



# **Technical Development Document for the Final Effluent Limitations Guidelines and Standards for the Meat and Poultry Products Point Source Category (40 CFR 432)**

The full document is available at: <http://www.epa.gov/ost/guide/mpp/>

EPA-821-R-04-011



## SECTION 10

# INCREMENTAL CAPITAL AND OPERATION AND MAINTENANCE COSTS FOR THE FINAL REGULATION

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This section presents EPA's estimates of costs for the meat and poultry products (MPP) industry to comply with the technology options EPA considered as the basis for the final effluent limitations guidelines (ELGs) and standards. A detailed description of the cost methodology and detailed cost estimates are provided in the supplementary technical document *Detailed Costing Document for the Final Effluent Limitations Guidelines and Standards for the Meat and Poultry Products Point Source Category* (hereinafter referred to as the Cost Report). Costs were specifically evaluated for each type of direct discharging MPP facility, including meat, poultry, combined meat and poultry (mixed), and independent rendering facilities. EPA estimated the compliance costs for each technology option to determine potential economic impacts on the MPP industry and to weigh those costs against the benefits of the reduction in pollutants and nutrients resulting from implementation of the technology options.

### 10.1 BACKGROUND

For the proposed rule, EPA developed compliance cost estimates based on the use of model facilities. Specifically, EPA subdivided the entire MPP industry into 19 groups and 4 size classes. EPA used these groups and size classifications to develop 76 model facility groups (19 groups x 4 class sizes = 76) to represent the range of potential MPP facilities currently operating. Costs were developed for each model facility group (MFG). To derive compliance costs for each MFG, the Computer Assisted Procedure for Design and Evaluation of Wastewater Treatment Systems (CAPDET) (Hydromantis, 2001), a computerized cost model, was used for developing construction and annual operation and maintenance costs for required treatment units. Construction costs were used to determine the capital cost of necessary treatment units. To provide the incremental costs for each set of model facilities, the model facility costs were then multiplied by the estimated number of facilities that require the upgrade. For selected technology options, EPA also estimated retrofit costs based on data collected as part of the rule development. Each set of model facility category costs and the retrofit costs were combined separately to

determine costs for each regulatory subcategory (regulatory subcategories A through D, F through I, J, K, and L). A detailed description of the cost method and cost estimates for the proposed rule are available in the development document for the proposed rule (USEPA, 2002).

In response to the proposed ELGs, the Industry Coalition commented that the model facilities EPA had developed were not representative of the MPP industry and that the cost estimates derived were not representative of actual industry costs (Industry Coalition, 2002). The Industry Coalition also criticized the use of CAPDET, which, they asserted, was primarily developed for estimating costs for municipal wastewater treatment.

## **10.2 REVISED METHODOLOGY FOR ESTIMATING COMPLIANCE COSTS**

In response to comments provided on the methods used for the proposed rule and to incorporate additional data collected after the proposed rule was published, EPA revised the methodology for estimating the costs to be incurred by MPP facilities to comply with the final ELGs. In particular, the revised methodology differed from that used for the proposed rule in two significant ways: (1) the costs were estimated on a facility-specific basis for all direct discharging facilities that received a detailed survey and for some that received only a screener survey (rather than using modeled facilities), and (2) the cost models used were customized for the MPP industry. EPA provided the documentation for the revised methodology in the NODA for review and comment (see 68 FR 48479; August 13, 2003).

Since the NODA was published, EPA made some additional changes to the cost methodology and model based on comments received. EPA modified the cost models as appropriate including, for example, revising the values for many of the constants and assumptions used in the model (e.g., labor rates, chemical costs), including costs for the addition of a holding/polishing pond with 7-day retention, and limiting the nitrate recycle rate to a maximum of five times the influent flow when costing facilities for Option 2.5 technology and higher. The Cost Report provides a more detailed description of the cost methodology used for the final rule, including all the equations, constants, and other cost information used by EPA to estimate the incremental capital and operation and maintenance costs associated with achieving the performance levels of the technology options considered by EPA for the final rule.

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The resulting facility-specific compliance cost estimates were then used to estimate compliance costs for the MPP industry (national estimates of costs). In particular, the facility-specific cost estimates were multiplied by the survey weight established for the particular facility. Further discussion of how survey weights were derived for each surveyed facility is provided in Appendix B. The weighted facility estimates were then grouped by regulatory subcategories (e.g., subcategories A through D, F through I, J, K and L) for use in analysis of the technology options.

Costs were specifically estimated for all direct discharging facilities that submitted detailed surveys and perform first processing, further processing, and/or rendering operations, and for direct discharging facilities that submitted only screener surveys and perform further processing and/or rendering operations. Because of the small amount of information available, facilities that had received only screener surveys were costed using additional information obtained from facilities that had performed further processing and/or rendering operations and had submitted a detailed survey. As shown in Table 10-1, cost estimates were derived for 74 direct discharging facilities. Among the 74 direct discharging facilities, 58 submitted detailed surveys and 16 submitted screener surveys.

**Table 10-1.** Number of Facilities for Which Specific Costs Were Estimated for Each MPP Regulatory Subcategory

Regulatory Subcategory	Facility Size	Number of Direct Discharge Facilities	
		Detailed Surveys	Screener Surveys
A–D	Small	1	0
	Non-small	19	0
K	Small	3	0
	Non-small	33	0
F–I and L <sup>a</sup>	Small and Non-small	1	12
J	Non-small	1	4
Total number of surveys		58	16

<sup>a</sup> Includes mixed facilities (facilities that process both meat and poultry).

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As described further in Section 10.5, EPA developed a series of cost models to estimate compliance costs for the 74 direct discharging MPP facilities for each of the technology options considered by the Agency. These models were developed based on cost and performance data related to treatment technologies in use at MPP facilities, supplemented as necessary with a combination of vendor supplied information, data and information provided in the comments on the proposal and NODA, and information from the literature.

Finally, the revisions to the cost estimates were also based on the use of all data available to EPA as part of the data collection efforts for the rule, including data from the detailed and screener surveys of the MPP industry, survey follow-up requests, and other data collection efforts. The MPP industry detailed survey, in particular, included data and information related to MPP facility wastewater characteristics, wastewater flows, and wastewater treatment system operation. Subsequent to the proposed rule, EPA visited and sampled several additional MPP facilities. Section 3 of this document describes EPA's data collection efforts for the development of the final rule.

### **10.3 TECHNOLOGY OPTIONS CONSIDERED AS BASIS FOR EFFLUENT LIMITATIONS GUIDELINES AND STANDARDS**

As described in more detail in Section 9, EPA identified a number of potential technology options that were considered as the basis for developing effluent limitations for the MPP industry. In response to comments on the proposed rule, the technology options EPA considered for the final rule were slightly modified from those considered for the proposed rule. The most significant modification is development of a technology option that accounts for treatment systems that employ partial denitrification of MPP wastewaters (Option 2.5). This technology option does not achieve the same degree of denitrification as the proposed Option 3 (complete denitrification). A summary of the technology options EPA considered as the basis for establishing final ELGs for MPP facilities is provided in Table 10-2. These technology options are applicable to pretreated MPP wastewaters. Pretreatment of MPP wastewater includes any combination of screening, flotation, equalization, dissolved air flotation (with or without chemical addition) and anaerobic treatment.

It should be noted that EPA develops ELGs based on the performance of a combination of processes and treatment technologies but does not require their use. Instead, selection of the specific processes and technologies used to treat MPP wastewaters is left to the discretion of individual MPP facilities. After promulgation of the final rule, EPA will require compliance with the final numerical limitations and standards; MPP facilities will not be required to use specific processes or technologies.

**Table 10-2.** Technology Options Considered by EPA for MPP Facilities

<b>Technology Option</b>	<b>Description</b>
1	Biological treatment <sup>a</sup> plus limited nitrification and disinfection
2	Biological treatment with complete nitrification and disinfection
2+P <sup>b</sup>	Option 2 plus phosphorus removal
2.5	Option 2 plus partial denitrification
2.5+P	Option 2 plus partial denitrification + phosphorus removal
3 <sup>b</sup>	Option 2 plus more complete denitrification
4	Option 2 plus more complete denitrification and phosphorus removal
5 <sup>b</sup>	Option 2 plus more complete denitrification plus chemical phosphorus removal plus filtration

<sup>a</sup> Biological treatment for the MPP ELGs is defined as the removal of biochemical oxygen demand from wastewater by an aerobic biological process.

<sup>b</sup> After the proposed rule was published, EPA no longer considered Option 3 because of difficulty finding facilities with Option 3 in place that had total nitrogen effluent data and no longer considered Options 2 + P and 5 because of the costs involved.

#### **10.4 LONG-TERM AVERAGE CONCENTRATIONS USED FOR ESTIMATING COSTS FOR THE TECHNOLOGY OPTIONS**

EPA identified treatment in-place at MPP facilities that form the basis for the technology options considered for the final ELGs for the MPP industry. The expected performance of each technology option can be described in terms of the long-term average (LTA) pollutant concentrations observed in the effluent at those MPP facilities that have the technology option. Table 10-3 presents the LTAs EPA derived for each technology option, which were used in the

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cost models as the basis for estimating compliance costs. The option LTA concentrations for mixed facilities (i.e., those facilities that process both poultry and meat) were weighted based on the flow and production at the facilities (as reported in the detailed or screener surveys) and the option LTA concentrations in Table 10-3.

**Table 10-3.** Long-Term Average Concentrations Used for Developing Cost Estimates for the Technology Options Considered for the Final MPP Industry Effluent Guidelines

Type of Operation	Technology Option	Technology Option LTA Concentrations (mg/L)						
		Bio-chemical Oxygen Demand	Total Kjeldahl Nitrogen	Ammonia-N	Nitrate+Nitrite	Total Nitrogen	Total Phosphorus	Total Suspended Solids
Poultry	1	8.8	7.17	5.19	N/A	N/A	N/A	10.21
	2	8.8	4.97	1.0	N/A	N/A	N/A	10.21
	2.5	8.8	4.97	1.0	29.24	34.2	N/A	10.21
	2.5+P	8.8	4.97	1.0	29.24	34.2	4.2	10.21
	4	7.0	1.34	0.17	0.52	1.86	2.27	5.05
Meat/ Rendering	1	7.0	8.095	6.115	N/A	N/A	N/A	25.10
	2	7.0	3.615	0.895	N/A	N/A	N/A	25.10
	2.5	7.0	3.615	0.895	30.59	34.2	N/A	25.10
	2.5+P	7.0	3.615	0.895	30.59	34.2	8.28	25.10
	4	6.45	3.17	0.185	10.34	13.51	5.12	18.65

N/A - not applicable.

## 10.5 COST MODELS

EPA developed a series of cost models to estimate the costs required to modify an existing MPP wastewater treatment system to achieve the technology option LTA concentrations (target effluent concentrations) shown in Table 10-3. For the final rule, EPA evaluated four technology options for non-small facilities, including Options 2, 2.5, 2.5+P, and 4. For small facilities, EPA evaluated two technology options for the final rule, including Options 1 and 2.

EPA developed four cost models for each of the technology options considered for non-small facilities (Options 2, 2.5, 2.5+P, and 4). EPA did not specifically develop a cost model for

Option 1 due the small number of facilities that were evaluated and the fact that the technology option included less complicated unit processes (as compared to those for Options 2, 2.5, 2.5+P, and 4). Therefore, the Option 2 cost model with minor modification (e.g., use of LTAs representing Option 1) was used to cost for Option 1. The costs estimated by the models include capital and operation and maintenance (O&M) costs. Within each model, EPA developed cost equations or curves derived from a combination of vendor-supplied information, data and information provided in the MPP detailed surveys, and data and information provided in comments on the proposed rule.

A brief summary of each cost model is provided below; a detailed description of each cost model is available in the Cost Report; and the electronic versions of the cost models are available in Sections 19.5 and 29.2 of the Administrative Record.

#### **10.5.1 Option 1 Cost Model (Biological Treatment with Limited Nitrification)**

The Option 1 cost model estimates the incremental cost required to modify an existing nitrifying MPP facility to achieve the Option 1 LTA concentrations shown in Table 10-3. EPA used the Option 2 cost model (see discussion in Section 10.5.2) with Option 1 LTAs to estimate Option 1 costs for small facilities. This approach produced acceptable cost estimates because the only difference between Options 1 and 2 is the LTAs for total Kjeldahl nitrogen (TKN) and ammonia (as nitrogen).

#### **10.5.2 Option 2 Cost Model (Nitrification)**

The Option 2 cost model estimates the incremental cost required by an existing nitrifying MPP facility to achieve the Option 2 performance levels (LTA concentrations) shown in Table 10-3. The capital cost estimated for this option includes the cost for the addition of a polymer feed system and a holding pond (that could serve as an emergency or polishing pond). The O&M costs include maintenance costs, energy costs for oxygen transfer to remove biochemical oxygen demand (BOD) and ammonia (as nitrogen), alkalinity costs, polymer costs, sludge disposal costs, sampling and analysis costs, and performance costs. The cost model also includes estimated labor costs and energy costs for the polymer feed system.

### **10.5.3 Option 2.5 Cost Model (Nitrification + Partial Denitrification)**

The Option 2.5 cost model estimates the incremental cost to be incurred by a nitrifying MPP facility to move from its baseline to Option 2.5 performance levels. The capital costs include, as needed, costs for anoxic tanks, pumps, mixers, methanol and polymer feed systems, a lagoon bypass, a sludge dewatering system, and a holding pond. The O&M costs include alkalinity costs, methanol costs, polymer costs, sludge disposal costs, sampling and analysis costs for process control, performance costs, compliance costs, and methane revenue loss due to lagoon bypass. The O&M costs also include maintenance costs, labor costs, and energy costs for anoxic tanks, pumps, mixers, methanol and polymer feed systems, a sludge dewatering system, and a holding pond.

### **10.5.4 Option 2.5+P Cost Model (Nitrification + Partial Denitrification + Phosphorus Removal)**

The Option 2.5+P cost model estimates the incremental cost to be incurred by a nitrifying MPP facility to move from its baseline to Option 2.5+P performance levels. The capital costs include, as needed, costs for anoxic tanks, pumps, mixers, methanol and polymer feed systems, an alum feed system, mix tanks, a lagoon bypass, a sludge dewatering system, and a holding pond. The O&M costs include alkalinity costs, polymer costs, alum costs, sludge disposal costs, sampling and analysis costs for process control, performance costs, compliance costs, and methane revenue loss due to lagoon bypass. The O&M costs also include estimated maintenance costs, labor costs, and energy costs for anoxic tanks, pumps, mixers, alum and polymer feed systems, mix tanks, a sludge dewatering system, and a holding pond.

### **10.5.5 Option 4 Cost Model (Nitrification + Denitrification + Phosphorous Removal)**

The Option 4 cost model estimates the incremental cost to be incurred by a nitrifying MPP facility to move from its baseline to Option 4 performance levels. The capital costs include, as needed, costs for anoxic tanks, aeration tanks, pumps, mixers, an aeration system, methanol, polymer and alum feed systems, mix tanks, a lagoon bypass, a filtration system, a sludge dewatering system, and a holding pond. The O&M costs include alkalinity costs, polymer costs, alum costs, sludge disposal costs, sampling and analysis costs for process control, performance

costs, compliance costs, and methane revenue loss due to installation of a lagoon bypass. The O&M costs also include maintenance costs, labor costs, and energy costs for anoxic tanks, aeration tanks, pumps, mixers, an aeration system, an alum and polymer feed system, mix tanks, a filtration system, a sludge dewatering system, and a holding pond. A filtration system is included in the model and used as necessary, particularly when a poultry facility requires use of a filter to achieve the LTA for total suspended solids (TSS).

## **10.6 ESTIMATING FACILITY COSTS**

The primary cost model inputs required for each MPP facility are wastewater treatment plant flow, and influent and effluent pollutant concentrations for select parameters. The data inputs for each facility were obtained from a variety of sources, including the MPP detailed and screener surveys, sampling episode reports, site visit reports, and discharge monitoring reports. In the absence of influent concentrations for a facility, the concentrations were derived from influent concentrations from facilities having similar processing operations and the expected performance (i.e., removal) based on the facility's treatment in place. EPA then classified each facility's wastewater treatment system based on the description provided in the detailed survey and the summary of monitoring data submitted with the survey. After reviewing the current effluent concentrations, treatment in place, Option LTA concentrations, and technology options, EPA decided whether new or additional treatment units would be required to achieve the Option LTA concentrations.

The four cost models (without modifications) estimate costs to convert a nitrification facility to the various technology options. According to the MPP detailed surveys responses, most direct discharging facilities in the MPP industry have treatment systems in place that are already nitrifying. The models described above were used to develop cost estimates for those facilities. However, for some MPP facilities with treatment systems that are not efficiently nitrifying, EPA determined that additional costs for the addition of, or modification to, tanks and/or the aeration system would be required to achieve the Option LTA concentrations. For those facilities the estimated additional costs were added to the costs generated by the cost models.

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To estimate costs for Options 2.5, 2.5+P, and 4 for facilities that are currently denitrifying, the cost models were run twice:

- The first run was used in calculating the costs by identifying equipment sizes involved for attaining the facility's current level of denitrification. The facility-level nitrate/nitrite concentrations for MPP facilities were obtained from survey responses. This run provided the design parameters (e.g., tank size, pump size, horsepower requirements) needed to achieve the nitrate/nitrite effluent concentrations reported by the facility.
- The second run was used in calculating the costs by identifying the equipment sizes involved for attaining the option LTA concentration levels. This run provided the facility-specific design parameters needed to achieve the option LTA concentrations.

The difference in the design parameters from the two model runs was then used to calculate the incremental costs for the facility (for all necessary components). More details regarding how the cost model accounted for existing MPP facilities that already have treatment systems that achieve some level of denitrification are provided in the Cost Report.

In some instances an MPP facility uses a unique treatment system (e.g., sequencing batch reactors) that the cost models were not designed to handle specifically. For these unique instances, the cost models were slightly modified to calculate costs for those particular facilities. However, the concepts and the design and cost equations used in the models remained the same when estimating costs for such facilities.

After costs were estimated for each detailed survey facility for each technology option, EPA multiplied the cost estimate for each facility by the applicable survey weight for the facility to derive a survey-weighted estimate. Weighted estimates were then summed. The result represents a national estimate of the compliance costs for achieving the performance levels associated with each technology option.

## **10.7 SUMMARY OF ESTIMATED COMPLIANCE COSTS**

For the final rule, EPA estimated the incremental costs for complying with the performance levels associated with the regulatory options considered by EPA for the final rule. The results of the cost analysis for each of the non-small direct discharging first processing facilities are provided in Table 10-4. Due to the need for protection of confidential business information (CBI), the individual facility results for the non-small direct discharging further processing and independent rendering facilities are not provided in this section, but are included in the CBI portion of the Administrative Record. A summary of the national cost estimates for all non-small direct discharging facilities is provided in Table 10-5.

Due to the need for protection of CBI, the individual facility results for all small direct discharging facilities are not provided in this section, but are also included in the CBI portion of the Administrative Record. A summary of the national cost estimates for all small direct discharging facilities is provided in Table 10-6. It should be noted that Table 10-6 also includes costs for mixed processors that are attributable to small levels of production of further processed meat (Subcategories F through I) and poultry (Subcategory L). The facility counts presented in these tables include the double counting of seven facilities with production in both non-small Subcategory L and small Subcategories F through I, and three facilities with production in small Subcategory L and small Subcategories F through I.

**Table 10-4.** Summary of Estimated Compliance Costs for Non-Small Direct Discharging First Processing Facilities by Facility and Regulatory Option

DETID	Category	Option 2		Option 2.5		Option 2.5+P		Option 4	
		Incremental Capital Cost	Incremental O&M Cost						
0011	P12	\$736,700	\$156,200	\$1,399,300	\$278,400	\$1,592,900	\$706,700	\$2,876,000	\$926,900
0012	M123 (R123/P2)	\$918,000	\$47,600	\$2,039,100	\$171,000	\$2,773,700	\$1,921,700	\$4,103,800	\$2,268,000
0019	P13	\$508,100	\$84,100	\$1,105,200	\$168,100	\$1,105,200	\$173,100	\$2,716,100	\$571,800
0020	P12	\$833,700	\$93,900	\$1,482,100	\$214,700	\$1,679,700	\$645,100	\$3,710,600	\$1,072,900
0022	P123	\$587,800	\$134,800	\$1,335,400	\$252,000	\$2,892,300	\$967,200	\$4,517,700	\$1,263,500
0026	P123	\$834,600	\$170,900	\$1,671,200	\$299,800	\$2,080,500	\$1,409,200	\$3,631,500	\$1,689,900
0027	P12	\$726,700	\$155,700	\$1,033,700	\$250,000	\$1,212,700	\$639,300	\$2,247,400	\$790,200
0029	P1	\$475,500	\$155,200	\$1,148,700	\$249,800	\$1,229,500	\$412,300	\$3,955,300	\$651,400
0032	P12	\$490,400	\$83,600	\$490,400	\$98,600	\$655,600	\$469,800	\$2,273,800	\$773,800
0039	P12	\$682,200	\$89,300	\$1,397,200	\$165,600	\$1,510,600	\$399,000	\$3,331,300	\$772,600
0042	P12	\$577,100	\$86,200	\$814,100	\$184,300	\$975,400	\$537,300	\$3,298,600	\$731,300
0044	P123	\$654,000	\$143,500	\$664,000	\$152,600	\$2,224,600	\$851,300	\$3,113,000	\$969,400
0045	P12	\$1,089,900	\$105,000	\$1,099,900	\$167,200	\$1,169,300	\$172,200	\$2,015,600	\$376,100
0046	R13	\$282,400	\$28,500	\$965,200	\$150,900	\$1,028,400	\$269,300	\$1,568,800	\$420,200
0054	P12	\$693,500	\$177,400	\$1,232,500	\$259,100	\$1,371,000	\$559,900	\$4,527,000	\$886,100
0256	R13	\$752,600	\$170,300	\$1,991,600	\$168,300	\$3,520,000	\$804,600	\$3,616,100	\$1,071,300
0271	P12	\$145,200	\$109,900	\$145,200	\$124,900	\$145,200	\$129,900	\$185,200	\$148,900
0272	P12	\$501,900	\$213,800	\$501,900	\$213,800	\$501,900	\$218,800	\$1,938,300	\$439,500
0273	P1	\$507,400	\$84,100	\$1,255,800	\$216,800	\$1,321,200	\$335,300	\$2,871,100	\$557,600
0274	P1	\$0	\$20,000	\$0	\$35,000	\$0	\$40,000	\$0	\$48,600
0275	R13	\$866,200	\$126,600	\$1,429,200	\$160,100	\$2,951,500	\$809,100	\$3,056,100	\$1,078,100
0277	R13	\$0	\$20,000	\$4,368,900	\$216,800	\$4,939,800	\$1,317,400	\$6,322,300	\$1,840,300

**Table 10-4.** Summary of Estimated Compliance Costs for Non-Small Direct Discharging First Processing Facilities by Facility and Regulatory Option (Continued)

DETID	Category	Option 2		Option 2.5		Option 2.5+P		Option 4	
		Incremental Capital Cost	Incremental O&M Cost						
0280	R13	\$558,700	\$36,800	\$3,213,700	\$267,000	\$3,360,500	\$1,101,300	\$3,618,600	\$1,173,400
0283	R13	\$501,800	\$53,900	\$1,835,000	\$156,700	\$2,120,600	\$814,700	\$2,786,000	\$1,054,400
0287	M13 (R13/P3)	\$0	\$35,100	\$1,360,900	\$169,600	\$1,451,500	\$348,200	\$2,163,100	\$598,400
0289	P12	\$151,600	\$123,700	\$634,000	\$223,400	\$757,200	\$490,400	\$2,944,100	\$719,700
0290	P1	\$339,700	\$30,200	\$339,700	\$45,200	\$339,700	\$50,200	\$835,600	\$254,600
0291	P12	\$432,700	\$33,000	\$1,030,100	\$148,400	\$1,174,800	\$461,600	\$2,829,500	\$750,200
0292	P123	\$547,400	\$85,300	\$988,000	\$191,400	\$988,000	\$196,400	\$2,760,500	\$490,500
0293	P123	\$585,200	\$86,400	\$1,581,800	\$219,000	\$1,649,000	\$295,700	\$3,237,400	\$529,800
0297	P12	\$522,300	\$60,700	\$532,300	\$65,100	\$1,916,200	\$429,700	\$3,168,100	\$704,200
0300	P123	\$1,631,500	\$252,700	\$1,641,500	\$210,200	\$1,865,200	\$687,700	\$2,393,800	\$1,003,800
0304	P1	\$447,700	\$82,300	\$457,700	\$84,100	\$555,200	\$267,000	\$1,496,300	\$409,000
0307	P123	\$371,500	\$31,200	\$1,159,600	\$155,600	\$1,179,500	\$268,400	\$2,688,900	\$527,500
0308	P12	\$449,500	\$82,500	\$426,100	\$122,100	\$581,300	\$399,800	\$2,140,900	\$694,400
0309	P1	\$429,100	\$157,400	\$441,000	\$159,500	\$506,600	\$321,500	\$1,923,400	\$529,600
0310	P123	\$677,400	\$89,200	\$687,400	\$-81,400	\$756,900	\$-76,400	\$1,658,800	\$129,800
0312	P12	\$435,300	\$49,700	\$1,009,300	\$122,700	\$1,109,200	\$328,700	\$2,840,700	\$617,500
0314	P1	\$432,000	\$81,800	\$432,000	\$96,800	\$505,600	\$206,300	\$2,024,400	\$486,000
0317	R13	\$367,200	\$102,000	\$1,738,100	\$319,000	\$1,806,700	\$481,800	\$1,952,600	\$508,800
0318	R13	\$885,000	\$46,600	\$3,204,600	\$49,900	\$3,672,700	\$1,179,400	\$4,763,600	\$1,521,300
0321	R13	\$1,621,700	\$279,200	\$2,850,500	\$201,100	\$4,589,900	\$1,277,900	\$4,715,200	\$1,532,800
0322	R13	\$1,947,700	\$78,500	\$6,475,400	\$250,200	\$7,463,400	\$2,575,200	\$8,494,600	\$3,174,400

**Table 10-4.** Summary of Estimated Compliance Costs for Non-Small Direct Discharging First Processing Facilities by Facility and Regulatory Option (Continued)

DETID	Category	Option 2		Option 2.5		Option 2.5+P		Option 4	
		Incremental Capital Cost	Incremental O&M Cost						
0325	R13	\$960,000	\$50,500	\$2,435,700	\$5,000	\$4,231,300	\$1,148,700	\$4,407,900	\$1,455,500
0326	R13	\$214,500	\$26,500	\$1,159,700	\$176,000	\$1,262,500	\$399,800	\$1,593,100	\$572,300
0328	R13	\$573,300	\$37,200	\$3,438,100	\$475,900	\$3,535,000	\$590,300	\$3,661,000	\$706,200
0332	M123 (R123/P2)	\$773,300	\$43,900	\$2,394,600	\$143,300	\$4,304,900	\$1,626,000	\$5,393,700	\$1,950,700
0333	R13	\$4,555,200	\$2,992,700	\$11,068,100	\$4,960,000	\$11,689,500	\$5,085,900	\$12,015,800	\$5,307,000
0336	R13	\$1,019,300	\$137,200	\$1,676,400	\$166,700	\$1,919,800	\$747,600	\$2,524,200	\$972,800
0339	P123	\$1,233,000	\$105,800	\$3,763,200	\$23,500	\$3,845,900	\$115,100	\$5,921,800	\$611,400
0340	P13	\$619,600	\$138,500	\$2,137,000	\$261,900	\$2,288,100	\$579,700	\$5,110,600	\$855,700
0342	R13	\$241,000	\$27,600	\$745,000	\$186,500	\$2,194,900	\$677,500	\$3,353,100	\$796,700

**Table 10-5.** Total and Average Compliance Costs for Non-small Facilities by Subcategory and Regulatory Option

Option	Total Costs (1000's, 2003 dollars)			Average Facility Costs (1000's, 2003 dollars)		
	Capital	Post-tax Annualized	Pre-tax Annualized	Capital	Post-tax Annualized	Pre-tax Annualized
Subcategory A-D						
Option 2	\$27,165	\$5,179	\$8,051	\$937	\$179	\$278
Option 2.5	\$75,061	\$12,395	\$18,435	\$2,588	\$427	\$636
Option 2.5+P	\$97,662	\$30,794	\$47,412	\$3,368	\$1,062	\$1,635
Option 4	\$121,753	\$37,382	\$57,451	\$4,198	\$1,289	\$1,981
Subcategory F-I <sup>1</sup>						
Option 2	\$1,106	\$294	\$294	\$276	\$73	\$73
Option 2.5	\$1,124	\$363	\$363	\$281	\$91	\$91
Option 2.5+P	\$1,216	\$396	\$396	\$304	\$99	\$99
Option 4	\$2,350	\$882	\$882	\$588	\$220	\$220
Subcategory J <sup>1</sup>						
Option 2	\$1,429	\$695	\$695	\$75	\$37	\$37
Option 2.5	\$7,755	\$3,123	\$3,123	\$408	\$164	\$164
Option 2.5+P	\$9,978	\$8,212	\$8,212	\$525	\$432	\$432
Option 4	\$12,827	\$11,237	\$11,237	\$675	\$591	\$591
Subcategory K						
Option 2	\$70,650	\$15,026	\$19,598	\$736	\$157	\$204
Option 2.5	\$147,592	\$28,067	\$35,151	\$1,537	\$292	\$366
Option 2.5+P	\$177,432	\$53,370	\$70,027	\$1,848	\$556	\$729
Option 4	\$366,069	\$93,408	\$1,205,090	\$3,813	\$973	\$1,255
Subcategory L <sup>1,2</sup>						
Option 2	\$1,495	\$615	\$615	\$149	\$62	\$62
Option 2.5	\$2,615	\$1,086	\$1,086	\$262	\$109	\$109
Option 2.5+P	\$4,207	\$1,630	\$1,630	\$421	\$163	\$163
Option 4	\$8,641	\$3,612	\$3,612	\$864	\$361	\$361
Total						
Option 2	\$101,845	\$21,808	\$29,253	\$645	\$138	\$185
Option 2.5	\$234,147	\$45,033	\$58,157	\$1,482	\$285	\$368
Option 2.5+P	\$290,495	\$94,403	\$127,677	\$1,839	\$597	\$808
Option 4	\$511,639	\$146,521	\$193,691	\$3,238	\$927	\$1,226

<sup>1</sup> For non-small facilities in Subcategories F through I, J, and L, post-tax annualized costs are equal to pre-tax annualized costs because the analysis is based on model facilities, and EPA assumed a tax shield of \$0 to avoid underestimating impacts.

<sup>2</sup> Subcategory includes seven mixed processor facilities with non-small levels of production in Subcategory L and small levels of production in Subcategory F through I; on average, 61 percent of their production falls into Subcategory L. Compliance costs for mixed processor facilities are distributed between subcategories based on their percentage of production in each.

**Table 10-6.** Total and Average Compliance Costs for Small Facilities by Subcategory and Regulatory Option

Option	Total Costs (1000's, 2003 dollars)			Average Costs (1000's, 2003 dollars)		
	Capital	Post-tax Annualized <sup>1</sup>	Pre-tax Annualized	Capital	Post-tax Annualized <sup>1</sup>	Pre-tax Annualized
Subcategory A-D <sup>2</sup>						
Option 1	\$2,000 - \$4,000	\$1,000 - \$2,500	\$1,000 - \$2,500	\$150 - \$175	\$80 - \$120	\$80 - \$120
Option 2 <sup>3</sup>	NA	NA	NA	NA	NA	NA
Subcategory F-I <sup>4</sup>						
Option 1	\$2,550	\$1,224	\$1,224	\$121	\$58	\$58
Option 2	\$2,550	\$1,233	\$1,233	\$121	\$59	\$59
Subcategory K <sup>2</sup>						
Option 1	\$7,500 - \$10,000	\$2,500 - \$5,000	\$2,500 - \$5,000	\$200 - \$400	\$75 - \$100	\$75 - \$100
Option 2	\$7,500 - \$10,000	\$2,500 - \$5,000	\$2,500 - \$5,000	\$200 - \$400	\$75 - \$100	\$75 - \$100
Subcategory L <sup>5</sup>						
Option 1	\$19	\$15	\$15	\$6	\$5	\$5
Option 2	\$19	\$15	\$15	\$6	\$5	\$5

<sup>1</sup> For small facilities, post-tax annualized costs are equal to pre-tax annualized costs because (1) the facility is an S corporation or LLC (Subcategories A through D and K), so taxes are paid on the income of the owning partners or (2) the analysis is based on model facilities (Subcategories F through I and L), and EPA assumed a tax shield of \$0 to avoid underestimating impacts.

<sup>2</sup> Estimated costs are presented as a range to prevent the disclosure of confidential business information.

<sup>3</sup> Option 2 was not costed for small facilities in this subcategory, because EPA did not propose further regulations.

<sup>4</sup> Subcategory includes 7 mixed processor facilities with small levels of production in Subcategory F-I and non-small levels of production in Subcategory L. This subcategory also includes 3 mixed processor facilities with small levels of production in Subcategory F-I and small levels of production in Subcategory L. Compliance costs for mixed processor facilities are distributed between subcategories based on their percentage of production in each.

<sup>5</sup> Subcategory includes 3 mixed processor facilities with small levels of production in Subcategory L and small levels of production in Subcategory F-I. Compliance costs for mixed processor facilities are distributed between subcategories based on their percentage of production in each.

## 10.8 SUPPLEMENTAL AND SENSITIVITY ANALYSES

As described previously in Section 10.2, EPA received a number of comments on the cost methodology and models used to estimate costs for the proposal and NODA. In particular, the Industry Coalition provided detailed comments on many aspects of the cost model. EPA specifically revised the cost methodology for the final rule to address many of the concerns raised

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by the Industry Coalition about the methods used for the proposal and NODA. In fact, many of the constants used in the new cost models for the final rule (as described further in the Cost Report) are taken from those provided by the Industry Coalition (e.g., constants provided in Appendix G to the Industry Coalition comments on the proposed rule; see DCN 300004).

Although EPA accommodated the majority of comments received on the cost methodology and model, there were several issues for which EPA performed sensitivity analyses (one of which, Run #3, is identified as the supplemental analysis) to determine the potential impact on final rule decisions. These analyses performed by EPA and the results are presented in Table 10-7. As described further in Section 13, EPA selected technology Options 2 and 2.5 as the basis for the BPT and BAT final effluent limitations, and therefore, the supplemental/sensitivity analyses were all performed for technology Options 2 and 2.5. As shown in Table 10-7, based on the results of these analyses, EPA did not change its conclusions regarding economic achievability, cost-reasonableness, or cost-effectiveness of the final rule.

It should be noted that EPA received detailed information about improvements to the wastewater treatment systems for the Facilities 307 and 339 from the actual facilities. The upgrades to the treatment systems occurred after EPA's base year (1999) of the survey (which is the base year for EPA's estimates of incremental compliance costs and pollutant removals). In EPA's sensitivity cost analyses 3 and 4, EPA chose to incorporate this information into its databases. EPA decided that, where facilities had provided enough detailed information regarding treatment system upgrades, the costs and pollutant loadings should reflect the best data possible. Due to the incorporation of this information, EPA's facility-specific estimates of costs and pollutant reductions at each of these two facilities is reduced as compared to the estimates in the cost run for the final rule (as presented in Section 10.8.1 above). Facility 307 is one of the two model facilities whose data (from the years after the upgrade occurred) form the basis of the total nitrogen limitations. Therefore, EPA performed an analysis of costs and pollutant reductions that reflected that treatment in place during those years

As shown in Table 10-7, there were four issues that served as the basis for the four supplemental/sensitivity cost model runs performed by EPA.

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- **Denitrification Rate** - As described further in the Cost Report, EPA used a denitrification rate of 0.171 mg nitrate/nitrite-N denitrified/mg MLVSS-day in its evaluation of different nutrient removal technologies. Using this nitrification rate in its cost model, EPA determined that achieving Option 2.5 nitrogen removals was economically achievable and cost-effective for MPP facilities. EPA recognizes, however, that the actual denitrification rate will vary among facilities and be dependent on a number of factors. In order to confirm its conclusion about the economic achievability of the final rule, EPA performed a sensitivity analysis to determine the potential impact of a lower denitrification rate on the costs of the rule.
- **Methanol Costs** - EPA received comments regarding the price volatility of methanol over the past 10 years, and the potential impact on the cost estimates. Further, comments were received regarding the fact that the unit cost estimates for methanol proposed for use in the cost model for the final rule (\$0.60 per gallon as provided in the industry comments on the proposed rule) are too low. Based on research performed by EPA, EPA believes that the use of \$0.60 per gallon (in 1999 year dollars which is equivalent to \$0.66 per gallon in year 2003 dollars) in the cost model was reasonable for 1999. However, EPA understands the potential varying prices for chemicals such as methanol, therefore, EPA used a methanol price of \$1.05 per gallon (in 1999 year dollars which is equivalent to \$1.16 per gallon in 2003 year dollars) in the supplemental analysis of costs for the final rule. EPA has concluded that increasing costs to \$1.16/gal would not change EPA's decisions regarding the final rule.
- **Emergency Pond Size** - Concerns were raised that EPA did not account for the addition of safety measures such as emergency holding basins that are needed to ensure that periodic upsets at MPP wastewater treatment plants do not result in non-compliance with the final effluent limitations. Although EPA believes that including an emergency pond at a properly designed and operated wastewater treatment plant would be desirable but not necessary, EPA included an emergency/polishing pond with a 7-day detention time in the cost model in an effort to respond to the concerns raised. The revised cost model includes costs for additional ponds that may serve as a polishing pond and/or an emergency storage pond. The pond is designed with a 7-day detention time to be located at the end of the treatment plant and ensures compliance at all times. The pond may be used as a polishing pond to meet the effluent TSS and BOD limits. Since polishing requires 1 to 3 days of detention time, only a fraction of the pond volume is needed for polishing the effluent. The pond may also be used for emergency storage during plant upset. Depending on the duration of plant upset, the entire volume of pond may be used for emergency storage during upset. EPA also performed a supplemental analysis to determine the affect of installation of an emergency pond with a 15-day detention time. As part of this analysis, EPA incorporated data and information provided by the Industry Coalition related to the presence and type of holding or emergency ponds at MPP facilities (which was

not specifically gathered in EPA's detailed survey questionnaire). In this analysis, EPA included costs for additional ponds or for increased capacity of existing ponds. Results of this analysis indicate that the estimated costs for Option 2.5 are still economically achievable, cost reasonable, and cost-effective (for nitrogen removal). Additional information related to how costs were estimated for holding/emergency ponds, including the analysis of costs assuming a 15-day detention time, is provided in the Cost Report.

- **Pretreatment for Facilities with High TKN Influent Loads**—In its primary cost analysis, EPA identified 5 detailed survey respondents with high influent TKN concentrations (i.e., greater than 200 mg/L). In order for these facilities to achieve the targeted long-term average concentration for total nitrogen on Table 10-3 using the Option 2.5 cost model (which is limited to a maximum nitrate recycle rate of 5 times), EPA estimated costs for a two-stage denitrification system. Based on industry comments on EPA's use of two-stage denitrification, EPA performed a supplemental analysis to cost the detailed survey facilities in that situation for additional pretreatment of their raw wastewater followed by single-stage denitrification. EPA costed the incorporation of DAF and chemical addition. The results of this supplemental would not change EPA's conclusions regarding the technology selection, economic achievability, or cost-effectiveness (for total nitrogen) for the final rule.

Table 10-7 provides a summary of the values used in the cost runs and their impact on the estimated costs for the final rule. A brief description of the cost runs follow.

*Original Cost Run:* The results of this cost run are used as the basis for the final rule and were presented in Section 10.8.1 above. This run was performed with the values of constants described in the Cost Report. The cost run included a 7-day holding pond which may be used by a facility both as a polishing pond and/or an emergency pond. Costs for the addition of a holding pond were not included for facilities that have a holding pond in place or a filtration system in place. The cost run was also based on a target LTA concentration of 34.2 mg/L for total nitrogen (see Table 10-3). The total pre-tax annualized costs (2003\$) for non-small facilities based on Option 2.5 was estimated to be \$58.2 million.

*Sensitivity Cost Run 1:* This cost run was performed on eight meat and 12 poultry facilities. Except for the denitrification rate, the values of all other constants used in the Original Cost Run were used. The results of this preliminary analysis indicate that reducing the

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denitrification rate to 0.09 lbs nitrate-N/lb VSS-day would increase the cost of meat and poultry facilities by 16 percent and 7 percent, respectively.

*Sensitivity Cost Run 2:* Similar to Supplement Cost Run 1, this cost run was performed on eight meat and 12 poultry facilities. The values of constants used in the Original Cost Run remained the same except that the denitrification rate was further reduced to 0.05 lbs nitrate-N/lb VSS-day. The results of this preliminary analysis indicate that the cost of meat and poultry facilities would increase by 41 percent and 16 percent, respectively.

*Sensitivity Cost Run 3 (Supplemental Analysis Run):* In this cost run additional facility information received since the Original Cost Run was incorporated by EPA into its analysis of costs. Therefore, the items costed based on treatment in place for some facilities were not the same as those used for the Original Cost Run. For instance, many facilities were costed for a holding pond in the Original Cost Run. Several of those facilities were later found to have a holding pond in place. Consequently, those facilities were no longer costed for a holding pond in this run. In addition, this cost run was based on an increased target LTA concentration of 45.35 mg/L for total nitrogen, which is higher than the total nitrogen levels used for the Original Cost Run. Additional features of this cost run include a revised methanol cost of \$1.05 per gallon and a holding pond with a 15-day detention time. Unlike the Original Cost Run, facilities with a filtration system were also costed for a holding pond. These costs provide a very conservative cost estimate for Option 2.5. The total pre-tax annualized costs (2003\$) for non-small facilities based on Option 2.5 were estimated to be \$52.8 million. The costs were reduced compared to the cost of the Original Cost Run because the target effluent LTA concentration for total nitrogen was increased by more than 10 mg/L to 45.35 mg/L. Moreover, incorporation of additional facility information contributed may have contributed to the decrease in costs.

*Sensitivity Cost Run 4:* This cost run is identical to the Supplemental Cost Run 3 except the denitrification rate is reduced to 0.05 lbs nitrate-N/lb VSS-day. All the features discussed in Supplemental Cost Run 3 are applicable to this cost run. However, it should be noted that the cost estimated by this cost run is extremely conservative and represent the high end of the Industry costs. The total pre-tax annualized costs (2003\$) for the entire rule for Option 2.5 were

estimated to be \$52.8 million. Even with this high end of the cost, the final rule was found to be cost effective.

**Table 10-7.** Summary of Supplemental Cost Analyses Performed for the MPP Final Rule

<b>Cost Run</b>	<b>Description</b>	<b>Denitrification Rate (lbs Nitrate-N/lb VSS-day)</b>	<b>Methanol Costs (\$/gallon)</b>	<b>Holding Pond Detention Time (Days)</b>	<b>Results (Annualized Costs)</b>
Original	Effluent TN = 34 mg/L	0.17	0.60	7	\$58.2 million
Sensitivity 1	Preliminary estimates Effluent TN = 34 mg/L	0.09	0.60	7	Increases cost for meat facilities by 16%; Increases cost for poultry facilities by 7%
Sensitivity 2	Preliminary estimates Effluent TN = 34 mg/L	0.05	0.60	7	Increases cost for meat facilities by 41%; Increases cost for poultry facilities by 16%
Sensitivity 3 <sup>a</sup>	Effluent TN = 45 mg/L	0.17	1.05	15	\$52.8 million
Sensitivity 4 <sup>a</sup>	Effluent TN = 45 mg/L	0.05	1.05	15	\$60.2 million

<sup>a</sup> These runs were based on higher target effluent nitrogen concentrations and also included updated facility data and information made available since the NODA. Run #3 was used as the supplemental analysis.

## 10.9 REFERENCES

Hydromantis, Inc.2001. *Computer Assisted Procedure for Design and Evaluation of Wastewater Treatment Systems (CAPDET), Version 1.0: State-of-the-art software for the design and cost estimation of wastewater treatment plants.* [computer program]. Hamilton, Canada. <http://www.hydromantis.com>.

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