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Environmental Assessment of Proposed Effluent Limitations Guidelines and Standards for the Meat and Poultry Products Industry Point Source

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Environmental Assessment

of Proposed Effluent Limitations Guidelines

and Standards for the

Meat and Poultry Products

Industry Point Source

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EXECUTIVE SUMMARY

Purpose of the Water Quality Environmental Assessment (WQEA)

The purpose of the Water Quality Environmental Assessment (WQEA) is to estimate the change in water quality conditions resulting from implementing an effluent guideline and pretreatment standards for a given industry. This assessment performed by the U.S. Environmental Protection Agency (EPA) as part of its effort to develop effluent limitations guidelines and pretreatment standards for Meat and Poultry Processing Industry (MPP) facilities.

Definition of MPP

EPA defines the meat and poultry products (MPP) industry as 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. The industry is often divided into three categories: (1) meat slaughtering and processing; (2) poultry slaughtering and processing; and (3) rendering.

Water Quality Issues Related to MPP

The meat poultry processing industry (excluding rendering) uses an estimated 150 billion gallons of water per year and ranks in the top third of all three digit SIC manufacturing sectors with regard to overall water consumption. Water is used to clean the product, clean and sanitize the production equipment, and to transport the waste away from the production area. Water can also be used as a part of the process, such as in scalding birds to facilitate feather removal or chilling the animal or meat to reduce its temperature. Although a portion of the water used by this industry is reused and or recycled, most of the water becomes wastewater that is ultimately discharged into the nation's waterways, either directly by the facility or indirectly through a Publically Owned Treatment Works (POTW).

Potential Environmental Impacts of MPP

The untreated wastewater of MPP facilities contains high concentrations of biodegradable

dissolved organics, biochemical oxygen demand (BOD), total suspended solids (TSS), oil and grease, pathogens, and nutrients such as nitrogen (including ammonia) and phosphorus. EPA's sampling data collected from MPP facilities also found treatable concentrations of some metals (e.g., copper and zinc). Some of these metals are fed to the animals as feed additives, and therefore are assumed to be the source for these pollutants in the wastewater.

The discharge of high levels of biodegradable organics into receiving streams results in increased microbial activity, as the microorganisms biodegrade these materials. Increases in microbial activity associated with excessive nutrient loadings requires greater amounts of oxygen than natural aeration processes can provide resulting in the decrease of available dissolved oxygen (DO) for more complex aquatic organisms. This potential of a pollutant to remove oxygen from receiving waters is called the biochemical oxygen demand (BOD). High concentrations of BOD can reduce the DO content of waterbodies to levels insufficient to support fish and invertebrates.

Habitat degradation can result from increased suspended particulate matter. Suspended particulate matter reduces light penetration, and thus primary productivity. Accumulation of suspended particles may also alter benthic spawning grounds and feeding habitats.

Nutrients, including phosphorus and nitrogen, are the primary causes of surface water eutrophication, which can reduce dissolved oxygen content of waterbodies to levels insufficient to support fish and invertebrates. Eutrophication may also increase the incidence of harmful algal blooms that release toxins as they die and can severely affect wildlife, as well as humans. Additionally, meat and poultry processing raw wastewaters contain significant amounts of organic nitrogen which rapidly breaks down into ammonia. If left untreated, this poses a direct toxicant to aquatic communities.

Oil and grease are known to produce toxic effects on aquatic organisms (e.g., fish, crustacea, larvae and eggs, gastropods, bivalves, invertebrates, and flora). Pathogens are known

to impact a variety of water uses including recreation, drinking water sources, and aquatic life and fisheries (Docket No. W-01-06, Record No. 10024 - Pathogen TMDL report).

Treatment Options Modeled

EPA modeled four treatment options (see Table ES-1) for this analysis. Three of the treatment options are for facilities which discharge directly to a water body. These facilities will be referred to as direct dischargers. EPA designates the treatment options for existing direct dischargers as Best Available Technology (BAT). One of the treatment options is for facilities which discharge indirectly to a water body through a Publicly Owned Treatment Work (POTW). These facilities will be referred to as indirect discharges. EPA designates the treatment options for existing indirect dischargers as Pretreatment Standards for Existing Sources (PSES).

Table ES-1: Regulatory Treatment Options

Regulatory Option ¹	Technical Component
BAT2	Dissolved Air Flotation (DAF) (advanced oil/water separation), Lagoon, and Disinfection (Oil and Grease, BOD ₅ , TSS, Pathogen removal) + Nitrification (NH ₃ removal)
BAT3	BAT2 + Denitrification (Nitrate removal)
BAT4	BAT3 + (Phosphorus removal)
PSES1	DAF, Equalization (Oil and Grease, TSS, removal) phosphorus removal

¹ BAT = Best Available Treatment PSES = Pretreatment Standards for Existing Sources

Facilities modeled

EPA had sufficient data to model 97 out of the 977 meat, poultry, and rendering facilities that are in scope of the regulatory options evaluated for this proposed rule. To prepare for the WQEA and a separate economic analysis, EPA mailed out 350 detailed surveys to generate both environmental and economic data. EPA received 230 detailed surveys in time for data analysis of this proposed rule making. Of the 230 detailed surveys, EPA received sufficient data to model

the environmental impacts of 97 facilities (36 direct dischargers and 61 indirect dischargers). EPA did not evaluate 79 facilities with zero discharges or 54 facilities for which EPA had insufficient data to conduct the water quality analysis.

Modeling Tools

EPA used the following tools for the WQEA:

- National Water Pollution Control Assessment Model (NWPCAM), version 1.1
- A modified Vaughn water quality ladder

EPA used NWPCAM was used to model the in-stream dissolved oxygen (DO) concentration, as influenced by pollutant reductions of BOD, total Kjeldahl nitrogen (TKN), total suspended solids (TSS) and fecal coliform bacteria (FCB). A detailed description of the NWPCAM is presented in Section 2.0 Methodology. EPA used a modified Vaughn water quality ladder to associate water quality and designated uses (Vaughn, unpublished). NWPCAM 1.1 compares the concentrations of BOD, TSS, FCB, and percent DO saturation (DO_{pct}) to benchmark values associated with swimming, fishing, and boating uses (see Table ES-2).

Table ES-2: Water Quality Criteria By Use

USE Supported	Water Quality Index (WQI) Criteria	BOD ₅	TSS	DO _{pct}	FCB
Swimming	99	1.5	10	83	200
Fishing	94.4	3	50	64	1000
Boating	79	4	100	45	2000

Note: BOD₅ = 5 day Biochemical Oxygen Demand (mg/L)
TSS = Total Suspended Solids (JTU)
DO_{pct} = percent of DO Saturation
FCB = Fecal Coliform Bacteria(MPN/100ml)

Swimming is associated with the most stringent water quality criteria, and boating is associated with the least stringent water quality criteria. For BOD, TSS, and FCB, the in-stream concentration must be below the benchmark value to attain a given use. For DO_{PCT} , the in-stream value must be greater than the benchmark value to meet criteria for that use. If even one parameter does not meet its benchmark value, the stream is not considered to support that use. If the stream reach does not attain any of the three uses, it is designated as "not supporting."

This approach is somewhat problematic since water quality improvements are considered to not occur unless movements result in migrating from one use category to another, e.g., fishing to swimming. The implication of this is that the baseline condition for a given stream reach must be just below the break point between categories so an improvement will result in the water quality conditions moving beyond the breakpoint. Furthermore, this also implies that no within use category movements have any value associated with them..

As an alternative to the stepwise ladder approach, EPA evaluated all water quality changes. To accomplish this a continuous Water Quality Index (WQI) was constructed. The WQI combines information from four water quality measures rather than using only the limiting lowest quality criterion to define use category. For this benefit valuation, NWPCAM compiled a WQI from turbidity, BOD, fecal coliforms, and dissolved oxygen indexes based on work by McClelland (1974). Since the baseline distribution of use categories is well understood and generally accepted, it is desirable for the distribution based on WQI to match the existing distribution of use categories in the baseline. EPA derived WQI values to represent the breakpoints on the water quality ladder based on empirical observation of the WQI distribution among use categories in the baseline data. EPA calculated the mean and standard deviation of WQIs for the reaches in each use category in the baseline population of reaches. If reaches are normally distributed within each use category, 84 percent of observed WQI for each category should be less than the mean WQI plus one standard deviation (SD). The Mean + SD value serves as the criterion for the boundary with the next higher use category. Table ES-3 shows the calculation and the resulting criteria.

Table ES-3: Empirical Calculation of Criteria from the Baseline Scenario

Use Category	Mean (WQI)	Standard Deviation (WQI)	Criterion (Mean + SD) (WQI)
No Use, 0	54.1	24.8	79.0
Boatable, 1	84.9	9.5	94.4
Fishable, 2	92.5	6.5	99.0
Swimmable, 3	98.5	2.3	

Source: EPA analysis of Baseline Access database, 10/2/2001

Water Quality Environmental Assessment Results

EPA modeled the combined baseline loading of 49.9 million lb/yr for sample set of 97 MPP facilities. The baseline loadings consist of the following pollutants: bio-chemical oxygen demand (BOD), total suspended solids (TSS), nitrogen, phosphorus, and total Kjeldahl nitrogen (TKN). The results for the various combinations of BAT and PSES scenarios modeled are presented in Table ES-4.

EPA estimates the preferred treatment option (Scenario 7) for this proposed rule would reduce pollutant discharges from 36 MPP facilities by 4.8 million lb/yr. For this 10 percent reduction, EPA estimates that this proposed rule would improve the WQI of 949 reach miles (6,687 miles for the national set). The average WQI for these 949 reaches increases from 74.9 to 75.9 (see Table ES-5) which is still just below the boatable criteria breakpoint of WQI = 79. The standard deviation suggest that 67 percent of the reaches impacted are located in the WQI range of 60 - 92.

Table ES - 4: Benefits Scenarios Modeled (97 facilities)¹

Scenario ²	Regulatory Options ³	Pollutant Load (million lbs/yr) ⁴	Pollutant Reduction (percent)	Step ⁵ Improvement: Overall use (reach miles)		Contiuous ⁶ Improvement: Water Quality Index (reach miles)	
				Sample ⁷	National ⁸	Sample	National
Baseline		49.9					
1	BAT2	47.5	5	17	116	926	6,325
2	BAT3	45.0	10	21	143	949	6,482
3	BAT4	44.8	10	21	143	952	6,502
4	BAT2 + PSES1	36.2	27	24	200	1216	9,799
5	BAT3 + PSES1	33.7	32	28	227	1240	9,968
6	BAT4 + PSES1	33.5	33	28	227	1244	10,000
7	BAT3 (meat, poultry), BAT2 (Rendering)	45.1	10	21	143	949	6,687
8	BAT3 (meat, poultry), BAT2 (Rendering) + PSES1	33.7	32	28	227	1240	9,813

¹ This table corrects several errors reported in preamble Table IX.G-1. For more information, please see Appendix A.

² EPA is proposing Scenario 7 for the MPP effluent guideline rule making

³ BAT = Best Available Treatment (for Direct Discharges)

PSES= Pretreatment Standards for Existing Sources (for Indirect Dischargers)

⁴ Pound totals include BOD, TSS, Nitrogen, Phosphorus and TKN. Some overlap between categories may be occurring

⁵ Improvement credited when threshold conditions are met

⁶ Improvement credited for any measurable change in water quality.

⁷ Sample set represents 97 facilities (36 direct and 61 indirect).

⁸ National set represents 977 facilities (246 direct and 731 indirect).

In addition to estimating the continuous change in water quality, EPA also analyzed the use category or step change approach. The reductions in loadings from the Scenario 7 with this approach would result in the improved overall use of 21 reach miles (for the sample set), which scales up to 143 reach miles (for the national set).

Table ES-5: Water Quality Index (WQI) Baseline and Proposed Treatment Level Statistics

Scenario	Average WQI ¹	Standard Deviation (SD)	Mean \pm SD ²	Minimum	Maximum ³
Baseline	74.9	16	59 - 91	6	99
BAT3 (meat, poultry), BAT2 (Rendering)	75.9	16.3	60 - 92	6	99

¹ Boatable criteria is 79. Reaches with WQIs less than 79, are designated as supporting no use.

² Represent the interval by which 67% of reaches are represented
Fishable criteria is 94.4.

³ Swimmable criteria is 99.

The large differences in miles of stream reaches affected attributable to these two approaches is intuitively consistent: the continuous approach will count all stream reaches where decreases in pollutants occur, whereas the use category approach will only estimate those instances where a change in water quality results in migrating from one use category to another.

Limitations of the WQEA

EPA believes that its analysis likely underestimates the potential benefits of the regulatory options evaluated for this proposal. Specifically, the current version of the NWPCAM model used for this environmental assessment (See Chapter 2) only models DO, BOD, Fecal Coliform, TKN, and TSS. Accordingly, the analysis presented in today's proposal addresses only a subset of MPP effluent contaminants. EPA intends to modify the model in support of the final rule to include the following: (1) modeling of nutrients for an eutrophication analysis of ponds and lakes; and (2) modeling of other pollutants for rivers and streams.

EPA did not evaluate the human health benefits associated with reduction of toxic pollutant discharges, because MPP effluents do not contain significant levels of toxic contaminants. Nonetheless, it is possible that MPP pollutants, especially nitrates, could have an impact on certain human receptors, if contaminants reach drinking water supplies.

EPA also did not evaluate the effects of MPP discharges on POTWs. MPP facilities discharge mostly conventional pollutants (BOD, TSS, oil and grease, and fecal coliform bacteria), which POTWs are designed to treat.

1.0 INTRODUCTION

The purpose of the Water Quality Environmental Assessment (WQEA) is to estimate the change in water quality conditions resulting from implementing an effluent guideline and pretreatment standards for a given industry.

This WQEA presents the results of the water quality assessment performed by the U.S. Environmental Protection Agency (EPA) as part of its effort to develop effluent limitations guidelines and pretreatment standards for Meat and Poultry Processing Industry (MPP) facilities.

1.1 DEFINITION OF MPP

EPA defines the meat and poultry products (MPP) industry as 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. The industry is often divided into three categories: (1) meat slaughtering and processing; (2) poultry slaughtering and processing; and (3) rendering.

1.2 WATER QUALITY ISSUES RELATED TO MPP

The meat poultry processing industry (excluding rendering) uses an estimated 150 billion gallons of water per year and ranks in the top third of all three digit SIC manufacturing sectors with regard to overall water consumption. Water is used to clean the product, clean and sanitize the production equipment, and to transport the waste away from the production area. Water can also be used as a part of the process, such as in scalding birds to facilitate feather removal or chilling the animal or meat to reduce its temperature. Although a portion of the water used by this industry is reused and or recycled, most of the water becomes wastewater that is ultimately discharged into the nation's waterways, either directly by the facility or indirectly through a

Publically Owned Treatment Works (POTW).

1.3 POTENTIAL ENVIRONMENTAL IMPACTS OF MPP

The untreated wastewater of MPP facilities contains high concentrations of biodegradable dissolved organics, biochemical oxygen demand (BOD), total suspended solids (TSS), oil and grease, pathogens, and nutrients nitrogen (including ammonia) and phosphorus. EPA's sampling data collected from MPP facilities also found treatable concentrations of some metals (e.g., copper and zinc). Some of these metals are fed to the animals as feed additives, and therefore are assumed to be the source for these pollutants in the wastewater.

The discharge of high levels of biodegradable organics into receiving streams results in increased microbial activity, as the microorganisms biodegrade these materials. This increase in microbial activity requires greater amounts of oxygen than natural aeration processes can provide. This deficit results in the decrease of available dissolved oxygen (DO) for more complex aquatic organisms. This potential of a pollutant to remove oxygen from receiving waters is called the biochemical oxygen demand (BOD). High concentrations of BOD can reduce the DO content of waterbodies to levels insufficient to support fish and invertebrates.

Habitat degradation can result from increased suspended particulate matter. Suspended particulate matter reduces light penetration, and thus primary productivity. Accumulation of suspended particles may also alter benthic spawning grounds and feeding habitats.

Nutrients, including phosphorus and nitrogen, are the primary causes of surface water eutrophication, which can reduce dissolved oxygen content of waterbodies to levels insufficient to support fish and invertebrates. Eutrophication may also increase the incidence of harmful algal blooms that release toxins as they die and can severely affect wildlife, as well as humans. Additionally, meat and poultry processing raw wastewaters contain significant amounts of

organic nitrogen which rapidly breaks down into ammonia. If left untreated, this poses a direct toxicant to aquatic communities.

Oil and grease are known to produce toxic effects on aquatic organisms (i.e., fish, crustacea, larvae and eggs, gastropods, bivalves, invertebrates, and flora). Pathogens are known to impact a variety of water uses including recreation, drinking water sources, and aquatic life and fisheries (Docket No. W-01-06, Record No. 10024 - Pathogen TMDL report).

1.4 ORGANIZATION OF REPORT

EPA has organized this WQEA report into five sections. Section 2 outlines the methodology EPA used to evaluate water quality effects from direct and indirect discharging facilities. Section 3 describes the data sources used for evaluating water quality effects, such as facility-specific data, water use category criteria, and documented environmental impact data. Section 4 presents a summary of the results of this analysis. Section 5 provides a complete list of references cited. Appendices B and C provide additional detail on the specific information addressed in the main report.

2.0 METHODOLOGY

2.1 INTRODUCTION

EPA evaluated potential water quality effects of discharges of conventional pollutants from meat and poultry processing (MPP) facilities on receiving streams in a national analysis of direct and indirect discharges¹. Specifically, EPA used the National Water Pollution Control Assessment Model (NWPCAM version 1.1) to model the change in reach specific instream concentrations of total suspended solids (TSS), fecal coliform bacteria (FCB), ultimate carbonaceous biochemical oxygen demand (CBOD_u), and dissolved oxygen (DO) concentration. Total Kjeldahl nitrogen (TKN) was also modeled to account for oxygen depletion through nitrogenous biochemical oxygen demand (NBOD).

The modeled changes in these concentrations were then used to identify changes in use categories ranging from the least desirable of no use, to boatable, to fishable, to the most desirable of swimmable.

In the following sections, EPA presents the water quality assessment approach, the NWPCAM model, the pollutants evaluated, and water use support determinations.

2.2 OVERVIEW OF WATER QUALITY ASSESSMENT APPROACH

The main purpose of the Water Quality Environmental Assessment (WQEA) is to estimate changes in water quality conditions resulting from adoption of new limitations and

¹Direct discharge facilities are those which discharge effluent directly into water bodies, usually following on-site wastewater treatment. Indirect discharge facilities are those which discharge effluent into a publicly owned treatment works (POTWs), which provides subsequent effluent treatment prior to discharge.

standards as established by the proposed rule. Developing these estimates involves a multi-step process that begins with the analysis presented in the MPP Technical Development Document (TDD) and ends with the MPP Economic Analysis. The first four steps, which are covered in the TDD, are:

1. Identify the universe of MPP discharging facilities
2. Differentiate MPP direct dischargers from MPP indirect dischargers
3. Characterize the technology in place for each of the MPP facilities being evaluated
4. Characterize effluent discharges from each of the MPP facilities being evaluated with baseline and various regulatory options being proposed.

The next three steps, which are the focus of this WQEA, are:

5. Identify and characterize the receiving water body for each direct discharger, and identify the associated POTW for each indirect discharger.
6. Estimate water quality conditions under current discharge conditions and under regulatory alternatives.
7. Quantify changes in water use categories (i.e., fishable, boatable, swimmable)

The final step, covered in the Economic Analysis, is:

8. Monetize changes in environmental benefits associated with changes in water use categories.

Even though the characterization of the MPP effluent discharges (step 4) is covered in the MPP TDD, a quick summary of the process is presented below. The rest of Section 2 presents EPA's methodology used to complete steps 5 through 7.

2.2.1 Characterize Effluent Discharges

EPA estimated baseline and treatment option loadings on a facility-specific level. The baseline loadings were based primarily on data provided in the 2001 MPP Detailed Survey. Where data for specific pollutants could not be obtained from the survey or facility compliance reports, EPA used surrogate data, so that each facility could be modeled for the full suite of pollutants of concern addressed by NWPCAM.

EPA estimated the treatment option loadings for each facility, based upon expected pollutant removals from implementation of the proposed effluent guideline. The evaluated treatment options are presented in Table 2-1.

Table 2-1: Regulatory Treatment Options

Regulatory Option ¹	Technical Component
BAT2	Dissolved Air Flotation (DAF) (advanced oil/water separation), Lagoon, and Disinfection (Oil and Grease, BOD ₅ , TSS, Pathogen removal) + Nitrification (NH ₃ removal)
BAT3	BAT2 + Denitrification (Nitrate removal)
BAT4	BAT3 + (Phosphorus removal)
PSES1	DAF, Equalization (Oil and Grease, TSS, removal) phosphorus removal

¹ BAT = Best Available Treatment (covers existing Direct Dischargers)
PSES = Pretreatment Standards for Existing Sources (covers existing Indirect Dischargers)

EPA only applied those BAT/PSES controls that would achieve pollutant concentration levels at least equal to the facility's current treatment in place. Under this approach, a facility that was characterized as having equivalent BAT2 technology in place would only obtain reduced pollutant concentrations levels under more stringent technology options (i.e., BAT3 or BAT4 controls).

2.2.2 Ensure MPP Survey Data is Model Ready

EPA performed several additional steps to ensure that the facility information provided through the MPP Survey, as well as the loadings data generated by the other analyses, could be successfully entered into the NWPCAM model. For example, data on facility specific location information provided in the survey had to be matched with NWPCAM location data for receiving water bodies. In cases where Survey respondents did not identify discharge location (direct dischargers) or associated POTW (indirect dischargers), EPA staff made follow-up calls to the facility operators to ensure that estimated discharges were allocated to the correct water body or POTW, respectively. The Agency made additional modifications to the facility loadings data set to ensure proper data formatting for use in the NWPCAM model. Once EPA entered the facility loadings into the NWPCAM model, EPA combined facility impacts with existing stream reach conditions to estimate water quality under both baseline and regulatory options.

2.3 OVERVIEW OF NWPCAM 1.1

NWPCAM is a national-level water quality modeling system and policy analysis tool. It incorporates a national-scale water quality model into a system designed for conducting policy simulations and benefits assessments. The core of NWPCAM is its water quality modeling system. The system is built on a surface water routing framework that covers virtually the entire inland region of the continental United States. This framework catalogs where surface waters are located and how they are interconnected, and it characterizes the dimensions and flow of water through this network. It is through this routing framework that the hydrological, hydrodynamic, and surface water transport components of the system are integrated into NWPCAM.

A second major component of the modeling system is the pollutant loadings data. This component defines the location and magnitude of discharges to the nationwide surface water network for a selected number of conventional and nutrient pollutants. These loadings are defined for both point and nonpoint sources of water pollution.

The kinetics component of the modeling system then incorporates information from the previous

components and simulates how the selected pollutants are dispersed and transformed throughout the surface water network. The primary output of these integrated modeling components are water quality estimates, primarily measured as in-stream pollutant concentrations, across this network.

2.3.1 Types of water pollution problems and policies that can be analyzed with NWPCAM

NWPCAM was originally developed and designed to conduct retrospective analyses of Clean Water Act policies, but has been adapted for conducting prospective analyses of new or proposed regulations. As the model has been expanded and refined, it has become suitable for analyzing an increasingly diverse set of water pollution problems and policies.

Because of its large scale, the development of NWPCAM's water quality modeling and policy evaluation system has been incremental. The scope of the model has been gradually expanded to include more pollutants, more pollutant sources (point and nonpoint), more water bodies, and more water quality measures. For instance, the first version of this model (the CWAEM) incorporated only two "conventional" pollutants (CBOD_u and TSS), and it included urban and rural nonpoint sources, municipal point sources, and "major" industrial point sources. A subsequent version (NWPCAM Version 1.0) added modeling capability for two additional conventional pollutants (FCB and DO) and added Combined Sewer Overflows (CSOs) and approximately 20,000 "minor" industrial dischargers. The entire model has been reimplemented from its original location on the EPA IBM mainframe running under SAS to a PC-based platform under Microsoft Access.

NWPCAM 1.1 models four conventional pollutants: DO, CBOD, TSS, and FCB. TKN is also included to support the modeling of DO and BOD. These pollutants have been the primary focus of federal water pollution control policies under the Clean Water Act and have the following advantages for modeling purposes:

- They can be characterized by first-order kinetics.
- Data is widely available to estimate point and nonpoint source loadings of these constituents.
- Existing surface water quality indices are based, at least in part, on these parameters.

For this analysis, NWPCAM 1.1 was further modified to also model total nitrogen and total phosphorous. However, only the four conventional pollutants were employed in use support determinations.

2.4 POLLUTANT PARAMETERS MODELED USING NWPCAM 1.1

2.4.1 Dissolved Oxygen (DO)

Levels of DO in surface water are commonly used as an indicator of aquatic health. High levels of oxygen are characteristic of good water quality that can support a high-quality fishery and diverse aquatic biota. Conversely, low or depleted oxygen concentrations indicate poor water quality and an inability to support a diverse population of aquatic biota. DO is added to water through photosynthesis and aeration from turbulent mixing, and is removed through respiration and sediment oxygen demand.

In NWPCAM 1.1, oxygen production from photosynthesis (P) and consumption from respiration (R) were assumed to balance (i.e., $P = R$ or $P - R = 0$). Increases in DO concentration due to atmospheric reaeration were accounted for by water temperature, velocity, and depth of the river channel. The additional atmospheric oxygen that can be contributed to a free-flowing stream falling over a dam or waterfall was not represented.

2.4.2 Biochemical Oxygen Demand (BOD)

Biodegradable organic materials, such as plant, fish, or animal matter, consume DO

during decomposition. The level of organics in wastewater and natural water bodies has historically been assessed using BOD, which measures the pollutants' potential to remove oxygen from the receiving waters. BOD is a primary determinant of DO concentrations in surface water.

Both the carbonaceous and nitrogenous components of the ultimate BOD (CBODU and NBODU, respectively) are needed to model DO. The decomposition of organic carbon was represented by the decay of CBODU as an oxygen equivalent measure of the amount of organic carbon. The labile/refractory and dissolved/particulate fractions of total organic carbon were not differentiated. Eutrophication was not considered in this model, so the contributions of algal respiration, algal mortality, and zooplankton grazing to organic carbon concentrations were also not represented.

Loadings of CBODU occur from both point (e.g., municipal and industrial dischargers) and nonpoint sources (e.g., urban runoff). Since effluent loading data for these sources are typically characterized as the 5-day BOD or CBOD (BOD5 and CBOD5, respectively), conversion factors were used to obtain CBODU for input to the model. BOD5 data obtained from literature was assumed to represent CBOD5 because of uncertainty related to the interpretation of BOD5 measurements (Hall and Foxen, 1984). The magnitude of the conversion factors for municipal dischargers depend on treatment level as the relative proportion of easily degraded materials in the effluent declines as the efficiency of waste treatment improves (Leo et al., 1984; Thomann and Mueller, 1987).

The sequential nitrogen-cycle processes of hydrolysis of organic nitrogen to ammonia, oxidation of ammonia to nitrite, and oxidation of nitrite to nitrate (nitrification) were simplified by combining these steps into a single NBOD representation. Because organic nitrogen in wastewater can be hydrolyzed to ammonia and thus contribute to the eventual oxygen demand in a receiving water, the total NBOD is determined as the oxygen equivalent of the sum of organic nitrogen and ammonia (see Equation 1). Total Kjeldahl nitrogen (TKN) represents the sum of

organic nitrogen and ammonia.

$$NBOD = \frac{O_2}{N} * TKN \quad (1)$$

where:

O_2/N = stoichiometric equivalent of 4.57 g oxygen per 1 g nitrogen consumed in the stepwise nitrification process of ammonia to nitrate, and

TKN = total Kjeldahl nitrogen.

Although the use of a lumped NBOD approach to account for the oxygen consumption component of the nitrogen cycle has known shortcomings in representing the lag time needed to initiate nitrification (Chapra, 1997), the approach adopted is consistent with other components of the simplified model framework.

2.4.3 Total Kjeldahl Nitrogen (TKN)

Total Kjeldahl nitrogen (TKN) is the sum of organic nitrogen and ammonia. It is the key pollutant in modeling DO. Sources of TKN include municipal and industrial discharges, combined sewer overflows, and urban and rural runoff. It is routinely measured in water and wastewater monitoring programs. Under aerobic conditions, nitrification occurs as described in Section 2.1.2 and results in DO consumption. Under anaerobic conditions, the reverse process (denitrification) occurs. During denitrification, nitrate is reduced to nitrite, nitrate is converted to free nitrogen, and the free nitrogen is either assimilated by nitrogen-fixing, blue-green algae, or released to the atmosphere as a gas.

In the absence of a national database to characterize benthic regeneration rates for ammonia, a stoichiometric weight ratio for oxygen to nitrogen of 15.1:1 (Redfield, Ketchum, and Richards, 1963) was used to define the equivalent amount of ammonia nitrogen released by decomposition of organic carbon in the sediment bed. The benthic release of ammonia to the

water column was estimated from the reach-dependent parameter values assigned for sediment oxygen demand (Di Toro, 1986; Di Toro et al., 1990).

2.4.4 Total Suspended Solids (TSS)

Total suspended solids (TSS) are used as a surrogate indicator of water transparency to characterize recreational service flows provided by a water body. Low TSS concentrations are associated with a high degree of water clarity. High concentrations of TSS are generally associated with murky or turbid waters and are therefore important contributors to perceptions of poor water quality. The assessment of economic benefits is, in part, dependent on changes in water transparency (as assessed by TSS) and corresponding improvements that result from implementing controls to reduce TSS loadings.

In NWPCAM 1.1, no distinction is made between the relative fractions of cohesive (clays and silts) and noncohesive (sands) particle sizes that contribute to deposition processes from the water column or the sediment bed concentration of solids that contributes to the resuspension of solids back into the water column. A simple net settling velocity was used to parameterize the interactions of particle size distributions with deposition and resuspension.

2.4.5 Fecal Coliform Bacteria (FCB)

In accordance with the practices of the EPA and other public health officials, the NWPCAM 1.1 model uses FCB as a surrogate indicator for waterborne pathogens that are known to cause a variety of human illnesses. Low densities of FCB are characteristic of good water quality and low risk of waterborne diseases. High concentrations of FCB indicate poor water quality and a high risk of waterborne diseases. Using typical water quality standards for primary contact recreation (swimming) and secondary contact recreation (boating), the concentration of FCB is directly related to service flows and economic benefits. The assessment of economic benefits, in part, depends on changes in FCB concentrations and improvements in service flows that may result from implementing controls to reduce FCB loadings.

FCB are introduced into natural waters by municipal and industrial wastewater discharges, combined sewer overflows, and urban and rural runoff. Animal feedlots in rural areas also contribute high loading rates of bacteria. High loading rates are most commonly associated with untreated or poorly treated human sewage or animal waste. Bacteria are lost from the water column by mortality, adsorption to particles, and settling. The mortality of coliform bacteria can be functionally related to salt content, water temperature, and incident solar radiation (Mancini, 1978). In shallow waters, bacteria can be reintroduced back into the water column by resuspension of particles under high flow conditions. In NWPCAM 1.1, the components of the mortality and net settling loss rate for FCB were parameterized by a lumped temperature-dependent net loss rate.

2.4.6 Nutrients (Total Nitrogen and Total Phosphorous)

Total nitrogen (TN) and total phosphorous (TP) are present in wastewater, surface runoff, rainwater, groundwater, and surface waters. They exist in organic and inorganic forms and in both dissolved and particulate fractions.

Elevated nutrient concentrations can affect a number of different water quality processes and endpoints. Perhaps the most direct impact of nutrient loading is the toxicity of ammonia and nitrate to aquatic and human populations. Ammonia, particularly the un-ionized form (NH₃), is highly toxic to aquatic organisms. Nitrates are considered a potential health concern for humans, particularly for infants.

Excessive enrichment with phosphorous and/or nitrogen is also associated with the process of cultural eutrophication, the anthropogenically induced acceleration of natural aging in aquatic systems. Symptoms include shifts in ecological processes (e.g., carbon, nitrogen, phosphorus, and oxygen cycling rates and dynamics) and plant and animal species. In the extreme state of "hypereutrophy," a system may suffer extensive DO depletion, wide diurnal shifts in oxygen corresponding with photosynthesis and respiration cycles, extreme bloom events, noxious and undesirable algal species, fish kills, foul odors, and turbidity.

Total nitrogen and total phosphorous were modeled using first order kinetics. Decay coefficients were obtained from the SPAtially Referenced Regressions On Watershed (SPARROW) study (Smith, Schwarz, and Alexander, 1997).

As mentioned above, nutrient concentrations were not considered in use support determinations. However, the development of regional nutrient criteria makes this a possibility for the future.

2.5 WATER QUALITY MODELING

NWPCAM 1.1 has the capability to model water quality in a stream reach after inclusion of all source loadings. A change of loadings from one source is realistically considered in comparison with the total loadings to a stream reach. NWPCAM 1.1 contains information on approximately 8,000 municipal facilities and 23,000 industrial facilities. It can be run on any scale, ranging from a basin to the entire United States.

Municipal and industrial select tables contain all loading information. Each discharger is associated with identification information (name and NPDES number), receiving water (as identified by CU, segment number, and distance along the stream reach), loading data (flow rate and concentrations), and a sequence number to identify the order in which stream reaches are modeled. The municipal and industrial select tables are generated each time the study area is selected. After the model is run, each stream reach is associated with steady-state flow rate and concentration information.

2.6 WATER USE SUPPORT DETERMINATIONS

In order to quantify the economic benefits associated with improved water quality, a

modified Vaughn water quality ladder is used to associate water quality and designated uses (Vaughn, unpublished). NWPCAM 1.1 compares the concentrations of BOD₅, TSS, FCB, and percent DO saturation (DO_{pct}) to benchmark values associated with swimming, fishing, and boating uses (see Table 2-2). Swimming is associated with the most stringent water quality criteria, and boating is associated with the least stringent water quality criteria. For BOD₅, TSS, and FCB, the in-stream concentration must be below the benchmark value to attain a given use. For DO_{pct}, the in-stream value must be greater than the benchmark value to meet the criterion for that use. If even one parameter does not meet its benchmark value, the stream is not considered to support that use. If the stream reach does not attain any of the three uses, it is designated as "not supporting."

Table 2-2: Water Quality Criteria Threshold By Use

USE Supported	Water Quality Index (WQI) Criteria	BOD₅	TSS	DO_{pct}	FCB
Swimming	99	1.5	10	83	200
Fishing	94.4	3	50	64	1000
Boating	79	4	100	45	2000

Note: BOD₅ = 5 day Biochemical Oxygen Demand (mg/L)
TSS = Total Suspended Solids (mg/L)
DO_{pct} = percent of DO Saturation
FCB = Fecal Coliform Bacteria(MPN/100ml)

This approach is somewhat problematic since water quality improvements are considered to not occur unless movements result in migrating from one use category to another, e.g., fishing to swimming. The implication of this is that the baseline condition for a given stream reach must be just below the break point between categories so an improvement will result in the water quality conditions moving beyond the breakpoint. Furthermore, this also implies that no within use category movements have any value associated with them..

As an alternative to the stepwise ladder approach, EPA evaluated all water quality changes. To accomplish this a continuous Water Quality Index (WQI) was constructed. The WQI combines information from four water quality measures rather than using only the limiting lowest quality criterion to define use category. For this benefit valuation, NWPCAM compiled a WQI from turbidity, BOD, fecal coliforms, and dissolved oxygen indexes based on work by McClelland (1974). Since the baseline distribution of use categories is well understood and generally accepted, it is desirable for the distribution based on WQI to match the existing distribution of use categories in the baseline. EPA derived WQI values to represent the breakpoints on the water quality ladder based on empirical observation of the WQI distribution among use categories in the baseline data. EPA calculated the mean and standard deviation of WQIs for the reaches in each use category in the baseline population of reaches. If reaches are normally distributed within each use category, 84 percent of observed WQI for each category should be less than the mean WQI plus one standard deviation (SD). The Mean + SD value serves as the criterion for the boundary with the next higher use category. Table 2-3 shows the calculation and the resulting criteria.

Table 2-3: Empirical Calculation of Criteria from the Baseline Scenario

Use Category	Mean (WQI)	Standard Deviation (WQI)	Criterion (Mean + SD) (WQI)
No Use, 0	54.1	24.8	79.0
Boatable, 1	84.9	9.5	94.4
Fishable, 2	92.5	6.5	99.0
Swimmable, 3	98.5	2.3	

Source: EPA analysis of Baseline Access database, 10/2/2001

2.7 FACILITY EFFLUENT DATA INPUTS FOR NWPCAM

Effluent data extracted from the MPP Detailed Surveys were entered into NWPCAM model for the 97 meat-processing facilities evaluated for the benefit analysis. As described below, some adjustments were required, because not all facilities collected data for all parameters evaluated in the environmental assessment.

Each facility's effluent was characterized by flow rate and the six water quality parameters discussed in section 2.0 (BOD5, TSS, FCB, TN, TKN, and TP). The current effluent quality at each facility was defined at the "baseline average concentration" (BAC). Direct discharge facilities were also associated with a maximum of three alternative effluent qualities that would result upon implementation of a Best Available Technology (BAT) control. Indirect discharge facilities were associated with one alternative effluent quality that would result upon implementation of the Pretreatment Standard for Existing Sources (PSES).

The facility effluent data were modified prior to use in NWPCAM. The type of discharger (i.e., direct or indirect) was changed for four industrial facilities based on the NWPCAM model. Of the 97 total facilities, 36 were direct dischargers and 61 were indirect dischargers. When facilities lacked data for one or more control options, the effluent quality was assumed to be identical to the baseline average concentration. The original data contained some instances of TKN concentrations that were larger than corresponding TN concentrations. In these instances, TN was set equal to TKN. The modified data was reformatted and inserted into NWPCAM as two tables (TTMunSelect and TTIndSelect).

2.8 MODEL RUNS

EPA performed nine model runs to estimate baseline conditions and water quality changes for various combinations of regulatory controls. They correspond to the following

scenarios shown in Table 2-4.

BAT options were applied to direct dischargers and PSES options were applied to indirect dischargers. It should be emphasized that differences between baseline loadings and technology treatment options were calculated prior to input into NWPCAM. As described in detail in the MPP Technical Development Document, facility loadings under alternative technology options were derived based on technology performance of model facilities for each MPP industry subcategory. The NWPCAM model used these estimates to model water quality changes in affected receiving water bodies on a facility-by-facility basis.

Table 2-4: Benefits Scenarios Modeled

Model Run	Regulatory Options ¹
1	Scenario 0: Baseline
2	Scenario 1: BAT2
3	Scenario 2: BAT3
4	Scenario 3: BAT4
5	Scenario 4: BAT2 + PSES1
6	Scenario 5: BAT3 + PSES1
7	Scenario 6: BAT4 + PSES1
8	Scenario 7: BAT3 (meat, poultry), BAT2 (Rendering)
9	Scenario 8: BAT3 (meat, poultry), BAT2 (Rendering) + PSES1

¹ BAT: Best Available Treatment (for Direct Discharges)
 BAT2: Dissolved Air Flotation (DAF) (advanced oil/water separation), Lagoon, and Disinfection (Oil and Grease, BOD₅, TSS, Pathogen removal) + Nitrification (NH₃ removal)
 BAT3: BAT2 + Denitrification (Nitrate removal)
 BAT4: BAT3 + Phosphorus removal
 PSES: Pretreatment Standards for Existing Sources (for Indirect Dischargers)
 PSES1: Dissolved Air Flotation (DAF) , Equalization (Oil and Grease, TSS removal)

2.9 CREATING MUNICIPAL AND INDUSTRIAL SELECT TABLES

To perform the nine model runs, one municipal select and nine industrial select tables were needed. The original NWPCAM model was run over the entire United States to generate one municipal and one industrial select table containing information on the facilities originally contained in NWPCAM. Nine copies were made of the industrial select table to correspond with baseline and Model Runs 2-9. Records for 151 facilities (36 direct industrial dischargers, 61 indirect industrial dischargers, and 59 municipalities) were inserted or updated using the facility specific data generated from the MPP Survey and other compliance reports. The specific approach to update the loadings data was dependent on the facility type (i.e., direct industrial discharger, indirect industrial discharger, municipal discharger). However, in each case a module was used to automatically update the appropriate table. Appendix A contains the code used in the modules.

2.10 DIRECT INDUSTRIAL DISCHARGERS

Data for the 36 direct discharge facilities were inserted in the industrial select tables without any modification.

2.11 INDIRECT INDUSTRIAL DISCHARGERS

The original version of NWPCAM did not include records for indirect dischargers, because their loadings were captured through the corresponding municipality. For this analysis, flow rates from the meat-processing facilities and municipalities were separated. This approach permitted adjustment of the loadings from the meat processing facilities without affecting the municipalities. New records were inserted into the industrial select tables for each indirect discharger. Pollutant concentration data were then multiplied by a factor to account for the

treatment received prior to discharge (see Table 2-5). The fractions estimate the proportion of pollutant retained based on level of municipal treatment. The module linked the indirect discharger to its municipality through the NPDES number. The treatment level of the municipality was used to determine the appropriate multiplication factors for updating the industrial select tables.

Table 2-5: Fraction of Pollutant Retained as a Function of Treatment Level

Treatment Type	Level	Fraction Retained					
		BOD ₅	TSS	FCB	TKN	TN	TP
Primary	2	0.70	0.50	0.65	0.78	0.78	0.87
Advanced Primary	3	0.50	0.30	0.65	0.78	0.78	0.87
Secondary	4	0.08	0.08	0.005	0.55	0.61	0.42
Advanced Treatment I	5	0.03	0.03	0.005	0.43	0.61	0.06
Advanced Treatment II	6	0.02	0.02	0.000032	0.12	0.48	0.06
Default	9	0.08	0.08	0.005	0.55	0.61	0.42

Notes: BOD₅ = Five-day biochemical oxygen demand
TSS = Total suspended solids
FCB = Fecal coliform bacteria
TKN = Total Kjeldahl nitrogen
TN = Total nitrogen
TP = Total phosphorous

2.12 POTWs

Mass and flow balances were developed to calculate new effluent information for the municipal facilities (see Equations 2 and 3). Appendix B contains full details on how the equations were developed.

$$Q_{mun,new} = Q_{mun,old} - Q_{meat} \quad (2)$$

$$C_{mun,new} = \frac{1}{Q_{mun,new}} [Q_{mun,old} C_{mun,old} - Q_{meat} C_{meat} f_{retained}] \quad (3)$$

where

$Q_{mun,new}$ = updated municipal flow rate (MGD)
 $Q_{mun,old}$ = original municipal flow rate (MGD)
 Q_{meat} = flow rate from the meat-processing facility (MGD)

$C_{mun,new}$ = updated municipal concentration (mg/L)
 $C_{mun,old}$ = original municipal concentration (mg/L)
 C_{meat} = concentration in the meat-processing facility's effluent (mg/L)
 $f_{retained}$ = fraction of pollutant retained after treatment.

Two municipalities received flow from multiple meat-processing facilities. For this situation, equations were developed to calculate total flow and average concentrations to use for Q_{meat} and C_{meat} in Equations 2 and 3 (see Equations 4 and 5).

$$Q_{meat} = Q_{meat,1} + Q_{meat,2} \quad (4)$$

$$C_{meat} = \frac{C_{meat,1} Q_{meat,1} + C_{meat,2} Q_{meat,2}}{Q_{meat,1} + Q_{meat,2}} \quad (5)$$

where

Q_{meat} = total flow rate from all meat-processing facilities (MGD)
 $Q_{meat,1}$ = flow rate from meat-processing facility 1 (MGD)

$Q_{\text{meat},2}$ = flow rate from meat-processing facility 2 (MGD)

C_{meat} = average concentration in effluent from all meat-processing facilities (mg/L)

$C_{\text{meat},1}$ = concentration in effluent from meat-processing facility 1 (mg/L)

$C_{\text{meat},2}$ = concentration in effluent from meat-processing facility 2 (mg/L).

There were nine meat-processing facilities that had a flow equal to or larger than their corresponding municipalities. For these treatment plants, the flow rate was divided in half and the original concentration values were retained.

Analysis using these equations revealed that there were 15 wastewater treatment plants that had negative concentrations for one or more parameters. This occurred when the meat facilities comprised a large fraction of the total municipal flow and/or when the meat facility effluent concentration was much larger than the municipal concentration. Negative concentrations were replaced by default concentration values based on treatment level (see Table 2-6).

Table 2-6: Default Effluent Characteristics by Treatment Level

Treatment Type	Level	Effluent Characteristics					
		BOD ₅	TSS	FCB	TKN	TN	TP
Primary	2	143.5	107.5	2.06E+06	23.4	23.4	5.2
Advanced Primary	3	102.5	64.5	2.06E+06	23.4	23.4	5.2
Secondary	4	16.4	17.2	1.58E+03	16.5	18.3	2.5
Advanced Treatment I	5	6.2	6.5	1.58E+03	12.9	18.4	0.4
Advanced Treatment II	6	4.1	4.3	1.00E+01	3.6	14.4	0.4
Default	9	16.4	17.2	1.58E+03	16.5	18.3	2.5

Notes: BOD₅ = Five-day biochemical oxygen demand (mg/L)
TSS = Total suspended solids (mg/L)
FCB = Fecal coliform bacteria (MPN/100 mL)
TKN = Total Kjeldahl nitrogen (mg/L)
TN = Total nitrogen (mg/L)
TP = Total phosphorous (mg/L)

3.0 DATA SOURCES

EPA uses readily available Agency and other databases, models, and reports to evaluate water quality effects. For the Meat and Poultry Processing (MPP) Environmental Assessment, EPA used two basic sets of data. The first data set was used to develop baseline conditions (current use levels) for stream reaches affected by MPP discharges. The second set of data were used to develop estimates of individual facility pollutant loadings. These data sets were then entered into the National Water Pollution Control Assessment Model (NWPCAM) to quantify impacts of the MPP dischargers under current and regulatory treatment levels. The following sections describe the specific types of data used to run the NWPCAM model and the primary sources for those data.

3.1 POINT SOURCE LOADS USED IN NWPCAM TO ESTIMATE BASELINE WATER QUALITY CONDITIONS

Point sources represented in NWPCAM 1.1 include municipal and industrial wastewater treatment plants and combined sewer overflows. Pollutant discharges from municipal and industrial outfall pipes are represented in the model by estimates of annual mean loading rates input at a discrete location along the length of a stream or river. Pollutant discharges from urban runoff and combined sewer overflows, accounted for by an urban network of multiple discrete outfall pipes discharging to one or more waterways, are aggregated and distributed uniformly to RF1 reaches within the urban land use portions of a watershed. Pollutant loads for point sources are estimated for each of the following state variables selected for NWPCAM 1.1:

- 5-day biochemical oxygen demand (BOD5)
- Total Kjeldahl nitrogen (TKN)
- Dissolved oxygen (DO)
- Total suspended solids (TSS)

- Fecal coliform bacteria (FCB).

3.1.1 Municipal and Industrial Dischargers

3.1.1.1 Primary Data Sources.

The primary data sources used to estimate the magnitude and location of municipal and industrial point source loads are the following EPA national databases:

- Permit Compliance System (PCS)
- Clean Water Needs Survey (CWNS)
- Industrial Facilities Database (IFD).

The PCS database, used by EPA to track compliance by a discharger with NPDES permit limits, provides monthly or quarterly summaries of monitored effluent flow and concentration data submitted to EPA as Discharge Monitoring Reports (DMRs) by "major" municipal and industrial facilities. Standard Industrial Classification (SIC) codes are used to identify the type of discharger (e.g., municipal, pulp and paper, allied chemicals). Data are generally not available in PCS for numerous small facilities classified by EPA as "minor" based on criteria that include effluent flow (<1 MGD), population served (<10,000), or a qualitative judgment of minimal "water quality impact."

The CWNS provides an inventory of the existing and projected status of both major and minor municipal wastewater treatment plants. The database contains records of population served, effluent flow rates, influent and effluent concentrations, and loads of conventional pollutants. The CWNS also includes a coded description to identify the category of each treatment plant by the level of existing and projected wastewater treatment. The levels of treatment performed by plants represented in the CWNS include the following treatment technologies that are summarized briefly below:

- Raw (no treatment): Wastewater is collected and discharged to surface waters

without any removal of pollutants.

- Primary: Screens and physical settling of wastewater results in separation and removal of heavy solids. Pollutants associated with large particles are removed.
- Advanced Primary: Enhanced settling and physical removal of pollutants are achieved with low to high doses of chemical coagulants such as metal salts or organic polyelectrolytes.
- Secondary: Removal of heavy solids by physical settling is followed by biological processes designed to enhance bacterial growth to decompose organic materials.
- Biological treatment processes used are designed to enhance the growth of suspended or attached bacteria in (a) activated sludge and waste stabilization ponds and (b) trickling filters.
- Advanced Secondary: Physical settling and conventional biological treatment are enhanced with either chemical coagulation or additional biological processes to increase the removal efficiency of solids, BOD, and nutrients.
- Tertiary or Advanced Treatment: Physical settling and conventional biological treatment are enhanced for very high removal efficiency with high dosage chemical coagulation, biological processes for nitrification and denitrification, filtration, and adsorption with granular activated carbon or reverse osmosis.
- No Discharge (to surface waters).

Technical details about these levels of municipal treatment can be obtained from standard environmental engineering texts (e.g., Metcalf and Eddy, 1991).

The IFD provides comprehensive records on effluent discharges from the nation's major and minor industrial facilities. A significant shortcoming of the IFD, however, is that EPA no longer maintains this database. Therefore, these data are no longer completely up to date. The RF1 database was used to link the locations of point source inputs with specific river-mile points on an RF1 reach for input to the model.

3.1.1.2 Typical Pollutant Concentrations.

For many major municipal facilities, reliable estimates of effluent flow, BOD5, and TSS concentrations were available from PCS and CWNS. Considerably fewer data were available to characterize municipal effluent concentration levels of TKN and FCB. For estimates of DO loads, effluent data were typically not reported by wastewater treatment facilities. Literature data were used to assign effluent DO levels assuming 50 percent saturation (at 25 degrees C).

Thousands of industrial facilities are included in EPA inventories of the nation's industrial wastewater dischargers. In both PCS and IFD, municipal and industrial facilities are identified by their NPDES identification number and a Standard Industry Category (SIC) code. For example, municipal sewage treatment facilities are assigned the SIC code of 4952. In general, the availability of data to characterize effluent flow and pollutant loading rates for industrial dischargers was more limited than for municipal facilities. Most of the largest industrial "major" sources are, however, included.

For municipal and industrial point sources (major and minor) in which actual discharge data were available from either PCS, IFD, or CWNS, those data were used to assign a loading rate for input to the model. For municipal point sources for which effluent data were not available, default effluent flow, loads, and concentrations, compiled from PCS, CWNS, and other sources (e.g., Metcalf and Eddy, 1991; EPA, 1995; NRC, 1993), were used to estimate typical pollutant loading rates for input to the model. For industrial point sources for which effluent flow and pollutant loading data were not available, typical pollutant loads (TPLs) and typical pollutant concentrations (TPCs), compiled as look-up tables for groups of four-digit level SIC codes were obtained from the National Oceanic and Atmospheric Administration (NOAA, 1994) to develop NWPCAM 1.1.

3.1.1.3 Inventory of Point Source Facilities.

There were 8,878 reach-indexed municipal facilities and 23,118 reach-indexed industrial facilities (direct discharge) included in NWPCAM version 1.1.

3.1.2 Urban Runoff and Combined Sewer Overflows

3.1.2.1 Primary Data Sources.

The public works infrastructure in every town and city includes an urban stormwater drainage system designed to collect and convey runoff from rainstorms and snow melt. Stormwater runoff can contribute significant intermittent loading of pollutants with adverse impacts on water quality and aquatic resources. EPA's National Urban Runoff Project (NURP) concluded that wet weather events contribute significant loadings of pathogens, heavy metals, toxic chemicals, and sediments (EPA, 1983). Over the past several years, EPA has worked closely with state and local governments to design and implement effective programs to reduce pollutant loading from urban runoff. Under the 1987 Amendments to the CWA, EPA published regulations for general permits for stormwater discharges from urban areas (Phase 1, >100,000 population; Phase 2, <100,000 population) and industrial sites. Reduction of pollutant loads to surface waters is typically accomplished using best management practices (BMPs) designed to remove debris accumulation on paved surfaces and to attenuate the rate of urban stormwater flow (Novotny and Olem, 1994).

As a vestige of public works practices in vogue from the nineteenth century (ca. 1850-1900), many older cities, primarily in the Northeast, Midwest, and Upper Midwest, have urban drainage systems that were designed, for cost-saving reasons, to convey both stormwater runoff and raw sewage. These combined sewer overflow (CSO) systems were intentionally designed to overflow and discharge the mixture of raw sewage and stormwater into the nearest urban waterway, when runoff from heavy rainstorms exceeded the hydraulic capacity of the combined sewer pipe network. Although pollutant loading from CSOs occurring only during heavy rainstorms is intermittent, high loading rates of pathogens often result in closure of recreational beaches and shellfish beds to protect public health (Brosnan and Heckler, 1996). Discharges from CSOs also can result in high loading rates of organic materials and accumulations of noxious sludge beds near CSO outfalls with locally depressed levels of dissolved oxygen. EPA (1997) estimates that about 880 older cities, including Washington, DC, for example, still have combined sewer systems that periodically discharge a mixture of raw

sewage and stormwater runoff into urban waterways. Several cities have also initiated costly construction projects to eliminate combined sewer systems by separating urban stormwater drainage from raw sewage collection systems. In Minneapolis-St. Paul, MN, for example, an aggressive \$320 million (1996 dollars) construction program implemented over a 10-year period from 1985-1995 eliminated the old combined sewer system and greatly improved compliance with water quality standards for FCB levels in the Upper Mississippi River (MCES, 1996).

3.1.2.2 Typical Pollutant Concentrations

Based on data archived in EPA's NURP database (EPA, 1983) and data compiled by Novotny and Olem (1994), a range of characteristic effluent concentrations is presented in Table 3-1 for urban runoff and for CSOs. The data in Table 3-1 illustrate the relative magnitude of the range of characteristic effluent levels for urban runoff and CSOs. The urban runoff loading rates used in NWPCAM 1.1 are based on data obtained from Lovejoy (1989) and Lovejoy and Dunkelberg (1990).

Table 3-1. Effluent Characteristics of Urban Runoff and CSOs

Parameter	Urban Runoff	CSO (Event Mean)
BOD5 (mg/L)	10-13	60-200 (115)
CBODU:CBOD5	3.0	1.4
TSS (mg/L)	141-224	100-1100 (370)
TKN (mg/L)	1.68-2.12	ND (6.5)
NH ₃ -N (mg-N/L)	ND	ND (1.9)
NO ₂ -N + NO ₃ -N (mg-N/L)	0.76-0.96	ND (1.0)
Total N (mg-N/L)	3-10	3-24 (7.5)
Total P (mg-P/L)	0.37-0.47	1-11
Total lead (mg/L)	161-204	ND (370)
Total coliforms (MPN/100 mL)	103-108	105-107 (ND)

Note: ND = no data.

MPN = most probable number.

3.1.2.3 Primary Data Sources for Urban Runoff Estimates

Annual urban runoff pollutant loading data have been compiled on a county-level basis by Lovejoy (1989) and Lovejoy and Dunkelberg (1990). Urban runoff loads were first transformed from county-level loads to catalog unit loads using the areal proportion of a county in a given catalog unit. Urban and rural runoff loads were then allocated to RF1 stream reaches based on the length of the reach and whether or not a populated place (1990 Census) was allocated with the reach. Estimates of effluent loads derived from CSO inputs are based on an analysis performed to support EPA's 1992 Clean Water Needs Survey (Tetra Tech, 1993) with the inventory of CSO facilities reduced from 1300 to 880 by EPA (1997). Effluent loads from CSOs are based on a pulse load driven by storm runoff volume and the pollutant load associated with a 5-year, 6-hour duration design storm event. Using the design storm parameter values, runoff volume was estimated from the CSO system drainage system, population served, and degree of imperviousness. Table 3-2 presents a nationally aggregated summary of the loading estimates used in NWPCAM 1.1 to represent pollutant loads contributed by urban runoff and CSOs.

Table 3-2. National Summary of Annual Load Estimates for Urban and Rural Runoff and CSOs (as metric tons/day)

Parameter	Urban Runoff	Rural Runoff	CSOs
BOD ₅	1,701	19,974	2,823
TSS	3,081	778,638	10,361

3.2 NONPOINT SOURCE LOADS

Nonpoint source loads, characterized as intermittent diffuse inputs distributed over an entire drainage basin, are related to hydrologic conditions, topography, physiography, and land

uses of a watershed. In NWPCAM 1.1, the county land-use data used by Lovejoy (1989) and Lovejoy and Dunkelberg (1990) to estimate pollutant loads over a drainage basin were classified very simply as either urban or rural. In NWPCAM 1.1, urban and rural runoff are the only nonpoint sources of pollutant loads included in the model framework. The very broad category of rural land uses accounts for essentially all other land uses not classified as urban (e.g., forest, agricultural pasture, and crops). The data obtained from Lovejoy's work (1989) do not allow a breakdown of rural nonpoint source loads into more detailed classifications of either forest or the several subclassifications of agricultural land uses (e.g., grassland, pasture, feedlots, cropland).

To assign the catalog unit-based rural nonpoint source loads as an input load for each RF1 reach, the loads were attenuated using drainage area-dependent sediment delivery ratios (SDR) assigned to each catalog unit (Vanoni, 1975). Since the data used to quantify rural nonpoint source loads are so highly aggregated, evaluations of policy scenarios for BMP controls of nonpoint sources are not possible in NWPCAM 1.1. Nonpoint source loads from rural land uses are included in the model framework to account for the contribution and impact of nonpoint source loads on water quality. The NPS data provided by Lovejoy and Dunkelberg is based on work done by Giannesi at Resources For the Future. The urban loadings are estimated using a simplified procedure that takes estimates of the number of urban residents per county and multiplies that number by coefficients to get total loadings of urban pollutants to the water. The "Lovejoy" rural loadings is a much more involved process that includes three modules. The first module estimates sheet and rill erosion, first estimating the total tons of erosion, then applying soil texture and stream density factors, which provides a net amount deposited to surface waters by county. Then, the elemental composition of the surface soil and non-sheet and rill sources are added in to get a total pounds of pollutants (BOD5, TSS, TKN, TP, Cu, Pb, Fe, Zn) reaching the surface waters. The second module accounts for livestock runoff by estimating the total manure generated by county, then applying USDA estimates of manure "losses" by state from volatilization, runoff, and seepage. The total quantity "lost" to surface waters is then partitioned into physical/chemical characteristics by assuming 12 percent of the total manure is total solids (TS), BOD5 is 23 percent of TS, COD is 95 percent of TS, TKN is 4.9 percent of TS, and TP is

1.6 percent of TS. This calculation produces total annual estimates of these pollutants reaching surface waters by county. The third module is a nutrient runoff module using the Cornell Nutrient Simulation Model; outputs from this module are not used in NWPCAM 1.1.

3.3 FACILITY-SPECIFIC LOADING DATA

EPA used various sources for collecting data on MPP facilities. The Agency obtained data through EPA site visits and sampling, and facility responses to 2001 Meat Products Industry Survey (herein referred to as the "Detailed Survey"). Information from the Detailed Survey provided many of the facility-specific parameters required for this analysis, such as annual discharge volume, current pollutant loadings, and discharge location information (i.e., name of receiving water body). EPA's data collection procedure is described in detail in Chapter 3 of the technical development document.

For the MPP facilities which responded to the Detailed Survey, EPA identified discharge location based primarily on NPDES information provided in the Survey. For indirect dischargers, EPA also used NPDES information provided by the respondent. Where such information was not available, EPA contacted the facility or performed additional analysis using either the EPA's Permit Compliance System (PCS) or the Industrial Facilities Discharge (IFD) database to identify the appropriate POTW.

EPA also extracted facility-specific pollutant loading information from the Detailed Surveys. Facilities respondents provided final discharge information for a suite of pollutants. As noted above and described in Chapter 2 of this document, the NWPCAM model assessed four conventional pollutants: DO, BOD, TSS, and FCB. In addition, loadings for TKN were also included to support the modeling of DO and BOD.

4.0 RESULTS

This section presents EPA's estimate of the water quality effects of Meat and Poultry Processing (MPP) discharges under baseline conditions and following the adoption of the proposed limits and standards. In addition, analytical results are presented for regulatory options that were evaluated by EPA, but not included in today's proposal.

EPA used the National Water Pollution Control Assessment Model (NWPCAM) to estimate the potential benefits of controlling discharges of bio-chemical oxygen demand (BOD5), total suspended solids (TSS), total Kjeldahl nitrogen (TKN) and fecal coliform bacteria (FCB) from MPP facilities. A total of 97 MPP facilities were modeled for this analysis, including 36 direct and 61 indirect dischargers. EPA estimates that 246 direct and 731 indirect discharges are within scope of the regulatory options evaluated for this proposed rule.

The first subsection (4.1) presents a summary of the overall results, modeled treatment options, modeled facilities, environmental scale-up factor and limitations of the Water Quality Environmental Assessment (WQEA). The second subsection, 4.2., presents documented impacts.

4.1 WQEA RESULTS SUMMARY

EPA modeled a sample set of 97 MPP facilities with a combined baseline loading of 49.9 million lb/yr (see Table 4-1). The baseline loadings consist of the following pollutants: BOD, TSS, nitrogen, phosphorus and TKN.

EPA estimates the preferred treatment option (Scenario 7) for this proposed rule would reduce pollutant discharges from 36 MPP facilities by 4.8 million lb/yr. For this 10 percent reduction, EPA estimates that this proposed rule would improve the WQI of 949 reach miles (6,687 miles for the national set). The average WQI for these 949 reaches increases from 74.9 to

75.9 (see Table 4-1) which is still just below the boatable criteria breakpoint of WQI = 79. The standard deviation suggest that 67 percent of the reaches impacted are located in the WQI range of 60 - 92.

Table 4-1: Benefits Scenarios Modeled (97 facilities)¹

Scenario ²	Regulatory Options ³	Pollutant Load (million lbs/yr) ⁴	Pollutant Reduction (percent)	Step ⁵ Improvement: Overall use (reach miles)		Contiuous ⁶ Improvement: Water Quality Index (reach miles)	
				Sample ⁷	National ⁸	Sample	National
Baseline		49.9					
1	BAT2	47.5	5	17	116	926	6,325
2	BAT3	45.0	10	21	143	949	6,482
3	BAT4	44.8	10	21	143	952	6,502
4	BAT2 + PSES1	36.2	27	24	200	1216	9,799
5	BAT3 + PSES1	33.7	32	28	227	1240	9,968
6	BAT4 + PSES1	33.5	33	28	227	1244	10,000
7	BAT3 (meat, poultry), BAT2 (Rendering)	45.1	10	21	143	949	6,687
8	BAT3 (meat, poultry), BAT2 (Rendering) + PSES1	33.7	32	28	227	1240	9,813

¹ This table corrects several errors reported in preamble Table IX.G-1. For more information, please see Appendix A.

² EPA is proposing Scenario 7 for the MPP effluent guideline rule making

³ BAT = Best Available Treatment (for Direct Discharges)

PSES= Pretreatment Standards for Existing Sources (for Indirect Dischargers)

⁴ Pound totals include BOD, TSS, Nitrogen, Phosphorus and TKN. Some overlap between categories may be occurring

⁵ Improvement credited when threshold conditions are met.

⁶ Improvement credited for any measurable change in water quality.

⁷ Sample set represents 97 facilities (36 direct and 61 indirect).

⁸ National set represents 977 facilities (246 direct and 731 indirect).

In addition to estimating the continuous change in water quality, EPA also analyzed the

use category or step change approach. The reductions in loadings from the Scenario 7 with this approach would result in the improved overall use of 21 reach miles (for the sample set), which scales up to 143 reach miles (for the national set).

The large differences in miles of stream reaches affected attributable to these two approaches is intuitively consistent: the continuous approach will count all stream reaches where decreases in pollutants occur, whereas the use category approach will only estimate those instances where a change in water quality results in migrating from one use category to another. The continual approach is considered to be the preferred method of estimating water quality impacts. The Economic Assessment presents the monetized benefits for this proposed rule, which are based on the continuous approach.

Table 4-2: Water Quality Index (WQI) Baseline and Proposed Treatment Level Statistics

Scenario	Average WQI ¹	Standard Deviation (SD)	Mean \pm SD Range ²	Min.	Max. ³
Baseline	74.9	16	59 - 91	6	99
BAT3 (meat, poultry), BAT2 (Rendering)	75.9	16.3	60 - 92	6	99

¹ Boatable criteria is 79. Reaches with WQIs less than 79, are designated as supporting no use.

² Represent the interval by which 67% of reaches are represented
Fishable criteria is 94.4.

³ Swimmable criteria is 99.

4.1.1 Treatment Options Modeled

EPA modeled four treatment options for analysis (see Table 4-3). Three of the treatment options are for facilities which discharge directly to a water body (i.e., direct dischargers). EPA designates the treatment options for direct dischargers as best available technology (BAT). One of the treatment options is for facilities which discharge indirectly to a water body (i.e., indirect dischargers), through a publicly owned treatment work (POTW). EPA designates the treatment

options for existing indirect dischargers as pretreatment standards for existing sources (PSES). The combination of BAT and PSES scenarios modeled is presented in Table 4-1.

Table 4-3: MPP Regulatory Treatment Options

Regulatory Option ¹	Technical Component
BAT2	Dissolved Air Flotation (DAF) (advanced oil/water separation), Lagoon, and Disinfection (Oil and Grease, BOD ₅ , TSS, Pathogen removal) + Nitrification (NH ₃ removal)
BAT3	BAT2 + Denitrification (Nitrate removal)
BAT4	BAT3 + (Phosphorus removal)
PSES1	DAF, Equalization (Oil and Grease, TSS, removal)

¹ BAT = Best Available Treatment (covers existing Direct Dischargers)

PSES = Pretreatment Standards for Existing Sources (covers existing Indirect Dischargers)

4.1.2 Facilities Modeled

EPA had sufficient data to model 97 out of the 977 meat, poultry, and rendering facilities which are in scope of the regulatory options evaluated in this proposed rule. To prepare for the Water Quality Environmental Assessment (WQEA) and a separate economic analysis, EPA mailed out 350 detailed surveys to generate both environmental and economic data. EPA received 241 detailed surveys in time for data analysis of this proposed rule making. Of the 241 detailed surveys, EPA received sufficient data to model the environmental impacts of 97 facilities (36 direct dischargers and 61 indirect dischargers). EPA did not evaluate 79 facilities with zero discharges or 65 facilities for which EPA had insufficient data to conduct the water quality analysis.

4.1.3 Simplified Environmental Scale-up Factor

EPA developed environmental scale-up factors for both the direct and indirect facilities.

The environmental scale-up factors are ratios between the number of facilities in scope and modeled. These scale-up factors allow EPA to approximate what the environmental impact of the proposed rule might be on the national level. These weighting factor were only used for estimating water quality impacts. EPA presents the separate methodology used for scaling of the monetized benefits in the Economic Analysis.

EPA estimates that 246 direct discharger facilities are in scope of the evaluated BAT options. Since EPA modeled 36 direct dischargers, the ratio of in scope directs (246) to modeled directs (36), is 6.83, or

$$\begin{aligned} \text{Scaling Factor direct dischargers} &= \frac{246 \text{ (in scope direct dischargers)}}{36 \text{ (modeled direct dischargers)}} \\ &= 6.83 \end{aligned}$$

EPA estimates that 731 indirect discharger facilities are in scope of the evaluated PSES1 option. Since EPA modeled 61 indirect dischargers, the ratio of in scope indirects (731) to modeled indirects (61) is 11.98, or

$$\begin{aligned} \text{Scaling Factor indirect dischargers} &= \frac{731 \text{ (in scope indirect dischargers)}}{61 \text{ (modeled indirect dischargers)}} \\ &= 11.98 \end{aligned}$$

4.1.4 Limitations of the WQEA

EPA believes that its analysis likely underestimates the potential benefits of the regulatory options evaluated for this proposal. Specifically, the current version of the NWPCAM

model used for this environmental assessment only models DO, BOD, fecal coliform bacteria, TKN and TSS. (See Chapter 2.) Accordingly, the analysis presented in today's proposal addresses only a subset of MPP effluent contaminants. EPA intends to modify the model in support of the final rule to include the following: (1) modeling of nutrients for an eutrophication analysis of ponds and lakes; and 2) modeling of other pollutants for rivers and streams.

EPA did not evaluate the human health benefits associated with reduction of toxic pollutant discharges, because MPP effluents do not contain significant levels of toxic contaminants. Nonetheless, it is possible that MPP pollutants, especially nitrates could have an impact on certain human receptors, if contaminants reach drinking water supplies. EPA also did not evaluate the effects of MPP discharges on POTWs. MPP facilities discharge mostly conventional pollutants (BOD5, TSS, oil and grease, and fecal coliform bacteria), which POTWs are designed to treat.

4.2 DOCUMENTED ENVIRONMENTAL IMPACTS AND PERMIT VIOLATIONS

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

While the literature search was not comprehensive and was limited mostly to newspaper articles and government press releases covering the last five years, EPA found 20 cases in which plant operators were cited for for a variety of permit violations. One meat processing facility was cited for more than 5,000 permit violations, which led to degradation of water quality in the affected river. In fact, this facility received the highest fine ever issued under the Clean Water Act. Other documented impacts cited in the articles included ten stream reaches with nutrient loadings, two sites with contaminated well water, one site with contaminated ground water, and

one lake threatened by nutrient loadings. In all cases, the identified source of contamination or perceived threat is an MPP facility. In cases in which permit levels were violated or alleged to be violated, NH₃-N, PO₄ , fecal coliform bacteria, and TSS were the most common contaminants of concern.

Eighteen of the articles document legal action in criminal cases taken against meat and poultry processing facility owners or operators . Documented legal action includes: (1) conspiracy of five facilities to violate the CWA; (2) one case of illegal dumping of waste; and (3) five cases of falsifying records, diluting waste samples, and/or destroying records. These legal actions resulted in possible cases of incarceration and fines ranging from \$0.25 million to \$12.6 million. Table 4-4 summarizes the environmental impacts identified and type of legal action pursued.

Table 4-4. Documented Environmental Effects of MPP Wastes on Water Quality

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

Table 4-4. Documented Environmental Effects of MPP Wastes on Water Quality (continued)

Identified Impacts	
Case #9	A poultry plant was fined \$6 million for allowing excessive runoff from its farms and processing plants.
Case #10	Pork Processing plant cited 20 times since 1994 for permit violations. Tests of receiving water body indicated high levels of several pollutants including ammonia and fecal bacteria.
Case #11	High levels of phosphorous were detected downstream from poultry processing plant. In addition, state alleged that high levels of ammonia and high temperatures resulted from plant's discharges.
Case#12	State Conservation Commission study indicated that waste from poultry processing plants threatened viability of lake due to discharges of phosphorous and nitrogen.
Case#13	Water Quality data collected by EPA indicated marked increase in phosphorous in many areas downstream from chicken plants.
Case#14	State Department of Natural Resources obtained a court order to compel poultry processor to adhere to State Water Quality Laws. The plant will reduce its discharge by about 50 percent under the court order.
Case#15	State environmental official filed suit against poultry processor for willfully contaminating groundwater in the vicinity of fields where the plant had sprayed with wastewater. Wastewater was laden with nitrates (1998)
Case#16	Owner of meat slaughter house indicted for allegedly dumping blood and other animal waste products into nearby water bodies (2000)
Case#17	State issued an order containing a \$25,000 fine for violating permit limits for ammonia, solids, and other pollutants.
Case #18	Operator of rendering plant sentenced for one month in prison for illegally discharging pollutants into river (1998). Ammonia and other pollutants were discharged and monitoring reports falsified.
Case #19	Meat further processing firm was fined \$28,000 for failing to file proper forms for discharge of oil, grease, TSS, and BOD (1998). Consent agreement also required company to install pollution equipment.

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APPENDIX A: PREAMBLE CORRECTION

Two corrections have been made since the signing of the MPP preamble. Corrections are noted as follows: Black line strikeouts (shown as: ~~black line strikeouts~~) represent original text that has been removed. Redline strikeouts (shown as: redlined text) represent newly added text.

The first correction is a typo found in the “Sample” column of Table IX.G-1 (page 155). The value of 21, should actually be 28.

Table IX.G-1: Modeled Environmental Benefits (97 facilities)

Scenario	Regulatory Options	Pollutant ¹ Load (million lbs/yr)	Pollutant Reduction (percent)	Overall use improvement ² (reach miles)	
				Sample	National
Baseline		49.9			
1	BAT2	47.5	5%	17	29 <u>116</u>
2	BAT3	45.0	10%	21	36 <u>143</u>
3	BAT4	44.8	10%	21	36 <u>143</u>
4	BAT2 + PSES1	36.2	27%	24	41 <u>200</u>
5	BAT3 + PSES1	33.7	32%	28	48 <u>227</u>
6	BAT4 + PSES1	33.5	33%	21 <u>28</u>	36 <u>227</u>
7	BAT3 (meat, poultry), BAT2 (Rendering)	45.1	10%	21	36 <u>143</u>
8	BAT3 (meat, poultry), BAT2 (Rendering) + PSES1	33.7	32%	28	48 <u>227</u>

Note 1: Baseline = 49.9 Million lbs/yr. Pound totals include BOD, TSS, Nitrogen, Phosphorus and TKN from 97 facilities. Some overlap between categories may be occurring

Note 2: Sample set represents 97 facilities (36 direct and 61 indirect). National set represents 246 direct and 731 indirect discharger facilities. ~~Of the 246 facilities represented, 79 facilities are zero dischargers, and therefore do not contribute to these modeled water quality impacts / improvements.~~

The second correction has to do with the scale-up of the overall use improvement to the national level. EPA originally used a scale-up factor of 1.72 which incorrectly assumed that the 246 facilities covered by this rule, consisted of both direct, indirect and land applying (or zero discharger) facilities. The calculation was done as follows:

$$\begin{aligned} \text{Scaling Factor} &= \frac{246 \text{ (Facilities in scope)} - 79 \text{ (zero dischargers)}}{97 \text{ (Modeled Facilities)}} \\ &= \mathbf{1.72} \end{aligned}$$

The 246 facilities are actually the direct dischargers in scope of this rule. Therefore a scale-up factor for the direct dischargers based on a simple ratio of the **total number of directs (246)** to the **number of directs modeled (36)** is **6.83**, or

$$\begin{aligned} \text{Scaling Factor}_{\text{direct dischargers}} &= \frac{246 \text{ (in scope}_{\text{direct dischargers}})}{36 \text{ (modeled}_{\text{direct dischargers}})} \\ &= \mathbf{6.83} \end{aligned}$$

An example calculation of scaling BAT3 overall use improvement to the national level is as follows:

$$\begin{aligned} \text{Use Improvement BAT3}_{\text{national}} &= \text{BAT3}_{\text{sample}} \times \text{Scaling Factor}_{\text{direct dischargers}} \\ &= 21 \text{ mi.} \times 6.83 \\ &= 143 \text{ mi} \end{aligned}$$

EPA estimates that 731 indirect facilities are in-scope of the PSES1 option. Therefore,

the scale-up factor for indirect dischargers based on a simple ratio of the **total number of indirects (731)** to the **number indirects modeled (61)** is **11.98**, or

$$\begin{aligned} \text{Scaling Factor}_{\text{indirect dischargers}} &= \frac{731 \text{ (in scope indirect dischargers)}}{61 \text{ (modeled indirect dischargers)}} \\ &= \mathbf{11.98} \end{aligned}$$

An example calculation of scaling PSES1 overall use improvement to the national level is as follows:

$$\begin{aligned} \text{PSES1 Use Improvement}_{\text{sample}} &= (\text{BAT3+PSES1})_{\text{sample}} - \text{BAT3}_{\text{sample}} \\ &= 28 \text{ mi} - 21 \text{ mi} \\ &= 7 \text{ mi} \end{aligned}$$

$$\begin{aligned} \text{PSES1 Use Improvement}_{\text{national}} &= \text{PSES1}_{\text{sample}} \times \text{Scaling Factor}_{\text{indirect dischargers}} \\ &= 7 \text{ mi} \times 11.98 \\ &= 84 \text{ mi} \end{aligned}$$

An example calculation of the scale-up of BAT3 + PSES1 overall use improvement to the national level is as follows:

$$\begin{aligned} (\text{BAT3} + \text{PSES1})_{\text{national}} &= \text{BAT3}_{\text{national}} + \text{PSES1}_{\text{national}} \\ &= 143 \text{ mi} + 84 \text{ mi} \\ &= 227 \text{ mi} \end{aligned}$$

As a result of this correction to the scaling methodology, EPA updated preamble Table IX.G-1 (see table above). EPA also corrects the following two sentences found in the preamble:

(page 150): “EPA estimates the national improvement in overall use to be ~~29~~ 116 to ~~49~~ 227 reach miles.

(page 154): “The recommended treatment option would result in the over-all use improvement of 21 river miles at the sample set, and approximately ~~36~~ 143 miles at the national level.”

Appendix B: Equations used to update municipal facility loadings

Variable Definition

$Q_{mun,new}$ = updated municipal flow rate (MGD)
 $Q_{mun,old}$ = original municipal flow rate (MGD)
 Q_{meat} = flow rate from the meat-processing facility (MGD)
 Q_o = flow rate to municipality from other (non-meat) sources (MGD)

$C_{mun,new}$ = updated municipal concentration (mg/L)
 $C_{mun,old}$ = original municipal concentration (mg/L)
 C_{meat} = concentration in the meat-processing facility's effluent (mg/L)
 C_o = concentration in the flow from other (non-meat) sources (mg/L)

f = fraction of pollutant retained after treatment

Flow Balance

$$Q_{mun,old} = Q_{mun,new} + Q_{meat}$$

Therefore

$$Q_{mun,new} = Q_{mun,old} - Q_{meat}$$

Mass Balance

Mass in – Mass out – Mass depleted = 0 (Steady-state)

$$(Q_{meat} C_{meat} + Q_o C_o) - Q_{mun,old} C_{mun,old} - (1-f)(Q_{meat} C_{meat} + Q_o C_o) = 0$$

$$(Q_{meat} C_{meat} + Q_o C_o) f - Q_{mun,old} C_{mun,old} = 0$$

$$Q_o C_o = \frac{Q_{mun,old} C_{mun,old}}{f} - Q_{meat} C_{meat}$$

$$C_o = \left[\frac{Q_{mun,old} C_{mun,old}}{f} - Q_{meat} C_{meat} \right] * \frac{1}{Q_o}$$

$$C_{mun,new} = f C_o = \frac{1}{Q_o} * [Q_{mun,old} C_{mun,old} - f Q_{meat} C_{meat}]$$

$$Q_o = Q_{mun,new}$$

Appendix C: Modules

Module 1: Update direct industrial dischargers

```
Sub UpdateTT Ind()  
'Create 9/14/01 by Megan Tulloch  
'Last modified 9/20/01 by Megan Tulloch  
'Modified 12/4/01 by A. Miles  
'Tables  
    Dim dbs As Database  
    Dim ttindselect As Recordset  
    Set dbs = CurrentDb()  
    Set ttindselect = dbs.OpenRecordset("TTDirect")  
'Variables  
    Dim v_bod As Variant  
    Dim v_tss As Variant  
    Dim v_tn As Variant  
    Dim v_tp As Variant  
    Dim v_fec As Variant  
    Dim v_tkn As Variant  
    Dim v_npdes As Variant  
    Dim v_flow As Variant  
'SQL query statement variables  
    Dim UpdqryStr As String  
    Dim SelqryStr As String  
'Open TT Industrial Data  
    SelqryStr = "select * from TTDirect where (option = 'BA T4' Or option = 'PSES1');"  
    Set ttindselect = dbs.OpenRecordset(SelqryStr)  
    DoCmd.SetWarnings False  
    ttindselect.MoveFirst  
    Do Until ttindselect.EOF  
'Set variables to TT industrial data values  
    v_bod = ttindselect!BOD  
    v_tss = ttindselect!TSS  
    v_tn = ttindselect!TN  
    v_tp = ttindselect!TP  
    v_fec = ttindselect!FEC  
    v_tkn = ttindselect!TKN  
    v_npdes = ttindselect!NPDES  
    v_flow = ttindselect!Flow 'If TT flow rates are in gpd, need to add conversion factor!  
'Update NWPCAM industrial select table with TT values by corresponding NPDES  
    UpdqryStr = "UPDATE indselect SET " & _  
    "flow = " & v_flow & ", bod = " & v_bod & ", tss = " & v_tss & ", tn = " & v_tn & ", tp = " & v_tp & ", fec = "  
    " & v_fec & ", tkn = " & v_tkn & " " & _  
    "WHERE npdes = " & v_npdes & ";"  
    DoCmd.RunSQL (UpdqryStr)  
    ttindselect.MoveNext  
Loop  
ttindselect.Close  
DoCmd.SetWarnings True  
End Sub
```

Module 2: Insert Indirect Industrial Facilities

```

Sub InsertTTMuntoInd()
'Create 9/14/01 by Megan Tulloch
'Last modified 9/20/01 by Megan Tulloch
'Modified 1/8/02 by A Miles
'Tables
    Dim dbs As Database
    Dim ttmunselect As Recordset
    Dim modmunselect As Recordset
    Set dbs = CurrentDb()
'Variables
    Dim i As Long
    Dim v_npdes As Variant
    Dim v_type As Variant
    Dim v_bod As Variant
    Dim v_tss As Variant
    Dim v_tn As Variant
    Dim v_tp As Variant
    Dim v_fec As Variant
    Dim v_tkn As Variant
    Dim v_ttfLOW
    Dim v_primary_BOD As Variant
    Dim v_primary_TSS As Variant
    Dim v_primary_TN As Variant
    Dim v_primary_TP As Variant
    Dim v_primary_FEC As Variant
    Dim v_primary_TKN As Variant
    Dim v_advprimary_BOD As Variant
    Dim v_advprimary_TSS As Variant
    Dim v_advprimary_TN As Variant
    Dim v_advprimary_TP As Variant
    Dim v_advprimary_FEC As Variant
    Dim v_advprimary_TKN As Variant
    Dim v_secondary_BOD As Variant
    Dim v_secondary_TSS As Variant
    Dim v_secondary_TN As Variant
    Dim v_secondary_TP As Variant
    Dim v_secondary_FEC As Variant
    Dim v_secondary_TKN As Variant
    Dim v_advwt1_BOD As Variant
    Dim v_advwt1_TSS As Variant
    Dim v_advwt1_TN As Variant
    Dim v_advwt1_TP As Variant
    Dim v_advwt1_FEC As Variant
    Dim v_advwt1_TKN As Variant
    Dim v_advwt2_BOD As Variant
    Dim v_advwt2_TSS As Variant
    Dim v_advwt2_TN As Variant
    Dim v_advwt2_TP As Variant
    Dim v_advwt2_FEC As Variant
    Dim v_advwt2_TKN As Variant

```

Dim v_default_BOD As Variant
 Dim v_default_TSS As Variant
 Dim v_default_TN As Variant
 Dim v_default_TP As Variant
 Dim v_default_FEC As Variant
 Dim v_default_TKN As Variant
 Dim v_seqno As Variant
 Dim v_mi As Variant
 Dim v_do As Variant
 Dim v_cbodtoubod As Variant
 Dim v_psfbod As Variant
 Dim v_psfTSS As Variant
 Dim v_cu As Variant
 Dim v_seg As Variant
 Dim v_name As Variant
 'SQL Query Statement Variables
 Dim TTselqryStr As String
 Dim SelqryStr As String
 Dim UpdqryStr As String
 Dim InsqryStr As String
 v_primary_BOD = 0.7
 v_primary_TSS = 0.5
 v_primary_TN = 0.78
 v_primary_TP = 0.87
 v_primary_FEC = 0.65
 v_primary_TKN = 0.78
 v_advprimary_BOD = 0.5
 v_advprimary_TSS = 0.3
 v_advprimary_TN = 0.78
 v_advprimary_TP = 0.87
 v_advprimary_FEC = 0.65
 v_advprimary_TKN = 0.78
 v_secondary_BOD = 0.08
 v_secondary_TSS = 0.08
 v_secondary_TN = 0.61
 v_secondary_TP = 0.42
 v_secondary_FEC = 0.0005
 v_secondary_TKN = 0.55
 v_advwt1_BOD = 0.03
 v_advwt1_TSS = 0.03
 v_advwt1_TN = 0.61
 v_advwt1_TP = 0.06
 v_advwt1_FEC = 0.0005
 v_advwt1_TKN = 0.43
 v_advwt2_BOD = 0.02
 v_advwt2_TSS = 0.02
 v_advwt2_TN = 0.48
 v_advwt2_TP = 0.06
 v_advwt2_FEC = 0.0000032
 v_advwt2_TKN = 0.12
 v_default_BOD = 0.08
 v_default_TSS = 0.08


```

v_default_TN = 0.61
v_default_TP = 0.42
v_default_FEC = 0.0005
v_default_TKN = 0.55
'Open TT Municipal Data
  TTSelqryStr = "select * from TTIndirect where option = 'BAC';"
  Set ttmunselect = dbs.OpenRecordset(TTSelqryStr)
  DoCmd.SetWarnings False
  i = 0
  ttmunselect.MoveFirst
  Do Until ttmunselect.EOF
  i = i + 1
'Select Row in NWPCAM Model Data corresponding TT data by NPDES
  SelqryStr = "select * from munselect where npdes = '" & ttmunselect!NPDES & "';"
  Set modmunselect = dbs.OpenRecordset(SelqryStr)
'Set variable from TT data to be moved into NWPCAM Industrial Table
  v_npdes = ttmunselect!NPDES
  v_type = "INDIRECT"
'Set Flow variables to be used in calculating loads
  v_ttflow = ttmunselect!Flow 'If TT flows are in gpd, need to add conversion factor.
  If modmunselect!LEVEL = 2 Then
'Calculate loads for both TT and NWPCAM municipal data
  v_bod = ttmunselect!BOD * v_primary_BOD
  v_tss = ttmunselect!TSS * v_primary_TSS
  v_tn = ttmunselect!TN * v_primary_TN
  v_tp = ttmunselect!TP * v_primary_TP
  v_fec = ttmunselect!FEC * v_primary_FEC
  v_tkn = ttmunselect!TKN * v_primary_TKN
ElseIf modmunselect!LEVEL = 3 Then
'Calculate loads for both TT and NWPCAM municipal data
  v_bod = ttmunselect!BOD * v_advprimary_BOD
  v_tss = ttmunselect!TSS * v_advprimary_TSS
  v_tn = ttmunselect!TN * v_advprimary_TN
  v_tp = ttmunselect!TP * v_advprimary_TP
  v_fec = ttmunselect!FEC * v_advprimary_FEC
  v_tkn = ttmunselect!TKN * v_advprimary_TKN
ElseIf modmunselect!LEVEL = 4 Then
'Calculate loads for both TT and NWPCAM municipal data
  v_bod = ttmunselect!BOD * v_secondary_BOD
  v_tss = ttmunselect!TSS * v_secondary_TSS
  v_tn = ttmunselect!TN * v_secondary_TN
  v_tp = ttmunselect!TP * v_secondary_TP
  v_fec = ttmunselect!FEC * v_secondary_FEC
  v_tkn = ttmunselect!TKN * v_secondary_TKN
ElseIf modmunselect!LEVEL = 5 Then
'Calculate loads for both TT and NWPCAM municipal data
  v_bod = ttmunselect!BOD * v_advwt1_BOD
  v_tss = ttmunselect!TSS * v_advwt1_TSS
  v_tn = ttmunselect!TN * v_advwt1_TN
  v_tp = ttmunselect!TP * v_advwt1_TP
  v_fec = ttmunselect!FEC * v_advwt1_FEC
  v_tkn = ttmunselect!TKN * v_advwt1_TKN

```

```

ElseIf modmunselect!LEVEL = 6 Then
'Calculate loads for both TT and NWPCAM municipal data
  v_bod = ttmunselect!BOD * v_advwt2_BOD
  v_tss = ttmunselect!TSS * v_advwt2_TSS
  v_tn = ttmunselect!TN * v_advwt2_TN
  v_tp = ttmunselect!TP * v_advwt2_TP
  v_fec = ttmunselect!FEC * v_advwt2_FEC
  v_tkn = ttmunselect!TKN * v_advwt2_TKN
ElseIf modmunselect!LEVEL = 9 Then
'Calculate concentrations for both TT and NWPCAM municipal data
  v_bod = ttmunselect!BOD * v_default_BOD
  v_tss = ttmunselect!TSS * v_default_TSS
  v_tn = ttmunselect!TN * v_default_TN
  v_tp = ttmunselect!TP * v_default_TP
  v_fec = ttmunselect!FEC * v_default_FEC
  v_tkn = ttmunselect!TKN * v_default_TKN
End If
'Insert into the NWPCAM industrial select table new values
  InsqryStr = "INSERT INTO indselect " & _
  "(flow,bod,tss,tn,tp,fec,tkn,npdes,type)" & _
  "VALUES (" & v_tflow & "," & v_bod & "," & v_tss & "," & v_tn & "," & v_tp & "," & v_fec & "," &
  v_tkn & "," & v_npdes & "," & _
  v_type & ");"
  DoCmd.RunSQL (InsqryStr)
'Set variables to be moved from NWPCAM Municipal Select table directly into Industrial Select Table
  v_seqno = modmunselect!seqno
  v_mi = modmunselect!MI
  v_do = modmunselect!DO
  v_cbodtoubod = modmunselect!CBODTOUBOD
  v_psfbod = modmunselect!PSFBOD
  v_psfss = modmunselect!PSFTSS
  v_cu = modmunselect!CU
  v_seg = modmunselect!SEG
  v_name = modmunselect!NAME
'Update the new row with the constant data to copied from the NWPCAM municipal select table
  UpdqryStr = "UPDATE indselect SET " & _
  "name = " & v_name & ", seqno = " & v_seqno & ", mi = " & v_mi & ", do = " & v_do & ", cbodtoubod =
  " & v_cbodtoubod & ", psfbod = " & v_psfbod & ", psfss = " & v_psfss & ", cu = " & v_cu & ", seg = " &
  v_seg & " & _
  "WHERE npdes = " & v_npdes & ";"
  DoCmd.RunSQL (UpdqryStr)
  ttmunselect.MoveNext
Loop
ttmunselect.Close
MsgBox i & " were updated"
DoCmd.SetWarnings False
End Sub

```


Module 3: Update municipal facilities

Sub UpdateMun()

'Create 11/12/01 by Megan Tulloch

'Last modified 11/13/01 by Megan Tulloch

'Tables

```
Dim dbs As Database
Dim ttmunselect As Recordset
Dim modmunselect As Recordset
Set dbs = CurrentDb()
```

'Variables

```
Dim i As Long
Dim v_npdes As Variant
Dim v_ttfLOW As Variant
Dim v_modflow As Variant
Dim v_bod_new As Variant
Dim v_tss_new As Variant
Dim v_tn_new As Variant
Dim v_tp_new As Variant
Dim v_fec_new As Variant
Dim v_flow_new As Variant
Dim v_tkn_new As Variant
Dim v_primary_BOD As Variant
Dim v_primary_TSS As Variant
Dim v_primary_TN As Variant
Dim v_primary_TP As Variant
Dim v_primary_FEC As Variant
Dim v_primary_TKN As Variant
Dim v_advprimary_BOD As Variant
Dim v_advprimary_TSS As Variant
Dim v_advprimary_TN As Variant
Dim v_advprimary_TP As Variant
Dim v_advprimary_FEC As Variant
Dim v_advprimary_TKN As Variant
Dim v_secondary_BOD As Variant
Dim v_secondary_TSS As Variant
Dim v_secondary_TN As Variant
Dim v_secondary_TP As Variant
Dim v_secondary_FEC As Variant
Dim v_secondary_TKN As Variant
Dim v_advwt1_BOD As Variant
Dim v_advwt1_TSS As Variant
Dim v_advwt1_TN As Variant
Dim v_advwt1_TP As Variant
Dim v_advwt1_FEC As Variant
Dim v_advwt1_TKN As Variant
Dim v_advwt2_BOD As Variant
Dim v_advwt2_TSS As Variant
Dim v_advwt2_TN As Variant
Dim v_advwt2_TP As Variant
Dim v_advwt2_FEC As Variant
Dim v_advwt2_TKN As Variant
```

```

Dim v_default_BOD As Variant
Dim v_default_TSS As Variant
Dim v_default_TN As Variant
Dim v_default_TP As Variant
Dim v_default_FEC As Variant
Dim v_default_TKN As Variant
'SQL Query Statement Variables
Dim TTselqryStr As String
Dim SelqryStr As String
Dim UpdqryStr As String
v_primary_BOD = 0.7
v_primary_TSS = 0.5
v_primary_TN = 0.78
v_primary_TP = 0.87
v_primary_FEC = 0.65
v_primary_TKN = 0.78
v_advprimary_BOD = 0.5
v_advprimary_TSS = 0.3
v_advprimary_TN = 0.78
v_advprimary_TP = 0.87
v_advprimary_FEC = 0.65
v_advprimary_TKN = 0.78
v_secondary_BOD = 0.08
v_secondary_TSS = 0.08
v_secondary_TN = 0.61
v_secondary_TP = 0.42
v_secondary_FEC = 0.0005
v_secondary_TKN = 0.55
v_advwt1_BOD = 0.03
v_advwt1_TSS = 0.03
v_advwt1_TN = 0.61
v_advwt1_TP = 0.06
v_advwt1_FEC = 0.0005
v_advwt1_TKN = 0.43
v_advwt2_BOD = 0.02
v_advwt2_TSS = 0.02
v_advwt2_TN = 0.48
v_advwt2_TP = 0.06
v_advwt2_FEC = 0.0000032
v_advwt2_TKN = 0.12
v_default_BOD = 0.08
v_default_TSS = 0.08
v_default_TN = 0.61
v_default_TP = 0.42
v_default_FEC = 0.0005
v_default_TKN = 0.55
'Open TT Municipal Data
TTselqryStr = "select * from TTIndirect where option = 'BAC';"
Set ttmunselect = dbs.OpenRecordset(TTselqryStr)
DoCmd.SetWarnings False
i = 0
ttmunselect.MoveFirst

```

```

Do Until ttmunselect.EOF
i = i + 1
'Select Row in NWPCAM Model Data corresponding TT data by NPDES
SelqryStr = "select * from munselect where npdes = " & ttmunselect!NPDES & ";"
Set modmunselect = dbs.OpenRecordset(SelqryStr)
'Set variable from TT data to be moved into NWPCAM Industrial Table
v_npdes = ttmunselect!NPDES
'Set Flow variables to be used in calculating loads
v_modflow = modmunselect!Flow
v_ttf flow = ttmunselect!Flow 'If TT flows are in gpd, need to add in conversion factor!
'Calculate new flow value to be inserted in industrial select table
'changed from ttmunselect!Flow to v_ttf flow
v_flow_new = modmunselect!Flow - v_ttf flow
'If new flow <0 then set all concentration variables to original values
If v_flow_new <= 0 Then
v_flow_new = modmunselect!Flow / 2
v_bod_new = modmunselect!BOD
v_tss_new = modmunselect!TSS
v_tn_new = modmunselect!TN
v_tp_new = modmunselect!TP
v_fec_new = modmunselect!FEC
v_tkn_new = modmunselect!TKN
ElseIf modmunselect!LEVEL = 2 Then
'Calculate loads for both TT and NWPCAM municipal data
v_bod_new = ((modmunselect!BOD * v_modflow) - (ttmunselect!BOD * v_primary_BOD * v_ttf flow)) /
v_flow_new
v_tss_new = ((modmunselect!TSS * v_modflow) - (ttmunselect!TSS * v_primary_TSS * v_ttf flow)) /
v_flow_new
v_tn_new = ((modmunselect!TN * v_modflow) - (ttmunselect!TN * v_primary_TN * v_ttf flow)) /
v_flow_new
v_tp_new = ((modmunselect!TP * v_modflow) - (ttmunselect!TP * v_primary_TP * v_ttf flow)) /
v_flow_new
v_fec_new = ((modmunselect!FEC * v_modflow) - (ttmunselect!FEC * v_primary_FEC * v_ttf flow)) /
v_flow_new
v_tkn_new = ((modmunselect!TKN * v_modflow) - (ttmunselect!TKN * v_primary_TKN * v_ttf flow)) /
v_flow_new
ElseIf modmunselect!LEVEL = 3 Then
'Calculate loads for both TT and NWPCAM municipal data
v_bod_new = ((modmunselect!BOD * v_modflow) - (ttmunselect!BOD * v_advprimary_BOD *
v_ttf flow)) / v_flow_new
v_tss_new = ((modmunselect!TSS * v_modflow) - (ttmunselect!TSS * v_advprimary_TSS * v_ttf flow)) /
v_flow_new
v_tn_new = ((modmunselect!TN * v_modflow) - (ttmunselect!TN * v_advprimary_TN * v_ttf flow)) /
v_flow_new
v_tp_new = ((modmunselect!TP * v_modflow) - (ttmunselect!TP * v_advprimary_TP * v_ttf flow)) /
v_flow_new
v_fec_new = ((modmunselect!FEC * v_modflow) - (ttmunselect!FEC * v_advprimary_FEC * v_ttf flow)) /
v_flow_new
v_tkn_new = ((modmunselect!TKN * v_modflow) - (ttmunselect!TKN * v_advprimary_TKN * v_ttf flow))
/ v_flow_new
ElseIf modmunselect!LEVEL = 4 Then
'Calculate loads for both TT and NWPCAM municipal data

```

```

    v_bod_new = ((modmunselect!BOD * v_modflow) - (ttmunselect!BOD * v_secondary_BOD * v_ttfloor)) / v_flow_new
    v_tss_new = ((modmunselect!TSS * v_modflow) - (ttmunselect!TSS * v_secondary_TSS * v_ttfloor)) / v_flow_new
    v_tn_new = ((modmunselect!TN * v_modflow) - (ttmunselect!TN * v_secondary_TN * v_ttfloor)) / v_flow_new
    v_tp_new = ((modmunselect!TP * v_modflow) - (ttmunselect!TP * v_secondary_TP * v_ttfloor)) / v_flow_new
    v_fec_new = ((modmunselect!FEC * v_modflow) - (ttmunselect!FEC * v_secondary_FEC * v_ttfloor)) / v_flow_new
    v_tkn_new = ((modmunselect!TKN * v_modflow) - (ttmunselect!TKN * v_secondary_TKN * v_ttfloor)) / v_flow_new
ElseIf modmunselect!LEVEL = 5 Then
'Calculate loads for both TT and NWPCAM municipal data
    v_bod_new = ((modmunselect!BOD * v_modflow) - (ttmunselect!BOD * v_advwt1_BOD * v_ttfloor)) / v_flow_new
    v_tss_new = ((modmunselect!TSS * v_modflow) - (ttmunselect!TSS * v_advwt1_TSS * v_ttfloor)) / v_flow_new
    v_tn_new = ((modmunselect!TN * v_modflow) - (ttmunselect!TN * v_advwt1_TN * v_ttfloor)) / v_flow_new
    v_tp_new = ((modmunselect!TP * v_modflow) - (ttmunselect!TP * v_advwt1_TP * v_ttfloor)) / v_flow_new
    v_fec_new = ((modmunselect!FEC * v_modflow) - (ttmunselect!FEC * v_advwt1_FEC * v_ttfloor)) / v_flow_new
    v_tkn_new = ((modmunselect!TKN * v_modflow) - (ttmunselect!TKN * v_advwt1_TKN * v_ttfloor)) / v_flow_new
ElseIf modmunselect!LEVEL = 6 Then
'Calculate loads for both TT and NWPCAM municipal data
    v_bod_new = ((modmunselect!BOD * v_modflow) - (ttmunselect!BOD * v_advwt2_BOD * v_ttfloor)) / v_flow_new
    v_tss_new = ((modmunselect!TSS * v_modflow) - (ttmunselect!TSS * v_advwt2_TSS * v_ttfloor)) / v_flow_new
    v_tn_new = ((modmunselect!TN * v_modflow) - (ttmunselect!TN * v_advwt2_TN * v_ttfloor)) / v_flow_new
    v_tp_new = ((modmunselect!TP * v_modflow) - (ttmunselect!TP * v_advwt2_TP * v_ttfloor)) / v_flow_new
    v_fec_new = ((modmunselect!FEC * v_modflow) - (ttmunselect!FEC * v_advwt2_FEC * v_ttfloor)) / v_flow_new
    v_tkn_new = ((modmunselect!TKN * v_modflow) - (ttmunselect!TKN * v_advwt2_TKN * v_ttfloor)) / v_flow_new
ElseIf modmunselect!LEVEL = 9 Then
'Calculate loads for both TT and NWPCAM municipal data
    v_bod_new = ((modmunselect!BOD * v_modflow) - (ttmunselect!BOD * v_default_BOD * v_ttfloor)) / v_flow_new
    v_tss_new = ((modmunselect!TSS * v_modflow) - (ttmunselect!TSS * v_default_TSS * v_ttfloor)) / v_flow_new
    v_tn_new = ((modmunselect!TN * v_modflow) - (ttmunselect!TN * v_default_TN * v_ttfloor)) / v_flow_new
    v_tp_new = ((modmunselect!TP * v_modflow) - (ttmunselect!TP * v_default_TP * v_ttfloor)) / v_flow_new
    v_fec_new = ((modmunselect!FEC * v_modflow) - (ttmunselect!FEC * v_default_FEC * v_ttfloor)) / v_flow_new

```

```
v_tkn_new = ((modmunselect!TKN * v_modflow) - (ttmunselect!TKN * v_default_TKN * v_ttflow)) /  
v_flow_new
```

End If

'QA new concentrations to see if any are < 0. If they are, set to default values based on treatment level.

```
If v_bod_new <= 0 Then
```

```
  If modmunselect!LEVEL = 2 Then
```

```
    v_bod_new = 143.5
```

```
  ElseIf modmunselect!LEVEL = 3 Then
```

```
    v_bod_new = 102.5
```

```
  ElseIf modmunselect!LEVEL = 4 Then
```

```
    v_bod_new = 16.4
```

```
  ElseIf modmunselect!LEVEL = 5 Then
```

```
    v_bod_new = 6.2
```

```
  ElseIf modmunselect!LEVEL = 6 Then
```

```
    v_bod_new = 4.1
```

```
  ElseIf modmunselect!LEVEL = 9 Then
```

```
    v_bod_new = 16.4
```

```
  End If
```

```
End If
```

```
If v_tss_new <= 0 Then
```

```
  If modmunselect!LEVEL = 2 Then
```

```
    v_tss_new = 107.5
```

```
  ElseIf modmunselect!LEVEL = 3 Then
```

```
    v_tss_new = 64.5
```

```
  ElseIf modmunselect!LEVEL = 4 Then
```

```
    v_tss_new = 17.2
```

```
  ElseIf modmunselect!LEVEL = 5 Then
```

```
    v_tss_new = 6.5
```

```
  ElseIf modmunselect!LEVEL = 6 Then
```

```
    v_tss_new = 4.3
```

```
  ElseIf modmunselect!LEVEL = 9 Then
```

```
    v_tss_new = 17.2
```

```
  End If
```

```
End If
```

```
If v_tn_new <= 0 Then
```

```
  If modmunselect!LEVEL = 2 Then
```

```
    v_tn_new = 23.4
```

```
  ElseIf modmunselect!LEVEL = 3 Then
```

```
    v_tn_new = 23.4
```

```
  ElseIf modmunselect!LEVEL = 4 Then
```

```
    v_tn_new = 18.3
```

```
  ElseIf modmunselect!LEVEL = 5 Then
```

```
    v_tn_new = 18.4
```

```
  ElseIf modmunselect!LEVEL = 6 Then
```

```
    v_tn_new = 14.4
```

```
  ElseIf modmunselect!LEVEL = 9 Then
```

```
    v_tn_new = 18.3
```

```
  End If
```

```
End If
```

```
If v_tp_new <= 0 Then
```

```
  If modmunselect!LEVEL = 2 Then
```

```
    v_tp_new = 5.2
```



```

ElseIf modmunselect!LEVEL = 3 Then
v_tp_new = 5.2
ElseIf modmunselect!LEVEL = 4 Then
v_tp_new = 2.5
ElseIf modmunselect!LEVEL = 5 Then
v_tp_new = 0.4
ElseIf modmunselect!LEVEL = 6 Then
v_tp_new = 0.4
ElseIf modmunselect!LEVEL = 9 Then
v_tp_new = 2.5
End If
End If
If v_fec_new <= 0 Then
If modmunselect!LEVEL = 2 Then
v_fec_new = 2060000
ElseIf modmunselect!LEVEL = 3 Then
v_fec_new = 2060000
ElseIf modmunselect!LEVEL = 4 Then
v_fec_new = 1580
ElseIf modmunselect!LEVEL = 5 Then
v_fec_new = 1580
ElseIf modmunselect!LEVEL = 6 Then
v_fec_new = 10
ElseIf modmunselect!LEVEL = 9 Then
v_fec_new = 1580
End If
End If
If v_tkn_new <= 0 Then
If modmunselect!LEVEL = 2 Then
v_tkn_new = 23.4

ElseIf modmunselect!LEVEL = 3 Then
v_tkn_new = 23.4
ElseIf modmunselect!LEVEL = 4 Then
v_tkn_new = 16.5
ElseIf modmunselect!LEVEL = 5 Then
v_tkn_new = 12.9
ElseIf modmunselect!LEVEL = 6 Then
v_tkn_new = 3.6
ElseIf modmunselect!LEVEL = 9 Then
v_tkn_new = 16.5
End If
End If
'Update the new row with the constant data to copied from the NWPCAM municipal select table
UpdqryStr = "UPDATE munselect SET " & _
"flow = " & v_flow_new & ", BOD = " & v_bod_new & ", TSS = " & v_tss_new & ", tn = " & v_tn_new
& ", TP = " & v_tp_new & ", FEC = " & v_fec_new & ", TKN = " & v_tkn_new & " " & _
"WHERE npdes = " & v_npdes & ";"
DoCmd.RunSQL (UpdqryStr)
ttmunselect.MoveNext
Loop
ttmunselect.Close

```

```
MsgBox i & " were updated"  
DoCmd.SetWarnings False  
End Sub
```

Module 4: Update indirect facilities

```
Sub UpdateTT Mun()
```

```
'Created 12/5/01 by Amy Miles
```

```
'Last modified 1/9/02 by Amy Miles
```

```
'Tables
```

```
    Dim dbs As Database
```

```
    Dim ttmunselect As Recordset
```

```
    Dim modmunselect As Recordset
```

```
    Set dbs = CurrentDb()
```

```
'Variables
```

```
    Dim i As Long
```

```
    Dim v_npdes As Variant
```

```
    Dim v_type As Variant
```

```
    Dim v_bod As Variant
```

```
    Dim v_tss As Variant
```

```
    Dim v_tn As Variant
```

```
    Dim v_tp As Variant
```

```
    Dim v_fec As Variant
```

```
    Dim v_tkn As Variant
```

```
    Dim v_ttfLOW
```

```
    Dim v_primary_BOD As Variant
```

```
    Dim v_primary_TSS As Variant
```

```
    Dim v_primary_TN As Variant
```

```
    Dim v_primary_TP As Variant
```

```
    Dim v_primary_FEC As Variant
```

```
    Dim v_primary_TKN As Variant
```

```
    Dim v_advprimary_BOD As Variant
```

```
    Dim v_advprimary_TSS As Variant
```

```
    Dim v_advprimary_TN As Variant
```

```
    Dim v_advprimary_TP As Variant
```

```
    Dim v_advprimary_FEC As Variant
```

```
    Dim v_advprimary_TKN As Variant
```

```
    Dim v_secondary_BOD As Variant
```

```
    Dim v_secondary_TSS As Variant
```

```
    Dim v_secondary_TN As Variant
```

```
    Dim v_secondary_TP As Variant
```

```
    Dim v_secondary_FEC As Variant
```

```
    Dim v_secondary_TKN As Variant
```

```
    Dim v_advwt1_BOD As Variant
```

```
    Dim v_advwt1_TSS As Variant
```

```
    Dim v_advwt1_TN As Variant
```

```
    Dim v_advwt1_TP As Variant
```

```
    Dim v_advwt1_FEC As Variant
```

```
    Dim v_advwt1_TKN As Variant
```

```
    Dim v_advwt2_BOD As Variant
```

Dim v_advwt2_TSS As Variant
Dim v_advwt2_TN As Variant
Dim v_advwt2_TP As Variant
Dim v_advwt2_FEC As Variant
Dim v_advwt2_TKN As Variant
Dim v_default_BOD As Variant
Dim v_default_TSS As Variant
Dim v_default_TN As Variant
Dim v_default_TP As Variant
Dim v_default_FEC As Variant
Dim v_default_TKN As Variant
Dim v_seqno As Variant
Dim v_mi As Variant
Dim v_do As Variant
Dim v_cbodtoubod As Variant
Dim v_psfbod As Variant
Dim v_psfstss As Variant
Dim v_cu As Variant
Dim v_seg As Variant
Dim v_name As Variant
v_primary_BOD = 0.7
v_primary_TSS = 0.5
v_primary_TN = 0.78
v_primary_TP = 0.87
v_primary_FEC = 0.65
v_primary_TKN = 0.78
v_advprimary_BOD = 0.5
v_advprimary_TSS = 0.3
v_advprimary_TN = 0.78
v_advprimary_TP = 0.87
v_advprimary_FEC = 0.65
v_advprimary_TKN = 0.78
v_secondary_BOD = 0.08
v_secondary_TSS = 0.08
v_secondary_TN = 0.61
v_secondary_TP = 0.42
v_secondary_FEC = 0.0005
v_secondary_TKN = 0.55
v_advwt1_BOD = 0.03
v_advwt1_TSS = 0.03
v_advwt1_TN = 0.61
v_advwt1_TP = 0.06
v_advwt1_FEC = 0.0005
v_advwt1_TKN = 0.43
v_advwt2_BOD = 0.02
v_advwt2_TSS = 0.02
v_advwt2_TN = 0.48
v_advwt2_TP = 0.06
v_advwt2_FEC = 0.000032
v_advwt2_TKN = 0.12
v_default_BOD = 0.08
v_default_TSS = 0.08

```

v_default_TN = 0.61
v_default_TP = 0.42
v_default_FEC = 0.0005
v_default_TKN = 0.55
'SQL query statement variables
  Dim TTselqryStr As String
  Dim UpdqryStr As String
  Dim SelqryStr As String
'Open TT Municipal Data
  TTselqryStr = "select * from TTIndirect where (option = 'BAT 4' Or option = 'PSES 1');"
  Set ttmunselect = dbs.OpenRecordset(TTselqryStr)
  DoCmd.SetWarnings False
  i = 0
  ttmunselect.MoveFirst
  Do Until ttmunselect.EOF
  i = i + 1
'Select Row in NWPCAM Model Data corresponding to TT data by NPDES number
  SelqryStr = "select * from munselect where npdes = " & ttmunselect!NPDES & ";"
  Set modmunselect = dbs.OpenRecordset(SelqryStr)
'Set variable from TT data to be moved into NWPCAM Industrial Table
  v_npdes = ttmunselect!NPDES
  v_type = "INDIRECT"
'Set Flow variables to be used in calculating loads
  v_ttflow = ttmunselect!Flow 'if TT flows are in gpd, need to add conversion factor
If modmunselect!LEVEL = 2 Then
'Calculate loads for both TT and NWPCAM municipal data
  v_bod = ttmunselect!BOD * v_primary_BOD
  v_tss = ttmunselect!TSS * v_primary_TSS
  v_tn = ttmunselect!TN * v_primary_TN
  v_tp = ttmunselect!TP * v_primary_TP
  v_fec = ttmunselect!FEC * v_primary_FEC
  v_tkn = ttmunselect!TKN * v_primary_TKN
ElseIf modmunselect!LEVEL = 3 Then
'Calculate loads for both TT and NWPCAM municipal data
  v_bod = ttmunselect!BOD * v_advprimary_BOD
  v_tss = ttmunselect!TSS * v_advprimary_TSS
  v_tn = ttmunselect!TN * v_advprimary_TN
  v_tp = ttmunselect!TP * v_advprimary_TP
  v_fec = ttmunselect!FEC * v_advprimary_FEC
  v_tkn = ttmunselect!TKN * v_advprimary_TKN
ElseIf modmunselect!LEVEL = 4 Then
'Calculate loads for both TT and NWPCAM municipal data
  v_bod = ttmunselect!BOD * v_secondary_BOD
  v_tss = ttmunselect!TSS * v_secondary_TSS
  v_tn = ttmunselect!TN * v_secondary_TN
  v_tp = ttmunselect!TP * v_secondary_TP
  v_fec = ttmunselect!FEC * v_secondary_FEC
  v_tkn = ttmunselect!TKN * v_secondary_TKN
ElseIf modmunselect!LEVEL = 5 Then
'Calculate loads for both TT and NWPCAM municipal data
  v_bod = ttmunselect!BOD * v_advwtl_BOD
  v_tss = ttmunselect!TSS * v_advwtl_TSS

```

```

v_tn = ttmunselect!TN * v_advwt1_TN
v_tp = ttmunselect!TP * v_advwt1_TP
v_fec = ttmunselect!FEC * v_advwt1_FEC
v_tkn = ttmunselect!TKN * v_advwt1_TKN
ElseIf modmunselect!LEVEL = 6 Then
'Calculate loads for both TT and NWPCAM municipal data
v_bod = ttmunselect!BOD * v_advwt2_BOD
v_tss = ttmunselect!TSS * v_advwt2_TSS
v_tn = ttmunselect!TN * v_advwt2_TN
v_tp = ttmunselect!TP * v_advwt2_TP
v_fec = ttmunselect!FEC * v_advwt2_FEC
v_tkn = ttmunselect!TKN * v_advwt2_TKN
ElseIf modmunselect!LEVEL = 9 Then
'Calculate concentrations for both TT and NWPCAM municipal data
v_bod = ttmunselect!BOD * v_default_BOD
v_tss = ttmunselect!TSS * v_default_TSS
v_tn = ttmunselect!TN * v_default_TN
v_tp = ttmunselect!TP * v_default_TP
v_fec = ttmunselect!FEC * v_default_FEC
v_tkn = ttmunselect!TKN * v_default_TKN
End If
'Update NWPCAM industrial select table with TT values by corresponding NPDES
UpdqryStr = "UPDATE indselect SET " & _
"flow = " & v_tflow & ", bod = " & v_bod & ", tss = " & v_tss & ", tn = " & v_tn & ", tp = " & v_tp & ",
fec = " & v_fec & ", tkn = " & v_tkn & " " & _
"WHERE npdes = " & v_npdes & ";"
DoCmd.RunSQL (UpdqryStr)
ttmunselect.MoveNext
Loop
ttmunselect.Close
MsgBox i & " were updated"
DoCmd.SetWarnings False
End Sub

```