when average values were not available in the survey. However, for EPA sampling episodes where concentrations of pollutants were reported below the sample detection limit, the Agency used the reported sample detection limit as the concentration. Analytical data from EPA sampling episodes were averaged on a daily basis at each sample location.

9.1.3 Establishment of Baseline Concentration Data

EPA derived baseline concentrations for each POC for each of the 151 facilities (48 direct and 103 indirect) used to generate baseline pollutant loads. These concentration estimates were then used to generate baseline pollutant concentrations for each of the 19 model facility groupings being analyzed by EPA.

EPA used the following hierarchy to calculate baseline concentrations for each facility:

1. When a facility provided concentration data (average values provided in the detailed survey and averages calculated by EPA from un-averaged self monitoring data as described previously in Section 9.1.2) for any of the 37 POCs, EPA used this average concentration.

2. For facilities where baseline concentrations were available from EPA sampling episodes, EPA used these concentrations. In addition, in the absence of any

baseline concentration data in the detailed survey, EPA transferred analytical data from the EPA sampling episodes for facilities in identical model facility groupings and with identical treatments-in-place. For example, for a poultry first processor (P1) facility with BAT-4 treatment-in-place, EPA used sampling episode data from available poultry first processor (P1) facilities with BAT-4 treatment-in-place. When such sampling data were available from more than one EPA sampling episode, EPA used an average concentration value of these episodes to transfer data to facilities in identical model facility groupings and with identical treatments-in-place. However, for the 11 facilities with EPA sampling episode data belonging to these facilities, the reported pollutant concentrations from respective individual episodes were used, without using an average concentration.

3. For facilities with no data after the above two steps, EPA used average concentrations from detailed survey data from other facilities in identical model facility groupings and with identical treatments-in-place to derive pollutant concentrations.

4. When survey data from facilities in identical model facility groupings were not available, EPA used an average of survey and sample data from facilities with identical treatments-in-place but in *similar* model facility groupings. EPA defined *similar* model facility groupings as those which have at least one of the processes for which an equivalent is being sought. For example, to impute baseline concentrations for a meat first processor and renderer (R13) facility, EPA considered the following: meat first processor (R1), meat first and further processor (R12), meat first, further processor, and renderer (R123), and meat further processor, and renderer (R23) as *similar* model facility groupings. EPA's rationale for this definition is that the above four meat model facility groupings have either the meat first processor model facility grouping (R1) or renderer model facility grouping (R3). The Agency used only available meat model facility groupings from the above four potential model facility groupings to impute

baseline concentrations. However, EPA did not use poultry facility data to derive concentrations for facilities categorized as meat, or vice versa.

5. For POCs where detailed survey and sampling episode data were not available to transfer according to the above four steps, the Agency used average concentrations of both detailed survey and sampling episode data from facilities in identical model facility groupings and with similar treatments-in-place to calculate an average baseline concentration for each pollutant in a model facility grouping. EPA defined a *similar* treatment-in-place as one that has the essential features of the technology to which it is being considered as an equivalent. At this stage of data imputation, except for microbiologicals, EPA used both direct and indirect discharge facilities to transfer analytical data between identical model facility groupings. For example, to obtain the baseline concentration of copper for a poultry first and further processor (P12) facility with PSES-2 treatment-in-place, EPA used an average of copper baseline concentration data from poultry first and further processor (P12) facilities with BAT-2 treatment-in-place. Though these two treatment technologies are not identical, for the purposes of data imputation EPA considered them as similar technologies for the treatment of certain pollutants.

6. When data from facilities in identical model facility groupings and with similar treatments-in-place were not available, an average concentration from facilities in similar model facility groupings, as defined in step 4, and with similar treatments-in-place, as defined in step 5, was used instead. Both detailed survey data and EPA sampling episode data were used to compute average concentrations.

7. When all of the above imputation methods (steps 1-6 for non-microbiologicals, steps 1-4 for microbiologicals) failed to derive pollutant concentrations, either because analytical data were lacking in the detailed survey, or because the model facility grouping the facility belonged to did not have EPA sampling episode data, the Agency used facility data from treatment options from the next tier level, but

in identical model facility groupings. For example, for poultry first processor (P1) model facility grouping with BAT-3 treatment in place when no data was available from P1 meat model facility grouping with BAT-3 treatment, EPA used the following hierarchy: (a) transfer concentration data from P1 facilities with BAT-2 treatment technology, (b) transfer data from P1 facilities with BAT-4 treatment technology. In either of the above two cases, EPA used average concentrations from a group of facilities rather than a single value reported by an individual facility.

8. At the next level of data imputation, EPA used a combination of items 6 and 7 above, using data from facilities in similar model facility groupings and with treatments-in-place from the next tier level to derive baseline pollutant concentrations.

9. For all microbiologicals, EPA transferred data within identical discharge types only. The Agency did not use microbiological data from indirect dischargers to derive concentrations for direct dischargers or vice versa. Other than this exemption, EPA followed the logic described above for deriving baseline concentration for microbiologicals.

When the baseline concentration of a pollutant derived by the above methods was lower than the corresponding concentration with the identical treatment-in-place and in the identical model facility grouping from the proposed treatment option, EPA equated the baseline concentration to the concentration of the pollutant in the proposed option. However, for facilities with available data from the detailed survey (i.e., step 1 above), and for the 11 facilities with data from EPA sampling episodes and facilities where analytical data from EPA sampling episodes were transferred between facilities in identical model facility groupings and with identical treatments-in-place (i.e., step 2 above), the Agency did not replace derived pollutant concentrations with concentrations from the proposed options, even when the baseline concentrations were lower than the concentrations in the corresponding proposed options.

Table 9-1 illustrates the sequence of the above 10 steps.

Table 9-1. Summary of Imputation Methods Used for Derivation of Baseline Concentrations

Step	Description	Model facility grouping	Treatment-in-place	Data Source
1	Use available detailed survey data	Identical	Identical	Facility-specific as provided in detailed survey
2	Use available analytical data from EPA sampling episodes for 11 facilities sampled and facilities in identical model facility grouping and with identical treatments-in-place	Identical	Identical	Facility-specific and averaged EPA sampling episodes
3	Use average concentrations of analytical data from detailed survey in identical model facility groupings and with identical treatments-in-place	Identical	Identical	Averaged detailed survey data when facility did not provide analytical data
4	Use average of detailed survey and EPA sampling episode data with identical treatments-in-place, but in similar model facility groupings	Similar	Identical	Detailed survey and EPA sampling episode data
5	Use average of detailed survey and EPA sampling episode data in identical model facility groupings but with similar treatments-in-place. Not used for microbiologicals	Identical	Similar	Detailed survey and EPA sampling episode data
6	Use average of detailed survey and EPA sampling episode data in similar model facility groupings and with similar treatments-in-place	Similar	Similar	Detailed survey and EPA sampling episode data
7	Use data in identical model facility groupings and with treatments-in-place from next tier levels	Identical	Next tier level of treatment-in-place	Detailed survey and EPA sampling episode data
8	Use data in similar model facility groupings and treatments-in-place from next tier levels	Similar	Next tier level of treatment-in-place	Detailed survey and EPA sampling episode data
9	For micribiologicals, data transfer was only within identical discharge types (direct or indirect) only	Similar or identical	Use data from direct and indirect facilities when deriving data for direct and indirect facilities, respectively.	Detailed survey and EPA sampling episode data
10	Use concentrations from proposed options when baseline concentration of pollutant is less than that in the proposed options, with the exception of concentrations derived in steps 1 and 2 above	Identical	Identical	Technology options as described in Section 9.2.3 and presented in Tables C-47 through C-75 in Appendix C

Certain pollutants that would normally sum to equal another pollutant (e.g., nitrate/nitrite and TKN should sum to total nitrogen) may not do so in these calculations, since the individual baseline concentrations for these pollutants were derived using data from different facilities and sampling episodes. For this proposal, EPA determined that these concentrations be reported as they are recorded in the detailed survey and in the EPA sampling episodes, and as calculated by the imputation methods described above. The Agency made a similar determination for derived concentrations of pollutants such as BOD_5 and $CBOD_5$, fecal coliform and total coliform, total phosphorus and dissolved phosphorus, etc.

The size of the facility (small or non-small) was not considered when transferring data within model facility groupings and treatments-in-place.

After pollutant concentration data were imputed separately for each direct and indirect facility, EPA calculated average concentration for 19 model facility groupings using concentration data from the individual facilities, separating small facilities from non-small facilities.

Average baseline concentrations for all 37 POCs for each model facility grouping are presented in Tables C-1 through C-29 in Appendix C.

When a particular meat model facility grouping was not represented by any of the facilities in the detailed survey, EPA used available, similar model facility groupings in the detailed survey to derive average pollutant concentrations for the missing model facility grouping. For example, in the meat model facility grouping for direct discharging non-small facilities, only R1, R12 and R13 model facility groupings were represented in direct discharging detailed survey. Similarly for direct discharging non-small poultry model facility grouping, only P1, P12, P123, and P13 model facility groupings were represented in the detailed survey. EPA used averages to compute the meat and poultry model facility grouping concentrations that best represented the model facility grouping without facilities in the detailed survey. This calculation used both small and non-small facilities. The model facility grouping averages that were derived using this method are identified with a footnote in Tables C-1 through C-29 in Appendix C, where applicable.

9.1.4 Calculation of Pollutant Loadings

EPA estimated baseline pollutant loadings for all 37 POCs using the average baseline concentrations, described in Section 9.1.3 for each model facility grouping and national flow (median) values derived from the screener survey for small and non-small facilities. Table 9-2 shows the median flow values as projected from the screener survey for direct and indirect dischargers.

Table 9-2. Median Flow for Direct and Indirect Dischargers by Model Facility Grouping and Size

Model Facility Grouping	Flow for Facilities (MGD)			
	Small	**Medium**	**Large**	**Very Large**
Meat first processors (R1)	0.00046	0.028	N/A[a]	N/A
Meat first/further processors (R12)	0.00058	0.440	N/A	N/A
Meat first/further processors and renderers (R123)	0.00120	2.11	3.42	N/A
Meat first processors and renderers (R13)	0.00140	0.630	0.932	2.90
Meat further processors (R2)	0.00038	0.09	0.017	0.00995
Meat further processors and renderers (R23)	0.000073	0.580	N/A	N/A
Poultry first processors (P1)	0.0160	0.720	0.885	1.90
Poultry first/further processors (P12)	0.00035	0.350	0.901	1.60
Poultry first/further processors and renderers (P123)	N/A	0.470	2.81	2.80
Poultry first processors and renderers (P13)	N/A	0.420	1.59	1.7
Poultry further processors (P2)	0.00077	0.086	0.434	0.0308
Poultry further processors and renderers (P23)	0.00350	0.049	0.850	N/A
Mixed poultry/meat further processors (M2)	0.00058	0.250	N/A	N/A
Mixed poultry/meat further processors and renderers (M23)[b]	0.00255	N/A	N/A	N/A
Renderers (REND)	0.140	0.034	0.090	0.177

[a] No facilities are represented in this model facility grouping
[b] Indirect dischargers only

The following equation was used for conventional pollutants, nutrients, metals and pesticides:

$$\text{Load} = \text{Flow} \times \text{Conc} \times 8.345$$

where

Load = pollutant loading, lbs/day

Flow = flow rate, million gallons per day

Conc = pollutant concentration, mg/L

8.345 = conversion factor, lbs/gal and mg/L.

For microbiological pollutants, the loads were computed using the following equation:

$$\text{Load} = \text{Flow} \times \text{Conc} \times 37.8$$

where

Load = pollutant loading, million cfu/day

Flow = flow rate, million gallons per day

Conc = pollutant concentration, cfu/100 mL

37.8 = conversion factor, L/gal and mL/L.

For Cryptosporidium, the loads were computed using the following equation:

$$\text{Load} = \text{Flow} \times \text{Conc} \times 3.78$$

where

Load = pollutant loading, million cysts/day

Flow = flow rate, million gallons per day

Conc = pollutant concentration, cysts per L

3.78 = conversion factor, L/gal.

EPA estimated pollutant loadings for the entire industry using the national estimates of the number of facilities in each meat model facility grouping multiplied by the model facility grouping loadings. Tables 9-3 and 9-4 present the number of facilities in each model facility grouping, as projected from the screener survey for direct and indirect dischargers.

Table 9-3. Number of Direct Discharger Facilities by Model Facility Grouping and Size

Model Facility Grouping	Number of Facilities			
	Small	**Medium**	**Large**	**Very Large**
Meat first processors (R1)	17	6	N/A[a]	N/A
Meat first/further processors (R12)	N/A	N/A	N/A	N/A
Meat first/further processors and renderers (R123)	25	17	7	N/A
Meat first processors and renderers (R13)	17	17	7	12
Meat further processors (R2)	43	10	1	1
Meat further processors and renders (R23)	N/A	4	N/A	N/A
Poultry first processors (P1)	N/A	17	25	7
Poultry first/further processors (P12)	N/A	6	2	8
Poultry first/further processors and renderers (P123)	N/A	2	3	1
Poultry first processors and renders (P13)	N/A	7	8	2
Poultry further processors (P2)	N/A	10	1	2
Poultry further processors and renders (P23)	N/A	N/A	N/A	N/A
Mixed poultry/red meat further processors (M2)	9	5	N/A	N/A
Renderers (REND)	6	7	6	8

[a] No facilities are represented in this model facility grouping

Table 9-4. Number of Indirect Discharger Facilities by Model Facility Grouping and Size

Model Facility Grouping	Number of Facilities			
	Small	**Medium**	**Large**	**Very Large**
Meat first processors (R1)	265	N/A[a]	N/A	N/A
Meat first/further processors (R12)	674	28	N/A	N/A
Meat first/further processors and renderers (R123)	50	12	5	N/A
Meat first processors and renders (R13)	12	7	3	5
Meat further processors (R2)	2,489	160	4	4
Meat further processors and renders (R23)	32	7	N/A	N/A
Poultry first processors (P1)	19	32	48	12
Poultry first/further processors (P12)	20	11	4	14
Poultry first/further processors and renderers (P123)	N/A	3	7	2
Poultry first processors and renders (P13)	N/A	2	2	1
Poultry further processors (P2)	272	133	4	18
Poultry further processors and renderers (P23)	4	9	6	N/A
Mixed poultry/meat further processors (M2)	707	97	N/A	N/A
Renderers (REND)	17	26	21	28
Mixed poultry/meat further processors and renders (M23)[b]	4	N/A	N/A	N/A

[a] No facilities are represented in this model facility grouping.
[b] indirect dischargers only

Tables 9-5 and 9-6 present the baseline loads generated for direct and indirect facilities, respectively.

Table 9-5. Baseline Loadings for Direct Dischargers

Pollutant Groups of Concern	Small Facility Baseline Loading	Non-Small Facility Baseline Loading	Units
Conventional pollutants [a]	2,633,600	46,926,729	lbs/yr
Toxic pollutants [b]	118,884	52,971,558	lbs/yr
Nutrients [c]	257,489	61,295,253	lbs/yr
Other Pollutants of Concern			
Aeromonas	37,398,048	74,124,203,180	million cfu/yr
Carbonaceous biochemical oxygen demand (CBOD)	10,971	5,436,829	lbs/yr
Chemical oxygen demand (COD)	7,211,921	45,006,868	lbs/yr
Chloride	831,715	289,715,129	lbs/yr
Cryptosporidium	440	40,016	million cysts/yr
Dissolved biochemical oxygen demand	22,325	2,890,205	lbs/yr
Dissolved phosphorus	24,345	6,097,899	lbs/yr
E. coli	37,590,901	78,926,098,937	million cfu/yr
Fecal coliform bacteria	4,012,138	35,157,310,463	million cfu/yr
Fecal streptococci	2,506,958	1,273,974,840	million cfu/yr
Orthophosphate	62,845	4,435,234	lbs/yr
Salmonella	17,007	6,738,113	million cfu/yr
Total coliform	35,508,476	96,100,436,605	million cfu/yr
Total dissolved solids (TDS)	3,721,125	907,402,228	lbs/yr
Total organic carbon (TOC)	68,602	5,932,150	lbs/yr
Total residual chlorine	1,212	475,125	lbs/yr
Volatile residue	784,276	114,282,048	lbs/yr

[a] Conventional pollutants: biochemical oxygen demand (BOD), hexane extractable material (HEM) and total suspended solids (TSS)
[b] Toxic pollutants: ammonia as nitrogen, carbaryl, nitrate-nitrite, barium, copper, chromium, *cis*-Permethrin, manganese, molybdenum, nickel, titanium, *trans*-Permethrin, vanadium, and zinc
[c] Nutrients: total nitrogen and total phosphorus

Table 9-6. Baseline Loadings for Indirect Dischargers

Pollutant Groups of Concern	Small Facility Baseline Loading	Non-Small Facility Baseline Loading	Units
Conventional pollutants [a]	31,966,596	1,018,858,887	lbs/yr
Toxic pollutants [b]	1,143,985	75,299,529	lbs/yr
Nutrients [c]	7,095,318	94,112,866	lbs/yr
Other Pollutants of Concern			
Aeromonas	19,184,904,649	1,084,294,192,937	million cfu/yr
Carbonaceous biochemical oxygen demand (CBOD)	18,098,643	547,829,773	lbs/yr
Chemical oxygen demand (COD)	28,814,396	941,098,914	lbs/yr
Chloride	22,053,547	752,413,059	lbs/yr
Cryptosporidium	229,949	4,310,247	million cysts/yr
Dissolved biochemical oxygen demand	14,962,017	381,609,489	lbs/yr
Dissolved phosphorus	477,206	14,902,848	lbs/yr
E. coli	66,192,758,859	3,257,404,839,755	million cfu/yr
Fecal coliform bacteria	46,703,268,777	2,944,853,206,446	million cfu/yr
Fecal streptococci	57,574,999,260	1,131,842,917,041	million cfu/yr
Orthophosphate	237,447	9,640,839	lbs/yr
Salmonella	583,562	44,105,854	million cfu/yr
Total coliform	71,410,481,190	3,326,332,420,450	million cfu/yr
Total dissolved solids (TDS)	38,778,129	1,423,824,756	lbs/yr
Total organic carbon (TOC)	9,442,455	197,631,108	lbs/yr
Total residual chlorine	3,333	113,586	lbs/yr
Volatile residue	26,271,375	1,197,019,690	lbs/yr

[a] Conventional pollutants: biochemical oxygen demand (BOD), hexane extractable material (HEM) and total suspended solids (TSS)

[b] Toxic pollutants: ammonia as nitrogen, carbaryl, nitrate-nitrite, barium, copper, chromium, *cis*-Permethrin, manganese, molybdenum, nickel, titanium, *trans*-Permethrin, vanadium, and zinc

[c] Nutrients: total nitrogen and total phosphorus

9.2 TECHNOLOGY OPTIONS LOADINGS

This section presents the methods used by EPA to develop pollutant loading estimates after implementation of various technology options being considered for the MPP industry. EPA defined options loadings as the estimated pollutant loadings in MPP wastewater after implementation of the selected technology option, also referred to as treated pollutant loadings. EPA estimated options loadings for all the MPP model facility groupings for each technology option being considered.

In order to estimate the technology option loadings, EPA first derived the treated pollutant concentrations for first processing, further processing and rendering wastewaters for each technology option. EPA then estimated technology option *concentrations* for each model facility grouping, from which technology option *loadings* could then be derived.

The following is a summary of the methods used by EPA to select data sources and compute technology option loads:

- Section 9.2.1 describes data sources used by EPA to compute technology option loadings for the pollutants of concern,
- Section 9.2.2 presents the methods used by EPA to compute average concentrations for first processing, further processing and rendering wastewaters for each technology option,
- Section 9.2.3 discusses the methods used by EPA to estimate technology option concentrations for each model facility grouping, and
- Section 9.2.4 outlines the methodology used to estimate technology option loadings for each model facility grouping.

9.2.1 Sources and Use of Available Data

To develop options loading estimates for the MPP industry, EPA used wastewater sampling data from MPP facilities with unit processes contained within each technology option being considered. As described in detail in Section 3, multi-day sampling was conducted at 11 MPP facilities. EPA performed multi-day sampling at two facilities, and nine facilities performed the multi-day sampling on behalf of EPA. EPA used the data from the two EPA sampled facilities, but only eight of the nine self-sampled facility sampling episodes in estimating options loadings. EPA discarded the data from sampling episode 6446 because the Agency needs to perform further review of the sampling data for this facility.[1] To a limited extent, in the absence of transferable sampling episode data, EPA used data received in the MPP detailed surveys to estimate option loadings.

All data values (such as pollutant concentrations and flows) used in the development of option loading estimations were derived as arithmetic averages. If pollutant concentrations were reported below the sample detection limit, EPA used the sample detection limit. The Agency used data from multiple sites for some options. In these cases, EPA first averaged the data for each site and then averaged the sites' averages with each other.

9.2.2 Calculation of Average Technology Option Pollutant Concentrations for First Processing, Further Processing and Rendering Wastewaters

This section describes in detail how, for each technology option, EPA calculated treated pollutant concentrations for wastewater from the three basic MPP operations (first processing, further processing and rendering). EPA used these values later to calculate the treated pollutant concentrations for each of the 15 model facility groupings identified from the MPP screener surveys.

For each technology option, facilities were chosen from sampling episodes that had all the technical unit processes of that technology option. Data from these sampling episodes were then used to derive treated pollutant concentrations for first processing, further processing, and rendering wastewaters after treatment by a particular technology option. If more than one facility

[1] This facility was one of nine that performed self-sampling on behalf of EPA. Note that EPA does not anticipate that the exclusion of sampling episode 6446 will significantly impact the technology option selection for proposal: This facility was one of five that EPA selected to represent BAT-2 technology option performance. EPA had sampling data from four other facilities using similar levels of treatment to use as the basis for proposal development.

was chosen for a technology option, then the treated pollutant concentration was derived from the average of all the facilities.

To the extent possible with available data, EPA set the treated pollutant concentrations for first processing, further processing, and rendering wastewaters for each technology option equal to the average effluent concentrations of the sampled facility or facilities that were chosen as representative of the technology option. However, whenever this specific data was unavailable, EPA calculated the concentration by one of three methods, depending on available data.

Method 1: When appropriate influent[2] data was available, it was multiplied by a factor that would estimate the pollutant concentration after treatment. This factor was derived using pollutant removal data from sampled facilities (in instances where several facilities were used in the calculations, the average removal of the facilities was used). The following equation was used:

Treated pollutant concentration = (influent concentration) x (1 - removal fraction)

where
pollutant removal fraction for a facility was calculated as follows[3]:

(influent concentration - effluent concentration) / (influent concentration)

Method 2: This method was based on estimating a facility pollutant mass balance between the final effluent and its components of first processing, further processing, and rendering wastewaters (as applicable). From this relationship, an equation to calculate the treated pollutant concentrations for first processing wastewater could be derived as follows:

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[2] An influent wastestream could consist entirely of one type of wastewater (first processing, further processing, or rendering), or any mixture of the three. When an influent concentration was used in calculating the treated concentration of the first processing, further processing, or rendering wastewater, it consisted solely of the appropriate wastewater type.

[3] Influent and effluent pollutant concentrations were derived from the arithmetic average concentrations for each sampling episode. All negative removal rates were set at zero.

Total pollutant effluent load = treated pollutant load from first processing + treated pollutant load from further processing + treated pollutant load from rendering operations

Substituting loads with concentrations and flows:

(Final effluent concentration x total flow) = (treated concentration of first processing wastewater x first processing wastewater flow) + (treated concentration of further processing wastewater x further processing wastewater flow) + (treated concentration of rendering wastewater x rendering wastewater flow)

Treated concentration of first processing wastewater = [(final effluent concentration x total flow) - (treated concentration of further processing wastewater x further processing wastewater flow) - (treated concentration of rendering wastewater x rendering wastewater flow)] / (first processing wastewater flow).

<u>*Method 3*</u>: When a specific technology option was not represented in the sampling episodes, then concentrations were derived assuming that the removal fractions between different technology option levels would be the same for meat and poultry facilities (i.e., the removal fraction between meat BAT-2 and meat BAT-3 treatment options would be the same as the removal fraction between poultry BAT-2 and poultry BAT-3 treatment options). This removal fraction would then be applied to the treated pollutant concentrations calculated for the technology option that was one step lower. This method is described in greater detail in the technology options discussion where this method was applied.

For the equations that follow, the following notations were used:

R1 = treated meat first processing wastewater concentration
R2 = treated meat further processing wastewater concentration
R3 = treated meat rendering wastewater concentration
P1 = treated poultry first processing wastewater concentration
P2 = treated poultry further processing wastewater concentration
P3 = treated poultry rendering wastewater concentration
influent@xxxx = influent concentration of sampling episode xxxx

effluent@xxxx = effluent concentration of sampling episode xxxx (discharge effluent, unless otherwise noted).

Technology Options for Direct Discharging Meat Facilities

This subsection describes how EPA calculated treated pollutant concentrations for wastewater from the three basic MPP operations (first processing, further processing, and rendering) for direct discharging meat facilities.

BAT-1 Technology Option for Meat Facilities

The BAT-1 technology option consists of the following unit processes: dissolved air flotation (DAF) (advanced oil/water separation), lagoon (oil and grease, BOD_5, and TSS removal), limited nitrification (ammonia (NH_3) removal), and disinfection (pathogen removal).

The BAT-1 and BAT-2 options consist of the same unit processes; however, under BAT-1, EPA assumed that MPP facilities would only achieve limited nitrification in comparison to BAT-2. Thus, EPA set the BAT-1 treated pollutant averages for meat facilities equal to the BAT-2 treated averages calculated for meat facilities (see next section), except for ammonia (NH_3 as N), nitrate/nitrite and total Kjeldahl nitrogen (TKN) concentrations.

The following methodology describes how EPA calculated BAT-1 concentrations for ammonia, nitrate/nitrite, and TKN.

EPA first estimated the ammonia concentration for meat first processing by taking an average of effluent ammonia concentrations from meat facilities 0280, 0287, 0318, and 0336, as reported in the MPP detailed surveys. These facilities were chosen, because their biological treatment systems were not considered advanced, and it was assumed that these facilities were not operating their system specifically to achieve full scale nitrification, and therefore would be representative of a BAT-1 treatment effluent.

EPA then assumed that the total nitrogen concentration for the BAT-1 treatment option would be equal to total nitrogen concentration for the BAT-2 treatment option. EPA believes that only the concentrations of the different forms of nitrogen in a given wastestream would change, but the total nitrogen concentration would not change (i.e., only the forms of nitrogen would change when shifting to a nitrification system).

To calculate the TKN concentration for meat first processing wastewater treated by BAT-1, the following relationships and equations were used to derive TKN estimates:

(TKN of BAT-1) = (ammonia of BAT-1) + (organic nitrogen of BAT-1)

then: (organic nitrogen of BAT-1) = (TKN of BAT-1) - (ammonia of BAT-1)

Assuming the relationship between total nitrogen and organic nitrogen remain the same from BAT-1 to BAT-2:

(organic nitrogen of BAT-1) = (organic nitrogen of BAT-2)

With substitutions:

(TKN of BAT-1) = (ammonia of BAT-1) + (organic nitrogen of BAT-2)

(TKN of BAT-1) = (ammonia of BAT-1) + [(TKN of BAT-2) - (ammonia of BAT-2)].

To calculate the nitrate/nitrite concentration:

Total nitrogen = (nitrate/nitrite) + (TKN)

Nitrate/nitrite = total nitrogen - TKN.

After determining the concentrations for ammonia, nitrate/nitrite, total nitrogen, and TKN for meat first processing, the ratios of ammonia, nitrate/nitrite, and TKN to total nitrogen for meat further processing and rendering were set equal to the ratios of meat first processing. With total nitrogen concentration values derived from BAT-2 treatment option numbers, the ammonia, nitrate/nitrite, and TKN concentrations could be calculated. For example, ammonia for R2 was equal to (ammonia of R1 divided by total nitrogen of R1 (this calculates the ratio)) multiplied by the total nitrogen value for R2.

Table C-30 of Appendix C summarizes the methods used to derive average concentrations for first processing, further processing, and rendering effluent wastewaters from meat facilities using BAT-1 treatment technology.

BAT-2 Technology Option for Meat Facilities

The BAT-2 technology option consists of the following unit processes: dissolved air flotation (advanced oil/water separation), lagoon (oil and grease, BOD_5, and TSS removal), nitrification (ammonia removal), and disinfection (pathogen removal),

EPA selected datasets from sampling episodes for facilities 6440, 6441, 6442, and 6447 to derive option concentrations, because these meat facilities all contained the unit processes of the BAT-2 technology option. When wastewater samples from the further processing and/or rendering operations were not available from a facility, appropriate sampling data from another facility (i.e., same wastewater type) were substituted to fill data gaps. EPA used influent rendering wastestream concentrations from sampling episode 6447 to substitute missing rendering wastestream concentrations for sampling episodes 6440, 6441, and 6442. EPA also used influent further processing wastestream concentrations from sampling episode 6335 to substitute missing further processing wastestream concentrations for sampling episode 6447. Table 9-7 summarizes data substitutions.

Table 9-7. Data Substitutions for BAT-2 Technology Option Sampling

Missing Data	Data Substitution
Influent rendering wastewater concentrations for sampling episodes 6440, 6441, and 6442	Influent rendering wastewater concentrations from sampling episode 6447
Influent further processing wastewater concentrations for sampling episode 6447	Influent further processing wastewater concentration from sampling episode 6335

Since EPA selected four facilities to derive treated pollutant concentrations for the BAT-2 treatment technology, wastewater concentrations were calculated for each facility, and the average of the four facilities was taken to derive the option concentrations.

The calculations to derive treated first processing, further processing, and rendering wastewater concentrations for facility 6440 are given below as an example of how concentrations were derived for each facility (refer to Table C-31 of Appendix C for equations):

- *First processing wastewater (R1)*: The first processing waste stream concentration was calculated through a mass balance approach as previously described (Method 2) in the beginning of Section 9.2.2. Because facility 6440 only performed first processing and rendering operations, the mass balance equation was modified to only subtract a rendering allocation load, where:

  Treated concentration of first processing wastewater = [(final effluent concentration x total flow) - (treated concentration of rendering wastewater x rendering wastewater flow)] / (first processing wastewater flow)

- *Further processing wastewater (R2)*: Since facility 6440 only performed first processing and rendering operations, the further processing wastewater calculations were not applicable.

- *Rendering wastewater (R3)*: The calculation for the rendering waste stream concentration followed Method 1 as described previously.

  R3 for facility 6440 = (a) x (influent rendering waste stream concentration of facility 6447) where: (a) = (1 - average removal fraction of facilities 6440, 6441, 6442 and 6447.)

  Since the influent rendering waste stream concentration of facility 6440 was unavailable, data from facility 6447 was used as a substitution.

Table C-31 of Appendix C contains the equations used to derive average concentrations for first processing, further processing, and rendering effluent wastewaters from meat facilities using BAT-2 treatment technology.

BAT-3 Technology Option for Meat Facilities

The BAT-3 technology option consists of the following unit processes: dissolved air flotation (advanced oil/water separation), lagoon (oil and grease, BOD_5, and TSS removal), nitrification (ammonia removal) and denitrification (nitrogen removal), and disinfection (pathogen removal).

The dataset from sampling episode 6335 was chosen because this meat facility contained the unit processes of the BAT-3 technology option[4]. Table 9-8 summarizes data substitutions.

Table 9-8. Data Substitutions for BAT-3 Technology Option Sampling

Missing Data	Data Substitution
Influent rendering wastewater concentration for sampling episode 6335	Influent rendering wastewater concentrations from sampling episode 6447

Table C-32 of Appendix C contains the equations used to derive average concentrations for first processing, further processing, and rendering effluent wastewaters from meat facilities using BAT-3 treatment technology.

BAT-4 Technology Option for Meat Facilities

The BAT-4 technology option consists of the following unit processes: dissolved air flotation (advanced oil/water separation), lagoon (oil and grease, BOD_5, and TSS removal), nitrification (ammonia removal), denitrification (nitrogen removal), phosphorus removal, and disinfection (pathogen removal).

Since sampling data from a meat facility that contained the unit processes of BAT-4 technology option were unavailable, the treated pollutant concentrations were derived by assuming that the removal fraction between poultry BAT-3 and BAT-4 technology options would be the same as the removal fraction between meat BAT-3 and BAT-4 technology options. This

[4] Facility 6335 is an indirect discharger, however, this facility also contained BAT-3 technology for the treatment of reuse water. EPA used data from the reuse water sampling point at this facility to represent the performance of the BAT-3 technology option.

removal fraction was then used to calculate average BAT-4 treated pollutant concentrations for meat facilities.

Table C-33 of Appendix C contains the equations used to derive average concentrations for first processing, further processing, and rendering effluent wastewaters from meat facilities using BAT-4 treatment technology.

Technology Options for Direct Discharging Poultry Facilities

This subsection describes how EPA calculated treated pollutant concentrations for wastewater from the three basic MPP operations (first processing, further processing, and rendering) for direct discharging poultry facilities.

BAT-1 Technology Option for Poultry Facilities

The BAT-1 technology option consists of the following unit processes: dissolved air flotation (advanced oil/water separation), lagoon (oil and grease, BOD_5, and TSS removal), limited nitrification (ammonia removal), and disinfection (pathogen removal).

EPA set the treated pollutant concentrations for BAT-1 poultry facilities equal to the treated pollutant concentrations calculated for BAT-2 poultry facilities (see next section), except for ammonia, nitrate/nitrite and total Kjeldahl nitrogen (TKN).

The Agency first estimated the ammonia concentration for poultry first processing by taking an average of effluent ammonia concentrations from facilities 0020, 0026, and 0308 as reported in the MPP detailed surveys. These facilities were chosen because their biological treatment systems were not considered advanced, and it was assumed that these facilities were not operating their systems specifically to achieve nitrification and therefore would be representative of a BAT-1 treatment effluent. The methodology for deriving the remaining pollutant concentrations was identical to that described previously in Section 9.2.2 for the BAT-1 technology option for meat facilities.

Table C-34 of Appendix C summarizes the methods used to derive average concentrations for first processing, further processing, and rendering effluent wastewaters from poultry facilities using BAT-1 treatment technology.

BAT-2 Technology Option for Poultry Facilities

The BAT-2 technology option comprises of the following unit processes: dissolved air flotation (advanced oil/water separation), lagoon (oil and grease, BOD_5, and TSS removal), nitrification (ammonia removal), and disinfection (pathogen removal).

The dataset from sampling episode 6445 was chosen because this poultry facility contained the unit processes of the BAT-2 technology option. Since facility 6445 only conducted first processing operations, appropriate influent data from other sampled poultry facilities was used. Table 9-9 summarizes data substitutions.

Table 9-9. Data Substitutions for BAT-2 Technology Option Sampling

Missing Data	Data Substitution
Influent further processing wastewater concentrations for sampling episode 6445	Influent further processing wastewater concentrations from sampling episodes 6443 and 6444
Influent rendering wastewater concentrations for sampling episode 6445	Influent rendering wastewater concentrations for sampling episode 6448

Table C-35 of Appendix C contains the equations used to derive average concentrations for first processing, further processing, and rendering effluent wastewaters from poultry facilities using BAT-2 treatment technology.

BAT-3 Technology Option for Poultry Facilities

The BAT-3 technology option consists of the following unit processes: dissolved air flotation (advanced oil/water separation), lagoon (oil and grease, BOD_5, and TSS removal), nitrification (ammonia removal), denitrification (nitrogen removal), and disinfection (pathogen removal),.

Since sampling data from a poultry facility that contained the unit processes of BAT-3 technology option were unavailable, the treated pollutant concentrations were derived by assuming that the removal fraction between the poultry BAT-2 and BAT-3 technology options would be the same as the removal fraction between the meat BAT-2 to BAT-3 technology options. This removal fraction was then combined with the poultry BAT-2 treated pollutant concentrations to derive poultry BAT-3 treated pollutant concentrations.

Table C-36 of Appendix C gives the equations used to derive average concentrations for first processing, further processing, and rendering effluent wastewaters from poultry facilities using BAT-3 treatment technology.

BAT-4 Technology Option for Poultry Facilities

The BAT-4 technology option consists of the following unit processes: dissolved air flotation (advanced oil/water separation), lagoon (oil and grease, BOD_5, and TSS removal), nitrification (ammonia removal), denitrification (nitrogen removal), phosphorus removal, and disinfection (pathogen removal).

The dataset from sampling episode 6304 was chosen because this poultry facility contained the unit processes of the BAT-4 technology option[5]. Since facility 6304 only conducted first processing operations, appropriate influent data from other sampled poultry facilities was used. Table 9-10 summarizes data substitutions.

Table 9-10. Data Substitutions for BAT-4 Technology Option Sampling

Missing or Replaced Data	Data Substitution
Influent further processing wastewater concentrations for sampling episode 6304	Influent further processing wastewater concentrations from sampling episodes 6443 and 6444
Influent rendering wastewater concentrations for sampling episode 6304	Influent rendering wastewater concentrations for sampling episode 6448

[5] Facility 6304 had sampling points prior and following a polishing filter unit process. EPA used effluent concentrations from the sampling point prior to the filter at this facility to represent performance of the BAT-4 technology option.

Table C-37 of Appendix C contains the equations used to derive average concentrations for first processing, further processing, and rendering effluent wastewaters from poultry facilities using BAT-4 treatment technology.

BAT-5 Technology Option for Poultry Facilities

The BAT-5 technology option consists of the following unit processes: dissolved air flotation (advanced oil/water separation), lagoon (oil and grease, BOD_5, and TSS removal), nitrification (ammonia removal), denitrification (nitrogen removal), phosphorus removal, polishing filter, and disinfection (pathogen removal).

The dataset from sampling episode 6304 was chosen because this poultry facility contained the unit processes of the BAT-5 technology option[6]. Since facility 6304 only conducted first processing operations, appropriate influent data from other sampled poultry facilities was used. Table 9-11 summarizes data substitutions.

Table 9-11. Data Substitutions for BAT-5 Technology Option Sampling

Missing or Replaced Data	Data Substitution
Influent further processing wastewater concentrations for sampling episode 6304	Influent further processing wastewater concentrations from sampling episodes 6443 and 6444
Influent rendering wastewater concentrations for sampling episode 6304	Influent rendering wastewater concentrations for sampling episode 6448

Table C-38 of Appendix C contains the equations used to derive average concentrations for first processing, further processing, and rendering effluent wastewaters from poultry facilities using BAT-5 treatment technology.

[6] Facility 6304 had sampling points prior and following a polishing filter unit process. EPA used effluent concentrations from the sampling point following the filter at this facility to represent performance of the BAT-5 technology option.

Technology Options for Indirect Discharging Meat Facilities

This subsection describes how EPA calculated treated pollutant concentrations for wastewater from the three basic MPP operations (first processing, further processing and rendering) for indirect discharging meat facilities.

PSES-1 Technology Option for Meat Facilities

The PSES-1 technology option consists of the following unit processes: of dissolved air flotation (advanced oil/water separation) and equalization (oil and grease, and TSS removal).

The dataset from sampling episode 6335 was chosen because this meat facility contained the unit processes of the PSES-1 technology option[7]. Table 9-12 summarizes data substitutions.

Table 9-12. Data Substitutions for PSES-1 Technology Option Sampling

Missing or Replaced Data	Data Substitution
Influent rendering wastewater concentrations for sampling episode 6335	Influent rendering wastewater concentrations for sampling episode 6447

Table C-39 of Appendix C gives the equations used to derive average concentrations for first processing, further processing, and rendering effluent wastewaters from meat facilities using PSES-1 treatment technology.

PSES-2 Technology Option for Meat Facilities

The PSES-2 technology option consists of the following unit processes: dissolved air flotation (advanced oil/water separation), equalization (oil and grease, and TSS removal), and nitrification (ammonia removal).

Since sampling data from a meat facility that contained the unit processes of the PSES-2 technology option was unavailable, the treated pollutant concentrations were derived from the calculated treated pollutant concentrations for meat BAT-2 and PSES-1 technology options for

[7] EPA used effluent data from the sampling point located after DAF and equalization of the treatment train to represent the performance of the PSES-1 technology option.

non-microbial and microbial pollutants, respectively. Because PSES-2 and BAT-2 technology options are similar in effective pollutant removals (except for microbial pollutants, due to the disinfection unit process of BAT-2), EPA assumed that the treated pollutant concentrations of both options would be similar for non-microbial pollutants. Also, since EPA believes that only a disinfection process would significantly change the microbial concentrations in MPP wastewaters, microbial pollutant concentrations for meat PSES-2 were set equal to treated pollutant concentrations of meat PSES-1 (since microbial concentrations would not be expected to change significantly in higher PSES option levels).

Table C-40 of Appendix C contains the equations used to derive average concentrations for first processing, further processing, and rendering effluent wastewaters from meat facilities using PSES-2 treatment technology.

PSES-3 Technology Option for Meat Facilities

The PSES-3 technology option consists of the following unit processes: dissolved air flotation (advanced oil/water separation), equalization (oil and grease, and TSS removal), nitrification (ammonia removal), and denitrification (nitrogen removal).

Since complete data from a meat facility that contained the unit processes of PSES-3 technology option was unavailable, the treated pollutant concentrations were derived from the calculated treated pollutant concentrations for the meat BAT-3 technology option for non-microbial pollutants. Because PSES-3 and BAT-3 technology options are similar in effective pollutant removals (except for microbial pollutants due to the disinfection unit process of BAT-3), EPA assumed that the treated pollutant concentrations of both options would be similar for non-microbial pollutants. Data from sampling episode 6335 was used to derive microbial pollutant concentrations.[8]

Table C-41 of Appendix C contains the equations used to derive average concentrations for first processing, further processing, and rendering effluent wastewaters from meat facilities using PSES-3 treatment technology.

[8] EPA used effluent data from the sampling point located prior to disinfection to represent the performance of the PSES-3 technology option for microbial pollutants.

PSES-4 Technology Option for Meat Facilities

The PSES-4 technology option consists of the following unit processes: dissolved air flotation (advanced oil/water separation), equalization (oil and grease, and TSS removal), nitrification (ammonia removal), denitrification (nitrogen removal) and phosphorus removal.

Since sampling data from a meat facility that contained the unit processes of PSES-4 technology option was unavailable, the treated pollutant concentrations were derived from the calculated treated pollutant concentrations for the meat BAT-4 technology option for non-microbial pollutants. Because PSES-4 and BAT-4 technology options are similar in effective pollutant removals (except for microbial pollutants due to the disinfection unit process of BAT-4), EPA assumed that the treated pollutant concentrations of both options would be similar for non-microbial pollutants. Data from sampling episode 6335 was used to derive microbial pollutant concentrations.[9]

Table C-42 of Appendix C contains the equations used to derive average concentrations for first processing, further processing, and rendering effluent wastewaters from meat facilities using PSES-4 treatment technology.

Technology Options for Indirect Discharging Poultry Facilities

This subsection describes how EPA calculated treated pollutant concentrations for wastewater from the three basic MPP operations (first processing, further processing and rendering) for indirect discharging poultry facilities.

PSES-1 Technology Option for Poultry Facilities

The PSES-1 technology option consists of the following unit processes: dissolved air flotation (advanced oil/water separation) and equalization (oil and grease, and TSS removal).

[9] EPA used effluent data from the sampling point located prior to disinfection to represent the performance of the PSES-4 technology option for microbial pollutants.

EPA chose datasets from sampling episodes 6443 and 6444, because these poultry facilities all contained the technical unit processes of the PSES-1 technology option. Table 9-13 summarizes data substitutions.

Table 9-13. Data Substitutions for PSES-1 Technology Option Sampling

Missing or Replaced Data	Data Substitution
Influent rendering wastewater concentrations for sampling episodes 6443 and 6444	Influent rendering wastewater concentrations for sampling episode 6448

Table C-43 of Appendix C shows the equations used to derive average concentrations for first processing, further processing, and rendering effluent wastewaters from poultry facilities utilizing PSES-1 treatment technology.

PSES-2 Technology Option for Poultry Facilities

The PSES-2 technology option consists of the following unit processes: dissolved air flotation (advanced oil/water separation), equalization (oil and grease, and TSS removal), and nitrification (ammonia removal).

Since sampling data from a poultry facility that contained the unit processes of PSES-2 technology option were unavailable, the treated pollutant concentrations were derived from the calculated treated pollutant concentrations of poultry BAT-2. Both technology options are similar in effective pollutant removals, except for microbial pollutants (due to disinfection unit process in BAT-2). EPA therefore decided that the treated pollutant concentrations of both options would be similar for non-microbial pollutants. Microbial pollutant concentrations were derived from sampling episode 6304 data.[10]

Table C-44 of Appendix C contains the equations used to derive average concentrations for first processing, further processing, and rendering effluent wastewaters from poultry facilities using PSES-2 treatment technology.

[10] EPA used data from the sampling point located following the diffused air flotation unit process (and before the disinfection unit process) at this facility to represent the performance of the PSES-2 technology option for microbial pollutants.

PSES-3 Technology Option for Poultry Facilities

The PSES-3 technology option consists of the following unit processes: dissolved air flotation (advanced oil/water separation), equalization (oil and grease, and TSS removal), nitrification (ammonia removal), and denitrification (nitrogen removal).

Since appropriate data from a sampled poultry facility that contained the unit processes of PSES-3 technology option were unavailable, EPA derived the treated pollutant concentrations from the calculated treated pollutant concentrations of poultry BAT-3. Both technology options are similar in effective pollutant removals, except for microbial pollutants (due to disinfection unit process in BAT-3). EPA therefore decided that the treated pollutant concentrations of both options would be similar for non-microbial pollutants. Microbial pollutant concentrations were derived from sampling episode 6443 data.[11]

Table C-45 of Appendix C shows the equations used to derive average concentrations for first processing, further processing, and rendering effluent wastewaters from poultry facilities using PSES-3 treatment technology.

PSES-4 Technology Option for Poultry Facilities

The PSES-4 technology option consists of the following unit processes: dissolved air flotation (advanced oil/water separation), equalization (oil and grease, and TSS removal), nitrification (ammonia removal), denitrification (nitrogen removal) and phosphorus removal.

Since sampling data from a poultry facility that contained the unit processes of PSES-4 technology option were unavailable, the treated pollutant concentrations were derived from the calculated treated pollutant concentrations of poultry BAT-4. Both technology options are similar in effective pollutant removals, except for microbial pollutants (due to disinfection unit process in BAT-4). EPA therefore decided that the treated pollutant concentrations of both

[11] EPA used microbial effluent concentrations from this facility to represent the treatment performance of the PSES-3 technology option on microbial pollutants.

options would be similar for non-microbial pollutants. Microbial pollutant concentrations were derived from sampling episode 6443 data[12].

Table C-46 of Appendix C shows the equations used to derive average concentrations for first processing, further processing, and rendering effluent wastewaters from poultry facilities utilizing PSES-4 treatment technology.

9.2.3 Development of Average Treated Pollutant Concentrations for each Model Facility Group

This section describes the method by which EPA developed average treated pollutant concentrations for 15 of the 19 model facility groupings used to represent the meat and poultry processing industry. Section 11 provides a discussion of the model facility groupings.[13] As described in Section 9.2.2 above, EPA developed average treated pollutant concentrations for each pollutant and technology option being considered by EPA for meat and poultry first processing (R1 and P1), further processing (R2 and P2), and rendering (R3 and P3). Since there are MPP facilities that perform combinations of these three types of MPP operations, EPA used the average treated pollutant concentrations for first processing, further processing, and rendering and the flow ratios among the various types of processes to derive flow-weighted average treated pollutant concentrations.

EPA calculated flow fractions for different meat and poultry groupings using available data from the MPP detailed survey. Specifically using flow rates reported in the MPP detailed survey, EPA determined the fraction of total flow attributable to each of the processes (first processing, further processing, and rendering). For example, EPA determined from a sample of poultry first and further processing facilities that 74.08 percent of the total flow was attributable to first processing and that the balance of 25.92 percent was from further processing operations. Similar flow fractions were derived for the remaining meat and poultry groupings and are

[12] EPA used microbial effluent concentrations from this facility to represent the treatment performance of the PSES-4 technology option on microbial pollutants.

[13] Note that although EPA organized the MPP industry into 19 model facility groupings, based on the MPP screener survey results, there were direct and indirect discharging facilities in only 15 model facility groups.

presented in Table 9-14 below. Since EPA used both direct and indirect facilities to derive the flow fractions, the same flow fractions were used for both direct and indirect facilities.

Using the flow fractions in Table 9-14 and the average treated pollutant concentrations derived as described in Section 9.2.2, EPA calculated pollutant concentrations for the various meat and poultry facility groupings. Since the flow fractions are expressed as percentages, EPA was able to compute the required concentrations without actual flow rates.

Table 9-14. Flow Fractions Used to Derive Average Treated Pollutant Concentrations

Model Facility Grouping	Flow Fraction		
	First Processing	Further Processing	Rendering
P1	[a]	[a]	[a]
P12	0.7408	0.2592	--
P123	0.553	0.1934	0.2535
P13	0.6857	--	0.3143
P2	[a]	[a]	[a]
P23	--	0.4328	0.5672
R1	[a]	[a]	[a]
R12	0.5266	0.4734	--
R123	0.356	0.32	0.324
R13	0.5235	--	0.4765
R2	[a]	[a]	[a]
R23	--	0.4968	0.5032
M1	[c]	[c]	[c]
M2	[b]	[b]	[b]
M12	[c]	[c]	[c]
M13	[c]	[c]	[c]
M23	[b]	[b]	[b]
M123	[c]	[c]	[c]
Render	--	--	[d]

[a] Average treated pollutant concentrations were derived directly from sampling episode data; flow fractions were not required.

[b] The average treated pollutant concentrations for the “mixed” model facilities groupings were calculated by taking the average of the treated pollutant concentrations of relevant poultry and meat operations (for the corresponding technology option and pollutant). For example, the average treated pollutant concentrations from P2 and R2 were averaged together to derive the average treated pollutant concentration for mixed further processing (M2).

[c] According to the MPP screener survey, there were no direct or indirect facilities in this model facility grouping.

[d] The “Rendering” model facility grouping average concentration was calculated by taking the average of the treated pollutant concentrations of P3 and R3 (for the corresponding technology option and pollutant).

For example, for a P12 facility, the wastewater will consist of first processing (P1) and further processing (P2) wastewater effluents. From Table 9-14, a P12 facility has a flow fraction of 0.7408 for first processing (P1) and 0.2592 for further processing (P2) wastewaters. If the average BOD concentration for first processing wastewater treated by the BAT-2 option were calculated to be 2.00 mg/L, and the further processing (P2) wastewater was calculated to be 5.91 mg/L, then the treated BOD concentration for a BAT-2 P12 facility would be:

$$P12 = (2.00 \text{ mg/L} \times 0.7408) + (5.91 \text{ mg/L} \times 0.2592) = 3.01 \text{ mg/L}$$

Tables C-47 through C-75 in Appendix C present the average treated pollutant concentration for each of the 15 model facility groupings for all pollutants of concern and all technology options being considered by EPA.

9.2.4 Development of Post-Compliance Pollutant Loadings for each Technology Option and each Model Facility Grouping

EPA estimated post-compliance pollutant loadings based on the average treated pollutant concentration for each of the 37 pollutants of concern, for each of the 15 model facility groupings, and for each technology being considered. For each model facility grouping, the number and size of facilities and median facility discharge flow was determined from the MPP screener surveys. EPA then estimated post-compliance pollutant loadings for each size of model facility grouping using the following equations:

$$\text{Load} = \text{Flow} \times \text{Conc} \times \text{CF} \times \text{NF} \qquad \text{(for small facilities)}$$

$$\text{Load} = \text{Flow} \times \text{Conc} \times \text{CF} \times \text{NF} \times 1.08 \qquad \text{(for non-small facilities)}$$ [14]

where:

Load = post-compliance pollutant loading, in lbs/day, million cfu/day, or million cysts/day

[14] EPA carefully selected 65 non-small "certainty" facilities to obtain site-specific information on major producers for all types of meat and poultry products as well as facilities identified as good performers by state and regional environmental personnel. These certainty facilities were not included in the screener survey projections for deriving national estimates. The certainty facilities represent eight percent of the total number of non-small facilities as estimated from screener survey projections. Thus, the estimated national loadings for non-small facilities were multiplied by a factor of 1.08 to account for the certainty facilities.

Flow = median flow rate, million of gallons per day (based on an average of 260 production days per year)

Conc = average treated pollutant concentration for the model facility grouping model facility grouping (as presented in Tables C-47 through C-75 in Appendix C), in mg/L, cfu/100 mL, or cysts/liter

CF = conversion factor, which is dependant on the concentration units of the pollutant:

mg/L = 8.345
cfu/100 mL = 37.8
cysts/liter = 3.78

NF = national estimate of the number of facilities for the model facility grouping and size.

Tables 9-15 and 9-16 present a summary of the post-compliance pollutant loadings for direct and indirect dischargers for all technology options being considered by EPA.

9.3 POLLUTANT REMOVALS

From baseline and technology option loadings, EPA estimated national pollutant removals after implementation of each technology option considered. This estimation was done by taking the difference between the baseline loadings and each technology option loadings.

Table 9-15. Technology Option Loading for Direct Dischargers

Pollutant Groups of Concern	Options Loadings									Units
	BAT-1		BAT-2		BAT-3		BAT-4		BAT-5 [d]	
	Small	Non-Small	Small	Non-Small	Small	Non-Small	Small	Non-Small	Non-Small	
Conventional pollutants [a]	336,706	28,405,563	336,706	28,405,563	239,196	19,723,690	74,162	14,848,506	6,628,913	lbs/yr
Toxic pollutants [b]	198,828	41,264,641	46,071	34,173,358	25,292	5,732,508	9,779	2,318,189	379,239	lbs/yr
Nutrients [c]	203,639	46,668,728	203,639	46,668,728	32,788	7,187,084	14,278	4,572,993	1,197,020	lbs/yr
Other Pollutants of Concern										
Aeromonas	8,325,096	3,532,187,013	8,325,096	3,532,187,013	3,857	10,661,121	425,842	445,526,130	3,180,251	million cfu/yr
Carbonaceous biochemical oxygen demand (CBOD)	7,138	1,758,927	7,138	1,758,927	14,621	3,154,816	24,794	4,748,895	942,344	lbs/yr
Chemical oxygen demand (COD)	180,692	21,468,569	180,692	21,468,569	182,071	18,002,535	234,596	20,387,776	9,147,581	lbs/yr
Chloride	639,252	382,961,031	639,252	382,961,031	617,218	45,502,064	811,197	482,396,856	25,058,084	lbs/yr
Cryptosporidium	N/A [e]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Dissolved biochemical oxygen demand	22,182	2,656,730	22,182	2,656,730	12,093	1,498,647	35,425	2,987,222	1,131,145	lbs/yr
Dissolved phosphorus	13,462	4,606,196	13,462	4,606,196	4,299	927,519	4,171	908,830	73,253	lbs/yr
E. coli	817,084	233,031,975	817,084	233,031,975	8,380	3,132,204	62,579	6,283,460	62,928,965	million cfu/yr
Fecal coliform bacteria	1,218,819	335,728,729	1,218,819	335,728,729	102,117	37,120,219	148,585	39,859,694	59,464,254	million cfu/yr
Fecal streptococci	378,959	78,819,775	378,959	78,819,775	80,593	2,409,632	348,410	17,376,440	9,059,549	million cfu/yr
Orthophosphate	12,125	3,620,792	12,125	3,620,792	3,952	1,811,671	3,087	760,102	3,836	lbs/yr

Table 9.15. Technology Option Loading for Direct Dischargers (continued)

Pollutant Groups of Concern	Options Loadings									Units
	BAT-1		BAT-2		BAT-3		BAT-4		BAT-5 [d]	
	Small	Non-Small	Small	Non-Small	Small	Non-Small	Small	Non-Small	Non-Small	
Salmonella	13,419	2,123,747	13,419	2,123,747	16,658	1,982,678	59	1,702,837	1,702,577	million cfu/yr
Total coliform	4,569,483	1,026,186,733	4,569,483	1,026,186,733	308,197	68,403,189	109,808	11,656,001	115,656,674	million cfu/yr
Total dissolved solids (TDS)	3,913,173	1,127,933,751	3,913,173	1,127,933,751	3,938,507	77,121,174	4,357,800	1,114,808,491	179,693,482	lbs/yr
Total organic carbon (TOC)	69,409	8,260,014	69,409	8,260,014	44,575	5,355,750	56,695	5,486,317	1,718,856	lbs/yr
Total residual chlorine	485	80,595	485	80,595	4,473	6,667,097	4,473	6,667,097	N/A	lbs/yr
Volatile Residue	793,525	149,720,716	793,525	149,720,716	582,625	80,907,268	742,666	109,422,341	70,578,145	lbs/yr

[a] Conventional pollutants: biochemical oxygen demand (BOD), hexane extractable material (HEM), and total suspended solids (TSS)
[b] Toxic pollutants: ammonia as nitrogen, carbaryl, nitrate-nitrite, barium, copper, chromium, *cis*-permethrin, manganese, molybdenum, nickel, titanium, *trans*-permethrin, vanadium, and zinc
[c] Nutrients: total nitrogen and total phosphorus
[d] BAT-5 treatment option was considered only for poultry model facility groupings. No direct discharging small BAT-5 poultry facilities exist.
[e] not available

Table 9-16. Technology Option Loading for Indirect Dischargers

Pollutant Groups of Concern	Options Loadings								Units
	PSES-1		PSES-2		PSES-3		PSES-4		
	Small	Non-Small	Small	Non-Small	Small	Non-Small	Small	Non-Small	
Conventional pollutants [a]	14,507,645	820,258,114	1,323,002	59,607,632	834,069	32,688,688	489,800	37,247,151	lbs/yr
Toxic pollutants [b]	1,241,072	97,035,039	174,898	16,290,095	86,554	3,753,669	38,035	1,908,384	lbs/yr
Nutrients [c]	1,387,651	84,759,188	923,307	51,850,941	157,728	8,363,155	102,660	6,726,428	lbs/yr
Other Pollutants of Concern									
Aeromonas	14,820,687,512	1,301,380,789,662	14,073,166,893	1,090,092,557,403	5,048,245,175	437,538,582,222	5,048,245,175	437,538,582,222	million cfu/yr
Carbonaceous biochemical oxygen demand (CBOD)	8,164,026	406,159,450	34,428	2,182,386	65,309	3,316,690	118,228	7,335,951	lbs/yr
Chemical oxygen demand (COD)	13,395,570	693,706,520	657,839	27,907,071	647,220	24,169,551	819,011	29,287,476	lbs/yr
Chloride	17,963,311	502,316,560	14,406,879	620,266,883	18,103,735	474,910,062	18,968,954	797,397,121	lbs/yr
Cryptosporidium	N/A[d]	N/A	2,279,487,921	N/A	N/A	N/A	N/A	N/A	million cysts/yr
Dissolved biochemical oxygen demand	8,015,656	286,463,154	84,615	3,112,088	46,365	1,759,195	125,002	4,787,019	lbs/yr
Dissolved phosphorus	171,422	7,366,753	115,836	5,190,198	35,757	1,326,120	34,719	1,300,034	lbs/yr
E. coli	31,400,159,074	3,206,691,095,489	27,596,967,456	1,472,017,006,101	15,417,053,170	1,591,395,207,841	15,417,053,170	1,591,395,207,841	million cfu/yr
Fecal coliform bacteria	34,245,841,873	3,388,008,109,881	30,550,007,399	1,667,024,622,884	15,443,958,242	1,592,499,542,417	15,443,958,242	1,592,499,542,417	million cfu/yr
Fecal streptococci	31,046,712,271	672,189,574,092	31,041,166,490	667,503,725,714	69,631,637	7,225,374,930	69,631,637	7,225,374,930	million cfu/yr
Orthophosphate	81,615	5,630,590	66,160	3,054,251	24,324	1,408,501	16,136	671,805	lbs/yr
Salmonella	1,356,677	21,790,576	2,143,566	220,245,327	65,621	4,294,742	65,621	4,294,742	million cfu/yr
Total coliform	35,628,502,122	3,123,192,328,783	32,418,068,379	1,628,553,753,188	15,443,958,242	1,592,499,542,417	15,443,958,242	1,592,499,542,417	million cfu/yr
Total dissolved solids (TDS)	32,505,098	904,001,014	31,102,546	1,512,457,571	32,596,519	726,386,727	35,151,094	1,555,476,996	lbs/yr
Total residual chlorine	2,715	144,060	3,608	171,512	48,946	4,638,105	48,946	4,638,105	lbs/yr

Table 9-16. Technology Option Loading for Indirect Dischargers (continued)

Pollutant Groups of Concern	Options Loadings								
	PSES-1		PSES-2		PSES-3		PSES-4		
	Small	Non-Small	Small	Non-Small	Small	Non-Small	Small	Non-Small	Units
Volatile residue	8,009,748	457,871,747	4,566,245	299,329,626	3,244,971	187,301,488	4,218,498	265,971,638	lbs/yr

[a] Conventional pollutants: biochemical oxygen demand (BOD), hexane extractable material (HEM), and total suspended solids (TSS)
[b] Toxic pollutants: ammonia as nitrogen, carbaryl, nitrate-nitrite, barium, copper, chromium, *cis*-permethrin, manganese, molybdenum, nickel, titanium, *trans*-permethrin, vanadium, and zinc
[c] Nutrients: total nitrogen and total phosphorus
[d] not available

SECTION 10

NON-WATER QUALITY ENVIRONMENTAL IMPACTS

Sections 304(b) and 306(b) of the Clean Water Act require EPA to consider non-water quality environmental impacts (including energy requirements) associated with effluent limitations guidelines and standards. To comply with these requirements, EPA considered the potential impact of the proposed meat and poultry products (MPP) rule on energy consumption, air emissions, and solid waste generation. A discussion of the proposed technology options is given in Section 9 of this Development Document. Considering energy use and environmental impacts across all media, the Agency has determined that the impacts identified in this section are justified by the benefits associated with compliance with the proposed limitations and standards. Section 10.1 discusses the energy requirements for implementing wastewater treatment technologies at MPP facilities. Section 10.2 presents the impact of the proposed technologies on air emissions, and section 10.3 discusses the impact on wastewater treatment sludge generation.

10.1 ENERGY REQUIREMENTS

EPA estimates that compliance with this rule will result in a small net decrease in energy consumption at non-small MPP facilities that are direct dischargers, and no change in energy consumption at all MPP facilities that are indirect dischargers (as EPA is proposing no PSES and PSNS for all MPP subcategories). EPA did, however, estimate the energy consumption at non-small MPP facilities that are indirect dischargers and noted a small net increase in energy consumption. Table 10-1 and 10-2 present estimates of energy usage by technology option for both non-small direct and indirect dischargers, respectively. For the selected proposal technology options which apply to non-small direct discharging facilities only, EPA estimates that there will be a reduction in total annual energy use (a net reduction of 144 million KWH/yr). This is a relatively small net reduction compared to the total annual amount of energy purchased by non-small direct discharging facilities (2,929 million KWH/yr). There are no incremental energy impacts for direct dischargers that are small poultry slaughterers (Subpart K) or small

Table 10-1. Incremental Energy Use for Existing Non-Small MPP Facilities, Direct Dischargers[a]

40 CFR 432 Subcategory Groupings[b]	Total Energy Purchased per Non-Small MPP Facility million KWH/fac.-yr	Incremental MPP WWTP Energy Use per Non-Small MPP Facility in units of million KWH/fac.-yr and Total Energy Usage Percent Increase per Non-Small MPP Facility [% Increase]			
		BAT-2	**BAT-3**	**BAT-4**	**BAT-5**
A, B, C, D	11.42	0.0221 [0.19%]	-0.9324 [-8.89%]	-1.0759 [-10.40%]	NA
F, G, H, I	13.46	0.0017 [0.01%]	-0.0239 [-0.18%]	-0.0354 [-02.26%]	NA
J	5.47	0 [0.00%]	-0.2415 [-4.62%]	-0.261 [-5.01%]	NA
K	13.53	0.0031 [0.02%]	-0.627 [-4.86%]	-0.6076 [-4.70%]	-0.6033 [-4.67%]
L	13.46	0.0021 [0.02%]	-0.1088 [-0.81%]	-0.1094 [-0.82%]	-0.1519 [-1.14%]

[a] "Non-small" facilities include Medium, Large, and Very Large Facilities. (See Section 11.3 for a description of these facility classifications.)

[b] Small Processors (Subpart E) are not covered under the proposal, and do not have any net incremental NWQIs (including energy usage.)

Table 10-2. Incremental Energy Use for Existing Non-Small MPP Facilities, Indirect Dischargers[a]

40 CFR 432 Subcategory Groupings[b]	Total Energy Purchased per Non-Small MPP Facility million KWH/fac.-yr	Incremental MPP WWTP Energy Use per Non-Small MPP Facility in units of million KWH/fac.-yr and Total Energy Usage Percent Increase per Non-Small MPP Facility [% Increase]			
		PSES-1	**PSES-2**	**PSES-3**	**PSES-4**
A, B, C, D	11.42	0.2644 [2.26%]	4.5467 [28.48%]	2.0473 [15.20%]	1.6061 [12.33%]
F, G, H, I	13.46	0.1227 [0.90%]	0.6021 [4.28%]	0.3404 [2.47%]	0.3137 [2.28%]
J	5.47	0.0243 [0.44%]	0.4617 [7.78%]	0.0061 [0.11%]	-0.0547 [-1.01%]
K	13.53	0.1423 [1.04%]	2.6724 [16.49%]	0.9385 [6.49%]	0.8078 [5.63%]
L	13.46	0.0995 [0.73%]	0.6519 [4.62%]	0.3194 [2.32%]	0.2933 [2.13%]

[a] "Non-small" facilities include Medium, Large, and Very Large Facilities. (See Section 11.3 for a description of these facility classifications.)

[b] Small Processors (Subpart E) are not covered under the proposal, and do not have any net incremental NWQIs (including energy usage.)

poultry further processors (Subpart L) because all of these small facilities are currently implementing the proposed limitations and standards (See Section 6.3.1 of Administrative Record - EPA 2001 Screener Survey). EPA is proposing no PSES and PSNS for all indirect dischargers in all MPP subcategories. EPA did, however, estimate the energy usage at non-small MPP facilities that are indirect dischargers and noted a small net increase in energy usage in most cases.

In estimating energy use associated with BAT-3, BAT-4, and BAT-5, it was assumed that anaerobic lagoon effluent would be used as the source of organic carbon necessary for denitrification. This approach reduces oxygen transfer requirements and associated electrical energy use for BOD reduction aerobically subsequent to anaerobic treatment. It has been demonstrated that the electrical energy required for complete nitrification can be reduced by approximately 20 percent through anoxic wastewater BOD reduction realized during denitrification (Randall et. al., 1999). BAT-4 provides a small additional reduction in electrical energy use as compared to BAT-3, given the BOD reduction occurring the anaerobic phosphorus release phase of phosphorus removal.

EPA used facility count, wastewater flow, and treatment-in-place data from the MPP screener survey and detailed survey to develop the energy use estimates presented in Tables 10-1 and 10-2. EPA also used data from the 1997 U.S. Census of Manufacturers to estimate energy demand for MPP facilities. See Appendix D for a listing of input values used to estimate energy usage.

10.2 AIR EMISSIONS IMPACTS

The Agency believes that wastewater treatment processes included in the technology options for this rule will not generate significant incremental air emissions, either directly from the facility or indirectly through increased air emissions impact from the electric power generation facilities providing the additional energy.

Odors are the only significant air pollution problem associated with the treatment of MPP wastewaters and generally are associated with anaerobic conditions. Thus, flow equalization basins, dissolved air flotation (DAF) units, and anaerobic lagoons are potential sources of malodors. However, odor problems usually are significant only when the sulfur content of MPP wastewaters is high especially when treatment facilities are well managed. Generally, MPP wastewater treatment facilities using anaerobic processes for treating wastewater with a low sulfur concentration have few odor problems (USEPA, 1974). At such facilities, maintaining a naturally occurring layer of floating solids in anaerobic contact basins and lagoons generally minimizes odors. Thus, the proposed technology options should not increase emissions of odorous compounds from well-managed MPP wastewater treatment facilities. EPA visited several MPP facilities that EPA considered to be operating the selected proposal technology options. None of these BAT facilities had odor control problems.

The requirement of nitrification for BAT-2 through BAT-5 should reduce ammonia emissions by reducing air stripping of ammonia during aerobic treatment. However, the requirement of anaerobic treatment for initial BOD reduction before aerobic treatment will increase methane and VOC emissions, but increases should be negligible given the current extensive use of lagoons and other anaerobic processes in MPP wastewater treatment. In addition, covering anaerobic lagoons and flaring the biogas captured can reduce these emissions. If the volume of biogas captured is sufficient, its use as a fuel to produce process heat or electricity, or both, is an option. EPA observed two MPP facilities capturing biogas for use as an alternative fuel during its 2001 site visits.

As previously stated, EPA estimates an annual net energy reduction of 144 million KWH for the selected proposal technology options which applies to non-small direct discharging facilities only. This annual net energy reduction, however, is small compared with the amount of energy used by MPP direct dischargers (2,929 million KWH/yr) and trivial when compared with the total electricity used by the entire United States in 1999 (3,501 billion KWH) (See the Energy Information Administration - http://www.eia.doe.gov/emeu/aer/txt/tab0812.htm).

10.3 SOLID WASTE GENERATION

The most significant non-water quality impact (NWQI) of the proposed technology options for this rule is the generation of additional solid wastes from MPP wastewater treatment.

One source of these additional solids generation is wastewater screening to remove larger suspended solids, such as pieces of soft and hard tissue, including feathers and hair as the initial treatment unit process. These solids are non-hazardous, have value as raw materials for by-product production by rendering, and are not considered to be soild waste. Accordingly, generation of this solids is not considered to have NWQIs. A second source of solids in MPP wastewaters treatment is DAF units used to remove a substantial fraction of the suspended solids in MPP wastewaters remaining after screening. At some MPP facilities, this material, commonly known as DAF float, is disposed of by rendering and has economic value. However, DAF float also is considered as a waste at some facilities and is disposed of by land filling or land application. The utilization of DAF float in the production of rendered products or disposal as a waste depends on the types of rendered product being produced. EPA noted during site visits to two independent rendering operations that sludges from dissolved air floatation units which use chemical additions to promote solids separation are rendered; however, the chemical bond between the organic matter and the polymers requires that the sludges be processed (rendered) at higher temperatures (260 ºF) and longer retention times (see Section 6.1.2.2 of Administrative Record - Renderer #1 CBI Site Visit Report). Because both direct and indirect dischargers currently use USC DAF extensively in MPP wastewater treatment, EPA feels that the proposed rule will have no significant impact on DAF float generation.

Additional sources of solids generated in the treatment of MPP wastewaters are the physiochemical and biological treatment processes used following DAF. These solids consist of a mixture of those suspended solids not initially removed by screening and DAF, and the microbial mass generated during biological treatment processes. These solids are collectively known as sludge and typically have a moisture content of between 95 and 98 percent before thickening. Generally, MPP wastewater sludges are thickened, stabilized, stored in holding ponds or anaerobic lagoons, and/or dried before ultimate disposal typically by land application. A wastewater treatment plant operator for a poultry slaughtering facility, which utilizes BAT-5 technology, noted that sludges from his facility are used as a soil amendment via subsurface injection for crops raised on the facility's property. Other options for the ultimate disposal of

MPP wastewater sludge are land filling and incineration, which require a substantial reduction in moisture content as a prerequisite.

EPA estimates that compliance with this proposed rule generally will slightly decrease the generation of sludges during MPP wastewater treatment. For the selected proposal technology options which apply to non-small direct discharging facilities only, EPA estimates that there will be a 3.4 percent reduction in total annual sludge production (a net reduction of approximately 16,500 tons/yr). This is a relatively small net reduction in comparison with the current total annual amount of sludge production by non-small direct facilities (approximately 500,000 tons/yr). Tables 10-3 and 10-4 present the amount of wastewater treatment sludge expected to diminish at non-small facilities as a result of implementing each of the technology options. It is assumed that the sludge generated contain 50 percent moisture after being dried in a sludge dryer. EPA used facility count, wastewater flow, and treatment-in-place data from the MPP screener survey and detailed survey to develop these sludge generation estimates. See Appendix D for a listing of input values used to estimate sludge generation. There are no incremental sludge generation impacts for direct dischargers that are small poultry slaughterers (Subpart K) or small poultry further processors (Subpart L), because all of these small facilities are currently implementing the proposed limitations and standards (Section 6.3.1 of Administrative Record—EPA 2001 Screener Survey). EPA also is proposing no PSES and PSNS for all indirect dischargers in all MPP subcategories. EPA did, however, estimate the sludge generation at non-small MPP facilities that are indirect dischargers and noted a nominal to substantial increase in sludge generation (Table 10-4).

As shown in Table 10-3, BAT-3 for direct dischargers results in a small net decrease in sludge generation when compared to the estimate of sludge generation for BAT-2. The estimates of sludge production for BAT-3 also are based on the assumption that anaerobic lagoon effluent will be the source of organic carbon necessary for denitrification. The use of organic carbon in anaerobic lagoon effluent for denitrification will reduce BOD and the sludge production during subsequent aerobic treatment to satisfy BOD reduction requirements for direct discharge. Although microbial mass is synthesized during denitrification, which requires anoxic conditions,

Table 10-3. Incremental Sludge Generation for Existing Non-Small MPP Facilities, Direct Dischargers[a]

40 CFR 432 Subcategory Groupings[b]	Baseline Total Sludge Generated at Non-Small MPP Facilities, Direct Dischargers (tons/year)	Incremental Sludge Generated - tons/yr and Percent Increase [% Increase] For Non-Small MPP Facilities, Direct Dischargers			
		BAT-2	BAT-3	BAT-4	BAT-5
A, B, C, D	353,794	0 [0.0%]	-5,976 [-1.7%]	-5,334 [-1.5%]	NA
F, G, H, I	6,564	0 [0.0%]	-45 [-0.7%]	-26 [-0.4%]	NA
J	3,655	0 [0.0%]	-124 [-3.4%]	-124 [-3.4%]	NA
K	129,917	0 [0.0%]	-10,353 [-8.0%]	8,533 [6.6%]	8,533 [6.6%]
L	3,326	0 [0.0%]	-146 [-4.4%]	-137 [-4.1%]	-909 [-27.3%]

[a] "Non-small" facilities include Medium, Large, and Very Large Facilities. (See Section 11.3 for a description of these facility classifications.)

[b] Small Processors (Subpart E) are not covered under the proposal, and do not have any net incremental NWQIs (including sludge generation.)

Table 10-4. Incremental Sludge Generation for Existing Non-Small MPP Facilities, Indirect Dischargers[a]

40 CFR 432 Subcategory Groupings[b]	Baseline Total Sludge Generated at Non-Small MPP Facilities, Indirect Dischargers (tons/year)	Incremental Sludge Generated - tons/yr and Percent Increase [% Increase] For Non-Small MPP Facilities, Indirect Dischargers			
		PSES-1	PSES-2	PSES-3	PSES-4
A, B, C, D	63,466	0 [0.0%]	227,567 [358.6%]	187,011 [294.7%]	189,695 [298.9%]
F, G, H, I	2,599	302 [11.6%]	58,071 [2234.6%]	48,598 [1870.1%]	50,046 [1925.8%]
J	9,520	32 [0.3%]	11,259 [118.3%]	9,212 [96.8%]	9,522 [100.0%]
K	38,422	97 [0.3%]	188,012 [489.3%]	162,621 [423.3%]	162,589 [423.2%]
L	2,360	228 [9.6%]	61,213 [2593.6%]	53,794 [2279.2%]	54,233 [2297.8%]

[a] "Non-small" facilities include Medium, Large, and Very Large Facilities. (See Section 11.3 for a description of these facility classifications.)

[b] Small Processors (Subpart E) are not covered under the proposal, and do not have any net incremental NWQIs (including sludge generation.)

the rate of net cell synthesis is lower than that under aerobic conditions. This reduction in sludge production with BAT-3 due to the reduction of BOD under anoxic conditions more than offsets the increased sludge production associated with complete nitrification (BAT-2), because of the very low growth rate of the microorganisms responsible for nitrification. Full-scale domestic wastewater treatment plants have shown a five to 15 percent reduction in waste sludge production after the inclusion of the nitrification/denitrification process (Randall, et. al, 1999). Implementation of BAT-4 and BAT-5 would further decrease sludge generation.

EPA also expects that more emphasis on pollution prevention by increased segregation of waste materials that have value as raw materials for the production of rendered products from wastewater flows could further reduce sludge generation. Examples of such pollution prevention practices include using alternatives of fluming to remove viscera from processing areas and initially "dry cleaning" facilities as the initial step in the daily cleaning of processing equipment and facilities. If contact with water is prevented, fats and proteins that become dissolved and are not captured subsequently by screening and DAF do not become sources of BOD and ammonia nitrogen. Such pollution prevention practices also have the potential to reduce overall water use in MPP processing.

10.4 REFERENCES

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SECTION 11

INCREMENTAL CAPITAL AND OPERATING AND MAINTENANCE COSTS FOR THE PROPOSED REGULATION

This section describes EPA's methodology for estimating engineering compliance costs associated with implementing the technology options proposed for the meat and poultry products (MPP) industry. EPA evaluated costs for each class of meat and poultry facilities, including meat, poultry, and combined meat-poultry (mixed) facilities. This section provides description of industry-wide compliance costs to achieve the proposed technology options.

11.1 OVERVIEW OF METHODOLOGY

EPA subdivided the entire MPP industry into 19 groupings and 4 size classes. EPA used these groupings and size classifications to develop 76 model facilities (19 groupings × 4 size classes) to represent the broad range of potential MPP facilities in current operation. The Computer Assisted Procedure for Design and Evaluation of Wastewater Treatment Systems (CAPDET) (Hydromantis, 2001), a computerized cost model, was used for developing the construction and annual operating cost of a treatment unit for each model facility. The construction cost was used to determine the capital cost of a treatment unit. The model facility costs were multiplied by the number of facilities that require the upgrade to provide the incremental costs for each set of model facilities. For selected technology options, EPA estimated retrofit costs based on each set of model facility costs. Each set of model facility category costs and the retrofit costs were combined separately to determine costs by regulatory subcategory (e.g., A through D, F through I, J, K, and L). Details of the method of cost estimating are presented in Section 11.9.

11.2 IDENTIFICATION OF TECHNOLOGY OPTIONS

EPA is proposing effluent limitations guidelines and standards based on a combination of processes and treatment technologies but is not requiring their use. Rather, the processes and technologies used to treat MPP wastewaters are left to the discretion of individual MPP facilities.

After promulgating the final rule, EPA will require compliance with the numerical limitations and standards and not require MPP facilities to use specific processes or technologies. The proposed technology options evaluated for existing direct dischargers (BPT/BCT/BAT), existing indirect dischargers (PSES), new direct dischargers (NSPS), and new indirect dischargers (PSNS) were based on an analysis of technology-in-place (TIP), according to data supplied in the MPP detailed surveys. A summary of the treatment units for the proposed technology options is shown in Table 11-1 and in Figures 11-1 through11-9. Note that Technology Option 5 is applicable to poultry facilities only.

Table 11-1. Proposed Technology Options for the MPP Industry

	Technology Options								
	Direct Discharger					**Indirect Discharger**			
Treatment Units	**1**	**2**	**3**	**4**	**5[a]**	**1**	**2**	**3**	**4**
Screen	X	X	X	X	X	X	X	X	X
Dissolved air flotation (DAF)	X	X	X	X	X	X	X	X	X
Equalization tank						X	X	X	X
Anaerobic lagoon	X	X	X	X	X				
Biological treatment with nitrification	X[b]	X	X	X	X		X	X	X
Biological treatment with nitrification and denitrification			X	X	X			X	X
Biological treatment with nitrification and denitrification and phosphorous removal				X	X				X
Filter					X				
Ultraviolet (UV) disinfection	X	X	X	X	X				

X: treatment unit is required for that option.
[a] EPA only considered Direct Option 5 for poultry facilities only.
[b] Direct Option 1 uses a less optimized form of nitrification. (See Section 11.8.4.)

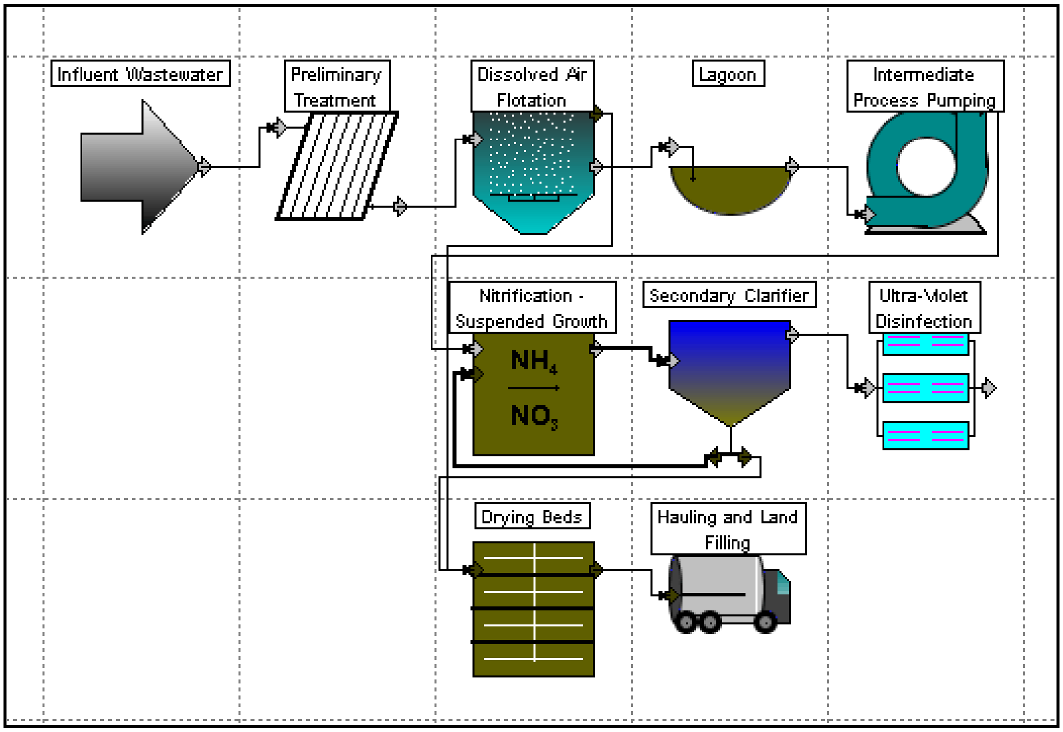

Figure 11-1. Treatment Unit Schematic for Direct Technology Option 1 (assuming incomplete nitrification).

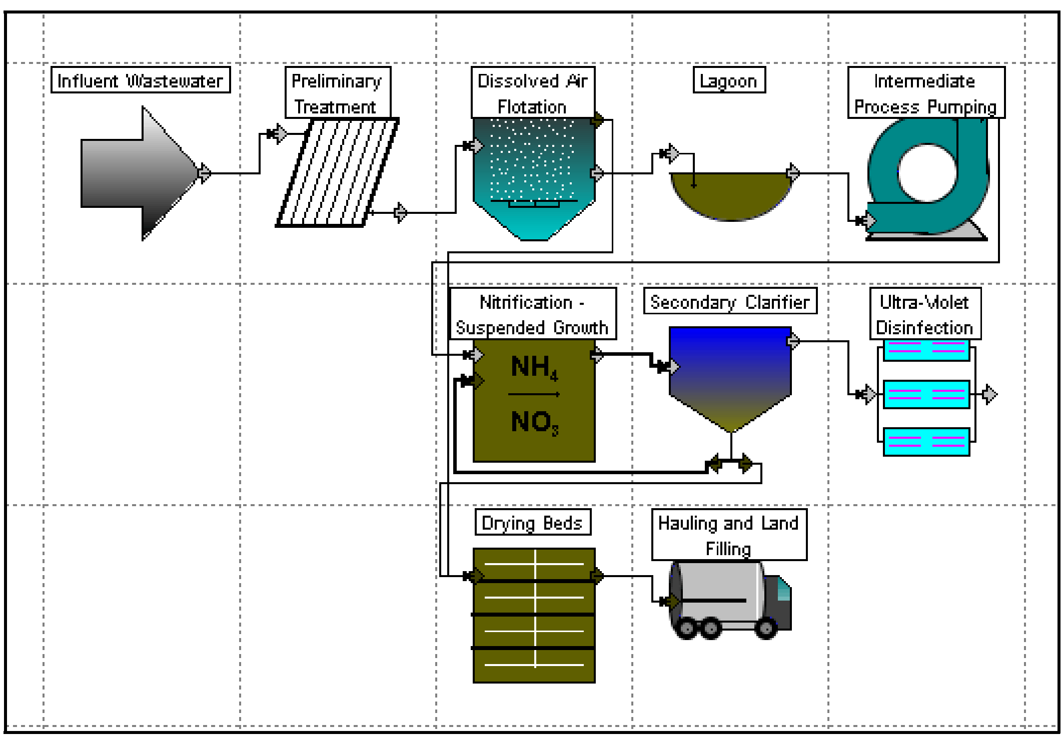

Figure 11-2. Treatment Unit Schematic for Direct Technology Option 2.

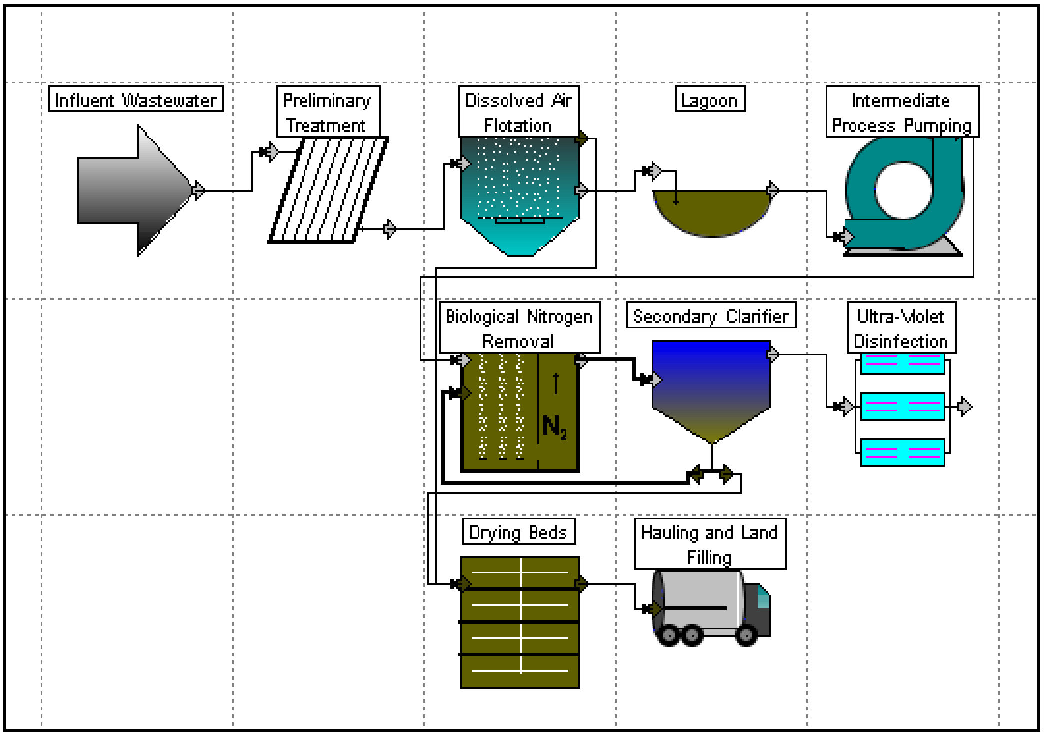

Figure 11-3. Treatment Unit Schematic for Direct Technology Option 3.

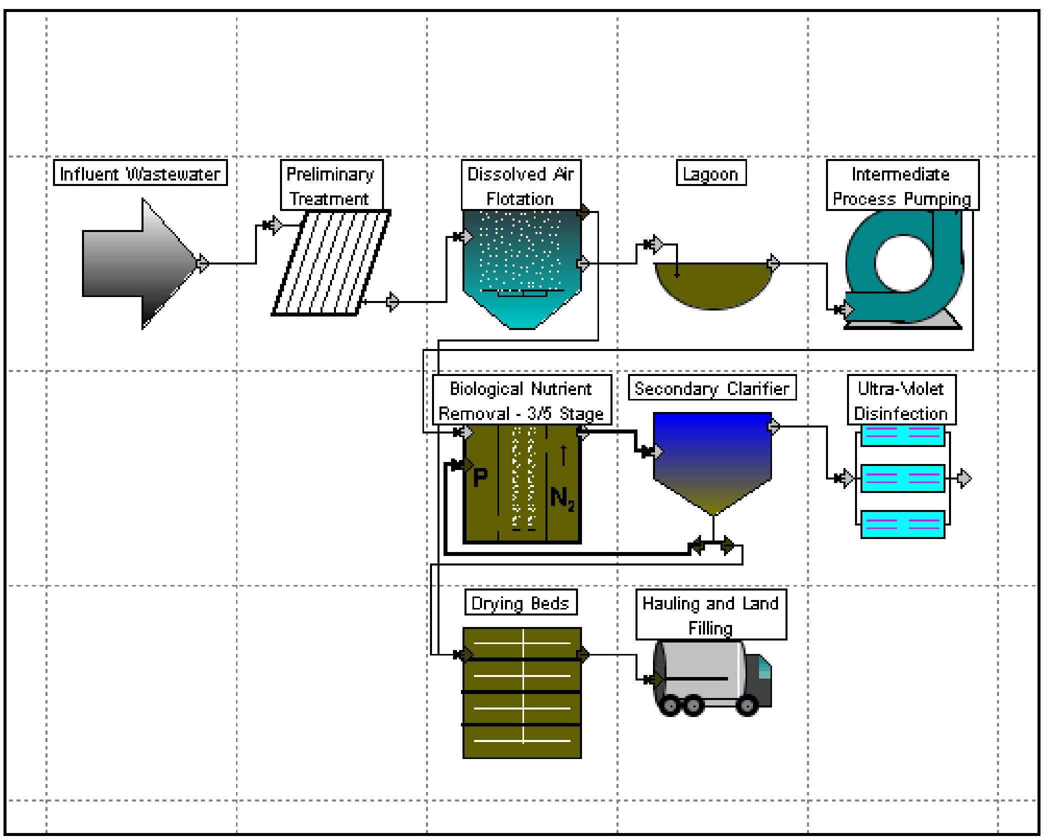

Figure 11-4. Treatment Unit Schematic for Direct Technology Option 4.

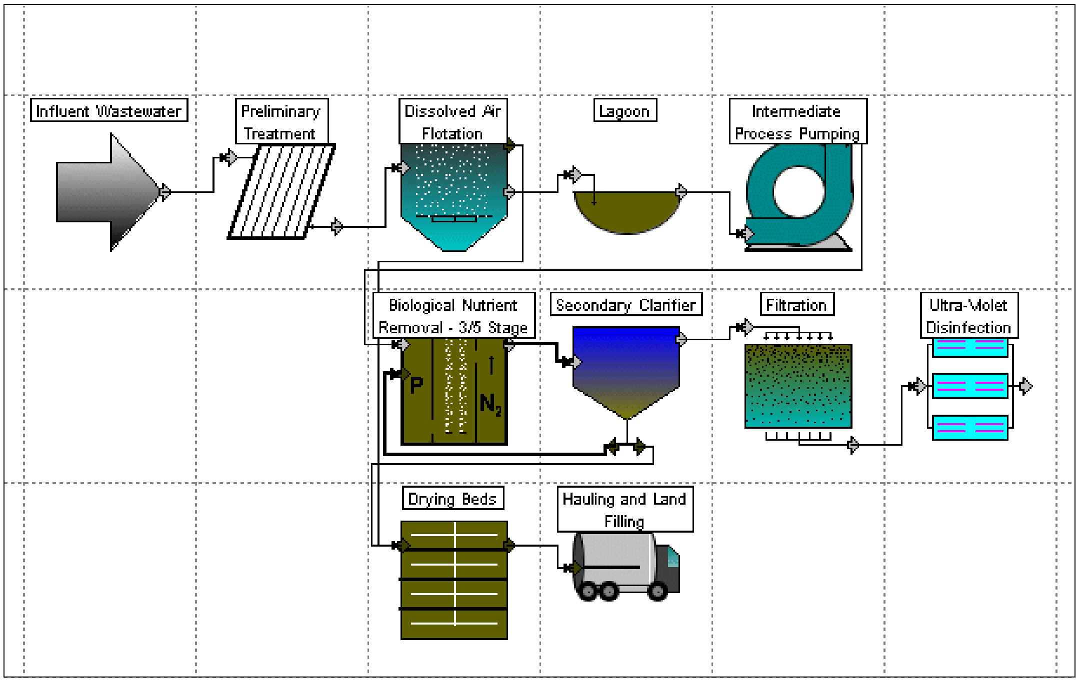

Figure 11-5. Treatment Unit Schematic for Direct Technology Option 5 (Poultry Only).

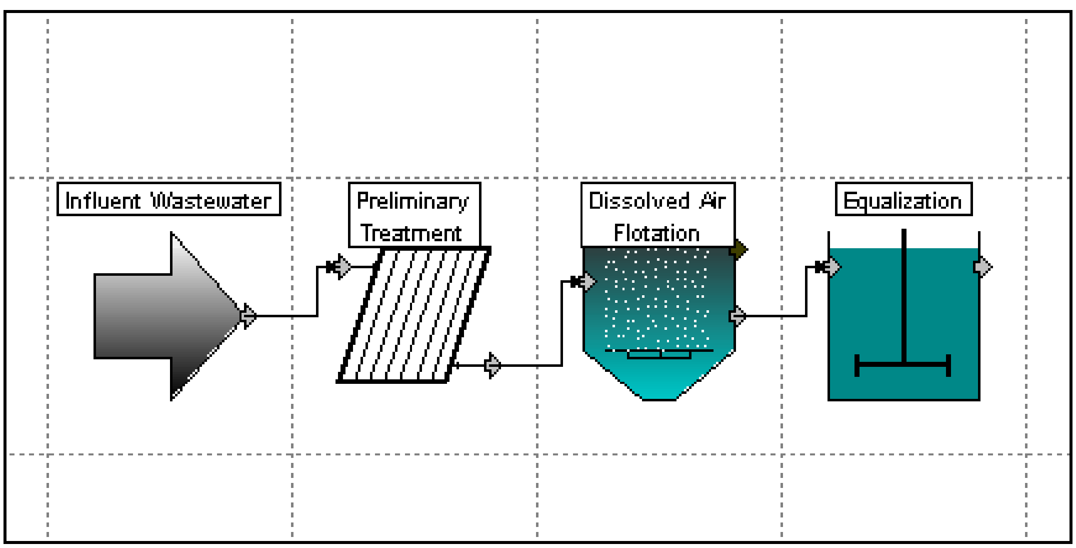

Figure 11-6. Treatment Unit Schematic for Indirect Technology Option 1.

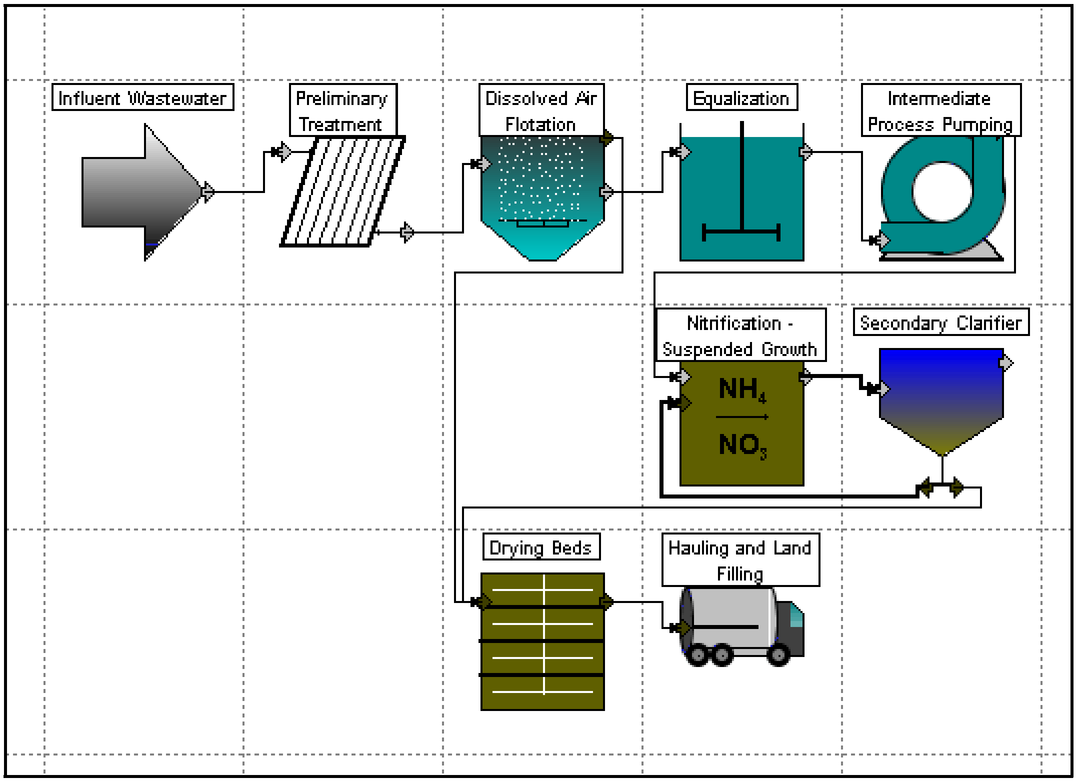

Figure 11-7. Treatment Unit Schematic for Indirect Technology Option 2.

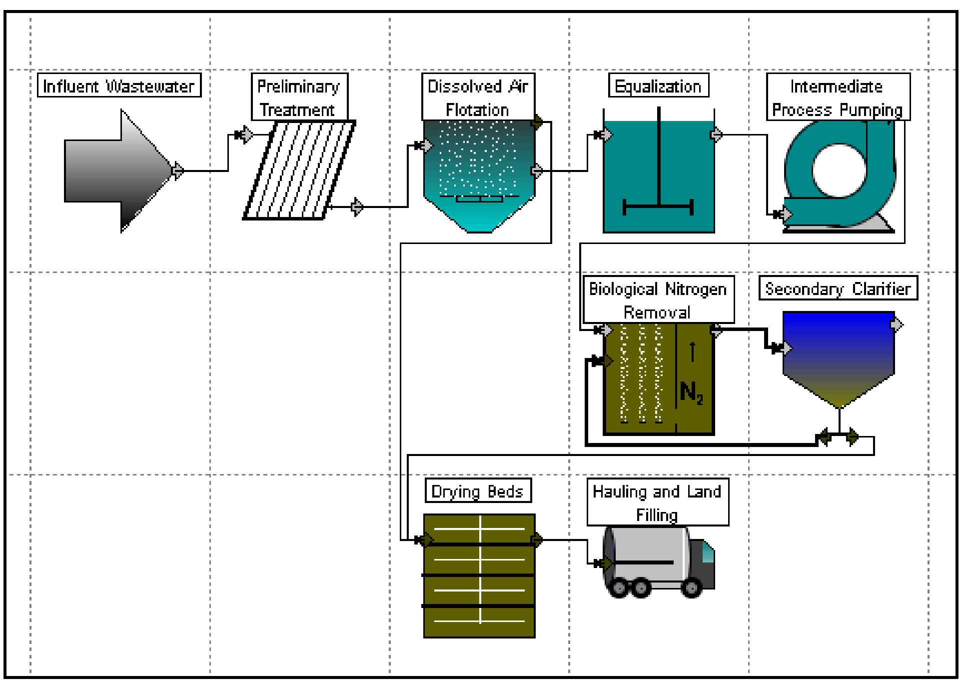

Figure 11-8. Treatment Unit Schematic for Indirect Technology Option 3.

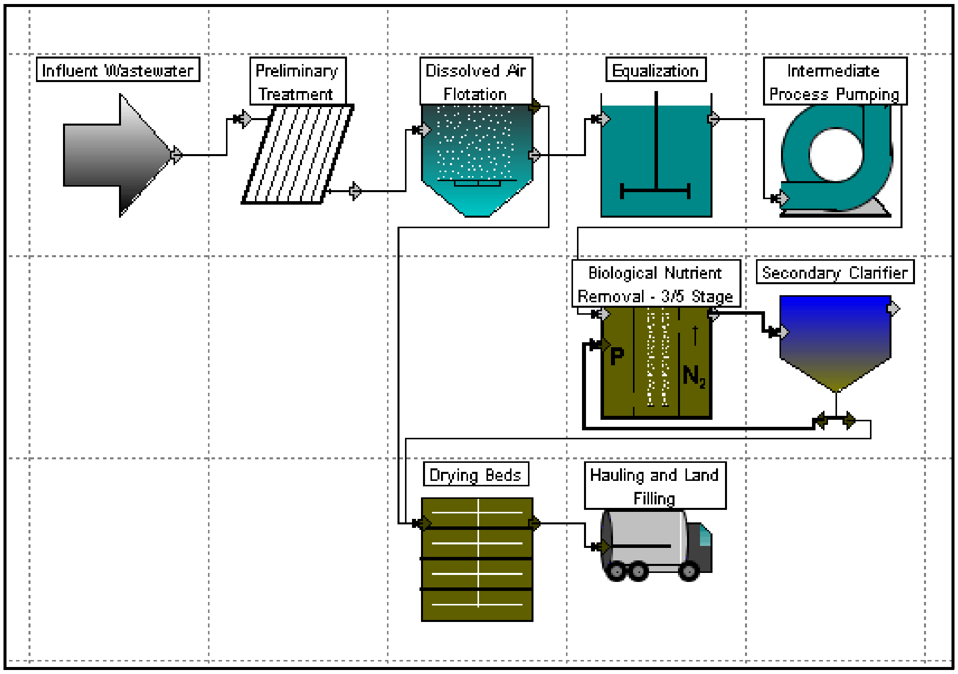

Figure 11-9. Treatment Unit Schematic for Indirect Technology Option 4.

11.3 DEVELOPMENT OF MPP MODEL FACILITIES

EPA used the MPP screener survey results to develop MPP model. These model facilities were used to estimate compliance costs and were also used in other analyses (e.g., pollutant reductions by treatment technology, economic impacts, non-water quality environmental impacts). To develop the MPP model facilities, EPA first separated MPP facilities based on the type of animal processed (e.g., meat, poultry, or both meat and poultry). To ensure that all MPP facilities identified in the MPP screener survey were accounted for, and that variations in raw wastewater characteristics are considered, EPA classified all MPP operations as first processing (e.g., slaughtering, carcass preparation, and quartering), further processing (e.g., deboning, cooking, sausage making), or rendering (wet or dry) and all possible combinations of these processes. These separations and classifications produced 19 different groupings, shown in Table 11-2.

Table 11-2. Definition of 19 MPP Facility Groupings

Number	Product Type	Model Facility Grouping Code	Process(es) Performed			Production Values Used to Define Size Classifications (in 1,000 lbs)			
			First Processing	Further Processing	Rendering	Small	Medium	Large	Very Large
1	Meat	R1	X			< 50,000	< 500,000	< 1,000,000	≥ 1,000,000
2	Meat	R2		X		< 50,000	< 3,000,000	< 6,000,000	≥ 6,000,000
3	Meat	R12	X	X		< 50,000	< 1,750,000	< 3,500,000	≥ 3,500,000
4	Meat	R13	X		X	< 60,000	< 600,000	< 1,200,000	≥ 1,200,000
5	Meat	R23		X	X	< 60,000	< 3,100,000	< 6,200,000	≥ 6,200,000
6	Meat	R123	X	X	X	< 60,000	< 1,850,000	< 3,700,000	≥ 3,700,000
7	Poultry	P1	X			< 10,000	< 150,000	< 300,000	≥ 300,000
8	Poultry	P2		X		< 7,000	< 125,000	< 250,000	≥ 250,000
9	Poultry	P12	X	X		< 8,000	< 137,000	< 275,000	≥ 275,000
10	Poultry	P13	X		X	< 20,000	< 250,000	< 500,000	≥ 500,000
11	Poultry	P23		X	X	< 17,000	< 225,000	< 450,000	≥ 450,000
12	Poultry	P123	X	X	X	< 18,000	< 238,000	< 475,000	≥ 475,000
13	Mixed[a]	M1	X			< 30,000	< 300,000	< 650,000	≥ 650,000
14	Mixed[a]	M2		X		< 30,000	< 1,500,000	< 3,000,000	≥ 3,000,000
15	Mixed[a]	M12	X	X		< 30,000	< 1,000,000	< 2,000,000	≥ 2,000,000
16	Mixed[a]	M13	X		X	< 40,000	< 400,000	< 850,000	≥ 850,000
17	Mixed[a]	M23		X	X	< 40,000	< 1,600,000	< 3,200,000	≥ 3,200,000
18	Mixed[a]	M123	X	X	X	< 40,000	< 1,100,000	< 2,200,000	≥ 2,200,000
19	Meat and/or Poultry	Render			X	< 10,000	< 100,000	< 200,000	≥ 200,000

[a] Meat and Poultry.

EPA then further separated each of the 19 groupings into four size classes (small, medium, large, and very large) based on total annual production data from the MPP screener survey to develop 76 model facilities (19 groupings × 4 size classes). The resultant model facilities allow EPA to consider MPP facility variations in (1) facility raw wastewater characteristics, as determined by the source animal distinction (e.g., meat or poultry) and processes performed (e.g., first processing, further processing; and rendering), and (2) facility size, which can support estimation of wastewater volumes generated and thus the size of required treatment units. EPA used these 76 model facilities to more accurately estimate costs, loadings, non-water quality environmental impacts, and economic impacts of the proposed limitations and standards on the MPP industry.

11.4 SELECTION OF A COST MODEL

EPA investigated various sources to collect cost information for the technology options considered. The sources include vendor quotations, literature, the wastewater cost (W/W Cost) computer model (W/W Cost, 1998), and the CAPDET computer model (Hydromantis, 2001). EPA did not use vendor quotations or literature to derive cost curves for treatment units because of a lack of detailed information. The W/W Cost model was also not used because of model limitations, particularly the fact that the model does not have the costs for all the treatment units considered in the technology options (e.g., denitrification). CAPDET was selected for estimating the compliance costs for the proposed MPP regulation because it is user-friendly and has a database that contains the latest costs (year 2000) of all the treatment units considered in the MPP technology options. More important, based on a comparison to actual costs for MPP facilities, CAPDET predicted the actual costs of MPP wastewater treatment plants reasonably well (see Section 11.11).

The CAPDET software was originally developed based on the need for a method of accurate and rapid preliminary design and cost estimating of wastewater treatment plant construction projects. The U.S. Army Corps of Engineers developed the software for EPA with the specific intent of assisting personnel responsible for wastewater treatment planning in the evaluation of wastewater treatment alternatives, based primarily on life cycle costs and degree of treatment provided. The major emphasis with CAPDET has been the development of accurate planning-level cost estimates for unit processes. The model was designed to provide the planning-level estimates based on knowledge of the basic system formulations and the use of cost curves. The software calculates the design of each unit process, based on the influent to the process, and then costs the design. This two-step approach gives the user the option to review the produced design and modify it. Typical design defaults have been used for each unit process to increase the acceptability of the calculated designs and make the software easier to use for planners that require planning-level cost estimates for a new facility or an upgrade to an existing facility.

Two basic methods are typically used for planning-level cost estimating. Parametric cost estimating is based on a statistical approach (i.e., statistical analysis of the cost of facilities of similar size and characteristics at other locations). A modification of this statistical approach is the development of standard designs for various flows and formulation of a cost based on engineering quantities. The second method identifies cost elements to which input unit prices are applied (i.e., cubic yards of concrete in a clarifier are quantified). To this number an input cost value for reinforced concrete in place is applied to determine construction costs. CAPDET combines both parametric and unit costing techniques for estimating total project costs.

Costs associated with construction of a wastewater treatment facility are divided into two categories: (1) unit process costs and (2) other direct and indirect costs. Unit process costs are those associated with a specific treatment process, such as a clarifier. Battery limits are drawn such that the clarifier is an individual functioning unit. Cost element estimating is used to determine the costs of the unit process within these battery limits. Other direct and indirect costs include those cost items required to create a functional treatment facility. These costs are derived parametrically from EPA-developed cost curves based on bid data.

11.5 DESCRIPTION OF COST COMPONENTS

Cost estimation has two components: (1) capital costs and (2) operation and maintenance costs. The capital cost is the initial investment a facility makes to build a treatment unit (or series of treatment units). The operation and maintenance costs are annual costs incurred to maintain and run that treatment unit (or series of treatment units).

11.5.1 Capital Costs

The basis of capital cost estimating is to identify all costs associated with wastewater treatment facility construction. These costs, once identified, can be categorized into two categories: (1) unit process construction costs and (2) other direct and indirect costs. The sum of the two costs provides the total capital costs. Often other direct and indirect costs are expressed as a percentage of the construction costs to determine the capital cost. A similar approach is followed to estimate the capital costs of the treatment units for the proposed regulation. The construction cost of treatment units obtained from CAPDET model runs is multiplied by a factor to determine the capital cost.

11.5.1.1 Construction Cost

The construction cost of a unit process is the cost to construct and install a treatment unit, including its associated housing, piping, and electric work. The costs are defined within battery limits, which are established to be the physical dimensions of the unit process plus 5 feet. The major cost items for construction of any unit process can be generally categorized as follows:

- Concrete or steel tanks and structures
- Installed equipment
- Building and housing
- Piping and insulation
- Electrical works, control systems, and other facilities

Structural Components

The costs of the structural component comprise the costs of reinforced concrete, earthwork, structures, and piping. The construction of earthen basins (such as anaerobic lagoons) is usually accomplished with equal cut-and-fill quantities. In other words, excavated material is used in embankments so that borrowing of dirt from outside is not necessary. The procedure is applicable only when soil and groundwater conditions are ideal, which the CAPDET model assumes to simplify costing procedures. The unit cost input consists of dollars per cubic yard of earthwork assuming equal cut-and-fill.

The costs of reinforced concrete structures are estimated as the sum of costs of concrete slabs and concrete walls because of the significant difference in costs between the two types of in-place structures. The unit cost inputs for both type of structures in the CAPDET model are in dollars per cubic yard (Hydromantis, 2001).

Equipment and Installation Costs

Equipment for the wastewater treatment system may constitute one of the largest items of identifiable fixable capital costs. Accurate estimation depends on up-to-date equipment cost data. With a limited number of unit cost input entries, it is very difficult to maintain a reliable cost database. The following description outlines a procedure that produces an accurate estimate within these limitations. The installed equipment cost is considered in three components: the purchase cost of the equipment, installation labor cost, and other minor costs such as electrical work, minor piping, foundations, painting, and the like.

The purchase cost of process equipment is a function of size or capacity. To minimize the number of cost inputs required, a standard unit of a particular size (or capacity) is selected and the purchase cost of all other units of that type is expressed as a fraction or multiple of the standard unit purchase cost. The exact form of the cost-versus-size relationship and the selection of the standard sizes for each major equipment item were determined from a review of manufacturers' information and available literature. In most cases, these size-cost relationships are relatively unaffected by inflation and other cost changes.

Two options are available by which the purchase cost of equipment can be escalated to account for inflation. The first option is for the user to obtain from equipment manufacturers the current cost of the standard size equipment at the treatment plant site. The purchase cost of any other size item of like equipment is then automatically escalated by the cost versus size relationships described above. The second option is to escalate the purchase costs by the use of cost indices (Hydromantis, 2001). Only one input is required for this process, the Marshall and Swift Equipment Cost Index. The 1977 and 2000 purchase prices of the standard size equipment are stored in the CAPDET model and are updated automatically if the cost index is input into the program. The latter of the two methods requires fewer input values. If the model user inputs a cost for equipment, the index is not used to update the new costs.

Man-hour requirements for installation are dependent on the type and size of equipment. The relationships between man-hour requirements for installation and equipment size and type have been established and are presented in the designs for each unit process. The installation cost is estimated by multiplying the man-hour requirements by the input labor rates. In many cases, data concerning manpower requirements for equipment installation were found to be incomplete or nonexistent. In such cases, the model uses a percentage of purchase price factor to calculate the cost of equipment installation. These factors, in general, were obtained from equipment manufacturers and published sources.

The other minor costs for each type of equipment may include costs of piping, steel, instruments, electrical components, insulation, painting, insurance, taxes, and so forth. These items are estimated as a percentage of the purchase costs. The percentage values will vary with the type and size of equipment. These percentage values were established based on design experience, engineering judgment, manufacturers' inputs, and previously published literature (Hydromantis, 2001).

Costs for Building and Housing

Buildings are essential in certain unit processes for protection against weather or maintenance of a requisite environment. The building requirements are related to the equipment to be housed and are estimated as square footage of floor space. Building costs are estimated by multiplying the square footage of floor space required by the unit cost per square foot (Hydromantis, 2001).

Costs for Piping System

Piping costs are evaluated independently. Estimating process piping costs presents the greatest challenge for the cost engineer. Estimating costs from detailed drawings is an arduous, time-consuming task much beyond the scope of CAPDET. Evaluation on any other basis might produce widely varying results. To estimate the cost of the "major piping system," a combination of two well-established estimating methods used by the chemical industries is employed. The costs of material are estimated by the use of the Dickson "N" method, and the field erection cost is estimated by the cost of "joints" method. The R.A. Dickson "N" method uses a technique to estimate purchase price of piping material similar to the one proposed to estimate equipment costs. Relationships are developed between the cost ratios, designated as N factors, and sizes of pipe material (Hydromantis, 2001).

With these factors stored in CAPDET for cast iron pipe, steel pipe, fittings, and valves, the user inputs only a limited number of unit costs of the reference components. The field erection costs for the piping system can be estimated by use of the cost-per-joint method. The unit of work measurement is the joint (two for couplings and valves, three for tees, etc.). Because joints require the bulk of piping labor for erection, the costs of handling, hanging pipe placement, and insulation are estimated as a fraction of the cost of makeup joints. The man-hours of field erection per joint for various pipe sizes and materials, as well as the fraction for placing and insulating, are evaluated in the quantities calculations. The field erection costs of the piping system are estimated based on the labor requirements and unit labor price inputs. The total piping system costs are the sum of the following items: (1) piping material costs, (2) field erection costs, and (3) other minor costs as a percentage of total piping costs.

In many cases it is impractical, at the planning level, to identify piping quantities and sizes. In such cases, a percentage of other construction cost factors is used to estimate piping cost. The method used is specific for each process (Hydromantis 2001).

11.5.1.2 Total Capital Costs

The construction cost of wastewater treatment facilities involves not only the cost of the construction of unit processes but also other direct and indirect costs incurred in creating a functional facility. Piping and pumping, and instrumentation and controls are examples of direct costs; engineering and contingency are examples of indirect costs. The total capital cost is the sum of the construction cost and other direct and indirect costs. Based on the cost information obtained from the cost document for the centralized waste treatment industry (USEPA, 1998), the other direct and indirect costs are estimated to be 69 percent of the construction cost of the treatment units. Direct and indirect costs as percentage of construction cost are provided in Table 11-3. (See Attachment 11-1 in Appendix D for details.) The capital cost for a treatment unit is obtained by multiplying the construction cost by 1.69 to estimate the total capital cost of the treatment unit.

Table 11-3. Cost Factors Used to Estimate Capital Costs

Cost Item	Cost Type	Cost Factor (Percent of Construction Cost)
Construction cost	Direct	100
Piping	Direct	17
Instrumentation and controls	Direct	13
Engineering	Indirect	19.5
Contingency	Indirect	19.5
Total capital cost		169

For details, see Attachment 11-1 in Appendix D.

11.5.2 Operation and Maintenance Costs

The operation and maintenance costs of a wastewater treatment unit process can be divided into several major categories: energy, operation labor, maintenance labor, chemical costs, operation and maintenance material and supply costs, and sludge disposal costs. The techniques and methods used in CAPDET for estimating operation and maintenance costs are presented below (Hydromantis, 2001).

11.5.2.1 Energy

Energy costs are derived from the calculated use of electric power, fuel oil, or natural gas. The quantities calculations generate the quantities of energy use, whereas the cost calculations apply user input unit prices to calculate the unit process energy cost. The total energy cost of the treatment facility is simply the sum of the energy costs for the unit processes.

The cost of electric power is by far the predominant energy cost for most processes. The procedure for calculating electric power cost is presented below. For some processes energy cost may involve natural gas and fuel oil. Because natural gas and fuel oil are consumed in relatively few processes, the costs of these fuels are tabulated as a material cost. For costing these fuels EPA use techniques similar to those used to calculate electric power costs.

Electric power consumption is estimated for each unit process and is part of the output data from the quantities calculations of each process. The power consumption for the treatment facility is simply the sum of the power consumption for the unit processes. The power consumption is converted to costs by multiplying the power consumption (in kilowatt-hours per year) by the unit price input for electric power costs (in dollars per kilowatt hour). Electric power rates vary according to location, peak demand, and level of consumption. EPA used the CAPDET default national cost of $0.08 per kilowatt-hour.

11.5.2.2 Labor Costs

The cost of labor can be divided into four categories: operation, maintenance, administrative and general, and laboratory. Recommended staffing for the different levels of manpower required for each of the four labor groups was established by using several publications on staffing of wastewater treatment facilities. Based on staffing charts in the literature, equations were developed to estimate an average labor rate for each labor group as a function of Operator II labor rate. The user can input the Operator II labor rate or accept the default value. The labor cost in each group is then calculated using the labor rate and the man-hours. EPA used the CAPDET default labor rates.

Operation labor and maintenance labor are applied to the unit processes specified in the treatment alternatives. The man-hours required over a year's time for operation labor and maintenance labor are calculated for each unit process. The total man-hours requirement is the sum of the requirement for each unit process in the treatment facility. However, administrative and general labor, as well as laboratory labor, is computed for the treatment facility as a whole. The man-hours required for administrative and general labor and for laboratory labor are determined from equations that involve average flow to the treatment plant.

11.5.2.3 Operation and Maintenance Material and Supply Costs

Operation and maintenance material and supply costs are calculated for each unit process. Typically, these costs are calculated as a percentage of the unit construction costs. The total operation and maintenance material and supply costs for the entire treatment facility are the sum of the costs for each unit process used in the treatment facility.

11.5.2.4 Chemical Costs

Four different chemicals are typically used at treatment facilities: lime, alum, ferric chloride, and polymers. Quantities of each chemical required by the treatment processes are calculated in the quantities calculations. These quantities are based on CAPDET's calculations to achieve desired removals or effluent concentrations from input (influent) concentrations. The cost of a chemical is determined by multiplying the amount required by the unit cost of the chemical. The total annual chemical costs for the facility are simply the sum of the five different chemicals used in the various processes.

11.5.2.5 Sludge Disposal Costs

The sludge generated by biological treatment units and DAF units is assumed to be dried and dewatered in sludge dewatering devices before being hauled off-site for land disposal. Therefore, for DAF and biological treatment systems, an additional annual cost of sludge disposal was added. CAPDET assumes sludge is dewatered in drying beds and sent to disposal at 50 percent solids content. A sludge disposal cost of $2.3/ton (Parker, 1998) was used for hauling of the dried sludge leaving the sludge dryer.

11.5.2.6 Total Operation and Maintenance

The total annual operation and maintenance cost is the sum of the energy costs, the labor costs, the operation and maintenance material and supply costs, the chemical costs, and the sludge disposal costs.

11.6 DESCRIPTION OF THE TREATMENT UNITS AND SELECTED DESIGN SPECIFICATIONS

For model runs, the cost modules in CAPDET are selected based on the treatment units required for the technology options shown previously in Table 11-1. This section describes the treatment units selected for the model runs. Descriptions of the treatment units, based on the technical document in CAPDET, are presented below (Hydromantis, 2001).

11.6.1 Preliminary Treatment

Preliminary treatment comprises two processes: screening and grit removal. Because most of the available cost information combines these processes and the costs of these treatment units are relatively small, cost estimates are parametric. Inaccuracy in estimating the cost of the preliminary treatment introduces only a small error in the total facility cost.

Screening devices are used to remove large objects that otherwise might damage pumps and other equipment, obstruct pipelines, and interfere with the normal operation of the treatment facilities. Bar screens are commonly used in the wastewater treatment facilities. Bar screens consist of vertical or inclined bars spaced at equal intervals across the channel where wastewater flows. The quantity of material removed by bar screening depends on the size of the bar spacings. These devices may be cleaned manually or mechanically. The design of bar screens is based on average and peak wastewater flow.

Grit removal is classified as a protective or a preventive measure. The process does not contribute materially to the reduction in the pollutant load applied to the wastewater treatment facility. Grit chambers are designed to remove grit, which can include sand, gravel, cinder, and other inorganic abrasive matter. Grit causes wear on pumps, fills pump sumps and sludge hoppers, clogs pipes and channels, and occupies valuable space in sludge digestion tanks. Grit removal, therefore, reduces the costs of maintaining mechanical equipment and eliminates operational difficulties caused by grit. Grit removal is recommended for small and large treatment facilities. Bar screens are usually installed ahead of grit chambers to remove large objects. The design of screens and grit chambers depends on the type selected, the type of grit removal equipment, the specifications of the selected grit removal equipment, and the quantity and quality of the grit to be handled. This process is part of preliminary treatment. Default design values in CAPDET were used to develop costs for preliminary treatment. A 15-year life expectancy was selected.

11.6.2 Dissolved Air Flotation

Flotation is a solid-liquid separation process. Separation is induced by introducing fine gas bubbles (usually air) into the system. The gas-solid aggregate has an overall bulk density less than the density of the liquid; thus, these aggregates rise to the surface of the fluid. Once the solid particles have floated to the surface, they can be collected by a skimming operation. In wastewater treatment, flotation is used as a clarifying process to remove suspended solids and as a thickening process to concentrate various types of sludges. However, the process generally is used for clarifying of certain industrial wastes and for concentrating waste-activated sludge.

Dissolved air flotation (DAF) involves air being dissolved in the wastewater under elevated pressures and later released at atmospheric pressure. The principal components of a dissolved air-pressure flotation system are a pressurizing pump, air injection facilities, a retention tank, a back pressure regulating device, and a flotation unit. The primary variables for flotation design are pressure, recycle ratio, feed solid concentration, detention period, air-to-solid ratio, use of polymers, and solids and hydraulic loadings. CAPDET sizes a circular DAF system with a concrete structure. Specific information on design specifications for DAF units was not available in the MPP detailed surveys. Therefore, the default design values in CAPDET were used to develop costs for dissolved air flotation. A 15-year life expectancy was selected.

11.6.3 Equalization

Equalization is used to dampen variable waste flows so that the treatment facility receives a relatively constant flow. It has been shown that many treatment processes operate better if extreme fluctuations in hydraulic and organic loadings are eliminated. Equalization basins are usually aerated to prevent the settling of solids and to prevent anaerobic conditions from developing.

The equalization basin volume is based on the magnitude and frequency of the variations in hydraulic and organic load. The basin volume required for equalizing dry weather diurnal flows is calculated based on two-hour flows for 24 consecutive hours. However, if the two-hour flow data are not available, the desired volume of the basin is based on the median flow (see Table 11-6). The program can be used for equalization of flows other than dry weather diurnal flows by inputting the required basin volume. Cost of equipment is calculated from current cost values in the selected database updated using the appropriate current cost indices. Default design values in CAPDET were used to develop costs including the assumption that the basin is aerated. A 15-year life expectancy was selected.

11.6.4 Lagoon

Lagoons have been extensively used for municipal and industrial wastewater treatment, where sufficient land area is available. According to the MPP detailed surveys reviewed for the proposed rulemaking, almost 30 percent of MPP facilities use a lagoon as part of their treatment system. Some of the reasons for the popularity of lagoons are that they (1) have operational stability with fluctuating loads, (2) usually require relatively unskilled operators, (3) incur low operational costs, and (4) involve low construction costs. Lagoons can be anaerobic, aerobic, or facultative.

Anaerobic lagoons are anaerobic throughout their depth, except for a very shallow upper layer. These lagoons are constructed deep to ensure anaerobic conditions and to conserve heat. Typically they are from 8 to 20 feet deep. Reductions of more than 65 percent of the influent BOD_5 are common with anaerobic lagoons.

For the model runs that included lagoons, an unlined anaerobic lagoon was selected with a BOD loading rate of 350 pounds per acre per day. A 12-foot lagoon depth and 15-year life expectancy were selected. Other parameters used to develop costs of an anaerobic lagoon were left at the default values provided by CAPDET.

11.6.5 Intermediate Pumping

Several locations in a treatment facility may require pumping. Pumping is typically required at points in the treatment train that create relatively high head losses or where a relatively consistent flow is desired for optimum performance (e.g., pumping wastewater from an anaerobic lagoon to a biological treatment system). The wastewater at this point is relatively clean and free from large solids, so that more efficient pumps can be used for these processes than for raw waste pumping. Default design values in CAPDET were used to develop costs for intermediate pumping stations. A 15-year life expectancy was selected.

11.6.6 Nitrification—Suspended Growth

Nitrogen in wastewater is present in several forms including organic nitrogen, ammonia nitrogen, nitrite nitrogen, and nitrate nitrogen. The prevalent forms in untreated MPP wastewater are organic nitrogen and ammonia nitrogen. Organic nitrogen exists in both soluble and particulate forms.

Nitrification is the process that converts organic and ammonia nitrogen to nitrate nitrogen. Nitrification may be coupled with denitrification, which reduces nitrate to nitrogen gas and removes the nitrogen from the water.

Suspended growth nitrification systems are similar in design to carbon oxidation-activated sludge systems. The biological growth is suspended in an aeration basin. Mechanical or diffused aerators provide oxygen for nitrification and provide mixing that keeps the solids in suspension. The mixed liquor is then clarified to remove suspended solids and concentrate the sludge for recycle. The solids retention time in a nitrification system is longer than that in a carbon oxidation system given the slower growth rate of the nitrifiers compared to heterotrophic bacteria. The plug flow suspended growth system is considered in CAPDET. Default design values in CAPDET were used to develop costs of a nitrification system. A 15-year life expectancy was selected. As described further in Section 11.9.2, there are situations where new unit processes may not be required to achieve full nitrification. To account for the ability of facilities to upgrade existing nitrification-suspended growth systems, EPA estimated retrofit costs.

11.6.7 Biological Nitrogen Removal

Biological nitrogen removal encompasses both nitrification and denitrification. Nitrification is the process that converts organic and ammonia nitrogen to nitrate nitrogen. Nitrification may be coupled with denitrification, which reduces nitrate to nitrogen gas and removes the nitrogen from the water. Experience has shown that significant biological nitrogen removal activity does not occur in strictly aerobic systems. Rather, such activity is achieved by incorporating an unaerated zone into the process design. For denitrification, an anoxic stage (nitrate present, no oxygen) is included. The reactor configuration typically includes an anaerobic/unaerated stage ahead of an aerobic reactor. These reactors are followed by a secondary clarifier used to concentrate the sludge and return it to the unaerated stage.

Denitrification is a two-step biological process. Nitrate is converted to nitrite, which in turn is reduced to nitrogen gas. This two-step process is termed "dissimilation." A broad range of bacteria, including *pseudomonas*, *micrococcus*, *achromobacter* and *bacillus*, can accomplish denitrification. These bacteria can use either nitrate or oxygen to oxidize organic material. Because the use of oxygen is more energetically favorable than using nitrate, denitrification must be conducted in the absence of oxygen (anoxic condition) to ensure that nitrate, rather than oxygen, is used in the oxidation of the organic material. For denitrification to occur, a carbon source must be available for oxidation. Carbonaceous material in the raw wastewater is often used as a carbon source. However, if the carbonaceous material in the wastewater is not available, an external carbon source may have to be added to the denitrification system. Default design values in CAPDET were used for the design parameters to develop costs for biological nitrogen removal. A 15-year life expectancy was selected.

11.6.8 Biological Nutrient Removal—3/5 Stage

Biological nutrient removal (BNR) encompasses both nitrogen removal and excess biological phosphorus removal. Excess biological phosphorus removal is a biologically mediated process used within activated sludge systems to achieve phosphorus removal from wastewater. The process involves cultivating certain microorganisms within the mixed community. These microorganisms, termed polyphosphate accumulating organisms (PAOs), have the ability to take up more phosphorus than they require for growth. The net effect of this uptake is a reduction of phosphorus concentration in wastewater to a level that can be less than 1 mg/L.

Experience has shown that significant BNR activity does not occur in strictly aerobic systems. Rather, BNR behavior is achieved by incorporating an unaerated zone into the process design. For denitrification, an anoxic stage (nitrate present, no oxygen) is included, and for phosphorus removal, an anaerobic stage (neither nitrate nor oxygen present) must be included in the reactor configuration. For a description of the nitrification and denitrification stages, refer to Section 11.6.7.

The three-stage BNR configuration includes an anaerobic stage, followed by an anoxic stage followed by an aerobic stage. One internal recycle is used to recycle nitrate from the aerobic stage to the anoxic stage and a return activated sludge (RAS) recycle is used to recycle thickened sludge from the clarifier to the anaerobic stage.

The five-stage configuration (also termed a "modified Bardenpho") is similar to the three-stage configuration in that the first three reactors are similar and one internal recycle recycles nitrate to the anoxic stage. However, to increase the nutrient removal capacity, two additional stages are placed after the aerobic stage and before the clarifier. The first of these stages is anoxic for more denitrification, and the second is aerobic for effluent polishing. The five-stage configuration was selected to develop costs for this process. Default design values in CAPDET were used to develop costs for the BNR process. A 15-year life expectancy was selected. It should be noted that due to limitations of the CAPDET model, EPA could not adjust for the fact that treatment in an anaerobic lagoon precedes the BNR process. This limitation most likely results in overestimating the cost for the BNR process.

11.6.9 Secondary Clarification

Secondary clarifiers are commonly used in conjunction with biological wastewater treatment systems to remove settleable solids. They produce an effluent low in suspended solids and an underflow of sufficient concentration to maintain a sufficient population of active microbial mass in the tank of biological activity. The secondary clarifiers are, therefore, designed to provide clarification, as well as thickening. The design of clarifiers is based on the solids loading rate, in addition to being governed by the overflow rate and detention time. The design calculation considers the peak incoming wastewater flow; the return sludge withdrawal usually takes place at a point very near the inlet to the tank. The performance of the final clarifiers is affected by the method of sludge withdrawal. The preferred sludge collection mechanism is a vacuum- or suction-type draw-off. Default design values in CAPDET were used to develop costs for secondary clarifiers. A 15-year life expectancy was selected. It should be noted that due to limitations of the CAPDET model, EPA could not adjust for the fact that treatment is an anaerobic lagoon precedes the BNR process. This limitation most likely results in overestimating the cost for the BNR process.

11.6.10 Filtration

Filtration is the removal of suspended solids (and bacteria) through a porous medium. The increasing concern for abatement of water pollution and the requirements for high-quality effluents from wastewater treatment facilities have resulted in the rapid and wide acceptance of filtration in wastewater treatment. Filtration is being used to remove biological floc from secondary effluents and phosphate precipitates from phosphate removal processes, and as a tertiary wastewater treatment operation to prepare effluents for reuse in water reuse, industry, agriculture, and recreation.

Granular media used in filtration include sand, coal, crushed anthracite, diatomaceous earth, perlite, and powdered, activated carbon. Sand filters have been most commonly. However, mixed dual-media and multi-media filters are more effective and easier and less expensive to operate than sand filters for the treatment of wastewaters. In the mixed dual-media and multi-media filters, two or three materials of different specific gravities and sizes are selected to ensure intermixing between the various media at the interfaces. Sand and anthracite are typically used for dual-media filters, while garnet is added for multi-media filters.

The design of filters depends on the influent wastewater characteristics, process and hydraulic loadings; method and intensity of cleaning; nature, size, and depth of the filtering material; and the required quality of the final effluent. Various sizes and types of filtration units are available in the market. For smaller installations, the package units usually are selected. For larger installations, concrete wall constructions are used for containing the filter units. A parametric cost curve is used for the package-type filtration units. The construction costs for the larger concrete wall, rectangular cell, and filtration systems are estimated based on equipment and material costs. Default design values in CAPDET were used to develop costs. A 15-year life expectancy was selected.

11.6.11 Drying Beds

Sludge drying beds are a common method for dewatering digested sludge, especially in small plants. Drying beds are usually constructed using 4 to 9 inches of sand over 8 to 18 inches of graded gravel. The beds are usually divided into at least three sections for operational purposes. An underdrain system, usually of vitrified clay pipes spaced 9 to 20 feet apart, is used to remove water.

The design of sludge beds is influenced by many factors, such as weather conditions, sludge characteristics, land value, proximity of residences, and use of sludge conditioning aids. Default design values in CAPDET were used to develop costs. Sludge produced in this process was assumed to contain 50 percent solids. A 15-year life expectancy was selected.

11.6.12 Disinfection

Disinfection is the selective destruction of pathogenic organisms; sterilization is the complete destruction of all microorganisms. Disinfection used in water and wastewater treatment has resulted in the control and reduction of waterborne diseases.

Disinfection may be accomplished through the use of chemical agents, physical agents, mechanical means, and radiation. In wastewater treatment the most commonly used disinfectant is chlorine; however, other halogens, ozone, and ultraviolet radiation have been used.

Ultraviolet (UV) disinfection has been used to disinfect wastewater for some time and is often the preferred disinfection method. UV disinfection has the following advantages over chemical methods: (1) no residual toxicity to aquatic communities; (2) more effective than chlorine in inactivating harmful viruses, spores, and cysts (e.g., *Cryptosporidium*); (3) improved safety; and (4) no production of harmful trihalomethanes and other chlorinated by-products.

The major disadvantage is cost, although this is improving as additional technology is brought to market. In addition, the UV sources must be cleaned regularly to maintain effective disinfection. High operational energy costs may also be a concern. EPA assumed that MPP facilities would use UV disinfection. Although this assumption may overestimate disinfection costs (as compared, for example, to chlorination), EPA feels that UV disinfection provides more environmental benefits than other options. Default design values in CAPDET were used to develop costs, and 15-year life expectancy was selected.

11.7 CAPDET MODEL INPUT

The input parameters required to run the CAPDET model consist of the influent pollutant concentrations, target effluent pollutant concentrations, wastewater flow, and design specifications of the treatment units. This section presents a discussion of the influent concentrations, effluent concentrations, and wastewater flow. The design specifications of the treatment units are discussed in Section 11.6.

11.7.1 Influent Concentrations

EPA obtained the influent concentrations from the 1-day, 3-day, and 5-day MPP sampling episodes. Data from the sampling locations that represent influent concentrations of the wastewater treatment system were selected. These sampling points were grouped based on the type of MPP operation shown in Table 11-2 in Section 11.3. For sampling points representing the same type of influent wastewater from multiple facilities, an average of the concentrations was taken. EPA reviewed and discarded those data that were questionable, based on engineering judgment. For example, BOD values that were reported higher than COD values were removed; total Kjedahl nitrogen values lower than ammonia values were removed. If data were not available, EPA derived data from similar operating facilities with similar wastewater characteristics.

Table 11-4 shows the influent concentrations used to run the CAPDET model. Default values provided in CAPDET were selected for the parameters for which no sampling value was available. These included percent volatile solids, cations, anions, nondegradable fraction of volatile suspended solids (VSS), and temperature. Soluble COD value was calculated assuming that the ratio of soluble BOD to BOD is same as the ratio of the soluble COD to COD. Because in most instances wastewater would be exposed to the atmosphere (i.e., exposed to oxygen), it was assumed that all nitrite would be converted to nitrate. Therefore, the nitrite concentration in the influent wastewater was assumed to be practically zero, and the nitrate concentration was set equal to the nitrate/nitrite concentration obtained from sampling episodes. The settleable solids value was obtained from the total suspended solids (TSS) concentration by using the following equation developed from data for domestic wastewater (Metcalf and Eddy, 1991):

Settleable solids = 0.0178 * TSS - 1.8031, where
TSS = total suspended solids concentration (mg/L).

11.7.2 Effluent Concentrations

The effluent concentrations were obtained from the 3-day and 5-day MPP sampling episodes performed by EPA and from MPP detailed survey responses. EPA identified best performing meat, poultry, rendering, and mixed facilities representing the technology options based on effluent concentrations and the TIP. If data were not available, EPA derived data from similar operating facilities with similar wastewater characteristics. Table 11-5 shows the long-term the effluent concentrations used for running the CAPDET model.[1] The model did not require any effluent concentrations for Technology Option 1 for indirect dischargers because performance is based solely on percent removals of influent concentrations. The costs for

[1] It should be noted that for purposes of estimating costs, EPA extracted data from the sampling episodes and MPP detailed surveys prior to completion of pollutant load reduction. As a result, the values used to represent desired effluent concentrations for purposes of generating costs were slightly different from the long-term averages used to generate expected pollutant load reductions.

Table 11-4. Influent Concentrations Used as Model Input

Model Facility Grouping Code	BOD_5	Soluble BOD_5	COD	Soluble COD	TSS	TKN	Total P[a]	NH_3-N	O&G[b]	NO_3-N	pH
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	s.u.
R1	1,126	563	2,252	1,126	1,051	128	9	43	394	0.00	7.00
R2	1,492	1,150	2,630	2,027	363	24	82	15	163	2.13	8.99
R12	2,941	1,245	5,917	2,505	1,590	164	51	127	386	5.38	7.46
R13	4,209	1,223	15,204	4,418	3,532	78	54	43	406	0.01	7.42
R23	2,941	1,245	5,917	2,505	1,590	164	51	127	386	5.38	7.46
R123	2,941	1,245	5,917	2,505	1,590	164	51	127	386	5.38	7.46
P1	1,175	279	2,164	514	654	47	9	7	724	3.70	6.74
P2	1,760	660	5,000	1,875	1,295	161	72	6	424	0.38	6.60
P12	1,270	391	3,364	1,035	767	121	21	7	252	0.49	6.66
P13	2,000	780	5,000	1,951	1,220	132	26	11	619	1.24	6.60
P23	2,000	780	5,000	1,951	1,220	132	26	11	619	1.24	6.60
P123	2,000	780	5,000	1,951	1,220	132	26	11	619	1.24	6.60
M2	1,670	732	3,445	1,511	1,226	127	100	30	557	1.25	8.99
M23	1,670	732	3,445	1,511	1,226	127	100	30	557	1.25	8.99
Render	4,432	2,824	6,980	4,447	954	124	26	120	160	9.81	7.41

Note: Model facility groupings for which EPA screener survey did not identify any facilities are not shown.
[a] Total phosphorus.
[b] Oil and grease (HEM).

Table 11-5. Target Effluent Concentrations Used as Model Input

Meat Type	Discharge Type	Option	Soluble BOD5	TSS	Total P[a]	Total Coliform	TKN	NH_3N[b]	NH_3N /TKN Ratio
			mg/L	mg/L	mg/L	cfu/100 mL	mg/L	mg/L	
Poultry	Direct	2	NR	8.60	NR	125	NR	0.44	NR
		3	1.53	8.27	NR	125	2.80	NR	0.17
		4	4.8	5.60	0.47	2	1.19	NR	NR
		5	3.00	5.50	0.41	2	1.29	NR	NR
	Indirect	2	NR	6.00	NR	NR	NR	0.60	NR
		3	2.96	6.00	NR	NR	3.57	NR	0.17
		4	4.80	5.60	0.47	NR	1.19	NR	NR
Meat	Direct	2	NR	21.67	NR	125	NR	0.57	NR
		3	1.53	8.27	NR	125	2.80	NR	0.17
		4	4.80	5.60	0.47	2	1.19	NR	NR
	Indirect	2	NR	34.60	NR	NR	NR	3.32	NR
		3	5.20	34.60	NR	NR	4.63	NR	0.72
		4	4.80	5.60	0.47	NR	1.19	NR	NR
Mixed	Direct	2	NR	7.88	NR	125	NR	0.38	NR
		3	1.53	8.27	NR	125	2.80	NR	0.17
		4	4.80	5.60	0.47	2	1.19	NR	NR
	Indirect	2	NR	34.60	NR	NR	NR	3.32	NR
		3	5.20	34.60	NR	NR	4.63	NR	0.72
		4	4.8	5.60	0.47	NR	1.19	NR	NR
Render	Direct	2	NR	21.67	NR	125	NR	0.57	NR
		3	1.53	8.27	NR	125	2.80	NR	0.17
		4	4.8	5.6	0.47	2	1.19	NR	NR
	Indirect	2	NR	34.60	NR	NR	NR	3.32	NR
		3	5.20	34.60	NR	NR	4.63	NR	0.72
		4	4.80	5.6	0.47	NR	1.19	NR	NR

NR: input not required to run that option.
[a] Total phosphorus.
[b] Concentrations during summer; concentrations during winter are 2.5 (default value) times summer concentration.

Technology Option 1 for direct dischargers were obtained from the costs of Technology Option 2. Therefore, Technology Option 1 for direct dischargers did not require any effluent concentrations.

11.7.3 Flow

Based on statistical analysis of the data in the MPP screener survey EPA developed 76 model facilities. (See Section 11.3.) The wastewater flow for each model facility, hereafter referred to as model facility flow, is equal to the median wastewater flow of the corresponding facilities identified in the MPP screener survey. Table 11-6 shows the model facility flows for 76 model facilities used in CAPDET model runs.

CAPDET requires average flow, maximum flow, and minimum flow of the treatment system to be costed as input to run the model. For each model facility, the average flow was taken equal to the respective model facility flow shown in Table 11-6. Since most facilities operate 5 days a week, the average daily flow (gallons/day) for Option 1 for indirect dischargers was calculated by dividing the flows (gallons/year) as reported in the screener surveys by 260 days/year. (Note: Option 1 for indirect discharges has equalization at the end of the treatment system.) All other options include some sort of biological treatment following equalization; therefore, a constant flow over 365 days a year was assumed for biological treatment for Indirect Options 2, 3, and 4. The treatment units for those options were costed on an average daily flow (gallons/day) obtained by dividing the flows (gallons/year) by 365 days/year. The maximum flow and the minimum flows were taken equal to 125 percent and 75 percent of the average flow, respectively.

11.8 OTHER COST MODELING PARAMETERS

In addition the costs provided by CAPDET, other cost modeling parameters were used to obtain industry-wide compliance costs. A description of other cost modeling parameters is provided below.

Table 11-6. Model Facility Median Flows for 76 Model Facility Categories

Model Facility Grouping Code	Flow (gallons/year)			
	Small	Medium	Large	Very Large
R1	120,000	7,164,858	N/A	N/A
R12	150,000	114,000,000	N/A	N/A
R13	366,300	163,800,000	242,207,998	745,000,000
R123	300,000	547,500,000	888,329,000	N/A
R2	100,000	23,580,000	4,507,584	2,588,000
R23	18,900	150,992,000	N/A	N/A
P1	4,169,000	188,005,312	230,124,007	501,764,107
P12	90,000	90,040,000	234,375,494	418,113,000
P13	N/A	110,463,705	413,250,000	442,000,000
P123	N/A	122,845,544	730,000,000	722,693,232
P2	199,100	22,321,000	112,887,720	8,000,000
P23	910,000	12,696,150	221,000,000	N/A
Render	36,500,000	8,925,000	23,400,000	46,081,200
M2	150,000	65,000,000	N/A	N/A
M23	663,000	N/A	N/A	N/A

Note: Model facility groupings for which EPA screener survey did not identify any facilities are not shown.
N/A: Not applicable because the EPA screener survey did not identify any facilities in this model facility classification.

11.8.1 Number of Facilities

Based on statistical analysis of the data in the MPP Screener Survey, EPA developed national estimates for the direct and indirect discharging facilities representing the 76 model facilities. Table 11-7 shows the national estimates by model facility category. These estimates do not include the 65 certainty select facilities because those facilities were not included in the MPP screener survey. EPA determined the incremental costs of the 65 certainty select facilities separately, based on the model facility category costs and the number of facilities.

Table 11-7. Number of Facilities in 19 MPP Facility Groupings by Size

Model Facility Grouping Code	Direct dischargers				Indirect dischargers			
	Small	Medium	Large	Very Large	Small	Medium	Large	Very Large
R1	17	6	0	0	265	0	0	0
R12	0	0	0	0	674	28	0	0
R13	17	17	7	12	12	7	3	5
R123	25	17	7	0	50	12	5	0
R2	43	10	1	1	2,489	160	4	4
R23	0	4	0	0	32	7	0	0
P1	0	17	25	7	19	32	48	12
P12	0	6	2	8	20	11	4	14
P13	0	7	8	2	0	2	2	1
P123	0	2	3	1	0	3	7	2
P2	0	10	1	2	272	133	4	18
P23	0	0	0	0	4	9	6	0
Render	6	7	6	8	17	26	21	28
M2	9	5	0	0	707	97	0	0
M23	0	0	0	0	4	0	0	0

Note: Model facility groupings for which EPA screener survey did not identify any facilities are not shown.

11.8.2 Frequency of Occurrence

EPA developed 76 model facilities, as discussed in Section 11.3. EPA considered only the direct and the indirect discharging facilities because those types of facilities will be affected by the proposed regulation. Because the wastewater in a direct discharging facility generally undergoes more treatment before discharge than that of an indirect discharging facility, the model facility categories were further grouped by the type of discharge. Because of the limited number of responses in the MPP detailed survey, the Agency grouped the medium, large, and very large direct and indirect facilities into two “non-small” facility groups for estimating current TIP.

EPA evaluated the wastewater treatment systems of all the direct and indirect discharging facilities in the MPP detailed survey. To determine the wastewater treatment upgrades necessary for the facilities to be in compliance with the proposed regulation, the Agency compared the existing TIP of the facilities with those of the technology options (Table 11-1). Based on the comparison, EPA determined the frequency of occurrence of treatment units for each of the model facility categories. Frequency of occurrence of a treatment unit is defined as the ratio of the number of facilities that have the treatment unit in place (or other treatment units that can perform the same function) to the total number of facilities in that category. The treatment units considered are those which are listed for the technology options in Table 11-1. As previously stated, EPA applied the same frequency of occurrence distribution across medium, large, and very large facilities for each of the two “non-small” facility groups. That is, the same frequency of occurrence distribution for each treatment unit was applied to all non-small indirect dischargers and the same frequency of occurrence distribution for each treatment unit was applied to all non-small direct dischargers. The frequency of occurrence of treatment units for each model facility is available in Attachment 11-2 in Appendix D. Facilities that do not have a treatment unit incur costs to upgrade to achieve the performance of the proposed technology options.

11.8.3 Number of Treatment Units Required

Because frequency of occurrence represents the fraction of facilities that have the treatment unit in place, “[1- frequency of occurrence]” represents the fraction of facilities that require the treatment unit for the technology option considered. Therefore, the number of facilities in a model facility category that require a treatment unit is given by

Number of facilities that require the treatment unit = (1-FO) × N, where

FO = frequency of occurrence of a treatment unit and

N = national estimate of the number of facilities in the model facility category.

11.8.4 Performance Cost

EPA estimated the incremental cost for each technology option by comparing the existing TIP of a facility identified in the MPP detailed survey with that of the proposed technology option, costed for the additional treatment units needed to meet the technology option. Therefore, a facility identified by the MPP detailed survey that has a TIP similar to a technology treatment option does not accrue any additional cost for that technology option. It is expected that the facilities with a TIP comparable to an option should be able to meet the proposed effluent limits of that option. In reality, however, some of these facilities with TIP may not be able to meet the proposed effluent limits because of inadequate operational practices. Therefore, to calculate the cost of improving the performance, EPA assumed a 10 percent increase in the total annual costs of all the facilities with TIP as performance cost. The performance cost may include cost for improving operation of the treatment plant, changing sludge retention time, altering dissolved oxygen content of wastewater in the tanks, mixing, monitoring, automation, and other costs that would improve the performance of the plant to achieve the desired effluent concentration.

Performance cost is also used to determine the costs for Technology Option 1 from the costs of Technology Option 2. Although Technology Option 1 contains the same treatment units as Technology Option 2 (see Table 11-1), the effluent quality of Technology Option 1 is inferior to that of Technology Option 2 because of limited nitrification. However, a facility with Technology Option 1 might achieve the effluent quality of Technology Option 2 by improving the operational practices (e.g., changing solids retention time, blowing more air to the aeration basin etc.). Therefore, the costs for Technology Option 1 for direct dischargers are determined to be equal to the costs of Technology Option 2, without the performance cost.

11.9 DERIVATION OF COST ESTIMATES

EPA determined compliance costs for the proposed options using the results of the CAPDET model runs and other cost modeling parameters (Section 11.8). For Technology Option 3 and Option 4 EPA also determined the compliance costs by retrofitting the existing treatment systems. This section discusses the method used to calculate the compliance costs with and without consideration of retrofit costs. Table 11-8 shows by size and discharge type the technology options that are costed for the proposed regulation.

Table 11-8. Technology Options by Size and Discharge Type Costed for the Proposed Regulation

Discharge Type	Technology Option	Non-Small Facilities		Small Facilities	
		Direct	Indirect	Direct	Indirect
Direct	1			X	
	2	X		X	
	3	X		X	
	3 (with retrofit costs)	X		X	
	4	X			
	4 (with retrofit costs)	X			
	5 (poultry only)	X			
Indirect	1		X		X
	2		X		X
	3		X		X
	3 (with retrofit costs)		X		
	4		X		X
	4 (with retrofit costs)		X		

X: Category is costed for that option.

EPA used the model facility approach to determine the incremental costs for the proposed rule. CAPDET was used for developing construction cost and annual operating and maintenance costs of treatment units for the model facility flow. The capital cost of a treatment unit was calculated using the construction cost obtained from CAPDET. The costs of a treatment unit times the number of facilities that require the upgrade yielded the incremental costs for each set of model facilities. The number of facilities that require upgrade is equal to the product of the "[1- frequency of occurrence]" of the treatment unit and the total number of facilities in the model facility category (see Section 11.8.3). As described in Section 11.9.2, retrofit costs for the applicable technology options were developed from the set of model facility costs. The model facility costs and the retrofit costs were combined separately to determine costs by regulatory subcategory.

The step-by-step method for calculating the incremental industry-wide cost is summarized below:

- Use the MPP screener survey data to establish production levels for each of the 76 model facilities.
- Use the MPP screener survey data to identify the median wastewater flow (model facility flow), and to estimate the number of MPP facilities nationally represented by each of the 76 model facilities.
- Use the MPP detailed survey data to determine frequency of occurrence for treatment units in each of the 76 model facilities.
- Develop construction costs and annual costs of treatment units from CAPDET using model facility wastewater flows and typical influent and effluent pollutant concentrations.
- Estimate capital costs of treatment units from construction costs (see Section 11.5).
- Estimate capital and annual costs on a national basis for each regulatory option of the 76 model facilities using capital and annual costs of treatment units, frequency of occurrence, and national estimate of MPP facilities for each of the 76 model facilities.
- Estimate the regulatory cost for each subcategory based on the model facility costs.

11.9.1 Model Facility Costs Without Consideration To Retrofit Costs

As discussed in Section 11.3, EPA developed 76 model facilities to represent the broad range of MPP facilities in current operation. Running the CAPDET model was the first step in calculating the incremental compliance costs. For each model facility, a process schematic representing the technology options (see Table 11-1) was developed in CAPDET. A preliminary treatment module in CAPDET that consisted of screen and grit removal was selected to represent the screens. The biological treatment units costed in CAPDET were nitrification module (under suspended growth) for Option 2, biological nitrogen removal module (under biological nutrient removal) for Option 3, and biological nutrient removal module with 3/5 stage (under biological nutrient removal) for Option 4 and Option 5. The biological treatment system consisted of the biological treatment units, clarifiers, pumps, blowers, and sludge drying beds.

Section 11.6 discusses the selected design specifications for the treatment units. The required input influent and effluent concentrations of the pollutants and the model facility flow used for the model runs are explained in Section 11.7.

With a given set of concentrations and flow, CAPDET calculates the construction cost and the annual operation costs of individual treatment units, as well as the total annual cost of the treatment scheme. The total annual cost of the treatment scheme is the sum of the annual operating costs of the treatment units and the labor costs for administrative and laboratory work (see Section 11.5.2). Because labor costs for administrative and laboratory work are available for the entire treatment system, the costs were proportioned to individual treatment units, based on the individual operation costs generated by CAPDET. Therefore, the annual operation cost of a treatment unit is the sum of the individual annual costs generated by CAPDET and the proportional costs of administrative and laboratory labor. For DAF and biological treatment systems, an additional annual cost of sludge disposal was added. A sludge disposal cost of $2.3/ton (Parker, 1998) was used as the cost for hauling of the dried sludge leaving the sludge dryer.

The construction cost of a treatment unit was obtained as an output of the CAPDET model runs. As discussed in Section 11.5.1, the capital cost of the treatment unit is obtained by multiplying the construction cost by 1.69. The model runs were performed using the 2000 cost database provided in CAPDET. The costs were adjusted to 1999 dollars using the *Engineering News* index (ENR, 2001). Once the capital and annual operating costs associated with treatment units were determined, the incremental capital and annual costs by model facility category were obtained by multiplying the treatment unit costs by the number of treatment units required for the technology option (see Section 11.8.3).

The national estimate of the number of facilities in the model facility category shown in Table 11-7 does not include the 65 certainty select facilities. EPA determined the incremental costs of the 65 certainty select facilities, based on the model facility category costs and the number of facilities. These costs were added to obtain the total industry-wide costs for non-small facilities.

Costs by model facility category are provided in Attachment 11-3 in Appendix D. Costs for Technology Option 1 for direct dischargers were developed for small direct discharging facilities only. Since Technology Option 1 for direct dischargers is the same as Technology Option 2 with limited nitrification, the costs for Technology Option 1 for direct dischargers are equal to the costs of Technology Option 2 without the performance cost. Costs for Technology Option 5 for direct dischargers were developed for poultry facilities only.

11.9.2 Model Facility Category Costs With Consideration to Retrofit Costs

EPA observed that many operations with some sort of treatment already in place may be able to upgrade the existing treatment process rather than construct an entirely new structure. The method of cost calculation described earlier in Section 11.9.1 assumes that even if a facility had a nitrification system in place, it would incur a cost of a new nitrification and denitrification (N+DN) system for Technology Option 3 and a new nitrification/denitrification with phosphorus removal (N+DN+DP) for Technology Option 4. These represent an upper bound of the cost because in reality the nitrification system can be retrofitted to a N+DN system, which may be retrofitted to a N+DN+DP system. Therefore, for Technology Options 3 and 4 two types of capital costs are calculated: upper bound costs and retrofit costs.

In light of the ability to retrofit nitrification to accomplish both nitrification and denitrification or to upgrade nitrification/denitrification to accomplish nitrification/denitrification with phosphorus removal, EPA solicited information related to retrofit costs from several technical experts for use in estimating compliance costs for the MPP industry. EPA contacted two experts in MPP wastewater treatment design and biological nutrient removal wastewater treatment systems (Tetra Tech, 2001).

Based on the input from these two experts, Table 11-9 presents the retrofit costs (as a percent of the cost of a nitrification system) as those needed to (1) upgrade a nitrification system to a N+DN system and (2) upgrade a nitrification system to a N+DN+DP system. As shown, each expert provided a range of estimates, which were relatively close to each other. The experts also noted that the upgrades might be as complicated as partitioning existing aeration tanks and/or adding additional tanks and accessories (generally reflected by the upper end of the range) or as simple as operational changes, such as switching air flow to the aeration basin on and off periodically (generally reflected by the lower end of the range).

Table 11-9. Estimated Retrofit Costs (As Percent of Nitrification Costs) to Upgrade a Nitrification System

Scenario	Estimate 1	Estimate 2
Nitrification to N+DN	25%–50%	15%–40%
Nitrification to N+DN+DP	50%–75%	25%–65%

Source: Tetra Tech, 2001.

Although the estimates provided by the two experts are very close, the arithmetic average of the midpoint of the range of the percentages they provided was used as the basis for incorporating retrofit costs into the MPP industry compliance cost estimates. In summary, it is estimated that to upgrade a nitrification system to a N+DN system, a facility would incur 33 percent of the capital cost of a nitrification system. To upgrade a nitrification system to a N+DN+DP system, a facility would incur 54 percent of the capital cost of a nitrification system. Therefore, retrofit costs were calculated for only Technology Options 3 and 4.

For the direct discharger technology options, nitrification costs were not available to calculate potential retrofit costs. (All direct dischargers were assumed to be performing biological treatment with nitrification, based on results from the MPP detailed survey.) Therefore, capital costs from the nitrification/denitrification technology option (Technology Option 3) were used as a surrogate for the nitrification costs. Because in most cases the Technology Option 3 costs would be expected to be lower than nitrification costs (generally because less oxygen is required and less control is needed for alkalinity), the retrofit percentages of 33 percent and 54 percent were increased. Specifically, based on professional judgment, it was assumed that to upgrade a nitrification system to a N+DN system, a facility would incur 45 percent of the capital cost of a greenfield nitrification/denitrification system and to upgrade a nitrification system to a N+DN+DP system, a facility would incur 65 percent of the capital cost of a greenfield nitrification/ denitrification system. As described in Section 11.11, these assumptions were reasonable when compared to actual costs at several MPP facilities.

For the indirect discharger regulatory options, it was assumed that there would be no real retrofit opportunities for the technology option requiring nitrification (Technology Option 2) because very few indirect dischargers possess the tanks and/or equipment for nitrification. However, based on the input from the experts there would be opportunities for retrofitting when moving to the nitrification/denitrification technology option (Technology Option 3) and the nitrification, denitrification, and phosphorus removal technology option (Technology Option 4). For these two technology options, the retrofit average percentages (33 percent and 54 percent) were used to adjust the compliance costs for only the fraction of those facilities that have the opportunity to retrofit.

11.10 ESTIMATED COSTS

The costs generated by the method outlined in Section 11.9 were used to calculate the compliance cost by regulatory category. This section presents the estimated costs for the proposed regulation.

11.10.1 Model Facility Costs

The model facility costs obtained by the method outlined in Section 11.9 are shown in the table provided in Attachment 11-3 of Appendix D. As shown in Table 11-7, results from the

EPA screener survey indicate that there are no MPP facilities for some model facilities (e.g., there are no reported MPP direct or indirect facilities for the "R1-Very Large" model facility). The costs for those categories are zero. Because all non-small facilities that discharge directly to surface waters currently have biological treatment with nitrification (based on data provided as part of the MPP detailed survey), the costs for Technology Option 2 were minimal. Costs for Technology Option 5 for direct dischargers were developed for poultry facilities only, while costs for Technology Option 1 for direct dischargers were developed for small direct discharging facilities only.

11.10.2 Regulatory Subcategory Costs

EPA developed a regulatory subcategory scheme for the proposed rule, based on various combinations of the 76 model facility category costs. There are 10 regulatory groupings, which are defined in Table 11-10.

Table 11-10. Definition of 10 MPP Regulatory Groupings

40 CFR Part 432 Subcategory	Facility Size[1]	Facility Type	Model Facility Grouping Code[a]
A, B, C, D	M, L, VL	Meat first processors	R1, R12, R13, R123
	S	Meat first processors	R1, R12, R13, R123
F, G, H, I	M, L, VL	Meat further processors	R2, R23, 0.61*M2[c]
	S[b]	Meat further processors	R2, R23, 0.59*M2[c], 0.5*M23[c]
J	M, L, VL	Independent renderers	Render
	S	Independent renderers	Render
K	M, L, VL	Poultry first processors	P1, P12, P13, P123
	S	Poultry first processors	P1, P12, P13, P123
L	M, L, VL	Poultry further processors	P2, P23, 0.39*M2[c]
	S	Poultry further processors	P2, P23, 0.41*M2[c], 0.5*M23[c]

[a] The following abbreviations apply: S = small, M = medium, L = large, VL = very large, R = meat facilities, P = poultry facilities, M = facilities producing both meat and poultry products, 1 = first processors, 2 = further processors, and 3 = meat or poultry facilities performing on-site rendering.
[b] This group of small meat further processors includes all meat facilities that annually produce fewer than 50 million pounds of finished product and all facilities currently covered under Subpart E (Small Processors).
[c] Costs of mixed meat are allocated to similar operations in the meat and poultry subcategory.

The 76 model facility costs are combined according to Table 11-10 to generate the costs by regulatory subcategory. For mixed (performing both meat and poultry) meat operations, the MPP screener survey identified only medium-sized facilities performing further processing (model facility code = M2) and small facilities performing further processing, and further processing and rendering (model facility codes = M2 and M23). EPA allocated the costs for mixed meat operations into the meat further processors regulatory grouping (40 CFR Part 432, Subcategories F through I) and poultry further processors regulatory grouping (40 CFR Part 432, Subcategory L) based on total annual production. EPA allocated the costs equally between the two groupings if production data were not available. Tables 11-11 to 11-14 show the costs by regulatory subcategory for non-small and small facilities.

11.11 COMPARISON OF MODEL PREDICTED COST WITH ACTUAL COST

Table 11-15 compares the costs (construction, capital, annual) provided by the facilities in the MPP detailed survey and the costs predicted by CAPDET. The costs are adjusted to 1999 dollars with the *Engineering News* cost index (ENR, 2001). As discussed in Section 11.5.1.2, the capital cost of a treatment unit is obtained by multiplying its construction cost by 1.69. The model runs were performed with the actual flows for these specific facilities provided in the MPP detailed survey by the facilities. However, the influent and the effluent concentrations of all the required pollutants were not available; therefore, the model runs were made with typical concentrations described in Section 11.7. For disinfection, the model runs were based on a UV disinfection system because the system was used to estimate the model facility category costs, as discussed in Section 11.9.

The percent difference in construction/capital cost varied between −34 percent and +44 percent, with the exception of one facility where the percent difference was +166 percent. [Note: Positive percentage differences indicate that the CAPDET model costs were higher than the actual costs and vice versa.] The percent difference in actual and model-predicted construction/capital costs for 6 out of 11 facilities is around 20 percent or lower. The percent difference in annual costs varied between −49 percent and 218 percent. The facility that has a difference of 218 percent uses chlorine for disinfection but was costed for a UV disinfection

Table 11-11. Incremental Capital, Retrofit, and Annual Costs of Non-small Direct Discharging Facilities

Tech. Option	Cost Type	Meat		Poultry		Rendering	65 Certainty Select Facilities	Total Costs
		A-D	F-I	K	L	J		
2	Capital	$8,246,826	$151,167	$1,484,907	$154,729	$0	$803,010	$10,840,639
	Annual	$8,341,357	$358,916	$4,319,010	$263,420	$512,217	$1,103,594	$14,898,514
3	Capital	$274,636,709	$2,466,851	$221,276,114	$12,148,868	$24,235,794	$42,781,147	$577,545,483
	Annual	$26,093,418	$380,659	$21,409,816	$1,446,099	$2,813,796	$4,171,503	$56,315,291
	Retrofit	$123,586,519	$1,110,083	$99,574,251	$5,466,990	$10,906,107	$19,251,516	$259,895,467
4	Capital	$567,299,659	$32,064,579	$292,840,006	$19,180,890	$27,388,270	$75,101,872	$1,013,875,276
	Annual	$49,288,019	$3,104,328	$25,768,368	$1,978,115	$2,949,043	$6,647,030	$89,734,903
	Retrofit	$178,513,861	$1,603,453	$143,829,474	$7,896,764	$15,753,266	$27,807,745	$375,404,564
5	Capital	N/A	N/A	$327,080,644	$17,719,557	N/A	$27,584,016	$372,384,217
	Annual	N/A	N/A	$26,630,326	$1,695,960	N/A	$2,266,103	$30,592,389

N/A: Not applicable because Direct Option 5 applies to poultry facilities only.

Table 11-12. Incremental Capital, Retrofit, and Annual Costs of Non-small Indirect Discharging Facilities

Tech. Option	Cost Type	Meat		Poultry		Rendering	65 Certainty Select Facilities	Total Costs
		A-D	F-I	K	L	J		
1	Capital	$32,125,587	$61,732,331	$42,407,911	$50,931,088	$3,497,420	$15,255,547	$205,949,884
	Annual	$3,134,010	$10,888,392	$5,560,401	$8,752,574	$862,033	$2,335,793	$31,533,203
2	Capital	$624,536,780	$388,978,549	$771,398,217	$375,177,189	$82,708,839	$179,423,966	$2,422,223,540
	Annual	$74,314,195	$53,466,015	$93,495,543	$57,932,593	$12,803,252	$23,360,928	$315,372,526
3	Capital	$460,188,220	$460,188,220	$637,073,223	$319,733,512	$121,046,542	$151,856,489	$2,050,062,606
	Annual	$40,491,298	$40,491,298	$55,838,473	$35,269,247	$13,057,455	$14,727,639	$198,823,125
	Retrofit	$374,210,631	$374,210,631	$575,708,468	$316,967,007	$78,857,861	$136,174,413	$1,838,354,575
4	Capital	$602,773,174	$602,773,174	$670,720,969	$444,047,365	$130,924,926	$190,219,346	$2,567,961,174
	Annual	$47,996,617	$47,996,617	$55,543,183	$40,216,343	$13,224,592	$16,246,718	$219,330,692
	Retrofit	$473,484,033	$473,484,033	$625,628,025	$442,131,680	$92,106,957	$172,749,802	$2,332,122,332

Table 11-13. Incremental Capital, Retrofit, and Annual Costs of Small Direct Discharging Facilities

Technology Option	Cost Type	Meat		Poultry		Rendering	Total Costs
		A-D	E-I	K	L	J	
1	Capital	$209,270	$137,394	$0	$22,523	$0	$369,187
	Annual	$7,002	$4,547	$0	$738	$0	$12,287
2	Capital	$209,270	$137,394	$0	$22,523	$0	$369,187
	Annual	$486,666	$273,721	$0	$26,343	$172,632	$959,362
3	Capital	$14,646,645	$1,452,166	$0	$682,701	$8,192,232	$24,973,744
	Annual	$2,752,231	$421,892	$0	$134,053	$909,610	$4,217,786
	Retrofit	$6,590,990	$653,475	$0	$307,215	$3,686,504	$11,238,185

Note: Zero costs ($0) indicate that no MPP facilities were identified from the MPP Screener Survey for this regulatory grouping.

Table 11-14. Incremental Capital and Annual Costs of Small Indirect Discharging Facilities for the Various TechnologyOptions

Technology Option	Cost Type	Meat		Poultry		Rendering	Total Costs
		A-D	E-I	K	L	J	
1	Capital	$119,827,472	$482,868,533	$4,546,294	$103,388,978	$2,796,848	$713,428,125
	Annual	$17,343,753	$70,665,654	$936,533	$16,386,885	$513,318	$105,846,143
2	Capital	$584,635,684	$1,559,329,895	$22,583,519	$376,667,269	$43,635,312	$2,586,851,679
	Annual	$100,720,499	$271,961,694	$3,641,817	$61,675,081	$6,030,492	$444,029,583
3	Capital	$592,231,249	$1,863,181,201	$26,520,704	$378,133,257	$36,320,992	$2,896,387,403
	Annual	$90,024,749	$281,660,364	$3,821,424	$54,803,074	$3,752,576	$434,062,187
4	Capital	$722,696,546	$2,207,175,158	$31,865,901	$446,101,763	$39,443,676	$3,447,283,044
	Annual	$96,489,992	$296,249,096	$4,032,023	$57,581,328	$3,717,570	$458,070,009

Table 11-15. Comparison of CAPDET Model Prediction of Capital (and Construction) and Annual Costs with Actual Costs

Facility Code	Treatment Units[a]	CAPDET Cost Model Prediction		Actual Cost		Percent Difference[c] (%)	
		Construction/ Capital Cost ($ 1999)	Annual Cost ($ 1999)	Construction/ Capital Cost ($ 1999)	Annual Cost ($ 1999)	Construction/ Capital	Annual
3	E+S+D		52399		50,000		+5
1502	S+E+D+L+E+N+D N+U+SD		527,713		1,032,000		-49
1762	S+D	404,195[2]		374,091[2]		+8	
4558	D	464,171		460,644		+1	
	E+N+DN+DP	2,992,424		2,676,968		+12	
	D+E+N+DN+DP+U	4,677,927	308,746	3,252,461	97,179	+44	+218
4787	E+D	151,549[b]	53,665	128,118[b]	46,940	+18	+14
6519	E+D+E+N+DN+U+ SD		684,696		690,000		-1
7012	S+E+D+L		529,836		280,000		+89
7041	S+D	3,194,882		1,200,000		+166	
	N+DN	7,910667		5,600,000		+41	
	S+D+L+N+DN+U		1,479,012		1,555,813		-5
7995	S+E+D+N+DN+SD	5,760,829	775,041	4,873,287	545,419	+18	+42
	D	334,069[b]		276,915[b]		+21	
	E+N+DN	2,339,460[b]		1,743,810[b]		+34	
8842	S+D+E	297,103	63,056	448,225	113,093	-34	-44

[a] S = screen, D = dissolved air floatation, E = equalization basin, N = nitrfication, N+DN = nitrification and denitrification, N+DN+DP = nitrification and dentrification and phosphorous removal, U = ultraviolet disinfection, SD = sludge dryer.
[b] Construction cost.
[c] Percent difference = (CAPDET cost - actual cost) x 100/actual cost.

system, which might have contributed to a higher model-predicted cost. The percent difference in actual and model-predicted annual costs for four out of nine facilities is within +/-15 percent. Therefore, EPA concludes that, in most cases, the model is able to predict the actual cost with reasonable accuracy. The difference in actual and predicted cost estimates may be attributed to approximate cost estimates provided by the facilities, engineering judgments used in the selection of the model parameters, and/or use of typical concentrations instead of the actual design concentrations. However, note that in most cases the predicted cost is higher than the actual costs. This indicates that the costs estimated by EPA for the options are unlikely to underestimate actual costs that a facility would incur to achieve the technology treatment option. Therefore, the economic impact of these costs should not be underestimated

As described previously in Section 11.9.2, all nitrification systems can be retrofitted to N+DN and N+DN+DP systems, and the capital costs incurred for such an upgrade are approximately 33 percent and 54 percent of the cost of a nitrification system. Based on engineering judgment, EPA refined the factors to be 45 percent and 65 percent of the cost of a greenfield N+DN system, respectively. Therefore, the retrofit cost to upgrade an N+DN system to an N+DN+DP system is approximately 20 percent (= 65 percent − 45 percent) of the cost of an N+DN system. Estimated retrofit capital costs of N+DN and N+DN+DP by model facility category for non-small direct discharging facilities are shown in Table 11-16 and Table 11-18, respectively (taken from Table A-4 of Appendix A). These estimated costs were compared with the retrofit costs for N+DN and N+DN+DP available in the literature. Table 11-17 and Table 11-19 show the retrofit costs available in the literature for several wastewater treatment plants that may be upgraded to N+DN and N+DN+DP systems respectively. If the initial investment cost is available, then the percent increase in the cost to upgrade was calculated and compared. If the initial investment cost of the treatment plants (up to nitrification) was not available, a normalized parameter of retrofit cost/MGD was used for the basis of comparison. Retrofit capital costs divided by the flow provided the retrofit costs per unit flow.

As shown in Table 11-16, the estimated retrofit costs for N+DN systems ranged from $1.3 million/MGD to $43 million/MGD with a mean and a median of $6.5 million/MGD and $3.2 million/MGD, respectively (based on $ 1999). The cost per MGD estimated is compared with the retrofit cost per MGD available in the literature. The retrofit cost per MGD (based on 1999 $) as reported in Table 11-17 varied between $12,000/MGD and $3.7 million/MGD with a mean and a median of $650,000/MGD and $300,000/MGD. Thus, comparing the mean and the median, it can be said that the estimated retrofit costs are almost 10 times higher than the costs reported in the literature. As discussed in Section 11.8.4, depending on the type of upgrade required, retrofit costs might vary from 15 percent to 50 percent of the cost of the nitrification

Table 11-16. Retrofit Capital Costs of Nitrification/Denitrification by Category for the Proposed Regulation

Model Facility Grouping Code	Size	Retrofit Capital Costs[a] ($ 1999)	N+DN Frequency Factor[b]	Number of Facilities[c]	Flow[d] (MGD)	Retrofit Capital Cost ($ 1999/MGD)
R2	Medium	98,815	0.98	10	0.065	7,601,158
R13	Medium	28,083,452	0.14	17	0.449	4,278,158
R23	Medium	118,769	0.98	4	0.414	3,586,005
R123	Medium	1,370,040	0.98	17	1.5	2,686,354
R2	Large	6,498	0.98	1	0.012	27,075,000
R13	Large	15,839,177	0.14	7	0.664	3,962,489
R123	Large	957,706	0.98	7	2.43	2,815,126
R2	Very large	6,022	0.98	1	0.007	43,016,786
R13	Very large	77,336,143	0.14	12	2.04	3,673,437
P1	Medium	12,695,217	0.23	17	0.515	1,883,186
P2	Medium	3,582,590	0.20	10	0.061	7,341,373
P12	Medium	3,395,017	0.25	6	0.247	3,054,447
P13	Medium	4,608,071	0.33	7	0.303	3,242,677
P123	Medium	2,081,694	0.00	2	0.337	3,088,567
P1	Large	21,222,194	0.23	25	0.63	1,749,923
P2	Large	788,937	0.20	1	0.309	3,191,492
P12	Large	1,966,867	0.25	2	0.642	2,042,437
P13	Large	13,232,186	0.33	8	1.13	2,184,683
P123	Large	11,611,084	0	3	2	1,935,181
P1	Very large	9,805,491	0.23	7	1.37	1,327,884
P2	Very large	532,854	0.2	2	0.022	15,137,898
P12	Very large	11,624,854	0.25	8	1.15	1,684,761
P13	Very large	3,478,687	0.33	2	1.21	2,145,484
P123	Very large	3,852,889	0	1	1.98	1,945,903
M2	Medium	1,442,589	0.59	5	0.178	3,953,381
Render	Medium	2,488,431	0	7	0.024	14,812,088
Render	Large	2,943,171	0	6	0.064	7,664,509
Render	Very large	5,474,505	0	8	0.126	5,431,057
Mean						**6,518,266**
Median						**3,217,084**

[a] From Table D-3 in Attachment 11-3 in Appendix D.
[b] From Table D-1 in Appendix D.
[c] From Table 11-7.
[d] Derived from Table 11-6.

Table 11-17. Wastewater Treatment Plants Evaluated for Biological Nitrogen Removal

State	Treatment Plant	Estimated Retrofit Capital Cost (million $ 1999)	Design Flow (MGD)	Estimated Retrofit Capital Cost/Flow ($ 1999/MGD)
Pennsylvania	Altoona City (E)	1.23	9	136,667
	Altoona City (W)	1.233	13.5	91,333
	Chambersburg	6.347	4.5	1,410,444
	Greater Hazleton	7.84	8.9	880,899
	Hanover	0.06	4.5	13,333
	Harrisburg	25.448	30	848,267
	Lancaster	1.077	29.7	36,263
	Lebanon	4.039	8	504,875
	Scranton	2.815	16	175,938
	State College	0.78	6	130,000
	Susquehanna	1.619	12	134,917
	Throop	3.32	7	474,286
	Williamsport (C)	6.339	7.2	880,417
	Williamsport (W)	5.246	4.5	1,165,778
	Wyoming Valley	0.763	32	23,844
	York City	1.78	26	68,462
Maryland	Brunswick	0.39	0.7	557,143
	Chestertown	1.35	0.9	1,500,000
	Crisfield	1.949	1	1,949,000
	Elkton	1.97	2.7	729,630
	Federalsburg	1.525	0.75	2,033,333
	Georges Creek	1.663	0.6	2,771,667
	Indian Head	0.532	0.49	1,085,714
	Mattawoman	4.25	15	283,333
	Winebrenner	1.48	0.6	2,466,667
New York	Binghampton	13.057	25	522,280
	Endicott	6.656	8	832,000
Virginia	Arlington	0.56	30	18,667
	Colonial Beach	0.09	2	45,000
	Dahlgren	0.03	0.325	92,308
	Dale Services #1	0.22	3	73,333
	Dale Services #8	0.22	3	73,333
	Fishersville	0.79	2	395,000
	Front Royal	0.05	4	12,500
	Harrisonburg	4.688	16	293,000
	H.L.Mooney	0.49	18	27,222
	Leesburg	2.77	4.85	571,134

State	Treatment Plant	Estimated Retrofit Capital Cost (million $ 1999)	Design Flow (MGD)	Estimated Retrofit Capital Cost/Flow ($ 1999/MGD)
	Lower Potomac	20.8	67	310,448
	Middle River/Verona	0.15	4.5	33,333
	Occoquan	0.51	6.25	81,600
	Parkins Mill	0.097	2	48,500
	Purcellville	1.3	1	1,300,000
	Rocco Foods	4.48	1.2	3,733,333
	Strasburg	0.12	0.975	123,077
	Stuarts Draft	1.24	1.4	885,714
	Waynesboro	3.5	4	875,000
	Woodstock	0.07	1	70,000
Mean				**654,659**
Median				**310,448**

Source: Randall et al., 1991.

system. To account for all kinds of upgrading, an upper bound percentage (45 percent of the cost of a nitrification and denitrification system) was used for retrofit cost estimation. This approach resulted in higher cost estimates. However, it should be noted that the range of estimated retrofit cost per MGD and those reported in literature overlap. This indicates that few of the facilities reported in the literature may actually incur greater than or equal to 45 percent of the cost of an N+DN system.

The costs to upgrade an N+DN system to an N+DN+DP system for the two treatment plants shown in Table 11-19 are 8 percent and 12 percent of the cost of the N+DN system. This cost is below the selected percentage of 20 percent used by EPA to estimate the retrofit costs of N+DN+DP from N+DN systems. Considering the fact that the cost of upgrading to an N+DN+DP system varies from facility to facility, the Agency believes that the selected 20 percent increase in cost is a reasonable estimate. The model-predicted cost and the cost available in the literature were also compared based on cost per MGD. The retrofit costs were calculated assuming the cost to upgrade from nitrification to an N+DN+DP system is 65 percent of the cost of an N+DN system (see Section 11.8.4). The estimated retrofit costs for upgrade from nitrification to N+DN+DP systems ranged from $77,000/MGD to $21 million/MGD (based on

Table 11-18. Retrofit Capital Costs Of Nitrification/Denitrification/Phosphorous Removal

Model Facility Grouping Code	Size	Retrofit Capital Costs[a] ($ 1999)	N+DN+DP Frequency Factor[b]	Number of Facilities[c]	Flow[d] (MGD)	Retrofit Capital Cost ($ 1999/MGD)
R2	Medium	142,733	0	10	0.065	219,589
R13	Medium	40,564,987	0	17	0.449	5,314,422
R23	Medium	171,555	0	4	0.414	103,596
R123	Medium	1,978,947	0	17	1.5	77,606
R2	Large	9,386	0	1	0.012	782,167
R13	Large	22,878,812	0	7	0.664	4,922,292
R123	Large	1,383,353	0	7	2.43	81,326
R2	Very large	8,699	0	1	0.007	1,242,707
R13	Very large	111,707,762	0	12	2.04	4,563,226
P1	Medium	18,337,536	0.08	17	0.515	2,276,654
P2	Medium	5,174,852	0.07	10	0.061	9,121,897
P12	Medium	4,903,914	0	6	0.247	3,308,984
P13	Medium	6,656,102	0.22	7	0.303	4,023,321
P123	Medium	3,006,892	0	2	0.337	4,461,263
P1	Large	30,654,281	0.08	25	0.63	2,115,547
P2	Large	1,139,575	0.07	1	0.309	3,965,534
P12	Large	2,841,030	0	2	0.642	2,212,640
P13	Large	19,113,158	0.22	8	1.13	2,710,625
P123	Large	16,771,565	0	3	2	2,795,261
P1	Very large	14,163,487	0.08	7	1.37	1,605,328
P2	Very large	769,678	0.07	2	0.022	18,809,335
P12	Very large	16,791,455	0	8	1.15	1,825,158
P13	Very large	5,024,770	0.22	2	1.21	2,661,989
P123	Very large	5,565,284	0	1	1.98	2,810,749
M2	Medium	2,083,739	0.04	5	0.178	2,438,834
Render	Medium	3,594,400	0	7	0.024	21,395,238
Render	Large	4,251,248	0	6	0.064	11,070,957
Render	Very large	7,907,619	0	8	0.126	7,844,860
Mean						**4,455,754**
Median						**2,752,943**

[a] From Table D-3 in Attachment 11-3 in Appendix D.
[b] From Table D-3 in Appendix D.
[c] From Table 11-7.
[d] derived from Table 11-6.

Table 11-19. Wastewater Treatment Plants Evaluated for Biological Phosphorus Removal

State	Treatment Plant	Design Flow (MGD)	Retrofit Capital Cost from AS to N+DN (1999 million $)	Retrofit Capital Cost from AS to N+DN+DP (1999 million $)	Retrofit Capital Cost from AS to N+DN+DP/ Flow (1999 $/MGD)	Percent Increase in Cost from N+DN to N+DN+DP
Virginia	Leesburg	4.85	2.77	2.98	614,433	7.6%
	Occoquan	6.25	0.51	0.57	91,200	11.8%

AS = activated sludge process.
Source: Randall et al., 1999.

$ 1999) with a mean and a median of $4.5 million/MGD and $2.7 million/MGD, respectively. The cost per MGD estimated was compared with the retrofit cost per MGD available in the literature. The retrofit cost per MGD as reported in Table 11-19 are $600,000/MGD and $91,000/MGD (based on $ 1999). These values reported in the literature are within the spectrum of the estimated costs of $77,000/MGD and $21 million/MGD, although on the lower end. As discussed in Section 11.9.2, depending on the type of upgrade required, retrofit costs might vary from 25 percent to 75 percent of the cost of the nitrification system. However, to account for all kinds of upgrades, an upper bound percentage (65 percent of the cost of a N+DN system) was used for retrofit cost estimation. This might have resulted in higher EPA cost estimates.

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SECTION 12

SELECTED TECHNOLOGY OPTIONS

As discussed in Section 2, EPA must promulgate six types of effluent limitations guidelines and standards for each major industrial category, as appropriate:

- Best Practicable Control Technology Currently Available (BPT)
- Best Control Technology for Conventional Pollutants (BCT)
- Best Available Technology Economically Achievable (BAT)
- New Source Performance Standards (NSPS)
- Pretreatment Standards for Existing Sources (PSES)
- Pretreatment Standards for New Sources (PSNS)

BPT, BCT, BAT, and NSPS limitations regulate only those sources that discharge effluent directly into waters of the United States. PSES and PSNS limitations restrict pollutant discharges for those sources that discharge effluent indirectly through sewers flowing to publicly owned treatment works (POTWs). This section presents the rationale EPA used in selecting technology options to serve as the basis for the proposed effluent limitations guidelines and standards for BPT, BCT, BAT, NSPS, PSES, and PSNS.

12.1 BEST PRACTICABLE CONTROL TECHNOLOGY CURRENTLY AVAILABLE (BPT)

In general, the BPT technology level represents the average of the best existing performances of plants of various processes, ages, sizes, or other common characteristics. Where existing performance is considered uniformly inadequate, BPT may be transferred from a different subcategory or industry. Limitations based on transfer of technology must be supported by a conclusion that the technology is indeed transferable and a reasonable prediction that it will be capable of meeting the prescribed effluent limits. (See *Tanners' Council of America* v. *Train*, 540 F.2nd 1188 (4th Cir. 1976).) BPT focuses on end-of-pipe treatment rather than process changes or internal controls, except where the process changes or internal controls are common industry practice.

The cost-benefit inquiry for BPT is a limited balancing, committed to EPA's discretion, which does not require the Agency to quantify the benefits in monetary terms. In balancing costs in relation to effluent reduction benefits, EPA considers the volume and nature of existing discharges expected after the application of BPT, the general environmental effects of the pollutants, and the cost and economic impact of the required pollution controls. When setting BPT limitations, EPA is required under Section 304(b) to perform a limited cost-benefit balancing to ensure the costs are not wholly out of proportion to the benefits achieved. (See *Weyerhaeuser Company* v. *Costle*, 590 F.2d 1011 (D.C. Cir. 1978).)

12.1.1 BPT Requirements for the Meat Subcategories

EPA is retaining the existing BPT limitations (BOD, TSS, fecal coliform, pH, and oil and grease) for all facilities currently covered under 40 CFR Part 432. It should be noted that in the proposed rule for oil and grease in particular, limitations and standards are listed as "O&G (HEM)" to indicate that the parameter should be measured as hexane extractable material (HEM). In contrast, EPA has retained the previous notation of "O&G" for the existing BPT limitations, but has included footnotes that indicate it can be measured as HEM. EPA used the two different notations because the existing BPT limitations and proposed limitations were based on analytical testing methods that used two different extraction solvents: freon and n-hexane, respectively. EPA has determined that the two methods are comparable (see *Approval of EPA Methods 1664, Revision A, and 9071B for Determination of Oil and Grease and Non-polar Material in EPA's Wastewater and Hazardous Waste Programs* [EPA-821-F-98-005, February 23, 1999, located at www.epa.gov/ost/methods/1664fs.html]) and *Analytical Method Guidance for EPA Method 1664A Implementation and Use* [EPA-821-R-00-003, February 2000, located at www.epa.gov/ost/methods/1664guide.pdf]). Because freon is an ozone-depleting agent and becoming more expensive, EPA believes that facilities will prefer to measure oil and grease as HEM for the existing BPT limitations. EPA solicits comments on its notation for the two types of oil and grease limitations and standards in the proposed rule.

EPA is also proposing an additional BPT limitation for COD for larger meat first and further processing facilities to reflect the better design and operation of the existing BPT treatment technology. EPA is retaining the existing BPT limitations and proposing no new BPT limitations for "small" facilities. EPA used production-based thresholds to subcategorize these small facilities (see related discussion in Section 5). EPA defines small MPP facilities as MPP facilities that produce less than the production-based thresholds defined in Section 5. See also Section 5 for a description of why and how EPA developed these production-based thresholds.

12.1.1.1 BPT for Subcategories A through D (Meat Slaughtering Facilities)

Regulated Pollutants

EPA proposes establishing BPT limitations for COD. These pollutants are characteristic of meat slaughtering wastewater. These proposed regulated pollutants are key indicators of the performance of the secondary biological treatment process, which is the key unit process of the model BPT treatment systems for these subcategories.

Technology Selected

EPA is proposing effluent limitations guidelines based on BPT-2 for Subcategories A through D. The treatment technologies that serve as the basis for the development of the proposed BPT limits are equalization, dissolved air flotation, secondary biological treatment including some degree of nitrification, and chlorination/dechlorination. BPT-2 represents an improved version of the existing BPT technology. EPA has determined that the cost and removal comparison for this option is reasonable.

As presented in the Economic Development Document for the proposed rule, three BPT options were considered. EPA estimated the costs and pollutant reductions that would be achieved if these options were applied to all 71 facilities subject to the proposal. Limitations based on BPT-2 remove at least 12.3 million pounds of pollutants over current discharge at an annualized compliance cost of $9.9 million ($1999). Limitations based on BPT-2 result in a cost-to-net income ratio of 0.28 percent, which means that approximately 0.28 percent of a facility's profits would be spent on compliance if it was to implement this option. Also, the estimates of the BPT cost to effluent reductions benefit is $0.81 ($1999/pound). Thus, this option is considered cost-reasonable. Detailed discussions on cost estimates are presented in Section 11.

EPA also evaluated Options 3 and 4 as basis for establishing BPT limitations that would be more stringent than the level of control being proposed. However, EPA believes that Option 2 represents BPT (or "average of the best") treatment for this industry subcategory. Options 3 and 4 were evaluated in the BCT analysis.

12.1.1.2 BPT for Subpart E—Small Processors

EPA is not proposing new limitations for Small Processors (Subpart E). Small processors are defined as operations that produce up to 2,730 kilograms (6,000 pounds) per day of any type or combination of meat product, and they are currently regulated under Subpart E of 40 CFR Part 432.

12.1.1.3 BPT for Subcategories F through I (Meat Further Processing Facilities)

Regulated Pollutants

EPA proposes establishing BPT limitations for COD, a pollutant characteristic of meat further processing wastewater. EPA considers COD a key indicator of the performance of the secondary biological treatment process, which is the key unit process of the model BPT treatment systems for these subcategories.

Technology Selected

EPA is proposing to establish effluent limitations based on BPT-2 for Subcategories F through I. The treatment technologies that serve as the basis for the development of the proposed BPT limits are equalization, dissolved air flotation, secondary biological treatment, and chlorination/dechlorination. As discussed previously, the proposed BPT-2 limits for COD reflect an average of the best performance of the existing technology in place at meat processing facilities, which includes secondary biological treatment. EPA has determined that the cost and removal comparison for this option is reasonable.

As presented in the Economic Development Document for the proposed rule, three BPT options were under consideration. BPT-2 removes at least 0.25 million pounds of pollutants over current discharge at an annualized compliance cost of $0.4 million ($1999). Option 2 results in a cost-to-net income ratio of 0.14 percent, which means that approximately 0.14 percent of a facility's profits would be spent on compliance if it was to implement this option. Also, the estimates of the BPT cost to effluent reductions benefit is $1.59 ($1999/pound). Thus, this option is considered cost-reasonable.

EPA also evaluated Options 3 and 4 as basis for establishing BPT more stringent than the level of control being proposed. However, EPA believes that Option 2 represents BPT (or "average of the best") treatment for this industry subcategory. Options 3 and 4 are considered in the evaluation of BCT controls.

12.1.2 BPT Requirements for the Poultry Subcategories

EPA proposes BPT limitations for conventional pollutants (BOD, TSS, fecal coliform bacteria, pH, and oil and grease) and nonconventional pollutants (ammonia as nitrogen, total nitrogen, and total phosphorus) for poultry first processing and poultry further processing that have not previously been regulated under the current Part 432 regulations.

12.1.2.1 BPT for Poultry First Processing Facilities (Subcategory K)

Regulated Pollutants

EPA proposes establishing BPT limitations for BOD, TSS, oil and grease (measured as HEM), and ammonia as nitrogen for facilities that slaughter no more than 10 million pounds per year (small facilities). EPA proposes establishing BPT limitations for BOD, TSS, oil and grease (measured as HEM), fecal coliform bacteria, ammonia as N, total nitrogen, and total phosphorus for facilities that slaughter more than 10 million pounds per year (large facilities). These pollutants are characteristic of poultry slaughtering wastewater. These proposed regulated pollutants are key indicators of the performance of the secondary and tertiary biological treatment processes, which are the key components of the model BPT treatment systems for the small and large facilities, respectively.

Technology Selected

EPA is proposing to establish effluent limitations based on BPT-1 for small facilities in Subcategory K. This option is based on the current practices in place at facilities as reported to EPA through the MPP detailed surveys. Option 1 assumes a less aggressive nitrification treatment than Option 2. Based on the MPP screener and detailed survey responses the Agency reviewed for proposal, no small poultry first processors exist; however, in the event that a small number of facilities that were not captured through EPA's survey efforts exist, EPA is proposing to establish BPT limits.

The Agency is proposing to establish effluent limitations based on BPT-3 for large facilities in Subcategory K. The treatment technologies that serve as the basis for the development of the proposed BPT limits are equalization, dissolved air flotation, and secondary biological treatment with nitrification and denitrification and chlorination/dechlorination. As presented in the Economic Development Document for the proposed rule, three BPT options were under consideration. EPA has estimated the costs and pollutant reductions associated with each technology option as it would apply to the 95 facilities that would be subject to these proposed requirements. BPT-2 removes at least 1.63 million pounds of pollutants over current discharge at an annualized cost of $4.8 million ($1999). BPT-3 removes at least an additional 5.7 million pounds of pollutants over BPT-2, at an additional annualized compliance cost of $29.7 million. BPT Option 2 results in a cost-to-net income ratio of 0.34 percent, which means that approximately 0.34 percent of a facility's profits would be spent on compliance if it was to implement this option. Also, the estimates of the BPT cost to effluent reductions benefit is $2.95 ($1999/pound). Option 3 results in a cost to net income ratio of 2.73 percent, and the BPT cost to effluent reduction benefit is $4.71 ($1999/pound). Thus, both of these options are considered cost-reasonable. However, because Option 3 removes more pollutants at a cost that is reasonable, BPT-3 was selected for this subcategory.

EPA also evaluated Option 4 as basis for establishing BPT more stringent than the level of control being proposed. EPA estimates that BPT-4 results in a cost-to-net income ratio of 3.56 percent and the ratio of cost to effluent reduction benefits is 5.46. However, EPA is not proposing to establish BPT limits based on BPT-4 because it determined that BPT-3 achieves nearly equivalent pollutant reductions at less cost. EPA has determined that BPT-3 would remove at least 7.32 million pounds of pollutants per year at a total annualized cost of $34.5 million ($1999). In contrast, BPT-4 would remove an additional 10.7 percent of pollutants at an additional cost of 28 percent. In view of the fact that BPT-4 appears to achieve minimal additional pollutant removal and yet would prompt additional total annualized costs of $9.7 million ($1999), EPA has selected BPT-3, not BPT-4, for this subcategory.

12.1.2.2 BPT for Poultry Further Processing Facilities (Subcategory L)

Regulated Pollutants

EPA proposes establishing BPT limitations for BOD, TSS, oil and grease (measured as HEM), and ammonia as N for facilities that further process no more than 7 million pounds per year (small facilities). EPA proposes establishing BPT limitations for BOD, TSS, oil and grease (measured as HEM), fecal coliform bacteria, ammonia as N, total nitrogen, and total phosphorus for facilities that further process more than 7 million pounds per year (large facilities). These pollutants are characteristic of poultry further processing wastewater. These proposed regulated pollutants are key indicators of the performance of the secondary and tertiary biological treatment processes, which are the key components of the model BPT treatment systems for the small and large facilities, respectively.

Technology Selected

EPA is proposing to establish BPT-1 for small facilities in Subcategory L. This is the same technology as described previously for Subcategoy K. EPA estimates that four small facilities could be affected by these proposed requirements and these requirements could cost $2,600.

The Agency is proposing to establish BPT-3 for large facilities in Subcategory L. The treatment technologies that serve as the basis for the development of the proposed BPT limits are equalization, dissolved air flotation, and secondary biological treatment with nitrification and denitrification and chlorination/dechlorination. As presented in the Economic Development

Document for the proposed rule, three BPT options were under consideration. For the 16 facilities that would be subject to these proposed requirements, EPA estimates that BPT-2 removes at least 0.09 million pounds of pollutants over current discharge at an annualized cost of $0.3 million ($1999). BPT-3 removes at least an additional 0.22 million pounds of pollutants over BPT-2, at an additional annualized compliance cost of $1.9 million. BPT Option 2 results in a cost-to-net income ratio of 0.39 percent, which means that approximately 0.39 percent of a facility's profits would be spent on compliance if it was to implement this option. Also, the estimate of the BPT cost to effluent reductions benefit is $3.28 ($1999/pound). Option 3 results in a cost-to-net income ratio of 4.23 percent, and the BPT cost to effluent reduction benefit is $7.11 ($1999/pound). Thus, both of these options are considered cost-reasonable. However, because Option 3 removes more pollutants at a cost that is reasonable, it was selected for this subcategory.

EPA also evaluated Option 4 as basis for establishing BPT more stringent than the level of control being proposed. EPA estimates that BPT-4 results in a cost-to-net income ratio of 6.04 percent and the BPT cost to effluent reduction benefit is $9.54 ($1999/pound). EPA is not proposing to establish BPT limits based on BPT-4 because it determined that BPT-3 achieves nearly equivalent pollutant reductions at less cost. EPA has determined that BPT-3 would remove at least 0.31 million pounds of pollutants per year at a total annualized cost of $2.2 million ($1999). In contrast, BPT-4 would remove at least 0.32 million pounds of pollutants at an additional cost of 36 percent. In view of the fact that BPT-4 appears to achieve less pollutant removal and yet would prompt additional total annualized costs of $1.9 million ($1999), EPA has selected BPT-3, not BPT-4, for this subcategory.

12.1.3 BPT Requirements for Independent Rendering Facilities (Subcategory J)

Regulated Pollutants

EPA proposes establishing BPT limitations for COD, a pollutant characteristic of meat rendering wastewater. COD is a key indicator of the performance of the secondary biological treatment process, which is the key component of the model BPT treatment systems for this subcategory.

Technology Selected

EPA is proposing to establish effluent limitations based on BPT-2 for Subcategory J. The treatment technologies that serve as the basis for the development of the proposed BPT limits are equalization, dissolved air flotation, and secondary biological treatment with nitrification and chlorination/dechlorination. Since secondary biological treatment already accomplishes some nitrification, EPA believes that the proposed BPT is an improved version of the existing BPT technology basis, which calls for secondary biological treatment. Option 2 results in a cost-to-net income ratio of 0.68 percent, which means that approximately 0.68 percent of a facility's profits would be spent on compliance if it was to implement this option. Also, estimates of the BPT cost to effluent reductions benefit is $0.03 ($1999/pound). Thus, this option is considered cost-reasonable.

EPA also evaluated Options 3 and 4 as basis for establishing BPT more stringent than the level of control being proposed. However, EPA believes that Option 2 represents BPT (or "average of the best") treatment for this industry subcategory. Options 3 and 4 were considered as possible options for revising the BCT limitations.

12.2 BEST CONTROL TECHNOLOGY FOR CONVENTIONAL POLLUTANTS (BCT)

The BCT methodology, promulgated in 1986 (51 FR 24974), discusses the Agency's consideration of costs in establishing BCT effluent limitations guidelines. EPA evaluates the reasonableness of BCT candidate technologies (those that are technologically feasible) by applying a two-part cost test:

1. The POTW test

2. The industry cost-effectiveness test

In the POTW test, EPA calculates the cost per pound of conventional pollutant removed by industrial discharges in upgrading from BPT to a BCT candidate technology and then compares this cost to the cost per pound of conventional pollutant removed in upgrading POTWs from secondary treatment. The upgrade cost to industry must be less than the POTW benchmark of $0.25 per pound (in 1976 dollars).

In the industry cost-effectiveness test, the ratio of the incremental BPT to BCT cost divided by the BPT cost for the industry must be less than 1.29 (i.e., the cost increase must be less than 29 percent). The Economic Development Document for the proposed rule provides more details on the calculations of the BCT cost tests.

In developing BCT limits, EPA considered whether there are technologies that achieve greater removals of conventional pollutants than those proposed for BPT, and whether those technologies are cost-reasonable according to the prescribed BCT tests. For subcategories A through D, E through I, K, and L, EPA identified no technologies that can achieve greater removals of conventional pollutants than the BPT standards that also pass the BCT cost test. Accordingly, EPA proposes to establish BCT effluent limitations equal to the current BPT limitations for these subcategories. In the Rendering subcategory (Subcategory J), EPA found that Option 2 would achieve greater removal of conventional pollutants and was cost-reasonable under the BCT cost tests and therefore proposes this technology as BCT.

12.3 BEST AVAILABLE TECHNOLOGY ECONOMICALLY ACHIEVABLE (BAT)

In general, BAT effluent limitations guidelines represent the best economically achievable performance of facilities in the industrial subcategory or category. The CWA establishes BAT as a principal national means of controlling the direct discharge of toxic and nonconventional pollutants. The factors considered in assessing BAT include the cost of achieving BAT effluent reductions, the age of equipment and facilities involved, the process(es) employed, potential process changes, and non-water quality environmental impacts including energy requirements, and such other factors as the EPA Administrator deems appropriate. The Agency retains considerable discretion in assigning the weight to be accorded these factors. An additional statutory factor considered in setting BAT is economic achievability. Generally, EPA determines economic achievability on the basis of total costs to the industry and the effect of compliance with BAT limitations on overall industry and subcategory financial conditions.

For purposes of the proposed rule, EPA has determined that each proposed model technology is technically available. EPA has also determined that each is economically achievable for the segment to which it applies. Further, EPA has determined, for the reasons set forth in Section 10, that none of the proposed technology options has unacceptable adverse non-water quality environmental impacts. EPA also considered the age, size, processes, and other engineering factors pertinent to facilities in the proposed segments for the purpose of evaluating the technology options. EPA is proposing to establish separate limits for facilities on the basis of size. As discussed in more detail in Section 5, EPA is not proposing to establish more stringent limitations for small meat slaughterers, nor is the Agency proposing to revise the limitations for the small meat processors subcategory (Subpart E). EPA survey data indicate that approximately 107 small meat processing facilities would have been subject to any new limitations. EPA estimates that the additional pollutant reductions achieved by establishing more stringent limitations for these small facilities would be minimal. For example, under Option 3, the pollutant load reduction attributable to small facilities is less than 0.1 percent of the total expected pollutant load reduction.

12.3.1 BAT Requirements for the Meat Subcategories

12.3.1.1 BAT for Subcategories A through D (Meat Slaughtering Facilities)

Regulated Pollutants

EPA proposes establishing BAT limitations for ammonia-N, total nitrogen, and total phosphorus. These pollutants are characteristic of meat slaughtering wastewater. These proposed regulated pollutants are key indicators of the performance of the tertiary biological treatment process, which is the technology basis for the BAT and NSPS requirements for these subcategories.

Technology Selected

EPA is proposing effluent limitations guidelines based on BAT-3 for Subcategories A through D. The treatment technologies that serve as the basis for the development of the proposed BAT limits are equalization, dissolved air flotation, and secondary biological treatment with nitrification and denitrification and chlorination/dechlorination. EPA has determined that the cost for nutrient removal for this subcategory is cost-effective (i.e., is less than the cost for nutrient removal performed at a POTW). The Economic Development Document for the proposed rule presents the methodology for evaluating cost-effectiveness for nutrient pollutants. As presented in the Economic Development Document for the proposed rule, three BAT options were considered. Effluent limitations based on BAT-2 remove approximately 2.0 million pounds of phosphorus over current discharge at an annualized compliance cost of $9.9 million ($1999). BAT-3 removes an additional 40 million pounds of nitrogen and phosphorus over BAT-2 at an additional annualized compliance cost of $32.3 million ($1999). Both of these options result in a cost-to-net income ratio of less than 1.5 percent, so both are considered economically achievable. However, because BAT-3 removes more pounds of nutrients at a cost that is economically achievable, EPA has chosen to propose effluent limitations based on BAT-3.

EPA also evaluated BAT-4 as a basis for establishing BAT more stringent than the level of control being proposed. As was the case for BAT-3, the cost-to-net income ratio of less than 2.4 percent shows that the option is economically achievable. However, EPA is not proposing to establish limits based on BAT-4 because BAT-3 achieves nearly equivalent reductions in nitrogen and phosphorus for much less cost. EPA has determined that BAT-3 would remove 42.8 million pounds of nitrogen and phosphorus per year at a total annualized cost of $42.2 million ($1999). In contrast, BAT-4 would remove 44.9 million pounds of nitrogen and phosphorus per year at a total annualized cost of $73.5 million ($1999). In view of the fact that BAT-4 appears to achieve an increase in removals of only 5.0 percent and yet would prompt annualized costs to increase by 74 percent, EPA has determined that BAT-3, not BAT-4, is the "best available" technology economically achievable for Subcategories A, B, C, and D.

12.3.1.2 BAT for Subcategories F through I (Meat Further Processing Facilities)

Regulated Pollutants

EPA proposes establishing BAT limitations for ammonia-N, total nitrogen, and total phosphorus. These pollutants are characteristic of meat further processing wastewater. These proposed regulated pollutants are key indicators of the performance of the tertiary biological treatment process, which is the key component of the model BAT and NSPS treatment system for these subcategories.

Technology Selected

EPA is proposing to establish effluent limitations based on BAT-3 for Subcategories F, G, H, and I. The treatment technologies that serve as the basis for the development of the proposed BAT limits are equalization, dissolved air flotation, and secondary biological treatment with nitrification and denitrification and chlorination/dechlorination. EPA has determined that the cost for nutrient removal for this subcategory is cost-effective and less than the cost for nutrient removal performed at a POTW. As presented in the Economic Development Document for the proposed rule, three BAT options were considered. EPA estimates that the 20 facilities in Subparts F through I would achieve a removal of approximately 0.04 million pounds of phosphorus over current discharge at an annualized compliance cost of $0.4 million ($1999) with BAT-2. BAT-3 removes an additional 2.08 million pounds of nitrogen and phosphorus over BAT-2 at an additional annualized compliance cost of $0.1 million ($1999). Both of these options result in a cost-to-net income ratio of less than 0.5 percent, so both are considered economically achievable. However, because BAT-3 removes more pounds of nutrients at a cost that is economically achievable, EPA has chosen to propose effluent limitations based on BAT-3.

The Agency also evaluated BAT-4 as a basis for establishing BAT more stringent than the level of control being proposed. As was the case for BAT-3, the cost-to-net income ratio of less than 1.4 percent shows that the option is economically achievable. However, EPA is not proposing to establish limits based on BAT-4 because it determined that BAT-3 achieves nearly equivalent reductions in nitrogen and phosphorus for much less cost. EPA has determined that BAT-3 would remove 2.12 million pounds of nitrogen and phosphorus per year at a total annualized cost of $0.5 million ($1999). In contrast, BAT-4 would remove only 4,530 additional pounds of nitrogen and phosphorus per year at a total annualized cost of $3.5 million ($1999). In view of the fact that BAT-4 appears to achieve an increase in removals of only 0.2 percent and yet would prompt annualized costs to increase by 600 percent, EPA has determined that BAT-3, not BAT-4, is the "best available" technology economically achievable for Subcategories F, G, H, and I.

12.3.2 BAT Requirements for the Poultry Subcategories

12.3.2.1 BAT for Poultry First Processing Facilities (Subcategory K)

Regulated Pollutants

EPA proposes to regulate the same pollutants for BAT as those for BPT. EPA proposes establishing BPT limitations for BOD, TSS, oil and grease (measured as HEM), and ammonia as N for facilities that slaughter no more than 10 million pounds per year (small facilities). EPA proposes establishing BPT limitations for BOD, TSS, oil and grease (measured as HEM), fecal coliform bacteria, ammonia as N, total nitrogen, and total phosphorus for facilities that slaughter more than 10 million pounds per year (large facilities). These pollutants are characteristic of poultry slaughtering wastewater. These proposed regulated pollutants are key indicators of the performance of the secondary and tertiary biological treatment process, which are the key components of the model BPT treatment systems for the small and large facilities, respectively.

Technology Selected

EPA is proposing to set BAT equal to BPT for small facilities in Subcategory K. EPA was unable to determine whether there is an economically achievable BAT treatment technology more stringent than that proposed for BPT because no small poultry first processors were identified. EPA based its decision on the fact that there is no economically achievable BAT treatment technology more stringent than that proposed for BPT for poultry first processors.

EPA is proposing to set BAT equal to BPT for large facilities in Subcategory K because it has determined that there is no economically achievable BAT treatment technology more stringent than the proposed BPT treatments. Also, EPA has determined that the cost for nutrient removal for this subcategory is cost-effective; it is less than the cost for nutrient removal performed at a POTW. As presented in the Economic Development Document for the proposed rule, three BAT options were under consideration. BAT-2 removes approximately 810,000 pounds of phosphorus over current discharge at an annualized compliance cost of $4.8 million ($1999). BAT-3 removes an additional 7.7 million pounds of nitrogen and phosphorus over BAT-2 at an additional annualized compliance cost of $29.7 million ($1999). BAT-2 results in a cost-to-net income ratio of less than 0.4 percent, so this option is considered economically achievable. Because BAT-3 results in a cost-to-net income ratio of less than 2.8 percent, which is also economically achievable, EPA has chosen to set BAT equal to BPT for Subcategory K.

EPA also evaluated BAT-4 as a basis for establishing BAT more stringent than the level of control being proposed. The cost-to-net income ratio of more than 3.6 percent for BAT-4 shows that the option is economically achievable. However, EPA is not proposing to establish BAT limits based on BPT-4 because it has determined that BPT-3 achieves nearly equivalent pollutant reductions at less cost. EPA has determined that BPT-3 would remove at least 8.37 million pounds of total nitrogen and total phosphorus per year at a total annualized cost of $34.5 million ($1999). In contrast, BPT-4 would remove only 8.87 pounds of total nitrogen and total phosphorus at an additional cost of 28 percent. In view of the fact that BPT-4 achieves similar pollutant removals and yet would prompt additional total annualized costs of $9.7 million ($1999), EPA has selected BPT-3, not BPT-4, for this subcategory. Thus, EPA has determined that BAT-3, not BAT-4, is the "best available" technology economically achievable for large facilities in Subcategory K.

12.3.2.2 BAT for Poultry Further Processing Facilities (Subcategory L)

Regulated Pollutants

EPA proposes to regulate the same pollutants for BAT as those for BPT. EPA proposes establishing BAT limitations for BOD, TSS, oil and grease (measured as HEM), and ammonia as N for facilities that further process no more than 7 million pounds per year (small facilities). EPA proposes establishing BAT limitations for BOD, TSS, oil and grease (measured as HEM), fecal coliform bacteria, ammonia as N, total nitrogen, and total phosphorus for facilities that further process more than 7 million pounds per year (large facilities). These pollutants are characteristic of poultry further processing wastewater. These proposed regulated pollutants are also key indicators of the performance of the secondary and tertiary biological treatment processes, which are the key components of the model BAT treatment systems for the small and large facilities, respectively.

Technology Selected

EPA is proposing to set BAT equal to BPT for small facilities in Subcategory L because it has determined that there is no economically achievable BAT treatment technology more stringent than the proposed BPT treatment. BAT-2 results in a cost-to-net income ratio of greater than 20 percent, which would cause significant economic impacts for these facilities, so EPA has chosen to set BAT equal to BPT for small facilities in Subcategory L.

The Agency is proposing to establish effluent limitations based on BAT-3 for large facilities in Subcategory L. The treatment technologies that serve as the basis for the development of the proposed BAT limits are equalization, dissolved air flotation, and secondary biological treatment with nitrification and denitrification. EPA has determined that there is no economically achievable BAT treatment technology more stringent than the proposed BPT treatment. As presented in the Economic Development Document for the proposed rule, three BAT options were considered. BAT-2 removes approximately zero pounds of phosphorus over current discharge at an annualized compliance cost of $0.3 million ($1999). BAT-3 removes an additional 0.32 million pounds of nitrogen and phosphorus over BAT-2 at an additional annualized compliance cost of $1.9 million ($1999). BAT-2 results in a cost-to-net income ratio of less than 0.4 percent, so this option is considered economically achievable. BAT-3 results in a cost-to-net income ratio of less than 4.25 percent, which is also economically achievable, so EPA has chosen to set BAT equal to BPT for Subcategory L.

EPA also evaluated BAT-4 as a basis for establishing BAT more stringent than the level of control being proposed. The cost-to-net income ratio of more than 6 percent for BAT-4 shows that the option would cause significant economic impacts. Also, EPA is not proposing to establish BAT limits based on BPT-4 because it determined that BAT-3 achieves nearly equivalent pollutant reductions at less cost. EPA has determined that BAT-3 would remove at least 0.32 million pounds of total nitrogen and total phosphorus per year at a total annualized cost of $2.2 million ($1999). In contrast, BPT-4 would remove only 0.318 pounds of total nitrogen and total phosphorus at an additional cost of 36 percent. In view of the fact that BPT-4 appears to achieve no additional pollutant removals and yet would prompt additional total annualized costs of $0.8 million ($1999), EPA has selected BPT-3, not BPT-4, for this subcategory. Thus, EPA has determined that BAT-3, not BAT-4, is the "best available" technology economically achievable for large facilities in Subcategory L.

12.3.3 BAT Requirements for Independent Rendering Facilities (Subcategory J)

Regulated Pollutants

EPA proposes to revise BAT limitations for ammonia-N. This pollutant is characteristic of meat rendering wastewater. The proposed regulated pollutant is a key indicator of the performance of the secondary biological treatment process, which is the key component of the model BPT, BAT, and NSPS treatment system for this subcategory.

Technology Selected

The Agency is proposing to establish effluent limitations based on BAT-2 for Subcategory J. The treatment technologies that serve as the basis for the development of the proposed BPT limits are equalization, dissolved air flotation, and secondary biological treatment with nitrification and chlorination/dechlorination. EPA has determined that this option is cost-effective and economically achievable. As presented in the Economic Development Document for the proposed rule, three BAT options were considered. EPA estimates that the 23 existing facilities that would be subject to the proposed rule would achieve removals of approximately 87,000 pounds of nitrogen and phosphorus over current levels discharged at an annualized compliance cost of $0.6 million ($1999) under BAT-2. BAT-3 removes an additional 396,000 pounds of phosphorus over BAT-2 at an additional annualized compliance cost of $3.7 million ($1999). BAT-2 results in a cost-to-net income ratio of less than 0.7 percent, so this option is considered economically achievable. BAT-3 results in a cost-to-net income ratio of greater than 5.5 percent, which is also considered economically achievable. However, because EPA has determined that the cost for nutrient removal for BAT-3 is not cost-effective and is more than the cost for nutrient removal performed at a POTW, EPA has chosen to propose effluent limitations based on BAT-2 for Subcategory J.

EPA also evaluated BAT-4 as a basis for establishing BAT more stringent than the level of control being proposed. The cost-to-net income ratio of more than 6.7 percent for BAT-4 is even greater than the ratio for Option 3. Since the Agency is not proposing Option 3 on the basis of the potential economic impact, EPA is not proposing Option 4, which has an even greater potential impact. Thus, EPA has determined that BAT-2 is the "best available" technology economically achievable for Subcategory J.

12.4 NEW SOURCE PERFORMANCE STANDARDS (NSPS)

New Source Performance Standards reflect effluent reductions that are achievable based on the best available demonstrated control technology. New facilities have the opportunity to install the best and most efficient production processes and wastewater treatment technologies. As a result, NSPS should represent the most stringent controls attainable through the application of the best available demonstrated control technology for all pollutants (that is, conventional, nonconventional, and priority pollutants). In establishing NSPS, EPA is directed to take into consideration the cost of achieving the effluent reduction and any non-water quality environmental impacts and energy requirements.

In selecting its proposed NSPS technology for these segments and subcategories, EPA considered all of the factors specified in CWA section 306, including the costs of achieving effluent reductions and the effect of costs on new projects (barrier to entry). The Agency also considered energy requirements and other non-water quality environmental impacts for the proposed NSPS options and concluded that these impacts were no greater than those for the proposed BAT technology options and are acceptable. EPA therefore concluded that the NSPS technology basis proposed constitutes the best available demonstrated control technology for those segments.

12.4.1 NSPS Requirements for Meat Subcategories

12.4.1.1 NSPS for Subcategories A through D (Meat Slaughtering Facilities)

Regulated Pollutants

EPA proposes to regulate the same pollutants for NSPS as those for BAT (ammonia-N, total nitrogen, and total phosphorus), with the addition of BOD, TSS, oil and grease (measured as HEM), and fecal coliform bacteria.

Technology Selected

The treatment technologies that serve as the basis for the development of the proposed NSPS limits are the same as the BAT for these subcategories. As was the case for BAT, EPA did not pursue additional, more stringent options for NSPS because as with existing sources Option 4 is not expected to achieve significant incremental pollutant reductions. Further, EPA does not expect that the cost to construct the treatment system to achieve Option 4 performance would be significantly less for a new source than it would be for an existing source to retrofit its existing system. Therefore, EPA proposes BAT-3 as the technology basis for NSPS for subcategories A throught D because the Agency believes BAT-3 represents the best demonstrated technology for this subcategory.

12.4.1.2 NSPS for Subpart E—Small Processors

EPA is not proposing new limitations for Small Processors (Subpart E). Small processors are defined as operations producing up to 2730 kilograms (6000 pounds) per day of any type or combination of meat product, are currently regulated under Subpart E of 40 CFR Part 432.

12.4.1.3 NSPS for Subcategories F through I (Meat Further Processing Facilities)

Regulated Pollutants

EPA proposes to regulate the same pollutants for NSPS as those for BAT (ammonia-N, total nitrogen, and total phosphorus), with the addition of BOD, TSS, oil and grease (measured as HEM), and fecal coliform bacteria.

Technology Selected

As was the case for BAT, EPA did not pursue additional, more stringent, options for NSPS because as with existing sources Option 4 is not expected to achieve significant incremental pollutant reductions. Further, EPA does not expect that the cost to construct the treatment system to achieve Option 4 performance would be significantly less for a new source than it would be for an existing source to retrofit its existing system. Therefore, EPA proposes BAT-3 as the technology basis for NSPS for Subcategories F through I because EPA believes it represents the best demonstrated technology for this subcategory.

12.4.2 NSPS Requirements for Poultry Subcategories

12.4.2.1 NSPS for Poultry First Processing Facilities (Subcategory K)

Regulated Pollutants

EPA proposes to regulate the same pollutants for NSPS as those for BAT. EPA proposes establishing NSPS limitations for BOD, TSS , oil and grease (measured as HEM), and ammonia as N for facilities that slaughter no more than 7 million pounds per year (small facilities). EPA proposes establishing NSPS limitations for BOD, TSS, oil and grease (measured as HEM), fecal coliform bacteria, ammonia as N, total nitrogen, and total phosphorus for facilities that slaughter more than 7 million pounds per year (large facilities). These pollutants are characteristic of poultry first processing wastewater. These proposed regulated pollutants are key indicators of the performance of the secondary and tertiary biological treatment processes, which are the key components of the model NSPS treatment systems for the small and large facilities, respectively.

Technology Selected

EPA did not pursue additional, more stringent options for small facilities in Subcategory K for NSPS because the Agency does not expect that the cost to construct the treatment system to achieve Option 2 performance would be significantly less for a new source than it would be for an existing source to retrofit its existing system. Therefore, EPA proposes BAT-1 as the technology basis for NSPS for small facilities in Subcategory K because EPA believes it represents the best demonstrated technology for this subcategory.

As was the case for BAT, EPA did not pursue additional, more stringent options for large facilities in Subcategory K for NSPS because, as with existing sources, Option 4 is not expected to achieve significant incremental pollutant reductions. Further, EPA does not expect that the cost to construct the treatment system to achieve Option 4 performance would be significantly less for a new source than it would be for an existing source to retrofit its existing system. Therefore, EPA proposes BAT-3 as the technology basis for NSPS for large facilities in Subcategory K because EPA believes it represents the best demonstrated technology for this subcategory.

12.4.2.2 NSPS for Poultry Further Processing Facilities (Subcategory L)

Regulated Pollutants

EPA proposes to regulate the same pollutants for NSPS as those for BAT. EPA proposes establishing NSPS limitations for BOD, TSS, oil and grease (measured as HEM), and ammonia as N for facilities that further process no more than 7 million pounds per year (small facilities). EPA proposes establishing NSPS limitations for BOD, TSS, oil and grease (measured as HEM), fecal coliform bacteria, ammonia as N, total nitrogen, and total phosphorus for facilities that further process more than 7 million pounds per year (large facilities). These pollutants are characteristic of poultry further processing wastewater. These proposed regulated pollutants are key indicators of the performance of the secondary and tertiary biological treatment processes, which are the key components of the model NSPS treatment systems for the small and large facilities, respectively.

Technology Selected

EPA did not pursue additional, more stringent options for small facilities in Subcategory L for NSPS because the Agency does not expect that the cost to construct the treatment system to achieve Option 2 performance would be significantly less for a new source than it would be for an existing source to retrofit its existing system. Therefore, EPA proposes BAT-1 as the technology basis for NSPS for small facilities in Subcategory L because the Agency believes it represents the best demonstrated technology for this subcategory.

The treatment technologies that serve as the basis for the development of the proposed NSPS limits are the same as the BAT for this subcategory. As was the case for BAT, EPA did not pursue additional, more stringent options for NSPS because, as with existing sources, Option 4 is not expected to achieve significant incremental pollutant reductions. Further, EPA does not expect that the cost to construct the treatment system to achieve Option 4 performance would be significantly less for a new source than it would be for an existing source to retrofit its system. Therefore, EPA proposes BAT-3 as the technology basis for NSPS for subcategory L because EPA believes it represents the best demonstrated technology for this subcategory.

12.4.3 NSPS Requirements for Independent Rendering Facilities (Subcategory J)

Regulated Pollutants

EPA proposes to revise the new source performance standards for BOD, TSS, oil and grease (measured as HEM), fecal coliform bacteria, and ammonia.

Technology Selected

The treatment technologies that serve as the basis for the development of the proposed NSPS limits are the same as the BAT and BPT for this subcategory. EPA does not expect a substantial cost savings for new facilities to design and construct a treatment system to achieve more stringent effluent standards consistent with either Option 3 or 4. Thus, EPA believes Options 3 and 4 could pose a barrier to entry for new sources in this subcategory. Therefore, EPA proposes BAT-2 as the technology basis for NSPS for Subcategory J because the Agency believes BAT-2 represents the best demonstrated technology economically achievable for this subcategory.

12.5 PRETREATMENT STANDARDS FOR EXISTING SOURCES (PSES) AND NEW SOURCES (PSNS)

National pretreatment standards are established for those pollutants in wastewater from indirect dischargers that might pass through, interfere with, or otherwise be incompatible with publicly owned treatment works (POTW) operations. Generally, pretreatment standards are designed to ensure that wastewaters from direct and indirect industrial dischargers are subject to similar levels of treatment. In addition, many POTWs are required to develop and implement local discharge limits applicable to their industrial indirect dischargers to satisfy any local requirements (see 40 CFR 403.5). POTWs that are not required to implement approved programs and have not had interference or pass through issues are not required to develop and implement local limits. Nationwide there are approximately 1500 POTWs with approved Pretreatment Programs and 13,500 small POTWs that are not required to develop and implement approved Pretreatment Programs.

National pretreatment standards have three principal objectives: (1) prevent the wide-scale introduction of pollutants into POTWs that will interfere with POTW operations, including use or disposal of municipal sludge; (2) prevent the introduction of pollutants into POTWs that will pass through the treatment works or will otherwise be incompatible with the treatment works; and (3) improve opportunities to recycle and reclaim municipal and industrial wastewaters and sludges.

Currently there are no categorical pretreatment standards for the MPP point source category. EPA is not proposing new pretreatment standards for existing or new MPP indirect dischargers. Although EPA has some information regarding effluents from MPP indirect dischargers that may pass through, interfere with, or otherwise be incompatible with POTW operations, it is not clear that the particular information justifies categorical pretreatment standards for this industry. The following sections discuss the information EPA was able to collect for this proposal and plans to collect after proposal.

12.5.1 POTW Interference

As noted earlier, there are no categorical pretreatment standards for MPP indirect dischargers; however, the national pretreatment standards prohibit the discharge of "Any pollutant, including oxygen demanding pollutants (BOD, etc.) released in a Discharge at a flow rate and/or pollutant concentration which will cause Interference with the POTW" (see 40 CFR 403.5(b)(4)). All indirect dischargers are prohibited from introducing into a POTW any pollutant(s) which cause pass through or interference regardless of whether categorical pretreatment standards or any national, state, or local pretreatment requirements apply (see 40 CFR 403.5(a)(1)). POTWs are required to develop and enforce Pretreatment Programs and/or set local limits to ensure renewed and continued compliance with the POTW's NPDES permit or sludge use or disposal practices (see 40 CFR 403.5(c)). According to data provided in the MPP detailed surveys, approximately one-third of the MPP facilities discharge to POTWs that discharge less than 5 MGD. These POTWs are often not required through their NPDES permits to develop and implement local Pretreatment Programs.

EPA typically does not establish pretreatment standards for conventional pollutants (e.g., BOD_5, TSS, oil and grease) because POTWs are designed to treat such pollutants, but EPA has exercised its authority to establish categorical pretreatment standards for conventional pollutants. For example, EPA established categorical pretreatment standards for new and existing sources with a 1-day maximum concentration of 100 mg/L oil and grease in the Petroleum Refining Point Source Category (40 CFR Part 419). This standard is based on the performance of one of two technologies (primary oil removal or dissolved air flotation). EPA identified this pretreatment standard as necessary to "minimize the possibility of slug loadings of oil and grease being discharged to POTW" (Docket No. W-01-06, Record No. 00167). EPA notes that oil and grease from Petroleum Refineries is not the same material as oil and grease from MPP facilities. EPA is considering the use of a similar 100 mg/L standard for preventing POTW interference by vegetable/animal oil and grease discharges.

EPA previously identified that high organic loadings and grease remaining in the MPP facility effluent might cause difficulty in the POTW treatment system and that the performance of trickling filters appears to be particularly sensitive (Docket No. W-01-06, Record No. 00162; Record No.00140). High loadings of oil and grease can also clog pipes and promote the growth of filamentous bacteria, which can inhibit the performance of the POTW (especially trickling filters, which are more often used at small POTWs) (Docket No. W-01-06, Record No. 00085). A concentration of 100 mg/L for oil and grease is often cited as a local limit, and compliance with this limit may require an effective dissolved air flotation device in addition to a catch basin and other primary treatment system (Docket No. W-01-06, Record No. 00162; Record No. 00140). EPA recognizes that much of this data was developed in the 1970s but believes that the data is still relevant today.

EPA also previously identified that oil and grease of petroleum origin has been reported to interfere with the aerobic processes of POTWs (Docket No. W-01-06, Record No. 00167). It is believed that the principal interference is caused by the attachment of oil and grease of petroleum origin onto floc particles, resulting in a slower settling rate, loss of solids by carryover out of the settling basin, and excessive release of BOD from the POTW to the environment. Additionally, EPA identified that oil and grease of petroleum origin may coat the biomass in activated sludge treatment units, thereby interfering with oxygen transfer and reducing treatment efficiency.

EPA regional and state permit writers and pretreatment coordinators identified approximately 20 cases where MPP indirect dischargers interfered with POTW operations (Docket No. W-01-06, Record No. 10037). Although some specific details are lacking, these cases generally describe how overloadings of various parameters (e.g., BOD_5, oil and grease, TSS, ammonia) and unequalized flows from MPP indirect dischargers have resulted in POTW interference incidents and POTW NPDES permit violations.

It is not clear, however, whether these identified interference incidents represent an industry-wide problem or are site-specific and more appropriately addressed by the general pretreatment prohibitions and local limits, or by POTW upgrades. Some of these instances do involve violations of local limits or were resolved by POTW upgrades, and therefore the general pretreatment prohibitions and local limits did work. EPA does not know, however, how frequently this was the case. More detailed information will be gathered to determine whether these facilities were in violation of the local limits, POTWs have upgraded since the incident, or these were one-time problems. EPA will collect more information from EPA and state pretreatment program coordinators, POTWs, and MPP indirect dischargers after proposal (1) to understand whether the general pretreatment prohibition is sufficient to address POTW interference and pass through incidents for this industry and (2) to determine if reoccurrences of these POTW interference and pass through incidents necessitate categorical pretreatment standards at the time of the final rule for non-small facilities.

Many POTWs are capable of controlling MPP indirect discharges through local limits or sufficient dilution with domestic wastewaters. Most of the approximately 1,500 POTWs with approved Pretreatment Programs have numeric oil and grease limits and many POTWs without approved Pretreatment Programs also have oil and grease limits. For example, EPA identified approximately two dozen Pretreatment Programs with local limits on oil and grease (Docket No. W-01-06, Record No. 10037). Oil and grease limits were most often in the range of 50 mg/L to 450 mg/L with 100 mg/L as the most common reported limit. Other Pretreatment Programs use descriptive requirements to limit interference from high oil and grease concentrations.

While most POTWs are not significantly affected by MPP indirect discharges, EPA notes that some, primarily smaller POTWs, including those not required to implement approved Pretreatment Programs, may have difficulty in properly treating MPP indirect discharges or in setting local limits. Some POTWs may be particularly susceptible to high and variable organic and oil and grease loadings. If MPP indirect dischargers are unable to reduce or equalize their high organic and oil and grease concentrations, some small POTWs receiving these discharges may be unable to dampen the peak loadings or equalize high organic and oil and grease concentrations from MPP indirect dischargers with domestic wastewater. MPP indirect discharges range from 3 to 20 times in organic concentrations than typical domestic wastewater (Docket No. W-01-06, Record No. 10038). Small POTW facilities are generally more susceptible to high and variable loadings from large MPP indirect dischargers. Small POTWs often use less sophisticated wastewater treatment systems (e.g., trickling filters, simple anaerobic lagoons), which may not be able to operate properly during periods of high flow or handle slug loads discharged by MPP facilities after a shut-down period (e.g., no or low MPP indirect loadings during weekend operations when no or limited MPP operations are taking place). Trickling filters at small POTW facilities may be unable to effectively process high organic and oil and grease concentrations and may allow unacceptable amounts of BOD and oil and grease concentrations to pass through if MPP indirect dischargers are not properly controlled. Anaerobic lagoons at small POTW facilities may be unable to convert ammonia to nitrate (a less toxic form of nitrogen) and are therefore unsuitable as a treatment step to ensure that the receiving water does not receive toxic amounts of ammonia. In one such instance, an MPP facility was directed to establish biological pretreatment (by installing a biological sequencing batch reactor) in order to discharge to the local POTW, which has a simple anaerobic lagoon system (Docket No. W-01-06, Record No.10039).

Representatives of the MPP industry and the Association of Metropolitan Sewerage Agencies (AMSA) stated to EPA that cases of POTW interference from MPP indirect dischargers are relatively infrequent occurrences and that they are best handled through local limits and proper enforcement (Docket No. W-01-06, Record No. 10040). AMSA is a membership organization that represents approximately 10 percent of the largest POTWs in the United States (about 150 of the 1,500 POTWs with Pretreatment Programs) and some small POTWs; however, none of the approximately 20 cases of interference incidents identified in the record involve AMSA members. EPA would collect additional information on other potential positive and negative impacts on POTW operations if the Agency were to set national categorical pretreatment standards for the prevention of interference with POTW operations. AMSA has stated that any attempt to reduce organic loadings from MPP facilities would also reduce the amount of revenue collected by their POTWs and have a detrimental effect on their operations. (Docket No. W-01-06, Record No. 10040). EPA will collect additional information on whether MPP indirect dischargers are causing interference issues on a national, ongoing basis and whether POTWs are addressing these interference issues in a timely manner once they are identified. Finally, EPA also will examine information on whether increased attention from federal and state Pretreatment Programs and/or Total Maximum Daily Load (TMDL) programs would sufficiently deal with MPP indirect discharges that might cause POTW interference in lieu of national categorical pretreatment standards.

12.5.2 POTW Pass Through

As noted above, federal categorical pretreatment standards are also designed to prevent the introduction into POTWs of pollutants that will pass through the treatment works or will otherwise be incompatible with the treatment works. Generally, to determine whether pollutants pass through POTWs, EPA compares the percentage of the pollutant removed by well-operated POTWs achieving secondary treatment with the percentage of the pollutant removed by each of the indirect technology options. As shown in Tables 12-1 and 12-2, EPA identified the MPP pollutants, based on EPA sampling efforts, that EPA would normally determine to pass through using EPA's standard methodology (i.e., the indirect technology option has a percent removal higher than the POTW percent removal).

Table 12-1. Removal Efficiencies for Meat Pollutants of Concern

MPP Pollutant of Concern	CAS Number	PSES Indirect Option 1 Treatment Efficiency	POTW Treatment Efficiency [a]
Oil and grease	C036	95	86
Copper	7440508	91	84
Molybdenum	7439987	82	19
Zinc	7440666	91	79

[a] These POTW removal efficiencies are from the 50-POTW study (Docket No. W-01-06, Record No. 00180).

Table 12-2. Removal Efficiencies for Poultry Pollutants of Concern

MPP Pollutant of Concern	CAS Number	PSES Indirect Option 1 Treatment Efficiency	POTW Treatment Efficiency [a]
Oil and grease	C036	90	87
Total Kjeldahl nitrogen (TKN)	C021	73	57
Total phosphorus	14265442	67	57
Barium	7440393	78	16
Manganese	7439965	60	36
Nickel	7440020	65	51
Zinc	7440666	53	79

[a] These POTW removal efficiencies are from the 50-POTW study (Docket No. W-01-06, Record No.00180).

PSES Indirect Option 1 (PSES1) is a physical-chemical treatment system (dissolved air flotation [DAF] with chemical flocculant addition, equalization tank) that primarily targets conventional pollutants including oil and grease. As the tables above indicate, PSES1 shows some metal and nutrient removals but it is not clear why a technology designed to control conventional pollutants also affects the level of other pollutants. EPA notes that many of these pollutants of concern that would normally be determined to exhibit pass through do so in low concentrations. For example, metal concentrations in MPP indirect dischargers are relatively low in comparison with conventional pollutants concentrations (e.g., BOD, TSS, and oil and grease). EPA will further investigate the data and potential mechanisms behind the removals of metals and nutrients by PSES1 to confirm the PSES1 treatment efficiencies. At the final regulation EPA may issue pretreatment standards based on pass through for all or a subset of these pollutants.

Further, EPA has received comments from AMSA that the database used to characterize POTW removal efficiencies is outdated and current POTW performance has improved. EPA is considering different options on how to examine current POTW performance. One option is to evaluate removal efficiencies based on a subset of the 50-POTW database that mainly includes those POTWs that receive large amounts of industrial and/or MPP indirect discharges. EPA will also continue to collect information on any cases of significant pass through from MPP indirect dischargers where the local limits were not set or exceeded and evaluate whether EPA should promulgate pretreatment standards for certain parameters (e.g., nutrients, TDS) based on their potential passage through POTWs and into receiving waters.

Although some pollutants may pass through POTWs following fairly limited treatment, current information available to EPA suggests that the overall levels of these pollutants in MPP raw wastewater do not justify establishing numeric categorical pretreatment standards. EPA is not proposing to establish pretreatment standards based on the difference between MPP pretreatment options and POTW removal efficiencies because the Agency is uncertain that the difference accurately reflects the incidences of pass through for this industry as a whole.

12.5.3 MPP Pretreatment Options Considered

Before determining no pass through or interference that justifies proposing additional regulations, EPA considered four pretreatment options for both existing and new sources. Table 12-3 details the summary of EPA's economic analysis of the PSES1 pretreatment option for the various MPP subcategories. If information that shows that there is sufficient interference or pass through to justify categorical pretreatment standards for this industry is provided to EPA, EPA will promulgate pretreatment standards in the final rule. With respect to preventing interference incidents, EPA will evaluate comments and additional information to determine whether another annual production size cutoff for MPP indirect dischargers should be established. Additionally, EPA is considering whether it should exempt from categorical pretreatment standards MPP indirect discharges that are below 5 percent of the dry weather hydraulic or organic capacity of the POTW treatment or another percentage level that is appropriate to prevent interference incidents if EPA decides to set categorical pretreatment standards for non-small facilities in the final rule.

Table 12-3. Economic Impacts and Toxic Cost-Effectiveness Summary Table for PSES Option 1, Non-Small Facilities

MPP Industry Sector (40 CFR Part 432, Subcategory)	Cost/Net Income (%)	Pre-Tax Annualized Cost ($1999 M)	PSES Option 1 Toxic Cost-Effectiveness	
			Removals (lb-eq)	$1981/lb-eq
Meat First Processors (A-D)	$0.6	$7.0	240,421	17
Meat Further Processors (F-I)	$0.8	$18.8	76,890	143
Independent Renderers (J)	$0.5	$1.3	3,918	198
Poultry First Processors (K)	$0.6	$10.8	377,651	17
Poultry Further Processors (L)	$1.5	$15.3	49,950	178

EPA notes that the PSES1 pretreatment option cost is generally at or below 1 percent of the facility's net income (profit). Also, based on MPP detailed surveys received in time for EPA's analysis, EPA notes that PSES1 is widely used in non-small MPP pretreatment operations to reduce BOD and oil and grease concentrations. Results from the MPP detailed survey used in estimating compliance costs indicate that 26 of the 103 indirect MPP facilities use PSES1. The

MPP detailed survey also identified the following breakdown of treatment-in-place: (1) 64 facilities use no pretreatment or pretreatment less effective than PSES1 (e.g., catch basins); (2) 12 facilities use PSES2; (3) one facility use PSES3; and (4) none of the facilities use PSES4. Based on MPP detailed survey data, the average oil and grease concentration from MPP indirect facilities using PSES1 technology (equalization basin, DAF) is 99.5 mg/L.

As previously stated, EPA is not proposing new pretreatment standards for existing or new MPP indirect dischargers because the Agency did not have sufficient information to demonstrate that effluents from MPP indirect dischargers interfere with, are incompatible with, or pass through POTW operations on a scale wide enough to justify national categorical pretreatment standards. Further, EPA has received comments from AMSA that the database used to characterize POTW removal efficiencies is outdated and current POTW performance has improved. EPA will work with states and pretreatment control authorities to collect additional data on a more systematic basis to determine whether national categorical pretreatment standards are necessary. If the additional and existing data indicate that MPP indirect dischargers interfere with or pass through POTW operations, one or more of the following options may be used to establish national categorical pretreatment standards in the final rule for non-small indirect dischargers.

- Establish numeric pretreatment standards for oil and grease and/or ammonia as nitrogen based on PSES1 (equalization and DAF) to prevent POTW interference.
- Establish numeric pretreatment standards for oil and grease and/or ammonia based on equalization alone to reduce MPP indirect discharge variable loads which can, in some cases, prevent POTW interference.
- Establish numeric pretreatment standards to prevent POTW pass through (e.g., oil and grease, nutrients, and/or metals).
- Establish narrative pretreatment standards for oil and grease and/or ammonia as nitrogen based on PSES1 (equalization and DAF) or equalization alone to prevent POTW interference.

- Allow POTWs to waive national categorical pretreatment standards for MPP indirect dischargers that do not interfere with POTW operation (e.g., MPP indirect discharger below 5 percent of dry weather hydraulic or organic capacity of the POTW treatment plant).

- Allow a POTW to waive national categorical pretreatment standards for ammonia for any MPP indirect discharges it receives when that POTW has nitrification capability (see 40 CFR Part 439 as an example of this type of waiver).

- Allow MPP indirect dischargers to demonstrate compliance with either numeric pretreatment standards or with EMS/BMP voluntary alternatives (see Section 8.8).

- Establish national categorical pretreatment standards for MPP indirect dischargers based on compliance with BMPs or a regulatory BMP alternative.

SECTION 13

LIMITATIONS AND STANDARDS: DATA SELECTION AND CALCULATION

This section describes the data sources, data selection, data conventions, and statistical methodology used by EPA in calculating the long-term averages (LTAs), variability factors (VFs), and proposed limitations. The proposed effluent limitations and standards for each subcategory and option are based on long-term average effluent values and variability factors that account for variation over time in treatment performance within a particular treatment technology.

Section 13.1 briefly describes the data sources (a more detailed discussion of data sources is provided in Section 3) and gives a general overview of EPA's evaluation and selection of facility datasets that are the basis of the proposed limitations. Section 13.2 presents the procedures for data aggregation. Sections 13.3 through 13.5 describe the estimation of daily effluent concentrations and adjustments performed when technology option specific data were unavailable. Section 13.6 provides an overview of the proposed limitations. Procedures for estimation of long-term averages, variability factors, and concentration-based limitations in Sections 13.7 through 13.10. Section 13.11 describes the conversion of these concentration-based limitations into the proposed production-normalized limitations.

13.1 OVERVIEW OF DATA AND EPISODE SELECTION

To estimate the long-term averages, variability factors, and proposed limitations, EPA used the same datasets as were used to calculate the post-compliance loading estimates, as described in Section 9. As described in Section 3, EPA selected 11 MPP facilities for multi-day sampling. The purpose of the multi-day sampling was to characterize pollutants in MPP raw wastewaters prior to treatment, as well as document wastewater treatment plant performance (including selected unit processes). Selection of facilities for multi-day sampling was based on an analysis of information collected during the site visits performed by EPA, as well as on the following criteria:

- The facility performed meat or poultry first processing, further processing, and/or rendering operations representative of MPP facilities;
- The facility used in-process treatment and/or end-of-pipe treatment technologies that EPA was considering for technology option selection; and
- Compliance monitoring data for the facility indicated that it was among the better performing treatment systems, or that it employed wastewater treatment process for which EPA sought data for option selection.

During each multi-day sampling episode, EPA sampled facility influent and effluent wastestreams. At some facilities, samples were also collected at intermediate points throughout the wastewater treatment system to assess the performance of individual treatment units. Some of the facilities chosen for sampling perform rendering and/or further processing operations in addition to meat and/or poultry first processing. For facilities that also performed rendering operations or further processing, wastewater from the rendering and/or further processing operations was sampled separately, when possible.

EPA used the data from sampling episodes to develop long-term average (LTA) effluent concentrations representative of performance of selected technology options.[1] As explained in Section 9, in the absence of sampling episode data for a particular type of process, EPA transferred data from other facilities that employ similar production and treatment processes to establish LTAs. EPA also used production and flow data contained in the MPP detailed surveys for use in deriving production normalized flow values.

From each selected facility data set, an episode-specific long-term average was calculated for each proposed regulated pollutant. Episode-specific long-term averages were then used to calculate option long-term averages, which were then applied to develop the proposed

[1] In developing the proposed limitations, EPA excluded the hexane extractable material (HEM) data collected on day 1 from the sample point 3 and day 2 from the sample point 4 at facility 6443 because the discharge values were found to be extremely variable in comparison to the other days (i.e., there was no evidence that the facility was consistently controlling the HEM discharges). In addition, EPA excluded the ammonia (as N) value on day 5 at episode 6335 because it was inconsistent with the other values at that sample point.

effluent limitations. For the final rule, EPA intends to further review and possibly revise the data selection methodology.

13.2 DATA AGGREGATION

In some cases, EPA determined that two or more samples had to be mathematically aggregated to obtain a single value that could be used in other calculations. As explained in this section, in some cases, this meant that field duplicates and grab samples were aggregated for a single sample point. Appendix F lists the data after these aggregations were completed and a single daily value was obtained for each day for each pollutant.

In all aggregation procedures, EPA considered the censoring type associated with the data. EPA considered measured values to be detected. In statistical terms, the censoring type for such data was 'non-censored' (NC). Measurements reported as being less than some sample-specific detection limit (e.g., <10 mg/L) were censored and were considered to be non-detected (ND). Laboratories can also report numerical results for specific pollutants detected in the samples as right censored. Right censored data are those reported as being greater than the highest calibration value of the analysis (e.g., >1000 ug/l). For calculating the proposed limitations, the right censored data were set to the reported amount and treated as non-censored data. In the tables and data listings in this document and the record for the rulemaking, EPA has used the abbreviations NC and ND to indicate the censoring types.

The distinction between the two censoring types is important because the procedure used to determine the variability factors considers censoring type explicitly. The variability factor estimation procedure models the facility data sets using the modified delta-lognormal distribution. In this distribution, data are modeled as a mixture of two distributions. Thus, EPA concluded that the distinctions between detected and non-detected measurements were important and should be an integral part of any data aggregation procedure. (See Appendix G for a detailed discussion of the modified delta-lognormal distribution.)

Because each aggregated data value entered into the modified delta-lognormal model as a single value, the censoring type associated with that value was also important. In many cases, a single aggregated value was created from unaggregated data that were all either detected or non-detected. In the remaining cases with a mixture of detected and non-detected unaggregated values, EPA determined that the resulting aggregated value should be considered as detected, because the pollutant was measured at detectable levels.

This section describes each of the different aggregation procedures. They are presented in the order that the aggregation was performed. That is, field duplicates were aggregated first and grab samples second.

13.2.1 Aggregation of Field Duplicates

During the EPA sampling episodes, the Agency collected a small number of field duplicates. Generally, ten percent of the number of samples collected were duplicated. Field duplicates are two samples collected for the same sampling point at approximately the same time, assigned different sample numbers, and flagged as duplicates for a single sample point at a facility.

Because the analytical data from each duplicate pair characterize the same conditions at that time at a single sampling point, EPA aggregated the data to obtain one data value for those conditions. The data value associated with those conditions was the arithmetic average of the duplicate pair.

Frequently, both samples in duplicate pair displayed the same censoring type. In this case, the censoring type of the aggregate was the same as the duplicates. When one sample in the duplicate pair was a non-censored and the other a non-detected type, EPA assigned the aggregated value as ‘non-censored’ because the pollutant had been present in one sample. (Even if the other duplicate had a zero value[2], the pollutant still would have been present had the samples been physically combined.) Table 13-1 summarizes the procedure for aggregating the analytical results from the field duplicates. This aggregation step for the duplicate pairs was the first step in the aggregation procedures for both influent and effluent measurements.

[2] This is presented as a ‘worst-case’ scenario. In practice, the laboratories cannot measure ‘zero’ values. Rather they report that the value is less than some level.

Table 13-1. Method for Aggregation of Field Duplicates

If the field duplicates are:	Censoring type of average is:	Value of aggregate is:	Formulas for aggregate value of duplicates:
Both non-censored	NC	arithmetic average of measured values	$(NC_1 + NC_2)/2$
Both non-detected	ND	arithmetic average of sample-specific detection limits	$(DL_1 + DL_2)/2$
One non-censored and one non-detected	NC	arithmetic average of measured value and sample-specific detection limit	(NC + DL)/2

NC - non-censored (or detected). ND - non-detected. DL - sample-specific detection limit.

13.2.2 Aggregation of Grab Samples

During the EPA sampling episodes, the Agency collected two types of samples: grab and composite. Typically, EPA collected composite samples. Of the pollutants proposed for regulation, HEM was the only one for which the chemical analytical method specifies that grab samples must be used. For HEM, EPA collected multiple (usually four) grab samples during a sampling day at a sample point. To obtain one value characterizing the pollutant levels at the sample point on a single day, EPA mathematically aggregated the measurements from the grab samples.

The procedure arithmetically averaged the measurements to obtain a single value for the day. When one or more measurements were non-censored, EPA determined that the appropriate censoring type of the aggregate was ‘non-censored’ because the pollutant was present. Table 13-2 summarizes the procedure.

13.3 DERIVATION OF TOTAL NITROGEN CONCENTRATIONS

Since total nitrogen was not analyzed, its daily concentrations were obtained as the sum of nitrate/nitrite (C005) and total Kjeldahl nitrogen (C021) before aggregation. If one of two values was non-censored, the censoring type of total nitrogen was non-censored. Any non-detect values were set as equal to the sample-specific detection limit in the sum.

Table 13-2. Procedure for Aggregation of Grab Samples

If the grab or multiple samples are:	Censoring type of Daily Value is:	Daily value is:	Formulas for Calculating Daily Value:
All non-censored	NC	arithmetic average of measured values	$\frac{\sum_{i=1}^{n} NC_i}{n}$
All non-detected	ND	arithmetic average of sample-specific detection limits	$\frac{\sum_{i=1}^{n} DL_i}{n}$
Mixture of non-censored and non-detected values (total number of observations is n=k+m)	NC	arithmetic average of measured values and sample-specific detection limits	$\frac{\sum_{i=1}^{k} NC_i + \sum_{i=1}^{m} DL_i}{n}$

NC - non-censored (or detected). ND - non-detected. DL - sample-specific detection limit.

13.4 DERIVATION OF EFFLUENT CONCENTRATION DATA

To the extent possible with available data, EPA calculated the proposed limitations for first processing, further processing, and rendering operations wastewater for each technology option from the daily effluent concentrations at the sampled facility or facilities chosen as representative of the technology option. However, when specific data were unavailable, EPA estimated the daily effluent concentrations for the model technology options, using assumptions similar to those applied during pollutant loading calculations explained in Section 9. This section describes the methodology used to estimate the daily effluent concentrations for the model technology options.

13.4.1 Calculation of Daily Effluent Concentrations

When influent data were available, they were multiplied by a removal fraction for the technology option. When there were more than one facility that could provide a removal fraction, the median of the removal fractions was used. The daily effluent concentrations were calculated as follows:

Effluent concentration = (influent concentration) x (1 - removal fraction) where the removal fraction for a facility was calculated using long-term averages (LTAs) as follows:

(influent LTA concentration - effluent LTA concentration) / (influent LTA concentration).

The calculation of long-term averages is discussed in Section 13.8. The facilities with negative removal fractions were excluded from calculations for the limitations for that specific analyte.

When there were no influent data available, the daily effluent concentrations were derived based on an estimation of the pollutant mass balance between the final effluent and its unit processes of first, further, and rendering wastewaters (as applicable for a facility). For example, the daily effluent concentrations for first processing wastewater could be derived from:

> Daily effluent concentration of first processing wastewater = [(Final daily effluent concentration x Total flow) - (Daily concentration of further processing wastewater[3] x Further processing wastewater flow) - (Daily concentration of rendering wastewater[3] x Rendering wastewater flow)] / (First processing wastewater flow)

The data and equations used to derive the daily effluent concentration values are summarized by technology options in Tables 13-3 through 13-7.

[3] If the daily concentrations for this unit process were from a different facility than the final effluent concentrations, the long-term average of the concentrations for the unit process was used instead of daily values.

Table 13-3. Data and Equations to Derive Technology Option Daily Effluent Concentrations for First Processing, Further Processing, and Rendering Operations Treated Wastewaters for Direct Discharging Meat Facilities (BAT-2 Technology Option)

	First Processing		Further Processing		Rendering Operations		
Facility	**D_1=Daily Effluent Concentrations**	**F_1=Flow (MGD)**	**D_2=Daily Effluent Concentrations**	**F_2=Flow (MGD)**	**D_3=Daily Effluent Concentrations**	**F_3= Flow (MGD)**	**Total Flow (MGD)**
6440	[(Daily effluent • Total Flow) - (LTA of D_3• F_3)] / F_1	0.83	N/A	N/A	(a) • (rendering influent@6447)	0.52	1.35
6441	[(Daily effluent • Total Flow) - (LTA of D_3• F_3)] / F_1	1.31	N/A	N/A	(a) • (rendering influent@6447)	0.48	1.79
6442	[(Daily effluent • Total Flow) - (LTA of D_3• F_3)] / F_1	1.53	N/A	N/A	(a) • (rendering influent@6447)	0.42	1.95
6447	[(Daily effluent • Total Flow) - (LTA of D_2• F_2)-(D_3 • F_3)] / F_1	0.51	(a) • (further processing influent@6335)	0.07	(a) • (rendering influent@6447)	0.15	0.73

(a) = (1- Removal fraction) where the Removal fraction is the median removal fraction of sampling episodes 6440, 6441, 6442 and 6447.

Table 13-4. Data and Equations to Derive Technology Option Daily Effluent Concentrations for First Processing, Further Processing, and Rendering Operations Treated Wastewaters for Direct Discharging Meat Facilities (BAT-3 Technology Option)

	First Processing		Further Processing		Rendering Operations		
Facility	**D_1=Daily Effluent Concentrations**	**F_1=Flow (MGD)**	**D_2=Daily Effluent Concentrations**	**F_2=Flow (MGD)**	**D_3=Daily Effluent Concentrations**	**F_3=Flow (MGD)**	**Total Flow (MGD)**
6335	[(reuse water daily effluent • Total Flow) -(D_2 • F_2) - (LTA of D_3 • F_3)] / (F_1)	0.17	(b) • (further processing daily influent)	0.45	(b) • (rendering daily influent@6447)	0.13	0.75

(b) = 1 - Removal fraction of sampling episode 6335 (through reuse water effluent)

Table 13-5. Data and Equations to Derive Daily Effluent Concentrations for First Processing, Further Processing, and Rendering Operations Treated Wastewaters for Direct Discharging Poultry Facilities (BAT-2 Technology Option)

Facility	First Processing) Daily Effluent Concentrations	Further Processing Daily Effluent Concentrations	Rendering Operations Daily Effluent Concentrations
6443	N/A	(a) • further processing influent	N/A
6444	N/A	(a) • further processing inffluent	N/A
6448	N/A	N/A	(a) • rendering influent
6445	Daily effluent	N/A	N/A

(a) = 1 - Removal fraction @ 6445

Table 13-6. Data and Equations to Derive Daily Effluent Concentrations for First Processing, Further Processing, and Rendering Operations Treated Wastewaters for Indirect Discharging Meat Facilities (PSES-1 Technology Option)

Facility	First Processing		Further Processing		Rendering Operations		Total Flow (MGD)
	D_1=Daily Effluent Concentrations	F_1=Flow (MGD)	D_2=Daily Effluent Concentrations	F_2=Flow (MGD)	D_3=Daily Effluent Concentrations	F_3=Flow (MGD)	
6335	[(Daily effluent • (Total Flow) - (D_2 • F_2) - (LTA of D_3 • F_3)] / F_1	0.17	(b) • further processing influent	0.45	(b) • (rendering influent@6447)	0.13	0.75

(b) = 1 - Removal fraction @ 6335

Table 13-7. Data and Equations to Derive Daily Effluent Concentrations for First Processing, Further Processing, and Rendering Operations Treated Wastewaters for Indirect Discharging Poultry Facilities (PSES-1 Technology Option)

Facility	First Processing		Further Processing		Rendering Operations		Total Flow (MGD)
	D1=Effluent Concentrations	F1=Flow (MGD)	D2=Effluent Concentrations	F2=Flow (MGD)	D3=Effluent Concentrations	F3=Flow (MGD)	
6448	N/A	N/A	N/A	N/A	(a) • Rendering Daily Effluent	N/A	N/A
6443	[(Daily effluent• Total Flow) - (D2 •F2)] / F1	0.91	(a) • (further processing daily influent)	0.84	N/A	N/A	1.75
6444	[(Daily effluent • Total Flow) - (D2 • F2)] / F1	0.53	(a) • (further procssing daily influent)	0.02	N/A	N/A	0.55

(a) = (1 - Removal fraction of 6443)

13.4.2 Censoring Type of Calculated Effluent Concentrations

When assigning the censoring type to the calculated concentration, EPA first determined the "lowest potential value" for each analyte. The lowest potential value is the minimum of the lowest detected (non-censored) value and the minimum of the nominal quantitation limits as defined in Appendix A. (Ammonia as nitrogen was the only one instance where the lowest detected value was less than the minimum of the nominal quantitation limits.) Each daily influent or effluent value was then compared to this lowest potential value. If the calculated value was less than the lowest potential value, the censoring type of this value was considered to be non-detect with a sample-specific detection limit equal to the lowest potential value. For example, suppose the influent concentration is non-censored. If the lowest potential value is 10 mg/L and the calculated effluent concentration is 7.5 mg/L, the effluent concentration is considered as a non-detected at a detection limit 10 mg/L. If the calculated value was greater than the lowest potential value, one of the following two methods of substitution was made.

Method 1: When the effluent concentration was calculated as a product of the proportion of residual pollutant concentration after treatment and the influent concentration of the sample point, the calculated effluent concentration was assigned the censoring type of the influent sample. Table 13-8 provides an example of the final censoring type using this method where the lowest potential value is 10 and the removal fraction is 50 percent.

Table 13-8. Example of Final Data Censoring Type Using Method 1

Influent Concentration		Effluent Concentration		
Amount	Censoring Type	Influent Concentration *(1-Removal Fraction)	Final Calculated Amount	Censoring Type
10	ND	5	10	ND
20	NC	10	10	NC
22	ND	11	11	ND

Method 2: When the effluent concentration method was calculated based on a facility pollutant mass balance between the final effluent and its unit processes of first, further, and rendering wastewaters (as applicable), it had the censoring type associated with the initial

effluent concentration. Table 13-9 provides an example of the final censoring type using this method where the lowest potential value is 10 and the removal fraction is 50 percent.

Table 13-9. Example of Final Data Censoring Type Using Method 2

Initial Effluent Concentration		Further Processing Effluent	Rendering Effluent	Calculated Effluent Concentration[a]	Final Calculated Effluent Concentration	
Amount	Censoring Type				Amount	Censoring Type
15	NC	10	20	8.75	10	ND
10	ND	10	24	9.70	10	ND
100	ND	10	40	136	136	ND
20	NC	10	10	25.78	25.78	NC

[a] Calculated Effluent Concentration=(Initial Effluent *0.73 - Further Processing Effluent*0.7- (1-Removal Fraction)*Rendering Effluent * 0.15) /0.51

13.5 DATA ADJUSTMENT

Once the daily effluent concentration for a facility was calculated, the data value was compared to the long-term average (LTA) of the actual measured effluent for that facility. When the calculated concentration was less than the LTA, it was replaced by the LTA. After a thorough review of the calculated effluent concentrations, EPA adjusted several of the concentration values when the calculation methodology resulted in effluent concentrations that were generally lower than documented performance values for the technology or lower than actual effluent concentrations. More specifically, the methodology used by EPA in the absence of effluent data for a particular meat or poultry process type was dependent at times on the transfer of data and treatment system performance from different facilities. There were instances when this methodology resulted in calculated concentrations that were below what EPA considered to be reasonable or realistic. In evaluating whether a derived effluent value was reasonable or realistic, EPA compared the data to expected ranges of effluent concentrations as provided in the technical literature.[4] EPA also ensured that a derived effluent data for a particular process type (i.e., first processing, further processing, or rendering) were never lower than the actual effluent concentration as reported in the sampling episodes.

[4] EPA particularly used the ranges presented in "Wastewater Engineering: Treatment, Disposal and Reuse" Metcalf & Eddy, 1995 for each technology option.

13.6 OVERVIEW OF LIMITATIONS

The following sections discuss the data selected as the basis for the proposed limitations, the data aggregation procedures, and the methodology used to obtain daily values for limitations. This section describes EPA's objective for daily maximum and monthly average limitations, the selection of percentiles for those limitations, and compliance with final limitations. EPA has included this discussion because these fundamental concepts are often the subject of comments on EPA's proposed effluent guidelines regulations and in EPA's contacts and correspondence with the industry.

13.6.1 Objective

In establishing daily maximum limitations, EPA's objective is to restrict the discharges on a daily basis at a level that is achievable for a facility that targets its treatment at the long-term average. EPA acknowledges that variability around the long-term average results from normal operations. This variability means that occasionally facilities may discharge at a level that is greater than the long-term average. This variability also means that facilities may occasionally discharge at a level that is considerably lower than the long-term average. To allow for these possibly higher daily discharges, EPA has established the daily maximum limitation. A facility that discharges consistently at a level near the daily maximum limitation would <u>not</u> be operating its treatment to achieve the long-term average, which is part of EPA's objective in establishing the daily maximum limitations. That is, targeting treatment to achieve the limitations may result in frequent values exceeding the limitations due to routine variability in treated effluent.

In establishing monthly average limitations, EPA's objective is to provide an additional restriction to help insure that facilities target their average discharges to achieve the long-term average. The monthly average limitation requires continuous dischargers to provide on-going control, on a monthly basis, that complements controls imposed by the daily maximum limitation. In order to meet the monthly average limitation, a facility must counterbalance a value near the daily maximum limitation with one or more values well below the daily maximum limitation. To achieve compliance, these values must result in a monthly average value at or below the monthly average limitation.

13.6.2 Selection of Percentiles

EPA calculates limitations based upon percentiles chosen with the intention, on one hand, to be high enough to accommodate reasonably anticipated variability within control of the facility and, on the other hand, to be low enough to reflect a level of performance consistent with the Clean Water Act requirement that these effluent limitations be based on the "best" technologies. The daily maximum limitation is an estimate of the 99th percentile of the distribution of the *daily* measurements. The monthly average limitation is an estimate of the 95th percentile of the distribution of the *monthly* averages of the daily measurements.

The 99th and 95th percentiles do not relate to, or specify, the percentage of time a discharger operating the "best available" or "best available demonstrated" level of technology will meet (or not meet) the limitations. Rather, the use of these percentiles relate to the development of limitations. (The percentiles used as a basis for the limitations are calculated using the products of the long-term averages and the variability factors as explained in the next section.) If a facility is designed and operated to achieve the long-term average on a consistent basis and the facility maintains adequate control of its processes and treatment systems, the allowance for variability provided in the limitations is sufficient to meet the requirements of the proposed rule. The use of 99 percent and 95 percent represents a need to draw a line at a definite point in the statistical distributions (100 percent is not feasible because it represents an infinitely large value) and a policy judgment about where to draw the line that would ensure that operators work hard to establish and maintain the appropriate level of control. In essence, in developing the proposed limitations, EPA has taken into account the reasonable anticipated variability in discharges that may occur at a well-operated facility. By targeting its treatment at the long-term average, a well-operated facility should be capable of complying with the limitations at all times because EPA has incorporated an appropriate allowance for variability into the limitations.

While the actual monitoring requirements will be determined by the permitting authority, the Agency has assumed thirty samples per month (i.e., daily monitoring) in determining the proposed maximum monthly average limitations. EPA recognizes that small poultry facilities are unlikely to operate on weekends and is soliciting comment on whether their monthly limitations should be based upon 20 days. Increasing or decreasing monitoring frequency does not affect the statistical properties of the underlying distribution of the data used to derive the limitations. However, monitoring less frequently theoretically results in average values that are more variable. As a consequence, average values based on 20 monitoring samples per month from small poultry facilities theoretically could be numerically larger than average values based upon 30 monitoring samples from non-small facilities. Thus, operators of small poultry facilities may find they need to design treatment systems to achieve an average below the long term average basis of the proposed limitations and/or more control over variability of the discharges in order to maintain compliance with the limitations. Attachment 13-5 in Appendix H provides a list of both the proposed limitations and those derived using a 20-day monitoring assumption.

In conjunction with the statistical methods, EPA performs an engineering review to verify that the limitations are reasonable based upon the design and expected operation of the control technologies and the facility process conditions. As part of that review, EPA examines the range of performance by the facility data sets used to calculate the limitations. Some facility data sets demonstrate the best available technology. Other facility data sets may demonstrate the same technology, but not the best demonstrated design and operating conditions for that technology. For these facilities, EPA will evaluate the degree to which the facility can upgrade its design, operating, and maintenance conditions to meet the limitations. If such upgrades are not possible, then the limitations are modified to reflect the lowest levels that the technologies can reasonably be expected to achieve.

13.6.3 Compliance with Limitations

EPA promulgates limitations that facilities are capable of complying with at all times by properly operating and maintaining their processes and treatment technologies. However, the issue of exceedances[5] or excursions is often raised by comments on proposed limitations (as has been the Agency's experience with proposals for other industries). For example, comments

[5] Values that exceed the limitations

often suggest that EPA include a provision that a facility is in compliance with permit limitations if its discharge does not exceed the specified limitations, with the exception that the discharge may exceed the monthly average limitations one month out of 20 and the daily average limitations one day out of 100. This issue was, in fact, raised in other rules, most notably in EPA's final Organic Chemicals, Plastics, and Synthetic Fibers (OCPSF) rulemaking. EPA's general approach there for developing limitations based on percentiles is the same in this proposal, and was upheld in Chemical Manufacturers Association v. U.S. Environmental Protection Agency, 870 F.2d 177, 230 (5th Cir. 1989). The Court determined that:

> EPA reasonably concluded that the data points exceeding the 99th and 95th percentiles represent either quality-control problems or upsets because there can be no other explanation for these isolated and extremely high discharges. If these data points result from quality-control problems, the exceedances they represent are within the control of the plant. If, however, the data points represent exceedances beyond the control of the industry, the upset defense is available.
>
> Id. at 230.

EPA's allowance for reasonable anticipated variability in its effluent limitations, coupled with the availability of the upset defense reasonably accommodates acceptable excursions. Any further excursion allowances would go beyond the reasonable accommodation of variability and would jeopardize the effective control of pollutant discharges on a consistent basis and/or bog down administrative and enforcement proceedings in detailed fact finding exercises, contrary to Congressional intent. See, e.g., Rep. No. 92-414, 92nd Congress, 2nd Sess. 64, reprinted in A Legislative History of the Water Pollution Control Act Amendments of 1972 at 1482; Legislative History of the Clean Water Act of 1977 at 464-65.

13.6.4 Summary of Proposed Limitations

The proposed limitations for pollutants for each option are provided as 'daily maximums' and 'maximums for monthly averages'. Definitions provided in 40 CFR 122.2 state that the daily maximum limitation is the "highest allowable 'daily discharge'" and the maximum for monthly average limitation (also referred to as the "monthly average limitation") is the "highest allowable average of 'daily discharges' over a calendar month, calculated as the sum of all 'daily discharges' measured during a calendar month divided by the number of 'daily discharges' measured during that month." Daily discharges are defined to be the "'discharge of a pollutant' measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of samplings." EPA has proposed daily maximum and monthly average limitations expressed in terms of allowable pollutant discharge (pounds) per unit of production (Live-Weight Killed, Finished Products, Raw Materials). In this document and elsewhere, EPA refers to such limitations as 'production-normalized.' EPA has proposed production-normalized limitations in terms of daily maximums, maximums for 20-day averages (poultry facilities only), and maximum for monthly averages.

To derive the proposed production-normalization limitations, EPA used the modified delta-lognormal distribution to develop limitations based upon the concentration data ("concentration-based limitations"). Sections 13.7 through13.10 describe the calculations for the concentration-based limitations. Section 13.11 describes the conversion of these limitations to "production-normalized limitations" using the model flow rates described in Section 11.

13.7 ESTIMATION OF CONCENTRATION-BASED LIMITATIONS

In estimating the concentration-based limitations, EPA determines an average performance level (the "option long-term average" discussed in the next section) that a facility with well-designed and operated model technologies (which reflect the appropriate level of control) is capable of achieving. This long-term average is calculated from the data from the facilities using the model technologies for the option. EPA expects that all facilities subject to the limitations will design and operate their treatment systems to achieve the long-term average performance level on a consistent basis because facilities with well-designed and operated model technologies have demonstrated that this can be done.

In the second step of developing a limitation, EPA determines an allowance for the variation in pollutant concentrations when processed through extensive and well designed treatment systems. This allowance for variance incorporates all components of variability including shipping, sampling, storage, and analytical variability. This allowance is incorporated into the limitations through the use of the variability factors (the "option variability factor" discussed in Section 13.9) which are calculated from the data from the facilities using the model technologies. If a facility operates its treatment system to meet the relevant long-term average, EPA expects the facility will be able to meet the limitations. Variability factors assure that normal fluctuations in a facility's treatment are accounted for in the limitations. By accounting for these reasonable excursions above the long-term average, EPA's use of variability factors results in limitations that are generally well above the actual long-term averages.

Facilities that are designed and operated to achieve long-term average effluent levels used in developing the limitation should be capable of compliance with the proposed limitations, which incorporate variability, at all times.

The following sections describe the calculation of long-term averages and variability factors.

13.8 ESTIMATION OF LONG-TERM AVERAGE CONCENTRATIONS

This section discusses the calculation of LTAs for each sample episode ("episode-specific LTA") and for each technology option ("option LTA") for each pollutant. The LTAs discussed in this section were used to develop the proposed limitations.

For each technology option being considered, EPA calculated LTAs that represent the best performing facilities (from the respective of types of treatment in-place and degree of expected pollutant removals). For purposes of proposal, EPA relied on EPA sampling episode data to calculate LTAs. EPA calculated LTAs for the following six meat and poultry processes:

- first processing (meat);
- further processing (meat);
- rendering (meat);
- first processing (poultry);
- further processing (poultry); and
- rendering (poultry).

LTAs were derived for each of the above six meat and poultry processes from effluent concentration data collected during the sampling episodes. Specifically, for each technology option being considered, effluent concentration data from representative facilities were used to derive LTAs for each pollutant of concern. Consistent with the methodology described in Section 9.2, in the absence of data for a particular meat and poultry process at a facility, EPA used the derived effluent concentration data.

13.8.1 Episode-specific Long-Term Average Concentrations

EPA calculated the episode-specific long-term average by using either the modified delta-lognormal distribution or the arithmetic average (see Appendix G). In Appendix H, EPA has listed the arithmetic average (column labeled 'Obs Mean') and the estimated episode-specific long-term average (column labeled 'Est LTA'). If EPA used the arithmetic average as the episode long-term average, then the two columns have the same value.

13.8.2 Option Long-Term Averages

EPA calculated the option long-term average for a pollutant as the *median* of the episode-specific long-term averages for that pollutant from selected episodes with the technology basis for the option. The median is the midpoint of the values ordered (i.e., ranked) from smallest to largest. If there is an odd number of values (with n=number of values), then the value of the (n+1)/2 ordered observation is the median. If there are an even number of values, then the two values of the n/2 and [(n/2)+1] ordered observations are arithmetically averaged to obtain the median value.

For example, for subcategory Y option Z, if the four (i.e., n=4) episode-specific long-term averages for pollutant X are:

Facility	Episode-Specific Long-Term Average
A	20 mg/L
B	9 mg/L
C	16 mg/L
D	10 mg/L

then the ordered values are:

Order	Facility	Episode-Specific Long-Term Average
1	B	9 mg/L
2	D	10 mg/L
3	C	16 mg/L
4	A	20 mg/L

And the pollutant-specific long-term average for option Z is the median of the ordered values (i.e., the average of the 2nd and 3rd ordered values): (10+16)/2 mg/L = 13 mg/L.

The option long-term averages were used in developing the proposed limitations for each pollutant within each regulatory option.

13.8.3 Substitution of LTAs

In a limited number of cases, EPA used substitutions for the calculated option-level LTAs because data existed that indicated the technology option performed at these levels (or better) at MPP facilities. Table 13-10 summarizes the option-level LTA substitutions. For poultry further processing BAT-2, the option LTA of TSS was substituted with 9.76 mg/L, which was the largest value reported in the MPP detailed survey for poultry facilities with further processing operations and implementing BAT-2 level treatment technology. For poultry rendering operation BAT-2, the option LTA of HEM was substituted with 19.5 mg/L, which was the largest value reported in the MPP detailed survey for poultry facilities with rendering operations and implementing BAT-2 level treatment technology. Finally, for poultry rendering operation BAT-1, the option LTA for COD was substituted with the average effluent from a poultry facility performing rendering operations.

Table 13-10. Substitution Values for Option-Level LTA

Pollutant	Substitution Value (mg/L)	Subcategory	Option	Calculated Option LTA (mg/L)	Source of Substitution Value
TSS	9.76	Poultry further processing	BAT-2	537.56	Largest concentration reported value in MPP survey data for poultry facilities with further processing operations at BAT-2.
HEM	19.5	Poultry rendering	BAT-2	334.96	Largest concentration reported value in MPP survey data for poultry facilities with rendering operations at BAT-2.
COD	29.64	Poultry rendering	BAT-2	168.92	Average concentration of treated rendering effluent at sampling episode 6448

13.8.4 Calculation of Poultry BAT-3 Option-Level Long-Term Averages

For poultry BAT-3, the technology option was not represented in the sampling episodes of poultry facilities. Thus, the option LTAs were calculated assuming that the removal fractions between different technology option levels would be the same for meat and poultry facilities (i.e., the removal fraction between meat BAT-2 and meat BAT-3 treatment options would be the same as the removal fraction between poultry BAT-2 and poultry BAT-3 treatment options). Thus, the removal fractions were calculated as follows:

Removal Fraction = (Option LTA from Meat BAT-2- Option LTA from Meat BAT-3)/ Option LTA from Meat BAT-2.

The resulting removal fraction would then be applied to the treated pollutant concentrations calculated for the technology option BAT-2 to obtain the option long-term averages as follows:

LTA = (Option LTA from Poultry BAT-2)*(1-Removal Fraction).

If the LTA was less than the option level LTA of the actual sampled effluent data used for Meat Option 3, it was replaced by the option level LTA of the actual sampled effluent data used for Meat BAT-3. The formula for the option level LTA for the option BAT-3 of Poultry is provided in Table 13-11.

Table 13-11. Formulas for Calculating BAT-3 Technology Option Level LTA for Poultry Facilities

	First Processing	Further Processing	Rendering Operations
RF = Removal Fraction	[(Option LTA of First Processing Meat BAT-2) - (Option LTA of First Processing Meat BAT-3)]/Option LTA of First Processing Meat BAT-2	[(Option LTA of Further Processing Meat BAT-2) - (Option LTA of Further Processing Meat BAT-3)]/Option LTA of Further Processing Meat BAT-2	[(Option LTA of Rendering Operation Meat BAT-2) - (Option LTA of Rendering Operation Meat BAT-3)]/Option LTA of Rendering Operation Meat BAT-2
Option LTA	(1 - RF) • (Option LTA of First Processing Poultry BAT-2)	(1 - RF) • (Option LTA of Further Processing Poultry BAT-2)	(1 - RF) • (Option LTA of Rendering Operation Poultry BAT-2)

13.8.5 Calculation of Independent Rendering BAT-2 Option-Level Long-Term Averages

The option level LTA for the independent rendering facilities was calculated as the average of the option level LTAs of rendering process from Meat BAT-2 and Poultry BAT-2. The formula for the option level LTA for the independent LTA is

Option LTA = [(Option LTA of Rendering Operation Meat BAT-2)+(Option LTA of Rendering Operation Meat BAT-2)]/2.

13.8.6 Adjustments to Option Long-Term Averages

To ensure that the option BAT-2 LTAs were no more stringent than the BAT-3 option LTAs, a comparison was made between the BAT-2 option LTAs and the BAT-3 option LTAs. BAT-2 option LTAs were substituted with BAT-3 option LTAs whenever they were more stringent than the corresponding BAT-3 option LTA. Table 13-12 identifies the cases for which the BAT-3 value was substituted for the calculated BAT-2 long-term average.

Table 13-12. BAT-2 Option LTA Substitutions

Subcategory	Process	Pollutant	Calculated Option BAT-2 LTA (mg/L)	Calculated Option BAT-3 LTA(mg/L)	Final Option BAT-2 LTA (mg/L)[a]
Poultry	First Processing	Ammonia as Nitrogen	0.25	2.34	2.34
		Biochemical Oxygen Demand	2.00	4.68	4.68
		Fecal Coliform	4.63	21.50	21.50
		Total Kjeldahl Nitrogen	1.61	2.08	2.08
		Total Phosphorus	0.77	6.97	6.97
		Total Residual Chlorine	0.22	15.96	15.96
	Further Processing	Ammonia As Nitrogen	0.85	2.34	2.34
		Fecal Coliform	4.63	21.50	21.50
	Rendering	Biochemical Oxygen Demand	2.16	4.68	4.68
		Fecal Coliform	5.60	21.50	21.50
		Total Phosphorus	2.55	6.97	6.97
Meat	First Processing	Ammonia As Nitrogen	0.70	3.75	3.75
	Further Processing	Ammonia As Nitrogen	0.52	2.34	2.34
	Rendering	Ammonia As Nitrogen	1.29	2.34	2.34
		Biochemical Oxygen Demand	6.92	8.35	8.35

[a] These values represent the LTAs that were subsequently used by EPA for deriving effluent limitations.

13.9 CALCULATION OF OPTION VARIABILITY FACTORS

In developing the option variability factors used in calculating the proposed limitations, EPA first developed daily and monthly episode-specific variability factors using the modified delta-lognormal distribution. The variability factors were estimated from the daily effluent data of the facility used to compute the episode-specific LTA's. This estimation procedure is described in Appendix G.

After calculating the episode-specific variability factors, EPA calculated the option daily variability factor as the *mean* of the episode-specific daily variability factors for that pollutant in the subcategory and option. Likewise, the option monthly variability factor was the mean of the episode-specific monthly variability factors for that pollutant in the subcategory and option. For poultry BAT-3, the option variability factors were transferred from the meat BAT-3 because, as described in Section 13.8.4 the technology option was not represented in the sampling episodes of poultry facilities. Because the BAT-3 technology options are the same for meat and poultry, EPA expects the variability to be similar, and thus transferred the variability factors from the meat BAT-3 dataset. Additionally, the variability factors for Independent Rendering BAT-2 were calculated as the average of option VF's from BAT-2 Meat and BAT-2 Poultry because the LTA was based on the average of option LTAs from BAT-2 Meat and BAT-2 Poultry.

13.9.1 Transfers of Option Variability Factors

After estimating the option variability factors, EPA identified several pollutants for which variability factors could not be calculated in some options. This resulted when all episode datasets for the pollutant in the option had too few detected measurements to calculate episode-specific variability factors (see data requirements in Appendix G). For example, if a pollutant had all non-detected values for all of the episodes in an option, then it was not possible to calculate option variability factors. When EPA could not calculate the option variability factors or determined that the calculated option variability factors should be replaced, EPA selected variability factors from other sources to provide an adequate allowance for variability in the proposed limitations. This section describes these cases.

Table 13-13 lists the pollutants for which EPA was unable to calculate option variability factors. For biochemical oxygen demand in Poultry BAT-2, EPA transferred the option variability factors from the Poultry BAT-3. EPA expects that these two options would have similar variability in the effluent concentrations. Likewise for HEM in Poultry BAT-2 and BAT-3 and Meat BAT-3, EPA transferred the variability factors from Meat BAT-2. For ammonia (as N), the variability factors for Poultry BAT-2 were transferred from Poultry BAT-3. EPA determined that the variability factors were unlikely to be more variable than the Poultry BAT-3. For total nitrogen, EPA transferred the option variability factors for total Kjeldahl nitrogen (TKN) from the same option because EPA did not calculate daily total nitrogen values. (Daily values are needed to calculate variability factors.) However, EPA had developed variability factors for the two pollutants, TKN and nitrate/nitrite, which are summed to obtain total nitrogen. Because TKN was the more variable of the two pollutants, EPA selected those variability factors to use in developing the total nitrogen limitations. EPA expects that total nitrogen would be no more variable than TKN.

Table 13-13. Cases where Option Variability Factors Could Not be Calculated

Pollutant	Technology Option	Source of Variability Factors
Biochemical oxygen demand	Poultry BAT-2	Poultry BAT 3
HEM	Poultry BAT-2	Meat BAT-2
	Poultry BAT-3	Meat BAT-2
	Meat BAT-3	Meat BAT-2
Ammonia (as N)	Poultry BAT-2	Poultry BAT-3
Total nitrogen	All technology options	TKN from the same option

13.10 SUMMARY OF STEPS USED TO DERIVE CONCENTRATION-BASED LIMITATIONS

This section summarizes the steps used to derive the proposed concentration-based limitations. For each pollutant in an option for each type of processing operation (first processing, further processing, and rendering), EPA performed the following steps in calculating the proposed concentration-based limitations:

Step 1: EPA calculated the *episode-specific long-term averages* and *daily and monthly variability factors* for all selected episodes with the model technology for the option for each type of processing operation. (See Attachment 13-2 in Appendix H for episode-specific long-term averages and variability factors.)

Step 2: EPA calculated the *option long-term average* as the median of the episode-specific long-term averages. (See Attachment 13-3 in Appendix H.)

Step 3: EPA calculated the *option variability factors* for each pollutants as the mean of the episode-specific variability factors from the episodes with the model technology. (See Appendix 13-3 in Appendix H.) The option daily variability factor is the mean of the episode-specific daily variability factors. Similarly, the option monthly variability factor is the mean of the episode-specific monthly variability factors.

Step 4: For the pollutants for which Steps 1 and 3 failed to provide option variability factors, EPA determined variability factors on a case-by-case basis. (See Table 13-13.)

Step 5: EPA calculated each proposed concentration-based *daily maximum limitation* for a pollutant using the product of the option long-term average and the option daily variability factor. (See Attachment 13-3 in Appendix H.)

Step 6: EPA calculated each proposed concentration-based *monthly average limitation* for a pollutant using the product of the option long-term average and the option monthly variability factor. (See Attachment 13-3 in Appendix H.)

The next section describes the conversion of the concentration-based limitations to the production-normalized limitations that are provided in the proposed regulation.

13.11 CONVERSION TO PRODUCTION-NORMALIZED LIMITATIONS

The previous discussions about the limitations were based upon concentration data. The proposed pollutant limitations are presented in terms of pounds of allowable pollutant discharge per 1,000 pounds of production units (lbs/1000 lbs). This section describes the conversion from concentration-based limitations to the production-normalized limitations in the proposed regulation. This section also provides EPA's methodology for determining the number of significant digits to use for the proposed production-normalized limitations.

13.11.1 Calculation of Production Normalized Limitations

In calculating the proposed production-normalized limitations, EPA used the concentration-based limitations, the production flow rates, and a conversion factor. The concentration-based limitations were calculated as described in the previous section and are listed in Attachment 13-3 in Appendix H. The following paragraphs briefly describe the production flow rates and the conversion factors used to calculate the production-normalized limitations.

The production flow rates used in the calculation are expressed as production-normalized flow rates (PNFs) in terms of gallons of water discharged per 1,000 pound of production units.[6] The production-normalized flow rates are provided in Attachment 13-4 in Appendix H. EPA used the following conversion factor:

$$conversion\ factor = \frac{3.7854\,L}{gal} \times \frac{lb}{453.593 \times 10^{3}\ mg} = 8.3454 \times 10^{n6}\ \frac{L/gal}{mg/lb}$$

The conversion factor assumes that the concentration-based limitations are expressed as milligrams per liter (mg/L). EPA used the production flows and the conversion factor to calculate each production-normalized limitation using the following basic equation:

Production-normalized limitation = Concentration-based limitation × Production-normalized flow rate × conversion factor

The following is an example of applying a conversion factor to the concentration-based limits:

For Meat First Processing technology option, suppose the concentration based daily maximum limitation is 0.1 mg/L. Using the production flow rate of 322.8 gal/1000 lb-LWK (Live-Weight Killed), the production-normalized daily maximum limitation for the First Processing Meat subcategory is:

$$LTA_{pn} = \frac{0.1\,mg}{L} \times \frac{322.8\ gal}{1000 lb - LWK} \times 8.3454 \times 10^{-3}\ \frac{L\ /\ gal}{mg\ /\ lb} = 0.2694\,\frac{lb}{1000\ lb - LWK}$$

[6] Production units include live weight killed (LWK) for first processing, finished product (FP) for further processing, and raw material (RM) for rendering.

13.11.2 Significant Digits for Production-Normalized Limitations

After completing the conversions described in the previous section, EPA rounded the proposed production-normalized limitations to three significant digits. EPA used a rounding procedure where values of five and above are rounded up and values of four and below are rounded down. For example, a value of 0.003455 would be rounded to 0.00346, while a value of 0.003454 would be rounded to 0.00345. The production-normalized limitations listed in Attachment 13-5 of Appendix H have three significant digits.

SECTION 14

REGULATORY IMPLEMENTATION

14.1 IMPLEMENTATION OF PART 432 THROUGH THE NPDES PERMIT PROGRAM AND THE NATIONAL PRETREATMENT PROGRAM

Under sections 301, 304, 306, and 307 of the CWA, EPA promulgates national effluent limitations guidelines and standards of performance for major industrial categories for three classes of pollutants: (1) conventional pollutants (i.e., total suspended solids, oil and grease, biochemical oxygen demand, fecal coliform bacteria, and pH); (2) toxic pollutants (e.g., toxic metals such as chromium, lead, nickel, and zinc; toxic organic pollutants such as benzene, benzo-*a*-pyrene, and naphthalene); and (3) non-conventional pollutants (e.g., ammonia-N, fluoride, iron, total phenols, and 2,3,7,8-tetrachlorodibenzofuran).

As discussed in Section 2, EPA must consider six types of effluent limitations guidelines and standards for each major industrial category, as appropriate. The types of effluent limitation guidelines and standards are presented in Table 14-1.

Table 14-1. Types of Effluent Limitation Guidelines and Standards

Abbreviation	Effluent Limitation Guideline or Standard
BPT	Best practicable control technology currently available
BAT	Best available technology economically achievable
BCT	Best control technology for conventional pollutants
NSPS	New source performance standards
PSES	Pretreatment standards for existing sources
PSNS	Pretreatment standards for new sources

Pretreatment standards apply to industrial facilities with wastewater discharges to POTWs. The effluent limitations guidelines and new source performance standards apply to industrial facilities with direct discharges in to navigable waters.

14.1.1 NPDES Permit Program

Section 402 of the CWA establishes the National Pollutant Discharge Elimination System (NPDES) permit program. The NPDES permit program is designed to limit the discharge of pollutants into navigable waters of the United States through a combination of various requirements, including technology-based and water quality-based effluent limitations. Technology-based effluent limitations guidelines and standards applicable to the meat and poultry processing industry are used by permit writers to derive NPDES permit technology-based effluent limitations. Water quality-based effluent limitations (WQBELs) are based on receiving water characteristics and ambient water quality standards, including designated water uses. They are derived independently from technology-based effluent limitations. The CWA requires that NPDES permits contain the more stringent of the applicable technology-based and water quality-based effluent limitations.

Section 402(a)(1) of the CWA provides that in the absence of promulgated effluent limitations guidelines or standards, the Administrator, or her designee, may establish technology-based effluent limitations for specific dischargers on a case-by-case basis. Federal NPDES permit regulations provide that these limits may be established using “best professional judgment” (BPJ) taking into account any proposed effluent limitations guidelines and standards and other relevant scientific, technical, and economic information.

Section 301 of the CWA, as amended by the Water Quality Act of 1987, requires that BAT effluent limitations for toxic pollutants be achieved as expeditiously as possible, but not later than three years from date of promulgation of such limitations and in no case later than March 31, 1989. Because the revisions to 40 CFR Part 432 will be promulgated after March 31, 1989, NPDES permit effluent limitations based on the revised effluent limitations guidelines must be included in the next NPDES permit issued after promulgation of the regulation, and the permit must require immediate compliance.

14.1.2 New Source Performance Standards

New sources must comply with the New Source Performance Standards (NSPS) and limitations of the MPP rule at the time they commence discharging MPP process wastewater. The Agency considers a discharger a new source if construction of the source begins after promulgation of the final rule (see 40 CFR 122.2; 40 CFR 403.3).

Following promulgation of revised NSPS, existing NSPS continue to apply for a limited period of time to new sources that commenced discharging MPP process wastewater within the time period beginning 10 years before the effective date of a final rule revising Part 432. Thus, if EPA promulgates revised NSPS for Part 432 in December 2003, and those regulations take effect in January 2004, any direct discharging new source that commenced discharge after January 1994 but before February 2004 would be subject to the currently codified NSPS for 10 years from the date it commenced discharge or during the period of depreciation or amortization of such facility, whichever comes first (see CWA section 306(d)). After that 10 year period expires, any new or revised BAT limitations would apply with respect to toxics and nonconventional pollutants. Limitations on conventional pollutants would be based on the current NSPS for conventional pollutants unless EPA promulgates revisions to BPT/BCT for conventional pollutants that are more stringent than these NSPS requirements. Appendix I provides the regulations at 40 CFR Part 432 (including NSPS), as codified in the 2001 edition of the Code of Federal Regulations for use during the applicable 10 year period.

14.1.3 National Pretreatment Standards

40 CFR Part 403 sets out national pretreatment standards which have three principal objectives. The first objective is to prevent the introduction of pollutants into publicly owned treatment works (POTWs) that will interfere with POTW operations, including use or disposal of municipal sludge. Second, national pretreatment standards are in place to prevent the introduction of pollutants into POTWs which will pass through the treatment works or will otherwise be incompatible with the treatment works. The final objective is to improve opportunities to recycle and reclaim municipal and industrial wastewaters and sludges.

The national pretreatment and categorical standards comprise a series of prohibited discharges to prevent the discharge of "any pollutant(s) which cause Pass Through or Interference" (see 40 CFR 403.5(a)(1)). Local control authorities are required to implement the national pretreatment program, including applying the federal categorical pretreatment standards to any industrial users that are subject to such categorical pretreatment standards, as well as any pretreatment standards derived locally (i.e., local limits) that are more restrictive than the federal standards.

The federal categorical pretreatment standards for existing sources must be achieved not later than three years following the date of publication of the final standards. This proposed regulation does not revise federal categorical pretreatment standards (PSES and PSNS) applicable to meat and poultry processing facilities regulated by 40 CFR Part 432. If EPA were to promulgate PSNS in the final rule, MPP new sources would be required to comply with the new source performance standards of the MPP rule at the time they commence discharging MPP process wastewater. Because the final rule is not expected within 120 days of the proposed rule, the Agency considers an indirect discharger a new source if its construction commences following promulgation of the final rule (see 40 CFR 122.2; 40 CFR 403.3). EPA expects to take final action on this proposal in December 2003.

In addition, Section 403.7 of the Clean Water Act provides the criteria and procedures to be used by a Control Authority to grant a categorical industrial user (CIU) variance from a pollutant limit specified in a categorical pretreatment standard to reflect removal by the POTW treatment plant of the pollutant. Procedures for granting removal credits are specified in 40 CFR 403.11.

14.2 UPSET AND BYPASS PROVISIONS

A "bypass" is an intentional diversion of the streams from any portion of a treatment facility. An "upset" is an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the permittee. EPA's regulations concerning bypasses and upsets for direct dischargers are set forth at 40 CFR 122.41(m) and (n) and for indirect dischargers at 40 CFR 403.16 and 403.17.

14.3 VARIANCES AND MODIFICATIONS

The CWA requires application of effluent limitations established pursuant to section 301 or pretreatment standards of section 307 to all direct and indirect dischargers. However, the statute provides for the modification of these national requirements in a limited number of circumstances. Moreover, the Agency has established administrative mechanisms to provide an opportunity for relief from the application of the national effluent limitations guidelines and pretreatment standards for categories of existing sources for toxic, conventional, and nonconventional pollutants.

14.3.1 Fundamentally Different Factors Variances

EPA will develop effluent limitations or standards different from the otherwise applicable requirements, if an individual discharging facility is fundamentally different with respect to factors considered in establishing the limitation of standards applicable to the individual facility. Such a modification is known as a "fundamentally different factors" (FDF) variance.

EPA provides for the FDF modifications from the BPT effluent limitations, BAT limitations for toxic and nonconventional pollutants, and BPT limitations for conventional pollutants for direct dischargers. For indirect dischargers, EPA provides for modifications from pretreatment standards. FDF variances for toxic pollutants were challenged judicially and ultimately sustained by the Supreme Court (see *Chemical Manufacturers Assn* v. *NRDC*, 479 U.S. 116 (1985)).

Subsequently, in the Water Quality Act of 1987, Congress added section 301(n) to the Act to authorize modifications of the otherwise applicable BAT effluent limitations or categorical pretreatment standards for existing sources if a facility is fundamentally different with respect to the factors specified in section 304 (other than costs) from those considered by EPA in establishing the effluent limitations or pretreatment standard. Section 301(n) also defined the conditions under which EPA may establish alternative requirements. Under Section 301(n), an application for approval of a FDF variance must be based solely on either information submitted during rulemaking raising the factors that are fundamentally different, or information the applicant did not have an opportunity to submit. The alternate limitation or standard must be no less stringent than justified by the difference and must not result in markedly more adverse non-water quality environmental impacts than does the national limitation or standard.

EPA regulations at 40 CFR Part 125 Subpart D, authorizing the Regional Administrators to establish alternative limitations and standards, further detail the substantive criteria used to evaluate FDF variance requests for direct dischargers. Thus, 40 CFR 125.31(d) identifies six factors (e.g., volume of process wastewater, age and size of a discharger's facility) that may be considered in determining whether or not a facility is fundamentally different. The Agency must determine whether, on the basis of one or more of these factors, the facility in question is fundamentally different from the facilities and factors considered by EPA in developing the nationally applicable effluent guidelines. The regulation also lists four other factors (e.g., infeasibility of installation within the time allowed or a discharger's ability to pay) that may not provide a basis for an FDF variance. In addition, under 40 CFR 125.31(b) (3), a request for limitations less stringent than the national limitation may be approved only if compliance with the national limitations would result in either a removal cost wholly out of proportion to the removal cost considered during development of the national limitations, or a non-water quality environmental impact (including energy requirements) fundamentally more adverse than the impact considered during development of the national limits. EPA regulations provide for an FDF variance for indirect dischargers at 40 CFR 403.13. The conditions for approval of a request to modify applicable pretreatment standards and factors considered are the same as those for direct dischargers.

The legislative history of Section 301(n) underscores the necessity for the FDF variance applicant to establish eligibility for the variance. EPA's regulations at 40 CFR 125.32(b)(1) are explicit in imposing this burden upon the applicant. The applicant must show that the factors relating to the discharge controlled by the applicant's permit which are claimed to be fundamentally different are, in fact, fundamentally different from those factors considered by EPA in establishing the applicable guidelines. The criteria for applying for and evaluating applications for variances from categorical pretreatment standards are included in the pretreatment regulations at 40 CFR 403.13(h)(9). An FDF variance is not available to a new source performance subject to NSPS or PSNS.

14.3.2 Economic Variances

Section 301(c) of the CWA authorizes a variance from the otherwise applicable BAT effluent guidelines for nonconventional pollutants due to economic factors. The request for a variance from effluent limitations developed from BAT guidelines must normally be filed by the discharger during the public notice period for the draft permit. Other filing time periods may apply, as specified in 40 CFR 122.21(1)(2). Specific guidance for this type of variance is available from EPA's Office of Wastewater Management.

14.3.3 Water Quality Variances

Section 301(g) of the CWA authorizes a variance from BAT effluent guidelines for certain nonconventional pollutants due to localized environmental factors. These pollutants include ammonia, chlorine, color, iron, and total phenols.

14.4 PRODUCTION BASIS FOR CALCULATION OF PERMIT LIMITATIONS

14.4.1 Background

The proposed effluent limitations guidelines and standards for BPT, BAT, and NSPS are expressed as mass limitations in pounds (of pollutant) per 1,000 pounds (of production unit). EPA is soliciting comment on PSES and PSNS numeric standards that are concentration-based. The NPDES regulations (40 CFR 122.45(f)) require permit writers to implement mass-based limitations for direct dischargers, but allow an exception when the limits are expressed in terms of other units of measurement (e.g., concentration). The General Pretreatment Regulations (40 CFR 403.6(d)) provide that the control authority may impose mass limitations on industrial users using dilution to meet applicable pretreatment requirements or where mass limitations are appropriate. EPA believes that MPP facilities that have been using the best pollution prevention and water conservation practices may also request that the permit writer or POTW use mass-based limits in their permits or control mechanism. See Section 6 for detailed information on water use levels for meat and poultry processing operations and rendering. EPA believes this information will be useful to permit writers and control authorities in those instances where they deem it appropriate to set mass-based limits.

14.4.2 Mass-Based Limitations and Standards

The proposed effluent limitations guidelines and standards for BPT, BAT, and NSPS are expressed as mass limitations in pounds (of pollutant) per 1,000 pounds (of production unit). Production units include live weight killed (LWK), equivalent live weight killed (ELWK), finished product (FP), and raw material (RM). The mass limitation is derived by multiplying an effluent concentration (determined from the analysis of treatment system performance) by an appropriate normalized wastewater volume ("production-normalized flow") determined for each MPP operation expressed in gallons per 1,000 pounds of product. The following equation describes how EPA calculated mass-based limitations and standards.

Mass-Based Limit = [CONC, mg/L] x [PNF, gal/1,000 lb] x [3.7854 L/gal] x [1 lb/453,592 mg]

where:

Mass-based limit	=	technology-based mass-based limit for each pollutant proposed for regulation. Expressed as a unitless fraction in terms of mass (lb) of pollutant per mass (1,000 lb) of production.
CONC, mg/L	=	technology-based concentration limits for each pollutant proposed for regulation. Expressed in units of mass (mg) of pollutant per volume (L) of wastewater.
PNF, gal/1,000 lb	=	production normalized flow (PNF) for the regulatory subcategory. Expressed in units of volume of wastewater generated (gal) per 1,000 pounds of production (LWK, ELWK, FP, or RM).
[3.7854 L/gal], [1 lb/453,592 mg]	=	conversion factors.

EPA developed the production-normalized flows to generate the limits in the proposed rule from survey questionnaire responses from MPP facilities. See Section 13.11 for a description of these production-normalized flows.

A facility subject to today's proposed regulation can use a combination of various treatment alternatives and/or water conservation practices to achieve a particular effluent limitation or standard. The model treatment systems provided in Section 11 illustrate several available options to achieve the proposed effluent limitations guidelines and standards.

The NPDES permit regulations discuss the use of mass-based limitations and standards. In order to convert the effluent limitations and standards expressed as pounds per 1,000 pounds of product to a monthly average or daily maximum permit limit, the permitting or control authority would use a production rate with units of 1,000 pounds per day. The NPDES permit regulations (40 CFR 122.45(b)(2)) require that NPDES permit limits be based on a "...reasonable measure of actual production." The production rates used for NPDES permitting for the MPP industry have commonly been the highest annual average production from the prior five year period prorated to a daily basis.

The objective in determining a production estimate for a facility is to develop a measure of production which can reasonably be expected to prevail during the next term of the permit. This measure is used in combination with the production-based limitations to establish a maximum mass of pollutant that may be discharged each day and month. However, if the permit production rate is based on the maximum month, then the permit could allow excessive discharges of pollutants during significant portions of the life of the permit. These excessive allowances may discourage facilities from ensuring optimal waste management, water conservation, and wastewater treatment practices during lower production periods. On the other hand, if the average permit production rate is based on an average derived from the highest year of production over the past five years, then facilities may have trouble ensuring that their waste management, water conservation, and wastewater treatment practices can accommodate shorter periods of higher production. This might require facilities to target a more stringent treatment level than that on which the limits were based during these periods of high production. To accomplish this, facilities would likely have to develop more efficient treatment systems and better water conservation and waste management practices during these periods.

When a facility is also covered by other existing effluent guidelines, the facility will need to comply with both regulations. In those cases, the permit writer will combine the limitations using an approach that proportions the limitations based on the different production levels (for production-based standards) or wastewater flows (for concentration-based standards). NPDES permit writers refer to it as the “building block approach.”

The proposed limitations neither require the installation of any specific control technology nor the attainment of any specific flow rate or effluent concentration. A facility can use various treatment alternatives or water conservation practices to achieve a particular effluent limitation or standard. Appendix J provides several examples of how these proposed limitations and standards will be applied.

14.5 BEST MANAGEMENT PRACTICES

Sections 304(e), 308(a), 402(a), and 501(a) of the CWA authorize the Administrator to prescribe BMPs as part of effluent limitations guidelines and standards, or as part of a permit. Section 304(e) of the CWA authorizes EPA to include BMPs in effluent limitations guidelines for certain toxic or hazardous pollutants for the purpose of controlling “plant site runoff, spillage or leaks, sludge or waste disposal, and drainage from raw material storage.” Section 402(a)(1) and NPDES regulations at 40 CFR 122.44(k) also provide for best management practices to control or abate the discharge of pollutants, when numeric limitations and standards are infeasible. In addition, section 402(a)(2), read in concert with section 501(a), authorizes EPA to prescribe as wide a range of permit conditions as the Administrator deems appropriate in order to ensure compliance with applicable effluent limitations and standards and such other requirements as the Administrator deems appropriate.

Dikes, curbs, and other control measures are being used at some MPP facilities to contain leaks and spills as part of good “housekeeping" practices.” However, on a facility-by-facility basis a permit writer may choose to incorporate BMPs into the permit. Section 8.8 provides a detailed discussion of pollution prevention and best management practices used in the MPP industry.

SECTION 15

GLOSSARY, ACRONYMS, AND ABBREVIATIONS

A

AAMP - The American Association of Meat Processors

Administrator - The Administrator of the U.S. Environmental Protection Agency

Agency - The U.S. Environmental Protection Agency

Alternate discharge - See Zero discharge

AMI - American Meat Institute

AMSA - Association of Metropolitan Sewerage Agencies

Average monthly discharge limitation - The highest allowable average of "daily discharges" over a calendar month, calculated as the sum of all "daily discharges" measured during the calendar month divided by the number of "daily discharges" measured during the month.

B

BAT - The best available technology economically achievable, applicable to effluent limitations for industrial discharges to surface waters, as defined by Section 304(b)(2)(B) of the CWA.

BCT - The best control technology for conventional pollutants, applicable to discharges of conventional pollutants from existing industrial point sources, as defined by Section 304(b)(4) of the CWA.

Blood processing - The blood may be heated to coagulate the albumin; then, the albumin and fibrin are separated (e.g., with a screen or centrifuge) from the blood water and forwarded for further processing. The blood water or serum remaining after coagulation may be evaporated for animal feed, or it may be sewered.

BOD_5 - Biochemical oxygen demand measured over a 5 day period.

BPJ - Best professional judgment

BPT - The best practicable control technology currently available, applicable to effluent limitations, for industrial discharges to surface waters, as defined by Section 304(b)(1) of the CWA.

C

Canned meat processor (Definition for 40 CFR 432, Subpart I) - An operation that prepares and cans meats (such as stew, sandwich spreads, or similar products) alone or in combination with other finished products at rates greater than 2730 kg (6000 lb) per day.

CFR - Code of Federal Regulations

Clean water act (CWA) - The Federal Water Pollution Control Act Amendments of 1972 (33 U.S.C. Section 1251 et seq.), as amended.

Complex slaughterhouse (Definition for 40 CFR 432, Subpart B) - A slaughterhouse that accomplishes extensive by-product processing, usually at least three of such operations as rendering, paunch and viscera handling, blood processing, hide processing, or hair processing

Conventional pollutants - Constituents of wastewater as determined by Section 304(a)(4) of the CWA (and EPA regulations), i.e., pollutants classified as biochemical oxygen demand, total suspended solids, oil and grease, fecal coliform, and pH.

D

Daily discharge - The discharge of a pollutant measured during any calendar day or any 24-hour period that reasonably represents a calendar day.

Deep-well injection - Long-term or permanent disposal of untreated, partially treated, or treated wastewaters by pumping the wastewater into underground formations of suitable character through a bored, drilled, or driven well.

Direct discharger - A facility that discharges or may discharge treated or untreated wastewaters into waters of the United States.

DMR - Discharge monitoring report

Dry rendering - The process of cooking animal byproducts by dry heat in open steam-jacketed tanks.

E

Effluent limitation guideline (ELGs) - Under CWA section 502(11), any restriction, including schedules of compliance, established by a State or the Administrator on quantities, rates, and concentrations of chemical, physical, biological, and other constituents which are discharged from point sources into navigable waters, the waters of the contiguous zone, or the ocean (CWA Sections 301(b) and 304(b)).

ELWK - Equivalent live weight killed

Existing source - For this rule, any facility from which there is or may be a discharge of pollutants, the construction of which is commenced before the publication of the final regulations prescribing a standard of performance under Section 306 of the CWA.

F

Facility- All contiguous property and equipment owned, operated, leased, or under the control of the same person or entity.

FDF - Fundamentally different factor

Finished product - The final manufactured product produced on site, including products intended for consumption with no additional processing as well as products intended for further processing, when applicable.

First processing - Operations which receive live meat animals or poultry and produce a raw, dressed meat or poultry product, either whole or in parts.

FSIS - Food Safety and Inspection Service

FTE - Full time equivalent employee

Further processing - Operations which use whole carcasses or cut-up meat or poultry products for the production of fresh or frozen products, and may include the following types of processing: cutting and deboning, cooking, seasoning, smoking, canning, grinding, chopping, dicing, forming, or breading.

G

Ground water - Water in a saturated zone or stratum beneath the surface of land or water

H

Ham processor (Definition for 40 CFR 432, Subpart H) - An operation that manufactures hams alone or in combination with other finished products at rates greater than 2730 kg (6000 lb) per day.

Hazardous waste - Any waste, including wastewater, defined as hazardous under RCRA, TSCA, or any state law.

Hexane extractable method (HEM) - A measure of oil and grease in wastewater by mixing the wastewater with hexane and measuring the oils and greases that are removed from the wastewater with the hexane. See 40 CFR Part 136.

Hide processing - Wet or dry hide processing. Includes demanuring, washing, and defleshing, followed by curing.

High-processing packinghouse (Definition for 40 CFR 432, Subpart D) - A packinghouse that processes both animals slaughtered at the site and additional carcasses from outside sources.

I

In scope - Facilities and/or wastewaters that EPA proposes to be subject to this guidelines.

Indirect discharger - A facility that discharges or may discharge wastewaters into a publicly owned treatment works.

L

Live weight killed (LWK) - The total weight of the total number of animals slaughtered during a specific time period.

Long-term average (LTA) - For purposes of the effluent guidelines, average pollutant levels achieved over a period of time by a facility, subcategory, or technology option. LTAs were used in developing the effluent limitations guidelines and standards in the proposed regulation.

Low-processing packinghouse (Definition for 40 CFR 432, Subpart C) - A packinghouse that processes no more than the total animals killed at that plant, normally processing less than the total kill.

M

Maximum monthly average discharge limitation - The highest allowable average of "daily discharges" over a calendar month, calculated as the sum of all "daily discharges" measured during the calendar month, divided by the number of "daily discharges" measured during the month.

Meat - The term "meat" includes all animal products from cattle, calves, hogs, sheep and lambs, etc., except those defined as poultry.

Meat cutter (Definition for 40 CFR 432, Subpart F) - An operation fabricates, cuts, or otherwise produces fresh meat cuts and related finished products from livestock carcasses, at rates greater than 2730 kg (6000 lb) per day.

Meat product operations - Include meat and poultry slaughtering operations, by-product operations, rendering, and further processing.

Minimum level - The level at which an analytical system gives recognizable signals and an acceptable calibration point.

MPP - Meat and poultry products

N

NAICS - North American Industry Classification System. NAICS was developed jointly by the U.S., Canada, and Mexico to provide new comparability in statistics about business activity across North America.

National pollutant discharge elimination system (NPDES) permit - A permit to discharge wastewater into waters of the United States issued under the National Pollutant Discharge Elimination system, authorized by Section 402 of the CWA. See NPDES.

Nitrification capability - The capability of a POTW treatment system to oxidize ammonia or ammonium salts initially to nitrites (via nitrosomonas bacteria,) and subsequently to nitrates (via Nitrobacter bacteria). Criteria for determining the nitrification capability of a POTW treatment system are: bioassays confirming the presence of nitrifying bacteria, and analyses of the nitrogen balance demonstrating a reduction in the concentration of ammonia or ammonium salts and an increase in the concentrations of nitrites and nitrates.

Non-contact cooling water - Water used for cooling in process and nonprocess applications which does not come into contact with any raw material, intermediate product, by-product, waste product (including air emissions), or finished product.

Non-conventional pollutants - Pollutants that are neither conventional pollutants nor priority pollutants listed at 40 CFR §401.15 and Part 423 Appendix A.

Non-detect value - The analyte is below the level of detection that can be reliably measured by the analytical method. This is also known in statistical terms as left-censoring.

Non-water quality environmental impact - Deleterious aspects of control and treatment technologies applicable to point source category wastes, including, but not limited to air pollution, noise, radiation, sludge and solid waste generation, and energy used.

NRA - National Renderers Association

NRDC - Natural Resources Defense Council

NPDES program - The National Pollutant Discharge Elimination System (NPDES) program authorized by Sections 307, 318, 402, and 405 of the Clean Water Act. It applies to facilities that discharge wastewater directly to United States surface waters.

NSPS - New Source Performance Standards, applicable to industrial facilities whose construction is begun after the effective date of the final regulations (if those regulations are promulgated after 120 days from publication of proposal in the Federal Register). See 40 CFR 122.2.

NTTA - National Technology Transfer and Advancement Act

NWPCAM - The National Water Pollution Control Assessment Model (version 1.1) is a computer model to model the instream dissolved oxygen concentration, as influenced by pollutant reductions of BOD_5, total Kjeldahl nitrogen, total suspended solids, and fecal coliform bacteria.

O

Off-site - Outside the boundaries of a facility

On-site - The same or geographically contiguous property, which may be divided by a public or private right-of-way, provided the entrance and exit between the properties is at a crossroads intersection, and access is by crossing as opposed to going along the right-of-way. Non-contiguous properties owned by the same company or locality but connected by a right-of-way, which it controls, and to which the public does not have access, is also considered on-site property.

Out-of-scope - Out-of-scope facilities are facilities which EPA has not determined to be subject to provisions of this guideline, or facilities that do not engage in meat products operations.

Outfall - The mouth of conduit drains and other conduits from which a facility effluent discharges into receiving waters.

P

Packinghouse - A plant that both slaughters animals and subsequently processes carcasses into cured, smoked, canned, or other prepared meat products.

Pass through - The term "pass through" means a discharge that exits the POTW into waters of the United States in quantities or concentrations which, alone or in conjunction with a discharge or discharges from other sources, is a cause of a violation of any requirement of the POTW's NPDES permit (including an increase in the magnitude or duration of a violation).

Point source - Any discernable, confined, and discrete conveyance from which pollutants are or may be discharged. See CWA section 502(14).

Pollutants of concern (POCs) - Pollutants commonly found in meat and poultry processing wastewaters. Generally, a chemical is considered as a POC if it is detected in untreated process wastewater at five times a baseline value in more than 10 percent of the samples.

Poultry - Broilers, other young chickens, hens, fowl, mature chickens, turkeys, capons, geese, ducks, and small game such as quail, pheasants, and rabbits.

Poultry operations - Includes poultry slaughtering operations, by-product operations, rendering, and further processing.

Priority pollutant - 126 compounds that are a subset of the 65 toxic pollutants and classes of pollutants outlined, pursuant to Section 307 of the CWA.

Process wastewater - Any water which, during red meat or poultry operations, comes into direct contact with or results from the storage, production, or use of any raw material, intermediate product, finished product, by-product, or waste product. Wastewater from equipment cleaning, direct-contact air pollution control devices, rinse water, storm water associated with industrial activity, and contaminated cooling water are considered to be process wastewater. Process wastewater may also include wastewater that is contract hauled for off-site disposal. Sanitary wastewater, uncontaminated noncontact cooling water, and storm water not associated with industrial activity are not considered to be process wastewater.

PSES - Pretreatment standards for existing sources of indirect discharges, under Section 307(b) of the CWA, applicable (for this rule) to indirect dischargers that commenced construction prior to promulgation of the final rule.

PSNS - Pretreatment standards for new sources under Section 307(c) of the CWA.

Publicly owned treatment works (POTW) - A treatment works as defined by section 212 of the Clean Water Act, which is owned by a State or municipality (as defined by section 502(4) of the Clean Water Act). This definition includes any devices and systems used in the storage, treatment, recycling and reclamation of municipal sewage or industrial wastes of a liquid nature. It also includes sewers, pipes and other conveyances, only if they convey wastewater to a POTW treatment plant. The term also means the municipality as defined in section 502(4) of the Clean Water Act, which has jurisdiction over the indirect discharges to and the discharges from such a treatment works.

R

Raw material - The basic input materials to a renderer, composed of animal and poultry trimmings, bones, meat scraps, dead animals, feathers and related usable by-products.

RCRA - The Resource Conservation and Recovery Act of 1976 (RCRA) (42 U.S.C. Section 6901 et seq.), which regulates the generation, treatment, storage, disposal, or recycling of solid and hazardous wastes.

Renderer (Definition for 40 CFR 432, Subpart J) - An independent or off-site rendering operation, conducted separately from a slaughterhouse, packinghouse, or poultry dressing or processing plant, that manufactures at rates greater than 75,000 pounds of raw material per day of meat meal, tankage, animal fats or oils, grease, and tallow, and may cure cattle hides, but excluding marine oils, fish meal, and fish oils.

RFA - Regulatory Flexibility Act

S

Sample-specific detection limit - The smallest quantity in the experiment calibration range that may be measured reliably in any given sample.

SAP - Sampling and analysis plan.

Sausage and luncheon meat processor (Definition for 40 CFR 432, Subpart G) - An operation that cuts fresh meats, grinds, mixes, seasons, smokes, or otherwise produces finished products, such as sausage, bologna, and luncheon meats at rates greater than 2730 kg (6000 lb) per day.

SBREFA - Small Business Regulatory Enforcement Fairness Act of 1996.

SCC - Sample control center

SER - Small entity representative

SIC - Standard Industrial Classification (SIC) - A numerical categorization system used by the U.S. Department of Commerce to catalogue economic activity. SIC codes refer to the products, or group of products, produced or distributed, or to services rendered by an operating establishment. SIC codes are used to group establishments by the economic activities in which they are engaged. SIC codes often denote a facility's primary, secondary, tertiary, etc. economic activities.

Simple slaughterhouse (Definition for 40 CFR 432, Subpart A) - A slaughterhouse that accomplishes very limited by-product processing, if any, usually no more than two of such operations as rendering, paunch and viscera handling, blood processing, hide processing, or hair processing.

Site - A site is generally one contiguous physical location at which manufacturing operations related to the meat products industry occur. This includes, but is not limited to, slaughtering, processing, and rendering. In some instances, a site may include properties located within separate fence lines, but located close to each other.

Slaughter house - A plant that slaughters animals and has as its main product fresh meat as whole, half, or quarter carcasses, or smaller meat cuts.

Small-business - The definitions of small business for the meat products industries are in SBA's regulations at 13 CFR 121.201. These size standards were updated effective October 1, 2000. SBA size standards for the meat and poultry products industry (i.e., for NAICS codes 311611, 311612, 311613, and 311615) define a "small business" as one with 500 or fewer employees.

Small processor - (Definition for 40 CFR 432, Subpart E) An operation that produces up to 2730 kg (6000 lb) per day of any type or combination of finished products.

Stearin - An ester of glycerol and stearic acid found in MPP wastewaters.

Surface water - Waters of the United States, as defined at 40 CFR 122.2.

T

TKN - Total Kjeldahl nitrogen

Treatment - Any method, technique, or process designed to change the physical, chemical, or biological character or composition of any metal-bearing, oily, or organic waste so as to neutralize such wastes, to render such wastes amenable to discharge, or to recover metal, oil, or organic content from the wastes.

TSS - Total suspended solids

V

Variability factor - Used in calculating a limitation (or standard) to allow for reasonable variation in pollutant concentrations when processed through extensively and well designed treatment systems. Variability factors assure that normal fluctuations in a facility's treatment are accounted for in the limitations. By accounting for these reasonable excursions above the long-term average, EPA's use of variability factors results in limitations that are generally well above the actual long-term averages.

Viscera handling (wet or dry viscera handling) - Includes removal of partially digested feed and washing of viscera.

W

Wastewater - See Process Wastewater.

Wastewater treatment - The processing of wastewater by physical, chemical, biological, or other means to remove specific pollutants from the wastewater stream, or to alter the physical or chemical state of specific pollutants in the wastewater stream. Treatment is performed for discharge of treated wastewater, recycle of treated wastewater to the same process which generated the wastewater, or for reuse of the treated wastewater in another process.

Wet rendering - The process of cooking animal byproducts by steam under pressure in closed tanks.

Z

Zero (or alternate) Discharge - Disposal of process and/or nonprocess wastewaters other than by direct discharge to a surface water or by indirect discharge to a POTW or PrOTW. Examples include land application, deep well injection, and contract hauling.

APPENDIX A

ANALYTICAL METHODS AND BASELINE VALUES

The analytical methods described in this appendix were used to determine pollutant levels in wastewater samples collected by EPA and industry at a number of meat and poultry product facilities (sampling efforts are described in Section 3.) In developing the proposed rule, EPA sampled facilities to determine the levels of *Aeromonas*, ammonia as nitrogen, biochemical oxygen demand (BOD), carbonaceous biochemical oxygen demand, chemical oxygen demand (COD), chloride, *Cryptosporidium*, dissolved biochemical oxygen demand, dissolved total phosphorus, *E. coli*, fecal coliform, fecal streptococcus, 21 metals, oil and grease (measured as hexane extractable material (HEM)), nitrate/nitrite, six pesticides, *Salmonella*, total coliform, total dissolved solids (TDS), total kjeldahl nitrogen (TKN), total organic carbon (TOC), total orthophosphate, total phosphorus, total residual chlorine, total suspended solids (TSS), and volatile residue. As explained in Section 7, EPA is regulating a subset of these pollutants.

Sections A.1 and A.2 of this appendix provide explanations of nominal quantitation limits and baseline values. Section A.3 describes the reporting conventions used by laboratories in expressing the results of the analyses. Section A.4 describes each analytical method and the corresponding baseline values that EPA used in determining the pollutants of concern. Section A.5 defines total nitrogen. Table A-1 lists the analytical methods and baseline values used for each pollutant.

A.1 NOMINAL QUANTITATION LIMITS

The nominal quantitation limit is the smallest quantity of an analyte that can be reliably measured with a particular method. Protocols used for determination of nominal quantitation limits in a particular method depend on the definitions and conventions that EPA used at the time the method was developed. The nominal quantitation limits associated with the methods addressed in this section fall into five categories.

1) The first category pertains to EPA Methods 1660 and 1664, which define the minimum level (ML) as the lowest level at which the entire analytical system must give a recognizable signal and an acceptable calibration point for the analyte. These methods are described in Section A.4.1.

2) The second category pertains specifically to EPA Method 1620, and is explained in detail in Section A.4.2.

3) The third category pertains to the remainder of the chemical methods (classical wet chemistry and pesticides) in which a variety of terms are used to describe the lowest level at which measurement results are quantitated. In some cases (especially with the classical wet chemistry analytes) the methods date to the 1970s and 1980s when different concepts of quantitation were employed by EPA. These methods typically list a measurement range or lower limit of measurement. The terms differ by method and, as discussed in subsequent sections, the levels presented are not always representative of the lowest levels laboratories currently can achieve.

   For those methods associated with a calibration procedure, the laboratories demonstrated through a low-point calibration standard that they were capable of reliable quantitation at method-specified (or lower) levels. In such cases these nominal quantitation limits are operationally equivalent to the ML (though not specifically identified as such in the methods). In the case of titrimetric or gravimetric methods, the laboratory adhered to the established lower limit of the measurement range published in the methods. Details of the specific methods are presented in Section A.4.3 through A.4.17.

4) The fourth category pertains to *Cryptosporidium*. There is currently no detection limit associated with the method used to determine *Cryptosporidium* (EPA Method 1622 described in Section A.4.18); so when *Cryptosporidium* was not found in the sample, there was no number that was associated with the sample. Therefore, there is no nominal quantitation limit for *Cryptosporidium*.

5) The fifth category pertains to all microbiological methods except *Cryptosporidium*. The fifth category pertains specifically to the multiple-tube test procedure and is explained in detail in Section A.4.19.

A.2 BASELINE VALUES

As described further in Section 7, in determining the pollutants of concern, EPA compared the reported concentrations for each pollutant to a multiple of the baseline value. As described in Section A.3 and shown in Table A-1, for most pollutants, the baseline value was set equal to the nominal quantitation limit for the analytical method. EPA made two general types of exceptions which are briefly described below. Section A.4 provides additional details about these exceptions in the context of the analytical method.

The first type of exceptions were baseline values that were different than the nominal quantitation limits in the analytical methods. When the baseline values had lower values, EPA made these exceptions because the laboratory had submitted data that demonstrated reliable measurements could be obtained at lower levels for those pollutants. When the baseline values had higher values, EPA concluded that the nominal quantitation limit for a specified method was less than the level that laboratories could reliably achieve and adjusted the baseline value upward.

The second type of exceptions were baseline values set at a common value for multiple analytical methods for the same pollutant. For some analytes, EPA permitted the laboratories to choose between methods to accommodate sample characteristics. When these methods had different nominal quantitation limits, EPA generally used the one with the lowest value or the one associated with the method used for most samples.

A.3 ANALYTICAL RESULTS REPORTING CONVENTIONS

The laboratories expressed results of the analyses either numerically or as not quantitated[1] for a pollutant in a sample. If the result is expressed numerically, then the pollutant was quantitated[2] in the sample. All of the analytical chemistry data were reported as liquid

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[1] Elsewhere in this document and in the preamble to the proposed rule, EPA refers to pollutants as "not detected" or "non-detected". This appendix uses the term "not quantitated" or "non-quantitated" rather than non-detected.

[2] Elsewhere in this document and in the preamble to the proposed rule, EPA refers to pollutants as "detected". This appendix uses the term "quantitated" rather than detected.

concentrations in weight/volume units, e.g., micrograms per liter (μg/L). *Cryptosporidium* results were reported in the calculated number of *Cryptosporidium* oocysts detected per liter. Bacteriological data generated using multiple-tube fermentation techniques were reported as most probable number (MPN)/100 mL.

For example, for a hypothetical pollutant X, the result would be reported as "15 μg/L" when the laboratory quantitated the amount of pollutant X in the sample as being 15 μg/L. For the non-quantitated results, for each sample, the laboratories reported a "sample-specific quantitation limit."[3] For example, for the hypothetical pollutant X, the result would be reported as "<10 μg/L" when the laboratory could not quantitate the amount of pollutant X in the sample. That is, the analytical result indicated a value less than the sample-specific quantitation limit of 10 μg/L. The actual amount of pollutant X in that sample is between zero (i.e., the pollutant is not present) and 10 μg/L. The sample-specific quantitation limit for a particular pollutant is generally the smallest quantity in the calibration range that can be measured reliably in any given sample. If a pollutant is reported as non-quantitated in a particular wastewater sample, this does not mean that the pollutant is not present in the wastewater, merely that analytical techniques (whether because of instrument limitations, pollutant interactions or other reasons) do not permit its measurement at levels below the sample-specific quantitation limit.

In its calculations, EPA generally substituted the reported value of the sample-specific quantitation limit for each non-quantitated result. In a few cases described in Section A.4.1, when the sample-specific quantitation limit was less than the baseline value, EPA substituted the baseline value for the non-quantitated result. And in a few instances also described in Section A.4.1, when the quantitated value was below the baseline value, EPA considered these values to be non-quantitated in the statistical analyses and substituted the baseline value for the measured value.

[3] Elsewhere in this document and in the preamble to the proposed rule, EPA refers to a "sample-specific quantitation limit" as a "sample-specific detection limit" or, more simply, as a "detection limit."

A.4 ANALYTICAL METHODS

EPA analyzed all of the meat product facility wastewater samples using methods identified in Table A-1. (As explained in Section 7, EPA is proposing to regulate only a subset of these analytes.) EPA generally used either EPA methods from "Methods for Chemical Analysis of Water and Wastes' (MCAWW) or the American Public Health Association's "Standard Methods for the Examination of Water and Wastewater." Table A-1 provides a summary of the analytical methods, the associated pollutants measured by the method, the nominal quantitation levels, and the baseline levels. The following sections provide additional information supporting the summary in Table A-1.

In analyzing samples, EPA generally used analytical methods approved at 40 CFR 136 for compliance monitoring or methods that had been in use by EPA for decades in support of effluent guidelines development. Exceptions for use of non-approved methods are explained in the method-specific subsections that follow Table A-1. Except for nitrate/nitrite, EPA proposed limitations or standards based only upon data generated by methods approved in 40 CFR Part 136. As explained in Section A.4.10, EPA used nitrate/nitrite data from Method 300.0 to develop the proposed limitations and standards for total nitrogen and is proposing the use of Method 300.0 for compliance.

Each of the following sections state whether the method is approved for compliance monitoring in 40 CFR Part 136 (even if the pollutant was not proposed to be regulated), provides a short description of the method, identifies the nominal quantitation limit, and explains EPA's choice for the baseline value. The sections are ordered alphabetically by analyte name within the five categories identified in Section A.1.

Table A-1. Analytical Methods and Baseline Values

Analyte	Method	CAS Number	Nominal Quantitation Value	Baseline Value	Unit
Aeromonas	9260L	C2101	2.0	2.0	/100mL
Ammonia as Nitrogen	350.2	7664417	0.20	0.20	mg/L
Antimony	1620	7440360	20.0	20.0	µg/L
Arsenic	1620	7440382	10.0	10.0	µg/L
Barium	1620	7440393	200.0	200.0	µg/L
Beryllium	1620	7440417	5.0	5.0	µg/L
BOD_5	405.1	C003	2.0	2.0	mg/L
Boron	1620	7440428	100.0	100.0	µg/L
Cadmium	1620	7440439	5.0	5.0	µg/L
Carbonaceous BOD_5	5210	C002	2.0	2.0	mg/L
	405.1	C002	2.0	2.0	mg/L
Carbaryl	632	63252	1.0	1.0	µg/L
COD	410.1	C004	50.0	5.0**	mg/L
	410.2	C004	5.0	5.0**	mg/L
	410.4 (automated)	C004	3.0	5.0**	mg/L
	410.4 (manual)	C004	20.0†		
	5220B	C004	5.0	5.0	mg/L
Chloride	300.0	16887006	0.05	1.0	mg/L
	325.3	16887006	1.0	1.0	mg/L
Chromium	1620	7440473	10.0	10.0	µg/L
cis-Permethrin	1660	61949766	5.0	5.0	µg/L
Cobalt	1620	7440484	50.0	50.0	µg/L
Copper	1620	7440508	25.0	25.0	µg/L
Cryptosporidium	1622	137259508			per_L
Dichlorvos	1657	62737	2.0	2.0	µg/L
Dissolved BOD_5	405.1	C003D	2.0	2.0	mg/L
Dissolved Total Phosphorus	365.2	14265442D	0.01	0.01	mg/L
	365.3	14265442D	0.01	0.01	mg/L
E. coli	9221F	C050	2.0	2.0	/100mL
Fecal Coliform	9221E	C2106	2.0	2.0	/100mL
Fecal Streptococcus	9230B	C2107	2.0	2.0	/100mL
HEM	1664	C036	5.0	5.0	mg/L
Lead	1620	7439921	50.0	50.0	µg/L
Malathion	1657	121755	2.0	2.0	µg/L
Manganese	1620	7439965	15	15	µg/L
Mercury	1620	7439976	0.20	0.20	µg/L
Molybdenum	1620	7439987	10.0	10.0	µg/L

Analyte	Method	CAS Number	Nominal Quantitation Value	Baseline Value	Unit
Nickel	1620	7440020	40.0	40.0	µg/L
Nitrate/Nitrite	300.0	C005	0.01	0.05	mg/L
	353.1	C005	0.01	0.05	mg/L
	353.2	C005	0.05	0.05	mg/L
Salmonella	FDA-BAM	68583357	2.0	2.0	/100mL
Selenium	1620	7782492	5.0	5.0	µg/L
Silver	1620	7440224	10.0	10.0	µg/L
Tetrachlorvinphos	1657	22248799	2.0	2.0	µg/L
Thallium	1620	7440280	10.0	10.0	µg/L
Tin	1620	7440315	30.0	30.0	µg/L
Titanium	1620	7440326	5.0	5.0	µg/L
Total Coliform	9221B	E10606	2.0	2.0	/100mL
Total Dissolved Solids	160.1	C010	10.0	10.0	mg/L
Total Kjeldahl Nitrogen	351.2	C021	0.10	0.5	mg/L
	351.3	C021	0.50	0.5	mg/L
Total Organic Carbon	415.1	C012	1.0	1.0	mg/L
Total Orthophosphate	300.0	C034	0.20	0.01	mg/L
	365.2	C034	0.01	0.01	mg/L
Total Phosphorus	365.2	14265442	0.01	0.01	mg/L
	365.3	14265442	0.01	0.01	mg/L
Total Residual Chlorine	HACH 8167	7782505	0.10	0.20	mg/L
	330.5	7782505	0.20	0.20	mg/L
Total Suspended Solids	160.2	C009	4.0	4.0	mg/L
trans-Permethrin	1660	61949777	5.0	5.0	µg/L
Vanadium	1620	7440622	50.0	50.0	µg/L
Volatile Residue	160.4	C030	10.0	10.0	mg/L
Yttrium	1620	7440655	5.0	5.0	µg/L
Zinc	1620	7440666	20.0	20.0	µg/L

[**]The baseline value was adjusted to reflect the lowest nominal quantitation limit of the titrimetric procedures (i.e., 410.1, 410.2, and 5220B). See Section A.4.6 for a detailed explanation.

[†]Method 410.4 lists two different quantitation limits that are dependent upon whether the automated or manual protocols were followed. The automated method limit =3 mg/L and the manual method limit =20 mg/L.

A.4.1 EPA Methods 1660 and 1664 (*cis*-Permethrin, *trans*-Permethrin, HEM)

Laboratories used EPA Method 1660 to measure *cis*-permethrin and *trans*-permethrin, and EPA Method 1664 to measure *n*-hexane extractable material (HEM). While 40 CFR Part 136 lists Method 1664 as an approved method for compliance monitoring of HEM, Part 136 does not list any methods for the pesticides *cis*-permethrin and *trans*-permethrin. However, Table 7 in 40 CFR 455 lists Method 1660 as approved for compliance monitoring of permethrin for the Pesticide Chemicals Point Source Category. (Permethrin is the common name given to any mixture of the two isomers, *cis*-permethrin and *trans*-permethrin.)

These methods use the minimum level (ML) concept for quantitation of the pollutant(s). The ML is defined as the lowest level at which the entire analytical system must give a recognizable signal and an acceptable calibration point for the analyte. When an ML is published in a method, the Agency has demonstrated that the ML can be achieved in at least one well-operated laboratory. When that laboratory or another laboratory uses that method, the laboratory is required to demonstrate, through calibration of the instrument or analytical system, that it can achieve pollutant measurements at the ML.

For *cis*-Permethrin, *trans*-Permethrin, and HEM, EPA used the method-specified MLs as the baseline values. In determining the pollutants of concern and in calculating the HEM standards, if a quantitated value or sample-specific quantitation limit was reported with a value less than the ML specified in the method, EPA substituted the value of the ML and assumed that the measurement was not quantitated. For example, for *cis*-permethrin with an ML of 5 µg/L, if the laboratory reported a quantitated value of 3 µg/L, EPA would have assumed that the concentration was not quantitated[4] with a sample-specific quantitation limit of 5 µg/L. The objective of this comparison was to identify any results for the three pollutants reported below the method-defined ML. Results reported below the ML were changed to the ML to ensure that all results used by EPA were reliable. In most cases, the quantitated values and sample-specific quantitation limits were equal to or greater than the baseline values.

[4] As explained in Appendix C, EPA applied different statistical assumptions to quantitated and non-quantitated results.

A.4.2 EPA Method 1620 (Metals)

Laboratories used EPA Method 1620 to measure the concentrations of 21 metals. While EPA Method 1620 is not listed in 40 CFR Part 136 as an approved method for compliance monitoring, it represents a consolidation of the analytical techniques in several 40 CFR 136-approved methods such as EPA Method 200.7 (inductively coupled plasma atomic emission (ICP) spectroscopy of trace elements) and Method 245.1 (mercury cold vapor atomic absorption technique). This method was developed specifically for the effluent guidelines program. EPA Method 1620 includes more metal analytes than are listed in the approved methods and contains quality control requirements at least as stringent as the 40 CFR Part 136-approved methods.

EPA Method 1620 employs the concept of an instrument detection limit (IDL). The IDL is defined as "the smallest signal above background noise that an instrument can detect reliably."[5] Data reporting practices for EPA Method 1620 analyses follow conventional metals reporting practices used in other EPA programs, in which values are required to be reported at or above the IDL. In applying EPA Method 1620, IDLs are determined on a quarterly basis by each analytical laboratory and are, therefore, laboratory-specific and time-specific. Although EPA Method 1620 contains MLs, these MLs pre-date EPA's recent refinements of the ML concept described earlier. The ML values associated with EPA Method 1620 are based on a consensus opinion reached between EPA and laboratories during the 1980s regarding levels that could be considered reliable quantitation limits when using EPA Method 1620. These limits do not reflect advances in technology and instrumentation since the 1980s. Consequently, the IDLs were used as the lowest values for reporting purposes, with the general understanding that reliable results can be produced at or above the IDL. Though the baseline values were derived from the MLs (or adjusted MLs) in EPA Method 1620, EPA used the laboratory-reported quantitated values and sample-specific quantitation limits, which captured concentrations down to the IDLs, in its data analyses.

[5] Keith, L.H., W. Crummett, J. Deegan, R.A. Libby, J.K. Taylor, G. Wentler (1983). "Principles of Environmental Analysis," Analytical Chemistry, Volume 55, Page 2217.

In general, EPA used the MLs specified in Method 1620 as the baseline values. However, EPA adjusted the baseline value for lead to 50 µg/L and boron to 100 µg/L. In EPA Method 1620, lead has an ML of 5 µg/L for graphite furnace atomic absorption (GFAA) spectroscopy analysis; EPA determined, however, that it was not necessary for the laboratories to measure down to such low levels, and that lead could be analyzed by inductively couple plasma atomic emission (ICP) spectroscopy.[6] Consequently, the ML requirement was adjusted to 50 µg/L, the ML for the ICP method. In EPA Method 1620, boron has an ML of 10 µg/L, but laboratory feedback years ago indicated that laboratories could not reliably achieve this low level. As a result, EPA only required laboratories to measure values at 100 µg/L and above. Thus, EPA adjusted the baseline value to 100 µg/L.

A.4.3 Method 350.2 (Ammonia as Nitrogen)

Ammonia as nitrogen was measured using Method 350.2, which is listed as approved for compliance monitoring in 40 CFR Part 136. Method 350.2 utilizes either colorimetric, titrimetric, or electrode procedures to measure ammonia.

Method 350.2 has a lower measurement range limit of 0.20 mg/L for the colorimetric and electrode procedures, and a lower measurement range limit of 1.0 mg/L for the titrimetric procedure. Rather than use different baseline values for the same pollutant, EPA used the 0.20 mg/L because it represented a value at which ammonia as nitrogen can be measured reliably by several determinative techniques in Method 350.2, as well as in other methods approved at 40 CFR 136.

A.4.4 Methods 405.1 and SM5210B (BOD_5, Carbonaceous BOD_5, and Dissolved BOD_5)

Biochemical Oxygen Demand (BOD_5), Carbonaceous BOD_5 ($cBOD_5$), and Dissolved BOD_5 were measured using Method 405.1 and Standard Method (SM) 5210B, both of which are approved for compliance monitoring in 40 CFR Part 136. BOD_5 and $cBOD_5$ are essentially the

[6] Also antimony, arsenic, selenium, and thallium were analyzed by ICP instead of GFAA. The method MLs were used because the laboratories demonstrated that their IDLs were able to quantitate below the ML for these four analytes.

same method, except an organic compound is added to the $cBOD_5$ test to inhibit nitrogenous oxygen deemand. If the sample does not include any nitrogenous demand to inhibit, the results should be comparable for BOD_5 and $cBOD_5$. BOD_5 and dissolved BOD_5 are the same method, except that the dissolved BOD_5 sample is filtered prior to analysis (either in the field or immediately upon receipt by the laboratory).

Method 405.1 and SM5210B are identical and the nominal quantitation limit, which is expressed in the methods as the lower limit of the measurement range at 2 mg/L, is the same for all three forms of BOD_5. EPA used this nominal quantitation limit of 2 mg/L as the baseline value in determining the pollutants of concern.

A.4.5 EPA Method 632 (Carbaryl)

Carbaryl was determined by EPA Method 632. There are no methods approved in 40 CFR Part 136 for carbaryl. However, Method 632 is approved for compliance monitoring of carbaryl for the Pesticide Chemicals Point Source Category (see Table 7 in 40 CFR Part 455).

In this method, samples are prepared by liquid-liquid extraction with methylene chloride in a separatory funnel. The extract is analyzed by a high-pressure liquid chromatograph with a UV detector. The nominal quantitation limit was determined by a low-point calibration standard. The nominal quantitation limit for carbaryl is 1 µg/L and was used as the baseline value.

A.4.6 Methods 410.1, 410.2, 410.4, and SM5220B (Chemical Oxygen Demand)

Chemical Oxygen Demand (COD) was measured using Methods 410.1, 410.2, 410.4, and SM5220B, of which Methods 410.1, 410.2, and 410.4 are approved for compliance monitoring in 40 CFR Part 136. Methods 410.1 and 410.2 are titrimetric procedures that follow identical analytical protocols, but differ only in the range of COD concentration that they are designed to measure. Reagent concentrations and sample volumes are adjusted to accommodate a wide range of sample concentrations, since the dynamic range of the chemistry used to detect COD is somewhat limited. Standard Method 5220B is a titrimetric method that incorporates the different reagent concentrations and sample volumes listed in Methods 410.1 and 410.2 into one method.

Data from all three of these methods are directly comparable. Method 410.4 is a colorimetric procedure.

Method 410.1 is designed to measure mid-level concentrations (greater than 50 mg/L) of COD and is associated with a nominal quantitation limit of 50 mg/L. Method 410.2 is designed to measure low-level concentrations of these parameters in the range of 5-50 mg/L. Method 410.4 has a measurement range of 3-900 mg/L for automated procedures and measurement range of 20-900 mg/L for manual procedures. EPA contracts required that laboratories measure down to the lowest quantitation limit possible for whatever method is used. Therefore, if the laboratory analyzes a sample using Method 410.1 and obtains a non-quantitated result, it must reanalyze the sample using Method 410.2. Thus, the quantitation limit reported for non-quantitated results was equal to 5 mg/L, unless sample dilutions were required for matrix complexities.

For all COD data, EPA used the baseline value of 5 mg/L that is associated with the lower quantitation limit for the titrimetric procedures because most of the data used to determine the pollutants of concern had been obtained by the titrimetric procedures (i.e., Methods 410.1, 410.2, or SM5220B).

A.4.7 Methods 325.3 and 300.0 (Chloride)

Chloride was measured using Methods 325.3, which is approved for compliance monitoring in 40 CFR Part 136, and 300.0, which is not listed in Part 136. Method 325.3 is a colorimetric (actually titrimetric) procedure and measures concentrations greater than 1 mg/L. Method 300.0 uses ion chromatography and can measure down to 0.05 mg/L. EPA allowed laboratories to use Method 300.0 even though it is not approved at 40 CFR Part 136 because the analytical methods normally used for chloride are subject to interferences sometimes present in samples containing blood, animal tissue, and/or other particulates. With Method 300.0, the complex matrices are not a factor and this method has a lower nominal quantitation limit than Method 325.1. (Section A.4.10 provides a more detailed description of Method 300.0.)

For all chloride data, EPA used the baseline value of 1 mg/L that is associated with the higher quantitation limit for the colorimetric procedure because most of the data used in the pollutants of concern analysis had been obtained by the colorimetric procedure (i.e., Method 325.3).

A.4.8 EPA Method 1657 (Dichlorvos, Malathion, Tetrachlorvinphos)

Laboratories used Method 1657 to measure dichlorvos, malathion, and tetrachlorvinphos concentrations in the samples. There is one approved method for malathion at 40 CFR Part 136: Standard Method 6630C; however, the other two pesticides are not listed in 40 CFR Part 136. EPA Method 1657 was selected for analysis of all three pesticides for several reasons, including:

- Method 1657 is approved for compliance monitoring of all three pesticides for the Pesticide Chemicals Point Source Category (see Table 7[7] in 40 CFR 455).
- EPA 1600-series methods were developed specifically for the effluent guidelines program; therefore, they have more stringent quality control requirements than Standard Methods; and
- It was more economical to use one method for the three pesticides, rather than analyzing malathion separately by SM6630C.

In Method 1657, samples are prepared by liquid-liquid extraction. The extract is dried and concentrated and a 1-μL aliquot of the extract is injected into the gas chromatography. The nominal quantitation limit of 2 μg/L was used as the baseline value for all three pesticides. This nominal quantitation limit was determined from the results of low-point calibration standards.

A.4.9 Methods 365.2 and 365.3 (Dissolved Total Phosphorus and Total Phosphorus)

Dissolved total phosphorus and total phosphorus were measured using Method 365.2 and 365.3, respectively. Both methods are approved for compliance monitoring of total phosphorus in 40 CFR Part 136. Total phosphorus represents all of the phosphorus present in the sample, regardless of form, as measured by the persulfate digestion procedure.

[7] Table 7 lists tetrachlorvinphos as stirofos.

The two methods differ only in the preparation of one of the reagents. Method 365.2 specifies the separation of the ammonium molybdate and the antimony potassium tartrate from the ascorbic acid reagent. Method 365.3 allows combining these reagents into a single solution. Because the chemistry is unaffected, the data are directly comparable.

These methods have the same nominal quantitation limit of 0.01 mg/L for both analytes. EPA used this value as the baseline value for both dissolved total phosphorus and total phosphorus.

A.4.10 Methods 300.0, 353.1, and 353.2 (Nitrate/Nitrite)

Nitrate/nitrite was measured using Methods 300.0, 353.1, and 353.2. Methods 353.1 and 353.2 are approved for compliance monitoring in 40 CFR Part 136, while Method 300.0 is not listed in Part 136. However, because nitrate/nitrite is a component of total nitrogen (see Section A.5), EPA is proposing to approve EPA Method 300.0 at 40 CFR Part 432 for compliance monitoring of nitrate/nitrite. Alternatively, EPA may amend 40 CFR Part 136 to include Method 300.0 for determination of nitrate/nitrite from wastewaters in the meat and poultry products point source category. In the preamble to the proposed rule, EPA has requested comment on the use of this method for the meat and poultry point source category and whether the method should be approved at 40 CFR Part 432 or at 40 CFR Part 136 or both.

Many of the analytical methods for nitrite/nitrate that are currently approved at 40 CFR Part 136, including Methods 353.1 and 353.2, are based on colorimetric techniques (i.e., adding reagents to a sample that form a colored product when they react with the nitrate/nitrite and measuring the intensity of the colored product). Such methods can be subject to interferences in the difficult matrices associated with this industry where samples may contain blood, animal tissue, and/or other particulates which affect both the color development and ability to pass light through the sample to measure the intensity of the colored product. In contrast, Method 300.0 employs the technique known as ion chromatography to measure 10 inorganic anions, including nitrate and nitrite. Ion chromatography permits the various inorganic anions to be separated from one another, as well as from other materials and contaminants present in the sample. Each anion can be identified on the basis of its characteristic retention time (the time required to pass through the instrumentation). After separation, the anions are measured by a conductivity detector that responds to changes in the effluent from the ion chromatograph that occur when the negatively charged anions (analytes) elute at characteristic retention times, thereby changing the conductivity of the solution. Thus, Method 300.0 offers better specificity for nitrate and nitrite in the presence of interferences compared to the approved colorimetric methods. Method 300.0 is located in the rulemaking record (Docket No. W-01-06, Record No.10036).

Methods 353.1 and 353.2 are essentially the same method, with variations in the technique used to reduce the nitrite (NO_2) present in the sample to nitrate (NO_3). Method 353.1 uses hydrazine to accomplish the reduction, while 353.2 uses cadmium granules. Method 353.2 is generally preferred simply because the cadmium granules are far easier to handle and less toxic than hydrazine. The chemistry of the colorimetric determination is the same, as are the interferences.

Each of the three methods lists slightly different nominal quantitation limits that are expressed in the methods as the lower limit of the measurement range. The nominal quantitation limit for Method 353.1 is 0.01 mg/L and the nominal quantitation limit for Method 353.2 is 0.05 mg/L. Rather than use different baseline values for the same pollutant, EPA used the nominal quantitation limit of 0.05 mg/L from Method 353.1 as the baseline value for nitrate/nitrite. EPA chose this value because Method 353.1 was used to obtain most of the data used in the pollutants of concern analysis. It is also the maximum of the nominal quantitation limits from the three methods.

A.4.11 Method 160.1 (Total Dissolved Solids)

Total Dissolved Solids (TDS) was measured by Method 160.1, which is approved for compliance monitoring in 40 CFR Part 136 (see 'residue – filterable'). Method 160.1 is a gravimetric method with a lower limit measurement range of 10 mg/L. EPA used this nominal quantitation limit of 10 mg/L as the baseline value.

A.4.12 Methods 351.2 and 351.3 (Total Kjeldahl Nitrogen (TKN))

Total Kjeldahl nitrogen (TKN) was measured by Methods 351.2 and 351.3, both of which are approved for compliance monitoring in 40 CFR Part 136. Method 351.2 is designed to be used with a flow colorimetry apparatus with a lower measurement range limit of 0.1 mg/L. Method 351.3 is a manual colorimetric analysis that has a lower measurement range limit of 0.5 mg/L. Rather than use different baseline values for the same pollutant, EPA used the nominal quantitation limit of 0.05 mg/L from Method 351.3 as the baseline value for TKN. EPA chose this value because Method 351.3 was used to obtain most of the data used in the pollutants of concern analysis. It is also the maximum of the nominal quantitation limits from the two methods.

A.4.13 Method 415.1 (Total Organic Carbon (TOC))

Total organic carbon (TOC) was determined by Method 415.1, which is approved for compliance monitoring in 40 CFR Part 136. Method 415.1 is a combustion (or oxidation) method with a lower measurement range limit of 1 mg/L. EPA used this nominal quantitation limit of 1 mg/L as the baseline value.

A.4.14 Methods 365.2 and 300.0 (Total Orthophosphate)

Methods 365.2 and 300.0 were used to measure orthophosphate concentrations. Total orthophosphate is the inorganic phosphorus (PO_4) in the sample. Method 365.2 is approved for compliance monitoring of total orthophosphate in 40 CFR Part 136, while Method 300.0 is not. As explained previously (see Sections A.4.7 and A.4.10), EPA allowed laboratories to use Method 300.0 because interferences, sometimes present in samples containing blood, animal tissue, and/or other particulates, are not a factor in the analysis.

Method 365.2 is a colorimetric method for determining orthophosphate and measures concentrations greater than 0.01 mg/L. Method 300.0 uses ion chromatography and can measure down to 0.20 mg/L. For all orthophosphate data, EPA used the baseline value of 0.01 mg/L, that is associated with the lower quantitation limit for the colorimetric procedure because the laboratories used Method 365.2 to produce the majority of the data used in the pollutants of concern analysis.

A.4.15 Methods HACH 8167 and 330.5 (Total Residual Chlorine)

Total residual chlorine was determined by Methods 330.5 and HACH 8167. Method 330.5 is approved for compliance monitoring in 40 CFR Part 136. Methods 330.5 and HACH 8167 use the same colorimetric reagent, N,N-diethyl-p-phenylene diamine (DPD), and are essentially the same procedure; thus, the data are directly comparable.

The nominal quantitation limit in Method 330.5 is 0.2 mg/L; the nominal quantitation limit for method HACH 8167 is 0.1 mg/L. Rather than use two different baseline values for the same pollutant, EPA used the value associated with Method 330.5 (i.e., 0.2 mg/L) as the baseline value because Method 330.5 produced the majority of the data used in the pollutants of concern analysis. It also is the higher of the two values.

A.4.16 Method 160.2 (Total Suspended Solids)

Total suspended solids (TSS) was determined by Method 160.2, which is approved for compliance monitoring in 40 CFR Part 136. Method 160.2 is a gravimetric method with a lower limit measurement range of 4 mg/L. The nominal quantitation limit of 4 mg/L was used as the baseline value.

A.4.17 Method 160.4 (Volatile Residue)

Volatile residue was determined by Method 160.4, which is approved for compliance monitoring in 40 CFR Part 136. Method 160.4 is a gravimetric and ignition method with a lower limit measurement range of 10 mg/L. The nominal quantitation limit of 10 mg/L was used as the baseline value.

A.4.18 EPA Method 1622 (*Cryptosporidium*)

Cryptosporidium was determined by EPA Method 1622, which, as explained in Section A.1, has not been approved for compliance monitoring. There are no 40 CFR Part 136-approved methods for *Cryptosporidium*; however, EPA proposed Method 1622 for ambient water monitoring on August 30, 2001 (66 FR 169, pages 45811-45829). In Method 1622, the laboratory filters a 10-L sample through an absolute-porosity filter to capture any target organisms that may be present, elutes the filter, concentrates the eluate, purifies the concentrate using immunomagnetic separation, and applies the purified sample to a microscope slide. The purified sample is stained with an antibody stain and a vital dye stain, and target organisms are identified and counted based on immunofluorescence assay, differential interference microscopy, and vital dye staining characteristics.

Due to the high turbidity of the sample matrices for these episodes, it was necessary for the analytical laboratory to modify the sample processing steps of the method, depending on the nature of the particulates in the sample. For samples that contained a high concentration of biological particles, a small volume of the sample (100 - 250 mL) was concentrated using centrifugation and then processed according to EPA Method 1622. For samples with lower concentrations of biological particulates that could be filtered, a 10-L sample was filtered through a compressed foam filter, the filter was eluted, and the eluate was concentrated by centrifugation and then processed according to EPA Method 1622.

As explained earlier, there is no detection limit or baseline value associated with EPA Method 1622; however, EPA used the baseline value of zero in the pollutant of concern analysis. Further, if *Cryptosporidium* was not quantitated, the sample was reported as zero.

A.4.19 SM9221B, SM9221E, SM9221F, SM9230B, SM9260L, FDA-BAM Chapter 5 (total coliform, fecal coliform, *E. coli*, fecal Streptococcus, *Aeromonas*, *Salmonella*)

Laboratories measured the densities of total coliform, fecal coliform, *E. coli*, fecal Streptococcus, *Aeromonas*, and *Salmonella* in 100-mL samples using the multiple-tube fermentation test specified in Standard Methods. EPA used methods approved for compliance monitoring in 40 CFR Part 136 for total coliform (SM9221B), fecal coliform (SM9221E), and fecal streptococcus (SM9230B). There are no 40 CFR Part 136-approved methods for *E.coli*, *Aeromonas*, and *Salmonella*; however, EPA proposed ambient water monitoring methods for *E.coli* on August 30, 2001 (66 FR 169, pages 45811-45829).

In measuring total coliforms (SM 9221B), fecal coliforms (SM 9221E), and *E. coli* (SM 9221F), samples were inoculated into a presumptive medium (Lauryl tryptose broth) and incubated. Tubes positive for growth and gas production were transferred into confirmatory media: brilliant green bile broth (for total coliforms), EC (for fecal coliforms), or EC-MUG (for *E. coli*). Tubes with acidic growth and gas production in their respective media were recorded as positive.

In measuring fecal streptococcus (SM 9230B), samples were inoculated into a presumptive medium (azide dextrose broth) and incubated. Tubes positive for turbidity (growth) were confirmed by streaking onto bile esculin agar plates. All plates with typical growth were recorded as positive for fecal streptococcus.

Aeromonas densities were determined using SM9260L, followed by the confirmation steps in EPA Method 1605, to minimize false positive results. Samples were inoculated into a presumptive medium (TSB30) and incubated. Tubes with growth were streaked onto ADA. All yellow colonies were isolated on nutrient agar and confirmed as Aeromonas if they were oxidase positive and were able to ferment trehalose. In addition to the biochemical confirmation, colony morphologies from ADA and nutrient agar were recorded and used to differentiate between Aeromonas and Bacillus.

The Food and Drug Administration-Biological Analytical Manual (FDA-BAM) Chapter 5 method was used to determine *Salmonella* densities. Samples were inoculated into a presumptive medium (tetrathionate broth) and incubated. Tubes with growth were streaked onto Hektoen enteric agar plates. Typical colonies were confirmed on triple sugar iron agar slants. The FDA-BAM method was used instead of the approved EPA Kenner-Clark method because FDA-BAM method performance is better suited for samples that contain blood and particulates.

The nominal quantitation limit for these analytes was determined using the most probable number (MPN) approach specified in Standard Methods. The MPN of each target organism per

100 mL was calculated based on the positive and negative results from the analysis of multiple replicates at multiple dilutions for each sample (see Table 9221.IV of Standard Methods and Table 2 in Appendix 2 of FDA-BAM). Based on the tables in Standard Methods, the nominal quantitation limit for all analytes was 2 MPN per 100 mL. The nominal quantitation limit was used as the baseline value. No values were reported below the baseline value.

Table II in 40 CFR 136.3 specifies holding times of six hours for some pathogens. In its sampling for this proposed rule, EPA measured counts in samples that had been retained longer than the six hours specified in Table II. In its data review narratives (located in Section 6.1.4.2 of the administrative record for the proposal), EPA has identified those samples that were retained longer than eight hours at the laboratory (includes the six hours holding time allotted for delivery to the laboratory plus an additional two hours at the laboratory). Method 9221E, an approved method[8] for fecal coliform, states that "Water treatment and other adverse environmental conditions often place great stress on indicator bacteria, resulting in an extended lag phase before logarithmic growth takes place." EPA is currently conducting a holding time study to assess potential changes in pathogen concentrations in effluents over time (8, 24, 30, and 48 hours after sample collection). This study will evaluate total and fecal coliforms, *Escherichia coli*, Aeromonas species, and fecal streptococci for both the meat products and aquaculture industries effluents. Additionally, Salmonella will be analyzed in meat products effluents. EPA is conducting this holding time study for two purposes: to evaluate the use of data in developing the limitations and standards; and for possible revisions to Table II. EPA notes that if the holding time can be extended to longer periods, overnight shipping of samples would be possible for compliance monitoring. However, EPA has not proposed any new limitations and standards for these analytes. Rather, EPA plans to retain the current limitations and standards for fecal coliform. The study plan for the holding time study is located at DCN 15060 in Section 6.1.4 of the administrative record for the proposal. In the forthcoming NODA, EPA will provide the data collected during the study and its evaluation of the results.

[8] Per Table IA of 40 CFR 136.3.

A.5 TOTAL NITROGEN

EPA proposes to regulate total nitrogen to ensure that the relationship between organic nitrogen (estimated by TKN) and inorganic nitrogen (estimated by nitrate/nitrite) is maintained, thus EPA is defining for the purposes of this industry 'total nitrogen' to be the sum of nitrate/nitrite and TKN. This summation will include nitrogen in the trinegative oxidation state (the dominant oxidation state of nitrogen in organic compounds), ammonia-nitrogen, and nitrogen in nitrite (NO_2^-) and nitrate (NO_3^-). In developing the limitations (see Section 13), EPA used a baseline value of 0.1 mg/L which is the sum of the baseline values for nitrate/nitrite (0.05 mg/L) and TKN (0.05 mg/L).

APPENDIX B

SURVEY DESIGN AND CALCULATION OF NATIONAL ESTIMATES

In 2001, EPA distributed two industry surveys. The first survey, entitled 2001 Meat Products Industry Screener Survey (short survey), was mailed to 1,650 meat products industry facilities. The second survey, entitled 2001 Meat Products Industry Survey (detailed survey), was mailed to 350 meat products industry facilities.

Section B.1 of this appendix describes the survey design (identification of facilities in the industry and sample design). Section B.2 of this appendix describes the selection of the sample. Section B.3 of this appendix describes response status of short survey facilities. Section B.4 of this appendix describes the calculation of sample weights. Section B.5 of this appendix describes the methodology for estimating national totals and their variance estimates. Section B.6 of this appendix summarizes EPA's plans for the analysis of the detailed survey.

B.1 SURVEY DESIGN

This section describes the development of the sampling plan, which includes identification of the meat products industry and stratification of facilities.

B.1.1 Sample Frame

To produce a mailing list of facilities for the detailed survey and short survey, EPA developed a sample frame of the meat products industry. A sample frame is a list of all members (sampling units) of a population, from which a random sample of members will be drawn for the survey. Therefore, a sample frame is the basis for the development of a sampling plan to select a random sample. EPA used several data sources to construct this sample frame. The March 2000 Hazard Analysis and Critical Control Points (HACCP) database was the main source of data. It was supplemented with information from the Urner-Barry Meat and Poultry Directory 2000 and an April 2000 list of 236 renderers provided by the National Renderers Association (NRA). The sample frame for the meat product survey contained 8,217 facilities.

EPA classified each facility into sampling strata by considering facility type, facility size, and type of animal used at the facility. Each facility was of one of the following 3 types: further processor, first processor, or renderer. Three size categories were used to determine the facility size. The size category was defined as large for facilities with 500 employees or more, small for facilities with 10 to 499 employees, and very small for facilities with 9 employees or less. Each facility on the sample frame specialized in one or several types of animal. These types of animal corresponded to poultry, beef, pork, and other. Renderers were not identified by size or animal type.

B.1.2 Sample Design

The sample frame for the survey included an unknown number of out-of-scope facilities. In order to obtain reliable counts of eligible meat product facilities, i.e., the facilities that were in-scope, by type and facility size directly from the frame, the survey was designed as a two-phase sample.

A first-phase sample of 2,000 facilities was selected from a sample frame containing 8,217 facilities. Additionally, a second-phase sample of 350 facilities was selected from the first-phase sample. All 350 second-phase sample facilities were mailed the detailed questionnaire, while the remaining 1,650 first-phase sample facilities received the short questionnaire. While the abridged form collected basic data to determine eligibility status and types of meat processed, the long form collected data about the 350 second-phase sample facilities for technical and financial information. Because of time constraints, both surveys were sent out simultaneously. To improve the accuracy of estimates from the detailed survey, the final weights will be calibrated to the estimated counts of eligible facilities from the short survey.

EPA identified a list of 65 facilities that were to be selected for the second-phase detailed sample with certainty to obtain information necessary for evaluating facility operations and best technology options. The first-phase and second-phase facility samples were stratified samples. Stratification separated the eligible population into non-overlapping strata that were as homogeneous as possible. Stratification assured that the sample would contain the same proportions as found on the sample frame, for those variables used to define the strata. The first-phase sample (selecting 1,935 non-certainties from 8,152) was stratified by facility type and size. The stratification of the second-phase sample was based only on facility type, since just 285 facilities were to be selected from the 1,935 first-phase non-certainties.

Table B-1 shows the distribution of facilities on the sample frame by facility type (first processor, further processor, renderer, or missing), size, and certainty status. Most certainty facilities were large first processors. Only 5 certainty facilities were small and none of the very small facilities were included in the sample with certainty.

B.1.3 Imputing for Missing Facility Type

In order to estimate the number of eligible facilities by type, size, and meat product (the purpose of the short survey) it was necessary to include samples of sufficient size from each facility-type-by-size stratum. This required assigning each facility on the frame to one of these strata; however, this information was unknown for many facilities; thus, EPA imputed the missing stratification data.

Table B-1. Distribution of facilities in the sample frame by certainty, facility type, and size

Certainty status	Facility type	Size				Total
		Large	Small	Very small	Unknown	
Non-certainties	First Processor	149	234	0	0	383
	Further Processor	34	883	0	0	917
	Renderer	0	0	0	235	235
	Unknown	50	1,259	5,308	0	6,617
Non-certainty total		233	2,376	5,308	235	8,152
Certainties	First Processor	56	3	0	0	59
	Further Processor	1	0	0	0	1
	Renderer	0	0	0	1	1
	Unknown	2	2	0	0	4
Certainty total		59	5	0	1	65
Grand total		292	2,381	5,308	236	8,217

From Table B-1 it is seen that facility type had to be imputed for 6,617 non-certainty facilities.[1] The facilities to be imputed a specific type were chosen randomly from the set of facilities with missing type. The facilities with unknown facility type were distributed between "first processors" and "further processors" proportionally to the reported size of each type.

[1] It should be noted that no imputation was carried out on the 4 certainty facilities with missing facility type, as they were to be included in the sample by design.

Therefore, 9 (=50 x (34/(34+149))) of the 50 large facilities with missing facility type were assigned to the further processor category, while the remaining 41 large facilities were assigned to the "first processor" category. Similarly, 995 of the 1,259 small facilities with missing facility type were assigned the "further processor" type, and the remaining 264 small facilities were assigned the "first processor" type. All very small facilities were assumed to be further processors because very small facilities in this industry were typically further processors.

All imputed values were used only for allocating the sample. None of the values were used for estimation and any wrong assumption simply resulted in a less efficient sample (larger variance). In addition, this imputation process was not expected to introduce any bias in the statistical procedure. For example, all very small facilities were assumed to be further processors; however, if any very small facility reported as a first processor it was treated as such in all analyses.

B.1.4 Imputing for Missing Animal Type

Before selecting the samples, the frame was sorted by animal type within each stratum. This allowed for appropriate representation of the different animal types in random selection of the sample. Table B-2 shows the distribution by animal type of noncertainty facilities that were not renderers. It should be noted that the stratification did not require the specification of animal type for the renderers. All large facilities with missing animal type were randomly assigned to one of the 7 animal type categories described in Table B-2 proportionally to the large facilities with animal types reported in the frame. On the other hand, small and very small facilities were combined and randomly assigned to animal type groups proportionally to the number of small facilities reported with animal types.

Table B-2. Distribution of noncertainty and non-renderer facilities imputed for animal type

Facility size	Animal type	Number of facilities reported on frame	Number of facilities imputed
Large	Pork only	17	4
	Poultry only	127	30
	Poultry & Pork	2	0
	Beef only	10	2
	Beef & Pork	6	1
	Beef & Poultry	3	2
	Beef & Poultry & Pork	23	6
	Missing	45	N/A
Small and very small	Pork only	157	805
	Poultry only	152	779
	Poultry & Pork	32	164
	Beef only	196	1,005
	Beef & Pork	203	1,041
	Beef & Poultry	76	390
	Beef & Poultry & Pork	438	2,246
	Missing	6,430	N/A
Total		7,917	6,475

B.2 SAMPLE SELECTION OF FACILITIES

The design of the first-phase sample was based upon the assumption that large facilities were more likely to be eligible than small facilities, which in turn were expected to be eligible more frequently than very small facilities. Thus, EPA determined that oversampling of the large facilities would be appropriate, in order to include many eligible facilities. Too much oversampling would reduce the accuracy of estimates because some facilities would have much greater weights than other facilities. An examination of alternative oversampling schemes[2] suggested balancing these two constraints by selecting large facilities at six times the rate of very small facilities, and at twice the rate of small facilities.

[2] DCN-55,001 July 28, 2000 memorandum from David Marker to Helen Jacobs and Jade Lee-Freeman.

After sorting by animal type, the facilities were selected from each stratum using systematic sampling scheme. Systematic sampling involve selecting every k^{th} facility where k is determined by the selection rate. The allocation of the sample is described in Table B-3. The allocation in Table B-3 was based upon the 6-3-1 rule according to which, large facilities were selected at a rate that

was 6 times higher than that of very small facilities and twice higher than that of small facilities. Using this allocation scheme, EPA selected a total of 2,000 facilities from the frame of 8,217 facilities.

Table B-3. Allocation of the first-phase sample

Stratum *h*	**Sample frame size** (N_h)	**First phase sample size** (n_h)
Certainty	65	65
Large First Processor	190	152
Large FurtherProcessor	43	34
Small First Processor	498	199
Small Further Processor	1,878	750
Very Small Further Processor	5,308	706
Renderer	235	94
Total	8,217	2,000

The 350 sample facilities were allocated in the second-phase sample to provide similar precision for each of seven analytic domains of interest. These domains were: poultry, beef, and pork further processors; poultry, beef, and pork first processors; and renderers. The 285 noncertainty sample facilities were therefore allocated so that approximately 41 (=285/7) were in each of these seven domains. The entire second-phase sample, including the noncertainty sample, consisted of 122 further processors, 121 first processors, and 42 renderers, along with 65 facilities selected with certainty. The facilities were sorted within facility type by animal type (as listed in Table B-4) before selecting the samples. Table B-4 shows how the first-phase sample in the previous table was distributed across the short and detailed surveys.

Table B-4. Allocation of the sample to the short and detailed surveys

Facility size and type	Sample size		
	First phase	Short survey	Detailed Survey
Certainty	65	0	65
Large First processor	152	100	52
Large Further processor	34	31	3
Small First processor	199	130	69
Small Further processor	750	688	62
Very small Further processor	706	649	57
Renderer	94	52	42
Total	2,000	1,650	350

For the purpose of selecting the sample of facilities, the WESSAMP SAS macro developed at Westat was used. WESSAMP selects systematic samples within sampling strata defined through a set of parameters.

B.3 RESPONSE STATUS OF SHORT (SCREENER) SAMPLE FACILITIES

Of the 1,650 facilities to which a short form was mailed, 601 did not return the form and their eligibility status was unknown as of April 24, 2001[3]. A total of 193 facilities that were either out-of-scope or could not be located were classified as ineligible. EPA assumed that some of the 601 facilities that did not return the short form were eligible nonrespondents. Therefore, it was necessary to estimate the number of ineligible facilities for sample weight adjustments. (See Section B.4.) The remaining 856 facilities were eligible respondents. These were facilities that returned a complete form and indicated that they engaged in meat processing. Table B-5 shows the response status by stratum for the facilities that were mailed a short survey.

[3] Any surveys processed after that date will be included in the revised estimates for the final rule.

Table B-5. Response status for the short survey by first-phase stratum

Stratum	Sample size	Eligible Respondent (S_1)	Nonrespondent (S_4)	Ineligible	
				Out-of-Scope (S_3)	Non-deliverable
Large First Processor	100	81	18	1	0
Large Further Processor	31	25	5	1	0
Small First Processor	130	76	41	10	3
Small Further Processor	688	350	247	53	38
Very Small Further Processor	649	287	281	36	45
Renderer	52	37	9	4	2
Total	1,650	856	601	105	88

B.4 WEIGHTING OF THE SHORT SURVEY

This section describes the methodology used to calculate the base weights, non-response adjustments, and the final weights for the short survey. In its analysis, EPA applied sample weights to survey data. The short survey was weighted in order to account for variable probabilities of selection, differential response rates, and ineligible facilities. The base weights and non-response adjustments reflect the probability of selection for each facility and adjustments for facility level non-responses, respectively. Weighting the data allows inferences to be made about all eligible facilities, not just those included in the sample, but also those not included in the sample or those that did not respond to the survey. Also, the weighted estimates have a smaller variance than unweighted estimates (see Section B.5 of this appendix for variance estimation.)

B.4.1 Base Weight Calculation

The first step in weighting the short survey was to assign a base weight to each of the sample facilities. The base weight associated with a short survey facility was calculated by multiplying the reciprocal of the probability of including that facility in the first-phase sample of 2,000 facilities, by the reciprocal of the probability of not including that facility in the detailed survey sample in the second phase. Table B-6 shows the calculation of the base weight. The short survey base weight for a given first-phase stratum *h* and second-phase stratum *l* can formally be written as follows:

$$Base\ weight_{hl} = \left(\frac{n_h}{N_h}\right)^{-1} \times \left(1 - \frac{m_l}{M_l}\right)^{-1}$$

where N_h is the number of facilities in the sample frame that belong to first-phase stratum *h*, n_h is the number of facilities selected in the first-phase sample that belong to first-phase stratum *h* (N_h and n_h are shown in Table B-5), M_l is the number of first-phase sample facilities that belonged to second-phase stratum *l*, and m_l is the number of facilities selected in the detailed survey sample from second-phase stratum *l*.

For example, in the first-phase sample, 34 of 43 large further processors were selected, so the first-phase inclusion probability was 0.7907. The second-phase sample only stratified by facility type, so the second-phase inclusion probability for further processors in the detailed survey was (3 + 62 + 57)/(34 + 750 + 706) = 0.0819 (see Table B-4). The overall inclusion probability for the short survey was (0.7907) x (1 - 0.0819) = 0.72596. The base weight was the reciprocal of this probability, 1.3775.

Table B-6. Base weight calculation for the short survey

Stratum	First-phase inclusion probability (n_h/N_h)	Second-phase detailed survey inclusion probabilities (m_l/M_l)	Short survey inclusion probabilities $\left(\frac{n_h}{N_h}\left(1-\frac{m_l}{M_l}\right)\right)$	Short survey base weights $\left(\left(\frac{n_h}{N_h}\right)^{-1} \times \left(1-\frac{m_l}{M_l}\right)^{-1}\right)$
Large First processor	0.8000	0.3447	0.52422	1.9076
Small First processor	0.3996	0.3447	0.26185	3.8191
Large Further processor	0.7907	0.0819	0.72596	1.3775
Small Further processor	0.3994	0.0819	0.36666	2.7273
Very Small Further processor	0.1330	0.0819	0.12212	8.1889
Renderer	0.4000	0.4468	0.22128	4.5192

B.4.2 Eligibility and Non-response Adjustment

The base weights associated with the short survey facilities were adjusted for non-response. Because the 601 nonresponding facilities had an unknown eligibility status, it was assumed that they were distributed among eligible and out-of-scope facilities in the same proportions as the respondents within each stratum. It was assumed that all nonrespondents did receive their surveys. The base weights of facilities were multiplied by the adjustment factor obtained by dividing the count of all sample facilities by the count of facilities with known eligibility status. The final weight, w_{hi} for a facility *i* in stratum *h*, can be written as follows:

$$\begin{aligned} w_{hi} &= (base\ weight)_{hi} \times (nonresponse\ adjustment)_h \\ &= (base\ weight)_{hi} \times \left(\frac{S_1 + S_3 + S_4}{S_1 + S_3} \right)_h \end{aligned}$$

where S_1, S_3, and S_4 represent counts for stratum *h* of eligible respondents, out-of-scope respondents who received their surveys, and facilities who did not respond, respectively (see Table B-6). This non-response adjustment was performed within strata in order to account for differential response rates in the short survey. For example, large further processors had 25 eligible respondents, 1 not involved in meat products, and 5 non-respondents. Its non-response adjustment factor was therefore 1.1923 (=31/26). Table B-7 shows the non-response adjustment factors and final weights for each stratum.

Table B-7. Non-response adjustment and final weight for the short survey

Stratum *h*	**Short survey base weight**	**Non-response adjustment** $\left(\frac{S_1 + S_3 + S_4}{S_1 + S_3} \right)$	**Short survey final weight** ***(W_{hi})***
Large First Processor	1.9076	1.2195	2.3264
Small First Processor	3.8191	1.4767	5.6398
Large Further Processor	1.3775	1.1923	1.6400
Small Further Processor	2.7273	1.6129	4.3880
Very Small Further Processor	8.1889	1.8670	15.2658
Renderer	4.5192	1.2195	5.5113

EPA plans to revise the short survey weighting and estimation to include the facilities whose responses were processed after the initial deadline. The same procedures will be used as described above, but the number of completes, ineligibles, and nonrespondents will change, and so will the weights. These revised short survey weights also will be used to revise the detailed survey weights. (See Section B.6.)

B.5 ESTIMATION METHOD

This section presents the general methodology and equations for calculating estimates from the short survey.

B.5.1 National Estimates

National total estimates were obtained for each characteristic and domain of interest by multiplying the reported value by the non-response-adjusted weight and by summing all weighted values for the facilities that belong to the domain of interest *k*.

$$\hat{y}_k = \sum_i w_{ki} y_{ki}$$

Similarly, ratio estimates (for example, of the mean) in a given domain *k* were obtained as a ratio of two national total estimates. For example, the average cattle production by facilities doing first processoring was calculated by dividing the weighted production of cattle by the weighted count of first processors.

$$\bar{y}_k = \frac{\sum_i w_{ki} y_{ki}}{\sum_i w_{ki}}$$

where w_{hi} is the non-response adjusted weight for facility *i*, y_{ki} is the cattle production for facility *i*, both in domain *k*, and the summation is over all facilities reporting cattle production.

Note that many facilities were involved in more than one type of activity or production. Their classification into one activity type, either first processoring, processing, rendering, or some combination was determined by the relative concentration of their production in any activity. Similar classification issues arose when reporting production by animal type (red meat, poultry, or mixed). If at least 85 percent of total production was of a given type of activity, it was classified accordingly (e.g., first processor). If no activity type accounted for 85 percent of production it was classified as mixed type. The same rule was used for animal type.

Further, note that the 65 certainty facilities were excluded from the short survey. The above estimation procedure will produce national estimates for all facilities except for those 65. To produce national estimates from the short survey that cover the entire meat products industry it will be necessary to combine these estimates with the reported data from the detailed questionnaires filled out for those 65 certainty facilities. Since these 65 facilities represent only themselves, they are each given a weight of one for such analyses. For the final rule, EPA will incorporate the values for the 65 facilities into its revised national estimates.

B.5.2 Variance Estimates

To compute the correct estimates of standard errors a set of jackknife replicate weights was constructed and attached to each facility. Under the jackknife replication method, a number of subsamples (called jackknife replicates) were generated from the full sample, and the entire weighting process as described in the previous sections was repeated for each replicate. In this way, a series of replicate weights were generated for each facility, which together with the full-sample weight were used to calculate sampling errors (see Wolters, 1985 for a description of the jackknife and other variance estimation methods)[4]. Given that there were almost 900 responding facilities for the short survey, it was decided to create 90 replicates for variance estimation. Each respondent was assigned a number between 1 and 90. The first replicate used the values from all facilities except those assigned to group 1. The other replicates were derived in a similar way by excluding the values for a different group each time.

In order to illustrate how the sampling errors have been calculated, let be the weighted national average estimate of a characteristic *y* (e.g., first processor meat production of cattle) for

[4] Wolters, K. M. (1985) Introduction to Variance Estimation, Springer-Verlag Publishers, New York.

the entire data set. If is the corresponding estimate for jackknife replicate *r*, then the estimated variance of *y* is given by the following formula:

$$\mathrm{var}(\bar{y}) = \sum_{r=1}^{90} \left(\bar{y}_{(r)} - \bar{y} \right)^2$$

where the summation extends over all 90 jackknife replicates that were formed for the short survey. This jackknife variance was often used to compute 95 percent confidence limits around the estimate. These limits are given by:

$$\bar{y} \pm 1.96 \sqrt{\mathrm{var}(\bar{y})}$$

The WesVar program was used to compute estimates of standard errors.

B.6 ANALYSIS OF THE DETAILED SURVEY

The process of detailed surveys is more complex and time-consuming than the process of short surveys due to its length and the details of survey responses. In order to meet the court ordered deadline for the proposed rule, EPA only analyzed the short surveys. Detailed surveys will be analyzed for the final rule using similar methodology described in Sections B.4 and B.5. For the final rule, the base weight associated with a detailed sample facility was calculated by multiplying the reciprocal of the probability of including that facility in the first-phase sample of 2,000 facilities, by the reciprocal of the probability of including that facility in the detailed survey sample. Table B-8 shows the calculation of the base weight. The detailed survey base weight for a given first-phase stratum *h* and second-phase stratum *l* can formally be written as follows:

$$Base\ weight_{hl} = \left(\frac{n_h}{N_h} \right)^{-1} \left(\frac{m_l}{M_l} \right)^{-1}$$

where N_h is the number of facilities in the sample that belong to first-phase stratum *h* (N_h and n_h are shown in Table B-3), n_h is the number of facilities selected in the first-phase sample that belong to first-phase stratum *h*, M_l is the number of first-phase sample facilities that belong to second-phase stratum *l*, and m_l is the number of facilities selected in the detailed survey sample from second-phase stratum *l* (second-phase stratum totals can be found in the column labeled "Detailed Survey" in Table B-4).

Table B-8. Base weight calculation for the detailed survey sample

Stratum	**First-phase inclusion probability (n_n / N_h)**	**Second-phase inclusion probabilities (m_l / M_l)**	**Detailed survey inclusion probabilities** $\left(\left(\frac{n_h}{N_h}\right)\left(\frac{m_l}{M_l}\right)\right)$	**Detailed survey base weights** $\left(\left(\frac{n_h}{N_h}\right)^{-1}\left(\frac{m_l}{M_l}\right)^{-1}\right)$
Large First Processor	0.8000	0.3447	0.2758	3.6260
Small First Processor	0.3996	0.3447	0.1378	7.2594
Large Further Processor	0.7907	0.0819	0.0647	15.4460
Small Further Processor	0.3994	0.0819	0.0327	30.5816
Very Small Further Processor	0.1330	0.0819	0.0109	91.8232
Renderer	0.4000	0.4468	0.1787	5.5952
Certainties	1.0000	1.0000	1.0000	1.0000

Due to duplication on the sample frame, a few facilities were sampled for both the short and detailed surveys. Such facilities were encouraged to complete both forms since estimates are made independently from both surveys.

The non-response adjustment for the detailed survey will be carried out with the same methodology used to adjust the base weights for the short survey (see Section B.4.2). However, the non-response-adjusted weights will further be adjusted to benchmark them to the weighted counts of eligible facilities calculated from the short survey. This is because the much larger sample size in the short survey provides better estimates of the number of eligible facilities in each stratum. This second adjustment will be done within the type and size categories and will yield the final weight. If *h* designates a first-phase stratum, then the detailed survey final weight w_i for a given facility *i* can be written as follows:

$$W_i = \left(NR - Adjusted\ Weight\right)_i \times \frac{\left(Estimated\ Number\ of\ Facilities\ from\ Short\ Survey\right)_h}{\left(Estimated\ Number\ of\ Facilities\ from\ Detailed\ Survey\right)_h}$$

National estimates and corresponding standard errors for the detailed survey will be calculated using the same methods described in Section B.5 for the short survey with the exception that for each jackknife replicate sample will be based on a different number of subsamples. In the documentation for the final rule, EPA will further describe the detailed questionnaire estimates.

APPENDIX C

TABLES TO SECTION 9

Table C-1. Average Baseline Concentrations for Meat First Processing (R1) Direct Dischargers

Pollutant of Concern	Small Facility Concentration	Non-Small Facility Concentration	Units
5-Day biochemical oxygen demand (BOD_5)	99.00	7.60	mg/L
Total suspended solids (TSS)	172.0	8.00	mg/L
Hexane extractable material (HEM)	9.00	14.54	mg/L
Fecal coliform bacteria	508.0	20.00	cfu/100 mL
Ammonia as nitrogen	6.12	8.77	mg/L
Carbaryl	0.001	0.001	mg/L
Carbonaceous biochemical oxygen demand (CBOD)	5.80	11.00	mg/L
Chemical oxygen demand (COD)	85.37	118.4	mg/L
Chloride	513.0	2,070	mg/L
Dissolved biochemical oxygen demand	5.00	5.20	mg/L
Dissolved phosphorus	20.62	7.10	mg/L
Nitrate-nitrite	245.5	102.0	mg/L
Total nitrogen	239.3	89.82	mg/L
Orthophosphate	24.09	11.73	mg/L
Total dissolved solids (TDS)	1,953	3,067	mg/L
Total Kjeldahl nitrogen (TKN)	5.66	7.65	mg/L
Total organic carbon (TOC)	17.69	19.14	mg/L
Total phosphorus	23.42	7.63	mg/L
Total residual chlorine	0.594	0.030	mg/L
Volatile residue	273.5	121.2	mg/L
Barium	—[a]	—	
Copper	0.00367	0.00297	mg/L
Chromium	1.21	0.00656	mg/L
Manganese	0.05069	0.19680	mg/L
Molybdenum	0.00679	0.00755	mg/L
Nickel	0.00305	0.03117	mg/L
Titanium	0.00153	0.00387	mg/L
Vanadium	0.00583	0.00356	mg/L
Zinc	0.05881	0.02281	mg/L
Aeromonas	2,951	1,296	cfu/100 mL
Cryptosporidium	0.3000	0.300	cysts/L
E. Coli	228.3	180.1	cfu/100 mL
Fecal streptococci	30.98	150.1	cfu/100 mL
Salmonella	—	—	
Total coliform	400.0	476.5	cfu/100 mL
cis-Permethrin	0.0160	0.0040	mg/L
trans-Permethrin	0.0160	0.0040	mg/L

[a] not applicable

Table C-2. Average Baseline Concentrations for Meat First/Further Processing (R12)[a] Direct Dischargers

Pollutant of Concern	Small Facility Concentration	Non-Small Facility Concentration	Units
5-Day biochemical oxygen demand (BOD_5)	6.16	6.16	mg/L
Total suspended solids (TSS)	25.67	25.67	mg/L
Hexane extractable material (HEM)	11.78	11.78	mg/L
Fecal coliform bacteria	38.94	38.94	cfu/100 mL
Ammonia as nitrogen	0.38	0.38	mg/L
Carbaryl	0.00100	0.00100	mg/L
Carbonaceous biochemical oxygen demand (CBOD)	4.00	4.00	mg/L
Chemical oxygen demand (COD)	48.33	48.33	mg/L
Chloride	1,587	1,587	mg/L
Dissolved biochemical oxygen demand	4.00	4.00	mg/L
Dissolved phosphorus	13.57	13.57	mg/L
Nitrate-nitrite	300.7	300.7	mg/L
Total nitrogen	304.7	304.7	mg/L
Orthophosphate	12.27	12.27	mg/L
Total dissolved solids (TDS)	3,930	3,930	mg/L
Total Kjeldahl nitrogen (TKN)	3.99	3.99	mg/L
Total organic carbon (TOC)	11.50	11.50	mg/L
Total phosphorus	15.43	15.43	mg/L
Total residual chlorine	0.792	0.792	mg/L
Volatile residue	270.0	270.0	mg/L
Barium	—[b]	—	
Copper	0.00417	0.00417	mg/L
Chromium	0.00100	0.00100	mg/L
Manganese	0.00553	0.00553	mg/L
Molybdenum	0.00757	0.00757	mg/L
Nickel	0.00183	0.00183	mg/L
Titanium	0.00100	0.00100	mg/L
Vanadium	0.00573	0.00573	mg/L
Zinc	0.02337	0.02337	mg/L
Aeromonas	36.33	36.33	cfu/100 mL
Cryptosporidium	0.300	0.300	cysts/L
E. Coli	54.00	54.00	cfu/100 mL
Fecal streptococci	20.67	20.67	cfu/100 mL
Salmonella	—	—	
Total coliform	124.7	124.7	cfu/100 mL
cis-Permethrin	0.0160	0.0160	mg/L
trans-Permethrin	0.0160	0.0160	mg/L

[a] Baseline concentration of R12 (small) was derived using R12 (non-small) since no R12 small direct discharge facilities were represented in the detailed survey

[b] not applicable

Table C-3. Average Baseline Concentrations for Meat First Processing and Rendering (R13)[a] Direct Dischargers

Pollutant of Concern	Small Facility Concentration	Non-Small Facility Concentration	Units
5-Day biochemical oxygen demand (BOD_5)	32.08	32.08	mg/L
Total suspended solids (TSS)	19.13	19.13	mg/L
Hexane extractable material (HEM)	84.67	84.67	mg/L
Fecal coliform bacteria	92.36	92.36	cfu/100 mL
Ammonia as nitrogen	2.47	2.47	mg/L
Carbaryl	0.00100	0.00100	mg/L
Carbonaceous biochemical oxygen demand (CBOD)	24.21	24.21	mg/L
Chemical oxygen demand (COD)	63.17	63.17	mg/L
Chloride	856.8	856.8	mg/L
Dissolved biochemical oxygen demand	11.29	11.29	mg/L
Dissolved phosphorus	23.87	23.87	mg/L
Nitrate-nitrite	134.4	134.4	mg/L
Total nitrogen	140.8	140.8	mg/L
Orthophosphate	12.72	12.72	mg/L
Total dissolved solids (TDS)	2,610	2,610	mg/L
Total Kjeldahl nitrogen (TKN)	7.46	7.46	mg/L
Total organic carbon (TOC)	16.72	16.72	mg/L
Total phosphorus	30.17	30.17	mg/L
Total residual chlorine	2.66	2.66	mg/L
Volatile residue	182.7	182.7	mg/L
Barium	—[b]	—	
Copper	0.00888	0.00888	mg/L
Chromium	0.00308	0.00308	mg/L
Manganese	0.07028	0.07028	mg/L
Molybdenum	0.00395	0.00395	mg/L
Nickel	0.01530	0.01530	mg/L
Titanium	0.00132	0.00132	mg/L
Vanadium	0.00454	0.00454	mg/L
Zinc	0.06153	0.06153	mg/L
Aeromonas	89,822	89,822	cfu/100 mL
Cryptosporidium	0.371	0.371	cysts/L
E. Coli	106,326	106,326	cfu/100 mL
Fecal streptococci	1,478.18	1,478.18	cfu/100 mL
Salmonella	—	—	
Total coliform	84,624	84,624	cfu/100 mL
cis-Permethrin	0.0069	0.0069	mg/L
trans-Permethrin	0.0069	0.0069	mg/L

[a] Baseline concentration of R13 (small) was derived using R13 (non-small) since no R13 small direct discharge facilities were represented in the detailed survey

[b] not applicable

Table C-4. Average Baseline Concentrations for Meat First/Further Processing and Rendering (R123)[a] Direct Dischargers

Pollutant of Concern	Small Facility Concentration	Non-Small Facility Concentration	Units
5-Day biochemical oxygen demand (BOD_5)	30.51	30.51	mg/L
Total suspended solids (TSS)	44.94	44.94	mg/L
Hexane extractable material (HEM)	36.08	36.08	mg/L
Fecal coliform bacteria	131.76	131.76	cfu/100 mL
Ammonia as nitrogen	3.43	3.43	mg/L
Carbaryl	0.00100	0.00100	mg/L
Carbonaceous biochemical oxygen demand (CBOD)	12.20	12.20	mg/L
Chemical oxygen demand (COD)	71.13	71.13	mg/L
Chloride	1,245	1,245	mg/L
Dissolved biochemical oxygen demand	6.80	6.80	mg/L
Dissolved phosphorus	17.10	17.10	mg/L
Nitrate-nitrite	202.9	202.9	mg/L
Total nitrogen	203.3	203.3	mg/L
Orthophosphate	14.30	14.30	mg/L
Total dissolved solids (TDS)	3,017	3,017	mg/L
Total Kjeldahl nitrogen (TKN)	6.03	6.03	mg/L
Total organic carbon (TOC)	15.54	15.54	mg/L
Total phosphorus	20.38	20.38	mg/L
Total residual chlorine	1.26	1.26	mg/L
Volatile residue	216.7	216.7	mg/L
Barium	—[b]	—	
Copper	0.00546	0.00546	mg/L
Chromium	0.20412	0.20412	mg/L
Manganese	0.06652	0.06652	mg/L
Molybdenum	0.00623	0.00623	mg/L
Nickel	0.01142	0.01142	mg/L
Titanium	0.00168	0.00168	mg/L
Vanadium	0.00499	0.00499	mg/L
Zinc	0.04190	0.04190	mg/L
Aeromonas	30,661	30,661	cfu/100 mL
Cryptosporidium	0.324	0.324	cysts/L
E. Coli	35,528	35,528	cfu/100 mL
Fecal streptococci	529.79	529.79	cfu/100 mL
Salmonella	—	—	
Total coliform	28,396	28,396	cfu/100 mL
cis-Permethrin	0.0110	0.0110	mg/L
trans-Permethrin	0.0110	0.0110	mg/L

[a] Baseline concentration of R123 was derived using average concentrations of R1 (small and non-small facilities) + R12 (non-small) + R13 (non-small facilities), since no R123 small or non-small direct discharge facilities were represented in the detailed survey

[b] not applicable

Table C-5. Average Baseline Concentrations for Meat Further Processing (R2)[a] Direct Dischargers

Pollutant of Concern	Small Facility Concentration	Non-Small Facility Concentration	Units
5-Day biochemical oxygen demand (BOD_5)	6.16	6.16	mg/L
Total suspended solids (TSS)	25.67	25.67	mg/L
Hexane extractable material (HEM)	11.78	11.78	mg/L
Fecal coliform bacteria	38.94	38.94	cfu/100 mL
Ammonia as nitrogen	0.38	0.38	mg/L
Carbaryl	0.00100	0.00100	mg/L
Carbonaceous biochemical oxygen demand (CBOD)	4.00	4.00	mg/L
Chemical oxygen demand (COD)	48.33	48.33	mg/L
Chloride	1,587	1,587	mg/L
Dissolved biochemical oxygen demand	4.00	4.00	mg/L
Dissolved phosphorus	13.57	13.57	mg/L
Nitrate-nitrite	300.7	300.7	mg/L
Total nitrogen	304.7	304.7	mg/L
Orthophosphate	12.27	12.27	mg/L
Total dissolved solids (TDS)	3,930	3,930	mg/L
Total Kjeldahl nitrogen (TKN)	3.99	3.99	mg/L
Total organic carbon (TOC)	11.50	11.50	mg/L
Total phosphorus	15.43	15.43	mg/L
Total residual chlorine	0.792	0.792	mg/L
Volatile residue	270.0	270.0	mg/L
Barium	—[b]	—	
Copper	0.00417	0.00417	mg/L
Chromium	0.00100	0.00100	mg/L
Manganese	0.00553	0.00553	mg/L
Molybdenum	0.00757	0.00757	mg/L
Nickel	0.00183	0.00183	mg/L
Titanium	0.00100	0.00100	mg/L
Vanadium	0.00573	0.00573	mg/L
Zinc	0.02337	0.02337	mg/L
Aeromonas	36.33	36.33	cfu/100 mL
Cryptosporidium	0.300	0.300	cysts/L
E. Coli	54.00	54.00	cfu/100 mL
Fecal streptococci	20.67	20.67	cfu/100 mL
Salmonella	—	—	
Total coliform	124.7	124.7	cfu/100 mL
cis-Permethrin	0.0160	0.0160	mg/L
trans-Permethrin	0.0160	0.0160	mg/L

[a] Baseline concentration of R2 was derived using R12 (non-small), since no R2 small or non-small direct discharge facilities were represented in the detailed survey

[b] not applicable

Table C-6. Average Baseline Concentrations for Meat Further Processing and Rendering (R23)[a] Direct Dischargers

Pollutant of Concern	Small Facility Concentration	Non-Small Facility Concentration	Units
5-Day biochemical oxygen demand (BOD_5)	19.12	19.12	mg/L
Total suspended solids (TSS)	22.40	22.40	mg/L
Hexane extractable material (HEM)	48.23	48.23	mg/L
Fecal coliform bacteria	65.65	65.65	cfu/100 mL
Ammonia as nitrogen	1.42	1.42	mg/L
Carbaryl	0.00100	0.00100	mg/L
Carbonaceous biochemical oxygen demand (CBOD)	14.11	14.11	mg/L
Chemical oxygen demand (COD)	55.75	55.75	mg/L
Chloride	1,222	1,222	mg/L
Dissolved biochemical oxygen demand	7.64	7.64	mg/L
Dissolved phosphorus	18.72	18.72	mg/L
Nitrate-nitrite	217.5	217.5	mg/L
Total nitrogen	222.7	222.7	mg/L
Orthophosphate	12.49	12.49	mg/L
Total dissolved solids (TDS)	3,270	3,270	mg/L
Total Kjeldahl nitrogen (TKN)	5.72	5.72	mg/L
Total organic carbon (TOC)	14.11	14.11	mg/L
Total phosphorus	22.80	22.80	mg/L
Total residual chlorine	1.73	1.73	mg/L
Volatile residue	226.3	226.3	mg/L
Barium	—[b]	—	
Copper	0.00652	0.00652	mg/L
Chromium	0.00204	0.00204	mg/L
Manganese	0.03791	0.03791	mg/L
Molybdenum	0.00576	0.00576	mg/L
Nickel	0.00857	0.00857	mg/L
Titanium	0.00116	0.00116	mg/L
Vanadium	0.00514	0.00514	mg/L
Zinc	0.04245	0.04245	mg/L
Aeromonas	44,929	44,929	cfu/100 mL
Cryptosporidium	0.336	0.336	cysts/L
E. Coli	53,190	53,190	cfu/100 mL
Fecal streptococci	749.42	749.42	cfu/100 mL
Salmonella	—	—	
Total coliform	42,374	42,374	cfu/100 mL
cis-Permethrin	0.0114	0.0114	mg/L
trans-Permethrin	0.0114	0.0114	mg/L

[a] Baseline concentration of R23 was derived using average concentrations of R12 (non-small) + R13 (non-small), since no R23 small or non-small direct discharge facilities were represented in the detailed survey

[b] not applicable

Table C-7. Average Baseline Concentration for Meat First Processing (R1) Indirect Dischargers

Pollutant of Concern	Small Facility Concentration	Non-Small Facility Concentration	Units
5-Day biochemical oxygen demand (BOD_5)	1,823	1,636	mg/L
Total suspended solids (TSS)	1,266	1,233	mg/L
Hexane extractable material (HEM)	246.2	256.5	mg/L
Fecal coliform bacteria	1,982,510	1,763,340	cfu/100 mL
Ammonia as nitrogen	381.0	217.2	mg/L
Carbaryl	0.0116	0.0148	mg/L
Carbonaceous biochemical oxygen demand (CBOD)	1,925	1890.6	mg/L
Chemical oxygen demand (COD)	3,884	3,600	mg/L
Chloride	1,087	1,381	mg/L
Dissolved biochemical oxygen demand	1,174	1,152	mg/L
Dissolved phosphorus	40.09	44.25	mg/L
Nitrate-nitrite	4.26	6.35	mg/L
Total nitrogen	393.1	369.0	mg/L
Orthophosphate	36.66	39.02	mg/L
Total dissolved solids (TDS)	2,554	2,400	mg/L
Total Kjeldahl nitrogen (TKN)	388.8	362.6	mg/L
Total organic carbon (TOC)	661.1	592.0	mg/L
Total phosphorus	55.15	61.96	mg/L
Total residual chlorine	0.611	0.676	mg/L
Volatile residue	2,028	1,800	mg/L
Barium	—[a]	—	
Copper	0.100	0.1193	mg/L
Chromium	0.0361	0.0318	mg/L
Manganese	1.02	0.7994	mg/L
Molybdenum	0.0164	0.0158	mg/L
Nickel	0.0321	0.0267	mg/L
Titanium	0.00864	0.0113	mg/L
Vanadium	0.00382	0.0047	mg/L
Zinc	0.457	0.4899	mg/L
Aeromonas	1,467,870	1,321,636	cfu/100 mL
Cryptosporidium	106.3	127.5	cysts/L
E. Coli	1,844,750	1,763,167	cfu/100 mL
Fecal streptococci	918,043	820,620	cfu/100 mL
Salmonella	—	—	
Total coliform	1,600,000	1,600,000	cfu/100 mL
cis-Permethrin	0.00411	0.00414	mg/L
trans-Permethrin	0.00434	0.00400	mg/L

[a] not applicable

Table C-8. Average Baseline Concentration for Red Meat First/Further Processing (R12) Indirect Dischargers

Pollutant of Concern	Small Facility Concentration	Non-Small Facility Concentration	Units
5-Day biochemical oxygen demand (BOD_5)	1,406	1,083	mg/L
Total suspended solids (TSS)	1,256	568.9	mg/L
Hexane extractable material (HEM)	192.6	117.1	mg/L
Fecal coliform bacteria	1,400,769	1,341,847	cfu/100 mL
Ammonia as nitrogen	334.4	404.5	mg/L
Carbaryl	0.01228	0.00952	mg/L
Carbonaceous biochemical oxygen demand (CBOD)	1,883	868.9	mg/L
Chemical oxygen demand (COD)	2,691	1,965	mg/L
Chloride	1,269	793.6	mg/L
Dissolved biochemical oxygen demand	1,183	921.6	mg/L
Dissolved phosphorus	40.92	36.19	mg/L
Nitrate-nitrite	4.97	45.20	mg/L
Total nitrogen	246.0	276.8	mg/L
Orthophosphate	32.44	24.58	mg/L
Total dissolved solids (TDS)	1,871	2,412	mg/L
Total Kjeldahl nitrogen (TKN)	241.0	231.6	mg/L
Total organic carbon (TOC)	684.2	477.1	mg/L
Total phosphorus	56.51	48.80	mg/L
Total residual chlorine	0.671	0.436	mg/L
Volatile residue	2,104	1,491	mg/L
Barium	—[a]	—	
Copper	0.108	0.0755	mg/L
Chromium	0.0315	0.0445	mg/L
Manganese	0.505	0.6194	mg/L
Molybdenum	0.0166	0.0136	mg/L
Nickel	0.0183	0.0205	mg/L
Titanium	0.0100	0.0059	mg/L
Vanadium	0.00363	0.00324	mg/L
Zinc	0.501	0.3204	mg/L
Aeromonas	839,877	1,127,373	cfu/100 mL
Cryptosporidium	127.5	59.53	cysts/L
E. Coli	1,600,000	1,500,066	cfu/100 mL
Fecal streptococci	950,517	656,497	cfu/100 mL
Salmonella	—	—	
Total coliform	1,600,000	1,431,028	cfu/100 mL
cis-Permethrin	0.00411	0.00649	mg/L
trans-Permethrin	0.00445	0.00640	mg/L

[a] not applicable

Table C-9. Average Baseline Concentration for Red Meat First Processing and Rendering (R13) Indirect Dischargers

Pollutant of Concern	Small Facility Concentration	Non-Small Facility Concentration	Units
5-Day biochemical oxygen demand (BOD_5)	412.0	1,514	mg/L
Total suspended solids (TSS)	93.00	581.4	mg/L
Hexane extractable material (HEM)	2.40	108.0	mg/L
Fecal coliform bacteria	1,811,050	1,811,050	cfu/100 mL
Ammonia as nitrogen	91.00	611.9	mg/L
Carbaryl	0.0010	0.0098	mg/L
Carbonaceous biochemical oxygen demand (CBOD)	478.0	1,546	mg/L
Chemical oxygen demand (COD)	862.0	2,725	mg/L
Chloride	542.0	542.0	mg/L
Dissolved biochemical oxygen demand	7.11	1,150	mg/L
Dissolved phosphorus	13.86	37.59	mg/L
Nitrate-nitrite	128.7	2.13	mg/L
Total nitrogen	250.5	336.0	mg/L
Orthophosphate	27.07	23.28	mg/L
Total dissolved solids (TDS)	2,517	2,400	mg/L
Total Kjeldahl nitrogen (TKN)	98.20	333.8	mg/L
Total organic carbon (TOC)	23.33	592.0	mg/L
Total phosphorus	14.38	51.07	mg/L
Total residual chlorine	0.404	0.248	mg/L
Volatile residue	257.7	1,800	mg/L
Barium	—[a]	—	
Copper	0.0027	0.0779	mg/L
Chromium	0.0500	0.0500	mg/L
Manganese	0.0303	0.9936	mg/L
Molybdenum	0.0065	0.0158	mg/L
Nickel	0.0029	0.0288	mg/L
Titanium	0.0010	0.0045	mg/L
Vanadium	0.0047	0.0021	mg/L
Zinc	0.0487	0.3234	mg/L
Aeromonas	1,251,966	1,251,966	cfu/100 mL
Cryptosporidium	0.150	42.50	cysts/L
E. Coli	1,487,234	1,600,000	cfu/100 mL
Fecal streptococci	16,664	820,620	cfu/100 mL
Salmonella	—	—	
Total coliform	1,177,498	1,600,000	cfu/100 mL cfu/100 mL
cis-Permethrin	0.00400	0.00409	mg/L
trans-Permethrin	0.00400	0.00400	mg/L

[a] not applicable

Table C-10. Average Baseline Concentration for Red Meat First/Further Processing and Rendering (R123)[a] Indirect Dischargers

Pollutant of Concern	Small Facility Concentration	Non-Small Facility Concentration	Units
5-Day biochemical oxygen demand (BOD_5)	156.7	156.7	mg/L
Total suspended solids (TSS)	210.1	210.1	mg/L
Hexane extractable material (HEM)	50.48	50.48	mg/L
Fecal coliform bacteria	728,066	728,066	cfu/100 mL
Ammonia as nitrogen	210.5	210.5	mg/L
Carbaryl	0.0054	0.0054	mg/L
Carbonaceous biochemical oxygen demand (CBOD)	654.6	654.6	mg/L
Chemical oxygen demand (COD)	1,201	1,201	mg/L
Chloride	1,306	1,306	mg/L
Dissolved biochemical oxygen demand	577.6	577.6	mg/L
Dissolved phosphorus	22.34	22.34	mg/L
Nitrate-nitrite	3.95	3.95	mg/L
Total nitrogen	120.4	120.4	mg/L
Orthophosphate	14.08	14.08	mg/L
Total dissolved solids (TDS)	2,827	2,827	mg/L
Total Kjeldahl nitrogen (TKN)	116.5	116.5	mg/L
Total organic carbon (TOC)	305.6	305.6	mg/L
Total phosphorus	29.08	29.08	mg/L
Total residual chlorine	0.179	0.179	mg/L
Volatile residue	960.6	960.6	mg/L
Barium	—[b]	—	
Copper	0.0404	0.0404	mg/L
Chromium	0.0266	0.0266	mg/L
Manganese	0.4409	0.4409	mg/L
Molybdenum	0.0110	0.0110	mg/L
Nickel	0.0169	0.0169	mg/L
Titanium	0.0028	0.0028	mg/L
Vanadium	0.0016	0.0016	mg/L
Zinc	0.1709	0.1709	mg/L
Aeromonas	496,918	496,918	cfu/100 mL
Cryptosporidium	21.40	21.40	cysts/L
E. Coli	803,169	803,169	cfu/100 mL
Fecal streptococci	410,313	410,313	cfu/100 mL
Salmonella	—	—	
Total coliform	803,664	803,664	cfu/100 mL
cis-Permethrin	0.0040	0.0040	mg/L
trans-Permethrin	0.0040	0.0040	mg/L

[a] Baseline concentration of R123 (small) was derived using R123 (non-small), since no R123 small indirect discharge facilities were represented in the detailed survey

[b] not applicable

Table C-11. Average Baseline Concentration for Red Meat Further Processing (R2) Indirect Dischargers

Pollutant of Concern	Small Facility Concentration	Non-Small Facility Concentration	Units
5-Day biochemical oxygen demand (BOD_5)	1,301	1,035	mg/L
Total suspended solids (TSS)	374.4	258.5	mg/L
Hexane extractable material (HEM)	135.0	96.59	mg/L
Fecal coliform bacteria	810,899	820,000	cfu/100 mL
Ammonia as nitrogen	22.81	37.87	mg/L
Carbaryl	0.00968	0.0108	mg/L
Carbonaceous biochemical oxygen demand (CBOD)	1,385	1,220	mg/L
Chemical oxygen demand (COD)	2,330	2,368	mg/L
Chloride	6,421	6,674	mg/L
Dissolved biochemical oxygen demand	1,076	1,150	mg/L
Dissolved phosphorus	65.09	59.05	mg/L
Nitrate-nitrite	15.61	2.13	mg/L
Total nitrogen	39.0	21.46	mg/L
Orthophosphate	21.82	22.80	mg/L
Total dissolved solids (TDS)	8,145	8,238	mg/L
Total Kjeldahl nitrogen (TKN)	23.39	19.33	mg/L
Total organic carbon (TOC)	566.6	600.2	mg/L
Total phosphorus	73.67	68.56	mg/L
Total residual chlorine	0.265	0.248	mg/L
Volatile residue	1,857	1,911	mg/L
Barium	—[a]	—	
Copper	0.0733	0.0779	mg/L
Chromium	0.0172	0.0267	mg/L
Manganese	0.0284	0.0293	mg/L
Molybdenum	0.0176	0.0176	mg/L
Nickel	0.00682	0.0067	mg/L
Titanium	0.00431	0.0045	mg/L
Vanadium	0.00224	0.0021	mg/L
Zinc	0.2902	0.2877	mg/L
Aeromonas	341,181	345,000	cfu/100 mL
Cryptosporidium	39.77	42.50	cysts/L
E. Coli	1,197,695	1,352,381	cfu/100 mL
Fecal streptococci	1,422,046	1,375,958	cfu/100 mL
Salmonella	—	—	
Total coliform	1,571,742	1,600,000	cfu/100 mL
cis-Permethrin	0.00486	0.00410	mg/L
trans-Permethrin	0.00477	0.00400	mg/L

[a] not applicable

Table C-12. Average Baseline Concentration for Meat Further Processing and Rendering (R23)[a] Indirect Dischargers

Pollutant of Concern	Small Facility Concentration	Non-Small Facility Concentration	Units
5-Day biochemical oxygen demand (BOD_5)	883.1	883.1	mg/L
Total suspended solids (TSS)	444.1	444.1	mg/L
Hexane extractable material (HEM)	94.09	94.09	mg/L
Fecal coliform bacteria	1,181,468	1,181,468	cfu/100 mL
Ammonia as nitrogen	240.4	240.4	mg/L
Carbaryl	0.0080	0.0080	mg/L
Carbonaceous biochemical oxygen demand (CBOD)	1,086	1,086	mg/L
Chemical oxygen demand (COD)	1,918	1,918	mg/L
Chloride	2,357	2,357	mg/L
Dissolved biochemical oxygen demand	830.3	830.3	mg/L
Dissolved phosphorus	37.17	37.17	mg/L
Nitrate-nitrite	25.83	25.83	mg/L
Total nitrogen	176.3	176.3	mg/L
Orthophosphate	22.52	22.52	mg/L
Total dissolved solids (TDS)	3,905	3,905	mg/L
Total Kjeldahl nitrogen (TKN)	147.5	147.5	mg/L
Total organic carbon (TOC)	444.3	444.3	mg/L
Total phosphorus	46.39	46.39	mg/L
Total residual chlorine	0.329	0.329	mg/L
Volatile residue	1,418	1,418	mg/L
Barium	—[b]	—	
Copper	0.0620	0.0620	mg/L
Chromium	0.0341	0.0341	mg/L
Manganese	0.3860	0.3860	mg/L
Molybdenum	0.0137	0.0137	mg/L
Nickel	0.0147	0.0147	mg/L
Titanium	0.0045	0.0045	mg/L
Vanadium	0.0026	0.0026	mg/L
Zinc	0.2642	0.2642	mg/L
Aeromonas	768,900	768,900	cfu/100 mL
Cryptosporidium	44.34	44.34	cysts/L
E. Coli	1,292,964	1,292,964	cfu/100 mL
Fecal streptococci	757,866	757,866	cfu/100 mL
Salmonella	—	—	
Total coliform	1,323,449	1,323,449cfu/1	cfu/100 mL
cis-Permethrin	0.0045	0.0045	mg/L
trans-Permethrin	0.0045	0.0045	mg/L

[a] Baseline concentration of R23 was derived using average concentrations of R12 (small and non-small facilities) + R123 (non-small), +R13 (small and non-small facilities) + R2 (small and non-small facilities), since no R23 small or non-small indirect discharge facilities were represented in the detailed survey

[b] not applicable

Table C-13. Average Baseline Concentrations for Poultry First Processing (P1) Direct Dischargers

Pollutant of Concern	Small Facility Concentration	Non-Small Facility Concentration	Units
5-Day biochemical oxygen demand (BOD_5)	7.00	4.15	mg/L
Total suspended solids (TSS)	31.50	11.73	mg/L
Hexane extractable material (HEM)	23.60	9.96	mg/L
Fecal coliform bacteria	560.0	173.4	cfu/100 mL
Ammonia as nitrogen	2.00	1.09	mg/L
Carbaryl	0.00100	0.00100	mg/L
Carbonaceous biochemical oxygen demand (CBOD)	478.0	4.08	mg/L
Chemical oxygen demand (COD)	862.0	25.09	mg/L
Chloride	542.0	81.55	mg/L
Dissolved biochemical oxygen demand	5.20	2.08	mg/L
Dissolved phosphorus	7.10	0.36	mg/L
Nitrate-nitrite	27.18	33.54	mg/L
Total nitrogen	89.82	27.22	mg/L
Orthophosphate	14.00	1.95	mg/L
Total dissolved solids (TDS)	3,067	721.3	mg/L
Total Kjeldahl nitrogen (TKN)	98.20	1.80	mg/L
Total organic carbon (TOC)	19.14	5.70	mg/L
Total phosphorus	7.63	2.39	mg/L
Total residual chlorine	—[a]	—	
Volatile residue	178.8	174.6	mg/L
Barium	0.06797	0.0057	mg/L
Copper	0.00876	0.0082	mg/L
Chromium	—	—	
Manganese	0.19680	0.0111	mg/L
Molybdenum	—	—	
Nickel	0.01212	0.0011	mg/L
Titanium	—	—	
Vanadium	—	—	
Zinc	0.0769	0.0715	mg/L
Aeromonas	65,085	1,431	cfu/100 mL
Cryptosporidium	—	—	
E. Coli	66,480	5.05	cfu/100 mL
Fecal streptococci	1,980	36.65	cfu/100 mL
Salmonella	111.2	2.00	cfu/100 mL
Total coliform	163,280	580	cfu/100 mL
cis-Permethrin	—	—	mg/L
trans-Permethrin	—	—	mg/L

[a] not applicable

Table C-14. Average Baseline Concentrations for Poultry First/Further Processing (P12)[a] Direct Dischargers

Pollutant of Concern	Small Facility Concentration	Non-Small Facility Concentration	Units
5-Day biochemical oxygen demand (BOD_5)	15.67	15.67	mg/L
Total suspended solids (TSS)	30.92	30.92	mg/L
Hexane extractable material (HEM)	19.12	19.12	mg/L
Fecal coliform bacteria	200,311	200,311	cfu/100 mL
Ammonia as nitrogen	2.22	2.22	mg/L
Carbaryl	0.00100	0.00100	mg/L
Carbonaceous biochemical oxygen demand (CBOD)	7.41	7.41	mg/L
Chemical oxygen demand (COD)	32.50	32.50	mg/L
Chloride	125.9	125.9	mg/L
Dissolved biochemical oxygen demand	2.49	2.49	mg/L
Dissolved phosphorus	7.44	7.44	mg/L
Nitrate-nitrite	39.32	39.32	mg/L
Total nitrogen	41.80	41.80	mg/L
Orthophosphate	4.28	4.28	mg/L
Total dissolved solids (TDS)	900.5	900.5	mg/L
Total Kjeldahl nitrogen (TKN)	2.76	2.76	mg/L
Total organic carbon (TOC)	8.68	8.68	mg/L
Total phosphorus	7.97	7.97	mg/L
Total residual chlorine	—[b]	—	
Volatile residue	526.4	526.4	mg/L
Barium	0.00531	0.00531	mg/L
Copper	0.02450	0.02450	mg/L
Chromium	—	—	
Manganese	0.01598	0.01598	mg/L
Molybdenum	—	—	
Nickel	0.00324	0.00324	mg/L
Titanium	—	—	
Vanadium	—	—	
Zinc	0.1173	0.1173mg/L	
Aeromonas	49,288	49,288	cfu/100 mL
Cryptosporidium	—	—	
E. Coli	16,622	16,622	cfu/100 mL
Fecal streptococci	929.6	929.6	cfu/100 mL
Salmonella	29.30	29.30	cfu/100 mL
Total coliform	200,753	200,753	cfu/100 mL
cis-Permethrin	—	—	
trans-Permethrin	—	—	

[a] Baseline concentration of P12 (small) was derived using P12 (non-small), since no P12 small direct discharge facilities were represented in the detailed survey

[b] not applicable

Table C-15. Average Baseline Concentrations for Poultry First Processing and Rendering (P13) Direct Dischargers

Pollutant of Concern	Small Facility Concentration	Non-Small Facility Concentration	Units
5-Day biochemical oxygen demand (BOD_5)	4.00	7.26	mg/L
Total suspended solids (TSS)	9.40	13.43	mg/L
Hexane extractable material (HEM)	5.97	15.25	mg/L
Fecal coliform bacteria	434.0	163	cfu/100 mL
Ammonia as nitrogen	1.33	0.78	mg/L
Carbaryl	0.00100	0.00127	mg/L
Carbonaceous biochemical oxygen demand (CBOD)	3.20	4.62	mg/L
Chemical oxygen demand (COD)	29.60	44.25	mg/L
Chloride	94.40	89.34	mg/L
Dissolved biochemical oxygen demand	2.20	4.67	mg/L
Dissolved phosphorus	14.50	11.49	mg/L
Nitrate-nitrite	64.76	50.00	mg/L
Total nitrogen	66.58	57.16	mg/L
Orthophosphate	12.56	9.73	mg/L
Total dissolved solids (TDS)	1,916	1,505	mg/L
Total Kjeldahl nitrogen (TKN)	1.82	2.50	mg/L
Total organic carbon (TOC)	11.49	11.51	mg/L
Total phosphorus	15.22	10.62	mg/L
Total residual chlorine	—[a]	—	
Volatile residue	130.0	166	mg/L
Barium	0.00256	0.00668	mg/L
Copper	0.04024	0.03279	mg/L
Chromium	—	—	
Manganese	0.02456	0.03721	mg/L
Molybdenum	—	—	
Nickel	0.00544	0.00562	mg/L
Titanium	—	—	
Vanadium	—	—	
Zinc	0.0925	0.0867	mg/L
Aeromonas	57.67	289.0	cfu/100 mL
Cryptosporidium	—	—	
E. Coli	123.3	91.69	cfu/100 mL
Fecal streptococci	73.20	58.88	cfu/100 mL
Salmonella	2.00	2.00	cfu/100 mL
Total coliform	1,308	959.1	cfu/100 mL
cis-Permethrin	—	—	
trans-Permethrin	—	—	

[a] not applicable

Table C-16. Average Baseline Concentrations for Poultry First/Further Processing and Rendering (P123)[a] Direct Dischargers

Pollutant of Concern	Small Facility Concentration	Non-Small Facility Concentration	Units
5-Day biochemical oxygen demand (BOD_5)	5.83	5.83	mg/L
Total suspended solids (TSS)	8.60	8.60	mg/L
Hexane extractable material (HEM)	95.26	95.26	mg/L
Fecal coliform bacteria	2.55	2.55	cfu/100 mL
Ammonia as nitrogen	0.44	0.44	mg/L
Carbaryl	0.00100	0.00100	mg/L
Carbonaceous biochemical oxygen demand (CBOD)	4.61	4.61	mg/L
Chemical oxygen demand (COD)	131.4	131.4	mg/L
Chloride	53.00	53.00	mg/L
Dissolved biochemical oxygen demand	4.62	4.62	mg/L
Dissolved phosphorus	7.44	7.44	mg/L
Nitrate-nitrite	39.32	39.32	mg/L
Total nitrogen	77.99	77.99	mg/L
Orthophosphate	4.28	4.28	mg/L
Total dissolved solids (TDS)	460.0	460.0	mg/L
Total Kjeldahl nitrogen (TKN)	4.18	4.18	mg/L
Total organic carbon (TOC)	12.38	12.38	mg/L
Total phosphorus	7.97	7.97	mg/L
Total residual chlorine	—[b]	—	
Volatile residue	577.0	577	mg/L
Barium	0.00600	0.00600	mg/L
Copper	0.02450	0.02450	mg/L
Chromium	—	—	
Manganese	0.01598	0.01598	mg/L
Molybdenum	—	—	
Nickel	0.00324	0.00324	mg/L
Titanium	—	—	
Vanadium	—	—	
Zinc	0.1362	0.1362	mg/L
Aeromonas	1,550	1,550	cfu/100 mL
Cryptosporidium	—	—	
E. Coli	2.00	2.00	cfu/100 mL
Fecal streptococci	0.0300	0.03	cfu/100 mL
Salmonella	2.00	2.00	cfu/100 mL
Total coliform	621.0	621.0	cfu/100 mL
cis-Permethrin	—	—	
trans-Permethrin	—	—	

[a] Baseline concentration of P123 (small) was derived using P123 (non-small), since no P123 small direct discharge facilities were represented in the detailed survey

[b] not applicable

Table C-17. Average Baseline Concentrations for Poultry Further Processing (P2)[a] Direct Dischargers

Pollutant of Concern	Small Facility Concentration	Non-Small Facility Concentration	Units
5-Day biochemical oxygen demand (BOD_5)	10.75	10.75	mg/L
Total suspended solids (TSS)	19.76	19.76	mg/L
Hexane extractable material (HEM)	57.19	57.19	mg/L
Fecal coliform bacteria	100,157	100,157	cfu/100 mL
Ammonia as nitrogen	1.33	1.33	mg/L
Carbaryl	0.00100	0.00100	mg/L
Carbonaceous biochemical oxygen demand (CBOD)	6.01	6.01	mg/L
Chemical oxygen demand (COD)	81.96	81.96	mg/L
Chloride	89.43	89.43	mg/L
Dissolved biochemical oxygen demand	3.55	3.55	mg/L
Dissolved phosphorus	7.44	7.44	mg/L
Nitrate-nitrite	39.32	39.32	mg/L
Total nitrogen	59.89	59.89	mg/L
Orthophosphate	4.28	4.28	mg/L
Total dissolved solids (TDS)	680	680	mg/L
Total Kjeldahl nitrogen (TKN)	3.47	3.47	mg/L
Total organic carbon (TOC)	10.53	10.53	mg/L
Total phosphorus	7.97	7.97	mg/L
Total residual chlorine	—[b]	—	
Volatile residue	552	552	mg/L
Barium	0.0057	0.0057	mg/L
Copper	0.0245	0.0245	mg/L
Chromium	—	—	
Manganese	0.0160	0.0160	mg/L
Molybdenum	—	—	
Nickel	0.0032	0.0032	mg/L
Titanium	—	—	
Vanadium	—	—	
Zinc	0.1268	0.1268	mg/L
Aeromonas	25,419	25,419	cfu/100 mL
Cryptosporidium	—	—	
E. Coli	8,312	8,312	cfu/100 mL
Fecal streptococci	464.80	464.80	cfu/100 mL
Salmonella	15.65	15.65	cfu/100 mL
Total coliform	100,687	100,687	cfu/100 mL
cis-Permethrin	—	—	
trans-Permethrin	—	—	

[a] Baseline concentration of P2 was derived using average concentrations of P12 (non-small) +P123 (non-small) since no P2 small or non-small direct discharge facilities were represented in the detailed survey

[b] not applicable

Table C-18. Average Baseline Concentrations for Non-Small Poultry Further Processing and Rendering (P23)[a] Direct Dischargers

Pollutant of Concern	Small Facility Concentration	Non-Small Facility Concentration	Units
5-Day biochemical oxygen demand (BOD_5)	9.04	9.04	mg/L
Total suspended solids (TSS)	16.98	16.98	mg/L
Hexane extractable material (HEM)	41.66	41.66	mg/L
Fecal coliform bacteria	66,871	66,871	cfu/100 mL
Ammonia as nitrogen	1.24	1.24	mg/L
Carbaryl	0.00105	0.00105	mg/L
Carbonaceous biochemical oxygen demand (CBOD)	5.31	5.31	mg/L
Chemical oxygen demand (COD)	66.95	66.95	mg/L
Chloride	90.24	90.24	mg/L
Dissolved biochemical oxygen demand	3.51	3.51	mg/L
Dissolved phosphorus	9.29	9.29	mg/L
Nitrate-nitrite	45.34	45.34	mg/L
Total nitrogen	60.55	60.55	mg/L
Orthophosphate	6.57	6.57	mg/L
Total dissolved solids (TDS)	1,024	1,024	mg/L
Total Kjeldahl nitrogen (TKN)	3.03	3.03	mg/L
Total organic carbon (TOC)	10.85	10.85	mg/L
Total phosphorus	9.62	9.62	mg/L
Total residual chlorine	—[b]	—	
Volatile residue	417	417	mg/L
Barium	0.0053	0.0053	mg/L
Copper	0.0285	0.0285	mg/L
Chromium	—	—	
Manganese	0.0209	0.0209	mg/L
Molybdenum	—	—	
Nickel	0.0040	0.0040	mg/L
Titanium	—	—	
Vanadium	—	—	
Zinc	0.1144	0.1144	mg/L
Aeromonas	17,004	17,004	cfu/100 mL
Cryptosporidium	—	—	
E. Coli	5,577	5,577	cfu/100 mL
Fecal streptococci	331.88	331.88	cfu/100 mL
Salmonella	11.10	11.10	cfu/100 mL
Total coliform	67,503	67,503	cfu/100 mL
cis-Permethrin	—	—	
trans-Permethrin	—	—	

[a] Baseline concentration of P23 was derived using average concentrations of P12 (non-small) + P13 (small and non-small facilities) + P123 (non-small), since no P23 small or non-small direct discharge facilities were represented in the detailed survey

[b] not applicable

Table C-19. Average Baseline Concentration for Poultry First Processing (P1) Indirect Dischargers

Pollutant of Concern	Small Facility Concentration	Non-Small Facility Concentration	Units
5-Day biochemical oxygen demand (BOD_5)	1,657	392.2	mg/L
Total suspended solids (TSS)	667	147.5	mg/L
Hexane extractable material (HEM)	743.7	55.77	mg/L
Fecal coliform bacteria	790,333	1,243,178	cfu/100 mL
Ammonia as nitrogen	7.82	10.62	mg/L
Carbaryl	0.163	0.00227	mg/L
Carbonaceous biochemical oxygen demand (CBOD)	1,013	345.4	mg/L
Chemical oxygen demand (COD)	1,990	472.9	mg/L
Chloride	92.74	217.3	mg/L
Dissolved biochemical oxygen demand	314.5	498.3	mg/L
Dissolved phosphorus	13.17	3.40	mg/L
Nitrate-nitrite	0.613	2.75	mg/L
Total nitrogen	38.44	48.77	mg/L
Orthophosphate	5.20	6.08	mg/L
Total dissolved solids (TDS)	503.8	752.0	mg/L
Total Kjeldahl nitrogen (TKN)	37.83	53.62	mg/L
Total organic carbon (TOC)	193.9	139.5	mg/L
Total phosphorus	10.61	17.40	mg/L
Total residual chlorine	—[a]	—	
Volatile residue	1,171	282.4	mg/L
Barium	0.0371	0.0180	mg/L
Copper	0.1218	0.0283	mg/L
Chromium	—	—	
Manganese	0.0575	0.1614	mg/L
Molybdenum	—	—	
Nickel	0.0066	0.0065	mg/L
Titanium	—	—	
Vanadium	—	—	
Zinc	0.239	0.0598	mg/L
Aeromonas	39,593	182,879	cfu/100 mL
Cryptosporidium	—	—	
E. Coli	786,333	1,291,380	cfu/100 mL
Fecal streptococci	663,583	58,746	cfu/100 mL
Salmonella	188.5	11.93	cfu/100 mL
Total coliform	1,054,000	1,248,749	cfu/100 mL
cis-Permethrin	—	—	
trans-Permethrin	—	—	

[a] not applicable

Table C-20. Average Baseline Concentration for Poultry First/Further Processing (P12)[a] Indirect Dischargers

Pollutant of Concern	Small Facility Concentration	Non-Small Facility Concentration	Units
5-Day biochemical oxygen demand (BOD_5)	403.8	403.8	mg/L
Total suspended solids (TSS)	188.6	188.6	mg/L
Hexane extractable material (HEM)	42.26	42.26	mg/L
Fecal coliform bacteria	923,559	923,559	cfu/100 mL
Ammonia as nitrogen	13.60	13.60	mg/L
Carbaryl	0.00100	0.00100	mg/L
Carbonaceous biochemical oxygen demand (CBOD)	160.0	160.0	mg/L
Chemical oxygen demand (COD)	466.5	466.5	mg/L
Chloride	185.1	185.1	mg/L
Dissolved biochemical oxygen demand	59.57	59.57	mg/L
Dissolved phosphorus	6.14	6.14	mg/L
Nitrate-nitrite	16.12	16.12	mg/L
Total nitrogen	47.00	47.00	mg/L
Orthophosphate	4.46	4.46	mg/L
Total dissolved solids (TDS)	954.9	954.9	mg/L
Total Kjeldahl nitrogen (TKN)	78.55	78.55	mg/L
Total organic carbon (TOC)	59.64	59.64	mg/L
Total phosphorus	13.89	13.89	mg/L
Total residual chlorine	—[b]	—	
Volatile residue	710.7	710.7	mg/L
Barium	0.0095	0.0095	mg/L
Copper	0.0236	0.0236	mg/L
Chromium	—	—	
Manganese	0.0673	0.0673	mg/L
Molybdenum	—	—	
Nickel	0.0044	0.0044	mg/L
Titanium	—	—	
Vanadium	—	—	
Zinc	0.1358	0.1358	mg/L
Aeromonas	192,500	192,500	cfu/100 mL
Cryptosporidium	—	—	
E. Coli	920,652	920,652	cfu/100 mL
Fecal streptococci	4,140	4,140	cfu/100 mL
Salmonella	45.68	45.68	cfu/100 mL
Total coliform	900,898	900,898	cfu/100 mL
cis-Permethrin	—	—	
trans-Permethrin	—	—	

[a] Baseline concentration of P12 (small) was derived using P12 (non-small), since no P12 small indirect discharge facilities were represented in the detailed survey

[b] not applicable

Table C-21. Average Baseline Concentration for Poultry First Processing and Rendering (P13)[a] Indirect Dischargers

Pollutant of Concern	Small Facility Concentration	Non-Small Facility Concentration	Units
5-Day biochemical oxygen demand (BOD_5)	253.0	253.0	mg/L
Total suspended solids (TSS)	41.33	41.33	mg/L
Hexane extractable material (HEM)	111.6	111.6	mg/L
Fecal coliform bacteria	944,808	944,808	cfu/100 mL
Ammonia as nitrogen	13.16	13.16	mg/L
Carbaryl	0.00100	0.00100	mg/L
Carbonaceous biochemical oxygen demand (CBOD)	232.7	232.7	mg/L
Chemical oxygen demand (COD)	434.0	434.0	mg/L
Chloride	214.0	214.0	mg/L
Dissolved biochemical oxygen demand	97.53	97.53	mg/L
Dissolved phosphorus	4.59	4.59	mg/L
Nitrate-nitrite	8.37	8.37	mg/L
Total nitrogen	71.42	71.42	mg/L
Orthophosphate	4.57	4.57	mg/L
Total dissolved solids (TDS)	890.5	890.5	mg/L
Total Kjeldahl nitrogen (TKN)	65.49	65.49	mg/L
Total organic carbon (TOC)	93.62	93.62	mg/L
Total phosphorus	18.18	18.18	mg/L
Total residual chlorine	—[b]	—	
Volatile residue	228.2	228.2	mg/L
Barium	0.0118	0.0118	mg/L
Copper	0.0234	0.0234	mg/L
Chromium	—	—	
Manganese	0.1016	0.1016	mg/L
Molybdenum	—	—	
Nickel	0.0052	0.0052	mg/L
Titanium	—	—	
Vanadium	—	—	
Zinc	0.0703	0.0703	mg/L
Aeromonas	192,500	192,500	cfu/100 mL
Cryptosporidium	—	—	
E. Coli	933,564	933,564	cfu/100 mL
Fecal streptococci	4,645	4,645	cfu/100 mL
Salmonella	36.05	36.05	cfu/100 mL
Total coliform	914,926	914,926	cfu/100 mL
cis-Permethrin	—	—	
trans-Permethrin	—	—	

[a] Baseline concentration of P12 (small) was derived using P12 (non-small), since no P12 small indirect discharge facilities were represented in the detailed survey

[b] not applicable

Table C-22. Average Baseline Concentration for Poultry First/Further Processing and Rendering (P123)[a] Indirect Dischargers

Pollutant of Concern	Small Facility Concentration	Non-Small Facility Concentration	Units
5-Day biochemical oxygen demand (BOD_5)	1,215	1,215	mg/L
Total suspended solids (TSS)	3,672	3,672	mg/L
Hexane extractable material (HEM)	244.6	244.6	mg/L
Fecal coliform bacteria	772,891	772,891	cfu/100 mL
Ammonia as nitrogen	15.56	15.56	mg/L
Carbaryl	0.02427	0.02427	mg/L
Carbonaceous biochemical oxygen demand (CBOD)	1,159	1,159	mg/L
Chemical oxygen demand (COD)	2,026	2,026	mg/L
Chloride	212.8	212.8	mg/L
Dissolved biochemical oxygen demand	287.9	287.9	mg/L
Dissolved phosphorus	21.98	21.98	mg/L
Nitrate-nitrite	6.78	6.78	mg/L
Total nitrogen	71.95	71.95	mg/L
Orthophosphate	6.65	6.65	mg/L
Total dissolved solids (TDS)	969.7	969.7	mg/L
Total Kjeldahl nitrogen (TKN)	79.55	79.55	mg/L
Total organic carbon (TOC)	215.8	215.8	mg/L
Total phosphorus	48.37	48.37	mg/L
Total residual chlorine	—[b]	—	
Volatile residue	4,198	4,198	mg/L
Barium	0.0249	0.0249	mg/L
Copper	0.0334	0.0334	mg/L
Chromium	—	—	
Manganese	0.0788	0.0788	mg/L
Molybdenum	—	—	
Nickel	0.0094	0.0094	mg/L
Titanium	—	—	
Vanadium	—	—	
Zinc	0.313	0.313	mg/L
Aeromonas	163,955	163,955	cfu/100 mL
Cryptosporidium	—	—	
E. Coli	774,597	774,597	cfu/100 mL
Fecal streptococci	104,827	104,827	cfu/100 mL
Salmonella	45.99	45.99	cfu/100 mL
Total coliform	830,389	830,389	cfu/100 mL
cis-Permethrin	—	—	
trans-Permethrin	—	—	

[a] Baseline concentration of P123 was derived using average concentrations of P1 (small and non-small facilities) + P12 (non-small) +P13 (non-small) + P2 (small and non-small facilities), since no P123 small or non-small indirect discharge facilities were represented in the detailed survey

[b] not applicable

Table C-23. Average Baseline Concentration for Poultry Further Processing (P2) Indirect Dischargers

Pollutant of Concern	Small Facility Concentration	Non-Small Facility Concentration	Units
5-Day biochemical oxygen demand (BOD_5)	5,481	872.7	mg/L
Total suspended solids (TSS)	27,523	582.7	mg/L
Hexane extractable material (HEM)	608.0	241.6	mg/L
Fecal coliform bacteria	87,500	325,383	cfu/100 mL
Ammonia as nitrogen	27.68	24.86	mg/L
Carbaryl	0.0150	0.0103	mg/L
Carbonaceous biochemical oxygen demand (CBOD)	4,185	2,941	mg/L
Chemical oxygen demand (COD)	7,032	4,910	mg/L
Chloride	297.3	297.3	mg/L
Dissolved biochemical oxygen demand	686.2	489.9	mg/L
Dissolved phosphorus	78.68	59.15	mg/L
Nitrate-nitrite	0.938	0.938	mg/L
Total nitrogen	141.9	109.6	mg/L
Orthophosphate	13.18	10.68	mg/L
Total dissolved solids (TDS)	1,707	1,105	mg/L
Total Kjeldahl nitrogen (TKN)	141.0	115.8	mg/L
Total organic carbon (TOC)	633.0	453.2	mg/L
Total phosphorus	192.5	102.4	mg/L
Total residual chlorine	—[a]	—	mg/L
Volatile residue	17,574	12,677	mg/L
Barium	0.0583	0.0432	mg/L
Copper	0.0100	0.0134	mg/L
Chromium	—	—	
Manganese	0.0242	0.0500	mg/L
Molybdenum	—	—	
Nickel	0.0242	0.0189	mg/L
Titanium	—	—	
Vanadium	—	—	
Zinc	0.986	0.810	mg/L
Aeromonas	153,000	166,167	cfu/100 mL
Cryptosporidium	—	—	
E. Coli	86,150	324,483	cfu/100 mL
Fecal streptococci	58,500	40,217	cfu/100 mL
Salmonella	2.00	2.00	cfu/100 mL
Total coliform	265,000	443,717	cfu/100 mL
cis-Permethrin	—	—	
trans-Permethrin	—	—	

[a] not applicable

Table C-24. Average Baseline Concentration for Poultry Further Processing and Rendering (P23)[a] Indirect Dischargers

Pollutant of Concern	Small Facility Concentration	Non-Small Facility Concentration	Units
5-Day biochemical oxygen demand (BOD_5)	1,278	1,278	mg/L
Total suspended solids (TSS)	4,761	4,761	mg/L
Hexane extractable material (HEM)	192.9	192.9	mg/L
Fecal coliform bacteria	691,603	691,603	cfu/100 mL
Ammonia as nitrogen	17.67	17.67	mg/L
Carbaryl	0.00489	0.00489	mg/L
Carbonaceous biochemical oxygen demand (CBOD)	1,318	1,318	mg/L
Chemical oxygen demand (COD)	2,290	2,290	mg/L
Chloride	232.1	232.1	mg/L
Dissolved biochemical oxygen demand	248.4	248.4	mg/L
Dissolved phosphorus	26.55	26.55	mg/L
Nitrate-nitrite	8.47	8.47	mg/L
Total nitrogen	81.40	81.40	mg/L
Orthophosphate	6.98	6.98	mg/L
Total dissolved solids (TDS)	1,084	1,084	mg/L
Total Kjeldahl nitrogen (TKN)	90.82	90.82	mg/L
Total organic carbon (TOC)	232.1	232.1	mg/L
Total phosphorus	59.83	59.83	mg/L
Total residual chlorine	—[b]	—	
Volatile residue	5,355	5,355	mg/L
Barium	0.0240	0.0240	mg/L
Copper	0.0195	0.0195	mg/L
Chromium	—	—	
Manganese	0.0687	0.0687	mg/L
Molybdenum	—	—	
Nickel	0.0104	0.0104	mg/L
Titanium	—	—	
Vanadium	—	—	
Zinc	0.3680	0.3680	mg/L
Aeromonas	181,528	181,528	cfu/100 mL
Cryptosporidium	—	—	
E. Coli	686,511	686,511	cfu/100 mL
Fecal streptococci	19,381	19,381	cfu/100 mL
Salmonella	27.91	27.91	cfu/100 mL
Total coliform	723,394	723,394	cfu/100 mL
cis-Permethrin	—	—	
trans-Permethrin	—	—	

[a] Baseline concentration of P23 was derived using average concentrations of P12 (non-small) + P13 (non-small) + P2 (small and non-small facilities), since no P23 small or non-small indirect discharge facilities were represented in the detailed survey

[b] not applicable

Table C-25. Average Baseline Concentrations for Rendering Only (REND)[a] Direct Dischargers

Pollutant of Concern	Small Facility Concentration	Non-Small Facility Concentration	Units
5-Day biochemical oxygen demand (BOD_5)	389.5	389.5	mg/L
Total suspended solids (TSS)	885	885	mg/L
Hexane extractable material (HEM)	155	155	mg/L
Fecal coliform bacteria	163.2	163.2	cfu/100 mL
Ammonia as nitrogen	4.42	4.42	mg/L
Carbaryl	0.001	0.001	mg/L
Carbonaceous biochemical oxygen demand (CBOD)	4.73	4.73	mg/L
Chemical oxygen demand (COD)	3,940	3,940	mg/L
Chloride	347	347	mg/L
Dissolved biochemical oxygen demand	11.5	11.5	mg/L
Dissolved phosphorus	11.5	11.5	mg/L
Nitrate-nitrite	40.1	40.1	mg/L
Total nitrogen	94.5	94.5	mg/L
Orthophosphate	33.02	33.02	mg/L
Total dissolved solids (TDS)	1,749	1,749	mg/L
Total Kjeldahl nitrogen (TKN)	108.8	108.8	mg/L
Total organic carbon (TOC)	36.07	36.07	mg/L
Total phosphorus	23.94	23.94	mg/L
Total residual chlorine	0.52	0.52	mg/L
Volatile residue	406.1	406.1	mg/L
Barium	0.01404	0.01404	mg/L
Copper	0.0086	0.0086	mg/L
Chromium	0.00344	0.00344	mg/L
Manganese	0.05477	0.05477	mg/L
Molybdenum	0.00438	0.00438	mg/L
Nickel	0.01211	0.01211	mg/L
Titanium	0.00961	0.00961	mg/L
Vanadium	0.02985	0.02985	mg/L
Zinc	0.08734	0.08734	mg/L
Aeromonas	806.9	806.9	cfu/100 mL
Cryptosporidium	0.50	0.50	cysts/L
E. Coli	271.9	271.9	cfu/100 mL
Fecal streptococci	240.5	240.5	cfu/100 mL
Salmonella	2.00	2.00	cfu/100 mL
Total coliform	593.8	593.8	cfu/100 mL
cis-Permethrin	0.004	0.004	mg/L
trans-Permethrin	0.004	0.004	mg/L

[a] Baseline concentration of small REND was derived using REND (non-small), since no REND small direct discharge facilities were represented in the detailed survey

Table C-26. Average Baseline Concentration for Rendering (Rend) Indirect Dischargers

Pollutant of Concern	Small Facility Concentration	Non-Small Facility Concentration	Units
5-Day biochemical oxygen demand (BOD_5)	476.4	1,691	mg/L
Total suspended solids (TSS)	352.6	694.7	mg/L
Hexane extractable material (HEM)	73.95	163.6	mg/L
Fecal coliform bacteria	1,021,164	562,878	cfu/100 mL
Ammonia as nitrogen	98.98	71.87	mg/L
Carbaryl	0.0098	0.0010	mg/L
Carbonaceous biochemical oxygen demand (CBOD)	1,715	720.1	mg/L
Chemical oxygen demand (COD)	2,629	2,887	mg/L
Chloride	542.0	339.9	mg/L
Dissolved biochemical oxygen demand	1,889	635.5	mg/L
Dissolved phosphorus	37.59	19.52	mg/L
Nitrate-nitrite	2.13	18.49	mg/L
Total nitrogen	1,130	611.5	mg/L
Orthophosphate	22.80	22.89	mg/L
Total dissolved solids (TDS)	2,453	1,807	mg/L
Total Kjeldahl nitrogen (TKN)	1,128	1,557	mg/L
Total organic carbon (TOC)	1,258	836.4	mg/L
Total phosphorus	51.07	26.24	mg/L
Total residual chlorine	0.248	0.3226	mg/L
Volatile residue	1,800	1,466	mg/L
Barium	N/A[a]	0.0281	mg/L
Copper	0.0779	0.0095	mg/L
Chromium	0.0500	0.0045	mg/L
Manganese	0.182	0.124	mg/L
Molybdenum	0.0158	0.0036	mg/L
Nickel	0.0067	0.0084	mg/L
Titanium	0.0045	0.0097	mg/L
Vanadium	0.0021	0.0272	mg/L
Zinc	0.323	0.0882	mg/L
Aeromonas	345,000	154,667	cfu/100 mL
Cryptosporidium	42.50	0.1500	cysts/L
E. Coli	1,600,000	1,233,333	cfu/100 mL
Fecal streptococci	1,385,099	1,600,000	cfu/100 mL
Salmonella	N/A	51.64	cfu/100 mL
Total coliform	1,600,000	1,233,333	cfu/100 mL
cis-Permethrin	0.0041	0.0040	mg/L
trans-Permethrin	0.0040	0.0040	mg/L

[a] not available

Table C-27. Average Baseline Concentrations for Mixed Poultry/Meat Further Processing (M2)[a] Direct Dischargers

Pollutant of Concern	Small Facility Concentration	Non-Small Facility Concentration	Units
5-Day biochemical oxygen demand (BOD_5)	8.45	8.45	mg/L
Total suspended solids (TSS)	22.72	22.72	mg/L
Hexane extractable material (HEM)	34.49	34.49	mg/L
Fecal coliform bacteria	50,098	50,098	cfu/100 mL
Ammonia as nitrogen	0.854	0.854	mg/L
Carbaryl	0.001	0.001	mg/L
Carbonaceous biochemical oxygen demand (CBOD)	5.01	5.01	mg/L
Chemical oxygen demand (COD)	65.15	65.15	mg/L
Chloride	838.0	838.0	mg/L
Dissolved biochemical oxygen demand	3.78	3.78	mg/L
Dissolved phosphorus	10.50	10.50	mg/L
Nitrate-nitrite	170.0	170.0	mg/L
Total nitrogen	182.3	182.3	mg/L
Orthophosphate	8.27	8.27	mg/L
Total dissolved solids (TDS)	2,305	2,305	mg/L
Total Kjeldahl nitrogen (TKN)	3.73	3.73	mg/L
Total organic carbon (TOC)	11.02	11.02	mg/L
Total phosphorus	11.70	11.70	mg/L
Total residual chlorine	0.555	0.555	mg/L
Volatile residue	410.8	410.8	mg/L
Barium	0.09816	0.09816	mg/L
Copper	0.01433	0.01433	mg/L
Chromium	0.00473	0.00473	mg/L
Manganese	0.01076	0.01076	mg/L
Molybdenum	0.00529	0.00529	mg/L
Nickel	0.00254	0.00254	mg/L
Titanium	0.00112	0.00112	mg/L
Vanadium	0.00772	0.00772	mg/L
Zinc	0.07507	0.07507	mg/L
Aeromonas	12,728	12,728	cfu/100 mL
Cryptosporidium	0.150	0.150	cysts/L
E. Coli	4,183	4,183	cfu/100 mL
Fecal streptococci	242.7	242.7	cfu/100 mL
Salmonella	8.83	8.83	cfu/100 mL
Total coliform	50,406	50,406	cfu/100 mL
cis-Permethrin	N/A[b]	N/A	
trans-Permethrin	N/A	N/A	

[a] Baseline concentration of M2 was derived using average concentrations of P2 (non-small) + R2 (non-small), since no M2 small or non-small direct discharge facilities were represented in the detailed survey

[b] not available

Table C-28. Average Baseline Concentration for Mixed Poultry/Meat Further Processing (M2) Indirect Dischargers

Pollutant of Concern	Small Facility Concentration	Non-Small Facility Concentration	Units
5-Day biochemical oxygen demand (BOD_5)	2,026	2,201	mg/L
Total suspended solids (TSS)	808.8	531.8	mg/L
Hexane extractable material (HEM)	170.2	98.69	mg/L
Fecal coliform bacteria	960,000	820,000	cfu/100 mL
Ammonia as nitrogen	92.81	41.66	mg/L
Carbaryl	0.0133	0.0092	mg/L
Carbonaceous biochemical oxygen demand (CBOD)	1,702	1,556	mg/L
Chemical oxygen demand (COD)	2,542	1,770	mg/L
Chloride	4,658	5,080	mg/L
Dissolved biochemical oxygen demand	1,151	1,150	mg/L
Dissolved phosphorus	59.70	59.70	mg/L
Nitrate-nitrite	3.71	2.13	mg/L
Total nitrogen	87.17	26.42	mg/L
Orthophosphate	27.23	56.90	mg/L
Total dissolved solids (TDS)	5,907	6,494	mg/L
Total Kjeldahl nitrogen (TKN)	83.68	24.73	mg/L
Total organic carbon (TOC)	599.2	599.2	mg/L
Total phosphorus	80.44	74.54	mg/L
Total residual chlorine	0.822	1.10	mg/L
Volatile residue	1,897	1,897	mg/L
Barium	0.079405	0.0829	mg/L
Copper	0.0934	0.0779	mg/L
Chromium	0.0116	0.0112	mg/L
Manganese	0.0314	0.0293	mg/L
Molybdenum	0.0173	0.0173	mg/L
Nickel	0.0090	0.0071	mg/L
Titanium	0.0071	0.0045	mg/L
Vanadium	0.0029	0.0021	mg/L
Zinc	0.241	0.1587	mg/L
Aeromonas	470,000	345,000	cfu/100 mL
Cryptosporidium	74.38	42.50	cysts/L
E. Coli	1,383,333	1,383,333	cfu/100 mL
Fecal streptococci	1,140,310	1,140,310	cfu/100 mL
Salmonella	2.00	2.00	cfu/100 mL
Total coliform	1,600,000	1,600,000	cfu/100 mL
cis-Permethrin	0.0042	0.0042	mg/L
trans-Permethrin	0.0040	0.0040	mg/L

Table C-29. Average Baseline Concentration for Mixed Poultry/Meat Further Processing and Rendering (M23)[a, b] Indirect Dischargers

Pollutant of Concern	Small Facility Concentration	Units
5-Day biochemical oxygen demand (BOD_5)	1,080	mg/L
Total suspended solids (TSS)	2,603	mg/L
Hexane extractable material (HEM)	143.5	mg/L
Fecal coliform bacteria	936,536	cfu/100 mL
Ammonia as nitrogen	129.1	mg/L
Carbaryl	0.006433296	mg/L
Carbonaceous biochemical oxygen demand (CBOD)	1,202	mg/L
Chemical oxygen demand (COD)	2,104	mg/L
Chloride	1,294	mg/L
Dissolved biochemical oxygen demand	539.4	mg/L
Dissolved phosphorus	31.86	mg/L
Nitrate-nitrite	17.15	mg/L
Total nitrogen	128.9	mg/L
Orthophosphate	14.75	mg/L
Total dissolved solids (TDS)	2,494	mg/L
Total Kjeldahl nitrogen (TKN)	119.2	mg/L
Total organic carbon (TOC)	338.2	mg/L
Total phosphorus	53.11	mg/L
Total residual chlorine	0.164	mg/L
Volatile residue	3,386	mg/L
Barium	N/A[c]	
Copper	0.0408	mg/L
Chromium	0.0171	mg/L
Manganese	0.227	mg/L
Molybdenum	0.0069	mg/L
Nickel	0.0126	mg/L
Titanium	0.0022	mg/L
Vanadium	0.0013	mg/L
Zinc	0.316	mg/L
Aeromonas	475,214	cfu/100 mL
Cryptosporidium	22.17	cysts/L
E. Coli	989,737	cfu/100 mL
Fecal streptococci	388,624	cfu/100 mL
Salmonella	N/A	
Total coliform	1,023,422	cfu/100 mL
cis-Permethrin	0.0022	mg/L
trans-Permethrin	0.0022	mg/L

[a] Baseline concentration of M23 was derived using average concentrations of P23 (small) + R23 (small) since no M23 small indirect discharge facilities were represented in the detailed survey
[b] No non-small indirect discharge facilities exist for Mixed Poultry/Red Meat Further Processing/Rendering (M23).
[c] not available

Table C-30. Data to Derive Technology Option Pollutant Concentrations for First Processing, Further Processing, and Rendering Effluent Wastewaters

BAT-1 Technology Option for Meat Facilities

	First Processing (R1) Effluent Concentrations	**Further Processing (R2) Effluent Concentrations**	**Rendering (R3) Effluent Concentrations**
Option Average For All Pollutants Except Ammonia, Nitrate/Nitrite, TKN	R1 of BAT-2	R2 of BAT-2	R3 of BAT-2
Option Average For Ammonia, Nitrate/Nitrite, TKN	See methodology described in Section 9	See methodology described in Section 9	See methodology described in Section 9

R1 of BAT-2 = average BAT-2 treated pollutant concentration of meat first processing wastewater
R2 of BAT-2 = average BAT-2 treated pollutant concentration of meat further processing wastewater
R3 of BAT-2 = average BAT-2 treated pollutant concentration of meat rendering wastewater

Table C-31. Data and Equations to Derive Technology Option Pollutant Concentrations for First Processing, Further Processing, and Rendering Effluent Wastewaters

BAT-2 Technology Option for Meat Facilities

Facility	First Processing (R1)		Further Processing (R2)		Rendering (R3)		Total Flow (MGD)
	Effluent Concentrations	Flow (MGD)	Effluent Concentrations	Flow (MGD)	Effluent Concentrations	Flow (MGD)	
6440	[(effluent@6440 • total flow of 6440) - (R3 concentration of 6440 • R3 flow of 6440)] / (R1 flow of 6440)	0.83	N/A	N/A	(a) • (rendering influent@6447)	0.52	1.35
6441	[(effluent@6441 • total flow of 6441) - (R3 concentration of 6441 • R3 flow of 6441)] / (R1flow of 6441)	1.31	N/A	N/A	(a) • (rendering influent@6447)	0.48	1.79
6442	[(effluent@6442 • total flow of 6442) - (R3 concentration of 6442 • R3 flow of 6442)] / (R1flow of 6442)	1.53	N/A	N/A	(a) • (rendering influent@6447)	0.42	1.95
6447	[(effluent@6447 • total flow of 6447) - (R2 concentration of 6447 • R2 flow of 6447) - (R3 concentration of 6447 • R3 flow of 6447)] / (R1 flow of 6447)	0.51	(a) • (further processing influent@6335)	0.07	(a) • (rendering influent@6447)	0.15	0.73
Option Average	Average of R1 concentrations for facilities 6440, 6441, 6442, and 6447		R2 concentration for 6447		Average of R3 concentrations for 6440, 6441, 6442, and 6447		

(a) = (1- removal fraction) where the removal fraction is the average removal fraction of sampling episodes 6440, 6441, 6442, and 6447.

Table C-32. Data and Equations to Derive Technology Option Pollutant Concentrations for First Processing, Further Processing, and Rendering Effluent Wastewaters

BAT-3 Technology Option for Meat Facilities.

Facility	First Processing (R1)		Further Processing (R2)		Rendering (R3)		Total Flow (MGD)
	Effluent Concentrations	**Flow (MGD)**	**Effluent Concentrations**	**Flow (MGD)**	**Effluent Concentrations**	**Flow (MGD)**	
6335	[(reuse water effluent@6335 • total flow) - (R2 concentration • R2 flow) - (R3 concentration • R3 flow)] / (R1 flow)	0.17	(b) • (further processing influent@6335)	0.45	(b) • (rendering influent@6447)	0.13	0.75
Option Average	R1 concentration for 6335		R2 concentration for 6335		R3 concentrations for 6335		

(b) = 1 - removal fraction of sampling episode 6335 (through reuse water effluent)

Table C-33. Data and Equations to Derive Technology Option Pollutant Concentrations for First Processing, Further Processing, and Rendering Effluent Wastewaters

BAT-4 Technology Option for Meat Facilities.

	First Processing (R1) Effluent Concentrations	Further Processing (R2) Effluent Concentrations	Rendering (R3) Effluent Concentrations
Option Average	(c) • (R1 of BAT-3)	(c) • (R2 of BAT-3)	(c) • (R3 of BAT-3)

(c) = (1- removal fraction between poultry BAT-3 and BAT-4 pollutant averages), where the “removal fraction between poultry BAT-3 and BAT-4 pollutant averages” is the removal fraction between the poultry BAT-3 option pollutant average concentration and corresponding poultry BAT-4 option average concentration. The removal fraction for each pollutant and subcategory is calculated as follows:

Removal fraction = [BAT-3 poultry concentration - BAT-4 poultry concentration] / [BAT-3 poultry concentration]

R1 of BAT-3 = average BAT-3 treated pollutant concentration of meat first processing wastewater
R2 of BAT-3 = average BAT-3 treated pollutant concentration of meat further processing wastewater
R3 of BAT-3 = average BAT-3 treated pollutant concentration of meat rendering wastewater

Table C-34. Data and Equations to Derive Technology Option Pollutant Concentrations for First Processing, Further Processing, and Rendering Effluent Wastewaters

BAT-1 Technology Option for Poultry Facilities

	First Processing (P1) Effluent Concentrations	Further Processing (P2) Effluent Concentrations	Rendering (P3) Effluent Concentrations
Option Average For All Pollutants Except Ammonia, Nitrate/Nitrite, TKN	P1 of BAT-2	P2 of BAT-2	P3 of BAT-2
Option Average For Ammonia, Nitrate/Nitrite, TKN	See methodology described in Section 9	See methodology described in Section 9	See methodology described in Section 9

P1 of BAT-2 = average BAT-2 treated pollutant concentration of poultry first processing wastewater
P2 of BAT-2 = average BAT-2 treated pollutant concentration of poultry further processing wastewater
P3 of BAT-2 = average BAT-2 treated pollutant concentration of poultry rendering wastewater

Table C-35. Data and Equations to Derive Technology Option Pollutant Concentrations for First Processing, Further Processing, and Rendering Effluent Wastewaters

BAT-2 Technology Option for Poultry Facilities

Facility	First Processing (P1) Effluent Concentrations	Further Processing (P2) Effluent Concentrations	Rendering (P3) Effluent Concentrations
6445	effluent@6445	N/A	N/A
Option Average	P1 for 6445	A1	B1

A1 = average of [(further processing influent@6443) • (1 - removal fraction of 6445)] and [(further processing influent@6444) • (1 - removal fraction of 6445)]
B1 = (rendering influent@6448) • (1 - removal fraction of 6445)

Table C-36. Data and Equations to Derive Technology Option Pollutant Concentrations for First Processing, Further Processing, and Rendering Effluent Wastewaters

BAT-3 Technology Option for Poultry Facilities

	First Processing (P1) Effluent Concentrations	Further Processing (P2) Effluent Concentrations	Rendering (P3) Effluent Concentrations
Option Average	(1 - Z) • (P1 of BAT-2)	(1 - Z) • (P2 of BAT-2)	(1 - Z) • (P3 of BAT-2)

‘Z’ values were calculated for each wastewater stream (P1, P2, or P3) as follows:

Z (P1, P2, or P3) = [BAT-2 meat concentration (R1, R2, or R3) - BAT-3 meat concentration (R1, R2, or R3)] / [BAT-2 meat concentration (R1, R2, or R3)]

P1 of BAT-2 = average BAT-2 treated pollutant concentration of poultry first processing wastewater
P2 of BAT-2 = average BAT-2 treated pollutant concentration of poultry further processing wastewater
P3 of BAT-2 = average BAT-2 treated pollutant concentration of poultry rendering wastewater

Table C-37. Data and Equations to Derive Technology Option Pollutant Concentrations for First Processing, Further Processing, and Rendering Effluent Wastewaters

BAT-4 Technology Option for Poultry Facilities

Facility	First Processing (P1) Effluent Concentrations	Further Processing (P2) Effluent Concentrations	Rendering (P3) Effluent Concentrations
6304	effluent prior to filter@6304	N/A	N/A
Option Average	P1 for 6304	A2	B2

A2 = average of [(influent@6443) • (1 - removal fraction of 6304 prior to filter)] and [(influent@6444) • (1 - removal fraction of 6304 prior to filter)]
B2 = (influent@6448) • (1 - removal fraction of 6304 prior to filter)

Table C-38. Data and Equations to Derive Technology Option Pollutant Concentrations for First Processing, Further Processing, and Rendering Effluent Wastewaters

BAT-5 Technology Option for Poultry Facilities

Facility	First Processing (P1) Effluent Concentrations	Further Processing (P2) Effluent Concentrations	Rendering (P3) Effluent Concentrations
6304	effluent through filter@6304	N/A	N/A
Option Average	P1 for 6304	A3	B3

A3 = average of [(further processing influent@6443) • (1 - removal fraction of 6304 through filter)] and [(further processing influent@6444) • (1 - removal fraction of 6304 through filter)]
B3 = (rendering influent@6448) • (1 - removal fraction of 6304 through filter)

Table C-39. Data and Equations to Derive Technology Option Pollutant Concentrations for First Processing, Further Processing, and Rendering Effluent Wastewaters

PSES-1 Technology Option for Meat Facilities

Facility	First Processing (R1)		Further Processing (R2)		Rendering (R3)		Total Flow (MGD)
	Effluent Concentrations	Flow (MGD)	Effluent Concentrations	Flow (MGD)	Effluent Concentrations	Flow (MGD)	
6335	((effluent[1]@6335 • (total flow)) - ([R2] • (R2 flow)) - ([R3] • (R3 flow))) / (R1 flow)	0.17	(e) • (further processing influent@6335)	0.45	(e) • (rendering influent@6447)	0.13	0.75
Option Average	R1 for 6335		R2 for 6335		R3 for 6335		

(e) = 1 - removal fraction @ 6335
[1] EPA used effluent data from the sampling point located after DAF and equalization of the treatment train to represent the performance of the PSES-1 technology option.

Table C-40. Data and Equations to Derive Technology Option Pollutant Concentrations for First Processing, Further Processing, and Rendering Effluent Wastewaters

PSES-2 Technology Option for Meat Facilities

	First Processing (R1) Effluent Concentrations	Further Processing (R2) Effluent Concentrations	Rendering (R3) Effluent Concentrations
Option Average For All Pollutants Except Microbials	R1 of BAT-2	R2 of BAT-2	R3 of BAT-2
Option Average For Microbials	R1 of PSES-1	R2 of PSES-1	R3 of PSES-1

R1 of BAT-2 = average BAT-2 treated pollutant concentration of meat first processing wastewater
R2 of BAT-2 = average BAT-2 treated pollutant concentration of meat further processing wastewater
R3 of BAT-2 = average BAT-2 treated pollutant concentration of meat rendering wastewater
R1 of PSES-1 = average PSES-1 treated pollutant concentration of meat first processing wastewater
R2 of PSES-1 = average PSES-1 treated pollutant concentration of meat further processing wastewater
R3 of PSES-1 = average PSES-1 treated pollutant concentration of meat rendering wastewater

Table C-41. Data and Equations to Derive Technology Option Pollutant Concentrations for First Processing, Further Processing, and Rendering Effluent Wastewaters

PSES-3 Technology Option for Meat Facilities

	First Processing (R1) Effluent Concentrations	Further Processing (R2) Effluent Concentrations	Rendering (R3) Effluent Concentrations
Option Average For All Pollutants Except Microbials	R1 of BAT-3	R2 of BAT-3	R3 of BAT-3
Option Average For Microbials	effluent[2]@6335	effluent[2]@6335	effluent[2]@6335

R1 of BAT-3 = average BAT-3 treated pollutant concentration of meat first processing wastewater
R2 of BAT-3 = average BAT-3 treated pollutant concentration of meat further processing wastewater
R3 of BAT-3 = average BAT-3 treated pollutant concentration of meat rendering wastewater
[2] EPA used effluent data from the sampling point located prior to disinfection.

Table C-42. Data and Equations to Derive Technology Option Pollutant Concentrations for First Processing, Further Processing, and Rendering Effluent Wastewaters

PSES-4 Technology Option for Meat Facilities

	First Processing (R1) Effluent Concentrations	Further Processing (R2) Effluent Concentrations	Rendering (R3) Effluent Concentrations
Option Average For All Pollutants Except Microbials	R1 of BAT-4	R2 of BAT-4	R3 of BAT-4
Option Average For Microbials	effluent[2]@6335	effluent[2]@6335	effluent[2]@6335

R1 of BAT-4 = average BAT-4 treated pollutant concentration of meat first processing wastewater
R2 of BAT-4 = average BAT-4 treated pollutant concentration of meat further processing wastewater
R3 of BAT-4 = average BAT-4 treated pollutant concentration of meat rendering wastewater
[2] EPA used effluent data from the sampling point located prior to disinfection

Table C-43. Data and Equations to Derive Technology Option Pollutant Concentrations for First Processing, Further Processing, and Rendering Effluent Wastewaters

PSES-1 Technology Option for Poultry Facilities

Facility	First Processing (P1)		First Processing (P2)		Rendering (P3)		Total Flow (MGD)
	Effluent Concentrations	Flow (MGD)	Effluent Concentrations	Flow (MGD)	Effluent Concentrations	Flow (MGD)	
6443	[(effluent@6443 • total flow of 6443) - (P2 concentration of 6443 • P2 flow of 6443)] / (P1 flow)	0.91	(f) • (further processing influent@6443)	0.84	N/A	N/A	1.57
6444	[(effluent@6444 • total flow of 6444) - (P2 concentration of 6444 • P2 flow of 6444)] / (P1 flow)	0.53	(f) • (further procssing influent@6444)	0.02	N/A	N/A	0.55
Option Average	Average of P1 for 6443 and 6444		Average of P2 for 6443 and 6444		M		

(f) = (1 - removal fraction of 6443)
M = (rendering influent@6448) • (1 - removal fraction of 6443)

Table C-44. Data and Equations to Derive Technology Option Pollutant Concentrations for First Processing, Further Processing, and Rendering Effluent Wastewaters

PSES-2 Technology Option for Poultry Facilities

	First Processing (P1) Effluent Concentrations	First Processing (P2) Effluent Concentrations	Rendering (P3) Effluent Concentrations
Options Average For All Pollutants Except Microbials	P1 of BAT-2	P2 of BAT-2	P3 of BAT-2
Options Average For Microbials	effluent after DAF@6304	effluent after DAF@6304	effluent after DAF@6304

P1 of BAT-2 = average BAT-2 treated pollutant concentration of poultry first processing wastewater
P2 of BAT-2 = average BAT-2 treated pollutant concentration of poultry further processing wastewater
P3 of BAT-2 = average BAT-2 treated pollutant concentration of poultry rendering wastewater

Table C-45. Data and Equations to Derive Technology Option Pollutant Concentrations for First Processing, Further Processing, and Rendering Effluent Wastewaters

PSES-3 Technology Option for Poultry Facilities

	First Processing (P1) Effluent Concentrations	First Processing (P2) Effluent Concentrations	Rendering (P3) Effluent Concentrations
Options Average For All Pollutants Except Microbials	P1 of BAT-3	P2 of BAT-3	P3 of BAT-3
Options Average For Microbials	effluent@6443	effluent@6443	effluent@6443

P1 of BAT-3 = average BAT-3 treated pollutant concentration of poultry first processing wastewater
P2 of BAT-3 = average BAT-3 treated pollutant concentration of poultry further processing wastewater
P3 of BAT-3 = average BAT-3 treated pollutant concentration of poultry rendering wastewater

Table C-46. Data and Equations to Derive Technology Option Pollutant Concentrations for First Processing, Further Processing, and Rendering Effluent Wastewaters

PSES-4 Technology Option for Poultry Facilities

	First Processing (P1) Effluent Concentrations	**First Processing (P2) Effluent Concentrations**	**Rendering (P3) Effluent Concentrations**
Options Average For All Pollutants Except Microbials	P1 of BAT-4	P2 of BAT-4	P3 of BAT-4
Options Average For Microbials	effluent@6443	effluent@6443	effluent@6443

P1 of BAT-4 = average BAT-4 treated pollutant concentration of poultry first processing wastewater
P2 of BAT-4 = average BAT-4 treated pollutant concentration of poultry further processing wastewater
P3 of BAT-4 = average BAT-4 treated pollutant concentration of poultry rendering wastewater

Table C-47. Average Technology Option Concentrations for Meat First Processing (R1) Direct Dischargers

Pollutant of Concern	BAT 1	BAT 2	BAT 3	BAT 4	Units
5-Day biochemical oxygen demand (BOD_5)	6.28	6.28	6.17	6.17	mg/L
Total suspended solids (TSS)	24.28	24.28	14.75	14.75	mg/L
Hexane extractable material (HEM)	7.28	7.28	14.28	3.31	mg/L
Fecal coliform bacteria	343.0	343.0	47.61	47.61	cfu/100 mL
Ammonia as nitrogen	5.03	0.408	15.40	12.06	mg/L
Carbaryl	N/A [a]	N/A	N/A	N/A	mg/L
Carbonaceous biochemical oxygen demand (CBOD)	5.62	5.62	9.44	9.44	mg/L
Chemical oxygen demand (COD)	62.01	62.01	41.98	41.98	mg/L
Chloride	733.9	733.9	N/A	774.3	mg/L
Dissolved biochemical oxygen demand	2.19	2.19	1.38	1.38	mg/L
Dissolved phosphorus	17.46	17.46	0.340	0.340	mg/L
Nitrate-nitrite	240.9	245.5	22.66	5.65	mg/L
Total nitrogen	239.3	239.3	30.62	15.12	mg/L
Orthophosphate	17.53	17.53	11.73	2.92	mg/L
Total dissolved solids (TDS)	2,964	2,964	N/A	2,162	mg/L
Total Kjeldahl nitrogen (TKN)	7.07	2.45	7.65	5.82	mg/L
Total organic carbon (TOC)	1.54	1.54	N/A	N/A	mg/L
Total phosphorus	19.97	19.97	6.10	6.10	mg/L
Total residual chlorine	0.336	0.336	58.18	58.18	mg/L
Volatile residue	273.5	273.5	74.07	74.07	mg/L
Barium	— [b]	—	—	—	
Copper	0.0023	0.0023	0.0030	0.0015	mg/L
Chromium	0.0019	0.0019	0.0066	0.0066	mg/L
Manganese	0.0507	0.0507	0.1326	0.1326	mg/L
Molybdenum	0.0068	0.0068	0.0076	0.0024	mg/L
Nickel	0.0031	0.0031	0.0312	0.0312	mg/L
Titanium	0.0015	0.0015	0.0039	0.0039	mg/L
Vanadium	0.0058	0.0058	0.0036	0.0012	mg/L
Zinc	0.0541	0.0541	0.0228	0.0228	mg/L
Aeromonas	1,235	1,235	6.50	6.50	cfu/100 mL
Cryptosporidium	N/A	N/A	N/A	N/A	
E. Coli	228.3	228.3	3.90	3.90	cfu/100 mL
Fecal streptococci	30.98	30.98	N/A	1.82	cfu/100 mL
Salmonella	—	—	—	—	
Total coliform	400.0	400.0	26.53	2.45	cfu/100 mL
cis-Permethrin	N/A	N/A	N/A	N/A	
trans-Permethrin	N/A	N/A	N/A	N/A	

[a] not available
[b] not applicable

Table C-48. Average Technology Option Concentrations for Meat First/Further Processing (R12)[a] Direct Dischargers

Pollutant of Concern	BAT 1	BAT 2	BAT 3	BAT 4	Units
5-Day biochemical oxygen demand (BOD_5)	3.31	3.31	3.25	3.25	mg/L
Total suspended solids (TSS)	12.78	12.78	7.77	7.77	mg/L
Hexane extractable material (HEM)	3.84	3.84	7.52	1.74	mg/L
Fecal coliform bacteria	180.6	180.6	25.07	25.07	cfu/100 mL
Ammonia as nitrogen	2.65	0.215	8.11	6.35	mg/L
Carbaryl	N/A [b]	N/A	N/A	N/A	
Carbonaceous biochemical oxygen demand (CBOD)	2.96	2.96	4.97	4.97	mg/L
Chemical oxygen demand (COD)	32.65	32.65	22.11	22.11	mg/L
Chloride	386.5	386.5	N/A	407.8	mg/L
Dissolved biochemical oxygen demand	1.16	1.16	0.725	0.725	mg/L
Dissolved phosphorus	9.20	9.20	0.179	0.179	mg/L
Nitrate-nitrite	126.8	129.3	11.93	N/A	mg/L
Total nitrogen	126.0	126.0	16.13	7.96	mg/L
Orthophosphate	9.23	9.23	6.18	1.54	mg/L
Total dissolved solids (TDS)	1,561	1,561	N/A	1,139	mg/L
Total Kjeldahl nitrogen (TKN)	3.72	1.29	4.03	3.07	mg/L
Total organic carbon (TOC)	0.811	0.811	N/A	N/A	mg/L
Total phosphorus	10.52	10.52	3.21	3.21	mg/L
Total residual chlorine	0.177	0.177	30.64	30.64	mg/L
Volatile Residue	144.0	144.0	39.01	39.01	mg/L
Barium	— [c]	—	—	—	
Copper	0.0012	0.0012	0.0016	0.0008	mg/L
Chromium	0.0010	0.0010	0.0035	0.0035	mg/L
Manganese	0.0267	0.0267	0.0698	0.0698	mg/L
Molybdenum	0.0036	0.0036	0.0040	0.0013	mg/L
Nickel	0.0016	0.0016	0.0164	0.0164	mg/L
Titanium	0.0008	0.0008	0.0020	0.0020	mg/L
Vanadium	0.0031	0.0031	0.0019	0.0006	mg/L
Zinc	0.0285	0.0285	0.0120	0.0120	mg/L
Aeromonas	650.1	650.1	3.42	3.42	cfu/100 mL
Cryptosporidium	N/A	N/A	N/A	N/A	
E. Coli	120.2	120.2	2.05	2.05	cfu/100 mL
Fecal streptococci	16.31	16.31	N/A	0.960	cfu/100 mL
Salmonella	—	—	—	—	
Total coliform	210.6	210.6	13.97	1.29	cfu/100 mL
cis-Permethrin	N/A	N/A	N/A	N/A	
trans-Permethrin	N/A	N/A	N/A	N/A	

[a] Data for this category were derived using methods described in Section 9.2.3
[b] not available
[c] not applicable

Table C-49. Average Technology Option Concentrations for Meat First Processing and Rendering (R13)[a] Direct Dischargers

Pollutant of Concern	BAT 1	BAT 2	BAT 3	BAT 4	Units
5-Day biochemical oxygen demand (BOD_5)	6.86	6.86	7.07	7.07	mg/L
Total suspended solids (TSS)	16.53	16.53	8.73	8.73	mg/L
Hexane extractable material (HEM)	7.67	7.67	10.41	2.02	mg/L
Fecal coliform bacteria	295.9	295.9	34.08	34.08	cfu/100 mL
Ammonia as nitrogen	2.70	0.797	8.74	6.99	mg/L
Carbaryl	N/A [b]	N/A	N/A	N/A	
Carbonaceous biochemical oxygen demand (CBOD)	4.99	4.99	10.48	10.48	mg/L
Chemical oxygen demand (COD)	49.86	49.86	40.69	40.69	mg/L
Chloride	479.3	479.3	N/A	533.0	mg/L
Dissolved biochemical oxygen demand	7.11	7.11	3.97	3.97	mg/L
Dissolved phosphorus	13.86	13.86	1.82	1.77	mg/L
Nitrate-nitrite	129.1	128.7	12.03	2.99	mg/L
Total nitrogen	138.9	138.9	18.04	8.39	mg/L
Orthophosphate	14.14	14.14	7.58	2.84	mg/L
Total dissolved solids (TDS)	2,517	2,517	N/A	2,301	mg/L
Total Kjeldahl nitrogen (TKN)	3.79	4.18	4.52	3.57	mg/L
Total organic carbon (TOC)	23.33	23.33	13.37	13.83	mg/L
Total phosphorus	14.38	14.38	4.74	4.74	mg/L
Total residual chlorine	0.299	0.299	30.65	30.65	mg/L
Volatile Residue	257.7	257.7	124.1	124.1	mg/L
Barium	— [c]	—	—	—	
Copper	0.0027	0.0027	0.0020	0.0013	mg/L
Chromium	0.0010	0.0010	0.0036	0.0036	mg/L
Manganese	0.0303	0.0303	0.0785	0.0785	mg/L
Molybdenum	0.0039	0.0039	0.0045	0.0018	mg/L
Nickel	0.0019	0.0019	0.0182	0.0182	mg/L
Titanium	0.0010	0.0010	0.0024	0.0024	mg/L
Vanadium	0.0034	0.0034	0.0020	0.0008	mg/L
Zinc	0.0352	0.0352	0.0143	0.0143	mg/L
Aeromonas	1,377	1,377	3.58	3.58	cfu/100 mL
Cryptosporidium	N/A	N/A	N/A	N/A	
E. Coli	195.8	195.8	2.78	2.78	cfu/100 mL
Fecal streptococci	36.01	36.01	0.111	5.37	cfu/100 mL
Salmonella	—	—	—	—	
Total coliform	326.4	326.4	21.79	4.15	cfu/100 mL
cis-Permethrin	N/A	N/A	N/A	N/A	
trans-Permethrin	N/A	N/A	N/A	N/A	

[a] Data for this category were derived using methods described in Section 9.2.3
[b] not available
[c] not applicable

Table C-50. Average Technology Option Concentrations for Meat First/Further Processing and Rendering (R123)[a] Direct Dischargers

Pollutant of Concern	BAT 1	BAT 2	BAT 3	BAT 4	Units
5-Day biochemical oxygen demand (BOD_5)	5.59	5.59	5.80	5.80	mg/L
Total suspended solids (TSS)	12.35	12.35	6.23	6.23	mg/L
Hexane extractable material (HEM)	6.38	6.38	7.97	1.46	mg/L
Fecal coliform bacteria	253.2	253.2	27.26	27.26	cfu/100 mL
Ammonia as nitrogen	1.86	0.600	6.01	4.82	mg/L
Carbaryl	N/A [b]	N/A	N/A	N/A	
Carbonaceous biochemical oxygen demand (CBOD)	4.01	4.01	8.80	8.80	mg/L
Chemical oxygen demand (COD)	39.08	39.08	33.23	33.23	mg/L
Chloride	1,910	1,910	N/A	2,489	mg/L
Dissolved biochemical oxygen demand	6.95	6.95	3.85	3.85	mg/L
Dissolved phosphorus	18.11	18.11	4.26	4.13	mg/L
Nitrate-nitrite	88.79	88.23	8.66	N/A	mg/L
Total nitrogen	96.11	96.11	12.52	5.91	mg/L
Orthophosphate	12.55	12.55	6.00	2.70	mg/L
Total dissolved solids (TDS)	3,889	3,889	N/A	4,201	mg/L
Total Kjeldahl nitrogen (TKN)	2.61	3.17	3.13	2.48	mg/L
Total organic carbon (TOC)	21.96	21.96	13.03	13.34	mg/L
Total phosphorus	16.48	16.48	5.86	5.86	mg/L
Total residual chlorine	0.255	0.255	20.92	20.92	mg/L
Volatile Residue	240.5	240.5	133.0	133.0	mg/L
Barium	— [c]	—	—	—	
Copper	0.0026	0.0026	0.0016	0.0011	mg/L
Chromium	0.00078	0.00078	0.0027	0.0026	mg/L
Manganese	0.0210	0.0210	0.0543	0.0543	mg/L
Molybdenum	0.0043	0.0043	0.0055	0.0037	mg/L
Nickel	0.0015	0.0015	0.0138	0.0138	mg/L
Titanium	0.00079	0.00079	0.0018	0.0018	mg/L
Vanadium	0.0026	0.0026	0.0015	0.0007	mg/L
Zinc	0.0287	0.0287	0.0113	0.0113	mg/L
Aeromonas	2,030	2,030	2.69	2.69	cfu/100 mL
Cryptosporidium	N/A	N/A	N/A	N/A	
E. Coli	181.6	181.6	2.36	2.36	cfu/100 mL
Fecal streptococci	36.61	36.61	2.78	6.35	cfu/100 mL
Salmonella	—	—	—	—	
Total coliform	323.9	323.9	21.70	5.32	cfu/100 mL
cis-Permethrin	N/A	N/A	N/A	N/A	
trans-Permethrin	N/A	N/A	N/A	N/A	

[a] Data for this category were derived using methods described in Section 9.2.3
[b] not available
[c] not applicable

Table C-51. Average Technology Option Concentrations for Meat Further Processing (R2) Direct Dischargers

Pollutant of Concern	BAT 1	BAT 2	BAT 3	BAT 4	Units
5-Day biochemical oxygen demand (BOD_5)	2.89	2.89	3.11	3.11	mg/L
Total suspended solids (TSS)	3.47	3.47	0.912	0.912	mg/L
Hexane extractable material (HEM)	3.65	3.65	2.78	0.27	mg/L
Fecal coliform bacteria	162.4	162.4	12.78	12.78	cfu/100 mL
Ammonia as nitrogen	0.0639	0.183	0.211	0.211	mg/L
Carbaryl	N/A [a]	N/A	N/A	N/A	
Carbonaceous biochemical oxygen demand (CBOD)	1.94	1.94	5.24	5.24	mg/L
Chemical oxygen demand (COD)	16.17	16.17	17.38	17.38	mg/L
Chloride	4,952	4,952	6,674	6,645	mg/L
Dissolved biochemical oxygen demand	6.59	6.59	3.59	3.59	mg/L
Dissolved phosphorus	27.15	27.15	9.44	9.16	mg/L
Nitrate-nitrite	3.06	2.13	1.51	0.27	mg/L
Total nitrogen	5.21	5.21	0.769	0.631	mg/L
Orthophosphate	9.16	9.16	2.65	2.42	mg/L
Total dissolved solids (TDS)	6,803	6,803	8,238	8,238	mg/L
Total Kjeldahl nitrogen (TKN)	0.0897	1.02	0.182	0.182	mg/L
Total organic carbon (TOC)	19.07	19.07	12.29	12.29	mg/L
Total phosphorus	20.94	20.94	8.23	8.23	mg/L
Total residual chlorine	0.161	0.161	0.248	0.248	mg/L
Volatile Residue	203.98	203.98	151.99	151.99	mg/L
Barium	— [b]	—	—	—	
Copper	0.0022	0.0022	0.00069	0.00069	mg/L
Chromium	0.00023	0.00023	0.00084	0.00050	mg/L
Manganese	0.0013	0.0013	0.0031	0.0031	mg/L
Molybdenum	0.0050	0.0050	0.0077	0.0077	mg/L
Nickel	0.00070	0.00070	0.0046	0.0046	mg/L
Titanium	0.00024	0.00024	0.00037	0.00037	mg/L
Vanadium	0.00091	0.00091	0.00042	0.00042	mg/L
Zinc	0.0147	0.0147	0.0050	0.0050	mg/L
Aeromonas	3,419	3,419	0.817	0.817	cfu/100 mL
Cryptosporidium	N/A	N/A	N/A	N/A	
E. Coli	151.5	151.5	1.46	1.46	cfu/100 mL
Fecal streptococci	37.89	37.89	8.45	8.45	cfu/100 mL
Salmonella	—	—	—	—	
Total coliform	318.6	318.6	21.50	7.81	cfu/100 mL
cis-Permethrin	N/A	N/A	N/A	N/A	
trans-Permethrin	N/A	N/A	N/A	N/A	

[a] not available
[b] not applicable

Table C-52. Average Technology Option Concentrations for Meat Further Processing and Rendering (R23)[a] Direct Dischargers

Pollutant of Concern	BAT 1	BAT 2	BAT 3	BAT 4	Units
5-Day biochemical oxygen demand (BOD_5)	5.21	5.21	5.60	5.60	mg/L
Total suspended solids (TSS)	5.76	5.76	1.51	1.51	mg/L
Hexane extractable material (HEM)	5.89	5.89	4.48	0.442	mg/L
Fecal coliform bacteria	203.5	203.5	16.02	16.02	cfu/100 mL
Ammonia as nitrogen	0.0987	0.707	0.816	0.816	mg/L
Carbaryl	N/A [b]	N/A	N/A	N/A	
Carbonaceous biochemical oxygen demand (CBOD)	3.13	3.13	8.45	8.45	mg/L
Chemical oxygen demand (COD)	26.41	26.41	28.39	28.39	mg/L
Chloride	2,560	2,560	3,451	3,436	mg/L
Dissolved biochemical oxygen demand	9.57	9.57	5.21	5.21	mg/L
Dissolved phosphorus	18.47	18.47	6.42	6.23	mg/L
Nitrate-nitrite	4.73	1.30	0.923	N/A	mg/L
Total nitrogen	16.96	16.96	2.51	0.815	mg/L
Orthophosphate	9.79	9.79	2.83	2.58	mg/L
Total dissolved solids (TDS)	4,399	4,399	5,327	5,327	mg/L
Total Kjeldahl nitrogen (TKN)	0.139	3.57	0.636	0.636	mg/L
Total organic carbon (TOC)	33.26	33.26	21.44	21.44	mg/L
Total phosphorus	14.55	14.55	5.72	5.72	mg/L
Total residual chlorine	0.210	0.210	0.324	0.324	mg/L
Volatile Residue	222.3	222.3	165.6	165.6	mg/L
Barium	— [c]	—	—	—	
Copper	0.0027	0.0027	0.00084	0.00084	mg/L
Chromium	0.00018	0.00018	0.00064	0.00038	mg/L
Manganese	0.0046	0.0046	0.0111	0.0111	mg/L
Molybdenum	0.0028	0.0028	0.0044	0.0044	mg/L
Nickel	0.00065	0.00065	0.0042	0.0042	mg/L
Titanium	0.00037	0.00037	0.00058	0.00058	mg/L
Vanadium	0.00081	0.00081	0.00037	0.00037	mg/L
Zinc	0.0146	0.0146	0.0050	0.0050	mg/L
Aeromonas	2,470	2,470	0.590	0.590	cfu/100 mL
Cryptosporidium	N/A	N/A	N/A	N/A	
E. Coli	155.8	155.8	1.50	1.50	cfu/100 mL
Fecal streptococci	39.72	39.72	8.86	8.86	cfu/100 mL
Salmonella	—	—	—	—	
Total coliform	281.9	281.9	19.02	6.91	cfu/100 mL
cis-Permethrin	N/A	N/A	N/A	N/A	
trans-Permethrin	N/A	N/A	N/A	N/A	

[a] Data for this category were derived using methods described in Section 9.2.3
[b] not available
[c] not applicable

Table C-53. Average Technology Option Concentrations for Meat First Processing (R1) Indirect Dischargers

Pollutant of Concern	PSES 1	PSES 2	PSES 3	PSES 4	Units
5-Day biochemical oxygen demand (BOD_5)	1,697	6.28	6.17	6.17	mg/L
Total suspended solids (TSS)	966.7	24.28	14.75	14.75	mg/L
Hexane extractable material (HEM)	39.01	7.28	14.28	3.31	mg/L
Fecal coliform bacteria	2,530,020	2,530,020	7,328	7,328	cfu/100 mL
Ammonia as nitrogen	1,079	0.408	15.40	12.06	mg/L
Carbaryl	N/A [a]	N/A	N/A	N/A	
Carbonaceous biochemical oxygen demand (CBOD)	1,392	5.62	9.44	9.44	mg/L
Chemical oxygen demand (COD)	2,812	62.01	41.98	41.98	mg/L
Chloride	N/A	733.9	N/A	774.3	mg/L
Dissolved biochemical oxygen demand	381.52	2.19	1.38	1.38	mg/L
Dissolved phosphorus	1.51	17.46	0.340	0.340	mg/L
Nitrate-nitrite	0.324	245.5	22.66	5.65	mg/L
Total nitrogen	564.9	239.3	30.62	15.12	mg/L
Orthophosphate	36.05	17.53	11.73	2.92	mg/L
Total dissolved solids (TDS)	N/A	2,964	N/A	2,162	mg/L
Total Kjeldahl nitrogen (TKN)	564.8	2.45	7.65	5.82	mg/L
Total organic carbon (TOC)	N/A	1.54	N/A	N/A	mg/L
Total phosphorus	28.62	19.97	6.10	6.10	mg/L
Total residual chlorine	0.340	0.34	58.18	58.18	mg/L
Volatile Residue	307.1	273.5	74.07	74.07	mg/L
Barium	— [b]	—	—	—	
Copper	0.0310	0.0023	0.0030	0.0015	mg/L
Chromium	0.0200	0.0019	0.0066	0.0066	mg/L
Manganese	1.73	0.0507	0.133	0.133	mg/L
Molybdenum	0.0033	0.0068	0.0076	0.0024	mg/L
Nickel	0.0499	0.0031	0.0312	0.0312	mg/L
Titanium	0.0042	0.0015	0.0039	0.0039	mg/L
Vanadium	0.0032	0.0058	0.0036	0.0012	mg/L
Zinc	0.125	0.0541	0.0228	0.0228	mg/L
Aeromonas	2,274,907	2,274,907	51,000	51,000	cfu/100 mL
Cryptosporidium	N/A	N/A	0.300	0.300	cysts/L
E. Coli	2,089,500	2,089,500	6,338	6,338	cfu/100 mL
Fecal streptococci	N/A	N/A	6.50	6.50	cfu/100 mL
Salmonella	—	—	—	—	
Total coliform	1,433,988	1,433,988	7,328	7,328	cfu/100 mL
cis-Permethrin	N/A	N/A	N/A	N/A	
trans-Permethrin	N/A	N/A	N/A	N/A	

[a] not available
[b] not applicable

Table C-54. Average Technology Option Concentrations for Meat First/Further Processing (R12)[a] Indirect Dischargers

Pollutant of Concern	PSES 1	PSES 2	PSES 3	PSES 4	Units
5-Day biochemical oxygen demand (BOD_5)	1,298	3.31	4.72	3.25	mg/L
Total suspended solids (TSS)	537.4	12.78	8.20	7.77	mg/L
Hexane extractable material (HEM)	24.14	3.84	8.83	1.74	mg/L
Fecal coliform bacteria	1,653,717	1,332,308	7,328	3,859	cfu/100 mL
Ammonia as nitrogen	575.1	0.215	8.21	6.35	mg/L
Carbaryl	N/A [b]	N/A	N/A	N/A	
Carbonaceous biochemical oxygen demand (CBOD)	1,098	2.96	7.45	4.97	mg/L
Chemical oxygen demand (COD)	2,032	32.65	30.34	22.11	mg/L
Chloride	N/A	386.5	N/A	407.8	mg/L
Dissolved biochemical oxygen demand	672.0	1.16	2.42	0.725	mg/L
Dissolved phosphorus	20.69	9.20	4.65	0.179	mg/L
Nitrate-nitrite	N/A	N/A	N/A	N/A	
Total nitrogen	304.2	126.0	16.49	7.96	mg/L
Orthophosphate	22.84	9.23	7.43	1.54	mg/L
Total dissolved solids (TDS)	N/A	1,561	N/A	1,139	mg/L
Total Kjeldahl nitrogen (TKN)	303.8	1.29	4.11	3.07	mg/L
Total organic carbon (TOC)	192.5	0.811	4.66	N/A	mg/L
Total phosphorus	33.36	10.52	7.11	3.21	mg/L
Total residual chlorine	0.193	0.177	30.76	30.64	mg/L
Volatile Residue	460.0	144.0	111.0	39.01	mg/L
Barium	— [c]	—	—	—	
Copper	0.0198	0.0012	0.0019	0.00081	mg/L
Chromium	0.0117	0.0010	0.0039	0.0035	mg/L
Manganese	0.926	0.0267	0.0713	0.0698	mg/L
Molybdenum	0.0033	0.0036	0.0076	0.0013	mg/L
Nickel	0.0295	0.0016	0.0186	0.0164	mg/L
Titanium	0.0024	0.00081	0.0022	0.0020	mg/L
Vanadium	0.0019	0.0031	0.0021	0.00064	mg/L
Zinc	0.0788	0.0285	0.0144	0.0120	mg/L
Aeromonas	1,333,263	1,197,966	51,000	26,857	cfu/100 mL
Cryptosporidium	N/A	N/A	0.300	0.158	cysts/L
E. Coli	1,470,027	1,100,331	6,338	3,337	cfu/100 mL
Fecal streptococci	N/A	N/A	6.50	3.42	cfu/100 mL
Salmonella	—	—	—	—	
Total coliform	1,305,229	755,138	7,328	3,859	cfu/100 mL
cis-Permethrin	N/A	N/A	N/A	N/A	
trans-Permethrin	N/A	N/A	N/A	N/A	

[a] Data for this category were derived using methods described in Section 9.2.3
[b] not available
[c] not applicable

Table C-55. Average Technology Option Concentrations for Meat First Processing and Rendering (R13)[a] Indirect Dischargers

Pollutant of Concern	PSES 1	PSES 2	PSES 3	PSES 4	Units
5-Day biochemical oxygen demand (BOD_5)	1,945	6.86	7.07	7.07	mg/L
Total suspended solids (TSS)	571.8	16.53	8.73	8.73	mg/L
Hexane extractable material (HEM)	28.45	7.67	10.41	2.02	mg/L
Fecal coliform bacteria	1,811,050	1,811,050	7,328	7,328	cfu/100 mL
Ammonia as nitrogen	611.9	0.797	8.74	6.99	mg/L
Carbaryl	N/A [b]	N/A	N/A	N/A	
Carbonaceous biochemical oxygen demand (CBOD)	1,546	4.99	10.48	10.48	mg/L
Chemical oxygen demand (COD)	2,725	49.86	40.69	40.69	mg/L
Chloride	N/A	479.3	N/A	533.0	mg/L
Dissolved biochemical oxygen demand	1,100	7.11	3.97	3.97	mg/L
Dissolved phosphorus	8.09	13.86	1.82	1.77	mg/L
Nitrate-nitrite	0.172	128.7	12.03	2.99	mg/L
Total nitrogen	332.8	138.9	18.04	8.39	mg/L
Orthophosphate	23.28	14.14	7.58	2.84	mg/L
Total dissolved solids (TDS)	N/A	2,517	N/A	2,301	mg/L
Total Kjeldahl nitrogen (TKN)	333.8	4.18	4.52	3.57	mg/L
Total organic carbon (TOC)	551.8	23.33	13.37	13.83	mg/L
Total phosphorus	22.23	14.38	4.74	4.74	mg/L
Total residual chlorine	0.201	0.299	30.65	30.65	mg/L
Volatile Residue	514.6	257.7	124.1	124.1	mg/L
Barium	— [c]	—	—	—	
Copper	0.0212	0.0027	0.0020	0.0013	mg/L
Chromium	0.0111	0.0010	0.0036	0.0036	mg/L
Manganese	0.994	0.0303	0.0785	0.0785	mg/L
Molybdenum	0.0020	0.0039	0.0045	0.0018	mg/L
Nickel	0.0288	0.0019	0.0182	0.0182	mg/L
Titanium	0.0026	0.0010	0.0024	0.0024	mg/L
Vanadium	0.0018	0.0034	0.0020	0.00079	mg/L
Zinc	0.0783	0.0352	0.0143	0.0143	mg/L
Aeromonas	1,251,966	1,251,966	51,000	51,000	cfu/100 mL
Cryptosporidium	N/A	N/A	0.300	0.300	cysts/L
E. Coli	1,487,234	1,487,234	6,338	6,338	cfu/100 mL
Fecal streptococci	16,664	16,664	6.50	6.50	cfu/100 mL
Salmonella	—	—	—	—	
Total coliform	1,177,498	1,177,498	7,328	7,328	cfu/100 mL
cis-Permethrin	N/A	N/A	N/A	N/A	
trans-Permethrin	N/A	N/A	N/A	N/A	

[a] Data for this category were derived using methods described in Section 9.2.3
[b] not available
[c] not applicable

Table C-56. Average Technology Option Concentrations for Meat First/Further Processing and Rendering (R123)[a] Indirect Dischargers

Pollutant of Concern	PSES 1	PSES 2	PSES 3	PSES 4	Units
5-Day biochemical oxygen demand (BOD_5)	1,596	5.59	5.80	5.80	mg/L
Total suspended solids (TSS)	407.9	12.35	6.23	6.23	mg/L
Hexane extractable material (HEM)	21.78	6.38	7.97	1.46	mg/L
Fecal coliform bacteria	1,448,804	1,448,804	7,328	7,328	cfu/100 mL
Ammonia as nitrogen	420.9	0.600	6.01	4.82	mg/L
Carbaryl	N/A [b]	N/A	N/A	N/A	
Carbonaceous biochemical oxygen demand (CBOD)	1,298	4.01	8.80	8.80	mg/L
Chemical oxygen demand (COD)	2,225	39.08	33.23	33.23	mg/L
Chloride	N/A	1,910	N/A	2,489	mg/L
Dissolved biochemical oxygen demand	1,066	6.95	3.85	3.85	mg/L
Dissolved phosphorus	18.95	18.11	4.26	4.13	mg/L
Nitrate-nitrite	N/A	N/A	N/A	N/A	
Total nitrogen	230.9	96.11	12.52	5.91	mg/L
Orthophosphate	18.44	12.55	6.00	2.70	mg/L
Total dissolved solids (TDS)	N/A	3,889	N/A	4,201	mg/L
Total Kjeldahl nitrogen (TKN)	231.3	3.17	3.13	2.48	mg/L
Total organic carbon (TOC)	537.5	21.96	13.03	13.34	mg/L
Total phosphorus	27.48	16.48	5.86	5.86	mg/L
Total residual chlorine	0.146	0.255	20.92	20.92	mg/L
Volatile Residue	551.6	240.5	133.0	133.0	mg/L
Barium	— [c]	—	—	—	
Copper	0.0167	0.0026	0.0016	0.0011	mg/L
Chromium	0.0084	0.00078	0.0027	0.0026	mg/L
Manganese	0.685	0.0210	0.0543	0.0543	mg/L
Molybdenum	0.0024	0.0043	0.0055	0.0037	mg/L
Nickel	0.0217	0.0015	0.0138	0.0138	mg/L
Titanium	0.0019	0.00079	0.0018	0.0018	mg/L
Vanadium	0.0014	0.0026	0.0015	0.00067	mg/L
Zinc	0.0621	0.0287	0.0113	0.0113	mg/L
Aeromonas	942,835	942,835	51,000	51,000	cfu/100 mL
Cryptosporidium	N/A	N/A	0.300	0.300	cysts/L
E. Coli	1,261,244	1,261,244	6,338	6,338	cfu/100 mL
Fecal streptococci	415,728	415,728	6.50	6.50	cfu/100 mL
Salmonella	—	—	—	—	
Total coliform	1,172,549	1,172,549	7,328	7,328	cfu/100 mL
cis-Permethrin	N/A	N/A	N/A	N/A	
trans-Permethrin	N/A	N/A	N/A	N/A	

[a] Data for this category were derived using methods described in Section 9.2.3
[b] not available
[c] not applicable

Table C-57. Average Technology Option Concentrations for Meat Further Processing (R2) Indirect Dischargers

Pollutant of Concern	PSES 1	PSES 2	PSES 3	PSES 4	Units
5-Day biochemical oxygen demand (BOD_5)	854.7	2.89	3.11	3.11	mg/L
Total suspended solids (TSS)	59.75	3.47	0.912	0.912	mg/L
Hexane extractable material (HEM)	7.59	3.65	2.78	0.274	mg/L
Fecal coliform bacteria	678,936	678,936	7,328	7,328	cfu/100 mL
Ammonia as nitrogen	14.80	0.183	0.211	0.211	mg/L
Carbaryl	N/A [a]	N/A	N/A	N/A	
Carbonaceous biochemical oxygen demand (CBOD)	772.0	1.94	5.24	5.24	mg/L
Chemical oxygen demand (COD)	1,164	16.17	17.38	17.38	mg/L
Chloride	6,674	4,952	6,674	6,645	mg/L
Dissolved biochemical oxygen demand	995.2	6.59	3.59	3.59	mg/L
Dissolved phosphorus	42.02	27.15	9.44	9.16	mg/L
Nitrate-nitrite	0.0216	2.13	1.51	0.275	mg/L
Total nitrogen	14.19	5.21	0.769	0.631	mg/L
Orthophosphate	8.15	9.16	2.65	2.42	mg/L
Total dissolved solids (TDS)	8,238	6,803	8,238	8,238	mg/L
Total Kjeldahl nitrogen (TKN)	13.44	1.02	0.182	0.182	mg/L
Total organic carbon (TOC)	507.2	19.07	12.29	12.29	mg/L
Total phosphorus	38.63	20.94	8.23	8.23	mg/L
Total residual chlorine	0.0300	0.161	0.248	0.248	mg/L
Volatile Residue	630.1	204.0	152.0	152.0	mg/L
Barium	— [b]	—	—	—	
Copper	0.0072	0.0022	0.00069	0.00069	mg/L
Chromium	0.0026	0.0002	0.00084	0.00050	mg/L
Manganese	0.0293	0.0013	0.0031	0.0031	mg/L
Molybdenum	0.0034	0.0050	0.0077	0.0077	mg/L
Nickel	0.0067	0.0007	0.0046	0.0046	mg/L
Titanium	0.00040	0.00024	0.00037	0.00037	mg/L
Vanadium	0.00038	0.00091	0.00042	0.00042	mg/L
Zinc	0.0276	0.0147	0.0050	0.0050	mg/L
Aeromonas	285,799	285,799	51,000	51,000	cfu/100 mL
Cryptosporidium	N/A	N/A	0.300	0.300	cysts/L
E. Coli	780,938	780,938	6,338	6,338	cfu/100 mL
Fecal streptococci	1,263,903	1,263,903	6.50	6.50	cfu/100 mL
Salmonella	—	—	—	—	
Total coliform	1,162,000	1,162,000	7,328	7,328	cfu/100 mL
cis-Permethrin	N/A	N/A	N/A	N/A	
trans-Permethrin	N/A	N/A	N/A	N/A	

[a] not available
[b] not applicable

Table C-58. Average Technology Option Concentrations for Meat Further Processing and Rending (R23)[a] Indirect Dischargers

Pollutant of Concern	PSES 1	PSES 2	PSES 3	PSES 4	Units
5-Day biochemical oxygen demand (BOD_5)	1,540	5.21	5.60	5.60	mg/L
Total suspended solids (TSS)	99.06	5.76	1.51	1.51	mg/L
Hexane extractable material (HEM)	12.25	5.89	4.48	0.44	mg/L
Fecal coliform bacteria	851,145	851,145	7,328	7,328	cfu/100 mL
Ammonia as nitrogen	57.16	0.707	0.816	0.816	mg/L
Carbaryl	N/A [b]	N/A	N/A	N/A	
Carbonaceous biochemical oxygen demand (CBOD)	1,247	3.13	8.45	8.45	mg/L
Chemical oxygen demand (COD)	1,902	26.41	28.39	28.39	mg/L
Chloride	3,451	2,560	3,451	3,436	mg/L
Dissolved biochemical oxygen demand	1,445	9.57	5.21	5.21	mg/L
Dissolved phosphorus	28.58	18.47	6.42	6.23	mg/L
Nitrate-nitrite	N/A	N/A	N/A	N/A	
Total nitrogen	46.23	16.96	2.51	0.81	mg/L
Orthophosphate	8.70	9.79	2.83	2.58	mg/L
Total dissolved solids (TDS)	5,327	4,399	5,327	5,327	mg/L
Total Kjeldahl nitrogen (TKN)	46.97	3.57	0.636	0.636	mg/L
Total organic carbon (TOC)	884.8	33.26	21.44	21.44	mg/L
Total phosphorus	26.85	14.55	5.72	5.72	mg/L
Total residual chlorine	0.0392	0.210	0.324	0.324	mg/L
Volatile Residue	686.7	222.3	165.6	165.6	mg/L
Barium	— [c]	—	—	—	
Copper	0.0088	0.0027	0.00084	0.00084	mg/L
Chromium	0.0020	0.00018	0.00064	0.00038	mg/L
Manganese	0.106	0.0046	0.0111	0.0111	mg/L
Molybdenum	0.0019	0.0028	0.0044	0.0044	mg/L
Nickel	0.0062	0.00065	0.0042	0.0042	mg/L
Titanium	0.0006	0.00037	0.00058	0.00058	mg/L
Vanadium	0.00034	0.00081	0.00037	0.00037	mg/L
Zinc	0.0274	0.0146	0.0050	0.0050	mg/L
Aeromonas	206,458	206,458	51,000	51,000	cfu/100 mL
Cryptosporidium	N/A	N/A	0.300	0.300	cysts/L
E. Coli	803,393	803,393	6,338	6,338	cfu/100 mL
Fecal streptococci	1,324,889	1,324,889	6.50	6.50	cfu/100 mL
Salmonella	—	—	—	—	
Total coliform	1,028,002	1,028,002	7,328	7,328	cfu/100 mL
cis-Permethrin	N/A	N/A	N/A	N/A	
trans-Permethrin	N/A	N/A	N/A	N/A	

[a] Data for this category were derived using methods described in Section 9.2.3
[b] not available
[c] not applicable

Table C-59. Average Technology Option Concentrations for Poultry First Processing (P1) Direct Dischargers

Pollutant of Concern	BAT 1	BAT 2	BAT 3	BAT 4	BAT 5	Units
5-Day biochemical oxygen demand (BOD_5)	2.00	2.00	1.96	8.60	3.00	mg/L
Total suspended solids (TSS)	8.20	8.20	4.98	5.60	4.00	mg/L
Hexane extractable material (HEM)	23.60	23.60	23.60	5.47	5.50	mg/L
Fecal coliform bacteria	2.00	2.00	0.278	2.00	41.60	cfu/100 mL
Ammonia as nitrogen	2.02	0.258	0.258	0.202	0.200	mg/L
Carbaryl	0.00100	0.00100	N/A [a]	0.00229	0.00100	mg/L
Carbonaceous biochemical oxygen demand (CBOD)	2.00	2.00	2.00	6.60	3.00	mg/L
Chemical oxygen demand (COD)	25.60	25.60	17.33	20.40	19.00	mg/L
Chloride	87.20	87.20	N/A	92.00	92.20	mg/L
Dissolved biochemical oxygen demand	2.00	2.00	1.26	4.80	3.00	mg/L
Dissolved phosphorus	0.378	0.378	0.00737	0.0500	0.0960	mg/L
Nitrate-nitrite	25.42	27.18	2.51	0.626	0.714	mg/L
Total nitrogen	28.74	28.74	3.68	1.82	2.00	mg/L
Orthophosphate	0.108	0.108	0.0723	0.0180	0.0100	mg/L
Total dissolved solids (TDS)	822.4	822.4	N/A	600.0	618.8	mg/L
Total Kjeldahl nitrogen (TKN)	3.32	1.56	1.56	1.19	1.29	mg/L
Total organic carbon (TOC)	5.86	5.86	5.86	3.52	3.77	mg/L
Total phosphorus	0.722	0.722	0.220	0.472	0.410	mg/L
Total residual chlorine	— [b]	—	—	—	—	
Volatile Residue	178.8	178.8	48.42	122.4	124.0	mg/L
Barium	0.00444	0.00444	0.00019	0.02132	0.02108	mg/L
Copper	0.00876	0.00876	0.00876	0.00456	0.00100	mg/L
Chromium	—	—	—	—	—	
Manganese	0.00740	0.00740	0.00740	0.07432	0.05514	mg/L
Molybdenum	—	—	—	—	—	
Nickel	0.00104	0.00104	0.00104	0.00288	0.00238	mg/L
Titanium	—	—	—	—	—	
Vanadium	—	—	—	—	—	
Zinc	0.07694	0.07694	0.03246	0.05004	0.00624	mg/L
Aeromonas	1,550	1,550	8.16	468.6	3.40	cfu/100 mL
Cryptosporidium	—	—	—	—	—	
E. Coli	2.00	2.00	0.03418	2.00	41.60	cfu/100 mL
Fecal streptococci	34.00	34.00	N/A	2.00	2.00	cfu/100 mL
Salmonella	2.00	2.00	1.82	2.00	2.00	cfu/100 mL
Total coliform	621.0	621.0	41.19	3.80	81.60	cfu/100 mL
cis-Permethrin	—	—	—	—	—	
trans-Permethrin	—	—	—	—	—	

[a] not available
[b] not applicable

Table C-60. Average Technology Option Concentrations for Poultry First/Further Processing (P12)[a] Direct Dischargers

Pollutant of Concern	BAT 1	BAT 2	BAT 3	BAT 4	BAT 5	Units
5-Day biochemical oxygen demand (BOD_5)	3.01	3.01	2.99	19.26	6.72	mg/L
Total suspended solids (TSS)	81.46	81.46	23.49	60.10	42.93	mg/L
Hexane extractable material (HEM)	25.12	25.12	23.30	4.62	4.65	mg/L
Fecal coliform bacteria	1.52	1.52	0.208	1.66	34.50	cfu/100 mL
Ammonia as nitrogen	1.63	0.387	0.387	0.347	0.344	mg/L
Carbaryl	0.00074	0.00074	N/A[b]	0.00170	0.00074	mg/L
Carbonaceous biochemical oxygen demand (CBOD)	2.96	2.96	2.96	12.34	5.61	mg/L
Chemical oxygen demand (COD)	34.04	34.04	27.91	35.81	33.36	mg/L
Chloride	141.6	141.6	N/A	144.9	145.2	mg/L
Dissolved biochemical oxygen demand	2.62	2.62	1.55	6.92	4.33	mg/L
Dissolved phosphorus	1.09	1.09	0.288	0.311	0.597	mg/L
Nitrate-nitrite	20.52	20.38	2.03	0.495	0.565	mg/L
Total nitrogen	50.00	50.00	6.97	4.82	5.32	mg/L
Orthophosphate	0.131	0.131	0.0684	0.0269	0.0149	mg/L
Total dissolved solids (TDS)	1,052	1,052	N/A	886.8	900.8	mg/L
Total Kjeldahl nitrogen (TKN)	2.68	2.82	1.45	3.91	4.24	mg/L
Total organic carbon (TOC)	8.14	8.14	6.79	7.07	7.56	mg/L
Total phosphorus	3.71	3.71	1.41	4.67	4.06	mg/L
Total residual chlorine	—[c]	—	—	—	—	
Volatile Residue	579.0	579.0	368.6	557.6	564.9	mg/L
Barium	0.00592	0.00592	0.00134	0.02108	0.02084	mg/L
Copper	0.00715	0.00715	0.00669	0.00400	0.00088	mg/L
Chromium	—	—	—	—	—	
Manganese	0.00645	0.00645	0.00645	0.06069	0.04502	mg/L
Molybdenum	—	—	—	—	—	
Nickel	0.00196	0.00196	0.00196	0.00519	0.00429	mg/L
Titanium	—	—	—	—	—	
Vanadium	—	—	—	—	—	
Zinc	0.128	0.128	0.0484	0.0823	0.0103	mg/L
Aeromonas	1,222	1,222	6.06	438.5	3.18	cfu/100 mL
Cryptosporidium	—	—	—	—	—	
E. Coli	1.52	1.52	0.0257	1.66	34.62	cfu/100 mL
Fecal streptococci	25.64	25.64	N/A	2.25	2.25	cfu/100 mL
Salmonella	2.00	2.00	1.86	1.48	1.48	cfu/100 mL
Total coliform	494.2	494.2	32.82	3.65	78.41	cfu/100 mL
cis-Permethrin	—	—	—	—	—	
trans-Permethrin	—	—	—	—	—	

[a] Data for this category were derived using methods described in Section 9.2.3
[b] not available
[c] not applicable

Table C-61. Average Technology Option Concentrations for Poultry First Processing and Rendering (P13)[a] Direct Dischargers

Pollutant of Concern	BAT 1	BAT 2	BAT 3	BAT 4	BAT 5	Units
5-Day biochemical oxygen demand (BOD_5)	2.04	2.04	2.02	11.56	4.03	mg/L
Total suspended solids (TSS)	16.41	16.41	6.25	11.85	8.46	mg/L
Hexane extractable material (HEM)	111.0	111.0	88.41	10.87	10.94	mg/L
Fecal coliform bacteria	2.11	2.11	0.248	4.96	103.1	cfu/100 mL
Ammonia as nitrogen	2.14	1.50	1.50	1.47	1.46	mg/L
Carbaryl	0.00073	0.00073	N/A [b]	0.00157	0.00069	mg/L
Carbonaceous biochemical oxygen demand (CBOD)	2.23	2.23	2.23	8.84	4.02	mg/L
Chemical oxygen demand (COD)	65.79	65.79	60.12	80.25	74.74	mg/L
Chloride	91.66	91.66	N/A	94.82	95.02	mg/L
Dissolved biochemical oxygen demand	4.67	4.67	2.66	13.10	8.18	mg/L
Dissolved phosphorus	0.647	0.647	0.140	0.165	0.317	mg/L
Nitrate-nitrite	26.94	26.82	7.55	1.49	1.69	mg/L
Total nitrogen	70.14	70.14	9.97	3.00	3.32	mg/L
Orthophosphate	0.216	0.216	0.0907	0.0499	0.0277	mg/L
Total dissolved solids (TDS)	1,027	1,027	N/A	874.1	887.0	mg/L
Total Kjeldahl nitrogen (TKN)	3.52	3.64	1.53	5.49	5.95	mg/L
Total organic carbon (TOC)	11.84	11.84	9.06	11.59	12.40	mg/L
Total phosphorus	1.25	1.25	0.446	1.35	1.17	mg/L
Total residual chlorine	— [c]	—	—	—	—	
Volatile Residue	302.3	302.3	167.1	271.9	275.5	mg/L
Barium	0.0050	0.0050	0.0010	0.0186	0.0184	mg/L
Copper	0.0098	0.0098	0.0072	0.0067	0.0015	mg/L
Chromium	—	—	—	—	—	
Manganese	0.0103	0.0103	0.0103	0.0815	0.0604	mg/L
Molybdenum	—	—	—	—	—	
Nickel	0.0024	0.0024	0.0024	0.0063	0.0052	mg/L
Titanium	—	—	—	—	—	
Vanadium	—	—	—	—	—	
Zinc	0.103	0.103	0.0395	0.0663	0.0083	mg/L
Aeromonas	1,088	1,088	5.60	352.7	2.56	cfu/100 mL
Cryptosporidium	—	—	—	—	—	
E. Coli	2.18	2.18	0.0312	5.49	114.26	cfu/100 mL
Fecal streptococci	36.88	36.88	N/A	24.55	24.55	cfu/100 mL
Salmonella	2.00	2.00	1.87	1.37	1.37	cfu/100 mL
Total coliform	675.7	675.7	45.10	8.73	187.5	cfu/100 mL
cis-Permethrin	—	—	—	—	—	
trans-Permethrin	—	—	—	—	—	

[a] Data for this category were derived using methods described in Section 9.2.3
[b] not available
[c] not applicable

Table C-62. Average Technology Option Concentrations for Poultry First/Further Processing and Rendering (P123)[a] Direct Dischargers

Pollutant of Concern	BAT 1	BAT 2	BAT 3	BAT 4	BAT 5	Units
5-Day biochemical oxygen demand (BOD_5)	2.79	2.79	2.77	18.94	6.61	mg/L
Total suspended solids (TSS)	69.48	69.48	19.81	51.30	36.65	mg/L
Hexane extractable material (HEM)	95.26	95.26	75.65	9.20	9.26	mg/L
Fecal coliform bacteria	1.73	1.73	0.202	4.13	85.90	cfu/100 mL
Ammonia as nitrogen	1.83	1.36	1.36	1.34	1.32	mg/L
Carbaryl	0.00059	0.00059	N/A[b]	0.00127	0.00055	mg/L
Carbonaceous biochemical oxygen demand (CBOD)	2.90	2.90	2.90	12.69	5.77	mg/L
Chemical oxygen demand (COD)	64.31	64.31	59.73	80.17	74.67	mg/L
Chloride	131.4	131.4	N/A	133.7	134.0	mg/L
Dissolved biochemical oxygen demand	4.62	4.62	2.61	13.07	8.17	mg/L
Dissolved phosphorus	1.13	1.13	0.323	0.337	0.648	mg/L
Nitrate-nitrite	22.98	21.81	6.22	1.22	1.39	mg/L
Total nitrogen	77.99	77.99	11.21	5.02	5.54	mg/L
Orthophosphate	0.213	0.213	0.0842	0.0503	0.0280	mg/L
Total dissolved solids (TDS)	1,158	1,158	N/A	1,035	1,045	mg/L
Total Kjeldahl nitrogen (TKN)	3.01	4.18	1.45	6.69	7.25	mg/L
Total organic carbon (TOC)	12.38	12.38	9.14	12.68	13.56	mg/L
Total phosphorus	3.37	3.37	1.29	4.31	3.75	mg/L
Total residual chlorine	—[c]	—	—	—	—	
Volatile Residue	577.0	577.0	383.0	567.7	575.1	mg/L
Barium	0.00600	0.00600	0.0017	0.0189	0.0187	mg/L
Copper	0.00841	0.00841	0.00595	0.00587	0.00129	mg/L
Chromium	—	—	—	—	—	
Manganese	0.00907	0.00907	0.00907	0.06990	0.05186	mg/L
Molybdenum	—	—	—	—	—	
Nickel	0.00282	0.00282	0.00282	0.00733	0.00606	mg/L
Titanium	—	—	—	—	—	
Vanadium	—	—	—	—	—	
Zinc	0.136	0.136	0.0501	0.0872	0.0109	mg/L
Aeromonas	933.0	933.0	4.53	352.6	2.56	cfu/100 mL
Cryptosporidium	—	—	—	—	—	
E. Coli	1.78	1.78	0.0254	4.57	95.00	cfu/100 mL
Fecal streptococci	30.08	30.08	N/A	20.37	20.37	cfu/100 mL
Salmonella	2.00	2.00	1.90	1.11	1.11	cfu/100 mL
Total coliform	570.4	570.4	38.09	7.67	164.6	cfu/100 mL
cis-Permethrin	—	—	—	—	—	
trans-Permethrin	—	—	—	—	—	

[a] Data for this category were derived using methods described in Section 9.2.3
[b] not available
[c] not applicable

Table C-63. Average Technology Option Concentrations for Poultry Further Processing (P2) Direct Dischargers

Pollutant of Concern	BAT 1	BAT 2	BAT 3	BAT 4	BAT 5	Units
5-Day biochemical oxygen demand (BOD_5)	5.91	5.91	5.91	49.73	17.35	mg/L
Total suspended solids (TSS)	290.8	290.8	76.39	215.9	154.2	mg/L
Hexane extractable material (HEM)	29.48	29.48	22.45	2.21	2.23	mg/L
Fecal coliform bacteria	0.140	0.140	0.0110	0.684	14.22	cfu/100 mL
Ammonia as nitrogen	0.518	0.757	0.757	0.763	0.755	mg/L
Carbaryl	N/A[a]	N/A	N/A	N/A	N/A	
Carbonaceous biochemical oxygen demand (CBOD)	5.71	5.71	5.71	28.75	13.07	mg/L
Chemical oxygen demand (COD)	58.14	58.14	58.14	79.87	74.39	mg/L
Chloride	297.3	297.3	297.3	296.0	296.6	mg/L
Dissolved biochemical oxygen demand	4.38	4.38	2.38	12.99	8.12	mg/L
Dissolved phosphorus	3.13	3.13	1.09	1.06	2.03	mg/L
Nitrate-nitrite	6.51	0.938	0.668	0.121	0.138	mg/L
Total nitrogen	110.8	110.8	16.36	13.41	14.80	mg/L
Orthophosphate	0.198	0.198	0.057	0.052	0.029	mg/L
Total dissolved solids (TDS)	1,707	1,707	1,707	1,707	1,707	mg/L
Total Kjeldahl nitrogen (TKN)	0.852	6.42	1.14	11.68	12.66	mg/L
Total organic carbon (TOC)	14.65	14.65	9.44	17.20	18.40	mg/L
Total phosphorus	12.23	12.23	4.81	16.68	14.49	mg/L
Total residual chlorine	—[b]	—	—	—	—	
Volatile Residue	1,723	1,723	1,284	1,802	1,825	mg/L
Barium	0.0101	0.0101	0.0046	0.0204	0.0202	mg/L
Copper	0.0026	0.0026	0.0008	0.0024	0.0005	mg/L
Chromium	—	—	—	—	—	
Manganese	0.0038	0.0038	0.0038	0.0217	0.0161	mg/L
Molybdenum	—	—	—	—	—	
Nickel	0.0046	0.0046	0.0046	0.0118	0.0097	mg/L
Titanium	—	—	—	—	—	
Vanadium	—	—	—	—	—	
Zinc	0.275	0.275	0.094	0.175	0.0218	mg/L
Aeromonas	285.9	285.9	0.068	352.4	2.56	cfu/100 mL
Cryptosporidium	—	—	—	—	—	
E. Coli	0.138	0.138	0.0013	0.706	14.69	cfu/100 mL
Fecal streptococci	1.73	1.73	0.386	2.95	2.95	cfu/100 mL
Salmonella	2.00	2.00	2.00	0.0071	0.0071	cfu/100 mL
Total coliform	131.7	131.7	8.88	3.23	69.31	cfu/100 mL
cis-Permethrin	—	—	—	—	—	
trans-Permethrin	—	—	—	—	—	

[a] not available
[b] not applicable

Table C-64. Average Technology Option Concentrations for Poultry Further Processing and Rendering (P23)[a] Direct Dischargers

Pollutant of Concern	BAT 1	BAT 2	BAT 3	BAT 4	BAT 5	Units
5-Day biochemical oxygen demand (BOD_5)	3.77	3.77	3.77	31.73	11.07	mg/L
Total suspended solids (TSS)	145.3	145.3	38.17	107.9	77.06	mg/L
Hexane extractable material (HEM)	183.9	183.9	140.1	13.82	13.90	mg/L
Fecal coliform bacteria	1.39	1.39	0.11	6.77	140.7	cfu/100 mL
Ammonia as nitrogen	1.59	2.72	2.72	2.74	2.71	mg/L
Carbaryl	0.00008	0.00008	N/A [b]	0.000004	0.000002	mg/L
Carbonaceous biochemical oxygen demand (CBOD)	4.02	4.02	4.02	20.22	9.19	mg/L
Chemical oxygen demand (COD)	112.2	112.2	112.2	154.1	143.6	mg/L
Chloride	186.2	186.2	186.2	185.4	185.8	mg/L
Dissolved biochemical oxygen demand	7.86	7.86	4.28	23.31	14.57	mg/L
Dissolved phosphorus	2.06	2.06	0.715	0.693	1.33	mg/L
Nitrate-nitrite	19.97	15.16	10.80	1.96	2.23	mg/L
Total nitrogen	138.94	138.94	20.53	8.98	9.91	mg/L
Orthophosphate	0.342	0.342	0.099	0.0903	0.0502	mg/L
Total dissolved solids (TDS)	1,574	1,574	1,574	1,574	1,574	mg/L
Total Kjeldahl nitrogen (TKN)	2.61	7.42	1.32	13.49	14.62	mg/L
Total organic carbon (TOC)	20.45	20.45	13.18	24.01	25.69	mg/L
Total phosphorus	6.65	6.65	2.61	9.07	7.87	mg/L
Total residual chlorine	— [c]	—	—	—	—	
Volatile Residue	1,070	1,070	797.2	1,119	1,134	mg/L
Barium	0.0079	0.0079	0.0036	0.0159	0.0158	mg/L
Copper	0.0080	0.0080	0.0025	0.0075	0.0016	mg/L
Chromium	—	—	—	—	—	
Manganese	0.0111	0.0111	0.0111	0.0645	0.0478	mg/L
Molybdenum	—	—	—	—	—	
Nickel	0.0050	0.0050	0.0050	0.0128	0.0106	mg/L
Titanium	—	—	—	—	—	
Vanadium	—	—	—	—	—	
Zinc	0.210	0.210	0.0718	0.133	0.0166	mg/L
Aeromonas	169.7	169.7	0.0405	209.11	1.52	cfu/100 mL
Cryptosporidium	—	—	—	—	—	
E. Coli	1.51	1.51	0.0146	7.74	161.1	cfu/100 mL
Fecal streptococci	25.23	25.23	5.63	43.10	43.10	cfu/100 mL
Salmonella	2.00	2.00	2.00	0.0071	0.0071	cfu/100 mL
Total coliform	507.8	507.8	34.27	12.45	267.3	cfu/100 mL
cis-Permethrin	—	—	—	—	—	
trans-Permethrin	—	—	—	—	—	

[a] Data for this category were derived using methods described in Section 9.2.3
[b] not available
[c] not applicable

Table C-65. Average Technology Option Concentrations for Poultry First Processing (P1) Indirect Dischargers

Pollutant of Concern	PSES 1	PSES 2	PSES 3	PSES 4	Units
5-Day biochemical oxygen demand (BOD_5)	152.4	2.00	1.96	8.60	mg/L
Total suspended solids (TSS)	N/A [a]	8.20	4.98	5.60	mg/L
Hexane extractable material (HEM)	24.36	23.60	23.60	5.47	mg/L
Fecal coliform bacteria	1,341,534	79,280	801,150	801,150	cfu/100 mL
Ammonia as nitrogen	7.52	0.258	0.258	0.202	mg/L
Carbaryl	N/A	0.0010	N/A	0.0023	mg/L
Carbonaceous biochemical oxygen demand (CBOD)	193.4	2.00	2.00	6.60	mg/L
Chemical oxygen demand (COD)	355.8	25.60	17.33	20.40	mg/L
Chloride	53.95	87.20	N/A	92.00	mg/L
Dissolved biochemical oxygen demand	55.53	2.00	1.26	4.80	mg/L
Dissolved phosphorus	0.0928	0.38	0.0074	0.0500	mg/L
Nitrate-nitrite	0.273	27.18	2.51	0.63	mg/L
Total nitrogen	30.61	28.74	3.68	1.82	mg/L
Orthophosphate	2.76	0.108	0.0723	0.0180	mg/L
Total dissolved solids (TDS)	458.5	822.4	N/A	600.0	mg/L
Total Kjeldahl nitrogen (TKN)	30.24	1.56	1.56	1.19	mg/L
Total organic carbon (TOC)	87.86	5.86	5.86	3.52	mg/L
Total phosphorus	6.96	0.722	0.220	0.472	mg/L
Total residual chlorine	— [b]	—	—	—	
Volatile Residue	68.76	178.8	48.42	122.40	mg/L
Barium	0.0108	0.0044	0.0002	0.0213	mg/L
Copper	0.0285	0.0088	0.0088	0.0046	mg/L
Chromium	—	—	—	—	
Manganese	0.1065	0.0074	0.0074	0.0743	mg/L
Molybdenum	—	—	—	—	
Nickel	0.0040	0.0010	0.0010	0.0029	mg/L
Titanium	—	—	—	—	
Vanadium	—	—	—	—	
Zinc	0.0291	0.0769	0.0325	0.0500	mg/L
Aeromonas	190,767	65,085	192,500	192,500	cfu/100 mL
Cryptosporidium	—	—	—	—	
E. Coli	1,331,004	66,480	801,150	801,150	cfu/100 mL
Fecal streptococci	5,867	1,980	3,650	3,650	cfu/100 mL
Salmonella	1.60	111.2	2.00	2.00	cfu/100 mL
Total coliform	1,259,454	163,280	801,150	801,150	cfu/100 mL
cis-Permethrin	—	—	—	—	
trans-Permethrin	—	—	—	—	

[a] not available
[b] not applicable

Table C-66. Average Technology Option Concentrations for Poultry First/Further Processing (P12)[a] Indirect Dischargers

Pollutant of Concern	PSES 1	PSES 2	PSES 3	PSES 4	Units
5-Day biochemical oxygen demand (BOD_5)	258.5	3.01	2.99	19.26	mg/L
Total suspended solids (TSS)	612.2	81.46	23.49	60.10	mg/L
Hexane extractable material (HEM)	34.02	25.12	23.30	4.62	mg/L
Fecal coliform bacteria	1,005,165	79,280	801,150	801,150	cfu/100 mL
Ammonia as nitrogen	10.55	0.387	0.387	0.347	mg/L
Carbaryl	N/A [b]	0.00074	N/A	0.0017	mg/L
Carbonaceous biochemical oxygen demand (CBOD)	260.5	2.96	2.96	12.34	mg/L
Chemical oxygen demand (COD)	436.2	34.04	27.91	35.81	mg/L
Chloride	117.0	141.6	N/A	144.9	mg/L
Dissolved biochemical oxygen demand	64.83	2.62	1.55	6.92	mg/L
Dissolved phosphorus	5.28	1.09	0.288	0.311	mg/L
Nitrate-nitrite	0.445	20.38	2.03	0.495	mg/L
Total nitrogen	32.98	50.00	6.97	4.82	mg/L
Orthophosphate	3.52	0.131	0.0684	0.0269	mg/L
Total dissolved solids (TDS)	667.1	1,052	N/A	886.8	mg/L
Total Kjeldahl nitrogen (TKN)	32.25	2.82	1.45	3.91	mg/L
Total organic carbon (TOC)	85.71	8.14	6.79	7.07	mg/L
Total phosphorus	21.77	3.71	1.41	4.67	mg/L
Total residual chlorine	— [c]	—	—	—	
Volatile Residue	798.4	579.0	368.6	557.6	mg/L
Barium	0.0114	0.0059	0.0013	0.0211	mg/L
Copper	0.0229	0.0072	0.0067	0.0040	mg/L
Chromium	—	—	—	—	
Manganese	0.0814	0.0065	0.0065	0.0607	mg/L
Molybdenum	—	—	—	—	
Nickel	0.0052	0.0020	0.0020	0.0052	mg/L
Titanium	—	—	—	—	
Vanadium	—	—	—	—	
Zinc	0.141	0.128	0.0484	0.0823	mg/L
Aeromonas	180,978	65,085	192,500	192,500	cfu/100 mL
Cryptosporidium	—	—	—	—	
E. Coli	1,000,319	66,480	801,150	801,150	cfu/100 mL
Fecal streptococci	4,467	1,980	3,650	3,650	cfu/100 mL
Salmonella	1.71	111.2	2.00	2.00	cfu/100 mL
Total coliform	967,397	163,280	801,150	801,150	cfu/100 mL
cis-Permethrin	—	—	—	—	
trans-Permethrin	—	—	—	—	

[a] Data for this category were derived using methods described in Section 9.2.3
[b] not available
[c] not applicable

Table C-67. Average Technology Option Concentrations for Poultry First Processing and Rendering (P13)[a] Indirect Dischargers

Pollutant of Concern	PSES 1	PSES 2	PSES 3	PSES 4	Units
5-Day biochemical oxygen demand (BOD_5)	105.2	2.04	2.02	11.56	mg/L
Total suspended solids (TSS)	6.74	16.41	6.25	11.85	mg/L
Hexane extractable material (HEM)	111.6	111.0	88.41	10.87	mg/L
Fecal coliform bacteria	944,808	79,280	801,150	801,150	cfu/100 mL
Ammonia as nitrogen	6.48	1.50	1.50	1.47	mg/L
Carbaryl	N/A [b]	0.00073	N/A	0.0016	mg/L
Carbonaceous biochemical oxygen demand (CBOD)	133.4	2.23	2.23	8.84	mg/L
Chemical oxygen demand (COD)	292.2	65.79	60.12	80.25	mg/L
Chloride	68.86	91.66	N/A	94.82	mg/L
Dissolved biochemical oxygen demand	41.38	4.67	2.66	13.10	mg/L
Dissolved phosphorus	0.451	0.647	0.140	0.165	mg/L
Nitrate-nitrite	8.37	26.82	7.55	1.49	mg/L
Total nitrogen	71.42	70.14	9.97	3.00	mg/L
Orthophosphate	2.04	0.22	0.0907	0.0499	mg/L
Total dissolved solids (TDS)	777.0	1026.57	N/A	874.1	mg/L
Total Kjeldahl nitrogen (TKN)	23.31	3.64	1.53	5.49	mg/L
Total organic carbon (TOC)	68.06	11.84	9.06	11.59	mg/L
Total phosphorus	5.52	1.25	0.446	1.35	mg/L
Total residual chlorine	— [c]	—	—	—	
Volatile Residue	226.9	302.3	167.1	271.9	mg/L
Barium	0.0094	0.0050	0.0010	0.0186	mg/L
Copper	0.0234	0.0098	0.0072	0.0067	mg/L
Chromium	—	—	—	—	
Manganese	0.0783	0.0103	0.0103	0.0815	mg/L
Molybdenum	—	—	—	—	
Nickel	0.0044	0.0024	0.0024	0.0063	mg/L
Titanium	—	—	—	—	
Vanadium	—	—	—	—	
Zinc	0.0703	0.103	0.0395	0.0663	mg/L
Aeromonas	151,265	65,085	192,500	192,500	cfu/100 mL
Cryptosporidium	—	—	—	—	
E. Coli	933,564	66,480	801,150	801,150	cfu/100 mL
Fecal streptococci	4,645	1,980	3,650	3,650	cfu/100 mL
Salmonella	36.05	111.2	2.00	2.00	cfu/100 mL
Total coliform	914,926	163,280	801,150	801,150	cfu/100 mL
cis-Permethrin	—	—	—	—	
trans-Permethrin	—	—	—	—	

[a] Data for this category were derived using methods described in Section 9.2.3
[b] not available
[c] not applicable

Table C-68. Average Technology Option Concentrations for Poultry First/Further Processing and Rendering (P123)[a] Indirect Dischargers

Pollutant of Concern	PSES 1	PSES 2	PSES 3	PSES 4	Units
5-Day biochemical oxygen demand (BOD_5)	193.4	2.79	2.77	18.94	mg/L
Total suspended solids (TSS)	465.5	69.48	19.81	51.30	mg/L
Hexane extractable material (HEM)	101.9	95.26	75.65	9.20	mg/L
Fecal coliform bacteria	770,439	79,272	801,070	801,070	cfu/100 mL
Ammonia as nitrogen	8.95	1.36	1.36	1.34	mg/L
Carbaryl	N/A [b]	0.00059	N/A	0.0013	mg/L
Carbonaceous biochemical oxygen demand (CBOD)	195.1	2.90	2.90	12.69	mg/L
Chemical oxygen demand (COD)	364.4	64.31	59.73	80.17	mg/L
Chloride	113.0	131.4	N/A	133.7	mg/L
Dissolved biochemical oxygen demand	51.05	4.62	2.61	13.07	mg/L
Dissolved phosphorus	4.25	1.13	0.323	0.337	mg/L
Nitrate-nitrite	6.93	21.81	6.22	1.22	mg/L
Total nitrogen	65.29	77.99	11.21	5.02	mg/L
Orthophosphate	2.74	0.213	0.0842	0.0503	mg/L
Total dissolved solids (TDS)	871.0	1,158	N/A	1,035	mg/L
Total Kjeldahl nitrogen (TKN)	26.14	4.18	1.45	6.69	mg/L
Total organic carbon (TOC)	70.28	12.38	9.14	12.68	mg/L
Total phosphorus	16.85	3.37	1.29	4.31	mg/L
Total residual chlorine	— [c]	—	—	—	
Volatile Residue	740.7	577.0	383.0	567.7	mg/L
Barium	0.0101	0.0060	0.0017	0.0189	mg/L
Copper	0.0202	0.0084	0.0059	0.0059	mg/L
Chromium	—	—	—	—	
Manganese	0.0650	0.0091	0.0091	0.0699	mg/L
Molybdenum	—	—	—	—	
Nickel	0.0052	0.0028	0.0028	0.0073	mg/L
Titanium	—	—	—	—	
Vanadium	—	—	—	—	
Zinc	0.146	0.136	0.0501	0.0872	mg/L
Aeromonas	151,584	65,079	192,481	192,481	cfu/100 mL
Cryptosporidium	—	—	—	—	
E. Coli	763,576	66,473	801,070	801,070	cfu/100 mL
Fecal streptococci	3,836	1,980	3,650	3,650	cfu/100 mL
Salmonella	29.46	111.2	2.00	2.00	cfu/100 mL
Total coliform	763,532	163,264	801,070	801,070	cfu/100 mL
cis-Permethrin	—	—	—	—	
trans-Permethrin	—	—	—	—	

[a] Data for this category were derived using methods described in Section 9.2.3
[b] not available
[c] not applicable

Table C-69. Average Technology Option Concentrations for Poultry Further Processing (P2) Indirect Dischargers

Pollutant of Concern	PSES 1	PSES 2	PSES 3	PSES 4	Units
5-Day biochemical oxygen demand (BOD_5)	561.6	5.91	5.91	49.73	mg/L
Total suspended solids (TSS)	2,379	290.8	76.39	215.9	mg/L
Hexane extractable material (HEM)	61.62	29.48	22.45	2.21	mg/L
Fecal coliform bacteria	43,813	79,280	801,150	801,150	cfu/100 mL
Ammonia as nitrogen	19.23	0.757	0.757	0.763	mg/L
Carbaryl	N/A [a]	N/A	N/A	N/A	
Carbonaceous biochemical oxygen demand (CBOD)	452.3	5.71	5.71	28.75	mg/L
Chemical oxygen demand (COD)	665.9	58.14	58.14	79.87	mg/L
Chloride	297.3	297.3	297.3	296.0	mg/L
Dissolved biochemical oxygen demand	91.38	4.38	2.38	12.99	mg/L
Dissolved phosphorus	20.10	3.13	1.09	1.06	mg/L
Nitrate-nitrite	0.938	0.938	0.668	0.121	mg/L
Total nitrogen	39.75	110.76	16.36	13.41	mg/L
Orthophosphate	5.67	0.198	0.0572	0.0522	mg/L
Total dissolved solids (TDS)	1,263	1,707	1,707	1,707	mg/L
Total Kjeldahl nitrogen (TKN)	37.97	6.42	1.14	11.68	mg/L
Total organic carbon (TOC)	79.57	14.65	9.44	17.20	mg/L
Total phosphorus	64.10	12.23	4.81	16.68	mg/L
Total residual chlorine	— [b]	—	—	—	
Volatile Residue	2,884	1,723	1,284	1,802	mg/L
Barium	0.0131	0.0101	0.0046	0.0204	mg/L
Copper	0.0068	0.0026	0.0008	0.0024	mg/L
Chromium	—	—	—	—	
Manganese	0.0098	0.0038	0.0038	0.0217	mg/L
Molybdenum	—	—	—	—	
Nickel	0.0085	0.0046	0.0046	0.0118	mg/L
Titanium	—	—	—	—	
Vanadium	—	—	—	—	
Zinc	0.460	0.275	0.0941	0.175	mg/L
Aeromonas	153,000	65,085	192,500	192,500	cfu/100 mL
Cryptosporidium	—	—	—	—	
E. Coli	55,215	66,480	801,150	801,150	cfu/100 mL
Fecal streptococci	464.7	1,980	3,650	3,650	cfu/100 mL
Salmonella	2.00	111.2	2.00	2.00	cfu/100 mL
Total coliform	132,690	163,280	801,150	801,150	cfu/100 mL
cis-Permethrin	—	—	—	—	
trans-Permethrin	—	—	—	—	

[a] not available
[b] not applicable

Table C-70. Average Technology Option Concentrations for Poultry Further Processing and Rendering (P23)[a] Indirect Dischargers

Pollutant of Concern	PSES 1	PSES 2	PSES 3	PSES 4	Units
5-Day biochemical oxygen demand (BOD_5)	244.3	3.77	3.77	31.73	mg/L
Total suspended solids (TSS)	1,049	145.3	38.17	107.9	mg/L
Hexane extractable material (HEM)	197.9	183.9	140.1	13.82	mg/L
Fecal coliform bacteria	63,930	79,280	801,150	801,150	cfu/100 mL
Ammonia as nitrogen	10.71	2.72	2.72	2.74	mg/L
Carbaryl	N/A [b]	0.000076	N/A	0.000004	mg/L
Carbonaceous biochemical oxygen demand (CBOD)	197.3	4.02	4.02	20.22	mg/L
Chemical oxygen demand (COD)	375.3	112.2	112.2	154.1	mg/L
Chloride	186.2	186.2	186.2	185.4	mg/L
Dissolved biochemical oxygen demand	45.51	7.86	4.28	23.31	mg/L
Dissolved phosphorus	9.40	2.06	0.715	0.693	mg/L
Nitrate-nitrite	15.16	15.16	10.80	1.96	mg/L
Total nitrogen	108.2	138.9	20.53	8.98	mg/L
Orthophosphate	2.71	0.342	0.0990	0.0903	mg/L
Total dissolved solids (TDS)	1,382	1,574	1,574	1,574	mg/L
Total Kjeldahl nitrogen (TKN)	21.07	7.42	1.32	13.49	mg/L
Total organic carbon (TOC)	48.55	20.45	13.18	24.01	mg/L
Total phosphorus	29.10	6.65	2.61	9.07	mg/L
Total residual chlorine	— [c]	—	—	—	
Volatile Residue	1,573	1,070	797.2	1,119	mg/L
Barium	0.0092	0.0079	0.0036	0.0159	mg/L
Copper	0.0098	0.0080	0.0025	0.0075	mg/L
Chromium	—	—	—	—	
Manganese	0.0137	0.0111	0.0111	0.0645	mg/L
Molybdenum	—	—	—	—	
Nickel	0.0067	0.0050	0.0050	0.0128	mg/L
Titanium	—	—	—	—	
Vanadium	—	—	—	—	
Zinc	0.290	0.210	0.0718	0.133	mg/L
Aeromonas	103,135	65,085	192,500	192,500	cfu/100 mL
Cryptosporidium	—	—	—	—	
E. Coli	61,605	66,480	801,150	801,150	cfu/100 mL
Fecal streptococci	1,324	1,980	3,650	3,650	cfu/100 mL
Salmonella	63.94	111.2	2.00	2.00	cfu/100 mL
Total coliform	150,041	163,280	801,150	801,150	cfu/100 mL
cis-Permethrin	—	—	—	—	
trans-Permethrin	—	—	—	—	

[a] Data for this category were derived using methods described in Section 9.2.3
[b] not available
[c] not applicable

Table C-71. Average Technology Option Concentrations for Mixed Meat/Poultry Further Processing (M2)[a] Direct Dischargers

Pollutant of Concern	BAT 1	BAT 2	BAT 3	BAT 4	Units
5-Day biochemical oxygen demand (BOD_5)	4.40	4.40	4.51	26.42	mg/L
Total suspended solids (TSS)	147.2	147.2	38.65	108.4	mg/L
Hexane extractable material (HEM)	16.56	16.56	12.61	1.24	mg/L
Fecal coliform bacteria	81.25	81.25	6.39	6.73	cfu/100 mL
Ammonia as nitrogen	0.291	0.470	0.484	0.487	mg/L
Carbaryl	N/A [b]	N/A	N/A	N/A	
Carbonaceous biochemical oxygen demand (CBOD)	3.82	3.82	5.47	16.99	mg/L
Chemical oxygen demand (COD)	37.15	37.15	37.76	48.63	mg/L
Chloride	2,624	2,624	3,486	3,471	mg/L
Dissolved biochemical oxygen demand	5.48	5.48	2.99	8.29	mg/L
Dissolved phosphorus	15.14	15.14	5.26	5.11	mg/L
Nitrate-nitrite	4.78	1.53	1.09	N/A	mg/L
Total nitrogen	57.98	57.98	8.57	7.02	mg/L
Orthophosphate	4.68	4.68	1.35	1.24	mg/L
Total dissolved solids (TDS)	4,255	4,255	4,972	4,972	mg/L
Total Kjeldahl nitrogen (TKN)	0.471	3.72	0.663	5.93	mg/L
Total organic carbon (TOC)	16.86	16.86	10.87	14.74	mg/L
Total phosphorus	16.59	16.59	6.52	12.46	mg/L
Total residual chlorine	2.01	2.01	2.06	2.06	mg/L
Volatile Residue	963.3	963.3	717.8	976.8	mg/L
Barium	0.0106	0.0106	0.0048	0.0127	mg/L
Copper	0.0024	0.0024	0.00074	0.0015	mg/L
Chromium	0.0122	0.0122	0.0125	0.0075	mg/L
Manganese	0.0025	0.0025	0.0034	0.0124	mg/L
Molybdenum	0.0070	0.0070	0.0084	0.0086	mg/L
Nickel	0.0027	0.0027	0.0046	0.0082	mg/L
Titanium	0.00086	0.00086	0.00092	0.0013	mg/L
Vanadium	0.0011	0.0011	0.00050	0.00076	mg/L
Zinc	0.145	0.145	0.0496	0.0898	mg/L
Aeromonas	1,853	1,853	0.442	176.6	cfu/100 mL
Cryptosporidium	N/A	N/A	N/A	N/A	
E. Coli	75.81	75.81	0.730	1.08	cfu/100 mL
Fecal streptococci	19.81	19.81	4.42	5.70	cfu/100 mL
Salmonella	1.61	1.61	2.00	0.0071	cfu/100 mL
Total coliform	225.1	225.1	15.19	5.52	cfu/100 mL
cis-Permethrin	N/A	N/A	N/A	N/A	
trans-Permethrin	N/A	N/A	N/A	N/A	

[a] Data for this category were derived using methods described in Section 9.2.3
[b] not available

Table C-72. Average Technology Option Concentrations for Mixed Meat/Poultry Further Processing (M2)[a] Indirect Dischargers

Pollutant of Concern	PSES 1	PSES 2	PSES 3	PSES 4	Units
5-Day biochemical oxygen demand (BOD_5)	708.1	4.40	4.51	26.42	mg/L
Total suspended solids (TSS)	1,219	147.2	38.65	108.4	mg/L
Hexane extractable material (HEM)	34.61	16.56	12.61	1.24	mg/L
Fecal coliform bacteria	361,375	379,108	404,239	404,239	cfu/100 mL
Ammonia as nitrogen	17.02	0.470	0.484	0.487	mg/L
Carbaryl	N/A [b]	N/A	N/A	N/A	
Carbonaceous biochemical oxygen demand (CBOD)	612.2	3.82	5.47	16.99	mg/L
Chemical oxygen demand (COD)	915.1	37.15	37.76	48.63	mg/L
Chloride	3,486	2,624	3,486	3,471	mg/L
Dissolved biochemical oxygen demand	543.3	5.48	2.99	8.29	mg/L
Dissolved phosphorus	31.06	15.14	5.26	5.11	mg/L
Nitrate-nitrite	N/A	N/A	N/A	N/A	
Total nitrogen	26.97	57.98	8.57	7.02	mg/L
Orthophosphate	6.91	4.68	1.35	1.24	mg/L
Total dissolved solids (TDS)	4,751	4,255	4,972	4,972	mg/L
Total Kjeldahl nitrogen (TKN)	25.71	3.72	0.663	5.93	mg/L
Total organic carbon (TOC)	293.4	16.86	10.87	14.74	mg/L
Total phosphorus	51.37	16.59	6.52	12.46	mg/L
Total residual chlorine	1.95	2.01	2.06	2.06	mg/L
Volatile Residue	1,757	963.3	717.8	976.8	mg/L
Barium	0.0111	0.0106	0.0048	0.0127	mg/L
Copper	0.0070	0.0024	0.00074	0.0015	mg/L
Chromium	0.0053	0.0122	0.0125	0.0075	mg/L
Manganese	0.0195	0.0025	0.0034	0.0124	mg/L
Molybdenum	0.0054	0.0070	0.0084	0.0086	mg/L
Nickel	0.0076	0.0027	0.0046	0.0082	mg/L
Titanium	0.0012	0.0009	0.00092	0.0013	mg/L
Vanadium	0.00082	0.0011	0.00050	0.00076	mg/L
Zinc	0.244	0.145	0.0496	0.0898	mg/L
Aeromonas	219,399	175,442	121,750	121,750	cfu/100 mL
Cryptosporidium	N/A	N/A	N/A	N/A	
E. Coli	418,076	423,709	403,744	403,744	cfu/100 mL
Fecal streptococci	632,184	632,941	1,828	1,828	cfu/100 mL
Salmonella	2.00	56.60	2.00	2.00	cfu/100 mL
Total coliform	647,345	662,640	404,239	404,239	cfu/100 mL
cis-Permethrin	N/A	N/A	N/A	N/A	
trans-Permethrin	N/A	N/A	N/A	N/A	

[a] Data for this category were derived using methods described in Section 9.2.3
[b] not available

Table C-73. Average Technology Option Concentrations for Mixed Meat/Poultry Further Processing and Rendering (M23)[a] Indirect Dischargers

Pollutant of Concern	PSES 1	PSES 2	PSES 3	PSES 4	Units
5-Day biochemical oxygen demand (BOD_5)	892.2	4.49	4.69	18.67	mg/L
Total suspended solids (TSS)	574.1	75.55	19.84	54.69	mg/L
Hexane extractable material (HEM)	105.1	94.92	72.27	7.13	mg/L
Fecal coliform bacteria	457,538	465,213	404,239	404,239	cfu/100 mL
Ammonia as nitrogen	33.94	1.71	1.77	1.78	mg/L
Carbaryl	N/A [b]	N/A	N/A	N/A	
Carbonaceous biochemical oxygen demand (CBOD)	721.9	3.57	6.23	14.34	mg/L
Chemical oxygen demand (COD)	1,138	69.31	70.30	91.27	mg/L
Chloride	1,819	1,373	1,819	1,811	mg/L
Dissolved biochemical oxygen demand	745.3	8.71	4.75	14.26	mg/L
Dissolved phosphorus	18.99	10.26	3.57	3.46	mg/L
Nitrate-nitrite	N/A	N/A	N/A	N/A	
Total nitrogen	77.22	77.95	11.52	4.90	mg/L
Orthophosphate	5.71	5.07	1.47	1.34	mg/L
Total dissolved solids (TDS)	3,354	2,987	3,450	3,450	mg/L
Total Kjeldahl nitrogen (TKN)	34.02	5.50	0.979	7.06	mg/L
Total organic carbon (TOC)	466.7	26.85	17.31	22.72	mg/L
Total phosphorus	27.97	10.60	4.17	7.39	mg/L
Total residual chlorine	0.912	1.00	1.06	1.06	mg/L
Volatile Residue	1,130	646.1	481.4	642.3	mg/L
Barium	0.0077	0.0077	0.0035	0.0097	mg/L
Copper	0.0093	0.0053	0.0017	0.0042	mg/L
Chromium	0.0047	0.0072	0.0075	0.0045	mg/L
Manganese	0.0599	0.0079	0.0111	0.0378	mg/L
Molybdenum	0.0041	0.0049	0.0057	0.0059	mg/L
Nickel	0.0064	0.0028	0.0046	0.0085	mg/L
Titanium	0.0061	0.0058	0.0059	0.0090	mg/L
Vanadium	0.0172	0.0174	0.0080	0.0149	mg/L
Zinc	0.159	0.112	0.0384	0.0691	mg/L
Aeromonas	154,796	135,772	121,750	121,750	cfu/100 mL
Cryptosporidium	N/A	N/A	N/A	N/A	
E. Coli	432,499	434,936	403,744	403,744	cfu/100 mL
Fecal streptococci	663,106	663,434	1,828	1,828	cfu/100 mL
Salmonella	32.97	56.60	2.00	2.00	cfu/100 mL
Total coliform	589,021	595,641	404,239	404,239	cfu/100 mL
cis-Permethrin	N/A	N/A	N/A	N/A	
trans-Permethrin	N/A	N/A	N/A	N/A	

[a] Data for this category were derived using methods described in Section 9.2.3
[b] not available

Table C-74. Average Technology Option Concentrations for Rendering (REND)[a] Direct Dischargers

Pollutant of Concern	BAT 1	BAT 2	BAT 3	BAT 4	Units
5-Day biochemical oxygen demand (BOD5)	4.82	4.82	5.10	13.03	mg/L
Total suspended solids (TSS)	21.17	21.17	5.56	13.79	mg/L
Hexane extractable material (HEM)	155.0	155.0	118.0	11.64	mg/L
Fecal coliform bacteria	123.3	123.3	9.70	15.31	cfu/100 mL
Ammonia as nitrogen	1.27	2.72	2.81	2.83	mg/L
Carbaryl	N/A [b]	N/A	N/A	N/A	
Carbonaceous biochemical oxygen demand (CBOD)	3.51	3.51	7.18	12.67	mg/L
Chemical oxygen demand (COD)	94.99	94.99	96.37	125.0	mg/L
Chloride	150.5	150.5	185.2	184.4	mg/L
Dissolved biochemical oxygen demand	11.51	11.51	6.27	19.00	mg/L
Dissolved phosphorus	5.56	5.56	1.93	1.88	mg/L
Nitrate-nitrite	18.31	13.25	9.44	1.71	mg/L
Total nitrogen	94.51	94.51	13.96	3.30	mg/L
Orthophosphate	5.43	5.43	1.57	1.43	mg/L
Total dissolved solids (TDS)	1,749	1,749	1,963	1,963	mg/L
Total Kjeldahl nitrogen (TKN)	2.07	7.13	1.27	7.98	mg/L
Total organic carbon (TOC)	36.07	36.07	23.26	29.84	mg/L
Total phosphorus	5.32	5.32	2.09	3.25	mg/L
Total residual chlorine	0.230	0.230	0.300	0.300	mg/L
Volatile Residue	406.1	406.1	302.6	388.6	mg/L
Barium	0.0051	0.0051	0.0023	0.0072	mg/L
Copper	0.0076	0.0076	0.0024	0.0062	mg/L
Chromium	0.0034	0.0034	0.0036	0.0021	mg/L
Manganese	0.0123	0.0123	0.0179	0.0580	mg/L
Molybdenum	0.0031	0.0031	0.0033	0.0034	mg/L
Nickel	0.0030	0.0030	0.0046	0.0088	mg/L
Titanium	0.0096	0.0096	0.0098	0.0149	mg/L
Vanadium	0.0299	0.0299	0.0137	0.0257	mg/L
Zinc	0.0873	0.0873	0.0299	0.0534	mg/L
Aeromonas	806.9	806.9	0.193	50.08	cfu/100 mL
Cryptosporidium	N/A	N/A	N/A	N/A	
E. Coli	81.35	81.35	0.783	7.33	cfu/100 mL
Fecal streptococci	42.35	42.35	9.44	41.50	cfu/100 mL
Salmonella	1.61	1.61	2.00	0.0071	cfu/100 mL
Total coliform	520.2	520.2	35.10	12.75	cfu/100 mL
cis-Permethrin	N/A	N/A	N/A	N/A	
trans-Permethrin	N/A	N/A	N/A	N/A	

[a] Data for this category were derived using methods described in Section 9.2.3
[b] not available

Table C-75. Average Technology Option Concentrations for Rendering Only (REND)[a] Indirect Dischargers

Pollutant of Concern	PSES 1	PSES 2	PSES 3	PSES 4	Units
5-Day biochemical oxygen demand (BOD_5)	1,109	4.82	5.10	13.03	mg/L
Total suspended solids (TSS)	86.10	21.17	5.56	13.79	mg/L
Hexane extractable material (HEM)	159.3	155.0	118.0	11.64	mg/L
Fecal coliform bacteria	550,222	550,222	404,239	404,239	cfu/100 mL
Ammonia as nitrogen	51.60	2.72	2.81	2.83	mg/L
Carbaryl	N/A [b]	N/A	N/A	N/A	
Carbonaceous biochemical oxygen demand (CBOD)	858.9	3.51	7.18	12.67	mg/L
Chemical oxygen demand (COD)	1,391	94.99	96.37	125.0	mg/L
Chloride	185.2	150.5	185.2	184.4	mg/L
Dissolved biochemical oxygen demand	950.0	11.51	6.27	19.00	mg/L
Dissolved phosphorus	8.27	5.56	1.93	1.88	mg/L
Nitrate-nitrite	13.01	13.25	9.44	1.71	mg/L
Total nitrogen	119.2	94.51	13.96	3.30	mg/L
Orthophosphate	4.85	5.43	1.57	1.43	mg/L
Total dissolved solids (TDS)	1,963	1,749	1,963	1,963	mg/L
Total Kjeldahl nitrogen (TKN)	44.12	7.13	1.27	7.98	mg/L
Total organic carbon (TOC)	641.20	36.07	23.26	29.84	mg/L
Total phosphorus	8.80	5.32	2.09	3.25	mg/L
Total residual chlorine	0.124	0.230	0.300	0.300	mg/L
Volatile Residue	657.2	406.1	302.6	388.6	mg/L
Barium	0.0047	0.0051	0.0023	0.0072	mg/L
Copper	0.0112	0.0076	0.0024	0.0062	mg/L
Chromium	0.0041	0.0034	0.0036	0.0021	mg/L
Manganese	0.099	0.0123	0.0179	0.0580	mg/L
Molybdenum	0.0030	0.0031	0.0033	0.0034	mg/L
Nickel	0.0055	0.0030	0.0046	0.0088	mg/L
Titanium	0.0098	0.0096	0.0098	0.0149	mg/L
Vanadium	0.0296	0.0299	0.0137	0.0257	mg/L
Zinc	0.0937	0.0873	0.0299	0.0534	mg/L
Aeromonas	96,606	96,606	121,750	121,750	cfu/100 mL
Cryptosporidium	N/A	N/A	N/A	N/A	
E. Coli	446,021	446,021	403,744	403,744	cfu/100 mL
Fecal streptococci	693,540	693,540	1,828	1,828	cfu/100 mL
Salmonella	56.60	56.60	2.00	2.00	cfu/100 mL
Total coliform	529,494	529,494	404,239	404,239	cfu/100 mL
cis-Permethrin	N/A	N/A	N/A	N/A	
trans-Permethrin	N/A	N/A	N/A	N/A	

[a] Data for this category were derived using methods described in Section 9.2.3

[b] not available

APPENDIX D

INPUT VALUES TO ESTIMATE ENERGY USAGE AND SLUDGE GENERATION

ENERGY USAGE INPUT VALUES

Number of MPP Facilities

40 CFR 432 Subcategory Groupings	Facility Size			
	Small		Non small	
	Direct	Indirect	Direct	Indirect
A, B, C, D	59	1003	82	70
E, F, G, H, I	48	2940	19	234
J	6	17	21	75
K	0	39	104	143
L	4	568	16	209

Data from EPA 1999 Screener Survey

Energy Usage[a] for Non Small Direct Dischargers per Treatment Option

40 CFR 432Subcategory Groupings	BAT2	BAT3	BAT4	BAT5
A, B, C, D	316,332,807	238,067,261	226,294,728	NA[b]
E, F, G, H, I	7,826,280	7,338,834	7,119,912	NA
J	9,930,289	4,859,038	4,450,288	NA
K	166,178,474	100,648,346	102,658,500	103,106,497
L	4,901,141	3,125,891	3,116,588	2,437,379

[a] Units are in kWH/yr
[b] Not applicable
Estimated using CAPDET

Energy Usage[a] for Non Small Indirect Discharges per Treatment Option

40 CFR 432 Subcategory Groupings	PSES1	PSES2	PSES3	PSES4
A, B, C, D	299,309,503	599,067,236	424,113,474	393,228,477
E, F, G, H, I	147,626,497	259,816,154	198,576,619	192,326,157
J	71,418,737	104,225,644	70,057,246	65,496,995
K	404,909,080	766,707,568	518,761,087	500,079,836
L	135,931,037	251,384,650	181,888,936	176,441,950

[a] Units are in kWH/yr
Estimated using CAPDE

Total Baseline MPP Energy Usage[a] for Non Small Direct Dischargers

40 CFR 432 Subcategory Groupings	Total Baseline Energy (KWh/yr)
A, B, C, D	314,521,360
E, F, G, H, I	7,793,105
J	9,930,289
K	165,853,063
L	4,867,236

[a] Units are in kWH/yr
Estimated using CAPDET

Total MPP Energy Usage[a] for Non Small Indirect Dischargers

40 CFR 432 Subcategory Groupings	Total Baseline Energy (KWh/yr)
A, B, C, D	280,799,419
E, F, G, H, I	118,919,076
J	69,596,688
K	384,558,363
L	115,134,700

[a] Units are in kWH/yr
Estimated using CAPDET

Total MPI Facility Energy[a] Purchased

Subcategory Groupings	Purchased (KWH/yr)	Not-Small Facilities	Small Facilities
A, B, C, D	4,751,145,000	386	1007
E, F, G, H, I	8,642,867,525	622	675
J	798,082,000	143	97
K	1,961,046,285	144	32
L	3,292,702,715	243	55

[a] Units are in kWH/yr
(Source: 1997 U.S. Census of Manufacturers Data)
Note: Census energy use data is not given for Group E-I
Group E-I Total Energy Purchased is based on the following calculation:

Number of Group E-I Facilities w/ 20 or more employess:	622
Number of Group E-I Facilities w/ 19 or fewer employess:	675
Total Energy (KWH/yr) purchased per Group E-I Not-Small Facility:	13,459,281
Total Energy (KWH/yr) purchased per Group E-I Small Facility:	401,770
Total Energy (KWH/yr) purchased for all Group E-I Facilities:	8,642,867,525

Note: Census data combines data for Groups K and L
Facility Counts and Energy Use for Groups K and L are estimated using ratios from Screener Survey

Subpart K Facilities from Screener Survey:	296
Subpart L Facilities from Screener Survey:	497
Number of Combination Census K&L Facilities w/ 20 or more employess:	387
Number of Combination Census K&L Facilities w/ 19 or fewer employess:	87
Total Energy (KWH/yr) purchased for Groups K and L:	5,253,749,000

Total MPI Facility Energy Purchased per Facility

40 CFR 432 Subcategory Groupings	Total Energy Purchased Per Small Facility (KWH/yr)	Total Energy Purchased Per Non Small Facility (KWH/yr)
A, B, C, D	340,877	11,419,383
E, F, G, H, I	401,770	13,459,281
J	163,290	5,470,230
K	403,840	13,528,635
L	401,770	13,459,281

[a] Units are in kWH/facility-yr
Ratio of Energy Use for Not-Small Facilities:Small Facilities: 33.5
Source: EPA 1974 Red Meat TDD (page 133)
Note: Assume the same Ratio of Energy Use for Not-Small Facilities:Small Facilities for Both Meat and Poultry
Note: Assume that Meat Further Processors and Poultry Further Processors
have similar energy requirements
Note: Assume that direct and indirect MPP facilities have similar energy requirements

SLUDGE GENERATION INPUT VALUES

Number of MPP Facilities

40 CFR 432	Facility Size			
Subcategory	Small		M, L, VL	
Groupings	Direct	Indirect	Direct	Indirect
A, B, C, D	59	1,003	82	70
E, F, G, H, I	48	2,940	19	234
J	6	17	21	75
K	0	39	104	143
L	4	568	16	209

Data from EPA 1999 Screener Survey

Sludge Generation for Non Small Direct Dischargers

40 CFR 432 Subcategory Groupings	BAT2 Nitrification	BAT3 Nit./De-Nit.	BAT4 P Removal	BAT5 Filter
A, B, C, D	353,794	347,818	348,460	NA
E, F, G, H, I	6,564	6,520	6,538	NA
J	3,655	3,531	3,531	NA
K	129,917	119,564	138,450	138,450
L	3,326	3,180	3,189	2,417

Sludge Generation for Non Small Indirect Dischargers

40 CFR 432 Subcategory Groupings	PSES1 DAF	PSES2 Nitrification	PSES3 Nit./De-Nit.	PSES4 P Removal
A, B, C, D	63,466	291,033	250,477	253,161
E, F, G, H, I	2,900	60,670	51,197	52,645
J	9,552	20,778	18,732	19,041
K	38,518	226,433	201,043	201,010
L	2,588	63,573	56,154	56,593

Total Baseline MPP Sludge Generated for Non Small Direct Dischargers

40 CFR 432 Subcategory Groupings	Total Baseline Sludge Generated (tons/yr)
A, B, C, D	353,794
E, F, G, H, I	6,564
J	3,655
K	129,917
L	3,326

Total Baseline MPP Sludge Generated for Non Small Indirect Dischargers

40 CFR 432 Subcategory Groupings	Total Baseline Sludge Generated (tons/yr)
A, B, C, D	63,466
E, F, G, H, I	2,599
J	9,520
K	38,422

APPENDIX E

ATTACHMENTS FOR COST ESTIMATION (CHAPTER 11)

ATTACHMENT 11-1. DEVELOPMENT OF COST FACTORS TO ESTIMATE CAPITAL COSTS FROM CONSTRUCTION COST

Capital cost can be categorized into two categories: (1) unit process construction costs; and (2) other direct and indirect costs. The summation of the above two costs provides the total capital costs. Often other direct and indirect costs are expressed as a percentage of the construction costs to determine the capital cost. Similar approach was followed to estimate the capital costs of the treatment units for the proposed regulation. The construction cost of treatment units obtained from CAPDET model runs were multiplied by a factor to determine the capital cost. This section discusses the method used to determine the factor that converts construction cost to capital cost.

The factor is determined from the costing document of the centralized waste treatment (CWT) industry (USEPA, 1998). The breakdown of the capital costs as provided in the costing document of CWT industry (USEPA, 1998) and the selected percentage for the MPP Industry are shown in table below. The percentage selected are the average of the ranges provided for the cost items. However, for piping the selected percentage is half the average of the range provided.

Cost Factors Used in Centralized Waste Treatment Industry and the Selected Cost Factors for the MPP Industry

Cost Item	Percentage Used in CWT Industry	Cost Item on which The Percentage is Based	Percentage Selected for MPP Industry
Equipment	Technology-Specific		
Installation	25 to 55 Percent	Equipment Cost	40 Percent
Piping	31 to 66 Percent	Equipment Cost	24 Percent
Instrumentation & Control	6 to 30 Percent	Equipment Cost	18 Percent
Engineering	15 Percent	Construction Cost[a]	15 Percent
Contingency	15 Percent	Construction Cost[a]	15 Percent

[a] Construction cost in CWT industry = cost of equipment + installation + piping + instrumentation and control

The unit process construction cost in CAPDET is less than the construction cost for CWT industry shown in the table above. After reviewing the components that constitute unit process construction cost in CAPDET (see Section 11.5.1.1 in Chapter 11), EPA determined that the unit process construction cost in CAPDET is at least equal to the installed equipment cost (equipment + installation) and partial cost of piping. Therefore, based on engineering judgement the Agency selected half the average of the range of percentages provided for piping to estimate capital costs. The selected percentages for the cost items were converted as a percentage of the unit process construction cost and is shown in Table 11- 3 in Chapter 11. Summation of the factors for the cost items shows that the capital cost is 1.69 times the unit process construction cost.

The method of expressing the selected percentages for the cost items shown in the table above as a percent of unit process construction cost of CAPDET is shown below:

E = Equipment Cost

I = Installation Cost
= 0.4 * E

Therefore,
INS = Installed Cost
= equipment + installation cost
= E + I
=1.4* E

U = Unit Process Construction Cost
Unit process construction cost is equal to the installed cost. Therefore,
U = INS
= 1.4*E
and
E = U/1.4

P = Piping Cost
= 0.24 * E
= 0.17*U

IC = Instrumentation and control cost

= 0.18 * E

= 0.13*U

C = Construction Cost in CWT

= E + I + P + IC

= E + 0.4*E + 0.24*E + 0.18*E

= 1.82*E

EN = Engineering

= 0.15*C

= 0.15*1.82*E

= 0.195*U

CONT = Contingency

= 0.15*C

= 0.15*1.82*E

= 0.195*U

CAP = total capital cost

= U + P + IC + EN +CONT

= U + 0.17*U + 0.13*U + 0.195*U + 0.195*U

= 1.69*U

ATTACHMENT 11-2. FREQUENCY OF OCCURRENCE OF TREATMENT UNITS AND PERFORMANCE FACTORS

EPA received 241 of the MPP Detailed Surveys (MPP Detailed Survey, 2001) before the cut-off date of May 29, 2001. Of 241 surveys, the Agency used 200 surveys for the development of frequency of occurrence and performance factors. The rest 41 surveys were not analyzed because of one or of the following reasons:

1. some were duplicate facilities,
2. some were not meat processing facility,
3. some have insufficient data, and
4. some were not processed at the time the cost estimation was performed.

EPA will use all surveys including those that were collected after the deadlines in upcoming analyses for the forthcoming Notice of Data Availability (NODA) and final rule.

Table E-1. Frequency of Occurrence of Treatment Units and Performance Factors by Model Facility Category for Non-Small Facilities

Meat Type	Model Facility Grouping Code	Discharge Type	Technology Option	Screen	DAF	Lagoon or Equalization[1]	N or N+DN or N+DN+DP[2]	Filter	Disinfection	Performance Factor[3]
Meat	R1	Direct	2	1.00	1.00	1.00	1.00	N/A	1.00	0.00
Meat	R2		2	1.00	1.00	1.00	1.00	N/A	0.98	0.60
Meat	R12		2	1.00	1.00	1.00	1.00	N/A	1.00	1.00
Meat	R13		2	1.00	1.00	1.00	1.00	N/A	0.93	0.79
Meat	R23		2	1.00	1.00	1.00	1.00	N/A	0.98	0.60
Meat	R123		2	1.00	1.00	1.00	1.00	N/A	0.98	0.60
Meat	R1		3	1.00	1.00	1.00	1.00	N/A	1.00	1.00
Meat	R2		3	1.00	1.00	1.00	0.98	N/A	0.98	0.38
Meat	R12		3	1.00	1.00	1.00	0.00	N/A	1.00	0.00
Meat	R13		3	1.00	1.00	1.00	0.14	N/A	0.93	0.14
Meat	R23		3	1.00	1.00	1.00	0.98	N/A	0.98	0.38
Meat	R123		3	1.00	1.00	1.00	0.98	N/A	0.98	0.38
Meat	R1		4	1.00	1.00	1.00	0.00	N/A	1.00	0.00
Meat	R2		4	1.00	1.00	1.00	0.00	N/A	0.98	0.00
Meat	R12		4	1.00	1.00	1.00	0.00	N/A	1.00	0.00
Meat	R13		4	1.00	1.00	1.00	0.00	N/A	0.93	0.00
Meat	R23		4	1.00	1.00	1.00	0.00	N/A	0.98	0.00
Meat	R123		4	1.00	1.00	1.00	0.00	N/A	0.98	0.00
Meat	R1	Indirect	1	1.00	0.33	0.67	N/A	N/A	N/A	0.33
Meat	R2		1	0.57	0.43	0.00	N/A	N/A	N/A	0.00
Meat	R12		1	1.00	0.80	0.60	N/A	N/A	N/A	0.40
Meat	R13		1	1.00	1.00	0.33	N/A	N/A	N/A	0.33
Meat	R23		1	0.91	0.71	0.42	N/A	N/A	N/A	0.21
Meat	R123		1	1.00	1.00	0.50	N/A	N/A	N/A	0.00
Meat	R1		2	1.00	0.33	0.67	0.00	N/A	N/A	0.00
Meat	R2		2	0.57	0.43	0.00	0.00	N/A	N/A	0.00
Meat	R12		2	1.00	0.80	0.60	0.20	N/A	N/A	0.20
Meat	R13		2	1.00	1.00	0.33	0.00	N/A	N/A	0.00
Meat	R23		2	0.91	0.71	0.42	0.14	N/A	N/A	0.04
Meat	R123		2	1.00	1.00	0.50	0.50	N/A	N/A	0.00
Meat	R1		3	1.00	0.33	0.67	0.00	N/A	N/A	0.00
Meat	R2		3	0.57	0.43	0.00	0.00	N/A	N/A	0.00

Table E-1. Frequency of Occurrence of Treatment Units and Performance Factors by Model Facility Category for Non-Small Facilities (continued)

Meat Type	Model Facility Grouping Code	Discharge Type	Technology Option	Screen	DAF	Lagoon or Equalization[1]	N or N+DN or N+DN+DP[2]	Filter	Disinfection	Performance Factor[3]
Meat	R12		2	1.00	0.80	0.60	0.20	N/A	N/A	0.20
Meat	R13		2	1.00	1.00	0.33	0.00	N/A	N/A	0.00
Meat	R23		2	0.91	0.71	0.42	0.14	N/A	N/A	0.04
Meat	R123		2	1.00	1.00	0.50	0.50	N/A	N/A	0.00
Meat	R1		3	1.00	0.33	0.67	0.00	N/A	N/A	0.00
Meat	R2		3	0.57	0.43	0.00	0.00	N/A	N/A	0.00
Meat	R12		3	1.00	0.80	0.60	0.00	N/A	N/A	0.00
Meat	R13		3	1.00	1.00	0.33	0.00	N/A	N/A	0.00
Meat	R23		3	0.91	0.71	0.42	0.10	N/A	N/A	0.10
Meat	R123		3	1.00	1.00	0.50	0.50	N/A	N/A	0.50
Meat	R1		4	1.00	0.33	0.67	0.00	N/A	N/A	0.00
Meat	R2		4	0.57	0.43	0.00	0.00	N/A	N/A	0.00
Meat	R12		4	1.00	0.80	0.60	0.00	N/A	N/A	0.00
Meat	R13		4	1.00	1.00	0.33	0.00	N/A	N/A	0.00
Meat	R23		4	0.91	0.71	0.42	0.00	N/A	N/A	0.00
Meat	R123		4	1.00	1.00	0.50	0.00	N/A	N/A	0.00
Poultry	P1	Direct	2	1.00	1.00	1.00	1.00	N/A	1.00	0.77
Poultry	P2		2	1.00	1.00	1.00	1.00	N/A	0.91	0.71
Poultry	P12		2	1.00	1.00	1.00	1.00	N/A	0.75	0.50
Poultry	P13		2	1.00	1.00	1.00	1.00	N/A	0.89	0.56
Poultry	P23		2	1.00	1.00	1.00	1.00	N/A	0.91	0.71
Poultry	P123		2	1.00	1.00	1.00	1.00	N/A	1.00	1.00
Poultry	P1		3	1.00	1.00	1.00	0.23	N/A	1.00	0.15
Poultry	P2		3	1.00	1.00	1.00	0.20	N/A	0.91	0.13
Poultry	P12		3	1.00	1.00	1.00	0.25	N/A	0.75	0.25
Poultry	P13		3	1.00	1.00	1.00	0.33	N/A	0.89	0.11
Poultry	P23		3	1.00	1.00	1.00	0.20	N/A	0.91	0.13
Poultry	P123		3	1.00	1.00	1.00	0.00	N/A	1.00	0.00
Poultry	P1		4	1.00	1.00	1.00	0.08	N/A	1.00	0.00
Poultry	P2		4	1.00	1.00	1.00	0.07	N/A	0.91	0.06
Poultry	P12		4	1.00	1.00	1.00	0.00	N/A	0.75	0.00
Poultry	P13		4	1.00	1.00	1.00	0.22	N/A	0.89	0.22

Table E-1. Frequency of Occurrence of Treatment Units and Performance Factors by Model Facility Category for Non-Small Facilities (continued)

Meat Type	Model Facility Grouping Code	Discharge Type	Technology Option	Screen	DAF	Lagoon or Equalization[1]	N or N+DN or N+DN+DP[2]	Filter	Disinfection	Performance Factor[3]
Poultry	P23		4	1.00	1.00	1.00	0.07	N/A	0.91	0.06
Poultry	P123		4	1.00	1.00	1.00	0.00	N/A	1.00	0.00
Poultry	P1		5	1.00	1.00	1.00	0.08	0.31	1.00	0.08
Poultry	P2		5	1.00	1.00	1.00	0.07	0.10	0.91	0.02
Poultry	P12		5	1.00	1.00	1.00	0.00	0.00	0.75	0.00
Poultry	P13		5	1.00	1.00	1.00	0.22	0.11	0.89	0.00
Poultry	P23		5	1.00	1.00	1.00	0.07	0.10	0.91	0.02
Poultry	P123		5	1.00	1.00	1.00	0.00	0.00	1.00	0.00
Poultry	P1	Indirect	1	1.00	0.73	0.73	N/A	N/A	N/A	0.55
Poultry	P2		1	0.67	0.33	0.33	N/A	N/A	N/A	0.33
Poultry	P12		1	1.00	1.00	1.00	N/A	N/A	N/A	0.60
Poultry	P13		1	1.00	1.00	1.00	N/A	N/A	N/A	1.00
Poultry	P23		1	0.92	0.77	0.77	N/A	N/A	N/A	0.62
Poultry	P123		1	0.92	0.77	0.77	N/A	N/A	N/A	0.62
Poultry	P1		2	1.00	0.73	0.73	0.09	N/A	N/A	0.09
Poultry	P2		2	0.67	0.33	0.33	0.00	N/A	N/A	0.00
Poultry	P12		2	1.00	1.00	1.00	0.40	N/A	N/A	0.40
Poultry	P13		2	1.00	1.00	1.00	0.00	N/A	N/A	0.00
Poultry	P23		2	0.92	0.77	0.77	0.12	N/A	N/A	0.12
Poultry	P123		2	0.92	0.77	0.77	0.12	N/A	N/A	0.12
Poultry	P1		3	1.00	0.73	0.73	0.00	N/A	N/A	0.00
Poultry	P2		3	0.67	0.33	0.33	0.00	N/A	N/A	0.00
Poultry	P12		3	1.00	1.00	1.00	0.00	N/A	N/A	0.00
Poultry	P13		3	1.00	1.00	1.00	0.00	N/A	N/A	0.00
Poultry	P23		3	0.92	0.77	0.77	0.00	N/A	N/A	0.00
Poultry	P123		3	0.92	0.77	0.77	0.00	N/A	N/A	0.00
Poultry	P1		4	1.00	0.73	0.73	0.00	N/A	N/A	0.00
Poultry	P2		4	0.67	0.33	0.33	0.00	N/A	N/A	0.00
Poultry	P12		4	1.00	1.00	1.00	0.00	N/A	N/A	0.00
Poultry	P13		4	1.00	1.00	1.00	0.00	N/A	N/A	0.00
Poultry	P23		4	0.92	0.77	0.77	0.00	N/A	N/A	0.00
Poultry	P123		4	0.92	0.77	0.77	0.00	N/A	N/A	0.00

Table E-1. Frequency of Occurrence of Treatment Units and Performance Factors by Model Facility Category for Non-Small Facilities (continued)

Meat Type	Model Facility Grouping Code	Discharge Type	Technology Option	Screen	DAF	Lagoon or Equalization[1]	N or N+DN or N+DN+DP[2]	Filter	Disinfection	Performance Factor[3]
Mixed	M2	Direct	2	1.00	1.00	1.00	1.00	N/A	0.95	0.66
Mixed	M2		3	1.00	1.00	1.00	0.59	N/A	0.95	0.25
Mixed	M2		4	1.00	1.00	1.00	0.04	N/A	0.95	0.03
Mixed	M2	Indirect	1	1.00	0.50	0.50	N/A	N/A	N/A	0.50
Mixed	M2		2	1.00	0.50	0.50	0.00	N/A	N/A	0.00
Mixed	M2		3	1.00	0.50	0.50	0.00	N/A	N/A	0.00
Mixed	M2		4	1.00	0.50	0.50	0.00	N/A	N/A	0.00
Meat and/or Poultry	Render	Direct	2	1.00	1.00	1.00	1.00	N/A	1.00	1.00
Meat and/or Poultry	Render		3	1.00	1.00	1.00	0.00	N/A	1.00	0.00
Meat and/or Poultry	Render		4	1.00	1.00	1.00	0.00	N/A	1.00	0.00
Meat and/or Poultry	Render	Indirect	1	0.91	0.91	0.82	N/A	N/A	N/A	0.36
Meat and/or Poultry	Render		2	0.91	0.91	0.82	0.45	N/A	N/A	0.45
Meat and/or Poultry	Render		3	0.91	0.91	0.82	0.00	N/A	N/A	0.00
Meat and/or Poultry	Render		4	0.91	0.91	0.82	0.00	N/A	N/A	0.00

Note: Model facility grouping for which EPA Screener Survey did not identify any facilities are not shown
N/A: Not applicable
Note 1: lagoon for direct dischargers and equalization for indrect dischargers.
Note 2: N= nitrification; N+DN = nitrification and denitrification; N+DN+DP = nitrification and denitrification and phosphorus removal.
Note 3: Fraction of facilities that need performance cost.

Table E-2. Frequency of Occurrence of Treatment Units and Performance Factors by Model Facility Category for Small Facilities

Meat Type	Model Facility Grouping Code	Discharge Type	Technology Option	Screen	DAF	Lagoon or Equalization[1]	N or N+DN or N+DN+DP[2]	Filter	Disinfection	Performance Factor[3]
Meat	R1	Direct	2	1.00	1.00	1.00	1.00	N/A	1.00	1.00
Meat	R2		2	1.00	1.00	1.00	1.00	N/A	0.98	0.60
Meat	R12		2	1.00	1.00	1.00	1.00	N/A	1.00	1.00
Meat	R13		2	1.00	1.00	1.00	1.00	N/A	0.93	0.79
Meat	R23		2	1.00	1.00	1.00	1.00	N/A	0.98	0.60
Meat	R123		2	1.00	1.00	1.00	1.00	N/A	0.98	0.60
Meat	R1		3	1.00	1.00	1.00	0.00	N/A	1.00	0.00
Meat	R2		3	1.00	1.00	1.00	0.98	N/A	0.98	0.38
Meat	R12		3	1.00	1.00	1.00	0.00	N/A	1.00	0.00
Meat	R13		3	1.00	1.00	1.00	0.14	N/A	0.93	0.14
Meat	R23		3	1.00	1.00	1.00	0.98	N/A	0.98	0.38
Meat	R123		3	1.00	1.00	1.00	0.98	N/A	0.98	0.38
Meat	R1		4	1.00	1.00	1.00	0.00	N/A	1.00	0.00
Meat	R2		4	1.00	1.00	1.00	0.00	N/A	0.98	0.00
Meat	R12		4	1.00	1.00	1.00	0.00	N/A	1.00	0.00
Meat	R13		4	1.00	1.00	1.00	0.00	N/A	0.93	0.00
Meat	R23		4	1.00	1.00	1.00	0.00	N/A	0.98	0.00
Meat	R123		4	1.00	1.00	1.00	0.00	N/A	0.98	0.00
Meat	R1	Indirect	1	0.75	0.50	0.50	N/A	N/A	N/A	0.25
Meat	R2		1	0.35	0.19	0.16	N/A	N/A	N/A	0.10
Meat	R12		1	0.67	0.33	0.33	N/A	N/A	N/A	0.00
Meat	R13		1	1.00	1.00	1.00	N/A	N/A	N/A	0.00
Meat	R23		1	0.91	0.71	0.42	N/A	N/A	N/A	0.21
Meat	R123		1	1.00	1.00	0.50	N/A	N/A	N/A	0.00
Meat	R1		2	0.75	0.50	0.50	0.00	N/A	N/A	0.00
Meat	R2		2	0.35	0.19	0.16	0.03	N/A	N/A	0.03
Meat	R12		2	0.67	0.33	0.33	0.00	N/A	N/A	0.00
Meat	R13		2	1.00	1.00	1.00	1.00	N/A	N/A	1.00
Meat	R23		2	0.91	0.71	0.42	0.14	N/A	N/A	0.04
Meat	R123		2	1.00	1.00	0.50	0.50	N/A	N/A	0.00
Meat	R1		3	0.75	0.50	0.50	0.00	N/A	N/A	0.00
Meat	R2		3	0.35	0.19	0.16	0.00	N/A	N/A	0.00
Meat	R12		3	0.67	0.33	0.33	0.00	N/A	N/A	0.00

Table E-2. Frequency of Occurrence of Treatment Units and Performance Factors by Model Facility Category for Small Facilities (continued)

Meat Type	Model Facility Grouping Code	Discharge Type	Technology Option	Screen	DAF	Lagoon or Equalization[1]	N or N+DN or N+DN+DP[2]	Filter	Disinfection	Performance Factor[3]
Meat	R13		3	1.00	1.00	1.00	0.00	N/A	N/A	0.00
Meat	R23		3	0.91	0.71	0.42	0.10	N/A	N/A	0.10
Meat	R123		3	1.00	1.00	0.50	0.50	N/A	N/A	0.50
Meat	R1		4	0.75	0.50	0.50	0.00	N/A	N/A	0.00
Meat	R2		4	0.35	0.19	0.16	0.00	N/A	N/A	0.00
Meat	R12		4	0.67	0.33	0.33	0.00	N/A	N/A	0.00
Meat	R13		4	1.00	1.00	1.00	0.00	N/A	N/A	0.00
Meat	R23		4	0.91	0.71	0.42	0.00	N/A	N/A	0.00
Meat	R123		4	1.00	1.00	0.50	0.00	N/A	N/A	0.00
Poultry	P1	Direct	2	1.00	1.00	1.00	1.00	N/A	1.00	1.00
Poultry	P2		2	1.00	1.00	1.00	1.00	N/A	0.91	0.71
Poultry	P12		2	1.00	1.00	1.00	1.00	N/A	0.75	0.50
Poultry	P13		2	1.00	1.00	1.00	1.00	N/A	0.00	0.00
Poultry	P23		2	1.00	1.00	1.00	1.00	N/A	0.91	0.71
Poultry	P123		2	1.00	1.00	1.00	1.00	N/A	1.00	1.00
Poultry	P1		3	1.00	1.00	1.00	0.00	N/A	1.00	0.00
Poultry	P2		3	1.00	1.00	1.00	0.20	N/A	0.91	0.13
Poultry	P12		3	1.00	1.00	1.00	0.25	N/A	0.75	0.25
Poultry	P13		3	1.00	1.00	1.00	0.00	N/A	0.00	0.00
Poultry	P23		3	1.00	1.00	1.00	0.20	N/A	0.91	0.13
Poultry	P123		3	1.00	1.00	1.00	0.00	N/A	1.00	0.00
Poultry	P1		4	1.00	1.00	1.00	0.00	N/A	1.00	0.00
Poultry	P2		4	1.00	1.00	1.00	0.07	N/A	0.91	0.06
Poultry	P12		4	1.00	1.00	1.00	0.00	N/A	0.75	0.00
Poultry	P13		4	1.00	1.00	1.00	0.00	N/A	0.00	0.00
Poultry	P23		4	1.00	1.00	1.00	0.07	N/A	0.91	0.06
Poultry	P123		4	1.00	1.00	1.00	0.00	N/A	1.00	0.00
Poultry	P1		5	1.00	1.00	1.00	0.00	0.00	1.00	0.00
Poultry	P2		5	1.00	1.00	1.00	0.07	0.10	0.91	0.02
Poultry	P12		5	1.00	1.00	1.00	0.00	0.00	0.75	0.00
Poultry	P13		5	1.00	1.00	1.00	0.00	0.00	0.00	0.00
Poultry	P23		5	1.00	1.00	1.00	0.07	0.10	0.91	0.02

Table E-2. Frequency of Occurrence of Treatment Units and Performance Factors by Model Facility Category for Small Facilities (continued)

Meat Type	Model Facility Grouping Code	Discharge Type	Technology Option	Screen	DAF	Lagoon or Equalization[1]	N or N+DN or N+DN+DP[2]	Filter	Disinfection	Performance Factor[3]
Poultry	P123		5	1.00	1.00	1.00	0.00	0.00	1.00	0.00
Poultry	P1	Indirect	1	0.00	0.00	0.00	N/A	N/A	N/A	0.00
Poultry	P2		1	0.33	0.00	0.00	N/A	N/A	N/A	0.00
Poultry	P12		1	1.00	1.00	1.00	N/A	N/A	N/A	0.60
Poultry	P13		1	1.00	1.00	1.00	N/A	N/A	N/A	1.00
Poultry	P23		1	0.92	0.77	0.77	N/A	N/A	N/A	0.62
Poultry	P123		1	0.92	0.77	0.77	N/A	N/A	N/A	0.62
Poultry	P1		2	0.00	0.00	0.00	0.00	N/A	N/A	0.00
Poultry	P2		2	0.33	0.00	0.00	0.00	N/A	N/A	0.00
Poultry	P12		2	1.00	1.00	1.00	0.40	N/A	N/A	0.40
Poultry	P13		2	1.00	1.00	1.00	0.00	N/A	N/A	0.00
Poultry	P23		2	0.92	0.77	0.77	0.12	N/A	N/A	0.12
Poultry	P123		2	0.92	0.77	0.77	0.12	N/A	N/A	0.12
Poultry	P1		3	0.00	0.00	0.00	0.00	N/A	N/A	0.00
Poultry	P2		3	0.33	0.00	0.00	0.00	N/A	N/A	0.00
Poultry	P12		3	1.00	1.00	1.00	0.00	N/A	N/A	0.00
Poultry	P13		3	1.00	1.00	1.00	0.00	N/A	N/A	0.00
Poultry	P23		3	0.92	0.77	0.77	0.00	N/A	N/A	0.00
Poultry	P123		3	0.92	0.77	0.77	0.00	N/A	N/A	0.00
Poultry	P1		4	0.00	0.00	0.00	0.00	N/A	N/A	0.00
Poultry	P2		4	0.33	0.00	0.00	0.00	N/A	N/A	0.00
Poultry	P12		4	1.00	1.00	1.00	0.00	N/A	N/A	0.00
Poultry	P13		4	1.00	1.00	1.00	0.00	N/A	N/A	0.00
Poultry	P23		4	0.92	0.77	0.77	0.00	N/A	N/A	0.00
Poultry	P123		4	0.92	0.77	0.77	0.00	N/A	N/A	0.00
Mixed	M2	Direct	2	1.00	1.00	1.00	1.00	N/A	0.95	0.66
Mixed	M2		3	1.00	1.00	1.00	0.59	N/A	0.95	0.25
Mixed	M2		4	1.00	1.00	1.00	0.04	N/A	0.95	0.03
Mixed	M2	Indirect	1	0.25	0.25	0.00	N/A	N/A	N/A	0.00
Mixed	M23		1	0.92	0.74	0.60	N/A	N/A	N/A	0.42
Mixed	M2		2	0.25	0.25	0.00	0.00	N/A	N/A	0.00
Mixed	M23		2	0.92	0.74	0.60	0.13	N/A	N/A	0.08

Table E-2. Frequency of Occurrence of Treatment Units and Performance Factors by Model Facility Category for Small Facilities (continued)

Meat Type	Model Facility Grouping Code	Discharge Type	Technology Option	Screen	DAF	Lagoon or Equalization[1]	N or N+DN or N+DN+DP[2]	Filter	Disinfection	Performance Factor[3]
Mixed	M2		3	0.25	0.25	0.00	0.00	N/A	N/A	0.00
Mixed	M23		3	0.92	0.74	0.60	0.05	N/A	N/A	0.05
Mixed	M2		4	0.25	0.25	0.00	0.00	N/A	N/A	0.00
Mixed	M23		4	0.92	0.74	0.60	0.00	N/A	N/A	0.00
Meat and/or Poultry	Render	Direct	2	1.00	1.00	1.00	1.00	N/A	1.00	1.00
Meat and/or Poultry	Render		3	1.00	1.00	1.00	0.00	N/A	1.00	0.00
Meat and/or Poultry	Render		4	1.00	1.00	1.00	0.00	N/A	1.00	0.00
Meat and/or Poultry	Render	Indirect	1	1.00	1.00	0.00	N/A	N/A	N/A	0.00
Meat and/or Poultry	Render		2	1.00	1.00	0.00	0.00	N/A	N/A	0.00
Meat and/or Poultry	Render		3	1.00	1.00	0.00	0.00	N/A	N/A	0.00
Meat and/or Poultry	Render		4	1.00	1.00	0.00	0.00	N/A	N/A	0.00

Note: Model facility grouping for which EPA Screener Survey did not identify any facilities are not shown

Note 1: lagoon for direct dischargers and equalization for indrect dischargers.

Note 2: N= nitrification; N+DN = nitrification and denitrification; N+DN+DP = nitrification and denitrification and phosphorus removal.

Note 3: Fraction of facilities that need performance cost.

ATTACHMENT 11-3. MPP COST MODEL RESULTS

Table E-3. Incremental Capital, Retrofit, and Annual Costs by Model Facility Category for the Technology Options for Non-Small Direct Discharging Facilities

Meat Type	Model Facility GroupingCode	Technology Option	Size	Incremental Capital Cost (1999 dollars)	Incremental Annual Cost (1999 dollars/year)	Retrofit Capital Cost (1999 dollars)
Meat	R1	2	medium	$0	$0	
Meat	R1	3	medium	$0	$68,389	$0
Meat	R1	4	medium	$4,805,019	$600,155	$0
Meat	R2	2	medium	$40,801	$83,974	
Meat	R2	3	medium	$219,589	$73,742	$98,815
Meat	R2	4	medium	$11,298,280	$1,190,031	$142,733
Meat	R12	2	medium	$0	$0	
Meat	R12	3	medium	$0	$0	$0
Meat	R12	4	medium	$0	$0	$0
Meat	R13	2	medium	$1,318,515	$1,048,562	
Meat	R13	3	medium	$62,407,672	$6,029,242	$28,083,452
Meat	R13	4	medium	$77,759,176	$6,922,657	$40,564,987
Meat	R23	2	medium	$86,867	$195,813	
Meat	R23	3	medium	$263,930	$79,640	$118,769
Meat	R23	4	medium	$13,428,162	$1,206,290	$171,555
Meat	R123	2	medium	$1,197,050	$2,418,999	
Meat	R123	3	medium	$3,044,534	$856,979	$1,370,040
Meat	R123	4	medium	$148,196,608	$13,012,161	$1,978,947
Meat	R2	2	large	$2,441	$6,111	
Meat	R2	3	large	$14,440	$5,772	$6,498
Meat	R2	4	large	$728,549	$94,430	$9,386
Meat	R13	2	large	$746,101	$600,468	
Meat	R13	3	large	$35,198,172	$3,352,896	$15,839,177
Meat	R13	4	large	$43,338,480	$3,811,846	$22,878,812
Meat	R123	2	large	$796,937	$1,543,199	
Meat	R123	3	large	$2,128,235	$536,065	$957,706
Meat	R123	4	large	$101,300,856	$8,111,398	$1,383,353
Meat	R2	2	very large	$2,441	$5,794	
Meat	R2	3	very large	$13,383	$5,469	$6,022
Meat	R2	4	very large	$666,963	$90,322	$8,699
Meat	R13	2	very large	$4,188,223	$2,730,129	
Meat	R13	3	very large	$171,858,096	$15,249,847	$77,336,143
Meat	R13	4	very large	$191,899,520	$16,829,802	$111,707,762
Poultry	P1	2	medium	$0	$464,331	
Poultry	P1	3	medium	$28,211,594	$2,771,936	$12,695,217
Poultry	P1	4	medium	$38,423,532	$3,388,889	$18,337,536
Poultry	P1	5	medium	$43,328,776	$3,559,653	
Poultry	P2	2	medium	$109,867	$157,341	

Meat Type	Model Facility GroupingCode	Technology Option	Size	Incremental Capital Cost (1999 dollars)	Incremental Annual Cost (1999 dollars/year)	Retrofit Capital Cost (1999 dollars)
Poultry	P2	3	medium	$7,961,311	$971,382	$3,582,590
Poultry	P2	4	medium	$11,202,192	$1,223,752	$5,174,852
Poultry	P2	5	medium	$12,980,543	$1,263,043	
Poultry	P12	2	medium	$183,111	$122,294	
Poultry	P12	3	medium	$7,544,483	$799,360	$3,395,017
Poultry	P12	4	medium	$12,174,484	$1,142,777	$4,903,914
Poultry	P12	5	medium	$14,069,858	$1,196,707	
Poultry	P13	2	medium	$94,947	$201,577	
Poultry	P13	3	medium	$10,240,157	$1,023,951	$4,608,071
Poultry	P13	4	medium	$13,578,900	$1,268,555	$6,656,102
Poultry	P13	5	medium	$15,686,408	$1,279,957	
Poultry	P23	2	medium	$0	$0	
Poultry	P23	3	medium	$0	$0	$0
Poultry	P23	4	medium	$0	$0	$0
Poultry	P23	5	medium	$0	$0	
Poultry	P123	2	medium	$0	$109,992	
Poultry	P123	3	medium	$4,625,987	$453,697	$2,081,694
Poultry	P123	4	medium	$5,060,322	$465,764	$3,006,892
Poultry	P123	5	medium	$5,761,179	$485,638	
Poultry	P1	2	large	$0	$771,560	
Poultry	P1	3	large	$47,160,432	$4,578,185	$21,222,194
Poultry	P1	4	large	$63,844,072	$5,556,303	$30,654,281
Poultry	P1	5	large	$71,418,344	$5,831,349	
Poultry	P2	2	large	$10,987	$40,757	
Poultry	P2	3	large	$1,753,193	$179,738	$788,937
Poultry	P2	4	large	$2,533,387	$222,356	$1,139,575
Poultry	P2	5	large	$2,839,889	$229,323	
Poultry	P12	2	large	$102,003	$78,470	
Poultry	P12	3	large	$4,370,816	$436,401	$1,966,867
Poultry	P12	4	large	$6,925,654	$591,656	$2,841,030
Poultry	P12	5	large	$7,814,065	$615,822	
Poultry	P13	2	large	$289,556	$630,111	
Poultry	P13	3	large	$29,404,858	$2,776,481	$13,232,186
Poultry	P13	4	large	$37,638,488	$3,349,248	$19,113,158
Poultry	P13	5	large	$41,474,372	$3,333,904	
Poultry	P23	2	large	$0	$0	
Poultry	P23	3	large	$0	$0	$0
Poultry	P23	4	large	$0	$0	$0
Poultry	P23	5	large	$0	$0	
Poultry	P123	2	large	$0	$683,867	
Poultry	P123	3	large	$25,802,408	$2,393,216	$11,611,084
Poultry	P123	4	large	$26,355,690	$2,371,851	$16,771,565
Poultry	P123	5	large	$29,505,104	$2,434,935	

Meat Type	Model Facility GroupingCode	Technology Option	Size	Incremental Capital Cost (1999 dollars)	Incremental Annual Cost (1999 dollars/year)	Retrofit Capital Cost (1999 dollars)
Poultry	P1	2	very large	$0	$365,712	
Poultry	P1	3	very large	$21,789,980	$2,085,341	$9,805,491
Poultry	P1	4	very large	$28,721,632	$2,487,245	$14,163,487
Poultry	P1	5	very large	$31,538,728	$2,600,235	
Poultry	P2	2	very large	$21,973	$22,342	
Poultry	P2	3	very large	$1,184,120	$156,858	$532,854
Poultry	P2	4	very large	$1,645,928	$197,467	$769,678
Poultry	P2	5	very large	$1,899,125	$203,594	
Poultry	P12	2	very large	$733,761	$498,609	
Poultry	P12	3	very large	$25,833,008	$2,568,780	$11,624,854
Poultry	P12	4	very large	$41,519,708	$3,483,518	$16,791,455
Poultry	P12	5	very large	$45,849,888	$3,605,577	
Poultry	P13	2	very large	$81,529	$166,489	
Poultry	P13	3	very large	$7,730,416	$730,819	$3,478,687
Poultry	P13	4	very large	$9,884,025	$880,307	$5,024,770
Poultry	P13	5	very large	$10,860,911	$876,332	
Poultry	P123	2	very large	$0	$225,998	
Poultry	P123	3	very large	$8,561,975	$791,649	$3,852,889
Poultry	P123	4	very large	$8,713,499	$782,255	$5,565,284
Poultry	P123	5	very large	$9,773,011	$810,217	
Mixed	M2	2	medium	$30,519	$110,204	
Mixed	M2	3	medium	$3,205,753	$354,157	$1,442,589
Mixed	M2	4	medium	$9,742,008	$857,795	$2,083,739
Meat and/or Poultry	Render	2	medium	$0	$113,892	
Meat and/or Poultry	Render	3	medium	$5,529,846	$721,420	$2,488,431
Meat and/or Poultry	Render	4	medium	$6,387,821	$771,669	$3,594,400
Meat and/or Poultry	Render	2	large	$0	$139,221	
Meat and/or Poultry	Render	3	large	$6,540,381	$781,690	$2,943,171
Meat and/or Poultry	Render	4	large	$7,439,749	$824,591	$4,251,248
Meat and/or Poultry	Render	2	very large	$0	$259,104	
Meat and/or Poultry	Render	3	very large	$12,165,567	$1,310,686	$5,474,505
Meat and/or Poultry	Render	4	very large	$13,560,700	$1,352,783	$7,907,619

Note: Model facility grouping for which EPA Screener Survey did not identify any facilities are not shown

Table E-4. Incremental Capital, Retrofit, and Annual Costs by Model Facility Category for the Technology Options for Non-Small Indirect Discharging Facilities

Meat Type	Model Facility Grouping Code	Technology Option	Size	Incremental Capital Cost (1999 dollars)	Incremental Annual Cost (1999 dollars/year)	Retrofit Capital Cost (1999 dollars)
Meat	R1	1	medium	$0	$0	
Meat	R1	2	medium	$0	$0	
Meat	R1	3	medium	$0	$0	$0
Meat	R1	4	medium	$0	$0	$0
Meat	R2	1	medium	$38,330,452	$7,709,886	
Meat	R2	2	medium	$201,309,152	$25,364,142	
Meat	R2	3	medium	$199,300,688	$23,456,988	$199,300,688
Meat	R2	4	medium	$281,684,640	$27,090,436	$281,684,640
Meat	R12	1	medium	$7,674,552	$998,181	
Meat	R12	2	medium	$109,691,736	$17,407,204	
Meat	R12	3	medium	$105,932,768	$9,853,671	$91,985,869
Meat	R12	4	medium	$110,184,632	$9,662,992	$99,994,413
Meat	R13	1	medium	$2,287,932	$254,753	
Meat	R13	2	medium	$59,993,712	$6,771,834	
Meat	R13	3	medium	$46,611,616	$4,199,786	$46,611,616
Meat	R13	4	medium	$47,687,252	$4,048,963	$47,687,252
Meat	R23	1	medium	$3,588,406	$417,189	
Meat	R23	2	medium	$37,076,732	$5,762,126	
Meat	R23	3	medium	$30,127,418	$2,774,500	$26,398,992
Meat	R23	4	medium	$34,521,628	$2,955,317	$31,268,069
Meat	R123	1	medium	$8,745,909	$726,438	
Meat	R123	2	medium	$109,926,016	$16,953,628	
Meat	R123	3	medium	$91,036,424	$8,076,983	$45,518,212
Meat	R123	4	medium	$177,182,640	$13,376,883	$100,133,552
Meat	R2	1	large	$655,045	$150,901	
Meat	R2	2	large	$2,912,704	$429,330	
Meat	R2	3	large	$3,182,873	$433,225	$3,182,873
Meat	R2	4	large	$3,873,326	$476,512	$3,873,326
Meat	R13	1	large	$1,516,879	$160,959	
Meat	R13	2	large	$40,301,924	$4,170,561	
Meat	R13	3	large	$27,905,144	$2,463,362	$27,905,144
Meat	R13	4	large	$28,278,274	$2,360,095	$28,278,274
Meat	R123	1	large	$5,758,217	$440,752	
Meat	R123	2	large	$93,439,408	$10,890,032	
Meat	R123	3	large	$53,024,956	$4,930,998	$26,512,478
Meat	R123	4	large	$103,721,944	$8,166,034	$61,672,110
Meat	R2	1	very large	$613,868	$141,092	
Meat	R2	2	very large	$2,613,792	$401,263	
Meat	R2	3	very large	$2,917,641	$412,937	$2,917,641
Meat	R2	4	very large	$3,453,399	$448,325	$3,453,399

Meat Type	Model Facility Grouping Code	Technology Option	Size	Incremental Capital Cost (1999 dollars)	Incremental Annual Cost (1999 dollars/year)	Retrofit Capital Cost (1999 dollars)
Meat	R13	1	very large	$6,142,098	$552,927	
Meat	R13	2	very large	$211,183,984	$18,120,936	
Meat	R13	3	very large	$135,677,312	$10,966,498	$135,677,312
Meat	R13	4	very large	$135,718,432	$10,381,650	$135,718,432
Poultry	P1	1	medium	$9,562,528	$1,258,507	
Poultry	P1	2	medium	$115,037,512	$12,767,587	
Poultry	P1	3	medium	$100,356,304	$8,990,328	$94,740,851
Poultry	P1	4	medium	$108,674,464	$9,147,063	$104,484,585
Poultry	P2	1	medium	$30,867,114	$5,828,478	
Poultry	P2	2	medium	$201,298,528	$31,688,606	
Poultry	P2	3	medium	$171,936,096	$20,252,848	$171,936,096
Poultry	P2	4	medium	$231,890,656	$23,024,832	$231,890,656
Poultry	P12	1	medium	$0	$68,129	
Poultry	P12	2	medium	$16,303,165	$2,956,783	
Poultry	P12	3	medium	$21,677,976	$2,174,673	$15,158,803
Poultry	P12	4	medium	$24,012,522	$2,243,099	$17,928,997
Poultry	P13	1	medium	$0	$23,373	
Poultry	P13	2	medium	$7,641,977	$1,182,946	
Poultry	P13	3	medium	$5,595,342	$536,207	$5,595,342
Poultry	P13	4	medium	$5,986,901	$538,194	$5,986,901
Poultry	P23	1	medium	$548,934	$141,398	
Poultry	P23	2	medium	$8,950,510	$1,388,507	
Poultry	P23	3	medium	$8,626,571	$1,065,967	$7,945,823
Poultry	P23	4	medium	$9,794,832	$1,129,871	$9,199,445
Poultry	P123	1	medium	$672,122	$99,076	
Poultry	P123	2	medium	$11,549,023	$1,758,065	
Poultry	P123	3	medium	$9,664,684	$905,141	$8,962,263
Poultry	P123	4	medium	$10,266,829	$905,079	$9,783,186
Poultry	P1	1	large	$16,734,425	$2,138,543	
Poultry	P1	2	large	$200,073,664	$22,075,687	
Poultry	P1	3	large	$173,983,472	$15,252,051	$164,267,147
Poultry	P1	4	large	$186,381,744	$15,435,507	$179,330,967
Poultry	P2	1	large	$2,567,397	$314,432	
Poultry	P2	2	large	$17,001,328	$2,707,538	
Poultry	P2	3	large	$13,121,277	$1,241,668	$13,121,277
Poultry	P2	4	large	$19,517,834	$1,414,858	$19,517,834
Poultry	P12	1	large	$0	$39,040	
Poultry	P12	2	large	$12,009,338	$2,187,666	
Poultry	P12	3	large	$14,762,752	$1,387,720	$10,442,884
Poultry	P12	4	large	$15,789,361	$1,391,181	$12,067,634
Poultry	P13	1	large	$0	$47,540	
Poultry	P13	2	large	$25,428,288	$3,478,462	
Poultry	P13	3	large	$15,341,535	$1,376,323	$15,341,535

Meat Type	Model Facility Grouping Code	Technology Option	Size	Incremental Capital Cost (1999 dollars)	Incremental Annual Cost (1999 dollars/year)	Retrofit Capital Cost (1999 dollars)
Poultry	P13	4	large	$15,772,579	$1,329,077	$15,772,579
Poultry	P23	1	large	$2,091,418	$262,429	
Poultry	P23	2	large	$36,721,092	$5,542,879	
Poultry	P23	3	large	$29,499,260	$2,685,068	$27,413,504
Poultry	P23	4	large	$30,831,876	$2,636,290	$29,511,578
Poultry	P123	1	large	$6,452,889	$659,240	
Poultry	P123	2	large	$164,122,080	$17,931,432	
Poultry	P123	3	large	$101,593,832	$8,207,464	$95,901,807
Poultry	P123	4	large	$102,261,784	$7,864,861	$100,625,481
Poultry	P1	1	very large	$7,150,359	$833,098	
Poultry	P1	2	very large	$91,395,024	$9,882,312	
Poultry	P1	3	very large	$77,402,288	$6,579,022	$73,150,514
Poultry	P1	4	very large	$81,054,640	$6,495,908	$78,201,521
Poultry	P2	1	very large	$2,999,867	$627,089	
Poultry	P2	2	very large	$18,458,508	$2,853,309	
Poultry	P2	3	very large	$16,864,996	$2,120,529	$16,864,996
Poultry	P2	4	very large	$20,471,944	$2,335,519	$20,471,944
Poultry	P12	1	very large	$0	$181,679	
Poultry	P12	2	very large	$67,846,544	$12,363,762	
Poultry	P12	3	very large	$79,723,664	$7,376,269	$56,789,942
Poultry	P12	4	very large	$83,178,600	$7,263,729	$64,562,014
Poultry	P13	1	very large	$0	$24,355	
Poultry	P13	2	very large	$13,342,282	$1,838,376	
Poultry	P13	3	very large	$8,127,148	$726,480	$8,127,148
Poultry	P13	4	very large	$8,339,379	$700,884	$8,339,379
Poultry	P123	1	very large	$1,835,588	$187,821	
Poultry	P123	2	very large	$46,649,320	$5,072,465	
Poultry	P123	3	very large	$28,844,226	$2,326,795	$27,230,232
Poultry	P123	4	very large	$29,002,166	$2,228,601	$28,544,782
Mixed	M2	1	medium	$30,400,918	$4,048,072	
Mixed	M2	2	medium	$237,813,392	$35,260,908	
Mixed	M2	3	medium	$204,321,312	$20,264,530	$204,321,312
Mixed	M2	4	medium	$337,282,624	$24,807,622	$337,282,624
Meat and/or Poultry	Render	1	medium	$820,897	$250,175	
Meat and/or Poultry	Render	2	medium	$16,379,139	$2,714,552	
Meat and/or Poultry	Render	3	medium	$24,948,242	$3,170,180	$16,153,835
Meat and/or Poultry	Render	4	medium	$27,943,370	$3,303,252	$19,348,984
Meat and/or Poultry	Render	1	large	$904,249	$239,983	

Meat Type	Model Facility Grouping Code	Technology Option	Size	Incremental Capital Cost (1999 dollars)	Incremental Annual Cost (1999 dollars/year)	Retrofit Capital Cost (1999 dollars)
Meat and/or Poultry	Render	2	large	$21,609,332	$3,370,251	
Meat and/or Poultry	Render	3	large	$31,996,360	$3,541,991	$20,806,984
Meat and/or Poultry	Render	4	large	$34,866,372	$3,604,617	$24,427,572
Meat and/or Poultry	Render	1	very large	$1,772,274	$371,875	
Meat and/or Poultry	Render	2	very large	$44,720,368	$6,718,449	
Meat and/or Poultry	Render	3	very large	$64,101,940	$6,345,284	$41,897,042
Meat and/or Poultry	Render	4	very large	$68,115,184	$6,316,723	$48,330,401

Note: Model facility grouping for which EPA Screener Survey did not identify any facilities are not shown

Table E-5. Incremental Capital and Annual Costs by Model Facility Category for the Technology Options of Small Direct Discharging Facilities

Meat Type	Model Facility Category Code	Technology Option	Size	Incremental Capital Cost (1999 dollars)	Incremental Annual Cost (1999 dollars/year)
Meat	R1	1	small	0	$0
Meat	R1	2	small	$0	$178,736
Meat	R1	3	small	$7,299,355	$1,413,095
Meat	R2	1	small	$104,984	$3,486
Meat	R2	2	small	$104,984	$235,812
Meat	R2	3	small	$469,743	$228,987
Meat	R12	1	small	$0	$0
Meat	R12	2	small	$0	$0
Meat	R12	3	small	$0	$0
Meat	R13	1	small	$148,233	$4,969
Meat	R13	2	small	$148,233	$146,722
Meat	R13	3	small	$7,057,751	$1,207,726
Meat	R23	1	small	$0	$0
Meat	R23	2	small	$0	$0
Meat	R23	3	small	$0	$0
Meat	R123	1	small	$61,037	$2,033
Meat	R123	2	small	$61,037	$161,208
Meat	R123	3	small	$289,539	$131,410
Mixed	M2	1	small	$54,933	$1,799
Mixed	M2	2	small	$54,933	$64,252
Mixed	M2	3	small	$1,665,124	$326,958
Meat and/or Poultry	Render	1	small	$0	$0
Meat and/or Poultry	Render	2	small	$0	$172,632
Meat and/or Poultry	Render	3	small	$8,192,232	$909,610

Note: Model facility grouping for which EPA Screener Survey did not identify any facilities are not shown

Table E-6. Incremental Capital and Annual Costs by Model Facility Category for the Technology Options of Small Indirect Discharging Facilities

Meat Type	Model Facility Grouping Code	Technology Option	Size	Incremental Capital Cost (1999 dollars)	Incremental Annual Cost (1999 dollars/year)
Readmeat	R1	1	small	$26,895,344	$3,873,826
Readmeat	R1	2	small	$151,499,760	$26,848,712
Readmeat	R1	3	small	$152,128,864	$23,960,492
Readmeat	R1	4	small	$183,388,576	$25,021,890
Readmeat	R2	1	small	$412,294,080	$58,444,990
Readmeat	R2	2	small	$1,276,559,616	$223,432,938
Readmeat	R2	3	small	$1,578,774,784	$238,175,152
Readmeat	R2	4	small	$1,867,879,936	$250,308,432
Readmeat	R12	1	small	$91,858,632	$12,875,693
Readmeat	R12	2	small	$419,484,096	$71,069,328
Readmeat	R12	3	small	$420,050,720	$62,482,176
Readmeat	R12	4	small	$498,965,536	$65,781,584
Readmeat	R13	1	small	$0	$0
Readmeat	R13	2	small	$0	$135,533
Readmeat	R13	3	small	$6,334,605	$988,796
Readmeat	R13	4	small	$7,825,042	$1,049,669
Readmeat	R23	1	small	$2,221,331	$418,784
Readmeat	R23	2	small	$14,641,294	$3,224,597
Readmeat	R23	3	small	$15,218,554	$3,073,139
Readmeat	R23	4	small	$20,195,592	$3,475,733
Readmeat	R123	1	small	$1,073,496	$594,234
Readmeat	R123	2	small	$13,651,828	$2,666,926
Readmeat	R123	3	small	$13,717,060	$2,593,285
Readmeat	R123	4	small	$32,517,392	$4,636,849
Poultry	P1	1	small	$4,546,294	$902,655
Poultry	P1	2	small	$16,988,052	$2,405,367
Poultry	P1	3	small	$17,149,222	$2,127,847
Poultry	P1	4	small	$20,165,204	$2,257,294
Poultry	P2	1	small	$55,658,488	$8,136,523
Poultry	P2	2	small	$187,852,080	$29,771,220
Poultry	P2	3	small	$188,329,104	$26,325,620
Poultry	P2	4	small	$221,011,072	$27,650,150
Poultry	P12	1	small	$0	$33,878
Poultry	P12	2	small	$5,595,467	$1,236,450
Poultry	P12	3	small	$9,371,482	$1,693,577
Poultry	P12	4	small	$11,700,697	$1,774,729
Poultry	P13	1	small	$0	$0
Poultry	P13	2	small	$0	$0
Poultry	P13	3	small	$0	$0
Poultry	P13	4	small	$0	$0
Poultry	P23	1	small	$193,859	$40,837

Meat Type	Model Facility Grouping Code	Technology Option	Size	Incremental Capital Cost (1999 dollars)	Incremental Annual Cost (1999 dollars/year)
Poultry	P23	2	small	$2,167,089	$366,679
Poultry	P23	3	small	$2,417,926	$343,616
Poultry	P23	4	small	$2,943,681	$364,323
Mixed	P2	1	small	$115,647,168	$19,957,532
Mixed	P2	2	small	$452,671,584	$76,483,208
Mixed	P2	3	small	$454,453,536	$68,212,416
Mixed	P2	4	small	$538,625,664	$71,655,976
Mixed	P23	1	small	$242,585	$53,873
Mixed	P23	2	small	$2,105,501	$358,133
Mixed	P23	3	small	$2,120,554	$333,495
Mixed	P23	4	small	$2,620,976	$375,810
Meat and/or Poultry	Render	1	small	$2,796,848	$513,318
Meat and/or Poultry	Render	2	small	$43,635,312	$6,030,492
Meat and/or Poultry	Render	3	small	$36,320,992	$3,752,576
Meat and/or Poultry	Render	4	small	$39,443,676	$3,717,570

Note: Model facility grouping for which EPA Screener Survey did not identify any facilities are not shown

APPENDIX F

AGGREGATED DAILY DATA FOR PROPOSED POLLUTANTS AND SUBCATEGORIES

--- Subcategory=Poultry -- Option=BAT2 ---

Analyte Name	CAS_NO	Episode	Method	Sample Point	Sample Day	Concentration	Unit	Baseline Value	Measure Type
AMMONIA AS NITROGEN	7664417	6443	350.2	SP-2	1	14.300	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6443	350.2	SP-2	2	6.490	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6443	350.2	SP-2	3	6.680	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6444	350.2	SP-3	1	93.300	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6444	350.2	SP-3	2	15.100	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6444	350.2	SP-3	3	30.200	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6445	350.2	SP-1	1	11.300	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6445	350.2	SP-1	2	8.430	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6445	350.2	SP-1	3	9.900	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6445	350.2	SP-1	4	9.370	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6445	350.2	SP-1	5	8.150	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6445	350.2	SP-3+SP-2	1	0.375	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6445	350.2	SP-3+SP-2	2	0.280	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6445	350.2	SP-3+SP-2	3	0.160	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6445	350.2	SP-3+SP-2	4	0.190	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6445	350.2	SP-3+SP-2	5	0.230	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6448	350.2	SP-2	1	115.000	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6448	350.2	SP-2	2	95.000	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6448	350.2	SP-2	3	191.000	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6448	350.2	SP-2	4	208.000	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6448	350.2	SP-2	5	161.000	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6448	350.2	SP-4+SP-3	1	0.965	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6448	350.2	SP-4+SP-3	2	1.390	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6448	350.2	SP-4+SP-3	3	0.960	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6448	350.2	SP-4+SP-3	4	1.540	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6448	350.2	SP-4+SP-3	5	1.510	MG/L	0.20	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6443	405.1	SP-2	1	2840.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6443	405.1	SP-2	2	4250.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6443	405.1	SP-2	3	2790.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6444	405.1	SP-3	1	3760.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6444	405.1	SP-3	2	18600.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6444	405.1	SP-3	3	645.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6445	405.1	SP-1	1	1840.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6445	405.1	SP-1	2	1910.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6445	405.1	SP-1	3	2060.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6445	405.1	SP-1	4	1990.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6445	405.1	SP-1	5	1480.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6445	405.1	SP-3+SP-2	1	2.000	MG/L	2.00	ND
BIOCHEMICAL OXYGEN DEMAND	C003	6445	405.1	SP-3+SP-2	2	2.000	MG/L	2.00	ND
BIOCHEMICAL OXYGEN DEMAND	C003	6445	405.1	SP-3+SP-2	3	2.000	MG/L	2.00	ND
BIOCHEMICAL OXYGEN DEMAND	C003	6445	405.1	SP-3+SP-2	4	2.000	MG/L	2.00	ND
BIOCHEMICAL OXYGEN DEMAND	C003	6445	405.1	SP-3+SP-2	5	2.000	MG/L	2.00	ND
BIOCHEMICAL OXYGEN DEMAND	C003	6448	405.1	SP-2	1	1720.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6448	405.1	SP-2	2	2050.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6448	405.1	SP-2	3	2010.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6448	405.1	SP-2	4	2070.000	MG/L	2.00	NC

Subcategory=Poultry -- Option=BAT2
(continued)

Analyte Name	CAS_NO	Episode	Method	Sample Point	Sample Day	Concentration	Unit	Baseline Value	Measure Type
BIOCHEMICAL OXYGEN DEMAND	C003	6448	405.1	SP-2	5	2070.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6448	405.1	SP-4+SP-3	1	3.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6448	405.1	SP-4+SP-3	2	3.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6448	405.1	SP-4+SP-3	3	4.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6448	405.1	SP-4+SP-3	4	4.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6448	405.1	SP-4+SP-3	5	5.000	MG/L	2.00	NC
CHEMICAL OXYGEN DEMAND	C004	6443	410.4	SP-2	1	3900.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6443	410.4	SP-2	2	4770.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6443	410.4	SP-2	3	2490.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6444	410.4	SP-3	1	7810.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6444	410.4	SP-3	2	20000.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6444	410.4	SP-3	3	3220.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6445	410.1	SP-1	1	4080.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6445	410.1	SP-1	2	1720.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6445	410.1	SP-1	3	2730.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6445	410.1	SP-1	4	2420.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6445	410.1	SP-1	5	4530.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6445	410.2	SP-3+SP-2	1	40.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6445	410.2	SP-3+SP-2	2	25.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6445	410.2	SP-3+SP-2	3	37.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6445	410.2	SP-3+SP-2	4	19.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6445	410.2	SP-3+SP-2	5	17.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6448	410.1	SP-2	1	18600.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6448	410.1	SP-2	2	17500.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6448	410.1	SP-2	3	9700.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6448	410.1	SP-2	4	10200.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6448	410.1	SP-2	5	36800.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6448	410.2	SP-4+SP-3	1	26.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6448	410.2	SP-4+SP-3	2	28.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6448	410.2	SP-4+SP-3	3	36.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6448	410.2	SP-4+SP-3	4	28.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6448	410.2	SP-4+SP-3	5	30.000	MG/L	5.00	NC
FECAL COLIFORM	C2106	6443	9221E	SP-2	2	170000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6443	9221E	SP-2	3	5000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6445	9221E	SP-1	1	900000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6445	9221E	SP-1	3	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6445	9221E	SP-1	4	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6445	9221E	SP-1	5	900000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6445	9221E	SP-3+SP-2	1	12.500	/100M	2.00	NC
FECAL COLIFORM	C2106	6445	9221E	SP-3+SP-2	3	2.000	/100M	2.00	ND
FECAL COLIFORM	C2106	6445	9221E	SP-3+SP-2	4	2.000	/100M	2.00	ND
FECAL COLIFORM	C2106	6445	9221E	SP-3+SP-2	5	2.000	/100M	2.00	ND
FECAL COLIFORM	C2106	6448	9221E	SP-2	1	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6448	9221E	SP-2	2	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6448	9221E	SP-2	3	1600000.000	/100M	2.00	NC

--- Subcategory=Poultry -- Option=BAT2 ---
(continued)

Analyte Name	CAS_NO	Episode	Method	Sample Point	Sample Day	Concentration	Unit	Baseline Value	Measure Type
FECAL COLIFORM	C2106	6448	9221E	SP-2	4	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6448	9221E	SP-2	5	900000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6448	9221E	SP-4+SP-3	1	41.500	/100M	2.00	NC
FECAL COLIFORM	C2106	6448	9221E	SP-4+SP-3	2	80.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6448	9221E	SP-4+SP-3	3	170.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6448	9221E	SP-4+SP-3	4	500.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6448	9221E	SP-4+SP-3	5	1300.000	/100M	2.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6443	1664	SP-2	1	1656.083	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6443	1664	SP-2	2	331.733	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6443	1664	SP-2	3	390.633	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6444	1664	SP-3	1	238.500	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6444	1664	SP-3	2	801.083	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6444	1664	SP-3	3	230.167	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6445	1664	SP-1	1	489.667	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6445	1664	SP-1	2	543.833	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6445	1664	SP-1	3	418.333	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6445	1664	SP-1	4	503.667	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6445	1664	SP-1	5	478.500	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6445	1664	SP-3+SP-2	1	5.917	MG/L	5.00	ND
HEXANE EXTRACTABLE MATERIAL	C036	6445	1664	SP-3+SP-2	2	6.000	MG/L	5.00	ND
HEXANE EXTRACTABLE MATERIAL	C036	6445	1664	SP-3+SP-2	3	93.833	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6445	1664	SP-3+SP-2	4	6.000	MG/L	5.00	ND
HEXANE EXTRACTABLE MATERIAL	C036	6445	1664	SP-3+SP-2	5	6.167	MG/L	5.00	ND
HEXANE EXTRACTABLE MATERIAL	C036	6448	1664	SP-2	1	2768.167	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6448	1664	SP-2	2	1134.333	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6448	1664	SP-2	3	499.167	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6448	1664	SP-2	4	1986.000	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6448	1664	SP-2	5	24739.833	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6448	1664	SP-4+SP-3	1	5.833	MG/L	5.00	ND
HEXANE EXTRACTABLE MATERIAL	C036	6448	1664	SP-4+SP-3	2	5.833	MG/L	5.00	ND
HEXANE EXTRACTABLE MATERIAL	C036	6448	1664	SP-4+SP-3	3	6.000	MG/L	5.00	ND
HEXANE EXTRACTABLE MATERIAL	C036	6448	1664	SP-4+SP-3	4	5.667	MG/L	5.00	ND
HEXANE EXTRACTABLE MATERIAL	C036	6448	1664	SP-4+SP-3	5	6.333	MG/L	5.00	NC
NITRATE/NITRITE	C005	6443	300.0	SP-2	1	3.230	MG/L	0.05	NC
NITRATE/NITRITE	C005	6443	300.0	SP-2	2	0.750	MG/L	0.05	ND
NITRATE/NITRITE	C005	6443	300.0	SP-2	3	0.750	MG/L	0.05	ND
NITRATE/NITRITE	C005	6444	300.0	SP-3	1	0.300	MG/L	0.05	ND
NITRATE/NITRITE	C005	6444	300.0	SP-3	2	0.300	MG/L	0.05	ND
NITRATE/NITRITE	C005	6444	300.0	SP-3	3	0.300	MG/L	0.05	ND
NITRATE/NITRITE	C005	6445	353.1	SP-1	1	1.660	MG/L	0.05	NC
NITRATE/NITRITE	C005	6445	353.1	SP-1	2	2.970	MG/L	0.05	NC
NITRATE/NITRITE	C005	6445	353.1	SP-1	3	3.640	MG/L	0.05	NC
NITRATE/NITRITE	C005	6445	353.1	SP-1	4	3.930	MG/L	0.05	NC
NITRATE/NITRITE	C005	6445	353.1	SP-1	5	0.570	MG/L	0.05	NC
NITRATE/NITRITE	C005	6445	353.1	SP-3+SP-2	1	16.800	MG/L	0.05	NC

Subcategory=Poultry -- Option=BAT2
(continued)

Analyte Name	CAS_NO	Episode	Method	Sample Point	Sample Day	Concentration	Unit	Baseline Value	Measure Type
NITRATE/NITRITE	C005	6445	353.1	SP-3+SP-2	2	22.100	MG/L	0.05	NC
NITRATE/NITRITE	C005	6445	353.1	SP-3+SP-2	3	31.500	MG/L	0.05	NC
NITRATE/NITRITE	C005	6445	353.1	SP-3+SP-2	4	31.400	MG/L	0.05	NC
NITRATE/NITRITE	C005	6445	353.1	SP-3+SP-2	5	33.400	MG/L	0.05	NC
NITRATE/NITRITE	C005	6448	353.1	SP-2	1	34.000	MG/L	0.05	NC
NITRATE/NITRITE	C005	6448	353.1	SP-2	2	25.500	MG/L	0.05	NC
NITRATE/NITRITE	C005	6448	353.1	SP-2	3	19.000	MG/L	0.05	NC
NITRATE/NITRITE	C005	6448	353.1	SP-2	4	21.000	MG/L	0.05	NC
NITRATE/NITRITE	C005	6448	353.1	SP-2	5	30.600	MG/L	0.05	NC
NITRATE/NITRITE	C005	6448	353.1	SP-4+SP-3	1	64.800	MG/L	0.05	NC
NITRATE/NITRITE	C005	6448	353.1	SP-4+SP-3	2	63.100	MG/L	0.05	NC
NITRATE/NITRITE	C005	6448	353.1	SP-4+SP-3	3	62.600	MG/L	0.05	NC
NITRATE/NITRITE	C005	6448	353.1	SP-4+SP-3	4	62.800	MG/L	0.05	NC
NITRATE/NITRITE	C005	6448	353.1	SP-4+SP-3	5	70.000	MG/L	0.05	NC
TOTAL KJELDAHL NITROGEN	C021	6443	351.3	SP-2	1	147.000	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6443	351.3	SP-2	2	24.600	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6443	351.3	SP-2	3	68.800	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6444	351.3	SP-3	1	271.000	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6444	351.3	SP-3	2	63.600	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6444	351.3	SP-3	3	271.000	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6445	351.3	SP-1	1	77.700	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6445	351.3	SP-1	2	26.600	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6445	351.3	SP-1	3	21.100	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6445	351.3	SP-1	4	27.800	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6445	351.3	SP-1	5	18.200	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6445	351.3	SP-3+SP-2	1	1.275	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6445	351.3	SP-3+SP-2	2	1.800	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6445	351.3	SP-3+SP-2	3	2.250	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6445	351.3	SP-3+SP-2	4	1.610	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6445	351.3	SP-3+SP-2	5	1.030	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6448	351.3	SP-2	1	171.000	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6448	351.3	SP-2	2	103.000	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6448	351.3	SP-2	3	202.000	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6448	351.3	SP-2	4	212.000	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6448	351.3	SP-2	5	210.000	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6448	351.3	SP-4+SP-3	1	1.315	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6448	351.3	SP-4+SP-3	2	1.915	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6448	351.3	SP-4+SP-3	3	1.070	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6448	351.3	SP-4+SP-3	4	2.250	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6448	351.3	SP-4+SP-3	5	2.510	MG/L	0.50	NC
TOTAL NITROGEN	C005+C021	6443	351.3	SP-2	1	150.230	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6443	351.3	SP-2	2	25.350	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6443	351.3	SP-2	3	69.550	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6444	351.3	SP-3	1	271.300	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6444	351.3	SP-3	2	63.900	MG/L	0.55	NC

--- Subcategory=Poultry -- Option=BAT2 ---
(continued)

Analyte Name	CAS_NO	Episode	Method	Sample Point	Sample Day	Concentration	Unit	Baseline Value	Measure Type
TOTAL NITROGEN	C005+C021	6444	351.3	SP-3	3	271.300	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6445	351.3	SP-1	1	79.360	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6445	351.3	SP-1	2	29.570	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6445	351.3	SP-1	3	24.740	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6445	351.3	SP-1	4	31.730	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6445	351.3	SP-1	5	18.770	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6445	351.3	SP-3+SP-2	1	18.075	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6445	351.3	SP-3+SP-2	2	23.900	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6445	351.3	SP-3+SP-2	3	33.750	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6445	351.3	SP-3+SP-2	4	33.010	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6445	351.3	SP-3+SP-2	5	34.430	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6448	351.3	SP-2	1	205.000	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6448	351.3	SP-2	2	128.500	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6448	351.3	SP-2	3	221.000	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6448	351.3	SP-2	4	233.000	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6448	351.3	SP-2	5	240.600	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6448	351.3	SP-4+SP-3	1	66.115	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6448	351.3	SP-4+SP-3	2	65.015	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6448	351.3	SP-4+SP-3	3	63.670	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6448	351.3	SP-4+SP-3	4	65.050	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6448	351.3	SP-4+SP-3	5	72.510	MG/L	0.55	NC
TOTAL PHOSPHORUS	14265442	6443	365.3	SP-2	1	94.500	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6443	365.3	SP-2	2	52.700	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6443	365.3	SP-2	3	69.400	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6444	365.3	SP-3	1	53.100	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6444	365.3	SP-3	2	77.200	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6444	365.3	SP-3	3	808.000	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6445	365.2	SP-1	1	11.700	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6445	365.2	SP-1	2	10.100	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6445	365.2	SP-1	3	11.700	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6445	365.2	SP-1	4	10.900	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6445	365.2	SP-1	5	12.400	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6445	365.2	SP-3+SP-2	1	0.620	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6445	365.2	SP-3+SP-2	2	1.890	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6445	365.2	SP-3+SP-2	3	0.170	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6445	365.2	SP-3+SP-2	4	0.210	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6445	365.2	SP-3+SP-2	5	0.610	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6448	365.2	SP-2	1	37.600	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6448	365.2	SP-2	2	31.600	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6448	365.2	SP-2	3	35.900	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6448	365.2	SP-2	4	31.100	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6448	365.2	SP-2	5	51.500	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6448	365.2	SP-4+SP-3	1	15.600	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6448	365.2	SP-4+SP-3	2	15.150	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6448	365.2	SP-4+SP-3	3	14.600	MG/L	0.01	NC

--- Subcategory=Poultry -- Option=BAT2 ---
(continued)

Analyte Name	CAS_NO	Episode	Method	Sample Point	Sample Day	Concentration	Unit	Baseline Value	Measure Type
TOTAL PHOSPHORUS	14265442	6448	365.2	SP-4+SP-3	4	14.900	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6448	365.2	SP-4+SP-3	5	15.600	MG/L	0.01	NC
TOTAL RESIDUAL CHLORINE	7782505	6443	330.5	SP-2	1	10.600	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6443	330.5	SP-2	2	9.300	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6443	330.5	SP-2	3	1.180	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6444	330.5	SP-3	1	1.120	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6444	330.5	SP-3	2	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6444	330.5	SP-3	3	0.780	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6445	330.5	SP-1	1	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6445	330.5	SP-1	2	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6445	330.5	SP-1	3	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6445	330.5	SP-1	4	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6445	330.5	SP-1	5	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6445	330.5	SP-3+SP-2	1	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6445	330.5	SP-3+SP-2	2	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6445	330.5	SP-3+SP-2	3	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6445	330.5	SP-3+SP-2	4	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6445	330.5	SP-3+SP-2	5	0.300	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6448	330.5	SP-2	1	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6448	330.5	SP-2	2	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6448	330.5	SP-2	3	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6448	330.5	SP-2	4	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6448	330.5	SP-2	5	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6448	330.5	SP-4+SP-3	1	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6448	330.5	SP-4+SP-3	2	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6448	330.5	SP-4+SP-3	3	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6448	330.5	SP-4+SP-3	4	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6448	330.5	SP-4+SP-3	5	0.200	MG/L	0.20	ND
TOTAL SUSPENDED SOLIDS	C009	6443	160.2	SP-2	1	1650.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6443	160.2	SP-2	2	1330.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6443	160.2	SP-2	3	1990.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6444	160.2	SP-3	1	4550.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6444	160.2	SP-3	2	148000.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6444	160.2	SP-3	3	7620.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6445	160.2	SP-1	1	805.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6445	160.2	SP-1	2	855.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6445	160.2	SP-1	3	760.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6445	160.2	SP-1	4	760.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6445	160.2	SP-1	5	700.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6445	160.2	SP-3+SP-2	1	12.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6445	160.2	SP-3+SP-2	2	5.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6445	160.2	SP-3+SP-2	3	7.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6445	160.2	SP-3+SP-2	4	5.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6445	160.2	SP-3+SP-2	5	11.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6448	160.2	SP-2	1	1960.000	MG/L	4.00	NC

Subcategory=Poultry -- Option=BAT2
(continued)

Analyte Name	CAS_NO	Episode	Method	Sample Point	Sample Day	Concentration	Unit	Baseline Value	Measure Type
TOTAL SUSPENDED SOLIDS	C009	6448	160.2	SP-2	2	2900.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6448	160.2	SP-2	3	2260.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6448	160.2	SP-2	4	1860.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6448	160.2	SP-2	5	7260.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6448	160.2	SP-4+SP-3	1	5.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6448	160.2	SP-4+SP-3	2	8.500	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6448	160.2	SP-4+SP-3	3	12.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6448	160.2	SP-4+SP-3	4	10.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6448	160.2	SP-4+SP-3	5	10.000	MG/L	4.00	NC

Subcategory=Poultry -- Option=PSES1

Analyte Name	CAS_NO	Episode	Method	Sample Point	Sample Day	Concentration	Unit	Baseline Value	Measure Type
AMMONIA AS NITROGEN	7664417	6443	350.2	SP-2	1	14.300	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6443	350.2	SP-2	2	6.490	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6443	350.2	SP-2	3	6.680	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6443	350.2	SP-3	1	8.320	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6443	350.2	SP-3	2	6.310	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6443	350.2	SP-3	3	6.310	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6443	350.2	SP-5+SP-4	1	5.490	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6443	350.2	SP-5+SP-4	2	3.205	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6443	350.2	SP-5+SP-4	3	7.410	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6444	350.2	SP-3	1	93.300	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6444	350.2	SP-3	2	15.100	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6444	350.2	SP-3	3	30.200	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6444	350.2	SP-5+SP-4	1	14.250	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6444	350.2	SP-5+SP-4	2	10.735	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6444	350.2	SP-5+SP-4	3	15.200	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6448	350.2	SP-2	1	115.000	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6448	350.2	SP-2	2	95.000	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6448	350.2	SP-2	3	191.000	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6448	350.2	SP-2	4	208.000	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6448	350.2	SP-2	5	161.000	MG/L	0.20	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6443	405.1	SP-2	1	2840.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6443	405.1	SP-2	2	4250.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6443	405.1	SP-2	3	2790.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6443	405.1	SP-3	1	2580.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6443	405.1	SP-3	2	640.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6443	405.1	SP-3	3	3290.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6443	405.1	SP-5+SP-4	1	159.300	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6443	405.1	SP-5+SP-4	2	158.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6443	405.1	SP-5+SP-4	3	325.000	MG/L	2.00	NC

--- Subcategory=Poultry -- Option=PSES1 ---
(continued)

Analyte Name	CAS_NO	Episode	Method	Sample Point	Sample Day	Concentration	Unit	Baseline Value	Measure Type
BIOCHEMICAL OXYGEN DEMAND	C003	6444	405.1	SP-3	1	3760.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6444	405.1	SP-3	2	18600.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6444	405.1	SP-3	3	645.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6444	405.1	SP-5+SP-4	1	187.500	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6444	405.1	SP-5+SP-4	2	139.500	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6444	405.1	SP-5+SP-4	3	282.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6448	405.1	SP-2	1	1720.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6448	405.1	SP-2	2	2050.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6448	405.1	SP-2	3	2010.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6448	405.1	SP-2	4	2070.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6448	405.1	SP-2	5	2070.000	MG/L	2.00	NC
CHEMICAL OXYGEN DEMAND	C004	6443	410.4	SP-2	1	3900.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6443	410.4	SP-2	2	4770.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6443	410.4	SP-2	3	2490.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6443	410.4	SP-3	1	4570.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6443	410.4	SP-3	2	3570.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6443	410.4	SP-3	3	3570.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6443	410.4	SP-5+SP-4	1	4131.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6443	410.4	SP-5+SP-4	2	431.500	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6443	410.4	SP-5+SP-4	3	349.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6444	410.4	SP-3	1	7810.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6444	410.4	SP-3	2	20000.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6444	410.4	SP-3	3	3220.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6444	410.4	SP-5+SP-4	1	579.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6444	410.4	SP-5+SP-4	2	400.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6444	410.4	SP-5+SP-4	3	444.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6448	410.1	SP-2	1	18600.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6448	410.1	SP-2	2	17500.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6448	410.1	SP-2	3	9700.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6448	410.1	SP-2	4	10200.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6448	410.1	SP-2	5	36800.000	MG/L	5.00	NC
FECAL COLIFORM	C2106	6443	9221E	SP-2	2	170000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6443	9221E	SP-2	3	5000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6443	9221E	SP-3	2	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6443	9221E	SP-3	3	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6443	9221E	SP-5+SP-4	2	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6443	9221E	SP-5+SP-4	3	2300.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6448	9221E	SP-2	1	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6448	9221E	SP-2	2	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6448	9221E	SP-2	3	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6448	9221E	SP-2	4	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6448	9221E	SP-2	5	900000.000	/100M	2.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6443	1664	SP-2	1	1656.083	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6443	1664	SP-2	2	331.733	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6443	1664	SP-2	3	390.633	MG/L	5.00	NC

--- Subcategory=Poultry -- Option=PSES1 ---
(continued)

Analyte Name	CAS_NO	Episode	Method	Sample Point	Sample Day	Concentration	Unit	Baseline Value	Measure Type
HEXANE EXTRACTABLE MATERIAL	C036	6443	1664	SP-3	2	293.400	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6443	1664	SP-3	3	301.167	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6443	1664	SP-5+SP-4	1	9.885	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6443	1664	SP-5+SP-4	3	5.900	MG/L	5.00	ND
HEXANE EXTRACTABLE MATERIAL	C036	6444	1664	SP-3	1	238.500	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6444	1664	SP-3	2	801.083	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6444	1664	SP-3	3	230.167	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6444	1664	SP-5+SP-4	1	34.892	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6444	1664	SP-5+SP-4	2	14.613	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6444	1664	SP-5+SP-4	3	7.800	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6448	1664	SP-2	1	2768.167	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6448	1664	SP-2	2	1134.333	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6448	1664	SP-2	3	499.167	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6448	1664	SP-2	4	1986.000	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6448	1664	SP-2	5	24739.833	MG/L	5.00	NC
NITRATE/NITRITE	C005	6443	300.0	SP-2	1	3.230	MG/L	0.05	NC
NITRATE/NITRITE	C005	6443	300.0	SP-2	2	0.750	MG/L	0.05	ND
NITRATE/NITRITE	C005	6443	300.0	SP-2	3	0.750	MG/L	0.05	ND
NITRATE/NITRITE	C005	6443	300.0	SP-3	1	0.750	MG/L	0.05	ND
NITRATE/NITRITE	C005	6443	300.0	SP-3	2	0.750	MG/L	0.05	ND
NITRATE/NITRITE	C005	6443	300.0	SP-3	3	0.750	MG/L	0.05	ND
NITRATE/NITRITE	C005	6443	300.0	SP-5+SP-4	1	1.480	MG/L	0.05	NC
NITRATE/NITRITE	C005	6443	300.0	SP-5+SP-4	2	0.750	MG/L	0.05	ND
NITRATE/NITRITE	C005	6443	300.0	SP-5+SP-4	3	0.750	MG/L	0.05	ND
NITRATE/NITRITE	C005	6444	300.0	SP-3	1	0.300	MG/L	0.05	ND
NITRATE/NITRITE	C005	6444	300.0	SP-3	2	0.300	MG/L	0.05	ND
NITRATE/NITRITE	C005	6444	300.0	SP-3	3	0.300	MG/L	0.05	ND
NITRATE/NITRITE	C005	6444	300.0	SP-5+SP-4	1	0.300	MG/L	0.05	ND
NITRATE/NITRITE	C005	6444	300.0	SP-5+SP-4	2	0.300	MG/L	0.05	ND
NITRATE/NITRITE	C005	6444	300.0	SP-5+SP-4	3	0.300	MG/L	0.05	ND
NITRATE/NITRITE	C005	6448	353.1	SP-2	1	34.000	MG/L	0.05	NC
NITRATE/NITRITE	C005	6448	353.1	SP-2	2	25.500	MG/L	0.05	NC
NITRATE/NITRITE	C005	6448	353.1	SP-2	3	19.000	MG/L	0.05	NC
NITRATE/NITRITE	C005	6448	353.1	SP-2	4	21.000	MG/L	0.05	NC
NITRATE/NITRITE	C005	6448	353.1	SP-2	5	30.600	MG/L	0.05	NC
TOTAL KJELDAHL NITROGEN	C021	6443	351.3	SP-2	1	147.000	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6443	351.3	SP-2	2	24.600	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6443	351.3	SP-2	3	68.800	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6443	351.3	SP-3	1	41.300	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6443	351.3	SP-3	2	94.300	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6443	351.3	SP-3	3	80.900	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6443	351.3	SP-5+SP-4	1	19.850	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6443	351.3	SP-5+SP-4	2	26.400	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6443	351.3	SP-5+SP-4	3	19.300	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6444	351.3	SP-3	1	271.000	MG/L	0.50	NC

-- Subcategory=Poultry -- Option=PSES1 --
(continued)

Analyte Name	CAS_NO	Episode	Method	Sample Point	Sample Day	Concentration	Unit	Baseline Value	Measure Type
TOTAL KJELDAHL NITROGEN	C021	6444	351.3	SP-3	2	63.600	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6444	351.3	SP-3	3	271.000	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6444	351.3	SP-5+SP-4	1	42.900	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6444	351.3	SP-5+SP-4	2	43.800	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6444	351.3	SP-5+SP-4	3	53.500	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6448	351.3	SP-2	1	171.000	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6448	351.3	SP-2	2	103.000	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6448	351.3	SP-2	3	202.000	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6448	351.3	SP-2	4	212.000	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6448	351.3	SP-2	5	210.000	MG/L	0.50	NC
TOTAL NITROGEN	C005+C021	6443	351.3	SP-2	1	150.230	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6443	351.3	SP-2	2	25.350	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6443	351.3	SP-2	3	69.550	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6443	351.3	SP-3	1	42.050	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6443	351.3	SP-3	2	95.050	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6443	351.3	SP-3	3	81.650	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6443	351.3	SP-5+SP-4	1	21.330	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6443	351.3	SP-5+SP-4	2	27.150	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6443	351.3	SP-5+SP-4	3	20.050	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6444	351.3	SP-3	1	271.300	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6444	351.3	SP-3	2	63.900	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6444	351.3	SP-3	3	271.300	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6444	351.3	SP-5+SP-4	1	43.200	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6444	351.3	SP-5+SP-4	2	44.100	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6444	351.3	SP-5+SP-4	3	53.800	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6448	351.3	SP-2	1	205.000	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6448	351.3	SP-2	2	128.500	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6448	351.3	SP-2	3	221.000	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6448	351.3	SP-2	4	233.000	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6448	351.3	SP-2	5	240.600	MG/L	0.55	NC
TOTAL PHOSPHORUS	14265442	6443	365.3	SP-2	1	94.500	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6443	365.3	SP-2	2	52.700	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6443	365.3	SP-2	3	69.400	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6443	365.3	SP-3	1	29.900	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6443	365.3	SP-3	2	47.900	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6443	365.3	SP-3	3	34.800	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6443	365.3	SP-5+SP-4	1	13.250	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6443	365.3	SP-5+SP-4	2	27.600	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6443	365.3	SP-5+SP-4	3	11.600	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6444	365.3	SP-3	1	53.100	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6444	365.3	SP-3	2	77.200	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6444	365.3	SP-3	3	808.000	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6444	365.3	SP-5+SP-4	1	1.510	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6444	365.3	SP-5+SP-4	2	2.285	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6444	365.3	SP-5+SP-4	3	49.400	MG/L	0.01	NC

--- Subcategory=Poultry -- Option=PSES1 ---
(continued)

Analyte Name	CAS_NO	Episode	Method	Sample Point	Sample Day	Concentration	Unit	Baseline Value	Measure Type
TOTAL PHOSPHORUS	14265442	6448	365.2	SP-2	1	37.600	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6448	365.2	SP-2	2	31.600	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6448	365.2	SP-2	3	35.900	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6448	365.2	SP-2	4	31.100	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6448	365.2	SP-2	5	51.500	MG/L	0.01	NC
TOTAL RESIDUAL CHLORINE	7782505	6443	330.5	SP-2	1	10.600	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6443	330.5	SP-2	2	9.300	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6443	330.5	SP-2	3	1.180	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6443	330.5	SP-3	1	0.210	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6443	330.5	SP-3	2	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6443	330.5	SP-3	3	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6443	330.5	SP-5+SP-4	1	0.790	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6443	330.5	SP-5+SP-4	2	0.640	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6443	330.5	SP-5+SP-4	3	1.010	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6444	330.5	SP-3	1	1.120	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6444	330.5	SP-3	2	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6444	330.5	SP-3	3	0.780	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6444	330.5	SP-5+SP-4	1	0.295	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6444	330.5	SP-5+SP-4	2	0.240	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6444	330.5	SP-5+SP-4	3	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6448	330.5	SP-2	1	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6448	330.5	SP-2	2	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6448	330.5	SP-2	3	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6448	330.5	SP-2	4	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6448	330.5	SP-2	5	0.200	MG/L	0.20	ND
TOTAL SUSPENDED SOLIDS	C009	6443	160.2	SP-2	1	1650.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6443	160.2	SP-2	2	1330.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6443	160.2	SP-2	3	1990.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6443	160.2	SP-3	1	1680.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6443	160.2	SP-3	2	1610.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6443	160.2	SP-3	3	1280.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6443	160.2	SP-5+SP-4	1	114.500	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6443	160.2	SP-5+SP-4	2	160.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6443	160.2	SP-5+SP-4	3	138.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6444	160.2	SP-3	1	4550.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6444	160.2	SP-3	2	148000.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6444	160.2	SP-3	3	7620.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6444	160.2	SP-5+SP-4	1	59.500	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6444	160.2	SP-5+SP-4	2	51.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6444	160.2	SP-5+SP-4	3	56.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6448	160.2	SP-2	1	1960.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6448	160.2	SP-2	2	2900.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6448	160.2	SP-2	3	2260.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6448	160.2	SP-2	4	1860.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6448	160.2	SP-2	5	7260.000	MG/L	4.00	NC

-- Subcategory=Red Meat -- Option=BAT2 --

Analyte Name	CAS_NO	Episode	Method	Sample Point	Sample Day	Concentration	Unit	Baseline Value	Measure Type
AMMONIA AS NITROGEN	7664417	6335	350.2	SP-2	1	6.810	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6335	350.2	SP-2	2	10.700	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6335	350.2	SP-2	3	13.200	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6335	350.2	SP-2	4	10.800	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6335	350.2	SP-2	5	34.100	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6440	350.2	SP-3	1	0.220	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6440	350.2	SP-3	2	0.120	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6440	350.2	SP-3	3	0.100	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6440	350.2	SP-5+SP-4	1	0.170	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6440	350.2	SP-5+SP-4	2	0.130	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6440	350.2	SP-5+SP-4	3	0.080	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6441	350.2	SP-1+SP-3	1	155.784	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6441	350.2	SP-1+SP-3	2	139.464	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6441	350.2	SP-1+SP-3	3	167.238	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6441	350.2	SP-6+SP-5	1	1.000	MG/L	0.20	ND
AMMONIA AS NITROGEN	7664417	6441	350.2	SP-6+SP-5	2	1.000	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6441	350.2	SP-6+SP-5	3	1.000	MG/L	0.20	ND
AMMONIA AS NITROGEN	7664417	6442	350.2	SP-1	1	38.600	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6442	350.2	SP-1	2	40.300	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6442	350.2	SP-1	3	54.600	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6442	350.2	SP-1	4	40.600	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6442	350.2	SP-1	5	39.800	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6442	350.2	SP-5+SP-4	1	0.610	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6442	350.2	SP-5+SP-4	2	0.435	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6442	350.2	SP-5+SP-4	3	1.220	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6442	350.2	SP-5+SP-4	4	0.910	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6442	350.2	SP-5+SP-4	5	0.790	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6447	350.2	SP-1	1	94.500	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6447	350.2	SP-1	2	86.900	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6447	350.2	SP-1	3	122.000	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6447	350.2	SP-3	1	5.790	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6447	350.2	SP-3	2	57.200	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6447	350.2	SP-3	3	92.200	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6447	350.2	SP-5+SP-4	1	0.390	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6447	350.2	SP-5+SP-4	2	0.480	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6447	350.2	SP-5+SP-4	3	0.660	MG/L	0.20	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6335	405.1	SP-2	1	1410.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6335	405.1	SP-2	2	1220.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6335	405.1	SP-2	3	1600.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6335	405.1	SP-2	4	1820.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6335	405.1	SP-2	5	1410.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6440	405.1	SP-3	1	600.000	MG/L	2.00	ND
BIOCHEMICAL OXYGEN DEMAND	C003	6440	405.1	SP-3	2	2020.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6440	405.1	SP-3	3	2130.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6440	405.1	SP-5+SP-4	1	8.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6440	405.1	SP-5+SP-4	2	7.000	MG/L	2.00	NC

--- Subcategory=Red Meat -- Option=BAT2 ---
(continued)

Analyte Name	CAS_NO	Episode	Method	Sample Point	Sample Day	Concentration	Unit	Baseline Value	Measure Type
BIOCHEMICAL OXYGEN DEMAND	C003	6440	405.1	SP-5+SP-4	3	6.000	MG/L	2.00	ND
BIOCHEMICAL OXYGEN DEMAND	C003	6441	405.1	SP-1+SP-3	1	1656.408	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6441	405.1	SP-1+SP-3	2	13297.699	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6441	405.1	SP-1+SP-3	3	2945.149	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6441	405.1	SP-6+SP-5	1	11.495	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6441	405.1	SP-6+SP-5	2	5.020	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6441	405.1	SP-6+SP-5	3	2.390	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6442	405.1	SP-1	1	4340.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6442	405.1	SP-1	2	8400.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6442	405.1	SP-1	3	7190.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6442	405.1	SP-1	4	6320.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6442	405.1	SP-1	5	5770.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6442	405.1	SP-5+SP-4	1	6.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6442	405.1	SP-5+SP-4	2	6.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6442	405.1	SP-5+SP-4	3	8.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6442	405.1	SP-5+SP-4	4	6.000	MG/L	2.00	ND
BIOCHEMICAL OXYGEN DEMAND	C003	6442	405.1	SP-5+SP-4	5	8.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6447	405.1	SP-1	1	2740.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6447	405.1	SP-1	2	3350.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6447	405.1	SP-1	3	5520.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6447	405.1	SP-3	1	3530.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6447	405.1	SP-3	2	2910.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6447	405.1	SP-3	3	4580.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6447	405.1	SP-5+SP-4	1	4.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6447	405.1	SP-5+SP-4	2	4.000	MG/L	2.00	ND
BIOCHEMICAL OXYGEN DEMAND	C003	6447	405.1	SP-5+SP-4	3	6.000	MG/L	2.00	NC
CHEMICAL OXYGEN DEMAND	C004	6335	410.1	SP-2	1	2570.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6335	410.1	SP-2	2	2600.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6335	410.1	SP-2	3	2630.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6335	410.1	SP-2	4	2700.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6335	410.1	SP-2	5	2650.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6440	410.1	SP-3	1	1780.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6440	410.1	SP-3	2	3670.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6440	410.1	SP-3	3	5920.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6440	410.2	SP-5+SP-4	1	34.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6440	410.2	SP-5+SP-4	2	31.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6440	410.2	SP-5+SP-4	3	34.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6441	410.4	SP-1+SP-3	1	4392.891	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6441	410.4	SP-1+SP-3	2	2694.342	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6441	410.4	SP-1+SP-3	3	3291.873	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6441	410.4	SP-6+SP-5	1	21.650	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6441	410.4	SP-6+SP-5	2	25.350	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6441	410.4	SP-6+SP-5	3	20.000	MG/L	5.00	ND
CHEMICAL OXYGEN DEMAND	C004	6442	410.1	SP-1	1	10100.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6442	410.1	SP-1	2	21600.000	MG/L	5.00	NC

--- Subcategory=Red Meat -- Option=BAT2 ---
(continued)

Analyte Name	CAS_NO	Episode	Method	Sample Point	Sample Day	Concentration	Unit	Baseline Value	Measure Type
CHEMICAL OXYGEN DEMAND	C004	6442	410.1	SP-1	3	18200.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6442	410.1	SP-1	4	47200.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6442	410.1	SP-1	5	12300.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6442	410.1	SP-5+SP-4	1	117.500	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6442	410.1	SP-5+SP-4	2	135.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6442	410.1	SP-5+SP-4	3	112.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6442	410.1	SP-5+SP-4	4	109.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6442	410.1	SP-5+SP-4	5	112.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6447	410.1	SP-1	1	5550.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6447	410.1	SP-1	2	5090.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6447	410.1	SP-1	3	7180.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6447	410.1	SP-3	1	8540.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6447	410.1	SP-3	2	6720.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6447	410.1	SP-3	3	8260.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6447	410.2	SP-5+SP-4	1	41.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6447	410.2	SP-5+SP-4	2	45.500	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6447	410.2	SP-5+SP-4	3	55.000	MG/L	5.00	NC
FECAL COLIFORM	C2106	6335	9221E	SP-2	1	300000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6335	9221E	SP-2	2	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6335	9221E	SP-2	3	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6335	9221E	SP-2	4	300000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6335	9221E	SP-2	5	300000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6440	9221E	SP-3	1	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6440	9221E	SP-3	2	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6440	9221E	SP-3	3	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6440	9221E	SP-5+SP-4	1	26.500	/100M	2.00	NC
FECAL COLIFORM	C2106	6440	9221E	SP-5+SP-4	2	36.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6440	9221E	SP-5+SP-4	3	2.000	/100M	2.00	ND
FECAL COLIFORM	C2106	6441	9221E	SP-1+SP-3	1	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6441	9221E	SP-1+SP-3	2	407518.610	/100M	2.00	NC
FECAL COLIFORM	C2106	6441	9221E	SP-1+SP-3	3	1180694.789	/100M	2.00	NC
FECAL COLIFORM	C2106	6441	9221E	SP-6+SP-5	1	2.000	/100M	2.00	ND
FECAL COLIFORM	C2106	6441	9221E	SP-6+SP-5	2	2.000	/100M	2.00	ND
FECAL COLIFORM	C2106	6441	9221E	SP-6+SP-5	3	2300.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6442	9221E	SP-1	1	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6442	9221E	SP-1	2	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6442	9221E	SP-1	3	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6442	9221E	SP-1	4	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6442	9221E	SP-1	5	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6442	9221E	SP-5+SP-4	1	13.500	/100M	2.00	NC
FECAL COLIFORM	C2106	6442	9221E	SP-5+SP-4	2	3.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6442	9221E	SP-5+SP-4	3	70.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6442	9221E	SP-5+SP-4	4	2300.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6442	9221E	SP-5+SP-4	5	80.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6447	9221E	SP-1	1	1600000.000	/100M	2.00	NC

--- Subcategory=Red Meat -- Option=BAT2 ---
(continued)

Analyte Name	CAS_NO	Episode	Method	Sample Point	Sample Day	Concentration	Unit	Baseline Value	Measure Type
FECAL COLIFORM	C2106	6447	9221E	SP-1	2	500000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6447	9221E	SP-1	3	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6447	9221E	SP-3	1	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6447	9221E	SP-3	2	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6447	9221E	SP-3	3	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6447	9221E	SP-5+SP-4	1	2.000	/100M	2.00	ND
FECAL COLIFORM	C2106	6447	9221E	SP-5+SP-4	2	66.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6447	9221E	SP-5+SP-4	3	30.000	/100M	2.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6335	1664	SP-2	1	230.167	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6335	1664	SP-2	2	186.000	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6335	1664	SP-2	3	96.333	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6335	1664	SP-2	4	122.833	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6335	1664	SP-2	5	178.500	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6440	1664	SP-3	1	107.167	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6440	1664	SP-3	2	160.667	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6440	1664	SP-3	3	226.667	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6440	1664	SP-5+SP-4	1	5.917	MG/L	5.00	ND
HEXANE EXTRACTABLE MATERIAL	C036	6440	1664	SP-5+SP-4	2	6.000	MG/L	5.00	ND
HEXANE EXTRACTABLE MATERIAL	C036	6440	1664	SP-5+SP-4	3	5.833	MG/L	5.00	ND
HEXANE EXTRACTABLE MATERIAL	C036	6441	1664	SP-1+SP-3	1	183.447	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6441	1664	SP-1+SP-3	2	57.341	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6441	1664	SP-1+SP-3	3	99.377	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6441	1664	SP-6+SP-5	1	5.733	MG/L	5.00	ND
HEXANE EXTRACTABLE MATERIAL	C036	6441	1664	SP-6+SP-5	2	5.858	MG/L	5.00	ND
HEXANE EXTRACTABLE MATERIAL	C036	6441	1664	SP-6+SP-5	3	5.783	MG/L	5.00	ND
HEXANE EXTRACTABLE MATERIAL	C036	6442	1664	SP-1	1	1926.833	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6442	1664	SP-1	2	4556.667	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6442	1664	SP-1	3	3318.333	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6442	1664	SP-1	4	3159.500	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6442	1664	SP-1	5	2026.667	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6442	1664	SP-5+SP-4	1	6.500	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6442	1664	SP-5+SP-4	2	6.000	MG/L	5.00	ND
HEXANE EXTRACTABLE MATERIAL	C036	6442	1664	SP-5+SP-4	3	6.000	MG/L	5.00	ND
HEXANE EXTRACTABLE MATERIAL	C036	6442	1664	SP-5+SP-4	4	6.000	MG/L	5.00	ND
HEXANE EXTRACTABLE MATERIAL	C036	6442	1664	SP-5+SP-4	5	5.833	MG/L	5.00	ND
HEXANE EXTRACTABLE MATERIAL	C036	6447	1664	SP-1	1	119.667	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6447	1664	SP-1	2	312.667	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6447	1664	SP-1	3	651.500	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6447	1664	SP-3	1	534.000	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6447	1664	SP-3	2	454.833	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6447	1664	SP-3	3	868.000	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6447	1664	SP-5+SP-4	1	5.333	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6447	1664	SP-5+SP-4	2	5.500	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6447	1664	SP-5+SP-4	3	24.833	MG/L	5.00	NC
NITRATE/NITRITE	C005	6335	353.1	SP-2	1	2.300	MG/L	0.05	NC

Subcategory=Red Meat -- Option=BAT2
(continued)

Analyte Name	CAS_NO	Episode	Method	Sample Point	Sample Day	Concentration	Unit	Baseline Value	Measure Type
NITRATE/NITRITE	C005	6335	353.1	SP-2	2	2.160	MG/L	0.05	NC
NITRATE/NITRITE	C005	6335	353.1	SP-2	3	1.890	MG/L	0.05	NC
NITRATE/NITRITE	C005	6335	353.1	SP-2	4	2.160	MG/L	0.05	NC
NITRATE/NITRITE	C005	6335	353.1	SP-2	5	2.120	MG/L	0.05	NC
NITRATE/NITRITE	C005	6440	353.1	SP-3	1	0.100	MG/L	0.05	NC
NITRATE/NITRITE	C005	6440	353.1	SP-3	2	0.190	MG/L	0.05	NC
NITRATE/NITRITE	C005	6440	353.1	SP-3	3	0.190	MG/L	0.05	NC
NITRATE/NITRITE	C005	6440	353.1	SP-5+SP-4	1	73.750	MG/L	0.05	NC
NITRATE/NITRITE	C005	6440	353.1	SP-5+SP-4	2	76.450	MG/L	0.05	NC
NITRATE/NITRITE	C005	6440	353.1	SP-5+SP-4	3	70.800	MG/L	0.05	NC
NITRATE/NITRITE	C005	6441	300.0	SP-1+SP-3	1	0.300	MG/L	0.05	ND
NITRATE/NITRITE	C005	6441	300.0	SP-1+SP-3	2	0.300	MG/L	0.05	ND
NITRATE/NITRITE	C005	6441	300.0	SP-1+SP-3	3	2.154	MG/L	0.05	NC
NITRATE/NITRITE	C005	6441	300.0	SP-6+SP-5	1	177.500	MG/L	0.05	NC
NITRATE/NITRITE	C005	6441	300.0	SP-6+SP-5	2	160.500	MG/L	0.05	NC
NITRATE/NITRITE	C005	6441	300.0	SP-6+SP-5	3	148.000	MG/L	0.05	NC
NITRATE/NITRITE	C005	6442	353.1	SP-1	1	0.010	MG/L	0.05	NC
NITRATE/NITRITE	C005	6442	353.1	SP-1	2	0.010	MG/L	0.05	ND
NITRATE/NITRITE	C005	6442	353.1	SP-1	3	0.040	MG/L	0.05	NC
NITRATE/NITRITE	C005	6442	353.1	SP-1	4	0.010	MG/L	0.05	ND
NITRATE/NITRITE	C005	6442	353.1	SP-1	5	0.020	MG/L	0.05	NC
NITRATE/NITRITE	C005	6442	353.1	SP-5+SP-4	1	172.000	MG/L	0.05	NC
NITRATE/NITRITE	C005	6442	353.1	SP-5+SP-4	2	165.000	MG/L	0.05	NC
NITRATE/NITRITE	C005	6442	353.1	SP-5+SP-4	3	168.000	MG/L	0.05	NC
NITRATE/NITRITE	C005	6442	353.1	SP-5+SP-4	4	156.000	MG/L	0.05	NC
NITRATE/NITRITE	C005	6442	353.1	SP-5+SP-4	5	159.000	MG/L	0.05	NC
NITRATE/NITRITE	C005	6447	353.1	SP-1	1	0.010	MG/L	0.05	ND
NITRATE/NITRITE	C005	6447	353.1	SP-1	2	0.820	MG/L	0.05	NC
NITRATE/NITRITE	C005	6447	353.1	SP-1	3	0.600	MG/L	0.05	NC
NITRATE/NITRITE	C005	6447	353.1	SP-3	1	0.010	MG/L	0.05	ND
NITRATE/NITRITE	C005	6447	353.1	SP-3	2	0.550	MG/L	0.05	NC
NITRATE/NITRITE	C005	6447	353.1	SP-3	3	0.010	MG/L	0.05	ND
NITRATE/NITRITE	C005	6447	353.1	SP-5+SP-4	1	313.500	MG/L	0.05	NC
NITRATE/NITRITE	C005	6447	353.1	SP-5+SP-4	2	273.000	MG/L	0.05	NC
NITRATE/NITRITE	C005	6447	353.1	SP-5+SP-4	3	282.000	MG/L	0.05	NC
TOTAL KJELDAHL NITROGEN	C021	6335	351.3	SP-2	1	36.000	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6335	351.3	SP-2	2	11.500	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6440	351.3	SP-3	1	153.000	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6440	351.3	SP-3	2	15.400	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6440	351.3	SP-3	3	163.000	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6440	351.3	SP-5+SP-4	1	1.985	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6440	351.3	SP-5+SP-4	2	1.645	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6440	351.3	SP-5+SP-4	3	1.840	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6441	351.3	SP-1+SP-3	1	399.757	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6441	351.3	SP-1+SP-3	2	501.210	MG/L	0.50	NC

--- Subcategory=Red Meat -- Option=BAT2 ---
(continued)

Analyte Name	CAS_NO	Episode	Method	Sample Point	Sample Day	Concentration	Unit	Baseline Value	Measure Type
TOTAL KJELDAHL NITROGEN	C021	6441	351.3	SP-1+SP-3	3	420.923	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6441	351.3	SP-6+SP-5	1	1.430	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6441	351.3	SP-6+SP-5	2	2.400	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6441	351.3	SP-6+SP-5	3	1.000	MG/L	0.50	ND
TOTAL KJELDAHL NITROGEN	C021	6442	351.3	SP-1	1	48.200	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6442	351.3	SP-1	2	74.700	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6442	351.3	SP-1	3	173.000	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6442	351.3	SP-1	4	42.500	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6442	351.3	SP-1	5	49.500	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6442	351.3	SP-5+SP-4	1	11.075	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6442	351.3	SP-5+SP-4	2	2.655	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6442	351.3	SP-5+SP-4	3	4.520	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6442	351.3	SP-5+SP-4	4	4.680	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6442	351.3	SP-5+SP-4	5	5.190	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6447	351.3	SP-1	1	96.400	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6447	351.3	SP-1	2	103.000	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6447	351.3	SP-1	3	225.000	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6447	351.3	SP-3	1	47.100	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6447	351.3	SP-3	2	56.900	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6447	351.3	SP-3	3	96.000	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6447	351.3	SP-5+SP-4	1	1.605	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6447	351.3	SP-5+SP-4	2	2.195	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6447	351.3	SP-5+SP-4	3	5.290	MG/L	0.50	NC
TOTAL NITROGEN	C005+C021	6335	351.3	SP-2	1	38.300	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6335	351.3	SP-2	2	13.660	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6440	351.3	SP-3	1	153.100	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6440	351.3	SP-3	2	15.590	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6440	351.3	SP-3	3	163.190	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6440	351.3	SP-5+SP-4	1	75.735	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6440	351.3	SP-5+SP-4	2	78.095	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6440	351.3	SP-5+SP-4	3	72.640	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6441	351.3	SP-1+SP-3	1	400.057	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6441	351.3	SP-1+SP-3	2	501.510	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6441	351.3	SP-1+SP-3	3	423.077	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6441	351.3	SP-6+SP-5	1	178.930	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6441	351.3	SP-6+SP-5	2	162.900	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6441	351.3	SP-6+SP-5	3	149.000	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6442	351.3	SP-1	1	48.210	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6442	351.3	SP-1	2	74.710	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6442	351.3	SP-1	3	173.040	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6442	351.3	SP-1	4	42.510	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6442	351.3	SP-1	5	49.520	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6442	351.3	SP-5+SP-4	1	183.075	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6442	351.3	SP-5+SP-4	2	167.655	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6442	351.3	SP-5+SP-4	3	172.520	MG/L	0.55	NC

-- Subcategory=Red Meat -- Option=BAT2 --
(continued)

Analyte Name	CAS_NO	Episode	Method	Sample Point	Sample Day	Concentration	Unit	Baseline Value	Measure Type
TOTAL NITROGEN	C005+C021	6442	351.3	SP-5+SP-4	4	160.680	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6442	351.3	SP-5+SP-4	5	164.190	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6447	351.3	SP-1	1	96.410	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6447	351.3	SP-1	2	103.820	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6447	351.3	SP-1	3	225.600	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6447	351.3	SP-3	1	47.110	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6447	351.3	SP-3	2	57.450	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6447	351.3	SP-3	3	96.010	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6447	351.3	SP-5+SP-4	1	315.105	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6447	351.3	SP-5+SP-4	2	275.195	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6447	351.3	SP-5+SP-4	3	287.290	MG/L	0.55	NC
TOTAL PHOSPHORUS	14265442	6335	365.2	SP-2	1	77.600	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6335	365.2	SP-2	2	85.200	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6335	365.2	SP-2	3	88.400	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6335	365.2	SP-2	4	78.900	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6335	365.2	SP-2	5	78.300	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6440	365.2	SP-3	1	29.500	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6440	365.2	SP-3	2	47.200	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6440	365.2	SP-3	3	93.400	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6440	365.2	SP-5+SP-4	1	10.700	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6440	365.2	SP-5+SP-4	2	11.850	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6440	365.2	SP-5+SP-4	3	12.400	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6441	365.3	SP-1+SP-3	1	28.157	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6441	365.3	SP-1+SP-3	2	28.114	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6441	365.3	SP-1+SP-3	3	122.484	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6441	365.3	SP-6+SP-5	1	12.000	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6441	365.3	SP-6+SP-5	2	11.470	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6441	365.3	SP-6+SP-5	3	11.000	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6442	365.2	SP-1	1	27.700	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6442	365.2	SP-1	2	34.700	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6442	365.2	SP-1	3	32.800	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6442	365.2	SP-1	4	32.800	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6442	365.2	SP-1	5	23.300	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6442	365.2	SP-5+SP-4	1	31.500	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6442	365.2	SP-5+SP-4	2	32.500	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6442	365.2	SP-5+SP-4	3	30.900	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6442	365.2	SP-5+SP-4	4	32.200	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6442	365.2	SP-5+SP-4	5	29.600	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6447	365.2	SP-1	1	34.700	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6447	365.2	SP-1	2	27.700	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6447	365.2	SP-1	3	34.100	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6447	365.2	SP-3	1	34.700	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6447	365.2	SP-3	2	27.100	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6447	365.2	SP-3	3	42.400	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6447	365.2	SP-5+SP-4	1	16.850	MG/L	0.01	NC

--- Subcategory=Red Meat -- Option=BAT2 ---
(continued)

Analyte Name	CAS_NO	Episode	Method	Sample Point	Sample Day	Concentration	Unit	Baseline Value	Measure Type
TOTAL PHOSPHORUS	14265442	6447	365.2	SP-5+SP-4	2	14.250	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6447	365.2	SP-5+SP-4	3	13.100	MG/L	0.01	NC
TOTAL RESIDUAL CHLORINE	7782505	6335	HACH 8167	SP-2	1	0.370	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6335	HACH 8167	SP-2	2	0.100	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6335	HACH 8167	SP-2	3	0.370	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6335	HACH 8167	SP-2	4	0.160	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6335	HACH 8167	SP-2	5	0.240	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6440	330.5	SP-3	1	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6440	330.5	SP-3	2	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6440	330.5	SP-3	3	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6440	330.5	SP-5+SP-4	1	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6440	330.5	SP-5+SP-4	2	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6440	330.5	SP-5+SP-4	3	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6441	330.5	SP-1+SP-3	1	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6441	330.5	SP-1+SP-3	2	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6441	330.5	SP-1+SP-3	3	0.269	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6441	330.5	SP-6+SP-5	1	0.205	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6441	330.5	SP-6+SP-5	2	0.285	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6441	330.5	SP-6+SP-5	3	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6442	330.5	SP-1	1	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6442	330.5	SP-1	2	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6442	330.5	SP-1	3	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6442	330.5	SP-1	4	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6442	330.5	SP-1	5	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6442	330.5	SP-5+SP-4	1	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6442	330.5	SP-5+SP-4	2	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6442	330.5	SP-5+SP-4	3	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6442	330.5	SP-5+SP-4	4	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6442	330.5	SP-5+SP-4	5	0.200	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6447	330.5	SP-1	1	0.400	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6447	330.5	SP-1	2	0.400	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6447	330.5	SP-1	3	0.400	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6447	330.5	SP-3	1	1.000	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6447	330.5	SP-3	2	1.000	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6447	330.5	SP-3	3	1.000	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6447	330.5	SP-5+SP-4	1	0.605	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6447	330.5	SP-5+SP-4	2	0.330	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6447	330.5	SP-5+SP-4	3	0.910	MG/L	0.20	NC
TOTAL SUSPENDED SOLIDS	C009	6335	160.2	SP-2	1	360.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6335	160.2	SP-2	2	420.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6335	160.2	SP-2	3	463.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6335	160.2	SP-2	4	337.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6335	160.2	SP-2	5	233.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6440	160.2	SP-3	1	840.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6440	160.2	SP-3	2	3080.000	MG/L	4.00	NC

--- Subcategory=Red Meat -- Option=BAT2 ---
(continued)

Analyte Name	CAS_NO	Episode	Method	Sample Point	Sample Day	Concentration	Unit	Baseline Value	Measure Type
TOTAL SUSPENDED SOLIDS	C009	6440	160.2	SP-3	3	2900.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6440	160.2	SP-5+SP-4	1	12.500	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6440	160.2	SP-5+SP-4	2	16.500	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6440	160.2	SP-5+SP-4	3	8.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6441	160.2	SP-1+SP-3	1	1359.677	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6441	160.2	SP-1+SP-3	2	1213.914	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6441	160.2	SP-1+SP-3	3	827.829	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6441	160.2	SP-6+SP-5	1	18.500	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6441	160.2	SP-6+SP-5	2	48.500	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6441	160.2	SP-6+SP-5	3	17.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6442	160.2	SP-1	1	3340.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6442	160.2	SP-1	2	2580.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6442	160.2	SP-1	3	3580.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6442	160.2	SP-1	4	3340.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6442	160.2	SP-1	5	3820.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6442	160.2	SP-5+SP-4	1	27.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6442	160.2	SP-5+SP-4	2	22.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6442	160.2	SP-5+SP-4	3	19.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6442	160.2	SP-5+SP-4	4	20.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6442	160.2	SP-5+SP-4	5	23.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6447	160.2	SP-1	1	850.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6447	160.2	SP-1	2	640.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6447	160.2	SP-1	3	1020.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6447	160.2	SP-3	1	1350.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6447	160.2	SP-3	2	1410.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6447	160.2	SP-3	3	1770.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6447	160.2	SP-5+SP-4	1	16.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6447	160.2	SP-5+SP-4	2	21.500	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6447	160.2	SP-5+SP-4	3	20.000	MG/L	4.00	NC

--- Subcategory=Red Meat -- Option=BAT3 ---

Analyte Name	CAS_NO	Episode	Method	Sample Point	Sample Day	Concentration	Unit	Baseline Value	Measure Type
AMMONIA AS NITROGEN	7664417	6335	350.2	SP-2	1	6.810	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6335	350.2	SP-2	2	10.700	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6335	350.2	SP-2	3	13.200	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6335	350.2	SP-2	4	10.800	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6335	350.2	SP-2	5	34.100	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6335	350.2	SP-3	1	140.000	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6335	350.2	SP-3	2	199.000	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6335	350.2	SP-3	3	251.000	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6335	350.2	SP-3	4	310.000	MG/L	0.20	NC

--- Subcategory=Red Meat -- Option=BAT3 ---
(continued)

Analyte Name	CAS_NO	Episode	Method	Sample Point	Sample Day	Concentration	Unit	Baseline Value	Measure Type
AMMONIA AS NITROGEN	7664417	6335	350.2	SP-3	5	464.000	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6335	350.2	SP-6	1	0.330	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6335	350.2	SP-6	2	1.250	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6335	350.2	SP-6	3	2.980	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6335	350.2	SP-6	4	2.900	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6447	350.2	SP-1	1	94.500	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6447	350.2	SP-1	2	86.900	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6447	350.2	SP-1	3	122.000	MG/L	0.20	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6335	405.1	SP-2	1	1410.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6335	405.1	SP-2	2	1220.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6335	405.1	SP-2	3	1600.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6335	405.1	SP-2	4	1820.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6335	405.1	SP-2	5	1410.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6335	405.1	SP-3	1	2060.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6335	405.1	SP-3	2	2070.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6335	405.1	SP-3	3	2070.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6335	405.1	SP-3	4	1740.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6335	405.1	SP-3	5	3100.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6335	405.1	SP-6	1	7.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6335	405.1	SP-6	2	3.000	MG/L	2.00	ND
BIOCHEMICAL OXYGEN DEMAND	C003	6335	405.1	SP-6	3	3.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6335	405.1	SP-6	4	4.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6335	405.1	SP-6	5	6.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6447	405.1	SP-1	1	2740.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6447	405.1	SP-1	2	3350.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6447	405.1	SP-1	3	5520.000	MG/L	2.00	NC
CHEMICAL OXYGEN DEMAND	C004	6335	410.1	SP-2	1	2570.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6335	410.1	SP-2	2	2600.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6335	410.1	SP-2	3	2630.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6335	410.1	SP-2	4	2700.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6335	410.1	SP-2	5	2650.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6335	410.1	SP-3	1	2000.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6335	410.1	SP-3	2	4310.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6335	410.1	SP-3	3	3850.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6335	410.1	SP-3	4	4880.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6335	410.1	SP-3	5	4930.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6335	410.2	SP-6	1	29.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6335	410.2	SP-6	2	31.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6335	410.2	SP-6	3	25.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6335	410.2	SP-6	4	23.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6335	410.2	SP-6	5	24.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6447	410.1	SP-1	1	5550.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6447	410.1	SP-1	2	5090.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6447	410.1	SP-1	3	7180.000	MG/L	5.00	NC
FECAL COLIFORM	C2106	6335	9221E	SP-2	1	300000.000	/100M	2.00	NC

--- Subcategory=Red Meat -- Option=BAT3 ---
(continued)

Analyte Name	CAS_NO	Episode	Method	Sample Point	Sample Day	Concentration	Unit	Baseline Value	Measure Type
FECAL COLIFORM	C2106	6335	9221E	SP-2	2	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6335	9221E	SP-2	3	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6335	9221E	SP-2	4	300000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6335	9221E	SP-2	5	300000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6335	9221E	SP-3	1	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6335	9221E	SP-3	2	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6335	9221E	SP-3	3	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6335	9221E	SP-3	4	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6335	9221E	SP-3	5	500000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6335	9221E	SP-6	1	2.000	/100M	2.00	ND
FECAL COLIFORM	C2106	6335	9221E	SP-6	2	2.000	/100M	2.00	ND
FECAL COLIFORM	C2106	6335	9221E	SP-6	4	2.000	/100M	2.00	ND
FECAL COLIFORM	C2106	6335	9221E	SP-6	5	80.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6447	9221E	SP-1	1	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6447	9221E	SP-1	2	500000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6447	9221E	SP-1	3	1600000.000	/100M	2.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6335	1664	SP-2	1	230.167	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6335	1664	SP-2	2	186.000	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6335	1664	SP-2	3	96.333	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6335	1664	SP-2	4	122.833	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6335	1664	SP-2	5	178.500	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6335	1664	SP-3	1	337.333	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6335	1664	SP-3	2	270.833	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6335	1664	SP-3	3	266.500	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6335	1664	SP-3	4	271.500	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6335	1664	SP-3	5	580.333	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6335	1664	SP-6	1	6.000	MG/L	5.00	ND
HEXANE EXTRACTABLE MATERIAL	C036	6335	1664	SP-6	2	5.667	MG/L	5.00	ND
HEXANE EXTRACTABLE MATERIAL	C036	6335	1664	SP-6	3	6.000	MG/L	5.00	ND
HEXANE EXTRACTABLE MATERIAL	C036	6335	1664	SP-6	4	6.167	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6335	1664	SP-6	5	5.667	MG/L	5.00	ND
HEXANE EXTRACTABLE MATERIAL	C036	6447	1664	SP-1	1	119.667	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6447	1664	SP-1	2	312.667	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6447	1664	SP-1	3	651.500	MG/L	5.00	NC
NITRATE/NITRITE	C005	6335	353.1	SP-2	1	2.300	MG/L	0.05	NC
NITRATE/NITRITE	C005	6335	353.1	SP-2	2	2.160	MG/L	0.05	NC
NITRATE/NITRITE	C005	6335	353.1	SP-2	3	1.890	MG/L	0.05	NC
NITRATE/NITRITE	C005	6335	353.1	SP-2	4	2.160	MG/L	0.05	NC
NITRATE/NITRITE	C005	6335	353.1	SP-2	5	2.120	MG/L	0.05	NC
NITRATE/NITRITE	C005	6335	353.1	SP-3	1	0.010	MG/L	0.05	ND
NITRATE/NITRITE	C005	6335	353.1	SP-3	2	42.000	MG/L	0.05	NC
NITRATE/NITRITE	C005	6335	353.1	SP-3	3	0.110	MG/L	0.05	NC
NITRATE/NITRITE	C005	6335	353.1	SP-3	4	0.080	MG/L	0.05	NC
NITRATE/NITRITE	C005	6335	353.1	SP-3	5	0.080	MG/L	0.05	NC
NITRATE/NITRITE	C005	6335	353.1	SP-6	1	4.710	MG/L	0.05	NC

--- Subcategory=Red Meat -- Option=BAT3 ---
(continued)

Analyte Name	CAS_NO	Episode	Method	Sample Point	Sample Day	Concentration	Unit	Baseline Value	Measure Type
NITRATE/NITRITE	C005	6335	353.1	SP-6	2	5.840	MG/L	0.05	NC
NITRATE/NITRITE	C005	6335	353.1	SP-6	3	5.460	MG/L	0.05	NC
NITRATE/NITRITE	C005	6335	353.1	SP-6	4	7.140	MG/L	0.05	NC
NITRATE/NITRITE	C005	6335	353.1	SP-6	5	6.970	MG/L	0.05	NC
NITRATE/NITRITE	C005	6447	353.1	SP-1	1	0.010	MG/L	0.05	ND
NITRATE/NITRITE	C005	6447	353.1	SP-1	2	0.820	MG/L	0.05	NC
NITRATE/NITRITE	C005	6447	353.1	SP-1	3	0.600	MG/L	0.05	NC
TOTAL KJELDAHL NITROGEN	C021	6335	351.3	SP-2	1	36.000	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6335	351.3	SP-2	2	11.500	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6335	351.3	SP-3	1	237.000	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6335	351.3	SP-3	2	269.000	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6335	351.3	SP-3	3	255.000	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6335	351.3	SP-3	4	285.000	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6335	351.3	SP-6	1	1.420	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6335	351.3	SP-6	2	1.330	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6335	351.3	SP-6	3	3.260	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6447	351.3	SP-1	1	96.400	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6447	351.3	SP-1	2	103.000	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6447	351.3	SP-1	3	225.000	MG/L	0.50	NC
TOTAL NITROGEN	C005+C021	6335	351.3	SP-2	1	38.300	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6335	351.3	SP-2	2	13.660	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6335	351.3	SP-3	1	237.010	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6335	351.3	SP-3	2	311.000	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6335	351.3	SP-3	3	255.110	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6335	351.3	SP-3	4	285.080	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6335	351.3	SP-6	1	6.130	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6335	351.3	SP-6	2	7.170	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6335	351.3	SP-6	3	8.720	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6447	351.3	SP-1	1	96.410	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6447	351.3	SP-1	2	103.820	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6447	351.3	SP-1	3	225.600	MG/L	0.55	NC
TOTAL PHOSPHORUS	14265442	6335	365.2	SP-2	1	77.600	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6335	365.2	SP-2	2	85.200	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6335	365.2	SP-2	3	88.400	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6335	365.2	SP-2	4	78.900	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6335	365.2	SP-2	5	78.300	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6335	365.2	SP-3	1	53.600	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6335	365.2	SP-3	2	66.300	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6335	365.2	SP-3	3	83.300	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6335	365.2	SP-3	4	65.000	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6335	365.2	SP-3	5	68.800	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6335	365.2	SP-6	1	3.260	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6335	365.2	SP-6	2	6.160	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6335	365.2	SP-6	3	8.900	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6335	365.2	SP-6	4	7.950	MG/L	0.01	NC

--- Subcategory=Red Meat -- Option=BAT3 ---
(continued)

Analyte Name	CAS_NO	Episode	Method	Sample Point	Sample Day	Concentration	Unit	Baseline Value	Measure Type
TOTAL PHOSPHORUS	14265442	6335	365.2	SP-6	5	7.700	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6447	365.2	SP-1	1	34.700	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6447	365.2	SP-1	2	27.700	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6447	365.2	SP-1	3	34.100	MG/L	0.01	NC
TOTAL RESIDUAL CHLORINE	7782505	6335	HACH 8167	SP-2	1	0.370	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6335	HACH 8167	SP-2	2	0.100	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6335	HACH 8167	SP-2	3	0.370	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6335	HACH 8167	SP-2	4	0.160	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6335	HACH 8167	SP-2	5	0.240	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6335	HACH 8167	SP-3	1	0.100	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6335	HACH 8167	SP-3	2	0.320	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6335	HACH 8167	SP-3	3	1.800	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6335	HACH 8167	SP-3	4	1.000	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6335	HACH 8167	SP-3	5	1.000	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6335	HACH 8167	SP-6	1	13.400	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6335	HACH 8167	SP-6	2	12.400	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6335	HACH 8167	SP-6	3	18.300	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6335	HACH 8167	SP-6	4	19.900	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6335	HACH 8167	SP-6	5	2.150	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6447	330.5	SP-1	1	0.400	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6447	330.5	SP-1	2	0.400	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6447	330.5	SP-1	3	0.400	MG/L	0.20	ND
TOTAL SUSPENDED SOLIDS	C009	6335	160.2	SP-2	1	360.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6335	160.2	SP-2	2	420.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6335	160.2	SP-2	3	463.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6335	160.2	SP-2	4	337.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6335	160.2	SP-2	5	233.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6335	160.2	SP-3	1	1720.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6335	160.2	SP-3	2	2000.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6335	160.2	SP-3	3	1860.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6335	160.2	SP-3	4	1520.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6335	160.2	SP-3	5	1250.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6335	160.2	SP-6	1	4.000	MG/L	4.00	ND
TOTAL SUSPENDED SOLIDS	C009	6335	160.2	SP-6	2	5.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6335	160.2	SP-6	3	4.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6335	160.2	SP-6	4	4.000	MG/L	4.00	ND
TOTAL SUSPENDED SOLIDS	C009	6335	160.2	SP-6	5	4.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6447	160.2	SP-1	1	850.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6447	160.2	SP-1	2	640.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6447	160.2	SP-1	3	1020.000	MG/L	4.00	NC

--- Subcategory=Red Meat -- Option=PSES1 ---

Analyte Name	CAS_NO	Episode	Method	Sample Point	Sample Day	Concentration	Unit	Baseline Value	Measure Type
AMMONIA AS NITROGEN	7664417	6335	350.2	SP-2	1	6.810	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6335	350.2	SP-2	2	10.700	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6335	350.2	SP-2	3	13.200	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6335	350.2	SP-2	4	10.800	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6335	350.2	SP-2	5	34.100	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6335	350.2	SP-3	1	140.000	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6335	350.2	SP-3	2	199.000	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6335	350.2	SP-3	3	251.000	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6335	350.2	SP-3	4	310.000	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6335	350.2	SP-3	5	464.000	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6335	350.2	SP-4	1	134.000	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6335	350.2	SP-4	2	193.000	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6335	350.2	SP-4	3	246.000	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6335	350.2	SP-4	4	321.000	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6335	350.2	SP-4	5	441.000	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6447	350.2	SP-1	1	94.500	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6447	350.2	SP-1	2	86.900	MG/L	0.20	NC
AMMONIA AS NITROGEN	7664417	6447	350.2	SP-1	3	122.000	MG/L	0.20	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6335	405.1	SP-2	1	1410.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6335	405.1	SP-2	2	1220.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6335	405.1	SP-2	3	1600.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6335	405.1	SP-2	4	1820.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6335	405.1	SP-2	5	1410.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6335	405.1	SP-3	1	2060.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6335	405.1	SP-3	2	2070.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6335	405.1	SP-3	3	2070.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6335	405.1	SP-3	4	1740.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6335	405.1	SP-3	5	3100.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6335	405.1	SP-4	1	945.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6335	405.1	SP-4	2	969.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6335	405.1	SP-4	3	1430.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6335	405.1	SP-4	4	1830.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6335	405.1	SP-4	5	1150.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6447	405.1	SP-1	1	2740.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6447	405.1	SP-1	2	3350.000	MG/L	2.00	NC
BIOCHEMICAL OXYGEN DEMAND	C003	6447	405.1	SP-1	3	5520.000	MG/L	2.00	NC
CHEMICAL OXYGEN DEMAND	C004	6335	410.1	SP-2	1	2570.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6335	410.1	SP-2	2	2600.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6335	410.1	SP-2	3	2630.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6335	410.1	SP-2	4	2700.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6335	410.1	SP-2	5	2650.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6335	410.1	SP-3	1	2000.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6335	410.1	SP-3	2	4310.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6335	410.1	SP-3	3	3850.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6335	410.1	SP-3	4	4880.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6335	410.1	SP-3	5	4930.000	MG/L	5.00	NC

--- Subcategory=Red Meat -- Option=PSES1 ---
(continued)

Analyte Name	CAS_NO	Episode	Method	Sample Point	Sample Day	Concentration	Unit	Baseline Value	Measure Type
CHEMICAL OXYGEN DEMAND	C004	6335	410.1	SP-4	1	1710.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6335	410.1	SP-4	2	1590.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6335	410.1	SP-4	3	1870.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6335	410.1	SP-4	4	1850.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6335	410.1	SP-4	5	1820.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6447	410.1	SP-1	1	5550.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6447	410.1	SP-1	2	5090.000	MG/L	5.00	NC
CHEMICAL OXYGEN DEMAND	C004	6447	410.1	SP-1	3	7180.000	MG/L	5.00	NC
FECAL COLIFORM	C2106	6335	9221E	SP-2	1	300000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6335	9221E	SP-2	2	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6335	9221E	SP-2	3	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6335	9221E	SP-2	4	300000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6335	9221E	SP-2	5	300000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6335	9221E	SP-3	1	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6335	9221E	SP-3	2	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6335	9221E	SP-3	3	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6335	9221E	SP-3	4	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6335	9221E	SP-3	5	500000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6335	9221E	SP-4	1	13000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6335	9221E	SP-4	2	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6335	9221E	SP-4	3	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6335	9221E	SP-4	4	900000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6335	9221E	SP-4	5	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6447	9221E	SP-1	1	1600000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6447	9221E	SP-1	2	500000.000	/100M	2.00	NC
FECAL COLIFORM	C2106	6447	9221E	SP-1	3	1600000.000	/100M	2.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6335	1664	SP-2	1	230.167	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6335	1664	SP-2	2	186.000	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6335	1664	SP-2	3	96.333	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6335	1664	SP-2	4	122.833	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6335	1664	SP-2	5	178.500	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6335	1664	SP-3	1	337.333	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6335	1664	SP-3	2	270.833	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6335	1664	SP-3	3	266.500	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6335	1664	SP-3	4	271.500	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6335	1664	SP-3	5	580.333	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6335	1664	SP-4	1	15.833	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6335	1664	SP-4	2	13.000	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6335	1664	SP-4	3	15.000	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6335	1664	SP-4	4	15.833	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6335	1664	SP-4	5	21.800	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6447	1664	SP-1	1	119.667	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6447	1664	SP-1	2	312.667	MG/L	5.00	NC
HEXANE EXTRACTABLE MATERIAL	C036	6447	1664	SP-1	3	651.500	MG/L	5.00	NC
NITRATE/NITRITE	C005	6335	353.1	SP-2	1	2.300	MG/L	0.05	NC

--- Subcategory=Red Meat -- Option=PSES1 ---
(continued)

Analyte Name	CAS_NO	Episode	Method	Sample Point	Sample Day	Concentration	Unit	Baseline Value	Measure Type
NITRATE/NITRITE	C005	6335	353.1	SP-2	2	2.160	MG/L	0.05	NC
NITRATE/NITRITE	C005	6335	353.1	SP-2	3	1.890	MG/L	0.05	NC
NITRATE/NITRITE	C005	6335	353.1	SP-2	4	2.160	MG/L	0.05	NC
NITRATE/NITRITE	C005	6335	353.1	SP-2	5	2.120	MG/L	0.05	NC
NITRATE/NITRITE	C005	6335	353.1	SP-3	1	0.010	MG/L	0.05	ND
NITRATE/NITRITE	C005	6335	353.1	SP-3	2	42.000	MG/L	0.05	NC
NITRATE/NITRITE	C005	6335	353.1	SP-3	3	0.110	MG/L	0.05	NC
NITRATE/NITRITE	C005	6335	353.1	SP-3	4	0.080	MG/L	0.05	NC
NITRATE/NITRITE	C005	6335	353.1	SP-3	5	0.080	MG/L	0.05	NC
NITRATE/NITRITE	C005	6335	353.1	SP-4	1	0.070	MG/L	0.05	NC
NITRATE/NITRITE	C005	6335	353.1	SP-4	2	0.080	MG/L	0.05	NC
NITRATE/NITRITE	C005	6335	353.1	SP-4	3	0.090	MG/L	0.05	NC
NITRATE/NITRITE	C005	6335	353.1	SP-4	4	0.090	MG/L	0.05	NC
NITRATE/NITRITE	C005	6335	353.1	SP-4	5	0.100	MG/L	0.05	NC
NITRATE/NITRITE	C005	6447	353.1	SP-1	1	0.010	MG/L	0.05	ND
NITRATE/NITRITE	C005	6447	353.1	SP-1	2	0.820	MG/L	0.05	NC
NITRATE/NITRITE	C005	6447	353.1	SP-1	3	0.600	MG/L	0.05	NC
TOTAL KJELDAHL NITROGEN	C021	6335	351.3	SP-2	1	36.000	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6335	351.3	SP-2	2	11.500	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6335	351.3	SP-3	1	237.000	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6335	351.3	SP-3	2	269.000	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6335	351.3	SP-3	3	255.000	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6335	351.3	SP-3	4	285.000	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6335	351.3	SP-4	1	138.000	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6335	351.3	SP-4	2	158.000	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6447	351.3	SP-1	1	96.400	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6447	351.3	SP-1	2	103.000	MG/L	0.50	NC
TOTAL KJELDAHL NITROGEN	C021	6447	351.3	SP-1	3	225.000	MG/L	0.50	NC
TOTAL NITROGEN	C005+C021	6335	351.3	SP-2	1	38.300	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6335	351.3	SP-2	2	13.660	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6335	351.3	SP-3	1	237.010	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6335	351.3	SP-3	2	311.000	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6335	351.3	SP-3	3	255.110	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6335	351.3	SP-3	4	285.080	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6335	351.3	SP-4	1	138.070	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6335	351.3	SP-4	2	158.080	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6447	351.3	SP-1	1	96.410	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6447	351.3	SP-1	2	103.820	MG/L	0.55	NC
TOTAL NITROGEN	C005+C021	6447	351.3	SP-1	3	225.600	MG/L	0.55	NC
TOTAL PHOSPHORUS	14265442	6335	365.2	SP-2	1	77.600	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6335	365.2	SP-2	2	85.200	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6335	365.2	SP-2	3	88.400	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6335	365.2	SP-2	4	78.900	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6335	365.2	SP-2	5	78.300	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6335	365.2	SP-3	1	53.600	MG/L	0.01	NC

--- Subcategory=Red Meat -- Option=PSES1 ---
(continued)

Analyte Name	CAS_NO	Episode	Method	Sample Point	Sample Day	Concentration	Unit	Baseline Value	Measure Type
TOTAL PHOSPHORUS	14265442	6335	365.2	SP-3	2	66.300	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6335	365.2	SP-3	3	83.300	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6335	365.2	SP-3	4	65.000	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6335	365.2	SP-3	5	68.800	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6335	365.2	SP-4	1	23.500	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6335	365.2	SP-4	2	24.200	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6335	365.2	SP-4	3	46.400	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6335	365.2	SP-4	4	32.500	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6335	365.2	SP-4	5	32.800	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6447	365.2	SP-1	1	34.700	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6447	365.2	SP-1	2	27.700	MG/L	0.01	NC
TOTAL PHOSPHORUS	14265442	6447	365.2	SP-1	3	34.100	MG/L	0.01	NC
TOTAL RESIDUAL CHLORINE	7782505	6335	HACH 8167	SP-2	1	0.370	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6335	HACH 8167	SP-2	2	0.100	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6335	HACH 8167	SP-2	3	0.370	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6335	HACH 8167	SP-2	4	0.160	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6335	HACH 8167	SP-2	5	0.240	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6335	HACH 8167	SP-3	1	0.100	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6335	HACH 8167	SP-3	2	0.320	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6335	HACH 8167	SP-3	3	1.800	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6335	HACH 8167	SP-3	4	1.000	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6335	HACH 8167	SP-3	5	1.000	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6335	HACH 8167	SP-4	1	0.100	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6335	HACH 8167	SP-4	2	0.100	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6335	HACH 8167	SP-4	3	0.110	MG/L	0.20	NC
TOTAL RESIDUAL CHLORINE	7782505	6335	HACH 8167	SP-4	4	0.100	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6335	HACH 8167	SP-4	5	0.100	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6447	330.5	SP-1	1	0.400	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6447	330.5	SP-1	2	0.400	MG/L	0.20	ND
TOTAL RESIDUAL CHLORINE	7782505	6447	330.5	SP-1	3	0.400	MG/L	0.20	ND
TOTAL SUSPENDED SOLIDS	C009	6335	160.2	SP-2	1	360.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6335	160.2	SP-2	2	420.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6335	160.2	SP-2	3	463.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6335	160.2	SP-2	4	337.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6335	160.2	SP-2	5	233.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6335	160.2	SP-3	1	1720.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6335	160.2	SP-3	2	2000.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6335	160.2	SP-3	3	1860.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6335	160.2	SP-3	4	1520.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6335	160.2	SP-3	5	1250.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6335	160.2	SP-4	1	253.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6335	160.2	SP-4	2	335.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6335	160.2	SP-4	3	253.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6335	160.2	SP-4	4	263.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6335	160.2	SP-4	5	272.000	MG/L	4.00	NC

--- Subcategory=Red Meat -- Option=PSES1 ---
(continued)

Analyte Name	CAS_NO	Episode	Method	Sample Point	Sample Day	Concentration	Unit	Baseline Value	Measure Type
TOTAL SUSPENDED SOLIDS	C009	6447	160.2	SP-1	1	850.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6447	160.2	SP-1	2	640.000	MG/L	4.00	NC
TOTAL SUSPENDED SOLIDS	C009	6447	160.2	SP-1	3	1020.000	MG/L	4.00	NC

APPENDIX G

MODIFIED DELTA-LOGNORMAL DISTRIBUTION

This appendix describes the modified delta-lognormal distribution and the estimation of the episode-specific long-term averages and variability factors used to calculate the proposed limitations and standards.[1] This appendix provides the statistical methodology that was used to obtain the results presented in Section 13.

G.1 BASIC OVERVIEW OF THE MODIFIED DELTA-LOGNORMAL DISTRIBUTION

EPA selected the modified delta-lognormal distribution to model pollutant effluent concentrations from the meat products industry in developing the long-term averages and variability factors. A typical effluent data set from a sampling episode or self-monitoring episode (see Section 13 for a discussion of the data associated with these episodes) consists of a mixture of measured (detected) and non-detected values. The modified delta-lognormal distribution is appropriate for such data sets because it models the data as a mixture of measurements that follow a lognormal distribution and non-detect measurements that occur with a certain probability. The model also allows for the possibility that non-detect measurements occur at multiple sample-specific detection limits.

The modified delta-lognormal distribution is a modification of the 'delta distribution' originally developed by Aitchison and Brown.[2] While this distribution was originally developed to model economic data, other researchers have shown the application to environmental data.[3] The resulting mixed distributional model, which combines a continuous density portion with a discrete-valued spike at zero, is also known as the delta-lognormal distribution. The delta in the name refers to the proportion of the overall distribution contained in the discrete distributional spike at zero; that is, the proportion of zero amounts. The remaining non-zero, non-censored (NC) amounts are grouped together and fit to a lognormal distribution.

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[1] In the remainder of this appendix, references to 'limitations' includes 'standards.'

[2] Aitchison, J. and Brown, J.A.C. (1963) The Lognormal Distribution. Cambridge University Press, pages 87-99.

[3] Owen, W.J. and T.A. DeRouen. 1980. "Estimation of the Mean for Lognormal Data Containing Zeroes and Left-Censored Values, with Applications to the Measurement of Worker Exposure to Air Contaminants." *Biometrics*, 36:707-719.

EPA modified this delta-lognormal distribution to incorporate multiple detection limits. In the modification of the delta portion, the single spike located at zero is replaced by a discrete distribution made up of multiple spikes. Each spike in this modification is associated with a distinct sample-specific detection limit associated with non-detected (ND) measurements in the database.[4] A lognormal density is used to represent the set of measured values. This modification of the delta-lognormal distribution is illustrated in Figure G-1.

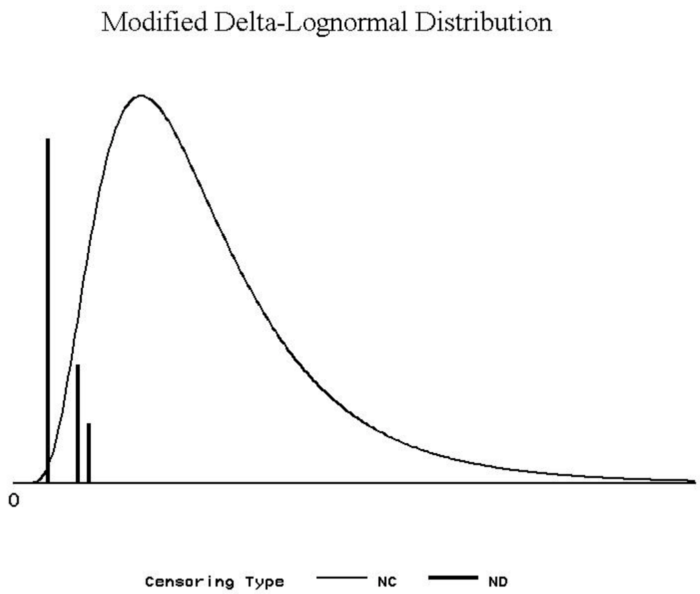

Figure G-1.

The following two subsections describe the delta and lognormal portions of the modified delta-lognormal distribution in further detail.

G.2 CONTINUOUS AND DISCRETE PORTIONS OF THE MODIFIED DELTA-LOGNORMAL DISTRIBUTION

The discrete portion of the modified delta-lognormal distribution models the non-detected values corresponding to the *k* reported sample-specific detection limits. In the model, δ

[4] Previously, EPA had modified the delta-lognormal model to account for non-detected measurements by placing the distributional "spike" at a single positive value, usually equal to the nominal method detection limit, rather than at zero. For further details, see Kahn and Rubin, 1989. This adaptation was used in developing limitations and standards for the organic chemicals, plastics, and synthetic fibers (OCPSF) and pesticides manufacturing rulemakings. EPA has used the current modification in several, more recent, rulemakings.

represents the proportion of non-detected values in the dataset and is the sum of smaller fractions, δ_i, each representing the proportion of non-detected values associated with each distinct detection limit value. By letting D_i equal the value of the i^{th} smallest distinct detection limit in the data set and the random variable X_D represent a randomly chosen non-detected measurement, the cumulative distribution function of the discrete portion of the modified delta-lognormal model can be mathematically expressed as:

$$\Pr\left(X_D \le c\right) = \frac{1}{\delta} \sum_{i:D_i \le c} \delta_i \qquad 0 < c \tag{G-1}$$

The mean and variance of this discrete distribution can be calculated using the following formulas:

$$E(X_D) = \frac{1}{\delta} \sum_{i=1}^{k} \delta_i \, D_i \tag{G-2}$$

$$Var(X_D) = \frac{1}{\delta} \sum_{i=1}^{k} \delta_i \left(D_i - E(X_D)\right)^2 \tag{G-3}$$

The continuous, lognormal portion of the modified delta-lognormal distribution was used to model the detected measurements from the meat products industry database. The cumulative probability distribution of the continuous portion of the modified delta-lognormal distribution can be mathematically expressed as:

$$\Pr\left[X_C \le c\right] = \Phi\left[\frac{\ln(c) - \mu}{\sigma}\right] \tag{G-4}$$

where the random variable X_C represents a randomly chosen detected measurement, Φ is the standard normal distribution, and μ and σ are parameters of the distribution.

The expected value, E(X_C), and the variance, Var(X_C), of the lognormal distribution can be calculated as:

$$E\left(X_C\right) = \exp\left(\mu + \frac{\sigma^2}{2}\right) \qquad \text{(G-5)}$$

$$Var\left(X_C\right) = \left[E\left(X_C\right)\right]^2 \left(\exp\left(\sigma^2\right) - 1\right) \qquad \text{(G-6)}$$

G.3 COMBINING THE CONTINUOUS AND DISCRETE PORTIONS

The continuous portion of the modified delta-lognormal distribution is combined with the discrete portion to model data sets that contain a mixture of non-detected and detected measurements. It is possible to fit a wide variety of observed effluent data sets to the modified delta-lognormal distribution. Multiple detection limits for non-detect measurements are incorporated, as are measured ("detected") values. The same basic framework can be used even if there are no non-detected values in the data set (in this case, it is the same as the lognormal distribution). Thus, the modified delta-lognormal distribution offers a large degree of flexibility in modeling effluent data.

The modified delta-lognormal random variable U can be expressed as a combination of three other independent variables, that is,

$$U = I_u X_D + \left(1 - I_u\right) X_C \qquad \text{(G-7)}$$

where X_D represents a random non-detect from the discrete portion of the distribution, X_C represents a random detected measurement from the continuous lognormal portion, and I_u is an indicator variable signaling whether any particular random measurement, u, is non-detected or non-censored (that is, I_u=1 if u is non-detected; I_u=0 if u is non-censored). Using a weighted sum, the cumulative distribution function from the discrete portion of the distribution (equation 1) can be combined with the function from the continuous portion (equation 4) to obtain the overall cumulative probability distribution of the modified delta-lognormal distribution as follows,

$$\Pr(U \leq c) = \sum_{i:D_i \leq c} \delta_i + (1-\delta)\Phi\left[\frac{\ln(c)-\mu}{\sigma}\right] \tag{G-8}$$

where D_i is the value of the i^{th} sample-specific detection limit.

The expected value of the random variable *U* can be derived as a weighted sum of the expected values of the discrete and continuous portions of the distribution (equations 2 and 5, respectively) as follows

$$E(U) = \delta E(X_D) + (1-\delta)E(X_C) \tag{G-9}$$

In a similar manner, the expected value of the random variable squared can be written as a weighted sum of the expected values of the squares of the discrete and continuous portions of the distribution as follows

$$E\left(U^2\right) = \delta E\left(X_D^2\right) + (1-\delta)E\left(X_C^2\right) \tag{G-10}$$

Although written in terms of U, the following relationship holds for all random variables, U, X_D, and X_C.

$$E\left(U^2\right) = Var(U) + [E(U)]^2 \tag{G-11}$$

So using equation 11 to solve for Var(U), and applying the relationships in equations 9 and 10, the variance of *U* can be obtained as

$$\mathrm{Var}(U) = \delta\left(\mathrm{Var}(X_D) + [\mathrm{E}(X_D)]^2\right) + (1-\delta)\left(\mathrm{Var}(X_C) + [\mathrm{E}(X_C)]^2\right) - [\mathrm{E}(U)]^2 \tag{G-12}$$

G.4 Episode-specific Estimates Under the Modified Delta-Lognormal Distribution

In order to use the modified delta-lognormal model to calculate the proposed limitations, the parameters of the distribution are estimated from the data. These estimates are then used to calculate the proposed limitations.

The parameters $\hat{\delta}_i$ and $\hat{\delta}$ are estimated from the data using the following formulas:

$$\hat{\delta}_i = \frac{1}{n}\sum_{j=1}^{n_d} I\left(d_j = D_i\right)$$
$$\hat{\delta} = \frac{n_d}{n} \qquad \text{(G-13)}$$

where n_d is the number of non-detected measurements, d_j, j = 1 to n_d, are the detection limits for the non-detected measurements, n is the number of measurements (both detected and non-detected) and I(…) is an indicator function equal to one if the phrase within the parentheses is true and zero otherwise. The "hat" over the parameters indicates that they are estimated from the data.

The expected value and the variance of the lognormal portion of the modified delta-lognormal distribution can be calculated from the data as:

$$\hat{E}\left(X_D\right) = \frac{1}{\hat{\delta}}\sum_{i=1}^{k} \hat{\delta}_i D_i \qquad \text{(G-14)}$$

$$\hat{V}ar\left(X_D\right) = \frac{1}{\hat{\delta}}\sum_{i=1}^{k} \hat{\delta}_i \left(D_i - E\left(X_D\right)\right)^2 \qquad \text{(G-15)}$$

The parameters of the continuous portion of the modified delta-lognormal distribution, $\hat{\mu}$ and $\hat{\sigma}^2$, are estimated by

$$\hat{\mu} = \sum_{i=1}^{n_c} \frac{\ln(x_i)}{n_c}$$
$$\hat{\sigma}^2 = \sum_{i=1}^{n_c} \frac{\left(\ln(x_i) - \hat{\mu}\right)^2}{n_c - 1} \tag{G-16}$$

where x_i is the i[th] detected measurement value and n_c is the number of detected measurements. Note that $n = n_d + n_c$.

The expected value and the variance of the lognormal portion of the modified delta-lognormal distribution can be calculated from the data as:

$$\hat{E}(X_C) = \exp\left(\hat{\mu} + \frac{\hat{\sigma}^2}{2}\right) \tag{G-17}$$

$$\hat{V}ar(X_C) = \left[\hat{E}(X_C)\right]^2 \left(\exp\left(\hat{\sigma}^2\right) - 1\right) \tag{G-18}$$

Finally, the expected value and variance of the modified delta-lognormal distribution can be estimated using the following formulas:

$$\hat{E}(U) = \hat{\delta}\hat{E}(X_D) + \left(1 - \hat{\delta}\right)\hat{E}(X_C) \tag{G-19}$$

$$\hat{V}ar(U) = \hat{\delta}\left(\hat{V}ar(X_D) + \left[\hat{E}(X_D)\right]^2\right) + \left(1 - \hat{\delta}\right)\left(\hat{V}ar(X_C) + \left[\hat{E}(X_C)\right]^2\right) - \left[\hat{E}(U)\right]^2 \tag{G-20}$$

Equations 17 through 20 are particularly important in the estimation of episode-specific long-term averages and variability factors as described in the following sections. These sections are preceded by a section that identifies the episode data set requirements.

G.4.1 Episode Data Set Requirements

Estimates of the necessary parameters for the lognormal portion of the distribution can be calculated with as few as two distinct detected values in a data set. (In order to calculate the variance of the modified delta-lognormal distribution, two distinct detected values are the minimum number that can be used and still obtain an estimate of the variance for the distribution.)

If an episode data set for a pollutant contained three or more observations with two or more distinct detected concentration values, then EPA used the modified delta-lognormal distribution to calculate long-term averages and variability factors. If the episode data set for a pollutant did not meet these requirements, EPA used an arithmetic average to calculate the episode-specific long-term average and excluded the dataset from the variability factor calculations (because the variability could not be calculated).

In statistical terms, each measurement was assumed to be independently and identically distributed from the other measurements of that pollutant in the episode data set.

The next two sections apply the modified delta-lognormal distribution to the data for estimating episode-specific long-term averages and variability factors for the iron and steel industry.

G.4.2 Estimation of Episode-specific Long-Term Averages

If an episode dataset for a pollutant met the requirements described in the last section, then EPA calculated the long-term average using equation 19. Otherwise, EPA calculated the long-term average as the arithmetic average of the daily values where the sample-specific detection limit was used for each non-detected measurement.

G.4.3 Estimation of Episode-Specific Variability Factors

For each episode, EPA estimated the daily variability factors by fitting a modified delta-lognormal distribution to the daily measurements for each pollutant. In contrast, EPA estimated monthly variability factors by fitting a modified delta-lognormal distribution to the monthly averages for the pollutant at the episode. EPA developed these averages using the same number of measurements as the assumed monitoring frequency for the pollutant. EPA is assuming that all pollutants will be monitored daily.[5]

G.4.3.1 Estimation of Episode-specific Daily Variability Factors

The episode-specific daily variability factor is a function of the expected value, and the 99th percentile of the modified delta-lognormal distribution fit to the daily concentration values of the pollutant in the wastewater from the episode. The expected value, was estimated using equation 19 (the expected value is the same as the episode-specific long-term average).

The 99th percentile of the modified delta-lognormal distribution fit to each data set was estimated by using an iterative approach. First, the pollutant-specific detection limits were ordered from smallest to largest. Next, the cumulative distribution function, p, for each detection limit was computed. The general form, for a given value c, was:

$$p = \sum_{i:D_i \le c} \hat{\delta}_i + \left(1 - \hat{\delta}\right)\Phi\left[\frac{\ln(c) - \hat{\mu}}{\hat{\sigma}}\right] \qquad \text{(G-21)}$$

where Φ is the standard normal cumulative distribution function. Next, the interval containing the 99th percentile was identified. Finally, the 99th percentile of the modified delta-lognormal distribution was calculated. The following steps were completed to compute the estimated 99th percentile of each data subset:

[5] Compliance with the monthly average limitations will be required in the final rulemaking regardless of the number of samples analyzed and averaged.

Step 1 Using equation 21, k values of p at $c=D_m$, m=1,...,k were computed and labeled p_m.

Step 2 The smallest value of m (m=1,...,k), such that $p_m \geq 0.99$, was determined and labeled as p_j. If no such m existed, steps 3 and 4 were skipped and step 5 was computed instead.

Step 3 Computed $p^* = p_j - \hat{\delta}_j$.

Step 4 If $p^* < 0.99$, then $\hat{P}99 = D_j$

else if $p^* \geq 0.99$, then

$$\hat{P}99 = \exp\left(\hat{\mu} + \hat{\sigma}\Phi^{-1}\left[\frac{0.99 - \sum_{i=1}^{j-1}\hat{\delta}_i}{1-\hat{\delta}}\right]\right) \tag{G-22}$$

where Φ^{-1} is the inverse normal distribution function.

Step 5 If no such m exists such that $p_m > 0.99$ (m=1,...,k), then

$$\hat{P}99 = \exp\left(\hat{\mu} + \hat{\sigma}\Phi^{-1}\left[\frac{0.99 - \hat{\delta}}{1-\hat{\delta}}\right]\right) \tag{G-23}$$

The episode-specific daily variability factor, VF1, was then calculated as:

$$VF1 = \frac{\hat{P}99}{\hat{E}(U)} \tag{G-24}$$

G.4.3.2 Estimation of Episode-Specific Monthly Variability Factors

EPA estimated the monthly variability factors by fitting a modified delta-lognormal distribution to the monthly averages. These equations use the same basic parameters, μ and σ, calculated for the daily variability factors. Episode-specific monthly variability factors were based on 30-day monthly averages because the monitoring frequency was assumed to be daily (approximately thirty times a month). As explained in Section 13.6.2, EPA recognizes that small poultry facilities are unlikely to operate on weekends and is soliciting comment on whether their monthly limitations should be based upon 20 days. This section describes the calculations for monthly variability factors based upon 30-day averages. To calculate the monthly variability factors based upon 20 days, the same basic procedure is used except that 20-day averages are used instead of 30-day averages.

Before estimating the episode-specific monthly variability factors, EPA considered whether autocorrelation was likely to be present in the effluent data. When data are said to be positively autocorrelated, it means that measurements taken at specific time intervals (such as 1 day or 2 days apart) are related. For example, positive autocorrelation would be present in the data if the final effluent concentration of HEM was relatively high one day and was likely to remain at similar high values the next and possibly succeeding days. Because EPA is assuming that the pollutants will be monitored daily, EPA based the monthly variability factors on the distribution of the averages of 30 (or 20) measurements. If concentrations measured on consecutive days were positively correlated, then the autocorrelation would have had an effect on the estimate of the variance of the monthly average and thus on the monthly variability factor. Adjustments for positive autocorrelation would increase the values of the variance and monthly variability factor. (The estimate of the long-term average and the daily variability factor are generally only slightly affected by autocorrelation.)

EPA has not incorporated an autocorrelation adjustment into its estimates of the monthly variability factors. In many industries, measurements in final effluent are likely to be similar from one day to the next because of the consistency from day-to-day in the production processes and in final effluent discharges due to the hydraulic retention time of wastewater in basins, holding ponds, and other components of wastewater treatment systems. To determine if autocorrelation exists in the data, a statistical evaluation is necessary. However, the data used for the proposal were insufficient for the purpose of evaluating autocorrelation. To estimate autocorrelation in the data, many measurements for each pollutant would be required with values for every single day over an extended period of time. If such data are available for the final rule, EPA intends to perform a statistical evaluation of autocorrelation and if necessary provide any adjustments to the limitations.

In calculating the monthly variability factors, EPA assumed that consecutive daily measurements were not correlated, and therefore

$$\hat{E}\left(\overline{U}_{30}\right)=\hat{E}\left(U\right) \qquad and \qquad \hat{V}ar\left(\overline{U}_{30}\right)=\frac{\hat{V}ar\left(U\right)}{30} \tag{G-25}$$

where $\hat{E}(U)$ and $\hat{V}ar(U)$ were calculated as shown in equations 19 and 20. Finally, because $\overline{U}_{30}$ is approximately normally distributed by the Central Limit Theorem, the estimate of the 95th percentile of a 30-day mean and the corresponding episode-specific 30-day variability factor (VF30) were approximated by

$$\hat{P}95_{30}=\hat{E}\left(\overline{U}_{30}\right)+\left[\Phi^{-1}(0.95)\right]\sqrt{\hat{V}ar\left(\overline{U}_{30}\right)} \tag{G-26}$$

where $\Phi^{-1}(0.95)$ is the 95th percentile of the inverse normal distribution. By using the substitutions in equation 25, equation 26 simplified to

$$\hat{P}95_{30}=\hat{E}\left(U\right)+\left[\Phi^{-1}(0.95)\right]\sqrt{\tfrac{1}{30}\hat{V}ar\left(U\right)} \tag{G-27}$$

Then

$$VF30=\frac{\hat{P}95}{\hat{E}\left(U\right)} \qquad because \qquad \hat{E}\left(\overline{U}_{30}\right)=\hat{E}\left(U\right) \tag{G-28}$$

G.4.3.3 Evaluation of Episode-Specific Variability Factors

Estimates of the necessary parameters for the lognormal portion of the distribution can be calculated with as few as two distinct measured values in a data set (in order to calculate the variance); however, these estimates can be unstable (as can estimates from larger data sets). As stated in Section G.4.1, EPA used the modified delta-lognormal distribution to develop episode-specific variability factors for data sets that had a three or more observations with two or more distinct measured concentration values.

To identify situations producing unexpected results, EPA reviewed all of the variability factors and compared daily to monthly variability factors. EPA used several criteria to determine if the episode-specific daily and monthly variability factors should be included in calculating the option variability factors. One criteria that EPA used was that the daily and monthly variability factors should be greater than 1.0. A variability factor less than 1.0 would result in a unexpected result where the estimated 99th percentile would be less than the long-term average. This would be an indication that the estimate of $\hat{\sigma}$ (the log standard deviation) was unstable. A second criteria was that the daily variability factor had to be greater than the monthly variability factor. All the episode-specific variability factors used for the proposed limitations and standards met these criteria.

G.5 REFERENCES

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APPENDIX H

ATTACHMENTS TO SECTION 13

--- Subcategory=Poultry -- Option=BAT2 ---

Analyte	Episode	Point	Episode Mean	Total Number Values	Num ND	Obs Std Dev	Obs Median Value	Mean Value NC	Std Dev NC	Min Value NC	Max Value NC	Min Value ND	Max Value ND	Unit
AMMONIA AS NITROGEN	6443	SP-2	9.16	3	0	4.46	6.68	9.16	4.46	6.49	14.30	.	.	MG/L
AMMONIA AS NITROGEN	6444	SP-3	46.20	3	0	41.48	30.20	46.20	41.48	15.10	93.30	.	.	MG/L
AMMONIA AS NITROGEN	6445	SP-3+SP-2	0.25	5	0	0.08	0.23	0.25	0.08	0.16	0.38	.	.	MG/L
AMMONIA AS NITROGEN	6445	SP-1	9.43	5	0	1.26	9.37	9.43	1.26	8.15	11.30	.	.	MG/L
AMMONIA AS NITROGEN	6448	SP-4+SP-3	1.27	5	0	0.29	1.39	1.27	0.29	0.96	1.54	.	.	MG/L
AMMONIA AS NITROGEN	6448	SP-2	154.00	5	0	48.31	161.00	154.00	48.31	95.00	208.00	.	.	MG/L
BIOCHEMICAL OXYGEN DEMAND	6443	SP-2	3293.33	3	0	828.87	2840.00	3293.33	828.87	2790.00	4250.00	.	.	MG/L
BIOCHEMICAL OXYGEN DEMAND	6444	SP-3	7668.33	3	0	9594.36	3760.00	7668.33	9594.36	645.00	18600.00	.	.	MG/L
BIOCHEMICAL OXYGEN DEMAND	6445	SP-3+SP-2	2.00	5	5	0.00	2.00	.	.	.	.	2.00	2.00	MG/L
BIOCHEMICAL OXYGEN DEMAND	6445	SP-1	1856.00	5	0	225.90	1910.00	1856.00	225.90	1480.00	2060.00	.	.	MG/L
BIOCHEMICAL OXYGEN DEMAND	6448	SP-4+SP-3	3.80	5	0	0.84	4.00	3.80	0.84	3.00	5.00	.	.	MG/L
BIOCHEMICAL OXYGEN DEMAND	6448	SP-2	1984.00	5	0	149.60	2050.00	1984.00	149.60	1720.00	2070.00	.	.	MG/L
CHEMICAL OXYGEN DEMAND	6443	SP-2	3720.00	3	0	1150.61	3900.00	3720.00	1150.61	2490.00	4770.00	.	.	MG/L
CHEMICAL OXYGEN DEMAND	6444	SP-3	10343.33	3	0	8672.11	7810.00	10343.33	8672.11	3220.00	20000.00	.	.	MG/L
CHEMICAL OXYGEN DEMAND	6445	SP-3+SP-2	27.60	5	0	10.43	25.00	27.60	10.43	17.00	40.00	.	.	MG/L
CHEMICAL OXYGEN DEMAND	6445	SP-1	3096.00	5	0	1173.55	2730.00	3096.00	1173.55	1720.00	4530.00	.	.	MG/L
CHEMICAL OXYGEN DEMAND	6448	SP-4+SP-3	29.60	5	0	3.85	28.00	29.60	3.85	26.00	36.00	.	.	MG/L
CHEMICAL OXYGEN DEMAND	6448	SP-2	18560.00	5	0	10979.66	17500.00	18560.00	10979.66	9700.00	36800.00	.	.	MG/L
FECAL COLIFORM	6443	SP-2	87500.00	2	0	116672.62	87500.00	87500.00	116672.62	5000.00	170000.00	.	.	/100MLS
FECAL COLIFORM	6445	SP-3+SP-2	4.63	4	3	5.25	2.00	12.50	.	12.50	12.50	2.00	2.00	/100MLS
FECAL COLIFORM	6445	SP-1	1250000.00	4	0	404145.19	1250000.00	1250000.00	404145.19	900000.00	1600000.00	.	.	/100MLS
FECAL COLIFORM	6448	SP-4+SP-3	418.30	5	0	524.92	170.00	418.30	524.92	41.50	1300.00	.	.	/100MLS
FECAL COLIFORM	6448	SP-2	1460000.00	5	0	313049.52	1600000.00	1460000.00	313049.52	900000.00	1600000.00	.	.	/100MLS
HEXANE EXTRACTABLE MATERIAL	6443	SP-2	792.82	3	0	748.19	390.63	792.82	748.19	331.73	1656.08	.	.	MG/L
HEXANE EXTRACTABLE MATERIAL	6444	SP-3	423.25	3	0	327.24	238.50	423.25	327.24	230.17	801.08	.	.	MG/L
HEXANE EXTRACTABLE MATERIAL	6445	SP-3+SP-2	23.58	5	4	39.27	6.00	93.83	.	93.83	93.83	5.92	6.17	MG/L
HEXANE EXTRACTABLE MATERIAL	6445	SP-1	486.80	5	0	45.56	489.67	486.80	45.56	418.33	543.83	.	.	MG/L
HEXANE EXTRACTABLE MATERIAL	6448	SP-4+SP-3	5.93	5	4	0.25	5.83	6.33	.	6.33	6.33	5.67	6.00	MG/L
HEXANE EXTRACTABLE MATERIAL	6448	SP-2	6225.50	5	0	10385.30	1986.00	6225.50	10385.30	499.17	24739.83	.	.	MG/L
NITRATE/NITRITE	6443	SP-2	1.58	3	2	1.43	0.75	3.23	.	3.23	3.23	0.75	0.75	MG/L
NITRATE/NITRITE	6444	SP-3	0.30	3	3	0.00	0.30	.	.	.	.	0.30	0.30	MG/L
NITRATE/NITRITE	6445	SP-3+SP-2	27.04	5	0	7.22	31.40	27.04	7.22	16.80	33.40	.	.	MG/L
NITRATE/NITRITE	6445	SP-1	2.55	5	0	1.41	2.97	2.55	1.41	0.57	3.93	.	.	MG/L
NITRATE/NITRITE	6448	SP-4+SP-3	64.66	5	0	3.11	63.10	64.66	3.11	62.60	70.00	.	.	MG/L
NITRATE/NITRITE	6448	SP-2	26.02	5	0	6.31	25.50	26.02	6.31	19.00	34.00	.	.	MG/L
TOTAL KJELDAHL NITROGEN	6443	SP-2	80.13	3	0	61.98	68.80	80.13	61.98	24.60	147.00	.	.	MG/L
TOTAL KJELDAHL NITROGEN	6444	SP-3	201.87	3	0	119.74	271.00	201.87	119.74	63.60	271.00	.	.	MG/L

--- Subcategory=Poultry -- Option=BAT2 ---
(continued)

Analyte	Episode	Point	Episode Mean	Total Number Values	Num ND	Obs Std Dev	Obs Median Value	Mean Value NC	Std Dev NC	Min Value NC	Max Value NC	Min Value ND	Max Value ND	Unit
TOTAL KJELDAHL NITROGEN	6445	SP-3+SP-2	1.59	5	0	0.47	1.61	1.59	0.47	1.03	2.25	.	.	MG/L
TOTAL KJELDAHL NITROGEN	6445	SP-1	34.28	5	0	24.59	26.60	34.28	24.59	18.20	77.70	.	.	MG/L
TOTAL KJELDAHL NITROGEN	6448	SP-4+SP-3	1.81	5	0	0.61	1.92	1.81	0.61	1.07	2.51	.	.	MG/L
TOTAL KJELDAHL NITROGEN	6448	SP-2	179.60	5	0	45.87	202.00	179.60	45.87	103.00	212.00	.	.	MG/L
TOTAL NITROGEN	6443	SP-2	81.71	3	0	63.32	69.55	81.71	63.32	25.35	150.23	.	.	MG/L
TOTAL NITROGEN	6444	SP-3	202.17	3	0	119.74	271.30	202.17	119.74	63.90	271.30	.	.	MG/L
TOTAL NITROGEN	6445	SP-3+SP-2	28.63	5	0	7.29	33.01	28.63	7.29	18.08	34.43	.	.	MG/L
TOTAL NITROGEN	6445	SP-1	36.83	5	0	24.29	29.57	36.83	24.29	18.77	79.36	.	.	MG/L
TOTAL NITROGEN	6448	SP-4+SP-3	66.47	5	0	3.49	65.05	66.47	3.49	63.67	72.51	.	.	MG/L
TOTAL NITROGEN	6448	SP-2	205.62	5	0	45.16	221.00	205.62	45.16	128.50	240.60	.	.	MG/L
TOTAL PHOSPHORUS	6443	SP-2	72.20	3	0	21.04	69.40	72.20	21.04	52.70	94.50	.	.	MG/L
TOTAL PHOSPHORUS	6444	SP-3	312.77	3	0	429.05	77.20	312.77	429.05	53.10	808.00	.	.	MG/L
TOTAL PHOSPHORUS	6445	SP-3+SP-2	0.70	5	0	0.70	0.61	0.70	0.70	0.17	1.89	.	.	MG/L
TOTAL PHOSPHORUS	6445	SP-1	11.36	5	0	0.88	11.70	11.36	0.88	10.10	12.40	.	.	MG/L
TOTAL PHOSPHORUS	6448	SP-4+SP-3	15.17	5	0	0.44	15.15	15.17	0.44	14.60	15.60	.	.	MG/L
TOTAL PHOSPHORUS	6448	SP-2	37.54	5	0	8.28	35.90	37.54	8.28	31.10	51.50	.	.	MG/L
TOTAL RESIDUAL CHLORINE	6443	SP-2	7.03	3	0	5.10	9.30	7.03	5.10	1.18	10.60	.	.	MG/L
TOTAL RESIDUAL CHLORINE	6444	SP-3	0.70	3	1	0.47	0.78	0.95	0.24	0.78	1.12	0.20	0.20	MG/L
TOTAL RESIDUAL CHLORINE	6445	SP-3+SP-2	0.22	5	4	0.04	0.20	0.30	.	0.30	0.30	0.20	0.20	MG/L
TOTAL RESIDUAL CHLORINE	6445	SP-1	0.20	5	5	0.00	0.20	.	.	.	.	0.20	0.20	MG/L
TOTAL RESIDUAL CHLORINE	6448	SP-4+SP-3	0.20	5	5	0.00	0.20	.	.	.	.	0.20	0.20	MG/L
TOTAL RESIDUAL CHLORINE	6448	SP-2	0.20	5	5	0.00	0.20	.	.	.	.	0.20	0.20	MG/L
TOTAL SUSPENDED SOLIDS	6443	SP-2	1656.67	3	0	330.05	1650.00	1656.67	330.05	1330.00	1990.00	.	.	MG/L
TOTAL SUSPENDED SOLIDS	6444	SP-3	53390.00	3	0	81949.04	7620.00	53390.00	81949.04	4550.00	148000.00	.	.	MG/L
TOTAL SUSPENDED SOLIDS	6445	SP-3+SP-2	8.00	5	0	3.32	7.00	8.00	3.32	5.00	12.00	.	.	MG/L
TOTAL SUSPENDED SOLIDS	6445	SP-1	776.00	5	0	57.81	760.00	776.00	57.81	700.00	855.00	.	.	MG/L
TOTAL SUSPENDED SOLIDS	6448	SP-4+SP-3	9.10	5	0	2.61	10.00	9.10	2.61	5.00	12.00	.	.	MG/L
TOTAL SUSPENDED SOLIDS	6448	SP-2	3248.00	5	0	2279.19	2260.00	3248.00	2279.19	1860.00	7260.00	.	.	MG/L

--- Subcategory=Poultry -- Option=PSES1 ---

Analyte	Episode	Point	Episode Mean	Total Number Values	Num ND	Obs Std Dev	Obs Median Value	Mean Value NC	Std Dev NC	Min Value NC	Max Value NC	Min Value ND	Max Value ND	Unit
AMMONIA AS NITROGEN	6443	SP-5+SP-4	5.37	3	0	2.11	5.49	5.37	2.11	3.21	7.41	.	.	MG/L
AMMONIA AS NITROGEN	6443	SP-2	9.16	3	0	4.46	6.68	9.16	4.46	6.49	14.30	.	.	MG/L
AMMONIA AS NITROGEN	6443	SP-3	6.98	3	0	1.16	6.31	6.98	1.16	6.31	8.32	.	.	MG/L
AMMONIA AS NITROGEN	6444	SP-5+SP-4	13.40	3	0	2.35	14.25	13.40	2.35	10.74	15.20	.	.	MG/L
AMMONIA AS NITROGEN	6444	SP-3	46.20	3	0	41.48	30.20	46.20	41.48	15.10	93.30	.	.	MG/L
AMMONIA AS NITROGEN	6448	SP-2	154.00	5	0	48.31	161.00	154.00	48.31	95.00	208.00	.	.	MG/L
BIOCHEMICAL OXYGEN DEMAND	6443	SP-5+SP-4	214.10	3	0	96.04	159.30	214.10	96.04	158.00	325.00	.	.	MG/L
BIOCHEMICAL OXYGEN DEMAND	6443	SP-2	3293.33	3	0	828.87	2840.00	3293.33	828.87	2790.00	4250.00	.	.	MG/L
BIOCHEMICAL OXYGEN DEMAND	6443	SP-3	2170.00	3	0	1371.75	2580.00	2170.00	1371.75	640.00	3290.00	.	.	MG/L
BIOCHEMICAL OXYGEN DEMAND	6444	SP-5+SP-4	203.00	3	0	72.50	187.50	203.00	72.50	139.50	282.00	.	.	MG/L
BIOCHEMICAL OXYGEN DEMAND	6444	SP-3	7668.33	3	0	9594.36	3760.00	7668.33	9594.36	645.00	18600.00	.	.	MG/L
BIOCHEMICAL OXYGEN DEMAND	6448	SP-2	1984.00	5	0	149.60	2050.00	1984.00	149.60	1720.00	2070.00	.	.	MG/L
CHEMICAL OXYGEN DEMAND	6443	SP-5+SP-4	1637.17	3	0	2160.12	431.50	1637.17	2160.12	349.00	4131.00	.	.	MG/L
CHEMICAL OXYGEN DEMAND	6443	SP-2	3720.00	3	0	1150.61	3900.00	3720.00	1150.61	2490.00	4770.00	.	.	MG/L
CHEMICAL OXYGEN DEMAND	6443	SP-3	3903.33	3	0	577.35	3570.00	3903.33	577.35	3570.00	4570.00	.	.	MG/L
CHEMICAL OXYGEN DEMAND	6444	SP-5+SP-4	474.33	3	0	93.28	444.00	474.33	93.28	400.00	579.00	.	.	MG/L
CHEMICAL OXYGEN DEMAND	6444	SP-3	10343.33	3	0	8672.11	7810.00	10343.33	8672.11	3220.00	20000.00	.	.	MG/L
CHEMICAL OXYGEN DEMAND	6448	SP-2	18560.00	5	0	10979.66	17500.00	18560.00	10979.66	9700.00	36800.00	.	.	MG/L
FECAL COLIFORM	6443	SP-5+SP-4	801150.00	2	0	1129744.50	801150.00	801150.00	1129744.50	2300.00	1600000.00	.	.	/100MLS
FECAL COLIFORM	6443	SP-2	87500.00	2	0	116672.62	87500.00	87500.00	116672.62	5000.00	170000.00	.	.	/100MLS
FECAL COLIFORM	6443	SP-3	1600000.00	2	0	0.00	1600000.00	1600000.00	0.00	1600000.0	1600000.00	.	.	/100MLS
FECAL COLIFORM	6448	SP-2	1460000.00	5	0	313049.52	1600000.00	1460000.00	313049.52	900000.00	1600000.00	.	.	/100MLS
HEXANE EXTRACTABLE MATERIAL	6443	SP-5+SP-4	7.89	2	1	2.82	7.89	9.89	.	9.89	9.89	5.90	5.90	MG/L
HEXANE EXTRACTABLE MATERIAL	6443	SP-2	792.82	3	0	748.19	390.63	792.82	748.19	331.73	1656.08	.	.	MG/L
HEXANE EXTRACTABLE MATERIAL	6443	SP-3	297.28	2	0	5.49	297.28	297.28	5.49	293.40	301.17	.	.	MG/L
HEXANE EXTRACTABLE MATERIAL	6444	SP-5+SP-4	19.10	3	0	14.09	14.61	19.10	14.09	7.80	34.89	.	.	MG/L
HEXANE EXTRACTABLE MATERIAL	6444	SP-3	423.25	3	0	327.24	238.50	423.25	327.24	230.17	801.08	.	.	MG/L
HEXANE EXTRACTABLE MATERIAL	6448	SP-2	6225.50	5	0	10385.30	1986.00	6225.50	10385.30	499.17	24739.83	.	.	MG/L
NITRATE/NITRITE	6443	SP-5+SP-4	0.99	3	2	0.42	0.75	1.48	.	1.48	1.48	0.75	0.75	MG/L
NITRATE/NITRITE	6443	SP-2	1.58	3	2	1.43	0.75	3.23	.	3.23	3.23	0.75	0.75	MG/L
NITRATE/NITRITE	6443	SP-3	0.75	3	3	0.00	0.75	.	.	.	.	0.75	0.75	MG/L
NITRATE/NITRITE	6444	SP-5+SP-4	0.30	3	3	0.00	0.30	.	.	.	.	0.30	0.30	MG/L
NITRATE/NITRITE	6444	SP-3	0.30	3	3	0.00	0.30	.	.	.	.	0.30	0.30	MG/L
NITRATE/NITRITE	6448	SP-2	26.02	5	0	6.31	25.50	26.02	6.31	19.00	34.00	.	.	MG/L
TOTAL KJELDAHL NITROGEN	6443	SP-5+SP-4	21.85	3	0	3.95	19.85	21.85	3.95	19.30	26.40	.	.	MG/L
TOTAL KJELDAHL NITROGEN	6443	SP-2	80.13	3	0	61.98	68.80	80.13	61.98	24.60	147.00	.	.	MG/L
TOTAL KJELDAHL NITROGEN	6443	SP-3	72.17	3	0	27.56	80.90	72.17	27.56	41.30	94.30	.	.	MG/L

-- Subcategory=Poultry -- Option=PSES1 --
(continued)

Analyte	Episode	Point	Episode Mean	Total Number Values	Num ND	Obs Std Dev	Obs Median Value	Mean Value NC	Std Dev NC	Min Value NC	Max Value NC	Min Value ND	Max Value ND	Unit
TOTAL KJELDAHL NITROGEN	6444	SP-5+SP-4	46.73	3	0	5.88	43.80	46.73	5.88	42.90	53.50	.	.	MG/L
TOTAL KJELDAHL NITROGEN	6444	SP-3	201.87	3	0	119.74	271.00	201.87	119.74	63.60	271.00	.	.	MG/L
TOTAL KJELDAHL NITROGEN	6448	SP-2	179.60	5	0	45.87	202.00	179.60	45.87	103.00	212.00	.	.	MG/L
TOTAL NITROGEN	6443	SP-5+SP-4	22.84	3	0	3.78	21.33	22.84	3.78	20.05	27.15	.	.	MG/L
TOTAL NITROGEN	6443	SP-2	81.71	3	0	63.32	69.55	81.71	63.32	25.35	150.23	.	.	MG/L
TOTAL NITROGEN	6443	SP-3	72.92	3	0	27.56	81.65	72.92	27.56	42.05	95.05	.	.	MG/L
TOTAL NITROGEN	6444	SP-5+SP-4	47.03	3	0	5.88	44.10	47.03	5.88	43.20	53.80	.	.	MG/L
TOTAL NITROGEN	6444	SP-3	202.17	3	0	119.74	271.30	202.17	119.74	63.90	271.30	.	.	MG/L
TOTAL NITROGEN	6448	SP-2	205.62	5	0	45.16	221.00	205.62	45.16	128.50	240.60	.	.	MG/L
TOTAL PHOSPHORUS	6443	SP-5+SP-4	17.48	3	0	8.80	13.25	17.48	8.80	11.60	27.60	.	.	MG/L
TOTAL PHOSPHORUS	6443	SP-2	72.20	3	0	21.04	69.40	72.20	21.04	52.70	94.50	.	.	MG/L
TOTAL PHOSPHORUS	6443	SP-3	37.53	3	0	9.31	34.80	37.53	9.31	29.90	47.90	.	.	MG/L
TOTAL PHOSPHORUS	6444	SP-5+SP-4	17.73	3	0	27.43	2.29	17.73	27.43	1.51	49.40	.	.	MG/L
TOTAL PHOSPHORUS	6444	SP-3	312.77	3	0	429.05	77.20	312.77	429.05	53.10	808.00	.	.	MG/L
TOTAL PHOSPHORUS	6448	SP-2	37.54	5	0	8.28	35.90	37.54	8.28	31.10	51.50	.	.	MG/L
TOTAL RESIDUAL CHLORINE	6443	SP-5+SP-4	0.81	3	0	0.19	0.79	0.81	0.19	0.64	1.01	.	.	MG/L
TOTAL RESIDUAL CHLORINE	6443	SP-2	7.03	3	0	5.10	9.30	7.03	5.10	1.18	10.60	.	.	MG/L
TOTAL RESIDUAL CHLORINE	6443	SP-3	0.20	3	2	0.01	0.20	0.21	.	0.21	0.21	0.20	0.20	MG/L
TOTAL RESIDUAL CHLORINE	6444	SP-5+SP-4	0.25	3	1	0.05	0.24	0.27	0.04	0.24	0.30	0.20	0.20	MG/L
TOTAL RESIDUAL CHLORINE	6444	SP-3	0.70	3	1	0.47	0.78	0.95	0.24	0.78	1.12	0.20	0.20	MG/L
TOTAL RESIDUAL CHLORINE	6448	SP-2	0.20	5	5	0.00	0.20	.	.	.	.	0.20	0.20	MG/L
TOTAL SUSPENDED SOLIDS	6443	SP-5+SP-4	137.50	3	0	22.75	138.00	137.50	22.75	114.50	160.00	.	.	MG/L
TOTAL SUSPENDED SOLIDS	6443	SP-2	1656.67	3	0	330.05	1650.00	1656.67	330.05	1330.00	1990.00	.	.	MG/L
TOTAL SUSPENDED SOLIDS	6443	SP-3	1523.33	3	0	213.62	1610.00	1523.33	213.62	1280.00	1680.00	.	.	MG/L
TOTAL SUSPENDED SOLIDS	6444	SP-5+SP-4	55.50	3	0	4.27	56.00	55.50	4.27	51.00	59.50	.	.	MG/L
TOTAL SUSPENDED SOLIDS	6444	SP-3	53390.00	3	0	81949.04	7620.00	53390.00	81949.04	4550.00	148000.00	.	.	MG/L
TOTAL SUSPENDED SOLIDS	6448	SP-2	3248.00	5	0	2279.19	2260.00	3248.00	2279.19	1860.00	7260.00	.	.	MG/L

-- Subcategory=Red Meat -- Option=BAT2 --

Analyte	Episode	Point	Episode Mean	Total Number Values	Num ND	Obs Std Dev	Obs Median Value	Mean Value NC	Std Dev NC	Min Value NC	Max Value NC	Min Value ND	Max Value ND	Unit
AMMONIA AS NITROGEN	6335	SP-2	15.12	5	0	10.85	10.80	15.12	10.85	6.81	34.10	.	.	MG/L

Subcategory=Red Meat -- Option=BAT2
(continued)

Analyte	Episode	Point	Episode Mean	Total Number Values	Num ND	Obs Std Dev	Obs Median Value	Mean Value NC	Std Dev NC	Min Value NC	Max Value NC	Min Value ND	Max Value ND	Unit
AMMONIA AS NITROGEN	6440	SP-5+SP-4	0.13	3	0	0.05	0.13	0.13	0.05	0.08	0.17	.	.	MG/L
AMMONIA AS NITROGEN	6440	SP-3	0.15	3	0	0.06	0.12	0.15	0.06	0.10	0.22	.	.	MG/L
AMMONIA AS NITROGEN	6441	SP-6+SP-5	1.00	3	2	0.00	1.00	1.00	.	1.00	1.00	1.00	1.00	MG/L
AMMONIA AS NITROGEN	6441	SP-1+SP-3	154.16	3	0	13.96	155.78	154.16	13.96	139.46	167.24	.	.	MG/L
AMMONIA AS NITROGEN	6442	SP-5+SP-4	0.79	5	0	0.30	0.79	0.79	0.30	0.44	1.22	.	.	MG/L
AMMONIA AS NITROGEN	6442	SP-1	42.78	5	0	6.65	40.30	42.78	6.65	38.60	54.60	.	.	MG/L
AMMONIA AS NITROGEN	6447	SP-5+SP-4	0.51	3	0	0.14	0.48	0.51	0.14	0.39	0.66	.	.	MG/L
AMMONIA AS NITROGEN	6447	SP-1	101.13	3	0	18.47	94.50	101.13	18.47	86.90	122.00	.	.	MG/L
AMMONIA AS NITROGEN	6447	SP-3	51.73	3	0	43.46	57.20	51.73	43.46	5.79	92.20	.	.	MG/L
BIOCHEMICAL OXYGEN DEMAND	6335	SP-2	1492.00	5	0	227.31	1410.00	1492.00	227.31	1220.00	1820.00	.	.	MG/L
BIOCHEMICAL OXYGEN DEMAND	6440	SP-5+SP-4	7.00	3	1	1.00	7.00	7.50	0.71	7.00	8.00	6.00	6.00	MG/L
BIOCHEMICAL OXYGEN DEMAND	6440	SP-3	1583.33	3	1	853.37	2020.00	2075.00	77.78	2020.00	2130.00	600.0	600.0	MG/L
BIOCHEMICAL OXYGEN DEMAND	6441	SP-6+SP-5	6.30	3	0	4.69	5.02	6.30	4.69	2.39	11.50	.	.	MG/L
BIOCHEMICAL OXYGEN DEMAND	6441	SP-1+SP-3	5966.42	3	0	6381.69	2945.15	5966.42	6381.69	1656.41	13297.70	.	.	MG/L
BIOCHEMICAL OXYGEN DEMAND	6442	SP-5+SP-4	6.80	5	1	1.10	6.00	7.00	1.15	6.00	8.00	6.00	6.00	MG/L
BIOCHEMICAL OXYGEN DEMAND	6442	SP-1	6404.00	5	0	1522.41	6320.00	6404.00	1522.41	4340.00	8400.00	.	.	MG/L
BIOCHEMICAL OXYGEN DEMAND	6447	SP-5+SP-4	4.67	3	1	1.15	4.00	5.00	1.41	4.00	6.00	4.00	4.00	MG/L
BIOCHEMICAL OXYGEN DEMAND	6447	SP-1	3870.00	3	0	1461.13	3350.00	3870.00	1461.13	2740.00	5520.00	.	.	MG/L
BIOCHEMICAL OXYGEN DEMAND	6447	SP-3	3673.33	3	0	844.18	3530.00	3673.33	844.18	2910.00	4580.00	.	.	MG/L
CHEMICAL OXYGEN DEMAND	6335	SP-2	2630.00	5	0	49.50	2630.00	2630.00	49.50	2570.00	2700.00	.	.	MG/L
CHEMICAL OXYGEN DEMAND	6440	SP-5+SP-4	33.00	3	0	1.73	34.00	33.00	1.73	31.00	34.00	.	.	MG/L
CHEMICAL OXYGEN DEMAND	6440	SP-3	3790.00	3	0	2072.61	3670.00	3790.00	2072.61	1780.00	5920.00	.	.	MG/L
CHEMICAL OXYGEN DEMAND	6441	SP-6+SP-5	22.33	3	1	2.74	21.65	23.50	2.62	21.65	25.35	20.00	20.00	MG/L
CHEMICAL OXYGEN DEMAND	6441	SP-1+SP-3	3459.70	3	0	861.62	3291.87	3459.70	861.62	2694.34	4392.89	.	.	MG/L
CHEMICAL OXYGEN DEMAND	6442	SP-5+SP-4	117.10	5	0	10.47	112.00	117.10	10.47	109.00	135.00	.	.	MG/L
CHEMICAL OXYGEN DEMAND	6442	SP-1	21880.00	5	0	14876.73	18200.00	21880.00	14876.73	10100.00	47200.00	.	.	MG/L
CHEMICAL OXYGEN DEMAND	6447	SP-5+SP-4	47.17	3	0	7.15	45.50	47.17	7.15	41.00	55.00	.	.	MG/L
CHEMICAL OXYGEN DEMAND	6447	SP-1	5940.00	3	0	1098.23	5550.00	5940.00	1098.23	5090.00	7180.00	.	.	MG/L
CHEMICAL OXYGEN DEMAND	6447	SP-3	7840.00	3	0	980.00	8260.00	7840.00	980.00	6720.00	8540.00	.	.	MG/L
FECAL COLIFORM	6335	SP-2	820000.00	5	0	712039.32	300000.00	820000.00	712039.32	300000.00	1600000.00	.	.	/100MLS
FECAL COLIFORM	6440	SP-5+SP-4	21.50	3	1	17.54	26.50	31.25	6.72	26.50	36.00	2.00	2.00	/100MLS
FECAL COLIFORM	6440	SP-3	1600000.00	3	0	0.00	1600000.00	1600000.00	0.00	1600000.0	1600000.00	.	.	/100MLS
FECAL COLIFORM	6441	SP-6+SP-5	768.00	3	2	1326.75	2.00	2300.00	.	2300.00	2300.00	2.00	2.00	/100MLS
FECAL COLIFORM	6441	SP-1+SP-3	1062737.80	3	0	604928.39	1180694.79	1062737.80	604928.39	407518.61	1600000.00	.	.	/100MLS
FECAL COLIFORM	6442	SP-5+SP-4	493.30	5	0	1010.54	70.00	493.30	1010.54	3.00	2300.00	.	.	/100MLS
FECAL COLIFORM	6442	SP-1	1600000.00	5	0	0.00	1600000.00	1600000.00	0.00	1600000.0	1600000.00	.	.	/100MLS

Subcategory=Red Meat -- Option=BAT2
(continued)

Analyte	Episode	Point	Episode Mean	Total Number Values	Num ND	Obs Std Dev	Obs Median Value	Mean Value NC	Std Dev NC	Min Value NC	Max Value NC	Min Value ND	Max Value ND	Unit
FECAL COLIFORM	6447	SP-5+SP-4	32.67	3	1	32.08	30.00	48.00	25.46	30.00	66.00	2.00	2.00	/100MLS
FECAL COLIFORM	6447	SP-1	1233333.33	3	0	635085.30	1600000.00	1233333.33	635085.30	500000.00	1600000.00	.	.	/100MLS
FECAL COLIFORM	6447	SP-3	1600000.00	3	0	0.00	1600000.00	1600000.00	0.00	1600000.0	1600000.00	.	.	/100MLS
HEXANE EXTRACTABLE MATERIAL	6335	SP-2	162.77	5	0	53.24	178.50	162.77	53.24	96.33	230.17	.	.	MG/L
HEXANE EXTRACTABLE MATERIAL	6440	SP-5+SP-4	5.92	3	3	0.08	5.92	.	.	.	.	5.83	6.00	MG/L
HEXANE EXTRACTABLE MATERIAL	6440	SP-3	164.83	3	0	59.86	160.67	164.83	59.86	107.17	226.67	.	.	MG/L
HEXANE EXTRACTABLE MATERIAL	6441	SP-6+SP-5	5.79	3	3	0.06	5.78	.	.	.	.	5.73	5.86	MG/L
HEXANE EXTRACTABLE MATERIAL	6441	SP-1+SP-3	113.39	3	0	64.21	99.38	113.39	64.21	57.34	183.45	.	.	MG/L
HEXANE EXTRACTABLE MATERIAL	6442	SP-5+SP-4	6.07	5	4	0.25	6.00	6.50	.	6.50	6.50	5.83	6.00	MG/L
HEXANE EXTRACTABLE MATERIAL	6442	SP-1	2997.60	5	0	1078.08	3159.50	2997.60	1078.08	1926.83	4556.67	.	.	MG/L
HEXANE EXTRACTABLE MATERIAL	6447	SP-5+SP-4	11.89	3	0	11.21	5.50	11.89	11.21	5.33	24.83	.	.	MG/L
HEXANE EXTRACTABLE MATERIAL	6447	SP-1	361.28	3	0	269.23	312.67	361.28	269.23	119.67	651.50	.	.	MG/L
HEXANE EXTRACTABLE MATERIAL	6447	SP-3	618.94	3	0	219.29	534.00	618.94	219.29	454.83	868.00	.	.	MG/L
NITRATE/NITRITE	6335	SP-2	2.13	5	0	0.15	2.16	2.13	0.15	1.89	2.30	.	.	MG/L
NITRATE/NITRITE	6440	SP-5+SP-4	73.67	3	0	2.83	73.75	73.67	2.83	70.80	76.45	.	.	MG/L
NITRATE/NITRITE	6440	SP-3	0.16	3	0	0.05	0.19	0.16	0.05	0.10	0.19	.	.	MG/L
NITRATE/NITRITE	6441	SP-6+SP-5	162.00	3	0	14.81	160.50	162.00	14.81	148.00	177.50	.	.	MG/L
NITRATE/NITRITE	6441	SP-1+SP-3	0.92	3	2	1.07	0.30	2.15	.	2.15	2.15	0.30	0.30	MG/L
NITRATE/NITRITE	6442	SP-5+SP-4	164.00	5	0	6.52	165.00	164.00	6.52	156.00	172.00	.	.	MG/L
NITRATE/NITRITE	6442	SP-1	0.02	5	2	0.01	0.01	0.02	0.02	0.01	0.04	0.01	0.01	MG/L
NITRATE/NITRITE	6447	SP-5+SP-4	289.50	3	0	21.27	282.00	289.50	21.27	273.00	313.50	.	.	MG/L
NITRATE/NITRITE	6447	SP-1	0.48	3	1	0.42	0.60	0.71	0.16	0.60	0.82	0.01	0.01	MG/L
NITRATE/NITRITE	6447	SP-3	0.19	3	2	0.31	0.01	0.55	.	0.55	0.55	0.01	0.01	MG/L
TOTAL KJELDAHL NITROGEN	6335	SP-2	23.75	2	0	17.32	23.75	23.75	17.32	11.50	36.00	.	.	MG/L
TOTAL KJELDAHL NITROGEN	6440	SP-5+SP-4	1.82	3	0	0.17	1.84	1.82	0.17	1.65	1.99	.	.	MG/L
TOTAL KJELDAHL NITROGEN	6440	SP-3	110.47	3	0	82.48	153.00	110.47	82.48	15.40	163.00	.	.	MG/L
TOTAL KJELDAHL NITROGEN	6441	SP-6+SP-5	1.61	3	1	0.72	1.43	1.92	0.69	1.43	2.40	1.00	1.00	MG/L
TOTAL KJELDAHL NITROGEN	6441	SP-1+SP-3	440.63	3	0	53.52	420.92	440.63	53.52	399.76	501.21	.	.	MG/L
TOTAL KJELDAHL NITROGEN	6442	SP-5+SP-4	5.62	5	0	3.19	4.68	5.62	3.19	2.66	11.08	.	.	MG/L
TOTAL KJELDAHL NITROGEN	6442	SP-1	77.58	5	0	54.76	49.50	77.58	54.76	42.50	173.00	.	.	MG/L
TOTAL KJELDAHL NITROGEN	6447	SP-5+SP-4	3.03	3	0	1.98	2.20	3.03	1.98	1.61	5.29	.	.	MG/L
TOTAL KJELDAHL NITROGEN	6447	SP-1	141.47	3	0	72.42	103.00	141.47	72.42	96.40	225.00	.	.	MG/L
TOTAL KJELDAHL NITROGEN	6447	SP-3	66.67	3	0	25.87	56.90	66.67	25.87	47.10	96.00	.	.	MG/L
TOTAL NITROGEN	6335	SP-2	25.98	2	0	17.42	25.98	25.98	17.42	13.66	38.30	.	.	MG/L
TOTAL NITROGEN	6440	SP-5+SP-4	75.49	3	0	2.74	75.74	75.49	2.74	72.64	78.10	.	.	MG/L
TOTAL NITROGEN	6440	SP-3	110.63	3	0	82.46	153.10	110.63	82.46	15.59	163.19	.	.	MG/L

Subcategory=Red Meat -- Option=BAT2
(continued)

Analyte	Episode	Point	Episode Mean	Total Number Values	Num ND	Obs Std Dev	Obs Median Value	Mean Value NC	Std Dev NC	Min Value NC	Max Value NC	Min Value ND	Max Value ND	Unit
TOTAL NITROGEN	6441	SP-6+SP-5	163.61	3	0	14.98	162.90	163.61	14.98	149.00	178.93	.	.	MG/L
TOTAL NITROGEN	6441	SP-1+SP-3	441.55	3	0	53.19	423.08	441.55	53.19	400.06	501.51	.	.	MG/L
TOTAL NITROGEN	6442	SP-5+SP-4	169.62	5	0	8.70	167.66	169.62	8.70	160.68	183.08	.	.	MG/L
TOTAL NITROGEN	6442	SP-1	77.60	5	0	54.77	49.52	77.60	54.77	42.51	173.04	.	.	MG/L
TOTAL NITROGEN	6447	SP-5+SP-4	292.53	3	0	20.46	287.29	292.53	20.46	275.20	315.11	.	.	MG/L
TOTAL NITROGEN	6447	SP-1	141.94	3	0	72.54	103.82	141.94	72.54	96.41	225.60	.	.	MG/L
TOTAL NITROGEN	6447	SP-3	66.86	3	0	25.77	57.45	66.86	25.77	47.11	96.01	.	.	MG/L
TOTAL PHOSPHORUS	6335	SP-2	81.68	5	0	4.83	78.90	81.68	4.83	77.60	88.40	.	.	MG/L
TOTAL PHOSPHORUS	6440	SP-5+SP-4	11.65	3	0	0.87	11.85	11.65	0.87	10.70	12.40	.	.	MG/L
TOTAL PHOSPHORUS	6440	SP-3	56.70	3	0	32.99	47.20	56.70	32.99	29.50	93.40	.	.	MG/L
TOTAL PHOSPHORUS	6441	SP-6+SP-5	11.49	3	0	0.50	11.47	11.49	0.50	11.00	12.00	.	.	MG/L
TOTAL PHOSPHORUS	6441	SP-1+SP-3	59.58	3	0	54.47	28.16	59.58	54.47	28.11	122.48	.	.	MG/L
TOTAL PHOSPHORUS	6442	SP-5+SP-4	31.34	5	0	1.15	31.50	31.34	1.15	29.60	32.50	.	.	MG/L
TOTAL PHOSPHORUS	6442	SP-1	30.26	5	0	4.68	32.80	30.26	4.68	23.30	34.70	.	.	MG/L
TOTAL PHOSPHORUS	6447	SP-5+SP-4	14.73	3	0	1.92	14.25	14.73	1.92	13.10	16.85	.	.	MG/L
TOTAL PHOSPHORUS	6447	SP-1	32.17	3	0	3.88	34.10	32.17	3.88	27.70	34.70	.	.	MG/L
TOTAL PHOSPHORUS	6447	SP-3	34.73	3	0	7.65	34.70	34.73	7.65	27.10	42.40	.	.	MG/L
TOTAL RESIDUAL CHLORINE	6335	SP-2	0.25	5	1	0.12	0.24	0.29	0.10	0.16	0.37	0.10	0.10	MG/L
TOTAL RESIDUAL CHLORINE	6440	SP-5+SP-4	0.20	3	3	0.00	0.20	.	.	.	.	0.20	0.20	MG/L
TOTAL RESIDUAL CHLORINE	6440	SP-3	0.20	3	3	0.00	0.20	.	.	.	.	0.20	0.20	MG/L
TOTAL RESIDUAL CHLORINE	6441	SP-6+SP-5	0.23	3	1	0.05	0.21	0.25	0.06	0.21	0.29	0.20	0.20	MG/L
TOTAL RESIDUAL CHLORINE	6441	SP-1+SP-3	0.22	3	2	0.04	0.20	0.27	.	0.27	0.27	0.20	0.20	MG/L
TOTAL RESIDUAL CHLORINE	6442	SP-5+SP-4	0.20	5	5	0.00	0.20	.	.	.	.	0.20	0.20	MG/L
TOTAL RESIDUAL CHLORINE	6442	SP-1	0.20	5	5	0.00	0.20	.	.	.	.	0.20	0.20	MG/L
TOTAL RESIDUAL CHLORINE	6447	SP-5+SP-4	0.62	3	0	0.29	0.61	0.62	0.29	0.33	0.91	.	.	MG/L
TOTAL RESIDUAL CHLORINE	6447	SP-1	0.40	3	3	0.00	0.40	.	.	.	.	0.40	0.40	MG/L
TOTAL RESIDUAL CHLORINE	6447	SP-3	1.00	3	3	0.00	1.00	.	.	.	.	1.00	1.00	MG/L
TOTAL SUSPENDED SOLIDS	6335	SP-2	362.60	5	0	87.80	360.00	362.60	87.80	233.00	463.00	.	.	MG/L
TOTAL SUSPENDED SOLIDS	6440	SP-5+SP-4	12.33	3	0	4.25	12.50	12.33	4.25	8.00	16.50	.	.	MG/L
TOTAL SUSPENDED SOLIDS	6440	SP-3	2273.33	3	0	1244.56	2900.00	2273.33	1244.56	840.00	3080.00	.	.	MG/L
TOTAL SUSPENDED SOLIDS	6441	SP-6+SP-5	28.00	3	0	17.77	18.50	28.00	17.77	17.00	48.50	.	.	MG/L
TOTAL SUSPENDED SOLIDS	6441	SP-1+SP-3	1133.81	3	0	274.82	1213.91	1133.81	274.82	827.83	1359.68	.	.	MG/L
TOTAL SUSPENDED SOLIDS	6442	SP-5+SP-4	22.20	5	0	3.11	22.00	22.20	3.11	19.00	27.00	.	.	MG/L
TOTAL SUSPENDED SOLIDS	6442	SP-1	3332.00	5	0	465.10	3340.00	3332.00	465.10	2580.00	3820.00	.	.	MG/L
TOTAL SUSPENDED SOLIDS	6447	SP-5+SP-4	19.17	3	0	2.84	20.00	19.17	2.84	16.00	21.50	.	.	MG/L
TOTAL SUSPENDED SOLIDS	6447	SP-1	836.67	3	0	190.35	850.00	836.67	190.35	640.00	1020.00	.	.	MG/L

Subcategory=Red Meat -- Option=BAT2
(continued)

Analyte	Episode	Point	Episode Mean	Total Number Values	Num ND	Obs Std Dev	Obs Median Value	Mean Value NC	Std Dev NC	Min Value NC	Max Value NC	Min Value ND	Max Value ND	Unit
TOTAL SUSPENDED SOLIDS	6447	SP-3	1510.00	3	0	227.16	1410.00	1510.00	227.16	1350.00	1770.00	.	.	MG/L

Subcategory=Red Meat -- Option=BAT3

Analyte	Episode	Point	Episode Mean	Total Number Values	Num ND	Obs Std Dev	Obs Median Value	Mean Value NC	Std Dev NC	Min Value NC	Max Value NC	Min Value ND	Max Value ND	Unit
AMMONIA AS NITROGEN	6335	SP-6	1.87	4	0	1.30	2.08	1.87	1.30	0.33	2.98	.	.	MG/L
AMMONIA AS NITROGEN	6335	SP-2	15.12	5	0	10.85	10.80	15.12	10.85	6.81	34.10	.	.	MG/L
AMMONIA AS NITROGEN	6335	SP-3	272.80	5	0	123.99	251.00	272.80	123.99	140.00	464.00	.	.	MG/L
AMMONIA AS NITROGEN	6447	SP-1	101.13	3	0	18.47	94.50	101.13	18.47	86.90	122.00	.	.	MG/L
BIOCHEMICAL OXYGEN DEMAND	6335	SP-6	4.60	5	1	1.82	4.00	5.00	1.83	3.00	7.00	3.00	3.00	MG/L
BIOCHEMICAL OXYGEN DEMAND	6335	SP-2	1492.00	5	0	227.31	1410.00	1492.00	227.31	1220.00	1820.00	.	.	MG/L
BIOCHEMICAL OXYGEN DEMAND	6335	SP-3	2208.00	5	0	518.33	2070.00	2208.00	518.33	1740.00	3100.00	.	.	MG/L
BIOCHEMICAL OXYGEN DEMAND	6447	SP-1	3870.00	3	0	1461.13	3350.00	3870.00	1461.13	2740.00	5520.00	.	.	MG/L
CHEMICAL OXYGEN DEMAND	6335	SP-6	26.40	5	0	3.44	25.00	26.40	3.44	23.00	31.00	.	.	MG/L
CHEMICAL OXYGEN DEMAND	6335	SP-2	2630.00	5	0	49.50	2630.00	2630.00	49.50	2570.00	2700.00	.	.	MG/L
CHEMICAL OXYGEN DEMAND	6335	SP-3	3994.00	5	0	1199.76	4310.00	3994.00	1199.76	2000.00	4930.00	.	.	MG/L
CHEMICAL OXYGEN DEMAND	6447	SP-1	5940.00	3	0	1098.23	5550.00	5940.00	1098.23	5090.00	7180.00	.	.	MG/L
FECAL COLIFORM	6335	SP-6	21.50	4	3	39.00	2.00	80.00	.	80.00	80.00	2.00	2.00	/100MLS
FECAL COLIFORM	6335	SP-2	820000.00	5	0	712039.32	300000.00	820000.00	712039.32	300000.00	1600000.00	.	.	/100MLS
FECAL COLIFORM	6335	SP-3	1380000.00	5	0	491934.96	1600000.00	1380000.00	491934.96	500000.00	1600000.00	.	.	/100MLS
FECAL COLIFORM	6447	SP-1	1233333.33	3	0	635085.30	1600000.00	1233333.33	635085.30	500000.00	1600000.00	.	.	/100MLS
HEXANE EXTRACTABLE MATERIAL	6335	SP-6	5.90	5	4	0.22	6.00	6.17	.	6.17	6.17	5.67	6.00	MG/L
HEXANE EXTRACTABLE MATERIAL	6335	SP-2	162.77	5	0	53.24	178.50	162.77	53.24	96.33	230.17	.	.	MG/L
HEXANE EXTRACTABLE MATERIAL	6335	SP-3	345.30	5	0	134.63	271.50	345.30	134.63	266.50	580.33	.	.	MG/L
HEXANE EXTRACTABLE MATERIAL	6447	SP-1	361.28	3	0	269.23	312.67	361.28	269.23	119.67	651.50	.	.	MG/L
NITRATE/NITRITE	6335	SP-6	6.02	5	0	1.03	5.84	6.02	1.03	4.71	7.14	.	.	MG/L
NITRATE/NITRITE	6335	SP-2	2.13	5	0	0.15	2.16	2.13	0.15	1.89	2.30	.	.	MG/L
NITRATE/NITRITE	6335	SP-3	8.46	5	1	18.75	0.08	10.57	20.96	0.08	42.00	0.01	0.01	MG/L
NITRATE/NITRITE	6447	SP-1	0.48	3	1	0.42	0.60	0.71	0.16	0.60	0.82	0.01	0.01	MG/L
TOTAL KJELDAHL NITROGEN	6335	SP-6	2.00	3	0	1.09	1.42	2.00	1.09	1.33	3.26	.	.	MG/L
TOTAL KJELDAHL NITROGEN	6335	SP-2	23.75	2	0	17.32	23.75	23.75	17.32	11.50	36.00	.	.	MG/L
TOTAL KJELDAHL NITROGEN	6335	SP-3	261.50	4	0	20.42	262.00	261.50	20.42	237.00	285.00	.	.	MG/L

Subcategory=Red Meat -- Option=BAT3 (continued)

Analyte	Episode	Point	Episode Mean	Total Number Values	Num ND	Obs Std Dev	Obs Median Value	Mean Value NC	Std Dev NC	Min Value NC	Max Value NC	Min Value ND	Max Value ND	Unit
TOTAL KJELDAHL NITROGEN	6447	SP-1	141.47	3	0	72.42	103.00	141.47	72.42	96.40	225.00	.	.	MG/L
TOTAL NITROGEN	6335	SP-6	7.34	3	0	1.30	7.17	7.34	1.30	6.13	8.72	.	.	MG/L
TOTAL NITROGEN	6335	SP-2	25.98	2	0	17.42	25.98	25.98	17.42	13.66	38.30	.	.	MG/L
TOTAL NITROGEN	6335	SP-3	272.05	4	0	32.67	270.10	272.05	32.67	237.01	311.00	.	.	MG/L
TOTAL NITROGEN	6447	SP-1	141.94	3	0	72.54	103.82	141.94	72.54	96.41	225.60	.	.	MG/L
TOTAL PHOSPHORUS	6335	SP-6	6.79	5	0	2.21	7.70	6.79	2.21	3.26	8.90	.	.	MG/L
TOTAL PHOSPHORUS	6335	SP-2	81.68	5	0	4.83	78.90	81.68	4.83	77.60	88.40	.	.	MG/L
TOTAL PHOSPHORUS	6335	SP-3	67.40	5	0	10.63	66.30	67.40	10.63	53.60	83.30	.	.	MG/L
TOTAL PHOSPHORUS	6447	SP-1	32.17	3	0	3.88	34.10	32.17	3.88	27.70	34.70	.	.	MG/L
TOTAL RESIDUAL CHLORINE	6335	SP-6	13.23	5	0	6.96	13.40	13.23	6.96	2.15	19.90	.	.	MG/L
TOTAL RESIDUAL CHLORINE	6335	SP-2	0.25	5	1	0.12	0.24	0.29	0.10	0.16	0.37	0.10	0.10	MG/L
TOTAL RESIDUAL CHLORINE	6335	SP-3	0.84	5	2	0.67	1.00	0.74	0.92	0.10	1.80	1.00	1.00	MG/L
TOTAL RESIDUAL CHLORINE	6447	SP-1	0.40	3	3	0.00	0.40	.	.	.	.	0.40	0.40	MG/L
TOTAL SUSPENDED SOLIDS	6335	SP-6	4.20	5	2	0.45	4.00	4.33	0.58	4.00	5.00	4.00	4.00	MG/L
TOTAL SUSPENDED SOLIDS	6335	SP-2	362.60	5	0	87.80	360.00	362.60	87.80	233.00	463.00	.	.	MG/L
TOTAL SUSPENDED SOLIDS	6335	SP-3	1670.00	5	0	294.28	1720.00	1670.00	294.28	1250.00	2000.00	.	.	MG/L
TOTAL SUSPENDED SOLIDS	6447	SP-1	836.67	3	0	190.35	850.00	836.67	190.35	640.00	1020.00	.	.	MG/L

Subcategory=Red Meat -- Option=PSES1

Analyte	Episode	Point	Episode Mean	Total Number Values	Num ND	Obs Std Dev	Obs Median Value	Mean Value NC	Std Dev NC	Min Value NC	Max Value NC	Min Value ND	Max Value ND	Unit
AMMONIA AS NITROGEN	6335	SP-4	267.00	5	0	119.16	246.00	267.00	119.16	134.00	441.00	.	.	MG/L
AMMONIA AS NITROGEN	6335	SP-2	15.12	5	0	10.85	10.80	15.12	10.85	6.81	34.10	.	.	MG/L
AMMONIA AS NITROGEN	6335	SP-3	272.80	5	0	123.99	251.00	272.80	123.99	140.00	464.00	.	.	MG/L
AMMONIA AS NITROGEN	6447	SP-1	101.13	3	0	18.47	94.50	101.13	18.47	86.90	122.00	.	.	MG/L
BIOCHEMICAL OXYGEN DEMAND	6335	SP-4	1264.80	5	0	370.71	1150.00	1264.80	370.71	945.00	1830.00	.	.	MG/L
BIOCHEMICAL OXYGEN DEMAND	6335	SP-2	1492.00	5	0	227.31	1410.00	1492.00	227.31	1220.00	1820.00	.	.	MG/L
BIOCHEMICAL OXYGEN DEMAND	6335	SP-3	2208.00	5	0	518.33	2070.00	2208.00	518.33	1740.00	3100.00	.	.	MG/L
BIOCHEMICAL OXYGEN DEMAND	6447	SP-1	3870.00	3	0	1461.13	3350.00	3870.00	1461.13	2740.00	5520.00	.	.	MG/L
CHEMICAL OXYGEN DEMAND	6335	SP-4	1768.00	5	0	117.13	1820.00	1768.00	117.13	1590.00	1870.00	.	.	MG/L
CHEMICAL OXYGEN DEMAND	6335	SP-2	2630.00	5	0	49.50	2630.00	2630.00	49.50	2570.00	2700.00	.	.	MG/L
CHEMICAL OXYGEN DEMAND	6335	SP-3	3994.00	5	0	1199.76	4310.00	3994.00	1199.76	2000.00	4930.00	.	.	MG/L

--- Subcategory=Red Meat -- Option=PSES1 ---
(continued)

Analyte	Episode	Point	Episode Mean	Total Number Values	Num ND	Obs Std Dev	Obs Median Value	Mean Value NC	Std Dev NC	Min Value NC	Max Value NC	Min Value ND	Max Value ND	Unit
CHEMICAL OXYGEN DEMAND	6447	SP-1	5940.00	3	0	1098.23	5550.00	5940.00	1098.23	5090.00	7180.00	.	.	MG/L
FECAL COLIFORM	6335	SP-4	1142600.00	5	0	700445.43	1600000.00	1142600.00	700445.43	13000.00	1600000.00	.	.	/100MLS
FECAL COLIFORM	6335	SP-2	820000.00	5	0	712039.32	300000.00	820000.00	712039.32	300000.00	1600000.00	.	.	/100MLS
FECAL COLIFORM	6335	SP-3	1380000.00	5	0	491934.96	1600000.00	1380000.00	491934.96	500000.00	1600000.00	.	.	/100MLS
FECAL COLIFORM	6447	SP-1	1233333.33	3	0	635085.30	1600000.00	1233333.33	635085.30	500000.00	1600000.00	.	.	/100MLS
HEXANE EXTRACTABLE MATERIAL	6335	SP-4	16.29	5	0	3.29	15.83	16.29	3.29	13.00	21.80	.	.	MG/L
HEXANE EXTRACTABLE MATERIAL	6335	SP-2	162.77	5	0	53.24	178.50	162.77	53.24	96.33	230.17	.	.	MG/L
HEXANE EXTRACTABLE MATERIAL	6335	SP-3	345.30	5	0	134.63	271.50	345.30	134.63	266.50	580.33	.	.	MG/L
HEXANE EXTRACTABLE MATERIAL	6447	SP-1	361.28	3	0	269.23	312.67	361.28	269.23	119.67	651.50	.	.	MG/L
NITRATE/NITRITE	6335	SP-4	0.09	5	0	0.01	0.09	0.09	0.01	0.07	0.10	.	.	MG/L
NITRATE/NITRITE	6335	SP-2	2.13	5	0	0.15	2.16	2.13	0.15	1.89	2.30	.	.	MG/L
NITRATE/NITRITE	6335	SP-3	8.46	5	1	18.75	0.08	10.57	20.96	0.08	42.00	0.01	0.01	MG/L
NITRATE/NITRITE	6447	SP-1	0.48	3	1	0.42	0.60	0.71	0.16	0.60	0.82	0.01	0.01	MG/L
TOTAL KJELDAHL NITROGEN	6335	SP-4	148.00	2	0	14.14	148.00	148.00	14.14	138.00	158.00	.	.	MG/L
TOTAL KJELDAHL NITROGEN	6335	SP-2	23.75	2	0	17.32	23.75	23.75	17.32	11.50	36.00	.	.	MG/L
TOTAL KJELDAHL NITROGEN	6335	SP-3	261.50	4	0	20.42	262.00	261.50	20.42	237.00	285.00	.	.	MG/L
TOTAL KJELDAHL NITROGEN	6447	SP-1	141.47	3	0	72.42	103.00	141.47	72.42	96.40	225.00	.	.	MG/L
TOTAL NITROGEN	6335	SP-4	148.08	2	0	14.15	148.08	148.08	14.15	138.07	158.08	.	.	MG/L
TOTAL NITROGEN	6335	SP-2	25.98	2	0	17.42	25.98	25.98	17.42	13.66	38.30	.	.	MG/L
TOTAL NITROGEN	6335	SP-3	272.05	4	0	32.67	270.10	272.05	32.67	237.01	311.00	.	.	MG/L
TOTAL NITROGEN	6447	SP-1	141.94	3	0	72.54	103.82	141.94	72.54	96.41	225.60	.	.	MG/L
TOTAL PHOSPHORUS	6335	SP-4	31.88	5	0	9.24	32.50	31.88	9.24	23.50	46.40	.	.	MG/L
TOTAL PHOSPHORUS	6335	SP-2	81.68	5	0	4.83	78.90	81.68	4.83	77.60	88.40	.	.	MG/L
TOTAL PHOSPHORUS	6335	SP-3	67.40	5	0	10.63	66.30	67.40	10.63	53.60	83.30	.	.	MG/L
TOTAL PHOSPHORUS	6447	SP-1	32.17	3	0	3.88	34.10	32.17	3.88	27.70	34.70	.	.	MG/L
TOTAL RESIDUAL CHLORINE	6335	SP-4	0.10	5	4	0.00	0.10	0.11	.	0.11	0.11	0.10	0.10	MG/L
TOTAL RESIDUAL CHLORINE	6335	SP-2	0.25	5	1	0.12	0.24	0.29	0.10	0.16	0.37	0.10	0.10	MG/L
TOTAL RESIDUAL CHLORINE	6335	SP-3	0.84	5	2	0.67	1.00	0.74	0.92	0.10	1.80	1.00	1.00	MG/L
TOTAL RESIDUAL CHLORINE	6447	SP-1	0.40	3	3	0.00	0.40	.	.	.	.	0.40	0.40	MG/L
TOTAL SUSPENDED SOLIDS	6335	SP-4	275.20	5	0	34.35	263.00	275.20	34.35	253.00	335.00	.	.	MG/L
TOTAL SUSPENDED SOLIDS	6335	SP-2	362.60	5	0	87.80	360.00	362.60	87.80	233.00	463.00	.	.	MG/L
TOTAL SUSPENDED SOLIDS	6335	SP-3	1670.00	5	0	294.28	1720.00	1670.00	294.28	1250.00	2000.00	.	.	MG/L
TOTAL SUSPENDED SOLIDS	6447	SP-1	836.67	3	0	190.35	850.00	836.67	190.35	640.00	1020.00	.	.	MG/L

---------- Subcategory=Poultry -- Option=BAT2 -- Processing=First ----------

Analyte	CAS_NO	Unit	Episode	Method	Est. LTA	1-Day V.F.	20-Day V.F.	30-Day V.F.
AMMONIA AS NITROGEN	7664417	MG/L	6445	350.2	0.250	2.051	1.126	1.103
BIOCHEMICAL OXYGEN DEMAND	C003	MG/L	6445	405.1	2.000	.	.	.
CHEMICAL OXYGEN DEMAND	C004	MG/L	6445	410.2	28.024	2.271	1.147	1.120
FECAL COLIFORM	C2106	/100MLS	6445	9221E	4.625	.	.	.
HEXANE EXTRACTABLE MATERIAL	C036	MG/L	6445	1664	23.583	.	.	.
TOTAL RESIDUAL CHLORINE	7782505	MG/L	6445	330.5	0.220	.	.	.
TOTAL SUSPENDED SOLIDS	C009	MG/L	6445	160.2	8.143	2.426	1.161	1.131

---------- Subcategory=Poultry -- Option=BAT2 -- Processing=Further ----------

Analyte	CAS_NO	Unit	Episode	Method	Est. LTA	1-Day V.F.	20-Day V.F.	30-Day V.F.
AMMONIA AS NITROGEN	7664417	MG/L	6443	350.2	0.295	.	.	.
AMMONIA AS NITROGEN	7664417	MG/L	6444	350.2	1.407	.	.	.
BIOCHEMICAL OXYGEN DEMAND	C003	MG/L	6443	405.1	3.573	.	.	.
BIOCHEMICAL OXYGEN DEMAND	C003	MG/L	6444	405.1	10.931	.	.	.
CHEMICAL OXYGEN DEMAND	C004	MG/L	6443	410.4	35.305	.	.	.
CHEMICAL OXYGEN DEMAND	C004	MG/L	6444	410.4	107.354	.	.	.
FECAL COLIFORM	C2106	/100MLS	6443	9221E	4.625	.	.	.
HEXANE EXTRACTABLE MATERIAL	C036	MG/L	6443	1664	45.503	.	.	.
HEXANE EXTRACTABLE MATERIAL	C036	MG/L	6444	1664	29.004	.	.	.
TOTAL SUSPENDED SOLIDS	C009	MG/L	6443	160.2	17.494	.	.	.
TOTAL SUSPENDED SOLIDS	C009	MG/L	6444	160.2	1057.618	.	.	.

---------- Subcategory=Poultry -- Option=BAT2 -- Processing=Rendering ----------

Analyte	CAS_NO	Unit	Episode	Method	Est. LTA	1-Day V.F.	20-Day V.F.	30-Day V.F.
AMMONIA AS NITROGEN	7664417	MG/L	6448	350.2	4.122	.	.	.
BIOCHEMICAL OXYGEN DEMAND	C003	MG/L	6448	405.1	2.164	.	.	.
CHEMICAL OXYGEN DEMAND	C004	MG/L	6448	410.1	168.925	.	.	.
FECAL COLIFORM	C2106	/100MLS	6448	9221E	5.601	.	.	.
HEXANE EXTRACTABLE MATERIAL	C036	MG/L	6448	1664	334.962	.	.	.

Subcategory=Poultry -- Option=BAT2 -- Processing=Rendering
(continued)

Analyte	CAS_NO	Unit	Episode	Method	Est. LTA	1-Day V.F.	20-Day V.F.	30-Day V.F.
TOTAL SUSPENDED SOLIDS	C009	MG/L	6448	160.2	34.383	.	.	.

Subcategory=Poultry -- Option=PSES1 -- Processing=First

Analyte	CAS_NO	Unit	Episode	Method	Est. LTA	1-Day V.F.	20-Day V.F.	30-Day V.F.
HEXANE EXTRACTABLE MATERIAL	C036	MG/L	6443	1664	5.000	.	.	.
HEXANE EXTRACTABLE MATERIAL	C036	MG/L	6444	1664	21.391	4.337	1.321	1.262

Subcategory=Poultry -- Option=PSES1 -- Processing=Further

Analyte	CAS_NO	Unit	Episode	Method	Est. LTA	1-Day V.F.	20-Day V.F.	30-Day V.F.
HEXANE EXTRACTABLE MATERIAL	C036	MG/L	6443	1664	23.512	.	.	.
HEXANE EXTRACTABLE MATERIAL	C036	MG/L	6444	1664	12.057	4.337	1.321	1.262

Subcategory=Poultry -- Option=PSES1 -- Processing=Rendering

Analyte	CAS_NO	Unit	Episode	Method	Est. LTA	1-Day V.F.	20-Day V.F.	30-Day V.F.
HEXANE EXTRACTABLE MATERIAL	C036	MG/L	6448	1664	183.742	.	.	.

Subcategory=Red Meat -- Option=BAT2 -- Processing=First

Analyte	CAS_NO	Unit	Episode	Method	Est. LTA	1-Day V.F.	20-Day V.F.	30-Day V.F.
AMMONIA AS NITROGEN	7664417	MG/L	6440	350.2	0.130	2.261	1.146	1.119
AMMONIA AS NITROGEN	7664417	MG/L	6441	350.2	1.000	.	.	.

Subcategory=Red Meat -- Option=BAT2 -- Processing=First
(continued)

Analyte	CAS_NO	Unit	Episode	Method	Est. LTA	1-Day V.F.	20-Day V.F.	30-Day V.F.
AMMONIA AS NITROGEN	7664417	MG/L	6442	350.2	0.888	2.307	1.150	1.123
AMMONIA AS NITROGEN	7664417	MG/L	6447	350.2	0.516	1.788	1.099	1.081
BIOCHEMICAL OXYGEN DEMAND	C003	MG/L	6440	405.1	8.267	1.310	1.048	1.039
BIOCHEMICAL OXYGEN DEMAND	C003	MG/L	6441	405.1	9.480	4.568	1.340	1.278
BIOCHEMICAL OXYGEN DEMAND	C003	MG/L	6442	405.1	7.601	1.474	1.061	1.050
BIOCHEMICAL OXYGEN DEMAND	C003	MG/L	6447	405.1	5.188	1.927	1.103	1.084
CHEMICAL OXYGEN DEMAND	C004	MG/L	6440	410.2	33.016	1.130	1.020	1.016
CHEMICAL OXYGEN DEMAND	C004	MG/L	6441	410.4	22.382	1.333	1.045	1.037
CHEMICAL OXYGEN DEMAND	C004	MG/L	6442	410.1	136.354	1.216	1.032	1.026
CHEMICAL OXYGEN DEMAND	C004	MG/L	6447	410.2	52.041	1.398	1.055	1.045
FECAL COLIFORM	C2106	/100MLS	6440	9221E	21.747	2.273	1.255	1.208
FECAL COLIFORM	C2106	/100MLS	6441	9221E	1503.957	.	.	.
FECAL COLIFORM	C2106	/100MLS	6442	9221E	1524.496	14.796	8.924	7.470
FECAL COLIFORM	C2106	/100MLS	6447	9221E	35.319	4.224	1.362	1.296
HEXANE EXTRACTABLE MATERIAL	C036	MG/L	6440	1664	5.917	.	.	.
HEXANE EXTRACTABLE MATERIAL	C036	MG/L	6441	1664	5.792	.	.	.
HEXANE EXTRACTABLE MATERIAL	C036	MG/L	6442	1664	6.067	.	.	.
HEXANE EXTRACTABLE MATERIAL	C036	MG/L	6447	1664	18.802	5.254	1.397	1.324
TOTAL RESIDUAL CHLORINE	7782505	MG/L	6440	330.5	0.200	.	.	.
TOTAL RESIDUAL CHLORINE	7782505	MG/L	6441	330.5	0.232	1.726	1.084	1.069
TOTAL RESIDUAL CHLORINE	7782505	MG/L	6442	330.5	0.200	.	.	.
TOTAL RESIDUAL CHLORINE	7782505	MG/L	6447	330.5	0.811	2.878	1.201	1.164
TOTAL SUSPENDED SOLIDS	C009	MG/L	6440	160.2	13.365	2.188	1.139	1.113
TOTAL SUSPENDED SOLIDS	C009	MG/L	6441	160.2	40.282	3.272	1.234	1.191
TOTAL SUSPENDED SOLIDS	C009	MG/L	6442	160.2	24.104	1.361	1.050	1.041
TOTAL SUSPENDED SOLIDS	C009	MG/L	6447	160.2	22.976	1.414	1.057	1.047

Subcategory=Red Meat -- Option=BAT2 -- Processing=Further

Analyte	CAS_NO	Unit	Episode	Method	Est. LTA	1-Day V.F.	20-Day V.F.	30-Day V.F.
AMMONIA AS NITROGEN	7664417	MG/L	6335	350.2	0.516	.	.	.
BIOCHEMICAL OXYGEN DEMAND	C003	MG/L	6335	405.1	4.736	.	.	.
CHEMICAL OXYGEN DEMAND	C004	MG/L	6335	410.1	47.337	.	.	.

--------------------------------------- Subcategory=Red Meat -- Option=BAT2 -- Processing=Further ---------------------------------------
(continued)

Analyte	CAS_NO	Unit	Episode	Method	Est. LTA	1-Day V.F.	20-Day V.F.	30-Day V.F.
FECAL COLIFORM	C2106	/100MLS	6335	9221E	298.696	.	.	.
HEXANE EXTRACTABLE MATERIAL	C036	MG/L	6335	1664	13.245	.	.	.
TOTAL RESIDUAL CHLORINE	7782505	MG/L	6335	HACH 8167	0.645	.	.	.
TOTAL SUSPENDED SOLIDS	C009	MG/L	6335	160.2	19.246	.	.	.

-------------------------------------- Subcategory=Red Meat -- Option=BAT2 -- Processing=Rendering --------------------------------------

Analyte	CAS_NO	Unit	Episode	Method	Est. LTA	1-Day V.F.	20-Day V.F.	30-Day V.F.
AMMONIA AS NITROGEN	7664417	MG/L	6440	350.2	1.286	2.261	1.146	1.119
AMMONIA AS NITROGEN	7664417	MG/L	6441	350.2	1.286	.	.	.
AMMONIA AS NITROGEN	7664417	MG/L	6442	350.2	1.286	2.307	1.150	1.123
AMMONIA AS NITROGEN	7664417	MG/L	6447	350.2	1.286	1.788	1.099	1.081
BIOCHEMICAL OXYGEN DEMAND	C003	MG/L	6440	405.1	7.011	1.310	1.048	1.039
BIOCHEMICAL OXYGEN DEMAND	C003	MG/L	6441	405.1	7.035	4.568	1.340	1.278
BIOCHEMICAL OXYGEN DEMAND	C003	MG/L	6442	405.1	6.820	1.474	1.061	1.050
BIOCHEMICAL OXYGEN DEMAND	C003	MG/L	6447	405.1	5.333	1.927	1.103	1.084
CHEMICAL OXYGEN DEMAND	C004	MG/L	6440	410.1	37.525	1.130	1.020	1.016
CHEMICAL OXYGEN DEMAND	C004	MG/L	6441	410.1	37.094	1.333	1.045	1.037
CHEMICAL OXYGEN DEMAND	C004	MG/L	6442	410.1	117.176	1.216	1.032	1.026
CHEMICAL OXYGEN DEMAND	C004	MG/L	6447	410.1	47.337	1.398	1.055	1.045
FECAL COLIFORM	C2106	/100MLS	6440	9221E	455.435	2.273	1.255	1.208
FECAL COLIFORM	C2106	/100MLS	6441	9221E	768.000	.	.	.
FECAL COLIFORM	C2106	/100MLS	6442	9221E	1194.777	14.796	8.924	7.470
FECAL COLIFORM	C2106	/100MLS	6447	9221E	455.435	4.224	1.362	1.296
HEXANE EXTRACTABLE MATERIAL	C036	MG/L	6440	1664	11.565	.	.	.
HEXANE EXTRACTABLE MATERIAL	C036	MG/L	6441	1664	11.546	.	.	.
HEXANE EXTRACTABLE MATERIAL	C036	MG/L	6442	1664	11.589	.	.	.
HEXANE EXTRACTABLE MATERIAL	C036	MG/L	6447	1664	14.997	5.254	1.397	1.324
TOTAL RESIDUAL CHLORINE	7782505	MG/L	6440	330.5	0.400	.	.	.
TOTAL RESIDUAL CHLORINE	7782505	MG/L	6441	330.5	0.400	1.726	1.084	1.069
TOTAL RESIDUAL CHLORINE	7782505	MG/L	6442	330.5	0.400	.	.	.
TOTAL RESIDUAL CHLORINE	7782505	MG/L	6447	330.5	0.645	2.878	1.201	1.164
TOTAL SUSPENDED SOLIDS	C009	MG/L	6440	160.2	12.632	2.188	1.139	1.113

Subcategory=Red Meat -- Option=BAT2 -- Processing=Rendering (continued)

Analyte	CAS_NO	Unit	Episode	Method	Est. LTA	1-Day V.F.	20-Day V.F.	30-Day V.F.
TOTAL SUSPENDED SOLIDS	C009	MG/L	6441	160.2	29.384	3.272	1.234	1.191
TOTAL SUSPENDED SOLIDS	C009	MG/L	6442	160.2	22.238	1.361	1.050	1.041
TOTAL SUSPENDED SOLIDS	C009	MG/L	6447	160.2	19.246	1.414	1.057	1.047

Subcategory=Red Meat -- Option=BAT3 -- Processing=First

Analyte	CAS_NO	Unit	Episode	Method	Est. LTA	1-Day V.F.	20-Day V.F.	30-Day V.F.
AMMONIA AS NITROGEN	7664417	MG/L	6335	350.2	3.754	6.485	1.508	1.415
BIOCHEMICAL OXYGEN DEMAND	C003	MG/L	6335	405.1	6.851	2.400	1.158	1.129
FECAL COLIFORM	C2106	/100MLS	6335	9221E	92.604	.	.	.
HEXANE EXTRACTABLE MATERIAL	C036	MG/L	6335	1664	5.900	.	.	.
NITRATE/NITRITE	C005	MG/L	6335	353.1	7.893	1.475	1.064	1.053
TOTAL KJELDAHL NITROGEN	C021	MG/L	6335	351.3	2.077	2.823	1.196	1.160
TOTAL NITROGEN	C005+C021	MG/L	6335	351.3	7.378	1.485	1.065	1.053
TOTAL PHOSPHORUS	14265442	MG/L	6335	365.2	7.864	2.350	1.154	1.126
TOTAL SUSPENDED SOLIDS	C009	MG/L	6335	160.2	4.925	1.347	1.041	1.033

Subcategory=Red Meat -- Option=BAT3 -- Processing=Further

Analyte	CAS_NO	Unit	Episode	Method	Est. LTA	1-Day V.F.	20-Day V.F.	30-Day V.F.
AMMONIA AS NITROGEN	7664417	MG/L	6335	350.2	2.343	6.485	1.508	1.415
BIOCHEMICAL OXYGEN DEMAND	C003	MG/L	6335	405.1	4.683	2.400	1.158	1.129
FECAL COLIFORM	C2106	/100MLS	6335	9221E	22.385	.	.	.
HEXANE EXTRACTABLE MATERIAL	C036	MG/L	6335	1664	5.900	.	.	.
NITRATE/NITRITE	C005	MG/L	6335	353.1	6.043	1.475	1.064	1.053
TOTAL KJELDAHL NITROGEN	C021	MG/L	6335	351.3	2.077	2.823	1.196	1.160
TOTAL NITROGEN	C005+C021	MG/L	6335	351.3	7.378	1.485	1.065	1.053
TOTAL PHOSPHORUS	14265442	MG/L	6335	365.2	8.422	2.350	1.154	1.126
TOTAL SUSPENDED SOLIDS	C009	MG/L	6335	160.2	4.207	1.347	1.041	1.033

------------------------------------- Subcategory=Red Meat -- Option=BAT3 -- Processing=Rendering -------------------------------------

Analyte	CAS_NO	Unit	Episode	Method	Est. LTA	1-Day V.F.	20-Day V.F.	30-Day V.F.
AMMONIA AS NITROGEN	7664417	MG/L	6447	350.2	2.343	.	.	.
BIOCHEMICAL OXYGEN DEMAND	C003	MG/L	6447	405.1	8.346	.	.	.
FECAL COLIFORM	C2106	/100MLS	6447	9221E	22.978	.	.	.
HEXANE EXTRACTABLE MATERIAL	C036	MG/L	6447	1664	7.772	.	.	.
NITRATE/NITRITE	C005	MG/L	6447	353.1	6.043	.	.	.
TOTAL KJELDAHL NITROGEN	C021	MG/L	6447	351.3	2.077	.	.	.
TOTAL NITROGEN	C005+C021	MG/L	6447	351.3	7.378	.	.	.
TOTAL PHOSPHORUS	14265442	MG/L	6447	365.2	6.965	.	.	.
TOTAL SUSPENDED SOLIDS	C009	MG/L	6447	160.2	4.207	.	.	.

------------------------------------- Subcategory=Red Meat -- Option=PSES1 -- Processing=First -------------------------------------

Analyte	CAS_NO	Unit	Episode	Method	Est. LTA	1-Day V.F.	20-Day V.F.	30-Day V.F.
AMMONIA AS NITROGEN	7664417	MG/L	6335	350.2	1092.514	2.614	.	1.145
HEXANE EXTRACTABLE MATERIAL	C036	MG/L	6335	1664	37.409	1.525	.	1.057

------------------------------------- Subcategory=Red Meat -- Option=PSES1 -- Processing=Further -------------------------------------

Analyte	CAS_NO	Unit	Episode	Method	Est. LTA	1-Day V.F.	20-Day V.F.	30-Day V.F.
AMMONIA AS NITROGEN	7664417	MG/L	6335	350.2	15.086	2.614	.	1.145
HEXANE EXTRACTABLE MATERIAL	C036	MG/L	6335	1664	7.816	1.525	.	1.057

------------------------------------- Subcategory=Red Meat -- Option=PSES1 -- Processing=Rendering -------------------------------------

Analyte	CAS_NO	Unit	Episode	Method	Est. LTA	1-Day V.F.	20-Day V.F.	30-Day V.F.
AMMONIA AS NITROGEN	7664417	MG/L	6447	350.2	99.697	.	.	.
HEXANE EXTRACTABLE MATERIAL	C036	MG/L	6447	1664	19.573	.	.	.

Attachment 13-3. Concentration-Based Limitations

--- Subcategory=Independent -- Option=BPT2 -- Processing=Rendering ---

Analyte	CAS Number	Baseline Value	Baseline Unit	Unit	LTA	1-Day V.F.	20-Day V.F.	30-Day V.F.	Daily Limit	20-Day Limit	30-Day Limit
AMMONIA AS NITROGEN	7664417	0.2	MG/L	MG/L	3.2325	2.0850	1.1287	1.1051	6.7397	3.6487	3.5723
BIOCHEMICAL OXYGEN DEMAND	C003	2.0	MG/L	MG/L	6.5146	2.3199	1.1380	1.1127	15.1132	7.4137	7.2487
CHEMICAL OXYGEN DEMAND	C004	5.0	MG/L	MG/L	36.0354	1.7700	1.0922	1.0753	63.7842	39.3595	38.7495
FECAL COLIFORM	C2106	2.0	/100MLS	/100MLS	316.6088	7.0979	3.8472	3.3247	2,247.2448	1,218.0526	1,052.6346
HEXANE EXTRACTABLE MATERIAL	C036	5.0	MG/L	MG/L	15.5386	5.2542	1.3973	1.3244	81.6432	21.7119	20.5791
TOTAL RESIDUAL CHLORINE	7782505	0.2	MG/L	MG/L	0.4000	2.3018	1.1423	1.1162	0.9207	0.4569	0.4465
TOTAL SUSPENDED SOLIDS	C009	4.0	MG/L	MG/L	27.5626	2.2423	1.1405	1.1147	61.8038	31.4350	30.7244

--- Subcategory=Poultry -- Option=BAT2 -- Processing=First ---

Analyte	CAS Number	Baseline Value	Baseline Unit	Unit	LTA	1-Day V.F.	20-Day V.F.	30-Day V.F.	Daily Limit	20-Day Limit	30-Day Limit
AMMONIA AS NITROGEN	7664417	0.2	MG/L	MG/L	2.3426	6.4850	1.5079	1.4147	15.1866	3.5334	3.2994
BIOCHEMICAL OXYGEN DEMAND	C003	2.0	MG/L	MG/L	4.6827	2.4003	1.1580	1.1290	11.2402	5.4224	5.2867
FECAL COLIFORM	C2106	2.0	/100MLS	/100MLS	21.5000	.	.	.	.	.	.
HEXANE EXTRACTABLE MATERIAL	C036	5.0	MG/L	MG/L	23.5833	5.2542	1.3973	1.3244	123.9116	32.9527	31.2334
TOTAL RESIDUAL CHLORINE	7782505	0.2	MG/L	MG/L	15.9610	.	.	.	.	.	.
TOTAL SUSPENDED SOLIDS	C009	4.0	MG/L	MG/L	8.1429	2.4260	1.1610	1.1314	19.7548	9.4536	9.2131

--- Subcategory=Poultry -- Option=BAT2 -- Processing=Further ---

Analyte	CAS Number	Baseline Value	Baseline Unit	Unit	LTA	1-Day V.F.	20-Day V.F.	30-Day V.F.	Daily Limit	20-Day Limit	30-Day Limit
AMMONIA AS NITROGEN	7664417	0.2	MG/L	MG/L	2.3426	6.4850	1.5079	1.4147	15.1866	3.5334	3.2994
BIOCHEMICAL OXYGEN DEMAND	C003	2.0	MG/L	MG/L	7.2518	2.4003	1.1580	1.1290	17.4068	8.3973	8.1871
FECAL COLIFORM	C2106	2.0	/100MLS	/100MLS	21.5000	.	.	.	.	.	.
HEXANE EXTRACTABLE MATERIAL	C036	5.0	MG/L	MG/L	37.2537	5.2542	1.3973	1.3244	195.7382	52.0540	49.3381
TOTAL SUSPENDED SOLIDS	C009	4.0	MG/L	MG/L	9.7600	2.4260	1.1610	1.1314	23.6780	11.3311	11.0428

--- Subcategory=Poultry -- Option=BAT2 -- Processing=Rendering ---

Analyte	CAS Number	Baseline Value	Baseline Unit	Unit	LTA	1-Day V.F.	20-Day V.F.	30-Day V.F.	Daily Limit	20-Day Limit	30-Day Limit
AMMONIA AS NITROGEN	7664417	0.2	MG/L	MG/L	4.1224	6.4850	1.5079	1.4147	26.7388	6.2212	5.8092
BIOCHEMICAL OXYGEN DEMAND	C003	2.0	MG/L	MG/L	4.6827	2.4003	1.1580	1.1290	11.2402	5.4224	5.2867
CHEMICAL OXYGEN DEMAND	C004	5.0	MG/L	MG/L	29.6394	2.2705	1.1467	1.1198	67.2972	33.9874	33.1895
FECAL COLIFORM	C2106	2.0	/100MLS	/100MLS	21.5000	.	.	.	.	.	.
HEXANE EXTRACTABLE MATERIAL	C036	5.0	MG/L	MG/L	19.5000	5.2542	1.3973	1.3244	102.4569	27.2471	25.8255
TOTAL SUSPENDED SOLIDS	C009	4.0	MG/L	MG/L	34.3830	2.4260	1.1610	1.1314	83.4139	39.9176	38.9020

--- Subcategory=Poultry -- Option=BAT3 -- Processing=First ---

Analyte	CAS Number	Baseline Value	Baseline Unit	Unit	LTA	1-Day V.F.	20-Day V.F.	30-Day V.F.	Daily Limit	20-Day Limit	30-Day Limit
AMMONIA AS NITROGEN	7664417	0.2	MG/L	MG/L	2.3426	6.4850	1.5079	1.4147	15.1918	3.5323	3.3140

--- Subcategory=Poultry -- Option=BAT3 -- Processing=First ---
(continued)

Analyte	CAS Number	Baseline Value	Baseline Unit	Unit	LTA	1-Day V.F.	20-Day V.F.	30-Day V.F.	Daily Limit	20-Day Limit	30-Day Limit
BIOCHEMICAL OXYGEN DEMAND	C003	2.00	MG/L	MG/L	4.6827	2.4003	1.1580	1.1290	11.2402	5.4224	5.2867
FECAL COLIFORM	C2106	2.00	/100MLS	/100MLS	21.5000	.	.	.	.	.	.
HEXANE EXTRACTABLE MATERIAL	C036	5.00	MG/L	MG/L	23.2225	5.2542	1.3973	1.3244	122.0159	32.4485	30.7555
NITRATE/NITRITE	C005	0.05	MG/L	MG/L	6.0431	1.4754	1.0644	1.0525	8.9158	6.4320	6.3606
TOTAL KJELDAHL NITROGEN	C021	0.50	MG/L	MG/L	2.0766	2.8230	1.1959	1.1600	5.8623	2.4835	2.4088
TOTAL NITROGEN	C005+C021	0.55	MG/L	MG/L	7.3779	2.8230	1.1959	1.1600	20.8279	8.8235	8.5582
TOTAL PHOSPHORUS	14265442	0.01	MG/L	MG/L	6.9647	2.3499	1.1540	1.1258	16.3664	8.0375	7.8406
TOTAL RESIDUAL CHLORINE	7782505	0.20	MG/L	MG/L	15.9610	5.4976	1.4182	1.3415	87.7476	22.6365	21.4115
TOTAL SUSPENDED SOLIDS	C009	4.00	MG/L	MG/L	4.2069	1.3473	1.0408	1.0333	5.6680	4.3786	4.3471

--- Subcategory=Poultry -- Option=BAT3 -- Processing=Further ---

Baseline Baseline 1-Day 20-Day 30-Day Daily 20-Day 30-Day

Analyte	CAS Number	Value	Unit	Unit	LTA	V.F.	V.F.	V.F.	Limit	Limit	Limit
AMMONIA AS NITROGEN	7664417	0.20	MG/L	MG/L	2.3426	6.4850	1.5079	1.4147	15.1918	3.5323	3.3140
BIOCHEMICAL OXYGEN DEMAND	C003	2.00	MG/L	MG/L	7.1697	2.4003	1.1580	1.1290	17.2098	8.3022	8.0944
FECAL COLIFORM	C2106	2.00	/100MLS	/100MLS	21.5000	.	.	.	.	.	.
HEXANE EXTRACTABLE MATERIAL	C036	5.00	MG/L	MG/L	16.5952	5.2542	1.3973	1.3244	87.1946	23.1883	21.9784
NITRATE/NITRITE	C005	0.05	MG/L	MG/L	6.0431	1.4754	1.0644	1.0525	8.9158	6.4320	6.3606
TOTAL KJELDAHL NITROGEN	C021	0.50	MG/L	MG/L	4.9440	2.8230	1.1959	1.1600	13.9567	5.9126	5.7348
TOTAL NITROGEN	C005+C021	0.55	MG/L	MG/L	7.3779	2.8230	1.1959	1.1600	20.8279	8.8235	8.5582
TOTAL PHOSPHORUS	14265442	0.01	MG/L	MG/L	6.9647	2.3499	1.1540	1.1258	16.3664	8.0375	7.8406
TOTAL RESIDUAL CHLORINE	7782505	0.20	MG/L	MG/L	15.9610	5.4976	1.4182	1.3415	87.7476	22.6365	21.4115
TOTAL SUSPENDED SOLIDS	C009	4.00	MG/L	MG/L	4.2069	1.3473	1.0408	1.0333	5.6680	4.3786	4.3471

-- Subcategory=Poultry -- Option=BAT3 -- Processing=Rendering --

Analyte	CAS Number	Baseline Value	Baseline Unit	Unit	LTA	1-Day V.F.	20-Day V.F.	30-Day V.F.	Daily Limit	20-Day Limit	30-Day Limit
AMMONIA AS NITROGEN	7664417	0.20	MG/L	MG/L	2.3426	6.4850	1.5079	1.4147	15.1918	3.5323	3.3140
BIOCHEMICAL OXYGEN DEMAND	C003	2.00	MG/L	MG/L	4.6827	2.4003	1.1580	1.1290	11.2402	5.4224	5.2867
FECAL COLIFORM	C2106	2.00	/100MLS	/100MLS	21.5000	.	.	.	.	.	.
HEXANE EXTRACTABLE MATERIAL	C036	5.00	MG/L	MG/L	13.0906	5.2542	1.3973	1.3244	68.7808	18.2914	17.3370
NITRATE/NITRITE	C005	0.05	MG/L	MG/L	6.0431	1.4754	1.0644	1.0525	8.9158	6.4320	6.3606
TOTAL KJELDAHL NITROGEN	C021	0.50	MG/L	MG/L	4.0956	2.8230	1.1959	1.1600	11.5619	4.8980	4.7508
TOTAL NITROGEN	C005+C021	0.55	MG/L	MG/L	7.3779	2.8230	1.1959	1.1600	20.8279	8.8235	8.5582
TOTAL PHOSPHORUS	14265442	0.01	MG/L	MG/L	6.9647	2.3499	1.1540	1.1258	16.3664	8.0375	7.8406
TOTAL RESIDUAL CHLORINE	7782505	0.20	MG/L	MG/L	15.9610	5.4976	1.4182	1.3415	87.7476	22.6365	21.4115
TOTAL SUSPENDED SOLIDS	C009	4.00	MG/L	MG/L	6.9734	1.3473	1.0408	1.0333	9.3954	7.2581	7.2059

-- Subcategory=Poultry -- Option=PSES1 -- Processing=First --

Analyte	CAS Number	Baseline Value	Baseline Unit	Unit	LTA	1-Day V.F.	20-Day V.F.	30-Day V.F.	Daily Limit	20-Day Limit	30-Day Limit
HEXANE EXTRACTABLE MATERIAL	C036	5	MG/L	MG/L	13.1953	4.3370	1.3209	1.2620	57.2276	17.4296	16.6526

Attachment 13-3. Concentration-Based Limitations

Subcategory=Poultry -- Option=PSES1 -- Processing=Further

Analyte	CAS Number	Baseline Value	Baseline Unit	Unit	LTA	1-Day V.F.	20-Day V.F.	30-Day V.F.	Daily Limit	20-Day Limit	30-Day Limit
HEXANE EXTRACTABLE MATERIAL	C036	5	MG/L	MG/L	17.7848	4.3370	1.3209	1.2620	77.1322	23.4919	22.4446

Subcategory=Poultry -- Option=PSES1 -- Processing=Rendering

Analyte	CAS Number	Baseline Value	Baseline Unit	Unit	LTA	1-Day V.F.	20-Day V.F.	30-Day V.F.	Daily Limit	20-Day Limit	30-Day Limit
HEXANE EXTRACTABLE MATERIAL	C036	5	MG/L	MG/L	183.7416	4.3370	1.3209	1.2620	796.8813	242.7032	231.8835

Subcategory=Red Meat -- Option=BAT3 -- Processing=First

Analyte	CAS Number	Baseline Value	Baseline Unit	Unit	LTA	1-Day V.F.	20-Day V.F.	30-Day V.F.	Daily Limit	20-Day Limit	30-Day Limit
AMMONIA AS NITROGEN	7664417	0.20	MG/L	MG/L	3.7540	6.4850	.	1.4147	24.3446	.	5.3106
BIOCHEMICAL OXYGEN DEMAND	C003	2.00	MG/L	MG/L	6.8507	2.4003	.	1.1290	16.4439	.	7.7342
FECAL COLIFORM	C2106	2.00	/100MLS	/100MLS	92.6042	.	.	.	.	.	.
HEXANE EXTRACTABLE MATERIAL	C036	5.00	MG/L	MG/L	5.9000	5.2542	.	1.3244	30.9998	.	7.8139
NITRATE/NITRITE	C005	0.05	MG/L	MG/L	7.8935	1.4754	.	1.0525	11.6458	.	8.3082
TOTAL KJELDAHL NITROGEN	C021	0.50	MG/L	MG/L	2.0766	2.8230	.	1.1600	5.8623	.	2.4088
TOTAL NITROGEN	C005+C021	0.55	MG/L	MG/L	7.3779	2.8230	.	1.1600	20.8279	.	8.5582
TOTAL PHOSPHORUS	14265442	0.01	MG/L	MG/L	7.8639	2.3499	.	1.1258	18.4795	.	8.8529
TOTAL SUSPENDED SOLIDS	C009	4.00	MG/L	MG/L	4.9254	1.3473	.	1.0333	6.6361	.	5.0896

Subcategory=Red Meat -- Option=BAT3 -- Processing=Further

Analyte	CAS Number	Baseline Value	Baseline Unit	Unit	LTA	1-Day V.F.	20-Day V.F.	30-Day V.F.	Daily Limit	20-Day Limit	30-Day Limit
AMMONIA AS NITROGEN	7664417	0.20	MG/L	MG/L	2.3426	6.4850	.	1.4147	15.1918	.	3.3140
BIOCHEMICAL OXYGEN DEMAND	C003	2.00	MG/L	MG/L	4.6827	2.4003	.	1.1290	11.2402	.	5.2867
FECAL COLIFORM	C2106	2.00	/100MLS	/100MLS	22.3854	.	.	.	.	.	.
HEXANE EXTRACTABLE MATERIAL	C036	5.00	MG/L	MG/L	5.9000	5.2542	.	1.3244	30.9998	.	7.8139
NITRATE/NITRITE	C005	0.05	MG/L	MG/L	6.0431	1.4754	.	1.0525	8.9158	.	6.3606
TOTAL KJELDAHL NITROGEN	C021	0.50	MG/L	MG/L	2.0766	2.8230	.	1.1600	5.8623	.	2.4088
TOTAL NITROGEN	C005+C021	0.55	MG/L	MG/L	7.3779	2.8230	.	1.1600	20.8279	.	8.5582
TOTAL PHOSPHORUS	14265442	0.01	MG/L	MG/L	8.4222	2.3499	.	1.1258	19.7916	.	9.4815
TOTAL SUSPENDED SOLIDS	C009	4.00	MG/L	MG/L	4.2069	1.3473	.	1.0333	5.6680	.	4.3471

Subcategory=Red Meat -- Option=BAT3 -- Processing=Rendering

Analyte	CAS Number	Baseline Value	Baseline Unit	Unit	LTA	1-Day V.F.	20-Day V.F.	30-Day V.F.	Daily Limit	20-Day Limit	30-Day Limit
AMMONIA AS NITROGEN	7664417	0.20	MG/L	MG/L	2.3426	6.4850	.	1.4147	15.1918	.	3.3140
BIOCHEMICAL OXYGEN DEMAND	C003	2.00	MG/L	MG/L	8.3465	2.4003	.	1.1290	20.0345	.	9.4230
FECAL COLIFORM	C2106	2.00	/100MLS	/100MLS	22.9777	.	.	.	.	.	.
HEXANE EXTRACTABLE MATERIAL	C036	5.00	MG/L	MG/L	7.7720	5.2542	.	1.3244	40.8356	.	10.2931
NITRATE/NITRITE	C005	0.05	MG/L	MG/L	6.0431	1.4754	.	1.0525	8.9158	.	6.3606

Subcategory=Red Meat -- Option=BAT3 -- Processing=Rendering (continued)

Analyte	CAS Number	Baseline Value	Baseline Unit	Unit	LTA	1-Day V.F.	20-Day V.F.	30-Day V.F.	Daily Limit	20-Day Limit	30-Day Limit
TOTAL KJELDAHL NITROGEN	C021	0.50	MG/L	MG/L	2.0766	2.8230	.	1.1600	5.8623	.	2.4088
TOTAL NITROGEN	C005+C021	0.55	MG/L	MG/L	7.3779	2.8230	.	1.1600	20.8279	.	8.5582
TOTAL PHOSPHORUS	14265442	0.01	MG/L	MG/L	6.9647	2.3499	.	1.1258	16.3664	.	7.8406
TOTAL SUSPENDED SOLIDS	C009	4.00	MG/L	MG/L	4.2069	1.3473	.	1.0333	5.6680	.	4.3471

Subcategory=Red Meat -- Option=BPT2 -- Processing=First

Analyte	CAS Number	Baseline Value	Baseline Unit	Unit	LTA	1-Day V.F.	20-Day V.F.	30-Day V.F.	Daily Limit	20-Day Limit	30-Day Limit
CHEMICAL OXYGEN DEMAND	C004	5	MG/L	MG/L	42.5286	1.2696	.	1.0309	53.9924	.	43.8410

Subcategory=Red Meat -- Option=BPT2 -- Processing=Further

Analyte	CAS Number	Baseline Value	Baseline Unit	Unit	LTA	1-Day V.F.	20-Day V.F.	30-Day V.F.	Daily Limit	20-Day Limit	30-Day Limit
CHEMICAL OXYGEN DEMAND	C004	5	MG/L	MG/L	47.3372	1.2696	.	1.0309	60.0973	.	48.7981

Subcategory=Red Meat -- Option=BPT2 -- Processing=Rendering

Analyte	CAS Number	Baseline Value	Baseline Unit	Unit	LTA	1-Day V.F.	20-Day V.F.	30-Day V.F.	Daily Limit	20-Day Limit	30-Day Limit
AMMONIA AS NITROGEN	7664417	0.2	MG/L	MG/L	2.3426	2.1189	.	1.1075	4.9637	.	2.5945
BIOCHEMICAL OXYGEN DEMAND	C003	2.0	MG/L	MG/L	8.3465	2.3199	.	1.1127	19.3629	.	9.2870
CHEMICAL OXYGEN DEMAND	C004	5.0	MG/L	MG/L	42.4314	1.2696	.	1.0309	53.8690	.	43.7408
FECAL COLIFORM	C2106	2.0	/100MLS	/100MLS	611.7175	7.0979	.	3.3247	4,341.8856	.	2,033.7878
HEXANE EXTRACTABLE MATERIAL	C036	5.0	MG/L	MG/L	11.5773	5.2542	.	1.3244	60.8294	.	15.3328
TOTAL RESIDUAL CHLORINE	7782505	0.2	MG/L	MG/L	0.4000	2.3018	.	1.1162	0.9207	.	0.4465
TOTAL SUSPENDED SOLIDS	C009	4.0	MG/L	MG/L	20.7423	2.0586	.	1.0980	42.6997	.	22.7749

Subcategory=Red Meat -- Option=PSES1 -- Processing=First

Analyte	CAS Number	Baseline Value	Baseline Unit	Unit	LTA	1-Day V.F.	20-Day V.F.	30-Day V.F.	Daily Limit	20-Day Limit	30-Day Limit
AMMONIA AS NITROGEN	7664417	0.2	MG/L	MG/L	1,092.5140	2.6138	.	1.1451	2,855.5686	.	1,251.0569
HEXANE EXTRACTABLE MATERIAL	C036	5.0	MG/L	MG/L	37.4089	1.5253	.	1.0573	57.0581	.	39.5531

Subcategory=Red Meat -- Option=PSES1 -- Processing=Further

Analyte	CAS Number	Baseline Value	Baseline Unit	Unit	LTA	1-Day V.F.	20-Day V.F.	30-Day V.F.	Daily Limit	20-Day Limit	30-Day Limit
AMMONIA AS NITROGEN	7664417	0.2	MG/L	MG/L	15.0862	2.6138	.	1.1451	39.4316	.	17.2754
HEXANE EXTRACTABLE MATERIAL	C036	5.0	MG/L	MG/L	7.8163	1.5253	.	1.0573	11.9218	.	8.2643

Attachment 13-3. Concentration-Based Limitations

-- Subcategory=Red Meat -- Option=PSES1 -- Processing=Rendering --

Analyte	CAS Number	Baseline Value	Baseline Unit	Unit	LTA	1-Day V.F.	20-Day V.F.	30-Day V.F.	Daily Limit	20-Day Limit	30-Day Limit
AMMONIA AS NITROGEN	7664417	0.2	MG/L	MG/L	99.6971	2.6138	.	1.1451	260.5842	.	114.1649
HEXANE EXTRACTABLE MATERIAL	C036	5.0	MG/L	MG/L	19.5734	1.5253	.	1.0573	29.8544	.	20.6953

Attachment 13-4. Production Values

Meat	First Processing	322.8 gal/1000 lb LWK[1]
	Further Processing	555.4 gal/1000 lb FP[2]
	Meat Cutting	130.4 gal/1000 lb FP
	Rendering	346.0 gal/1000 lb RM[3]
Poultry	First Processing	1,289 gal/1000 lb LWK
	Further Processing	315.7 gal/1000 lb FP
	Rendering	346.0 gal/1000 lb RM
Independent Rendering		346.0 gal/1000 lb RM

[1]Live Weight Killed

[2]Finished Product

[3]Raw Material

Attachment 13-5. Production-Normalized Limitations

Meat Type=Independent -- Option=BPT2 -- Processing=Rendering

Analyte	CAS Number	General Process	Production	Production Unit	Production-normalized LTA	Production-normalized Daily Limit	Production-normalized 20-day Limit	Production-normalized 30-day Limit	Production-normalized Unit
AMMONIA AS NITROGEN	7664417	Renderers	346.0	gal/1000 lb RM	0.00933	0.0194	0.0105	0.0103	lb/1000 lb RM
BIOCHEMICAL OXYGEN DEMAND	C003	Renderers	346.0	gal/1000 lb RM	0.0188	0.0436	0.0214	0.0209	lb/1000 lb RM
CHEMICAL OXYGEN DEMAND	C004	Renderers	346.0	gal/1000 lb RM	0.104	0.184	0.113	0.111	lb/1000 lb RM
FECAL COLIFORM	C2106	Renderers	346.0	gal/1000 lb RM	0.914	6.48	3.51	3.03	lb/1000 lb RM
HEXANE EXTRACTABLE MATERIAL	C036	Renderers	346.0	gal/1000 lb RM	0.0448	0.235	0.0626	0.0594	lb/1000 lb RM
TOTAL RESIDUAL CHLORINE	7782505	Renderers	346.0	gal/1000 lb RM	0.00115	0.00265	0.00131	0.00128	lb/1000 lb RM
TOTAL SUSPENDED SOLIDS	C009	Renderers	346.0	gal/1000 lb RM	0.0795	0.178	0.0907	0.0887	lb/1000 lb RM

Meat Type=Poultry -- Option=BAT2 -- Processing=First

Analyte	CAS Number	General Process	Production	Production Unit	Production-normalized LTA	Production-normalized Daily Limit	Production-normalized 20-day Limit	Production-normalized 30-day Limit	Production-normalized Unit
AMMONIA AS NITROGEN	7664417	First Processors	1289	gal/1000 lb LWK	0.0252	0.163	0.0380	0.0355	lb/1000 lb LWK
BIOCHEMICAL OXYGEN DEMAND	C003	First Processors	1289	gal/1000 lb LWK	0.0503	0.120	0.0583	0.0568	lb/1000 lb LWK
FECAL COLIFORM	C2106	First Processors	1289	gal/1000 lb LWK	0.231	.	.	.	lb/1000 lb LWK
HEXANE EXTRACTABLE MATERIAL	C036	First Processors	1289	gal/1000 lb LWK	0.253	1.33	0.354	0.335	lb/1000 lb LWK
TOTAL RESIDUAL CHLORINE	7782505	First Processors	1289	gal/1000 lb LWK	0.171	.	.	.	lb/1000 lb LWK
TOTAL SUSPENDED SOLIDS	C009	First Processors	1289	gal/1000 lb LWK	0.0875	0.212	0.101	0.0991	lb/1000 lb LWK

Meat Type=Poultry -- Option=BAT2 -- Processing=Further

Analyte	CAS Number	General Process	Production	Production Unit	Production-normalized LTA	Production-normalized Daily Limit	Production-normalized 20-day Limit	Production-normalized 30-day Limit	Production-normalized Unit
AMMONIA AS NITROGEN	7664417	Further Processors	315.7	gal/1000 lb FP	0.00617	0.0400	0.00931	0.00869	lb/1000 lb FP
BIOCHEMICAL OXYGEN DEMAND	C003	Further Processors	315.7	gal/1000 lb FP	0.0191	0.0458	0.0221	0.0215	lb/1000 lb FP
FECAL COLIFORM	C2106	Further Processors	315.7	gal/1000 lb FP	0.0566	.	.	.	lb/1000 lb FP
HEXANE EXTRACTABLE MATERIAL	C036	Further Processors	315.7	gal/1000 lb FP	0.0981	0.515	0.137	0.129	lb/1000 lb FP
TOTAL SUSPENDED SOLIDS	C009	Further Processors	315.7	gal/1000 lb FP	0.0257	0.0623	0.0298	0.0290	lb/1000 lb FP

Meat Type=Poultry -- Option=BAT2 -- Processing=Rendering

Analyte	CAS Number	General Process	Production	Production Unit	Production-normalized LTA	Production-normalized Daily Limit	Production-normalized 20-day Limit	Production-normalized 30-day Limit	Production-normalized Unit
AMMONIA AS NITROGEN	7664417	Renderers	346.0	gal/1000 lb RM	0.0119	0.0772	0.0179	0.0168	lb/1000 lb RM
BIOCHEMICAL OXYGEN DEMAND	C003	Renderers	346.0	gal/1000 lb RM	0.0135	0.0324	0.0156	0.0152	lb/1000 lb RM
CHEMICAL OXYGEN DEMAND	C004	Renderers	346.0	gal/1000 lb RM	0.0855	0.194	0.0981	0.0958	lb/1000 lb RM
FECAL COLIFORM	C2106	Renderers	346.0	gal/1000 lb RM	0.0620	.	.	.	lb/1000 lb RM
HEXANE EXTRACTABLE MATERIAL	C036	Renderers	346.0	gal/1000 lb RM	0.0563	0.295	0.0786	0.0745	lb/1000 lb RM
TOTAL SUSPENDED SOLIDS	C009	Renderers	346.0	gal/1000 lb RM	0.0992	0.240	0.115	0.112	lb/1000 lb RM

Attachment 13-5. Production-Normalized Limitations

----- Meat Type=Poultry -- Option=BAT3 -- Processing=First -----

Analyte	CAS Number	General Process	Production	Production Unit	Production-normalized LTA	Production-normalized Daily Limit	Production-normalized 20-day Limit	Production-normalized 30-day Limit	Production-normalized Unit
AMMONIA AS NITROGEN	7664417	First Processors	1289	gal/1000 lb LWK	0.0252	0.163	0.0379	0.0356	lb/1000 lb LWK
BIOCHEMICAL OXYGEN DEMAND	C003	First Processors	1289	gal/1000 lb LWK	0.0503	0.120	0.0583	0.0568	lb/1000 lb LWK
FECAL COLIFORM	C2106	First Processors	1289	gal/1000 lb LWK	0.231	.	.	.	lb/1000 lb LWK
HEXANE EXTRACTABLE MATERIAL	C036	First Processors	1289	gal/1000 lb LWK	0.249	1.31	0.349	0.330	lb/1000 lb LWK
NITRATE/NITRITE	C005	First Processors	1289	gal/1000 lb LWK	0.0650	0.0959	0.0691	0.0684	lb/1000 lb LWK
TOTAL KJELDAHL NITROGEN	C021	First Processors	1289	gal/1000 lb LWK	0.0223	0.0630	0.0267	0.0259	lb/1000 lb LWK
TOTAL NITROGEN	C005+C021	First Processors	1289	gal/1000 lb LWK	0.0793	0.224	0.0949	0.0920	lb/1000 lb LWK
TOTAL PHOSPHORUS	14265442	First Processors	1289	gal/1000 lb LWK	0.0749	0.176	0.0864	0.0843	lb/1000 lb LWK
TOTAL RESIDUAL CHLORINE	7782505	First Processors	1289	gal/1000 lb LWK	0.171	0.943	0.243	0.230	lb/1000 lb LWK
TOTAL SUSPENDED SOLIDS	C009	First Processors	1289	gal/1000 lb LWK	0.0452	0.0609	0.0471	0.0467	lb/1000 lb LWK

----- Meat Type=Poultry -- Option=BAT3 -- Processing=Further -----

Analyte	CAS Number	General Process	Production	Production Unit	Production-normalized LTA	Production-normalized Daily Limit	Production-normalized 20-day Limit	Production-normalized 30-day Limit	Production-normalized Unit
AMMONIA AS NITROGEN	7664417	Further Processors	315.7	gal/1000 lb FP	0.00617	0.0400	0.00930	0.00873	lb/1000 lb FP
BIOCHEMICAL OXYGEN DEMAND	C003	Further Processors	315.7	gal/1000 lb FP	0.0188	0.0453	0.0218	0.0213	lb/1000 lb FP
FECAL COLIFORM	C2106	Further Processors	315.7	gal/1000 lb FP	0.0566	.	.	.	lb/1000 lb FP
HEXANE EXTRACTABLE MATERIAL	C036	Further Processors	315.7	gal/1000 lb FP	0.0437	0.229	0.0610	0.0579	lb/1000 lb FP
NITRATE/NITRITE	C005	Further Processors	315.7	gal/1000 lb FP	0.0159	0.0234	0.0169	0.0167	lb/1000 lb FP
TOTAL KJELDAHL NITROGEN	C021	Further Processors	315.7	gal/1000 lb FP	0.0130	0.0367	0.0155	0.0151	lb/1000 lb FP
TOTAL NITROGEN	C005+C021	Further Processors	315.7	gal/1000 lb FP	0.0194	0.0548	0.0232	0.0225	lb/1000 lb FP
TOTAL PHOSPHORUS	14265442	Further Processors	315.7	gal/1000 lb FP	0.0183	0.0431	0.0211	0.0206	lb/1000 lb FP
TOTAL RESIDUAL CHLORINE	7782505	Further Processors	315.7	gal/1000 lb FP	0.0420	0.231	0.0596	0.0564	lb/1000 lb FP
TOTAL SUSPENDED SOLIDS	C009	Further Processors	315.7	gal/1000 lb FP	0.0110	0.0149	0.0115	0.0114	lb/1000 lb FP

----- Meat Type=Poultry -- Option=BAT3 -- Processing=Rendering -----

Analyte	CAS Number	General Process	Production	Production Unit	Production-normalized LTA	Production-normalized Daily Limit	Production-normalized 20-day Limit	Production-normalized 30-day Limit	Production-normalized Unit
AMMONIA AS NITROGEN	7664417	Renderers	346.0	gal/1000 lb RM	0.00676	0.0438	0.0102	0.00956	lb/1000 lb RM
BIOCHEMICAL OXYGEN DEMAND	C003	Renderers	346.0	gal/1000 lb RM	0.0135	0.0324	0.0156	0.0152	lb/1000 lb RM
FECAL COLIFORM	C2106	Renderers	346.0	gal/1000 lb RM	0.0620	.	.	.	lb/1000 lb RM
HEXANE EXTRACTABLE MATERIAL	C036	Renderers	346.0	gal/1000 lb RM	0.0377	0.198	0.0528	0.0500	lb/1000 lb RM
NITRATE/NITRITE	C005	Renderers	346.0	gal/1000 lb RM	0.0174	0.0257	0.0185	0.0183	lb/1000 lb RM
TOTAL KJELDAHL NITROGEN	C021	Renderers	346.0	gal/1000 lb RM	0.0118	0.0333	0.0141	0.0137	lb/1000 lb RM
TOTAL NITROGEN	C005+C021	Renderers	346.0	gal/1000 lb RM	0.0213	0.0601	0.0254	0.0247	lb/1000 lb RM
TOTAL PHOSPHORUS	14265442	Renderers	346.0	gal/1000 lb RM	0.0201	0.0472	0.0232	0.0226	lb/1000 lb RM
TOTAL RESIDUAL CHLORINE	7782505	Renderers	346.0	gal/1000 lb RM	0.0460	0.253	0.0653	0.0618	lb/1000 lb RM
TOTAL SUSPENDED SOLIDS	C009	Renderers	346.0	gal/1000 lb RM	0.0201	0.0271	0.0209	0.0208	lb/1000 lb RM

Attachment 13-5. Production-Normalized Limitations

Meat Type=Poultry -- Option=PSES1 -- Processing=First

Analyte	CAS Number	General Process	Production	Production Unit	Production-normalized LTA	Production-normalized Daily Limit	Production-normalized 20-day Limit	Production-normalized 30-day Limit	Production-normalized Unit
HEXANE EXTRACTABLE MATERIAL	C036	First Processors	1289	gal/1000 lb LWK	0.141	0.615	0.187	0.179	lb/1000 lb LWK

Meat Type=Poultry -- Option=PSES1 -- Processing=Further

Analyte	CAS Number	General Process	Production	Production Unit	Production-normalized LTA	Production-normalized Daily Limit	Production-normalized 20-day Limit	Production-normalized 30-day Limit	Production-normalized Unit
HEXANE EXTRACTABLE MATERIAL	C036	Further Processors	315.7	gal/1000 lb FP	0.0468	0.203	0.0618	0.0591	lb/1000 lb FP

Meat Type=Poultry -- Option=PSES1 -- Processing=Rendering

Analyte	CAS Number	General Process	Production	Production Unit	Production-normalized LTA	Production-normalized Daily Limit	Production-normalized 20-day Limit	Production-normalized 30-day Limit	Production-normalized Unit
HEXANE EXTRACTABLE MATERIAL	C036	Renderers	346.0	gal/1000 lb RM	0.530	2.30	0.700	0.669	lb/1000 lb RM

Meat Type=Red Meat -- Option=BAT3 -- Processing=First

Analyte	CAS Number	General Process	Production	Production Unit	Production-normalized LTA	Production-normalized Daily Limit	Production-normalized 20-day Limit	Production-normalized 30-day Limit	Production-normalized Unit
AMMONIA AS NITROGEN	7664417	First Processors	322.8	gal/1000 lb LWK	0.0101	0.0655	.	0.0143	lb/1000 lb LWK
BIOCHEMICAL OXYGEN DEMAND	C003	First Processors	322.8	gal/1000 lb LWK	0.0184	0.0442	.	0.0208	lb/1000 lb LWK
FECAL COLIFORM	C2106	First Processors	322.8	gal/1000 lb LWK	0.249	.	.	.	lb/1000 lb LWK
HEXANE EXTRACTABLE MATERIAL	C036	First Processors	322.8	gal/1000 lb LWK	0.0158	0.0835	.	0.0210	lb/1000 lb LWK
NITRATE/NITRITE	C005	First Processors	322.8	gal/1000 lb LWK	0.0212	0.0313	.	0.0223	lb/1000 lb LWK
TOTAL KJELDAHL NITROGEN	C021	First Processors	322.8	gal/1000 lb LWK	0.00559	0.0157	.	0.00648	lb/1000 lb LWK
TOTAL NITROGEN	C005+C021	First Processors	322.8	gal/1000 lb LWK	0.0198	0.0561	.	0.0230	lb/1000 lb LWK
TOTAL PHOSPHORUS	14265442	First Processors	322.8	gal/1000 lb LWK	0.0211	0.0497	.	0.0238	lb/1000 lb LWK
TOTAL SUSPENDED SOLIDS	C009	First Processors	322.8	gal/1000 lb LWK	0.0132	0.0178	.	0.0137	lb/1000 lb LWK

Meat Type=Red Meat -- Option=BAT3 -- Processing=Further

Analyte	CAS Number	General Process	Production	Production Unit	Production-normalized LTA	Production-normalized Daily Limit	Production-normalized 20-day Limit	Production-normalized 30-day Limit	Production-normalized Unit
AMMONIA AS NITROGEN	7664417	Further Processors	555.4	gal/1000 lb FP	0.0108	0.0704	.	0.0153	lb/1000 lb FP
BIOCHEMICAL OXYGEN DEMAND	C003	Further Processors	555.4	gal/1000 lb FP	0.0217	0.0520	.	0.0245	lb/1000 lb FP
FECAL COLIFORM	C2106	Further Processors	555.4	gal/1000 lb FP	0.103	.	.	.	lb/1000 lb FP
HEXANE EXTRACTABLE MATERIAL	C036	Further Processors	555.4	gal/1000 lb FP	0.0273	0.143	.	0.0362	lb/1000 lb FP
NITRATE/NITRITE	C005	Further Processors	555.4	gal/1000 lb FP	0.0280	0.0413	.	0.0294	lb/1000 lb FP
TOTAL KJELDAHL NITROGEN	C021	Further Processors	555.4	gal/1000 lb FP	0.00962	0.0271	.	0.0111	lb/1000 lb FP
TOTAL NITROGEN	C005+C021	Further Processors	555.4	gal/1000 lb FP	0.0341	0.0965	.	0.0396	lb/1000 lb FP
TOTAL PHOSPHORUS	14265442	Further Processors	555.4	gal/1000 lb FP	0.0390	0.0917	.	0.0439	lb/1000 lb FP

Attachment 13-5. Production-Normalized Limitations

Meat Type=Red Meat -- Option=BAT3 -- Processing=Further (continued)

Analyte	CAS Number	General Process	Production	Production Unit	Production-normalized LTA	Production-normalized Daily Limit	Production-normalized 20-day Limit	Production-normalized 30-day Limit	Production-normalized Unit
TOTAL SUSPENDED SOLIDS	C009	Further Processors	555.4	gal/1000 lb FP	0.0194	0.0262	.	0.0201	lb/1000 lb FP

Meat Type=Red Meat -- Option=BAT3 -- Processing=Rendering

Analyte	CAS Number	General Process	Production	Production Unit	Production-normalized LTA	Production-normalized Daily Limit	Production-normalized 20-day Limit	Production-normalized 30-day Limit	Production-normalized Unit
AMMONIA AS NITROGEN	7664417	Renderers	346.0	gal/1000 lb RM	0.00676	0.0438	.	0.00956	lb/1000 lb RM
BIOCHEMICAL OXYGEN DEMAND	C003	Renderers	346.0	gal/1000 lb RM	0.0241	0.0578	.	0.0272	lb/1000 lb RM
FECAL COLIFORM	C2106	Renderers	346.0	gal/1000 lb RM	0.0663	.	.	.	lb/1000 lb RM
HEXANE EXTRACTABLE MATERIAL	C036	Renderers	346.0	gal/1000 lb RM	0.0224	0.117	.	0.0297	lb/1000 lb RM
NITRATE/NITRITE	C005	Renderers	346.0	gal/1000 lb RM	0.0174	0.0257	.	0.0183	lb/1000 lb RM
TOTAL KJELDAHL NITROGEN	C021	Renderers	346.0	gal/1000 lb RM	0.00599	0.0169	.	0.00695	lb/1000 lb RM
TOTAL NITROGEN	C005+C021	Renderers	346.0	gal/1000 lb RM	0.0213	0.0601	.	0.0247	lb/1000 lb RM
TOTAL PHOSPHORUS	14265442	Renderers	346.0	gal/1000 lb RM	0.0201	0.0472	.	0.0226	lb/1000 lb RM
TOTAL SUSPENDED SOLIDS	C009	Renderers	346.0	gal/1000 lb RM	0.0121	0.0163	.	0.0125	lb/1000 lb RM

Meat Type=Red Meat -- Option=BAT3 -- Processing=Meat Cutters

Analyte	CAS Number	General Process	Production	Production Unit	Production-normalized LTA	Production-normalized Daily Limit	Production-normalized 20-day Limit	Production-normalized 30-day Limit	Production-normalized Unit
AMMONIA AS NITROGEN	7664417	Meat Cutters	130.4	gal/1000 lb FP	0.00254	0.0165	.	0.00360	lb/1000 lb FP
BIOCHEMICAL OXYGEN DEMAND	C003	Meat Cutters	130.4	gal/1000 lb FP	0.00509	0.0122	.	0.00575	lb/1000 lb FP
FECAL COLIFORM	C2106	Meat Cutters	130.4	gal/1000 lb FP	0.0243	.	.	.	lb/1000 lb FP
HEXANE EXTRACTABLE MATERIAL	C036	Meat Cutters	130.4	gal/1000 lb FP	0.00642	0.0337	.	0.00850	lb/1000 lb FP
NITRATE/NITRITE	C005	Meat Cutters	130.4	gal/1000 lb FP	0.00657	0.00970	.	0.00692	lb/1000 lb FP
TOTAL KJELDAHL NITROGEN	C021	Meat Cutters	130.4	gal/1000 lb FP	0.00225	0.00637	.	0.00262	lb/1000 lb FP
TOTAL NITROGEN	C005+C021	Meat Cutters	130.4	gal/1000 lb FP	0.00802	0.0226	.	0.00931	lb/1000 lb FP
TOTAL PHOSPHORUS	14265442	Meat Cutters	130.4	gal/1000 lb FP	0.00916	0.0215	.	0.0103	lb/1000 lb FP
TOTAL SUSPENDED SOLIDS	C009	Meat Cutters	130.4	gal/1000 lb FP	0.00457	0.00616	.	0.00473	lb/1000 lb FP

Meat Type=Red Meat -- Option=BPT2 -- Processing=First

Analyte	CAS Number	General Process	Production	Production Unit	Production-normalized LTA	Production-normalized Daily Limit	Production-normalized 20-day Limit	Production-normalized 30-day Limit	Production-normalized Unit
CHEMICAL OXYGEN DEMAND	C004	First Processors	322.8	gal/1000 lb LWK	0.114	0.145	.	0.118	lb/1000 lb LWK

Attachment 13-5. Production-Normalized Limitations

Meat Type=Red Meat -- Option=BPT2 -- Processing=Further

Analyte	CAS Number	General Process	Production	Production Unit	Production-normalized LTA	Production-normalized Daily Limit	Production-normalized 20-day Limit	Production-normalized 30-day Limit	Production-normalized Unit
CHEMICAL OXYGEN DEMAND	C004	Further Processors	555.4	gal/1000 lb FP	0.219	0.278	.	0.226	lb/1000 lb FP

Meat Type=Red Meat -- Option=BPT2 -- Processing=Rendering

Analyte	CAS Number	General Process	Production	Production Unit	Production-normalized LTA	Production-normalized Daily Limit	Production-normalized 20-day Limit	Production-normalized 30-day Limit	Production-normalized Unit
AMMONIA AS NITROGEN	7664417	Renderers	346.0	gal/1000 lb RM	0.00676	0.0143	.	0.00749	lb/1000 lb RM
BIOCHEMICAL OXYGEN DEMAND	C003	Renderers	346.0	gal/1000 lb RM	0.0241	0.0559	.	0.0268	lb/1000 lb RM
CHEMICAL OXYGEN DEMAND	C004	Renderers	346.0	gal/1000 lb RM	0.122	0.155	.	0.126	lb/1000 lb RM
FECAL COLIFORM	C2106	Renderers	346.0	gal/1000 lb RM	1.76	12.5	.	5.87	lb/1000 lb RM

HEXANE EXTRACTABLE MATERIAL	C036	Renderers	346.0	gal/1000 lb RM	0.0334	0.175	.	0.0442	lb/1000 lb RM
TOTAL RESIDUAL CHLORINE	7782505	Renderers	346.0	gal/1000 lb RM	0.00115	0.00265	.	0.00128	lb/1000 lb RM
TOTAL SUSPENDED SOLIDS	C009	Renderers	346.0	gal/1000 lb RM	0.0598	0.123	.	0.0657	lb/1000 lb RM

----- Meat Type=Red Meat -- Option=BPT2 -- Processing=Meat Cutters -----

Analyte	CAS Number	General Process	Production	Production Unit	Production-normalized LTA	Production-normalized Daily Limit	Production-normalized 20-day Limit	Production-normalized 30-day Limit	Production-normalized Unit
CHEMICAL OXYGEN DEMAND	C004	Meat Cutters	130.4	gal/1000 lb FP	0.0515	0.0654	.	0.0531	lb/1000 lb FP

----- Meat Type=Red Meat -- Option=PSES1 -- Processing=First -----

Analyte	CAS Number	General Process	Production	Production Unit	Production-normalized LTA	Production-normalized Daily Limit	Production-normalized 20-day Limit	Production-normalized 30-day Limit	Production-normalized Unit
AMMONIA AS NITROGEN	7664417	First Processors	322.8	gal/1000 lb LWK	2.94	7.69	.	3.37	lb/1000 lb LWK
HEXANE EXTRACTABLE MATERIAL	C036	First Processors	322.8	gal/1000 lb LWK	0.100	0.153	.	0.106	lb/1000 lb LWK

----- Meat Type=Red Meat -- Option=PSES1 -- Processing=Further -----

Analyte	CAS Number	General Process	Production	Production Unit	Production-normalized LTA	Production-normalized Daily Limit	Production-normalized 20-day Limit	Production-normalized 30-day Limit	Production-normalized Unit
AMMONIA AS NITROGEN	7664417	Further Processors	555.4	gal/1000 lb FP	0.0699	0.182	.	0.0800	lb/1000 lb FP
HEXANE EXTRACTABLE MATERIAL	C036	Further Processors	555.4	gal/1000 lb FP	0.0362	0.0552	.	0.0383	lb/1000 lb FP

Attachment 13-5. Production-Normalized Limitations

Meat Type=Red Meat -- Option=PSES1 -- Processing=Rendering

Analyte	CAS Number	General Process	Production	Production Unit	Production-normalized LTA	Production-normalized Daily Limit	Production-normalized 20-day Limit	Production-normalized 30-day Limit	Production-normalized Unit
AMMONIA AS NITROGEN	7664417	Renderers	346.0	gal/1000 lb RM	0.287	0.752	.	0.329	lb/1000 lb RM
HEXANE EXTRACTABLE MATERIAL	C036	Renderers	346.0	gal/1000 lb RM	0.0565	0.0862	.	0.0597	lb/1000 lb RM

Meat Type=Red Meat -- Option=PSES1 -- Processing=Meat Cutters

Analyte	CAS Number	General Process	Production	Production Unit	Production-normalized LTA	Production-normalized Daily Limit	Production-normalized 20-day Limit	Production-normalized 30-day Limit	Production-normalized Unit
AMMONIA AS NITROGEN	7664417	Meat Cutters	130.4	gal/1000 lb FP	0.0164	0.0429	.	0.0188	lb/1000 lb FP
HEXANE EXTRACTABLE MATERIAL	C036	Meat Cutters	130.4	gal/1000 lb FP	0.00850	0.0129	.	0.00899	lb/1000 lb FP

APPENDIX I

40 CFR PART 432

PART 432—MEAT PRODUCTS POINT SOURCE CATEGORY

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432.106 Pretreatment standards for new sources.
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AUTHORITY: Secs. 301, 304 (b) and (c), 306 (b) and (c), and 307(c) of the Federal Water Pollution Control Act, as amended; 33 U.S.C. 1251, 1311, 1314 (b) and (c), 1316 (b) and (c), 1317(c); 86 Stat. 816 et seq., Pub. L. 92–500; 91 Stat. 1567, Pub. L. 95–217.

SOURCE: 39 FR 7897, Feb. 28, 1974, unless otherwise noted.

Subpart A—Simple Slaughterhouse Subcategory

§ 432.10 Applicability; description of the simple slaughterhouse subcategory.

The provisions of this subpart are applicable to discharges resulting from the production of red meat carcasses, in whole or part, by simple slaughterhouses.

§ 432.11 Specialized definitions.

For the purpose of this subpart:

(a) Except as provided below, the general definitions, abbreviations and methods of analysis set forth in 40 CFR part 401 shall apply to this subpart.

(b) The term ''slaughterhouse'' shall mean a plant that slaughters animals and has as its main product fresh meat as whole, half or quarter carcasses or smaller meat cuts.

(c) The term ''simple slaughterhouse'' shall mean a slaughterhouse which accomplishes very limited by-product processing, if any, usually no more than two of such operations as rendering, paunch and viscera handling, blood processing, hide processing, or hair processing.

(d) The term ''LWK'' (live weight killed) shall mean the total weight of the total number of animals slaughtered during the time to which the effluent limitations apply; i.e., during any one day or any period of thirty consecutive days.

(e) The term ''ELWK'' (equivalent live weight killed) shall mean the total weight of the total number of animals slaughtered at locations other than the slaughterhouse or packinghouse, which animals provide hides, blood, viscera or renderable materials for processing at that slaughterhouse, in addition to those derived from animals slaughtered on site.

(f) The term ''oil and grease'' shall mean those components of process waste water amenable to measurement by the method described in ''Methods for Chemical Analysis of Water and Wastes,'' 1971, EPA, Analytical Quality Control Laboratory, page 217.

§ 432.12 Effluent limitations guidelines representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available.

Except as provided in §§ 125.30 through 125.32, any existing point source subject to this subpart shall achieve the following effluent limitations representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available (BPT):

(a) The following limitations establish the quantity or quality of pollutants or pollutant properties, controlled by this section and attributable to on-site slaughter or subsequent meat, meat product or by-product processing of carcasses of animals slaughtered on-site, which may be discharged by a point source subject to the provisions of this subpart after application of the best practicable control technology currently available:

Effluent characteristic	Effluent limitations: Maximum for any 1 day	Effluent limitations: Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kilograms per 1,000 kg LWK)	
BOD*5*	0.24	0.12
TSS	0.40	0.20
Oil and grease	0.12	0.06
Fecal coliform	(1)	(1)
pH	(2)	(2)
	English units (pounds per 1,000 lb LWK)	
BOD*5*	0.24	0.12
TSS	0.40	0.20
Oil and grease	0.12	0.06
Fecal coliform	(1)	(1)
pH	(2)	(2)

[1] Maximum at any time 400 mpn/100 ml.
[2] Within the range 6.0 to 9.0.

(b) The following limitations establish the quantity or quality of pollutants or pollutant properties, controlled by this section and attributable to the processing (defleshing, washing and curing) of hides derived from animals slaughtered at locations other than the slaughterhouse, which may be discharged by a point source subject to the provisions of this subpart, in addition to the discharge allowed by § 432.12(a):

Effluent characteristic	Effluent limitations: Maximum for any 1 day	Effluent limitations: Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kilograms per 1,000 kg ELWK)	
BOD*5*	0.04	0.02
TSS	0.08	0.04
	English units (pounds per 1,000 lb ELWK)	
BOD*5*	0.04	0.02
TSS	0.08	0.04

(c) The following limitations establish the quantity or quality of pollutants or pollutant properties, controlled by this section and attributable to the processing of blood derived from animals slaughtered at locations other than the slaughterhouse, which may be discharged by a point source subject to the provisions of this subpart, in addition to the discharge allowed by § 432.12(a):

Effluent characteristic	Effluent limitations: Maximum for any 1 day	Effluent limitations: Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kilograms per 1,000 kg ELWK)	
BOD*5*	0.04	0.02
TSS	0.08	0.04
	English units (pounds per 1,000 lb ELWK)	
BOD*5*	0.04	0.02
TSS	0.08	0.04

(d) The following limitations establish the quantity or quality of pollutants or pollutant properties, controlled by this section and attributable to the wet or low temperature rendering of material derived from animals slaughtered at locations other than the slaughterhouse, which may be discharged by a point source subject to the provisions of this subpart, in addition to the discharge allowed by § 432.12(a):

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kilograms per 1,000 kg ELWK)	
BOD5	0.06	0.03
TSS	0.12	0.06
	English units (pounds per 1,000 lb ELWK)	
BOD5	0.06	0.03
TSS	0.12	0.06

(e) The following limitations establish the quantity or quality of pollutants or pollutant properties, controlled by this section and attributable to the dry rendering of material derived from animals slaughtered at locations other than the slaughterhouse, which may be discharged by a point source subject to the provisions of this subpart, in addition to the discharge allowed by § 432.12(a):

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kilograms per 1,000 kg ELWK)	
BOD5	0.02	0.01
TSS	0.04	0.02
pH	([1])	([1])
	English units (pounds per 1,000 lb ELWK)	
BOD5	0.02	0.01
TSS	0.04	0.02
pH	([1])	([1])

[1] Within the range 6.0 to 9.0.

[39 FR 7897, Feb. 28, 1974, as amended at 60 FR 33964, June 29, 1995]

§ 432.13 [Reserved]

§ 432.14 Pretreatment standards for existing sources.

Any existing source subject to this subpart that introduces process wastewater pollutants into a publicly owned treatment works must comply with 40 CFR part 403. In addition, the following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property	Pretreatment standard
pH	No limitation.
BOD5	Do.
TSS	Do.
Oil and grease	Do.
Fecal coliform	Do.

[40 FR 6446, Feb. 11, 1975, as amended at 60 FR 33964, June 29, 1995]

§ 432.15 Standards of performance for new sources.

(a) The following standards of performance establish the quantity or quality of pollutants or pollutant properties, controlled by this section and attributable to on-site slaughter or subsequent meat, meat product or by-product processing of carcasses of animals slaughtered on-site which may be discharged by a new source subject to the provisions of this subpart: the limitations shall be as specified in § 432.12(a), with the exception that in addition to the pollutants or pollutant properties controlled by that subsection, discharges of ammonia shall not exceed the limitations set forth below:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kilograms per 1,000 kg LWK)	
Ammonia	0.34	0.17
	English units (pounds per 1,000 lb LWK)	
Ammonia	0.34	0.17

(b) The following standards of performance establish the quantity or quality of pollutants or pollutant properties, controlled by this section and attributable to the processing of blood derived from animals slaughtered at locations other than the slaughterhouse, which may be discharged by a new source subject to the provisions of this subpart, in addition to the discharge allowed by §§ 432.15(a) and 432.12(c):

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kilograms per 1,000 kg ELWK)	
Ammonia	0.06	0.03
	English units (pounds per 1,000 lb ELWK)	
Ammonia	0.06	0.03

(c) The following standards of performance establish the quantity or quality of pollutants or pollutant properties, controlled by this section and attributable to the wet or low temperature rendering of material derived from animals slaughtered at locations other than slaughterhouse, which may be discharged by a new source subject to the provisions of this subpart, in addition to the discharge allowed by §§ 432.15(a) and 432.12(d):

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kilograms per 1,000 kg ELWK)	
Ammonia	0.10	0.05
	English units (pounds per 1,000 lb ELWK)	
Ammonia	0.10	0.05

(d) The following standards of performance establish the quantity or quality of pollutants or pollutant properties, controlled by this section and attributable to the dry rendering of material derived from animals slaughtered at locations other than the slaughterhouse which may be discharged by a new source subject to the provisions of this subpart, in addition to the discharge allowed by §§ 432.15(a) and 432.12(e):

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kilograms per 1,000 kg ELWK)	
Ammonia	0.04	0.02
	English units (pounds per 1,000 lb ELWK)	
Ammonia	0.04	0.02

[39 FR 7897, Feb. 28, 1974; 39 FR 26423, July 19, 1974]

§ 432.16 Pretreatment standards for new sources.

Any new source subject to this subpart that introduces process wastewater pollutants into a publicly owned treatment works must comply with 40 CFR part 403.

[60 FR 33964, June 29, 1995]

§ 432.17 Effluent limitations guidelines representing the degree of effluent reduction attainable by the application of the best conventional pollutant control technology.

Except as provided in §§ 125.30 through 125.32, any existing point source subject to this subpart shall achieve the following effluent limitations representing the degree of effluent reduction attainable by the application of the best conventional pollutant control technology (BCT): The limitations shall be the same as those specified for conventional pollutants (which are defined in § 401.16) in § 432.12 of this subpart for the best practicable control technology currently available (BPT).

[51 FR 25001, July 9, 1986]

Subpart B—Complex Slaughterhouse Subcategory

§ 432.20 Applicability; description of the complex slaughterhouse subcategory.

The provisions of this subpart are applicable to discharges resulting from the production of red meat carcasses, in whole or part, by complex slaughterhouses.

§ 432.21 Specialized definitions.

For the purpose of this subpart:

(a) Except as provided below, the general definitions, abbreviations and methods of analysis set forth in 40 CFR part 401 shall apply to this subpart.

(b) The term ''slaughterhouse'' shall mean a plant that slaughters animals and has as its main product fresh meat as whole, half or quarter carcasses or smaller meat cuts.

(c) The term ''complex slaughterhouse'' shall mean a slaughterhouse that accomplishes extensive by-product processing, usually at least three of such operations as rendering, paunch and viscera handling, blood processing, hide processing, or hair processing.

(d) The term ''LWK'' (live weight killed) shall mean the total weight of the total number of animals slaughtered during the time to which the effluent limitations apply; i.e., during any one day or any period of thirty consecutive days.

(e) The term ''ELWK'' (equivalent live weight killed) shall mean the total weight of the total number of animals slaughtered at locations other than the slaughterhouse or packinghouse, which animals provide hides, blood, viscera or renderable materials for processing at that slaughterhouse, in addition to those derived from animals slaughtered on site.

(f) The term ''oil and grease'' shall mean those components of process waste water amenable to measurement by the method described in ''Methods for Chemical Analysis of Water and Wastes,'' 1971, EPA, Analytical Quality Control Laboratory, page 217.

§ 432.22 Effluent limitations guidelines representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available.

Except as provided in §§ 125.30 through 125.32, any existing point source subject to this subpart shall achieve the following effluent limitations representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available (BPT):

(a) The following limitations establish the quantity or quality of pollutants or pollutant properties, controlled by this section and attributable to on-site slaughter or subsequent meat, meat product or by-product processing of carcasses of animals slaughtered on-site, which may be discharged by a point source subject to the provisions of this subpart after application of the best practical control technology currently available:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kilograms per 1,000 kg LWK)	
BOD5	0.42	0.21
TSS	0.50	0.25
Oil and grease	0.16	0.08
Fecal coliform	(1)	(1)
pH	(2)	(2)
	English units (pounds per 1,000 lb LWK)	
BOD5	0.42	0.21
TSS	0.50	0.25
Oil and grease	0.16	0.08
Fecal coliform	(1)	(1)
pH	(2)	(2)

[1] Maximum at any time 400 mpn/100 ml.
[2] Within the range 6.0 to 9.0.

(b) The following limitations establish the quantity or quality of pollutants or pollutant properties, controlled by this section and attributable to the processing (defleshing, washing and curing) of hides derived from animals slaughtered at locations other than the slaughterhouse, which may be discharged by a point source subject to the provisions of this subpart, in addition to the discharge allowed by paragraph (a) of this section:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kilograms per 1,000 kg ELWK)	
BOD5	0.04	0.02
TSS	0.08	0.04
	English units (pounds per 1,000 lb ELWK)	
BOD5	0.04	0.02
TSS	0.08	0.04

(c) The following limitations establish the quantity or quality of pollutants or pollutant properties, controlled by this section and attributable to the processing of blood derived from animals slaughtered at locations other than the slaughterhouse, which may be discharged by a point source subject to the provisions of this subpart, in addition to the discharge allowed by paragraph (a) of this section:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kilograms per 1,000 kg ELWK)	
BOD5	0.04	0.02
TSS	0.08	0.04
	English units (pounds per 1,000 lb ELWK)	
BOD5	0.04	0.02
TSS	0.08	0.04

(d) The following limitations establish the quantity or quality of pollutants or pollutant properties, controlled by this section and attributable to the wet or low temperature rendering of material derived from animals slaughtered at locations other than the slaughterhouse, which may be discharged by a point source subject to the provisions of this subpart, in addition to the discharge allowed by paragraph (a) of this section:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kilograms per 1,000 kg ELWK)	
BOD5	0.06	0.03
TSS	0.12	0.06
	English units (pounds per 1,000 lb ELWK)	
BOD5	0.06	0.03
TSS	0.12	0.06

(e) The following limitations establish the quantity or quality of pollutants or pollutant properties, controlled by this section and attributable to the dry rendering of material derived from animals slaughtered at locations other than the slaughterhouse, which may be discharged by a point source subject to the provisions of this subpart, in addition to the discharge allowed by paragraph (a):

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kilograms per 1,000 kg ELWK)	
BOD5	0.02	0.01
TSS	0.04	0.02
	English units (pounds per 1,000 lb ELWK)	
BOD5	0.02	0.01
TSS	0.04	0.02

[39 FR 7897, Feb. 28, 1974; 39 FR 26423, July 19, 1974, as amended at 45 FR 82254, Dec. 15, 1980; 60 FR 33964, June 29, 1995]

§ 432.23 [Reserved]

§ 432.24 Pretreatment standards for existing sources.

Any existing source subject to this subpart that introduces process wastewater pollutants into a publicly owned treatment works must comply with 40 CFR part 403. In addition, the following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property	Pretreatment standard
pH	No limitation.
BOD5	Do.
TSS	Do.
Oil and grease	Do.
Fecal coliform	Do.

[40 FR 6446, Feb. 11, 1975, as amended at 60 FR 33965, June 29, 1995]

§ 432.25 Standards of performance for new sources.

(a) The following standards of performance establish the quantity or quality of pollutants or pollutant properties, controlled by this section and attributable to on-site slaughter or subsequent meat, meat product or by-product processing of carcasses of animals slaughtered on-site which may be discharged by a new source subject to the provisions of this subpart: The limitations shall be as specified in § 432.22(a), with the exception that in addition to the pollutants or pollutant properties controlled by that subsection, discharges of ammonia shall not exceed the limitations set forth below:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kilograms per 1,000 kg LWK)	
Ammonia	0.48	0.24
	English units (pounds per 1,000 lb LWK)	
Ammonia	0.48	0.24

(b) The following standards of performance establish the quantity or quality of pollutants or pollutant properties, controlled by this section and attributable to the processing of blood derived from animals slaughtered at locations other than the slaughterhouse, which may be discharged by a new source subject to the provisions of this subpart, in addition to the discharge allowed by paragraph (a) of this section and § 432.22(c):

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kilograms per 1,000 kg ELWK)	
Ammonia	0.06	0.03
	English units (pounds per 1,000 lb ELWK)	
Ammonia	0.06	0.03

(c) The following standards of performance establish the quantity or quality of pollutants or pollutant properties, controlled by this section and attributable to the wet or low temperature rendering of material derived from animals slaughtered at locations other than the slaughterhouse, which may be discharged by a new source subject to the provisions of this subpart, in addition to the discharge allowed by paragraph (a) of this section and § 432.22(d):

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kilograms per 1,000 kg ELWK)	
Ammonia	0.10	0.05
	English units (pounds per 1,000 lb ELWK)	
Ammonia	0.10	0.05

(d) The following standards of performance establish the quantity or quality of pollutants or pollutant properties, controlled by this section and attributable to the dry rendering of material derived from animals slaughtered at locations other than the slaughterhouse, which may be discharged by a new source subject to the provisions of this subpart, in addition to the discharge allowed by paragraph (a) of this section and § 432.22(e):

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kilograms per 1,000 kg ELWK)	
Ammonia	0.04	0.02
	English units (pounds per 1,000 lb ELWK)	
Ammonia	0.04	0.02

[39 FR 7897, Feb. 28, 1974; 39 FR 26423, July 19, 1974]

§ 432.26 Pretreatment standards for new sources.

Any new source subject to this subpart that introduces process wastewater pollutants into a publicly owned treatment works must comply with 40 CFR part 403.

[60 FR 33965, June 29, 1995]

§ 432.27 Effluent limitations guidelines representing the degree of effluent reduction attainable by the application of the best conventional pollutant control technology.

Except as provided in §§ 125.30 through 125.32, any existing point source subject to this subpart shall achieve the following effluent limitations representing the degree of effluent reduction attainable by the application of the best conventional pollutant control technology (BCT): The limitations shall be the same as those specified for conventional pollutants (which are defined in § 401.16) in § 432.22 of this subpart for the best practicable control technology currently available (BPT).

[51 FR 25001, July 9, 1986]

Subpart C—Low-Processing Packinghouse Subcategory

§ 432.30 Applicability; description of the low-processing packinghouse subcategory.

The provisions of this subpart are applicable to discharges resulting from the production of red meat carcasses in whole or part, by low-processing packinghouses.

§ 432.31 Specialized definitions.

For the purpose of this subpart:

(a) Except as provided below, the general definitions, abbreviations and methods of analysis set forth in 40 CFR part 401 shall apply to this subpart.

(b) The term ''packinghouse'' shall mean a plant that both slaughters animals and subsequently processes carcasses into cured, smoked, canned or other prepared meat products.

(c) The term ''low processing packinghouse'' shall mean a packinghouse that processes no more than the total animals killed at that plant, normally processing less than the total kill.

(d) The term ''LWK'' (live weight killed) shall mean the total weight of the total number of animals slaughtered during the time to which the effluent limitations apply; i.e., during any one day or any period of thirty consecutive days.

(e) The term ''ELWK'' (equivalent live weight killed) shall mean the total weight of the total number of animals slaughtered at locations other than the slaughterhouse or packinghouse, which animals provide hides, blood, viscera or renderable materials for processing at that slaughterhouse, in addition to those derived from animals slaughtered on-site.

(f) The term ''oil and grease'' shall mean those components of process waste water amenable to measurement by the method described in ''Methods for Chemical Analysis of Water and Wastes,'' 1971, EPA, Analytical Quality Control Laboratory, page 217.

§ 432.32 Effluent limitations guidelines representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available.

Except as provided in §§ 125.30 through 125.32, any existing point source subject to this subpart shall achieve the following effluent limitations representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available (BPT):

(a) The following limitations establish the quantity or quality of pollutants or pollutant properties, controlled by this section and attributable to onsite slaughter or subsequent meat, meat product or byproduct, processing of carcasses of animals slaughtered on-site, which may be discharged by a point source subject to the provisions of this subpart after application of the best practicable control technology currently available:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kilograms per 1,000 kg LWK)	
BOD*5*	0.34	0.17
TSS	0.48	0.24
Oil and grease	0.16	0.08
Fecal coliform	[1]	[1]
pH	[2]	[2]
	English units (pounds per 1,000 lb LWK)	
BOD*5*	0.34	0.17
TSS	0.48	0.24
Oil and grease	0.16	0.08
Fecal coliform	[1]	[1]
pH	[2]	[2]

[1] Maximum at any time 400 mpn/100 ml.
[2] Within the range 6.0 to 9.0.

(b) The following limitations establish the quantity or quality of pollutants or pollutant properties, controlled by this section and attributable to the processing (defleshing, washing and curing) of hides derived from animals slaughtered at locations other than the packinghouse, which may be discharged by a point source subject to the provisions of this subpart, in addition to the discharge allowed by paragraph (a) of this section:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kilograms per 1,000 kg ELWK)	
BOD*5*	0.04	0.02
TSS	0.08	0.04

(c) The following limitations establish the quantity or quality of pollutants or pollutant properties, controlled by this section and attributable to the processing of blood derived from animals slaughtered at locations other than the packinghouse, which may be discharged by a point source subject to the provisions of this subpart, in addition to the discharge allowed by paragraph (a) of this section:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kilograms per 1,000 kg ELWK)	
BOD5	0.04	0.02
TSS	0.08	0.04
	English units (pounds per 1,000 lb ELWK)	
BOD5	0.04	0.02
TSS	0.08	0.04

(d) The following limitations establish the quantity or quality of pollutants or pollutant properties, controlled by this section and attributable to the wet or low temperature rendering of material derived from animals slaughtered at locations other than the packinghouse, which may be discharged by a point source subject to the provisions of this subpart, in addition to the discharge allowed by paragraph (a) of this section:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kilograms per 1,000 kg ELWK)	
BOD5	0.06	0.03
TSS	0.12	0.06
	English units (pounds per 1,000 lb ELWK)	
BOD5	0.06	0.03
TSS	0.12	0.06

(e) The following limitations establish the quantity or quality of pollutants or pollutant properties, controlled by this section and attributable to the dry rendering of material derived from animals slaughtered at locations other than the packinghouse, which may be discharged by a point source subject to the provisions of this subpart, in addition to the discharge allowed by paragraph (a) of this section:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kilograms per 1,000 kg ELWK)	
BOD5	0.02	0.01
TSS	0.04	0.02
	English units (pounds per 1,000 lb ELWK)	
BOD5	0.02	0.01
TSS	0.04	0.02

[39 FR 7897, Feb. 28, 1974, as amended at 60 FR 33965, June 29, 1995]

§ 432.33 [Reserved]

§ 432.34 Pretreatment standards for existing sources.

Any existing source subject to this subpart that introduces process wastewater pollutants into a publicly owned treatment works must comply with 40 CFR part 403. In addition, the following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property	Pretreatment standard
pH	No limitation.
BOD5	Do.
TSS	Do.
Oil and grease	Do.
Fecal coliform	Do.

[40 FR 6447, Feb. 11, 1975, as amended at 60 FR 33965, June 29, 1995]

§ 432.35 Standards of performance for new sources.

(a) The following standards of performance establish the quantity or quality of pollutants or pollutant properties, controlled by this section and attributable to on-site slaughter or subsequent meat, meat product or by product processing of carcasses of animals slaughtered on-site which may be discharged by a new source subject to the provisions of this subpart: The limitations shall be as specified in § 432.32(a), with the exception that in addition to the pollutants or pollutant properties controlled by that subsection, discharges of ammonia shall not exceed the limitations set forth below:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kilograms per 1,000 kg LWK)	
Ammonia	0.48	0.24
	English units (pounds per 1,000 lb LWK)	
Ammonia	0.48	0.24

(b) The following standards of performance establish the quantity or quality of pollutants or pollutant properties, controlled by this section and attributable to the processing of blood derived from animals slaughtered at locations other than the packinghouse, which may be discharged by a new source subject to the provisions of this subpart, in addition to the discharge allowed by paragraph (a) of this section and § 432.32(c):

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kilograms per 1,000 kg ELWK)	
Ammonia	0.06	0.03
	English units (pounds per 1,000 lb ELWK)	
Ammonia	10.06	0.03

(c) The following standards of performance establish the quantity or quality of pollutants or pollutant properties, controlled by this section and attributable to the wet or low temperature rendering of material derived from animals slaughtered at locations other than the packinghouse, which may be discharged by a new source subject to the provisions of this subpart, in addition to the discharge allowed by paragraph (a) of this section and § 432.32(a).

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kilograms per 1,000 kg ELWK)	
Ammonia	0.10	0.05
	English units (pounds per 1,000 lb ELWK)	
Ammonia	0.10	0.05

(d) The following standards of performance establish the quantity or quality of pollutants or pollutant properties, controlled by this section and attributable to the dry rendering of material derived from animals slaughtered at locations other than the packinghouse, which may be discharged by a new source subject to the provisions of this subpart, in addition to the discharge allowed by paragraph (a) of this section and § 432.32(e):

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kilograms per 1,000 kg ELWK)	
Ammonia	0.04	0.02
	English units (pounds per 1,000 lb ELWK)	
Ammonia	0.04	0.02

[39 FR 7897, Feb. 28, 1974; 39 FR 26423, July 19, 1974]

§ 432.36 Pretreatment standards for new sources.

Any new source subject to this subpart that introduces process wastewater pollutants into a publicly owned treatment works must comply with 40 CFR part 403.

[60 FR 33965, June 29, 1995]

§ 432.37 Effluent limitations guidelines representing the degree of effluent reduction attainable by the application of the best conventional pollutant control technology.

Except as provided in §§ 125.30 through 125.32, any existing point source subject to this subpart shall achieve the following effluent limitations representing the degree of effluent reduction attainable by the application of the best conventional pollutant control technology (BCT): The limitations shall be the same as those specified for conventional pollutants (which are defined in § 401.16) in § 432.32 of this subpart for the best practicable control technology currently available (BPT).

[51 FR 25001, July 9, 1986]

Subpart D—High-Processing Packinghouse Subcategory

§ 432.40 Applicability; description of the high-processing packinghouse subcategory.

The provisions of this subpart are applicable to discharges resulting from the production of red meat carcasses, in whole or part, by high-processing packinghouses.

§ 432.41 Specialized definitions.

For the purpose of this subpart:

(a) Except as provided below, the general definitions, abbreviations and methods of analysis set forth in 40 CFR part 401 shall apply to this subpart.

(b) The term ''packinghouse'' shall mean a plant that both slaughters animals and subsequently processes carcasses into cured, smoked, canned or other prepared meat products.

(c) The term ''high-processing packinghouse'' shall mean a packinghouse which processes both animals slaughtered at the site and additional carcasses from outside sources.

(d) The term ''LWK'' (live weight killed) shall mean the total weight of the total number of animals slaughtered during the time to which the effluent limitations apply; i.e., during any one day or any period of thirty consecutive days.

(e) The term ''ELWK'' (equipment live weight killed) shall mean the total weight of the total number of animals slaughtered at locations other than the slaughterhouse or packinghouse, which animals provide hides, blood, viscera or renderable materials for processing at that slaughterhouse, in addition to those derived from animals slaughtered on-site.

(f) The term ''oil and grease'' shall mean those components of process waste water amenable to measurement by the method described in ''Methods for Chemical Analysis of Water and Wastes,'' 1971, EPA, Analytical Quality Control Laboratory, page 217.

§ 432.42 Effluent limitations guidelines representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available.

Except as provided in §§ 125.30 through 125.32, any existing point source subject to this subpart shall achieve the following effluent limitations representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available (BPT):

(a) The following limitations establish the quantity or quality of pollutants or pollutant properties, controlled by this section and attributable to onsite slaughter or subsequent meat, meat product or byproduct processing of carcasses of animals slaughtered on-site, which may be discharged by a point source subject to the provisions of this subpart after application of the best practicable control technology currently available:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kilograms per 1,000 kg LWK)	
BOD_5+	0.48	0.24
TSS+	0.62	0.31
Oil and grease	0.26	0.13
Fecal coliform	(1)	(1)
pH	(2)	(2)
	English units (pounds per 1,000 lb LWK)	
BOD_5+	0.48	0.24
TSS+	0.62	0.31
Oil and grease	0.26	0.13
Fecal coliform	(1)	(1)
pH	(2)	(2)

[1] Maximum at any time 400 mpn/100 ml.
[2] Within the range 6.0 to 9.0.

+The values for BOD_5 and suspended solids are for average plants, i.e., plants with a ratio of average weight of processed meat products to average LWK of 0.55. Adjustments can be made for high-processing packinghouses at other ratios according to the following equations:

$$\text{kg } BOD_5/1000 \text{ kg LWK}=0.21+0.23 \quad (v—0.4)$$

$$\text{kg SS}/1000 \text{ kg LWK}=0.28+0.30 \quad (v—0.4)$$

where

v-kg processed meat products/kg LWK.

(b) The following limitations establish the quantity or quality of pollutants or pollutant properties, controlled by this section and attributable to the processing (defleshing, washing and curing) of hides derived from animals slaughtered at locations other than the packinghouse, which may be discharged by a point source subject to the provisions of this subpart, in addition to the discharge allowed by paragraph (a) of this section:

Effluent characteristic	Effluent limitations: Maximum for any 1 day	Effluent limitations: Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kilograms per 1,000 kg ELWK)	
BOD5	0.04	0.02
TSS	0.08	0.04
	English units (pounds per 1,000 lb ELWK)	
BOD5	0.04	0.02
TSS	0.08	0.04

(c) The following limitations establish the quantity or quality of pollutants or pollutant properties, controlled by this section and attributable to the processing of blood derived from animals slaughtered at locations other than the packinghouse, which may be discharged by a point source subject to the provisions of this subpart, in addition to the discharge allowed by paragraph (a) of this section:

Effluent characteristic	Effluent limitations: Maximum for any 1 day	Effluent limitations: Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kilograms per 1,000 kg ELWK)	
BOD5	0.04	0.02
TSS	0.08	0.04
	English units (pounds per 1,000 lb ELWK)	
BOD5	0.04	0.02
TSS	0.08	0.04

(d) The following limitations establish the quantity or quality of pollutants or pollutant properties, controlled by this section and attributable to the wet or low temperature rendering of material derived from animals slaughtered at locations other than the packinghouse, which may be discharged by a point source subject to the provisions of this subpart, in addition to the discharge allowed by paragraph (a) of this section:

Effluent characteristic	Effluent limitations: Maximum for any 1 day	Effluent limitations: Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kilograms per 1,000 kg ELWK)	
BOD5	0.06	0.03
TSS	0.12	0.06
	English units (pounds per 1,000 lb ELWK)	
BOD5	0.06	0.03
TSS	0.12	0.06

(e) The following limitations establish the quantity or quality of pollutants or pollutant properties, controlled by this section and attributable to the dry rendering of material derived from animals slaughtered at locations other than the packinghouse, which may be discharged by a point source subject to the provisions of this subpart, in addition to the discharge allowed by paragraph (a) of this section:

Effluent characteristic	Effluent limitations: Maximum for any 1 day	Effluent limitations: Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kilograms per 1,000 kg ELWK)	
BOD5	0.02	0.01
TSS	0.04	0.02
	English units (pounds per 1,000 lb ELWK)	
BOD5	0.02	0.01
TSS	0.04	0.02

[39 FR 7897, Feb. 28, 1974, as amended at 60 FR 33965, June 29, 1995]

§ 432.43 [Reserved]

§ 432.44 Pretreatment standards for existing sources.

Any existing source subject to this subpart that introduces process wastewater pollutants into a publicly owned treatment works must comply with 40 CFR part 403. In addition, the following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a point source subject to the provisions of this subpart.

Pollutant or pollutant property	Pretreatment standard
pH	No limitation.
BOD*5*	Do.
TSS	Do.
Oil and grease	Do.
Fecal coliform	Do.

[40 FR 6447, Feb. 11, 1975, as amended at 60 FR 33965, June 29, 1995]

§ 432.45 Standards of performance for new sources.

(a) The following standards of performance establish the quantity or quality of pollutants or pollutant properties, controlled by this section and attributable to on-site slaughter or subsequent meat, meat product or byproduct processing or carcasses of animals slaughtered onsite which may be discharged by a new source subject to the provisions of this subpart: The limitations shall be as specified in § 432.42(a), with the exception that in addition to the pollutants or pollutant properties controlled by that subsection, discharges of ammonia shall not exceed the limitations set forth below:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kilograms per 1,000 kg LWK)	
Ammonia	0.80	0.40
	English units (pounds per 1,000 lb LWK)	
Ammonia	0.80	0.40

(b) The following standards of performance establish the quantity or quality of pollutants or pollutant properties, controlled by this section and attributable to the processing of blood derived from animals slaughtered at locations other than the packinghouse, which may be discharged by a new source subject to the provisions of this subpart, in addition to the discharge allowed by paragraph (a) of this section and § 432.42(c):

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kilograms per 1,000 kg ELWK)	
Ammonia	0.06	0.03
	English units (pounds per 1,000 lb ELWK)	
Ammonia	0.06	0.03

(c) The following standards of performance establish the quantity or quality of pollutants or pollutant properties, controlled by this section and attributable to the wet or low temperature rendering of material derived from animals slaughtered at locations other than the packinghouse, which may be discharged by a new source subject to the provisions of this subpart, in addition to the discharge allowed by paragraph (a) of this section and § 423.42(d):

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kilograms per 1,000 kg ELWK)	
Ammonia	0.10	0.05
	English units (pounds per 1,000 lb ELWK)	
Ammonia	0.10	0.05

(d) The following standards of performance establish the quantity or quality of pollutants or pollutant properties, controlled by this section and attributable to the dry rendering of material derived from animals slaughtered at locations other than the packinghouse, which may be discharged by a new source subject to the provisions of this subpart, in addition to the discharge allowed by paragraph (a) of this section and § 432.42(e):

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kilograms per 1,000 kg ELWK)	
Ammonia	0.04	0.02
	English units (pounds per 1,000 lb ELWK)	
Ammonia	0.04	0.02

[39 FR 7897, Feb. 28, 1974; 39 FR 26423, July 19, 1974]

§ 432.46 Pretreatment standards for new sources.

Any new source subject to this subpart that introduces process wastewater pollutants into a publicly owned treatment works must comply with 40 CFR part 403.

[60 FR 33965, June 29, 1995]

§ 432.47 Effluent limitations guidelines representing the degree of effluent reduction attainable by the application of the best conventional pollutant control technology.

Except as provided in §§ 125.30 through 125.32, any existing point source subject to this subpart shall achieve the following effluent limitations representing the degree of effluent reduction attainable by the application of the best conventional pollutant control technology (BCT): The limitations shall be the same as those specified for conventional pollutants (which are defined in § 401.16) in § 432.42 of this subpart for the best practicable control technology currently available (BPT).

[51 FR 25001, July 9, 1986]

Subpart E—Small Processor Subcategory

SOURCE: 40 FR 905, Jan. 3, 1975, unless otherwise noted.

§ 432.50 Applicability; description of the small processor subcategory.

The provisions of this subpart are applicable to discharges resulting from the production of finished meat products such as fresh meat cuts, smoked products, canned products, hams, sausages, luncheon meats, or similar products by a small processor.

§ 432.51 Specialized definitions.

For the purpose of this subpart:

(a) Except as provided below, the general definitions, abbreviations and methods of analysis set forth in 40 CFR part 401 shall apply to this subpart.

(b) The term ''small processor'' shall mean an operation that produces up to 2730 kg (6000 lb) per day of any type or combination of finished products.

(c) The term ''finished product'' shall mean the final manufactured product as fresh meat cuts, hams, bacon or other smoked meats, sausage, luncheon meats, stew, canned meats or related products.

§ 432.52 Effluent limitations guidelines representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available.

Except as provided in §§ 125.30 through 125.32, any existing point source subject to this subpart shall achieve the following effluent limitations representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available (BPT):

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kg/kkg of finished product)	
BOD_5	2.0	1.0
TSS	2.4	1.2
Oil and grease	1.0	0.5
pH	(1)	(1)
Fecal coliforms	(2)	(2)
	English units (lb/1,000 lb of finished product)	
BOD_5	2.0	1.0
TSS	2.4	1.2
Oil and grease	1.0	0.5
pH	(1)	(1)
Fecal coliforms	(2)	(2)

1 Within the range 6.0 to 9.0.
2 No limitation.

[40 FR 905, Jan. 3, 1975, as amended at 60 FR 33965, June 29, 1995]

§§ 432.53—432.54 [Reserved]

§ 432.55 Standards of performance for new sources.

The following standards of performance establish the quantity or quality of pollutants or pollutant properties, controlled by this section, which may be discharged by a new source subject to the provisions of this subpart:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kg/kkg of finished product)	
BOD5	1.0	0.5
TSS	1.2	0.6
Oil and grease	0.5	0.25
pH	(1)	(1)
Fecal coliforms	(2)	(2)
	English units (lb/1,000 lb of finished product)	
BOD5	1.0	0.5
TSS	1.2	0.6
Oil and grease	0.5	0.25
pH	(1)	(1)
Fecal coliforms	(2)	(2)

[1] Within the range 6.0 to 9.0.
[2] No limitation.

§ 432.56 Pretreatment standards for new sources.

Any new source subject to this subpart that introduces process wastewater pollutants into a publicly owned treatment works must comply with 40 CFR part 403. In addition, the following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a new source subject to the provisions of this subpart:

Pollutant or pollutant property	Pretreatment standard
BOD5	No limitation.
TSS	Do.
Oil and grease	Do.
pH	Do.
Fecal coliform	Do.

[40 FR 905, Jan. 3, 1975, as amended at 60 FR 33965, June 29, 1995]

§ 432.57 Effluent limitations guidelines representing the degree of effluent reduction attainable by the application of the best conventional pollutant control technology.

Except as provided in §§ 125.30 through 125.32, the following limitations establish the quantity or quality of pollutants or pollutant properties, controlled by this section, which may be discharged by a point source subject to the provisions of this subpart after application of the best conventional pollutant control technology:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kg/kkg of finished product)	
BOD5	1.0	0.5
TSS	1.2	0.6
Oil and grease	0.5	0.25
pH	(1)	(1)
Fecal coliforms	(2)	(2)
	English units (lb/1,000 lb of finished product)	
BOD5	1.0	0.5
TSS	1.2	0.6
Oil and grease	0.5	0.25
pH	(1)	(1)
Fecal coliforms	(2)	(2)

[1] Within the range 6.0 to 9.0.
[2] No limitation.

[51 FR 25001, July 9, 1986]

Subpart F—Meat Cutter Subcategory

SOURCE: 40 FR 906, Jan. 3, 1975, unless otherwise noted.

§ 432.60 Applicability; description of the meat cutter subcategory.

The provisions of this subpart are applicable to discharges resulting from the fabrication or manufacture of fresh meat cuts such as steaks, roasts, chops, etc. by a meat cutter.

§ 432.61 Specialized definitions.

For the purpose of this subpart:

(a) Except as provided below, the general definitions, abbreviations and methods of analysis set forth in 40 CFR part 401 shall apply to this subpart.

(b) The term ''meat cutter'' shall mean an operation which fabricates, cuts, or otherwise produces fresh meat cuts and related finished products from livestock carcasses, at rates greater than 2730 kg (6000 lb) per day.

(c) The term ''finished product'' shall mean the final manufactured product as fresh meat cuts including, but not limited to, steaks, roasts, chops, or boneless meats.

§ 432.62 Effluent limitations guidelines representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available.

Except as provided in §§ 125.30 through 125.32, any existing point source subject to this subpart shall achieve the following effluent limitations representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available (BPT):

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kg/kkg of finished product)	
BOD5	0.036	0.018
TSS	0.044	0.022
Oil and grease	0.012	0.000
pH	(1)	(1)
Fecal coliforms	(2)	(2)
	English units (lb/1,000 lb of finished product)	
BOD5	0.036	0.018
TSS	10.044	0.022
Oil and grease	0.012	0.006
pH	(1)	(1)
Fecal coliforms	(2)	(2)

[1] Within the range 6.0 to 9.0.
[2] Maximum at any time 400 mpn/100 ml.

[40 FR 906, Jan. 3, 1975, as amended at 60 FR 33965, June 29, 1995]

§ 432.63 Effluent limitations guidelines representing the degree of effluent reduction attainable by the application of the best available technology economically achievable.

The following limitations establish the quantity or quality of pollutants or pollutant properties, controlled by this section, which may be discharged by a point source subject to the provisions of this subpart after application of the best available technology economically achievable:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
	Milligrams per liter—effluent	
Ammonia	8.0 mg/l	4.0

[44 FR 50748, Aug. 29, 1979]

§ 432.64 [Reserved]

§ 432.65 Standards of performance for new sources.

The following standards of performance establish the quantity or quality of pollutants or pollutant properties, controlled by this section, which may be discharged by a new source subject to the provisions of this subpart:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kg/kkg of finished product)	
BOD5	0.036	0.018
TSS	0.044	0.022
Oil and grease	0.012	0.006
pH	(1)	(1)
Fecal coliforms	(2)	(2)
	English units (lb/1,000 lb of finished product)	
BOD5	0.030	0.015
TSS	0.036	0.018
Oil and grease	0.012	0.006
pH	(1)	(1)
Fecal coliforms	(2)	(2)

[1] Within the range 6.0 to 9.0.
[2] Maximum at any time 400 mpn/100 ml.

§ 432.66 Pretreatment standards for new sources.

Any new source subject to this subpart that introduces process wastewater pollutants into a publicly owned treatment works must comply with 40 CFR part 403. In addition, the following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a new source subject to the provisions of this subpart:

Pollutant or pollutant property	Pretreatment standard
BOD5	No limitation.
TSS	Do.
Oil and grease	Do.
pH	Do.
Fecal coliform	Do.

[40 FR 906, Jan. 3, 1975, as amended at 60 FR 33965, June 29, 1995]

§ 432.67 Effluent limitations guidelines representing the degree of effluent reduction attainable by the application of the best conventional pollutant control technology.

Except as provided in §§ 125.30 through 125.32, any existing point source subject to this subpart shall achieve the following effluent limitations representing the degree of effluent reduction attainable by the application of the best conventional pollutant control technology (BCT): The limitations shall be the same as those specified for conventional pollutants (which are defined in § 401.16) in § 432.62 of this subpart for the best practicable control technology currently available (BPT).

[51 FR 25001, July 9, 1986]

Subpart G—Sausage and Luncheon Meats Processor Subcategory

SOURCE: 40 FR 907, Jan. 3, 1975, unless otherwise noted.

§ 432.70 Applicability; description of the sausage and luncheon meat processor subcategory.

The provisions of this subpart are applicable to discharges resulting from the manufacture of fresh meat cuts, sausage, bologna, and other luncheon meats by a sausage and luncheon meat processor.

§ 432.71 Specialized definitions.

For the purpose of this subpart:

(a) Except as provided below, the general definitions, abbreviations and methods of analysis set forth in 40 CFR part 401 shall apply to this subpart.

(b) The term ''sausage and luncheon meat processor'' shall mean an operation which cuts fresh meats, grinds, mixes, seasons, smokes or otherwise produces finished products such as sausage, bologna and luncheon meats at rates greater than 2730 kg (6000 lb) per day.

(c) The term ''finished product'' shall mean the final manufactured product as fresh meat cuts including steaks, roasts, chops or boneless meat, bacon or other smoked meats (except hams) such as sausage, bologna or other luncheon meats, or related products (except canned meats).

§ 432.72 Effluent limitations guidelines representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available.

Except as provided in §§ 125.30 through 125.32, any existing point source subject to this subpart shall achieve the following effluent limitations representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available (BPT):

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kg/kkg of finished product)	
BOD_5	0.56	0.28
TSS	0.68	0.34
Oil and grease	0.20	0.10
pH	(1)	(1)
Fecal coliforms	(2)	(2)
	English units (lb/1,000 lb of finished product)	
BOD_5	0.56	0.28
TSS	0.68	0.34
Oil and grease	0.20	0.10
pH	(1)	(1)
Fecal coliforms	(2)	(2)

[1] Within the range 6.0 to 9.0.
[2] Maximum at any time 400 mpn/100 ml.

[40 FR 907, Jan. 3, 1975, as amended at 60 FR 33966, June 29, 1995]

§ 432.73 Effluent limitations guidelines representing the degree of effluent reduction attainable by the application of the best available technology economically achievable.

The following limitations establish the quantity or quality of pollutants or pollutant properties, controlled by this section, which may be discharged by a point source subject to the provisions of this subpart after application of the best available technology economically achievable:

[Milligrams per liter—effluent]

Effluent characteristics	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
Ammonia	80 mg/l	4.0

[44 FR 50748, Aug. 29, 1979]

§ 432.74 [Reserved]

§ 432.75 Standards of performance for new sources.

The following standards of performance establish the quantity or quality of pollutants or pollutant properties, controlled by this section, which may be discharged by a new sources subject to the provisions of this subpart:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kg/kkg of finished product)	
BOD5	0.56	0.28
TSS	0.68	0.34
Oil and grease	0.20	0.10
pH	(1)	(1)
Fecal coliforms	(2)	(2)
	English units (lb/1,000 lb of finished product)	
BOD5	0.48	0.24
TSS	0.58	0.29
Oil and grease	0.20	0.10
pH	(1)	(1)
Fecal coliforms	(2)	(2)

[1] Within the range 6.0 to 9.0.
[2] Maximum at any time 400 mpn/100 ml.

§ 432.76 Pretreatment standards for new sources.

Any new source subject to this subpart that introduces process wastewater pollutants into a publicly owned treatment works must comply with 40 CFR part 403. In addition, the following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a new source subject to the provisions of this subpart:

Pollutant or pollutant property	Pretreatment standard
BOD5	No limitation.
TSS	Do.
Oil and grease	Do.
pH	Do.
Fecal coliform	Do.

[40 FR 907, Jan. 3, 1975, as amended at 60 FR 33966, June 29, 1995]

§ 432.77 Effluent limitations guidelines representing the degree of effluent reduction attainable by the application of the best conventional pollutant control technology.

Except as provided in §§ 125.30 through 125.32, any existing point source subject to this subpart shall achieve the following effluent limitations representing the degree of effluent reduction attainable by the application of the best conventional pollutant control technology (BCT): The limitations shall be the same as those specified for conventional pollutants (which are defined in § 401.16) in § 432.72 of this subpart for the best practicable control technology currently available (BPT).

[51 FR 25001, July 9, 1986]

Subpart H—Ham Processor Subcategory

SOURCE: 40 FR 908, Jan. 3, 1975, unless otherwise noted.

§ 432.80 Applicability; description of the ham processor subcategory.

The provisions of this subpart are applicable to discharges resulting from the manufacture of hams alone or in combination with other finished products by a ham processor.

§ 432.81 Specialized definitions.

For the purpose of this subpart:

(a) Except as provided below, the general definitions, abbreviations and methods of analysis set forth in 40 CFR part 401 shall apply to this subpart.

(b) The term ''ham processor'' shall mean an operation which manufactures hams alone or in combination with other finished products at rates greater than 2730 kg (6000 lb) per day.

(c) The term ''finished products'' shall mean the final manufactured product as fresh meat cuts including steaks, roasts, chops or boneless meat, smoked or cured hams, bacon or other smoked meats, sausage, bologna or other luncheon meats (except canned meats).

§ 432.82 Effluent limitations guidelines representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available.

Except as provided in §§ 125.30 through 125.32, any existing point source subject to this subpart shall achieve the following effluent limitations representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available (BPT):

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kg/kkg of finished product)	
BOD5	0.62	0.31
TSS	0.74	0.37
Oil and grease	0.22	0.11
pH	(1)	(1)
Fecal coliform	(2)	(2)
	English units (lb/1,000 lb of finished product)	
BOD5	0.62	0.31
TSS	0.74	0.37
Oil and grease	0.22	0.11
pH	(1)	(1)
Fecal coliform	(2)	(2)

[1] Within the range 6.0 to 9.0.
[2] Maximum at any time 400 mpn/100 ml.

[40 FR 908, Jan. 3, 1975, as amended at 60 FR 33966, June 29, 1995]

§ 432.83 Effluent limitations guidelines representing the degree of effluent reduction attainable by the application of the best available technology economically achievable.

The following limitations establish the quantity or quality of pollutants or pollutant properties, controlled by this section, which may be discharged by a point source subject to the provisions of this subpart after application of the best available technology economically achievable:

[Milligrams per liter—effluent]

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
Ammonia	8.0 mg/l	4.0

[44 FR 50748, Aug. 29, 1979]

§ 432.84 [Reserved]

§ 432.85 Standards of performance for new sources.

The following standards of performance establish the quantity or quality of pollutants or pollutant properties, controlled by this section, which may be discharged by a new source subject to the provisions of this subpart:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kg/kkg of finished product)	
BOD5	0.62	0.31
TSS	0.74	0.37
Oil and grease	0.22	0.11
pH	(1)	(1)
Fecal coliform	(2)	(2)
	English units (lb/1,000 lb of finished product)	
BOD5	0.62	0.31
TSS	0.74	0.37
Oil and grease	0.22	0.11
pH	(1)	(1)
Fecal coliform	(2)	(2)

[1] Within the range 6.0 to 9.0.
[2] Maximum at any time 400 mpn/100 ml.

§ 432.86 Pretreatment standards for new sources.

Any new source subject to this subpart that introduces process wastewater pollutants into a publicly owned treatment works must comply with 40 CFR part 403. In addition, the following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a new source subject to the provisions of this subpart:

Pollutant or pollutant property	Pretreatment standard
BOD5	No limitation.
TSS	Do.
Oil and grease	Do.
pH	Do.
Fecal coliform	Do.

[40 FR 908, Jan. 3, 1975, as amended at 60 FR 33966, June 29, 1995]

§ 432.87 Effluent limitations guidelines representing the degree of effluent reduction attainable by the application of the best conventional pollutant control technology.

Except as provided in §§ 125.30 through 125.32, any existing point source subject to this subpart shall achieve the following effluent limitations representing the degree of effluent reduction attainable by the application of the best conventional pollutant control technology (BCT): The limitations shall be the same as those specified for conventional pollutants (which are defined in § 401.16) in § 432.82 of this subpart for the best practicable control technology currently available (BPT).

[51 FR 25001, July 9, 1986]

Subpart I—Canned Meats Processor Subcategory

SOURCE: 40 FR 909, Jan. 3, 1975, unless otherwise noted.

§ 432.90 Applicability; description of the canned meats processor subcategory.

The provisions of this subpart are applicable to discharges resulting from the manufacture of canned meats alone or in combination with any other finished products, by a canned meats processor.

§ 432.91 Specialized definitions.

For the purpose of this subpart:

(a) Except as provided below, the general definitions, abbreviations and methods of analysis set forth in 40 CFR part 401 shall apply to this subpart.

(b) The term ''canned meat processor'' shall mean an operation which prepares and cans meats (such as stew, sandwich spreads, or similar products) alone or in combination with other finished products at rates greater than 2730 kg (6000 lb.) per day.

(c) The term ''finished products'' shall mean the final manufactured product as fresh meat cuts including steaks, roasts, chops or boneless meat, hams, bacon or other smoked meats, sausage, bologna or other luncheon meats, stews, sandwich spreads or other canned meats.

§ 432.92 Effluent limitations guidelines representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available.

Except as provided in §§ 125.30 through 125.32, any existing point source subject to this subpart shall achieve the following effluent limitations representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available (BPT):

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kg/kkg of finished product)	
BOD5	0.74	0.37
TSS	0.90	0.45
Oil and grease	0.26	0.12
pH	(1)	(1)
Fecal coliform	(2)	(2)
	English units (lb/1,000 lb of finished product)	
BOD5	0.74	0.37
TSS	0.90	0.45
Oil and grease	0.26	0.13
pH	(1)	(1)
Fecal coliform	(2)	(2)

[1] Within the range 6.0 to 9.0.
[2] Maximum at any time 400 mpn/100 ml.

[40 FR 909, Jan. 3, 1975, as amended at 60 FR 33966, June 29, 1995]

§ 432.93 Effluent limitations guidelines representing the degree of effluent reduction attainable by the application of the best available technology economically achievable.

The following limitations establish the quantity or quality of pollutants or pollutant properties, controlled by this section, which may be discharged by a point source subject to the provisions of this subpart after application of the best available technology economically achievable:

[Milligrams per liter—effluent]

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
Ammonia	8.0 mg/l	4.0

[44 FR 50748, Aug. 29, 1979]

§ 432.94 [Reserved]

§ 432.95 Standards of performance for new sources.

The following standards of performance establish the quantity or quality of pollutants or pollutant properties, controlled by this section, which may be discharged by a new source subject to the provisions of this subpart:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kg/kkg of finished product)	
BOD5	0.74	0.37
TSS	0.90	0.45
Oil and grease	0.26	0.13
pH	(1)	(1)
Fecal coliform	(2)	(2)
	English units (lb/1,000 lb of finished product)	
BOD5	0.74	0.37
TSS	0.90	0.45
Oil and grease	0.26	0.13
pH	(1)	(1)
Fecal coliform	(2)	(2)

1 Within the range 6.0 to 9.0.

2 Maximum at any time 400 mpn/100 ml.

§ 432.96 Pretreatment standards for new sources.

Any new source subject to this subpart that introduces process wastewater pollutants into a publicly owned treatment works must comply with 40 CFR part 403. In addition, the following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a new source subject to the provisions of this subpart:

Pollutant or pollutant property	Pretreatment standard
BOD5	No limitation.
TSS	Do.
Oil and grease	Do.
pH	Do.
Fecal coliform	Do.

[40 FR 909, Jan. 3, 1975, as amended at 60 FR 33966, June 29, 1995]

§ 432.97 Effluent limitations guidelines representing the degree of effluent reduction attainable by the application of the best conventional pollutant control technology.

Except as provided in §§ 125.30 through 125.32, any existing point source subject to this subpart shall achieve the following effluent limitations representing the degree of effluent reduction attainable by the application of the best conventional pollutant control technology (BCT): The limitations shall be the same as those specified for conventional pollutants (which are defined in § 401.16) in § 432.92 of this subpart for the best practicable control technology currently available (BPT).

[51 FR 25001, July 9, 1986]

Subpart J—Renderer Subcategory

SOURCE: 40 FR 910, Jan. 3, 1975, unless otherwise noted.

§ 432.100 Applicability; description of the renderer subcategory.

The provisions of this subpart are applicable to discharges resulting from the manufacture of meat meal, dried animal by-product residues (tankage), animal oils, grease and tallow, perhaps including hide curing, by a renderer.

§ 432.101 Specialized definitions.

For the purpose of this subpart:

(a) Except as provided below, the general definitions, abbreviations and methods of analysis set forth in 40 CFR part 401 shall apply to this subpart.

(b) The term ''renderer'' shall mean an independent or off-site rendering operation, conducted separate from a slaughterhouse, packinghouse or poultry dressing or processing plant, which manufactures at rates greater than 75,000 pounds of raw material per day of meat meal, tankage, animal fats or oils, grease, and tallow, and may cure cattle hides, but excluding marine oils, fish meal, and fish oils.

(c) The term ''tankage'' shall mean dried animal by-product residues used in feedstuffs.

(d) The term ''tallow'' shall mean a product made from beef cattle or sheep fat that has a melting point of 40°C or greater.

(e) The term ''raw material'' or as abbreviated herein, ''RM'', shall mean the basic input materials to a renderer composed of animal and poultry trimmings, bones, meat scraps, dead animals, feathers and related usable by-products.

§ 432.102 Effluent limitations guidelines representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available.

(a) Except as provided in §§ 125.30 through 125.32, and subject to the provisions of paragraph (b) of this section, any existing point source subject to this subpart shall achieve the following effluent limitations representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available (BPT):

Effluent characteristic	Effluent limitations: Maximum for any 1 day	Effluent limitations: Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kg/kkg of raw material)	
BOD*5*	0.34	0.17
TSS	0.42	0.21
Oil and grease	0.20	0.10
pH	(1)	(1)
Fecal coliform	(2)	(2)
	English units (lb/1,000 lb of raw material)	
BOD*5*	0.34	0.17
TSS	0.42	0.21
Oil and grease	0.20	0.10
pH	(1)	(1)
Fecal coliform	(2)	(2)

[1] Within the range 6.0 to 9.0.
[2] Maximum at any time 400 mpn/100 ml.

(b) The limitations given in paragraph (a) of this section for BOD*5* and TSS are derived for a renderer which does no cattle hide curing as part of the plant activities. If a renderer does conduct hide curing, the following empirical formulas should be used to derive an additive adjustment to the effluent limitations for BOD*5* and TSS.

BOD*5* Adjustment (kg/kkg RM)=[8.0×(number of hides)/kg of raw material]
(lb/1,000 lb RM)=[17.6×(number of hides)/lbs of raw material]
TSS Adjustment (kg/kkg RM)=[11.0×(number of hides)/kg of raw material]
(lb/1,000 lb RM)=[24.2×(number of hides)/lbs of raw material]

[40 FR 910, Jan. 3, 1975; 40 FR 11874, Mar. 14, 1975, as amended at 60 FR 33966, June 29, 1995]

§ 432.103 Effluent limitations guidelines representing the degree of effluent reduction attainable by the application of the best available technology economically achievable.

The following limitations establish the quantity or quality of pollutants or pollutant properties, controlled by this section, which may be discharged by a point source subject to the provisions of this subpart after application of the best available technology economically achievable:

Effluent characteristic	Effluent limitations: Maximum for any 1 day	Effluent limitations: Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kg/kkg of raw material)	
Ammonia	0.14	0.07
	English units (lb/1,000 lb of raw material)	
Ammonia	0.14	0.07

[44 FR 50748, Aug. 29, 1979]

§ 432.104 [Reserved]

§ 432.105 Standards of performance for new sources.

(a) Subject to the provisions of paragraph (b) of this section, the following standards of performance establish the quantity or quality of pollutants or pollutant properties, controlled by this section, which may be discharged by a new source subject to the provisions of this subpart:

Effluent characteristics	Effluent limitations: Maximum for any 1 day	Effluent limitations: Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kilograms per 1,000 kg of raw material)	
BOD*5*	0.18	0.09
TSS	.22	.11
Oil and grease	.10	.05
Ammonia	.14	.07
pH	(1)	(1)
Fecal coliforms	(2)	(2)
	English units (pounds per 1,000 lb of raw material)	
BOD*5*	0.18	0.09
TSS	.22	.11
Oil and grease	.10	.05
Ammonia	.14	.07
pH	(1)	(1)
Fecal coliforms	(2)	(2)

[1] Within the range 6.0 to 9.0.
[2] Maximum at any time 400 mpn/100 ml.

(b) The standards given in paragraph (a) of this section for BOD*5* and TSS are derived for a renderer which does no cattle hide curing as part of the plant activities. If a renderer does conduct hide curing, the following empirical formulas should be used to derive an additive adjustment to the standards for BOD*5* and TSS.

BOD*5* adjustment (kilograms per 1,000 kg of raw material)=
8.0×(number of hides)/kilograms of raw material
(pounds per 1,000 lb of raw material)=
17.6×(number of hides)/pounds of raw material
TSS adjustment (kilograms per 1,000 kg of raw material)=
11.0×(number of hides)/kilograms of raw material
(pounds per 1,000 lb of raw material)=
24.2×(number of hides)/pounds of raw material

[42 FR 54419, Oct. 6, 1977]

§ 432.106 Pretreatment standards for new sources.

Any new source subject to this subpart that introduces process wastewater pollutants into a publicly owned treatment works must comply with 40 CFR part 403. In addition, the following pretreatment standard establishes the quantity or quality of pollutants or pollutant properties controlled by this section which may be discharged to a publicly owned treatment works by a new source subject to the provisions of this subpart:

Pollutant or pollutant property	Pretreatment standard
BOD*5*	No limitation.
TSS	Do.
Oil and grease	Do.
pH	Do.
Fecal coliform	Do.

[40 FR 910, Jan. 3, 1975, as amended at 60 FR 33966, June 29, 1995]

§ 432.107 Effluent limitations guidelines representing the degree of effluent reduction attainable by the application of the best conventional pollution control technology.

(a) Except as provided in §§ 125.30 through 125.32, and subject to the provisions of paragraph (b) of this section, the following limitations establish the quantity or quality of pollutants or pollutant properties, controlled by this section, which may be discharged by a point source subject to the provisions of this subpart after application of the best conventional pollutant control technology:

Effluent characteristic	Effluent limitations	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
	Metric units (kg/kkg of raw material)	
BOD*5*	0.18	0.09
TSS	0.22	0.11
Oil and grease	0.10	0.05
Fecal coliforms	(1)	(1)
pH	(2)	(2)
	English units (lb/1,000 lb. of raw material)	
BOD*5*	0.18	0.09
TSS	0.22	0.11
Oil and grease	0.10	0.05
Fecal coliforms	(1)	(1)
pH	(2)	(2)

[1] Maximum at any time: 400 mpn/100 ml.
[2] Within the range 6.0 to 9.0.

(b) The limitations given in paragraph (a) of this section for BOD*5* and TSS are derived for a renderer which does no cattle hide curing as part of the plant activities. If a renderer does conduct hide curing, the following empirical formulas should be used to derive an additive adjustment to the effluent limitations for BOD*5* and TSS.

BOD*5* Adjustment (kg/kkg RM)=3.6×(number of hides)/kg of raw material
(lb/1,000 lb RM)=7.9×(number of hides)/lbs of raw material
TSS Adjustment (kg/kkg RM)=6.2×(number of hides)/kg of raw material
(lb/1,000 lb RM)=13.6×(number of hides)/lbs of raw material

[51 FR 25001, July 9, 1986]

APPENDIX J

EXAMPLES OF CALCULATING MPP LIMITATIONS AND STANDARDS

Example 1: Determine the maximum monthly BPT BOD_5 limit for a complex slaughterhouse that operates 280 days per year and slaughters on average 700 cattle (1,000 lb/head) and 1,000 hogs (225 lb/head) on-site per day.

Solution 1: First calculate the amount of live weight killed (LWK) on-site.

On-site LWK = (700 cattle/day) x (1,000 lb/head) + (1,000 hogs/day) x (225 lb/head)
= 925,000 lb-LWK/day
= (925,000 lb-LWK/day) x (280 days/year) = 259 million lb-LWK/year

This facility is a complex slaughterhouse (Subpart B) and is subject to 432.22(b)(1) (i.e., facility slaughters on-site more than 50 million lb-LWK per year) which is set equivalent to 432.22(a)(1) for BOD_5, TSS, O&G, and fecal coliform bacteria.

The facility does not taken any material from an outside source so there is no adjustments to the maximum monthly BPT BOD_5 limit [0.21 kg-BOD_5/kkg-LWK (or lb-BOD_5/1,000 lb-LWK)]. This monthly BPT BOD_5 limit is taken from 432.22(b)(1), which is equivalent to 432.22(a)(1) for BOD_5, TSS, O&G and fecal coliform bacteria.

Example 2: Determine the maximum monthly BAT ammonia (as N) limit for a sausage processor that operates 280 days per year and produces 200,000 pounds of finished product (on average per day).

Solution 2: First calculate the annual amount of finished product (FP).

Annual FP = (200,000 lb-FP/day) x (280 days/year) = 56 million lb-FP/year

This facility is a sausage processor (Subpart G) and is subject to 432.73(b) (i.e., the facility generates more than 50 million lb-FP per year). The maximum monthly average limit for ammonia (as N) is 0.0153 kg-ammonia-N/kkg-FP (or lb-ammonia-N/1,000 lb-FP). [Note: The units for 432.63(b) and 432.73(b) were incorrectly given as “mg/L (ppm)”. These units should read “Pounds per 1,000 lbs (or g/kg) of finished product.”]

Example 3: What are the maximum monthly average BOD_5 and TSS BPT mass-based limits for a High-Processing Packinghouse which slaughters 100 million LWK pounds per year and that has an average processed meat products (lb) to average LWK (lb) ratio (v) of 0.65.

Solution 3: This facility is a high-processing packinghouse (Subpart D) and is subject to 432.42(b)(1) (i.e., facility slaughters more than 50 million lb-LWK per year) which is set equivalent to 432.42(a)(1) for BOD_5, TSS, O&G, and fecal coliform. Therefore, use the 432.42(a)(1) adjustment equation as follows:

$v = 0.65$

$$\text{lb-BOD}_5 / 1{,}000 \text{ lb-LWK} = 0.21 + 0.23 (v - 0.4) = 0.21 + 0.23 (0.65 - 0.4) = 0.2675$$
$$\sim 0.27 \text{ lb-BOD}_5 / 1{,}000 \text{ lb-LWK}$$

$$\text{lb-TSS}/ 1{,}000 \text{ lb-LWK} = 0.28 + 0.30 (v - 0.4) = 0.28 + 0.30 (0.65 - 0.4) = 0.355$$
$$\sim 0.36 \text{ lb-TSS}/ 1{,}000 \text{ lb-LWK}$$

Note: The maximum daily BOD_5 and TSS BPT limits are twice the maximum monthly average BOD_5 and TSS BPT limits.

Example 4: What are the maximum monthly average BOD_5 and TSS BPT limits for an independent rendering facility which handles 206,000 lb of raw material (RM) per day, operates 280 days per year, and also cures 100 hides.

Solution 4: This facility is a independent renderer (Subpart J) and is subject to 432.102 (i.e., facility uses raw material at rates greater than 10 million pounds per year, see 432.101(b)). As this facility also cures hides, use the incremental adjustment equations provided in 432.102(2) as follows:

Adjusted BPT Max. Monthly Limits = 432.102(a) BPT Max. Monthly Limits + 432.102(2) Incremental Hide Curing BPT Adjustments

432.102(a) BPT BOD_5 Max. Monthly Limit = 0.17 1b-BOD_5/1,000 lb-RM

432.102(a) BPT TSS Max. Monthly Limit = 0.21 1b-TSS/1,000 lb-RM

BOD_5 Incremental Hide Curing Adjustment = [17.6 x (No. of Hides)]/lb-RM
= [17.6 x 100]/206,000
= 0.0085 1b-BOD_5./1,000 lb-RM

TSS Incremental Hide Curing Adjustment = [24.2 x (No. of Hides)]/lb-RM
= [24.2 x 100]/206,000
= 0.012 1b-TSS/1,000 lb-RM

Adjusted BOD_5 BPT Max. Monthly Limit = (0.17 1b-BOD_5/1,000 lb-RM) + (0.0085 1b-BOD_5/1,000 lb-RM)
= 0.1785 1b-BOD_5/1,000 lb-RM

Adjusted TSS BPT Max. Monthly Limit = (0.21 1b-TSS/1,000 lb-RM) + (0.012 1b-TSS/1,000 lb-RM)
= 0.222 1b-TSS/1,000 lb-RM

Note: The maximum daily BOD_5 and TSS BPT limits are twice the maximum monthly average BOD_5 and TSS BPT limits.

Example 5: Determine the maximum monthly average BPT BOD_5 limit for a complex slaughterhouse that also performs hide, blood, and dry rendering. The complex slaughterhouse operates 280 days per year, slaughters on-site (on average per day) 700 cattle (1,000 lb/head) and 1,000 hogs (225 lb/head) and also processes (on average per day) 300 hides, 10,000 gallons of blood, and 200,000 lb of raw by-products (offal and bone) for dry rendering from an off-site source.

Solution 5: This facility is a complex slaughterhouse (Subpart B) and is subject to 432.22(b)(1) (i.e., the facility slaughters on-site more than 50 million lb-LWK per year) which is set equivalent to 432.22(a)(1) for BOD_5, TSS, O&G, and fecal coliform bacteria.

Because this facility also cures hides and dry renders blood and offal and bone, use the incremental adjustments provided in 432.22(b), which are set to be equivalent to the incremental adjustments provided in 432.12(a). The incremental BPT BOD_5 and TSS adjustments for Subparts A, B, C, and D are calculated using the following table.

Table EX-5. MPP BOD_5 and TSS Adjustment Factors for BPT Limits

	Daily Max BPT, kg/kkg-ELWK[b]		Monthly Max BPT, kg/kkg-ELWK[b]		
Processing	**BOD_5**	**TSS**	**BOD_5**	**TSS**	**Notes**
Hide	0.04	0.08	0.02	0.04	a
Blood	0.04	0.08	0.02	0.04	a
Wet Rendering	0.06	0.12	0.03	0.06	a
Dry Rendering	0.02	0.04	0.01	0.02	a

Source: 432.12(a)

[a] These BOD_5 and TSS BPT adjustment factors are for Subparts A, B, C, and D. They are used according to the following relationships:

Adjusted Effluent Limit = On-site Kill Effluent Limit + Incremental Adjustment to On-site Kill Limit

where:

Incremental Adjustment to On-site Kill Limit = (Adjustment Factor from Table EX-5) x (Total weight of source animals as kkg-ELWK) / (On-site kkg-LWK)

[b] If the weight of the off-site source animals (i.e., equivalent live weight killed (ELWK)) which generated the materials for blood processing, rendering, or hide processing is not known, estimate the ELWK by the use of the

following relationships (Source: U.S. EPA, Red Meat Development Document, EPA-440/1-74-012-a, February, 1974, page 140):

For Blood:

Equivalent live weight killed (ELWK) in kkg = (liters of blood) x (0.028) or (gal of blood) x (0.108)

Equivalent live weight killed (ELWK) in kkg = (kg of blood) x (0.029) or (lb of blood) x (0.013)

For Rendering Material:

Equivalent live weight killed (ELWK) in kkg = (kg of rendering materials) x (0.0067) or (lb of rendering materials) x (0.003)

For Cattle Hides:

Equivalent live weight killed (ELWK) in kkg = (No. of hides) x (0.45)

Use the given values and the adjustment factors and relationships to calculate the required BPT limits.

On-site LWK = (700 cattle/day) x (1,000 lb/head) + (1,000 hogs/day) x (225 lb/head)
= 925,000 lb-LWK/day
= 419,573 kg-LWK/day = 419.6 kkg-LWK/day

$ELWK_{blood}$ = (10,000 gal) x (0.108) = 1,080 kkg-ELWK

$ELWK_{rendering}$ = (200,000 lb) x (0.003) = 600 kkg-ELWK

$ELWK_{hides}$ = (300 hides) x (0.45) = 135 kkg-ELWK

BOD_5 Incremental Adjustment for Blood Processing (BOD_5 IA_{blood}) = (0.02 kg-BOD_5/kkg-ELWK) x (1,080 kkg-ELWK/419.6 kkg-LWK)
= 0.051 kg-BOD_5/kkg-LWK

BOD_5 IA_{hides} = (0.02 kg-BOD_5/kkg-ELWK) x (135 kkg-ELWK/419.6 kkg-LWK)
= 0.006 kg-BOD_5/kkg-LWK

$BOD_5\ IA_{rendering}$ = (0.01 kg-BOD_5/kkg-ELWK) x (600 kkg-ELWK/419.6 kkg-LWK)
= 0.014 kg-BOD_5/kkg-LWK

$\sum BOD_5\ IA$ = $BOD_5\ IA_{blood}$ + $BOD_5\ IA_{hides}$ + $BOD_5\ IA_{rendering}$
= 0.051 + 0.006 + 0.014
= 0.071 kg-BOD_5/kkg-LWK (or lb-BOD_5/1,000 lb-LWK)

On-site Kill Effluent Limit for BOD_5 = 0.21 [Taken from 432.22(b)(1) which is equivalent to 432.22(a)(1) for BOD_5, TSS, O&G and fecal coliform bateria.]

Adjusted BOD_5 Effluent Limit = 0.21 + 0.071
= 0.281 kg-BOD_5/kkg-LWK (or lb-BOD_5/1,000 lb-LWK)

Example 6: Determine the maximum monthly average BAT ammonia (as N) limit for a high-processing packinghouse that operates 280 days per year, slaughters on-site (on average per day) 700 cattle (1,000 lb/head) and 1,000 hogs (225 lb/head), produces (on average per day) 200,000 pounds of final fresh products resulting from the further processing of meat carcasses, and renders (on average per day) 370,000 pounds of raw material.

Solution 6: First calculate the amount of live weight killed (LWK) on-site.

On-site LWK = (700 cattle/day) x (1,000 lb/head) + (1,000 hogs/day) x (225 lb/head)
= 925,000 lb-LWK/day
= (925,000 lb-LWK/day) x (280 days/year) = 259 million LWK pounds/year

This facility is a high-processing packinghouse (Subpart D) and is subject to 432.43 (i.e., the facility slaughters on-site more than 50 million lb-LWK per year). The 432.43 BAT limits are set to be equivalent to the 432.13 BAT limits. The incremental BAT adjustments for Subparts A, B, C, and D are calculated using the following table.

Table EX-6. MPP Adjustment Factors for BAT Limits

Regulated Parameter	Daily Max BAT		Monthly Max BAT		Notes
	Further Processing kg/kkg-FP	Rendering kg/kkg-RM	Further Processing kg/kkg-FP	Rendering kg/kkg-RM	
Ammonia (as N)	0.0704	0.0438	0.0153	0.0096	a
Total Nitrogen	0.0965	0.0601	0.0396	0.0247	a
Total Phosphorus	0.0917	0.0472	0.0439	0.0226	a

Source: 432.13

[a]These BAT adjustment factors are for Subparts A, B, C, and D are used according to the following relationships:

Adjusted Effluent Limit = On-site Kill Effluent Limit + Incremental Adjustment to On-site Kill Limit

where:

$$\text{Incremental Adjustment to On-site Kill Limit} = \text{(Adjustment Factor from Table EX-6)} \times \frac{\text{(Further Proc. Products or Rendering RM in kkg)}}{\text{(On-site kkg-LWK)}}$$

On-site LWK = (700 cattle/day) x (1,000 lb/head) + (1,000 hogs/day) x (225 lb/head)
= 925,000 lb-LWK/day
= 419,573 kg-LWK/day = 419.6 kkg-LWK/day

Further Processing Products = 200,000 lb-FP/day

= 90.7 kkg-FP/day

Rendering Raw Material = 370,000 lb-RM/day

= 167.8 kkg-RM/day

Ammonia-N Incremental Adjustment for Further Processing (NH_3-N IA_{FP}) = (0.0153 kg-NH_3-N/kkg-FP) x (90.7 kkg-FP/419.6 kkg-LWK)

= 0.003 kg-NH_3-N/kkg-LWK

NH_3-N IA_{RM} = (0.0096 kg-NH_3-N/kkg-RM) x (167.8 kkg-RM/419.6 kkg-LWK)

= 0.004 kg-NH_3-N/kkg-LWK

$\sum NH_3$-N IA = NH_3-N IA_{FP} + NH_3-N IA_{RM}

= 0.003 + 0.004

= 0.007 kg-NH_3-N/kkg-LWK (or lb-NH_3-N/1000 lb-LWK)

On-site Kill Effluent Limit = 0.0143 kg-NH_3-N/kkg-LWK

[Taken from 432.43, which is equivalent to 432.13.]

Adjusted NH_3-N Effluent Limit = 0.0143 + 0.007

= 0.0213 kg-NH_3-N/kkg-LWK (or lb-NH_3-N/1000 lb-LWK)

Example 7: Determine the maximum monthly average BAT ammonia (as N) limit for a poultry first processor that operates 280 days per year, slaughters on-site (on average per day) 100,000 chickens (5.5 lb/head), produces (on average per day) 300,000 pounds of final fresh products resulting from the further processing of poultry carcasses, and renders (on average per day) 220,000 pounds of raw material.

Solution 7: First calculate the amount of Live Weight Killed (LWK) on-site.

On-site LWK = (100,000 chicken/day) x (5.5 lb/head) = 550,000 lb-LWK/day

= (550,000 lb-LWK/day) x (280 days/year) = 154 million LWK pounds/year

This facility is a poultry first processor (Subpart K) and is subject to 432.113. The 432.113 BAT limits are set equivalent to the 432.112 BPT limits. The applicable BAT limits for this facility are found in 432.112(b), because this facility slaughters on-site more than 10 million lb-LWK per year. The incremental BAT adjustments are calculated using the following table.

Table EX-7: MPP Adjustment Factors for BAT Limits

Regulated Parameter	Daily Max BAT		Monthly Max BAT		Notes
	Further Processing kg/kkg-FP	Rendering kg/kkg-RM	Further Processing kg/kkg-FP	Rendering kg/kkg-RM	
Ammonia (as N)	0.0400	0.0771	0.0087	0.0168	a
Total Nitrogen	0.0548	0.0601	0.0226	0.0247	a
Total Phosphorus	0.0431	0.0472	0.0206	0.0226	a

Source: 432.112

[a] These BAT adjustment factors are used according to the following relationships:

Adjusted Effluent Limit = On-site Kill Effluent Limit + Incremental Adjustment to On-site Kill Limit

where:

$$\text{Incremental Adjustment to On-site Kill Limit} = (\text{Adjustment Factor from Table EX-7}) \times \frac{\text{(Further Proc. Products or Rendering RM in kkg)}}{\text{(On-site kkg-LWK)}}$$

On-site LWK = 550,000 lb-LWK/day

= 249,476 kg-LWK/day = 249.5 kkg-LWK/day

Further Processing Products = 300,000 lb-FP/day

= 136.1 kkg-FP/day

Rendering Raw Material = 220,000 lb-RM/day

= 99.8 kkg-RM/day

Ammonia-N Incremental Adjustment for Further Processing (NH_3-N IA_{FP}) = (0.0087 kg-NH_3-N/kkg-FP) x (136.1 kkg-FP/249.5 kkg-LWK)

= 0.005 kg-NH_3-N/kkg-LWK

NH_3-N IA_{RM} = (0.0168 kg-NH_3-N/kkg-RM) x (99.8 kkg-RM/249.5 kkg-LWK)

= 0.007 kg-NH_3-N/kkg-LWK

$\sum NH_3$-N IA = NH_3-N IA_{FP} + NH_3-N IA_{RM}

= 0.005 + 0.007

= 0.012 kg-NH_3-N/kkg-LWK (or lb-NH_3-N/1000 lb-LWK)

On-site Kill Effluent Limit = 0.0356 kg-NH_3-N/kkg-LWK
[Taken from 432.113 which is equivalent to 432.112(b)(1) as this facility slaughters on-site more than 10 million lb-LWK per year]

Adjusted NH_3-N Effluent Limit = 0.0356 + 0.012

= 0.0476 kg-NH_3-N/kkg-LWK (or lb-NH_3-N/1000 lb-LWK)