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Development Document for Effluent Limitations Guidelines and Standards for the

Final

Organic Chemicals, Plastics and Synthetic Fibers

Point Source Category

Volume II

ABSTRACT

This document describes the technical development of the U.S. Environmental Protection Agency's promulgated effluent limitations guidelines and standards that control the discharge of pollutants into navigable waters and publicly owned treatment works (POTWs) by existing and new sources in the organic chemicals, plastics, and synthetic fibers point source category. The regulation establishes effluent limitations guidelines attainable by the application of the "best practicable control technology currently available" (BPT) and the "best available technology economically achievable" (BAT), Pretreatment standards applicable to existing and new discharges to POTWs (PSES and PSNS, respectively), and new source performance standards (NSPS) attainable by the application of the "best available demonstrated control technology." The regulation was promulgated under the authority of Sections 301, 304, 306, 307, 308, and 501 of the Clean Water Act (the Federal Water Pollution Control Act Amendments of 1972, 33 U.S.C. 1251 et seq., as amended). It was also promulgated in response to the Settlement Agreement in Natural Resources Defense Council, Inc. v. Trian, 8 ERC 2120 (D.D.C. 1976), modified, 12 ERC 1833 (D.D.C.).

DEVELOPMENT DOCUMENT FOR EFFLUENT LIMITATIONS GUIDELINES NEW SOURCE PERFORMANCE STANDARDS AND PRETREATMENT STANDARDS FOR THE ORGANIC CHEMICALS AND THE PLASTICS AND SYNTHETIC FIBERS POINT SOURCE CATEGORY

Volume II

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SECTION VIII

ENGINEERING COSTS AND NON-WATER QUALITY ASPECTS

A. INTRODUCTION

This section addresses the capital and operation and maintenance costs associated with meeting BPT, BAT, and PSES effluent limitations guidelines. Incremental expenditures required to upgrade control and treatment technology presently in-place have been presented where applicable.

The section has been organized into the following parts:

- Costing Methodologies
  - BPT
  - BAT
  - PSES
  - Other Factors
- BPT Technologies
  - Activated Sludge
  - Biological Treatment Upgrades
  - Chemically Assisted Clarification
  - Filtration
  - Polishing Ponds
  - Algae Control
- BAT and PSES Technologies
  - Steam Stripping
  - Activated Carbon
  - Coagulation/Flocculation/Clarification
  - Cyanide Destruction
  - In-Plant Biological Treatment
- Additional Costs
  - Contract Hauling
  - Monitoring Costs
  - Sludge Disposal (Incineration)
  - RCRA Baseline Costs
- Wastewater and Air Emissions Loadings
  - BPT Conventional Pollutant Wastewater Loadings
  - BAT and PSES Toxic Pollutant Wastewater Loadings
  - BAT and PSES Toxic Pollutant Air Emission Loadings.

B. COSTING METHODOLOGIES

1. BPT Costing Methodology

BOD_5 and TSS effluent long-term average target values were provided by the subcategorization regression model equation for BPT Option I. The target value is the long-term average concentration that represents compliance with BPT limitations. These targets are presented in Appendix VII-A of this document. For full-response plants without reported BOD_5 and TSS effluent values for their current discharges and for Part A plants [reported BOD_5 and TSS effluent data for combined organic chemicals, plastics, and synthetic fibers (OCPSF) and non-OCPSF wastewaters], estimated values were calculated using a revised version of the regression equation that calculated BOD_5 and TSS long-term average discharge concentration values based on the plant's product mix and the reported BOD_5 and TSS discharge values from OCPSF plants having similar product mixes. Appendix VIII-A presents the methodology used to estimate these values.

A delta BOD_5 and TSS (i.e., the amount, if any, by which a plant currently exceeds the long-term average target values) were calculated by subtracting the target values from the reported BOD_5 and TSS effluent values for each plant. These delta values were then compared to the delta BOD_5 and TSS ranges contained in Table VIII-1, and based on whether biological treatment or polishing ponds were already in-place, a treatment technology was selected for costing. For estimating compliance costs, plants with only aerobic or anaerobic lagoons were not considered to have biological treatment in-place because of the relatively inefficient and unpredictable nature of their performance. For example, a plant with biological treatment in-place, no polishing pond in-place, reported BOD_5 and TSS effluent data of 35 mg/l and 45 mg/l, respectively, and target BOD_5 and TSS values of 20 mg/l and 40 mg/l, respectively, would yield delta BOD_5 and TSS values of 15 mg/l and 5 mg/l, respectively. Based on the BPT costing rules outlined in Table VIII-1, this plant would be costed for biological treatment upgrades and a chemically assisted clarifier.

TABLE VIII-1.
BPT COSTING RULES

I. BIOLOGICAL TREATMENT IN PLACE	SYSTEM TO COST
A. Δ BOD 0-3 mg/l and;	
1. Δ TSS 0-3 mg/l	0 COSTS
2. Δ TSS > 3 without polishing pond	Chemically assisted clarifier (additional unit operation)
3. Δ TSS > 3 with polishing pond	Add $CuSO_4$ or upgrade existing secondary clarifier (when present) with polymer addition system
B. Δ BOD > 3-15 mg/l and,	
1. Δ TSS 0-3 mg/l	Biological treatment upgrades
2. Δ TSS > 3 without polishing pond	Biological treatment upgrades and chemically assisted clarifier (additional unit operation)
3. Δ TSS > 3 with polishing pond	Biological treatment upgrades and add $CuSO_4$
C. Δ BOD > 15-25 mg/l and;	
1. Δ TSS 0-3 mg/l	Biological treatment upgrades and chemically assisted clarifier (additional unit operation)
2. Δ TSS > 3 without polishing pond	Biological treatment upgrades and chemically assisted clarifier (additional unit operation)
3. Δ TSS > 3 with polishing pond	Biological treatment upgrades, chemically assisted clarifier (additional unit operation), and add $CuSO_4$.

TABLE VIII-1.
BPT COSTING RULES
(Continued)

D. Δ BOD > 25 mg/l and;	
1. Δ TSS 0-3 mg/l	Second stage biological
2. Δ TSS > 3 without polishing pond	Second stage biological
3. Δ TSS > 3 with polishing pond	Second stage biological
BIOLOGICAL TREATMENT NOT IN-PLACE	
A. Δ BOD 0-3 mg/l and;	
1. Δ TSS 0-3 mg/l	0 COSTS
2. Δ TSS > without polishing pond	Chemically assisted clarifier (additional unit operation)
3. Δ TSS > 3 with polishing pond	Add $CuSO_4$
B. Δ BOD > 3-15 mg/l and,	
1. Δ TSS 0-3 mg/l	Activated sludge
2. Δ TSS > 3 without polishing pond	Chemically assisted clarifier (additional unit operation)
3. Δ TSS > 3 with polishing pond	Chemically assisted clarifier (additional unit operation) and add $CuSO_4$
C. Δ BOD > 15 mg/l	Activated sludge

The following are the U.S. Environmental Protection Agency's (EPA's) decision criteria for the BPT cost estimation procedures:

- Delta BOD_5 and TSS ranges from 0 to 3 mg/l did not require additional costs because, in EPA's judgment, improved housekeeping and operation of the existing treatment system should enable a plant to attain the applicable target with minimal cost expenditures. For example, as cited in Section VII, modifying the speed of the sludge riser pipe mechanism at a POTW circular clarifier reduced effluent TSS by 10.5 percent.

- The Agency assumed that part of the required additional TSS removals necessary at plants with polishing ponds in-place was due to algae problems and these plants were costed for copper sulfate addition; for those plants with polishing ponds that also had secondary clarifiers in-place, clarifier upgrade costs associated with a polymer addition system were estimated and used.

- BOD_5 removals required at plants without biological treatment in-place and having a delta TSS of 0 to 3 mg/l were costed for full-scale activated sludge because EPA assumed the BOD_5 present was soluble.

- Plants without polishing ponds in-place would add chemically assisted clarification (CAC) to achieve additional TSS removals. CAC has been shown (see Section VII) to remove TSS to levels between 20 and 30 mg/l, which would allow plants to meet all TSS subcategory long-term averages.

- For plants that have to remove 15 to 25 mg/l of BOD_5 and 3 mg/l or greater of TSS, the Agency has assumed that a significant portion of the BOD_5 can be removed with the removal of the TSS (i.e., insoluble BOD_5 associated with the TSS) and that the remainder of the BOD_5 (i.e., soluble BOD_5) can be removed through biological treatment system upgrades. With typical BOD_5 raw waste concentrations in the OCPSF industry of 600 mg/l, biological treatment upgrades would have to provide only an additional 6 percent removal. As shown in Section VII, biological treatment upgrades can achieve these percent removals consistently.

Using the technologies selected by the methodology described above and in Table VIII-1, a cost estimate was developed using the cost curves presented in the following sections and each plant's OCPSF process wastewater flows from the Section 308 Questionnaire data base. As noted in Section VII, the Agency considers certain wastewater flows originally reported by some plants as nonprocess wastewater to be more properly handled as process wastewater for the purposes of establishing effluent limitations and estimating engineering costs of compliance. In the Agency's judgment, these designed "nonprocess" flows are contaminated by process sources of conventional pollutants that should characterize them as process wastewater under 40 CFR 401.11(q). A listing of "contaminated nonprocess" (defined as process) and uncontaminated nonprocess wastewaters can be found in Section VII.

The Agency considered the use of peak or maximum wastewater flows for calculating compliance costs for BPT end-of-pipe treatment, but decided that average wastewater flows were more appropriate for cost estimation purposes for the following reasons:

- EPA did not possess plant-by-plant peak or maximum flow data for use in compliance cost estimates.
- EPA did obtain daily flow data for the daily data plants used for BPT variability factor calculations. Analysis of these data revealed that using the 90th percentile of the daily flow data to approximate peak or maximum flow caused flow to increase approximately 25 percent on average.
- EPA performed a sensitivity analysis using the Computer Assisted Procedure for the Design and Evaluation of Wastewater Treatment Systems (CAPDET) activated sludge algorithm to determine the effect of the maximum flow input variable on compliance costs for activated sludge. The results showed that the input of a maximum flow, which was 30 percent higher than the average flow into the large system activated sludge CAPDET algorithm, yielded annual compliance costs that were less than 1 percent higher. (Capital costs were approximately 2 percent higher, while the O&M cost difference was negligible.)

In addition to the reasons stated above, EPA also believes that proper equalization of wastewater flows in preliminary treatment steps prior to discharge to biological treatment and other downstream treatment technologies negates the detrimental effects of flow surges as well as the need to oversize downstream technologies to account for these flows. As stated in Section VII, approximately 104 of 304 direct discharging OCPSF plants have equalization in-place. The Agency also determined that cost estimation for plant-by-plant flow equalization units was not possible, since proper design of equalization basins requires hourly flow data, which EPA did not obtain as part of its Section 308 Questionnaire. However, the presence of other preliminary treatment technologies, such as neutralization (175 plants), primary clarification (62 plants), flotation (11 plants), oil removal/separation (110 plants), and coagulation/flocculation (41 plants), can provide equalization retention times of up to 4 hours. (8-3) Moreover, EPA compared the cost estimates generated for biological treatment systems from the CAPDET costing algorithm (described later in this section) to those obtained from wastewater treatment equipment vendors. The vendor quotes for biological treatment systems included equalization unit operations and generally compared favorably to the cost estimates generated by CAPDET.

Based on these factors, the Agency has decided to retain the use of average flow as the basis of its compliance cost estimates.

The design parameters and cost curves for each of the technologies costed for BPT are presented later in this section.

2. BAT Costing Methodology

Prior to calculation of BAT compliance costs, certain preliminary evaluations were performed. First, it was necessary to determine raw waste concentrations for the toxic pollutants present in the product/process waste streams at each plant. This was done using the toxic pollutant loadings estimates calculated using only the Master Process File (MPF). The MPF is the primary source of raw waste toxic pollutant data, providing data for 176 product/processes utilized by the OCPSF industry. For product/processes other than these 176, product average raw waste concentrations were calculated by using all product/processes that manufacture a particular product, regardless of process. If none of the 176 product/processes in the MPF covered a particular product/process on a product basis, average raw waste concentrations were constructed by grouping product/processes in the MPF by common generic processes. Table VIII-2 presents the major generic processes that were used to calculate these generic average raw waste concentrations.

Once actual raw waste concentrations were established for each product/process waste stream, these concentrations were compared to influent "trigger" values or long-term median effluent values from the in-plant control applicable to each regulated pollutant. "Trigger" values were established for regulated pollutants to determine if particular in-plant technology was neces-

TABLE VIII-2.
GENERIC CHEMICAL PROCESSES

Acid Cleavage	Fiber Production
Acylation	Fluorination
Addition	
Alcoholysis	Hydration
Alkoxylation	Hydroacetylation
Amination	Hydrocyanation
Ammoxidation	Hydrogenation
	Hydrohalogenation
Bromination	Hydrolysis
	Hydroxylation
Carbonylation	
Chlorination	Iodination
Chlorohydrination	Isomerization
Condensation	
Crystallization/Distillation	Neutralization
Cyanation	Nitration
	Nitrosation
Decarboxylation	Oxidation
Dehydration	Oxidation/Reduction
Dehydrogenation	Oximation
Dehydrohalogenation	Oxyhalogenation
Depolymerization	
Diazotization	Peroxidation
Dimerization	Phosgenation
Distillation	Phosphonation
	Polymerization
Electrohydrodimerization	Pyrolysis
Epoxidation	
Esterification	Rearrangement
Etherification	
Extraction	Sulfation
Extractive Distillation	Sulfonation
	Transesterification

sary and needed to be costed for a particular product/process waste stream. They were developed through the review of Verification, EPA/CMA 5-Plant Study, and EPA 12-Plant Study sampling data by determining the average influent concentration of each regulated pollutant that produced an effluent concentration that was comparable to the long-term average values being considered for the BAT options. A listing of the BAT Option II "trigger" value for each regulated pollutant is presented in Table VIII-3.

If a product/process waste stream's concentration for a regulated pollutant was higher than that pollutant's "trigger" value, then the applicable in-plant control was costed to remove or reduce the concentration of the pollutant. Otherwise, it was assumed that the end-of-pipe BPT treatment system would suffice to achieve the BAT limitations; i.e., no in-plant controls would be added by the plant to comply with BAT limitations. For those direct discharging plants without biological treatment in-place after BPT costing, long-term average effluent values for the in-plant control applicable to each regulated pollutant were used instead of "trigger" values.

Only BAT Option II was costed for the final costing exercise and is described in detail in this section. A list of the pollutants regulated under this option and the long-term average effluent value for each pollutant are presented in Table VIII-4. Two versions of BAT Option II were costed, using in-plant biological treatment (BAT Option IIB) in place of activated carbon and steam stripping (BAT Option IIA) for the pollutants listed in Table VIII-5. Also, two pollutants (4-nitrophenol and 4,6-dinitro-o-cresol), which were previously costed for steam stripping for BAT Option IIA, were now costed for activated carbon in BAT Option IIB because of the lack of steam stripping performance data and the presence of activated carbon performance data for limitations calculations. Also, one pollutant (nitrobenzene), which was previously costed for activated carbon only for BAT Option IIA, was now costed for steam stripping followed by activated carbon because the available performance data for limitations calculations relies on steam stripping and activated carbon. It should be noted that originally the Agency had estimated compliance costs using three strippability and adsorpability groups (high, medium, and low) for its July 17, 1985 Notice of Availability (NOA). (These groups have been previously discussed in Section VII.) However, for its

TABLE VIII-3.
"TRIGGER" VALUES USED AS BAT OPTION II IN-PLANT COSTING TARGETS
FOR PLANTS WITH END-OF-PIPE BIOLOGICAL TREATMENT IN-PLACE

Pollutant Number	Pollutant Name	Concentration (mg/l)
1	Acenaphthene	1.0
3	Acrylonitrile	200.0
4	Benzene	40.0
6	Carbon Tetrachloride	1.0
7	Chlorobenzene	1.0
8	1,2,4-Trichlorobenzene	0.25
9	Hexachlorobenzene	0.92
10	1,2-Dichloroethane	5.0
11	1,1,1-Trichloroethane	5.0
12	Hexachloroethane	0.5
13	1,1-Dichloroethane	0.015
14	1,1,2-Trichloroethane	5.0
16	Chloroethane	1.0
23	Chloroform	3.0
25	1,2-Dichlorobenzene	1.0
26	1,3-Dichlorobenzene	1.0
27	1,4-Dichlorobenzene	1.0
29	1,1-Dichloroethylene	10.0
30	1,2-trans-Dichloroethylene	10.0
32	1,2-Dichloropropane	3.0
33	1,3-Dichloropropene	3.0
34	2,4-Dimethylphenol	30.0
38	Ethylbenzene	40.0
39	Fluoranthene	5.0
42	Bis(2-Chloroisopropyl)Ether	1.0
44	Methylene Chloride	5.0
45	Methyl Chloride	5.0
52	Hexachlorobutadiene	5.0
55	Naphthalene	25.0

TABLE VIII-3.
"TRIGGER" VALUES USED AS BAT OPTION II IN-PLANT COSTING TARGETS
FOR PLANTS WITH END-OF-PIPE BIOLOGICAL TREATMENT IN-PLACE
(Continued)

Pollutant Number	Pollutant Name	Concentration (mg/l)
56	Nitrobenzene	1.0
57	2-Nitrophenol	1.0
58	4-Nitrophenol	10.0
59	2,4-Dinitrophenol	2.0
60	4,6-Dinitro-o-cresol	10.0
65	Phenol	900.0
66	Bis(2-Ethylhexyl)Phthalate	5.0
68	Di-n-Butyl-Phthalate	5.0
70	Diethyl Phthalate	5.0
71	Dimethyl Phthalate	5.0
72	Benzo(a)Anthracene	1.0
73	Benzo(a)Pyrene	1.0
74	3,4-Benzofluoranthene	1.0
75	Benzo(k)Fluoranthane	1.0
76	Chrysene	1.0
77	Acenaphthylene	1.0
78	Anthracene	1.0
80	Fluorene	1.0
81	Phenanthrene	1.0
84	Pyrene	1.0
85	Tetrachloroethylene	5.0
86	Toluene	10.0
87	Trichloroethylene	5.0
88	Vinyl Chloride	10.0
119	Chromium	1.3
120	Copper	2.0
121	Cyanide	1.0
122	Lead	1.0
124	Nickel	2.5
128	Zinc	1.0

TABLE VIII-4.
BAT LONG-TERM MEDIANS USED AS COSTING TARGETS
FOR PLANTS WITHOUT BIOLOGICAL TREATMENT IN-PLACE

Pollutant Number	Pollutant Name	Concentration (mg/l)
1	Acenaphthene	0.010
3	Acrylonitrile	0.050
4	Benzene	0.015
6	Carbon Tetrachloride	0.015
7	Chlorobenzene	0.015
8	1,2,4-Trichlorobenzene	0.015
9	Hexachlorobenzene	0.015
10	1,2-Dichloroethane	0.015
11	1,1,1-Trichloroethane	0.015
12	Hexachloroethane	0.015
13	1,1-Dichloroethane	0.015
14	1,1,2-Trichloroethane	0.015
16	Chloroethane	0.050
23	Chloroform	0.015
25	1,2-Dichlorobenzene	0.015
26	1,3-Dichlorobenzene	0.015
27	1,4-Dichlorobenzene	0.015
29	1,1-Dichloroethylene	0.015
30	1,2-trans-Dichloroethylene	0.015
32	1,2-Dichloropropane	0.015
33	1,3-Dichloropropene	0.015
34	2,4-Dimethylphenol	0.010
38	Ethylbenzene	0.015
39	Fluoranthene	0.012
42	Bis(2-chloroisopropyl)Ether	0.015
44	Methylene Chloride	0.015
45	Methyl Chloride	0.050
52	Hexachlorobutadiene	0.015
55	Naphthalene	0.010

TABLE VIII-4.
BAT LONG-TERM MEDIANS USED AS COSTING TARGETS
FOR PLANTS WITHOUT BIOLOGICAL TREATMENT IN-PLACE
(Continued)

Pollutant Number	Pollutant Name	Concentration (mg/l)
56	Nitrobenzene	0.713
57	2-Nitrophenol	0.020
58	4-Nitrophenol	0.050
59	2,4-Dinitrophenol	0.373
60	4,6-Dinitro-o-cresol	0.024
65	Phenol	0.010
66	Bis(2-Ethylhexyl)Phthalate	0.050
68	Di-n-Butyl-Phthalate	0.025
70	Diethyl Phthalate	0.045
71	Dimethyl Phthalate	0.025
72	Benzo(a)Anthracene	0.010
73	Benzo(a)Pyrene	0.010
74	3,4-Benzofluoranthene	0.010
75	Benzo(k)Fluoranthane	0.010
76	Chrysene	0.010
77	Acenaphthylene	0.010
78	Anthracene	0.010
80	Fluorene	0.010
81	Phenanthrene	0.010
84	Pyrene	0.010
85	Tetrachloroethylene	0.015
86	Toluene	0.015
87	Trichloroethylene	0.015
88	Vinyl Chloride	0.050
119	Chromium	0.263
120	Copper	0.406
121	Cyanide	0.180
122	Lead	0.043
124	Nickel	0.600
128	Zinc	0.549

TABLE VIII-5.
POLLUTANTS TO BE CONTROLLED USING IN-PLANT
BIOLOGICAL TREATMENT

Pollutant Number	Pollutant Name
1	Acenaphthene
3	Acrylonitrile
34	2,4-Dimethylphenol
39	Fluoranthene
55	Naphthalene
65	Phenol
66	Bis(2-Ethylhexyl)Phthalate
68	Di-N-Butyl Phthalate
70	Diethyl Phthalate
71	Dimethyl Phthalate
72	Benzo(a)Anthracene
73	Benzo(a)Pyrene
74	3,4-Benzofluoranthene
75	Benzo(k)Fluoranthene
76	Chrysene
77	Acenaphthylene
78	Anthracene
80	Fluorene
81	Phenanthrene
84	Pyrene

December 8, 1986 NOA, EPA decided to place each pollutant in its most logical technology grouping for the purposes of compliance cost estimates, and this resulted in all pollutants selected for steam stripping to fall in the high and medium strippability groups (see Tables VIII-6 and VIII-7). Since the pollutants remaining for activated carbon were predominantly in the medium and low adsorpability groups, the Agency decided to shift the pollutants remaining in the high adsorpability group to the medium adsorpability group and to use only two adsorpability (medium and low) groups for estimating compliance costs for BAT Option IIA. As noted above, further revisions were made to the pollutants in these groupings with the addition of in-plant biological treatment as a basis for compliance cost estimations for BAT Option IIB.

The various treatment technologies that could be costed depended upon each toxic pollutant's characteristics, including its volatility, adsorpability, and solubility. Tables VIII-6 through VIII-9 present the organic toxic pollutants that are best treated by steam stripping (high and medium strippability groups) and activated carbon (medium and low adsorpability groups), respectively, which were used to cost BAT Option IIA. Tables VIII-10 through VIII-13 present the organic toxic pollutants that are best treated by steam stripping (high and medium strippability groups) and activated carbon (medium and low adsorpability groups), respectively, which were used to cost BAT Option IIB. Chemical precipitation, specifically sulfide precipitation, was costed for toxic pollutant metals control. The treatability data in Section VII show that sulfide precipitation can remove toxic metals to levels even lower than lime precipitation. Furthermore, sulfide precipitation is more costly to purchase and operate than lime precipitation. However, since the promulgated numerical limitations are based on lime precipitation for metals control, the estimated costs of compliance are conservatively high, and account for those plants that may prefer to install sulfide precipitation in order to meet the required level of pollution control. Cyanide destruction (alkaline chlorination) was costed for total cyanide for both BAT Options IIA and IIB.

After selection of the appropriate technologies for each pollutant product/process combination, the product/process flows were summed for each technology and this sum was used to estimate the compliance costs associated

TABLE VIII-6.
HIGH STRIPPABILITY PRIORITY POLLUTANTS
COSTED STEAM STRIPPING FOR BAT OPTION IIA AND PSES IVA

Pollutant Number	Pollutant Name
4	Benzene
6	Carbon tetrachloride
7	Chlorobenzene
11	1,1,1-Trichloroethane
13	1,1-Dichloroethane
16	Chloroethane
23	Chloroform
26	1,3-Dichlorobenzene
27	1,4-Dichlorobenzene
29	1,1-Dichloroethylene
30	1,2-trans-Dichloroethylene
38	Ethylbenzene
45	Methyl chloride
85	Tetrachlorethylene
86	Toluene
87	Trichloroethylene
88	Vinyl chloride

TABLE VIII-7.
MEDIUM STRIPPABILITY PRIORITY POLLUTANTS
COSTED FOR STEAM STRIPPING FOR BAT OPTION IIA AND PSES OPTION IVA

Pollutant Number	Pollutant Name
1	Acenaphthene
3	Acrylonitrile
8	1,2,4-Trichlorobenzene
9	Hexachlorobenzene
10	1,2-Dichloroethane
12	Hexachloroethane
14	1,1,2-Trichloroethane
25	1,2-Dichlorobenzene
32	1,2-Dichloropropane
33	1,3-Dichloropropene
42	bis(2-Chloroisopropyl) Ether
44	Methylene Chloride
52	Hexachlorobutadiene
55	Naphthalene
58	4-Nitrophenol
60	4,6-Dinitro-o-cresol
75	Benzo(k)fluoranthane
77	Acenaphthylene
78	Anthracene
80	Fluorene
81	Phenanthrene

TABLE VIII-8.
MEDIUM ADSORPABILITY PRIORITY POLLUTANTS COSTED FOR
ACTIVATED CARBON FOR BAT OPTION IIA AND PSES OPTION IVA

Pollutant Number	Pollutant Name
39	Fluoranthene
57	2-Nitrophenol
66	bis(2-Ethylhexyl) Phthalate
67	Butyl Benzyl Phthalate
68	di-n-Butyl Phthalate
70	Diethyl Phthalate
71	Dimethyl Phthalate

TABLE VIII-9.
LOW ADSORPABILITY PRIORITY POLLUTANTS COSTED FOR
ACTIVATED CARBON FOR BAT OPTION IIA AND PSES OPTION IVA

Pollutant Number	Pollutant Name
34	2,4-Dimethylphenol
56	Nitrobenzene
59	2,4-Dinitrophenol
65	Phenol
72	Benzo(a)Anthracene
73	Benzo(a)Pyrene
74	3,4-Benzofluoranthane
75	Benzo(k)fluoranthene
76	Chrysene
84	Pyrene

TABLE VIII-10.
HIGH STRIPPABILITY PRIORITY POLLUTANTS COSTED FOR
STEAM STRIPPING FOR BAT OPTION IIB AND PSES OPTION IVB

Pollutant Number	Pollutant Name
4	Benzene
6	Carbon Tetrachloride
7	Chlorobenzene
11	1,1,1-Trichlorobenzene
13	1,1-Dichloroethane
16	Chlorobenzene
23	Chloroform
26	1,3-Dichlorobenzene
27	1,4-Dichlorobenzene
29	1,1-Dichloroethylene
30	1,2-Trans-Dichloroethylene
38	Ethylbenzene
45	Methyl Chloride
85	Tetrachloroethylene
86	Toluene
87	Trichloroethylene
88	Vinyl Chloride

TABLE VIII-11.
MEDIUM STRIPPABILITY PRIORITY POLLUTANTS COSTED FOR
STEAM STRIPPING FOR BAT OPTION IIB AND PSES OPTION IVB

Pollutant Number	Pollutant Name
8	1,2,4-Trichlorobenzene
9	Hexachlorobenzene
10	1,2-Dichloroethane
12	Hexachloroethane
14	1,1,2-Trichloroethane
25	1,2-Dichlorobenzene
32	1,2-Dichloropropane
33	1,3-Dichloropropene
42	Bis(2-Chloroisopropyl)Ether
44	Methylene Chloride
52	Hexachlorobutadiene
56	Nitrobenzene

TABLE VIII-12.
MEDIUM ADSORPABILITY PRIORITY POLLUTANTS COSTED FOR ACTIVATED CARBON FOR BAT OPTION IIB AND PSES OPTION IVB

Pollutant Number	Pollutant Name
57	2-Nitrophenol
58	4-Nitrophenol
60	4,6-Dinitro-o-Cresol

TABLE VIII-13.
LOW ADSORPABILITY PRIORITY POLLUTANTS COSTED FOR
ACTIVATED CARBON FOR BAT OPTION IIB AND PSES OPTION IVB

Pollutant Number	Pollutant Name
56	Nitrobenzene
59	2,4-Dinitrophenol

with that technology. For plants that submitted only Part A of the Section 308 Questionnaire, detailed product/process flow and production information were not available and detailed raw waste concentration estimates could not be prepared. However, model raw waste concentrations could be generated based on BPT subcategories by aggregating full-response plants by BPT subcategories (using the 95 percent rule previously mentioned in Section V) and mode of discharge and calculating subcategory average raw waste concentrations for direct and indirect dischargers.

Using these BPT subcategory average raw waste concentrations, treatment technologies were chosen for compliance cost estimates. However, Part A only respondents submitted only total OCPSF wastewater flow and EPA determined that use of this flow would result in overestimated compliance costs, since only a fraction of the total flow would generally require treatment by in-plant controls. To compensate for this, the Agency determined the percentage of the total OCPSF process wastewater flow treated by in-plant controls already in-place at full-response plants and applied these percentages to the total OCPSF process flow reported by each Part A plant. These adjusted flows were then used to estimate compliance costs for applicable in-plant controls. Table VIII-14 presents the percentages that were used to adjust the total OCPSF process wastewater flows for each in-plant control.

Since there are numerous approaches for implementing effective pollutant control practices, EPA does not specify what technology must be used to achieve the promulgated numerical effluent limitations and standards.

The design parameters and cost curves for each of the technologies costed for BAT are presented later in this section.

3. PSES Costing Methodology

Prior to individual plant-by-plant costing, raw waste concentrations were determined for each plant using the same methodology described in the BAT Costing section. These raw waste concentrations were established for each product/process waste stream and were compared to the long-term median (LTM) effluent values for the in-plant control applicable for each regulated

TABLE VIII-14.
OVERALL AVERAGES OF THE AVERAGE RATIO VALUES
(PROCESS TO TOTAL FLOW)

Technology	Organics	Other	Plastics
Carbon Adsorption	0.220	0.522	0.519
Chemical Precipitation and Cyanide Destruction	0.260	0.128	0.354
Steam Stripping	0.226	0.125	0.237

pollutant. If the raw waste concentration for a regulated pollutant was greater than the LTM effluent value, the applicable in-plant control technology was costed. This procedure was followed until all the product/process waste streams had been costed and all flows to be costed for a particular in-plant control could be totaled for input to the costing algorithm. Only PSES Option IV was costed for this recosting exercise and a list of the pollutants regulated under this option and the LTM effluent value for each pollutant are listed in Table VIII-15. As with the BAT costing, two versions of PSES Option IV were costed using in-plant biological treatment (Option IVB) in place of activated carbon and steam stripping (Option IVA) for the regulated pollutants in Table VIII-5. Two pollutants (4-nitrophenol and 4,6-dinitro-o-cresol), which were previously costed for steam stripping for PSES Option IVA, were now costed for activated carbon in PSES Option IVB because of the lack of stripping data and the presence of carbon data for limits calculations. Also, one pollutant (nitrobenzene), which was previously costed for activated carbon only, was now costed for steam stripping followed by activated carbon based upon the data available for limitations calculations. The various treatment technologies that were costed for PSES Options IVA and IVB follow the same rules and tables as BAT Options IIA and IIB, respectively, for the pollutants regulated under PSES.

The design parameters and cost curves for each technology costed for PSES are presented in later Section VIII subsections.

4. Other Factors

a. Temperature Correction Factors for Activated Sludge

Although activated sludge systems can be used as the BPT technology throughout the United States, the design of the systems should vary due to climate conditions. Plants in colder climates should design their systems to account for lower biodegradability rates during the colder seasons. Therefore, EPA has taken these added costs into account in its costing procedures.

First, in designing new or add-on systems, CAPDET takes into account local temperature conditions by allowing the system user to enter the lowest design temperature as an input parameter. EPA used the National Oceanic and

TABLE VIII-15.
REGULATED POLLUTANTS AND LTMs
FOR PSES OPTION IV

Pollutant Number	Pollutant Name	Concentration (mg/l)
1	Acenaphthene	0.010
*3	Acrylonitrile	0.050
4	Benzene	0.015
6	Carbon Tetrachloride	0.015
7	Chlorobenzene	0.015
8	1,2,4-Trichlorobenzene	0.015
9	Hexachlorobenzene	0.015
10	1,2-Dichloroethane	0.015
11	1,1,1-Trichloroethane	0.015
12	Hexchloroethane	0.015
13	1,1-Dichloroethane	0.015
14	1,1,2-Trichloroethane	0.015
16	Chloroethane	0.050
23	Chloroform	0.015
25	1,2-Dichlorobenzene	0.015
26	1,3-Dichlorobenzene	0.015
27	1,4-Dichlorobenzene	0.015
29	1,1-Dichlorobenzene	0.015
30	1,2,-trans-Dichloroethylene	0.015
32	1,2-Dichloropropane	0.015
33	1,3-Dichloropropene	0.015
34	2,4-Dimethylphenol	0.010
38	Ethylbenzene	0.015
39	Fluoranthene	0.012
*42	Bis(2-Dichloroisopropyl) Ether	0.015
44	Methylene Chloride	0.015
45	Methyl Chloride	0.050
52	Hexachlorobutadiene	0.015

TABLE VIII-15.
REGULATED POLLUTANTS AND LTMs
FOR PSES OPTION IV
(Continued)

Pollutant Number	Pollutant Name	Concentration (mg/l)
55	Naphthalene	0.010
56	Nitrobenzene	0.713
57	2-Nitrophenol	0.020
58	4-Nitrophenol	0.050
**59	2,4-Dinitrophenol	0.373
60	4,6-Dinitro-o-Cresol	0.024
65	Phenol	0.010
66	Bis(2-ethylhexyl)phthalate	0.050
68	Di-n-Butyl-phthalate	0.025
70	Diethyl Phthalate	0.045
71	Dimethyl Phthalate	0.010
***72	Benzo(a)Anthracene	0.010
*74	3,4-Benzofluoranthene	0.010
***76	Chrysene	0.010
**77	Acenaphthylene	0.010
78	Anthracene	0.010
80	Fluorene	0.010
81	Phenanthrene	0.010
85	Tetrachloroethylene	0.015
86	Toluene	0.015
87	Trichloroethylene	0.015
88	Vinyl Chloride	0.050
121	Cyanide	0.180
122	Lead	0.197
128	Zinc	0.549

*Pollutants were considered regulated for costing purposes, but were later reserved for PSES.
**Pollutants were considered regulated for costing purposes, but were later excluded on the basis of paragraph eight of the Settlement Agreement.
***Pollutants were considered regulated for costing purposes, but were later determined not to pass-through.

Atmospheric Administration (NOAA) data (1979) for determining the lowest minimum monthly average temperature (See Table VIII-16). However, since water temperature cannot fall below 0°C, and rarely below 5°C, EPA established a minimum water temperature of 5°C as the minimum water temperature for the purposes of this costing procedure.

In addition, although some states have minimum temperature above 20°C, EPA has established 20°C as the highest temperature in calculating activated sludge costs. Table VIII-16 presents EPA wastewater temperature values (middle column) used with CAPDET.

EPA has also costed biological treatment upgrades, which will also be affected by climate conditions. Therefore, EPA has developed a cost factor that was applied to each upgrade cost, depending on the location of the plant.

In order to take into account the effect of temperature in the design and cost estimation of activated sludge system upgrades, the following factor was derived:

$$\text{Temperature Correction Factor} = \left(\frac{k_B}{k_S}\right)^{0.7}$$

Where k_B = Base Line k

k_S = k rate established for each State

0.7 = Cost Scale Factor

The ratio $\frac{k_B}{k_S}$ is derived from the following general equation:

$$k_S = k_B \times (\Theta)^{(T_S - T_B)}$$

where Θ = 1.07

T_B = 20°C

and T_S = State Temperature.

Therefore,

$$\frac{k_S}{k_B} = (1.07)^{(T_S - T_B)}$$

TABLE VIII-16.
TEMPERATURES AND TEMPERATURE COST FACTORS
USED TO CALCULATE ACTIVATED SLUDGE COSTS AND TO ADJUST
BIOLOGICAL TREATMENT UPGRADE COSTS

State	Minimum Monthly Average Ambient Temperature (°C) (1)	Corresponding Wastewater Temperature (°C)	Cost Factor
Alabama	8	13	1.4
Alaska	-13	5	2.0
Arizona	6	11	1.5
Arkansas	4	9	1.7
California	8	13	1.4
Colorado	-6	5	2.0
Connecticut	-2	5	2.0
Delaware	0	5	2.0
Florida	16	20	1.0
Georgia	7	12	1.5
Hawaii	22	20	1.0
Idaho	-2	5	2.0
Illinois	-4	5	2.0
Indiana	-6	5	2.0
Iowa	-7	5	2.0
Kansas	-2	5	2.0
Kentucky	0	5	2.0
Louisiana	10	15	1.3
Maine	-12	5	2.0
Maryland	1	6	1.9
Massachusetts	-3	5	2.0
Michigan	-5	5	2.0
Minnesota	-13	5	2.0
Mississippi	8	13	1.4
Missouri	-1	5	2.0
Montana	-8	5	2.0
Nebraska	-6	5	2.0
Nevada	-1	5	2.0
New Hampshire	-6	5	2.0
New Jersey	0	5	2.0
New Mexico	2	7	1.8
New York	-3	5	2.0
North Carolina	6	11	1.5
North Dakota	-14	5	2.0
Ohio	-3	5	2.0
Oklahoma	3	8	1.8
Oregon	2	7	1.8
Pennsylvania	-2	5	2.0
Rhode Island	-1	5	2.0
South Carolina	8	13	1.4
South Dakota	-9	5	2.0

TABLE VIII-16.
TEMPERATURES AND TEMPERATURE COST FACTORS
USED TO CALCULATE ACTIVATED SLUDGE COSTS AND TO ADJUST
BIOLOGICAL TREATMENT UPGRADE COSTS
(Continued)

State	Minimum Monthly Average Ambient Temperature (°C) (1)	Corresponding Wastewater Temperature (°C)	Cost Factor
Tennessee	4	9	1.7
Texas	8	13	1.4
Utah	-3	5	2.0
Vermont	-8	5	2.0
Virginia	3	8	1.8
Washington	-3	5	2.0
West Virginia	0	5	2.0
Wisconsin	-8	5	2.0
Wyoming	-6	5	2.0
Puerto Rico	24	20	1.0

(1) Source of Data: National Oceanic and Atmospheric Administration, Comparison Climatic Data for the United States through 1979 (30 years of data), Environmental Data and Information Service, Asheville, North Carolina.

Thus, the temperature correction factor is:

$$\left(\frac{k_B}{k_S}\right)^{0.7} = \left(1.07\right)^{-(T_S-T_B)0.7}$$

Column three of Table VIII-16 presents the corresponding cost factor, using this equation for each state. These factors were then used to adjust the capital and O&M activated sludge upgrade costs.

b. Land Cost

Due to continuing urbanization, the cost of land available for wastewater treatment plant sites has increased substantially in recent years, and can be a significant part of the initial plant cost.

The area required for the plant site depends upon plant capacity, type of treatment, treatment components, site topography, and requirements for anticipated plant expansions.

Since land costs may vary widely from place to place, it is difficult to obtain a nationwide average figure. However, based on an industrial real estate market survey report (prepared by the Society of Industrial Realtors in 1983), the average land costs for suburban sites of each state can be obtained. The results are presented in Tables VIII-17 and VIII-18.

Table VIII-17 shows the estimated unit land prices for the unimproved suburban sites of major cities and the average for each state. The unimproved sites are also in the top 25 percent of overall desirability of the existing inventory and zoned for industrial use. Streets and utilities may not yet be installed, but are reasonably close and available. Rail service may or may not be available. Table VIII-18 is a summary of the estimated land prices for each state. For those states that have no land prices available, the regional average figures were used. For example, in the Northeast region, no land prices are available for Maine and Rhode Island; therefore, the regional average figure of $24,700 was used for these states. Table VIII-18 also indicates that, in general, the average land price for the North Central region is the

TABLE VIII-17.
LAND COSTS FOR SUBURBAN AREAS

Region: NORTHEAST
(Unimproved, 10-100 Acre Land Price in Suburban Areas)
(From: Industrial Real Estate Market Survey 1983)

MA	Land Price ($\$/ft^2$) 1982	NY	Land Price ($\$/ft^2$) 1982	CT	Land Price ($\$/ft^2$) 1982	NH	Land Price ($\$/ft^2$) 1982	NJ	Land Price ($\$/ft^2$) 1982	PA	Land Price ($\$/ft^2$) 1982
Boston	1.62	Buffalo	0.11	Hartford	0.48	Nashua	0.38	Northern Suburbs	1.02	Philadelphia	0.39
		Suburbs	0.83								
Springfield	0.18	Syracuse	0.20	New Haven	0.45					Pittsburgh	0.15
Average	0.90 or $39,200/Acre		0.38 or $16,000/Acre		0.46 or $20,000/Acre		0.38 or $16,600/Acre		1.02 or $44,000/Acre		0.27 or $11,800/Acre

Regional Average: $24,700

TABLE VIII-17.
LAND COSTS FOR SUBURBAN AREAS (Continued)

Region: SOUTH

GA	Land Price ($/ft^2) 1982	TX	Land Price ($/ft^2) 1982	MD	Land Price ($/ft^2) 1982	SC	Land Price ($/ft^2) 1982	NC	Land Price ($/ft^2) 1982	FL	Land Price ($/ft^2) 1982
Atlanta	$1.00	Austin	0.70	Baltimore	0.45	Charleston	0.20	Charlotte	0.25	Fort Lauderdale	1.25
		Dallas	1.35			Greenville	0.33	Greensboro	0.50	Jacksonville	0.34
		Fort Worth	0.37							Miami	1.31
		Houston	2.25							Orlando	0.50
		San Antonio	0.75							Tampa	0.80
Average	1.00 or $43,600/Acre		1.08 or $47,000/Acre		0.45 or $19,600/Acre		0.27 or $11,800/Acre		0.38 or $16,600/Acre		0.84 or $36,600/Acre

AR	Land Price ($/ft^2) 1982	TN	Land Price ($/ft^2) 1982	AL	Land Price ($/ft^2) 1982	LA	Land Price ($/ft^2) 1982	VA	Land Price ($/ft^2) 1982	OK	Land Price ($/ft^2) 1982
Fort Smith	0.50	Memphis	0.35	Mobile	0.15	New Orleans	1.00	Richmond	0.45	Oklahoma City	0.43
										Tulsa	0.55
Average	0.50 or $21,800/Acre		0.35 or $15,200/Acre		0.15 or $6,500/Acre		1.00 or $43,600/Acre		0.45 or $19,600/Acre		0.49 or $21,300/Acre

DC	Land Price ($/ft^2) 1982	DE	Land Price ($/ft^2) 1982
Washington	1.50	Wilmington	0.36
Average	1.50 or $65,300/Acre		0.36 or $15,700/Acre

Regional Average: $27,000 Acre

TABLE VIII-17.
LAND COSTS FOR SUBURBAN AREAS (Continued)

Region: NORTH CENTRAL
(Unimproved, 10-100 Acre Land Price in Suburb Areas)

OH	Land Price ($/ft^2) 1982	IL	Land Price ($/ft^2) 1982	IA	Land Price ($/ft^2) 1982	MI	Land Price ($/ft^2) 1982	IN	Land Price ($/ft^2) 1982	MO	Land PRICE ($/ft^2) 1982
Akron	0.18	Chicago	0.75	Davenport	0.18	Detroit	0.30	Evansville	0.17	St. Louis	0.75
Cleveland	0.18			Des Moines	0.15	Grand Rapids	0.19	Fort Wayne	0.16		
Columbus	0.15			Sioux City	0.18			Indianapolis	0.35		
Toledo	0.90							South Bend	0.15		
								Terre Haute	0.50		
Average (1982)	0.35 or $15,200/Acre		0.75 or $32,000/Acre		0.17 or $7,400/Acre		0.24 or $10,500/Acre		0.27 or $11,800/Acre		0.75 or $32,700/Acre

WI	Land Price ($/ft^2) 1982	MN	Land Price ($/ft^2) 1982	NE	Land Price ($/ft^2) 1982	KS	Land Price ($/ft^2) 1982
Milwaukee	0.90	Minneapolis-St. Paul	0.50	Omaha*	0.70	Wichita	0.10
Average	0.90 or $39,200/Acre		0.50 or $21,800/Acre		0.70 or $30,500/Acre		0.10 or $4,360/Acre

*Less than 10 Acres
Regional Average: $20,600

TABLE VIII-17.
LAND COSTS FOR SUBURBAN AREAS
(Continued)

Region: WEST

NM	Land Price ($/ft^2) 1982	CO	Land Price ($/ft^2) 1982	CA	Land Price ($/ft^2) 1982	AZ	Land Price ($/ft^2) 1982	OR	Land Price ($/ft^2) 1982	NV	Land Price ($/ft^2) 1982
Albuquerque	0.45	Denver	0.88	LA (Orange County)	6.25	Phoenix	1.50	Portland	1.67	Reno	0.80
				LA (South Bay)	6.50						
				Oakland	2.00						
				San Diego	3.00						
				San Francisco	8.00						
				San Joaquin Cty	0.46						
Average (1982)	0.45 or $19,600/Acre		0.88 or $38,300/Acre		4.37 or $190,400/Acre		1.50 or $65,300/Acre		1.67 or $72,700/Acre		0.80 or $34,800/Acre

WA	Land Price ($/ft^2) 1982
Seattle	2.00
Average	2.00 or $87,100/Acre

Regional Average: $72,600

TABLE VIII-18.
SUMMARY OF LAND COSTS IN THE UNITED STATES

Region	State	Estimated Land Price ($/Acre)
Northeast	Connecticut	20,000
	*Maine	24,700
	Massachusetts	39,200
	New Hampshire	16,600
	New Jersey	44,400
	New York	16,600
	Pennsylvania	11,800
	*Rhode Island	24,700
	AVERAGE	$24,700
North Central	Illinois	32,700
	Indiana	11,800
	Iowa	7,400
	Kansas	4,360
	Michigan	10,500
	Minnesota	21,800
	Missouri	32,700
	*New Mexico	20,600
	Ohio	15,200
	Nebraska	30,500
	*North Dakota	20,600
	*South Dakota	20,600
	Wisconsin	39,200
	AVERAGE	$20,600
South	Alabama	6,500
	Arkansas	21,800
	Delaware	15,700
	Florida	36,600
	Georgia	43,600
	*Kentucky	27,000
	Louisiana	43,600
	Maryland	19,600
	*Mississippi	27,000
	North Carolina	16,600
	Oklahoma	21,300
	South Carolina	11,800
	Tennessee	15,200
	Texas	47,000
	Virginia	19,600
	Washington D.C.	65,300
	*West Virginia	27,000
	AVERAGE	$27,000

TABLE VIII-18.
SUMMARY OF LAND COSTS IN THE UNITED STATES
(Continued)

Region	State	Estimated Land Price ($/Acre)
West	*Alaska	72,600
	Arizona	65,300
	California	190,400
	Colorado	38,300
	*Hawaii	72,600
	*Idaho	72,600
	*Montana	72,600
	Nevada	34,800
	New Mexico	19,600
	Oregon	72,700
	*Utah	72,600
	Washington	87,100
	Wyoming	72,600
	AVERAGE	$72,600

*Obtained from Regional Average Price

least expensive one with an average of approximately $20,600. The Northeast and South regions have average land prices of $24,700 and $27,000, respectively. The average land price for the West region seems to be the most expensive, ranging from $19,600 to $190,400, with an average of $72,600.

In order to determine the amount of land required for costing purposes, EPA developed plot-plans for each treatment technology, and calculated the land required for a range of system sizes. These land requirements were curve-fitted such that a land requirement, in acres, could be calculated for every treatment system costed. The individual plant land requirements were multiplied by the corresponding state land cost estimates (Table VIII-18) to obtain plant-by-plant cost estimates for land requirements.

b. RCRA Baseline Costs for Surface Impoundments

In November 1984, the Hazardous and Solid Waste Amendments (HSWA) to the Resource Conservation and Recovery Act (RCRA) were enacted. As a result, costs must be determined for upgrading surface impoundments to comply with this law. Facilities that have "aggressive biological treatment processes" can obtain an exemption from the requirements. Aggressive biological treatment facility means a surface impoundment system in which the initial impoundment of the secondary treatment segment of the facility utilizes intense mechanical aeration to enhance biological activity to degrade wastewater pollutants and:

- The hydraulic retention time in such initial impoundment is no longer than 5 days under normal operating conditions on an annual average basis;
- The hydraulic retention time in such an initial impoundment is no longer than 30 days under normal operating conditions on an annual average basis, provided that the sludge in such an impoundment does not constitute a hazardous waste as identified by the extraction procedure toxicity characteristic in effect on the date of enactment of HSWA; or
- Such a system utilizes activated sludge treatment in the first portion of secondary treatment.

This includes all activated sludge and aerated lagoon systems. Therefore, RCRA baseline costs will only have to be determined for facilities with neutralization, equalization, primary sedimentation, aerobic lagoons, and anaerobic lagoons.

C. BPT TECHNOLOGIES

1. Activated Sludge

The activated sludge process is a biological treatment method where aerobic biological growths are aerated, mixed with wastewater, and subsequently separated in a secondary clarifier. The microorganisms present in activated sludge are bacteria, fungi, rotifers, protozoa, and worms. Bacteria are responsible for metabolizing the organic material, so that the solids will flocculate and settle.

For the purpose of representing the costs for large biological systems (>0.5 MGD) in the OCPSF industry, the completely mixed activated sludge process has been selected. The completely mixed activated sludge process is defined as having a uniform oxygen uptake rate throughout all parts of the aeration tank and sufficient mixing to maintain the solids in the aeration tank in suspension. This process is widely used in the OCPSF industry, requires a minimum amount of land, can be applied in any geographical location, and accommodates a wide range of organic influent loads.

To represent the costs of small biological systems (≤0.5 MGD) in the OCPSF industry, the extended aeration activated sludge process has been selected. This process is better suited for small facilities as it is easier to operate than other modifications of the activated sludge process, and many small plants may have difficulty obtaining adequately skilled operators. These small systems are priced as "package" units, with everything except the foundations and raw pumping stations furnished as a single unit.

The advantage of package systems is that they are pre-engineered, saving much of the costs for engineering design. In addition, since they are pre-engineered, the units are constructed of standardized "off-the-shelf" components, which also saves on capital costs. For systems above 0.25 MGD, and as large as 1 MGD, package plants consist of pre-fabricated steel internal sections and concrete outer shells. The equipment manufacturers provide design drawings for the concrete outer shells, which are constructed on-site. EPA has confirmed through telephone contacts with equipment suppliers that package systems of this type are available well above 0.5 MGD.

The Army Corps of Engineers CAPDET Computer Model can be used to design and cost a number of biological treatment processes, including complete mix, contact stabilization, high rate, and extended aeration activated sludge systems. It contains a library of unit processes that can be used to treat a particular waste stream. The individual unit processes comprising a waste treatment scheme (e.g., activated sludge followed by a secondary clarifier) may be specified with the necessary design parameters required for each process. The CAPDET computer model then uses the generated waste treatment system design specifications to calculate the cost of its construction and operation. The default values presented in Table VIII-19 are used in the cost calculations.

To determine the k-rate (biokinetic rate constant) values to be used in the costing exercise, a summary was made of actual k-rate values and mixed liquor volatile suspended solids (MLVSS) values taken from OCPSF 308 Questionnaires (See Table VIII-20). The average k-rate and MLVSS values calculated are 0.138/hr and 3700 mg/l, respectively.

The large facility CAPDET model requires the input of the k-rate (l/mg-hr), calculated as follows:

$$K = k/S_o = (0.138/hr)/S_o$$

The small facility CAPDET model requires the input of the following k-rate values:

k_m = metabolism constant
= $k\ (MLVSS)/S_o = (0.138/hr)(3700\ mg/l)/(500\ mg/l)$
= 1.02/hr

k_s = synthesis factor
= 10.4/hr (CAPDET default value)

TABLE VIII-19.
ACTIVATED SLUDGE DEFAULT AND REPLACEMENT DATA
FOR UNIT COST ITEMS USED IN COSTING EXERCISE
CAPDET MODEL (1979)

Building Cost	48.00	$/SQ FT
Excavation	1.20	$/CU YD
Wall Concrete	207.00	$/CU YD
Slab Concrete	91.00	$/CU YD
Marshall and Swift Index	577.00	-
Crane Rental	67.00 (35.43)	$/HR
Canopy Roof	15.75	$/SQ FT
Labor Rate (Equipment Installation)	13.40 (15.57)	$/HR
Operator II Labor Rate	7.50 (15.57)	$/HR
Electricity	0.04 (0.05)	$/KHR
Chemical Cost-Lime	0.03	$/LB
Chemical Cost-Alum	0.04	$/LB
Chemical Cost-Iron	0.06	$/LB
Chemical Cost-Polymer	1.62	$/LB
Engineering News Record Cost Index (1979)	2,886 (3,003.00)	-
Engineering News Record Cost Index (1982)	(3,825.00)	-
Handrail	25.20 $/FT	
Pipe Cost Index	295.20 -	
Pipe Installation Labor Rate	14.70 $/HR	

( ) replacement values.

TABLE VIII-20.
ACTIVATED SLUDGE
K-VALUES AND MLVSS VALUES FROM 308 QUESTIONNAIRES

Questionnaire No.	Type of Facility	K-Value (Day^{-1})	MLVSS (ml/g)
500	Organics	3.353	5500
525	Organics	0.043	4000
1409	Organics	10.145	500
1494	Organics	0.356	5000
1609	Organics	4.670	3700
2701	Organics	0.428	3500
662	Plastics	2.343	2400
908	Plastics	2.454	4000
1343	Plastics	0.629	2500
1349	Plastics	9.969	2500
1446	Plastics	0.893	3000
1695	Plastics	0.621	2500
1766	Plastics	3.586	3000
2181	Plastics	2.654	2500
2315	Plastics	5.836	4500
2626	Plastics	0.214	3000
2631	Plastics	7.176	4300
Average	Organics	3.2 (0.133 hr^{-1})	3700
Average	Plastics	3.3 (0.138 hr^{-1})	3100

k_e = endogenous respiration factor
= 0.02/hr (CAPDET default value).

Also, an analysis of the capital costs generated by the CAPDET program was made. For several representative CAPDET runs, the indirect cost items that were intended for municipal plant design (such as 201 Planning Costs), and the land costs (which are addressed as a separate cost item), were subtracted from the total project cost. This revised project cost was compared to the equipment capital cost; the ratio of these figures was determined to be 1.86. Therefore, in the costing exercise, the CAPDET-generated equipment capital costs were increased by the factor of 1.86, then adjusted from 1979 dollars to 1982 dollars, to arrive at the total project capital costs. O&M costs were taken directly from the CAPDET runs, and only increased from 1979 to 1982 dollars.

In order to benchmark CAPDET, design data were taken from 13 OCPSF plants (Table VIII-21). In order to check the consistency of the OCPSF plant data used in this analysis, comparisons were made between reported OCPSF capital costs per gallon of aeration tank size versus flow, and reported costs per 1,000 gallons vs. pounds of BOD_5 removed per 1,000 gallons. There should be a correlation evident from these comparisons; however, there is a considerable amount of scatter in the actual plant data (Table VIII-22). The capital cost per gallon of tank ranged from $0.10 to $6.25, with an average of $1.99 and a standard deviation of $2.16. O&M costs per 1,000 gallons ranged from $0.46 to $7.12, with an average of $2.33 and a standard deviation of $2.30. Therefore, the reported plant data may contain costs that should not be taken into account in EPA's analysis. For example, a plant may have included its plant expansion as part of other improvements at the site. However, the plant's accounting system may not allow for the breakout of the costs in sufficient detail for direct comparison to EPA's estimates. For example, a plant may choose to upgrade its sewer system or road network near the treatment plant. It may account for these construction activities as part of "treatment plant capital improvement project."

Some plants may use waste steam or spent chemicals from the plant process units in the treatment system. If the plant does not account for these as

TABLE VIII-21.
ACTIVATED SLUDGE
TABLE OF REPORTED "308" QUESTIONNAIRE DATA

Facility Questionnaire Number	Flow (MGD)	Detention Time TD (day)	K_m (1/mg/hr)	S_o (mg/l)	S_e (mg/l)	TSS_i (mg/l)	TSS_e (mg/l)	Temperature (°C)	MLSS (mg/l)	MLVSS (mg/l)
500	0.720	15.0	0.000063	2,209	17.5	8,000	40	23.6	6250	5,500
525	1.50	1.0	0.000027	65	18	100	43	10	6,000	4,000
662	6.48	3.0	0.000075	1,300	93	600	50	17	3,081	2,400
908	1.40	6.0	0.000024	4,280	291	514	233	27	5,000	4,000
1343	0.374*	2.8	0.210	307	20	100	25	13	N/A	2,500
1349	0.501	0.26	0.00058	720	72	1,000	100	16	2,800	2,500
1609	1.5	1.0	0.0001	1,920	192	1,300	100	38	5,000	3,700
1695	1.84	0.57	0.00019	215	42	101	36	32	N/A	2,500
1766	0.432*	3.0	0.260	1,750	90	625	150	10	N/A	3,000
2626	0.865	9.0	0.000026	350	20	1,800	25	20	4,000	3,000
2631	9.40	1.5	0.00027	1,125	27	840	48	31	5,000	4,250
2701	0.144*	2.0	0.062	1,000	250	0	250	25	N/A	3,500
2536	3.6	1.2	0.0037	713	14	100	15	26.1	2,160	2,000

*Small facilities less than 0.5 MGD
N/A Not Available

DEFINITIONS:
K_m = BOD removal rate constant
S_o = Soluble BOD_5 in influent
S_e = Soluble BOD_5 in effluent
TSS_i = total suspended solids in influent
TSS_e = total suspended solids in effluent
MLSS = Mixed liquor suspended solids
MLVSS = Mixed liquor volatile suspended solids

TABLE VIII-22.
ACTIVATED SLUDGE
TABLE OF REPORTED CAPITAL COST PER GALLON AND O&M COST PER 1,000 GALLON*

Facility Questionnaire Number	Flow (MGD)	Tank Volume (MG)	Reported Capital Cost Per Gallon ($)	(Assuming 365 Day/Yr) Total Gallon (MG)	Lb BOD Removed Per 1000 Gallon	O&M Cost Per 1000 Gallon ($)
500	0.720	10.8	0.101	262.8	18.28	1.30
525	1.50	1.5	2.05	547.5	0.392	1.42
908	1.40	8.4	1.48	511.0	33.27	6.29
1343	0.374	1.05	0.467	136.5	2.39	1.21
1349	0.501	0.130	4.42	182.9	5.41	1.83
1609	1.50	1.50	0.705	547.5	14.41	0.751
1695	1.84	1.05	6.25	671.6	1.44	1.18
1766	0.432	1.30	0.888	157.7	13.84	1.15
2626	0.865	7.79	0.248	315.7	2.75	0.912
2631	9.40	14.1	0.686	3431	9.16	1.90
2701	0.144	0.288	5.53	52.6	6.26	7.12
2536	3.60	4.32	0.724	1314	5.38	0.462

*1982 Dollars

costs to the treatment system, they may report unusually low O&M costs. Therefore, actual reported costs can be expected to vary widely around EPA's calculated costs.

Table VIII-23 presents the comparison between reported plant capital and O&M costs and the costs calculated by CAPDET in 1982 dollars. Table VIII-24 presents a comparison of reported and CAPDET-calculated detention times.

Although the individual plant cost comparisons vary greatly, for the reasons noted earlier, CAPDET's total capital costs for the sum of all the plants are close to (15% higher) the reported total capital costs incurred. Even though there are differences in design (CAPDET designs concrete tanks whereas some plants use more costly steel tanks or less costly earthen basins with or without liners), EPA has concluded that its cost estimates accurately reflect expected costs that will be incurred by compliance with this regulation.

Table VIII-25 details the individual components of the aggregrated O&M costs presented in Table VIII-23. An investigation of the individual O&M costs showed that reported operating labor costs were higher than CAPDET default value labor costs in every case, by factors ranging up to 15 times CAPDET costs. Similarly, maintenance labor costs differed by factors ranging up to 14 times CAPDET default value costs. Followup telephone calls to the plants in question revealed the reasons for the major differences. The labor rates submitted in the supplemental questionnaires included fringe benefits such as workmen's compensation, FICA, vacation, etc. The fringe benefits are generally between 25 to 40 percent of total labor costs. Other plants also included overhead and overtime in their labor rates. One plant's labor rates were based on annual costs for operating the entire treatment plant rather than just the activated sludge system. Table VIII-26 shows that the operation man-hours reported for the 5 plants listed ranged from 3 to 11 times the predicted CAPDET values. However, reported maintenance man-hours varied little from CAPDET for small facilities ($\leq$0.50 MGD).

The data in Table VIII-25 show that CAPDET's estimates for the non-labor O&M costs are close to the reported values. Again, a particular plant's

TABLE VIII-23.
ACTIVATED SLUDGE
COMPARISON OF CAPDET AND REPORTED CAPITAL AND O&M COSTS (1982 DOLLARS)

Facility Questionnaire Number*	Flow (MGD)	Capital Costs ($)		O&M Costs ($/Yr)	
		Reported	CAPDET	Reported	CAPDET
500	0.720	1,090,900	7,775,295	342,521	555,219
525	1.50	3,080,033	2,919,627	779,093	121,058
908	1.40	12,413,398	7,711,333	3,216,222	1,419,083
1343	0.374	489,848	445,086	221,616	45,898
1349	0.501	573,986	1,050,064	335,570	141,840
1609	1.50	1,057,269	2,786,307	411,336	749,624
1695	1.84	6,564,288	1,428,127	789,781	169,902
1766	0.432	1,154,129	500,073	182,000	47,501
2626	0.865	1,935,200	6,644,254	287,817	257,274
2631	9.40	9,677,460	14,319,559	6,512,820	2,398,098
2701	0.144	1,593,000	240,266	374,694	37,346
2536	3.60	3,126,000	3,169,031	606,660	534,298
	Total	42,755,511	48,989,022	14,060,130	6,477,141

*Plant No. 662 deleted

TABLE VIII-24.
ACTIVATED SLUDGE
COMPARISON OF REPORTED AND CAPDET DETENTION TIMES (T_d)

Facility Questionnaire Number	Flow	T_d Reported (Day)	T_d CAPDET (Day)
500	0.720	15.0	11.79
525	1.50	1.0	1.98
908	1.40	6.0	3.79
1343	0.374	2.8	2.8
1349	0.501	0.260	0.348
1609	1.50	1.0	0.304
1695	1.84	0.057	0.158
1766	0.432	3.0	3.0
2626	0.865	9.0	9.0
2631	9.40	1.5	0.713
2701	0.144	2.0	2.0
2536	3.60	1.2	1.2

TABLE VIII-25.
ACTIVATED SLUDGE
COMPARISON OF REPORTED AND CAPDET O&M COSTS (1982 DOLLARS)

	Reported Cost ($)	CAPDET Cost ($)	Q(MGD)
Plant No. 500			
Operating Labor Cost	140,636	87,273	0.720
Maintenance Labor cost	38,807	42,710	
Power Cost	129,542	285,102	
Material Cost	33,536	138,831	
Plant No. 525			
Operating Labor Cost	298,942	38,928	1.5
Maintenance Labor Cost	224,890	16,434	
Power Cost	113,368	26,419	
Material Cost	141,893	39,281	
Plant No. 908			
Operating Labor Cost	1,457,406	158,492	1.4
Maintenance Labor Cost	698,562	91,567	
Power Cost	424,338	1,075,806	
Material Cost	635,916	93,221	
Plant No. 1343			
Operating Labor Cost	86,455	27,937	0.374
Maintenance Labor Cost	7,334	12,193	
Power Cost	96,618	1,781	
Material Cost	31,209	3,987	
Plant No. 1349			
Operating Labor Cost	216,897	47,878	0.501
Maintenance Labor Cost	56,145	20,437	
Power Cost	42,197	64,700	
Material Cost	20,330	8,832	
Plant No. 1609			
Operating Labor Cost	139,476	118,218	1.5
Maintenance Labor Cost	59,100	62,540	
Power Cost	35,460	550,108	
Material Cost	177,300	18,763	

TABLE VIII-25.
ACTIVATED SLUDGE
COMPARISON OF REPORTED AND CAPDET O&M COSTS (1982 DOLLARS)
(Continued)

	Reported Cost ($)	CAPDET Cost ($)	Q(MGD)
Plant No. 1695			
Operating Labor Cost	177,867	55,884	1.84
Maintenance Labor Cost	186,066	24,467	
Power Cost	76,721	80,222	
Material Cost	349,848	9,336	
Plant No. 1766			
Operating Labor Cost	82,740	28,536	0.432
Maintenance Labor Cost	40,188	12,683	
Power Cost	59,100	2,056	
Material Cost	-	4,225	
Plant No. 2626			
Operating Labor Cost	137,112	50,138	0.865
Maintenance Labor Cost	14,775	21,561	
Power Cost	115,836	67,727	
Material Cost	20,094	117,853	
Plant No. 2631			
Operating Labor Cost	632,370	228,630	9.4
Maintenance Labor Cost	1,452,678	141,854	
Power Cost	3,330,876	1,950,971	
Material Cost	1,096,896	76,647	
Plant No. 2701			
Operating Labor Cost	354,600	24,282	0.144
Maintenance Labor Cost	13,002	9,394	
Power Cost	11,820	685	
Material Cost	7,092	2,985	

TABLE VIII-26.
ACTIVATED SLUDGE
COMPARISON OF OPERATION AND MAINTENANCE MAN-HOURS

Facility Questionnaire Number	Q(MGD)	Operation Man-hours		Maintenance Man-Hours	
		Reported	CAPDET	Reported	CAPDET
525	1.50	16,760	1,569	9,500	792
1343	0.374	8,320	1,464	730	892
1695	1.84	11,000	2,441	10,900	1,301
1766	0.432	4,793	1,490	1,872	925
2701	0.144	10,950	1,270	400	702

reported values may be unnecessarily high due to accounting features, as discussed earlier. However, EPA believed that an adjustment to its labor rates was necessary, as follows. Table VIII-27 presents the reported operating and labor rates for nine plants. These rates were adjusted as a result of follow-up telephone calls made to the individual plants and provide an overall average labor rate (that generally includes fringe benefits, overhead, etc. but excludes unrelated expenses) of $19.77/hour (1982 dollars). These data were used to adjust the CAPDET default labor rate to $15.57 hour (1979 dollars). Power and material costs also differed, but not as dramatically as the labor costs.

The land requirements calculated by CAPDET are inconsistent for small facilities (flow $\leq$0.5 MGD) and appear to be excessively high for large facilities (flow >0.5 MGD). An investigation into the development of the CAPDET program revealed the land requirement equation to be invalid for small facilities.

In developing new land requirements for small facilities, activated sludge package plant vendors were contacted. The package plant dimensions they supplied were scaled up to represent the total land required for the package units peripherals (pumps, controls, access areas, etc.).

Table VIII-28 presents the total revised land requirements calculated for small facilities. The equation that describes the relationship of acreage to plant flow is:

- Small Facilities ($\leq$0.5 MGD):

$$LAND = \exp[A + B \times \ln(Q) + C \times \ln(Q)^2]$$

where:

A = -0.563658

B = 0.57498

C = 0.04199

Q = flow (MGD).

TABLE VIII-27.
ACTIVATED SLUDGE
TABLE OF REPORTED OPERATING AND
MAINTENANCE LABOR RATES (1982 DOLLARS)

Facility Questionnaire Number	Flow (MGD)	Reported Labor Rates		Average ($/hr.)
		Operating ($/hr.)	Maintenance ($/hr.)	
500	0.720	21.30	21.56	21.43
525	1.50	17.84	23.67	20.76
908	1.40	23.64	23.64	23.64
1343	0.374	10.39	10.05	10.22
1609	1.50	25.36	23.63	24.50
1695	1.84	16.17	17.07	16.62
1766	0.432	17.26	21.46	19.36
2626	0.865	15.65	24.63	20.14
2631	9.40	21.29	21.30	21.30
Total Average				$19.77

TABLE VIII-28.
ACTIVATED SLUDGE
REVISED LAND REQUIREMENTS

Flow (MGD)	Land Required (Acres)
0.001	0.075
0.005	0.100
0.010	0.100
0.050	0.125
0.100	0.200
0.500	0.400
0.750	1.75
1.000	2.25
1.500	3.00
2.000	3.25
3.000	5.25
4.000	6.75
5.000	9.00

For large facilities, the revised land requirements were calculated using data generated by the CAPDET program. The calculated total land requirements are presented in Table VIII-28 and are represented by the following equation:

- Large Facilities (>0.5 MGD):

$$LAND = \exp[A + B \times \ln(Q) + C \times \ln (Q)^2]$$

where:

A = 0.762447

B = 0.61494

C = 0.16432

Q = flow (MGD).

2. Biological Treatment Upgrades

Based on the Section 308 Questionnaires, a large number of OCPSF plants use biological treatment to control BOD_5 and organic priority pollutants in their effluent waste streams. Many of these plants were built in the early 1970's, and were designed to meet present permit limitations based on best professional judgment, which may be less stringent than the BPT limitations. As such, these plants cannot meet BPT limitations without certain system modifications or upgrades. The purpose of the bio-upgrade costing procedure is to develop costs for plants that only require small improvements (i.e., less than 15 mg/l of additional BOD_5 removal or approximately 6 percent additional BOD_5 removal).

After a preliminary screening of approximately 50 Section 308 Questionnaires, 13 organic chemical manufacturing facilities with modified biological treatment systems were selected for initial consideration. Since the annualized capital cost curve will only be used to represent "improved biological treatment" (i.e., will only be applied to plants where a small effluent BOD_5 increment (4 to 15 mg/l) above BPT limitations exists), plants with major modifications, such as construction of additional aeration tanks, clarifiers, or tertiary filters, were eliminated from consideration. After facilities with major modifications were eliminated, five facilities were considered to meet the criteria for the appropriate improvement in technology (see Table VIII-29). Details of the treatment systems reviewed and those retained for analysis can be found in the final detailed costing document in the Costing Section of the Public Record.

To determine the degree of improvement in biological treatment efficiency after modifications, the Agency gathered available BOD_5 and flow data for the wastewater treatment systems' influent and effluent streams at the five selected OCPSF facilities. The data were selected to reflect time periods preceding and following biological treatment system modifications. The difference between the BOD_5 removal rates occurring before and after treatment plant modifications provides a measure of the improvement in plant performance. The improvement in performance can be related to the modifications made and their costs. Data for use in this analysis were obtained from industrial discharge monitoring reports (DMRs) and Section 308 Questionnaires.

A review of the pertinent information showed influent and effluent data for a number of the manufacturing facilities to be missing. Of the selected five facilities, only two plants present meaningful influent and effluent data before and after their modifications, and three other plants provided only effluent data, making it difficult to construct a cost curve. However, by using the three plants that had effluent data and calculating the difference between effluent BOD_5 loadings before and after their system modifications, additional data for incremental BOD_5 removal were obtained.

These five facilities provide a representative cross-section of product mix in the final OCPSF subcategories (see Table VIII-30). Also, each facility's wastewater treatment system is considered a well-operated biological treatment system, based on the BPT editing rule of at least 95 percent BOD_5 removal or an effluent BOD_5 less than or equal to 40 mg/l. Table VIII-31 presents the available influent and effluent data for each of the five facilities used in the analysis.

For the calculation of the annualized unit capital costs presented in Table VIII-29, the annualized capital costs for each facility were taken to be 19.2 percent of the corresponding capital costs in 1982 dollars. Annualized

TABLE VIII-29.
CAPITAL AND ANNUAL COSTS OF BIOLOGICAL TREATMENT MODIFICATIONS
FOR ACTIVATED SLUDGE SYSTEM UPGRADES

Facility Questionnaire Number	Modification	Additional BOD_5 Removal (Lbs/Day)	Annualized Capital Cost (1) ($)	Annualized Unit Capital Cost ($/Lb Removed)
2592	Settling Aids for Secondary Clarification	192*	35,000	0.50
267	Additional Aeration	7,773*	332,000	0.12
2181	Additional Aeration	321	88,000	0.75
296	Additional Aeration Additional Aeroflocculators Polymer Addition System	3,944*	282,000	0.20
1977	Clarifier Modification	16,760	319,000	0.05

(1) Annualized Costs = 19.2 percent of Capital Cost in 1982 dollars.

*Additional BOD_5 removal calculated based on the difference between effluent BOD_5 loadings before and after modifications.

TABLE VIII-30.
PRODUCT MIX OF THE FIVE FACILITIES
USED IN THE DEVELOPMENT OF THE CAPITAL COST CURVE
FOR ACTIVATED SLUDGE SYSTEM UPGRADES

Facility	Products	Product Group
A	Acetic Anhydride	Commodity
	Cellulose Acetate Resin	Thermoplastics
	Cellulose Acetate Fibers	Fibers
	Acetic Acid Esters	Bulk
	Formaldehyde	Commodity
B	Salicylic Acid	Specialty
	Alkanol Amines	Specialty
	Glycol Ethers	Specialty
	Polyglycols	Specialty
	Polyols	Specialty
	Acrylamide	Specialty
	Polyacrylamide	Specialty
	Acetic Acid	Commodity
	Ethylcellulose Polyether	Specialty
	Ethanol	Commodity
	Diethyl Ethers	Specialty
	Methylcellulose Polyethers	Specialty
	Styrene Butadiene Resins	Thermoplastics
	Polyvinylidiene Resins	Thermoplastics
	ABS Resins	Thermoplastics
	SAN Resins	Thermoplastics
	Polystyrene	Specialty
	Styrene	Commodity
	Vinyltoluene	Specialty
	Benzene	Commodity
	Mixed Xylenes	Commodity
	Chloroacetic Acid	Specialty

TABLE VIII-30.
PRODUCT MIX OF THE FIVE FACILITIES
USED IN THE DEVELOPMENT OF THE CAPITAL COST CURVE
FOR ACTIVATED SLUDGE SYSTEM UPGRADES
(Continued)

Facility	Products	Product Group
C	Acrylic Fiber	Fibers
	Nylon 66	Fibers
	Nylon 66 Fiber	Fibers
	Polyester	Fibers
	Polyester	Fibers
D	SAN Resins	Thermoplastics
	ABS Resins	Thermoplastics
E	Acetylene	Bulk
	Ethylene	Commodity
	Propylene	Commodity
	Butylenes	Commodity
	Benzene	Commodity
	Toluene	Commodity
	Xylenes	Commodity
	1,2-Dichloroethane	Commodity
	Ethylene Diamine	Commodity
	Polyethylene Polyamines	Specialty
	Ethylamine	Bulk
	Isopropylamine	Bulk
	Ethylene Oxide	Commodity
	Ethylene Glycol	Commodity
	Diethylene Glycol	Bulk
	Polyoxyethylene Glycol	Bulk
	Ethylene Glycol Monomethyl Ether	Bulk
	Acrolein	Specialty
	Acrylic Acid	Bulk

TABLE VIII-30.

PRODUCT MIX OF THE FIVE FACILITIES
USED IN THE DEVELOPMENT OF THE CAPITAL COST CURVE
FOR ACTIVATED SLUDGE SYSTEM UPGRADES
(Continued)

Facility	Products	Product Group
E (Continued)	Acrylic Acid Esters	Bulk
	Paracetic Acid	Specialty
	Acetic Acid	Commodity
	Misc. Oxides & Epoxides	Specialty
	Cyclohexanone	Bulk

TABLE VIII-31.
CURRENT INFLUENT AND EFFLUENT BOD_5 CONCENTRATIONS AT THE FIVE FACILITIES USED IN THE DEVELOPMENT OF CAPITAL COST CURVES FOR ACTIVATED SLUDGE SYSTEM UPGRADES

Facility Questionnaire Number	Influent BOD_5* Concentration (mg/l)	Effluent BOD_5* Concentration (mg/l)
1977	617	27
267	160**	10**
2592	1,187	63
2181	338	4
296	4,695	216

*Data obtained from the 1983 Supplemental "308" Questionnaire

**Soluble BOD_5

unit capital costs were then obtained by dividing the annualized capital costs by the annual BOD_5 mass removal. The relationships between annualized capital costs versus additional BOD removal and annualized unit capital cost versus additional BOD_5 removal are presented in Figures VIII-1 and VIII-2. In general, the annualized unit capital cost, ranging from $0.05 to $0.75 per pound of BOD_5 removal, decreased with increasing mass BOD_5 removal, indicating an economy of scale.

It should be noted that the cost curve has a minimum value of 100 lbs/day of additional BOD_5 removal. For BOD_5 mass removal of less than 100 lbs/day, $0.75/pound was used, which was the highest cost determined in this analysis.

The derivations of annual O&M costs are based upon the process design and cost estimating algorithms of the January 1981 CAPDET model for completely mixed activated sludge. Briefly, O&M costs for activated sludge processes are computed as a function of reactor air requirements; in the case of completely mixed activated sludge using diffused aeration, O&M costs are based upon required air flow, while costs for systems using mechanical aerators are based upon the total horsepower of the aeration equipment. It is also important to realize that the derived air requirement is solely a function of BOD_5 removal; i.e., according to the derived model, any amount of BOD_5 desired can be removed by increased aeration. Although in practice this is not always true, for these applications of the methodology, i.e., for relatively small reductions of BOD_5, this relationship appears to be valid.

When using the CAPDET method in the calculation of these increased O&M costs, the design temperature is assumed to be 20°C. The increased aeration calculated is then adjusted for the operating temperature using the State temperature cost factors. These values are based upon the State's minimum monthly average ambient temperature. The State temperature cost factors reflect the higher costs associated with operating an activated sludge system whose winter temperatures deviate from ambient conditions.

Table VIII-32 presents the projected capital and operation and maintenance costs for upgrades to the existing activated sludge systems at the five facilities utilized in the capital cost analysis as measured by the incremental BOD_5 removal improvements.

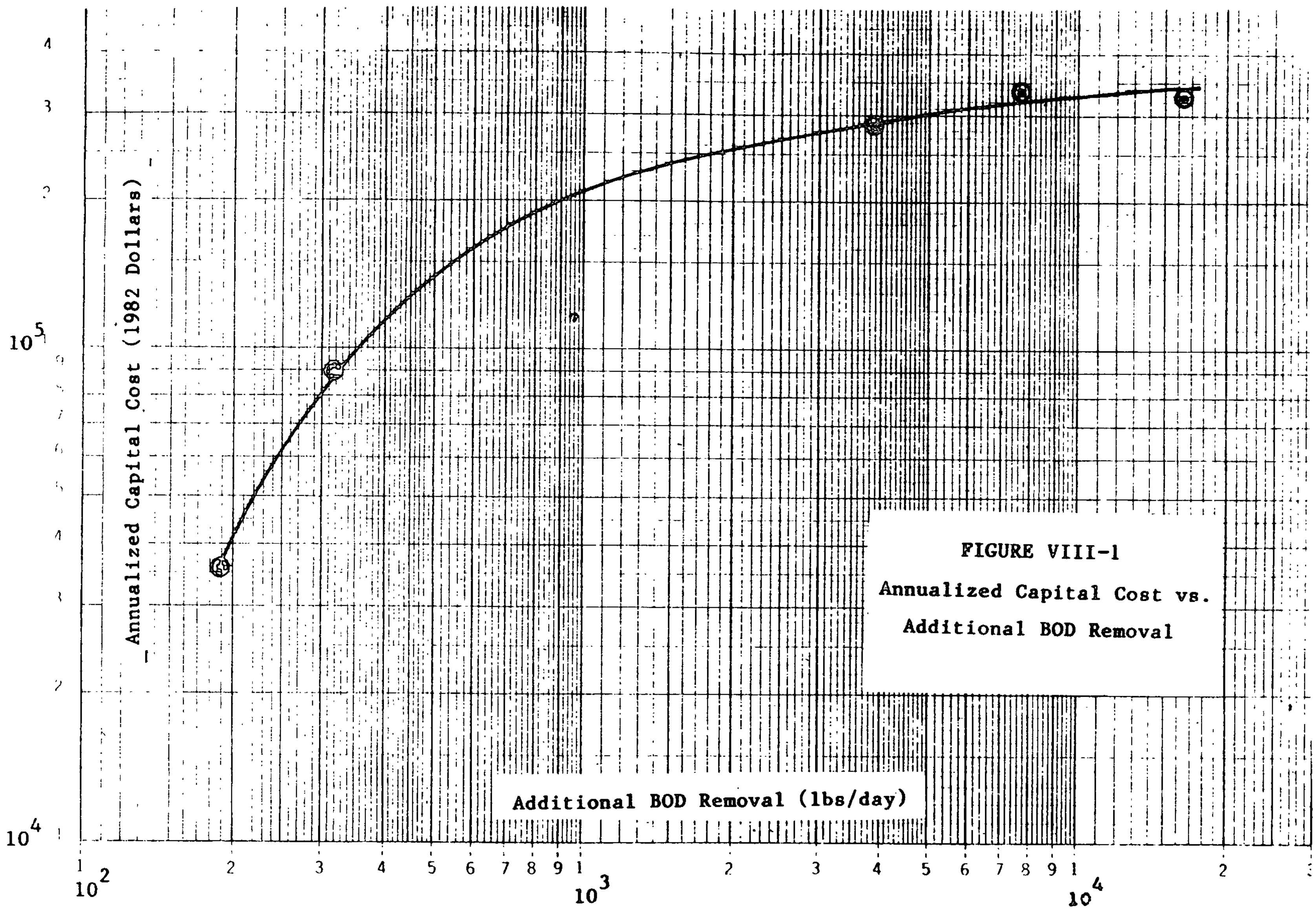


FIGURE VIII-1
Annualized Capital Cost vs.
Additional BOD Removal

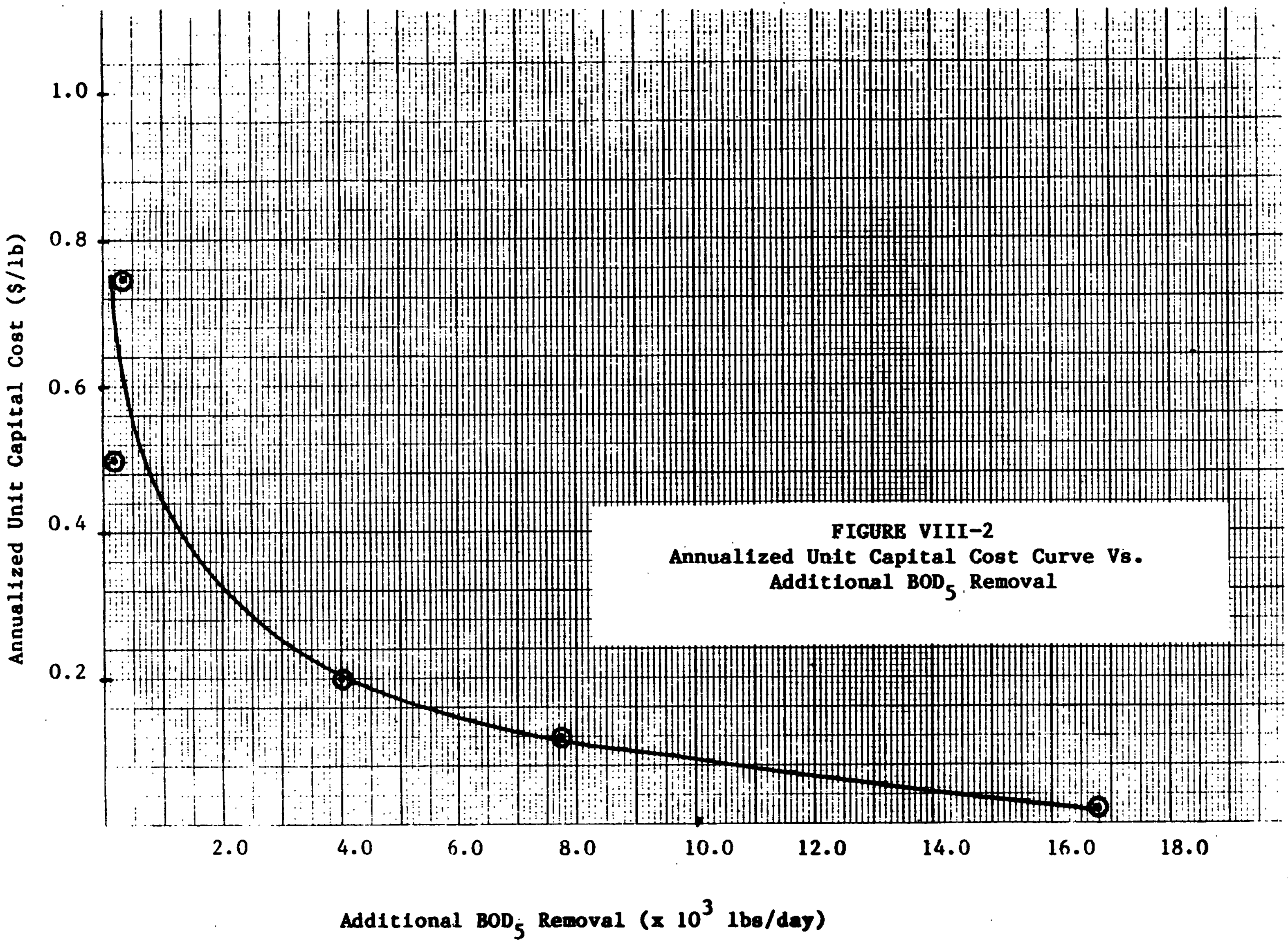


FIGURE VIII-2
Annualized Unit Capital Cost Curve Vs. Additional BOD_5 Removal

TABLE VIII-32.
PROJECTED CAPITAL AND OPERATION AND MAINTENANCE (O&M) COSTS
ASSOCIATED WITH ACTIVATED SLUDGE SYSTEM UPGRADES

Facility Questionnaire Number	Annual Unit Capital Cost ($/Lb) (1982$)	Annual Unit O&M Cost ($/Lb) (1979$)	Additional BOD_5 Removal (Lbs/Day)
1977	0.056	0.039	16,760
267	0.115	0.059	7,773
2592	0.514	0.127	192
2181	0.785	0.133	321
296	0.201	0.048	3,944

3. Chemically Assisted Clarification

Chemically assisted clarifiers (CACs) are designed to allow wastewater to flow slowly and quiescently, permitting solids denser than water to settle to the bottom and materials less dense than water (including oil and grease) to flow to the surface. Polymers are added to the wastewater to enhance liquid-solid separation. Settled solids form a sludge at the bottom of the clarifier which is usually pumped out either continuously or intermittently. Oil and grease and other floating materials may be skimmed off the surface.

Chemically assisted clarifiers may be used alone or as part of a more complex treatment process.

Cost estimates for CAC systems were derived from an Environmental Science and Engineering, Inc. costing methodology prepared for the pesticides industry. A summary of the design specifications and estimated land requirements is presented in Table VIII-33.

Components of the clarification system include concrete clarifiers (minimum of two units), sludge pumps, polymer storage tanks, and polymer feeders. The clarification system also includes sitework, electrical, piping, and instrumentation (SEP&I). Table VIII-34 shows the itemized capital costs for the clarification systems with flow rates ranging from 0.01 to 20 MGD. The estimated equipment costs for sludge removal systems, pumps, polymer feeders, and polymer storage tanks were obtained from manufacturers' quotes. The unit costs for reinforced concrete, excavation, and epoxy coating were determined from vendor quotes to be $\$345/yd^3$, $\$6.78/yd^3$, and $\$2.50/ft^2$, respectively. The SEP&I costs were taken to be 48 percent of the total equipment costs, and the construction costs were the sum of the equipment and SEP&I costs. Both the engineering and contingency costs were each assumed to be 15 percent of the construction costs. The final capital costs were converted to 1982 dollars using ENR's Construction Index. Since it is difficult to obtain a representative unit land cost, land costs are not included in the estimates, but were determined on a plant-by-plant basis as discussed earlier in this section.

TABLE VIII-33.
SUMMARY OF CHEMICALLY ASSISTED CLARIFICATION SPECIFICATIONS

Parameters	Flow Rate (MGD)							
	0.01	0.05	0.10	0.50	1.0	5.0	10.0	20.0
Number of Clarifier Cells	2	2	2	2	2	2	2	4
Diameter (ft)*	15	15	15	30	40	90	125	125
Side Water Depth (ft)	12	12	12	12	12	12	12	12
Design Overflow Rates (gpd/ft^2)	400	400	400	400	400	400	400	400
Polymer Dosage (mg/l)	1	1	1	1	1	1	1	1
Land (Acre)	0.11	0.11	0.11	0.19	0.26	0.72	1.17	2.12

*Since the minimum size of the sludge removal mechanism is 15 ft, clarifier diameters for the 0.01, 0.05, and 0.10 MGD flow systems were over designed.

TABLE VIII-34.
ITEMIZED CAPITAL COSTS FOR CHEMICALLY
ASSISTED CLARIFIERS

Item	Flow Rate (MGD)							
	0.01	0.05	0.10	0.5	1.0	5.0	10.0	20.0
Excavation	3,460	3,460	3,460	8,360	12,800	49,250	88,850	177,690
Reinforced Concrete	27,600	27,600	27,600	62,790	91,080	293,940	495,420	990,840
Epoxy Coating	4,180	4,180	4,180	10,130	15,080	20,640	88,850	177,700
Sludge Removal System	43,780	43,780	43,780	60,450	75,040	125,000	191,600	383,200
Sludge Pumps	5,630	5,630	5,630	5,630	5,630	12,500	19,160	38,320
Polymer Feed System	18,760	18,760	18,760	21,890	21,890	44,000	66,000	120,000
SEP&I	49,640	49,640	49,640	81,240	106,330	261,760	455,950	906,120
Construction Cost	153,050	153,050	153,050	250,490	327,850	807,090	1,405,830	2,793,870
Engineering	22,960	22,960	22,960	37,580	49,180	121,070	210,880	419,080
Contingency	22,960	22,960	22,960	37,580	49,180	121,070	210,880	419,080
Total Capital Cost (1983 $)	198,970	198,970	198,970	325,650	426,210	1,049,230	1,827,590	3,632,030
Total Capital Cost (1982 $)	190,480	190,480	190,480	311,780	408,040	1,004,440	1,749,590	3,476,900

Annual operating costs were estimated based on energy, chemicals, labor, maintenance, and taxes and insurance. A summary of the itemized operating costs is presented in Table VIII-35. The estimated annual energy costs were based on manufacturers' recommendations on motor-horse power for sludge removal mechanisms, pumps, and polymer feed systems, plus control and lighting requirements. A unit electricity cost of $0.08/kwh was used for cost estimates. The unit labor costs were based on EPA's Treatability Manual at $24,500/man-yr for labor and $34,600/man-yr for supervision. The Hercu Floc 815 unit price of $2.80/lb was used for calculating chemical costs. The annual maintenance costs were taken to be 4 percent of the total capital costs. Taxes and insurance costs were assumed to be 2 percent of the total capital costs. The final operating costs were also converted to 1982 dollars using ENR's Construction Index.

Figures VIII-3 and VIII-4 show the relationship between flow rates and the capital and annual O&M costs, respectively. Figure VIII-5 presents the estimated land requirements versus flow rates. The land requirements were estimated based upon the sizes of the clarifiers plus adequate space for repairs and general access.

A benchmark analysis was performed to compare the cost estimates with OCPSF plant installations. Based on the recent Section 308 Questionnaires, 21 OCPSF plants were selected that had provided capital costs information on their primary or secondary clarifiers. The costs were converted to 1982 dollars using the ENR Construction Index. The results are presented in Table VIII-36. The wastewater flow rates under study range from 0.14 to 7.5 MGD. In general, although there are differences in the cost comparisons between EPA's estimates and the industry plants, there is no definitive pattern to the difference in either magnitude or direction. Approximately 67 percent of the facilities (or 14 plants) have cost differences within ±80 percent. However, four out of the 21 facilities show extremely high discrepancies with percent differences greater than 100 percent.

Due to the lack of detailed design information from the Section 308 Questionnaires, a larger number of unknown site-specific factors may exist, thus affecting the cost comparison. For example, critical design parameters

TABLE VIII-35.
ITEMIZED ANNUAL OPERATING COSTS FOR CHEMICALLY ASSISTED CLARIFIERS

Item	Flow Rate(MGD)							
	0.01	0.05	0.10	0.5	1.0	5.0	10.0	20.0
Energy	1,820	1,958	1,958	3,172	4,248	15,670	30,015	59,820
Polymer	85	430	855	4,265	8,530	42,620	85,235	30,360
Labor	1,581	4,010	5,344	12,870	16,790	41,500	77,000	125,000
Maintenance	6,957	7,960	7,960	13,030	17,050	41,970	73,105	145,285
Taxes and Insurance	3,479	3,980	3,980	6,515	8,525	20,985	36,555	72,645
Total Operating Cost (1983 $)	13,925	18,340	20,100	39,855	55,150	162,745	301,910	433,110
Total Operating Cost (1982 $)	13,330	17,560	19,245	38,165	52,800	155,800	289,020	414,615

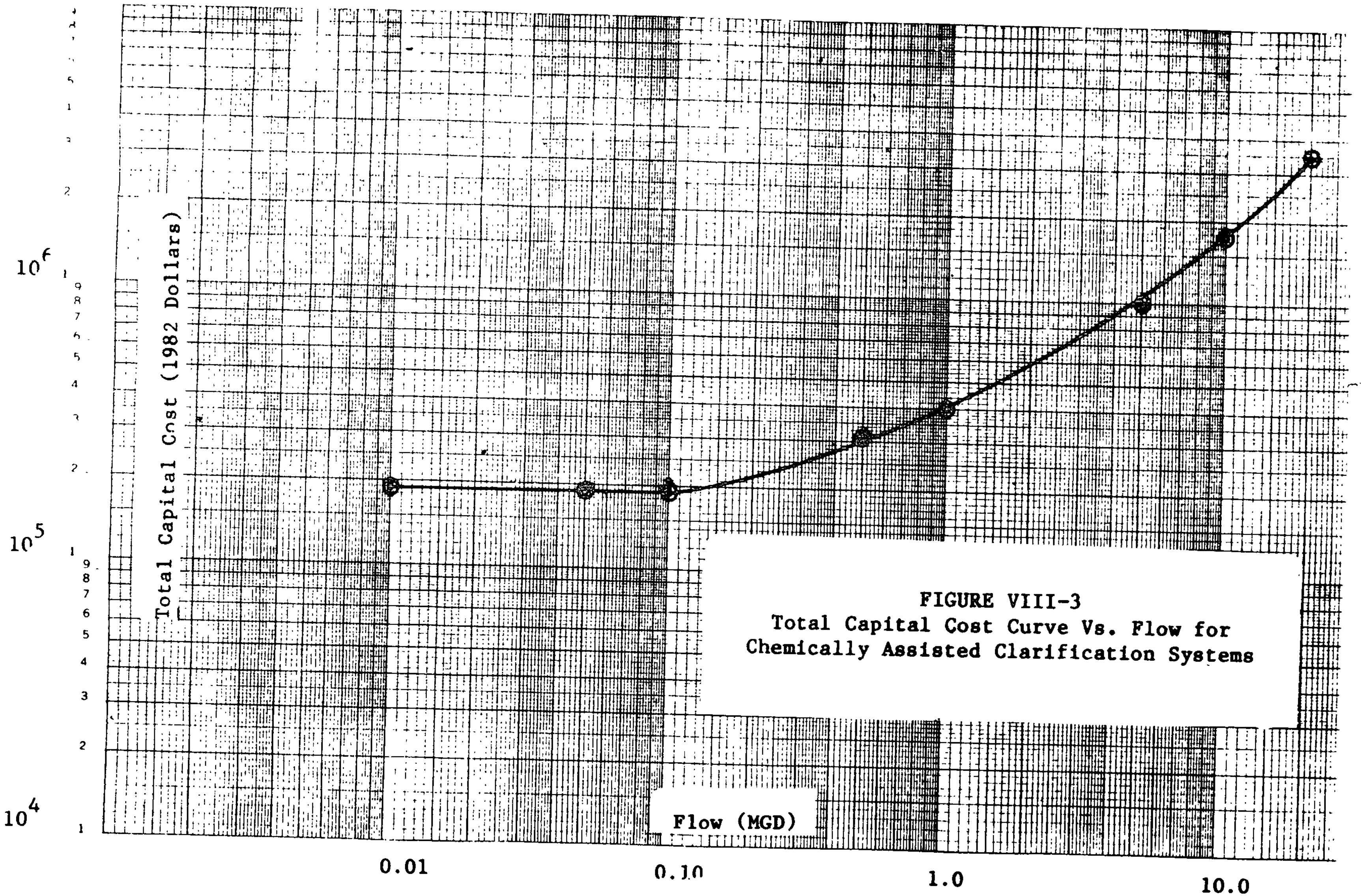


FIGURE VIII-3
Total Capital Cost Curve Vs. Flow for Chemically Assisted Clarification Systems

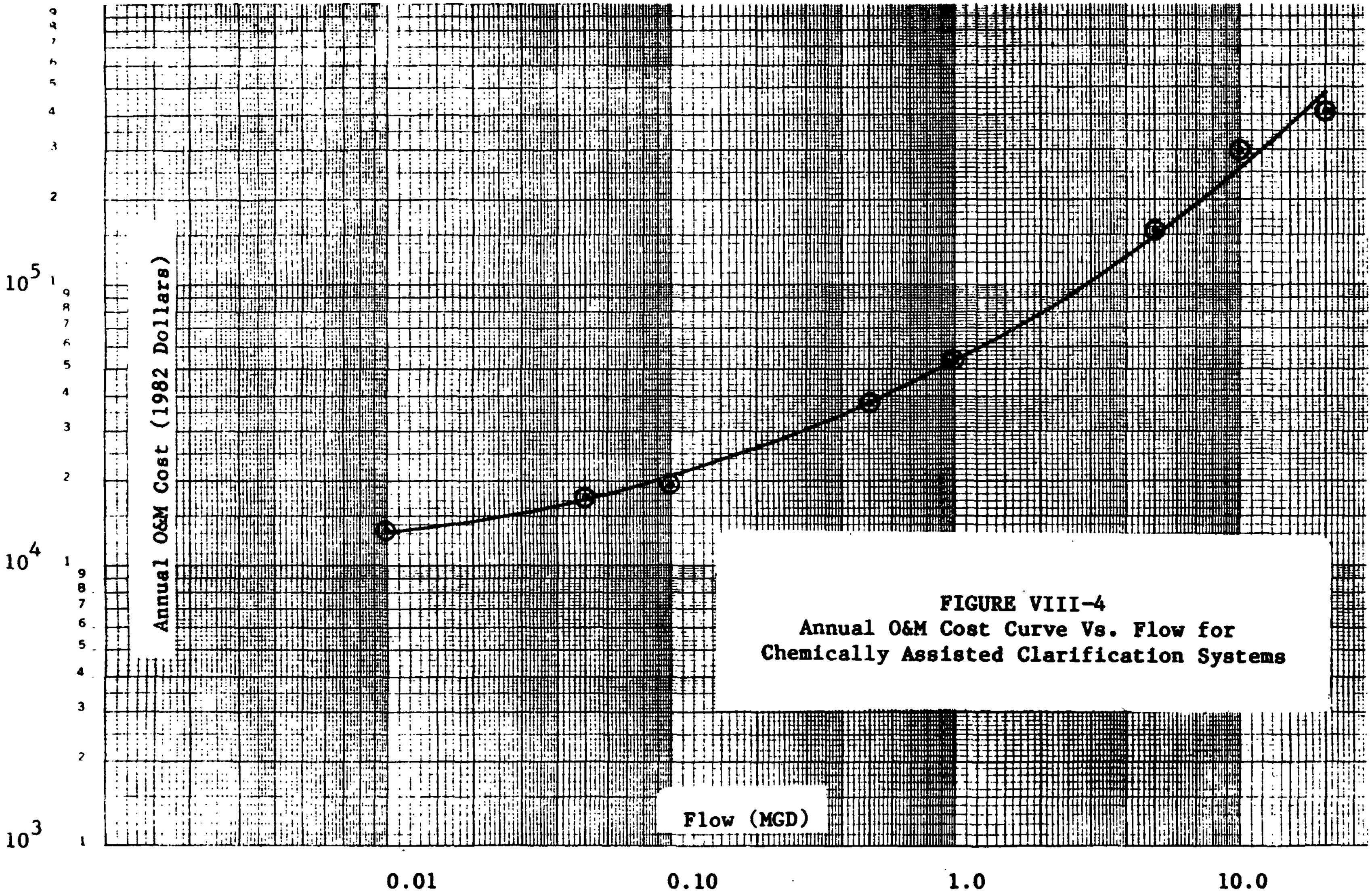


FIGURE VIII-4
Annual O&M Cost Curve Vs. Flow for
Chemically Assisted Clarification Systems

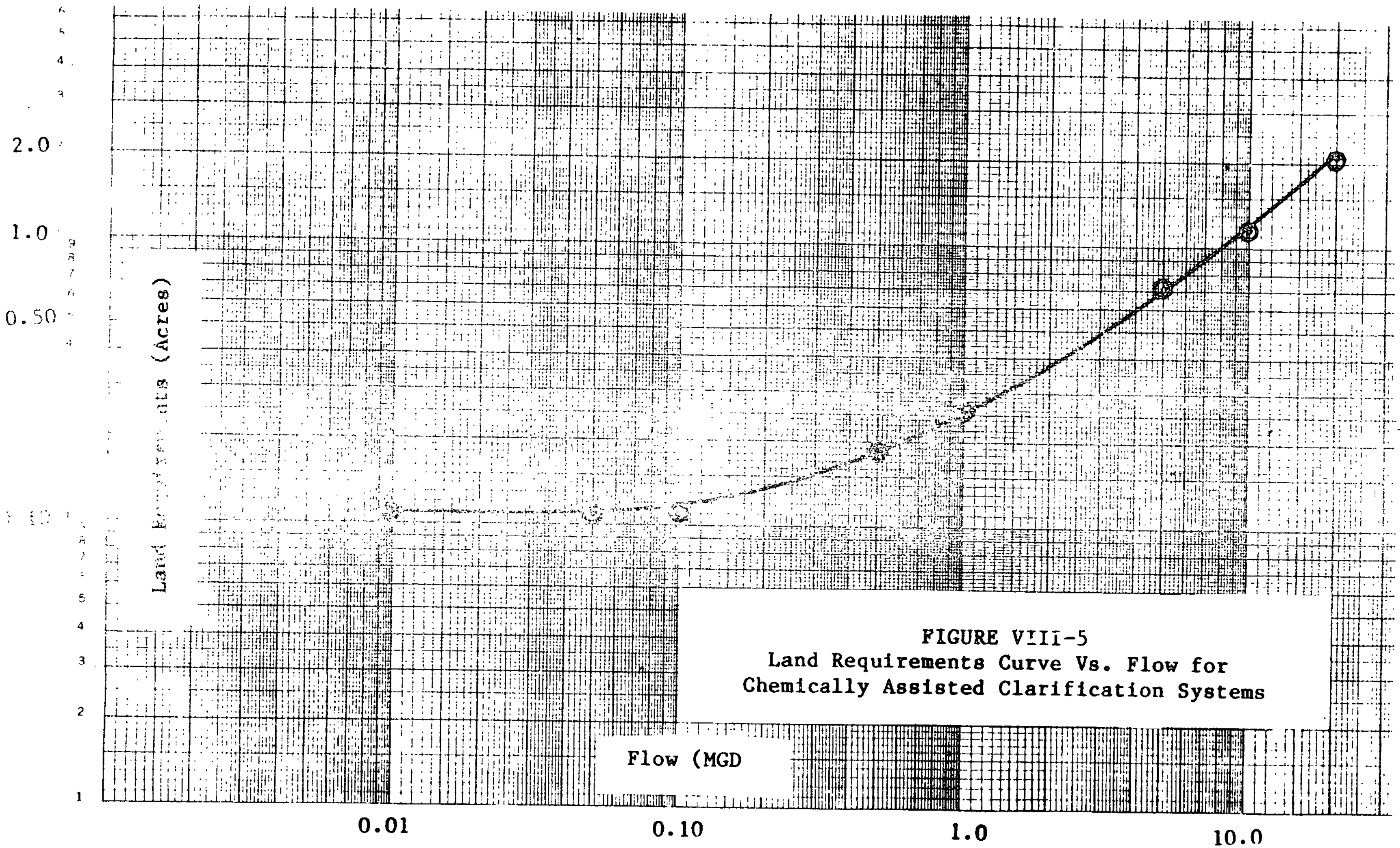


FIGURE VIII-5
Land Requirements Curve Vs. Flow for Chemically Assisted Clarification Systems

TABLE VIII-36.
BENCHMARK COMPARISON

Facility Number	Treatment system	Flow (mgd)	Reported Costs (1982 $)	EPA's Estimates (1982 $)	Difference (EPA-Reported) ($)	% Difference Compared to reported Cost*
2701	Sec. Clarifier and Setl. Aids (1976)	0.14	$6.4x10^5$	$2.1x10^5$	$-4.3x10^5$	67% low
1343	Sec. Clarifier and Setl. Aids (1976)	0.37	$2.1x10^5$	$2.8x10^5$	$+7x10^4$	33% high
1349	Sec. Clarifier (1969)	0.50	$2.6x10^5$	$3.1x10^5$	$+5x10^4$	19% high
2376	Prim. Clarifier and Neutralization (1974)	0.50	$6.6x10^5$	$3.1x10^5$	$-3.5x10^5$	53% low
2110	Sec. Clarifier (1972)	0.58	$6.0x10^4$	$3.3x10^5$	$+2.7x10^5$	450% high
2181	Prim. Clarifier and Surge Tank (1975)	0.58	$8.4x10^5$	$3.3x10^5$	$-5.1x10^5$	61% low
0500	Sec. Clarifier (1978)	0.72	$2.8x10^5$	$3.5x10^5$	$+0.7x10^5$	25% high
1267	Sec. Clarifier (1974)	0.83	$8.0x10^4$	$3.8x10^5$	$+3.0x10^5$	375% high
2315	Sec. Clarifier (1958)	1.30	$6.5x10^5$	$4.7x10^5$	$-1.8x10^5$	28% low
0005	Sec. Clarifier and Setl. Aids (1960)	1.44	$4.2x10^6$	$5.0x10^5$	$-3.7x10^6$	88% low
1609	Sec. Clarifier and Polymer Add'n System (1975)	1.50	$2.3x10^5$	$5.1x10^5$	$+2.8x10^5$	122% high

TABLE VIII-36.

BENCHMARK COMPARISON
(Continued)

Facility Number	Treatment System	Flow (MGD)	Reported Costs (1982 $)	EPA's Estimates (1982 $)	Difference (EPA-Reported) ($)	% Difference Compared to Reported Cost*
0444	Sec. Clarifier (1973)	2.00	$3.8x10^6$	$6.0x10^5$	$-3.2x10^6$	84% low
2592	Sec. Clarifier and Setl. Aids (1972)	2.02	$8.4x10^5$	$6.0x10^5$	$-2.4x10^5$	29% low
0063	Prim. Clarifier (1973)	2.40	$4.1x10^5$	$6.7x10^5$	$+2.6x10^5$	63% high
1494	Sec. Clarifier and Setl. Aids (1972)	3.00	$3.8x10^5$	$7.8x10^5$	$+4.0x10^5$	105% high
1977	Sec. Clarifier (1975)	3.10	$4.2x10^5$	$8.0x10^5$	$+3.8x10^5$	90% high
0296	2 Sec. Clarifiers and Setl. Aids (1974)	3.82	$2.7x10^6$	$9.1x10^5$	$-1.79x10^6$	66% low
2528	Prim. Clarifier (1954)	4.71	$6.0x10^5$	$1.1x10^6$	$+5.0x10^5$	83% high
2242	Sec. Clarifier (Rev.) (1974)	6.00	$1.4x10^6$	$1.3x10^6$	$-1.0x10^5$	7% low
2430	Sec. Clarifier and Setl. Aids (1977)	6.74	$7.1x10^6$	$1.4x10^6$	$-5.7x10^6$	80% low
2227	Sec. Clarifier and Setl. Aids (1977)	7.50	$2.5x10^6$	$1.5x10^6$	$-1.0x10^6$	40% low

* % Difference = $\frac{\text{EPA-Reported}}{\text{Reported}}$ x 100%

such as overflow rate, detention time, type of tank used, weir loading rate, and chemical feed systems, etc., were all unavailable for the estimates. This may be the major reason why some significant discrepancies exist. Potential cost estimate differences may be introduced further by the geographical locations of the facilities. In addition, differences between the actual construction costs of the treatment systems and the conversion of such costs into 1982 dollars most likely contributes to these discrepancies. Despite some of the large discrepancies, EPA's cost estimates have been judged to be acceptable, considering the unknown factors and the possible variations in the cost estimating procedures which may vary significantly from one company to another.

Based on the benchmark analysis, it is concluded that EPA's cost estimates on clarification systems are within a reasonable range normally associated with actual industrial practices.

4. Filtration Systems

Filtration is an established unit operation for achieving supplemental removal of residual suspended solids from wastewater effluent of chemical and biological treatment processes. The types of filters can be classified according to the number of filtering media used, such as single-medium or multimedia beds. In multimedia filters, two or more layers of different granular materials are present in the bed. Because of their high capacity and good quality effluent, multimedia filters are receiving widespread use in new plants for the additional removal of TSS and insoluble BOD_5. Typical media used for multimedia filters include anthracite, sand, and garnet.

The complete filtration operation essentially involves two phases: filtration and backwashing. Filtration is accomplished by passing the wastewater to be filtered through the filter bed. Within the filter bed, the removal of the suspended solids contained in the wastewater is accomplished by a complex process involving one or more removal mechanisms, such as straining, sedimentation, interception, impaction, and adsorption. As the head loss across the filter bed increases to a limiting value, the end of the filter run is reached. At this point, the filter must be backwashed to remove the suspended solids that have accumulated within the filter bed.

Important parameters that must be considered in the design of multimedia filters include influent wastewater suspended solids level, solids characteristics, filtration rates, and filter medium characteristics. Table VIII-37 presents a summary of the filtration system specifications used in the CAPDET runs to develop the cost curves. Average flow values range from 0.01 to 20 MGD. For small plants where the required filter surface areas are less than 400 ft^2 (or <2.3 MGD), the CAPDET model uses package filters for economic reasons. For larger plants with required surface areas of greater than 400 ft^2 (or >2.3 MGD), filters with concrete wall construction are always used.

The cost summary output data were adjusted prior to incorporation into the summary tables. Capital costs were calculated based upon total project costs less miscellaneous nonconstruction costs, 201 planning costs, technical costs, land costs, interest during construction, and laboratory costs. Operation and maintenance costs were obtained directly from the initial year O&M costs.

Table VIII-38 presents a summary of the capital and O&M costs for filtration systems in 1982 dollars. Figures VIII-6 and VIII-7 represent the cost curves in 1982 dollars. Figure VIII-8 presents the estimated land requirements versus flow rates.

5. Polishing Ponds

Polishing ponds are usually used as an additional solids removal step following biological treatment processes. They are often used in place of secondary clarifiers following aerated lagoons. Where sufficient land is available at low cost, polishing ponds may present an economically attractive alternative to multimedia filtration or microscreening.

Cost estimates for the polishing pond systems were made for six systems covering a wide range of flow conditions (0.07 to 20 MGD). The design basis for these estimates involves a 1-day detention. Four of the six sizes selected are from actual OCPSF plants. The other two plants were selected at high flow rates of 10 and 20 MGD.

TABLE VIII-37.
SUMMARY OF FILTRATION SYSTEM SPECIFICATIONS

Parameter	Flow Rate (MGD) 0.01*	0.1*	1.0*	2.0*	10.0	20.0
Total Filter (ft^2) Surface Area	1.7	17.4	174	347	1740	3470
Depth of Filter Bed (ft)	-	-	9	9	9	9
Number of Filter Cells	4	4	4	4	4	8
Land (Acre) (Minimum 0.1 Acre)	0.1	0.1	0.2	0.4	1.0	2.0

Design Specifications	Media Used	
Influent TSS = 40 mg/l	Anthracite	1 Layer
Effluent TSS = 16 mg/l	Sand	1 Layer
Filtration Rate = 4 gpm/ft^2	Garnet Sand	1 Layer
Backwash Rate = 20 gpm/ft^2	Gravel	1 Layer

		K	POR	DIA	SF	SG
*Package Plant	Anthracite	6	0.50	0.0046	7.0	1.4
	Sand	5	0.40	0.0020	8.5	2.65
	Garnet	4	0.47	0.0010	8.0	2.65
	Gravel	6	0.60	0.050	6.0	2.65

K = Coefficient of Permeability
POR = Porosity
DIA = Particle Diameter (ft)
SF = Shape Factor
SG = Specific Gravity

TABLE VIII-38.
SUMMARY OF CAPITAL AND O&M COSTS FOR FILTRATION SYSTEMS
1982 DOLLARS (MARCH)

Flow (MGD)	Capital Cost ($)*	Annual O&M ($)
0.01	205,720	21,937
0.10	253,773	30,949
1.00	519,684	52,347
2.00	657,833	64,456
10.00	1,328,275	109,963
20.00	2,633,803	153,207

*Calculated based upon total project cost less miscellaneous nonconstruction cost, 201 planning cost, technical cost, land cost, interest during construction, and laboratory cost.

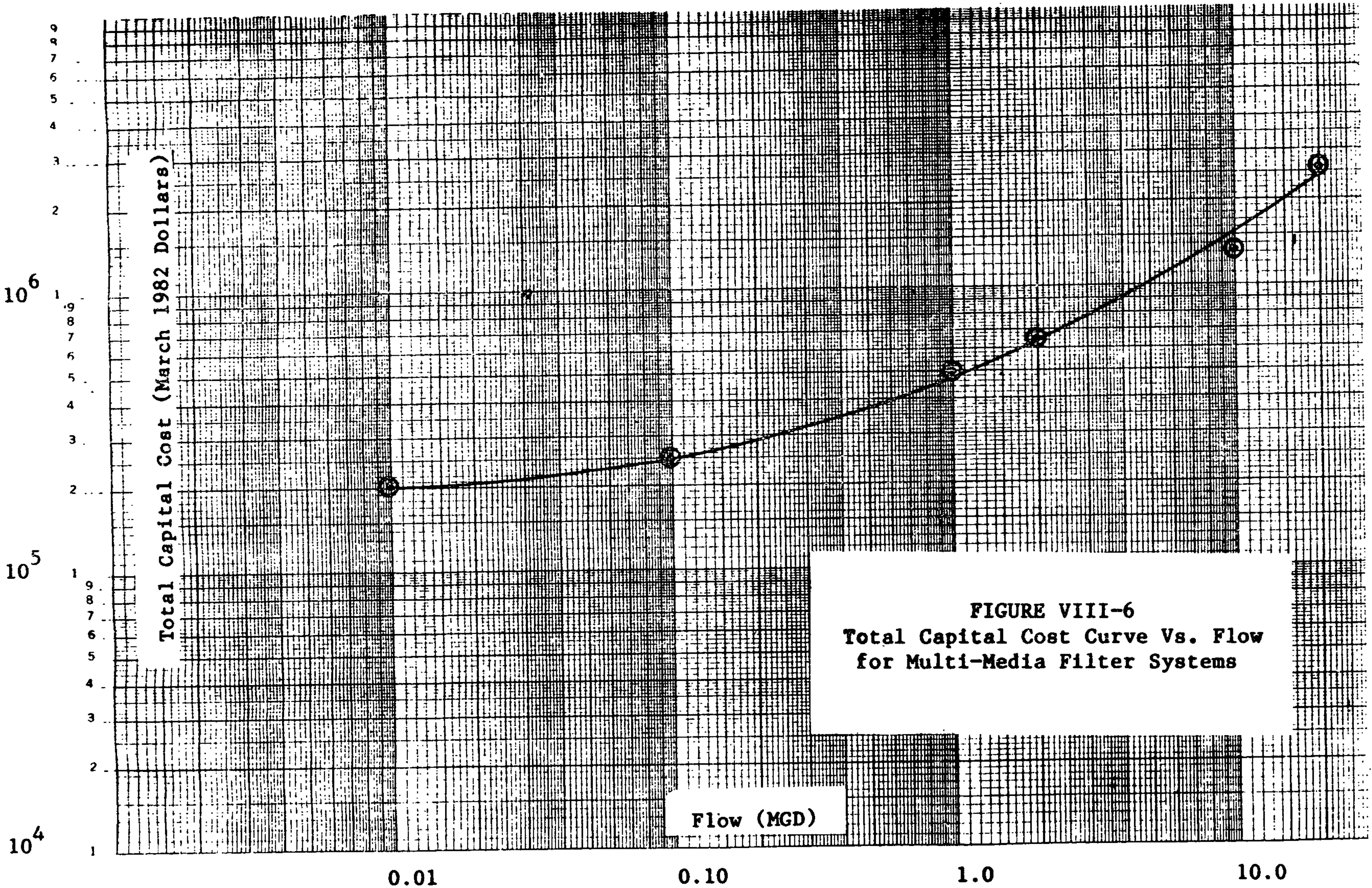


FIGURE VIII-6
Total Capital Cost Curve Vs. Flow for Multi-Media Filter Systems

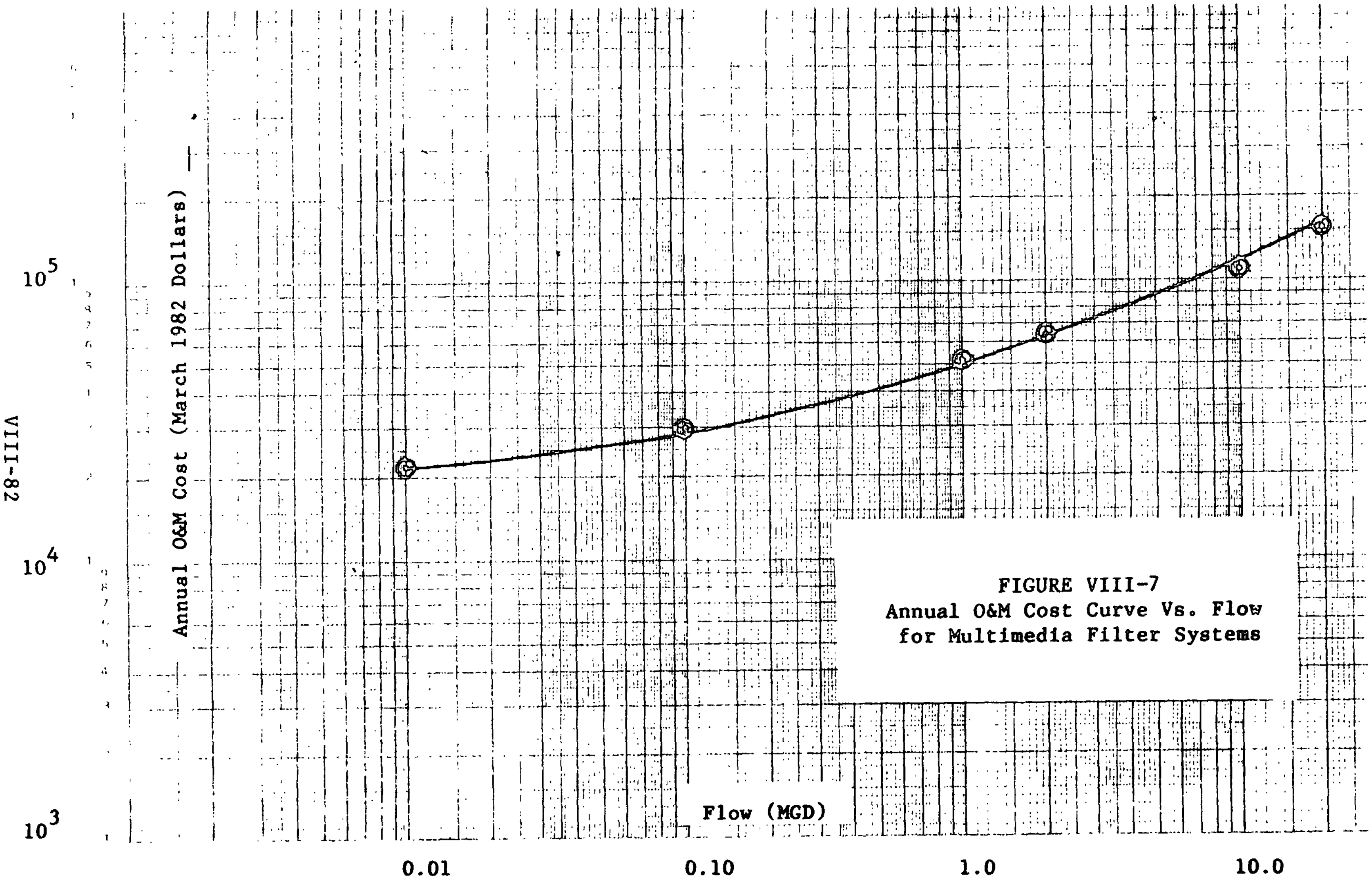


FIGURE VIII-7
Annual O&M Cost Curve Vs. Flow
for Multimedia Filter Systems

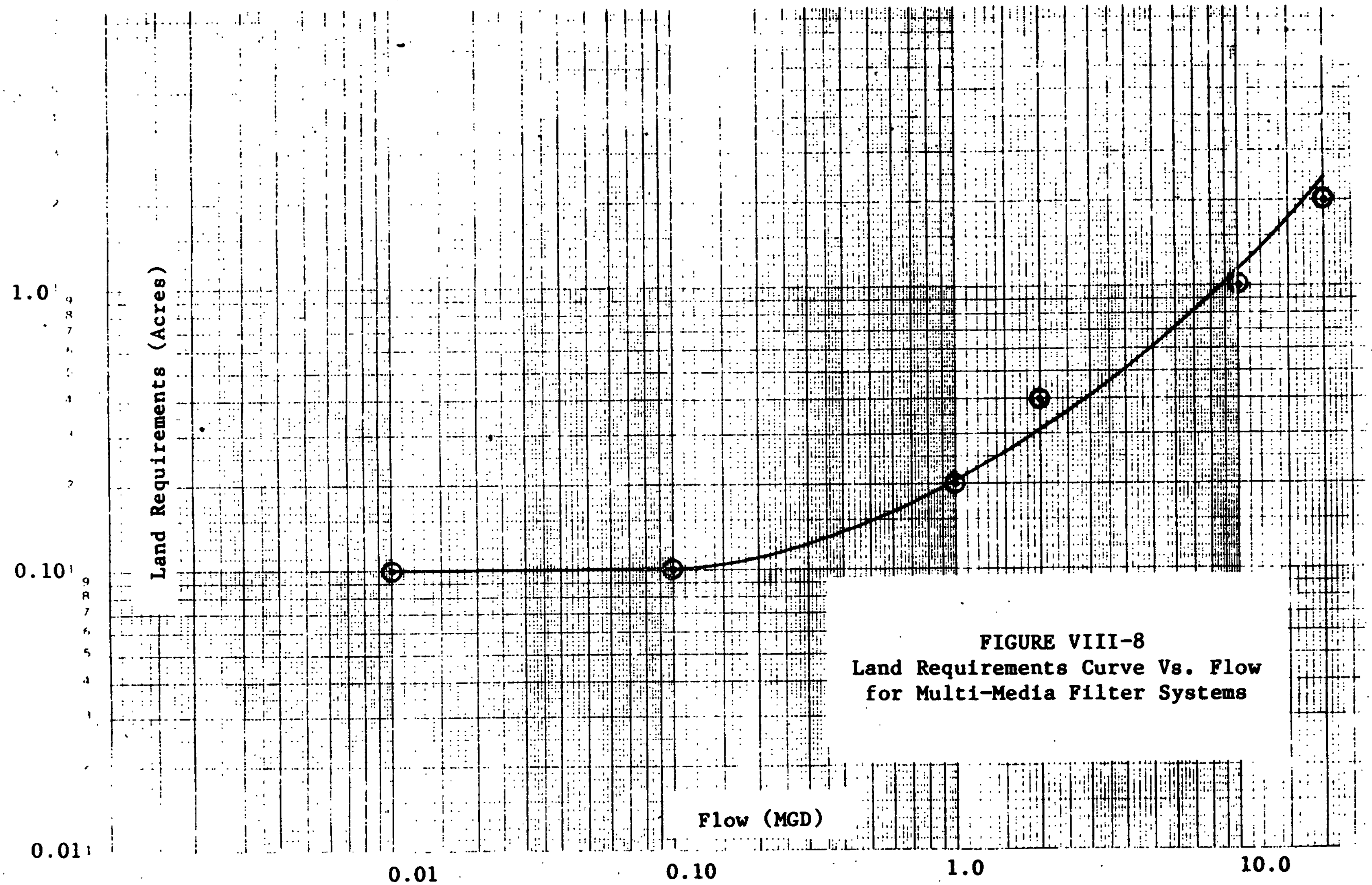


FIGURE VIII-8
Land Requirements Curve Vs. Flow for Multi-Media Filter Systems

The capital costs were estimated based on costs for excavation, earth preparation, and liner installation. Capital costs also include miscellaneous (15%), engineering (15%), and contingencies (15%). A unit cost of $1.20 per cubic yard was assumed for both excavation and earth preparation. The unit cost for liner installation ($0.54/ft^2$) was obtained directly from manufacturers' recommendations. The total annual O&M cost for each system was obtained by assuming the O&M cost to be 10 percent of the total capital cost plus sludge disposal expenses at $7,600 per year per MGD flow. A summary of the capital and annual O&M costs in 1982 dollars are presented in Table VIII-39. Figures VIII-9 and VIII-10 represent cost curves in 1982 dollars. Figure VIII-11 shows the land requirements versus flow rates for the six systems.

6. Algae Control

Annual costs for algae control were also estimated for existing polishing ponds. The control of algae growth in ponds, lakes, and reservoirs can be a serious problem in water quality management. Among the nuisances created by the often sudden blooming of one or more algal genera are: odors and tastes; fish kills; poisoned water fowl; shortened filter runs in water-purification plants; growths in pipes and other water conduits; and interference with industrial water uses. Therefore, proper control of algae growth in ponds is necessary to avoid the potential nuisances in the ponds and/or receiving waters.

The most common means of treatment for the control of algae is copper sulfate. Copper sulfate can be fed into the influent of small ponds or fed from boats to large ponds. For large pond applications, burlap bags filled with copper sulfate crystals are dragged through the water by boats to provide the necessary treatment.

The cost estimates for algae control were based upon the following assumptions:

- A typical copper sulfate application rate of 0.82 lbs/acre-ft (or 0.30 mg/l of copper sulfate in the upper 1 ft of the pond water)
- A copper sulfate application frequency of 4 days/year

TABLE VIII-39.

SUMMARY OF CAPITAL AND O&M COSTS FOR POLISHING PONDS

Flow (MGD)	Capital Cost* (1982 Dollars)	Yearly O&M Costs (1982 Dollars)
0.07	20,300	2,750
0.86	55,500	14,000
1.44	90,700	23,200
5.07	305,000	80,300
10.00	684,000	166,700
20.00	1,402,400	336,800

*Land costs are not included

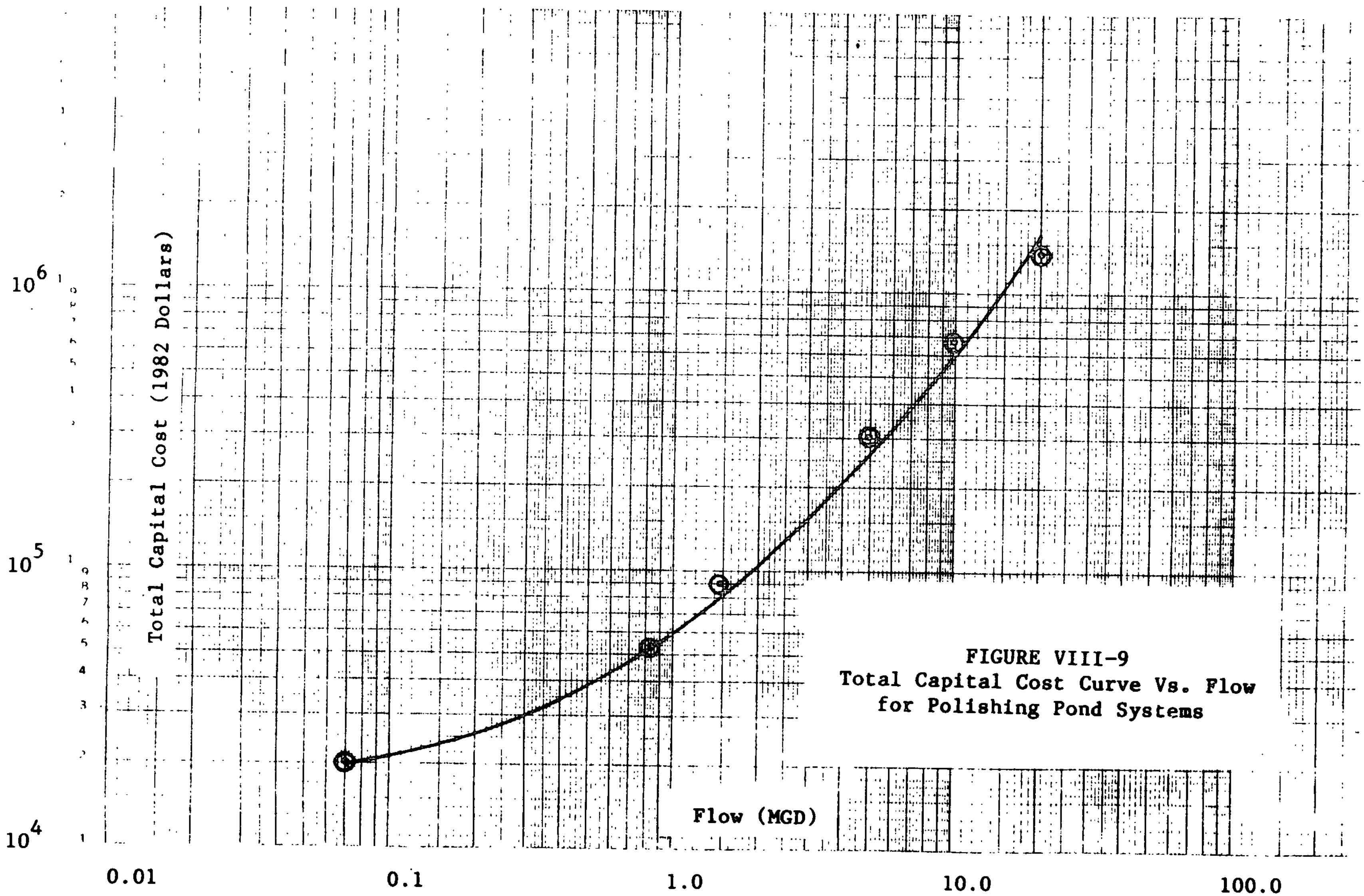


FIGURE VIII-9
Total Capital Cost Curve Vs. Flow for Polishing Pond Systems

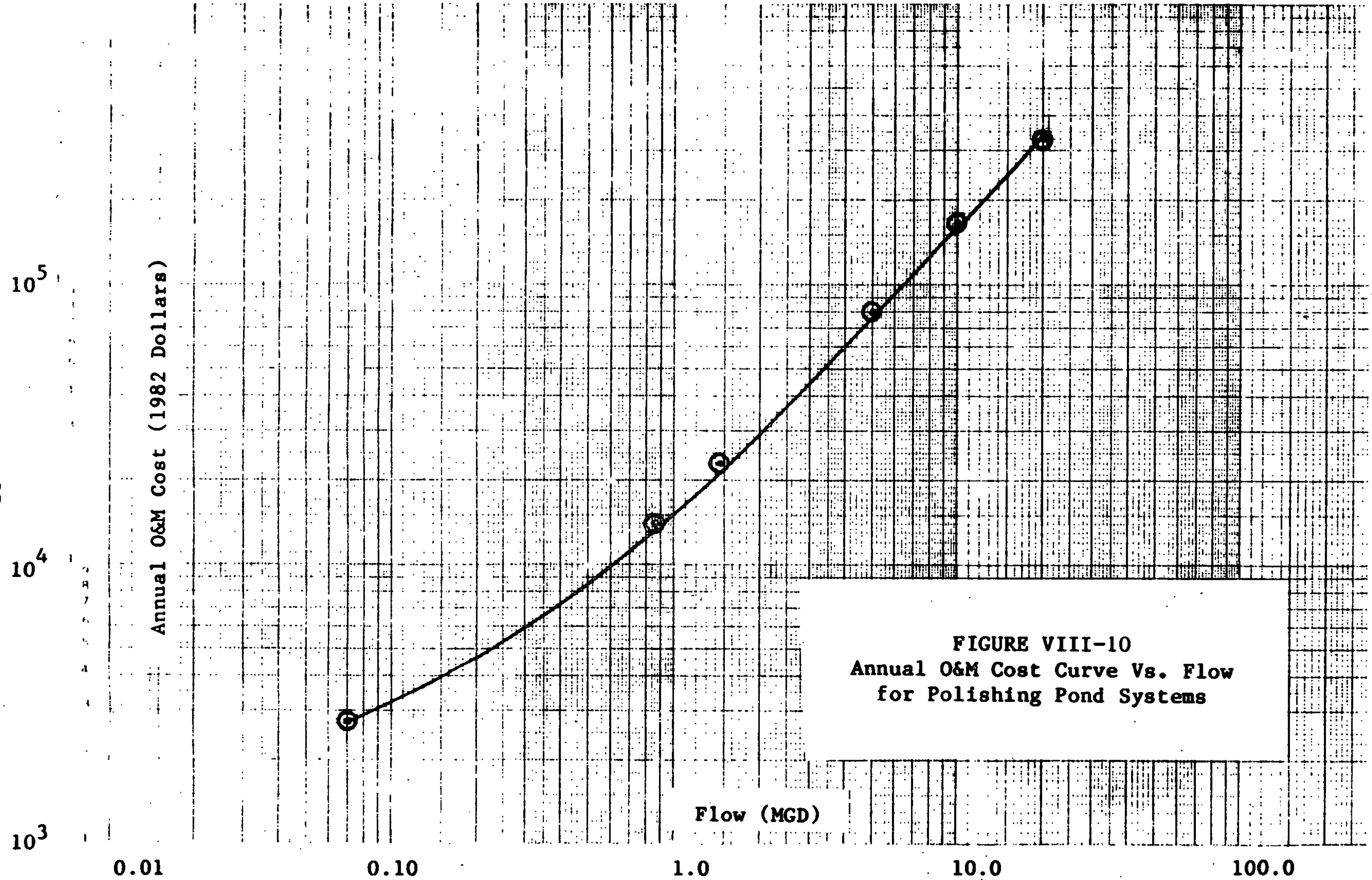


FIGURE VIII-10
Annual O&M Cost Curve Vs. Flow for Polishing Pond Systems

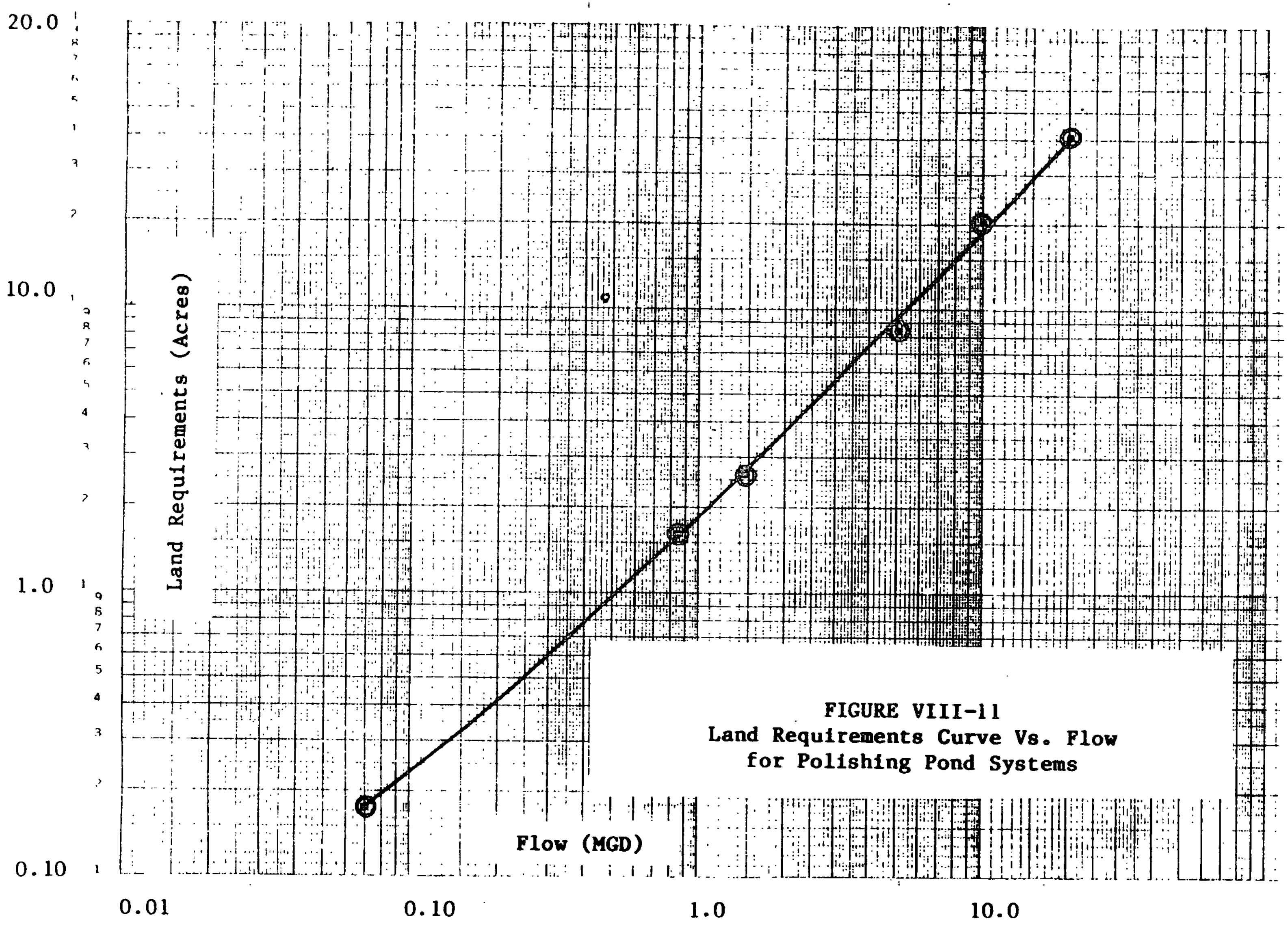


FIGURE VIII-11
Land Requirements Curve Vs. Flow for Polishing Pond Systems

- Copper sulfate ($CuSO_4 \cdot 5H_2O$) cost at $1/lb with a solubility of 20% by weight

- Labor cost to be $40/hr for a certified copper sulfate applicator

- Equipment rental cost as well as other itemized costs for algae control are presented in Table VIII-40 and Figure VIII-12.

The Agency estimated that the application of copper sulfate to a typical polishing pond will not cause the wastewater discharged from the pond to violate final BAT or PSES concentration-based effluent limitations. This analysis, which is in the public record, is based on the fact that copper sulfate is only applied to the top 6 inches to 1 foot of water, and only once or twice per algae season. However, when these low concentrations of copper sulfate are diluted with the remaining capacity of the ponds, the resulting effluent is well below the required BAT levels.

After estimating copper sulfate addition costs based on the methodology presented in Table VIII-1, the Agency became concerned that the greater than 3 mg/l delta TSS values for plants costed only for copper sulfate addition could possibly not be the result of algae problems and that the addition of copper sulfate would not allow these plants to comply with BPT effluent limitations. To address this possibility, the Agency identified all plants with treatment systems for which only copper sulfate addition was costed, and listed their in-place treatment technology. Table VIII-41 presents the 10 treatment systems (nine plants), along with their corresponding wastewater flows, locations, and in-place treatment technology. For the four treatment systems without either biological treatment or a secondary clarifier in-place, the Agency assumed that the delta TSS occurred because of algae problems. For the remaining six treatment systems, the Agency assumed that the cause of each treatment system's delta TSS value was a poorly performing secondary clarifier; EPA thereby replaced the copper sulfate addition costs with the cost of upgrading each secondary clarifier with a polymer addition system. Table VIII-42 presents the capital and O&M costs of the polymer addition systems and the technology basis for these costs while Table VIII-43 presents the capital and O&M costs for each of the selected six treatment systems.

TABLE VIII-40.
ANNUAL OPERATING COST FOR ALGAE CONTROL
IN POLISHING PONDS
(1982 Dollars)

Item	Flow Rate (MGD) 0.20	1.0	5.0	10.0	20.0
Copper Sulfate Cost	10	50	250	500	1,000
Labor	3,840	7,680	11,520	15,360	19,200
Equipment Rental	1,200	1,200	1,200	1,200	1,200
Total Annual Cost	5,050	8,930	12,970	17,060	21,400

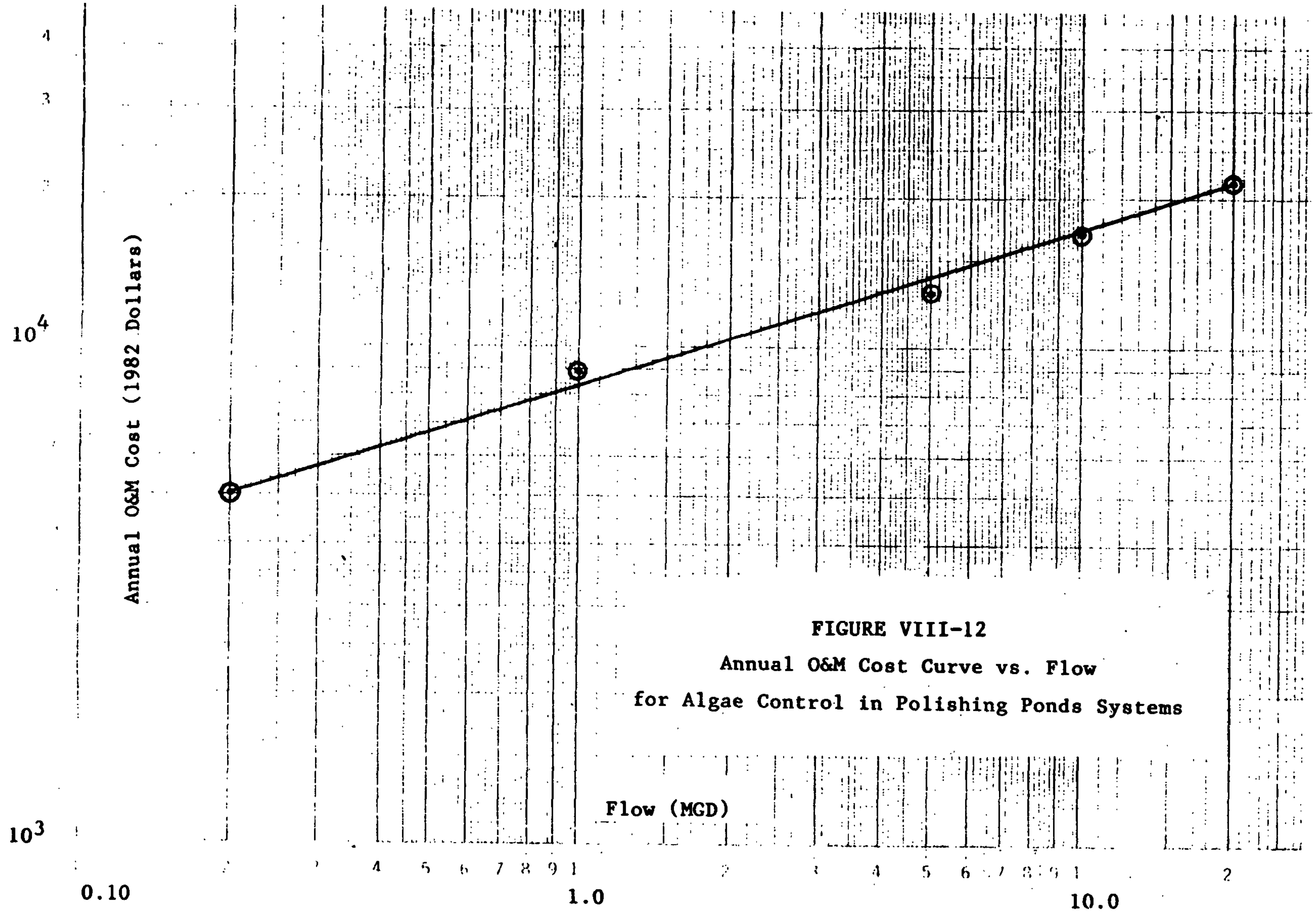


FIGURE VIII-12

Annual O&M Cost Curve vs. Flow for Algae Control in Polishing Ponds Systems

TABLE VIII-41.
TEN TREATMENT SYSTEMS WITH POLISHING PONDS IN-PLACE (AT NINE PLANTS) THAT WERE COSTED ONLY FOR COPPER SULFATE ADDITION

Plant Number	Flow (MGD)	State	Delta BOD_5	Delta TSS	Activated Sludge	Other Bio Treatment	No Bio Treatment	Secondary Clarifier
663	0.407	TX	0	19	-	-	X	-
844	0.850	OH	0	22	-	X	-	X
1020	0.1086	TX	0	15	-	X	-	-
1203	0.253	NC	2	7	X	-	-	X
1349	1.012	NJ	2	7	X	-	-	X
1769	38.7	NJ	0	28	X	-	-	X
2073	1.559	LA	0	12	-	-	X	-
2315	1.31	VA	0	18	X	-	-	X*
2328.1	0.331	IL	0	6	X	-	-	X*
2328.2	0.014	IL	0	6	-	-	X	-

*Polishing pond is followed by filtration

TABLE VIII-42.
SUMMARY OF CAPITAL AND O&M COSTS FOR POLYMER ADDITION SYSTEMS FOR UPGRADING SECONDARY CLARIFIERS

Flow (MGD)	capital Cost ($)	O&M Cost ($/yr)
0.050	10,000*	13,092
0.500	14,000 (Est.)	27,969
1.000	18,000 (Est.)	44,493
5.000	50,000*	176,702
10.000	90,000 (Est.)	341,942
50.000	413,650 (Est.)	1,663,948

*Direct vendor quotes

(Est.) = Estimated from vendor quotes

TABLE VIII-43.
SUMMARY OF POLYMER ADDITION COSTS FOR SIX TREATMENT SYSTEMS
SELECTED FOR SECONDARY CLARIFIER UPGRADES

Plant Number	Capital Cost ($)	O&M Cost ($/yr)
844	26,890	70,000
1203	11,640	19,000
1349	17,680	44,500
1769	322,330	1,300,000
2315	20,180	54,000
2328.1	12,270	22,000

D. BAT AND PSES TECHNOLOGIES

1. Steam Stripping

Steam stripping is used in both industrial chemical production (for recovery and/or recycle) and in industrial waste treatment to remove gases or volatile organic chemicals from wastewater streams by injection of steam into a tray or packed distillation column. In most cases, the volatile components are water soluble. Stripping is a cost-effective alternative for the treatment of a wide range of aqueous streams containing organics. It can be used both as an in-plant process for the recovery of organics from concentrated aqueous streams and as an end-of-pipe treatment for the removal of dilute concentrations of organics from wastewaters prior to discharge or recycle.

Steam stripping is usually conducted as a continuous operation in a packed tower or fractionating distillation column (sieve tray or bubble cap) with more than one stage of vapor-liquid contact. The wastewater enters near the top of the distillation column and then flows by gravity countercurrent to the steam with organic vapors rising up from the bottom of the column. As the wastewater passes down through the column, it contacts the vapors rising from the bottom of the column. As a result, the wastewater contains progressively less volatile organic compounds as it moves toward the bottom of the column. Reflux can be used depending on the composition of the vapor stream that is desired.

To provide a basis for the development of steam stripping costs, data were extracted from the Supplemental 308 Questionnaires submitted by those facilities utilizing steam strippers on their waste streams (see Table VIII-44). The capital and O&M costs taken from the Questionnaires were scaled up to 1982 using the appropriate Engineering News Record indices. Where installation costs were not provided, they were assumed to be 50 percent of the capital costs.

TABLE VIII-44.
COMPARISON OF PREDICTED AND REPORTED CAPITAL AND O&M COSTS FOR STEAM STRIPPING

Plant Number	Diameter (Inches)	Height (Feet)	Reported Capital ($MM)1982	Predicted Capital ($MM)	Reported O&M ($MM)1982	Predicted O&M ($MM)	Flow, Q (MGD)
296a	66	30	0.873	0.506	1.199	0.663	0.421
296b	114	55	1.442	1.554	0.352	0.469	0.0006
296d	90	45	1.172	0.924	0.652	0.430	0.069
296g	60	31	0.672	0.474	0.084	0.236	0.0031
500	60	180	1.595	1.453	0.300	0.454	0.230
908a	36	30	0.396	0.350	0.035	0.142	0.013
1446	30	16.5	0.457	0.307	0.162	0.261	0.165
2626	42	16	0.473	0.328	0.227	0.225	0.072
2701c	72	42	0.415	0.663	0.144	0.679	0.412
525a	48	65	0.436	0.547	0.367	0.253	0.075
525b	54	70.2	0.466	0.645	0.328	0.287	0.083
525c	54	70.2	0.340	0.645	0.481	0.382	0.158
662a	60	14	0.149	0.362	0.353	0.239	0.005
695a	36	22.5	0.194	0.332	0.219	0.209	0.083
695b	30	27	0.941	0.325	0.233	0.144	0.043
Total			10.021	9.415	5.136	5.073	

Although packed towers are less expensive than sieve-tray towers, the latter operate more efficiently and over a wider range of liquid flow rates. Also, sieve-trays are easily accessible for cleaning, and thus used more extensively by the OCPSF industry. Therefore, tray towers were chosen for use in the design analysis.

A goodness-of-fit analysis was then performed to determine the best relationship between the capital and O&M costs and significant steam stripper design parameters, such as volatility, wastewater flow, and diameter and height of the distillation column. The results of this analysis showed that capital costs were best related to the diameter (D) and height (H) of the distillation column, while O&M costs were best related to the diameter of the distillation column and wastewater flow (Q). The equations are given as:

$$\text{Capital Cost (in million dollars)} = 0.246 - 2.88\times10^{-4}(D) + 2.22\times10^{-4}(D^2H)$$

$$\text{O\&M Cost (in million dollars)} = 3.68\times10^{-3}(D) + 0.809(Q) - 0.023$$

The Water General Corporation developed a methodology for designing and costing stripping systems for the separation of organic pollutants from a wastewater (Process Design Manual for the Stripping of Organics, EPA 68-03-3002, October 1983). This design was adapted for use in this costing exercise.

An important characteristic that determines the effectiveness of steam stripping is the relative volatility or vapor pressure of the organic(s) that are going to be stripped from the wastewater. At least one third of the 126 chemicals on EPA's priority pollutant list have vapor pressures high enough to be effectively stripped from aqueous waste streams. For aqueous mixtures, this vapor-liquid equilibrium can be expressed by Henry's Law. The Water General design uses a stripping factor (S) to determine the tower specifications; this factor is related to the Henry's Law Constant of the pollutant to be stripped, as shown below.

$$S = \frac{KV}{L} \quad \text{Where} \quad K = \frac{\text{Henry's Law Constant (atm)}}{\text{Tower Operating Pressure (atm)}}$$

V = Vapor Rate (lb/hr)
L = Liquid Rate (lb/hr)
Tower Operating Pressure = 1.0 atm

Given the direct relationship between tower dimensions and pollutant Henry's Law Constant, and the relationship between tower dimensions and costs, it was decided to divide the priority pollutants into two groups (high and medium) by their Henry's Law Constant values for the purposes of costing (see Table VIII-45). A representative pollutant from each group was used in the cost study; benzene represents the high Henry's Law Constant pollutants, and hexachlorobenzene represents the medium Henry's Law Constant pollutants.

Twenty-three plants with steam stripper data from the Supplemental 308 Questionnaires were reviewed, and their influent and effluent concentrations tabulated. Table VIII-46 presents the data. Only those plants removing priority pollutants from their wastewater were included in the survey. An assessment of the 1983 Supplemental Questionnaire data provided median influent and effluent average concentrations of 390 and 2.3 mg/l, respectively. However, EPA sampling study data have shown that OCPSF steam strippers can achieve effluent concentrations as low as the analytical minimum level for many pollutants (see Section VII for a listing of these data).

Tables VIII-47, VIII-48, and VIII-49 list the values assigned to the steam stripper design variables for the original July 1985 notice cost exercise and this final cost exercise.

The results of this analysis are presented in Tables VIII-50 and VIII-51. For both effluent concentration options, equations were derived that yield the steam stripper capital cost in terms of wastewater flow rate for both high and medium Henry's Law Constant pollutants. Operation and maintenance (O&M) costs for the strippers are functions of flow rate only, and are the same for all options and pollutants. These equations are presented in Table VIII-52. The relationships of capital costs and O&M costs versus flow are presented graphically in Figures VIII-13 through VIII-17.

Steam stripper capital costs include:

- Feed tank (approximately 24-hour detention time)
- Preheater
- Distillation column (sieve tray)

TABLE VIII-45.
PRIORITY POLLUTANTS DIVIDED INTO GROUPS
ACCORDING TO HENRY'S CONSTANT VALUES

High HI 3×10^{2} to 10^{-1}	Medium HI 10^{-2} to 10^{-3}
Benzene	Acenaphthene
Carbon Tetrachloride	Acrylonitrile
Chlorobenzene	1,2-Dichloroethane
1,1,1-Trichloroethane	Hexachloroethane
Chloroethane	1,1,2-Trichloroethane
1,1-Dichloroethane	1,1,2,2-Tetrachloroethane
Chloroform	Methylene Chloride
Chloromethane	1,2-Dichloropropane
Toluene	1,3-Dichloropropene
Vinyl Chloride	1,1,1-Tribromomethane
1,1-Dichloroethene	Bis (2-Chloroisopropyl) Ether
1,2-Trans-dichloroethene	4-Chlorophenyl Phenyl Ether
Trichloroethene	4-Bromophenyl Phenyl Ether
Tetrachloroethene	1,2-Dichlorobenzene
Hexachloro-1,3-butadiene	1,2,4-Trichlorobenzene
Hexachlorocyclopentadiene	Hexachlorobenzene
Bromomethane	4-Nitrophenol
Dichlorobromomethane	4,6-Dinitro-o-cresol
1,3-Dichlorobenzene	Acenaphthylene
1,4-Dichlorobenzene	Anthracene
Ethylbenzene	Benzo(k)fluoranthene
	Fluorene
	Naphthalene
	Phenanthrene
	Dimethyl Nitrosoamine
	Diphenyl Nitrosoamine

Henry's constant units are $mg/m^3/mg/m^3$

TABLE VIII-46.
REPORTED STEAM STRIPPING AVERAGE INFLUENT AND EFFLUENT DATA
FROM THE 1983 SUPPLEMENTAL QUESTIONNAIRE

Plant No.	Pollutant	Influent Concentration(S_o)	Effluent Concentration(S_o)	% Removal
695	1,2-Dichloroethane	877 ppm	<1.0 ppm	99.89
	Methylene Chloride	130 ppm	<1.0 ppm	99.2
	Ethylene Dichloride	2,000 ppm	<1.0 ppm	99.95
	Bis(2-Chloroethyl)ether	400 ppm	<10.0 ppm	97.5
	Trichloroethylene	700 ppm	50.0 ppm	92.9
1446	Chlorobenzene	698 ppm	0.73 ppm	99.9
	Methylene Chloride	11,554 ppm	0.61 ppm	99.5
2701	Chlorinated Hydrocarbons	3,000 ppm	<0.5 ppm	99.85
	Chlorinated Hydrocarbons	1,000 ppm	<5.0 ppm	80.0
500	Nitrobenzene	2,400 ppm	1.0 ppm	99.96
	Benzene	100 ppm	N.D ppm	100.0
2626	Vinyl Chloride	50,000 ppm	≤10.0 ppm	99.98
2631	Ethylene Dichloride	5.7 ppm	<0.001 ppm	99.98
	2-Chloroethanol	1,222 ppm	11.0 ppm	99.1
	Trichlorethanol	3,246 ppm	151.0 ppm	95.3
1349	Vinyl Chloride	1461 ppm	16.0 ppm	98.9
908	Hydrocarbons	390 ppm	117.0 ppm	70.0
717	Vinyl Chloride	-	2.2 ppm	-
1891	Vinyl Chloride	318 ppm	5.3 ppm	98.3
1904	Benzene	-	0.06 ppm	-
	1,2-Dichloroethane	-	2.0 ppm	-
	Methylene Chloride	-	0.188 ppm	-
267	Vinyl Chloride	-	3.4 ppm	-
	Vinyl Chloride	-	5.6 ppm	-
	1,1-Dichloroethylene	-	2.5 ppm	-
	1,1-Dichloroethylene	-	1.5 ppm	-
	1,2-Dichloroethane	-	4.7 ppm	-
	1,1-Dichloroethylene	-	3.5 ppm	-
	1,1-Dichloroethylene	-	2.8 ppm	-
	Vinyl Chloride	-	2.3 ppm	-
	Vinyl Chloride	-	2.7 ppm	-
415	1,2-Dichloroethane	2,000 ppm	1.0 ppm	99.95

TABLE VIII-46.
REPORTED STEAM STRIPPING AVERAGE INFLUENT AND EFFLUENT DATA
FROM THE 1983 SUPPLEMENTAL QUESTIONNAIRE
(Continued)

Plant No.	Pollutant	Influent Concentration(S_o)	Effluent Concentration(S_e)	% Removal
569	1,2-Dichloroethane	-	10.0 ppm	-
	Cyanide	-	<0.4 ppm	-
	Phenol	-	0.015 ppm	-
	Methylene Chloride	-	0.001 ppm	-
	Bis(2-ethylhexyl)phthalate	-	0.043 ppm	-
	Bis(2-chloroethyl)ether	-	0.58 ppm	-
669	Ethylbenzene	-	3.44 ppm	-
913	Vinyl Chloride	3.7 ppm	0.03 ppm	99.2
	Chloroethane	23 ppm	0.07 ppm	99.7
	Methylene Chloride	20 ppm	0.13 ppm	99.35
	1,1-Dichloroethylene	-	0.01 ppm	-
	1,1-Dichloroethane	6 ppm	0.03 ppm	99.5
811	Vinyl Chloride	-	9.6 ppm	-
887	Phenol	-	971.0 ppm	-
1532	Vinyl Chloride	-	6.1 ppm	-
	1,2-Dichloroethane	-	780.0 ppm	-
2055	Ethylbenzene	-	15.1 ppm	-
	Carbon Tetrachloride	-	171.0 ppm	-
2272	Benzene	46 ppm	-	-
	Toluene	82 ppm	-	-
	Ethyl Benzene	4.2 ppm	-	-
	Chloroform	0.11 ppm	-	-
	Phenol	-	60.3 ppm	-
4002	1,2-Dichloroethane	-	126.0 ppm	-
4017	Vinyl Chloride	-	0.1 ppm	-

TABLE VIII-47.
STEAM STRIPPING DESIGN PARAMETERS FOR
HIGH HENRY'S LAW CONSTANT POLLUTANTS

Design Parameter	Units	Notice Costs	Latest Costs	Upgrade Costs
Representative Pollutant		1,1,1 Trichloroethane	Benzene	Benzene
CP = Specific heat of reflux	cal/g-°K	1.0	1.0	1.0
DIFL = Liquid-phase diffusivity	ft^2/hr	1.29×10^{-4}	1.623×10^{-4}	1.623×10^{-4}
DIFV = Gas-phase diffusivity of pollutant into water vapor	ft^2/hr	0.629	0.501	0.501
FC = Final concentration of organic	mg/l	0.002	Option I = 1.0 Option II = 0.01	0.037
G = Steam rate into tower	MGD	0.10 x L	0.10 x L	0.13 x L
GAMD = Activity coefficient of pollutant in organic phase	unitless	1.0	1.0	1.0
GAMS = Activity coefficient of pollutant in aqueous phase	unitless	346	660	660
IC = Initial concentration of organic	mg/l	200	390	2.3
K = Vapor-liquid equilibrium constant	atm/atm	737.0	253.3	253.3
L = Liquid feed into tower	MGD	0.01-1.00	0.01-1.00	0.01-1.00
LPRIM = Latent heat of steam	cal/g	542.0	542.0	542.0
MU = Gas-phase viscosity	lb/ft-hr	294.3×10^{-3}	294.3×10^{-3}	294.3×10^{-3}

TABLE VIII-47.
STEAM STRIPPING DESIGN PARAMETERS FOR HIGH HENRY'S LAW CONSTANT POLLUTANTS
(Continued)

Design Parameter	Units	Notice Costs	Latest Costs	Upgrade Costs
PSI = Fractional entrainment mass fraction	mole/mole	0.01	0.008	0.011
PR = Operating pressure of column	atm	1.0	1.0	1.0
REFLUX = Reflux Ratio	unitless	0.0	0.0	0.50
RHOG = Vapor density	lb_m/ft^3	0.037	0.037	0.037
RHOL = Liquid density	lb_m/ft^3	60	60	60
SAFE = Safety factor for Vm	unitless	0.75	0.75	0.75
SIGL = Liquid surface tension	dyne/cm	58.9	58.9	58.9
TB = Boiling point of aqueous reflux	°C	100	100	100
TR = Reflux temperature	°C	9	9	9
XPRF = Tray construction indicator	unitless	Perforated	Perforated	Perforated

TABLE VIII-48.
STEAM STRIPPING DESIGN PARAMETERS FOR
MEDIUM HENRY'S LAW CONSTANT POLLUTANTS

DESIGN PARAMETER	UNITS	NOTICE COSTS	LATEST COSTS	UPGRADE COSTS
Representative Pollutant		Acrylonitrile	Hexachloro-Benzene	Hexachloro-Benzene
CP = Specific heat of reflux	cal/g-°K	1.0	1.0	1.0
DIFL = Liquid-phase diffusivity	ft^2/hr	1.69×10^{-4}	9.918×10^{-5}	9.918×10^{-5}
DIFV = Gas-phase diffusivity of pollutant into water vapor	ft^2/hr	0.751	0.311	0.311
FC = Final concentration of organic	mg/l	0.002	Option I = 1.0 Option II = 0.01	0.012
G = Steam rate into tower	MGD	0.10 x L	0.10 x L	0.13 x L
GAMD = Activity coefficient of pollutant in organic phase	unitless	1.0	1.0	1.0
GAMS = Activity coefficient of pollutant in aqueous phase	unitless	15.93	3.775×10^6	3.775×10^6
IC = Initial concentration of organic	mg/l	200	390	2.3
K = Vapor-liquid equilibrium constant	atm/atm	30.5	37.3	37.3
L = Liquid feed into tower	MGD	0.01-1.00	0.01-1.00	0.01-1.00
LPRIM = Latent heat of steam	cal/g	542.0	542.0	542.0
MU = Gas-phase viscosity	lb/ft-hr	294.3×10^{-3}	294.3×10^{-3}	294.3×10^{-3}

TABLE VIII-48.
STEAM STRIPPING DESIGN PARAMETERS FOR
MEDIUM HENRY'S LAW CONSTANT POLLUTANTS
(Continued)

Design Parameter	Units	Notice Costs	Latest Costs	Upgrade Costs
PSI = Fractional entrainment mass fraction	mole/mole	0.01	0.008	0.011
PR = Operating pressure of column	atm	1.0	1.0	1.0
REFLUX = Reflux Ratio	unitless	0.0	0.0	0.50
RHOG = Vapor density	lb_m/ft^3	0.037	0.037	0.037
RHOL = Liquid density	lb_m/ft^3	60	60	60
SAFE = Safety factor for Vm	unitless	0.75	0.75	0.75
SIGL = Liquid surface tension	dyne/cm	58.9	58.9	58.9
TB = Boiling point of aqueous reflux	°C	100	100	100
TR = Reflux temperature	°C	9	9	9
XPRF = Tray construction indicator	unitless	Perforated	Perforated	Perforated

TABLE VIII-49.
STEAM STRIPPING DESIGN PARAMETERS FOR
LOW HENRY'S LAW CONSTANT POLLUTANTS

Design Parameter	Units	Notice Costs*
Representative pollutant		Nitrobenzene
CP = Specific heat of reflux	cal/g-°k	1.0
DIFL = Liquid-phase diffusivity	ft^2/hr	1.15×10^{-4}
DIFV = Gas-phase diffusivity of pollutant into water vapor	ft^2/hr	0.531
FC = Final concentration of organic	mg/l	0.002
G = Steam rate into tower	MGD	0.10 X L
GAMD = Activity coefficient of pollutant in organic phase	unitless	1.0
GAMS = Activity coefficient of pollutant in aqueous phase	unitless	626.6
IC = Initial concentration of organic	mg/l	200
K = Vapor-liquid equilibrium constant	atm/atm	17.15
L = Liquid feed into tower	MGD	0.01 - 1.00
LPRIM = Latent heat of steam	cal/g	542.0
MU = Gas-phase viscosity	lb/ft-hr	294.3×10^{-3}
PSI = Fractional entrainment mass fraction	mole/mole	0.01
PR = Operating pressure of column	atm	1.0
REFLUX = Reflux Ratio	unitless	0.0
RHOG = Vapor density	lb_m/ft^3	0.037
RHOL = Liquid density	lb^m/ft^3	60
SAFE = Safety factor for Vm	unitless	0.75
SIGL = Liquid surface tension	dyne/cm	58.9

TABLE VIII-49.
STEAM STRIPPING DESIGN PARAMETERS FOR
LOW HENRY'S LAW CONSTANT POLLUTANTS
(Continued)

Design Parameter	Units	Notice Costs*
TB = Boiling point of aqueous reflux	°C	100
TR = Reflux temperature	°C	9
XPRF = Tray construction indicator	unitless	Perforated

*Low Henry's Law Constant pollutants were not considered in the final costing exercise

TABLE VIII-50.
STEAM STRIPPING RESULTS FOR REMOVAL OF BENZENE
(1982 $)

Effluent Concentration (ppm)	Flow (MGD)	Height (Ft)	Capital Cost ($)	O&M Cost ($)	Diameter (Ft)
0.01	0.010	19.9	295,879	11,816	1.0
0.01	0.050	14.3	298,735	23,076	1.5
0.01	0.075	12.1	300,891	48,058	1.8
0.01	0.100	10.7	302,805	73,020	2.1
0.01	0.500	10.0	340,985	471,637	4.4
0.01	0.750	10.0	366,176	720,607	5.4
0.01	1.000	10.0	391,372	969,521	6.2
1.00	0.010	11.2	293,594	11,816	1.0
1.00	0.050	10.0	296,308	23,076	1.5
1.00	0.075	10.0	299,136	48,058	1.8
1.00	0.100	10.0	301,962	73,020	2.1
1.00	0.500	10.0	340,985	471,637	4.4
1.00	0.750	10.0	366,176	720,607	5.4
1.00	1.000	10.0	391,372	969,521	6.2

TABLE VIII-51.
STEAM STRIPPING RESULTS
FOR REMOVAL OF HEXACHLOROBENZENE
(1982 $)

Effluent Concentration (ppm)	Flow (MGD)	Height (Ft)	Capital Cost ($)	O&M Cost ($)	Diameter (Ft)
0.01	0.010	50.2	302,201	11,816	1.0
0.01	0.050	41.2	303,825	23,076	1.5
0.01	0.075	37.7	322,685	48,058	1.8
0.01	0.100	35.6	330,972	73,020	2.1
0.01	0.500	34.2	462,875	471,637	4.4
0.01	0.750	32.7	538,117	720,607	5.4
0.01	1.000	31.9	611,976	969,521	6.2
1.00	0.010	27.7	297,913	11,816	1.0
1.00	0.050	22.7	303,523	23,076	1.5
1.00	0.075	20.8	308,297	48,058	1.8
1.00	0.100	19.6	312,861	73,020	2.1
1.00	0.500	18.8	385,531	471,637	4.4
1.00	0.750	18.0	426,990	720,607	5.4
1.00	1.000	17.6	467,684	969,521	6.2

TABLE VIII-52.
EQUATIONS FOR DETERMINING COMPUTERIZED COST CURVES
FROM STEAM STRIPPING RESULTS (1982 $)

Capital Cost	
Benzene $S_e = 0.01$ mg/l	$\ln(\text{capital cost}) = 12.8578 + 0.1506 \ln(\text{flow}) + 0.0203 (\ln(\text{flow}))^2$
Benzene $S_e = 1.0$ mg/l	$\ln(\text{capital cost}) = 12.8231 + 0.1282 \ln(\text{flow}) + 0.0175 (\ln(\text{flow}))^2$
Hexachlorobenzene $S_e = 0.01$ mg/l	$\ln(\text{capital cost}) = 13.3041 + 0.3702 \ln(\text{flow}) + 0.0482 (\ln(\text{flow}))^2$
Hexachlorobenzene $S_e = 1.0$ mg/l	$\ln(\text{capital cost}) = 13.0350 + 0.2355 \ln(\text{flow}) + 0.0311 (\ln(\text{flow}))^2$
Operation and Maintenance Costs	
All Pollutants All Concentrations	$\ln(\text{O\&M cost}) = 13.9091 + 1.5111 \ln(\text{flow}) + 0.1108 (\ln(\text{flow}))^2$

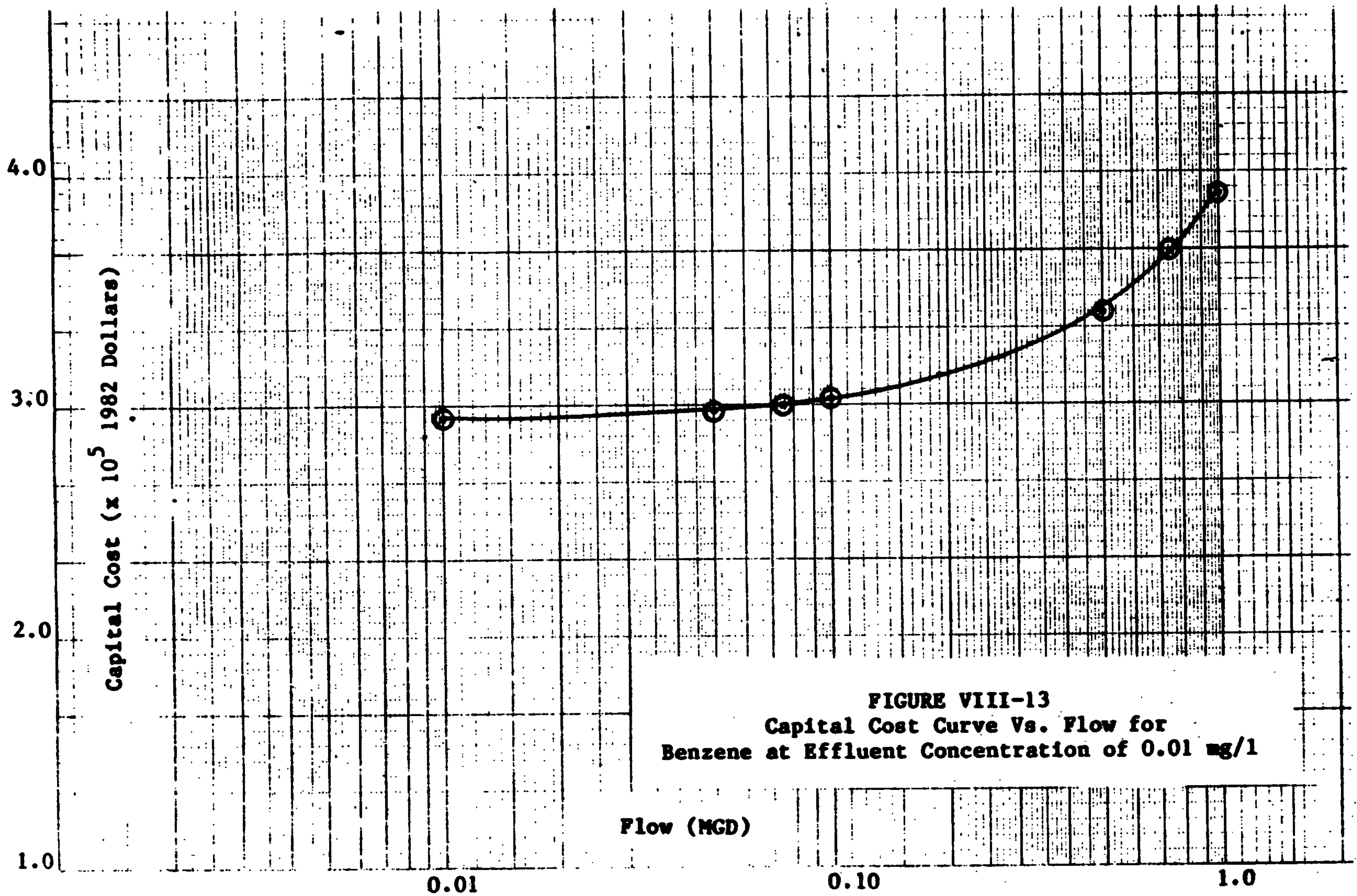


FIGURE VIII-13
Capital Cost Curve Vs. Flow for
Benzene at Effluent Concentration of 0.01 mg/l

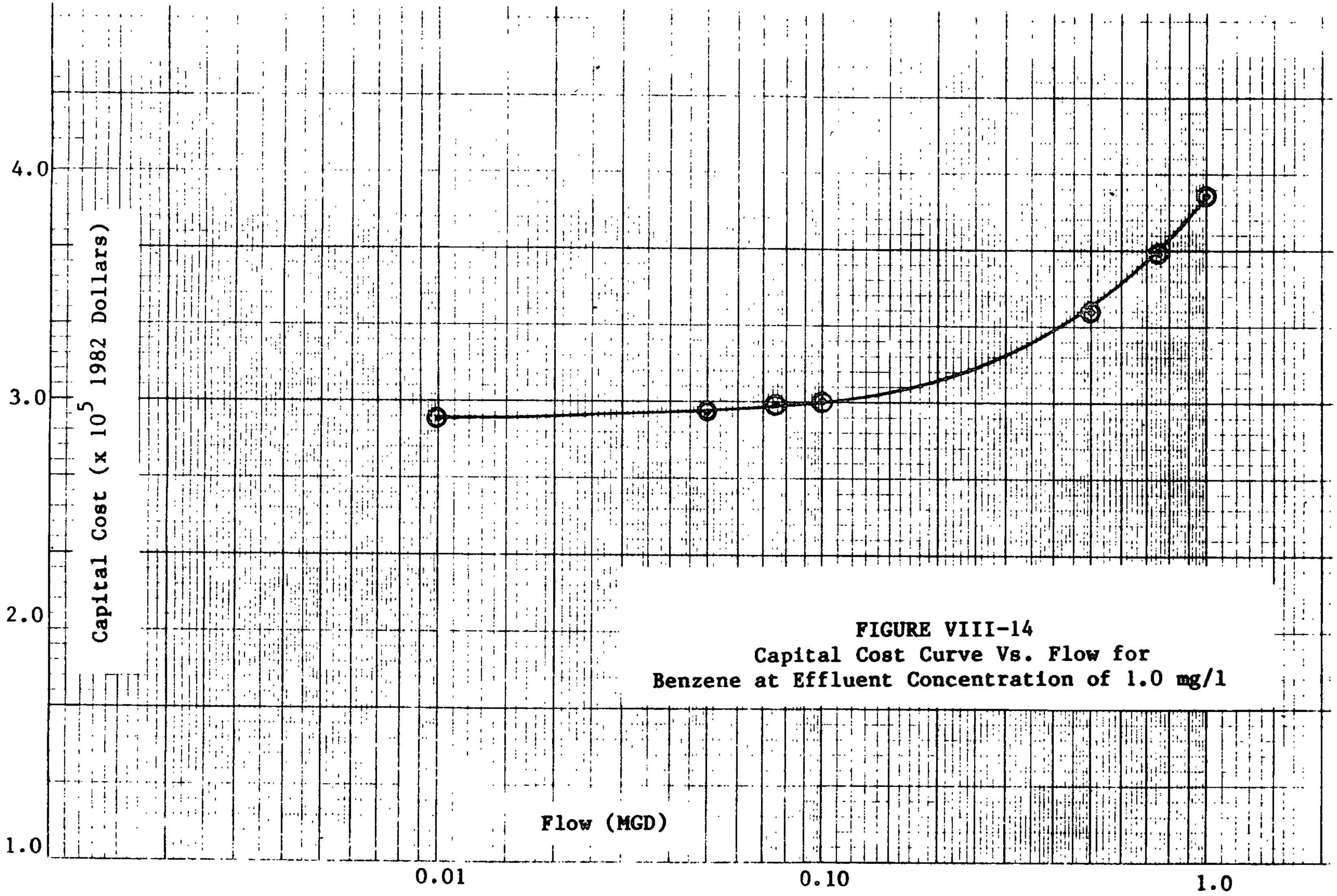


FIGURE VIII-14
Capital Cost Curve Vs. Flow for
Benzene at Effluent Concentration of 1.0 mg/l

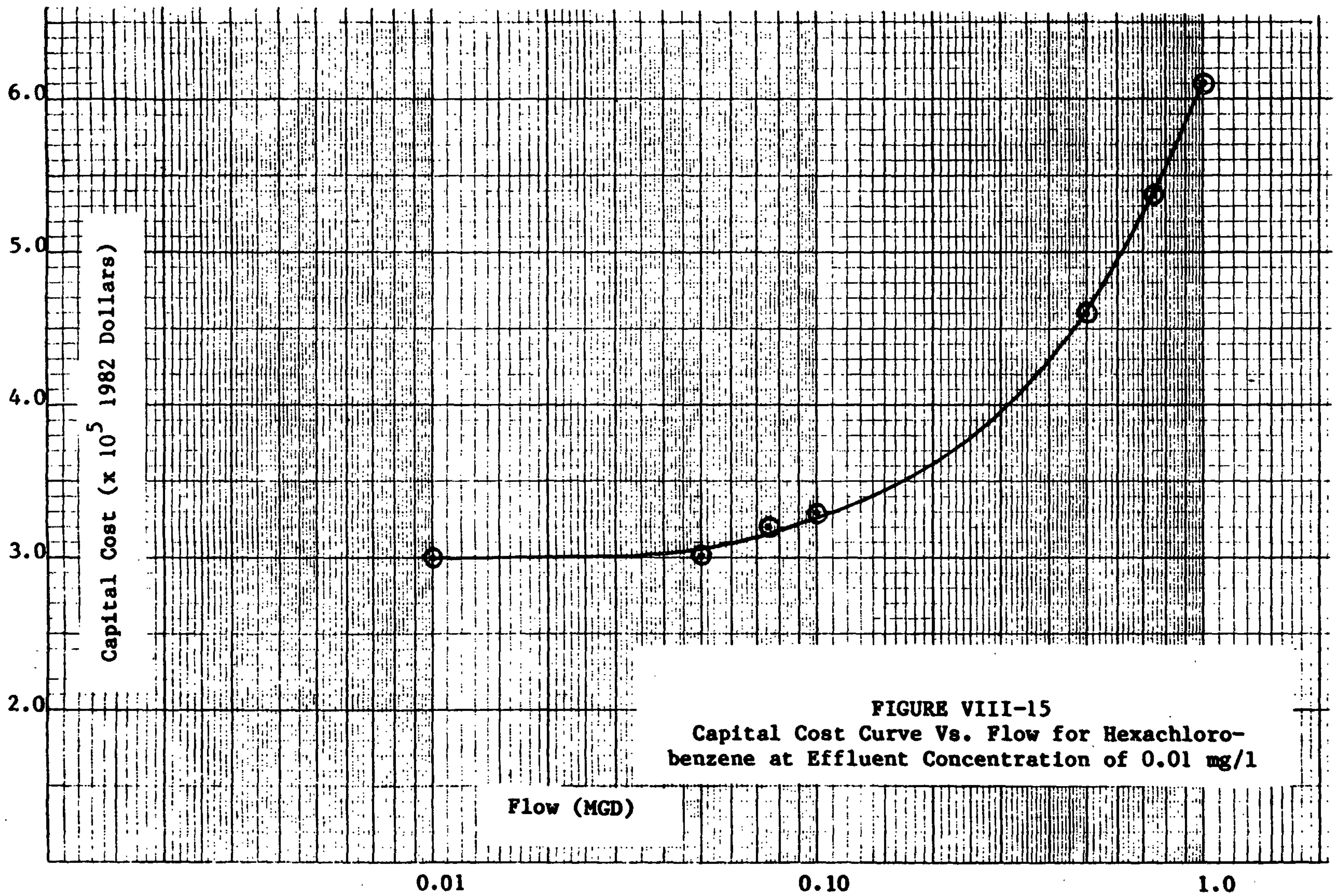


FIGURE VIII-15
Capital Cost Curve Vs. Flow for Hexachlorobenzene at Effluent Concentration of 0.01 mg/l

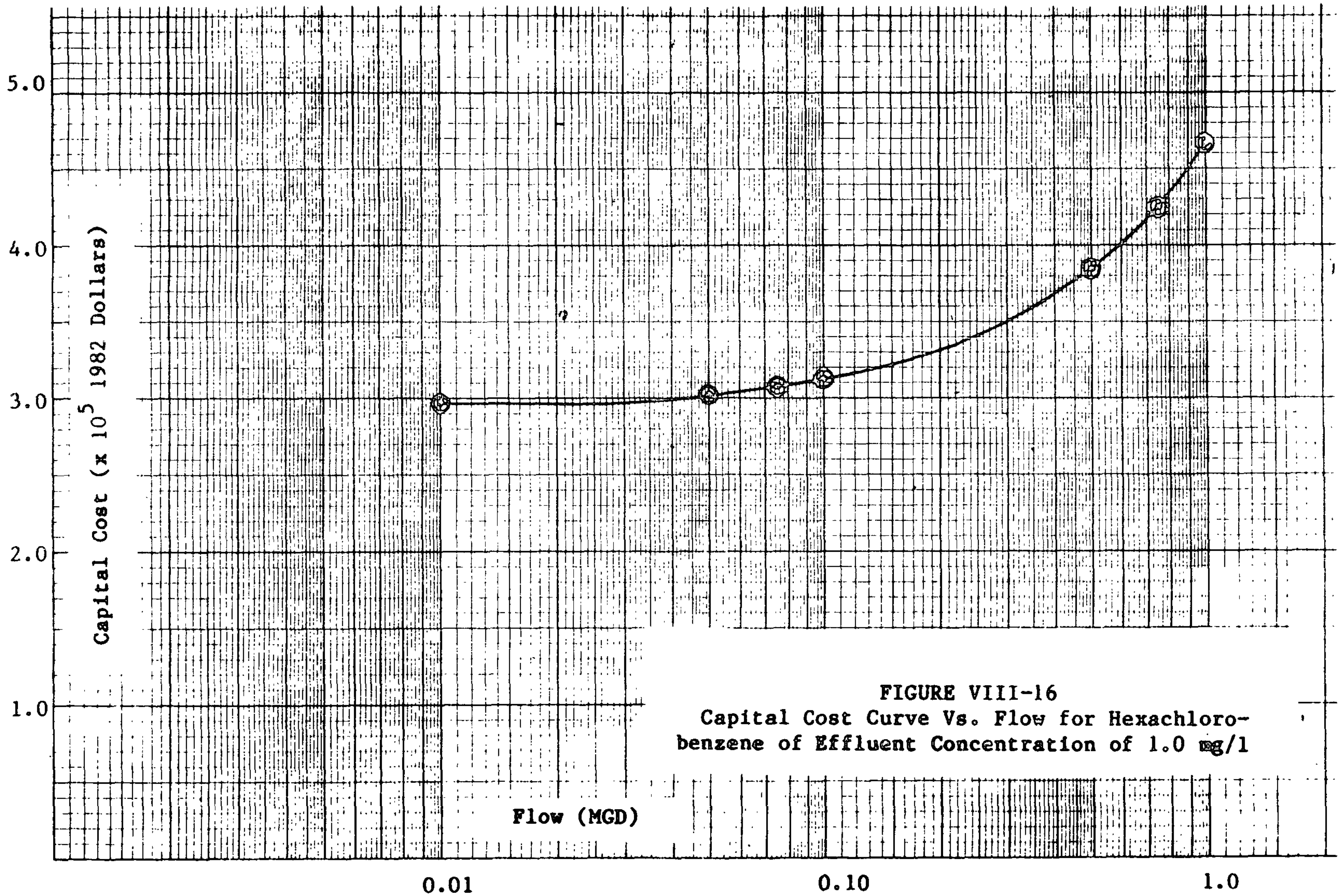


FIGURE VIII-16
Capital Cost Curve Vs. Flow for Hexachlorobenzene of Effluent Concentration of 1.0 mg/l

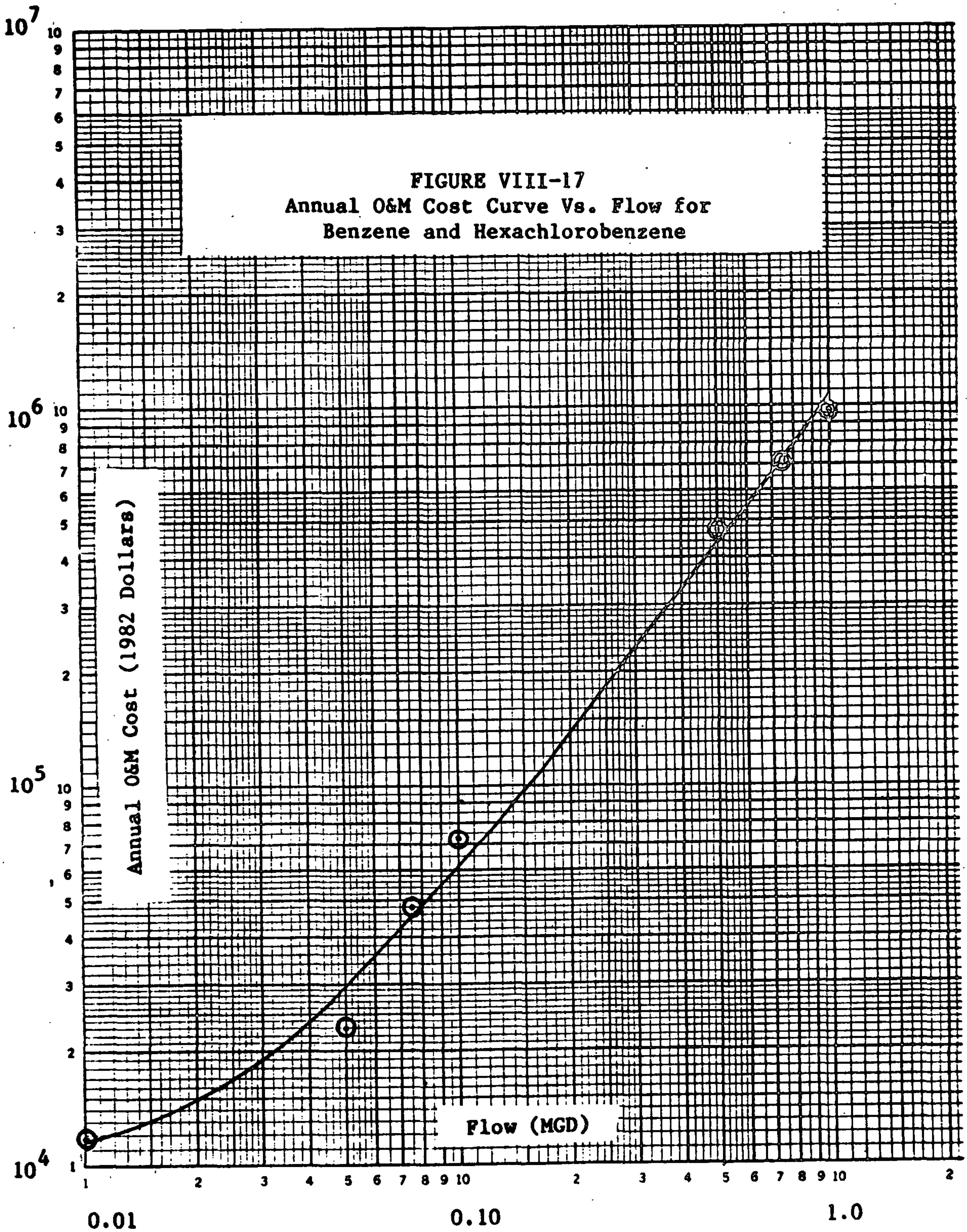


FIGURE VIII-17
Annual O&M Cost Curve Vs. Flow for
Benzene and Hexachlorobenzene
Annual O&M Cost (1982 Dollars)
Flow (MGD)
10^7
10^6
10^5
10^4
0.01
0.10
1.0

- Condenser
- Decanter
- Pumps.

Steam stripper operation and maintenance costs include:

- Operation and maintenance labor
- Maintenance materials
- Steam energy
- Electricity.

a. Steam Stripping Overhead Disposal Cost Estimates

A steam stripper produces an overhead waste stream of concentrated organic pollutants that have been stripped from the main waste stream. Based on manufacturers' information, this overhead waste stream flow is estimated to be 1 percent of the total waste stream flow. Estimates of the cost incurred for the disposal of steam stripper overhead were developed based on vendor quotations. These data are presented in Table VIII-53.

For overhead waste flows of 100 gallons per day (gpd) or less, the cost-effective option was determined to be contract hauling for off-site treatment and/or disposal. The price for contract hauling is $1.22 per gallon, treating the overhead as a hazardous waste.

The steam stripper was assumed to be in operation 260 days per year (5 days per week for 52 weeks). The annual contract hauling cost for a steam stripper with a total waste stream flow of 0.01 MGD (overhead flow of 100 gpd) is $31,270. This cost is for operation and maintenance; there are no capital costs involved for the contract hauling option.

To determine a relationship between steam stripper and overhead disposal costs, the steam stripper capital cost was converted to an annualized capital cost using the 19.2 percent capital cost conversion factor. This annualized cost was then added to the steam stripper annual O&M cost to find the total annual cost. The ratio of overhead disposal annual cost to the total steam stripper annual cost is 45 percent.

TABLE VIII-53.
STEAM STRIPPING (SS) OVERHEAD
DISPOSAL COST ESTIMATES

Total Flow (MGD)	SS Capital ($)	SS O&M $	Over- head Flow (gpd)	Dis- posal Method	Over- head Capital ($)	% Over- head Capital to SS Capital	Over- head O&M ($)	% Overhead O&M to SS O&M
0.01	302,201	11,816	100	Contract Hauling	N/A	N/A	31,270*	45%**
0.50	462,875	471,673	5,000	Incin- eration	280,000	60%	376,000	80%
1.00	611,976	969,521	10,000	Incin- eration	300,000	49%	598,000	62%

*Basis for contract hauling cost:

$1.22/gallon x 100 gpd x 260 days/year = $31,270/year

**Conversion of steam stripper capital $ to annualized capital $:

$302,201 x 0.192 = $58,023

% Overhead O&M to steam stripper O&M:

$$\frac{\$31,270}{\$58,023 \; \& \; \$11,816} \times 100 = 45\%$$

For overhead waste flows of 1,000 gpd or greater, on-site incineration of the steam stripper overhead waste is the most economically practical solution. Prices for hazardous waste incinerators were solicited from manufacturers and were used as the basis for the capital cost estimates. The O&M costs were approximated based on fuel oil consumption, labor costs, and an annual parts and maintenance budget of 10 percent of the capital cost. The capital costs for the purchase and installation of a waste incineration system for steam strippers with total waste stream flows of 0.10 to 1.00 MGD ranged from $200,000 to $300,000. The annual O&M costs were estimated at $184,000 to $598,000.

To apply the steam stripping overhead disposal cost estimates to the costing methodology, ratios were derived between the steam stripper costs generated via the computerized design program and the overhead estimates that were developed via vendor quotations for contract hauling and incineration. For total waste stream flows of 0.50 and 1.00 MGD, the ratios of overhead disposal capital costs to steam stripper capital costs are 60 and 49 percent, respectively (no capital costs are incurred for contract hauling). The average of these ratios is 55 percent.

Similarly, the ratios of overhead disposal annual O&M costs to steam stripper annual O&M costs for total waste stream flows of 0.01, 0.50, and 1.00 are 45, 80, and 62 percent, respectively. The average of these ratios is 62 percent.

Thus, the cost for disposal of steam stripper overhead waste are represented as follows:

Overhead Capital $ = 0.55 (Steam Stripper Capital $)

Overhead O&M $ = 0.62 (Steam Stripper O&M $)

b. Steam Stripping Upgrades

Although upgrade costs for existing steam strippers for a group of randomly selected plants were included in the BAT and PSES compliance costs for the December 8, 1986, NOA, the Agency reexamined the necessity of steam stripper upgrade costs for its final calculation of BAT and PSES compliance costs. The Agency determined that direct dischargers with both steam stripping and biological treatment in-place (or plants for which biological treatment was costed for compliance with BPT) would not require steam stripper upgrades since their effluent from steam stripping would only have to achieve the "trigger" value concentrations (see Table VIII-3) rather than the final BAT effluent limitations. For direct dischargers without biological treatment in-place and indirect dischargers, the Agency identified 12 plants with only steam stripping in-place (3 direct, 9 indirect) for which steam stripping upgrade costs may be appropriate. Table VIII-54 presents the cost estimates for steam stripper upgrades at these plants using the methodology developed for the December 8, 1986, NOA cost estimates. Based on the relatively small number of plants, the fact that no performance data existed to determine how many of these plants were actually performing well, and the relatively low costs associated with these upgrades, the Agency decided not to include upgrade costs for steam strippers in its final BAT and PSES compliance cost estimations. However, a separate economic impact assessment of these upgrade costs generally shows insignificant incremental economic impacts for these plants. The assessment concludes that the upgrade costs are also not significant in terms of the overall impact results associated with the OCPSF regulation.

2. Activated Carbon Systems

Activated carbon adsorption is a physical separation process in which highly porous carbon particles remove a variety of substances from water. Adsorption is affected by many factors including molecular size and weight of the adsorbate, solubility and polarity of the adsorbate, and pore structure of the carbon.

The cost estimates for activated carbon treatment systems were divided into two categories: large systems (flow ranging from 0.5 to 20 MGD) and small systems (flow ranging from 0.01 to 0.2 MGD) based on the requirements of on-site carbon regeneration systems. For the large systems where on-site carbon regeneration systems are included, a modified version of the CAPDET

TABLE VIII-54.
STEAM STRIPPING UPGRADE COSTS

BAT - Direct - 3 Plants			PSES - Indirect - 9 Plants		
Plant #	Cap($)	O&M($/Yr)	Plant #	Cap($)	O&M($/Yr)
105	4,350	70,000	72	2,600	9,000
913	18,000	600,000	283	9,000	420,000
1785	3,800	48,000	494	7,800	240,000
TOTAL	26,150	718,000	702	3,000	20,000
			1657	8,600	295,000
			1740	3,300	30,000
			2635	9,000	420,000
			4014	2,600	5,500
			4047	2,600	5,500
			TOTAL	48,500	1,445,000

computer costing algorithm was used for development of both capital and annual operating costs. For the small systems, where off-site carbon regeneration systems are generally used, the costing methodology developed by Environmental Science and Engineering, Inc. (ESE) for the pesticide industry was modified and used for the OCPSF industry.

Each of the large and small systems was further divided into in-plant carbon treatment and end-of-pipe carbon treatment systems for cost estimates. In-plant carbon treatment is directed toward removing toxic organic pollutants before they are combined with the plant's overall wastewater. It is also employed to avoid undesirable impacts on a plant's end-of-pipe treatment system. End-of-pipe treatment is used to remove dilute organic pollutants from the manufacturing plant's combined waste stream before discharge.

For development of activated carbon treatment capital and operating costs, the following design parameters were used:

- Flow rate
- Influent waste characteristics
- Desired effluent quality
- Empty bed residence time (EBRT)
- Activated carbon usage rate
- Operation and maintenance requirements
- On-site or off-site thermal regeneration.

a. Large Activated Carbon Systems Cost Estimates

The basic calculation tool used to develop engineering costs for the large systems is the computer program CAPDET. The CAPDET model is designed to provide rapid design, cost estimating, and ranking by cost of municipal sewage treatment plant alternatives. With some modifications, the model can be used to design activated carbon systems for industrial waste treatment in a flow range of 0.501 to 20 MGD. A summary of the adjustments considered necessary is presented in Table VIII-55.

TABLE VIII-55.
ADJUSTMENTS TO CAPDET DEFAULT DATA AND RESULTS
FOR ACTIVATED CARBON SYSTEMS

CAPDET Value	Adjusted Value	Description
Effluent COD = 1.0 mg/l	Effluent Total Organic Priority Pollutants In-Plant BAT: Biodegradable = 1.0 mg/l Non-Biodegradable = 0.1 mg/l In-Plant PSES = 0.1 mg/l End-of-Pipe = 0.05 mg/l	Default
Adsorber Capacity = 0.5 lb COD/lb Carbon	<u>In-Plant BAT Treatment Carbon Adsorption Capacities</u> Biodegradable Total Organic Priority Pollutants: Medium: 0.15 total organic priority pollutants/lb carbon (lbs/lb carbon) Low : 0.04 lbs/lb carbon Non-Biodegradable Total Organic Priority Pollutants: Medium: 0.05 lbs/lb carbon Low : 0.02 lbs/lb carbon <u>In-Plant PSES Treatment Carbon Adsorption Capacities</u> Medium: 0.05 lbs/lb carbon Low : 0.02 lbs/lb carbon <u>End-of-Pipe Treatment Carbon Adsorption Capacity</u> Low Carbon Adsorption Capacity = 0.005 lb/lb	Default

TABLE VIII-55.
ADJUSTMENTS TO CAPDET DEFAULT DATA AND RESULTS
FOR ACTIVATED CARBON SYSTEMS
(Continued)

CAPDET Value	Adjusted Value	Description
Empty Bed Residence Time = 25 min.	Empty Bed Residence Time = 45 min.	Default
Furnace Loading Rate = 75 $lb/d/ft^2$	Furnace Loading Rate = 120 $lb/d/ft^2$	Default
Misc. Non-Construction 201 Planning Inspection Land Costs Interest During Con.	Delete: Misc. Non-Construction Costs 201 Planning Inspection Land Costs Interest During Construction	Results

Since the major purpose of carbon treatment is to remove organic priority pollutants from wastewaters, it would be more appropriate to input influent/effluent total organic priority pollutants to the model, instead of COD values. To determine typical levels of influent/effluent total organic priority pollutants, EPA evaluated data from nine of the 12 plants sampled in the EPA 12-Plant Study to determine ranges of concentration before and after OCPSF biological treatment. The results are presented in Table VIII-56. Since all of the influent/effluent waste streams contain more than one organic priority pollutant, the sum of these individual pollutants were tabulated. The concentration ranges of the average total influent and effluent organic priority pollutants are 118,667 to 179,809 µg/l, and 2,489 to 2,498 µg/l, respectively. Based on these values and the effluent discharge requirements, total influent/ effluent organic priority pollutant levels were selected for the following carbon system design targets:

- Selected in-plant BAT treatment levels

  - Biodegradable priority pollutants treatable by activated carbon. Under this category, it is assumed that the in-plant carbon treatment systems are followed by biological treatment systems. Since the priority pollutants are biodegradable, a 90 percent biological removal credit was assigned to the bio-systems. Therefore, the design total effluent organic priority pollutant level was raised from 0.1 mg/l to 1.0 mg/l.

    Total influent organic priority pollutant level = 180 mg/l
    Total effluent organic priority pollutant level = 1.0 mg/l

  - Non-Biodegradable priority pollutants treatable by activated carbon. For the non-biodegradable pollutants, a total effluent organic priority pollutant level of 0.1 mg/l was used for the activated carbon system design. The 0.1 mg/l was based upon Table D-2 of the July 17, 1985, Notice of Availability. It is assumed that for typical OCPSF plants, a total of five to 10 organic priority pollutants will appear in their process waste streams. Therefore, an average effluent total organic priority pollutant level of 0.1 mg/l was selected for design.

    Total influent organic priority pollutant level = 180 mg/l
    Total effluent organic priority pollutant level = 0.10 mg/l

- Selected in-plant PSES treatment levels

  - For all organic priority pollutants treatable by activated carbon, the following total influent/effluent priority pollutant levels are used for PSES carbon treatment design.

    Total influent organic priority pollutant level = 180 mg/l
    Total effluent organic priority pollutant level = 0.1 mg/l

TABLE VIII-56

INFLUENT/EFFLUENT LEVELS OF TOTAL ORGANIC PRIORITY POLLUTANTS OF BIOLOGICAL TREATMENT SYSTEMS FOR TYPICAL ORGANIC CHEMICAL PLANTS

Plant No.	Total Influent Priority Pollutant Concentration (µg/l)	Total Effluent Priority Pollutant Concentration (µg/l)
3	43,612 - 548,140	24 - 70
4	741 - 21,570	-
5	827 - 25,750	22 - 30
6	488,113	168.8
7	145,747	-
9	15,860	4,148
10	781	1,833
11	247,110	-
14	125,215	8,736
Average	18,677 - 179,809	2,849 - 2,498

- Selected end-of-pipe treatment levels

  - For all organic priority pollutants treatable by activated carbon, the following total influent/effluent priority pollutant levels are used for end-of-pipe carbon treatment design.

    Total influent organic priority pollutant level = 10 mg/l
    Total effluent organic priority pollutant level = 0.05 mg/l.

Since the CAPDET carbon adsorption system design was dependent upon factors such as contact time, flow rate, and carbon adsorption capacity (instead of COD removal efficiencies), the replacement of COD input data with total organic priority pollutant data would not affect the basic design principles.

One of the controlling factors in determining capital and annual operating costs is carbon adsorption capacity defined as pounds of pollutants adsorbed per pound of carbon used. For plants requiring more than 400 lbs/day of carbon, the CAPDET model also requires the installation of on-site carbon regeneration systems (see CAPDET Manual), which increases the capital costs significantly. When the carbon consumption rate is less than 400 lbs/day, no on-site regeneration is required. The CAPDET model assumes a default value of 0.5 lb COD/lb carbon for design. This is considerably higher than those for the removal of organic chemical compounds.

Generally, the carbon adsorption capacities for specific organic compounds are dependent upon their molecular structure, molecular weight, and solubility. The nonpolar, high molecular weight organics with low solubility have been found to be preferentially adsorbed. In contrast, polar, low molecular weight organics with high degrees of solubility tend to be poorly adsorbed (see Table VIII-57 for examples of carbon capacities). In addition, pH, temperature, and carbon types/pore sizes also affect adsorption capacity.

In 1980, EPA conducted comprehensive isotherm testing on 128 organic compounds using consistent experimental techniques (8-1). Based on the results of EPA's testing, 29 selected organic pollutants that were treatable by activated carbon systems to an effluent level of 1.0 mg/l (see Table VIII-57) were divided into three groups (high, medium, and low carbon adsorption capacities) for the in-plant BAT carbon treatment system design

TABLE VIII-57.
SUMMARY OF IN-PLANT CARBON ADSORPTION CAPACITIES*
(LBS OF POLLUTANTS ADSORBED/LB CARBON)

Compound	Adsorption Capacity (lb/lb)	Compound	Adsorption Capacity (lb/lb)
bis (2-Ethylhexyl) phthalate	11.300	Phenanthrene	0.215
Butylbenzyl phthalate	1.520	Dimethylphenyl-carbinol	0.210
Heptachlor	1.220	4-Aminobiphenyl	0.200
Heptachlor epoxide	1.038	beta-Naphthol	0.200
Endosulfan Sulfate	0.686	alpha-Endosulfan	0.194
Endrin	0.666	Acenaphthene	0.190
Fluoranthene	0.664	4,4' Methylene-bis-(2-chloroaniline)	0.190
Aldrin	0.651	Benzo(k)fluoranthene	0.181
PCB-1232	0.630	Acridine orange	0.180
beta-Endosulfan	0.615	alpha-Naphthol	0.180
Dieldrin	0.606	4,6-Dinitro-o-cresol	0.169
Hexachlorobenzene	0.450	alpha-Naphthylamine	0.160
Anthracene	0.376	2,4-Dichlorophenol	0.157
4-Nitrobiphenyl	0.370	1,2,4-Trichlorobenzene	0.157
Fluorene	0.330	2,4,6-Trichlorophenol	0.155
DDT	0.322	beta-Naphthylamine	0.150
2-Acetylaminofluorene	0.138	Pentachlorophenol	0.150
alpha-BHC	0.303	2,4-Dinitrotoluene	0.146
Anethole	0.300	2,6-Dinitrotoluene	0.145
3,3'-Dichlorobenzidine	0.300	4-Bromophenyl phenyl ether	0.144
2-Chloronaphthalene	0.280	p-Nitroaniline	0.140
Phenylmercuric Acetate	0.270	1,1-Diphenylhydrazine	0.135
Hexachlorobutadiene	0.258	Naphthalene	0.132
gamma-BHC (lindane)	0.256	1-Chloro-2-nitrobenzene	0.130
p-Nonylphenol	0.250	1,2-Dichlorobenzene	0.129
4-Dimethylaminoazobenzene	0.249	p-Chlorometacresol	0.124
Chlordane	0.245	1,4-Dichlorobenzene	0.121
PCB-1221	0.242	Benzothiazole	0.120
DDE	0.232	Diphenylamine	0.120
Acridine yellow	0.230	Guanine	0.120
Benzidine dihydrochloride	0.220	Styrene	0.120
beta-BHC	0.220	1,3-Dichlorobenzene	0.118
N-Butylphthalate	0.220	Acenaphthylene	0.115
N-Nitrosodiphenylamine	0.220	4-Chlorophenyl phenyl ether	0.111
		Diethyl phthalate	0.110

TABLE VIII-57.
SUMMARY OF IN-PLANT CARBON ADSORPTION CAPACITIES*
(LBS OF POLLUTANTS ADSORBED/LB CARBON)
(Continued)

Compound	Adsorption Capacity (lb/lb)	Compound	Adsorption Capacity (lb/lb)
2-Nitrophenol	0.099	Bromoform	0.020
Dimethyl phthalate	0.097	Carbon tetrachloride	0.011
Hexachloroethane	0.097	bis (2-Chloroethoxy)	
Chlorobenzene	0.091	methane	0.011
p-Xylene	0.085	Uracil	0.011
		Benzo(ghi)perylene	0.011
2,4-Dimethylphenol	0.078		
4-Nitrophenol	0.076	1,1,2,2-Tetrachloro-	
Acetophenone	0.074	ethane	0.011
1,2,3,4-Tetrahydro-		1,2-Dichloropropene	0.0082
naphthalene	0.074	Dichlorobromemethane	0.0079
Adenine	0.071	Cyclohexanone	0.0062
Dibenzo (a,h) anthracene	0.069	1,1,2,-Trichloroethane	0.0058
Nitrobenzene	0.058	Trichlorofluoromethane	0.056
3,4-Benzofluoranthene	0.057	5-Fluorocuracil	0.0055
1,2-Dibromo-3-Chloro-		1,1,-Dichloroethylene	0.0049
propane	0.053	Dibromochloromethane	0.0048
Ethylbenzene	0.053	2-Chloroethyl vinyl	
2-Chlorophenol	0.051	ether	0.0039
Tetrachloroethene	0.051	1,2-Dichloroethane	0.0036
o-Anisidine	0.050	1,2-trans-Dichloroethene	0.0031
5-Bromouracil	0.044	Chloroform	0.0026
		1,1,1-trichloroethane	0.0025
Benzo(a)pyrene	0.034		
2,4-Dinitrophenol	0.003	1,1-Dichloroethane	0.0018
Isophorone	0.032	Acrylonitrile	0.0014
Trichloroethene	0.028	Methylene chloride	0.0013
Thymine	0.026	Acrolein	0.0012
		Cytosine	0.0011
Toluene	0.026		
5-Chlorouracil	0.025	Benzene	0.0010
N-Nitrosodi-n-propylamine	0.024	Ethylenediaminetetra-	
bis(2-Chloroisopropyl)		acetic acid	0.00086
ether	0.024	Benzoic acid	0.00076
Phenol	0.021	Chlorethane	0.00059
		N-Dimethylnitrosamine	6.8X10^{-8}

*Table obtained from Carbon Adsorption Isotherms for Toxic Organics, Municipal Environmental Research Laboratory, Cincinnati, OH, at an effluent level of 1.0 mg/l.

(see Table VIII-58). The average of all carbon adsorption capacities in each group was used as a representative rate for the in-plant BAT treatment carbon system design. The average carbon adsorption capacities for the high, medium, and low groups are 2.4, 0.13, and 0.04 lbs of pollutants adsorbed per pound of activated carbon, respectively. However, as discussed earlier in this section, in the final costing, only two groups of carbon adsorption capacities were used; the high capacity pollutants were transferred to the medium group, and this new medium group and the low group were used.

Similarly, for the in-plant PSES treatment where either no biological treatment system follows the carbon system or the pollutants are non-biodegradable, the adsorption capacity of each specific organic priority pollutant was obtained directly from isotherm curves of the EPA study at an effluent level of 0.10 mg/l (see Table VIII-59). These pollutants were then divided into three groups as shown in Table VIII-60 and the average of all carbon adsorption capacities in each group was used as a representative rate.

For the end-of-pipe systems, the adsorption capacity for each specific organic priority pollutant was obtained directly from isotherm curves of the EPA study at an effluent level of 0.05 mg/l total toxic organics (see Table VIII-61). The pollutants were then divided into three groups as shown in Table VIII-62.

A summary of the CAPDET design specifications (large flow systems) for the in-plant and end-of-pipe carbon treatment systems is presented in Tables VIII-63, VIII-64, and VIII-65. The design dimensions and number of carbon units for all the 20 MGD flows were adjusted to make the height to diameter ratio more reasonable. Since the furnace size and the carbon column volume remain unchanged, the capital cost increase is considered insignificant. The capital costs were obtained by subtracting the following costs from the total project costs:

- Miscellaneous non-construction costs
- 201 planning cost
- Inspection
- Land costs
- Interest during construction.

TABLE VIII-58.
CARBON USAGE RATE FOR PRIORITY POLLUTANTS
(IN-PLANT BAT TREATMENT)
(LBS OF POLLUTANTS ADSORBED/LB CARBON)

High(2.4 lbs/lb)	Medium (0.13 lb/lb)	Low (0.04 lb/lb)
Bis (2-Ethylhexyl) Phthalate	2,4-Dichlorophenol	2,4-Dimethylphenol
Butyl Benzyl Phthalate	2,4,6-Trichlorophenol	Dibenzo (a,h) Anthracene
Fluorathene	Pentachlorophenol	Nitrobenzene
3,3-Dichlorobenzidine	2,4-Dinitrotoluene	2-Chlorophenol
2-Chloronaphthalene	2,6-Dinitrotoluene	Benzo (a) Pyrene
N-Butyl Phthalate	1,2-Dichlorobenzene	2,4-Dinitrophenol
	Diethyl Phthalate	Phenol
	2-Nitrophenol	Bromoform
	Dimethyl Phthalate	Benzo (ghi) Perylene
		2-Chloroethyl Vinyl Ether

Note: For the final cost estimates, only two adsorpability groups (medium and low) were used with high adsorpability pollutants being combined with medium.

TABLE VIII-59.
SUMMARY OF IN-PLANT CARBON ADSORPTION CAPACITIES*
(LBS OF POLLUTANTS ADSORBED/LB CARBON)

Compound	Adsorption Capacity (lb/lb)	Compound	Adsorption Capacity (lb/lb)
Bis (2-Ethylhexyl) phthalate	0.341	2,4-Dimethylphenol	0.028
3,3'-Dichlorobenzidine	0.190	Nitrobenzene	0.025
Fluorene	0.170	3,4-Benzo Fluoranthene	0.024
Fluoranthene	0.164	2-Chlorophenol	0.020
Hexachlorobenzene	0.110	Isophorone	0.013
Benzidine Dihydrochloride	0.097	N-Nitrosodi-N-Propylamine	0.013
2-Chloronaphthalene	0.096	Benzo (a) Pyrene	0.012
N-Nitrosodiphenylamine	0.091	Dibenzo (a,h) Anthracene	0.012
Hexachlorobutadiene	0.091	Toluene	0.009
Acenaphthene	0.084	2,4-Dinitrophenol	0.008
Butyl Benzyl Phthalate	0.084	Trichloroethane	0.007
Phenanthrene	0.078	Benzo (ghi) Perylene	0.006
1,2,4-Trichlorobenzene	0.078	Bis(2-Chloroisopropyl) Ether	0.006
N-Butyl Phthalate	0.077	Bromoform	0.006
4,6-Dinitro-O-Cresol	0.076	Phenol	0.006
Anthracene	0.075	1,1,2,2-Tetrachloroethane	0.005
2,4-Dinitrotoluene	0.071	Bis(2-Chloroethoxy) Methane	0.003
2,6-Dinitrotoluene	0.070	Carbon Tetrachloride	0.002
2-4-Dichlorophenol	0.065	Tetrachloroethane	0.014
2,4,6-Trichlorophenol	0.061	Dichlorobromomethane	0.002
4-Chlorophenyl Phenyl Ether	0.061	1,1-Dichloroethylene	0.002
Diethyl Phthalate	0.059	1,2-Dichloropropane	0.002
Pentachlorophenol	0.055	1,1,2-Trichloroethane	0.002
Naphthalene	0.050	1,1,1-Trichloroethane	0.001
Acenaphenylene	0.049	1,2-Trans-Dichloroethane	0.0009
Benzo (k) Fluoranthene	0.048	2-Chloroethyl Vinyl Ether	0.0006
1,2-Dichlorobenzene	0.047	Chloroform	0.0005
2-Nitrophenol	0.046	1,1-Dichloroethane	0.0005
4-Nitrophenol	0.043	1,2-Dichloroethane	0.0005
4,4-Methylene-bis(2-Chloroaniline)	0.043	Acrylonitrile	0.0004
1,3-Dichlorobenzene	0.042	Acrolein	0.0003
Hexachloroethane	0.041	Methylene Chloride	0.00009

TABLE VIII-59.
SUMMARY OF IN-PLANT CARBON ADSORPTION CAPACITIES*
(LBS OF POLLUTANTS ADSORBED/LB CARBON)
(Continued)

Compound	Adsorption Capacity (lb/lb)	Compound	Adsorption Capacity (lb/lb)
1,4-Dichlorobenzene	0.041	Chloroethane	0.00007
Dimethyl Phthalate	0.038		
4-Bromophenyl Phenyl Ether	0.030		

*Table obtained from Carbon Adsorption Isotherms for Toxic Organics, Municipal Environmental Research Laboratory, Cincinnati, OH, at an effluent level of 0.10 mg/l.

TABLE VIII-60.
CARBON USAGE RATE FOR PRIORITY POLLUTANTS
(IN-PLANT PSES TREATMENT)
(LBS OF POLLUTANTS ADSORBED/LB CARBON)

High (0.11 lb/lb)	Medium (0.05 lb/lb)	Low (0.02 lb/lb)
Bis (2-Ethylhexyl) Phthalate (0.341)	2,4-Dichlorphenol (0.065)	2,4-Dimethylphenol (0.028)
Butyl Benzyl Phthalate (0.084)	2,4,6-Trichlorophenol (0.061)	Dibenzo (a,h) Anthracene (0.012)
Fluorathene (0.164)	Pentachlorophenol (0.055)	Nitrobenzene (0.025)
3,3-Dichlorobenzidine (0.190)	2,4-Dinitrotoluene (0.071)	*3,4-Benzo-Fluoranthene (0.024)
2-Chloronaphthalene (0.096)	2,6-Dinitrotoluene (0.070)	2-Chlorophenol (0.020)
N-Butyl Phthalate (0.077)	1,2-Dichlorobenzene (0.047)	Benzo (a) Pyrene (0.012)
	Diethyl Phthalate (0.059)	2,4-Dinitrophenol (0.008)
	2-Nitrophenol (0.046)	*Isophorone (0.013)
	Dimethyl Phthalate (0.038)	*N-Nitrosodi-N-Propylamine (0.013)
		Phenol (0.006)
		Bromoform (0.006)
		*Bis (2-Chloroethoxy) Methane (0.003)
		Benzo (ghi) Perylene (0.006)

*Non-biodegradable pollutants

TABLE VIII-61.
SUMMARY OF CARBON ADSORPTION CAPACITIES
(END-OF-PIPE)
(LBS OF POLLUTANTS ADSORBED/LB CARBON)

Compound	Adsorption Capacity (lb/lb)	Compound	Adsorption Capacity (lb/lb)
3,3'-Dichlorobenzidine	0.165	2-Chlorophenol	0.016
Bis(2-ethylhexyl) Phthalate	0.120	Fluorene	0.015
Fluoranthene	0.110	N-Nitrosodi-n-propylamine	0.011
Benzidine dihydro-chloride	0.075	Tetrachlorethene	0.009
Hexachlorobenzene	0.072	Benzo (a) pyrene	0.008
N-Nitrosodiphenylamine	0.070	Dibenzo (a,h) anthracene	0.007
Hexachlorobutadiene	0.067	Toluene	0.006
Acenaphthene	0.065	Trichloroethene	0.005
4,6-Dinitro-o-cresol	0.060	Benzo (g,h,i) perylene	0.004
2,4-Dichlorophenol	0.060	Bis (2-Chloroispropyl) ether	0.004
2,4-Dinitrotoluene	0.058	Bromoform	0.004
2,6-Dinitrotoluene	0.058	Phenol	0.004
Phenanthrene	0.058	1,1,2,2-Tetachloroethane	0.003
N-Butylphthalate	0.057	Carbon Tetrachloride	0.001
4-Chlorophenyl phenyl ether	0.050	Dichlorobromomethane	0.001
2-Chloronaphthalene	0.048	1,2-Dichloroethylene	0.001
Anthracene	0.044	1,2-Dichloropropane	0.001
Diethyl phthalate	0.042	Isophorone	0.001
Pentachlorophenol	0.041	1,1,2-Trichloroethane	0.001
2,4-dimethylphenol	0.040	1,1,1-Trichloroethane	0.0009
1,2,4-Trichlorobenzene	0.040	1,2-Trans-dichloroethane	0.0007
2,4,6-Trichlorobenzene	0.040	Acrylonitrile	0.0003
Naphthalene	0.039	Chloroform	0.0003
Acenaphthylene	0.037	1,2-dichloroethane	0.0003
Butylbenzyl phthalate	0.036	Acrolein	0.0002
2-Nitrophenol	0.035	1,1-Dichloroethane	0.0002
1,2-Dichlorobenzene	0.034	Chloroethane	0.00004
Benzo (k) fluoranthene	0.032	Methylene Chloride	0.00004
1,3-Dichlorobenzene	0.032		
Hexachlorethane	0.032		
4-Nitrophenol	0.032		
1,4-Dichlorobenzene	0.030		
4,4-Methylene-bis-(2-chloroaniline)	0.029		
Dimethyl phthalate	0.029		
4-Bromophenyl phenyl ether	0.019		
Nitrobenzene	0.019		
3,4-Benzo fluoranthene	0.018		

*Table obtained from Carbon Adsorption Isotherms for Toxic Organics, Municipal Environmental Research Laboratory, Cincinnati, OH, at an effluent level of 0.05 mg/l.

TABLE VIII-62.
CARBON USAGE RATE FOR PRIORITY POLLUTANTS
(END-OF-PIPE TREATMENT)
(LBS OF POLLUTANTS ADSORBED/LB CARBON)

High (0.08 lb/lb)	Medium (0.04 lb/lb)	Low (0.005 lb/lb)
3,3-Dichlorobenzidine (0.165)	Diethyl Phthalate (0.042)	4-Bromophenyl Phenyl Ether (0.019)
Bis (2-Ethylhexyl) Phthalate (0.126)	Pentachlorophenol (0.041)	Nitrobenzene (0.019)
Fluoranthene (0.110)	2,4-Dimethylphenol (0.040)	3,4-Benzofluoranthene (0.018)
Benzidine Dihydrochloride (0.075)	1,2,4-Trichlorobenzene (0.040)	2-Chlorophenol (0.016)
Hexachlorobenzene (0.072)	2,4,6-Trichlorobenzene (0.040)	Fluorene (0.015)
N-Nitrosodiphenylamine (0.070)	Naphthalene (0.039)	N-Nitrosodi-n-propylamine (0.011)
Hexachlorobutadiene (0.067)	Acenaphthylene (0.037)	Tetrachloroethane (0.009)
Acenaphthene (0.065)	Butyl Benzyl Phthalate (0.036)	Benzo(a)pyrene (0.008)
4,6-Dinitro-o-cresol (0.060)	2-Nitrophenol (0.035)	Dibenzo(a,h)anthracene (0.007)
2,4-Dichlorophenol (0.060)	1,2-Dichlorobenzene (0.034)	Toluene (0.006)
2,4-Dinitrotoluene (0.058)	Benzo(k)fluoranthene (0.032)	Trichloroethene (0.005)
2,6-Dinitrotoluene (0.058)	1,3-Dichlorobenzene (0.032)	Benzo(ghi)perylene (0.004)
Phenanthrene (0.058)	Hexachloroethane (0.032)	Bis(2-Chloroisopropyl) ether (0.004)
N-Butylphthalate (0.057)	4-Nitrophenol (0.032)	Bromoform (0.004)
4-Chlorophenyl Phenyl Ether (0.050)	1,4-Dichlorobenzene (0.030)	Phenol (0.004)
2-Chloronaphthalene (0.048)	4,4'-Methylene-bis-(2-Chloroaniline) (0.029)	
Anthracene (0.044)		1,1,2,2-Tetrachloroethane (0.003)
	Dimethyl Phthalate (0.029)	Carbon Tetrachloride (0.001)
		Dichlorobromomethane (0.001)
		1,1-Dichloroethylene (0.001)
		1,2-Dichloropropane (0.001)
		Isophorone (0.001)
		1,1,2-Trichloroethane (0.001)
		1,1,1-Trichloroethane (0.0009)
		1,2-Trans-Dichloroethane (0.0007)
		Acrylonitrile (0.0003)
		Chloroform (0.0003)
		1,2-Dichloroethane (0.0003)
		Acrolein (0.0002)
		1,1-Dichloroethane (0.00002)
		Chloroethane (0.00004)
		Methylene Chloride (0.00004)

TABLE VIII-63.
GRANULAR ACTIVATED CARBON EQUIPMENT COST BASIS
IN-PLANT CARBON TREATMENT SYSTEM
LOW CARBON ADSORPTION CAPACITY

Description*	BAT Carbon Adsorption Capacity: 0.15 lbs/lb						PSES Carbon Adsorption Capacity: 0.05 lbs/lb					
	0.5	1.0	2.0	5.0	10.0	20.0	0.5	1.0	2.0	5.0	10.0	20.0
Activated Carbon Units	Two 6.07'dia x 28.3' High	Two 8.58'dia x 28.3' High	Two 12.1'dia x 28.3' High	Six 11.1'dia x 28.3' High	Six 15.7'dia x 28.3' High	Four 27.1'dia x 40' High	Two 6.07'dia x 28.3' High	Two 8.58'dia x 28.3' High	Two 12.1'dia x 28.3' High	Six 11.1'dia x 28.3' High	Six 15.7'dia x 28.3' High	Four 27.1'dia x 40' High
Empty Bed Residence Time (min)	45	45	45	45	45	45	45	45	45	45	45	45
Carbon Bed Volume (ft^3)	2,302	4,596	9,192	22,978	45,956	91,912	2,302	4,596	9,192	22,978	45,956	91,912
Furnace Size	One 5.5'dia	One 7.0'dia	One 10.5'dia	One 16.5'dia	Two 16.5'dia	Three 16.5'dia	One 8.5'dia	One 12.0'dia	One 16.5'dia	Two 18.0'dia	Four 18.0'dia	Seven 20.0'dia

*Flow in millions of gallons per day (MGD)

TABLE VIII-64.
GRANULAR ACTIVATED CARBON EQUIPMENT COST BASIS
IN-PLANT CARBON TREATMENT SYSTEM
LOW CARBON ADSORPTION CAPACITY

Description*	BAT Carbon Adsorption Capacity: 0.04 lbs/lb						PSES Carbon Adsorption Capacity: 0.02 lbs/lb					
	0.5	1.0	2.0	5.0	10.0	20.0	0.5	1.0	2.0	5.0	10.0	20.0
Activated Carbon Units	Two 6.07'dia x 28.3' High	Two 8.58'dia x 28.3' High	Two 12.1'dia x 28.3' High	Six 11.1'dia x 28.3' High	Six 15.7'dia x 28.3' High	Four 27.1'dia x 40' High	Two 6.07'dia x 28.3' High	Two 8.58'dia x 28.3' High	Two 12.1'dia x 28.3' High	Six 11.1'dia x 28.3' High	Six 15.7'dia x 28.3' High	Four 27.1'dia x 40' High
Empty Bed Residence Time (min)	45	45	45	45	45	45	45	45	45	45	45	45
Carbon Bed Volume (ft^3)	2,302	4,596	9,192	22,978	45,956	91,912	2,302	4,596	9,192	22,978	45,956	91,912
Furnace Size	One 10.5'dia	One 14.5'dia	One 18.0'dia	Two 20.0'dia	Four 20.0'dia	Eight 20.0'dia	One 14.5'dia	One 18.0'dia	Two 18.0'dia	Four 20.0'dia	Eight 20.0'dia	Sixteen 20.0'dia

*Flow in millions of gallons per day (MGD)

TABLE VIII-65.
GRANULAR ACTIVATED CARBON EQUIPMENT COST BASIS
(END-OF-PIPE TREATMENT)

Description*	High Carbon Adsorption Capacity[1]						Medium Carbon Adsorption Capacity[2]						Low Carbon Adsorption Capacity[3]					
	0.5	1.0	2.0	5.0	10.0	20.0	0.5	1.0	2.0	5.0	10.0	20.0	0.5	1.0	2.0	5.0	10.0	20.0
Activated Carbon Units	Four 6'dia x 28' High	Four 9'dia x 28' High	Four 12'dia x 28' High	Twelve 11'dia x 28' High	Twelve 16'dia x 28' High	Sixteen 16'dia x 40' High	Four 6'dia x 28' High	Four 9'dia x 28' High	Four 12'dia x 28' High	Twelve 11'dia x 28' High	Twelve 16'dia x 28' High	Sixteen 16'dia x 40' High	Four 6'dia x 28' High	Four 9'dia x 28' High	Four 12'dia x 28' High	Twelve 11'dia x 28' High	Twelve 16'dia x 28' High	Sixteen 16'dia x 40' High
Empty Bed Residence Time (min)	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45
Carbon Bed Volume (ft^3)	2,300	4,577	9,192	22,962	45,769	91,923	2,300	4,577	9,192	22,962	45,769	91,923	2,300	4,577	9,192	22,962	45,769	91,923
Furnace Size	One 4'dia	One 4'dia	One 5'dia	One 8'dia	One 9'dia	One 13'dia	One 4'dia	One 5'dia	One 6'dia	One 9'dia	One 13'dia	One 17'dia	One 9'dia	One 11'dia	One 14'dia	One 22'dia	Two 22'dia	Four 22'dia

[1]High Carbon Adsorption Capacity = 0.08 lb/lb

[2]Medium Carbon Adsorption Capacity = 0.04 lb/lb

[3]Low Carbon Adsorption Capacity = 0.005 lb/lb

*Flow in millions of gallons per day (MGD)

The estimated capital and annual operating costs (in 1982 dollars) for both the in-plant and end-of-pipe treatment systems are shown in Tables VIII-66, VIII-67 and VIII-68. Figures VIII-18 to VIII-27 present the capital and O&M costs versus flow curves. The procedure for using these curves is as follows:

- Determine whether system is for in-plant or end-or-pipe treatment
- Select carbon adsorption capacities for each individual pollutant from Tables VIII-57 and VIII-59 (in-plant treatment) or Table VIII-61 (end-of-pipe treatment)
- In the cases where more than one organic priority pollutant is present in the influent, use the lowest carbon adsorption capacity for design
- Obtain capital and annual O&M costs from appropriate curves in Figures VIII-18 to VIII-27.

b. Small Activated Carbon System Cost Estimates

As plant flow decreases, installation of on-site carbon regeneration systems becomes less economical. The small system costs were derived by modifying ESE's carbon systems costing methodology prepared for the pesticide industry. Major adjustments included using an EBRT of 45 minutes for adsorber design. No on-site regeneration systems are included.

Tables VIII-69 through VIII-72 show the itemized capital and annual O&M costs for both the in-plant and end-of-pipe treatment systems. These costs were further plotted against flows as shown in Figures VIII-28 to VIII-33. The procedure for using these curves is the same as that described for large systems. Since it is difficult to obtain a representative unit land cost, land costs were not included in the capital cost estimates but were estimated separately. The estimated land requirements for both the large and small systems are presented in Figure VIII-34.

3. Coagulation/Flocculation/Clarification Systems

The purpose of the coagulation/flocculation/clarification process is to remove heavy metals and colloidal and dissolved solids from wastewaters. Various coagulants and coagulant aids such as alum, ferric chloride, sodium

TABLE VIII-66.
TOTAL CAPITAL AND O&M COSTS FOR LARGE
IN-PLANT MEDIUM CARBON ADSORPTION TREATMENT SYSTEMS[1]
(1982 $)

Flow (mgd)	BAT Carbon Adsorption Capacity[2] Total Capital Cost ($)	BAT Carbon Adsorption Capacity[2] Total O&M Cost ($)	PSES Carbon Adsorption Capacity[2] Total Capital Cost ($)	PSES Carbon Adsorption Capacity[2] Total O&M Cost ($)
0.501	2,544,648	233,002	3,357,968	456,169
1.0	3,394,643	343,153	4,150,659	732,192
2.0	4,622,127	528,966	6,326,876	1,244,899
5.0	7,208,356	998,582	13,480,578	2,664,111
10.0	12,932,415	1,739,129	25,464,477	4,786,939
20.0	22,708,398	3,066,940	49,180,422	8,759,708

[1]Empty Bed Residence Time: 45 minutes

[2]lb Priority Pollutant Adsorbed/lb Carbon

BAT: 0.15 lbs/lb

PSES: 0.05 lbs/lb

TABLE VIII-67.
TOTAL CAPITAL AND O&M COSTS FOR LARGE IN-PLANT LOW CARBON ADSORPTION TREATMENT SYSTEMS[1]
(1982 $)

Flow (mgd)	BAT Carbon Adsorption Capacity[2] Total Capital Cost ($)	BAT Carbon Adsorption Capacity[2] Total O&M Cost ($)	PSES Carbon Adsorption Capacity[2] Total Capital Cost ($)	PSES Carbon Adsorption Capacity[2] Total O&M Cost ($)
0.501	3,200,029	401,044	3,696,919	712,940
1.0	3,811,546	630,977	5,589,129	1,217,276
2.0	5,812,933	1,062,073	10,524,128	2,166,835
5.0	12,307,324	2,235,290	23,068,103	4,713,206
10.0	23,119,477	4,029,652	44,635,237	8,638,145
20.0	42,759,733	7,316,708	87,549,151	15,946,832

[1]Empty Bed Residence Time: 45 minutes

[2]lb Priority Pollutant Adsorbed/lb Carbon
BAT: 0.04 lbs/lb
PSES: 0.02 lbs/lb

TABLE VIII-68.
COST ESTIMATE FOR LARGE END-OF-PIPE CARBON TREATMENT SYSTEMS[1]

(1982 $)

	Carbon Adsorption Capacity[2]					
	High		Medium		Low	
Flow (mgd)	Capital $	O&M $/yr.	Capital $	O&M $/yr.	Capital $	O&M $/yr.
0.5	2,033,596	59,713	2,262,752	76,778	3,330,906	234,694
1	2,814,712	84,928	3,097,725	112,939	4,421,835	387,976
2	3,990,254	125,803	4,340,036	173,219	5,785,526	653,426
5	6,593,114	227,013	7,056,035	325,623	9,945,948	1,405,563
10	9,979,462	379,046	10,551,841	554,272	18,155,788	2,598,399
20	16,099,882	655,800	16,609,423	967,193	34,270,092	4,732,227

[1]Cost estimate includes carbon regeneration furnaces

[2]lb Priority Pollutant Adsorbed/lb Carbon
High Carbon Adsorption Capacity = 0.08 lb/lb
Medium Carbon Adsorption Capacity = 0.04 lb/lb
Low Carbon Adsorption Capacity = 0.005 lb/lb

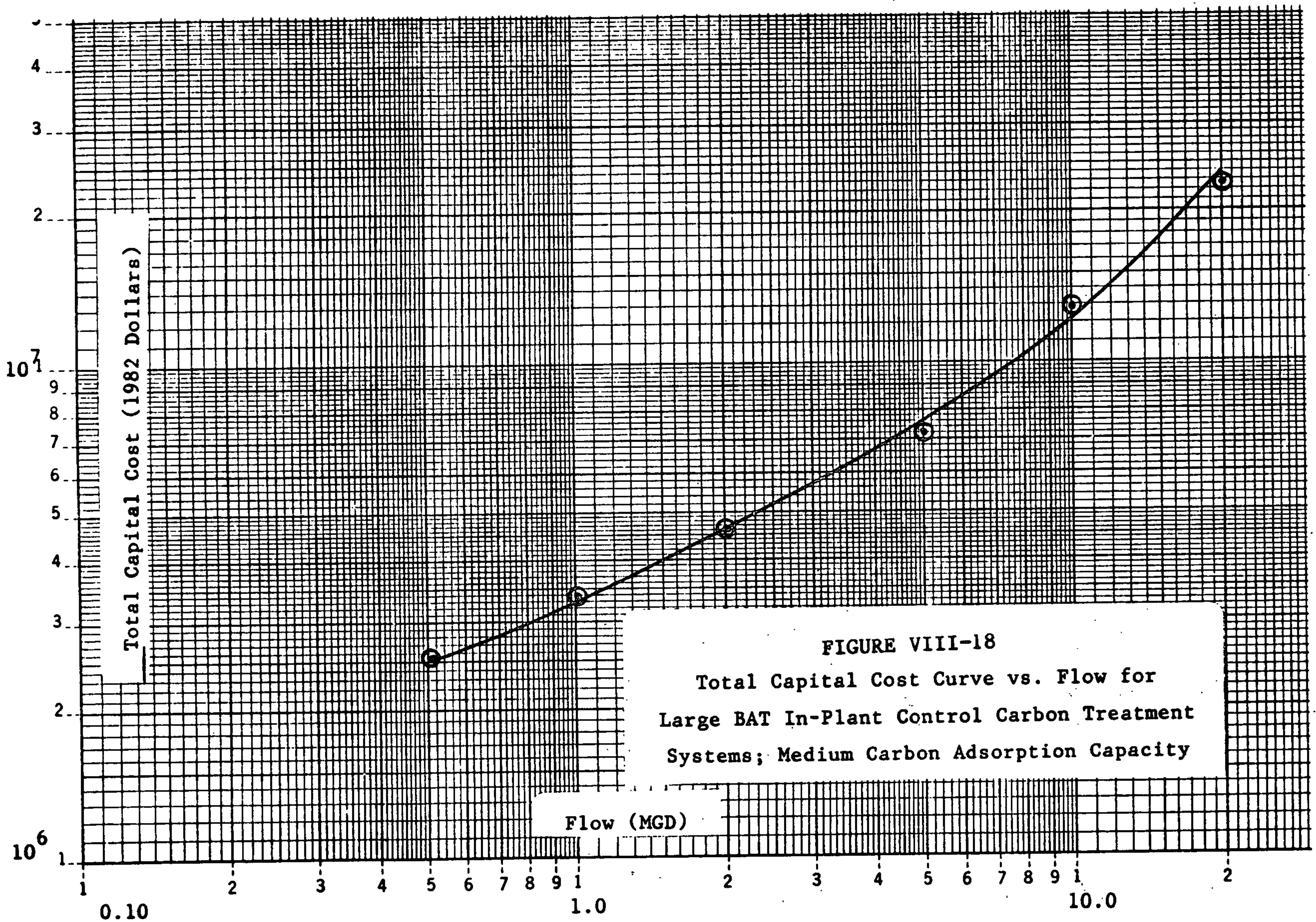


FIGURE VIII-18
Total Capital Cost Curve vs. Flow for
Large BAT In-Plant Control Carbon Treatment
Systems; Medium Carbon Adsorption Capacity

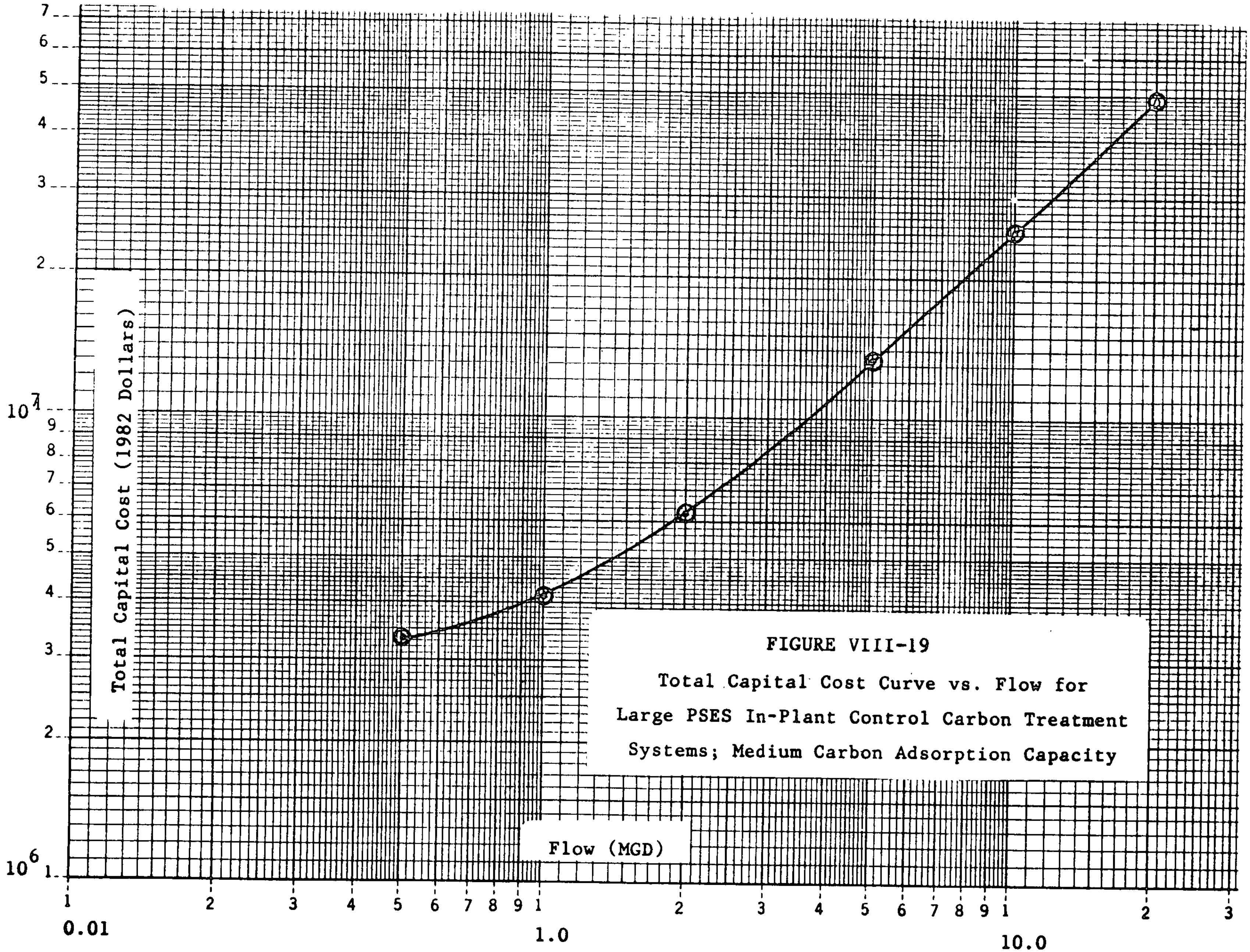


FIGURE VIII-19

Total Capital Cost Curve vs. Flow for Large PSES In-Plant Control Carbon Treatment Systems; Medium Carbon Adsorption Capacity

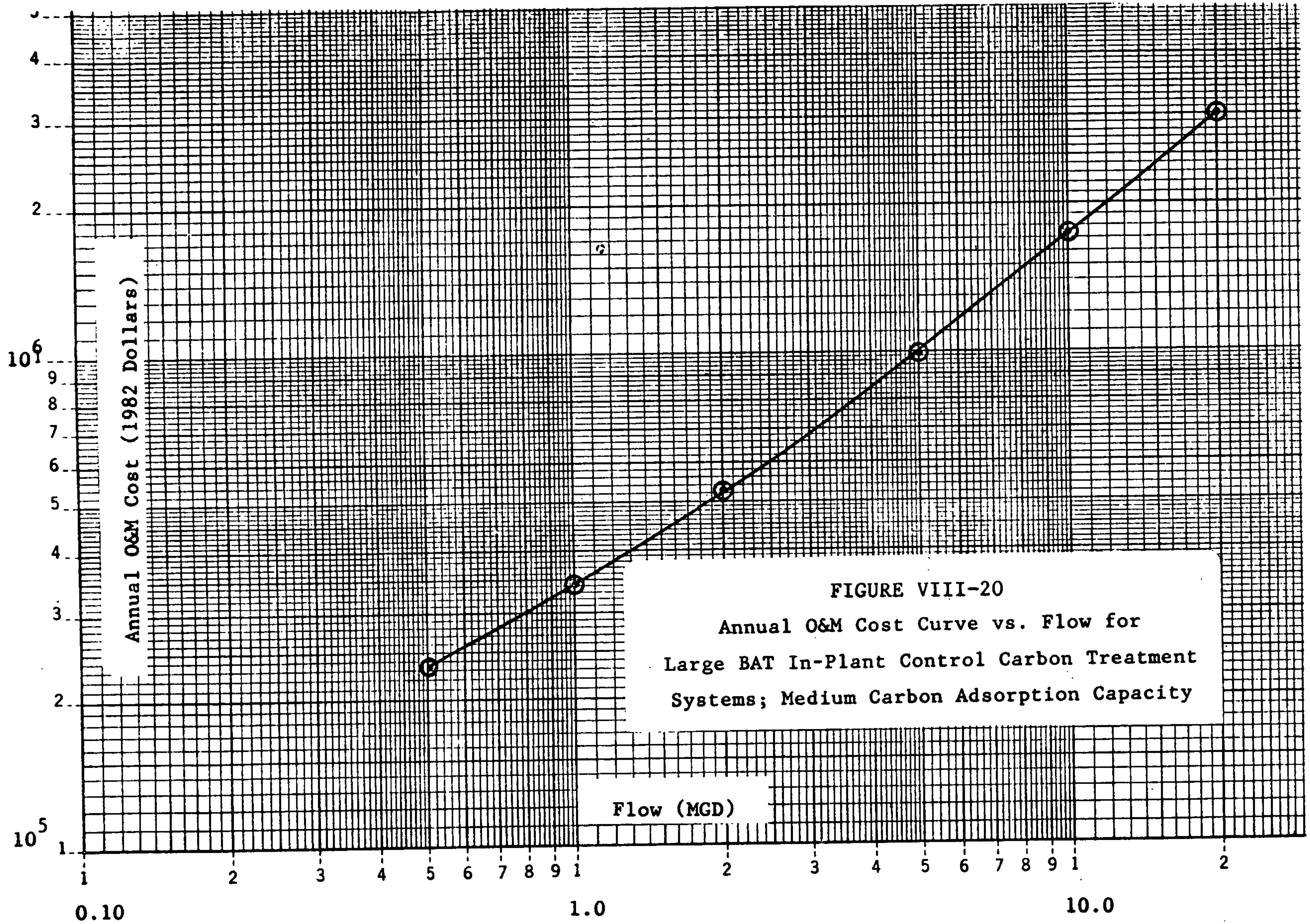


FIGURE VIII-20
Annual O&M Cost Curve vs. Flow for Large BAT In-Plant Control Carbon Treatment Systems; Medium Carbon Adsorption Capacity

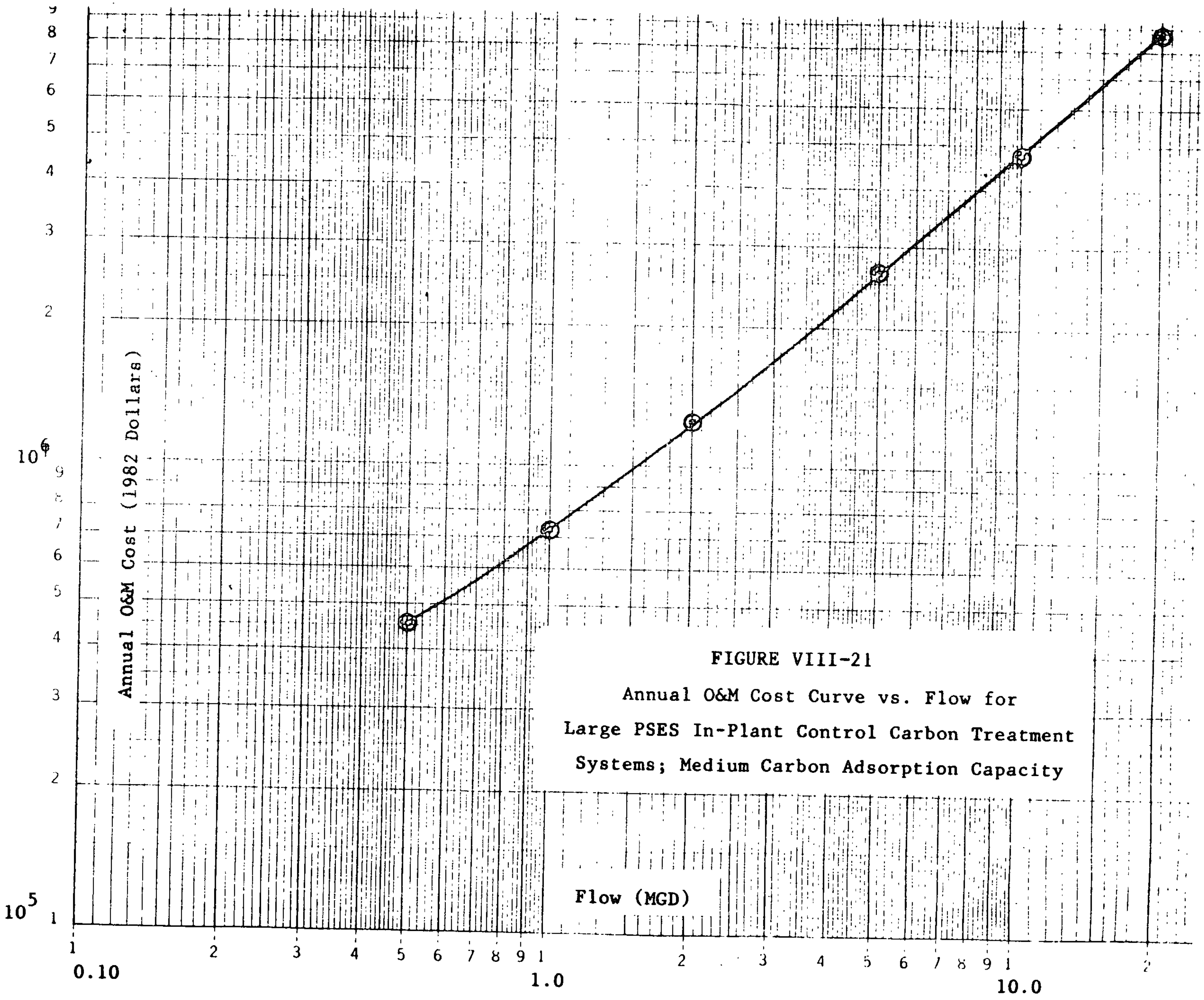


FIGURE VIII-21

Annual O&M Cost Curve vs. Flow for Large PSES In-Plant Control Carbon Treatment Systems; Medium Carbon Adsorption Capacity

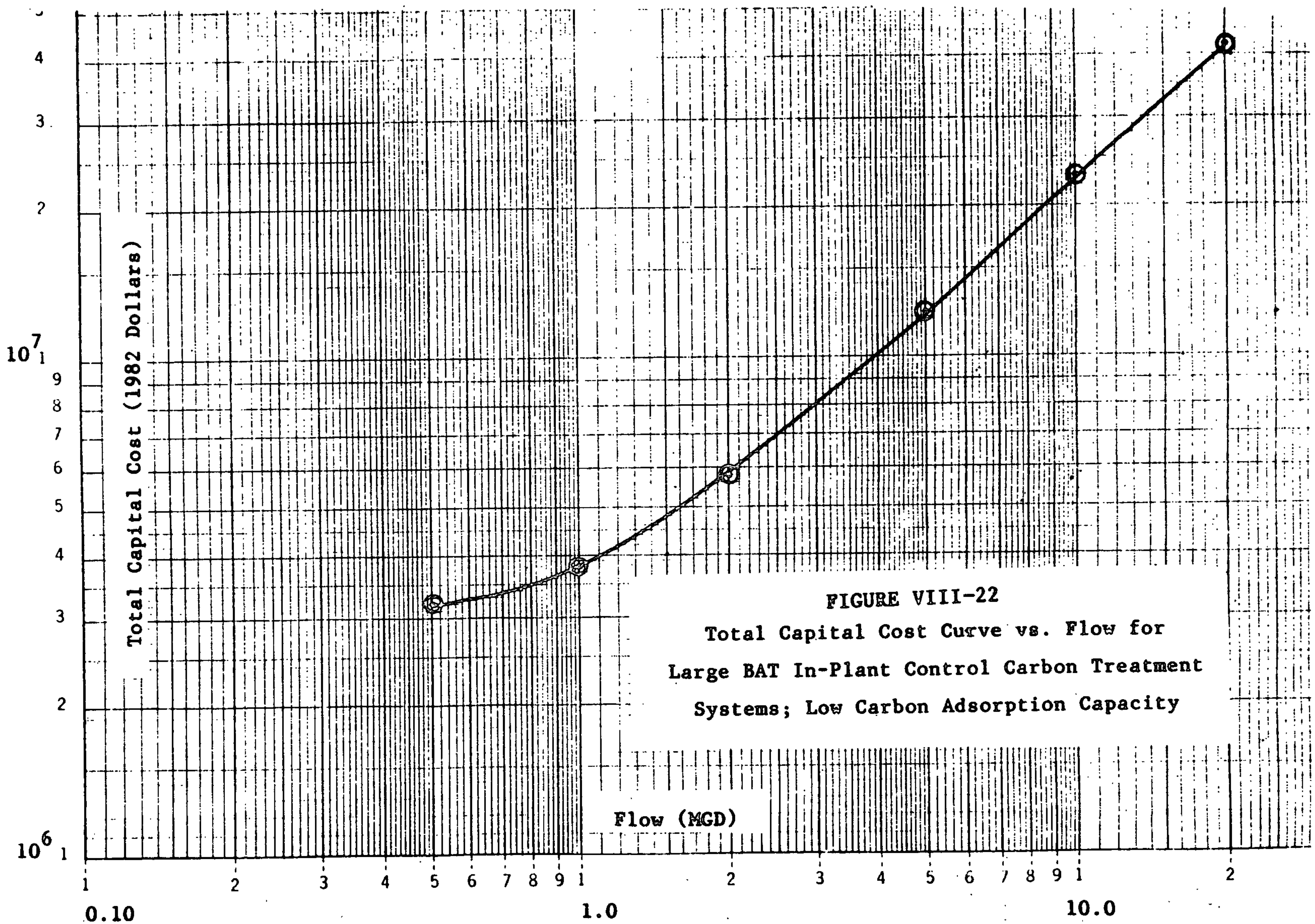


FIGURE VIII-22
Total Capital Cost Curve vs. Flow for
Large BAT In-Plant Control Carbon Treatment
Systems; Low Carbon Adsorption Capacity

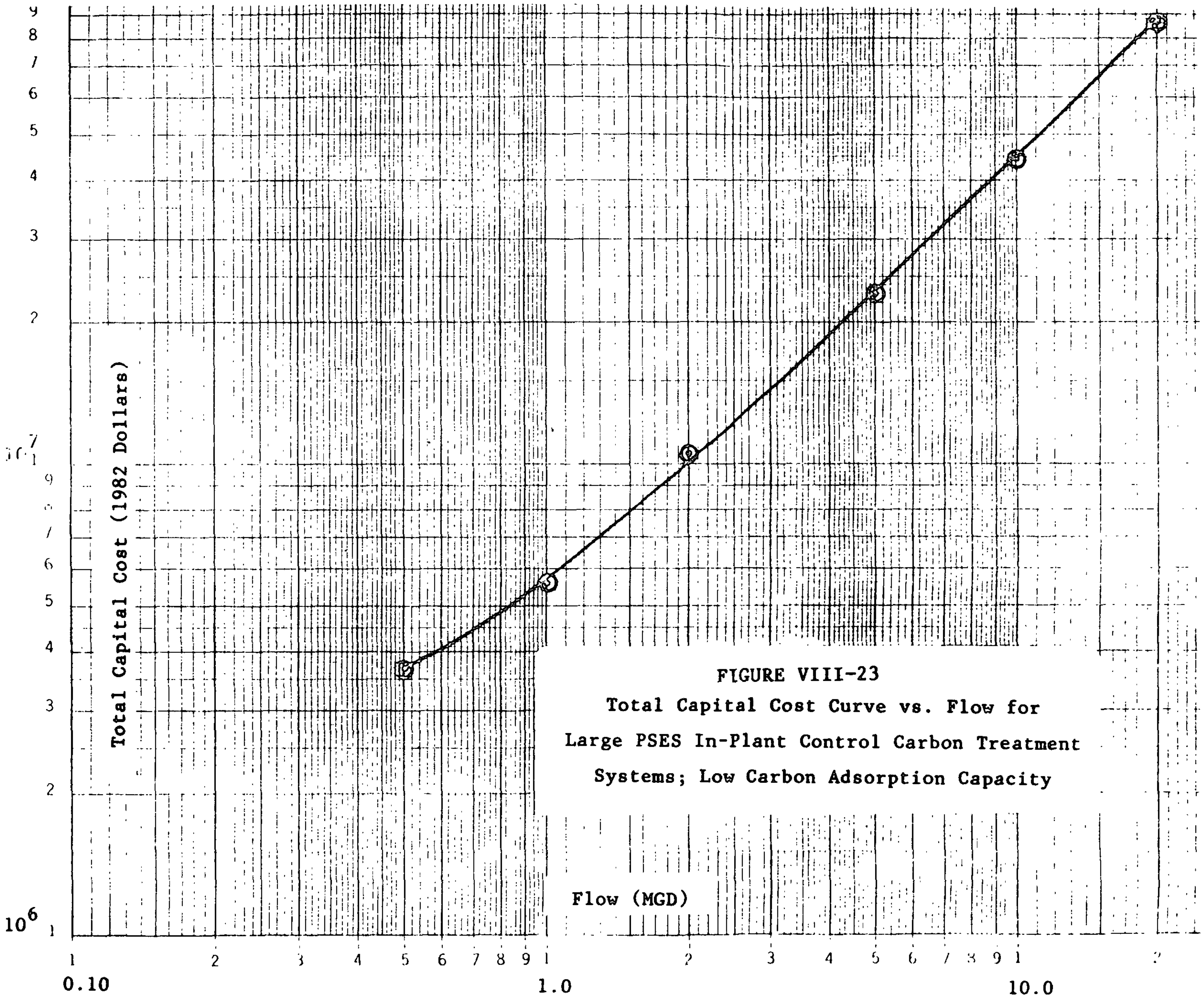


FIGURE VIII-23
Total Capital Cost Curve vs. Flow for Large PSES In-Plant Control Carbon Treatment Systems; Low Carbon Adsorption Capacity

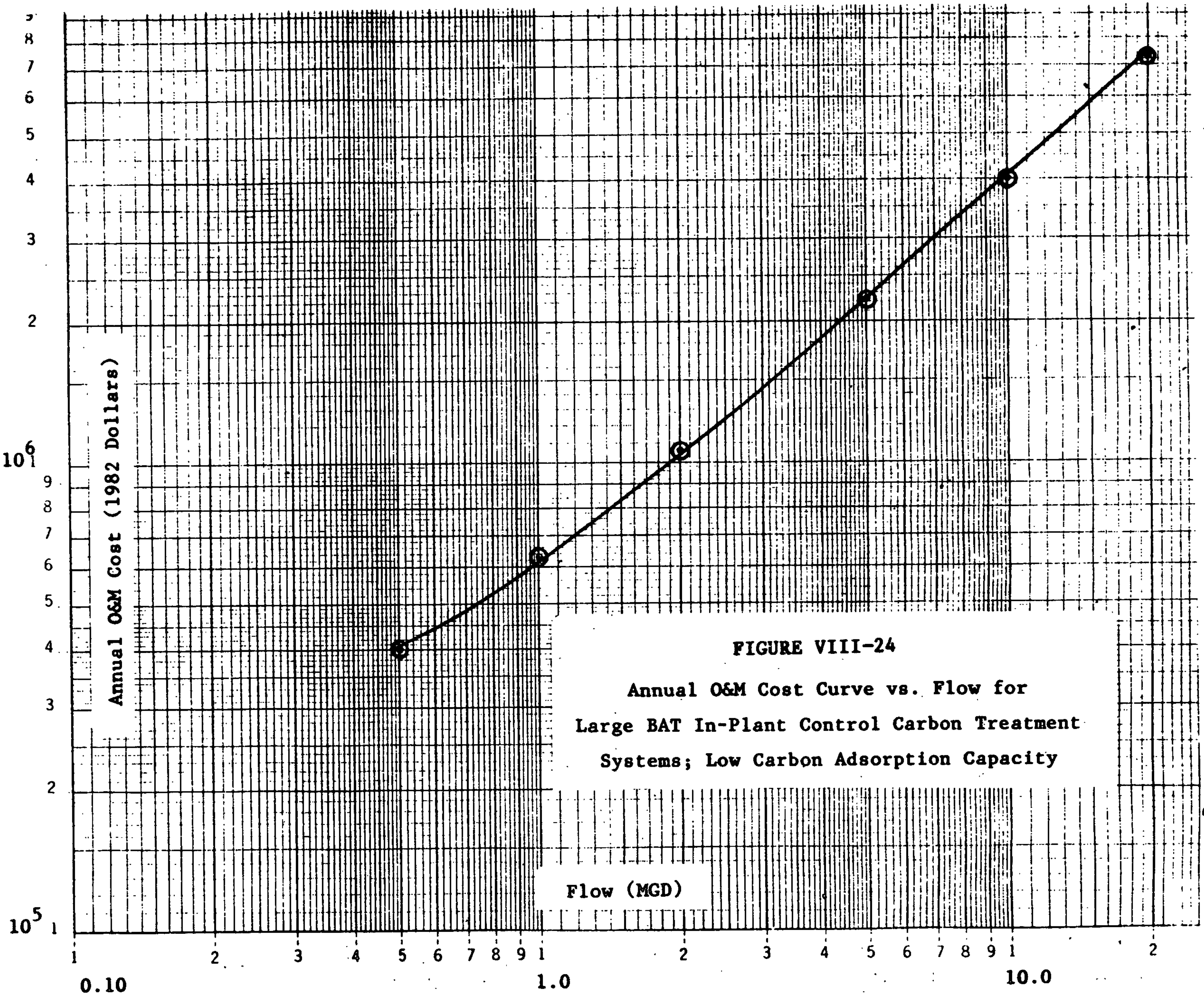


FIGURE VIII-24

Annual O&M Cost Curve vs. Flow for Large BAT In-Plant Control Carbon Treatment Systems; Low Carbon Adsorption Capacity

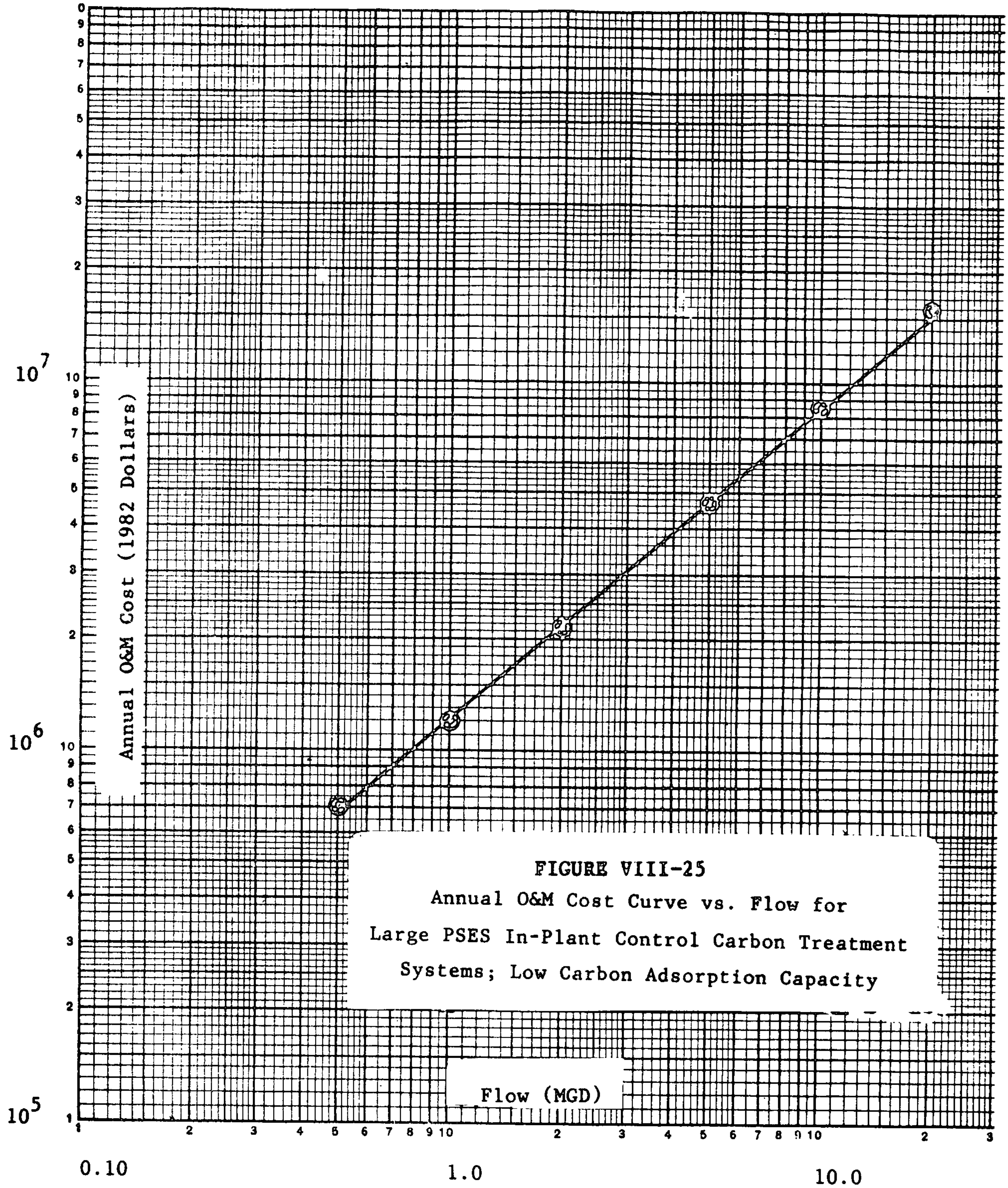


FIGURE VIII-25

Annual O&M Cost Curve vs. Flow for Large PSES In-Plant Control Carbon Treatment Systems; Low Carbon Adsorption Capacity

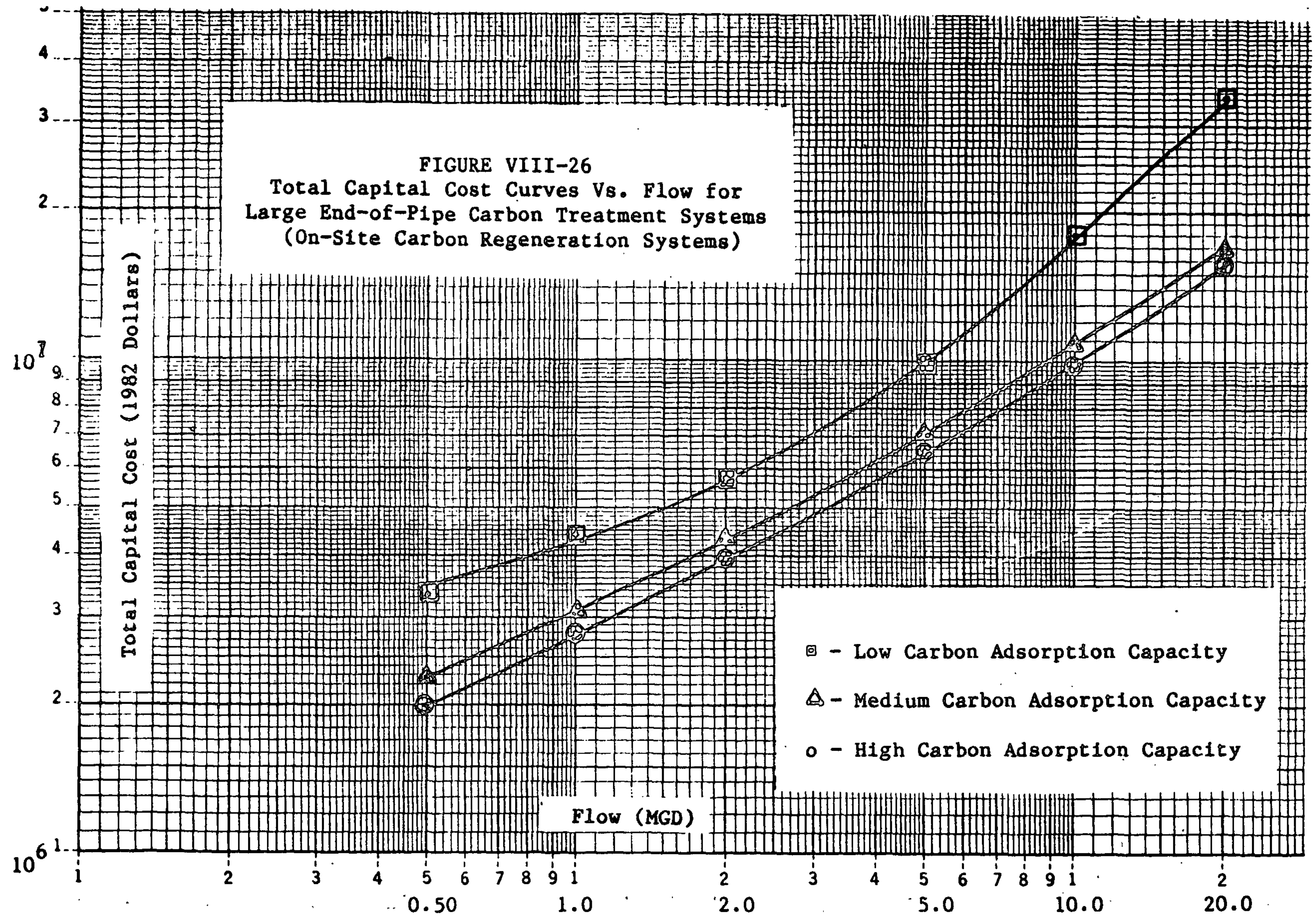


FIGURE VIII-26
Total Capital Cost Curves Vs. Flow for Large End-of-Pipe Carbon Treatment Systems (On-Site Carbon Regeneration Systems)

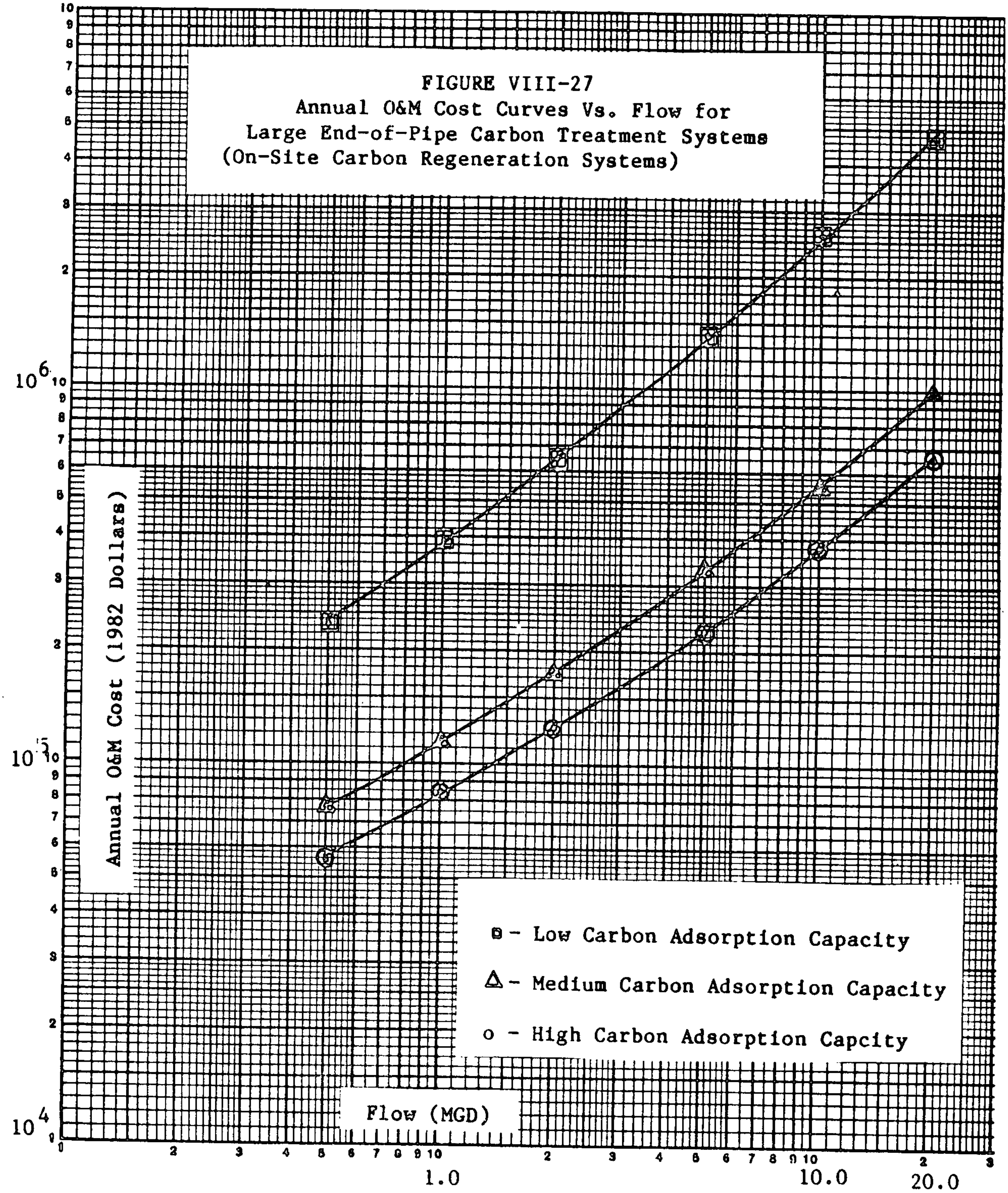


FIGURE VIII-27
Annual O&M Cost Curves Vs. Flow for
Large End-of-Pipe Carbon Treatment Systems
(On-Site Carbon Regeneration Systems)
Annual O&M Cost (1982 Dollars)
Flow (MGD)
10^6
10^5
10^4
1.0
10.0
20.0
□ - Low Carbon Adsorption Capacity
Δ - Medium Carbon Adsorption Capacity
o - High Carbon Adsorption Capcity

TABLE VIII-69.
ITEMIZED CAPITAL COST FOR SMALL
IN-PLANT AND END-OF-PIPE CARBON TREATMENT SYSTEMS
(1982 $)

Item	Flow (mgd)				
	0.01	0.02	0.05	0.10	0.20
Adsorber Const. Costs	56,702	86,248	166,864	274,914	454,799
Initial Carbon Fill Costs	1,737	2,998	7,596	15,192	30,372
Engineering	8,766	13,387	26,169	43,516	72,776
Contingency	8,766	13,387	26,169	43,516	72,776
Total Capital Costs	75,971	116,020	226,798	377,138	630,723

TABLE VIII-70.
ITEMIZED O&M COST FOR SMALL IN-PLANT
MEDIUM CARBON TREATMENT SYSTEMS[1]
(1982 $)

Item	0.01 (MGD)		0.02 (MGD)		0.05 (MGD)		0.10 (MGD)		0.20 (MGD)	
	BAT	PSES	BAT	PSES	BAT	PSES	BAT	PSES	BAT	PSES
Energy	650	650	790	790	1,230	1,230	1,960	1,960	3,420	3,420
Carbon Regeneration	16,347	61,301	32,694	122,601	81,734	306,503	163,468	613,006	326,936	1,226,011
Make-Up Carbon	2,906	10,898	5,812	21,796	14,531	54,489	29,061	108,979	58,122	217,958
Labor	29,200	29,200	29,200	29,200	29,200	29,200	29,200	29,200	29,200	29,200
Maintenance	3,039	3,039	4,641	4,641	9,072	9,072	15,085	15,085	25,229	25,229
Tax and Insurance	1,519	1,519	2,320	2,320	4,536	4,536	7,543	7,543	12,614	12,614
Total O&M Costs	53,661	106,607	75,457	181,348	140,303	405,030	246,317	775,773	455,521	1,514,432

[1]Empty Bed Residence Time: 45 minutes

[2]lb Priority Pollutant Adsorbed/lb carbon
BAT: 0.15 lbs/lb
PSES: 0.05 lbs/lb

TABLE VIII-71.
ITEMIZED O&M COST FOR SMALL IN-PLANT
LOW CARBON TREATMENT SYSTEMS[1]
(1982 $)

Item	0.01 (MGD) BAT	0.01 (MGD) PSES	0.02 (MGD) BAT	0.02 (MGD) PSES	0.05 (MGD) BAT	0.05 (MGD) PSES	0.10 (MGD) BAT	0.10 (MGD) PSES	0.20 (MGD) BAT	0.20 (MGD) PSES
Energy	650	650	790	790	1,230	1,230	1,960	1,960	3,420	3,420
Carbon Regeneration	49,287	123,218	98,574	246,435	246,435	616,088	492,870	1,232,176	985,740	2,464,351
Make-Up Carbon	8,762	21,905	17,524	43,811	43,811	109,527	87,621	219,053	175,243	438,107
Labor	29,200	29,200	29,200	29,200	29,200	29,200	29,200	29,200	29,200	29,200
Maintenance	3,039	3,039	4,641	4,641	9,072	9,072	15,085	15,085	25,229	25,229
Tax and Insurance	1,519	1,519	2,320	2,320	4,536	4,536	7,543	7,543	12,614	12,614
Total O&M Costs	92,457	179,531	153,049	327,197	334,284	769,653	634,279	1,505,017	1,231,446	2,972,921

[1]Empty Bed Residence Time: 45 minutes

[2]lb Priority Pollutant Adsorbed/lb carbon
BAT: 0.04 lbs/lb
PSES: 0.02 lbs/lb

TABLE VIII-72.
ITEMIZED O&M COST FOR SMALL
END-OF-PIPE CARBON TREATMENT SYSTEMS
(1982 $)

Item	0.01 (MGD) High	0.01 (MGD) Medium	0.01 (MGD) Low	0.02 (MGD) High	0.02 (MGD) Medium	0.02 (MGD) Low	0.05 (MGD) High	0.05 (MGD) Medium	0.05 (MGD) Low	0.10 (MGD) High	0.10 (MGD) Medium	0.10 (MGD) Low	0.20 (MGD) High	0.20 (MGD) Medium	0.20 (MGD) Low
Energy	700	700	700	800	800	800	1,500	1,500	1,500	1,800	1,800	1,800	3,500	3,500	3,500
Carbon Make-Up ($0.45/lb)	2,000	3,000	26,200	3,400	6,400	52,400	7,700	16,200	130,200	16,900	32,900	261,900	32,400	65,000	520,000
Labor	16,300	16,300	16,300	16,300	16,300	16,300	16,300	16,300	16,300	16,300	16,300	16,300	16,300	16,300	16,300
Maintenance	4,000	4,000	4,000	6,400	6,400	6,400	12,000	12,000	12,000	20,000	20,000	20,000	33,500	33,500	33,500
Tax & Insurance	2,000	2,000	2,000	3,100	3,100	3,100	6,000	6,000	6,000	10,000	10,000	10,000	16,700	16,700	16,700
Total O&M Cost	25,000	26,000	49,200	30,000	33,000	79,000	43,500	52,000	166,000	65,000	81,000	310,000	102,400	135,000	590,000

*lb Priority Pollutant Adsorbed /lb Carbon
High Carbon Adsorption Capacity = 0.08 lb/lb
Medium Carbon Adsorption Capacity = 0.04 lb/lb
Low Carbon Adsorption Capacity = 0.005 lb/lb

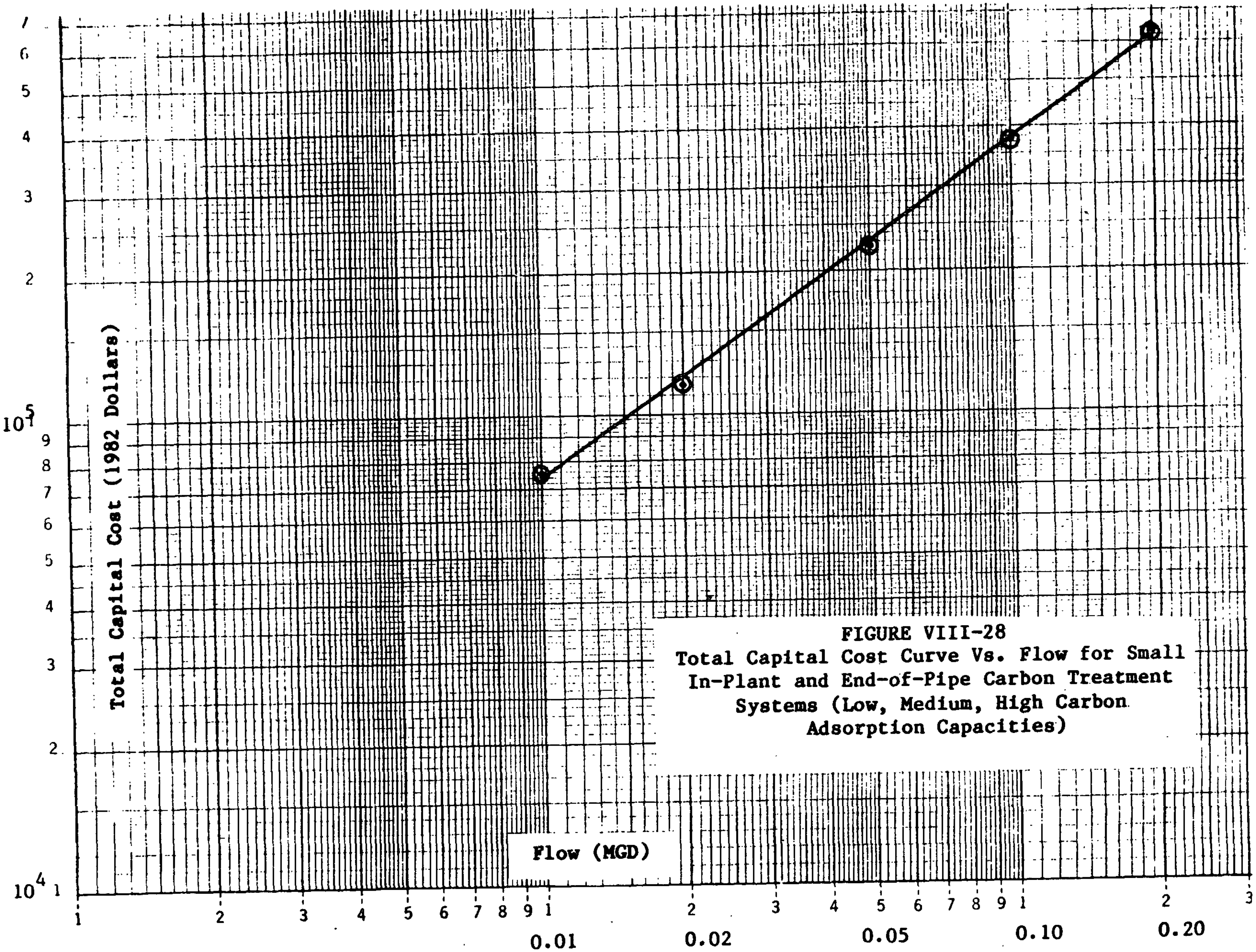


FIGURE VIII-28
Total Capital Cost Curve Vs. Flow for Small In-Plant and End-of-Pipe Carbon Treatment Systems (Low, Medium, High Carbon Adsorption Capacities)

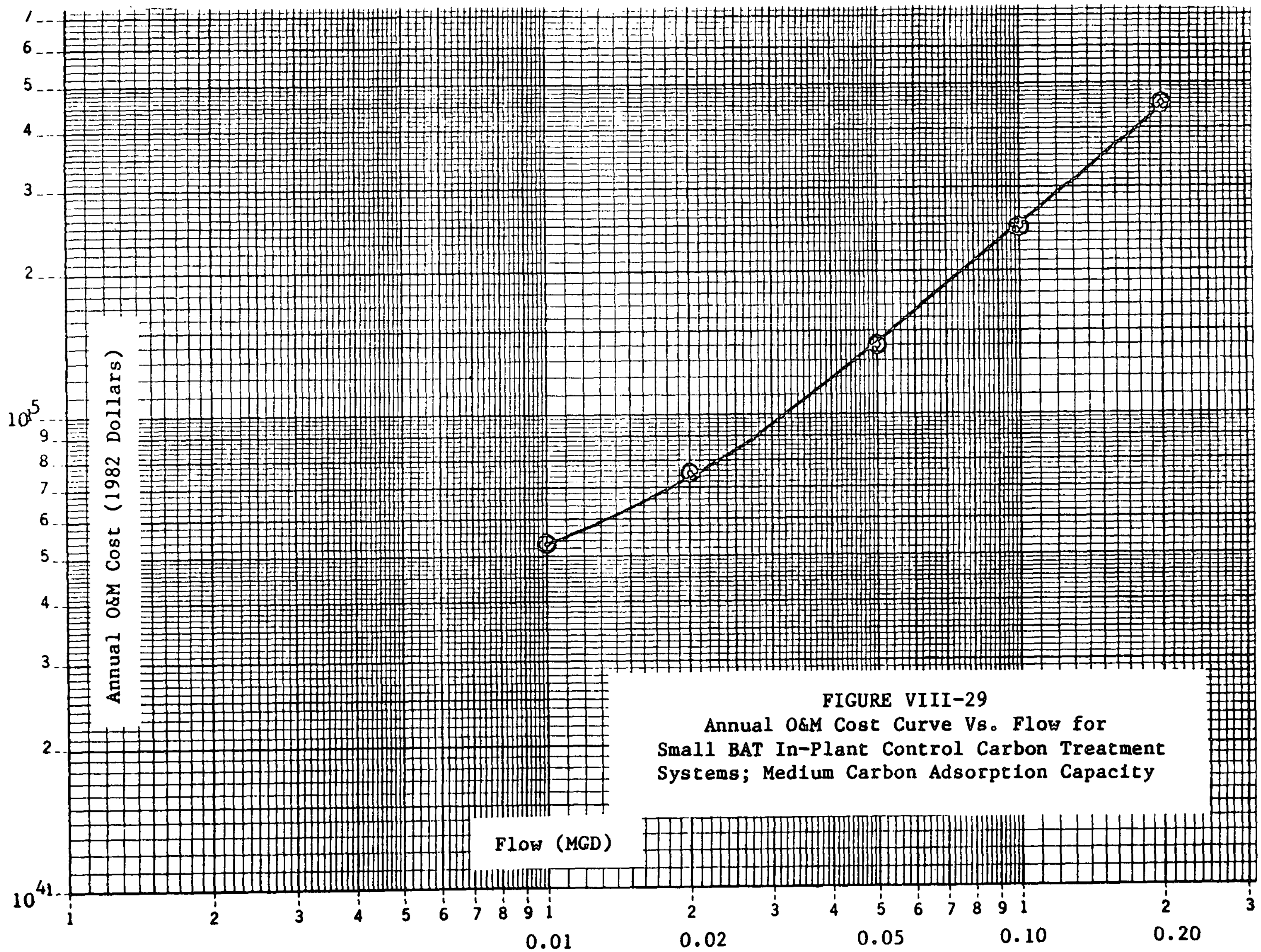


FIGURE VIII-29
Annual O&M Cost Curve Vs. Flow for
Small BAT In-Plant Control Carbon Treatment
Systems; Medium Carbon Adsorption Capacity

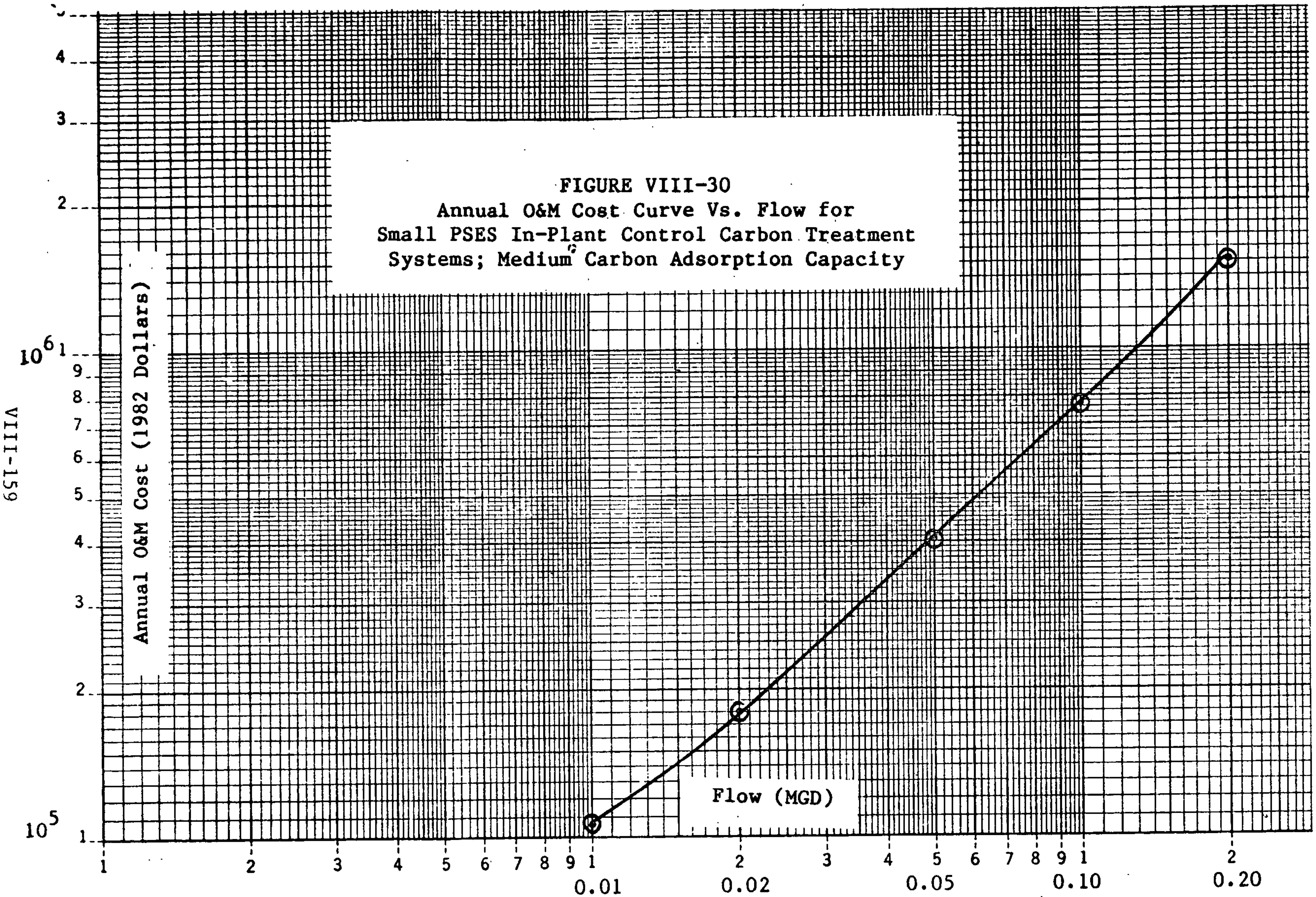


FIGURE VIII-30
Annual O&M Cost Curve Vs. Flow for
Small PSES In-Plant Control Carbon Treatment
Systems; Medium Carbon Adsorption Capacity

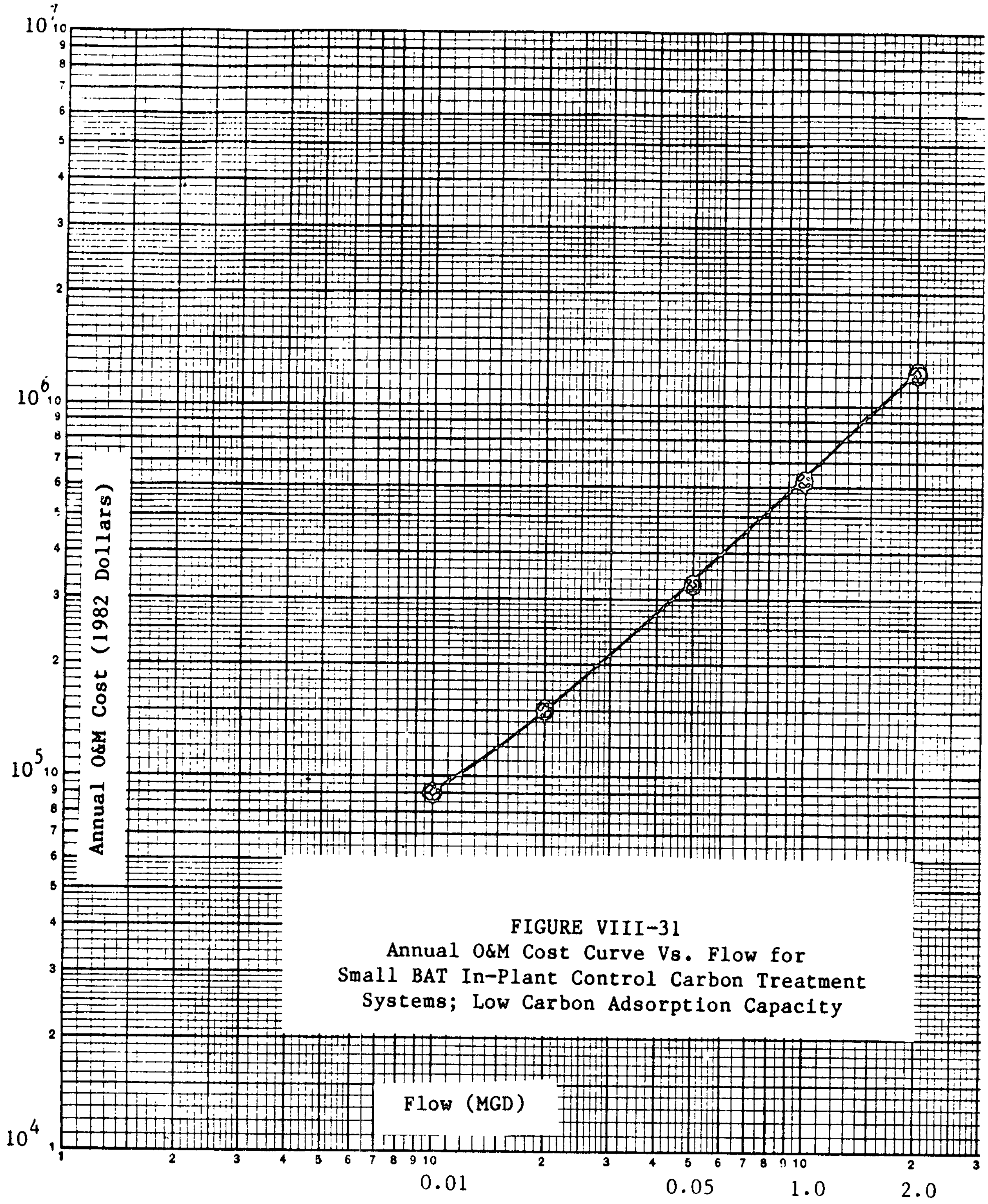


FIGURE VIII-31
Annual O&M Cost Curve Vs. Flow for
Small BAT In-Plant Control Carbon Treatment
Systems; Low Carbon Adsorption Capacity

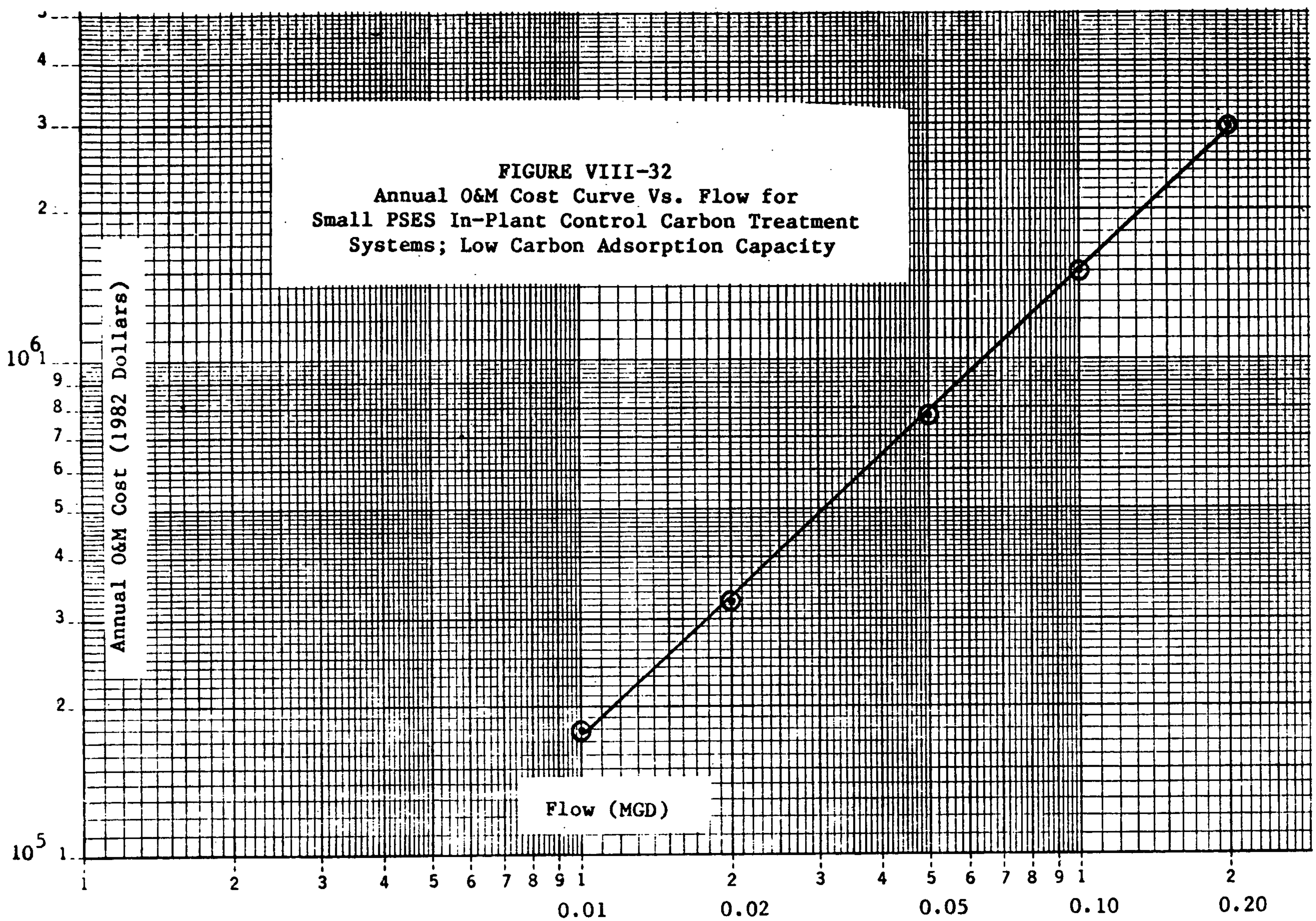


FIGURE VIII-32
Annual O&M Cost Curve Vs. Flow for
Small PSES In-Plant Control Carbon Treatment
Systems; Low Carbon Adsorption Capacity
Annual O&M Cost (1982 Dollars)
Flow (MGD)
10^6
10^5
0.01
0.02
0.05
0.10
0.20

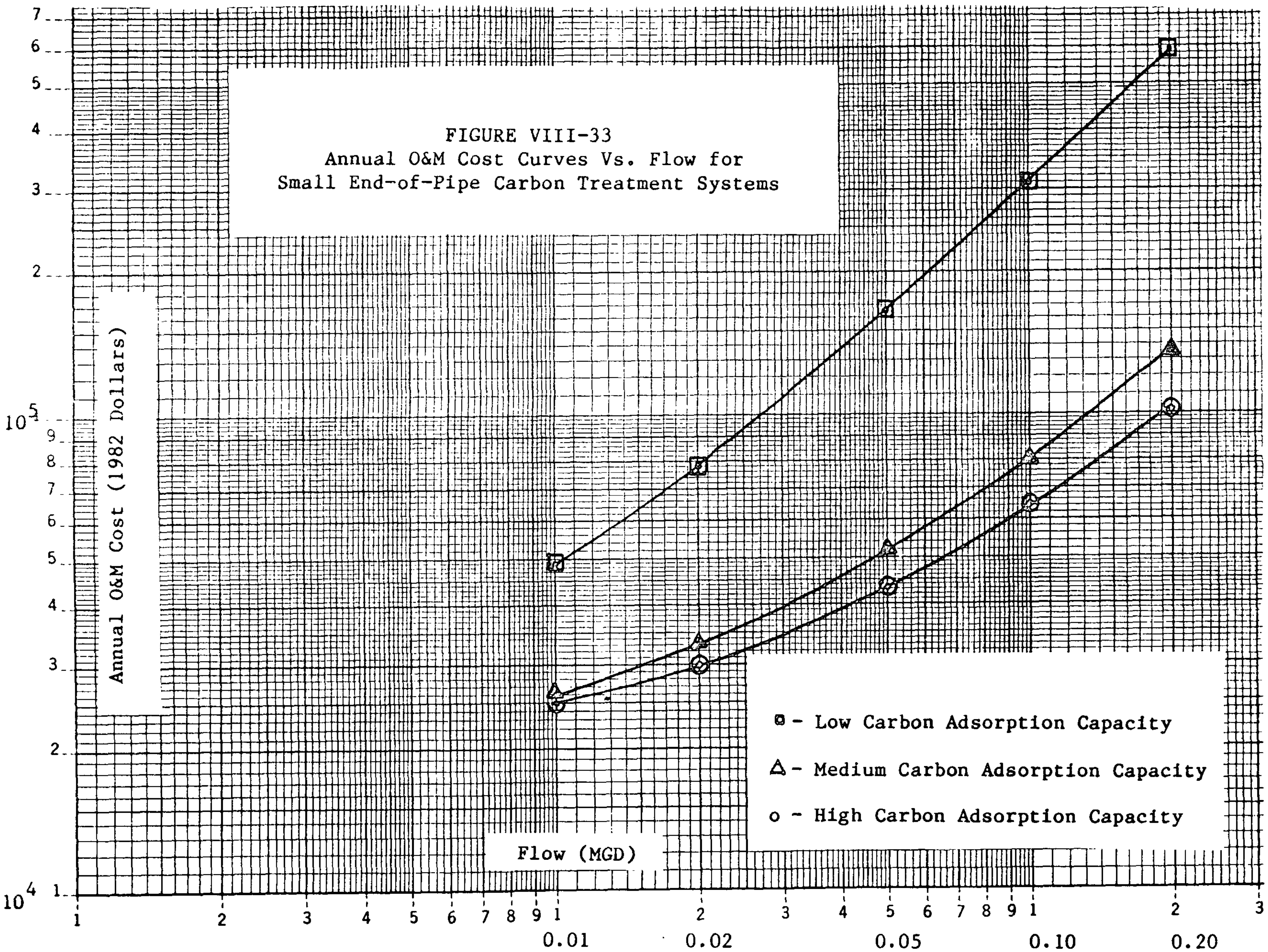


FIGURE VIII-33
Annual O&M Cost Curves Vs. Flow for
Small End-of-Pipe Carbon Treatment Systems

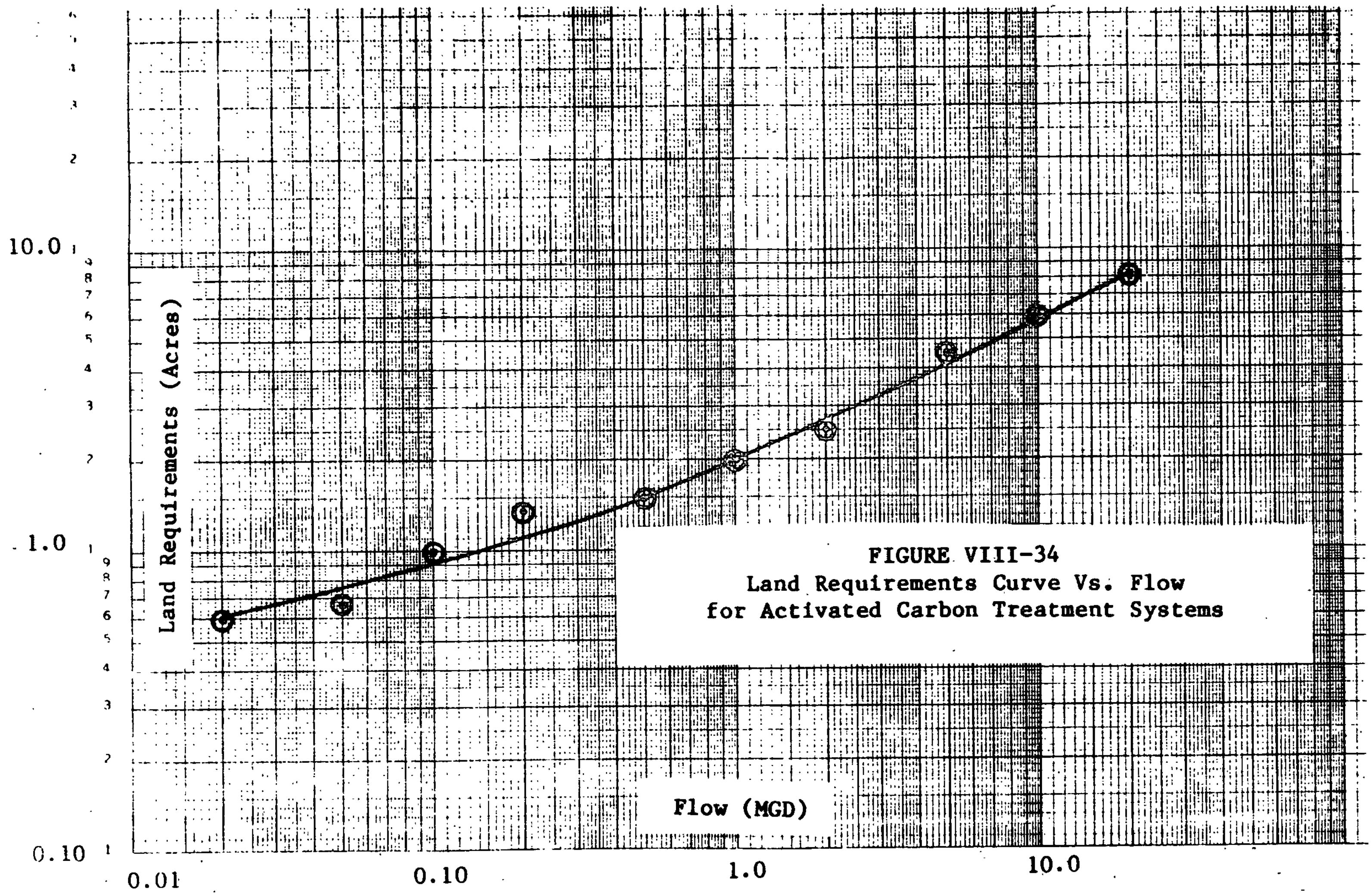


FIGURE VIII-34
Land Requirements Curve Vs. Flow
for Activated Carbon Treatment Systems

sulfide, ferrous sulfide, organic polymers, and sodium hydroxide are often used depending on the specific waste material to be removed. The coagulants are rapidly mixed with the wastewater, and the colloidal particles are allowed to agglomerate into a floc large enough to be removed by subsequent clarification. Coagulation/flocculation/clarification is a chemical process by which soluble metallic ions and certain anions are converted to an insoluble form for subsequent removal from the wastewater stream. The performance of the process is affected by chemical interactions, temperature, pH, solubility variances, and mixing effects.

Many coagulation reactions occur very rapidly, during which some soluble kinetic intermediates can be adsorbed on the colloidal surfaces. For these reasons, rapid and complete dispersion of coagulants is necessary. Failure to provide adequate coagulant distribution may cause localized pH or ion concentrations that can hinder the colloid destabilization to the point of requiring more coagulant addition. For high speed mixing, a retention time of 30 seconds to 2 minutes has been reported satisfactory. For the development of good floc characteristics, retention times of 15 to 30 minutes have been suggested.

Cost estimates were developed using a conservative gravity clarifier design overflow rate of 400 gpd/ft^2 and residence times for sizing the rapid mix tanks (coagulation tanks) and flocculation tanks of 2 minutes and 20 minutes, respectively. The capital and annual operating costs were obtained by adding the estimated costs for the coagulation/flocculation system to those costs estimated for the clarification system (see previous section on chemically assisted clarification). Both capital and annual operating costs calculated for the coagulation/flocculation/clarification systems were made for flow rates of 0.2, 1.0, 5.0, 10.0, and 20.0 MGD. The itemized capital costs are listed in Table VIII-73.

The estimated process equipment and materials costs were obtained from a manufacturer (Envirex). The capital costs for coagulation/flocculation were added to those for clarification to obtain the total costs for the entire system (see Table VIII-73). The results are plotted in Figure VIII-35.

TABLE VIII-73.
ITEMIZED CAPITAL COSTS FOR COAGULATION/FLOCCULATION/CLARIFICATION SYSTEMS

	Flow Rate (mgd)				
	0.2	1.0	5.0	10.0	20.0
Process Equipment	21,300	23,900	39,300	-	84,200
Materials	16,200	23,000	39,500	-	93,700
Subcontracts and Shop Labor	200	200	300	-	300
Insurance	400	600	1,300	-	3,700
Taxes	900	1,000	1,600	-	3,400
Field Labor	21,000	33,200	64,400	-	170,000
Field Office Personnel, Construction Equipment and Tools	6,400	10,000	19,400	-	51,000
Subtotal	66,400	91,900	165,800	-	406,300
Contingency	10,000	13,800	24,900	-	60,900
Subtotal	76,400	105,700	190,700	-	467,200
Overhead	3,800	5,300	9,500	-	23,400
Total (1977 $)	80,200	111,000	200,200	*297,000	490,600
Total (1982 $)	120,000	166,000	299,000	441,000	733,000
Clarification System (1982 $)	220,000	408,000	1,004,000	1,750,000	3,477,000
Grand Total (1982 $)	340,000	574,000	1,303,000	2,191,000	4,210,000

*Cost estimates for the 10 MGD flow system were obtained by extrapolating the cost values for the 5 MGD and 20 MGD systems.

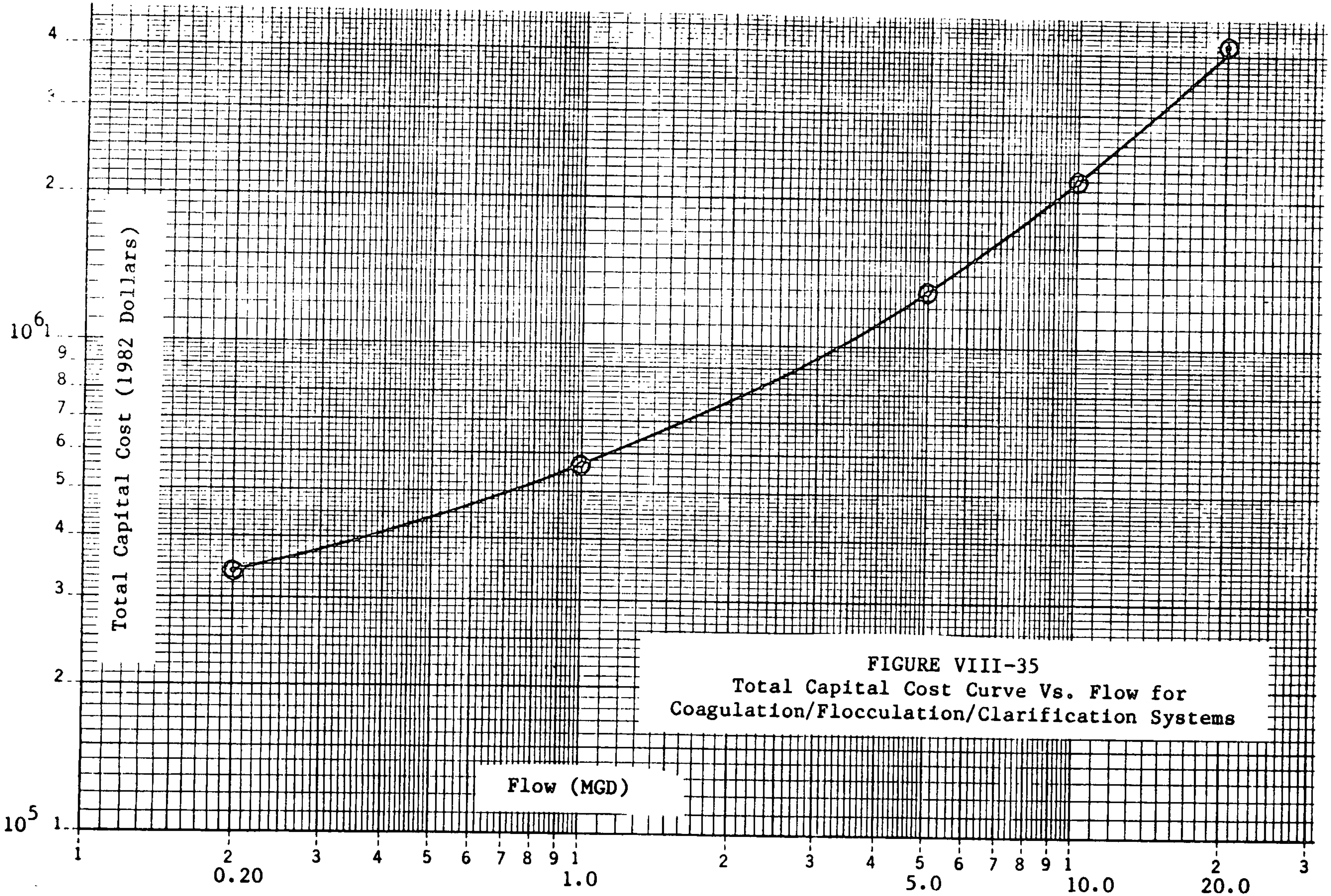


FIGURE VIII-35
Total Capital Cost Curve Vs. Flow for
Coagulation/Flocculation/Clarification Systems

The estimated capital costs did not include costs for equalization tanks and lime storage tanks. As described below, equalization tanks are not required since typical raw wastewaters from the OCPSF industry contain relatively low levels of heavy metals. The land acreage requirements for each flow system were estimated based upon the sizes of the process equipment plus adequate space for repairs and general access. A curve showing the relationship between the land requirements and flow rates is presented in Figure VIII-36.

Annual operating costs are presented in Table VIII-74. A unit electricity cost of $0.08/kwh was used.

A polymer dosage of 1 mg/l has been assumed for all cases. The unit price of Hercu Floc 815 at $2.80/lb was used for calculating polymer costs. The addition of lime is determined by the actual stoichiometric requirements of the selected reaction plus 50 percent in excess of the required amount. Based on a survey of 48 organic chemical plants, the average influent total heavy metal concentrations to the in-plant metals control systems seldom exceed 4 mg/l. The most common heavy metals appearing in OCPSF plants include copper, chromium, zinc, and lead. Therefore, an influent total heavy metal concentration of 10 mg/l was assumed for estimating the stoichiometric requirements. The unit lime cost is based on $43.00/ton for hydrated lime delivered in bags (Chemical Weekly Reporter, 1982).

The annual maintenance costs were assumed to be 4 percent of the total capital costs. Taxes and insurance costs were assumed to be 2 percent of the total capital costs. The total operating costs were plotted against flow rates as shown in Figure VIII-37.

A benchmark analysis was performed to compare the coagulation/flocculation/clarification system cost estimates with reported industry experience. Appropriate cost data were available from the Section 308 Questionnaires for seven OCPSF facilities. The wastewater flow rates of these facilities range from 0.58 to 7.5 MGD, falling well within the costing curve flow range. All the capital costs were converted to 1982 dollars using ENR's Construction Index. The results are presented in Table VIII-75.

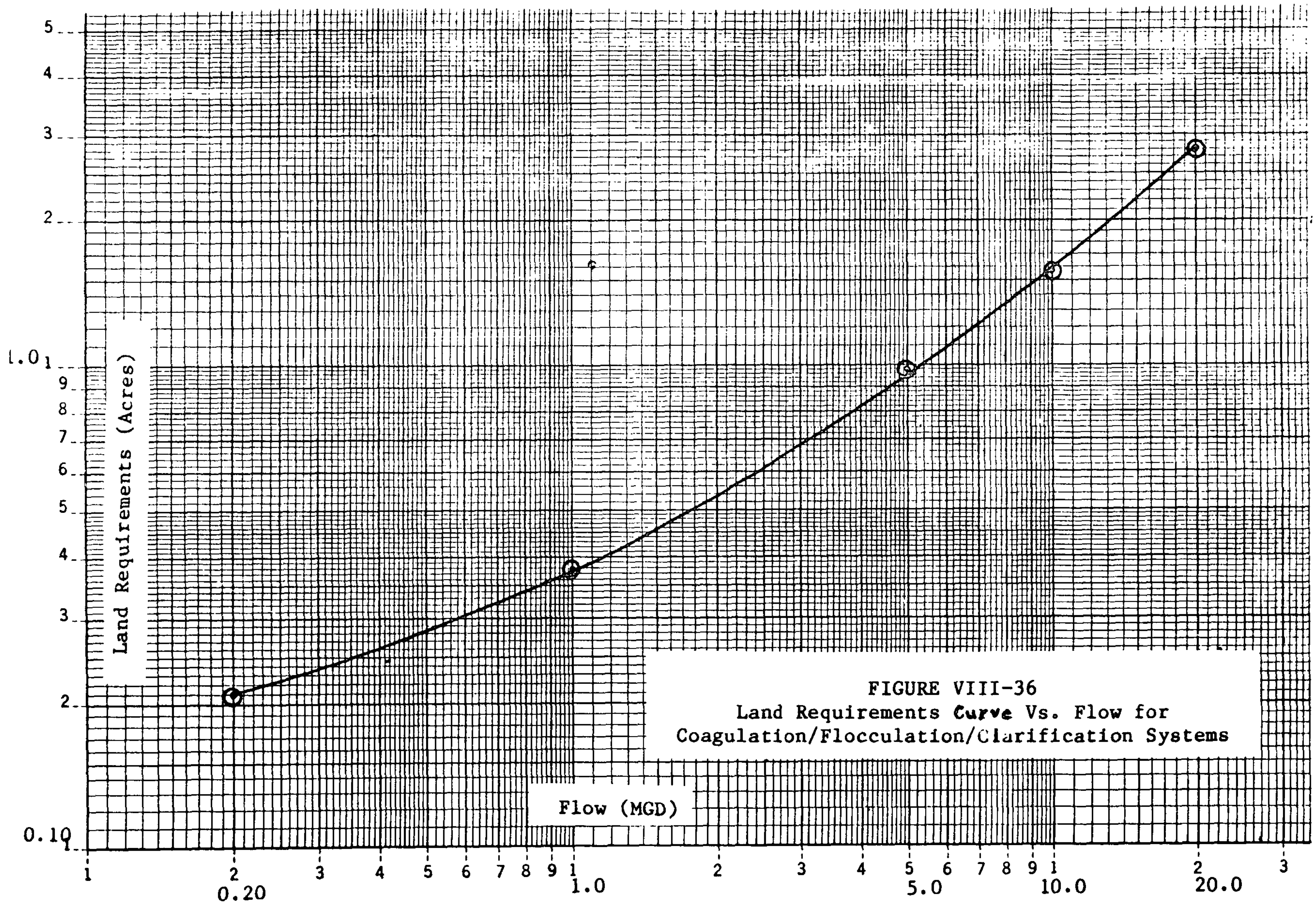


FIGURE VIII-36
Land Requirements Curve Vs. Flow for
Coagulation/Flocculation/Clarification Systems

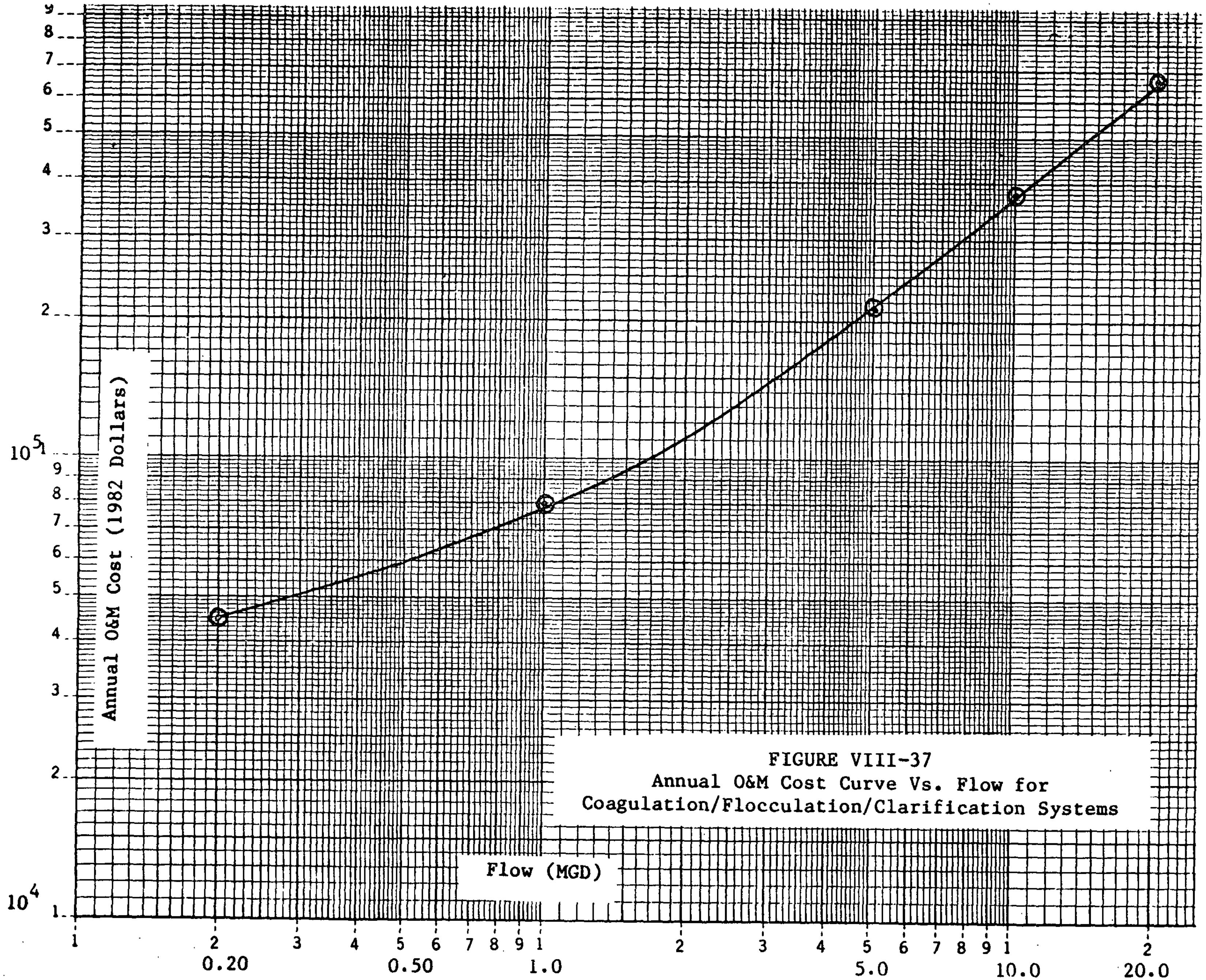


FIGURE VIII-37
Annual O&M Cost Curve Vs. Flow for
Coagulation/Flocculation/Clarification Systems

TABLE VIII-74.
ITEMIZED ANNUAL OPERATING COSTS FOR
COAGULATION/FLOCCULATION/CLARIFICATION SYSTEMS

Item	Flow Rates (mgd)				
	0.2	1.0	5.0	10.0	20.0
Energy	2,700	4,600	16,900	32,200	62,900
Chemicals	1,900	9,700	48,200	96,300	192,700
Labor	20,700	31,100	69,800	118,800	164,800
Maintenance	13,300	23,000	52,300	86,900	168,800
Taxes and Insurance	6,600	11,500	26,100	43,800	84,200
Total Operating Cost (1982 $)	45,200	79,900	213,300	378,000	673,400

TABLE VIII-75.
BENCHMARK COMPARISON FOR
COAGULATION/FLOCCULATION/CLARIFICATION SYSTEMS

Facility No.	Flow (mgd)	Capital Costs (Built Year $)	Reported Capital Costs (1982 $)	EPA Estimated Capital Costs (1982 $)	Difference (EPA-Reported)	% Difference Compared to Reported Cost**
2181	0.58	$6.64x10^5$ (1975)	$1.15x10^6$	$4.68x10^5$	$-6.82x10^5$	59% low
2474*	1.73	$3.57x10^5$ (1975)	$6.18x10^5$	$7.60x10^5$	$1.42x10^5$	23% low
2695*	2.00	$6.78x10^5$ (1974)	$1.28x10^6$	$8.20x10^5$	$-4.60x10^5$	36% low
0063	2.40	$3.96x10^5$ (1973)	$8.44x10^5$	$9.00x10^5$	$0.56x10^5$	7% high
0683	3.10	$3.21x10^5$ (1977)	$4.76x10^5$	$1.05x10^6$	$5.74x10^5$	121% high
1688	7.20	$9.06x10^5$ (1978)	$1.25x10^6$	$1.80x10^6$	$5.50x10^5$	44% high
2227	7.50	$1.21x10^6$ (1977)	$1.80x10^6$	$1.83x10^6$	$0.03x10^6$	2% high

*Only coagulation/flocculation system costs are available from Questionnaire. Reported total costs were based on coagulation/flocculation system costs plus EPA-estimated clarifier costs at corresponding flows.

$$**\% \text{ Difference} = \frac{\text{EPA-Reported}}{\text{Reported}} \times 100\%$$

In general, although there are differences in the cost comparisons between EPA's estimates and actual industry data, there is no definitive pattern to the differences in either magnitude or direction. From Table VIII-75, approximately 86 percent of the total facilities are estimated to have cost differences within ±60 percent. A comparison of capital costs between actual systems and EPA's estimates is shown in Figure VIII-38. As illustrated, the reported capital cost for plant 2181 seems to be unusually high compared to other facilities with flow rates several times that of plant 2181. In contrast, the reported capital cost for plant 683 seems to be significantly lower than that of other facilities with flow rates lower than that of plant 683. This probably indicates that both plants may have introduced some design specifications that were different from typical values. Except for these two points, the remaining points shown in Figure VIII-38 seem to follow the cost curve quite reasonably.

Although a certain degree of discrepancy exists, variations between reported systems and EPA's estimates are judged to be within the acceptable range normally associated in industrial practice for preliminary engineering cost estimation.

Some OCPSF wastewaters can contain complexed metals that are tied up by particular chemicals (complexing agents). When this occurs, the metals are prevented from precipitating and falling out of solution. Metals complexing also interferes with typical precipitation techniques employed by many facilities. Therefore, caustic or lime precipitation treatment methods are not always successful when used on complexed metal waste streams.

Sulfide precipitation, a relatively new precipitation process, has been reported as very effective in removing complexed metals at low levels (less than 20 mg/l). In addition, sulfide precipitation is capable of reducing the solubility of heavy metals to much lower levels than hydroxide, thus accomplishing greater heavy metal removal. However, if sodium sulfide is used, care must be taken to maintain the pH of the solution above 8 in order to prevent the generation of toxic hydrogen sulfide gas. The use of ferrous sulfide can eliminate the problem of hydrogen sulfide evolution since iron will give up its sulfide and precipitate any metal that has a lower solubility

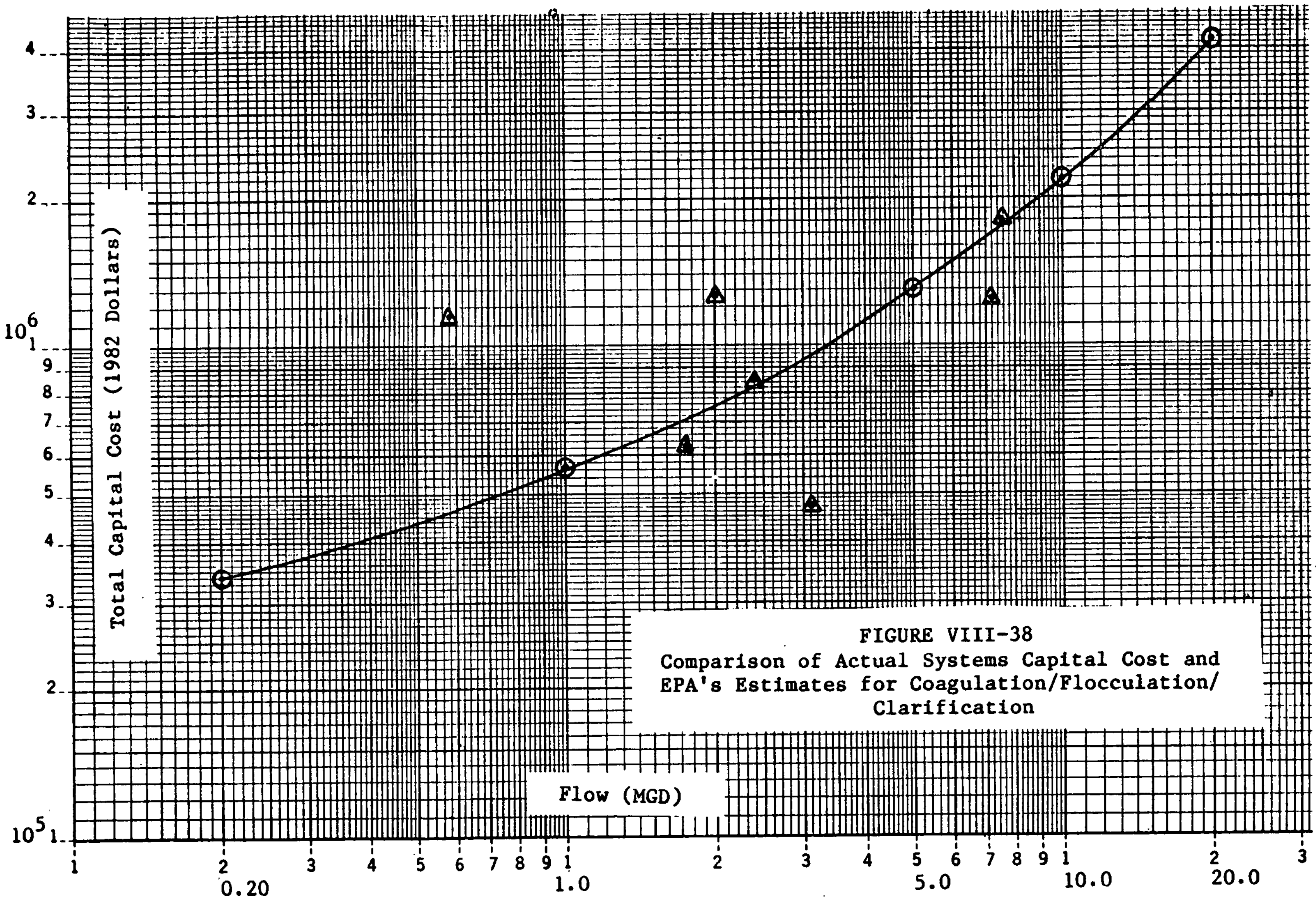


FIGURE VIII-38
Comparison of Actual Systems Capital Cost and EPA's Estimates for Coagulation/Flocculation/ Clarification

than the ferrous sulfide. Under alkaline conditions, the iron will then precipitate as the hydroxide (8-2).

The equipment required for sulfide precipitation is very similar to that used for lime precipitation. Since the levels of complexed metals in OCPSF wastewaters are relatively low, a one-stage sulfide precipitation system would be adequate. Both the ferrous sulfide and polymer would be fed to the coagulation tank. In addition, a lime [$Ca(OH)_2$] feed and pH control system must be installed to ensure that the reaction is in the alkaline range. The presence of calcium ion (Ca^{+2}), which functions as a coagulant, would enhance the precipitation process.

The estimated capital and annual operating costs for sulfide precipitation systems are presented in Tables VIII-76 and VIII-77. Figures VIII-39 and VIII-40 show the capital and O&M cost curves.

In general, the capital cost difference between the lime precipitation systems and the sulfide precipitation system is insignificant. The annual operating costs for the sulfide precipitation systems, however, would be higher than those of the lime precipitation systems by a factor of 0.5, due to the higher ferrous sulfide cost (at approximately $0.40/lb). A comparison of the annual operating costs for lime precipitation systems and sulfide precipitation systems is presented in Table VIII-78.

a. Chemical Precipitation Upgrades

In addition to upgrades to existing steam strippers, the Agency also assessed upgrade costs for existing chemical precipitation systems; these systems comprise the second most numerous in-plant control category. EPA identified all direct and indirect discharging OCPSF plants with chemical precipitation in-place, and upgrade costs were estimated for each plant. Chemical precipitation upgrade costs were estimated by taking the chemical costs from the lime precipitation cost curves, assuming that lime precipitation was in-place and that the necessary upgrade involved increased chemical dosage. A total of 20 direct dischargers and 9 indirect dischargers were identified by the Agency, and upgrade costs were estimated for each;

TABLE VIII-76.
ITEMIZED CAPITAL COSTS FOR SULFIDE PRECIPITATION SYSTEMS

Item	Flow Rate (mgd)				
	0.2	1.0	5.0	10.0	20.0
Process Equipment	22,400	25,100	41,300	-	88,400
Materials	17,000	24,200	41,500	-	98,400
Subcontracts and Shop Labor	200	200	300	-	300
Insurance	400	600	1,400	-	3,900
Taxes	900	1,100	1,700	-	3,600
Field Labor	23,000	34,900	67,600	-	178,500
Field Office Personnel, Construction Equipment and Tools	6,700	10,500	20,400	-	53,600
Subtotal	70,600	96,600	174,200	-	426,700
Contingency	10,500	14,500	26,100	-	64,000
Subtotal	31,100	111,100	200,300	-	490,700
Overhead	4,000	5,600	10,000	-	24,600
Total (1977 $)	85,100	116,700	210,300	*312,000	515,300
Total (1982 $)	127,000	174,500	314,100	463,000	769,900
Clarification System (1982 $)	220,000	408,000	1,004,000	1,750,000	3,477,000
Grand Total (1982 $)	347,000	582,500	1,318,000	2,213,000	4,247,000

*Cost estimates for the 10 MGD flow system were obtained by extrapolating the cost values for the 5 MGD and 20 MGD systems.

TABLE VIII-77.
ANNUAL OPERATING COSTS FOR SULFIDE PRECIPITATION SYSTEMS

	Flow Rates (mgd)				
Item	0.2	1.0	5.0	10.0	20.0
Energy	2,700	4,600	16,900	32,200	62,900
Chemicals	7,100	35,400	176,900	355,500	711,100
Labor	20,700	31,100	69,800	118,800	164,800
Maintenance	13,300	23,000	52,300	86,900	168,800
Taxes and Insurance	6,600	11,500	26,100	43,800	84,200
Total Operating Cost (1982 $)	50,400	105,600	342,000	637,200	1,191,800

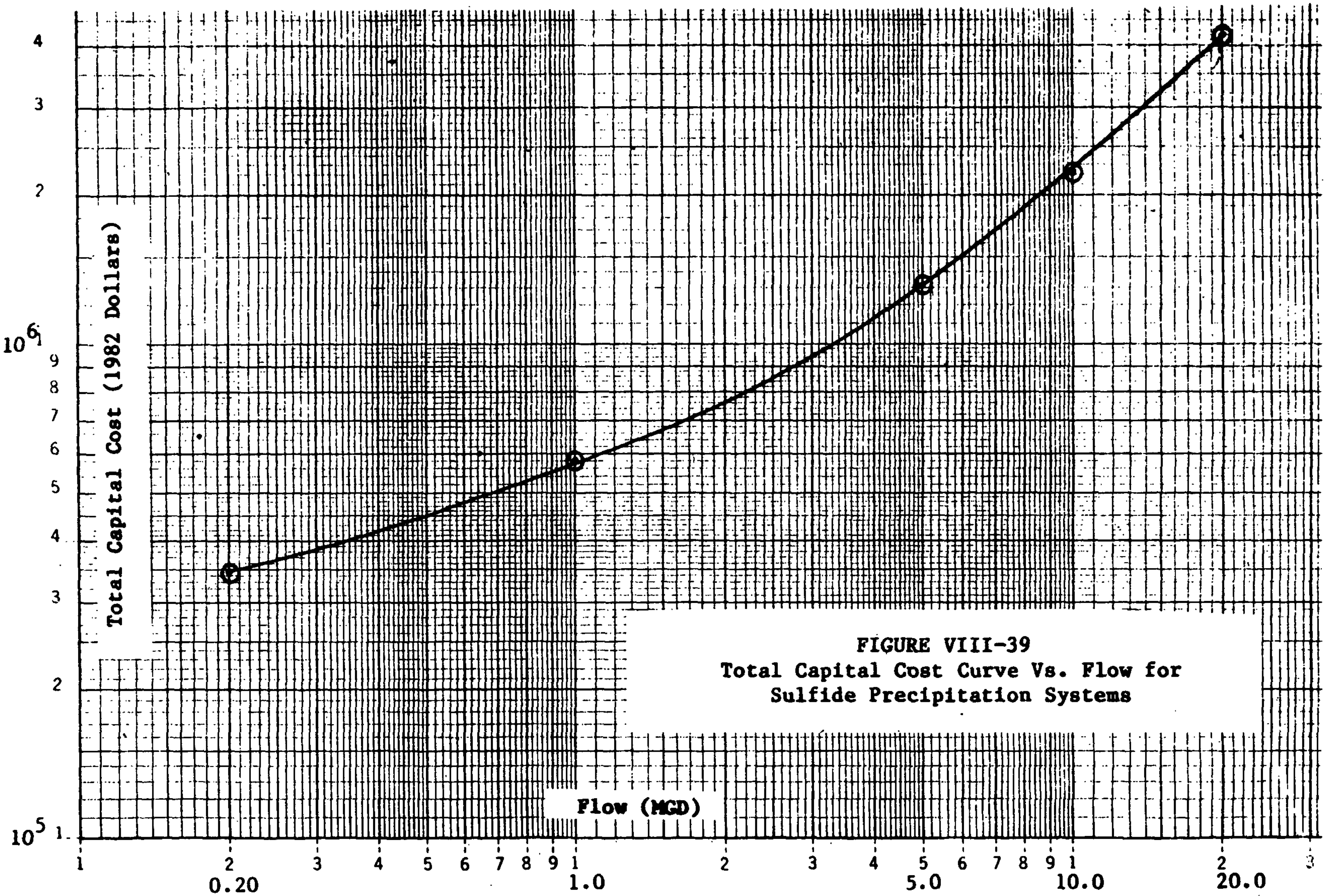


FIGURE VIII-39
Total Capital Cost Curve Vs. Flow for
Sulfide Precipitation Systems

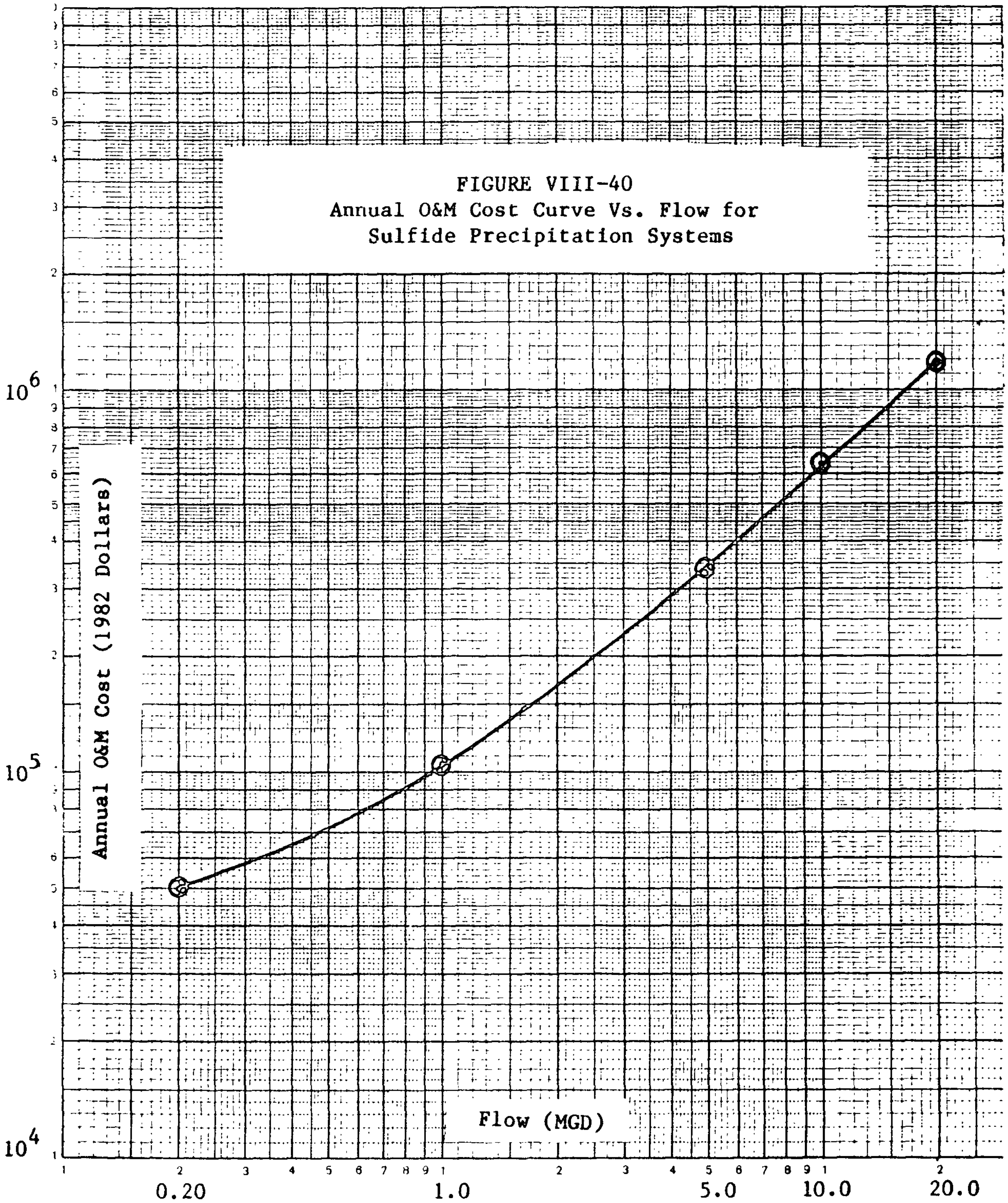


FIGURE VIII-40
Annual O&M Cost Curve Vs. Flow for
Sulfide Precipitation Systems
Annual O&M Cost (1982 Dollars)
10^6
10^5
10^4
Flow (MGD)
0.20
1.0
5.0
10.0
20.0

TABLE VIII-78.
A COMPARISON OF ANNUAL OPERATING COSTS FOR
LIME PRECIPITATION SYSTEMS AND SULFIDE PRECIPITATION SYSTEMS

Item	Flow Rates (mgd) 0.2	1.0	5.0	10.0	20.0	
Lime Precipitation						
Energy	2,700	4,600	16,900	32,200	62,900	
Chemicals	1,900	9,700	48,200	96,300	192,700	
Labor	20,700	31,100	69,800	118,800	164,800	
Maintenance	13,300	23,000	52,300	86,900	168,800	
Taxes and Insurance	6,600	11,500	26,100	43,800	84,200	
Total Operating Cost (1982 $)	45,200	79,900	213,300	378,000	673,400	
Sulfide Precipitation						
Energy	2,700	4,600	16,900	32,200	62,900	
Chemicals*	7,100	35,400	176,900	355,500	711,100	
Labor	20,700	31,100	69,800	118,800	164,800	
Maintenance	13,300	23,000	52,300	86,900	168,800	
Taxes and Insurance	6,600	11,500	26,100	43,800	84,200	
Total Operating Cost (1982 $)	50,400	105,600	342,000	637,200	1,191,800	
Total Operating Cost Ratio (Sulfide Precipitation/Lime Precipitation)	1.12	1.32	1.60	1.69	1.77	Avg 1.5
Net Increase	0.12	0.32	0.60	0.69	0.77	Avg 0.5

*Ferrous sulfide at two times stoichiometric requirement and $0.40/lb.
Lime at 1.5 lbs per 1,000 gallon wastewater and $0.02/lb (pH 8.5).
Polymer at 1 mg/l dosage rate and $2.8/lb.

these upgrade costs are presented in Table VIII-79. In addition, plant 399 was costed for a complete lime precipitation system since its in-place precipitation unit utilizes sodium hydroxide to facilitate the recovery of zinc; therefore, the plant would not be able to improve its system with the methods used for costing other plants.

Based on the relatively small number of plants, the fact that performance data were limited to determine how many of these plants were actually performing well, and the relatively low costs associated with these upgrades, the Agency decided not to include upgrade costs for chemical precipitation units in its final BAT and PSES compliance cost estimates. However, a separate economic impact assessment of these upgrade costs generally shows insignificant incremental economic impacts for these plants. The assessment concludes that the upgrade costs are also not significant in terms of the overall impact associated with the OCPSF regulation.

4. Cyanide Destruction

The oxidation of cyanide by chlorine is a state-of-the-art process used in the metal finishing and OCPSF industries. Cyanide destruction is capable of achieving removal efficiencies of 99 percent or greater, and reduces cyanide to the levels of analytical detection.

Chlorine is primarily used as an oxidizing agent, and can be utilized in elemental or hypochlorite form. The procedure using hypochlorite is shown in the following two step chemical reaction:

1) $NaCN + NaOCl \rightarrow NaCNO + NaCl$
2) $2NaCNO + 3NaOCl + H_2O \rightarrow 3NaCl + N_2 + 2NaHCO_3$

In the first step, cyanide is oxidized to cyanate in the presence of hypochlorite and sodium hydroxide with the base required to maintain a pH range of 9 to 11. The second step oxidizes cyanate to carbon dioxide (as sodium bicarbonate) and nitrogen at a controlled pH of 8.5. The alkaline chlorine oxidation of cyanide is suitable for automatic operation; the process can be performed at ambient temperatures and is inexpensive. The use of

TABLE VIII-79.
CHEMICAL PRECIPITATION UPGRADE COSTS

Plant No.	O&M Costs ($/Yr)	Plant No.	O&M Costs ($/Yr)	Plant No.	O&M Costs ($/Yr)
		BAT - Direct - 20 Plants			
63	4,750	1348	1,000	2447	1,000
190	1,700	1522	48,000	2474	2,850
485	3,500	1572	25,000	2692	1,000
695	60,000	1769	29,000	2739	1,000
775	4,750	1785	7,000		
871	3,750	2030	1,600	TOTAL	212,400
1059	14,500	2292	1,000		
		2429	1,000		

Plant No.	Capital Costs ($)	O&M ($/Yr)	Land Costs($)
399	2,000,000	335,000	9,100

Plant No.	O&M ($/Yr)
PSES - Indirect - 9 Plants	
72	1,000
206	1,000
212	1,000
293	1,600
905	1,000
1126	1,600
1357	1,000
1534	3,500
1848	1,000
Total	12,700

sodium hypochlorite also retards the formation of chlorinated organics, which occur when using other sources of chlorine in the presence of certain toxic pollutants.

Cyanide can also be destroyed using either ozone or hydrogen peroxide. The oxidation of cyanide using ozone results in high capital and energy costs, and its efficiency is limited when treating wastewaters containing more than one pollutant. Destruction of cyanide using hydrogen peroxide results in high energy costs because of the necessity to heat the incoming wastewater prior to treatment. Peroxide only partially oxidizes cyanide to cyanate, and the addition of a formaldehyde catalyst results in a higher strength (BOD_5 value) wastewater.

The important design parameters for the cyanide destruction system include the influent and required effluent concentrations of cyanide, the total wastewater flow, the cyanide reactor retention time, and the chemical feed systems. A summary of design specifications is presented in Table VIII-80. The influent cyanide concentration of 10 mg/l is based on industry data; the alkaline chlorination treatment system reduces the cyanide effluent concentration to 0.1 mg/l.

The two-stage alkaline chlorination system capital cost estimates were provided by a vendor (Lancy International, Inc.), and represent installation and equipment costs in 1982 dollars. Equipment items include a two-stage reactor with a total retention time of 1 hour, transfer station, chemical feed system, pumps, instrumentation, and controls. The capital costs do not include buildings or foundations.

O&M costs for the alkaline chlorination system include chemical costs for sodium hypochlorite and sodium hydroxide at dosages of 7.5 lbs and 8 lbs per pound of cyanide (free CN) destruction, respectively. The unit costs for sodium hypochlorite and sodium hydroxide, based upon the Chemical Marketing Reporter, are $0.50 and $0.10/lb, respectively. The O&M costs also include energy costs ($0.08/kwh), labor ($20/hr), maintenance (4% of capital cost), and tax and insurance (2% of capital cost). The estimated capital and annual operating cost for cyanide destruction systems are presented in Table VIII-81. Figures VIII-41 and VIII-42 present the capital and O&M cost curves in 1982 dollars.

TABLE VIII-80.
DESIGN SPECIFICATIONS FOR CYANIDE DESTRUCTION SYSTEM

Influent CN = 10 mg/l	
Effluent CN = 0.1 mg/l	
Cyanide Reactor Retention Time = 30 minutes in each reactor	
Sodium Hypochlorite Dosage = 7.5 lbs/lb CN	
Sodium Hydroxide Dosage = 8.0 lbs/lb CN	

TABLE VIII-81.
TOTAL CAPITAL AND O&M COST FOR CYANIDE DESTRUCTION SYSTEMS

Flow (MGD)	Alkaline Chlorination Capital Cost ($)	Annual O&M Cost ($) Using Sodium Hypochlorite
0.01	45,000	25,000
0.02	48,000	26,200
0.05	52,500	29,800
0.10	60,000	35,900
0.20	80,000	47,800
0.50	120,000	81,500
1.0	175,000	159,400
2.0	245,000	270,100
5.0	400,000	637,800

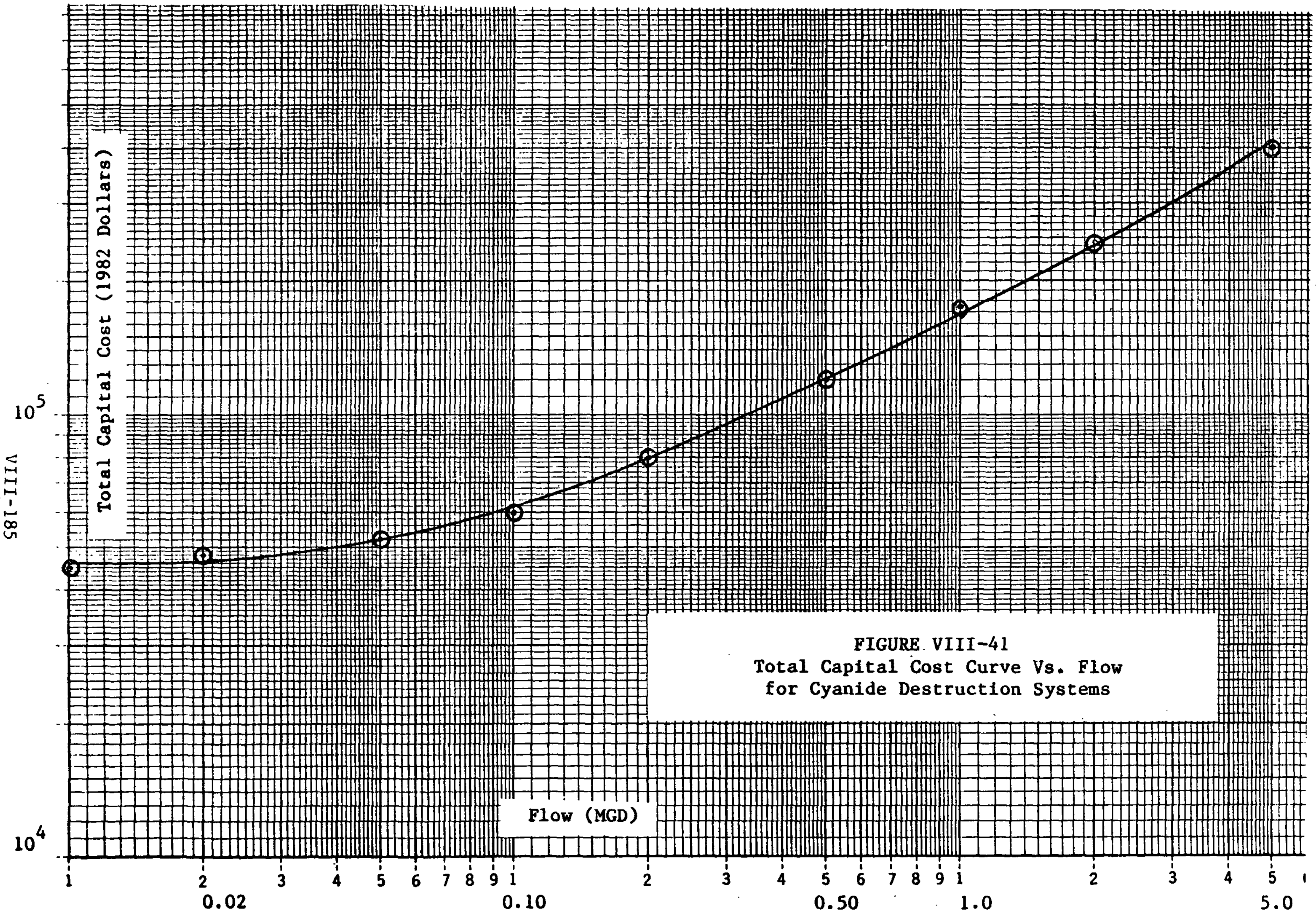


FIGURE VIII-41
Total Capital Cost Curve Vs. Flow
for Cyanide Destruction Systems

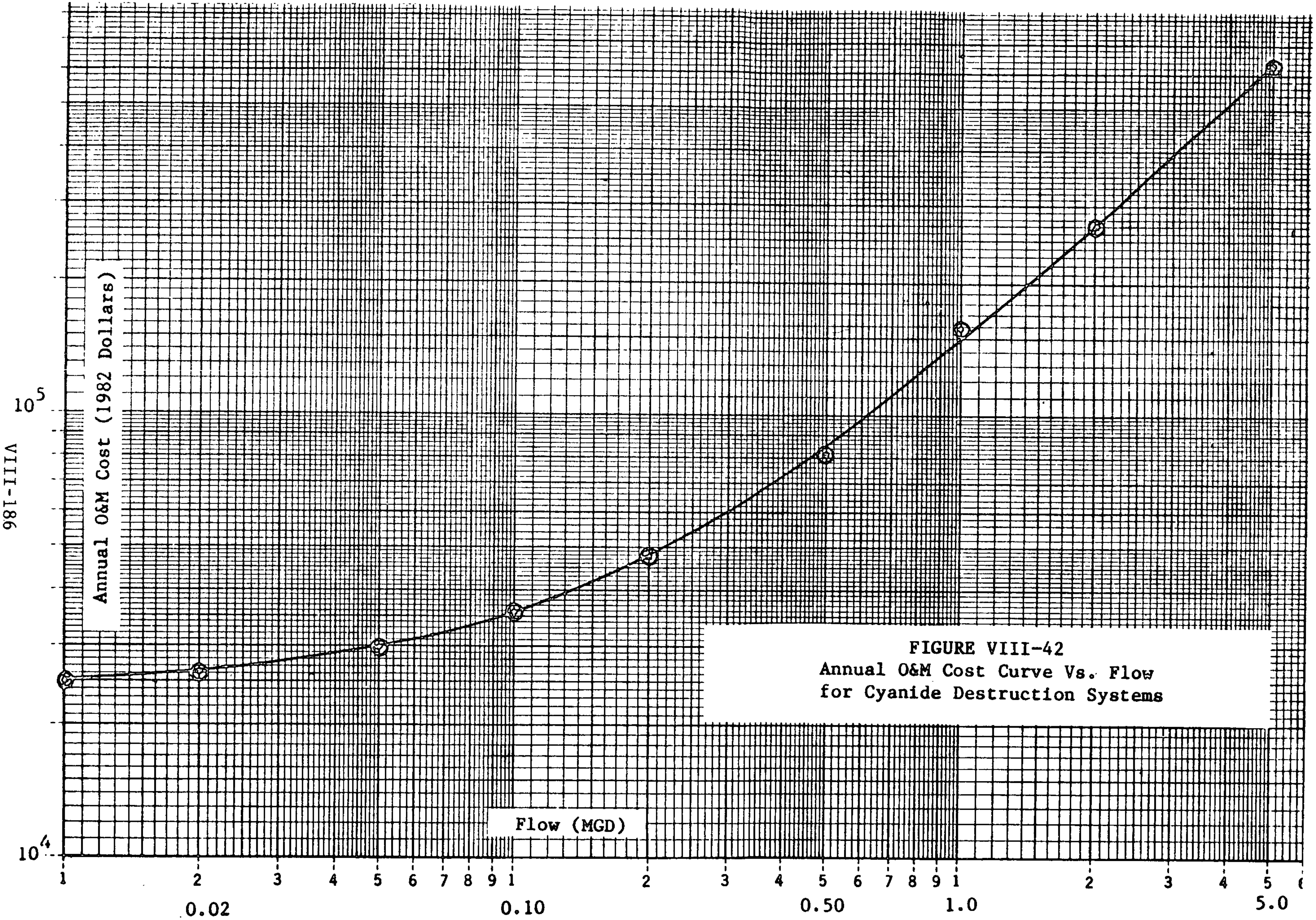


FIGURE VIII-42
Annual O&M Cost Curve Vs. Flow
for Cyanide Destruction Systems

5. In-Plant Biological Treatment

An activated sludge system, supplied as a unit by a manufacturer, serves as an example of an in-plant biological system for the purposes of this subsection. The system consists of an equalization tank, an extended aeration tank, and associated pumps and controls.

The CAPDET design program was used to cost these systems. Vendor quotes for small facilities were obtained and were found to be in the same range as CAPDET costs; therefore, for the purpose of consistency, CAPDET was used for all flows.

To address the concern that biological treatment would be as effective and less costly than activated carbon and steam stripping for certain pollutants (see Table VIII-5), a comparison of technology costs for a theoretical 0.05 MGD PSES plant was made. The results of this comparison, presented in Table VIII-82, show the capital cost for activated sludge to be considerably lower than that for the other technologies, and show the O&M cost for activated sludge to be about 5 percent of the O&M costs for activated carbon and in the same range as the O&M costs for steam stripping.

As a result of the cost savings involved in using biological treatment for these pollutants, cost curves were developed for the implementation of biological treatment at OCPSF plants to achieve BAT requirements. The curves were broken down into small facilities (flow $\leq$0.5 MGD) and large facilities (flow >0.5 MGD). All costs were generated using the CAPDET design program and are presented in Table VIII-83. The cost curves are presented in Figures VIII-43 to VIII-46.

The land requirements for in-plant biological treatment systems were calculated in the same manner as the revised land costs presented in the activated sludge section of this document. The in-plant biological treatment system land requirements are given in Table VIII-84 and Figures VIII-47 and VIII-48.

TABLE VIII-82.
COMPARISON OF TECHNOLOGY COSTS
FOR PSES PLANTS*

Technology	Capital Costs (1982 $)	O&M Costs (1982 $)
Steam Stripping (Medium)	299,123	32,100
Activated Carbon (Low)	225,574	767,991
Activated Sludge (CAPDET)	121,392	33,922

*Approximate flow = 50,000 gpd (0.05 MGD)

TABLE VIII-83.
TOTAL CAPITAL AND O&M COST FOR THE IN-PLANT BIOLOGICAL TREATMENT CONTROL SYSTEMS

Flow (MGD)	Total Capital Cost ($)	Total O&M Cost ($)
Small Facilities: Flow < 0.501 MGD		
0.001	27,236	32,891
0.005	48,760	33,154
0.010	60,886	33,248
0.050	121,392	33,922
0.100	164,871	34,412
0.500	342,679	47,858
Large Facilities: Flow ≥ 0.501 MGD		
0.75	2,084,538	162,671
1.00	2,589,391	199,183
1.50	3,468,873	266,755
2.00	4,848,953	340,863
3.00	6,656,745	467,721
4.00	8,320,540	588,561
5.00	9,928,336	705,587

Values Used in CAPDET Program

Detention time (t_d) = 24 hours
Influent BOD_5 (S_o) == 500 mg/l
Effluent BOD_5 (S_e) = 25 mg/l
Effluent TSS (TSS_o) = 40 mg/l
Small facilities: K_m = 1.02/hr; K_s = 10.4/hr; K_o = 0.02/hr
Large facilities: K = 0.00028 1/mg hr
MLSS = 5,286 mg/l
MLVSS = 3,700 mg/l

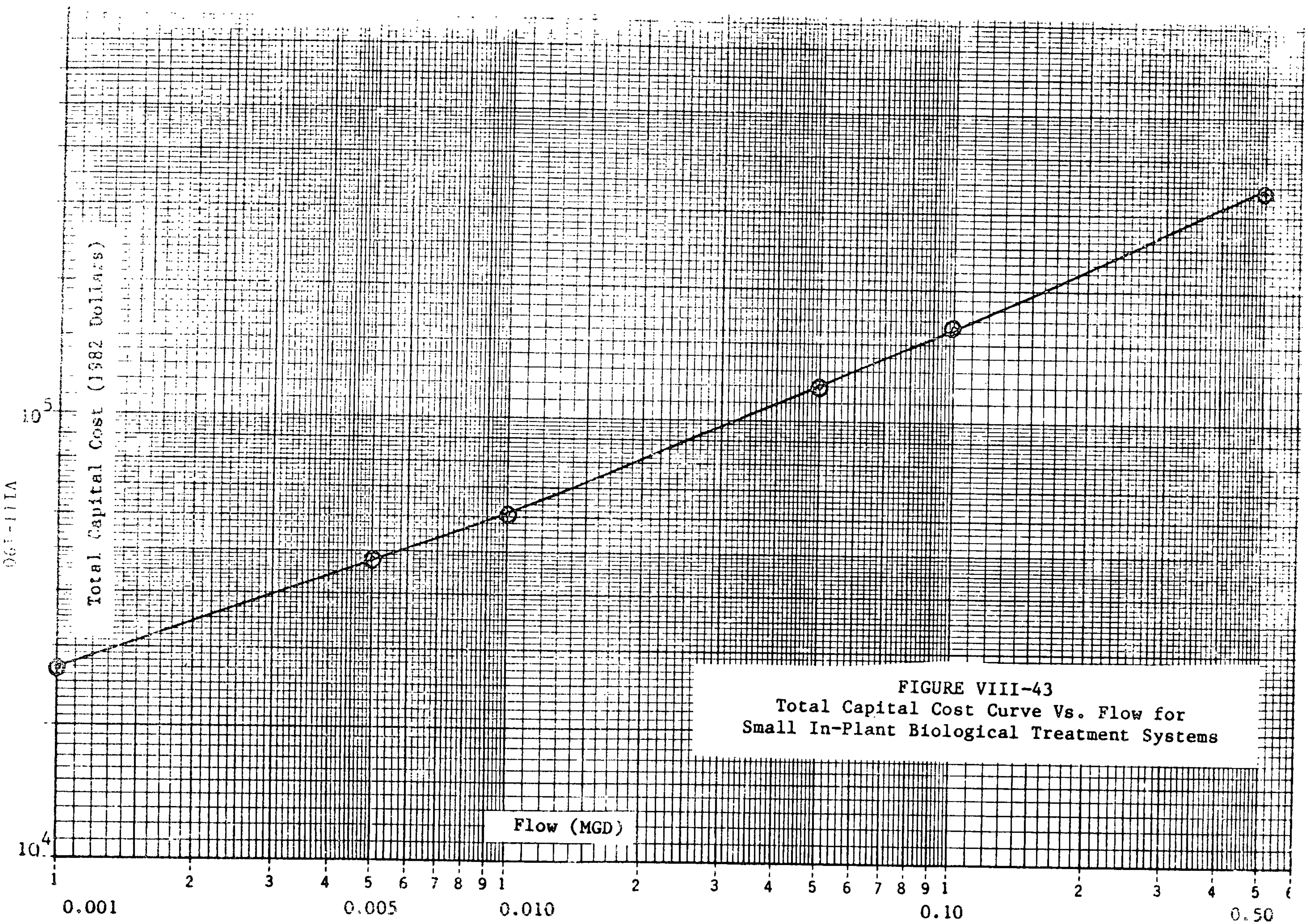


FIGURE VIII-43
Total Capital Cost Curve Vs. Flow for
Small In-Plant Biological Treatment Systems

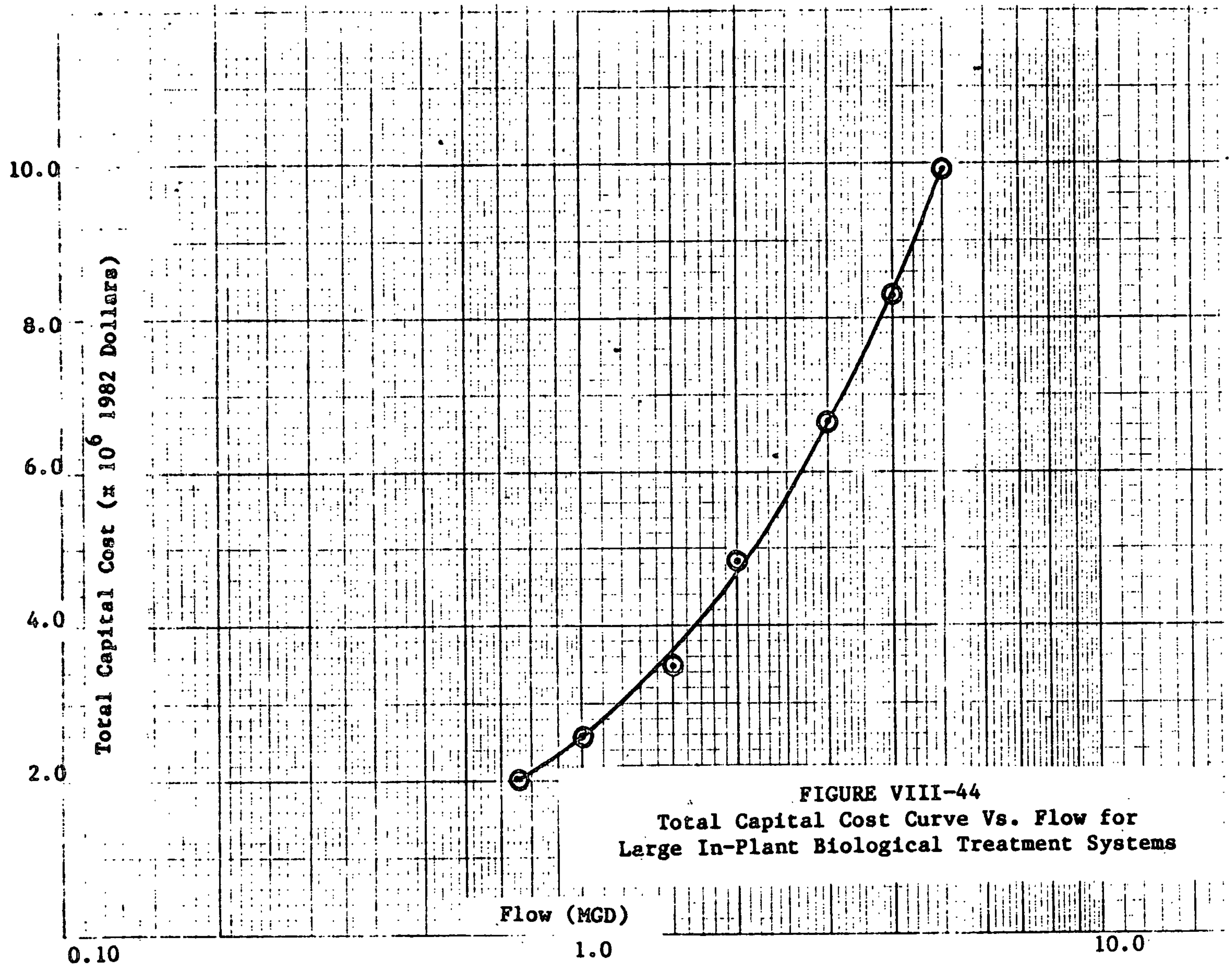


FIGURE VIII-44
Total Capital Cost Curve Vs. Flow for
Large In-Plant Biological Treatment Systems

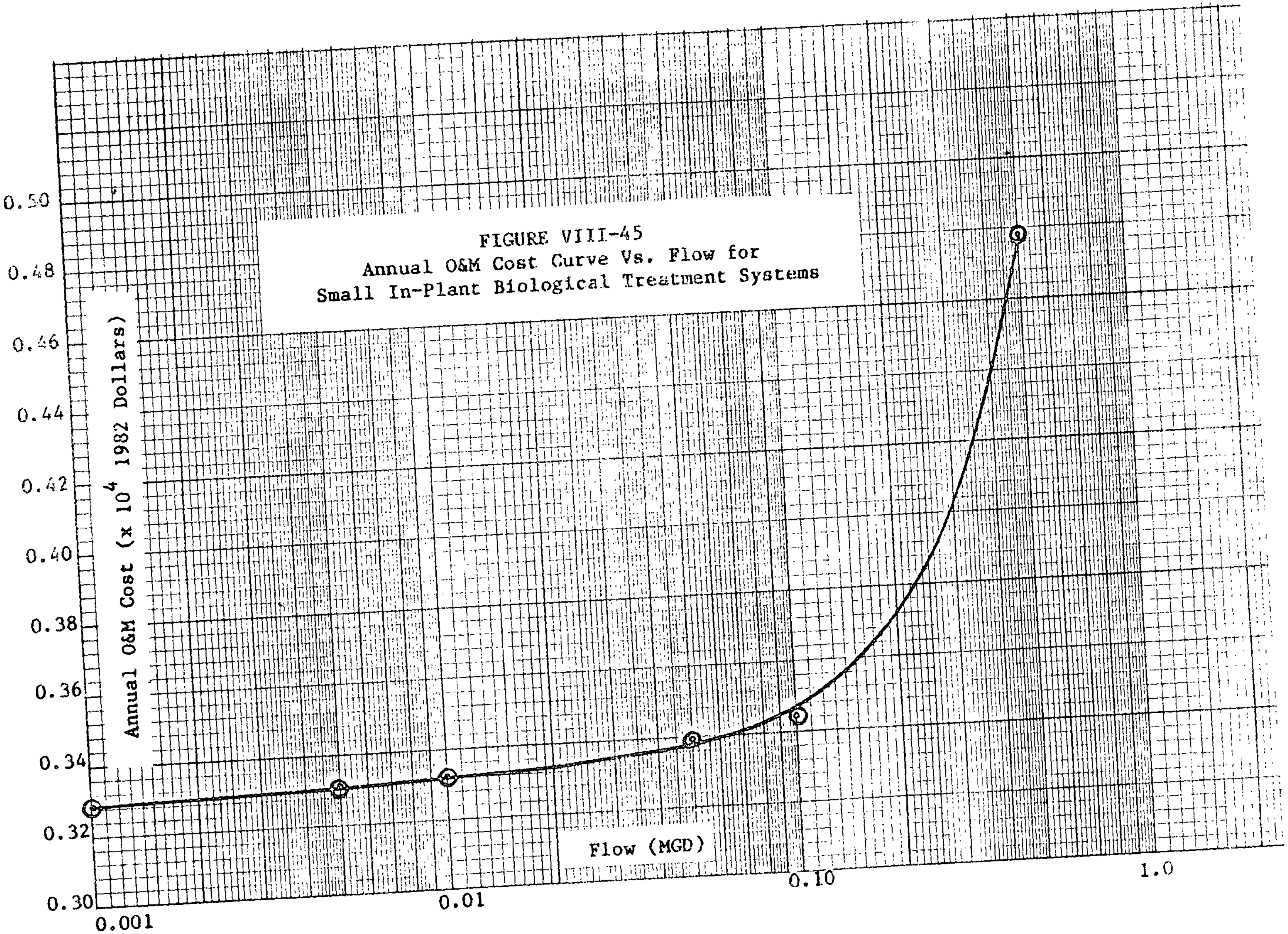


FIGURE VIII-45
Annual O&M Cost Curve Vs. Flow for
Small In-Plant Biological Treatment Systems

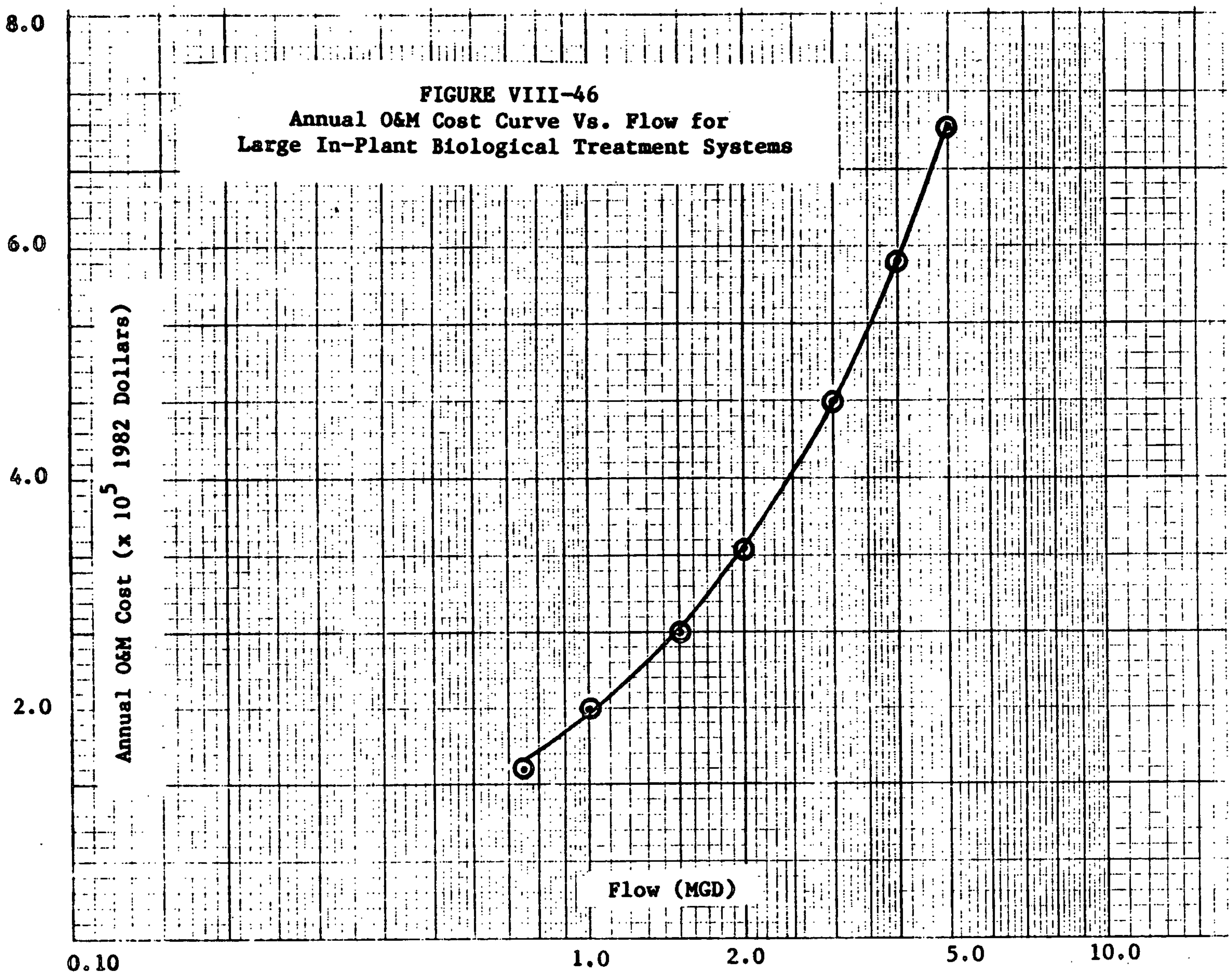


FIGURE VIII-46
Annual O&M Cost Curve Vs. Flow for
Large In-Plant Biological Treatment Systems

TABLE VIII-84.
IN-PLANT BIOLOGICAL TREATMENT LAND REQUIREMENTS

Flow (MGD)	Land Requirements (Acres)
0.001	0.050
0.005	0.075
0.010	0.075
0.050	0.125
0.100	0.175
0.500	0.400
0.750	1.750
1.000	1.750
1.500	3.000
2.000	3.250
3.000	5.250
4.000	6.750
5.000	9.000

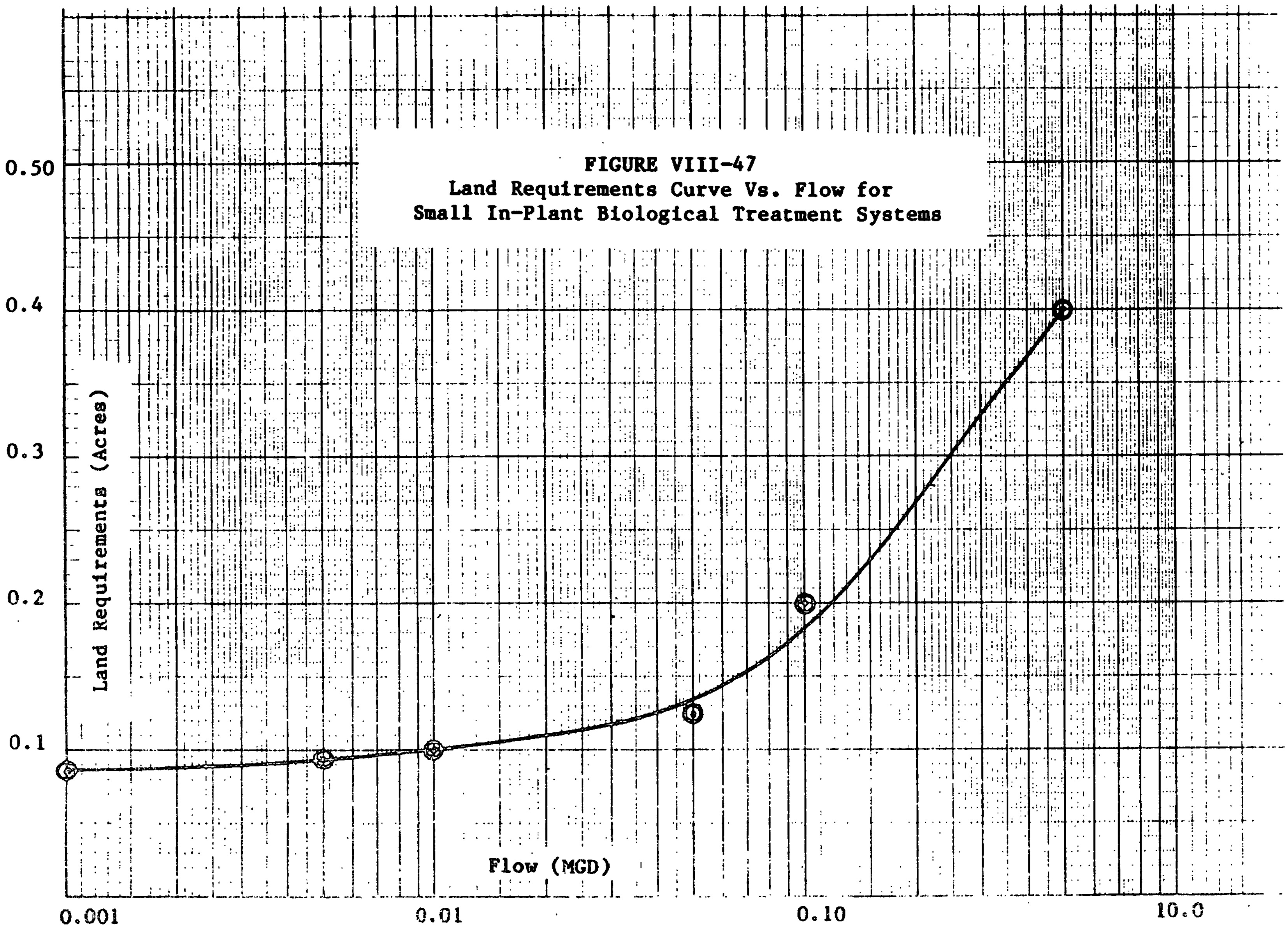


FIGURE VIII-47
Land Requirements Curve Vs. Flow for Small In-Plant Biological Treatment Systems

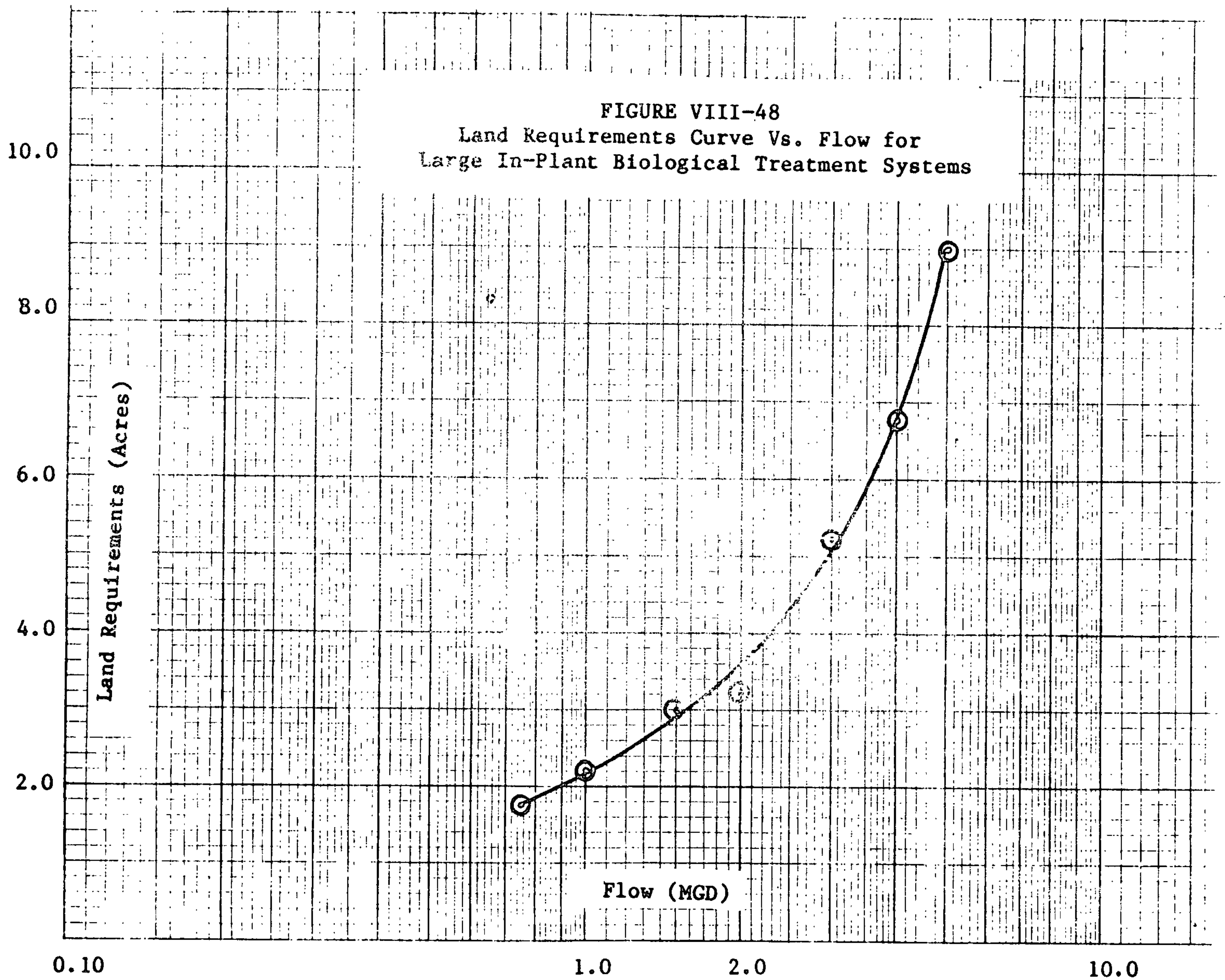


FIGURE VIII-48
Land Requirements Curve Vs. Flow for
Large In-Plant Biological Treatment Systems

E. ADDITIONAL COSTS

1. Contract Hauling

One method of achieving zero discharge involves contract hauling and disposal. This method consists of paying a contract hauler/disposer to pick up the liquid wastes at the generation site and to haul them to another site for treatment or disposal. Due to the high cost involved, contract hauling is usually limited to low volume concentrated wastes only. The wastes can be classified as either hazardous or nonhazardous; many of them may require highly specialized treatment technologies for disposal (i.e., powdered activated carbon treatment (PACT), steam stripping, chemical fixation/ solidification, etc.).

A portion of the wastewater from the OCPSF industry would be considered hazardous; however, the EPA data base does not contain enough information to determine which plants' effluents are hazardous and which are not. Therefore, in order to be conservative, all wastewaters were assumed to be hazardous.

Cost estimates for contract hauling require the consideration of a number of factors, including waste quantity, waste quality, distance from the waste generation site to the treatment/disposal site, and off-site treatment/ disposal techniques used. Since all these factors vary widely, a representative cost can be difficult to establish. For the purposes of estimating the cost on a national basis, the following assumptions have been made:

- The hauling distance is 500 miles in radius from the plant site
- All the wastes are classified as hazardous
- Either 5,000-gallon tank trucks or 55-gallon drums are used, depending on the quantity of waste.

In order to include transportation costs for 500 miles, $2,000 per 5,000-gallon tank truck has been used. This estimate is based on quotes from hazardous waste hauling firms. Actual quotes are included in the public record.

EPA's estimate for contract hauling is $1.22/gallon of hazardous waste.

2. Monitoring Costs

Monitoring costs will be incurred by all OCPSF manufacturers that discharge process wastewater either directly to a receiving stream or indirectly to a POTW. Direct dischargers will have effluent monitoring requirements, as well as effluent limitations, specified in NPDES permits. Indirect dischargers will have monitoring requirements and effluent standards specified by the operating authority of the POTW.

This section presents a method that estimates the cost of compliance monitoring for OCPSF manufacturers. Monitoring costs for purposes other than effluent compliance (i.e., raw waste analysis, operational control analysis, and analysis to control in-plant treatment technologies), are excluded from the following cost estimates.

The following assumptions have been made in estimating compliance monitoring costs:

- All process wastewater will be discharged through a single outfall. Where plants utilize more than one outfall to discharge process effluents, the monitoring costs will increase by a factor equal to the number of outfalls.
- The only costs associated with flow monitoring are capital costs for flow metering equipment. These capital costs are already included in the capital costs for a specific treatment technology.
- Labor and equipment costs associated with sample collection are not included. Sample shipment costs are also excluded.
- It is assumed that all existing OCPSF facilities currently have NPDES permits or, in the case of indirect dischargers, sewer use permits. It is further assumed that the monitoring requirements in NPDES permits adequately address the monitoring of conventional parameters, specifically BOD_5, TSS, and pH. Therefore, there will be no incremental increase in monitoring costs for these parameters. Because current permits generally do not require monitoring for specific organics or metals, it is assumed that all monitoring costs for BAT and PSES parameters (toxic organics and heavy metals) will represent additional monitoring costs.
- In projecting total industry costs, the above assumptions are expected to be offsetting. Although a few plants may not currently have adequate monitoring for conventional parameters, the additional cost for these facilities will be offset by the lower costs incurred by the few plants that currently monitor for specific organics or metals.

The cost of compliance monitoring will depend upon: 1) the sampling frequency, 2) the type and number of specific parameters to be analyzed, and 3) the analytical costs for those specific parameters. The sampling frequency refers to the number of samples costed per month. The first sampling frequency required a certain number of samples to be collected and analyzed per month based on process wastewater flow. An alternative, more stringent sampling frequency was also costed which requires three samples per month regardless of flow in addition to one complete priority pollutant scan per month. Table VIII-85 presents these sampling frequencies for each of the costed monitoring options. The costs for the most stringent monitoring frequency, Option II, were used in the Agency's final BAT and PSES compliance cost estimates.

In order to simplify the costing methodology, the BAT parameters (priority pollutant metals and organics) have been grouped into the four categories listed below:

- Volatile Fraction - Includes all volatile priority pollutant organics
- Acid Fraction - Includes all organic priority pollutants that are extractable under acid conditions
- Base/Neutral Fraction - Includes all priority pollutants that are extractable under basic or neutral conditions
- Metals - Includes all priority pollutant metals and cyanide.

The GC/MS analysis methodology is specific for the particular organic fraction. EPA-approved methods 624 and 1624 are used to analyze for the volatile fraction; methods 625 and 1625 are used to determine the acid and base/neutral fractions.

The number of pollutants to be analyzed and the number of fractions in each sample collected as a function of flow are presented in Table VIII-86. Separate projections are shown for plastics-only plants and for organics plants. Organics plants include facilities that produce both plastics and organics at the same location.

TABLE VIII-85.
MONITORING FREQUENCIES

Option I Monitoring Frequency for Method 624/625

Flow (MGD)	Organics # Samples/Month	Organics # Scans/yr	Plastics # Samples/Month	Plastics # Scans/yr
<0.5	2	0	2	0
0.5 - 4.99	2	0	2	0
5.0 - 9.99	4	1	4	0
>10.0	4	2	4	1

Option I Monitoring Frequency for Method 1624/1625

Flow (MGD)	Organics # Samples/Month	Organics # Scans/yr	Plastics # Samples/Month	Plastics # Scans/yr
<0.5	2	0	2	0
0.5 - 4.99	2	0	2	0
5.0 - 9.99	2	1	2	0
>10.0	2	2	2	1

Option II Monitoring Frequency for Methods 624/625 and 1624/1625

Flow (MGD)	Organics # Samples/Month	Organics # Scans/Month	Plastics # Samples/Month	Plastics # Scans/Month
<0.5	3	1	3	1
0.5 - 4.99	3	1	3	1
5.0 - 9.99	3	1	3	1
>10.0	3	1	3	1

TABLE VIII-86.
NUMBER OF PARAMETERS AND FRACTIONS TO BE ANALYZED

Flow (MGD)	Organics Plants			Plastics Plants		
	Metal Parameter(s)	Organic Parameter(s)	Analysis Fraction(s)	Metal Parameter(s)	Organic Parameter(s)	Analysis Fraction(s)
<0.500	2	2	1	1	1	1
0.500-4.99	2	4	2	2	2	1
5.00-9.99	4	6	2	2	2	2
>10.00	6	9	3	4	4	2

The quantitative analysis of priority pollutants in industrial effluents may involve several methodologies. The fundamental technique for the determination of these pollutants is gas chromatography. This technique separates compounds in mixtures by interaction between a mobile and a stationary phase. The order in which the compounds exit the instrument is a function of the physical/chemical properties of the compounds and the mobile and stationary phases. The separated compounds are then detected by the mass spectrometer and are subsequently identified and quantified. Various EPA-approved methodologies have been examined. These GC/MS analysis options include:

- Method 624 - Purgeables: A purge and trap GC/MS method used for the quantitative determination of purgeable organics (the volatile fraction).
- Method 625 - Base/Neutrals and Acids: A GC/MS method designed to determine those organic priority pollutants that are partitioned into an organic solvent and are amenable to gas chromatography (the acid and base/neutral fractions).
- Method 1624 - Volatile Organic Compounds by Isotope Dilution GC/MS: A revised version of the purge and trap Method 624 designed to determine the purgeable (the volatile fraction) organics.
- Method 1625 - Semivolatile Organic Compounds by Isotope Dilution GC/MS: A revised version of the 625 method designed to determine semivolatile organic pollutants.

The costs for methods 1624/1625 were used in the Agency's final BAT and PSES cost estimates.

The primary cost component for each of the three organic fractions involves sample preparation. Once the initial sample preparation for any given fraction is completed, costs resulting from additional parameter analysis via GC/MS separation is minimal and may consist of small incremental payments. The following equation is used to estimate the cost of the organic analysis for method 624/625 (1982 dollars):

$$C_o = (f \times 75) + (S_o \times 25)$$

where:

C_o = cost per sample for organics in 1982 dollars

f = number of organic fractions to be analyzed (maximum = 3)

S_o = the total number of organic compounds to be quantified.

Similarly, metals analysis is estimated using the following equation:

$$C_m = 25 + (S_m \times 10)$$

where:

C_m = cost per sample for metals in 1982 dollars

S_m = the total number of metals to be quantified

The 1982 compliance costs for methods 1624/1625 have been estimated using the following equation:

$$C_o = (f \times 195) + (S_o \times 65)$$

where:

C_o = cost per sample for organic analysis in 1982 dollars

f = number of organic fractions to be analyzed (maximum = 3)

S_o = the total number of organic compounds to be quantified

Similarly, the metals analysis is estimated using the following equation:

$$C_m = 25 + (S_m \times 10)$$

where:

C_m = cost per sample for metals analysis in 1982 dollars

S_m = the total number of metals to be quantified

Where Table VIII-84 indicates that complete priority pollutant scans should be performed, the cost of such analysis has been estimated at $1,000 using methods 624/625, and at $1,350 using methods 1624/1625.

The sampling frequency, the effluent flow, the number of fractions and parameters to be analyzed, and the type of analysis methodology used and its associated costs are all factors that determine a facility's estimated annual compliance monitoring costs. Table VIII-87 presents a comparison of these variables and the associated costs as a function of flow. It again should be noted that the costs for monitoring frequency Option II for methods 1624/1625 were used in the Agency's final BAT and PSES cost estimates.

3. Sludge Disposal and Incineration

Sludges are generated by the following three wastewater treatment processes: activated sludge, coagulation/flocculation/clarification systems, and chemically assisted clarification. Therefore, the costs for sludge disposal must be part of the costs for these three technologies.

TABLE VIII-87.
COMPARISON OF ANNUAL MONITORING COSTS (1982 DOLLARS) FOR ORGANIC AND PLASTICS FACILITIES
USING ANALYSIS METHODS 624/625 OR 1624/1625 WITH EITHER A MORE STRINGENT OR
LESS STRINGENT MONITORING FREQUENCY

Flow (MGD)	Method 624/625 Option I Monitoring Frequency		Method 624/625 Option II Monitoring Frequency		Method 1624/1625 Option I Monitoring Frequency		Method 1624/1625 Option II Monitoring Frequency	
	Organics	Plastics	Organics	Plastics	Organics	Plastics	Organics	Plastics
<0.500	4,080	3,240	18,120	16,860	8,905	7,105	29,520	26,820
0.500-4.99	7,080	4,080	22,620	18,120	16,705	8,905	41,220	29,520
5.00-9.99	18,520	11,760	25,140	20,820	21,630	13,585	46,620	36,540
>10	27,680	16,120	31,260	23,340	32,795	18,510	61,020	65,340

Dewatering is a physical unit operation used to reduce the moisture content of raw or biological sludge. The principal purpose of dewatering is to reduce sludge volume and weight, thus minimizing costs for sludge transportation and ultimate disposal. Typical sludge dewatering techniques include sludge drying beds, vacuum filtration, centrifugation, and belt filter press. After a comprehensive review of the four techniques, the belt filter press was selected as the sludge dewatering mechanism for OCPSF industries. The advantages of a belt filter press over other dewatering techniques include: the ability of high pressure machines to produce very dry cakes, the high filtrate quality, and low power requirements. The disadvantages of a belt filter press include: high sensitivity to incoming sludge characteristics, high chemical consumption, and a short media life. Despite these disadvantages, more industries are using this technique to dewater their sludge primarily because of its high efficiency.

The addition of sludge conditioning chemicals is necessary prior to the mechanical dewatering of sludges. The objective of chemical conditioning is to adjust the chemical and physical conditions of the sludges to improve its dewatering characteristics. Chemical conditioning results in coagulation of the solids and release of the absorbed water. Chemicals most commonly used for sludge conditioning include ferric chloride, lime, alum, and organic polymer.

In order to estimate the capital costs of belt filter press systems, certain assumptions were made prior to sizing the equipment. These include the following design characteristics:

- Long-Term Average Influent TSS to the End-of-Pipe Treatment System = 200 mg/l
- Average Feed Sludge Total Solids = 2%
- Filter Press Discharge Cake Solids Concentration = 20%
- Belt Filter Press Design Loading Rates (recommended by Komline-Sanderson Engineering Corporation):

    Solids Loading Rate = 500 lbs/hr/meter
    Hydraulic Loading Rate = 45 gpm/meter

- Belt Filter Press Operating Time = 8 hrs/day.

Table VIII-88 presents a summary of the design specifications and equipment sizes for wastewater flow rates ranging from 0.5 to 20 MGD. The itemized capital costs for the design and land requirements are presented in Table VIII-89. The estimated equipment costs, which include belt filter press units, sludge feed pumps, and polymer feed systems, were obtained directly from manufacturers' recommendations. Costs for conveyors, piping, and instrumentation were assumed to be 20 percent of the total equipment costs. The installation costs were taken to be 50 percent of the total equipment costs. Both the engineering and contingency costs were each assumed to be 15 percent of the total construction costs. The final capital costs were converted to 1982 dollars using the ENR Construction Index, and then plotted against flow rates as shown in Figure VIII-49. The land requirements for each flow system were estimated based upon the size of the process equipment plus adequate space for repairs and general access. Figure VIII-50 provides the land requirements at various flow rates.

Annual operating costs were estimated based on energy, chemicals, labor, maintenance, and taxes and insurance requirements as shown in Table VIII-90. The estimated annual energy costs were based on manufacturers' recommendations of motor horsepower requirements for each system. A unit electricity cost of $0.08/kwh was used for estimating energy costs. The unit labor costs were based upon EPA's Treatability Manual at $24,500/man-year for labor and $34,600/man-year for supervision. Annual chemical costs for sludge conditioning were estimated from manufacturers' recommendations at a polymer cost of $5.00/ton dry sludge. The annual maintenance costs were taken to be 4 percent of the total capital costs. Taxes and insurance costs were assumed to be 2 percent of the total capital costs. The final operating costs were converted to 1982 dollars using ENR's Construction Index, and then plotted against flow rates as shown in Figure VIII-51.

Fluidized bed incineration for wastewater sludge disposal involves the destruction of wastewater solids through combustion. In general, dewatered sludge is pumped into the incineration vessel containing a heated catalytic bed. This bed is fluidized at approximately 100 percent of its at rest volume

TABLE VIII-88.
SUMMARY OF DESIGN SPECIFICATIONS FOR
BELT FILTER PRESS SYSTEMS

Parameter	Flow Rates (MGD) 0.5	1.0	5.0	10.0	20.0
Sludge Production Rates (lbs/day)	834	1,668	8,340	16,680	33,360
Design Solids Loading Rates (lbs/hr)	104	208	1,040	2,080	4,160
Hydraulic Loading Rate (gpm)	10.4	20.8	104	208	416
Filter Press Size*	One 1/2 m	One 1/2 m	Two 1-1/2 m	Three 2 m	Five 2 m

*All data provided by Komline-Sanderson Engineering Corporation

TABLE VIII-89.
ITEMIZED CAPITAL COSTS FOR BELT FILTER PRESS SYSTEMS

Item	Flow (MGD) 0.5	1.0	5.0	10.0	20.0
Equipment Costs*	75,000	75,000	190,000	315,000	525,000
Conveyors, Piping, and Instrumentation (20%)	15,000	15,000	38,000	63,000	105,000
Total Equipment Cost	90,000	90,000	228,000	378,000	630,000
Installation (50%)	45,000	45,000	114,000	189,000	315,000
Total Construction	135,000	135,000	342,000	567,000	945,000
Engineering (15%)	20,300	20,300	51,300	85,100	141,800
Contingency (15%)	20,300	20,300	51,300	85,100	141,800
Total Capital Cost (1984 $)	175,600	175,600	444,600	737,200	1,228,600
Total Capital Cost (1982 $)	161,500	161,500	409,000	678,200	1,130,200
Land Requirements (Acres)	0.06	0.06	0.10	0.14	0.23

*All data provided by Komline-Sanderson Engineering Corporation

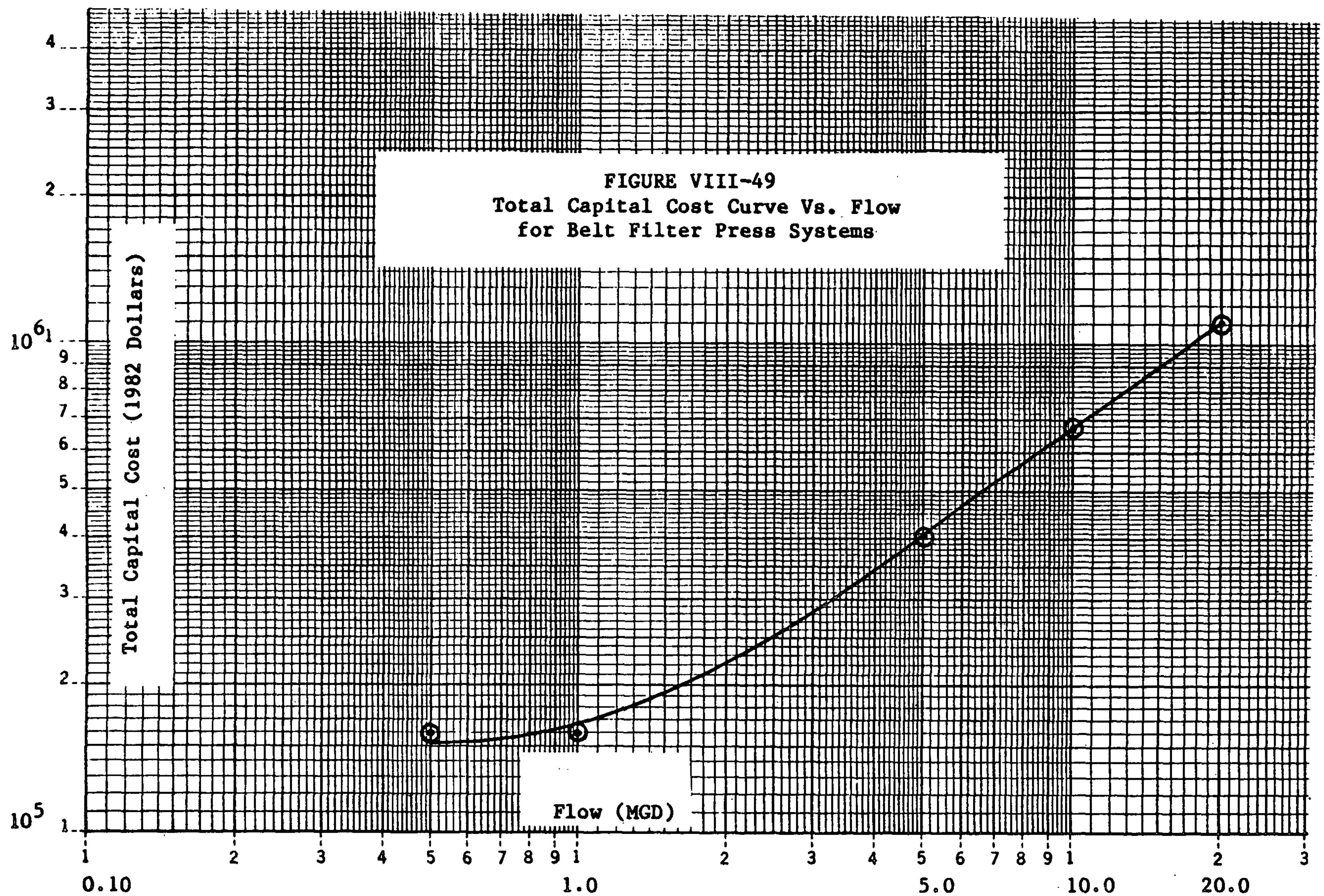


FIGURE VIII-49
Total Capital Cost Curve Vs. Flow
for Belt Filter Press Systems

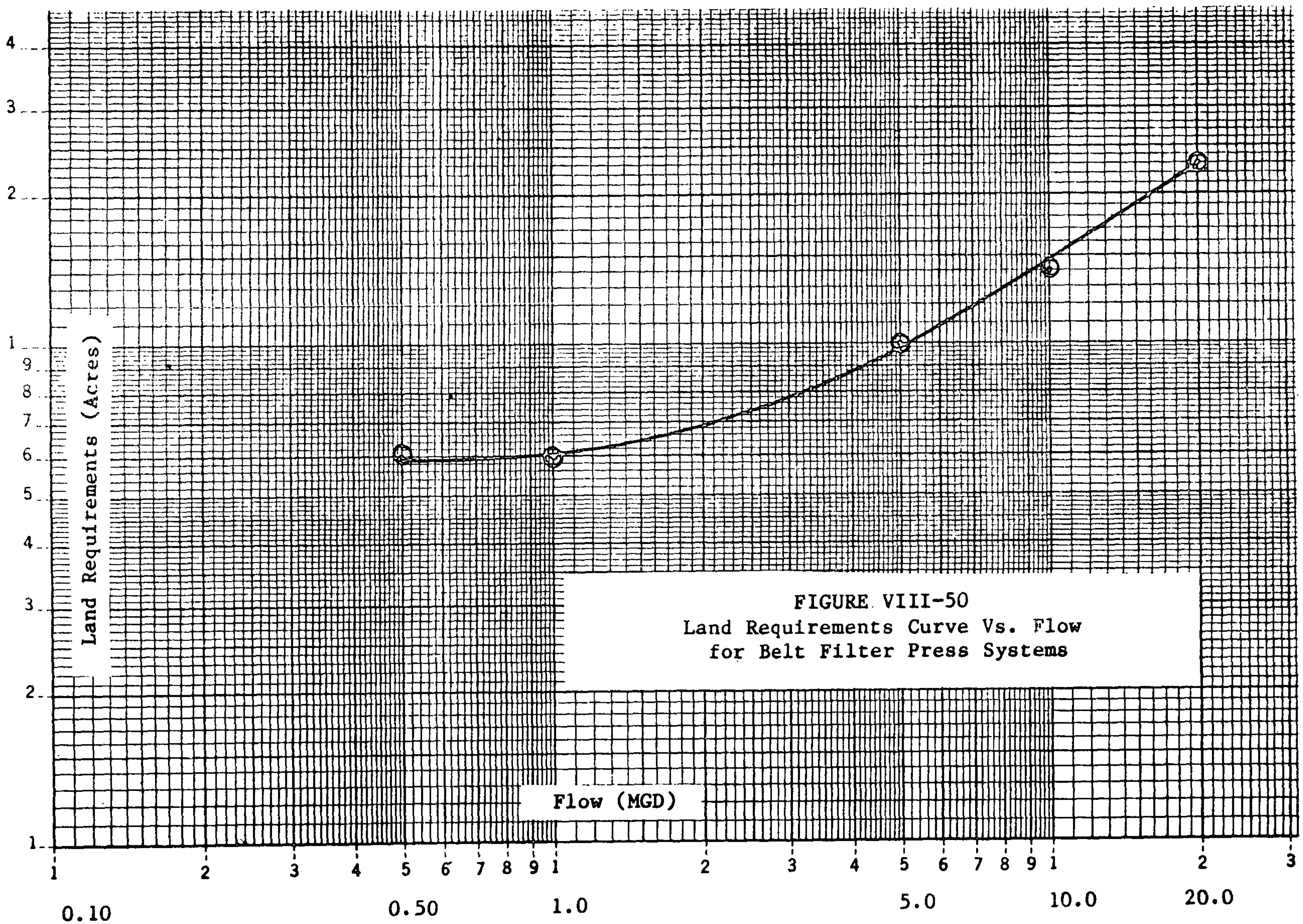


FIGURE VIII-50
Land Requirements Curve Vs. Flow
for Belt Filter Press Systems

TABLE VIII-90.
ITEMIZED ANNUAL OPERATING COSTS FOR BELT FILTER PRESS SYSTEMS

	Flow (MGD)				
Item	0.5	1.0	5.0	10.0	20.0
Energy	200	200	800	1,200	1,600
Polymer	700	1,400	7,000	14,000	28,000
Labor	7,000	7,000	14,000	21,000	35,000
Maintenance	7,000	7,000	17,800	23,400	50,000
Taxes and Insurance	3,500	3,500	8,900	11,700	25,000
Total Annual Operating Cost (1984 $)	18,400	19,100	48,500	71,300	139,600
Total Annual Operating Cost (1982 $)	16,900	17,600	44,600	65,600	128,400

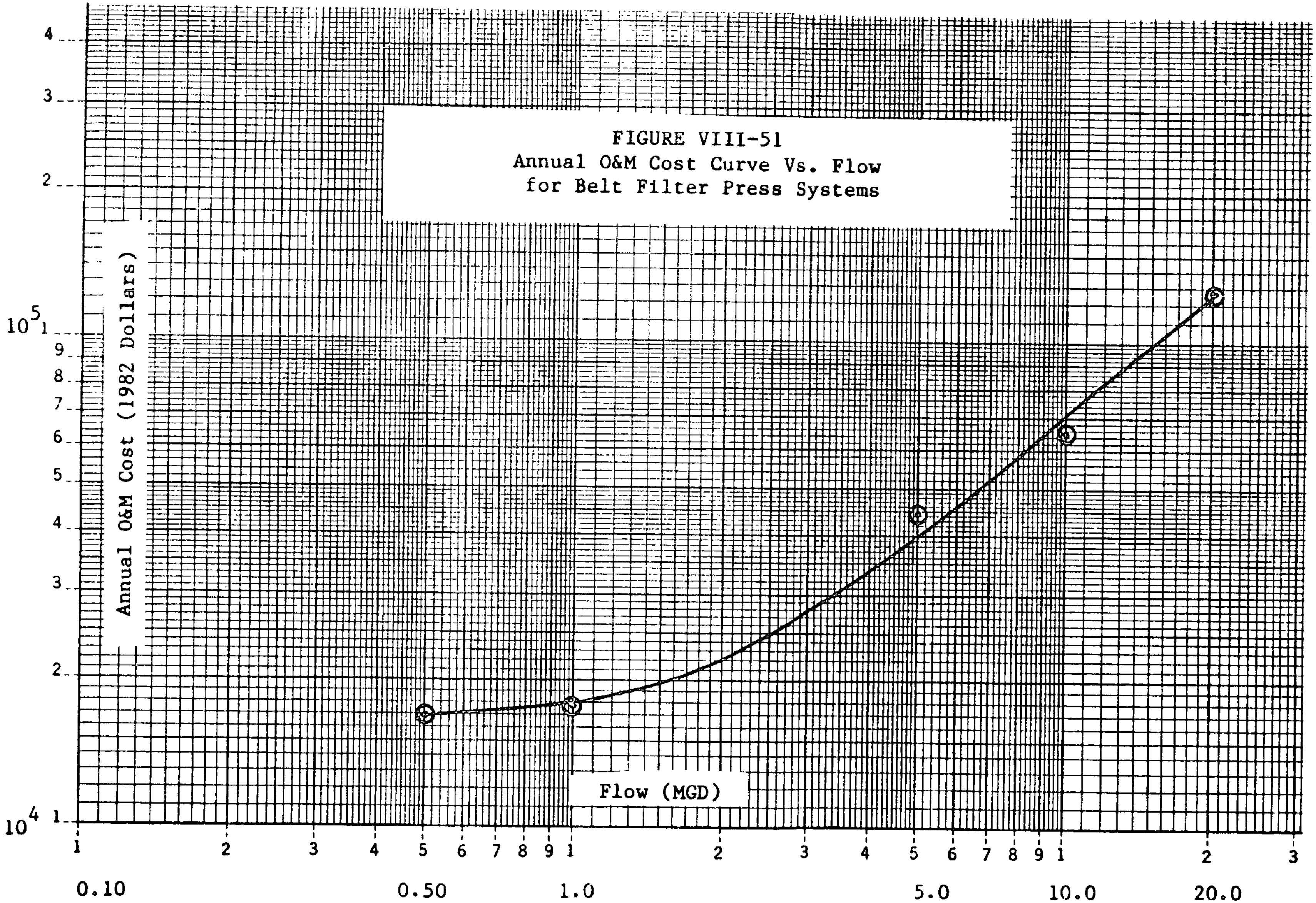


FIGURE VIII-51
Annual O&M Cost Curve Vs. Flow
for Belt Filter Press Systems

by a controlled upward airflow (at pressure of 2.0 to 5.0 psig). Typical temperatures for combustion range from 1,200 to 1,600°F. Supplemental fuel may be added to keep temperatures at optimum levels if the sludge characteristics do not allow for autogeneous combustion. Burning of waste sludge produces ash, which is carried out the top of the furnace and removed by air pollution control devices. Sand carried out with the ash must be replaced. Sand losses are approximately 5 percent of the bed volume for every 300 hours of operation. Sludge feed to the furnace is introduced either above or directly into the bed.

Fluidized bed incinerators are very specialized equipment; they are not usually designed by general consultants, and not installed by the general contractor for the waste treatment facility. The incinerator is usually obtained on a turnkey basis from the manufacturer (i.e., the manufacturer designs and installs all the equipment required for incineration of the sludge).

Both the capital and O&M cost estimates for fluidized bed incineration systems were derived from manufacturers' recommendations. A summary of the design specifications for wastewater flow rates ranging from 0.5 to 20 MGD is presented in Table VIII-91. In order to calculate sludge production rates and to size the incinerators, certain assumptions were made on sludge characteristics. The sludge production rates were obtained based on an influent wastewater TSS concentration of 200 mg/l. The total solids of the feed sludge to the incineration systems were assumed to be 20 percent (after mechanical dewatering). The volatile solids were assumed to be 80 percent of the total dry solids. Based on sludge production rates and the operating schedules, the sludge feed rates were calculated. Furnace design data were provided from manufacturers' recommendations. Since there is a minimum incinerator dimension of 4 feet in diameter, systems designed for the 0.5 MGD and 1.0 MGD flows were very conservative with an operating schedule of 3 days per week for each system (see Table VIII-91).

Table VIII-92 presents the itemized capital costs and land requirements for the fluidized bed systems. The installed equipment costs, which include fluidized bed reactor, pumps, nozzles, instrumentation, and wet Venturi

TABLE VIII-91.
SUMMARY OF FLUIDIZED BED INCINERATOR SYSTEM
DESIGN SPECIFICATIONS

Parameter	Flow (MGD) 0.5	1.0	5.0	10.0	20.0
Sludge Feed Characteristics					
Sludge Production Rate (lb solids/day)	834	1,668	8,340	16,680	33,360
Total Solids (%)	20	20	20	20	20
Volatile Solids (% Dry Solids)	80	80	80	80	80
Sludge Feed Rate (lbs/hr)	243	292	730	973	1,946
Incinerator Design*					
Inside Diameter	4'Dia	5'Dia	6'Dia	8.5'Dia	12'Dia
Operating Schedule					
(a) hrs/day	6	8	16	16	16
(b) days/wk	3	3	5	5	5
Ash Mass (lb solids/hr)	49	58	146	195	389

*Design data provided by Zimpro, Inc.

TABLE VIII-92.
ITEMIZED CAPITAL COSTS FOR FLUIDIZED BED
INCINERATOR SYSTEMS

Item	Flow (MGD)				
	0.5	1.0	5.0	10.0	20.0
Installed Equipment Costs	760,000	840,000	900,000	1,200,000	1,500,000
Installed Buildings, Foundations, and Utility Systems (10%)	76,000	84,000	90,000	120,000	150,000
Total Capital Costs (1984 $)	836,000	924,000	990,000	1,320,000	1,650,000
Total Capital Costs (1982 $)	769,000	850,000	910,700	1,214,000	1,518,000
Land Requirements (Acres)	0.1	0.1	0.1	0.1	0.1

scrubber systems were obtained directly from manufacturer's quotes (Zimpro, Inc.). Costs for foundations, buildings, and utility systems were assumed to be 10 percent of the installed equipment cost. Based on Zimpro's recommendations, the total installed costs also include engineering and contingency costs. The final capital costs were converted to 1982 dollars using ENR's Construction Index, and then plotted against flow rates as shown in Figure VIII-52. Since it is difficult to obtain representative land costs, they are not included in these estimates. However, the acreage of land requirements for each flow system were estimated based upon the sizes of the process equipment plus adequate space for repairs and general access. Since the sizes of all the incinerators did not change significantly, the assumption of an area of 0.1 acre for each system is adequate.

Annual operating costs were estimated based on expenses of supplemental fuel oil, electricity, labor, maintenance (including ash disposal), and taxes and insurance as shown in Table VIII-93. The estimated annual fuel oil and electrical power requirements were obtained from USEPA's Energy Conservation in Municipal Wastewater Treatment (1978) and from manufacturers' recommendations. A heat value of 141,000 BTU/gallon for No. 2 oil was assumed to convert the fuel requirements from BTUs to gallons. The unit costs for No. 2 oil and electricity were assumed to be \$1.00/gallon and \$0.08/kwh, respectively. The unit labor cost was assumed to be \$30,000/man-yr. The annual maintenance costs, which include ash disposal and makeup sand, were taken to be 4 percent of the total capital costs. Taxes and insurance costs were assumed to be 2 percent of the total capital costs. The final operating costs were converted to 1982 dollars using ENR's Construction Index, and then plotted against flow rates as shown in Figure VIII-53.

In order to apply these costs to the three technologies that require it, the sludge disposal costs have been analyzed. In this manner a \$/yr/MGD can be computerized in order to make the costing exercise more efficient. Table VIII-94 summarizes the costs detailed earlier in this section.

In order to annualize the capital costs, a cost factor of 0.192 was used to represent capital recovery and depreciation. Table VIII-95 presents the annualized costs for the flow ranges included in this study.

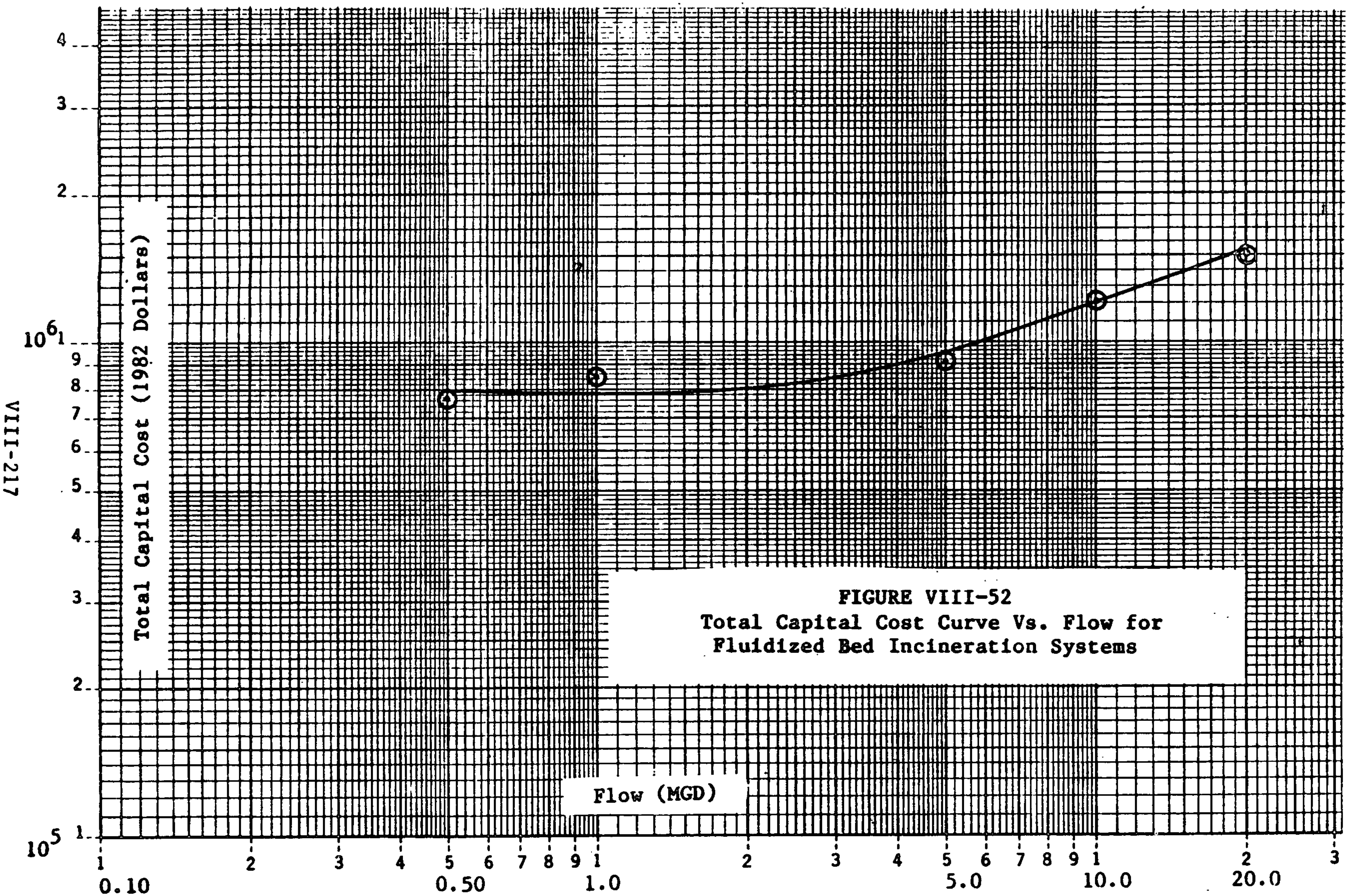


FIGURE VIII-52
Total Capital Cost Curve Vs. Flow for
Fluidized Bed Incineration Systems

TABLE VIII-93.
ITEMIZED ANNUAL OPERATING COSTS FOR FLUIDIZED BED INCINERATION SYSTEMS

Item	Flow Rates (MGD) 0.5	1.0	5.0	10.0	20.0
Fuel Oil (BTU/yr x 10^6)	106,400 (15,000)	127,700 (18,000)	283,700 (40,000)	425,500 (60,000)	851,100 (120,000)
Electricity (kWh/yr x 10^5)	36,000 (4.5)	64,000 (8.0)	88,000 (11.0)	160,000 (20.0)	280,000 (35.0)
Labor	7,000	7,000	30,000	30,000	30,000
Maintenance	33,400	37,000	39,600	52,800	66,000
Taxes and Insurance	16,700	18,500	19,800	26,400	33,000
Total Annual Operating Cost (1984 $)	199,500	254,200	461,000	694,700	1,260,000
Total Annual Operating Cost (1982 $)	183,500	233,800	424,100	639,100	1,159,000

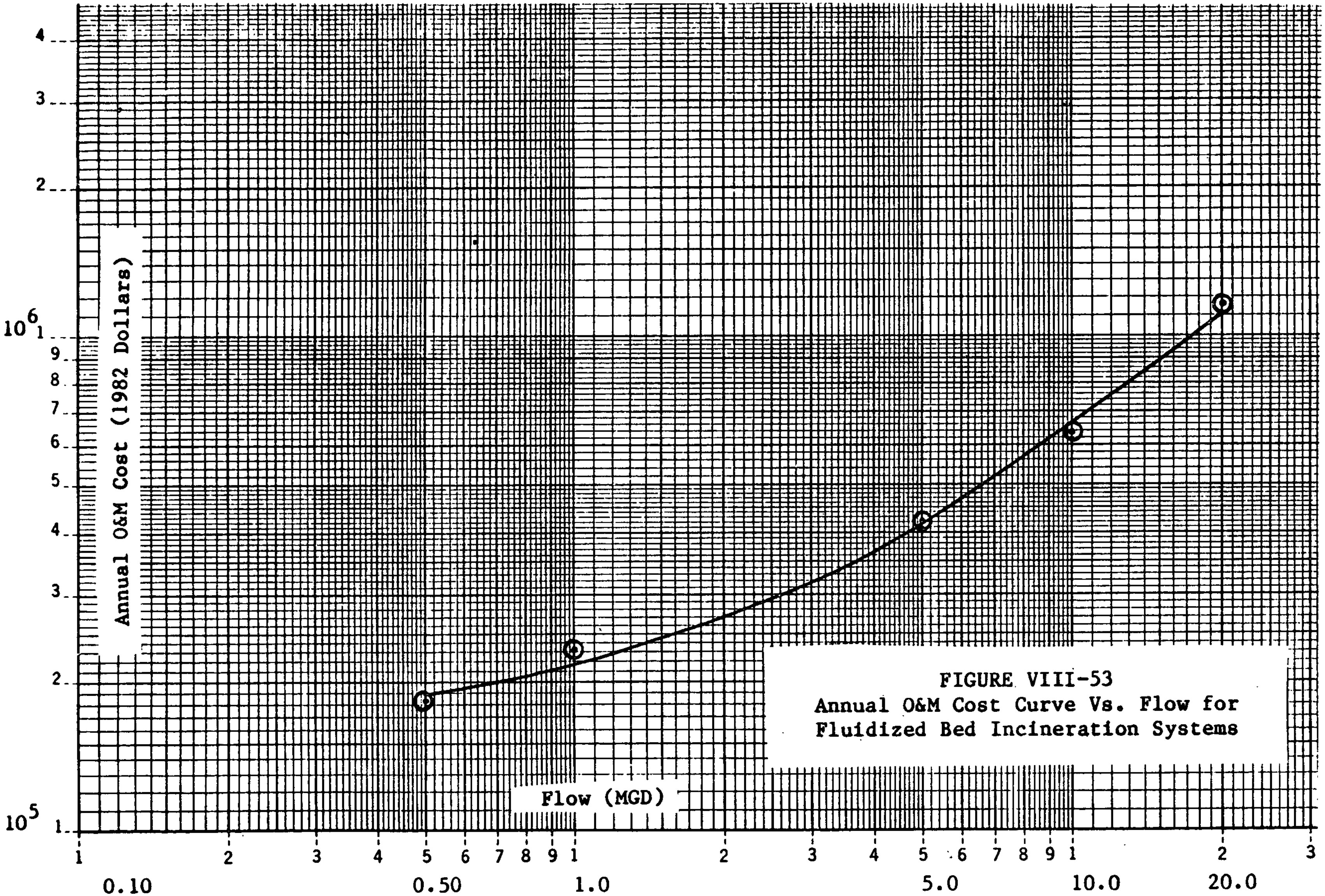


FIGURE VIII-53
Annual O&M Cost Curve Vs. Flow for Fluidized Bed Incineration Systems

TABLE VIII-94.
CAPITAL AND O&M COSTS FOR THE BELT FILTER PRESS AND FLUIDIZED BED INCINERATION SYSTEMS

Item	Flow Rates (MGD)				
	0.5	1.0	5.0	10.0	20.0
Capital Costs for Belt Filter Press Systems	161,500	161,500	409,000	678,200	1,130,200
Capital Costs for Fluidized Bed Incineration Systems	769,000	850,000	910,700	1,214,000	1,518,000
Total Capital Costs	930,500	1,011,500	1,319,700	1,892,200	2,648,200
O&M Costs for Belt Filter Press Systems	16,900	17,600	44,600	65,600	128,400
O&M Costs for Fluidized Bed Incineration Systems	183,500	233,800	424,100	639,100	1,159,000
Total O&M Costs	200,400	251,400	468,700	704,700	1,287,400

TABLE VIII-95.
ANNUALIZED COSTS FOR SLUDGE HANDLING SYSTEMS*

Flow Range (MGD)	Sludge Handling Unit Cost ($/yr/MGD)
>10 - 20.0	90,000
>5 - 10.0	107,000
>1 - 5.0	144,000
>.5 - 1.0	446,000
<0.5	758,000

*Technologies applied: CAPDET, coagulation/flocculation, and tertiary clarifiers.

4. RCRA Baseline Costs

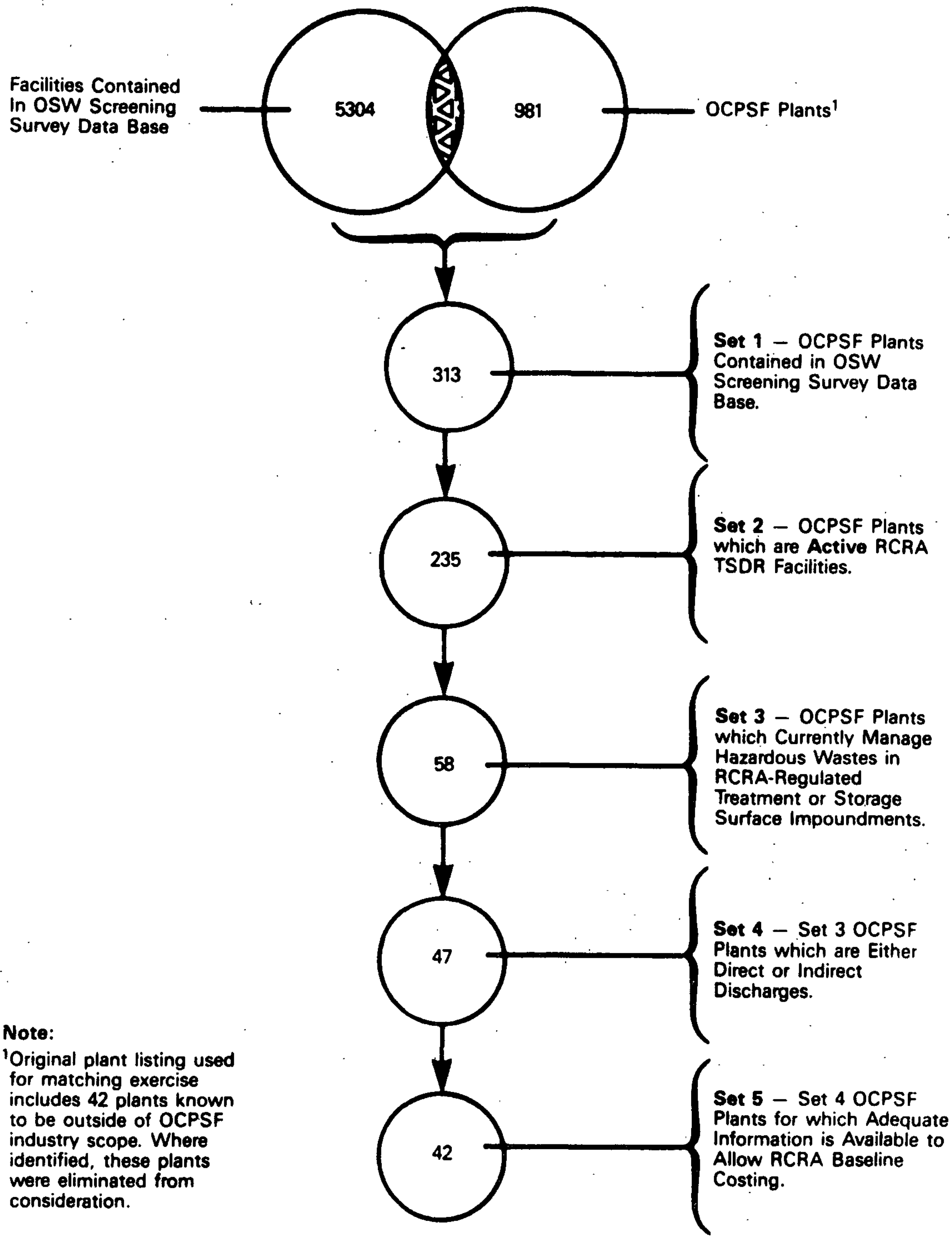
a. Introduction

The Hazardous and Solid Waste Amendments enacted in November 1984 (Public Law 98-616, November 8, 1984) require that each existing surface impoundment be in compliance with the requirements concerning the treatment, storage, and disposal of all hazardous wastes. As a result of this new legislation, OCPSF manufacturing facilities were reviewed to determine what costs would be incurred as a result of the amendment.

A total of 48 OCPSF facilities were selected for inclusion in the RCRA baseline costing analysis. The selection process for these OCPSF plants is described in the following section.

b. Identification of OCPSF Plants Requiring RCRA Baseline Costing

Figure VIII-54 provides an overview of the methodology used in identifying OCPSF plants requiring RCRA baseline costing. Initially, in an effort to identify OCPSF plants that manage hazardous waste in any type of RCRA-regulated unit, the universe of 981 OCPSF plants (Part A and Part ABC) contained in the Section 308 Questionnaire data base was matched against a universe of 5,304 facilities contained in the data base for the 1986 National Screening Survey of Hazardous Waste Treatment, Storage, Disposal, and Recycling Facilities currently maintained by the EPA Office of Solid Waste (OSW). The OSW screening survey provides a relatively comprehensive accounting of hazardous waste facilities in the U.S.; the survey was designed to collect sufficient information from every treatment, storage, disposal, and recycling (TSDR) facility to allow the selection of a statistically valid sample of TSDR facilities for a detailed follow-up survey. The Screening Survey Data Base contains data on hazardous waste TSDR activities for the year 1985. Based on a comparison of plant name, location, and address, the data base matching exercise yielded a total of 313 OCPSF plants. An additional 78 OCPSF plants were eliminated from consideration due to their inactive RCRA status as of the year 1985. These inactive units include facilities that never treated, stored, disposed of, or recycled hazardous wastes; facilities that have ceased all TSDR activities and closed all TSDR units since November 19, 1980; and



Note:
[1]Original plant listing used for matching exercise includes 42 plants known to be outside of OCPSF industry scope. Where identified, these plants were eliminated from consideration.

Figure VIII-54. Overview of Methodology for Identification of OCPSF Plants Requiring RCRA Baseline Costing

facilities that have notified EPA of their intent to close or submitted closure plans for all TSDR units. Elimination of these inactive facilities produced a listing of 235 OCPSF plants that may be considered active TSDR facilities.

Subsequent stages of the facility sorting exercise were directed at the identification of OCPSF plants operating wastewater treatment units potentially affected by major new RCRA regulatory requirements, including groundwater monitoring certification, minimum technology requirements, and the land disposal ban. Because surface impoundments used to manage hazardous wastes are significantly impacted by these new rules, considerable emphasis was placed on the identification of OCPSF plants that may be operating impoundments as part of their wastewater treatment systems.

Many treatment processes (e.g., equalization, sedimentation, biological treatment, etc.) utilized by the OCPSF industry are frequently conducted in surface impoundments as well as tanks. Where these impoundments handle hazardous wastes, OCPSF facilities may be required to either replace these units with tanks, or retrofit the impoundments with double liners and install groundwater monitoring wells to detect any groundwater contamination resulting from unit releases. The sorting exercise focused initially on treatment impoundments, but was subsequently expanded to include storage impoundments when it became evident based on a review of RCRA programmatic records (e.g., Part A and Part B permit applications, and RCRA facility assessments) that certain wastewater management units could be characterized interchangeably as treatment or storage units. For example, equalization or emergency spill basins may be described alternatively as treatment or storage operations. As indicated in Figure VIII-54, the sorting exercise identified 58 OCPSF plants that manage hazardous wastes in treatment impoundments, storage impoundments, or both. This total almost certainly includes OCPSF plants that utilize impoundments solely in conjunction with non-wastewater activities (e.g., sludge holding basins). Nonetheless, because available data were not sufficient to enable distinction between wastewater and non-wastewater use of impoundments, it was conservatively assumed that where impoundments are present at a facility, they are used in conjunction with wastewater treatment.

Other RCRA-regulated units potentially used to manage sludges, other solid residuals (e.g., landfills, disposal impoundments), or wastewaters not covered by OCPSF effluent guidelines (e.g., underground injection well) were not considered. In particular, land disposal units (e.g., sludge holding basins) potentially used to manage wastewater treatment sludges were not addressed since it has already been conservatively assumed that any additional wastewater treatment sludges resulting from compliance with OCPSF effluent guidelines will be dewatered and then combusted in on-site or off-site hazardous waste incinerators.

Eleven of the 58 OCPSF plants operating hazardous waste treatment or storage impoundments were eliminated from consideration due to their zero discharge (e.g., underground injection, recycling) or unknown discharge status. These plants will not be directly affected by OCPSF effluent guidelines, and therefore have not been evaluated for RCRA baseline costing. As shown in Figure VIII-54, the set of plants considered for RCRA baseline costing includes 47 OCPSF facilities that manage hazardous waste in treatment or storage impoundments, and that discharge either directly to surface waters or indirectly to a POTW. Five of these plants were later deleted from the costing list due to a lack of plant-specific information necessary to perform costing.

c. RCRA Cost Estimates

The parameters used to design and cost liners and monitoring wells are listed in Table VIII-96. Anaerobic lagoons were assumed to have a median detention time and depth of 35 days and 12 feet, respectively, while aerobic lagoons and polishing ponds were assumed to have a median detention time and depth of 25 days and 4 feet, respectively. Equalization and sedimentation basins were assumed to have a median detention time and depth of 5 days and 4 feet, respectively. Liner costs for installation and materials are actual vendor quotes and are scaled according to the Engineering News Record Index. Monitoring wells assume a minimum of four wells, three downgradient and one upgradient of the surface impoundment to be monitored. A table was established relating the facility's flow to the number of wells required, for the flow range of 0 to 18 MGD.

TABLE VIII-96.
PARAMETERS USED TO DESIGN AND COST LINERS AND MONITORING WELLS

Lagoons

	Detention Time (Days)	Depth (Ft)
1. Aerobic	25	4
2. Anaerobic	35	12
3. Equalization	5	4
4. Sedimentation	5	4
5. Polishing Pond	25	4

Liner Costs

1. High Density Polyethylene: Material Cost - $.40/ft^2
   Installation Cost - $.25/ft^2

2. Actual Cost Used in this Analysis: $0.6878/ft^2 taken from polishing pond liner costs.

Note: The costs assume that the surface to be lined is smooth. These costs were based on vendors' quotes.

Monitoring Costs

1. Wells: Assume at a very minimum 4 wells, 3 downgradient and 1 upgradient. The following table was established:

Flow Range (MGD)	Number of Wells
0-2	4
>2-4	8
>4-6	12
>6-8	16
>8-10	20
>10-12	24
>12-14	28
>14-16	32
>16-18	36

a. Well Depth - Ranges from 40 to 200 ft, depending on the geographic region. For this analysis we used 120-ft depths.

b. Installation Cost - Ranges from $2,000-$3,000 for 2" dia. polyvinyl chloride (PVC) pipe. Use 3,000 ÷ 40 ft = $75/ft

c. Manhour Cost - Labor rate of $20/hr; takes two men 10 days to drill four wells.

Well depths range anywhere from 40 to 200 feet depending on the geological location (southwest wells are generally deeper than northeast wells), so a median value of 120 feet was used. Installation costs for drilling wells range from $2,000 to $3,000 for a 2-inch diameter polyvinyl chloride pipe. This results in an installation cost of $75/ft when a 40-foot depth is assumed. This provides a very conservative cost figure. Man-hour costs are based on a labor rate of $20/hour, and it is assumed that four wells can be drilled in 10 working days by two workers. Again, this is a conservative estimate.

In addition to the equipment and installation costs, an annual cost covering administrative, sampling and analysis, and liner inspection costs was estimated at 20 percent of the total costs calculated for each facility. Although this estimate was considered extremely conservative, it was left at 20 percent to cover the requirements set forth in 40 CFR 265.92 and associated appendices.

Table VIII-97 presents the liner and monitoring well equipment and installation costs for the 42 selected OCPSF facilities. Table VIII-98 presents a summary of the liner costs, monitoring well costs, and the annual 20 percent contingency cost (which covers administration, sampling and analysis, and liner inspections) for each plant selected. Liner equipment and installation costs total $19.702 million; monitoring well equipment and installation costs total $2.891 million per year; and contingency costs total $44.518 million for the 42 selected OCPSF facilities.

d. Summary of BPT, BAT, and PSES Compliance Costs

Based on the cost methodology and cost estimation procedures for each of the technologies discussed previously in this section, BPT, BAT, and PSES compliance costs were calculated, and are presented in Table VIII-99. While compliance costs are presented for three BAT options, only one distinct PSES technology option was retained for final cost estimation. In addition, no monitoring costs were estimated for BPT because the Agency assumed existing monitoring frequencies for BOD_5 and TSS were adequate. Also, BPT, BAT, and PSES compliance costs were not estimated for all OCPSF plants. Table VIII-100

TABLE VIII-97.

LINER AND MONITORING WELL EQUIPMENT AND INSTALLATION COSTS FOR SELECTED OCPSF FACILITIES

OCPSF Plant Number	Plant Flow (MGD)	Type of Impoundment* Used to Manage Hazardous Waste	Equal	Sed	Aerobic Lagoon	Anaerobic Lagoon	Polishing Pond	Impoundment Vol. (ft^3)	Impoundment Area (ft^2)	Liner Cost ($)	Monitoring Cost ($)
76	0.40	S	Deleted due to lack of technical costing information								
190	0.13	T,S	X	-	-	-	X	521,400	130,300	89,520	35,701
250	0.50	T,S	X	-	-	-	-	334,300	83,560	57,380	35,701
293	0.630	S	X	-	-	-	-	421,200	105,300	72,300	35,701
296	2.650	T	X	X	-	-	-	708,600	117,200	121,700	71,402
392	0.156	S	X	-	-	-	-	104,300	26,070	17,900	35,701
415	6.50	T,S	X	-	-	-	-	4,345,000	1,086,000	746,000	142,804
500	0.485	T,S	X	X	-	-	X	2,269,000	567,400	389,600	35,701
523	0.160	S	X	-	-	-	-	107,000	26,740	18,360	35,701
624	None	Deleted due to lack of technical costing information									
662	4.720	T,S	X	X	-	-	-	6,310,000	1,578,000	1,083,000	107,103
683	3.650	T	-	X	-	-	-	2,440,000	610,000	418,900	71,402
695	16.700	T,S	X	X	-	-	-	22,320,000	5,582,000	3,834,000	285,608
819	1.0160	S	X	-	-	-	-	679,200	169,800	116,600	35,701
844	0.493	T,S	X	X	-	-	-	6,592,000	164,800	113,200	35,701

TABLE VIII-97.
LINER AND MONITORING WELL EQUIPMENT AND INSTALLATION COSTS FOR SELECTED OCPSF FACILITIES
(Continued)

OCPSF Plant Number	Plant Flow (MGD)	Type of Impoundment* Used to Manage Hazardous Waste	Equal	Sed	Aerobic Lagoon	Anaerobic Lagoon	Polishing Pond	Impoundment Vol. (ft^3)	Impoundment Area (ft^2)	Liner Cost ($)	Monitoring Cost ($)
851	1.9450	T,S	X	-	-	-	-	1,300,000	325,100	223,200	35,701
876	0.3540	S	X	X	-	-	-	473,300	118,300	81,260	35,701
908	1.250	T,S	X	X	-	-	-	1,671,000	417,800	286,900	35,701
1069	0.7940	T,S	X	-	-	-	-	530,800	132,700	91,120	35,701
1133	1.300	T,S	X	-	-	-	-	869,100	217,300	149,200	35,701
1322	None	S	Deleted due to lack of technical costing information								
1494	2.0850	T,S	X	X	-	-	-	2,788,000	697,000	479,400	71,402
1522	9.480	T,S	-	X	-	-	-	6,337,000	1,584,000	1,089,000	178,505
1656	0.0440	S	X	-	-	-	-	29,410	7,353	5,057	35,701
1688	1.2040	T	X	X	-	-	-	1,610,000	402,400	276,800	35,701
1753	3.30	T,S	X	X	-	-	-	4,412,000	1,103,000	758,600	71,402
1769	34.40	S	-	X	-	-	-	23,670,000	5,916,000	4,069,000	642,618
1797	0.1180	T	X	X	-	-	-	472,900	118,300	81,380	35,701
1890	1.3520	T	X	-	-	-	-	903,800	226,000	115,400	35,701
1910	0.6380	S	Deleted due to lack of technical costing information								

TABLE VIII-97.
LINER AND MONITORING WELL EQUIPMENT AND INSTALLATION COSTS FOR SELECTED OCPSF FACILITIES
(Continued)

OCPSF Plant Number	Plant Flow (MGD)	Type of Impoundment* Used to Manage Hazardous Waste	Equal	Sed	Aerobic Lagoon	Anaerobic Lagoon	Polishing Pond	Impoundment Vol. (ft^3)	Impoundment Area (ft^2)	Liner Cost ($)	Monitoring Cost ($)
1911	2.16	T	X	-	-	-	-	1,444,000	361,000	248,300	71,402
2070	0.2589	T,S	X	X	-	-	-	347,400	86,840	59,720	35,701
2110	0.4890	T,S	X	-	-	-	-	332,900	83,230	57,250	35,701
2123	0.110	S	X	-	-	-	-	73,540	18,380	12,640	35,701
2148	1.7170	T	X	X	X	-	X	13,780,000	3,434,000	2,368,000	35,701
2227	3.980	S	X	X	-	-	-	5,322,000	1,330,000	915,000	71,402
2268	0.0350	S	X	-	-	-	-	23,400	5,849	4,023	35,701
2297	0.0246	S	-	X	-	-	-	16,450	4,111	2,828	35,701
2345	0.15978	T	-	X	X	-	-	640,900	159,700	110,200	35,701
2390	0.0946	S	X	-	-	-	-	63,240	15,810	10,870	35,701
2481	0.920	T	X	X	-	-	-	1,230,000	307,600	211,600	35,701
2527	0.200	T,S	-	-	X	-	-	668,500	167,000	114,900	35,701
2609	0.0469	S	X	X	-	-	-	62,700	15,680	10,780	35,701
2673.1	0.0810	T,S	X	-	X	-	-	324,900	81,230	55,870	35,701
2673.2	0.0810	T,S	-	-	-	X	-	379,100	25,270	17,380	

TABLE VIII-97.
LINER AND MONITORING WELL EQUIPMENT AND INSTALLATION COSTS FOR SELECTED OCPSF FACILITIES
(Continued)

OCPSF Plant Number	Plant Flow (MGD)	Type of Impoundment* Used to Manage Hazardous Waste	Equal	Sed	Aerobic Lagoon	Anaerobic Lagoon	Polishing Pond	Impoundment Vol. (ft^3)	Impoundment Area (ft^2)	Liner Cost ($)	Monitoring Cost ($)
2680	0.080	S	X	-	-	-	-	53,480	13,370	9,196	35,701
2695	2.6180	S	Deleted due to lack of technical costing information								
2739	0.9700	T,S	X	-	-	-	X	3,891,000	972,600	669,500	35,701

*S = Surface impoundment
T = Tank

TABLE VIII-98.
SUMMARY OF LINER, MONITORING, AND
ADMINISTRATIVE RCRA BASELINE COSTS

Plant No.	Liner Cost Installed ($)	Monitoring Cost ($)	Administrative Cost* ($/year)
190	89,520	35,701	25,044
250	57,380	35,701	18,616
293	72,300	35,701	21,600
296	121,700	71,402	38,620
392	17,900	35,701	10,720
415	746,000	142,804	177,761
500	389,600	35,701	85,060
523	18,360	35,701	10,812
662	1,083,000	107,103	238,021
683	418,900	71,402	98,060
695	3,834,000	285,608	823,922
819	116,600	35,701	30,460
844	113,200	35,701	29,780
851	223,200	35,701	51,780
876	81,260	35,701	23,392
908	286,900	35,701	64,520
1069	91,120	35,701	25,364
1133	149,200	35,701	36,980
1494	479,400	71,402	110,160
1522	1,089,000	178,505	253,501
1656	5,057	35,701	8,152
1688	276,800	35,701	62,500
1753	758,600	71,402	166,000
1769	4,069,000	642,618	942,324
1797	81,380	35,701	23,416
1890	155,400	35,701	38,220
1911	248,300	71,402	63,940
2070	59,720	35,701	19,084
2110	57,250	35,701	18,590
2123	12,640	35,701	9,668
2148	2,368,000	35,701	480,740
2227	915,000	71,402	197,280
2668	4,023	35,701	7,945
2297	2,828	35,701	7,706
2345	110,200	35,701	29,180
2390	10,870	35,701	9,314
2481	211,600	35,701	49,460
2527	114,900	35,701	30,120
2609	10,780	35,701	9,296
2673	73,250	35,701	21,790
2680	9,196	35,701	8,979
2739	669,000	35,701	140,940

*Administrative Cost = 20% of Liner Cost + 20% of Monitoring Cost

TABLE VIII-99.
SUMMARY OF BPT, BAT, AND PSES COMPLIANCE COSTS FOR FINAL REGULATORY OPTIONS
(1982 $)

	Total Capital Costs	Total O&M Costs	Total Land Costs	Contract Hauling Costs	Monitoring Costs
BPT					
-Option I	188,387,926	38,287,089	4,687,175	489,830	**
-Option III	312,100,385	50,629,069	6,696,206	489,830	**
BAT					
-Option I	61,178,529	19,654,285	2,107,061	1,441,881	9,394,810
-Option II	308,370,369	143,613,283	6,792,303	1,566,565	9,475,252
-Option III	893,897,707	285,233,753	18,983,728	1,085,641	9,467,282
PSES					
-Option IV	260,776,472	124,301,498	7,347,380	10,094,061	11,068,558

**No monitoring costs were estimated for BPT because it was assumed that existing monitoring frequencies for BOD_5 and TSS were adequate.

TABLE VIII-100.
PLANTS WITH NO COST

BPT			BAT			PSES		
Plant No.	Part A/ABC	Discharge Code	Plant No.	Part A/ABC	Discharge Code	Plant No.	Part A/ABC	Discharge Code
306	A	Direct	306	A	Direct	85	A	Indirect
373	ABC	Direct	373	ABC	Direct	259	ABC	Dir/Ind
408	A	Drect	408	A	Direct	303	ABC	Indirect
511	A	Direct	511	A	Direct	339	ABC	Indirect
586	A	Direct	586	A	Direct	434	ANC	Indirect
915	ABC	Direct	601	ABC	Dir/Ind	513	ABC	Indirect
1167	A	Direct	915	ABC	Direct	566	ABC	Indirect
1285	A	Direct	1167	A	Direct	601	ABC	Dir/Ind
1342	A	Direct	1285	A	Direct	614	ABC	Dir/Ind
2624	A	Direct	1342	A	Direct	751	ABC	Indirect
4005	A	Direct	1776	ABC	Direct	853	ABC	Indirect
4058	A	Direct	1794	ABC	Dir/Ind	962	ABC	Dir/Ind
			2624	A	Direct	1060	ABC	Indirect
			2647	ABC	Dir/Ind	1238	ABC	Indirect
			4005	A	Direct	1260	ABC	Indirect
			4058	A	Direct	1617	ABC	Dir/Ind
						1664	A	Indirect
						1765	ABC	Indirect
						1782	ABC	Indirect
						1794	ABC	Dir/Ind
						1836	ABC	Indirect
						2062	ABC	Dir/Ind
						2153	A	Indirect
						2297	ABC	Indirect
						2313	ABC	Dir/Ind
						2349	ABC	Indirect
						2446	A	Indirect
						2475	ABC	Indirect
						2497	A	Indirect
						2505	A	Indirect
						2706	ABC	Indirect
						2745	ABC	Indirect
						4010	ABC	Dir/Ind
						4012	ABC	Indirect
						4031	A	Ind/Zer
						4056	ABC	Indirect
						4060	ABC	Indirect

presents the plants for which compliance costs were not estimated. A total of 12 plants, 16 plants, and 37 plants were not costed for BPT, BAT, and PSES, respectively. The predominant reasons for not calculating compliance costs included missing flow data and/or missing production data which, in turn, precluded the estimation of toxic pollutant loadings that provide the basis for estimating BAT and PSES compliance cost. In addition, all direct/indirect dischargers were only costed as either a direct or an indirect discharger since product/process toxic pollutant loadings were difficult to separate into ultimate direct and indirect waste streams. This reduces the number of plants not costed by one plant for BAT and by nine plants for PSES.

As part of the Small Plant Economic Impact Analysis (EIA), a total of 48 direct and indirect dischargers were identified for further analysis and validation of their raw waste toxic pollutant loadings. In general, these plants were either Part A respondees that had their loadings estimated based on information from full-response plants, or full-response plants whose loadings were calculated on a generic basis. (Details of the methodology used to calculate toxic pollutant loadings are discussed in the next portion of this section.) For the Small Plant EIA, the Agency carefully validated each plant's loadings so that compliance costs and loadings before and after compliance could be adjusted accordingly. This was accomplished by investigating each plant's product mix and identifying plants with similar product mixes that had been sampled during one of the Agency's field sampling programs. This was done so that the pollutants estimated to occur in each plant's raw waste loadings could be adjusted to include only those pollutants found in the raw wastewater of the sampling plant with the most similar product mix. Of the 48 plants evaluated, raw waste loadings were adjusted for 12 plants (10 indirect, 2 direct), and revised compliance costs and loadings were recalculated and substituted for those that were originally estimated. Also, during this validation, it was discovered that the process flow value used for compliance cost estimation purposes at one plant was incorrect, so revised compliance costs for this plant were also recalculated and substituted.

Appendix VIII-B presents a listing of the plant-by-plant compliance cost estimates associated with the BPT, BAT, and PSES effluent limitations.

F. WASTEWATER AND AIR EMISSION LOADINGS

1. BPT Conventional Pollutant Wastewater Loadings

Conventional pollutant (BOD_5 and TSS) wastewater loadings associated with current and BPT Option I discharges were calculated in the following manner:

- Current BOD_5 and TSS effluent wastewater loadings were calculated by obtaining reported BOD_5 and TSS effluent concentrations from the BPT costing file (including imputed BOD_5 and TSS effluent data discussed earlier in this section and in Appendix VIII-A), multiplying by the total OCPSF contaminated flow value (in MGD obtained from the BPT cost file), and then multiplying by a standard units conversion factor (8.34) and 365 to obtain an annual loading of both BOD_5 and TSS.
- To obtain BPT Option I BOD_5 and TSS effluent wastewater loadings, the same procedure as described above for current loadings was used, except the BPT Option I BOD_5 and TSS targets from the BPT cost file were substituted for the reported BOD_5 and TSS effluent data. For plants with reported concentrations less than their target values, the reported values were used.

Current discharge loadings of BOD_5 and TSS have been estimated to be approximately 61.49 and 99.59 million pounds per year, respectively. The annual BOD_5 and TSS BPT discharge loadings, based on the selection of BPT Option I, are 19.76 and 33.32 million pounds per year, respectively. Therefore, BPT Option I control reduces current BOD_5 and TSS levels by 68 and 67 percent, respectively.

Appendix VIII-C presents plant-by-plant current, BPT Option I, and BPT Option III BOD_5 and TSS loadings.

2. BAT and PSES Toxic Pollutant Wastewater Loadings

a. Introduction

Plants within the OCPSF industries use water for a wide variety of purposes: direct process contact uses (e.g., waste streams from reactors, raw material recovery, solvent recovery, product separation, and refining); indirect process contact uses (e.g., in pumps, seals, and vacuum jet and steam ejector systems); maintenance, equipment cleaning, and work area washdowns;

air pollution control; waste transport; noncontact cooling; and noncontact ancilliary uses (e.g., boilers and utilities). With the exception of non-contact waters, wastewater from these industries is potentially contaminated to a greater or lesser degree with priority pollutants. Because the OCPSF industry uses large amounts of water in the manufacture of products (17 percent of the total water consumed by all manufacturing establishments in 1978), these industries generate raw wastewaters that contain significant concentrations of priority pollutants.

Most of this wastewater receives some treatment to reduce pollutant concentrations prior to environmental discharge, either as an individual process waste stream or in a wastewater treatment plant serving combined waste streams from the entire facility. To determine what pollutants merit regulation, as well as determining the costs and benefits of removing regulated priority pollutants, the Agency has acquired extensive analytical data on priority pollutant concentrations in industry wastewaters.

The Agency has estimated raw, current, projected BPT effluent, projected PSES effluent, and projected BAT effluent priority pollutant waste loadings for the OCPSF industry to estimate the relative environmental benefit (as measured by reduction of priority pollutants discharged to surface waters or to POTWs) of each of the final BAT and PSES regulatory options. These loadings (as calculated for individual product/processes) were also used for costing purposes. These loadings have been calculated on a plant-by-plant model basis using both industry-generated data (i.e., 1983 Section 308 Questionnaire data) and analytical data acquired by the Agency in various sampling studies. OCPSF industry waste loadings are presented in Appendix VIII-D. The following sections describe the methodology used to calculate waste loads from the OCPSF industries.

b. Methodology for Waste Load Calculation

This section presents the approach taken by the Agency for waste load calculations. A general methodology is presented first. Analytical data for toxic pollutants are discussed next. Flow data and the assumptions used to calculate product/process flow follows, with plant-specific waste load calculations presented last.

There are four distinct levels at which toxic pollutant waste loads from a plant can be calculated. The first level is at an aggregated product/process level (or plant level) where waste streams from several processes are combined. If toxic pollutant concentration and flow are known for the aggregate raw waste stream (i.e., prior to any treatment that may affect toxic pollutant removal) and the final waste stream (after the current treatment system), then both raw and current waste loads may be calculated as:

$$RWL_i = [P_i]F_i$$

$$CWL_e = [P_e]F_e$$

where:

RWL_i = raw waste load for a pollutant

CWL_e = current waste load for a pollutant

$[P_i]$ = concentration of a pollutant in raw wastewater

$[P_e]$ = concentration of a pollutant in final discharge

F_i = raw wastewater flow

F_e = final discharge wastewater flow.

If more than one aggregated wastewater stream exists at a plant, toxic pollutant loadings are summed to determine the total waste load.

The second level at which toxic pollutant waste loads from a plant can be calculated is at a product/process or production unit level. The Agency has sampled the raw wastewaters of 176 product/processes employed by the OCPSF industries that generally manufacture high production volume organic chemicals, plastics, and synthetic fibers. These processes, which are listed in Tables VIII-101 and VIII-102, comprise approximately 60 percent of the OCPSF industries' total production. This collection of product/process data is known as the Master Process File (MPF).

Given toxic pollutant concentrations for a given production process and using wastewater flow specific to that product/process, toxic pollutant waste load can be calculated as before. The total waste load from a plant is the sum of the individual product/process waste loads generated at an OCPSF plant.

TABLE VIII-101.
MAJOR PRODUCTS BY PROCESS OF THE ORGANIC CHEMICALS INDUSTRY

Product	Process (feedstock)
Acetaldehyde	By-product (Acrolein/Propene/Oxidation Oxidation (Ethene)
Acetic Acid	By-product (Polyvinyl Alcohol) Carbonylation (Methanol) Co-product (Terephthalic Acid) Oxidation (Acetaldehyde) Oxidation (Butane)
Acetic Anhydride	Addition (Acetic Acid/Ketene)
Acetone	Oxidation (Isopropanol/H_2O_2) Peroxication/Acid Cleavage (Cumene)
Acetonitrile	By-product (Acrylonitrile/Ammoxidation/Propane)
Acetylene	By-product (Propane Pyrolysis) Hydrolysis (Calcium Carbide) Oxidation (Methane)
Acrolein	Oxidation (Propene)
Acrylamide	Hydration (Acrylonitrile) Formylation/Hydration (Acetylene/Carbon Monoxide/Water) Oxidation (Acrolein) Oxidation (Propene)
Acrylic Acid Esters	Esterification (Miscellaneous Alcohols)
Ethyl Acrylate	Esterification (Acrylic Acid/Etahnol)
Ethylhexyl Acrylate	Esterification (Acrylic Acid/2-Ethylhexanol)
Isobutyl Acrylate	Esterification (Acrylic Acid/Isobutanol)
n-Butyl Acrylate	Esterification (Acrylic Acid/n-Butanol)
Acrylonitrile	Ammoxidation (Propene)
Adipic Acid	Oxidation (Cyclohexane) Oxidation (Cyclohexanol) Oxidation (Cyclohexanone)
Adiponitrile	Ammonolysis/Dehydration (Adipic Acid) Chlorination/Cyanation (Butadiene) Electrohydrodimerization (Acrylonitrile)
Alkyl Amines	Hydrogenation (Fatty Nitriles)

TABLE VIII-101.
MAJOR PRODUCTS BY PROCESS OF THE ORGANIC CHEMICALS INDUSTRY
(Continued)

Product	Process (feedstock)
Alkyl Phenols	Alkylation (Phenol)
Allyl Alcohol	Reduction (Acrolein/Aluminum Butoxide)
Amyl Acetates	Esterification (Acetic Acid/Amyl Alcohols)
Aniline	Hydrogenation (Nitrobenzene)
Benzene	Distillation (BTX Extract Cat Reformate) Distillation (BTX Extract - Coal Tar Light Oil) Distillation (BTX Extract - Pyrolysis Gasoline) Hydrodealkylization (Toluene/Xylene)
Benzoic Acid	Oxidation (Toluene)
Benzyl Alcohol	Hydrolysis (Benzyl Chloride)
Benzyl Chloride	Chlorination (Toluene)
Bisphenol-A	Condensation (Acetone/Phenol)
BTX	Pyrolysis (Gasoline)
1,3-Butadiene	Extractive Distillation (C4 Pyrolyzates)
Butenes	Extractive Distillation (C4 Pyrolyzates)
n-Butyl Alcohol	Hydrogenation (n-Butyraldehyde/Oxo Process)
sec-Butyl Alcohol	Hydration (Butenes)
Caprolactam	Rearrangement (Cyclohexanone Oxime)
Carbon Tetrachloride	Chlorination (Carbon Disulfide) Chlorination (Methane) Chlorination (Methyl Chloride) Co-product (Tetrachloroethene)
Cellulose Butyrates	Esterification (Cellulose)
Cellulose Acetate/ Propionate	Esterification (Cellulose)
Chlorobenzene	Chlorination (Benzene)

TABLE VIII-101.
MAJOR PRODUCTS BY PROCESS OF THE ORGANIC CHEMICALS INDUSTRY
(Continued)

Product	Process (feedstock)
Chlorodifluoromethane	Hydrofluorination (Chloroform)
Chloroform	Chlorination (Methane) Chlorination (Methyl Chloride)
3-Chloronitrobenzene	Chlorination (Nitrobenzene)
Coal Tar	Coking (Coal)
Creosote	Distillation (Coal Tar Light Oil)
Cumene	Alkylation (Benzene/Propene)
Cyclohexane	Hydrogenation (Benzene)
Cyclohexanol/one (Mixed)	Oxidation (Cyclohexane)
Cyclopentatidene Dimer	Extractive Distillation (C5 Pyrolyzates)
1,2-Dichlorobenzene	Chlorination (Benzene)
1,4-Dichlorobenzene	Chlorination (Benzene)
Dichlorodifluoromethane	Hydrofluorination (Carbon Tetrachloride)
1,2-Dichloroethane	Direct Chlorination (Ethene) Oxychlorination (Ethene)
Diethylene Glycol	Co-product (Ethylene Glycol)
Diisopropyl Benzene	Alkylation of Benzene (Cumene)
Diketene	Dierization (Ketene/Acetic Acid)
Diethyl Terephthalate	Esterifcation (Terphthallic Acid) Oxidation/Esterification (p-Xylene)
Dinitrotoluene (Mixed)	Nitration (Toluene)
Dyes and Dye Intermediates	-------------
Epichlorohydrin	Epoxidation (Allyl Chloride/Chorohydrination)
Ethanol	Hydration (Ethene)

TABLE VIII-101.
MAJOR PRODUCTS BY PROCESS OF THE ORGANIC CHEMICALS INDUSTRY
(Continued)

Product	Process (feedstock)
Ethoxylates, Alkylphenol	Etherification (Phenol/Ethylene Oxide)
Ethoxylates, Alkyl	Etherification (Linear Alcohols/Ethylene Oxide)
Ethylamine	Ammonolysis (Ethanol)
Ethylbenzene	Alkylation (Benzene) Distillation (BTX Extract)
Ethene	Pyrolysis (Ethane/Propane/Butane/LPG) Pyrolysis (Naphtha/Gas Oil) Pyrolysis (Ethane/Propane/Butane/Naphtha)
Ethylene Diamine	Amination (1,2-Dichloroethane)
Ethylene Glycol	Hydrolysis (Ethylene Oxide)
Ethylene Oxide	Epoxidation (Ethylene Chlorohydrin) Oxidation (Ethene)
2-Ethylhexanol	Condensation/Hydrogenation (n-Butaldehyde)
Formaldehyde	Oxidation (Methanol-Silver Catalyst)
Formic Acid	By-product (Butane Oxidation)
Glycerine (Synthetic)	Hydration (Allyl Alcohol)
Hexamethylenediamine	Depolymerization (Nylon 66) Hydrogenation (Adiponitrile)
Hydroquinone	Oxidation (Aniline)
Hydroxyethyl Cellulose	Etherification (Cellulose)
Hydroxypropyl Cellulose	Etherification (Cellulose)
Isobutanol	Hydrogenation (Isobutyraldehyde-Oxo Process)
Isobutylene	Dehydration (tert-Butanol) Extraction (C4 Pyrolyzate)
Isoprene	Extractive Distillation (C5 Pyrolyzate)
Isopropanol	Hydration (Propene)

TABLE VIII-101.
MAJOR PRODUCTS BY PROCESS OF THE ORGANIC CHEMICALS INDUSTRY
(Continued)

Product	Process (Feedstock)
Maleic Anyhydride	Oxidation (Benzene)
Methacrylic Acid	Hydrolysis (Acetone Cyanohydrin)
Methacrylic Acid Esters	Esterification (Methacyrlic Acid/Alcohols)
Methanol	Oxidation (H.P. Synthesis Natural Gas/Synthetic Gas) Oxidation (L.P. Synthesis Natural Gas/Synthetic Gas)
Methyl Chloride	Chlorination (Methane) Hydrochlorination (Methanol)
Methyl Ethyl Ketone	Reduction (Acrolein/Aluminum Butoxide)
Methyl Isobutyl Carbinol	Condensation (Acetone)
Methyl Isobutyl Ketone	Hydrogenation (Mesityl Oxide)
Methyl Methacrylate	Methanolysis (Acetone Cyanohydrin)
Methyl Salicylate	Esterification (Salicylic Acid)
Methylamines	Ammination (Methanol/Ammonia)
Methylene Chloride	Chlorination (Methane) Chlorination (Methyl Chloride)
Methyl Styrene	By-product (Acetone/Phenol by Cumene Oxidation)
Naphthalene	Distillation (Pyrolysis Gas) Separation (Coal Tar Distillate)
Neopentanoic Acid	Oxidation (Isobutylene via Oxo Process)
Nitrobenzene	Nitration (Benzene)
4-Nitrophenol & Sodium Salt	Nitration (Phenol)
Nonyl Phenol	Alkylation (Phenol)
Nylon Salt	Condensation (Adipic Acid/Hexamethylene Diamine)
Oxo Aldehydes/Alcohols	Oxidation (Hydrocarbons - Oxo Process)
Pentachlorophenol	Chlorination (Phenol)

TABLE VIII-101.
MAJOR PRODUCTS BY PROCESS OF THE ORGANIC CHEMICALS INDUSTRY
(Continued)

Product	Process (Feedstock)
Phenol	Peroxidation/Acid Cleavage (Cumene)
Phosphate Esters	Phosgenation (Phosphoryl Chloride/Phenol/Isodecanol)
Phthalate Ester, Bis 2-Ethylhexyl	Alcoholysis (Phthatlic Anhydride/2-Ethylhexanol)
Butylbenzyl	Alcoholysis (Phthalic Anhydride/Butanol/Benzylchloride)
C11-C14	Alcoholysis (Phthalic Anhydride/C11-C14 Alcohols)
Diethyl	Alcoholysis (Phthalic Anhydride/Ethanol)
Diphenyl	Esterification (Phenol/Phthalyl Chloride)
Phthalic Anhydride	Oxidation (Naphthalene) Oxidation (o-Xylene)
Pitch Tar Residue	Separation (Coal Tar Light Oil distillate)
Polyethylene Glycol	Polymerization (Ethylene Oxide)
Polyethylene Polyamines	Amination (Ethylene Diamine/2,3-Dichloroethane/NH_3)
Polymeric Methylene Dianiline	Condensation (Aniline/Formaldehyde)
Polymeric Methylene Diphenyl Diisocyanate	Phosgenation (Polymethylene Dianiline)
Polyoxyethylene Glycol	Condensation (Propylene Glycol/Propylene Oxide)
Polyoxypropylene Glycol	Propoxylation (Glycerine)
Propene	Pyrolysis (Ethane/Propane/Butane/LPG) Pyrolysis (Naphtha and/or Gas Oil) Pyrolysis (Naphtha, Propane, Ethane, Butane)
Propionaldehyde	Hydroformylation (Ethene-Oxo Process)
Propionic Acid	Oxidation (Propionaldehyde)

TABLE VIII-101.
MAJOR PRODUCTS BY PROCESS OF THE ORGANIC CHEMICALS INDUSTRY
(Continued)

Product	Process (Feedstock)
n-Propyl Acetate	Esterification (Acetic Acid Propanol)
n-Propyl Alcohol	Hydrogenation (Propionaldehyde)
Propylene Oxide	Epoxidation (Propene via Chlorohydrin)
Salicylic Acid	Carboxylation (Sodium Phenolate)
Styrene	Dehydrogenation (Ethylbenzene)
Terephthalic Acid	Catalytic Oxidation (p-Xylene)
Tetrachloroethene	Chlorination (1,2-Dichloroethane/Other Chlorinated Hydrocarbons) Chlorination (Acetylene) Chlorination (Hydrocarbons)
Tetrachlorophthalic Anhydride	Chlorination (Phthalic Anhydride)
Tetraethlene Glycol	Co-product (Ethylene Glycol)
Tetraethyl Lead	Alkylation (Ethyl Chloride/Sodium-Lead Alloy)
Tetramethyl Lead	Alkylation (Methyl Chloride/Sodium-Lead Alloy)
Toluene	Distillation (BTX Extract - Cat Reformate) Distillation (BTX Extract - Coal Tar Light Oil) Distillation (BTX Extract - Pyrolysis Gasoline)
Toluenediamine (Mixture)	Hydrogenation (Dinitrotoluenes)
2,4-Toluenediamine	Hydrogenation (Dinitrotoluenes)
Toluene Diisocyanates (Mixture)	Phosgenation (Toluenediamines)
2,4-Toluene Diisocyanate	Phosgenation (2,4-Toluenediamine)
Trichloroethene	Chlorination (1,2-Dichloroethane/Other Hydrocarbons) Chloriantion (Acetylene)
Trichlorofluoromethane	Hydrofluorination (Carbon Tetrachloride)
Triethylene Glycol	Co-product (Ethylene Glycol/Ethylene Oxide) Recovery from Ethylene Glycol Still Bottoms

TABLE VIII-101.
MAJOR PRODUCTS BY PROCESS OF THE ORGANIC CHEMICALS INDUSTRY
(Continued)

Product	Process (Feedstock)
Vinyl Acetate	Esterification (Acetylene/Acetic Acid) Esterification (Ethene/Acetic Acid Gas Phase) Esterification (Ethene/Acetic Acid Liquid Phase)
Vinyl Chloride	Dehydrochlorination (1,2-Dichloroethane) Dehydrochlorination (1,2-Dichloroethane - Balanced Process)
Vinylidene Chloride	Dehydrochlorination (Trichloroethane)
Xylenes, Mixed	Extraction (Cat Reformate) Extraction (Coal Tar Light Oil) Extraction (Pyrolysis Gasoline) Separation (Xylene Bottoms)
m-Xylene	Fractionation (Mixed Xylenes)
o-Xylene	Distillation (Mixed Xylenes)
p-Xylene	Isomerization/Crystallization (Mixed Xylenes)

TABLE VIII-102.
MAJOR PRODUCTS BY PROCESS OF THE PLASTICS/SYNTHETIC FIBERS INDUSTRY

Product	Process (Feedstock)
ABS Resin	Emulsion Polymerization
ABS/San Resin	Emulsion/Suspension Polymerization
Acrylic Fiber (85% Polyacrylonitrile)	Suspension Polymerization - Wet Spinning
Acrylic Latex	Emulation Polymerization
Acrylic Resins	Solution Polymerization
Alkyd Resins	Condensation/Polymerization
Cellulose Acetate Fibers	Spinning from Acetylated Cellulose
Cellulose Acetate Resin	Acetylation (Cellulose)
Epoxy Resins	Condensation (Epichlorohydrin/Novolak Resins) Condensation (Epichlorohydrin/Bisphenol A) Condensation (Polyols/Epichlorohydrin) Epoxidation (Polymers)
Melamine Resins	Condensation (Melamine/Formaldehyde)
Monacrylic Fiber	Spinning
Nylon 6 Resin	Condensation (Caprolactam)
Nylon 66 Resin	Condensation (Nylon Salt)
Petroleum Hydrocarbon Resins	Condensation (C5-C8 Unsaturated)
Phenolic Resin	Condensation (Phenol/Formaldehyde)
Polycarbonates	------------------
Polyester Fibers	Melt Spinning (DMT/Ethylene Glycol) Melt Spinning (TPA/Ethylene Glycol)
Polyester Resins	Condensation (TPA/Ethylene Glycol) Condensation (DMT/Ethylene Glycol)
Polyethylene Resins	High Pressure Polymerization (LDPE) Solution Polymerization (HDPE)
Polypropylene Resin	Solution Polymerization
Polystyrene and Copolymers	Bulk Polymerization

TABLE VIII-102.
MAJOR PRODUCTS BY PROCESS OF THE PLASTICS/SYNTHETIC FIBERS INDUSTRY
(Continued)

Product	Process (Feedstock)
Polyvinyl Acetate Resins	Emulsion Polymerization
Polyvinyl Alcohol Resin	Hydrolysis (Polyvinyl Acetate) Solution Polymerization (Vinyl Acetate/ Hydrolysis of Polymer)
Polyvinyl Chloride	Bulk Polymerization Emulsion Polymerization Suspension Polymerization
Rayon	Viscose Process
San Resins	Suspension Polymerization
Silicones	Hydrolysis (Chlorosilanes)
Silicone Fluids	Hydrolysis/Cyclization (Chlorosilanes)
Silicone Resins	Hydrolysis/Cyclization (Chlorosilanes)
Silicone Rubbers	Hydrolysis/Cyclization (Chlorosilanes)
Styrene-Butadiene Resin	Emulsion Polymerization
Unsaturated Polyester Resin	Condensation (Maleic and Phthalic Anhydrides/ Glycols
Urea Resins	Condensation (Urea/Formaldehyde)

A third level at which toxic pollutant waste loads from a plant can be calculated is at the product level. This approach entails averaging toxic pollutant concentrations from the MPF by product rather than product/process. One hundred and twenty-one specific products are covered by the MPF, comprising 86 percent of the OCPSF industries' total production. Using toxic pollutant concentration for a specific product and using wastewater flow specific to that product, product-specific waste loads can be calculated as before. Again, the total load from a plant is calculated as the sum of individual product waste loads.

The last and most general level at which plant-specific waste loads can be calculated is at the generic process level. This approach entails averaging toxic pollutant concentrations from the MPF by generic process rather than by product/process; each product/process reported by the OCPSF industries has been assigned a generic chemical process. Table VII-103 lists the generic chemical processes employed by the OCPSF industry. Ninety-eight percent of all products manufactured by the OCPSF industries are covered by generic chemical process calculations. Using generic process toxic pollutant concentrations for a specific product and using wastewater flow specific to that product, product-specific waste loads can be calculated as before. Again, the total waste load from a plant is calculated as the sum of individual product waste loads.

c. Pollutant Concentration Data

A variety of studies have been undertaken by EPA to collect toxic pollutant concentrations in the OCPSF industries' wastewaters. Studies that have produced significant data on raw and current wastewater characteristics included in the loadings calculations include the 1983 Section 308 Questionnaire Survey, the Screening Studies (Phases I and II), and the Verification Study. Toxic and conventional pollutant data collected at the product/process level from the Verification Study make up the Master Process File. These studies are summarized in Table VIII-104 and discussed below. Toxic pollutant concentration data used for calculation of raw waste loads are presented in the Loadings Section of the Public Record.

TABLE VIII-103.
GENERIC CHEMICAL PROCESSES

Acid Cleavage	Fiber Production
Acylation	Fluorination
Addition	
Alcoholysis	Hydration
Alkoxylation	Hydroacetylation
Amination	Hydrocyanation
Ammoxidation	Hydrogenation
	Hydrohalogenation
Bromination	Hydrolysis
	Hydroxylation
Carbonylation	
Chlorination	Iodination
Chlorohydrination	Isomerization
Condensation	
Crystallization/Distillation	Neutralization
Cyanation	Nitration
	Nitrosation
Decarboxylation	
Dehydration	Oxidation
Dehydrogenation	Oxidation/Reduction
Dehydrohalogenation	Oximation
Depolymerization	Oxyhalogenation
Diazotization	
Dimerization	Peroxidation
Distillation	Phosgenation
	Phosphonation
Electrohydrodimerization	Polymerization
Epoxidation	Pyrolysis
Esterification	
Etherification	Rearrangement
Extraction	
Extractive Distillation	Sulfation
	Sulfonation
	Transesterification

TABLE VIII-104.
OVERVIEW OF WASTEWATER STUDIES INCLUDED IN RAW WASTEWATER TOXIC POLLUTANT LOADINGS CALCULATIONS

Element	Screening Study: Phase I	Screening Study: Phase II	Verification Study
Dates	August 1977 to March 1978	December 1979	1978 to 1980
Number of Plants	131	40	37
Direct Dischargers	-	14	30
Indirect Dischargers	-	14	5
Other Dischargers	-	2	2
Sampling Locations	Raw water, treatment influent and effluent, some product/process effluents	Same as Phase I	Product/process influents and effluents for 29 plastics and 147 organics, and raw water
Sampling Duration*	1 day	1 day	3 days
Pollutants Tested	All priority pollutants but asbestos	Same as Phase I	Specific pollutants from specific product/processes
Analytical Methods for Organic Pollutants	GC/MS, 1977 QA/QC protocol, 4-AAP for phenols	GC/MS, 1979 QA/QC protocol	GC/CD with confirmatory GC/MS on 10% of samples
Labs Participating	EPA Regions VII, VI, IV; Envirodyne; Midwest Research Institute (MRI)	Environmental Science & Engineering	Labs: Envirodyne, MRI, Southwest Research Institute, Gulf South Research Institute, Jacobs (PJB Labs), Acurex

*Generally, samples were 24-hour composites; cyanide, phenols, and volatile organics were generally grab samples or a series of grab samples.

Section 308 Questionnaire Data

In September 1983, the Agency requested new information on current manufacturing processes and wastewater control/treatment practices related to the production of organic chemicals and/or plastics and synthetic fibers. Data were collected at two levels: primary and secondary OCPSF plants. Primary plants (i.e., plants whose manufacture of OCPSF products was more than 50 percent of total plant production in 1982; plants whose OCPSF wastewaters were segregated; plants whose OCPSF process wastewaters represented 75 percent or more of total process wastewater flow treated in a treatment facility) provided a general profile of the plant, detailed production data, detailed wastewater treatment data, detailed disposal techniques, and analytical data summaries. Secondary OCPSF plants (i.e., plants not meeting the above criteria) provided only general profile data.

With regard to toxic pollutant data, the Agency requested 1980 average priority pollutant concentration data from primary organic and plastics producers for the following sample points:

- Influent and effluent data for in-plant wastewater control or treatment unit operations
- Influent to the main (end-of-pipe) wastewater treatment system
- Intermediate sampling points within the main (end-of-pipe) wastewater treatment system
- The effluent sampling point from the main (end-of-pipe) wastewater treatment system
- The effluent sampling point if the wastewater is discharged without treatment.

Average concentrations for toxic pollutant parameters were calculated as follows:

- All not detected (ND), trace (TR), and less than (LT) the detection limit values were not included in the calculation of average concentrations
- All greater than (GT) the detection limit values were included in the calculation of average concentrations as the detection limit

- All ND, TR, and LT the detection limit values were counted in the number of observations below the detection limit.

No new analytical data were to be generated by this data request; additionally, data generated for design analysis or similar purposes were not to be reported. Of the 545 plants requested to submit analytical data, 40 plants submitted data useful for the calculation of raw waste loads.

Screening Phase I

The wastewater quality data reported in the 1976 Section 308 Questionnaires were the result of monitoring and analyses by each of the individual plants and their contract laboratories. To expand its priority pollutant data base and improve data quality by minimizing the discrepancies among sampling and analysis procedures, EPA performed the Phase I Screening Study in 1977 and 1978. The Agency and its contractors sampled at 131 plants, chosen because they operated product/processes that manufactured the highest volume organic chemicals, plastics and synthetic fibers.

Samples were taken of the raw plant water, some product/process influent and effluents, and influents and effluents at the plant wastewater treatment facilities. Samples were analyzed for all priority pollutants except asbestos, and for several conventional and nonconventional pollutants. Screening samples were collected and analyzed in accordance with procedures described in the EPA Screening Procedures Manual (1977).

Screening Phase II

In December 1979, samples were collected from an additional 40 plants (known as Phase II facilities) manufacturing products such as dyes, flame retardants, coal tar distillates, photographic chemicals, flavors, surface active agents, aerosols, petroleum additives, chelating agents, microcrystalling waxes, and other low volume specialty chemicals. As in the Phase I Screening Study, samples were analyzed for all the priority pollutants except asbestos. Procedures delineated in the 1977 EPA Screening Manual were followed in analyzing priority pollutants. As in Screening Phase I, some samples for metals analysis were preserved by addition of acid in the field (in accordance with the 1977 Manual), and acid was added to the remaining samples when they arrived at the laboratory. In addition, the organic compounds producing peaks not attributable to priority pollutants with a magnitude of at least 1 percent of the total ion current were identified by computer matching.

Intake, raw influent, and effluent samples were collected for nearly every facility sampled. In addition, product/process wastewaters that could be isolated at a facility were also sampled, as were influents and effluents from some treatment technologies in place. Fourteen direct dischargers, 24 indirect dischargers, and two plants discharging to deep wells were sampled. Table VIII-105 lists the product/process and other waste streams sampled at each plant.

Verification Program

The Verification Program was designed to verify the occurrence of specific priority pollutants in waste streams from individual product/processes. Product/processes to be sampled were chosen to maximize coverage of the product/processes used to manufacture major organic chemicals and plastics. The priority pollutants selected for analysis in the waste stream from each product/process were chosen to meet either of two criteria:

- They were believed to be raw materials, precursors, or products in the product/process, according to the process chemistry employed by the plant
- They had been detected in the grab samples taken several weeks before the 3-day Verification Program.

The Agency sampled at six integrated manufacturing facilities for the pilot program to develop the "Verification Protocol." Thirty-seven plants were eventually involved in the Verification effort. Samples were taken from the effluents of 147 product/processes manufacturing organic chemicals and 29 product/processes manufacturing plastics and synthetic fibers, as well as from treatment system influents and effluents at selected facilities.

TABLE VIII-105.
PHASE II SCREENING - PRODUCT/PROCESS AND OTHER
WASTE STREAMS SAMPLED AT EACH PLANT

Plant Number	Waste Stream Samples
1	Combined raw waste (fluorocarbon)
2	Anthracene Coal tar pitch
3	Combined raw wastes (dyes)
4	Combined raw wastes (coal tar)
5	Combined raw wastes (dyes)
6	Oxide Polymer
7	Freon
8	Freon
9	Ethoxylation
10	Nonlube oil additives Lube oil additives
11	Combined raw wastes (dyes)
12	Combined raw wastes (flavors)
13	Combined raw wastes (specialty chemicals)
14	Combined raw wastes (flavors)
15	Hydroquinone
16	Esters Polyethylene Sorbitan monosterate
17	Dyes
18	Combined raw wastes (surface active agents)
19	Fatty acids

TABLE VIII-105.
PHASE II SCREENING - PRODUCT/PROCESS AND OTHER
WASTE STREAMS SAMPLED AT EACH PLANT
(Continued)

Plant Number	Waste Stream Samples
20	Organic pigments Salicylic acid Fluorescent brightening agent
21	Surfactants
22	Dyes
23	Combined raw wastes (flavors)
24	Chlorination of paraffin
25	Phthalic anhydride
26	Combined raw wastes (unspecified)
27	Dicyclohexyl phthalate
28	Plasticizers Resins
29	Combined raw wastes (unspecified)
30	Polybutyl phenol Zinc Dialkyldithiophosphate Calcium phenate Mannich condensation product Oxidized co-polymers
31	Tris (β-chloroethyl) phosphate
32	Ether sulfate sodium salt Lauryl sulfate sodium salt Xylene distillation
33	Dyes
34	Maleic anhydride Formax formaldehyde Phosphate ester Hexamethylenetetramine

TABLE VIII-105.
PHASE II SCREENING - PRODUCT/PROCESS AND OTHER
WASTE STREAMS SAMPLED AT EACH PLANT
(Continued)

Plant Number	Waste Stream Samples
35	Acetic acid
36	Combined raw wastes (coal tar)
37	"680" Brominated fire retardants Tetrabromophthalic anhydride Hexabromocyclodedecane
38	Hexabromocyclodedecane
39	Fatty acid amine ester Calcium sulfonate in solvent (alcohol) Oil field deemulsifier blend (aromatic solvent) Oxylakylated phenol--formaldehyde resin Ethoxylated monyl phenol Ethoxylated phenol--formaldehyde resin
40	Combined raw wastes (surface active agents)

Each plant was visited about 4 weeks before the 3-day Verification sampling to discuss the sampling program with plant personnel, to determine in-plant sampling locations, and to take a grab sample at each designated sampling site. These samples were analyzed to develop the analytical methods used at each plant for the 3-day Verification Program and to develop the target list of pollutants described above for analyses at each site during the 3-day sampling. Some pollutants that had been put on the list for Verification since they were believed to be raw materials, precursors, or co-products were not detected in the Verification Program grab samples. If such a pollutant was also not detected in the sample from the first day of the 3-day Verification sampling, it was dropped from the analysis list for that sample location. Other compounds were added to the analysis list when they were found in the Verification grab sample at a concentration exceeding the analytical minimum level. Priority pollutants known by plant personnel to be present in the plant's wastewater were also added to the Verification list.

At each plant, Verification samples generally included process water supply, product/process effluents, and treatment facility influent and effluent. Water being supplied to the process was sampled to establish the background concentration of priority pollutants. The product/process effluent waste loads were later corrected for these influent waste loadings. Product/process samples were taken at locations that would best provide representative samples. At various plants, samples were taken at the influent to and effluent from both in-process and end-of-pipe wastewater treatment systems.

d. Flow Data

Flow data are derived exclusively from the 1983 Section 308 Questionnaire responses. Wastewater flow data from primary organic chemical and plastics facilities are provided for each individual product/process by wastewater source (e.g., an aqueous waste stream resulting from quenching of a reaction product, or washdown of process equipment); for product groups at in-plant, preliminary, secondary, and tertiary treatment processes (i.e., wastewater effluent flows through these treatment processes); for miscellaneous wastewaters entering the main treatment system; and for final effluent discharge. These data allow waste loads to be calculated for individual product/processes, product groups, or total plant effluent for primary organic chemical and plastics producers provided that corresponding toxic pollutant data are available.

In some instances, primary organic chemical and plastic plants reported data for combined product/processes; moreover, certain plants did not provide product/process-specific data. In such cases, product/process flows were estimated by production in weighting either product group flow, if available, or total wastewater flow, if product group flow was unavailable. For plants that did not provide production data, total process flow was apportioned equally between product/processes.

Secondary OCPSF plants provided only general data regarding plant operations. These data include 1982 production data by eight-digit Census product code, OCPSF process and nonprocess wastewater flow, total plant wastewater flow, OCPSF process wastewater disposal methods, treatment technologies, and pollutant summaries. Wastewater flow was not reported by product/process for secondary plants.

e. <u>Waste Load Calculation</u>

It is obvious from the preceding discussion that primary OCPSF plant-specific waste loads can be calculated in more than one way, depending on the availability of toxic pollutant concentration data and flow data. For primary plants that have provided 1983 Section 308 Questionnaire toxic pollutant data, waste loads for individual pollutants may be estimated. Waste loads can be calculated for a given plant on the basis of either product/processes employed by that plant or the products manufactured by that plant. Waste loads can also be calculated on the basis of the generic processes employed by a plant. Secondary OCPSF plant toxic pollutant waste loads must be calculated in a fundamentally different way and extrapolated from primary OCPSF plant toxic pollutant waste loads.

There are limitations to each waste load calculation approach. Although waste load calculations using plant-specific toxic pollutant concentrations (either from 1983 Section 308 Questionnaire data or screening data) are likely to be most accurate, such data are available for relatively few plants. Waste load calculations using MPF toxic pollutant concentrations can be made for all plants employing product/processes contained in the MPF. The MPF can be generalized to products, allowing even greater coverage of the OCPSF industry. Most generally, waste loads may be generated on the basis of the generic process chemistry employed by a plant.

Rather than select any one method for waste load calculation, the Agency determined that all waste load calculation methods would be used when appropriate, thus providing maximum coverage of the industry with the greatest accuracy possible. The following hierarchy of data sources was established:

1) Where Section 308 Questionnaire toxic pollutant data were available, these data would be used to calculate raw waste loads for those toxic pollutants.

2) Where the combined raw wastewaters of a plant had been sampled in either Phase I or Phase II screening studies, these toxic pollutant concentration data would be used to calculate the raw waste loads from these plants.

3) Raw waste loads would next be calculated using MPF toxic pollutant concentration data for product/processes covered by the MPF. Where product/process waste loads could not be calculated at a plant, product-specific waste loads were calculated using the Product Averaged Master Process File.

4) For plants manufacturing products that could not be calculated by the above methods, generic process raw waste loads were calculated using the Generic Process Averaged Master Process File. Because the generic process method necessarily generated extraneous pollutants for any given product, raw waste loads from these plants were extensively reviewed; those pollutants believed to be inconsistent with process chemistry practiced at a plant were deleted from the raw waste load file. Pollutants deleted from the generic process averaged waste loads are presented in the Loadings Section of the Public Record.

Figure VIII-55 summarizes the methodology used to calculate raw waste loads.

Waste loads for secondary OCPSF plants were extrapolated from the waste loads calculated for primary OCPSF plants in the following way:

- Flow-weighted toxic pollutant concentrations were calculated for each subcategory using data from primary OCPSF plants:

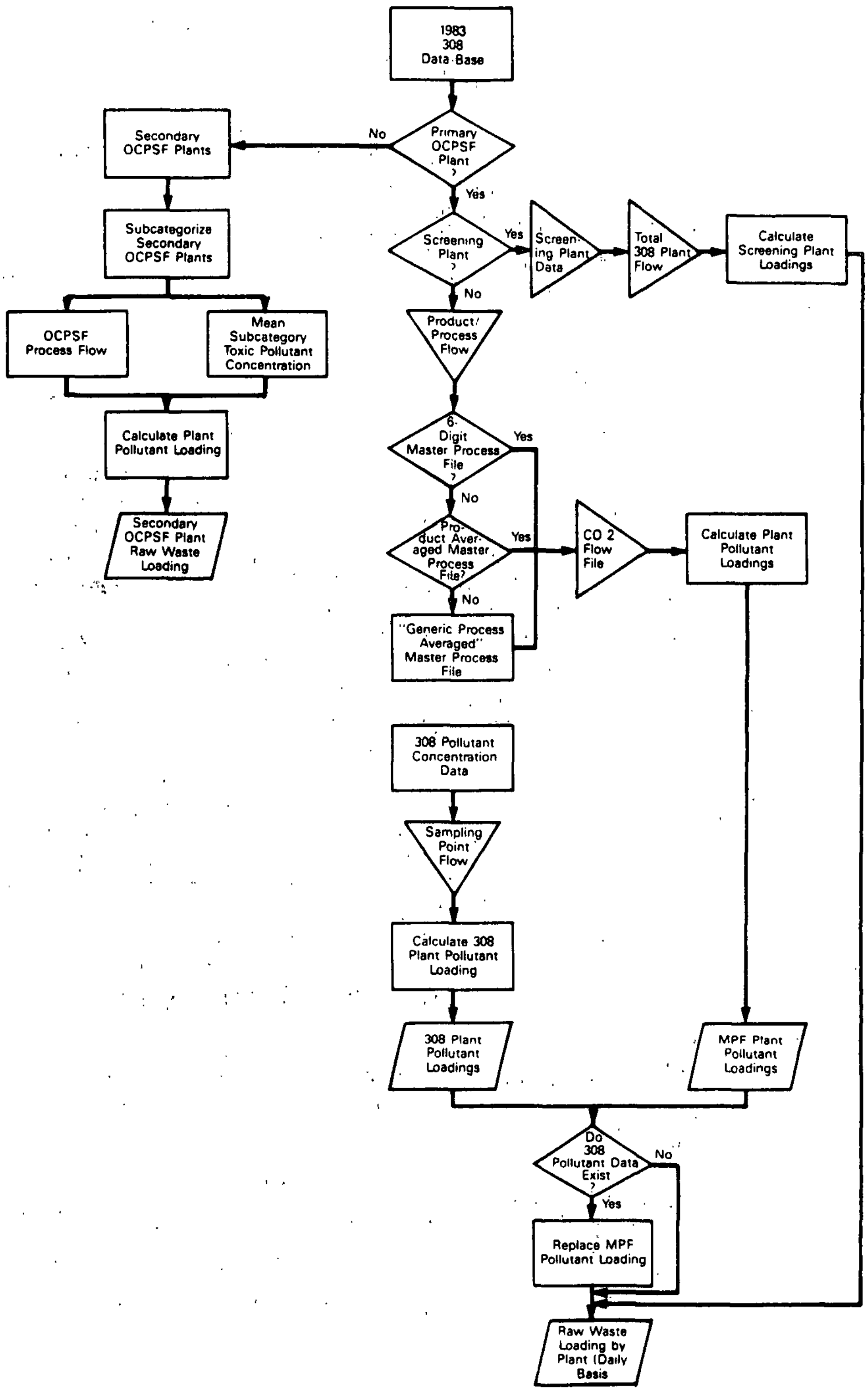


Figure VIII-55. Raw Waste Load Calculation Logic Flow

$$\bar{C}_{i,k} = \sum_{j=1}^{n} RWL_{i,j,k} \Big/ \sum_{j=1}^{n} F_{j,k}$$

where:

$\bar{C}_{i,k}$ = the mean toxic pollutant concentration of pollutant i for subcategory k

$RWL_{i,j,k}$ = the raw waste load for pollutant i at plant j of subcategory k

$F_{j,k}$ = the total process flow for plant j of subcategory k.

- Plant-specific raw waste loads are calculated from mean subcategory toxic pollutant concentrations and the OCPSF process flow at a plant:

$$RWL_{i,j'} = \bar{C}_{i,k}(F_{j'})$$

where:

$RWL_{i,j'}$ = the raw waste load for toxic pollutant i at plant j' (where ' denotes a secondary OCPSF plant)

$F_{j'}$ = the total OCPSF process at plant j'.

f. BPT, BAT, and Current Waste Load Calculations

BPT, BAT, and current waste load of individual plants were calculated for those pollutants found in the raw waste load as follows:

- Average toxic pollutant effluent concentrations were calculated using the toxic pollutant sampling data base (i.e., Verification, EPA/CMA 5-Plant and EPA 12-Plant sampling studies). Separate toxic pollutant effluent concentrations were calculated to represent the loadings following compliance with BPT, BAT, and PSES effluent limitations. These BPT, BAT, and PSES toxic pollutant effluent concentrations are presented in Table VIII-106.

- To calculate current wastewater loadings for direct dischargers, BPT toxic pollutant concentrations were adjusted for those plants that incurred BPT compliance costs by the ratio of actual BOD_5 to the target BOD_5 calculated for that individual plant by the BPT regression model (based on editing rules of at least 95% BOD_5 removal or 40 mg/l BOD_5). Plants that did not incur BPT compliance costs were assigned current loadings based on the BPT effluent concentrations, while plants that incurred neither BPT nor BAT compliance costs were assigned current loadings based on the BAT effluent concentrations.

TABLE VIII-106.
BPT, BAT OPTION II, BAT OPTION III, AND PSES
TOXIC POLLUTANT CONCENTRATIONS USED IN LOADINGS

Pollutant Number	Pollutant Name	BPT (ppb)	BAT Option II (ppb)	BAT Option III (ppb)	PSES (ppb)
1	Acenaphthene	10	10	10	10
2	Acrolein	50	50	50	50
3	Acrylonitrile	50	50	50	50
4	Benzene	10	10	10	29
5	Benzidine	187	50	50	50
6	Carbon Tetrachloride	10	10	10	65
7	Chlorobenzene	10	10	10	65
8	1,2,4-Trichlorobenzene	43	43	10	65
9	Hexachlorobenzene	10	10	10	65
10	1,2-Dichloroethane	382	85	10	65
11	1,1,1-Trichloroethane	10	10	10	10
12	Hexachloroethane	10	10	10	65
13	1,1-Dichloroethane	10	10	10	10
14	1,1,2-Trichoroethane	10	10	10	10
15	1,1,2,2-Tetrachloroethane	10	10	10	65
16	Chloroethane	50	50	50	50
18	Bis(2-Chloroethyl) Ether	430	65	10	65
19	2-Chloroethyl Vinyl Ether	293	65	10	65
20	2-Chloronaphthalene	10	10	10	10
21	2,4,6-Trichlorophenol	358	50	10	50
22	p-Chloro-m-Cresol	143	32	10	50
23	Chloroform	17	17	10	44
24	2-Chlorophenol	10	10	10	50
25	1,2-Dichlorobenzene	48	48	10	65
26	1,3-Dichlorobenzene	25	25	10	65
27	1,4-Dichlorobenzene	10	10	10	65
28	3,3-Dichlorobenzene	187	50	50	50

TABLE VIII-106.
BPT, BAT OPTION II, BAT OPTION III, AND PSES
TOXIC POLLUTANT CONCENTRATIONS USED IN LOADINGS
(Continued)

Pollutant Number	Pollutant Name	BPT (ppb)	BAT Option II (ppb)	BAT Option III (ppb)	PSES (ppb)
29	1,1-Dichloroethene	10	10	10	10
30	trans-1,2-Dichloroethylene	78	10	10	11
31	2,4-Dichlorophenol	18	18	10	50
32	1,2-Dichloropropane	122	65	10	65
33	1,3-Dichloropropene	23	23	10	65
34	2,4-Dimethylphenol	10	10	10	10
35	2,4-Dinitrotoluene	59	59	10	50
36	2,6-Dinitrotoluene	133	133	10	50
37	1,2-Diphenylhydrazine	187	50	50	50
38	Ethyl Benzene	10	10	10	65
39	Fluoranthene	12	12	10	12
40	4-Chlorophenyl phenyl Ether	50	50	50	50
41	4-Bromophenyl phenyl Ether	50	50	50	50
42	Bis(2-chloroisopropyl) Ether	157	65	10	65
43	Bis-chloroethoxy Methane	293	65	10	65
44	Methylene chloride	150	23	10	11
45	Methyl Chloride	50	50	50	50
46	Methyl Bromide	43	27	15	49
47	Bromoform	43	27	15	49
48	Dichlorobromomethane	22	22	10	65
51	Chlorodibromomethane	38	38	10	65
52	Hexachlorobutadiene	10	10	10	65
53	Hexachlorocyclopentadiene	50	50	50	50
54	Isophorone	46	46	16	50
55	Naphthalene	10	10	10	10
56	Nitrobenzene	14	14	14	949
57	2-Nitrophenol	28	28	20	20

TABLE VIII-106.
BPT, BAT OPTION II, BAT OPTION III, AND PSES
TOXIC POLLUTANT CONCENTRATIONS USED IN LOADINGS
(Continued)

Pollutant Number	Pollutant Name	BPT (ppb)	BAT Option II (ppb)	BAT Option III (ppb)	PSES (ppb)
58	4-Nitrophenol	50	50	50	50
59	2,4-Dinitrophenol	50	50	50	373
60	4,6-Dinitro-o-cresol	24	24	24	24
61	N-Nitrosodimethylamine	50	50	50	50
62	N-Nitrosodiphenylamine	50	50	50	50
63	N-Nitrosodi-n-propylamine	50	50	50	50
64	Pentachlorophenol	188	50	50	50
65	Phenol	10	10	10	10
66	Bis(2-ethylhexyl) Phthalate	47	47	10	44
67	Butyl Benzyl Phthalate	30	30	10	23
68	Di-n-Butyl Phthalate	18	18	10	13
69	Di-n-Octyl Phthalate	30	30	10	23
70	Diethyl Phthalate	43	43	10	24
71	Dimethyl Phthalate	10	10	10	10
72	Benzo(a) Anthracene	10	10	10	10
73	Benzo(a) Pyrene	10	10	10	10
74	3,4-Benzofluoranthene	10	10	10	10
75	Benzo(k) Fluoranthene	10	10	10	10
76	Chrysene	10	10	10	10
77	Acenaphthylene	10	10	10	10
78	Anthracene	10	10	10	10
79	Benzo(ghi) perylene	10	10	10	10
80	Fluorene	10	10	10	10
81	Phenanthrene	10	10	10	10
82	Dibenzo (a,h) Anthracene	10	10	10	10
83	Indeno(1,2,3-d) Pyrene	10	10	10	10
84	Pyrene	11	11	10	10

TABLE VIII-106.
BPT, BAT OPTION II, BAT OPTION III, AND PSES
TOXIC POLLUTANT CONCENTRATIONS USED IN LOADINGS
(Continued)

Pollutant Number	Pollutant Name	BPT (ppb)	BAT Option II (ppb)	BAT Option III (ppb)	PSES (ppb)
85	Tetrachloroethylene	13	10	10	12
86	Toluene	10	10	10	13
87	Trichloroethylene	13	10	10	12
88	Vinyl Chloride	--	50	65	50
114	Antimony	158	158	158	158
119	Chromium	572	572	572	572
120	Copper	815	815	815	815
121	Cyanide	180	180	180	180
122	Lead	197	197	197	197
124	Nickel	942	942	942	942
128	Zinc	549	549	549	549

- To calculate current loadings for indirect dischargers, plants that incurred PSES compliance costs were assigned current loadings based on the raw waste concentration of each pollutant present. Plants that did not incur PSES compliance costs were assigned current loadings based on the PSES effluent concentrations.

- Effluent concentrations as derived above were multiplied by the total process wastewater flow to calculate current loadings, while loadings after compliance with BPT, BAT, and PSES effluent limitations were calculated by multiplying total process wastewater flow by the BPT, BAT, and PSES effluent concentration presented in Table VIII-106.

- Since current, BPT, BAT, and PSES toxic pollutant wastewater loadings were calculated using effluent concentrations based on industry average sampling data, in some cases, these loadings exceeded the raw waste loadings of certain toxic pollutants. In such cases, the loading for these toxic pollutants was deleted from the applicable loading file.

Figures VIII-56 and VIII-57 present the methodology used to calculate 1) current, BPT, and BAT loadings for direct dischargers, and 2) current and PSES loadings for indirect dischargers, respectively.

g. Annualized Waste Load

Product/process flow data provided by primary OCPSF plants in the 1983 Section 308 Questionnaire are reported in millions of gallons per day (MGD) when operating. Primary plants have also provided total annual production data and operating rate data by product/process. The Agency has calculated operating days for each product/process at each primary OCPSF plant by dividing the annual product/process production by the product/process operating rate. Multiplication of daily product/process waste load by product/process operating days yields annualized product/process waste loads. Toxic pollutant waste loads from individual product/processes at a plant are then summed by pollutant to yield total waste load for individual plants.

Product/process production data are unavailable for secondary OCPSF producers, and annual waste loads cannot be calculated in a manner analogous to those estimated for primary OCPSF plants. Annual waste loadings from secondary OCPSF plants were estimated from daily waste loads by assuming that OCPSF product/processes generating wastewaters operated 4 days per week or 208 days per year.

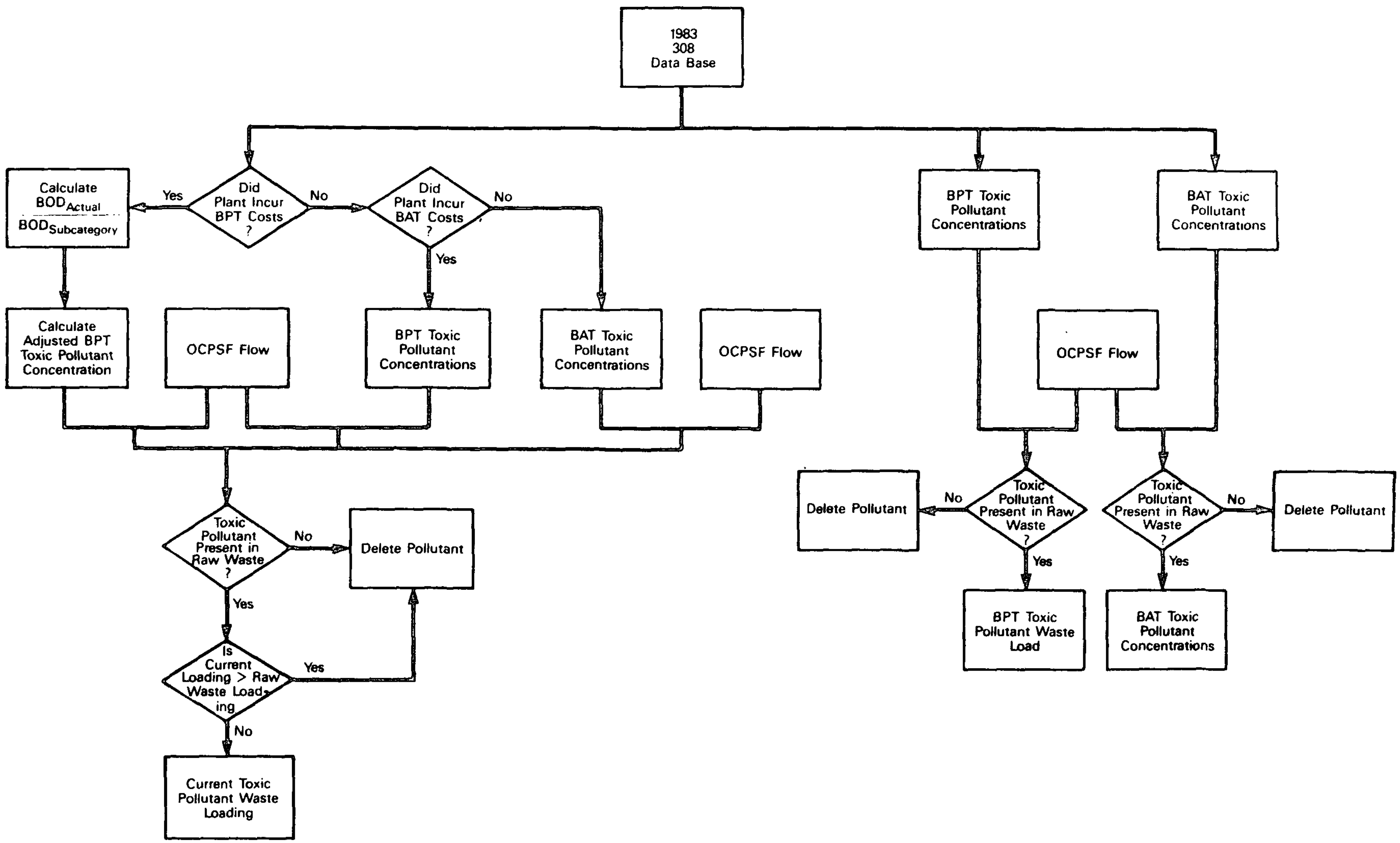


Figure VIII-56. BPT, BAT, and Current Waste Load Calculation Logic Flow

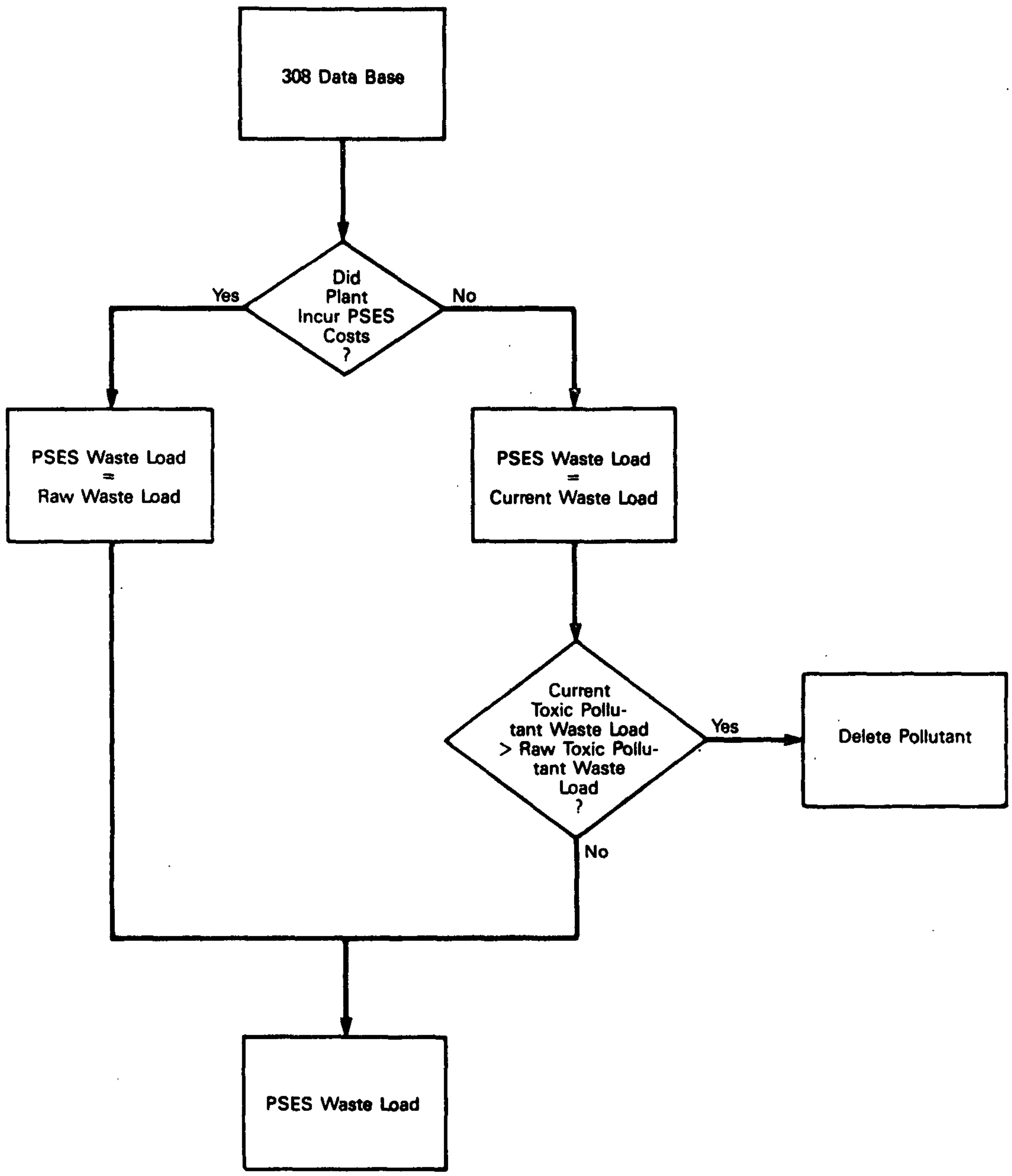


Figure VIII-57. PSES Waste Load Calculation

h. Raw Waste Load Validation

Where OCPSF plants have provided toxic pollutant data (i.e., 1983 Section 308 Questionnaire analytical data summaries) or were sampled during the Phase I or Phase II screening studies, comparison of these toxic pollutant raw waste loads with those calculated using the Master Process File has proven possible. Differences between toxic pollutant waste loads calculated from 1983 Section 308 Questionnaire toxic pollutant concentrations were calculated and then compared statistically using the t-Test. Raw waste loads calculated from screening data were similarly compared to raw waste loads calculated using the MPF. In neither case were significant differences found between calculation methods. Details of these validation analyses can be found in the Loadings Section of the Public Record.

i. Summary

Table VIII-107 presents the raw waste, current, and BAT toxic pollutant wastewater loadings for OCPSF direct discharging plants; Table VIII-108 presents the raw waste, current, and PSES toxic pollutant wastewater loadings for OCPSF indirect discharging plants. As noted in the previous section, loadings for 12 plants were re-examined and revised based on the methodology detailed. Appendix VIII - D presents plant-by-plant current, BAT (Option II), and PSES wastewater loadings.

3. BAT and PSES Toxic Pollutant Air Emission Loadings

EPA has concluded that at least 32 toxic pollutants are emitted to the air by OCPSF wastewater treatment systems, and EPA has estimated the amount of these emissions. In order to estimate the toxic pollutant air emissions generated by OCPSF treatment systems and the associated reductions resulting from the implementation of the final BAT and PSES effluent limitations, the Agency developed a methodology that utilized the plant-by-plant wastewater loadings and fraction volatilized factors (f_i) that were generally obtained from the Agency's February 1986 Domestic Sewage Study. A discussion of the selection of volatile pollutants and the f_is follows.

TABLE VIII-107
BAT WASTEWATER TOXIC POLLUTANT LOADINGS

CHEMNUM	CHEMNAME	RAW WASTE LOAD(LBS/YR)	CURRENT LOAD(LBS/YR)	BAT OPTION I LOAD(LBS/YR)	BAT OPTION II LOAD(LBS/YR)	BAT OPTION III LOAD(LBS/YR)
1	ACENAPHTHENE	103844	3419	1707.9	1707.9	1707.9
2	ACROLEIN	53353920	12856	5385.2	5385.2	5385.2
3	ACRYLONITRILE	2576531	22474	12190.4	12190.4	12190.4
4	BENZENE	3430633	83748	4953.0	4953.0	4953.0
6	CARBON TETRACHLORIDE	175502	4521	2070.5	2070.5	2070.5
7	CHLOROBENZENE	287968	2260	1394.2	1394.2	1394.2
8	1,2,4-TRICHLOROBENZENE	29685	2080	1752.0	1752.0	407.4
9	HEXACHLOROBENZENE	452324	691	604.4	604.4	604.4
10	1,2-DICHLOROETHANE	5414413	120851	59269.9	14380.4	1915.1
11	1,1,1-TRICHLOROETHANE	18898	2959	1657.7	1657.7	1657.7
12	HEXACHLOROETHANE	1389593	515	463.2	463.2	463.2
13	1,1-DICHLOROETHANE	169802	2650	1318.3	1318.3	1318.3
14	1,1,2-TRICHLOROETHANE	4150846	4020	1028.2	1028.2	1028.2
15	1,1,2,2-TETRACHLOROETHANE	1378	704	581.5	581.5	581.5
16	CHLOROETHANE	395564	12897	7909.3	7909.3	7909.3
20	2-CHLORONAPHTHALENE	1732	901	866.9	866.9	866.9
21	2,4,6-TRICHLOROPHENOL	55320	14106	12902.3	1837.8	367.6
22	PARA-CHLORO-META-CRESOL	78280	7103	6621.8	1482.2	463.2
23	CHLOROFORM	253890	9240	3894.6	3894.6	2334.2
24	2-CHLOROPHENOL	280084	1946	1298.7	1298.7	1298.7
25	1,2-DICHLOROBENZENE (O-DICHLOROBENZENE)	79201	6815	5534.9	5534.9	1260.4
26	1,3-DICHLOROBENZENE (M-DICHLOROBENZENE)	18372	1907	1558.9	1558.9	899.7
27	1,4-DICHLOROBENZENE (P-DICHLOROBENZENE)	1432289	1132	580.9	580.9	580.9
28	3,3-DICHLOROBENZIDINE	1194611	7388	6759.3	1837.8	1837.8
29	VINYLIDENE CHLORIDE	1156644	2934	1434.1	1434.1	1434.1
30	1,2-TRANSDICHLOROETHYLENE	136139	3519	3255.1	508.0	508.0
31	2,4-DICHLOROPHENOL	250756	1900	1750.5	1750.5	998.1
32	PROPYLENE CHLORIDE	377635	8012	6891.7	3726.7	659.2
33	1,3-DICHLOROPROPENE	25407	1341	1164.6	1164.6	563.9
34	2,4-DIMETHYLPHENOL	297441	2399	1504.4	1504.4	1504.4
35	2,4-DINITROTOLUENE	174705	7280	6009.3	6009.3	1018.5
36	2,6-DINITROTOLUENE	28015	7913	6295.9	6295.9	473.4
38	ETHYLBENZENE	466646	9283	4536.0	4536.0	4536.0
39	FLUORANTHENE	19413	2761	1938.5	1938.5	1649.8
42	BIS-(2-CHLOROISOPROPYL) ETHER	6111	4714	4682.2	1939.0	298.3
44	DICHLOROMETHANE	931933	19051	12021.3	3143.2	1366.6
45	CHLOROMETHANE	3678170	12460	7723.1	7723.1	7723.1
48	DICHLOROBROMOMETHANE	2851	1285	1116.0	1116.0	563.9
49	TRICHLOROFLUOROMETHANE	1480	1480	1308.8	1308.8	1308.8
54	ISOPHORONE	471723	2951	2586.6	2586.6	899.7
55	NAPHTHALENE	494427	12642	4363.7	4363.7	4363.7
56	NITROBENZENE	4526906	2275	1673.8	1673.8	1673.8
57	2-NITROPHENOL	31175	3183	2645.5	2645.5	1894.2
58	4-NITROPHENOL	69179	4729	4437.6	4437.6	4437.6
59	2,4-DINITROPHENOL	45335	3827	2639.5	2639.5	2639.5
60	4,6-DINITRO-O-CRESOL	38041	2133	2052.5	2052.5	2052.5
63	N-NITROSODI-N-PROPYLAMINE	4024	1971	1802.9	1802.9	1802.9
65	PHENOL	25845385	41619	7006.8	7006.8	7006.8

TABLE VIII-107 (CONT.)
BAT WASTEWATER TOXIC POLLUTANT LOADINGS

CHEMNUM	CHEMNAME	RAW WASTE LOAD(LBS/YR)	CURRENT LOAD(LBS/YR)	BAT OPTION I LOAD(LBS/YR)	BAT OPTION II LOAD(LBS/YR)	BAT OPTION III LOAD(LBS/YR)
66	BIS-(2-ETHYLHEXYL) PHTHALATE	187707	6210	5402	5402	1546
67	BUTYLBENZYL PHTHALATE	4986	2749	2616	2616	872
68	DI-N-BUTYL PHTHALATE	99106	2306	1584	1584	930
69	DI-N-OCTYL PHTHALATE	7147	1941	1686	1686	738
70	DIETHYL PHTHALATE	84327	3577	2735	2735	717
71	DIMETHYL PHTHALATE	323733	1459	1067	1067	1067
72	BENZO(A)ANTHRACENE	2784	801	499	499	499
73	BENZO(AH)PYRENE	1004	636	517	517	517
74	BENZO-B-FLUORANTHENE	703	501	425	425	425
75	BENZO(K)FLUORANTHENE	1134	464	389	389	389
76	CHRYSENE	22399	1201	932	932	932
77	ACENAPHTHYLENE	136631	4446	2847	2847	2847
78	ANTHRACENE	75063	6224	2174	2174	2174
79	BENZO(GHI)PERYLENE	2066	965	929	929	929
80	FLUORENE	406247	5347	2867	2867	2867
81	PHENANTHRENE	309952	3308	2110	2110	2110
82	DIBENZO(A,H)ANTHRACENE	2040	492	458	458	458
83	INDENO(1,2,3-C,D)PYRENE	820	567	557	557	557
84	PYRENE	36539	2839	1599	1599	1459
85	PERCHLOROETHYLENE	75217	2374	1279	1279	1279
86	TOLUENE	4077645	33313	5497	5497	5497
87	TRICHLOROETHYLENE	241515	3985	2237	1758	1758
88	CHLOROETHYLENE	65897	28808	28789	28808	28808
114	ANTIMONY (TOTAL)	36039	10765	9359	9359	9359
119	CHROMIUM (TOTAL)	857868	66044	59519	59519	59519
120	COPPER (TOTAL)	3027365	66908	51359	51359	51359
121	CYANIDE (TOTAL)	5567735	28017	19561	19561	19561
122	LEAD (TOTAL)	3662889	14480	10508	10508	10508
128	ZINC (TOTAL)	18105273	808370	257668	121707	121707
		=========	=======	======	======	======
		151846052	1597940	710316	490345	436261

TABLE VIII-108
PSES WASTEWATER TOXIC POLLUTANT LOADINGS

CHEMNUM	CHEMNAME	RAW WASTE LOAD(LBS/YR)	CURRENT LOAD(LBS/YR)	PSES OPTION IV LOAD(LBS/YR)
1	ACENAPHTHENE	79630	73798	97.22
2	ACROLEIN	4724519	4597806	1367.23
3	ACRYLONITRILE	350105	342338	1228.51
4	BENZENE	373103	354554	1889.58
6	CARBON TETRACHLORIDE	23969	22661	688.15
7	CHLOROBENZENE	1713	1576	358.77
8	1,2,4-TRICHLOROBENZENE	20203	19621	1220.92
9	HEXACHLOROBENZENE	1800	1649	341.91
10	1,2-DICHLOROETHANE	48388	43956	1525.36
11	1,1,1-TRICHLOROETHANE	502	493	203.55
13	1,1-DICHLOROETHANE	23687	23228	144.00
14	1,1,2-TRICHLOROETHANE	138538	131567	113.43
16	CHLOROETHANE	38314	36573	543.31
20	2-CHLORONAPHTHALENE	120	115	61.91
23	CHLOROFORM	14468	13985	782.45
24	2-CHLOROPHENOL	16124	15308	646.82
25	1,2-DICHLOROBENZENE (O-DICHLOROBENZENE)	7309	6774	454.48
26	1,3-DICHLOROBENZENE (M-DICHLOROBENZENE)	4693	4327	413.67
27	1,4-DICHLOROBENZENE (P-DICHLOROBENZENE)	3592	3320	413.67
29	VINYLIDENE CHLORIDE	5573	5251	85.22
30	1,2-TRANSDICHLOROETHYLENE	492	470	93.75
31	2,4-DICHLOROPHENOL	307	302	262.61
32	PROPYLENE CHLORIDE	250942	238913	926.33
34	2,4-DIMETHYLPHENOL	97893	93052	108.57
35	2,4-DINITROTOLUENE	20546	18919	336.02
36	2,6-DINITROTOLUENE	6510	5988	322.47
38	ETHYLBENZENE	371653	365061	3240.86
39	FLUORANTHENE	23337	21216	71.67
42	BIS-(2-CHLOROISOPROPYL) ETHER	2093	1975	482.04
44	DICHLOROMETHANE	7777	7663	416.06
45	CHLOROMETHANE	19364	18549	663.18
49	TRICHLOROFLUOROMETHANE	0	0	.
53	HEXACHLOROCYCLOPENTADIENE	795	795	84.53
54	ISOPHORONE	949	889	295.61
55	NAPHTHALENE	73546	70234	432.09
56	NITROBENZENE	95778	91122	9472.96
57	2-NITROPHENOL	844	784	129.84
58	4-NITROPHENOL	2616870	83	71.79
59	2,4-DINITROPHENOL	10014	9291	2197.01
64	PENTACHLOROPHENOL	116	116	98.46
65	PHENOL	9892346	7560961	770.40
66	BIS-(2-ETHYLHEXYL) PHTHALATE	27950	25806	817.45
67	BUTYLBENZYL PHTHALATE	256	244	135.99
68	DI-N-BUTYL PHTHALATE	195	188	103.02
70	DIETHYL PHTHALATE	1021	938	143.85
71	DIMETHYL PHTHALATE	369	349	80.74
73	BENZO(AH)PYRENE	524	504	112.15
76	CHRYSENE	8255	7498	59.30

TABLE VIII-108(CONT.)

PSES WASTEWATER TOXIC POLLUTANT LOADINGS

CHEMNUM	CHEMNAME	RAW WASTE LOAD(LBS/YR)	CURRENT LOAD(LBS/YR)	PSES OPTION IV LOAD(LBS/YR)
77	ACENAPHTHYLENE	8739	4699	251.2
78	ANTHRACENE	1716	1650	135.5
79	BENZO(GHI)PERYLENE	121	116	52.4
80	FLUORENE	3229	2734	128.9
81	PHENANTHRENE	6960	6448	136.2
84	PYRENE	1743	1647	112.4
85	PERCHLOROETHYLENE	460	444	175.1
86	TOLUENE	914921	896498	1150.2
87	TRICHLOROETHYLENE	11932	11388	222.2
88	CHLOROETHYLENE	26519	26226	1706.0
114	ANTIMONY (TOTAL)	6756	6417	1671.6
120	COPPER (TOTAL)	2798484	2709650	23944.1
121	CYANIDE (TOTAL)	4200150	4055380	2530.5
122	LEAD (TOTAL)	124487	112139	2453.0
124	NICKEL (TOTAL)	54665	53949	2424.6
128	ZINC (TOTAL)	525758	438349	9775.6
		========	========	=======
		28093735	22568540	81378.5

a. Selection of Pollutants for Air Emission Assessments and Estimation of Volatilization Factors

The Agency proposed to establish in-plant limitations for 20 priority pollutant volatile organic compounds (VOCs) generally based on their propensity to volatilize from end-of-pipe biological treatment systems (50 FR 29071, July 17, 1985). Subsequent to this Notice, the Agency continued to study this issue.

There are essentially three dominant processes that affect the removal of pollutants from wastewater within treatment system unit operations: air stripping, adsorption to solids or the biomass, and biodegradation. The extent to which each process contributes to the removal of pollutants from wastewater can vary significantly. It is a function of both the physical and chemical characteristics of each pollutant, as well as the conditions present in each treatment unit operation.

The organic priority pollutants were divided into three "strippability" groups (high, medium, and low) as shown in Table VII-6 based on their Henry's Law Constants. A compound's potential for volatilization is related to its tendency to vaporize and its propensity to remain in solution. The principal measure that has been used in the literature is the Henry's Law Constant. The Henry's Law Constant is a ratio of a compound's vapor pressure and solubility, which measures a compound's tendency to partition between the aqueous and gaseous phases at equilibrium. The higher a substance's Henry's Law Constant, the more likely that compound is to migrate from water to air.

The initial list of 20 VOCs were expanded into a group of 32 selected volatile and semivolatile priority pollutant VOCs for the purposes of estimating a portion of the OCPSF industry priority pollutant air emissions from wastewater treatment systems and for estimating steam stripping with overhead recovery (or destruction) engineering costs of compliance. Use of steam stripping with recovery would ensure removal of VOCs from both the water and air media rather than allow the typical transfer of VOCs from water to air. Selection of the 32 VOCs was also influenced by two EPA studies that used various means to estimate the fraction f_i of volatile pollutants that would be emitted into the air from biological treatment systems--the February 1986

Report to Congress on the Discharge of Hazardous Wastes to Publicly Owned Treatment Works (The Domestic Sewage Study) and the National VOC Study (8-4). Table VIII-109 lists 40 of the 48 high and medium strippable priority pollutant VOCs that were either proposed for regulation in July 1985, or were finally regulated. The Domestic Sewage Study and the National VOC Study estimates of the fraction volatilized, f_i, from unacclimated biological treatment systems are listed in separate columns for each pollutant.

With three exceptions, a compound was included among the 32 selected VOCs if it had a high Henry's Law Constant; if it was proposed for in-plant limits in the July 1985 notice; or if its fraction volatilized was estimated to be approximately 20 percent or higher in either the Domestic Sewage Study or National VOC Study. However, acrylonitrile was included even though only 10 percent was estimated to volatilize from unacclimated biological treatment systems. Since acrylonitrile was among the "Top 50" chemicals produced in 1980, significant air emissions could result based on its production volume alone. Acenaphthene was included based on the initial judgment that less than 20 percent could be significant. Bromoform probably should have been included, but the Agency lacked sufficient information to promulgate effluent limitations.

The F_is used in the estimation of air emissions presented in this document are listed in the last column of Table VIII-109. They were based on the Domestic Sewage Study f_i estimates wherever possible; otherwise, the National VOC Study f_i estimates were used.

Based on considerations of removal mechanisms and typical treatment practices, several of the high and medium Henry's Law Constant pollutants were not included in the final list of 32 VOCs, because they would more likely be treated through adsorption or adsorption/biodegradation mechanisms rather than through steam stripping. For example, 4-nitrophenol and 4,6-dinitro-o-cresol are more appropriately treated by activated carbon, and another five pollutants [benzo(k)fluoranthene, acenaphthylene, anthracene, fluorene, and phenathrene] are appropriately treated by biological treatment or activated carbon. Similarly, three of the selected 32 VOCs (acenaphylene, acrylonitrile, and naphthalene) may be more appropriately treated with biological treatment or

TABLE VIII-109.
PRIORITY POLLUTANTS CONSIDERED FOR ESTIMATING A PORTION OF THE OCPSF INDUSTRY AIR EMISSIONS FROM WASTEWATER TREATMENT SYSTEMS FOR 32 SELECTED VOCS

Pollutant No.	Pollutant Name	Henry's Law Group	July 1985 Proposed In-Plant Limits	f_i DSS[1]	f_i NVOCS[2]	32 VOCS[3]	f_i For Air	Selected Estimating Emissions
1	Acenaphthene	M		<0.2	0.1	X		0.1
3	Acrylonitrile	M		0.05	0.1	X		0.05
4	Benzene	H	X	0.8	0.85	X		0.8
6	Carbon tetrachloride	H	X	0.9	0.8	X		0.9
7	Chlorobenzene	H	X	0.5	0.85	X		0.5
8	1,2,4-Trichlorobenzene	M		0.6	0.15	X		0.6
9	Hexachlorobenzene	M	X		0.1	X		0.1
10	1,2-Dichloroethane	M	X	0.9	0.5	X		0.9
11	1,1,1-Trichloroethane	H	X	0.9	0.8	X		0.9
12	Hexachloroethane	M	X	0.05	0.3	X		0.05
13	1,1-Dichloroethane	H		0.9	0.8	X		0.9
14	1,1,2-Trichloroethane	M	X	0.8	0.7	X		0.8
16	Chloroethane	H		0.9	0.8	X		0.9
23	Chloroform	H	X	0.9	0.8	X		0.9
25	1,2-Dichlorobenzene	M	X	0.9	0.4	X		0.9
26	1,3-Dichlorobenzene	H	X	0.9	0.4	X		0.9
27	1,4-Dichlorobenzene	H	X	0.9	0.4	X		0.9
29	1,1-Dichloroethylene	H	X	0.9	0.8	X		0.9
30	1,2-Trans-dichloroethylene	H	X	0.9	0.7	X		0.9
32	1,2-Dichloropropane	M	X	0.9	0.7	X		0.9
33	1,3-Dichloropropene	M			0.8	X		0.8
38	Ethylbenzene	H		0.8	0.85	X		0.8
42	Bis(2-chloroisopropyl) ether	M			0.5	X		0.5
44	Methylene chloride	M	X	0.6	0.8	X		0.6
45	Methyl chloride	H		0.95	0.95	X		0.95
47	Bromoform	M			0.3			

TABLE VIII-109.
PRIORITY POLLUTANTS CONSIDERED FOR ESTIMATING A PORTION OF THE OCPSF INDUSTRY AIR EMISSIONS FROM WASTEWATER TREATMENT SYSTEMS FOR 32 SELECTED VOCS
(Continued)

Pollutant No.	Pollutant Name	Henry's Law Group	July 1985 Proposed In-Plant Limits	f_i DSS[1]	f_i NVOCS[2]	32 VOCS[3]	f_i For Air	Selected Estimating Emissions
48	Dichlorobromomethane	H			0.6	X		0.6
52	Hexachlorobutadiene	M		0.05	0.2	X		0.05
55	Naphthalene	M		0.3	0.1	X		0.3
58	4-Nitrophenol	M			0.1			
60	4,6-Dinitro-o-cresol	M			0.1			
75	Benzo(k)fluoranthene	M			0.1			
77	Acenaphthylene	M			0.1			
78	Anthracene	M		0	0.1			
80	Fluorene	M			0.1			
81	Phenanthrene	M			0.1			
85	Tetrachloroethylene	H	X	0.8	0.6	X		0.8
86	Toluene	H	X	0.8	0.85	X		0.8
87	Trichloroethylene	H	X	0.8	0.8	X		0.8
88	Vinyl chloride	H	X	0.95	0.8	X		0.95

[1]Fraction volatilized from unacclimated biological treatment system. Source: The February 1986 Report to Congress on the Discharge of Hazardous Wastes to Publicly Owned Treatment Works (The Domestic Sewage Study).

[2]Fraction volatilized from unacclimated biological treatment systems. Source: A November 21, 1985 draft listing of f_is that were being developed for the National VOC Study. The final report (8-4) listed the f_i for 4-nitrophenol as 0.000.

[3]The 32 VOCs used for estimating a portion of the air emissions from OCPSF wastewater treatment systems.

activated carbon rather than steam stripping. Therefore, the remaining 29 of the selected 32 VOCs that were regulated had estimated engineering costs of compliance based on steam stripping controls.

b. Modification of the Pass-Through Analysis Based on Volatilization

For the purpose of considering volatilization in the pass-through analysis, the Agency reassessed the estimates of the fraction volatilized from unacclimated biological treatment systems, because these estimates did not fully consider air emissions prior to end-of-pipe biological systems or POTWs.

Most of the available information and research has focused on the fate of VOCs in biological treatment systems. Until recently, not many studies have focused on the fate of VOCs in wastewater collection systems and non-biological wastewater treatment unit operations. Nevertheless, volatile organic compounds are emitted from wastewater beginning at the point when the wastewater first contacts air. Thus, air pollutants from wastewater may be of concern immediately as the wastewater is discharged from the process unit operations. Sources of emissions include flumes, sumps, sewers, junction boxes, open storage tanks, screens, settling basins, equalization basins, pH adjustment stations, nutrient addition stations, biological treatment systems, air or steam strippers lacking overhead or product recovery, and any other units in contact with the air. Any source of turbulence such as a bend in the collection system, centrifical pump, or spray nozzle tends to increase air emissions. According to a 1984 field study of a wastewater treatment system at an organic chemicals facility cited in the Domestic Sewage Study, 10 to 15 percent of influent toluene volatilized in the primary system, 25 to 35 percent volatilized in the equalization basins, and 10 to 34 percent volatilized from the aeration basins.

In the pass-through analysis described in Section VI, three volatile pollutants (hexachlorobenzene, hexachloroethane, and hexachlorobutadiene) are regulated for BAT but have neither POTW nor bench- or pilot-scale performance data, and are regarded as passing through the POTW due to air emissions. Although relatively low percentages (5 to 10 percent) of the loadings of these three pollutants that reach the POTW biological treatment system are projected to be emitted into the air, as shown in Table VIII-110, an estimated 19 to 39, 59 to 66, and 48 to 73 percent, respectively, of the pollutants are projected to be emitted prior to the biological system. These estimates could be even higher considering the emissions from the POTW collection and sewer systems.

c. Calculation of BAT and PSES Air Emission Loadings

For direct discharging plants, the raw waste load for each pollutant was taken from the wastewater loadings, and the f_i for each pollutant was applied to generate current air emissions for each plant if steam stripping was not already in-place. If steam stripping was in-place, current air emission loadings were set equal to the BAT wastewater loadings multiplied by f_i. Then, depending on whether the plant was costed for steam stripping or had steam stripping in-place (which is the in-plant technology generally used to control the toxic pollutants that make up these air emissions) and if biological treatment was already in-place or costed for compliance with BPT, the air emission loadings related to compliance with BAT effluent limitations were calculated as follows:

- For plants without biological treatment in-place (or not costed for compliance with BPT) that were costed for steam stripping or have steam stripping already in-place, BAT priority pollutant air emission loadings were set equal to the BAT priority pollutant wastewater loadings multiplied by f_i for each pollutant.

- For plants with biological treatment in-place (or costed for compliance with BPT) that were costed for steam stripping or have steam stripping already in-place, BAT priority pollutant air emission loadings for each pollutant were set equal to 1.0 mg/l multiplied by OCPSF process flow, f_i, and units and annual loadings conversion factors.

- For all remaining plants, BAT priority pollutant air emissions loadings were set equal to current air emission loadings.

Prior to summation of individual pollutant BAT air emission loadings, a factor of 2.89 was applied to the BAT loadings to account for the general assumption that a plant with a steam stripper in-place would reduce all raw waste loadings of volatile pollutants to 1.0 mg/l (or BAT effluent levels if no biological treatment was in-place) prior to discharge to the end-of-pipe treatment system (where it was initially assumed all air emissions would

TABLE VIII-110.
VOLATILIZATION FROM PRE-BIOLOGICAL UNIT OPERATIONS
FOR SELECTED VOCs

Pollutant No.	Pollutant Name	Estimated Pre-biological Volatilization[1] Based on Residence Times of 24-hours	48-hours	Biological f_i Selected from TABLE VIII-109
8	1,2,4-Trichlorobenzene	0.52	0.77	0.6
9	Hexachlorobenzene	0.19	0.39	0.1
12	Hexachloroethane	0.59	0.66	0.05
26	1,3-Dichlorobenzene	0.54	0.79	0.9
52	Hexachlorobutadiene	0.48	0.73	0.05
1	Acenaphthene	(0.26)	(0.51)	0.1
3	Acrylonitrile	(0.20)	(0.42)	0.05
55	Naphthalene	0.57	0.82	0.3
77	Acenaphthylene	(0.52)	(0.76)	0.1
78	Anthracene	(0.15)	(0.30)	0.1
80	Fluorene	(0.12)	(0.25)	0.1
81	Phenathrene	(0.27)	(0.52)	0.1

[1]Source: Unpublished study, "Estimating Emissions from OCPSF Wastewater Treatment Facilities," Hugh Wise, March 6, 1986

( ) Calculated based on methodology presented in the March 6, 1986 study.

occur). This factor was developed after concern was expressed that the steam stripper in-place might not be treating all sources of volatile pollutants that would be discharged to the end-of-pipe treatment system and eventually be emitted to the air. The methodology used to derive this factor was as follows:

- Thirty-two plants with steam strippers in-place were selected for a detailed analysis of their raw waste loadings of volatile pollutants in each individual product/process waste stream.
- For each plant, the raw waste loadings of volatile pollutants actually being treated by the in-place steam stripper was determined, and the BAT air emission loadings were revised.
- A ratio of the revised BAT air emission loadings and the BAT air emission loadings previously estimated was calculated for each plant, and 2.89, which was the median of these ratios, was selected to adjust the BAT air emission loadings for all plants.

In addition, 10 of the 32 plants were identified as large VOC emitters in the EPA-OPPE National VOC Study and were selected for further adjustments. Based on the analysis detailed above, the current and BAT air emission loadings were adjusted on a plant-by-plant basis, and additional steam stripping costs were estimated based on these adjusted loadings. These additional steam stripping costs were added to the existing BAT compliance costs, while the existing current and BAT air emission loadings were replaced by the adjusted values.

The methodology for calculating toxic pollutant air emissions loadings for indirect discharging plants was similar to that used for direct dischargers. Current toxic pollutant air emissions loadings were calculated by multiplying raw wastewater loadings by f_i for each pollutant for plants without steam stripping in-place and by multiplying current PSES toxic pollutant wastewater loadings by f_i for each pollutant for plants with steam stripping in-place. Then, depending on whether a plant was costed for steam stripping or had steam stripping in-place, the air emission loadings related to compliance with PSES effluent limitations were calculated as follows:

- For plants that were costed for steam stripping, the PSES toxic pollutant air emission loadings were set equal to the PSES toxic pollutant wastewater loadings multiplied by the f_i for each pollutant.

- For plants that were not costed for steam stripping, the PSES toxic pollutant air emissions were set equal to the raw wastewater loadings multiplied by the f_i for each pollutant.

Table VIII-111 presents the current and BAT toxic pollutant air emissions loadings for OCPSF direct discharging plants; Table VIII-112 presents the current and PSES toxic pollutant air emission loadings for OCPSF indirect discharging plants. Appendix VIII-E presents plant-by-plant current, BAT, and PSES air emission loadings.

TABLE VIII -- 111

BAT TOXIC POLLUTANT AIR EMISSION LOADINGS(lbs/year)

POLLUTANT NUMBER	POLLUTANT NAME	CURRENT LOAD	BAT LOAD OPT I	BAT LOAD OPT II	BAT LOAD OPT III
1	ACENAPHTHENE	8057	6600	4873	4873
3	ACRYLONITRILE	108880	101829	81765	81765
4	BENZENE	2144253	2062318	464776	464776
6	CARBON TETRACHLORIDE	71819	67055	41631	41631
7	CHLOROBENZENE	131848	125333	45511	45511
8	1,2,4-TRICHLOROBENZENE	15795	13819	13819	13819
9	HEXACHLOROBENZENE	28248	23990	7643	7643
10	1,2-DICHLOROETHANE	2047818	1953747	173360	173360
11	1,1,1-TRICHLOROETHANE	16190	16050	16043	16043
12	HEXACHLOROETHANE	46566	39538	3813	3813
13	1,1-DICHLOROETHANE	91488	82100	68372	68372
14	1,1,2-TRICHLOROETHANE	3159273	2986525	67039	67039
16	CHLOROETHANE	311068	275574	109386	109386
23	CHLOROFORM	113169	81329	46588	46588
25	1,2-DICHLOROBENZENE (O-DICHLOROBENZENE)	66122	58993	58406	58406
26	1,3-DICHLOROBENZENE (M-DICHLOROBENZENE)	5061	4246	4246	4246
27	1,4-DICHLOROBENZENE (P-DICHLOROBENZENE)	786116	667845	73483	73483
29	VINYLIDENE CHLORIDE	598864	512189	84421	84421
30	1,2-TRANSDICHLOROETHYLENE	72194	61452	60838	60838
32	PROPYLENE CHLORIDE	234033	208387	92049	92049
33	1,3-DICHLOROPROPENE	13325	11632	11632	11632
38	ETHYLBENZENE	305326	296754	133460	133460
42	BIS-(2-CHLOROISOPROPYL) ETHER	6013	5964	5964	5964
44	DICHLOROMETHANE	441395	266389	99355	99355
45	CHLOROMETHANE	4332866	4256830	131270	131270
*47	BROMOFORM				
48	DICHLOROBROMOMETHANE	1389	1313	1313	1313
55	NAPHTHALENE	103053	97182	62145	62145
85	PERCHLOROETHYLENE	30043	27671	26974	26974
86	TOLUENE	2583807	2448123	957242	957242
87	TRICHLOROETHYLENE	61174	54291	47721	47721
88	CHLOROETHYLENE	58926	56469	56469	56469
		========	========	=======	=======
		17,994,181	16,871,537	3,051,609	3,051,609

*Air emissions were not tracked for bromoform, an unregulated pollutant.

TABLE VIII -- 112

PSES TOXIC POLLUTANT AIR EMISSION LOADINGS(lbs/year)

POLLUTANT NUMBER	POLLUTANT NAME	CURRENT LOAD	PSES LOAD OPT IV
1	ACENAPHTHENE	7379	9.4
3	ACRYLONITRILE	17117	60.9
4	BENZENE	283643	1510.7
6	CARBON TETRACHLORIDE	20395	619.4
7	CHLOROBENZENE	788	179.6
8	1,2,4-TRICHLOROBENZENE	11773	732.4
9	HEXACHLOROBENZENE	165	34.3
10	1,2-DICHLOROETHANE	39560	1372.9
11	1,1,1-TRICHLOROETHANE	444	182.8
13	1,1-DICHLOROETHANE	20905	129.5
14	1,1,2-TRICHLOROETHANE	105254	90.6
16	CHLOROETHANE	32916	488.9
23	CHLOROFORM	12586	704.2
25	1,2-DICHLOROBENZENE (O-DICHLOROBENZENE)	6097	409.4
26	1,3-DICHLOROBENZENE (M-DICHLOROBENZENE)	3894	372.6
27	1,4-DICHLOROBENZENE (P-DICHLOROBENZENE)	2988	372.6
29	VINYLIDENE CHLORIDE	4726	76.7
30	1,2-TRANSDICHLOROETHYLENE	422	84.3
32	PROPYLENE CHLORIDE	215022	833.6
38	ETHYLBENZENE	292048	2592.8
42	BIS-(2-CHLOROISOPROPYL) ETHER	987	241.2
44	DICHLOROMETHANE	4598	249.6
45	CHLOROMETHANE	17621	629.9
*47	BROMOFORM		
55	NAPHTHALENE	21070	129.3
85	PERCHLOROETHYLENE	355	140.0
86	TOLUENE	717197	919.7
87	TRICHLOROETHYLENE	9110	177.6
88	CHLOROETHYLENE	24915	1621.1
		=========	========
		1,873,976	14,966.0

*Air emissions were not tracked for bromoform, an unregulated pollutant.

SECTION IX.
EFFLUENT QUALITY ATTAINABLE THROUGH THE APPLICATION OF BEST PRACTICABLE CONTROL TECHNOLOGY CURRENTLY AVAILABLE

A. INTRODUCTION

This section identifies model technologies, pollutants regulated, and the effluent limitations guidelines that are based on the degree of effluent reduction attainable through the application of the best practicable control technology currently available (BPT). Best practicable control technology currently available is generally based upon the average of the best existing performance (in terms of treated effluent discharged) by plants of various sizes, ages, and unit processes within an industry or subcategory. Where existing performance is uniformly inadequate, BPT may be transferred from a different subcategory or category. Limitations based on transfer technology must be supported by a conclusion that the technology is indeed transferable, and a reasonable prediction that it will be capable of achieving the prescribed effluent limits (see Tanners' Council of America v. Train, 540 F 2d 1188 (4th Cir. 1976)). While best practicable control technology currently available focuses on end-of-pipe treatment technology rather than process changes or internal controls, BPT can include process changes or internal controls when the changes or controls are normal practice within the industry.

BPT considers the total cost of the application of technology in relation to the effluent reduction benefits to be achieved from the technologies. The cost/benefit inquiry for BPT is a limited balancing, which does not require the Agency to quantify benefits in monetary terms (see American Iron and Steel v. EPA, 526 F 2d 1027 (3rd Cir. 1975)). In balancing costs in relation to effluent reduction benefits, EPA considers the volume and nature of existing discharges, the volume and nature of discharges except after application of BPT, the general environmental effects of the pollutants, and the cost and economic impacts of the required pollution control level. The Clean Water Act (CWA) does not require or permit consideration of water quality problems attributable to particular point sources or industries, or water quality improvements in particular water bodies (see Weyerhaeuser Company v. Costle, 11 ERC 2149 (D.C. Cir. 1978)).

2. Regulated Pollutants

EPA is regulating three conventional pollutant parameters at BPT. They are BOD_5, TSS, and pH. BOD_5 is commonly measured in OCPSF process wastewater since the organic chemicals produced by the OCPSF industry are generally biodegradable. Since TSS is a common OCPSF industry raw wastewater constituent and since treatment of BOD_5 with biological treatment generates suspended solids, TSS is controlled at BPT. The pH parameter is controlled to ensure that the wastewater characteristics are properly balanced between acid and alkaline conditions. The other conventional pollutants, fecal coliform and oil and grease, are not regulated at BPT. Fecal coliform is not present in OCPSF process wastewater. Oil and grease, when present in OCPSF wastewater, are typically controlled in conjunction with BOD_5 and TSS.

3. BPT Subcategorization

The Agency designated seven product-based subcategory classifications for the OCPSF category to be used for the purpose of establishing BPT limitations. These subcategory classifications are 1) rayon fibers (viscose process only); 2) other fibers (SIC 2823, except rayon, and 2824); 3) thermoplastics (SIC 28213); 4) thermosets (SIC 28214); 5) commodity organic chemicals (SIC 2865 and 2869); 6) bulk organic chemicals (SIC 2865 and 2869); and 7) specialty organic chemicals (SIC 2865 and 2869). The subcategory-specific products and product groups are listed in Appendix III-A.

In the final subcategorization scheme described in Section IV, facilities are not assigned to a single subcategory based on predominant production amongst the seven subcategory classifications, as most plants have production that overlaps two or more subcategories. In applying the limitations set forth in the regulation, the permit writer will use what is essentially a building-block approach that takes into consideration applicable subcategory characteristics based upon the proportion of production quantities within each subcategory at the plant. Production characteristics are reflected explicitly in the plant's limitations through the use of this approach.

B. TECHNOLOGY SELECTION

The Agency developed three technology options for consideration in developing BPT limitations. Option I consists of biological treatment, which usually involves either activated sludge or aerated lagoons, followed by clarification (and preceded by appropriate process controls and in-plant treatment to ensure that the biological system may be operated optimally). Many direct discharge facilities in the OCPSF industry have installed this kind of treatment.

Option II consists of Option I technology with the addition of a polishing pond to follow biological treatment.

Option III includes multimedia filtration as an alternative technology (in lieu of Option II ponds) to achieve TSS control beyond Option I biological treatment.

EPA selected Option I, biological treatment with clarification, as the technology basis for BPT limitations controlling BOD_5 and TSS for the OCPSF industry. This option has previously been referred to simply as "biological treatment." However, a properly designed biological treatment system includes "secondary clarification," which usually consists of a clarifier following the biological treatment step. EPA's costing methodology for BPT Option I includes the installation of chemically-assisted clarifiers for plants needing significantly improved TSS control. Option I technology is in place at 157 of the 304 direct discharging plants in the OCPSF industry data base. Seventy-one of these plants are included in the Option I data base used to develop the BPT limitations, since their treatment passes the 95 percent/40 mg/l BOD_5 editing criteria; 23 of these facilities have reported actual long-term averages less than or equal to their respective Option I subcategory proportioned (based on 1980 production) long-term average concentration targets.

EPA rejected Options II and III because they are not clearly demonstrated to enhance the treatment of OCPSF discharges beyond the levels achieved by the Option I requirements, and because they do not currently appear to be used by a representative portion of the industry.

As shown in Section VII, most plants that have installed polishing ponds have done so to improve the substandard treatment afforded by their biological systems. In general, if the plants' biological treatment systems were well-designed and well-operated, polishing ponds would not have been installed. For example, some plants that have land readily available use polishing ponds to achieve some of the BOD_5 removal that would otherwise be achieved by activated sludge treatment; for them, BOD_5 removal is accomplished more economically by polishing ponds. Almost none of the identified plants have installed ponds to achieve additional removal of BOD_5 and TSS beyond that achieved by well-operated, well-designed biological treatment with clarification.

Further, EPA believes that there are significant problems associated with the installation and operation of polishing ponds added to biological treatment (Option II) at some OCPSF facilities. Due to the size of the polishing ponds (often significantly larger than activated sludge systems), land availability may inhibit installation at some plants. In addition, algae growth in warm climates interferes with the operation of the polishing ponds by creating high suspended solids levels. Consequently, the Agency has concluded that Option II polishing ponds, added to good biological treatment, are not sufficiently demonstrated or practicable as a basis for BPT limitations for the OCPSF industry.

As also described in Section VII, EPA has evaluated Option III (biological treatment plus multimedia filtration) technology to determine if this option can achieve, in a practicable manner, additional conventional pollutant removal beyond that achievable by well-designed, well-operated biological treatment with secondary clarification. Like Option II, the results of the analysis of Option III data do not provide evidence of a significant difference in performance between plants with good biological treatment alone compared to those with biological treatment plus filtration. The data do not support any firm estimate either of incremental pollutant removal benefits or of incremental costs for Option III technology.

EPA believes that effective biological treatment including clarification, rather than alternatives whose effectiveness and practicability have not been sufficiently documented, is the appropriate basis for BPT limitations in the OCPSF industry.

Currently, 70 plants in the OCPSF Section 308 Questionnaire data base rely exclusively upon end-of-pipe physical/chemical treatment. Forty-one of these plants reported effluent BOD_5 values, and 45 plants reported effluent TSS values. Some of these plants have such low levels of BOD_5 that they will only have to upgrade their treatment to meet the TSS limits. Some of the plants reporting BOD_5 values were achieving low concentrations by dilution with nonprocess waters; for these plants, the BOD_5 concentrations were adjusted to take this dilution into account. Based upon this evaluation, plants that did not meet the long-term average target for BOD_5 (approximately 71 percent of these plants) were determined for costing purposes either to have sufficient BOD_5 in their OCPSF process wastewaters to support biological treatment or to have flows small enough (less than 500 gallons per day) to be contract hauled. In addition, the plants were costed to upgrade treatment of TSS where necessary as part of installing the activated sludge (biological) treatment and clarification, upgrading to chemically assisted clarification, using algae control at existing polishing ponds, or contract hauling. The TSS limitations for plants without biological treatment are based upon the performance of clarifiers, using the data from biological treatment plants' secondary clarifier performance.

C. BPT Effluent Limitations Guidelines

To analyze treatment effectiveness for each of the individual subcategories, EPA developed a method for assessing the treatability data from the many OCPSF plants whose influents and effluents are composed of wastewater from two or more subcategory operations. A regression equation, presented in Section VII, was used as the basis for determining BPT limitations. This equation accounts for multiple subcategory plants in an explicit and straight forward manner. For the final regulation, the regression equation was used to model long-term average effluent BOD_5 as a function of the proportion of the production of each subcategory at each facility. The coefficients of this equation are estimated from actual plant data using standard statistical regression methods. The equation has a coefficient that corresponds to each of the subcategory classifications. The BPT subcategory long-term average effluent values are determined for each subcategory using the appropriate coefficient.

BPT limitations for each subcategory are based on a combination of long-term average effluent values and variability factors that account for variation in day-to-day treatment performance within a plant. The long-term averages are target values that a plant's treatment system should achieve on an average basis. The variability factors are values that represent the ratio of a large value that would be expected to occur only rarely (on a daily or monthly average basis) to the long-term average. The purpose of the variability factor is to allow for variation in effluent concentrations that comprise the long-term average. A facility that designs and operates its treatment system to achieve a long-term average on a consistent basis should be able to comply with the daily and monthly limitations in the course of normal operations.

The BPT long-term average effluent values were developed from a data base composed of selected plant average values reported to the Agency in the 1983 Section 308 Questionnaire discussed previously. In this survey, plants were to report average annual influent and effluent BOD_5 and TSS along with technical information concerning treatment operation, process flows, and subcategory production classification. The selected plants were included in the average of the best existing performance for BOD_5 only if the plants achieved at least a 95 percent removal efficiency for BOD_5 or a long-term average effluent BOD_5 concentration at or below 40 mg/l. The Agency also saw a need to edit the data base for TSS performance. Two edits were used for TSS data. The primary edit was that the data must be from a plant that met the BOD_5 edit cited above. The second edit was an additional requirement that the plant's average effluent TSS must be 100 mg/l or less. Plants meeting these edits were included among the average best existing performance for TSS.

In a well-designed, well-operated biological treatment system, achievable effluent TSS concentration levels are related to achievable effluent BOD_5 levels and, in fact, often are fairly proportional to BOD_5. This is reflected in the OCPSF data base for those plants that meet the BOD_5 performance editing criteria, provided that they also exhibit proper clarifier performance. By only using TSS data from plants that had good BOD_5 treatment, the Agency established an effective initial edit for TSS removal by the biological system. However, as BOD_5 is reduced through biological treatment, additional

TSS may be generated in the form of biological solids. Thus, some plants may need to add post-biological, secondary clarifiers or second stage clarifiers to assure that such biological solids are appropriately treated.

Thus, while the 95/40 BOD_5 editing ensures good BOD_5 treatment and a basic level of TSS removal, plants meeting this BOD_5 editing level will not necessarily meet a TSS level suitable for inclusion in the data base used to set TSS limitations. To ensure that the TSS data base for setting limitations reflects proper control, the editing criteria were established.

The variability factors were developed from a data base composed of individual daily measurements on treated effluent BOD_5 and TSS from 21 and 20 of these OCPSF plants, respectively. Daily measurement data are required to determine variability factors, and were obtained from plants as part of the 1983 Section 308 Supplemental Questionnaire and from prior data submittals. In the history of the development of effluent guidelines regulations, variability factors are generally determined from data bases composed of different sets of plants and, usually, smaller numbers of plants in comparison to data sets consisting of plant annual averages. Many plants do not monitor frequently enough for inclusion of their data to determine day-to-day variability; many plants do not have monitoring records for the period being studied (1980, in the case of the OCPSF BPT study), since some plants do not maintain the records of daily values used to report monthly averages for longer than 3 years. Individual daily pollutant measurements are therefore more difficult to obtain. However, plants in the OCPSF annual average and daily data bases cover the full range of subcategory classifications as stipulated by this regulation.

The promulgated BPT effluent limitations guidelines for each subcategory are presented in Table IX-1. These limitations were determined by multiplying the long-term averages for each subcategory, shown in Tables VII-53 and VII-54, by the respective BOD_5 and TSS variability factors shown in Tables VII-56 and VII-57. Another regulated parameter, pH, must remain within the range of 6.0 to 9.0 at all times. The applicability of the regulations are described in detail in Section III of this document.

TABLE IX-1.
BPT EFFLUENT LIMITATIONS AND NSPS BY SUBCATEGORY (mg/l)

	Effluent Limitations[1]			
	Maximum for Monthly Average		Maximum for Any One Day	
Subcategory	BOD_5	TSS	BOD_5	TSS
Rayon Fibers	24	40	64	130
Other Fibers	18	36	48	115
Thermoplastic Resins	24	40	64	130
Thermosetting Resins	61	67	163	216
Commodity Organic Chemicals	30	46	80	149
Bulk Organic Chemicals	34	49	92	159
Specialty Organic Chemicals	45	57	120	183

[1]pH, also a regulated parameter, must remain within the range of 6.0 to 9.0 at all times.

[2]Product and product group listings for each subcategory are contained in Appendix III-A.

D. COST AND EFFLUENT REDUCTION BENEFITS

As described in Section VIII of this document, the Agency estimated the engineering cost of compliance with the BPT effluent limitations guidelines and the associated pollutant reduction benefits. The Agency estimated that compliance with the promulgated BPT regulations would cost the OCPSF direct discharge plants $193.1 million in capital investment and $38.8 million for annual operation and maintenance (O&M) (in 1982 dollars), and would remove 41.7 million lb/yr of BOD_5 and 66.3 million lb/yr of TSS in addition to current removals. EPA has concluded that the costs of compliance with BPT are justified by the resultant pollutant removal.

E. IMPLEMENTATION OF THE BPT EFFLUENT LIMITATIONS GUIDELINES

The promulgated effluent limitations guidelines are concentration-based, thus not regulating flow. The permit writer must use a reasonable estimate of process wastewater discharge and the concentration limitations to develop mass limitations for the NPDES permit.

Process wastewater discharge is defined in the regulation to include wastewaters resulting from manufacture of OCPSF products that come in direct contact with raw materials, intermediate products, final products, and surface runoff from the immediate process area that has the potential to become contaminated. Noncontact cooling waters, utility wastewaters, general site surface runoff, groundwater, and other nonprocess waters generated on site are specifically excluded from the definition of process wastewater discharges. In cases where the process wastewater flow claimed by industry may be excessive, the permit writer may develop a more appropriate process wastewater flow for use in computing the mass effluent limitations. The following items should be considered in developing the more appropriate process wastewater flow:

- A review of the component flows to ensure that the claimed flows are, in fact, process wastewater flows as defined by the regulation.
- A review of plant operations to ensure that sound water conservation practices are being followed. Examples include minimization of process water uses; cascading or countercurrent washes or rinses, where possible; and reuse or recycle of intermediate process waters or treated wastewaters at the process area and in wastewater treatment operations (pump seals, equipment and area washdowns, etc.).

A review of barometric condenser use at the process level. Often, barometric condensers will generate relatively large volumes of slightly contaminated water. Replacement of barometric condensers with surface condensers can reduce wastewater volumes significantly and result in collection of condensates that may be returned to the process.

As noted in the preamble of the final regulation, the Agency intends to issue guidance for determining the appropriate flow upon which to base mass permit requirements.

The Agency promulgated concentration-based limitations for seven subcategories. Therefore, for plants with production activities classified by two or more subcategories, the permit writer would use a building-block approach based on production proportioning to use the promulgated subcategorical limitations as a basis for establishing plant-specific permit requirements. For a specific plant, let w_j be the proportion of the plant's total OCPSF production in subcategory j. Then the plant-specific limitations are given by:

- Plant BOD_5 LIMIT = $\sum_{j=1}^{7} w_j$ (BOD_5 $LIMIT_j$)
- Plant TSS LIMIT = $\sum_{j=1}^{7} w_j$ (TSS $LIMIT_j$).

BOD_5 $LIMIT_j$ and TSS $LIMIT_j$ are the respective subcategorical BOD_5 and TSS Maximum for Any One Day or Maximum for Monthly Average limitations presented in Table IX-1. For a hypothetical plant with the product mix and production quantities shown in Table IX-2, the permit writer would use these equations, as illustrated in tabular form in the table, to calculate the plant's Maximum for Monthly Average concentration limitations of 26.4 and 42.6 mg/l of BOD_5 and TSS, respectively. The permit writer would then use the plant's annual average process wastewater flow to convert the concentration-based limitations into mass-based limitations. If the hypothetical plant's annual average process wastewater flow was 1.27 million gallons per day (MGD), then the

TABLE IX-2.
DERIVATION OF BPT LIMITATIONS FOR A HYPOTHETICAL PLANT

Subcategory	OCPSF Product Mix	Annual Plant Production MM lbs/yr	Subcategory Proportion (w_j)*	Subcategory Monthly Max (mg/l)** BOD_5	Subcategory Monthly Max (mg/l)** TSS	Plant Limitations ($\Sigma(wj)(LIMIT_j)$) BOD_5	Plant Limitations ($\Sigma(wj)(LIMIT_j)$) TSS
Commodity	Vinyl Chloride	2.22					
	Phenol	1.00					
	Methanol	0.80					
	Acetone	0.75					
		Σ = 4.77	0.40	30	46	12.0	18.4
Bulk	Adiponitrile	0.65					
	Hexamethylene diamine	0.55					
		Σ = 1.20	0.10	34	49	3.4	4.9
Thermoplastics	Polystrene resins	0.75					
	Polyester resins	1.20					
	PVC resins	2.00					
		Σ = 3.95	0.33	24	40	7.9	13.2
Other Fibers	Acrylic Fibers	1.00					
	Modacrylic Fibers	1.00					
		Σ = 2.00	0.17	18	36	3.1	6.1
COLUMN TOTALS		11.92	1.00			26.4	42.6

*w_j = annual subcategory production/total annual OCPSF production

**limitations from Table IX-1

conversion for the Maximum for Monthly Average BOD_5 limitation would be as follows:

$$BOD_5 \text{ Mass limit} = (26.4 \text{ mg/l } BOD_5)(1.27 \text{ MGD})(8.34)$$
$$= 279.6 \text{ lbs/day } BOD_5.$$

Limits for other parameters would be calculated in a similar manner.

The final NPDES permit limitations will be the sum of the OCPSF mass effluent limitations derived and any mass effluent limitations developed on a case-by-case basis using best professional judgment by the permit writer to take into account non-OCPSF and nonprocess wastewater discharges.

F. NON-WATER QUALITY ENVIRONMENTAL IMPACTS

The elimination or reduction of one form of pollution may create or aggravate other environmental problems. Therefore, Section 304(b) and 306 of the CWA require EPA to consider the non-water quality environmental impacts (including energy requirements) of certain regulations. In compliance with these provisions, EPA has considered the effect of these regulations on air pollution, solid waste generation, and energy consumption.

The non-water quality environmental impacts associated with this regulation are described below.

1. Air Pollution

The effect of BPT, if viewed alone, would likely involve a moderate increase in volatile pollutant concentrations in the ambient air immediately surrounding some OCPSF industry plants. This would be the result of plants installing or upgrading the performance of aerated lagoons, activated sludge basins, and equalization basins, thus more effectively driving off volatile organic compounds. This consequence will be more than offset by the effect of compliance efforts to meet BAT, because many plants are expected to comply with the BAT limitations by installing in-process controls that effectively remove volatile organic compounds before they reach the end-of-pipe controls. These in-process controls would be accompanied by effective air pollution controls. Thus, there should be a net decrease in both air loadings and concentrations of volatile organic compounds in the treated effluents from BPT and BAT combined.

2. Solid Waste

EPA considered the effect that these regulations would have on the production of solid waste, including hazardous waste defined under Section 3001 of the Resource Conservation and Recovery Act (RCRA). EPA estimates that increases in total solid waste of 16,090 metric tons of sludge per year, including hazardous waste, resulting from the OCPSF regulation will be insignificant compared to current levels. The Agency included sludge incineration in the estimated engineering costs of compliance for any incremental sludge generated by the BPT model treatment systems. Therefore, the net residual solid waste, in the form of ash, will be negligible.

3. Energy Requirements

EPA estimated that the attainment of BPT will increase energy consumption by a small increment over present industry use. With the exception of sludge incineration, the estimated increased energy consumption for BPT treatment systems is 24,308 barrels of No. 2 fuel oil per year. The estimated increased energy consumption associated with the corresponding sludge incineration is 271,042 barrels of No. 2 fuel oil per year.

SECTION X.
EFFLUENT QUALITY ATTAINABLE THROUGH THE APPLICATION OF THE BEST AVAILABLE TECHNOLOGY ECONOMICALLY ACHIEVABLE

A. INTRODUCTION

Effluent limitations guidelines based on the best available technology economically achievable (BAT), in general, represent the best control and treatment technology employed by a specific point source within the industrial category or subcategory, or by another industry where it is readily transferable. Emphasis is placed on additional treatment techniques applied in addition to the treatment systems currently employed for best practicable control technology (BPT), as well as process changes and improvements in internal process control and treatment technology optimization.

The factors considered in assessing BAT include the age of equipment and facilities involved, the process employed, process changes, nonwater quality environmental impacts (including energy requirements), and the costs of application of such technology. BAT technology represents the best existing economically achievable performance of plants of various ages, sizes, processes, or other characteristics. Those categories whose existing performance is uniformly inadequate may require a transfer of BAT from a different subcategory or category. BAT may include process changes or internal controls, even when these are not common industry practice. This level of technology also considers those plant processes and control and treatment technologies, which at pilot plant and other levels have demonstrated both technological performance and economic viability at a level sufficient to justify investigation.

B. BAT SUBCATEGORIZATION

The U.S. Environmental Protection Agency (EPA) promulgated BAT limitations for two subcategories. These subcategories are largely determined by raw waste characteristics. First, the end-of-pipe biological treatment subcategory includes plants that have or will install biological treatment to comply with BPT limits. Second, the non-end-of-pipe biological treatment subcategory includes plants that generate such low levels of BOD_5 that they do not need biological treatment or choose to use physical/chemical controls to comply with the BPT limitations for BOD_5.

Different limits are being established for these two subcategories. Biological treatment is an integral part of the model BAT treatment technology for the end-of-pipe biological treatment subcategory; it achieves incremental removals of some priority pollutants beyond the removals achieved by in-plant treatment without end-of-pipe biological treatment. In addition, the Agency established two different limitations for the pollutant zinc. One is based on data collected from rayon manufacturers using the viscose process and acrylic fibers manufacturers using the zinc chloride/solvent process. This limitation applies only to those plants that use the viscose process to manufacture rayon or the zinc chloride/solvent process to manufacture acrylic fibers. The other zinc limitation is based on the performance of chemical precipitation technology used in the metal finishing point source category, and applies to all plants other than those described above.

The Agency issued BAT limits for 63 priority pollutants for facilities with end-of-pipe biological treatment, including 57 organic priority pollutants, 5 metal priority pollutants, and cyanide. For facilities without end-of-pipe biological treatment, BAT limits were issued for 59 priority pollutants, including 53 organic priority pollutants, 5 metal priority pollutants, and cyanide.

C. TECHNOLOGY SELECTION

The Agency developed three technology options for end-of-pipe BAT effluent limitations. (The Agency decided not to promulgate any supplemental in-plant BAT limitations to control volatile pollutants.) The statutory assessment of BAT considers costs, but does not require a balancing of costs against effluent reduction benefits [see Weyerhaeuser v. Costle, 11 ERC 2149 (D.C. Cir. 1978)]; however, in establishing BAT, the Agency gave substantial weight to the reasonableness of costs.

1. Option I

This option would establish concentration-based BAT effluent limitations for priority pollutants based on using BPT-level biological treatment for dischargers using end-of-pipe biological treatment. For plants not using end-of-pipe biological treatment, the Option I treatment is in-plant controls, consisting of physical/chemical treatment and in-plant biological treatment to achieve the same toxic pollutant limits as are achieved by end-of-pipe biological treatment at BPT.

2. Option II

This option would establish concentration-based BAT effluent limitations based on the performance of the end-of-pipe treatment component required to meet BPT limitations (biological treatment for the end-of-pipe biological treatment subcategory and physical/chemical treatment for the non-end-of-pipe biological treatment subcategory), plus in-plant control technologies that would remove priority pollutants from waste streams from particular processes prior to discharge to the end-of-pipe treatment system. Two variations of Option II were considered, which varied in-plant control technology used to treat selected priority pollutants, including several polynuclear aromatic hydrocarbons, several phthalate esters, and phenol. The in-plant technologies that form the sole basis of the limitations for the non-end-of-pipe biological treatment plants include steam stripping to remove volatile priority pollutants; activated carbon for various base/neutral priority pollutants; chemical precipitation for metals; alkaline chlorination for cyanide; and in-plant biological treatment (Option IIB) or activated carbon adsorption (Option IIA) for removal of selected priority pollutants, including polynuclear aromatics, phthalate esters, acrylonitrile, phenol, and 2,4-dimethyphenol. After considering the application of activated carbon adsorption systems (Option IIA) to remove these pollutants, EPA rejected this option on the basis of available data demonstrating that the effluent levels achieved by biological systems treating waste streams from segregated processes or waste streams with high levels of these pollutants are equivalent to activated carbon adsorption technology.

3. Option III

BAT Option III adds activated carbon adsorption to the end-of-pipe treatment to follow biological treatment or physical/chemical treatment in addition to the Option II level of in-plant controls.

Option I technology is capable of treating some organic pollutants to some extent; however, it does not represent the best available technology. In particular, the effectiveness of biological treatment for removing metal pollutants and volatile organic pollutants is limited. Its effectiveness for other pollutants is often less than what the Option II technologies can achieve. The Agency identified many plants that combine various types of in-plant treatment with end-of-pipe biological treatment. Therefore, EPA decided to reject Option I.

Option III (addition of end-of-pipe carbon adsorption) achieves further reduction in concentrations of some pollutants after Option II, particularly for organic pollutants that are less biodegradable. The capital investment cost associated with activated carbon adsorption systems that are large enough to treat the volume of water discharged from end-of-pipe treatment is high: $1.2 billion and the annualized cost of $831.9 million (1986 dollars). As described in the Economic Impact Analysis, these incremental costs would be expected to cause substantial incremental impacts, including 26 plant closures, and 16 product line closures resulting in a loss of 6,475 jobs. In addition, 44 plants would incur other significant impacts. Given the exceptionally high costs and significant economic impacts associated with Option III, EPA decided not to adopt Option III as the basis for BAT regulation.

The Agency selected Option II as the basis for BAT limits for both BAT subcategories.

D. POLLUTANT SELECTION

In developing the OCPSF regulations, priority toxic pollutants of concern were identified through analytical programs to detect and quantify these pollutants in the raw wastewaters discharged from various product/process lines that were most important or most common in the industry. The initial work in determining the chemical constituents present in the process wastewaters began in 1977. EPA did not attempt to identify or quantify pollutants other than the priority toxic and conventional pollutants. The initial effort included screening process wastewaters for the presence of compounds on the priority pollutant list of 129 compounds or classes of compounds identified in the NRDC Consent Decree.

Over the next several years, data were gathered to further identify pollutants being discharged from specific processes and in combined discharges from facilities with multiple processes.

The final BAT Organic Chemicals, Plastics, and Synthetic Fibers (OCPSF) regulations for the end-of-pipe biological treatment subcategory regulate the 63 toxic pollutants shown in Table X-1. Regulating such a large number of the toxic pollutants is unprecedented in the effluent guidelines rulemaking program, reflecting the fact that many of the organic toxic pollutants are directly manufactured by OCPSF facilities as well as used as raw materials or generated as by-products in industry processes. The Agency does not have sufficient in-plant data to regulate one metal priority pollutant (antimony) and two organic priority pollutants (2,4,6-trichlorophenol and 3,3'-dichlorobenzidine) in the end-of-pipe biological treatment subcategory.

The data base for the non-end-of-pipe biological treatment subcategory limitations (shown in Table X-2) includes data from the same plants used in the biological end-of-pipe subcategory if samples of the influent and effluent around the in-plant treatment technologies were collected. Even with these data, there are seven priority pollutants for which the Agency does not have sufficient data to set limitations for the non-end-of-pipe biological treatment subcategory. For these seven pollutants (2-chlorophenol, 2,4-dichlorophenol, 2,4-dinitrotoluene, 2,6-dinitrotoluene, antimony, 2,4,6-trichlorophenol, and 3,3'-dichlorobenzidine) the Agency did not set final limits. Limitations for these pollutants are being reserved pending collection of additional information concerning their removal by in-plant physical/chemical (or dedicated biological) treatment systems. Thus, the non-end-of-pipe biological treatment subcategory limitations cover 59 toxic pollutants.

TABLE X-1.
BAT EFFLUENT LIMITATIONS AND NSPS FOR THE
END-OF-PIPE BIOLOGICAL TREATMENT SUBCATEGORY

Pollutant Number	Pollutant Name	BAT Effluent Limitations and NSPS[1] Maximum for Any One Day	BAT Effluent Limitations and NSPS[1] Maximum for Monthly Average
1	Acenaphthene	59	22
3	Acrylonitrile	242	96
4	Benzene	136	37
6	Carbon Tetrachloride	38	18
7	Chlorobenzene	28	15
8	1,2,4-Trichlorobenzene	140	68
9	Hexachlorobenzene	28	15
10	1,2-Dichloroethane	211	68
11	1,1,1-Trichloroethane	54	21
12	Hexachloroethane	54	21
13	1-1-Dichloroethane	59	22
14	1,1,2-Trichloroethane	54	21
16	Chloroethane	268	104
23	Chloroform	46	21
24	2-Chlorophenol	98	31
25	1,2-Dichlorobenzene	163	77
26	1,3-Dichlorobenzene	44	31
27	1,4-Dichlorobenzene	28	15
29	1,1-Dichloroethylene	25	16
30	1,2-Trans-dichloroethylene	54	21
31	2,4-Dichlorophenol	112	39
32	1,2-Dichloropropane	230	153
33	1,3-Dichloropropene	44	29
34	2,4-Dimethylphenol	36	18
35	2,4-Dinitrotoluene	285	113
36	2,6-Dinitrotoluene	641	255
38	Ethylbenzene	108	32
39	Fluoranthene	68	25
42	Bis(2-Chloroisopropyl)ether	757	301
44	Methylene Chloride	89	40
45	Methyl Chloride	190	86
52	Hexachlorobutadiene	49	20
55	Naphthalene	59	22
56	Nitrobenzene	68	27
57	2-Nitrophenol	69	41
58	4-Nitrophenol	124	72
59	2,4-Dinitrophenol	123	71
60	4,6-Dinitro-o-cresol	277	78
65	Phenol	26	15
66	Bis(2-ethylhexyl)phthalate	279	103
68	Di-n-butyl phthalate	57	27
70	Diethyl phthalate	203	81

TABLE X-1.
BAT EFFLUENT LIMITATIONS AND NSPS FOR THE
END-OF-PIPE BIOLOGICAL TREATMENT SUBCATEGORY (Continued)

Pollutant Number	Pollutant Name	BAT Effluent Limitations and NSPS[1] Maximum for Any One Day	Maximum for Monthly Average
71	Dimethyl phthalate	47	19
72	Benzo(a)anthracene	59	22
73	Benzo(a)pyrene	61	23
74	3,4-Benzofluoranthene	61	23
75	Benzo(k)fluoranthene	59	22
76	Chrysene	59	22
77	Acenaphthylene	59	22
78	Anthracene	59	22
80	Fluorene	59	22
81	Phenanthrene	59	22
84	Pyrene	67	25
85	Tetrachloroethylene	56	22
86	Toluene	80	26
87	Trichloroethylene	54	21
88	Vinyl Chloride	268	104
119	Total Chromium[2]	2,770	1,110
120	Total Copper[2]	3,380	1,450
121	Total Cyanide[3]	1,200	420
122	Total Lead[2]	690	320
124	Total Nickel[2]	3,980	1,690
128	Total Zinc[2,4]	2,610	1,050

[1]All units are micrograms per liter.

[2]Metals limitations apply only to noncomplexed metal-bearing waste streams, including those listed in Table X-4. Discharges of chromium, copper, lead, nickel, and zinc from "complexed metal-bearing process wastewater," listed in Table X-5, are not subject to these limitations.

[3]Cyanide limitations apply only to cyanide-bearing waste streams, including those listed in Table X-3.

[4]Total zinc limitations and standards for rayon fiber manufacture by the viscose process and acrylic fiber manufacture by the zinc chloride/solvent process are 6,796 µg/l and 3,325 µg/l for Maximum for Any One Day and Maximum for Monthly Average, respectively.

TABLE X-2.
BAT EFFLUENT LIMITATIONS AND NSPS FOR THE
NON-END-OF-PIPE BIOLOGICAL TREATMENT SUBCATEGORY

Pollutant Number	Pollutant Name	BAT Effluent Limitations and NSPS[1] Maximum for Any One Day	Maximum for Monthly Average
1	Acenaphthene	47	19
3	Acrylonitrile	232	94
4	Benzene	134	57
6	Carbon Tetrachloride	380	142
7	Chlorobenzene	380	142
8	1,2,4-Trichlorobenzene	794	196
9	Hexachlorobenzene	794	196
10	1,2-Dichloroethane	574	180
11	1,1,1-Trichloroethane	59	22
12	Hexachloroethane	794	196
13	1-1-Dichloroethane	59	22
14	1,1,2-Trichloroethane	127	32
16	Chloroethane	295	110
23	Chloroform	325	111
25	1,2-Dichlorobenzene	794	196
26	1,3-Dichlorobenzene	380	142
27	1,4-Dichlorobenzene	380	142
29	1,1-Dichloroethylene	60	22
30	1,2-Trans-dichloroethylene	66	25
32	1,2-Dichloropropane	794	196
33	1,3-Dichloropropene	794	196
34	2,4-Dimethylphenol	47	19
38	Ethylbenzene	380	142
39	Fluoranthene	54	22
42	Bis(2-Chloroisopropyl)ether	794	196
44	Methylene Chloride	170	36
45	Methyl Chloride	295	110
52	Hexachlorobutadiene	380	142
55	Naphthalene	47	19
56	Nitrobenzene	6,402	2,237
57	2-Nitrophenol	231	65
58	4-Nitrophenol	576	162
59	2,4-Dinitrophenol	4,291	1,207
60	4,6-Dinitro-o-cresol	277	78
65	Phenol	47	19
66	Bis(2-ethylhexyl)phthalate	258	95
68	Di-n-butyl phthalate	43	20
70	Diethyl phthalate	113	46

TABLE X-2.
BAT EFFLUENT LIMITATIONS AND NSPS FOR THE
NON-END-OF-PIPE BIOLOGICAL TREATMENT SUBCATEGORY (Continued)

Pollutant Number	Pollutant Name	BAT Effluent Limitations and NSPS[1] Maximum for Any One Day	Maximum for Monthly Average
71	Dimethyl phthalate	47	19
72	Benzo(a)anthracene	47	19
73	Benzo(a)pyrene	48	20
74	3,4-Benzofluoranthene	48	20
75	Benzo(k)fluoranthene	47	19
76	Chrysene	47	19
77	Acenaphthylene	47	19
78	Anthracene	47	19
80	Fluorene	47	19
81	Phenanthrene	47	19
84	Pyrene	48	20
85	Tetrachloroethylene	164	52
86	Toluene	74	28
87	Trichloroethylene	69	26
88	Vinyl Chloride	172	97
119	Total Chromium[2]	2,770	1,110
120	Total Copper[2]	3,380	1,450
121	Total Cyanide[3]	1,200	420
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[1]All units are micrograms per liter.

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[3]Cyanide limitations apply only to cyanide-bearing waste streams, including those listed in Table X-3.

[4]Total zinc limitations and standards for rayon fiber manufacture by the viscose process and acrylic fiber manufacture by the zinc chloride/solvent process are 6,796 µg/l and 3,325 µg/l for Maximum for Any One Day and Maximum for Monthly Average, respectively.

Even though nonconventional pollutants and certain toxic pollutants are not directly limited by this regulation, they will nonetheless be indirectly controlled in many cases by the technologies used to comply with the promulgated limitations if they are present in treatable concentrations. While the degree of such indirect control will vary, in some cases unregulated pollutants will be substantially reduced by the operation of technologies installed to comply with limitations for related regulated pollutants.

In the final rule, EPA decided that each discharger in a subcategory will be subject to the effluent limitations for all pollutants regulated for that subcategory. Once a pollutant is regulated in the OCPSF regulation, it must also be limited in the National Pollutant Discharge Elimination System (NPDES) permit issued to direct dischargers [see Sections 301 and 304 of the Act; see also 40 CFR 8122.44(a)]. EPA recognizes that guidance on appropriate monitoring requirements for OCPSF plants would be useful, particularly to ensure that monitoring will not be needlessly required for pollutants that are not likely to be discharged at a plant. EPA intends to publish guidance on OCPSF monitoring in the near future. This guidance will address the issues of compliance monitoring in general, of initially determining which pollutants should be subject only to infrequent monitoring based on a conclusion that they are unlikely to be discharged, and of determining the appropriate flow upon which to base mass permit requirements.

E. BAT EFFLUENT LIMITATIONS GUIDELINES

The BAT limits are based on priority pollutant data from both OCPSF and other industrial plants with BAT model treatment technologies in place. In selecting plants and product/processes for use in developing the data base for BAT limitations, EPA gave priority to product/processes involving the manufacture of either priority pollutants or high-volume chemicals derived from priority pollutants. In each stage of its BAT data base development, the Agency has attempted to obtain data from OCPSF plants representing BAT performance to provide as complete coverage as possible for the priority pollutants discharged by the OCPSF industry. The Agency used information collected in all surveys as a basis for identifying representative plants to be sampled.

The BAT data base described in Section VII for organic priority pollutants and the toxic metal zinc (for certain rayon and acrylic fibers producers) contains data that adequately represent the performance of wastewater treatment technology employed by the OCPSF industry. Data for toxic metals (including zinc from producers other than those mentioned above) and cyanide have been transferred from another industry data base. Section VII also describes data base editing and calculation of pollutant long-term means and corresponding variability factors.

1. Volatiles Limits

The Agency based BAT limitations and costs for volatile pollutants on in-plant steam stripping technology alone for plants without end-of-pipe biological treatment. For all volatiles limited in the end-of-pipe biological treatment subcategory, except 1,1-dichloroethane, the combination of steam stripping and end-of-pipe biological treatment are used for limitations (and costing). The data used to derive these limits for the end-of-pipe biological treatment subcategory were taken from plants that exhibited good volatile pollutant reduction across the entire treatment system. For the end-of-pipe biological treatment subcategory, the limitations (and costs) are based on the removals achieved by only steam stripping for one pollutant (1,1-dichloroethane), since the data for this pollutant demonstrated a treated effluent from the steam stripper at the lowest possible level (a long-term average steam stripping effluent level at the analytical minimum level of 10 ppb) and no data were available from the end-of-pipe biological treatment for this pollutant. To establish limits for the non-end-of-pipe biological treatment subcategory, the Agency used steam stripping data for volatile organic pollutants collected from plants that either did not have end-of-pipe biological treatment or provided data on the separate performance of the in-plant steam stripping treatment technology.

2. Cyanide Limitations

The final regulation contains concentration-based effluent limitations for total cyanide, which are to be applied only to the flows discharged from cyanide-bearing process waste streams covered by the regulation. The selected technology basis for controlling the discharge of cyanide from OCPSF manufacturing operations is chemical oxidation by the alkaline chlorination method.

Eleven direct and indirect discharge OCPSF plants use cyanide destruction, including some plants that reported the use of alkaline chlorination. However, performance data on cyanide destruction are not available from the OCPSF industry. Nonetheless, performance data on cyanide destruction by alkaline chlorination in the metal finishing industry are available.

Limitations are based upon the transfer of alkaline chlorination (chemical oxidation) technology from the metal finishing industry data base. These limitations apply only to the cyanide-bearing waste streams; thus, only cyanide-bearing process wastewater flow should be used by permit writers to convert the concentration-based cyanide limitations into mass-based permit limitations. The product/processes considered to have cyanide-bearing process wastewater are listed in Table X-3. This list is based on EPA's review of data in the record.

3. Metals Limitations

The final rule contains concentration-based effluent limitations for chromium, copper, lead, nickel, and zinc. The limitations are to be applied only to the flows discharged from metal-bearing process wastewaters. The product/processes considered to have metal-bearing process wastewater are listed in Table X-4. This list is based on EPA's review of data in the record. Separate zinc limitations have been established for rayon manufacturers using the viscose process and acrylic fibers manufacturers using the zinc chloride/solvent process.

The concentration limitations are based upon the use of hydroxide precipitation technology, which is the standard metals removal technology that forms the basis for virtually all of EPA's BAT metals limitations for metal-bearing wastewaters. Because little OCPSF data on the effectiveness of hydroxide precipitation technology are available, EPA decided to transfer data for this technology from the metal finishing industry. A comparison of the metals raw waste data from metal finishing plants with the validated

TABLE X-3.
CYANIDE-BEARING WASTE STREAMS
(by product/process)

Acetone cyanohydrin/Acetone + Hydrogen cyanide

Acetonitrile/By-product of acrylonitrile from propylene by ammoxidation

Acrylic resins/Solution polymerization

Acrylic fiber (85% acrylonitrile)/Suspension polymerization, and wet spinning

Acrylic fiber (85% acrylonitrile)/Solution polymerization, and wet spinning

Acrylonitrile/Ammoxidation of propylene

Adiponitrile/Butadiene + Hydrogen cyanide (direct cyanation)

Allylnitrile/Allyl chloride + Sodium cyanide

Dimethoxybenzaldehyde/Hydroquinone dimethyl ether + Hydrogen cyanide, hydrolysis

Benzyl cyanide/Benzyl chloride + Sodium cyanide

Coal tar products/Distillation of coal tar condensate

Cyanoacetic acid/Chloracetic acid + Sodium cyanide

Cyanuric chloride/Catalyzed trimerization of cyanogen chloride

Vat dyes, Indigo paste as Vat Blue 1/Sodamide + potassium N-Phenylglycine, fused with caustic/N-phenylglycine + aniline + Formaldehyde + Sodium bisulfite, sodium cyanide, hydrolysis with potassium hydroxide

Disperse dyes, Azo and Vat

Ethylenediamine tetraacetic acid/Ethylenediamine + Formaldehyde + Sodium cyanide

Diethylenetriamine pentaacetic acid/Diethylenetriamine + Formaldehyde + Sodium cyanide

N,N'-bis(o-Acetamidophenol)ethylenediamine, ferric complex/Salicyladehyde + Ethylenediamine + Hydrogen cyanide, hydrolysis to amide

Diethylenetriamine pentaacetic acid, pentasodium salt/Diethylenetriamine pentaacetic acide + caustic

Ethylenediamine tetraacetic acid, metal salts/Ethylenediamine tetraacetic acid + metal bases

Hydroxyethyl ethylenediamine triacetic acid, trisodium salt/Ethylenediamine + Ethylene oxide + Formaldehyde + Sodium cyanide, hydrolysis

TABLE X-3.
CYANIDE-BEARING WASTE STREAMS
(by product/process) (Continued)

Hexamethylene diisocyanate/Hexamethylene diamine (1,6-Diaminohexane) + phosgene

5,5-Dimethyl hyantoin/Acetone + ammonia + carbon dioxide + hydrogen cyanide

Hydrogen cyanide/By-product of acrylonitrile by ammoxidation of propylene

Iminodiacetic acid/Hexamethylene tetraamine + Hydrogen cyanide, hydrolysis of iminoacetonitrile salt

Methionine/Acrolein + Methyl mercaptan, with hydrogen cyanide and ammonium carbonate

Methylene Diphenylisocyanate (MDI)/Phosgenation of methylene dianiline from Aniline + Formaldehyde

Nitrilotriacetic acid/Hexamethylene tetraamine + Hydrogen cyanide, hydrolysis of nitrilotriacetonitrile salt

Picolines, mixed/Condensation of acetaldehyde + formaldehyde + ammonia

Organic piqments, Azo/Diazotization of aniline cogener, coupling to B-Napthol

Polyurethane resins/Diisocyanate + Polyoxyalkylene glycol

Polyurethane fibers (Spandex)/Polyoxyalkylene glycol + Tolylene diisocyanate + dialkylamine

Pyrimidines, 2-Isopropyl-4-methoxy-/Isobutyronitrile + methanol, ammonia and methylacetoacetate (ring closure)

Pyridine (synthetic)/Condensation of acetaldehyde + ammonia + formaldehyde

Cyanopyridine/Ammoxidation of picoline

Sarcosine (N-Methyl glycine), sodium salt/Hexamethylene tetraamine + Sodium cyanide, hydrolysis

Thiophene acetic acid/Chloromethylation (Hydrogen chloride + Formaldehyde) + Sodium cyanide, hydrolysis

Tolylene diisocyanate (isomeric mixture)/Tolylene diamines + Phosgene

Tris(anilino)S-triazine/Cyanuric chloride + Aniline and its cogeners

Triethylorthoformate/Ethanol + Hydrogen cyanide

Trimethylorthoformate/Methanol + Hydrogen cyanide

TABLE X-4.
NONCOMPLEXED METAL-BEARING WASTE STREAMS
FOR CHROMIUM, COPPER, LEAD, NICKEL, AND ZINC
(by product/process)

Chromium

Methylhydroabietate/Esterification of hydroabietic acid (rosin) with methanol

Acrylic acid/Oxidation of propylene via acrolein

N-butyl alcohol/Hydrogenation of n-Butraldehyde, Oxo process

Cyclohexanone/From phenol via cyclohexanol by hydrogenation-dehydrogenation

Fatty amines/Hydrogenation of fatty nitriles (batch)

Helioptropin/Oxidation of isosafrole, chromium catalyst

Isobutanol/Hydrogenation of isobutyraldehyde, Oxo process

Cyclohexyl Mercaptan/Cyclohexanol + Hydrogen sulfide

Ethyl Mercaptan/Ethanol + Hydrogen sulfide

Methanol/H.P. Synthesis from natural gas via synthetic gas

Oxo Alcohols, C7-C11/Carbonation & hydrogenation of C6-C10 Olefins

Polyoxypropylene diamine/Polypropylene glycol + Ammonia

n-Propyl alcohol/Hydrogenation of propionaldehyde, Oxo process

SAN resin/Suspension polymerization

Styrene/Dehydrogenation of ethylbenzene

Styrene/Dehydration of methyl benzyl alcohol (co-product of propylene oxide)

1-Tetralol, 1-Tetralone mix/Oxidation of tetralin (1,2,3,4-Tetrahydronaphthalene)

3,3,3-Trifluoropropene/Catalyzed hydrogen fluoride exchange with chlorinated propane

Vinyl toluene/Dehydrogenation (thermal) of ethyltoluene

TABLE X-4.
NONCOMPLEXED METAL-BEARING WASTE STREAMS
FOR CHROMIUM, COPPER, LEAD, NICKEL, AND ZINC
(by product/process) (Continued)

Copper

Methylhydroabietate/Esterification of hydroabietic acid (rosin) with methanol

Acetaldehyde/Oxidation of ethylene with cupric chloride catalyst

Acetic acid/Catalytic oxidation of butane

Acetone/Dehydrogenation of isopropanol

Acrylamide/Catalytic hydration of acrylonitrile

Acrylic acid/Oxidation of propylene via acrolein

Acrylonitrile/Propylene ammoxidation

Adipic acid/Oxidation of cyclohexanol-cyclohexanone mixture

Adipic acid/Oxidation of cyclohexane via cyclohexanol-cyclohexanone mixture

Allynitrile/Allychloride + sodium cyanide

Aniline/Hydrogenation of nitrobenzene

Benzofurans, 2,3-Dihydro-2,2-dimethyl-7-benzofuranol/from o-Nitrophenol + Methallyl chloride

n-Butyl alcohol/Hydrogenation of n-Butyraldehyde, Oxo process

1,4-Butanediol/Hydrogenation of 1,4-butynediol

Butyrolactone/Dehydrogenation of 1,4-butanediol

Caprolactam/From cyclohexane via cyclohexanone and its oxime

Lilian (hydroxydihydrocitronellal)/Hydration and oxidation of citronellol

1,2-Dichloroethane/Oxyhydrochlorination of ethylene

Dialkyldithiocarbamates, mètal salts/Dialkylamines + carbon disulfide

2-Ethylhexanol/from n-Butyraldehyde by Aldo condensation and hydrogenation

Fatty amines/Hydrogenation of fatty nitriles (batch)

Geraniol/B-Myrcene + Hydrogen chloride, esterification of geranyl chloride, hydrolysis of qeranyl acetate

TABLE X-4.
NONCOMPLEXED METAL-BEARING WASTE STREAMS
FOR CHROMIUM, COPPER, LEAD, NICKEL, AND ZINC
(by product/process) (Continued)

<u>Copper</u> (Continued)

Furfuryl alcohol/Hydrogenation of furfural

Geranial (Citral)/Oxidation of geraniol (copper catalyst)

Glyoxal/Oxidation of ethylene glycol

Isobutanol/Hydrogenation of isobutyraldehyde, Oxo process

Isopropanol/Catalytic hydrogenation of acetone

2-Mercaptobenzothiazoles, copper salt/2-Mercaptobenzo-thiazole + copper salt

Methanol/High-pressure synthesis from natural gas via synthetic gas

Methanol/Low-pressure synthesis from natural gas via synthetic gas

Methyl ethyl ketone/Dehydrogenation of sec-Butanol

Oxo alcohols, C7-C11/Carbonation & hydrogenation of C6-C10 olefins

Phenol/Liquid phase oxidation of benzoic acid

Polyoxyalkylene amines/Polyoxyalkylene glycol + ammonia

Polyphenylene oxide/Solution polymerization of 2,6-xylenol by oxidative coupling (cuprous salt catalyst)

Polyoxypropylene diamine/Polypropylene glycol + Ammonia

Quinaldine (dye intermediate)/Skraup reaction of aniline + crotonaldehyde

Silicones, silicone fluids/Hydrolysis and condensation of chlorosilanes

Silicones, silicone rubbers/Hydrolysis and condensation of chlorosilanes

Silicones, silicone specialties (grease, dispersion agents, defoamers & other products)

Silicones: silicone resins/Hydrolysis & condensation of methyl, phenyl & vinyl chlorosilanes

Silicones: silicone fluids/Hydrolysis of chlorosilanes to acyclic & cyclic organosiloxanes

Styrene/Dehydration of a-Methylbenzyl alcohol (coproduct of propylene oxide)

TABLE X-4.
NONCOMPLEXED METAL-BEARING WASTE STREAMS
FOR CHROMIUM, COPPER, LEAD, NICKEL, AND ZINC
(by product/process) (Continued)

Copper (Continued)

Tetrachloroethylene (perchloroethylene)/Oxyhydrochlorination of tetrachloroethane

Tris(anilino)s-triazine/Cyanuric chloride + aniline + cogeners

Trichloroethylene/Oxyhydrochlorination of tetrachloroethane

Unsaturated polyester resin/Reaction of maleic anhydride + phthalic anhydride + propylene glycol polyester with styrene or methyl methacrylate

Lead

Alkyd resin/Condensation polymerization

Alkyd resins/Condensation polymerization of phthalic anhydride + glycerin + vegetable oil esters

Anti-knock fuel additive/Blending purchased tetraethyl lead & tetramethyl lead additives

Dialkydithiocarbamates, metal salts/Dialkylamines + carbon disulfide

Thiuram (dimethyldithiocarbamate) hexasulfide/Dimethyl-dithiocarbamate + sulfur

Triphenylmethane dyes (methyl violet)/Condensation of Formaldehyde + N-Methylaniline + N,N-dimethylaniline, oxidation of reaction product

4,4'-Bis-(N,N-dimethylaniline) carbinol, Michler's hydrol/Oxidation of 4,4'-Methylene-bis(N,N-dimethyl aniline) with lead oxide

Naphthenic acid salts

Stearic acid, metal salts/Neutralization with a metallic base

Tetraethyl lead/Alkyl halide + sodium-lead alloy

Tetramethyl lead/Alkyl halide + sodium-lead alloy

Nickel

Acetates, 7,11-Hexadecadien-1-ol (gossyplure)/Coupling reactions, low-pressure hydrogenation, esterification

TABLE X-4.
NONCOMPLEXED METAL-BEARING WASTE STREAMS
FOR CHROMIUM, COPPER, LEAD, NICKEL, AND ZINC
(by product/process) (Continued)

Nickel (Continued)

Acetates, 9-dodecen-1-ol (pheromone)/Coupling reactions, low pressure hydrogenation, esterification

Acrylic acid/oxidation of propylene via acrolein

Acrylonitrile/Propylene ammoxidation

n-Alkanes/Hydrogenation of C6-C22 alpha olefins (ethylene oligomers)

Adiponitrile/Direct cyanation of butadiene

Alkyl amines/Amination of alcohols

4-Aminoacetanilide/Hydrogenation of 4-Nitroacetanilide

BTX/Hydrogenation of olefins (cyclohexenes)

Terphenyls, hydrogenated/Nickel catalyst, hydrogenation of terphenyl

Bisphenol-A, hydrogenated (Biscyclohexanol-A)/Hydrogenation of Bisphenol-A

Butadiene (1,3)/Extractive distillation of C-4 pyrolyzates

n-Butanol/Hydrogenation of n-Butyraldehyde, Oxo process

1,3-Butylene glycol/Hydrogenation of acetaldol

1,4-Butanediol/Hydrogenation of 1,4-butynediol

Butylenes (mixed)/Distillation pf C4 pyrolyzates

4-Chloro-2-aminophenol/Hydrogenation of 4-Chloro-2-nitrophenol

Lilial (hydroxydihydrocitronellal)/Hydration and oxidation of citronellol

Cycloparaffins/Catalytic hydrogenation of aromatics in kerosene solvent

Cyclohexanol/Hydrogenation of phenol, distillation

Cyclohexanone/From phenol via cyclohexanol by hydrogenation-dehydrogenation

Dialkyldithiocarbamates, metal salts/Dialkylamines + carbon disulfide

Ethylamine/Reductive amination of ethanol

TABLE X-4.
NONCOMPLEXED METAL-BEARING WASTE STREAMS
FOR CHROMIUM, COPPER, LEAD, NICKEL, AND ZINC
(by product/process) (Continued)

Nickel (Continued)

Ethylamines (mono, di, tri)/Reductive ammination (ammonia + hydrogen) of ethanol

Isoeugenol, high % trans/Separation of mixed cis & trans isoeugenols

2-Ethylhexanol/from n-Butyraldehyde by Aldol condensation and hydrogenation

Fatty acids, hydrogenated/tallow & coco acids + Hydrogen

Fatty amines/Hydrogenation of fatty nitriles (batch)

Fatty amines/Hydrogenation of tallow & coco nitriles

Glyoxal-urea formaldehyde textile resin/condensation to N-bis(hydroxymethyl) ureas & N,N'-(dihydroxyethyl) ureas

11-hexadecenal/Coupling rxns, low-pressure hydrogenation

Hexahydrophthalic anhydride/Condensation of butadiene & maleic anhydride (Diels-Alder reaction) + hydrogenation

Isobutanol/Hydrogenation of isobutyraldehyde, Oxo process

Diisobutyl amine/Ammonolysis of isobutanol

Isopropyl amines (mono, di)/Reductive ammination (Ammonia + Hydrogen) of isopropanol

Linalool/Pyrolysis of 2-Pinanol

Methanol/High-pressure synthesis from natural gas via synthetic gas

Methanol/Low-pressure sythesis fron natural gas via synthetic gas

Methanol/Butane oxidation

Tris-(hydroxymethyl) methyl amine/Hydrogenation of tris-(hydroxymethyl) nitromethane

N-Methyl morpholine/Morpholine + Methanol

N-Ethyl morpholine/Morpholine + Ethanol

2-Methyl-7,8-epoxy octadecane/Coupling reactions, low-pressure hydrogenation, epoxidation

TABLE X-4.
NONCOMPLEXED METAL-BEARING WASTE STREAMS
FOR CHROMIUM, COPPER, LEAD, NICKEL, AND ZINC
(by product/process) (Continued)

<u>Nickel</u> (Continued)

Alpha-Olefins/Ethylene oligomer, & Zeigler Cat.

Petroleum hydrocarbon resins, hydrogenated/Hydrogenation of petroleum hydrocarbon resin products

Pinane/Hydrogenation of A-Pinene

2-Pinanol/Reduction of pinane hydroperoxide

Bis-(p-Octylphenol) sulfide, Nickel salt/p-Octylphenol + sulfur chloride (S_2Cl_2), neutralize with Nickel base

Piperazine/Reductive amination of ethanol amine (ammonia & hydrogenation, metal catalyst)

N,N-Dimethylpiperazine/Condensation piperazine + formaldehyde, hydrogenation

Polyoxylalkylene amines/Polyoxyalkylene glycol + Ammonia

Polyoxypropylene diamine/Polypropylene glycol + Ammonia

2-Amino-2-methyl-1-propanol/Hydrogenation of 2-Nitro - 2-methyl-1-propanol

3-Methoxypropyl amine/Reductive amination of acrylamide with methanol & hydrogen

N-Propylamine/Reductive ammination (ammonia + hydrogen) of n-propanol

Sorbitol/Hydrogenation of sugars

Sulfolane/Condensation butadiene + sulfur dioxide, Hydrogenation

Thionocarbamates, N-Ethyl-o-isopropyl/Isopropyl xanthate + Ethylamine

Toluene diamine (mixture)/Catalytic hydrogenation of dinitrotoluene

Mehtylated urea-formaldehyde resins (textile)/Methylation of urea-formaldehyde adduct

Methylated urea-formaldehyde glyoxol (textile resin)/Reaction of methylated urea-formaldehyde + glyoxal

TABLE X-4.
NONCOMPLEXED METAL-BEARING WASTE STREAMS
FOR CHROMIUM, COPPER, LEAD, NICKEL, AND ZINC
(by product/process) (Continued)

Zinc

Methylhydroabietate, diels-alder adducts/Derivatives of abietic esters from rosin

Acrylic resins/Emulsion or solution polymerization to coatings

Acrylic resins (latex)/Emulsion polymerization of acrylonitrile with polybutadiene

Acrylic fibers (85% polyacrylonitrile) by solution polymerization/Wet spinning

Alkyd Resins/Condensation polymerization of phthalic anhydride + glycerin + vegetable oil esters

Benzene/By-product of styrene by ethylbenzene dehydrogenation

Benzene/By-product of vinyl toluene (from ethyltoluene)

n-butyl alcohol/Hydrogenation of n-Butyraldehyde, Oxo process

Coumarin (benz-a-pyrone)/Salicylaldehyde, Oxo process

Cycloparaffins/Catalytic hydrogenation of aromatics in kerosene solvent

Dithiocarbamates, zinc salt/Reaction of zinc oxide + Sodium dithiocarbamates

Dialkyldithiocarbamates, metal salts/Diakylamines + Carbon disulfide

Dithiocarbamates, metal salts/Dithiocarbamic acid + metal oxide

Thiuram (dimethyldithiocarbamate) hexasulfide/Dimethyl-dithiocarbamate + sulfur

Fluorescent brighteners/Coumarin based

Ethyl acetate/Redox reaction (Tschenko) of acetaldehyde

Ethylbenzene/Benzene alkylation in liquid phase

Ethylbenzyl chloride/Chloromethylation (Hydrogen chloride + formaldehyde, zinc chloride) of ethylbenzene

2-Ethyl hexanol/Aldol condensation-hydrogenation of n-Butyraldehyde

Glyoxal-urea formaldehyde textile resin/Condensation to N-bis (hydroxymethyl) ureas + N,N'-(Dihydroxyethyl) ureas

TABLE X-4.
NONCOMPLEXED METAL-BEARING WASTE STREAMS
FOR CHROMIUM, COPPER, LEAD, NICKEL, AND ZINC
(by product/process) (Continued)

Zinc (Continued)

Isobutanol/Hydrogenation of isobutyraldehyde, Oxo process

Isopropanol/Catalytic hydrogenation of acetone

Methallylidene diacetate/Condensation of 2-Methypropenal + acetic anhydride

Methanol/Low-pressure sythesis from natural gas via synthetic gas

Methyl chloride/Hydrochlorination of methanol

Methylethyl ketone/Dehydrogenatin of sec-Butanol

Naphthenic acid salts

Nylon

Nylon 6 & 66 copolymers/Polycondensation of Nylon salt + Caprolatam

Nylon 6 fiber/Extrusion (melt spinning)

Oxo alcohols, C12-C15/Hydroformylation & hydrogenation of C11-C14 olefins

Phenolic urethan resins/Phenol + excess formaldehyde + Methylene aniline diisocyanate

Polystyrene (crystal) modified/Polystyrene + sulfonation, chloromethylation and/or amination

Rayon/Viscose process

SAN resin/Emulsion polymerization

Silicones: silicone rubbers/Hydrolysis and condensation of chlorosilanes

Silicones: silicone specialties (grease, dispersion agents, defoamers & other products)

Silicones: Silicone resins/Hydrolysis & condensation of methyl, phenyl & vinyl chlorosilanes

Silicones: silicone fluids/Hydrolysis of chlorosilanes to acyclic & cyclic organosiloxanes

Stearic acid, metal salts/Neutralization with a metallic base

TABLE X-4.
NONCOMPLEXED METAL-BEARING WASTE STREAMS
FOR CHROMIUM, COPPER, LEAD, NICKEL, AND ZINC
(by product/process) (Continued)

Zinc (Continued)
Styrene/Dehydrogenation of ethylbenzene
Styrene-butadiene resin/Emulsion polymerization
Vinyl acetate/Reduction of acetylene + acetic acid
Vinyl toluene/Dehydrogenation (thermal) of ethyltoluene
Xylenes, mixed/By-product vinyl toluene (from ethyltoluene)

product/process OCPSF raw waste data indicated that the concentrations of the metals of concern are generally within the range of concentrations found at metal finishing plants (see Table VII-4). Also, the metal finishing wastewater matrices contained organic compounds that are used as cleaning solvents and plating bath additives. Some of these compounds serve as complexing agents and their presence is reflected in the metal finishing industry data base. This data base contains hydroxide precipitation performance results from plants with waste streams from certain operations (electroless plating, immersion plating, or printed board circuit board manufacturing) containing complexing agents. This is important because the data base reflects both treatment of waste streams containing complexing agents and segregating these waste streams prior to treatment.

The transfer of technology and limitations from the metal finishing industry is further supported by the principle of precipitation. Given sufficient retention time and the proper pH (which is achieved by the addition of hydroxide frequently in the form of lime), and barring the binding up of metals in strong organic complexes (see dicussion below), a metal exceeding its solubility level in water can be removed to a particular level--that is the effluent can be treated to a level approaching its solubility level for each constituent metal. This is a physical/chemical phenomenon that is relatively independent of the type of wastewater, barring the presence of strong complexing agents.

However, some product/processes do have wastewaters that contain organic compounds that bind up the metals in stable complexes that are not amenable to optimal settling through the use of lime. Strongly complexed priority pollutant metals are used or created, for instance, in the manufacture of metal complexed dyestuffs (metallized dyes) or metallized organic pigments. The most common priority pollutant metals found in these products are trivalent chromium and copper. The degree of complexing of these metals may vary among different product/processes. Consequently, each plant may need to use a different set of unique technologies to remove these metals. Thus, metals limits are not set by this regulation and must be established by permit writers on a case-by-case basis, for certain product/processes containing complexed metals. These product/processes are listed in Table X-5.

TABLE X-5.
COMPLEXED METAL BEARING WASTE STREAMS FOR
CHROMIUM, COPPER, LEAD, NICKEL, AND ZINC
(by product/process)

Chromium

Azo dye intermediates/Substituted diazonium salts + coupling compounds

Vat dyes/Mixing purchased dyestuffs (Anthraquinones, polycyclic Quinones and Indigoids)

Acid dyes

Azo dyes, metallized/Azo dye + metal acetate

Acid dyes, Azo (including metallized)

Organic pigments, miscellaneous lakes and toners

Copper

Disperse dyes

Vat dyes/Mixing purchased dyestuffs (Anthraquinones, polycyclic Quinones and Indigoids)

Acid dyes

Direct dyes

Vat dyes

Sulfur dyes

Disperse dyecoupler/N-substitution of 2-Amino-4-acetamidoanisole

Azo dyes, metallized/Azo dye + metal acetate

Direct dyes, Azo

Disperse dyes, Azo and Vat

Organic pigment Green 7/Copper phthalocyanine

Organic pigments

Organic pigments/Phthalocyanine pigments

Organic pigments/Copper phthalocyanine (Blue Crude)

Organic pigments, miscellaneous lakes and toners

TABLE X-5.
COMPLEXED METAL BEARING WASTE STREAMS FOR
CHROMIUM, COPPER, LEAD, NICKEL, AND ZINC
(by product/process) (Continued)

Lead

Organic pigments, Quinacridines

Organic pigments, Thioindigoids

Nickel

Azo dyes, metallized/Azo dye + metal acetate

Zinc

Organic pigments/Azo pigments by diazotization and coupling

The list in Table X-5 has been compiled based upon an analysis summarized in Section V of this document. EPA concluded that all other metal-bearing process wastewaters (whether listed in Table X-4 or established as metal-bearing by a permit writer) can be treated using hydroxide precipitation to the levels set forth in the regulation.

Finally, EPA established a separate zinc limitation for rayon manufacturers using the viscose process and acrylic fibers manufacturers using the zinc chloride/solvent process. Process wastewaters from the rayon/viscose and acrylic/zinc chloride/solvent processes contain zinc at levels that are typically a hundred times the levels in other OCPSF wastewaters. EPA has collected data assessing the performance of chemical precipitation with lime and clarification in treating zinc in these discharges. The final limitations are based on these data.

4. Other Organic Pollutants

The Agency considered two in-plant technologies for the removal of organic pollutants other than those removed by steam stripping. These are activated carbon adsorption and in-plant biological treatment.

Activated carbon adsorption is a proven technology primarily used for the removal of organic chemical contaminants from individual process waste streams. The carbon has a large surface area per unit mass and removes pollutants through adsorption and physical separation mechanisms. In addition to removal of most organic chemicals, activated carbon achieves limited removal of other pollutants such as BOD_5 and metals. Carbon used in a fixed column, as opposed to being directly applied in a granular or powdered form to a waste stream, may also act as a filtration unit.

Eighteen OCPSF plants in the data base for this regulation are known to use activated carbon as an in-plant treatment technology. Although performance data for a specific individual in-plant carbon adsorption unit prior to biological treatment was not available, the Agency collected performance data from an in-plant carbon adsorption unit following steam stripping at an OCPSF facility for which the carbon adsorption unit treated a separate process waste stream prior to discharge. This unit was sampled during the EPA 12-plant sampling study. This plant manufactures only inter-related products whose similar waste streams are combined and sent to a physical/chemical treatment system consisting of steam stripping followed by activated carbon. The toxic pollutants associated with these waste streams are removed by either steam stripping or activated carbon, or a combination of these two technologies.

The Agency has decided to use this available performance data from the end-of-pipe carbon adsorption unit as the basis for establishing BAT limits for four pollutants (2-nitrophenol, 4-nitrophenol, 2-4-dinitrophenol, and 4,6-dinitro-o-cresol) and the combination of steam stripping and activated carbon adsorption for nitrobenzene. These data show good removals for the carbon adsorption unit of 4,6-dinitro-o-cresol, 2-nitrophenol, and 4-nitrophenol. However, the data indicate that for 2,4-dinitrophenol and nitrobenzene, the carbon adsorption unit is experiencing competitive adsorption phenomena. This condition exists when a matrix contains adsorbable compounds in solution that are being selectively adsorbed, and desorbed. The data from the plant sampled by EPA and from another carbon adsorption unit for nitrobenzene at a plant that submitted data yield effluent limitations that are higher when compared to the other organic pollutant effluent limitations in this regulation. However, EPA believes that the final limitations based upon this currently available data are generally achievable across the industry. Nonetheless, even this level of demonstrated treatment gives significant removals for these compounds. (Current levels of 150,000 pounds annually would be reduced to less than 10,000 pounds annually after BAT and PSES.) Therefore, limitations for 2,4-dinitrophenol and nitrobenzene are based upon this technology data. Further work to identify additional technologies or use of carbon adsorption units in series for removal of these compounds will be conducted to determine whether removal of these compounds can be improved.

For certain waste streams and pollutants, in-plant biological treatment is an effective and less costly alternative to carbon adsorption for control of toxic organic pollutants, especially those that are effectively absorbed into the sludge and relatively biodegradable. In-plant biological treatment may require a longer detention time and certain species of acclimated biomass to be effective as compared to end-of-pipe biological treatment that is predominantly designed to treat BOD_5; EPA has determined that in-plant biological treatment with an acclimated biomass is as effective as activated carbon adsorption for removing priority pollutants such as polynuclear aromatics, phthalate esters, acrylonitrile, phenol, and 2,4-dimethylphenol. EPA has thus selected this treatment for BAT control of these pollutants.

In-plant biological treatment is demonstrated at 33 plants in the OCPSF data base. Three plants' data were available for use in developing the in-plant BAT limitations for the above pollutants. The performance data for in-plant biological treatment were taken from plants that treat major sources of polynuclear aromatic hydrocarbons, phthalate esters, acrylonitrile, phenol, and 2,4-dimethylphenol in biological treatment systems. The Agency determined that these data are appropriate for use in characterizing the performance of in-plant biological treatment based upon the waste stream characteristics of the influent to the treatment systems. For the pollutants that have limits derived on the basis of this in-plant technology, the limitations for the non-end-of-pipe biological treatment subcategory are more stringent than the category for which end-of-pipe biological treatment is added. Both biological treatment systems (end-of-pipe and the dedicated systems used for the in-plant biological treatment basis) remove these pollutants from the waste stream in most cases to levels at or below the analytical minimum level. However, available data indicate that the variability of the larger end-of-pipe biological systems in the data base is greater. This may be explained by the fact that the larger end-of-pipe systems receive commingled waste streams with a larger number of organic pollutants, and thus may be more susceptible to daily fluctuations in performance.

The Agency also relied on the ability of end-of-pipe biological treatment to achieve additional pollutant removal beyond carbon adsorption and in-plant biological treatment, except in the case of 4,6-dinitro-o-cresol. For this pollutant only the in-plant activated carbon technology is used as a basis in both BAT subcategories. Thus, BAT limitations are lower for several pollutants regulated by the end-of-pipe biological treatment subcategory.

Four pollutants (2-chlorophenol, 2,4-dichlorophenol, 2,4-dinitrotoluene, and 2,6-dinitrotoluene) are regulated in the end-of-pipe biological treatment subcategory that are not regulated in the non-end-of-pipe biological treatment subcategory because the Agency lacks sufficient in-plant data on which to base limits.

The promulgated BAT effluent limitations guidelines for the end-of-pipe and non-end-of-pipe biological treatment subcategories and shown in Tables X-1 and X-2, respectively. These limitations were determined by multiplying the long-term averages for each subcategory, shown in Table VII-64, by the appropriate pollutant variability factors shown in Tables VII-66 and VII-67 for organics and in Tables VII-68 and VII-69 for metals.

F. COST AND EFFLUENT REDUCTION BENEFITS

As described in Section VIII of this document, the Agency estimated the engineering cost of compliance with the promulgated BAT effluent limitations guidelines and the associated pollutant reduction benefits. The Agency estimated that compliance with the BAT regulations, incremental to BPT, would cost the OCPSF direct discharge plants $315.2 in capital investment and $154.7 for annual O&M and monitoring (in 1982 dollars) and would remove a total of 1.1 million lb/yr of priority pollutants beyond removals by the BPT technology. EPA determined that Option II is the best available technology economically achievable for all plants except for a subset of small plants. For plants whose annual OCPSF production is less than or equal to 5 million pounds, EPA concluded that Option II is not economically achievable. For these plants, EPA has set BAT equal to BPT.

G. IMPLMENTATION OF THE BAT EFFLUENT LIMITATIONS GUIDELINES

1. NPDES Permit Limitations

The promulgated effluent limitations guidelines are concentration-based, thus not regulating flow. As described in Section IX, the permit writer must use a reasonable estimate of process wastewater discharge and the concentration limitations to develop mass limitations for the NPDES permit. The final NPDES permit limitations will be the sum of the OCPSF mass effluent limitations and any mass effluent limitations developed on a case-by-case basis using best professional judgment by the permit writer to take into account non-OCPSF and nonprocess wastewater discharges.

In the case of chromium, copper, lead, nickel, zinc, and total cyanide, the discharge quantity (mass) shall be determined by multiplying the concentrations listed in Tables X-1 and X-2 for these pollutants times the flow from metal-bearing waste streams for the metals and times the flow from cyanide-bearing waste streams for total cyanide. Metal- and cyanide-bearing waste streams are defined as those waste streams listed in Tables X-4 and X-3, respectively, plus any additional process wastewater streams identified by the permitting authority on a case-by-case basis as metal- or cyanide-bearing based upon a determination: 1) that such streams contain significant amounts of the pollutants identified above, and that 2) the combination of such streams, prior to treatment, with the Tables X-3 and X-4 waste streams, will result in substantial reduction of these pollutants. This determination must be based upon a review of relevant engineering, production, and sampling and analysis information. Compliance could be monitored in-plant or, after accounting for dilution by noncyanide- and nonmetal-bearing process wastewater and nonprocess wastewaters, at the outfall. (Of course, the permit writer may on a case-by-case basis provide additional discharge allowances for metals and cyanide in non-OCPSF process or other wastewaters where they are present at significant levels. These allowances must be based upon the permit writer's best professional judgment of BAT as well.) This approach is similar to that taken by EPA in other industry effluent limitations guidelines. (See 40 CFR Parts 433 and 439 for monitoring requirements related to their cyanide limitations.)

2. NPDES Monitoring Requirements

The final OCPSF regulations regulate 63 toxic pollutants for BAT (and 47 toxic pollutants for PSES). Regulating such a large number of the toxic priority pollutants is unprecedented in the effluent guideliens rulemaking program, reflecting the fact that many of the organic toxic pollutants are directly manufactured by OCPSF facilities as well as used as raw materials or generated as by-products in industry processes.

EPA determined that the OCPSF industry should not be subcategorized based on product mix for the BAT rule because the pollutants are treatable to comparable levels for a wide variety of plants within the industry. However, EPA promulgated BAT limitations for two subcategories that are largely determined by conventional pollutant raw waste characteristics (see Section IV of this document). Nevertheless, most OCPSF plants routinely discharge only a limited subset (e.g., 5 to 15) of the toxic pollutants regulated. Thus, in the case of a typical plant in the industry, the regulations impose limitations for many pollutants that are not in fact discharged by the plant.

EPA sought to address this concern in the July 17, 1985 Federal Register Notice by proposing a monitoring scheme whereby monitoring for pollutants could be drastically reduced if preliminary monitoring and other information indicated that the pollutants would not be discharged at significant levels.

The July 17, 1985 proposal of a monitoring scheme provoked substantial comments from both sides of the issue. Some argued that the scheme required more initial monitoring than was necessary to determine whether pollutants were likely to be present in the discharge during the permit term. Many of these commenters also argued that EPA's test for determining which pollutants would require more frequent monitoring was too stringent (i.e., too inclusive). In contrast, one commenter argued that the test did not adequately account for discharge variability, and thus would result in the incorrect conclusion that certain pollutants were not likely to be discharged (were not "pollutants of concern") when in fact they would be discharged at levels and frequencies that warrant frequent compliance monitoring.

In the final rule, EPA decided that each discharger in a subcategory should be subject to the effluent limitations for all pollutants regulated for that subcategory. First, EPA recognized the difficulty in guaranteeing that a plant will never during the permit term discharge a pollutant regulated for the applicable subcategory. Many factors do cause changes in the nature of OCPSF plant wastewater discharges, such as process changes, raw material changes, and product line changes, as well as more subtle factors that may result in changes in the wastewater matrix. Inserting a limitation in a plant's permit for a pollutant not generally expected (based on initial information) to be discharged ensures that in fact the plant will be vigilant not to introduce the pollutant into its discharge without adequate treatment. Second, limitation of each such pollutant is fair, since in the event that a plant does discharge such a pollutant, EPA has determined that each of the regulated pollutants can be successfully treated by OCPSF dischargers by the use of the best available technology economically achievable.

Once a pollutant is regulated in the OCPSF regulation for dischargers in a particular subcategory, it must also be limited in the NPDES permit issued to any discharger in that subcategory (see Sections 301 and 304 of the Act; see also 40 CFR §122.44(a)). The question remains, however, as to how much monitoring will be required for the various pollutants regulated by the permit.

EPA believes that industry's concern that OCPSF dischargers not be required to expend unnecessary resources to monitor for nonexistent pollutants is legitimate. While dischargers will normally monitor frequently for at least some organic toxic pollutants that are expected to be discharged, their monitoring costs would increase if other organic pollutants were added to the list. Whether the cost increase would be significant would depend on several factors, including whether the plant used GC/CD or GC/MS methods (which in turn depends on the number of organic pollutants discharged by the plant) and whether the additional pollutants were members of the same class of compounds as the pollutants expected to be discharged. The incremental cost of monitoring using Methods 1624 and 1625 for organics and atomic adsorption for metals could range from $295 for one organic compound and one metal to $1,350 for a scan of all regulated organic and metal priority pollutants. Thus, it is desirable to minimize unnecessary monitoring. However, as discussed above and in the July 17, 1985 Notice, there is legitimate concern that pollutants may be discharged even if some initial information (e.g., a permit application) suggests that the pollutants are not currently discharged.

After considering the comments submitted on both sides of the issue raised by the July 17, 1985 Notice, EPA has decided that the appropriate monitoring scheme for plants in this industry, as in other industries for which EPA has promulgated effluent limitations guidelines and standards in the past, is best determined on a case-by-case basis. EPA has generally refrained from setting inflexible monitoring requirements in effluent guideline regulations for other industries, and the NPDES permit regulations have similarly been written to allow the permit writer to establish in the permit (subject to all the procedural and substantive safeguards afforded by the NPDES permit procedures of 40 CFR Parts 122 and 124 and by the judicial review provision of Section 509(b) of the Act) a set of monitoring requirements that are appropriately tailored to the plant (see 40 CFR Sections 122.44(i) and 122.48).

The NPDES regulations provide guidelines setting forth minimum monitoring and reporting requirements for NPDES dischargers. Section 122.48 requires that each permit specify requirements regarding monitoring type, intervals, and frequency sufficient to yield data that are representative of the monitored activity. Secton 122.44(i) adds that the monitoring results must be reported with a frequency depending on the nature and effect of the discharge, but in no case less than once per year. Sections 122.41, 122.44, and 122.48 contain numerous other requirements concerning monitoring and reporting.

However, the NPDES regulations do not establsh more specific requirements as to the frequency of monitoring that should be required. The frequency with which compliance monitoring should be performed will normally depend upon a variety of factors. One factor, of course, is the level at which particular pollutants are likely to be discharged in the event that the plant fails to treat its effluent adequately. This level would depend on production-, process-, and raw material-related factors, as discussed above and elsewhere in this document. Other factors relevant to setting monitoring requirements include the size of the plant, the volume of the plant's flow, the nature and sensitivity of standards applicable for the receiving water, and other site-specific factors. Permit writers have throughout the history of the NPDES permit program made judgments as to the appropriate monitoring frequencies for particular plants, based upon these site-specific considerations. EPA believes that this approach remains the most appropriate for the OCPSF industry as it has been for all other industries.

EPA recognizes that specific guidance on appropriate monitoring requirements for OCPSF plants would be useful, particularly to ensure that monitoring not be needlessly required for pollutants that are not likely to be discharged at a plant. One noteworthy factor is the monitoring scheme assumed by EPA for purposes of estimating the costs of complying with the OCPSF regulation. EPA has assumed that all plants would monitor their toxic pollutants four times per month. In addition, EPA has assumed that three of the four analyses would include only those toxic pollutants expected to be present at levels of regulatory concern. However, the fourth monthly analysis included all regulated toxic pollutants.

In assessing wastewater data as part of the analysis for developing appropriate monitoring frequencies for toxic pollutants, permit writers should take special care to account for the effects of dilution, which may indicate the absence of pollutants that may be discharged. For example, as shown in Appendix VII-G, an indication on an NPDES permit application Form 2C that a pollutant is absent or is present only at very low concentrations may reflect dilution and may fail to reveal that the pollutant is genuinely associated with and discharged from particular plant processes, and thus needs to be monitored frequently. Thus, permit writers should obtain in-plant, pre-dilution data when necessary to characterize properly the wastewater for purposes of establishing monitoring requirements.

To address issues of particular concern in permitting OCPSF dischargers, EPA intends to publish guidance on OCPSF monitoring in the near future. This guidance will address both the issues of compliance monitoring and of initially determining which pollutants should be subject only to infrequent monitoring based on a conclusion that they are unlikely to be discharged.

H. NON-WATER QUALITY ENVIRONMENTAL IMPACTS

The elimination or reduction of one form of pollution may create or aggravate other environmental problems. Therefore, Sections 304(b) and 306 of the Act require EPA to consider the non-water quality environmental impacts (including energy requirements) of certain regulations. In compliance with these provisions, EPA has considered the effect of these regulations on air pollution, solid waste generation, and energy consumption.

The non-water quality environmental impacts associated with this regulation are described below:

1. Air Pollution

The effect of compliance efforts to meet BAT will result in significant reduction in air emissions, because many plants are expected to comply with the BAT limitations by installing in-process controls that effectively remove volatile organic compounds before they reach the end-of-pipe controls. These in-process controls would be accompanied by effective air pollution controls. Thus, there should be a net decrease in both air loadings and concentrations of volatile organic compounds in the treated effluents.

The air emissions of the 32 volatile organic priority pollutants selected to represent a portion of the OCPSF air emissions are projected to be reduced from the current air emission loadings of 18.0 million pounds per year to 3.1 million pounds per year based on the installation and proper operation of the BAT in-plant control technology (see Table VIII-111).

2. Solid Waste

EPA considered the effect these regulations would have on the production of solid waste, including hazardous waste defined under Section 3001 of the Resource Conservation and Recovery Act (RCRA). EPA estimates that increases in total solid waste of 22,102 metric tons of sludge per year, including hazardous waste, resulting from the OCPSF regulation will be insignificant compared to current levels. The Agency included sludge incineration in the estimated engineering costs of compliance for any incremental sludge generated by the BAT model treatment systems. Therefore, the net residual solid waste, in the form of ash, will be negligible.

3. Energy Requirements

EPA estimated that the attainment of BAT will increase energy consumption by a small increment over present industry use. The estimated increased energy consumption for BAT treatment systems is, with the exception of sludge incineration, 416,440 barrels of No. 2 fuel oil per year. The estimated increased energy consumption associated with the corresponding sludge incineration is 166,011 barrels of No. 2 fuel oil per year.

SECTION XI

EFFLUENT QUALITY ATTAINABLE THROUGH THE APPLICATION OF NEW SOURCE PERFORMANCE STANDARDS (NSPS)

A. INTRODUCTION

The basis for new source performance standards (NSPS) under Section 306 of the Clean Water Act is the best available demonstrated technology. New plants have the opportunity to install the best and most efficient production processes and wastewater treatment technologies. As a result, NSPS should represent the most stringent numerical values attainable through the application of best available demonstrated control technology for all pollutants (toxic, conventional, and nonconventional).

B. POLLUTANT AND TECHNOLOGY SELECTION

EPA promulgated NSPS on the basis of the best available demonstrated technology for all new sources. NSPS are established for conventional pollutants (BOD_5, TSS, and pH) on the basis of BPT model treatment technology. Priority pollutant limits are based on the BAT model treatment technology.

The Agency considered the same technology options as discussed previously for BPT and BAT. BPT Options II (biological treatment plus polishing ponds) and III (biological treatment plus multimedia filtration) were rejected because they were not well-demonstrated in the OCPSF category. BAT Option I (equivalent to BPT) was rejected as the basis for priority pollutant limits for the same reason that it was rejected for BAT; BAT Option I is not the best available demonstrated technology. BAT Option III, which included end-of-pipe activated carbon, was rejected because of its high cost and the relatively small incremental removal it would achieve, and because it is not a well-demonstrated end-of-pipe technology, either with or without biological treatment technology.

The Agency issued conventional pollutant new source performance standards for the same seven subcategories for which BPT limits were established. These standards are equivalent to the limits established for BPT (see Table IX-1).

Priority pollutant new source performance standards are applied to new sources according to the same subcategorization scheme applicable under BAT. The set of standards in the end-of-pipe biological treatment subcategory will apply to new sources that use biological treatment in order to comply with BOD_5 and TSS standards. Standards are established for 63 priority pollutants in this set (see Table X-1). The standards in the subcategory for sources that do not use end-of-pipe biological treatment apply to new sources that will generate such low levels of BOD_5 that they do not need end-of-pipe biological treatment or that choose to use physical/chemical controls to comply with the BOD_5 standard. These facilities will have priority pollutant standards for 59 constituents, based on the application of the in-plant control technologies with or without end-of-pipe physical/chemical treatment (see Table X-2).

EPA has determined that NSPS will not cause a barrier to entry for new source OCPSF plants.

SECTION XII

EFFLUENT QUALITY ATTAINABLE THROUGH THE APPLICATION OF PRETREATMENT STANDARDS FOR EXISTING SOURCES AND PRETREATMENT STANDARDS FOR NEW SOURCES

A. INTRODUCTION

Section 307(b) of the Clean Water Act (CWA) requires EPA to promulgate pretreatment standards for existing sources (PSES). These standards must be achieved within 3 years of promulgation. PSES are designed to prevent the discharge of pollutants that pass through, interfere with, or are otherwise incompatible with the operation of publicly owned treatment works (POTWs). The legislative history of the Clean Water Act of 1977 indicates that pretreatment standards are to be technology-based, and analogous to the best available technology.

Section 307(c) of the CWA requires EPA to promulgate pretreatment standards for new sources (PSNS) at the same time that it promulgates NSPS. New indirect discharging facilities, like new direct discharging facilities, have the opportunity to incorporate the best available demonstrated technologies, including process changes, in-plant controls, and end-of-pipe treatment technologies, and to use plant site selection to ensure adequate treatment system installation.

General pretreatment regulations applicable to all existing and new source indirect dischargers appear in 40 CFR Part 403. These regulations describe the Agency's overall policy for establishing and enforcing pretreatment standards for new and existing users of a POTW, and delineate the responsibilities and deadlines applicable to each party in this effort. In addition, 40 CFR Part 403, Section 403.5(b), outlines prohibited discharges that apply to all users of a POTW.

B. POLLUTANT SELECTION

PSES and PSNS applicable to indirect dischargers are generally analogous to BAT limitations and NSPS applicable to direct dischargers. The Agency promulgated PSES and PSNS for 47 priority pollutants determined to pass through POTWs. The standards apply to all existing and new indirect discharging OCPSF plants. EPA determined which pollutants to regulate in PSES and PSNS on the basis of whether or not they pass through, cause an upset, or otherwise interfere with the operation of a POTW (including interference with sludge practices).

The principal means by which the Agency evaluates pollutant pass-through is to compare the pollutant percentage removed by POTWs with the percentage removed to comply with BAT limitations. The development and implementation of the POTW pass-through analysis are discussed in Section VI.

C. TECHNOLOGY SELECTION

Indirect dischargers generate wastewaters with the same pollutant characteristics as the direct discharge plants; therefore, the same technology options as discussed previously for BAT and NSPS are appropriate for application at PSES and PSNS. The Agency promulgated PSES and PSNS for all indirect dischargers on the same technology basis as the BAT Option II non-end-of-pipe biological treatment subcategory. EPA did not include end-of-pipe biological treatment in the final PSES model technology based on the considerations discussed below.

As a matter of treatment theory, biological pretreatment may be largely redundant to the biological treatment provided by the POTW. The primary function of biological treatment is to reduce BOD_5 loadings, whether at the OCPSF plant or at the POTW. Of course, an OCPSF treatment system may be more acclimated to the types of wastes discharged by the OCPSF plant than would the POTW. However, this distinction is of limited importance once the OCPSF wastewaters are pretreated by BAT-level in-plant physical/chemical or biological treatment.

The data indicate that biological pretreatment over and above the in-plant treatment that is implemented in the model technology for BAT and PSES regulation results in very modest incremental removals of priority (toxic) pollutants. This can be seen by comparing the BAT limitations for plants with and without end-of-pipe biological treatment. Since both sets of limitations are quite low for virtually all pollutants, the total incremental increase of toxic pollutants removed by adding end-of-pipe biological treatment to in-plant treatment would be less than 13,000 pounds. Actually, the quantity removed would be less, because biological treatment probably would not be used by a number of indirect dischargers with low BOD_5. These plants would be subject only to limitations equivalent to BAT limits without end-of-pipe biological treatment. As described in the Economic Impact Analysis, the cost of achieving these removals would be $20.8 million annually (in 1986 dollars). Moreover, this option would result in the closure of two additional plants, with 371 incremental job losses. Based upon all of these factors (relatively small incremental removals, high cost, significant economic impact, and redundancy of treatment equipment), EPA did not promulgate PSES and PSNS based upon end-of-pipe biological treatment.

In addition, while information is limited, EPA believes that at least some indirect dischargers located in urban areas may lack sufficient land to install end-of-pipe treatment. (Indirect dischargers tend to have more limited access to land than direct dischargers, although this is not always the case.)

Although EPA rejected the option of adding end-of-pipe biological treatment, the Agency has sometimes used biological treatment as part of its model technology for the in-plant treatment of certain nonvolatile pollutants. Specifically, for such pollutants, EPA has in some cases used biological treatment systems as an alternative to in-plant activated carbon adsorption for some adsorpable/biodegradable organic pollutants. Thus, EPA has in fact used biological treatment as part of PSES model treatment technology where appropriate.

D. PSES AND PSNS

The pretreatment standards for existing and new sources for the 47 pollutants determined to pass through POTWs are shown in Table XII-1. These pretreatment standards are identical to the effluent limitations guidelines established for BAT and NSPS for the non-end-of-pipe biological treatment subcategory.

TABLE XII-1.
PRETREATMENT STANDARDS FOR EXISTING AND NEW SOURCES (PSES and PSNS)

Pollutant Number	Pollutant Name	Pretreatment Standards[1] Maximum for Any One Day	Maximum for Monthly Average
1	Acenaphthene	47	19
4	Benzene	134	57
6	Carbon Tetrachloride	380	142
7	Chlorobenzene	380	142
8	1,2,4-Trichlorobenzene	794	196
9	Hexachlorobenzene	794	196
10	1,2-Dichloroethane	574	180
11	1,1,1-Trichloroethane	59	22
12	Hexachloroethane	794	196
13	1-1-Dichloroethane	59	22
14	1,1,2-Trichloroethane	127	32
16	Chloroethane	295	110
23	Chloroform	325	111
25	1,2-Dichlorobenzene	794	196
26	1,3-Dichlorobenzene	380	142
27	1,4-Dichlorobenzene	380	142
29	1,1-Dichloroethylene	60	22
30	1,2-Trans-dichloroethylene	66	25
32	1,2-Dichloropropane	794	196
33	1,3-Dichloropropene	794	196
34	2,4-Dimethylphenol	47	19
38	Ethylbenzene	380	142
39	Fluoranthene	54	22
44	Methylene Chloride	170	36
45	Methyl Chloride	295	110
52	Hexachlorobutadiene	380	142
55	Naphthalene	47	19
56	Nitrobenzene	6,402	2,237
57	2-Nitrophenol	231	65
58	4-Nitrophenol	576	162
60	4,6-Dinitro-o-cresol	277	78
65	Phenol	47	19
66	Bis(2-ethylhexyl)phthalate	258	95
68	Di-n-butyl phthalate	43	20
70	Diethyl phthalate	113	46
71	Dimethyl phthalate	47	19
78	Anthracene	47	19
80	Fluorene	47	19
81	Phenanthrene	47	19
84	Pyrene	48	20
85	Tetrachloroethylene	164	52
86	Toluene	74	28
87	Trichloroethylene	69	26

TABLE XII-1.
PRETREATMENT STANDARDS FOR EXISTING AND
NEW SOURCES (PSES AND PSNS) (Continued)

Pollutant Number	Pollutant Name	Pretreatment Standards[1]	
		Maximum for Any One Day	Maximum for Monthly Average
88	Vinyl Chloride	172	97
121	Total Cyanide[2]	1,200	420
122	Total Lead[3]	690	320
128	Total Zinc[3,4]	2,610	1,050

[1]All units are micrograms per liter.

[2]Cyanide limitations apply only to cyanide-bearing waste streams, including those listed in Table X-3.

[3]Metals limitations apply only to noncomplexed metal-bearing waste streams, including those listed in Table X-4. Discharges of lead and zinc from "complexed metal-bearing process wastewater," listed in Table X-5, are not subject to these limitations.

[4]Total zinc limitations and standards for rayon fiber manufacture by the viscose process and acrylic fiber manufacture by the zinc chloride/solvent process are 6,796 µg/l and 3,325 µg/l for Maximum for Any One Day and Maximum for Monthly Average, respectively.

E. COST AND EFFLUENT REDUCTION BENEFITS

As described in Section VIII of this document, the Agency estimated the engineering cost of compliance with the promulgated pretreatment standards for existing sources and the associated pollutant reduction benefits. The Agency estimated that compliance with the PSES regulations would cost the OCPSF indirect discharge plants $268.1 million in capital investment and $145.5 million for annual operation and maintenance (O&M) and monitoring (in 1982 dollars), and would remove a total of 8.8 million lb/yr of priority pollutants. EPA has therefore concluded that promulgation of PSES as described above is warranted for OCPSF indirect dischargers.

EPA has determined not to exempt small plants from PSES and PSNS, or to establish less stringent PSES or PSNS for them. While the impacts on small plants are significant, they are in the Agency's opinion neither so high nor so disproportionate as to justify an exemption, especially in light of the continued discharge of substantial amounts of toxic pollutants that an exemption would permit. EPA believes that an exemption for small indirect dischargers is not compelled by the fact that a segment of small direct dischargers have received some regulatory relief in the form of a lower level of regulation. Since the mid-1970s, small direct dischargers have been regulated by NPDES permits and will continue to be subject to BPT limitations, thereby assuring that most toxic pollutants will be removed from their wastewaters. In contrast, most indirect dischargers have to this day failed to install any pretreatment. The Agency has determined that PSNS will not cause a barrier to entry for new OCPSF plants.

F. NON-WATER QUALITY ENVIRONMENTAL IMPACTS

The elimination or reduction of one form of pollution may create or aggravate other environmental problems. Therefore, Sections 304(b) and 306 of the CWA require EPA to consider non-water quality environmental impacts (including energy requirements) of certain regulations. In compliance with these provisions, EPA has considered the effect of these regulations on air pollution, solid waste generation, and energy consumption.

The non-water quality environmental impacts associated with this regulation are described below.

1. Air Pollution

The effect of compliance efforts to meet PSES will result in significant reduction in air emissions, because many plants are expected to comply with the PSES limitations by installing in-process controls that effectively remove volatile organic compounds before they reach the end-of-pipe controls or sewer. These in-process controls would be accompanied by effective air pollution controls. Thus, there should be a net decrease in both air loadings and concentrations of volatile organic compounds in the treated effluents.

The air emissions of the 32 volatile organic priority pollutants selected to represent a portion of the OCPSF air emissions are projected to be reduced from the current air emission loadings of 2.8 million pounds per year to 0.015 million pounds per year, based on the installation and proper operation of the PSES in-plant control technology (see Table VIII-112).

2. Solid Waste

EPA considered the effect these regulations would have on the production of solid waste, including hazardous waste defined under Section 3001 of the Resource Conservation and Recovery Act (RCRA). EPA estimates that increases in total solid waste of 3,992 metric tons of sludge per year, including hazardous waste, resulting from the OCPSF regulation will be insignificant compared to current levels. The Agency included sludge incineration in the estimated engineering costs of compliance for any incremental sludge generated by the PSES model treatment systems. Therefore the net residual solid waste, in the form of ash, will be negligible.

3. Energy Requirements

EPA estimated that the attainment of PSES will increase energy consumption by a small increment over present industry use. With the exception of sludge incineration, the estimated increased energy consumption for PSES treatment systems is 343,269 barrels of No. 2 fuel oil per year. The estimated increased energy consumption associated with the corresponding sludge incineration is 52,020 barrels of No. 2 fuel oil per year.

SECTION XIII

BEST CONVENTIONAL POLLUTANT CONTROL TECHNOLOGY

The 1977 Amendments to the Clean Water Act added Section 301(b)(2)(e), establishing "best conventional pollutant control technology (BCT) for the discharge of conventional pollutants from existing industrial point sources. Section 304(a)(4) designated the following as conventional pollutants: BOD_5, TSS, fecal coliform, pH, and any additional pollutants defined by the Administrator as conventional. The Administrator designated oil and grease a conventional pollutant on July 30, 1979 (44 FR 44501).

BCT is not an additional limitation; BCT merely replaces BAT for the control of conventional pollutants. In addition to other factors specified in Section 304(b)(4)(B), the CWA requires that the BAT effluent limitations guidelines be assessed in light of a two-part "cost-reasonableness" test [see American Paper Institute v. EPA, 660 F 2d 954 (4th Cir. 1981)]. The first test compares the cost for private industry to reduce its discharge of conventional pollutants with the cost to publicly owned treatment works (POTWs) for similar levels of reduction in their discharge of these pollutants. The second test examines the cost-effectiveness of additional industrial treatment beyond BPT. EPA must find that limitations are "reasonable" under both tests before establishing them as BCT. In no case may BCT be less stringent than BPT.

EPA has promulgated a methodology for establishing BCT effluent limitations guidelines (51 FR 24974, July 8, 1986). EPA did not establish BCT limitations as part of the final OCPSF rulemaking.

SECTION XIV

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The U.S. Environmental Protection Agency (USEPA) appreciates the contributions to the OCPSF rulemaking effort by the Science Applications International Corporation (SAIC) personnel of McLean, Virginia, and Paramus, New Jersey. Mr. Arthur E. Shattuck (Senior Project Manager), Mr. John B. Sunda (Environmental Engineer), Dr. Maurice E.B. Owens (Senior Project Manager), Dr. William D. Grubbs (Senior Statistician), Mr. Wai-Kouk W. Yu (Senior Systems Analyst), and Mr. George R. Wilkie (Programmer/Analyst) were the key contributors in completing the detailed technical study and drafting the initial report on which this document is based. Other personnel who contributed to the project investigations and reports were Ms. Joyce S. Schlesinger (Principal), Mr. Frank O. Marrazza (Senior Associate Engineer), and Mr. Peter R. Karasik (Senior Associate Engineer) of the Environ Corporation, Washington, D.C. Dr. Gary L. Liberson of Lloyd Associates, Washington, D.C., and Dr. William A. Lowenbach, currently with Karch & Associates, Washington, D.C., provided expert assistance in the areas of statistical analysis and process chemistry, respectively. Word processing was performed at SAIC by Ms. Lenore Wagner, Ms. Wendy Witz, and Mr. Frank Tennant. The entire contractor technical staff consistently exhibited personal dedication and resourcefulness in developing, managing, and interpreting one of the Agency's largest and most complicated industrial data bases.

The Agency acknowledges the plant managers, engineers, and other industry representatives whose cooperation and assistance in site visitations and information gathering activities greatly contributed to the completion of this project. The Agency also appreciates the careful review and comments provided by many members of the public in response to the interim OCPSF reports, studies, and rulemaking record material.

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Mr. Gary Amendola, EPA Region V
Mr. Ed McHam, EPA Region VI
Ms. Susan Wyatt, Office of Air and Radiation (RTP)
Ms. Vivian Thompson, Office of Air and Radiation

SECTION XV

GLOSSARY

ABSORPTION. A process in which one material (the absorbent) takes up and retains another (the absorbate) with the formation of a homogeneous mixture having the attributes of a solution. Chemical reaction may accompany or follow absorption.

ACCLIMATION. The ability of an organism to adapt to changes in its immediate environment.

ACID. A substance which dissolves in water forming hydrogen ions.

ACTIVATED CARBON. Carbon which is treated by high temperature heating with steam or carbon dioxide to produce an internal porous particle structure. It is used for adsorbing gases, vapors, and colloidal particles.

ACTIVATED CARBON ADSORPTION. A method of wastewater treatment used to remove dissolved and colloidal organic material. Treatment systems can involve the application of wastewater to a fixed-bed column containing granular carbon, or the addition of powdered activated carbon to wastewater in a contacting basin.

ACTIVATED CARBON REGENERATION. Regeneration of carbon after its adsorptive capacity has been reached, involving oxidation and removal of organic matter from the carbon surface.

ACTIVATED SLUDGE. Floc produced from raw or settled wastewater by the growth of aerobic microorganisms during activated sludge treatment.

ACTIVATED SLUDGE PROCESS. A biological wastewater treatment process in which a mixture of wastewater and activated sludge is agitated and aerated. The activated sludge is subsequently separated from the treated wastewater (mixed liquor) by sedimentation and wasted or returned to the process as needed.

ADDITIONAL POLYMERIZATION. The combination of monomers by the direct addition or combination of the monomer molecules with one another to form polymers.

ADSORPTION. A phenomenon whereby molecules in a fluid phase are attracted to and held on a solid surface by a physical or weak chemical bond.

ADSORPTION ISOTHERM. A plot used in evaluating the effectiveness of activated carbon treatment by showing the amount of impurity adsorbed versus the amount remaining. They are determined at a constant temperature by varying the amount of carbon used or the concentration of the impurity in contact with the carbon.

ADVANCED WASTE TREATMENT. Any treatment method or process employed following biological treatment to increase the removal of pollutants, to remove substances that may be deleterious to receiving waters or the environment, or to produce a high-quality effluent suitable for reuse in any specific manner or for discharge under critical conditions. The term tertiary treatment is commonly used to denote advanced waste treatment methods.

AERATED LAGOON. Bacterial stabilization of wastewater in a natural or artificial wastewater treatment pond in which mechanical or diffused-air aeration is used to supplement the oxygen supply.

AERATION. Contact between oxygen and a liquid by one of the following methods: spraying the liquid in the air, bubbling air through the liquid, or agitation of the liquid to promote surface absorption of air.

AERATION PERIOD. (1) The theoretical time, usually expressed in hours, that the mixed liquor is subjected to aeration in an aeration tank undergoing activated-sludge treatment. It is equal to the volume of the tank divided by the volumetric rate of flow of wastes and return sludge. (2) The theoretical time that liquids are subjected to aeration.

AERATION TANK. A vessel for injecting air into the water.

AEROBIC. Taking place in the presence of free molecular oxygen.

AEROBIC BIOLOGICAL OXIDATION. Any waste treatment or process utilizing aerobic organisms, in the presence of air or oxygen, as agents for stabilizing the organic load in a wastewater.

AEROBIC DIGESTION. A process in which microorganisms obtain energy by endogenous or auto-oxidation of their cellular protoplasm. The biologically degradable constituents of cellular material are slowly oxidized to carbon dioxide, water and ammonia, with the ammonia being further converted into nitrates during the process.

ALKALI. A water-soluble metallic hydroxide that ionizes strongly.

ALKYLATION. A process wherein an alkyl group (-R) is added to a molecule.

ALUM. A hydrated aluminum sulfate or potassium aluminum sulfate or ammonium aluminum sulfate which is used as a settling agent. A coagulant.

AMMONIA NITROGEN. A gas released by the microbiological decay of plant and animal proteins. When ammonia nitrogen is found in waters, it is indicative of incomplete treatment.

AMMONIA STRIPPING. A modification of the aeration process for removing gases in water. Ammonium ions in wastewater exist in equilibrium with ammonia and hydrogen ions. As pH increases, the equilibrium shifts to the right and above pH 9 ammonia may be liberated as a gas by agitating the wastewater in the presence of air. This is usually done in a packed tower with an air blower.

AMMONIFICATION. The process in which ammonium is liberated from organic compounds by microorganisms.

AMMONOLYSIS. The formation of an amino compound using aqueous ammonia.

AMMOXIDATION. The introduction of a cyanide group into an organic compound via interaction with ammonia and oxygen to form nitriles.

ANAEROBIC. Taking place only in the absence of free molecular oxygen.

ANAEROBIC BIOLOGICAL TREATMENT. Any treatment method or process utilizing anaerobic or facultative organisms, in the absence of air, for the purpose of reducing the organic matter in wastes or organic solids settled out from wastes.

ANAEROBIC DIGESTION. Stabilization of biodegradable materials in primary and excess activated sludge by oxidation to carbon dioxide, methane and other inert products. The primary digester serves mainly to reduce volatile suspended solids (VSS), while the secondary digester is mainly for solids-liquid separation, sludge thickening, and storage.

ANION. An ion with a negative charge.

API SEPARATOR. A primary physical wastewater treatment process capable of removing free oil and settleable solids from water.

AQUEOUS SOLUTION. A solution in which water is the solvent.

AUXILIARY FACILITIES. The non-productive facilities which provide utilities and other services used by the manufacturing plant; also known as "offsite" or "off-battery-limits" facilities. Includes "non-process equipment" and other service facilities and buildings, change houses, etc.

AVERAGE. See "Mean."

AZEOTROPE. A liquid mixture that is characterized by a constant minimum or maximum boiling point which is lower or higher than that of any of the components and that distills without change in composition.

BACKWASHING. The process of cleaning a rapid sand or mechanical filter by reversing the flow of water.

BADCT (NSPS) EFFLUENT LIMITATIONS. Limitations for new sources which are based on the application of the Best Available Demonstrated Control Technology.

BASE. A substance which dissolves in water forming hydroxyl ions.

BASIN. See "Lagoon."

BAT EFFLUENT LIMITATIONS. Limitations for direct discharge point sources, other than publicly owned treatment works, which are based on the application of the Best Available Technology Economically Achievable. These limitations must be achieved as expeditiously as practicable but no later than March 31, 1989.

BATCH PROCESS. A process which has an intermittent flow of raw materials into the process and, consequently, an intermittent flow of product and process waste from the process.

BCT EFFLUENT LIMITATIONS. Limitations for conventional pollutants from direct discharge point sources, other than publicly owned treatment works, which are based on the application of the Best Conventional Pollutant Control Technology. These limitations must be achieved as expeditiously as practicable but no later than March 31, 1989.

BIOCHEMICAL OXYGEN DEMAND (BOD). A measure of organic pollution in a water or wastewater sample. It is determined by measuring the oxygen used by microorganisms to oxidize the organic contaminants of a sample under standard laboratory conditions.

BIOLOGICAL WASTEWATER TREATMENT. Forms of wastewater treatment in which aerobic or anaerobic microorganisms are used to stabilize, oxidize, and nitrify the unstable organic matter present.

BIOLOGICALLY REFRACTIVE. A substance which is partially or totally nonbiodegradable in biological waste treatment processes.

BIOTA. The plant and animal life of a stream or other water body.

BLOWDOWN. The removal of a portion of any process flow to maintain the constituents of the flow at desired levels.

BOD5. The standard measure for biochemical oxygen demand (BOD) involving incubation of the water or wastewater sample at 20C for 5 days.

BPT EFFLUENT LIMITATIONS. Limitations for direct discharge point sources, other than publicly owned treatment works, which are based on the application of the Best Practicable Control Technology Currently Available. These limitations must be achieved by March 31, 1989 if the limitations require a level of control substantially greater or based on fundamentally different control technology than existing permits.

BREAK POINT. The point at which impurities first appear in the effluent of a granular activated carbon adsorption bed.

BREAK POINT CHLORINATION. The addition of sufficient chlorine to destroy or oxidize all substances that create a chlorine demand with an excess amount remaining in the free residual state.

BUFFER. A solution containing either a weak acid and its salt or a weak base and its salt which thereby resists changes in acidity or basicity, i.e., resists changes in pH.

BULK ADDITION. See "Addition Polymerization."

CARBON ADSORPTION. A process used to remove pollutants from wastewaters by contacting the water with activated carbon.

CARCINOGEN. A substance that causes cancer in animal tissue.

CATALYST. A substance which changes the rate of a chemical reaction but undergoes no permanent chemical change itself.

CATION. An ion with a positive charge.

CENTRAL LIMIT THEOREM. A statistical result which states that for a sufficiently large sample size n, the distribution of means of random samples from a population with finite variance will be approximately normal in form, regardless of the form of the underlying population distribution.

CENTRATE. The liquid fraction that is separated from the solids fraction of a slurry through centrifugation.

CENTRIFUGE. (a) The treatment process whereby solids such as sludge can be separated from a liquid by the use of centrifugal force. (b) The machine used to separate solids by centrifugal force.

CHELATlNG. Forming a compound containing a metal ion in a ring-like molecular configuration.

CHEMICAL OXYGEN DEMAND (COD). A measure of the oxygen demand equivalent to that portion of organic matter in a sample which can be oxidized by a strong chemical oxidant.

CHLORINATION. The application of chlorine to water, sewage or industrial wastes, generally for the purpose of disinfection but frequently for accomplishing other biological or chemical results.

CLARIFICATION. Process of removing turbidity and suspended solids by settling.

CLARIFIER. A mechanical unit in which clarification is performed.

CLAYS. Aluminum silicates less than 0.002 mm (2.0 μm) in size. Because of their size, most clay types can go into colloidal suspension.

CLEAN WATER ACT. The Federal Water Pollution Control Act of 1972, as amended (33 U.S.C. § 1251 et seq.).

COAGULANTS. Chemicals, such as alum, iron salts, or lime, added in relatively large concentrations to reduce the forces tending to keep suspended particles apart.

COAGULATION. The process whereby chemicals are added to a wastewater resulting in a reduction of the forces tending to keep suspended particles apart. The process occurs in a rapid or flash mix basin.

COLLOID. Tiny solid, semi-solid, or liquid particulates in a solvent that are not removable by sedimentation.

COMBINED SEWER. A sewer which carries both sewage and storm water run-off.

COMPLEXING. Forming a compound containing a number of parts, often used to describe a metal atom associated with a set of organic ligands.

COMPOSITE SAMPLE. A combination of individual samples of wastewater taken at selected intervals to minimize the effect of the variations in individual samples. Individual samples making up the composite may be of equal volume or be roughly proportioned to the volume of flow of liquid at the time of sampling.

CONCENTRATION. The total mass of the suspended or dissolved particles contained in a unit volume at a given temperature and pressure.

CONDENSATION. (a) The change of state of a substance from the vapor to the liquid form. (b) A chemical reaction in which two or more molecules combine, with the separation of water or some other simple substance.

CONDUCTIVITY. A measurement of electrolyte concentration by determining electrical conductance in a water sample.

CONSENT DECREE. The Settlement Agreement entered into by EPA with the Natural Resources Defense Council and approved by the U.S. District Court for the District of Columbia on June 7, 1976 (8 ERC 2120, D.D.C. 1976), modified on March 9, 1979 (12 ERC 1833, D.D.C. 1979) and again by Order of the Court dated October 26, 1982, August 2, 1983, January 6, 1984, July 5, 1984, January 7, 1985, April 24, 1986 and January 8, 1987. One of the principal provisions of the Settlement Agreement was to direct EPA to consider an extended list of 65 classes of toxic pollutants in 21 industrial categories in the development of effluent limitations guidelines and new source performance standards. This list has since been limited to 126 specific toxic pollutants and expanded to 34 industrial categories.

CONTACT STABILIZATION. Aerobic digestion.

CONTINUOUS PROCESS. A process which has a constant flow of raw materials into the process and consequently a constant flow of product from the process.

CONTRACT DISPOSAL. Disposal of waste products through an outside party for a fee.

CONVENTIONAL POLLUTANTS. Constituents of wastewater as determined under Section 304(a)(4) of the Clean Water Act of 1977, including pollutants classified as biochemical oxygen demand, suspended solids, fecal coliform, pH, and oil and grease.

COOLING WATER - (PROCESS WASTEWATER). Water used for cooling purposes which may become contaminated through contact with process raw materials, intermediate, or final products.

COOLING WATER - (NON-PROCESS WASTEWATER). Water used for cooling purposes which has no direct contact with any process raw materials, intermediates, or final products.

CRACKING. A process wherein heat and pressure are used for the rearrangement of the molecular structure of hydrocarbons or low-octane petroleum fractions.

CRYSTALLIZATION. The formation of solid particles within a homogeneous phase. Formation of crystals separates a solute from a solution and generally leaves impurities behind in the mother liquid.

CYANIDE A. Cyanides amendable to chlorination as described in 40 CFR Part 136.

CYANIDE, TOTAL. Total cyanide as determined by the test procedure specified in 40 CFR Part 136.

CYCLONE. A conical shaped vessel for separating either entrained solids or liquid materials from the carrying air or vapor. The vessel has a tangential entry nozzle at or near the largest diameter, with an overhead exit for air or vapor and a lower exit for the more dense materials.

DAILY DATA. Flow and pollutant measurements (BOD, COD, TOC, pH, etc.) taken by certain plants on a daily basis for extended periods of time.

DEALKYLATION. The removal of an alkyl group (-R) from a molecule.

DEEP WELL INJECTION. Disposal of wastewater into a deep well such that a porous, permeable formation of a larger area and thickness is available at sufficient depth to ensure continued, permanent storage.

DEGREASING. The process of removing greases and oils from sewage, waste and sludge.

DEHYDRATION. The removal of water from a material.

DEHYDROGENATION. The removal of one or more hydrogen atoms from an organic molecule.

DEMINERALIZATION. The removal of ions from wastewater. Demineralization processes include reverse osmosis, electrodialysis, and ion exchange.

DENITRIFICATION. Bacterial mediated reduction of nitrate to nitrite. Other bacteria may further reduce the nitrite to ammonia and finally nitrogen gas. This reduction of nitrate occurs under anaerobic conditions. The nitrate replaces oxygen as an electron acceptor during the metabolism of carbon compounds under anaerobic conditions. The heterotrophic microorganisms which participate in this process include pseudomonades, achromobacters and bacilli.

DESORPTION. The reverse of adsorption. A phenomenon whereby an adsorbed molecule leaves the surface of the adsorbent.

DIAZOTIZATION. The conversion of an amine (-NH2) to a diazonium salt by reaction with nitrous acid.

DIGESTER. A tank in which biological decomposition (digestion) of the organic matter in sludge takes place.

DIGESTION. (a) The biological decomposition of organic matter in sludge. (b) The process carried out in a digester.

DIRECT DISCHARGE. Discharge of wastewater into navigable water.

DISCHARGE. (a) To dispose of wastewater before or after treatment to a water source (stream, river, etc.) or to an additional treatment facility (e.g., POTW). (b) The wastewater being disposed.

DISSOLVED AIR FLOTATION. A flotation process that adds air to wastewater in the form of fine bubbles which become attached to suspended sludge particles, increasing the buoyancy of the particles and producing more positive flotation.

DISSOLVED OXYGEN (DO). The oxygen dissolved in sewage, water or other liquids, usually expressed either in milligrams per liter or percent of saturation. It is the test used in BOD determination.

DISTILLATION. A separation or purification process that involves vaporization of a portion of a liquid feed by heating and subsequent condensation of the vapor.

DOUBLE-EFFECT EVAPORATORS. Double effect evaporators are two evaporators in series where the vapors from one are used to boil liquid in the other.

DRYING BED. A wastewater treatment unit usually consisting of a bed of sand on which sludge is placed to dry by evaporation and drainage.

DUAL MEDIA FILTRATION. A deep-bed filtration system utilizing two separate and discrete layers of dissimilar media (e.g., anthracite and sand) placed one on top of the other to perform the filtration function.

EFFLUENT. (a) A liquid which leaves a unit operation or process. (b) Sewage, water or other liquids which flow out of a reservoir basin, treatment plant or any other unit operation.

EFFLUENT LIMITATION. A maximum permissible concentration or mass of pollutant per unit of production (or time or other unit) of selected constituents of effluent that is subject to regulation under the National Pollutant Discharge Elimination System (NPDES).

ELECTRODIALYSIS. The separation of a substance from solution through a membrane accomplished by the application of an electric potential across to the membrane.

ELECTROLYTIC. Relating to a chemical change produced by passage of a current through a conducting substance (such as water).

ELUTION. (1) The process of washing out or removing a substance through the use of a solvent. (2) In an ion exchange process, the stripping of adsorbed ions from an ion exchange resin by passing solutions containing other ions in relatively high concentrations through the resin.

ELUTRIATION. A process of sludge conditioning whereby the sludge is washed, either with fresh water or plant effluent, to reduce the sludge alkalinity and fine particles, thus decreasing the amount of required coagulant in further treatment steps or in sludge dewatering.

EMULSION. A suspension of fine droplets of one liquid in another.

EMULSION ADDITION. See "Addition Polymerization."

END-OF-PIPE (EOP) TECHNOLOGIES. Final treatment processes used to remove or alter selected constituents of the wastewater from manufacturing operations.

ENTRAINMENT SEPARATOR. A device to remove liquid and/or solids from a gas stream. Energy source is usually derived from pressure drop to create centrifugal force.

EQUALIZATION. A process by which variations in flow and composition of a waste stream are averaged in an impoundment or basin.

EQUALIZATION BASIN. A holding basin in which variations in flow and composition of a liquid are averaged.

ESTERIFICATION. The production of esters from carboxylic acids by the replacement of the hydrogen of the hydroxyl group with a hydrocarbon group.

EVAPORATION POND. An open holding facility which depends primarily on climatic conditions such as evaporation, precipitation, temperature, humidity, and wind velocity to effect dissipation (evaporation) of wastewater. External means such as spray recirculation or heating can be used to increase the rate of evaporation.

EXISTING SOURCE. Any facility from which there is or may be a discharge of pollutants, the construction of which is commenced before the publication of proposed regulations prescribing a standard of performance under Section 306 of the Act.

FACULTATIVE. Having the ability to live under both aerobic or anaerobic conditions.

FACULTATIVE LAGOON. A treatment method combining both aerobic and anaerobic lagoons. It is divided by loading and thermal stratifications into an aerobic surface and an anaerobic bottom.

FEDERAL WATER POLLUTION CONTROL ACT AMENDMENTS OF 1972. Public Law 92-500 which provides the legal authority for current EPA water pollution abatement projects, regulations, and policies. The Federal Water Pollution Control Act was amended further on December 27, 1977, in legislation referred to as The Clean Water Act (P.L. 95-217) and in 1978, 1981, and 1987.

FEEDSTOCK. The material initially supplied to a process and used in the production of a final product.

FERMENTATION. Oxidative decomposition of complex substances through the action of enzymes or ferments produced by microorganisms.

FERRITE. A chemical compound containing iron.

FID. Flame ionization detection.

FILTER CAKES. Wet solids generated by the filtration of solids from a liquid. This filter cake may be a pure material (product) or a waste material containing additional fine solids (i.e., diatomaceous earth) that has been added to aid in the filtration.

FILTRATION. A process whereby a liquid is passed through a porous medium in order to capture and remove particles from the liquid.

FLOCCULENTS Water-soluble organic polyelectrolytes that are used alone or in conjunction with inorganic coagulants, such as lime, alum or ferric chloride, or with coagulant aids to agglomerate solids suspended in aqueous systems.

FLOCCULATION. The agglomeration of colloidal and finely divided suspended matter that will settle by gravity

FLOTATION. The raising of suspended matter as scum to the surface of the liquid in a tank by aeration, the evolution of gas, chemicals, electrolysis, heat, bacterial decomposition or natural density difference, and the subsequent removal of the scum by skimming.

FLOW RATES. The amount of water or wastewater going into or out of a plant during a certain time period (GPM, MGD, etc).

FRACTIONATION (OR FRACTIONAL DISTILLATION). The separation of constituents, or group of constituents, of a liquid mixture of miscible and volatile substances by vaporization and recondensing at specific boiling point ranges.

GC. Gas chromatography.

GC/CD. Gas chromatography/conventional detectors.

GC/MS. Gas chromatography/mass spectrometry.

GENERIC PROCESS CHEMISTRY. As defined in this document, classes of chemical reactions which share a common mechanism or yield related products (e.g., chlorination, oxidation, ammoxidation, cracking and reforming, and hydrolysis). Forty-one major generic processes have been identified in the Organic Chemicals and Plastics/Synthetic Fibers Industries.

GRAB SAMPLE. (a) Instantaneous sampling; (b) a sample taken at a random location and at a random time.

GRAVITY SEPARATOR. A treatment unit that uses density differences and gravitational pull to separate two immiscible substances.

GRIT CHAMBER. A small detention chamber or an enlargement of a sewer designed to reduce the velocity of flow of the liquid and permit the separation of mineral from organic solids by differential sedimentation.

GROUND WATER. The body of water that is retained in the saturated zone which tends to move by hydraulic gradient to lower levels.

HALOGENATION. The incorporation of one of the halogen elements (bromine, chlorine, or fluorine) into a chemical compound.

HARDNESS. A measure of the capacity of water for precipitating soap. It is reported as the hardness that would be produced if a certain amount of $CaCO3$ were dissolved in water.

HEAVY METALS. A general name given for the ions of metallic elements, such as copper, zinc, iron, chromium and aluminum. Heavy metals are normally removed from a wastewater by the formation of an insoluble precipitate (usually a metallic hydroxide).

HYDROCARBON. A compound containing only carbon and hydrogen.

HYDROFORMYLATION. Addition of a formyl molecule (H-CHO) across a double bond to form an aldehyde.

HYDROGENATION. A reaction of hydrogen with an organic compound.

HYDROLYSIS. A chemical reaction in which water reacts with another substance to form two or more new substances.

HYDROXIDE. A chemical compound containing the radical group OH.

IMHOFF TANK. A combination wastewater treatment tank which allows sedimentation to take place in its upper compartment and digestion to take place in its lower compartment.

IN-PLANT CONTROL TECHNOLOGIES. Controls or measures applied within the manufacturing process to reduce or eliminate pollutant and hydraulic loadings of raw wastewater.

IN-PLANT SOURCE CONTROL. Controls or measures applied at the source of a waste to eliminate or reduce the necessity for further treatment.

INCINERATION. The combustion (by burning) of organic matter in wastewater sludge.

INDIRECT DISCHARGE. The discharge of wastewaters to publicly owned treatment works (POTW).

INFLUENT. Any sewage, water or other liquid, either raw or partly treated, flowing into a reservoir, basin, treatment plant, or any part thereof. The influent is the stream entering a unit operation.

ION EXCHANGE. A treatment process in which metal ions and other contaminants may be removed from waters by exchanging them with ions on a solid (resin) matrix.

LAGOON. A pond containing raw or partially treated wastewater in which aerobic or anaerobic stabilization occurs.

LANDFILL. A controlled dump for solid wastes in which garbage, trash, etc., is buried in layers separated and covered by dirt.

LC50. Lethal concentration 50; the concentration of a toxic material at which 50 percent of the exposed test organisms die.

LD50. Lethal dose 50; the dose of a toxic material at which 50 percent of the exposed test organisms die.

LEACH. To dissolve out by the action of a percolating liquid, such as water, seeping through a sanitary landfill.

LIME. A substance formed from limestone, which is an accumulation of organic remains consisting mostly of calcium carbonate. When burned, limestone yields lime (a solid). The hydrated form of chemical lime is calcium hydroxide.

LIQUID-LIQUID EXTRACTION. The removal of a solute from another liquid by mixing that combination with a solvent preferential to the substance to be removed.

MASS FLOW. A measure of the transfer of mass in units of mass per time-area mass (time x area).

MAXIMUM FOR ANY ONE DAY LIMITATIONS. Effluent limitations determined by multiplying long-term average effluent concentrations by appropriate variability factors.

MAXIMUM MONTHLY FOR AVERAGE LIMITATIONS. Effluent limitations determined by multiplying long-term average effluent concentrations by appropriate variability factors.

MEAN. Average; the sum of the items in a set divided by the number of items.

MEDIAN. The number lying in the middle of an increasing or decreasing series of numbers such that the same number of values appears above the median as do below it.

METAL CATALYZED ADDITION. See "addition polymerization."

MICROBIAL. Of or pertaining to microbes, single-celled organisms (e.g., bacteria).

MIXED LIQUOR. A mixture of activated sludge and organic matter undergoing activated sludge treatment in an aeration tank.

MIXED LIQUOR SUSPENDED SOLlDS (MLSS). A measure of the concentration of matter in a biological treatment process.

MODE. The number which occurs with the greatest frequency in a set of values.

MOLECULAR WEIGHT. The relative weight of a molecule compared to the weight of an atom of carbon taken as exactly 12.00; the sum of the atomic weights of the atoms in a molecule.

MUTAGEN. Substance causing mutations or changes in the genetic material of an organisms.

NATIONAL POLLUTION DISCHARGE ELIMINATION SYSTEM (NPDES). A federal program requiring industry to obtain permits to discharge plant effluents to the nation's water courses.

NAVIGABLE WATERS. Includes all navigable waters of the United States; tributaries of navigable waters; interstate waters; intrastate lakes, rivers and streams which are utilized by interstate travellers for recreational or other purposes; intrastate lakes, rivers and streams from which fish or shellfish are taken and sold in interstate commerce; and intrastate lakes, rivers and streams which are utilized for industrial purposes by industries in interstate commerce.

NEUTRALIZATION. The restoration of the hydrogen or hydroxyl ion balance in a solntion so that the ionic concentrations of each are equal.

NEW SOURCE. Any facility from which there is or may be a discharge of pollutants, the construction of which is commenced after the promulgation of regulations prescribing a standard of performance under section 306 of the Act.

NITRATE NITROGEN. The final decomposition product of the organic nitrogen compounds. Determination of this parameter indicates the degree of waste treatment.

NITRATION. The replacement of a hydrogen on a carbon atom with a nitro group ($-NO_2$) through the use of nitric acid or mixed acid.

NITRIFICATION. The conversion of nitrogenous matter into nitrates by bacteria.

NITRITE NITROGEN. An intermediate stage in the decomposition of organic nitrogen to the nitrate form. Tests for nitrite nitrogen can determine whether the applied treatment is sufficient.

NON-CONTACT COOLING WATER. Water used for cooling that does not come into direct contact with any raw material, intermediate product, waste product or finished product.

NON-PROCESS WASTEWATERS. Wastewaters generated by a manufacturing process which have not come in direct contact with the products, wastes, or reactants used in the process. These include such streams as noncontact cooling water, cooling tower blowdown, boiler blowdown, etc.

NON-CONVENTIONAL POLLUTANTS. Pollutant parameters which have not been designated as either conventional pollutants or toxic pollutants.

NON-WATER QUALITY ENVIRONMENTAL IMPACT. Effects of wastewater control and treatment technologies upon aspects of the environment other than water, including, but not limited to, air pollution, noise, radiation, sludge and solid waste generation, and energy usage. Consideration of non-water quality environmental impacts during the development of effluent limitations regulations is required in sections 304(b) and 306 of the Clean Water Act.

NORMAL SOLUTION. A solution that contains 1 gm molecular weight of the dissolved substance divided by the hydrogen equivalent of the substance (that is, one gram equivalent) per liter of solution. Thus, a one normal solution of sulfuric acid (H_2SO_4, mol. wt. 98) contains 98/2 or 49 gms of H_2SO_4, per liter.

NSPS. New Source Performance Standards for new sources.

NUTRIENT. Any substance assimilated by an organisms which promotes growth and replacement of cellular constituents.

NUTRIENT ADDITION. The process of adding nitrogen or phosphorous in a chemically combined form to a waste stream.

OIL AND GREASE. (a) Oligenous liquids or gels that form scums and slicks on water. (b) Those substances soluble in freon which are present in water and wastes. Oil and grease are conventional pollutants as defined under EPA regulations.

OIL-RECOVERY SYSTEM. Equipment used to reclaim oil from wastewater.

ORGANIC LOADING. In the activated sludge process, the food to microorganisms (F/M) ratio defined as the amount of biodegradable material available to a given amount of microorganisms per unit of time.

OXIDATION. (a) A process in which an atom or group of atoms loses electrons. (b) The introduction of one or more oxygen atoms into a molecule, accompanied by the release of energy.

OXIDATION POND. A man-made lake or body of water in which wastes are consumed by bacteria. An oxidation pond receives an influent which has gone through primary treatment in contrast to a lagoon which receives raw untreated sewage.

OXIDATION/REDUCTION (OR). A class of chemical reactions in which one of the reacting species gives up electrons (oxidation) while another species in the reaction accepts electrons (reduction).

OXO PROCESS. A process wherein olefinic hydrocarbon vapors are passed over cobalt catalysts in the presence of carbon monoxide and hydrogen to produce alcohols, aldehydes, and other oxygenated organic compounds. Also known as hydrocarbonylation and hydroformylation.

OXYACETYLATION. A process using ethylene, acetic acid, and oxygen commonly used to produce vinyl acetate.

OXYGEN ACTIVATED SLUDGE. An activated sludge process using pure oxygen as an aeration gas (rather than air). This is a patented process marketed by Union Carbide under the trade name "UNOX".

OXYGEN, AVAILABLE. The quantity of atmospheric oxygen dissolved in the water of a stream; the quantity of dissolved oxygen available for the oxidation of organic matter in sewage.

OXYGEN, DISSOLVED. The oxygen (usually designated as DO) dissolved in sewage, water, or another liquid and usually expressed in parts per million or percent of saturation.

OZONATION. A water or wastewater treatment process involving the use of ozone as an oxidizing agent.

OZONE. That molecular oxygen with three atoms of oxygen forming each molecule. The third atom of oxygen in each molecule of ozone is loosely bound and easily released. Ozone is used sometimes for the disinfection of water but more frequently for the oxidation of taste-producing substances, such as phenol, in water and for the neutralization of odors in gases or air.

PARAMETER. A representative variable which describes some sort of pollution (BOD, TOC, etc.).

PART PER BILLION (PPB). Parts by weight in sewage analysis, equal to micrograms per liter divided by the specific gravity. Parts per billion (ppb) is always understood to imply a weight/weight ratio, although in practice volume may be measured instead of weight usually in units of micrograms per liter (μg/L).

PARTS PER MILLION (PPM). Parts by weight in sewage analysis, equal to milligrams per liter divided by the specific gravity. Parts per million (ppm) is always understood to imply a weight/weight ratio, although in practice volume may be measured instead of weight usually in units of millograms per liter (mg/L).

PERCOLATION. The movement of water beneath the ground surface both vertically and horizontally, but above the groundwater table.

PHOSPHATE. Phosphate ions exist as an ester or salt of phosphoric acid, such as calcium phosphate rock. In municipal wastewater, it is most frequently present as orthophosphate.

PHOSPHORUS PRECIPITATION. The addition of the multivalent metallic ions of calcium, iron and aluminum to wastewater to form insoluble precipitates with phosphorus.

PHYSICAL-CHEMICAL WASTEWATER TREATMENT. Processes that utilize physical and chemical means to treat wastewaters.

POINT SOURCE. Any discernible, confined, and discrete conveyance from which pollutants are or may be discharged.

POINT SOURCE CATEGORY. A collection of industrial sources with similar function or product, established for the purpose of establishing federal standards for the disposal of wastewter.

POLISHING. A final water treatment step used to remove any remaining organics from the water.

POLISHING PONDS. Stabilization lagoons used as a final treatment step to remove any remaining organics.

POLLUTANT LOADING. The ratio of the total daily mass discharge of a particular pollutant to the total daily production expressed in terms of (g pollutant)/(kg wet production).

POLYELECTROLYTES. Linear or branched synthetic chemicals (polymers) used to speed up the removal of solids from sewage. These chemicals cause solids to coagulate or clump together more rapidly than do chemicals such as alum or lime. They can be anionic (negative charge), nonionic (positive and negative charges) or cationic (positive charge-the most common). They have high molecular weights and are water-soluble. Compounds similar to the polyelectrolyte flocculants include surface-active agents and ion exchange resins. The former are low molecular weight, water soluble compounds used to disperse solids in aqueous systems. The latter are high molecular weight, water-insoluble compunds used to selectively replace certain ions already present in water with more desirable or less noxious ions.

POLYMER. A large molecule consisting of 5 or more identical connecting units.

PRECIPITATION. The phenomenon which occurs when a substance held in solution passes out of that solution into solid form.

PRETREATMENT. Any wastewater treatment process used to reduce the pollution load before the wastewater is discharged to a publicly owned treatment works (POTW).

PRIMARY TREATMENT. The first major treatment in a wastewater treatment works normally consisting of clarification, neutralization, and related physical/chemical treatment.

PRIORITY POLLUTANTS. One hundred twenty-six compounds that are a subset of the toxic pollutants specified in the 1976 Consent Decree and that were the focus of study in the development of BAT regulations for the Organic Chemicals and Plastics/Synthetic Fibers Industry.

PROCESS EQUIPMENT. All equipment and appurtenances employed in the actual manufacturing process.

PROCESS WASTEWATER. Any water which, during manufacturing or processing, comes into contact with or results from the production or use of any raw material, intermediate, finished product, by-product, or waste product.

PROCESS WATER. Any water (solid, liquid or vapor) which, during the manufacturing process, comes into direct contact with any raw materials, intermediate product, by-product, waste product, or finished product.

PRODUCT/PROCESS. That chemical process used for producing a certain chemical product; one process may be used for producing many products and, similarly, one product may be made using different chemical processes.

PUBLICLY OWNED TREATMENT WORKS (POTW). Facilities that collect, treat, or otherwise dispose of wastewaters, and are owned and operated by a village, town, county, authority or other public agency.

PYROLYSIS. The transformation of a compound into one or more substances by heat alone (i.e., without oxidation).

pH. A measure of the acidity or alkalinity of a water sample; equal to the negative common logarithm of the hydrogen ion concentration.

QA/QC. Quality assurance/quality control.
RAW WASTE LOAD. The quantity of pollutant in wastewater prior to treatment.

RECEIVING WATERS. Rivers, lakes, oceans or other courses that receive treated or untreated wastewaters.

RECYCLING. The reuse of materials by returning them to the process from which they came or by using them in another process.

REDUCTION. A process in which an atom (or group of atoms) gains electrons.

REFORMING. A process wherein heat and pressure are used for the rearrangement of the molecular structure of hydrocarbons or low-octane petroleum fractions.

REGENERATION. The renewing for reuse of materials such as activated carbon, single ion exchange resins, and filter beds by appropriate means to remove organics, metals, solids, etc.

RESIN. The solid substrate used in ion exchange process.

RETENTION TIME. Volume of the vessel divided by the flow rate through the vessel.

REVERSE OSMOSIS. The separation of a solvent and a solute by the application of pressure in excess of natural osmotic pressure to the solution side of the membrane forcing the solvent to the other side.

ROTATING BIOLOGICAL CONTACTOR. See "rotating biological disc."

ROTATING BIOLOGICAL DISC. A treatment unit used to remove pollutants from wastewaters whereby rotating discs containing sludge are partially submerged into the wastewater allowing the sludge microorganisms to degrade the wastes.

SANITARY LANDFILL. A sanitary landfill is a land disposal site employing an engineered method of disposing of solid wastes on land in a manner that minimizes environmental hazards by spreading the wastes in thin layers, compacting the solid waste to the smallest practical volume, and applying cover material at the end of each operating day. The two basic sanitary landfill methods are trench fill and area or ramp fill. The method chosen is dependent on many factors such as drainage and type of soil at the proposed landfill site.

SCREENING. The removal of relatively coarse, floating, and suspended solids by straining through racks or screens.

SECONDARY TREATMENT. The second major step in a waste treatment system, generally considered to be biological treatment.

SEDIMENTATION. The separation of suspended solids from wastewater by gravity.

SEED. To introduce microorganisms into a culture medium.

SEMI-VOLATILE ORGANIC POLLUTANTS. For purposes of this report, organic pollutants which are analyzed and measured by EPA analytical Method 625 for base/neutrals and acids and Method 1625 for semi-volatile organic compounds by isotope dilution GC/MS.

SETTLEABLE SOLIDS. Suspended solids which will settle out of a liquid waste in a given period of time.

SETTLEMENT AGREEMENT. See "Consent Decree."

SETTLING PONDS. An impoundment for the settling out of solids.

SIC CODES. Standard Industrial Classification Codes used by the U.S. Department of Commerce to denote segments of industry.

SKIMMING. The process of removing floating grease or scum from the surface of wastewater in a tank.

SLUDGE. The accumulated solids separated from liquids, such as water or wastewater, during processing.

SLUDGE POND. A basin used for the storage, digestion, or dewatering of sludge.

SOLUBILITY. The ability of a substance to dissolve or become soluble in another substance, usually water.

SOLUTE. The substance dissolved in a solvent.

SOLVENT. A liquid commonly used to dissolve or disperse another substance.

SOLVENT EXTRACTION. The extraction of selected components from a mixture of two or more components by treating with a substance that preferentially dissolves one or more of the components in the mixture (liquid-liquid extraction).

SPENT. Used material that will no longer accomplish that purpose for which it is designed (e.g., spent activated carbon which will no longer adsorb pollutants to an acceptable degree).

SPRAY EVAPORATION. A method of wastewater disposal in which the water in a holding lagoon equipped with spray nozzles is sprayed into the air to expedite evaporation.

SPRAY IRRIGATION. A method of disposing of some wastewaters by spraying them on land, usually from pipes equipped with spray nozzles.

STABILIZATION POND. Large, shallow, earthen basins used for the treatment of wastewater by natural processes involving the use of both algae and bacteria.

STANDARD OF PERFORMANCE. A maximum concentration or mass of pollutant per unit of production (or time or other unit) for selected constituents of an effluent that are subject to regulation.

STEAM DISTILLATION. Fractionation in which steam is introduced as one of the vapors or in which steam is injected to provide the heat of the system.

STEAM STRIPPING. A treatment process used to remove volatile components by passing steam through a solution which transfers the components from a liquid mixture to the gas phase.

STILL BOTTOM. The residue remaining after distillation of a material. The residue can vary from a watery slurry to a thick tar which may turn hard when cooled.

STOICHIOMETRIC. Characteristic of a chemical reaction in which reactants are present in proportions such that there is no excess of any reactant following completion of the reaction.

SUBCATEGORY. A segment of a point source category where selected characteristics of that segment are related but are distinct from other segments of the category and are therefore subject to uniform national standards.

SUBSTRATE. (1) Reactant portion of any biochemical reaction; the material transformed into a product. (2) Any substance used as a nutrient by a microorganisms. (3) The liquor in which activated sludge or other material is kept in suspension.

SUPERNATANT. A substance floating above or on the surface of another substance.

SURGE TANK. A tank for absorbing and dampening the wavelike motion of a volume of liquid; an in-process storage tank that acts as a flow buffer between process tanks.

SUSPENDED SOLIDS. Solids that either float on the surface of, or are in suspension in, water, wastewater, or other liquids.

SUSPENSION ADDITION. See "Addition Polymerization."

TERATOGEN. Substance causing birth defects in the offspring following exposure of one or both of the parents.

TERTIARY TREATMENT. The third major step in a waste treatment facility, generally referring to treatment processes following biological treatment.

THICKENING. A process by which sludge is concentrated, usually by sedimentation or centrifugation.

308 DATA. Information gathered from plants under authority of Section 308 of the Clean Water Act.

TOTAL ORGANIC CARBON (TOC). A measure of the organic contamination of a water sample.

TOTAL SUSPENDED SOLIDS (TSS). The entire amount of suspended solids in a sample of water.

TOXIC POLLUTANTS. Pollutants declared "toxic" under Section 307(a)(1) of the Clean Water Act.

TREATMENT TECHNOLOGY. Any pretreatment or end-of-line treatment unit which is used in conjunction with process wastewater. The unit may be used at any point from the process wastewater source to final discharge from plant property.

TRICKLING FILTER. A treatment unit consisting of broken stone or other coarse material over which wastewater is applied and is allowed to trickle through. Attached to the media are microorganisms (sludge) which degrade wastes in the wastewater.

ULTRAFILTRATION. A treatment similar to reverse osmosis except that ultrafiltration treats solutions with larger solute particles so that the solvents can more easily filter through the membrane.

UPSET. An unintentional noncompliance occurring for reasons beyond control of the permittee.

VACUUM FILTRATION. A process used to reduce the water content of sludge. A filter consisting of a cylindrical drum mounted on a horizontal axis and covered with a filter cloth revolves partially submergenced in the liquid, and a vacuum is maintained under the cloth for the larger part of each revolution to extract moisture. The cake which forms on the filter is continuously scraped off.

VARIABILITY FACTORS. Pollutant-specific peaking factors that relate the numerical limitations for the maximum for any one day and the maximum for monthly average to the long-term average value.

VOLATILE ORGANIC COMPOUNDS (VOCs). For purposes of this report, the 32 volatile and semi-volatile organic pollutants listed in Table VI-9 and selected based on Henry's Law Constants to represent a portion of the OCPSF priority pollutant air emissions. (The EPA Office of Air defines VOCs as any organic compound which participates in atmospheric photochemical reactions; that is, any organic compound other than those which the Administrator designates as having negligible photochemical reactivity. The EPA Office of Air is currently considering reformulating this definition.)

VOLATILE ORGANIC POLLUTANTS. For purposes of this report, organic pollutants which are analyzed and measured by EPA analytical Method 624 for purgeables and Method 1624 for volatile organic compounds by isotope dilution GC/MS.

VOLATILE SUSPENDED SOLIDS (VSS). The quantity of suspended solids lost after the ignition of total suspended solids.

VOLATILITY. The ability of a substance to volatilize or evaporate.

WASTE STREAM. A separated or combined polluted water flow resulting from a plant's process(es).

WASTE TREATMENT PLANT. A series of tanks, screens, filters, pumps and other equipment by which pollutants are removed from water.

WASTEWATER. Process water contaminated to such an extent that it cannot be reused in the process without repurification.

WATER USAGE. Ratio of the spent water from a manufacturing operation to the total production, expxessed in terms of (liters of wastewater/day)/(kilogram of production/day).

WET AIR POLLUTION CONTROL. The technique of air pollution abatement utilizing water as an absorptive media.

WET SCRUBBER. An air pollution control device which involves the wetting of particles in an air stream and the impingement of wet or dry particles on collecting surfaces, followed by flushing.

ZERO OR ALTERNATE DISCHARGE. Methods of wastewater discharge from point sources which do not involve discharge to navigable waters either directly or indirectly through publicly owned treatment works. Zero or alternate discharge methods include wastewater reuse, evaporation ponds, deep well injection, incineration, contract hauling, land application, and off-site privately owned treatment.

Appendix III-A contains lists of the products and product groups within each BPT subcateogry (product groups are noted with an "*"):

Table I:	Rayon Fibers Subcategory List of Products and Product Groups
Table II:	Other Fibers Subcategory List of Products and Product Groups
Table III:	Thermoplastic Resins Subcategory List of Products and Product Groups
Table IV:	Thermosetting Resins Subcategory List of Products and Product Groups
Table V:	Commodity Organic Chemicals Subcategory List of Products and Product Groups
Table VI:	Bulk Organic Chemicals Subcategory List of Products and Product Groups
Table VII:	Specialty Organic Chemicals Subcategory List of Products and Product Groups

TABLE I

.RAYON FIBERS SUBCATEGORY

RAYON FIBERS(VISCOSE PROCESS ONLY)

TABLE II

OTHER FIBERS SUBCATEGORY LIST OF PRODUCTS AND PRODUCT GROUPS(*)

* ACRYLIC FIBERS(85% POLYACRYLONITRILE)
* CELLULOSE ACETATE FIBERS
* FLUOROCARBON (TEFLON) FIBERS
* MODACRYLIC FIBERS
* NYLON 6 FIBERS
  NYLON 6 MONOFILAMENT
* NYLON 66 FIBERS
  NYLON 66 MONOFILAMENT
* POLYAMIDE FIBERS (QUIANA)
* POLYARAMID (KEVLAR) RESIN-FIBERS
* POLYARAMID (NOMEX) RESIN-FIBERS
* POLYESTER FIBERS
* POLYETHYLENE FIBERS
* POLYPROPYLENE FIBERS
* POLYURETHANE FIBERS (SPANDEX)

TABLE III

THERMOPLASTIC RESINS SUBCATEGORY LIST OF PRODUCTS AND PRODUCT GROUPS(*)

* ABIETIC ACID & DERIVATIVES
* ABS RESINS
* ABS-SAN RESIN
* ACRYLATE-METHACRYLATE LATEXES
* ACRYLIC LATEX
* ACRYLIC RESINS
  CELLOPHANE
  CELLULOSE ACETATE BUTYRATES
  CELLULOSE ACETATE RESIN
  CELLULOSE ACETATES
  CELLULOSE ACETATES PROPIONATES
  CELLULOSE NITRATE
  CELLULOSE SPONGE
* ETHYLENE-METHACRYLIC ACID COPOLYMERS
* ETHYLENE-VINYL ACETATE COPOLYMERS
* FATTY ACID RESINS
* FLUOROCARBON POLYMERS
  NYLON 11 RESIN
* NYLON 6 - 66 COPOLYMERS
* NYLON 6 - NYLON 11 BLENDS
  NYLON 6 RESIN
  NYLON 612 RESIN
  NYLON 66 RESIN
* NYLONS
* PETROLEUM HYDROCARBON RESINS
* POLVINYL PYRROLIDONE & COPOLYMERS
* POLY(ALPHA)OLEFINS
  POLYACRYLIC ACID
* POLYAMIDES
* POLYARYLAMIDES
  POLYBUTADIENE
* POLYBUTENES

TABLE III(CONTINUED)

THERMOPLASTIC RESINS SUBCATEGORY LIST OF PRODUCTS AND PRODUCT GROUPS(*)

POLYBUTENYL SUCCINIC ANHYDRIDE
POLYCARBONATES
* POLYESTER RESINS
* POLYESTER RESINS, POLYBUTYLENE TEREPHTHALATE
* POLYESTER RESINS, POLYOXYBENZOATE
POLYETHYLENE
* POLYETHYLENE - ETHYL ACRYLATE RESINS
* POLYETHYLENE - POLYVINYL ACETATE COPOLYMERS
POLYETHYLENE RESIN (HDPE)
POLYETHYLENE RESIN (LDPE)
POLYETHYLENE RESIN, SCRAP
POLYETHYLENE RESIN, WAX (LOW M.W.)
POLYETHYLENE RESIN,LATEX
POLYETHYLENE RESINS
* POLYETHYLENE RESINS, COMPOUNDED
* POLYETHYLENE, CHLORINATED
* POLYIMIDES
* POLYPROPYLENE RESINS
POLYSTYRENE (CRYSTAL)
POLYSTYRENE (CRYSTAL) MODIFIED
* POLYSTYRENE + COPOLYMERS
* POLYSTYRENE - ACRYLIC LATEXES
POLYSTYRENE IMPACT RESINS
POLYSTYRENE LATEX
POLYSTYRENE, EXPANDABLE
POLYSTYRENE, EXPANDED
* POLYSULFONE RESINS
POLYVINYL ACETATE
* POLYVINYL ACETATE & PVC COPOLYMERS
* POLYVINYL ACETATE COPOLYMERS
* POLYVINYL ACETATE RESINS
POLYVINYL ALCOHOL RESIN
POLYVINYL CHLORIDE
POLYVINYL CHLORIDE, CHLORINATED
* POLYVINYL ETHER-MALEIC ANHYDRIDE
* POLYVINYL FORMAL RESINS
* POLYVINYLACETATE + METHACRYLIC COPOLYMERS
* POLYVINYLACETATE ACRYLIC COPOLYMERS
* POLYVINYLACETATE-2-ETHYLHEXYLACRYLATE COPOLYMERS
POLYVINYLIDENE CHLORIDE
* POLYVINYLIDENE CHLORIDE COPOLYMERS
* POLYVINYLIDENE-VINYL CHLORIDE RESINS
* PVC COPOLYMERS, ACRYLATES (LATEX)
* PVC COPOLYMERS, ETHYLENE-VINYL CHLORIDE
* ROSIN DERIVATIVE RESINS
* ROSIN MODIFIED RESINS
* ROSIN RESINS
* SAN RESINS
* SILICONES:SILICONE RESINS
* SILICONES:SILICONE RUBBERS
* STYRENE MALEIC ANHYDRIDE RESINS
STYRENE POLYMERIC RESIDUE
* STYRENE-ACRYLIC COPOLYMER RESINS
* STYRENE-ACRYLONITRILE-ACRYLATES COPOLYMERS
* STYRENE-BUTADIENE RESINS

TABLE III (CONTINUED)

THERMOPLASTIC RESINS SUBCATEGORY LIST OF PRODUCTS AND PRODUCT GROUPS(*)

* STYRENE-BUTADIENE RESINS (<50% BUTADIENE)
* STYRENE-BUTADIENE RESINS (LATEX)
* STYRENE-DIVINYL BENZENE RESINS (ION XCHANGE)
* STYRENE-METHACRYLATE TERPOLYMER RESINS
* STYRENE-METHYL METHACRYLATE COPOLYMERS
* STYRENE, BUTADIENE, VINYL TOLUENE TERPOLYMERS
* SULFONATED STYRENE-MALEIC ANHYDRIDE RESINS
* UNSATURATED POLYESTER RESINS
* VINYL TOLUENE RESINS
* VINYL TOLUENE-ACRYLATE RESINS
* VINYL TOLUENE-BUTADIENE RESINS
* VINYL TOLUENE-METHACRYLATE RESINS
* VINYLACETATE-N-BUTYLACRYLATE COPOLYMERS

TABLE IV

THERMOSETTING RESINS SUBCATEGORY LIST OF PRODUCTS AND PRODUCT GROUPS(*)

* ALKYD RESINS
DICYANODIAMIDE RESIN
* EPOXY RESINS
* FUMARIC ACID POLYESTERS
* FURAN RESINS
GLYOXAL-UREA FORMALDEHYDE TEXTILE RESIN
* KETONE-FORMALDEHYDE RESINS
* MELAMINE RESINS
* PHENOLIC RESINS
* POLYACETAL RESINS
POLYACRYLAMIDE
* POLYURETHANE PREPOLYMERS
* POLYURETHANE RESINS
* UREA FORMALDEHYDE RESINS
* UREA RESINS

TABLE V

COMMODITY ORGANIC CHEMICALS SUBCATEGORY LIST OF PRODUCTS AND PRODUCT GROUPS(*)

A. ALIPHATIC ORGANIC CHEMICALS AND CHEMICAL GROUPS

ACETALDEHYDE
ACETIC ACID
ACETIC ANHYDRIDE
ACETONE
ACRYLONITRILE
ADIPIC ACID
* BUTYLENES (BUTENES)
CYCLOHEXANE
ETHANOL
ETHYLENE
ETHYLENE GLYCOL
ETHYLENE OXIDE
FORMALDEHYDE
ISOPROPANOL
METHANOL
POLYOXYPROPYLENE GLYCOL
PROPYLENE
PROPYLENE OXIDE

TABLE V(CONTINUED)

B. AROMATIC ORGANIC CHEMICALS

VINYL ACETATE
1,3-BUTADIENE
BENZENE
CUMENE
DIMETHYL TEREPHTHALATE
ETHYLBENZENE
M-XYLENE(IMPURE)
P-XYLENE
PHENOL
* PITCH TAR RESIDUES
* PYROLYSIS GASOLINES
STYRENE
TEREPHTHALIC ACID
TOLUENE
* XYLENES, MIXED
O-XYLENE

C. HALOGENATED ORGANIC CHEMICALS

VINYL CHLORIDE
1,2-DICHLOROETHANE

TABLE VI

BULK ORGANIC CHEMICALS SUBCATEGORY LIST OF PRODUCTS AND PRODUCT GROUPS(*)

A. ALIPHATIC ORGANIC CHEMICALS AND CHEMICAL GROUPS

* ACETIC ACID ESTERS
* ACETIC ACID SALTS
ACETONE CYANOHYDRIN
ACETYLENE
ACRYLIC ACID
* ACRYLIC ACID ESTERS
* ALKOXY ALKANOLS
* ALKYLATE
* ALPHA-OLEFINS
BUTANE (ALL FORMS)
* C-4 HYDROCARBONS(UNSATURATED)
CALCIUM STEARATE
CAPROLACTAM
CARBOXYMETHYL CELLULOSE
CELLULOSE ACETATE BUTYRATES
* CELLULOSE ETHERS
CITRIC ACID
CUMENE HYDROPEROXIDE
CYCLOHEXANOL
CYCLOHEXANOL, CYCLOHEXANONE(MIXED)
CYCLOHEXANONE
CYCLOHEXENE
* C12-C18 PRIMARY ALCOHOLS
* C5 CONCENTRATES
* C9 CONCENTRATES
DECANOL
DIACETONE ALCOHOL
* DICARBOXYLIC ACIDS & SALTS
DIETHYL ETHER
DIETHYLENE GLYCOL
DIETHYLENE GLYCOL DIETHYL ETHER

TABLE VI(CONTINUED)

A. ALIPHATIC ORGANIC CHEMICALS AND CHEMICAL GROUPS(CONT.)

DIETHYLENE GLYCOL DIMETHYL ETHER
DIETHYLENE GLYCOL MONOETHYL ETHER
DIETHYLENE GLYCOL MONOMETHYL ETHER
* DIMER ACIDS
DIOXANE
ETHANE
ETHLYENE GLYCOL MONOPHENYL ETHER
* ETHOXYLATES, MISC.
ETHYLENE GLYCOL DIMETHYL ETHER
ETHYLENE GLYCOL MONOBUTYL ETHER
ETHYLENE GLYCOL MONOETHYL ETHER
ETHYLENE GLYCOL MONOMETHYL ETHER
* FATTY ACIDS
GLYCERINE(SYNTHETIC)
GLYOXAL
HEXANE
* HEXANES AND OTHER C6 HYDROCARBONS
ISOBUTANOL
ISOBUTYLENE
ISOBUTYRALDEHYDE
ISOPHORONE
ISOPHTHALIC ACID
ISOPRENE
ISOPROPYL ACETATE
LIGNINSULFONIC ACID, CALCIUM SALT
MALEIC ANHYDRIDE
METHACRYLIC ACID
* METHACRYLIC ACID ESTERS
METHANE
METHYL ETHYL KETONE
METHYL METHACRYLATE
METHYL TERT-BUTYL ETHER
METHYLISOBUTYL KETONE
* N-ALKANES
N-BUTYL ALCOHOL
N-BUTYLACETATE
N-BUTYRALDEHYDE
N-BUTYRIC ACID
N-BUTYRIC ANHYDRIDE
* N-PARAFFINS
N-PROPYL ACETATE
N-PROPYL ALCOHOL
NITRILOTRIACETIC ACID
NYLON SALT
OXALIC ACID
* OXO ALDEHYDES & ALCOHOLS
PENTAERYTHRITOL
PENTANE
* PENTENES
* PETROLEUM SULFONATES
PINE OIL
POLYOXYBUTYLENE GLYCOL
POLYOXYETHYLENE GLYCOL
PROPANE
PROPIONALDEHYDE

TABLE VI(CONTINUED)

A. ALIPHATIC ORGANIC CHEMICALS AND CHEMICAL GROUPS(CONT.)

PROPIONIC ACID
PROPYLENE GLYCOL
SEC-BUTYL ALCOHOL
SODIUM FORMATE
SORBITOL
STEARIC ACID, CALCIUM SALT (WAX)
TERT-BUTYL ALCOHOL
1-BUTENE
1-PENTENE
1,4-BUTANEDIOL
1SOBUTYL ACETATE
2-BUTENE(CIS AND TRANS)
2-ETHYL HEXANOL
2-ETHYLBUTYRALDEHYDE
2,2,4-TRIMETHYL-1,3-PENTANEDIOL

B. AMINE AND AMIDE ORGANIC CHEMICALS AND CHEMICAL GROUPS

2,4-DIAMINOTOLUENE
* ALKYL AMINES
ANILINE
CAPROLACTAM, AQUEOUS CONCENTRATE
DIETHANOLAMINE
DIPHENYLAMINE
* ETHANOLAMINES
ETHYLAMINE
ETHYLENEDIAMINE
ETHYLENEDIAMINETETRACETIC ACID
* FATTY AMINES
HEXAMETHYLENE DIAMINE
ISOPROPYLAMINE
M-TOLUIDINE
MELAMINE
MELAMINE CRYSTAL
* METHYLAMINES
METHYLENE DIANILINE
N-BUTYLAMINE
N,N-DIETHYLANILINE
N,N-DIMETHYLFORMAMIDE
* NITROANILINES
POLYMERIC METHYLENE DIANILINE
SEC-BUTYLAMINE
TERT-BUTYLAMINE
TOLUENEDIAMINE (MIXTURE)
* TOLUIDINES
O-PHENYLENEDIAMINE
2,6-DIMETHYLANILINE
4-(B-HYDROXYETHYLETHYLAMINO)-2-HYDROXYETHYL ANILINE
4,4'-METHYLENEBIS(N,N'-DIMETHYL)-ANILINE
4,4'-METHYLENEDIANILINE

C. AROMATIC ORGANIC CHEMICALS AND CHEMICAL GROUPS

A-METHYLSTYRENE
* ALKYL BENZENES
* ALKYL PHENOLS
* ALKYLBENZENE SULFONIC ACIDS, SALTS

TABLE VI(CONTINUED)

C. AROMATIC ORGANIC CHEMICALS AND CHEMICAL GROUPS(CONT.)

AMINOBENZOIC ACID (META AND PARA)
ASPIRIN
B-NAPHTHALENE SULFONIC ACID
BENZENEDISULFONIC ACID
BENZOIC ACID
BIS (2-ETHYLHEXYL) PHTHALATE
BISPHENOL A
BTX-BENZENE,TOLUENE,XYLENE(MIXED)
BUTYL OCTYL PHTHALATE
COAL TAR
* COAL TAR PRODUCTS (MISC.)
CREOSOTE
* CRESOLS, MIXED
CYANURIC ACID
* CYCLIC AROMATIC SULFONATES
DIBUTYL PHTHALATE
DIISOBUTYL PHTHALATE
DIISODECYL PHTHALATE
DIISOOCTYL PHTHALATE
DIMETHYL PHTHALATE
DINITROTOLUENE (MIXED)
DITRIDECYL PHTHALATE
M-CRESOL
METANILIC ACID
METHYLENEDIPHENYLDIISOCYANATE
NAPHTHALENE
* NAPHTHAS,SOLVENT
NITROBENZENE
NITROTOLUENE
NONYLPHENOL
P-CRESOL
PHTHALIC ACID
PHTHALIC ANHYDRIDE
* TARS & PITCHES
TERT-BUTYLPHENOL
* TOLUENE DIISOCYANATES (MIXTURE)
TRIMELLITIC ACID
O-CRESOL
1-TETRALOL, 1-TETRALONE MIX
2,4-DINITROTOLUENE
2,6-DINITROTOLUENE

D. HALOGENATED ORGANIC CHEMICALS AND CHEMICAL GROUPS

1,4-PHENYLENEDIAMINE DIHYDROCHLORIDE
ALLYL CHLORIDE
BENZYL CHLORIDE
CARBON TETRACHLORIDE
CHLORINATED PARRAFINS,35-64 PCT,CHLORINE
CHLOROBENZENE
* CHLOROBENZENES (MIXED)
CHLORODIFLUOROETHANE
CHLOROFORM
* CHLOROMETHANES
* CHLOROPHENOLS
CHLOROPRENE

TABLE VI(CONTINUED)

D. HALOGENATED ORGANIC CHEMICALS AND CHEMICAL GROUPS(CONT.)

CYANOGEN CHLORIDE
CYANURIC CHLORIDE
DICHLOROPROPANE
EPICHLOROHYDRIN
ETHYL CHLORIDE
* FLUOROCARBONS (FREONS)
METHYL CHLORIDER
METHYLENE CHLORIDE
PENTACHLOROPHENOL
PHOSGENE
TETRACHLOROETHYLENE
TRICHLOROETHYLENE
TRICHLOROFLUOROMETHANE
VINYLIDENE CHLORIDE
1,1-DICHLOROETHANE
1,1,1-TRICHLOROETHANE
2-CHLORO-5-METHYLPHENOL (6-CHLORO-M-CRESOL)
2,4-DICHLOROPHENOL

E. OTHER ORGANIC CHEMICALS AND CHEMICAL GROUPS

ADIPONITRILE
CARBON DISULFIDE
DITHIOPHOSPHATES, SODIUM SALT
FATTY NITRILES
* ORGANO-TIN COMPOUNDS
* PHOSPHATE ESTERS
TETRAETHYL LEAD
TETRAMETHYL LEAD
* URETHANE PREPOLYMERS
* WAXES, EMULSIONS & DISPERSIONS

TABLE VII

SPECIALTY ORGANIC CHEMICALS SUBCATEGORY LIST OFPRODUCTS AND PRODUCT GROUPS(*)

(INCLUDES ALL ORGANIC CHEMICALS AND ORGANIC CHEMICAL GROUPS WHICH ARE NOT LISTED AS COMMODITY OR BULK ORGANIC CHEMICALS. SPECIALTY ORGANIC CHEMICALS PRODUCTS AND PRODUCT GROUPS INCLUDE BUT ARE NOT LIMITED TO THE CHEMICALS LISTED BELOW.)

A. ALIPHATIC ORGANIC CHEMICALS AND CHEMICAL GROUPS

(+-)-1,2,3,4-DIEPOXYBUTANE
ACETAL
ACETALDOL
ACETYL PEROXIDE
* ACETYLENIC ALCOHOLS & DIOLS
ACROLEIN
* ACYCLIC ACID SALTS
* ADIPIC ACID ESTERS (MISC.)
ADIPIC ACID, DI(2-ETHYLHEXYL)ESTER
ADIPIC ACID, DI-ISODECYL ESTER
ADIPIC ACID, DI-TRIDECYL ESTER
ADIPIC ACID, N-OCTYL-N-DECYL ESTER
ALLYL ALCOHOL
* AMYL ACETATES
* AMYL ALCOHOLS
BIS(DIMETHYLETHYL)PEROIDE
BIS(2-ETHYLHEXYL)SEBACATE

TABLE VII(CONTINUED)

A. ALIPHATIC ORGANIC CHEMICALS AND CHEMICAL GROUPS(CONT.)

BUTYL STEARATE
* BUTYRIC ACID ESTERS
BUTYROLACTONE
CELLULOSE SPONGE
CELLULOSE,OXIDIZED
* CHLOROFORMATES
CITRONELLOL
CROTONALDEHYDE
CROTONIC ACID
CYCLAMEN ALDEHYDE(P-ISOPROPYL-A-METHLHYDROCINNAMALDEHYDE)
CYCLONITE
CYCLOOCTADIENE
CYCLOPENTADIENE DIMER
CYCLOPENTANE
* CYCLOPROPANES
DECABORANE
DI(2-ETHYLHEXYL)-AZELATE
DI(2-ETHYLHEXYL)-PEROXY DICARBONATE
DIETHYL CARBAMAZINE CITRATE
DIETHYL CARBONATE
DIETHYLENE GLYCOL MONOBUTYL ETHER
DIETHYLENE GLYCOL MONOBUTYL ETHER ACETATE
DIETHYLENE GLYCOL MONOETHYL ETHER ACETATE
DIISOBUTYLENE
DIKETENE
DILINOLEIC ACID, AMMONIUM SALT
DIMYRISTYL THIODIPROPIONATE
DIPROPYLENE GLYCOL
DODECENE (PROPYLENE TETRAMER)
ENDRIN KETONE
* EPOXIDIZED ESTERS
ERYTHRITOL ANHYDRIDE
ETHLYENE GLYCOL MONOMETHYL ETHER ACETATE
ETHYL ACETATE
ETHYL BUTYRIC ACID
ETHYL CELLULOSE
ETHYL ORTHOFORMATE
ETHYL OXALATE
ETHYLENE CARBONATE
ETHYLENE GLYCOL DIACETATE
ETHYLENE GLYCOL MONOBUTYL ETHER ACETATE
ETHYLENE GLYCOL MONOETHYL ETHER ACETATE
ETHYLENE GLYCOL MONOPROPYL ETHER
ETHYLENEDIAMINE-N,N'-DISTEARIC ACID
* FATTY ACID ESTERS
FORMIC ACID
FUMARIC ACID
GERANIOL
GERANYL NITRILE
GLUCOHEPTANATE, SODIUM SALT
GLUTAMIC ACID, MONOSODIUM SALT
GLYCEROL TRI (POLYOXYPROPYLENE) ETHER
* GLYCERYL ESTERS, MIXED FATTY ACIDS
GLYCERYL STEARATE
GLYCIDOL

TABLE VII(CONTINUED)

A. ALIPHATIC ORGANIC CHEMICALS AND CHEMICAL GROUPS(CONT.)

GLYCINE
GLYCOLOLNITRILE (HYDROXYACETONITRILE)
* GLYOXAL-FORMALDEHYDE MIXTURES
HEPTANE
HEPTENE
HEXADECYL ALCOHOL
HEXAHYDROPHTHALIC ANHYDRIDE
HEXAMETAPOL
HEXAMETHYLENE GLYCOL(1,6-HEXANEDIOL)
HEXANOIC ACID (CAPROIC ACID)
HEXYLENE GLYCOL
* HYDANTOINS
* HYDROCARBON SOLVENT (SHELL SOL 140)
HYDROXYACETIC ACID (GLYCOLIC ACID)
HYDROXYETHYL CELLULOSE
HYDROXYPROPYL CELLULOSE
IMINODIACETIC ACID
IONONE
ISOAMYL ALCOHOL
ISOBUTYL MALEATE-HEPTANOL-KEROSINE MIX
ISODECANOL
ISOOCTYL ALCOHOL
ISOPENTANE
ISOPROPYL STEARATE
ISOPROPYLETHER
KETENE
LACTIC ACID
LAURIC ACID
LIMONENE
MAGNESIUM METHYLATE
MALEIC ACID
MESITYL OXIDE
* METALLIC CARBOXYLATES
* METHACRYLAMIDES, DIMETHYLAMINOPROPYL
METHYL ACETATE
METHYL ACETOACETATE
METHYL BUTYNOL
METHYL CELLULOSE
METHYL ETHYL KETONE PEROXIDE
METHYL FORMATE
METHYL RED
METHYL STEARATE
METHYL-12-HYDROXYSTEARATE
METHYLAL
METHYLCYCLOHEXANE
METHYLCYCLOHEXANOL
METHYLCYCLOHEXANONE
METHYLCYCLOPENTANE
METHYLCYLOHEXYL CARBINOL
METHYLISOBUTYL CARBINAL
METHYLPENTYNOL
MICHLER'S KETONE
N-BUTYLACRYLATE

TABLE VII(CONTINUED)

A. ALIPHATIC ORGANIC CHEMICALS AND CHEMICAL GROUPS(CONT.)

N,N-DIETHANOL STEARAMIDE
OCTANE
OLEIC ACID
P-MENTHANE-8-HYDROPEROXIDE
PARALDEHYDE
PERACETIC ACID
* PEROXYESTERS
POLYETHYLENE GLYCOL STEARATE
POLYGLYCEROL
POLYISOPRENE SOLUTION
POLYVINYL ACETATE
POLYVINYL ALCOHOL
POLYVINYL BUTYRAL
* PROPOXYLATES
PROPYLENE TETRAMER
PROPYLENE TRIMER
PROPYNE AND ALLENE
SODIUM DIBUTYLDITHIOCARBAMATE
SODIUM FORMALDEHYDE SULFOXYLATE
SODIUM LAURYLSULFATE
SODIUM METHYLATE
STEARIC ACID
STEARIC ACID, CALCIUM SALT (EMULSION)
* STEARIC ACID, METAL SALTS
STEARIC ACID, STARCH ESTER
STEARIC ACID, ZINC SALT
TERT-BUTYL PEROXYPIVALATE
TERT-BUTYLHYDROPEROXIDE
TERT-BUTYLPEROXIDE
* TETRA-ALKYL LEAD MIXTURES
TETRAETHYLENE GLYCOL
TETRAKIS(HYDROXYMETHYL)PHOSPHONIUM HYDOXIDE
TRANS CROTONALDEHYDE
TRIETHYL CITRATES
TRIETHYLENE GLYCOL
TRIETHYLENE GLYCOL DIMETHYL ETHER
TRIETHYLENE GLYCOL MONOETHYL ETHER
TRIISOBUTYLENE
TRIPHENYL PHOSPHATE
TRIPROPYLENE GLYCOL
TRIPROPYLENE OXIDE
TRIS(ISOPROPYLPHENYL) PHOSPHATE
TRIS(2-ETHYLHEXYL) PHOSPHATE
* VEGETABLE OILS, SULFATED
1,2-DIHYDRO-2,2,4-TRIMETHYL QUINOLINE
1,2-EPOXYPROPANE
1,2,4-BUTANETRIOL
1,3 BUTYLENE GLYCOL
1,4 CYCLOHEXANEDIMETHANOL
1,4-BUTENEDIOL
1,4-BUTYNEDIOL
12-HYDROXYSTEARIC ACID
2-(2-(2-METHOXYETHOXY)-ETHANOL

TABLE VII(CONTINUED)

A. ALIPHATIC ORGANIC CHEMICALS AND CHEMICAL GROUPS(CONT.)

2-(2-BUTOXYETHOXY)-ETHANOL
2-(2-ETHOXYETHOXY)-ETHANOL
2-(2-METHOXYETHOXY)-ETHANOL
2-ETHYLHEXANOIC ACID
2-HEPTANONE
2-HEXANONE
2-METHYL-1-PENTANOL
2-METHYLPENTANE
2-METHYLPROPENAL (METHACROLEIN)
2,2-IMINODIETHANOL
2,4-PENTADIONE PEROXIDE
2,5-DIMETHYL-2,4-HEXADIENE
2,5-DIMETHYL-2,5-DI(T-BUTYL PEROXY)HEX-3-YNE
2,5-DIMETHYL-2,5-DI(T-BUTYL PEROXY)HEXANE
4-METHYL-1-POLYMETHYLPENTENE
4-METHYL-2-PENTANOL
4-NITRO-2,5-DIETHOXY CHLOROBENZENE
5-METHYL-2-HEXANONE
5-METHYL-3-HEPTANONE
9,10-EPOXY-OCTADECANOIC ACID,BUTYL ESTER

B. AMINE AND AMIDE ORGANIC CHEMICALS AND CHEMICAL GROUPS

(2-METHYLPHENYL)(3-METHYL-4-AMINO)DIAZENE
ACETAMIDE
ACETANILIDE
* ACETANILIDES & COGENERS
* ACETOACETANILIDES & COGENERS
ACRYLAMIDE
ALLYLAMINE
AMINOALCOHOL SULFATE
AMINOETHYLETHANOLAMINE
AMYLAMINE
ANILINE HYDROCHLORIDE
ANISIDINE
* ARYLAMIDES AND COGENERS
AZODICARBONAMIDE
BENZAMIDE
BENZOIC ACID, M-(N,N-DIMETHYLAMINO)
BENZOTRIAZOLE
BENZYLAMINE
BIS(4-AMINO-2-SULFONIC ACID)STILBENE TRIAZINE CHLORIDE
CHLORAMINE
CYANOPYRIDINE
CYCLOHEXYLAMINE
CYCLOPHOSPHAMIDE
DIAMINOBENZOIC ACID
DIAZOACETIC ESTER
DICYCLOHEXYLAMINE
DIETHYLAMINE
DIETHYLENE TRIAMINE
DIMETHYL BUTYL AMINE
DIMETHYLAMINE
DINITROSOPENTAMETHYLENETETRAMINE

TABLE VII(CONTINUED)

B. AMINE AND AMIDE ORGANIC CHEMICALS AND CHEMICAL GROUPS(CONT.)

DODECYL SULFATE TRIETHANOLAMINE SALT
DODECYLAMINE
DODECYLANILINE
FORMAMIDE
HEXAMETHYLENEIMINE
HEXAMETHYLENETETRAMINE
HYDROXYLAMINE
ISATOIC ANHYDRIDE
ISOSAFROLE
* LONG-CHAIN AMIDES, N-ETHOXYSULFATE
M-DIMETHYL AMINO PHENOL
M-PHENYLENEDIAMINE
MECHLORETHAMINE
MORPHOLINE
N-CYCLOHEXYL-2-BENZOTHIAZOLESULFENAMIDE
N-ETHYL-N-PHENYL BENZYL AMINE
N-METHYLANILINE
N-PHENYL-2-NAPHTHYLAMINE
N-1-NAPHTHYL-ETHYLENEDIAMINE-DIHYDROCHLORIDE
N,N-DIMETHYL-P-NITROSOANILINE
N,N-DIMETHYLANILINE
N,N'-DIPHENYL-P-PHENYLENEDIAMINE
NIACINAMIDE
NITRAMINE
P-(PHENYLAZO)-ANILINE
P-AMINOPHENOL
P-ANISIDINE
P-NITROANILINE
P-PHENETIDINE
P-PHENYLENEDIAMINE
PERYLENE TETRA CARBOXYLIC ACID DIIMIDE
PHENYLDIMETHYL AMMONIUM CHLORIDE
* PHENYLENE DIAMINES
PHENYLHYDROXYLAMINE
PHTHALIMIDE
* POLYETHYLENE POLYAMINES
* POLYOXYALKYLENE AMINES
PROPYLAMINE
* PYRIDINES, SUBSTITUTED
* PYRIMIDINES
* PYRROLIDONES
QUINALIDINE
SALICYLANILIDE
* SUBSTITUTED BENZENE DIAZONIUM CHLORIDES
* SUCCINIMIDES
TETRAETHYLENEPENTAMINE
TETRAMETHYLENEDIAMINE
TETRAMETHYLETHYLENEDIAMINE
THIAMINE PYROPHOSPHATE
THIOACETAMIDE
* THIONOCARBAMATES
TOLUENESULFONAMIDE
TOLYLTRIAZOLE
TRIALLYLAMINE

TABLE VII(CONTINUED)

B. AMINE AND AMIDE ORGANIC CHEMICALS AND CHEMICAL GROUPS(CONT.)

TRIETHANOLAMINE
TRIETHYLAMINE
TRIETHYLENEDIAMINE
TRIETHYLENETETRAMINE
TRIMETHYLAMINE
* TRIMETHYLAMINOETHYLETHANOLAMINE-BASED FORMULATIONS
* XYLIDINES
O-METHYL-HYDROXYLAMINE
O-NITROANILINE
O-NITROANISOLE
O-PHENETIDINE
1-AMINO-2-BROMO-4-HYDROXYANTHROQUINONE
2-AMINO-5-NITROTHIAZOLE
2-AMINO-6-METHYL PYRIDINE
2-AMINOTHIAZOLE NITRATE
2-AMINOTHIOPHENOL
2-BIPHENYLAMINE
2-BROMO-4,6-DINITROANILINE
2-DIMETHYLAMINOETHANOL
2-ETHYL-4-METHYL-IMIDAZOLE
2-NITRODIPHENYL AMINE(REFINED)
2,4-DINITROANILINE
2,4,5-TRIMETHYLANILINE
2,4'-BIPHENYLDIAMINE
2,5-DIANILINO TEREPHTHALIC ACID
2,6-TOLUENE DI(DIAZONIUM CHLORIDE)
3-AMINOPROPIONITRILE
3-DIMETHYLAMINOPHENOL
3-N-BUTYLAMINO-4-METHOXY BENZENE SULFONAMIDE
4-AMINOACETANILIDE
4-BIPHENYLAMINE
4-FLUORO-3-NITROANILINE
4-ISOPROPOXYDIPHENYLAMINE
4,4'-BIS-(N,N-DIMETHYLANILINE) CARBINOL

C. AROMATIC ORGANIC CHEMICALS AND CHEMICAL GROUPS

(EPOXYETHYL)-BENZENE
A-NAPHTHOL
ACENAPHTHENE
ACENAPHTHYLENE
ACETOPHENONE
* ALKYLNAPHTHALENES (METHYL)
* ALPHA TOLUENESULFONIC ACIDS
ALPHA-HEXYLCINNAMALDEHYDE
AMYL PHENOL
ANISOLE
ANTHRACENE
ANTHRAQUINONE
* ARYLESTERS AND COGENERS
AZOXYBENZENE
B-NAPHTHOL
BENZALDEHYDE
BENZIL

TABLE VII(CONTINUED)

C. AROMATIC ORGANIC CHEMICALS AND CHEMICAL GROUPS(CONT.)

BENZILIC ACID
BENZO-A-PYRENE
* BENZOATE ESTERS
* BENZOFURANS
BENZOIN
BENZOIN GUM (BENZOYLPHENYLCARBANOL)
BENZOPHENONE
BENZOYL PEROXIDE
BENZYL ACETATE
BENZYL ALCOHOL
BENZYL BENZOATE
BIPHENYL
BIS(ALPHA,ALPHA-DIMETHYLBENZYL)PEROXIDE
BUTYL BENZYL PHTHALATE
BUTYL PHTHALYL BUTYL GLYCOLATE
COUMARIN(BENZ-A-PYRONE)
CRESYLIC ACID
* C11-C14 PHTHALATE
* C15-C19 PHTHALATE
* C7-C10 PHTHALATE
D,L-MENTHOL
DI-N-HEXYL PHTHALATE
DI-N-OCTYL PHTHALATE
DIBENZYL AZO DICARBOXYLATE
DICYCLOHEXYL PHTHALATE
DIDECYL PHTHALATE
DIETHYL PHTHALATE
DIISONONYL-DECYL PHTHALATE
DIISOPROPYL BENZENE
DIISOPROPYL BENZENE EMULSION
DIMETHYL ETHER
DIMETHYL PHTHALATE ESTER
DIMETHYLBENZYL HYDROPEROXIDE - ALPHA,ALPHA
DIPHENYL OXIDE
DIPHENYL PHTHALATE
* DIPHENYLALKANES
DIPHENYLTHIOUREA
DIVINYLBENZENE
DODECYLBENZENE SULFONIC ACID SODIUM SALT
DODECYLPHENOL
ETHYL ACETOACETATE
EUGENOL (2-METHOXY-4-ALLYLPHENOL)
* FURFURALS
FURFURYL ALCOHOL
HYDROQUINONE
INDENO (1,2,3,-C,D) PYRENE
ISOPROPYL PHENOL
M-PHENOXYBENZALDEHYDE
M-PHENOXYBENZYL ALCOHOL
M-PHENOXYTOLUENE
METHYL SALICYLATE
* MIXED ALCOHOL PHTHALATE
N-HEPTYL-NONYL-UNDECYL PHTHALATE

TABLE VII(CONTINUED)

C. AROMATIC ORGANIC CHEMICALS AND CHEMICAL GROUPS(CONT.)

N-HEXYL-(2-ETHYLHEXYL) PHTHALATE
N-HEXYL-(2-ETHYLHEXYL)-ISODECYL PHTHALATE
N-HEXYL-HEPTYL-NONYL-UNDECYL PHTHALATE
N-HEXYL-OCTYL-DECYL PHTHALATE
N-OCTYL N-DECYL PHTHALATE
NEOPENTANOIC ACID
OCTYL DECYL PHTHALATE
OCTYLPHENOL
P-BENZYL OXYPHENOL
P-HYDROXYBENZOIC ACID
P-TERT-BUTYL BENZOIC ACID
PHENOXYETHYL ISOBUTYRATE
PHENYL ACETIC ACID, POTASSIUM SALT
PHENYLACETALDEHYDE, DIMETHYLACETAL
* POLYARYL ETHERS
* POLYBENZYLALKYLBENZENES
POLYETHYL BENZENE
PYRENE
PYRIDINE
* PYRROLES
QUINONE
SALICYLALDEHYDE
SALICYLIC ACID
SODIUM BENZOATE
SODIUM CARBOXYMETHYL CELLULOSE
SODIUM PHENATE
SODIUM THIOSULFATE
SORBIC ACID
TANNIC ACID
TERT-AMYLENE-A-METHYLSTYRENE
TERT-BUTYLESTER PEROXYBENZOIC ACID
TETRAHYDROFURAN
TETRAHYDROPHTHALIC ANHYDRIDE
* TOLUIC ACIDS
TRIPHENYL CYANURATE
1,2 BENZANTHRACENE
1,2-DIPHENOXYETHANE
1,2,3,4-TETRAHYDRONAPHTHALENE
1,2,5,6 DIBENZANTHRACENE
1,3-DIMETHOXYBENZENE
1,3,5-BENZENETRICARBOXYLIC ACID
1,4-DIBUTOXYBENZENE
2-HYDROXY-4-(OCTYLOXY)BENZOPHENONE
2-HYDROXY-4-METHOXY-BENZOPHENONE
2-PHENOXYETHANOL
2,4 XYLENOL
2,4-DI-T-BUTYL PHENYL-8,5-DI-T-BUTYL-4-HYDROXY BENZOATE
2,4-PENTADIONE PEROXIDE
2,4,6-TRINITROPHENOL
2,5-XYLENOL
3,4-XYLENOL
3,5-XYLENOL
8-HYDROXYQUINOLINE

TABLE VII(CONTINUED)

D. HALOGENATED ORGANIC CHEMICALS AND CHEMICAL GROUPS

A-BROMOACETOXYMETHYL DIOXOLANE
A, B-EPOXY-B-METHYLHYDROCINNAMIC ACID, ETHYL ESTER
ACETYL CHLORIDE
* ACID CHLORIDES
* ALKYL BROMIDES
* ALKYL CHLORIDE CELLULOSE
AMYL CHLORIDE
BENZOTRICHLORIDE
BENZOTRIFLUORIDE
BENZOYL CHLORIDE
BENZYL DICHLORIDE
BIS (2-CHLOROETHOXY) METHANE
BIS (2-CHLOROISOPROPYL) ETHER
BIS (2-CHLROETHYL-1HYDROXYETHYL) PHOSPHONIC ACID
BIS(2-CHLOROETHYL)VINYL PHOSPHONATE
BIS(2,3-DIBRMOPROPYLETHER)TETRABROMOBISPHENOLATE
BIS(4-CHLOROPHENYL)SULFONE
BISHEXACHLOROCYCLOPENTADIENE
BORONTRIFLUORIDE-METHANOL COMPLEX
BROMOBENZENE
BROMOCHLORENDOCYCLOOCTADIENE
BROMOCHLOROMETHANE
* BROMOETHYL BENZENES (-MONO, -DI, -TRI)
BROMONAPHTHALENE
BROMOTRIFLUOROMETHANE
CARBON TETRABROMIDE
CARBON TETRAFLUORIDE
CETYL BROMIDE
CHLORAL HYDRATE
* CHLORINATED PARAFFIN SULFONATES
* CHLORINATED POLYPHOSPHATES
CHLORO-ACETALDEHYDE
CHLORO-ACETOPHENONE
CHLOROACETIC ACID
CHLOROACETONE
CHLOROBENZALDEHYDE
* CHLOROBENZOIC ACID AND ESTERS
CHLOROBENZOTRICHLORIDE (O,P)
CHLOROBENZOYL CHLORIDE
CHLORODIFLUOROMETHANE
CHLOROMETHYLMETHYL ETHER
CHLORONAPHAZINE
* CHLORONAPHTHALENES
CHLOROPICRIN (TRICHLORONITROMETHANE)
CHLOROSTYRENE
CHLOROSULFONIC ACID
CHLOROTRIFLUOROMETHANE
CHOLINE CHLORIDE
DECABROMOBIPHENYL
DECABROMOBIPHENYL ETHER
DIBROMOBUTENEDIOL
DIBROMODIFLUOROMETHANE

TABLE VII(CONTINUED)

D. HALOGENATED ORGANIC CHEMICALS AND CHEMICAL GROUPS(CONT.)

DIBROMOMETHANE
DIBROMONEOPENTYL GLYCOL
DICHLOROANILINE
DICHLOROBROMOMETHANE
DICHLORODIFLUOROMETHANE
DICHLOROFLUOROMETHANE
DICHLOROHYDRIN
DICHLOROMETHYL ETHER
DICHLORONITROBENZENE
* DICHLORONITROBENZENES
DIETHYL CHLOROETHYLAMINE
DIETHYL 2-BROMOETHYLPHOSPHONATE
DIFLUOROETHANE
ETHYL BROMIDE
ETHYL CHLOROACETATE
ETHYL IODIDE
ETHYLBENZYL CHLORIDE
ETHYLENE CHLOROHYDRIN
ETHYLENE DIBROMIDE
FLUOROACETAMIDE
FLUOROACETATE, SODIUM SALT
HEPTACHLOR EPOXIDE
HEXABROMOBENZENE
HEXABROMOBIPHENOL
HEXABROMOCYCLODODECANE
HEXACHLOROBENZENE
HEXACHLOROBUTADIENE
HEXACHLOROCYCLOPENTADIENE
HEXACHLOROETHANE
HEXAFLUOROPROPYLENE DIOXIDE
IODOMETHANE
ISOPHTHALOYL CHLORIDE
ISOPROPYL CHLORIDE
* LONG-CHAIN CHLORIDES
M-CHLOROANILINE
M-CHLORONITROBENZENE
M-CHLOROTOLUENE
M-DICHLOROBENZENE
METHALLYL CHLORIDE
METHYL BROMIDE
METHYL IODIDE
MONOCHLOROHYDRIN (3-CHLORO-1, 2-PROPANEDIOL)
N-BUTYLCHLORIDE
O-DICHLOROBENZENE
P-CHLOROANILINE
P-CHLORONITROBENZENE
P-CHLOROPHENYL ESTER ISOCYANIC ACID
P-CHLOROTOLUENE
P-DICHLOROBENZENE
PENTACHLOROBENZENE
PENTACHLORONAPTHALENE
PHENYLACETYL CHLORIDE
PHTHALOYL CHLORIDE

TABLE VII(CONTINUED)

D. HALOGENATED ORGANIC CHEMICALS AND CHEMICAL GROUPS(CONT.)

POLYCHLORINATED DIPHENYL ETHERS
POLYCHLORINATED TRIPHENYLS
PROPYL CHLORIDE
PROPYLENE CHLOROHYDRIN
PROPYLENE DICHLORIDE
SODIUM CHLOROACETATE
SOYBEAN OIL, BROMINATED
TEREPHTHALOYL CHLORIDE
TETRABROMO-TETRAMETHYL-DIHYDROXYBIPHENYL
TETRABROMOPHTHALIC ANHYDRIDE
TETRACHLOROBISPHENOL A
* TETRACHLOROETHANES
TETRACHLOROPHENOL
TETRACHLOROPHTHALIC ANHYDRIDE
TETRAFLUORODICHLOROETHANE
TETRAFLUOROETHYLENE
TETRAKIS(HYDROXYMETHYL)PHOSPHONIUM BROMIDE
TETRAKIS(HYDROXYMETHYL)PHOSPHONIUM CHLORIDE
TOLUENESULFONYL CHLORIDE
TRANS-1,4-DICHLORO-2-BUTENE
TRIBROMONEOPENTYL ALCOHOL
TRICHLOROACETIC ACID
* TRICHLOROBENZENES
TRIFLUOROACETIC ACID
TRIFLUORODICHLOROETHANE
TRIFLUOROETHANOL
TRIGLYCOL DICHLORIDE
TRIPHENYLMETHANE
TRIS(2-CHLOROETHYL) PHOSPHATE
TRIS(2,3-DIBROMOPROPYL) PHOSPHATE
TRIS(2,3-DICHLOROPROPYL) PHOSPHATE
TRIS(2,4,6-TRIBROMOPHENYL) PHOSPHATE
TRIS(4-BROMOPBENYL) PHOSPHATE
VINYL BROMIDE
O-CHLOROANILINE
O-CHLORONITROBENZENE
O-CHLOROTOLUENE
1-CHLORO-2-METHYLPROPENE
1,1,1,2-TETRACHLOROETHANE
1,1,1,3,3,3-HEXAFLUORO-2-PROPANONE
1,1,2-TRICHLORO-1,2,2-TRIFUOROETHANE
1,1,2-TRICHLOROETHANE
1,1,2,2 TETRACHLOROETHANE
1,1,2,2-TETRABROMOETHANE
1,2 TRANS-DICHLOROETHYLENE
1,2-DICHLOROETHYLENE
1,2-DICHLOROPROPANE
1,2,3-TRICHLOROBENZENE
1,2,3-TRICHLOROPROPANE
1,2,3,4-TETRACHLOROBENZENE
1,2,3,5-TETRACHLOROBENZENE
1,2,4-TRICHLOROBENZENE
1,2,4,5-TETRACHLOROBENZENE

TABLE VII(CONTINUED)

D. HALOGENATED ORGANIC CHEMICALS AND CHEMICAL GROUPS(CONT.)

1,3-DICHLOROPROPENE
1,3,5-TRICHLOROBENZENE
2-BROMOETHANOL
2-BROMOPYRIDINE
2-CHLORO-1,3-BUTADIENE
2-CHLORO-4-TRIFLUOROMETHYL-3-CARBOXY-4'-NITRODIPHENYL ETHER
2-CHLOROETHYL VINYL ETHER (MIXED)
2-CHLOROHYDROQUINONE
2-CHLORONAPHTHALENE
2-CHLORONITROPHENOL
2-CHLOROPHENOL
2-CHLOROPYRIDINE
2,2-DICHLOROETHYL ETHER
2,3-DIBROMOPROPANOL
2,3-DICHLOROQUINOXALINE
2,4,6-TRICHLORO-S-TRIAZINE
2,4,6-TRICHLOROPHENOL
3-CHLORO-2-METHYLPROPENE
3-TRICHLORO-METHYL-5-CHLORO-1,2,4-THIADIAZOLE
3,3'-DICHLOROBENZIDINE
3,4,5-TRICHLOROPHENOL
4-BROMOPHENYL PHENYL ETHER
4-CHLORO-2-AMINOPHENOL
4-CHLOROPHENYL PHENYL ETHER

E. OTHER ORGANIC CHEMICALS AND CHEMICAL GROUPS

A-NAPHTHALENE SULFONIC ACID
A-TERPINEOL
ACETONITRILE
* ALKYL MALEIC ANHYDRIDE, SODIUM SALT
* ALKYL NITRATES
* ALKYLNITRITES
* ALKYLTHIOLS, C14, C16, C18
ALLYLNITRILE
ALPHA-CEDRENE (VERTOFIX COEUR)
ALUMINUM ALKYLS, TRIETHYL
AMINOETHYL HYDROGEN SULFATE
AMYL MERCAPTAN
ANTHRANILIC ACID
* AROMA CHEMICALS(FRAGRACES)
B-PICOLINE
BENZENESULFONIC ACID
BENZONITRILE
BENZYL CYANIDE
BETA-MYRCENE
BIS(CHLORENDO) BICYCLOPENTADIENE
BIS(CHLORENDO) CYCLODCTADIENE
BIS(CHLORENDO) FURAN
BIS(DIBUTYLDITHIOCARBAMATO) ZINC
BIS(DIETHYLDITHIOCARBAMATO) ZINC
BIS(P-OCTYLPHENOL) SULFIDE, NICKEL SALT
CALCIUM CYANAMIDE
CAMPHENE

TABLE VII(CONTINUED)

E. OTHER ORGANIC CHEMICALS AND CHEMICAL GROUPS(CONT.)

* CARBAMATES
CARYOPHYLLENE (4,11,11-TRIMETHYL-8-METHYLENEBICYCLO(7-7-0) UNDEC-4-ENE)
CASTOR OIL (INCLUDING USP)
CELLULOSE NITRATE
CELLULOSE TETRANITRATE
CHLORENDIC ACID
* CHLORENDIC SALTS
CHLORENDOCYCLOOCTADIENE
CRESYL DIPHENYLPHOSPHATE
CYANOACETIC ACID
DIANISIDINE
DIBENZOFURAN
DIETHYL BIS (2-HYDROXYETHYL) PHOSPHONATE
DIETHYL SULFATE
DIMETHYL HYDRAZINE
DIMETHYL SULFATE
DIMETHYL SULFIDE
DIMETHYL SULFOXIDE
* DINITROBENZENES(M,O,P)
DINITROSOBENZENE
DIOXOLANE
* DIRECT DYES
* DISILAZANES
* DITHIOCARBAMATES, SODIUM SALT
* DITHIOCARBAMATES, 2-DIMETHYLAMINO ETHYL, HYDROCHLORIDE
DODECYLMERCAPTAN
DODECYLGUANIDINE ACETATE
* DYES & DYE INTERMEDIATES
* EPOXIDIZED ALPHA-OLEFINS
ETHYL PHOSPHONOTHIOIC DICHLORIDE
ETHYL SODIUM OXALACETATE
ETHYL THIOUREA
ETHYL VANILLIN
ETHYLCYANOACETATE
* FATS, SULFURIZED
* FATTY ACID METAL SALTS
FISHER'S BASE (1,3,3-TRIMETHYL-2-METHYLENE INDOLINE)
* GUAR-STARCH DERIVATIVES
HELIOTROPIN
HEXAMETHYENE BIURET-URETHANE
HEXAMETHYLENE DIISOCYANATE
HEXYL ALCOHOL SULFATE, SODIUM SALT
HYDRAZINE
HYDRAZINE MONOACETATE, METHANOL SOLUTION
HYDRAZINE SOLUTIONS
HYDRAZOBENZENE
* ISOCYANURATES
LAUROYL PEROXIDE
LAURYL ALCOHOL SULFATE
LIGNIN DERIVATIVES
LIGNINSULFONIC ACID,FERROCHROME SALT
LINALOOL
* LONG-CHAIN ESTERS,SULFOETHOXYLATES

TABLE VII(CONTINUED)

E. OTHER ORGANIC CHEMICALS AND CHEMICAL GROUPS(CONT.)

MALEIC HYDRAZIDE
MALIC ACID
MALONDIANILIDE
MANNITOL, CRYSTAL
MECRYLATE
METHALLYLIDENE DIACETATE
METHIONINE
* METHYL IONONES
METHYL ISOCYANATE
METHYLHYDRAZINE
MONOHYDRATEHYDRAZINE
N-BUTYRONITRILE
N-NITROSODI-N-PROPYLAMINE
N-NITROSODIMETHYLAMINE
N-NITROSODIPHENYLAMINE
* NAPHTHENIC ACID SALTS
NAPHTHENIC ACID,COPPER SALT
NAPTHENIC ACID, LEAD SALT
NITRILOTRIS(METHYLENE) TRIPHOSPHONIC ACID
NITROBENZOIC ACID (M,O,P)
NITROETHANE
NITROMETHANE
NITROPHENOL
NITROPROPANE
NONENE(MIXED ISOMERS)
OCTYL SULFATE, SODIUM SALT
* ORGANIC PIGMENTS
* ORGANO-TIN COMPOUNDS
P-BENXOQUINONE DIOXIME
P-DIOXANE
P-NITROACETANILIDE
P-NITROANISOLE
P-NITROPHENOL & SODIUM SALT
P-NITROTOLUENE-O-SULFONIC ACID
PERCHLOROMETHYL MERCAPTAN
* PERFUMES & FLAVORS, MISC.
* PHENOLSULFONIC ACIDS
PHENYL ANTHRANILIC ACID
* PHOSPHINES--ALKYL,ARYL OR ALKOXY (MIXED)
PICRIC ACID
PIGMENT BLUE 15, ALPHA AND BETA FORMS
PIGMENT GREEN 7
PIGMENT YELLOW 12
PINANE
PINANE HYDROPEROXIDE
PINENE (ALPHA & BETA)
PIPERAZINE
POLYAZELAIC ANHYDRIDE
* POLYBENZIMIDAZOLES
* POLYBENZOTHIAZOLES
POLYNAPHTHALENE SULFONATE, SODIUM SALT
POLYPHENYLENE OXIDE
POLYPHENYLENE SULFIDE

TABLE VII(CONTINUED)

E. OTHER ORGANIC CHEMICALS AND CHEMICAL GROUPS(CONT.)

POLYSULFIDE POLYETHER
POLYURETHANE RESINS
POLYVINYL PYRROLIDONE
POLYVINYL PYRROLIDONE IODOPHORE
POTASSIUM PYROPHOSPHATE
PYRONES
QUATERNIZED COMPLEX ETHER
QUINOLINES, COPPER-8-HYDROXYQUINOLINOLATE
* RAFFINATE
RESORCINOL
RESORCYLIC ACID
S,S,S-TRIBUTYL ESTER PHOSPHOROTRITHIOIC ACID
SACCHARIN
SELENIUM DIMETHYLDITHIOCARBAMATE
SEMICARBAZIDE HYDROCHLORIDE
SORBITAN FATTY ACID ESTERS
SPIROGERMANIUM
STILBENE
SUCCINIC ACID
SUCCINONITRILE
SULFANILIC ACID
SULFOLANE
* SULFURIZED NATURAL FATS & OILS
SYMCLOSENE
TERPENE OIL
TETRABRMOPHENYL-HEXACHLOROBICYCLOHEPTADIENE
TETRABUTYL PHOSPHONIUM SILONOLATE
TETRAKIS(DIETHYLDITHIOCARBAMATO)SELENIUM
TETRAKIS(HYDROXYMETHYL)PHOSPHONIUM SULFATE
THIOPHENE ACETIC ACID
THIOUREA, COMPLEX
THIRAM
TOLUENE 2,4-DIISOCYANATE
TOLUENE 2,6-DIISOCYANATE
TOXAPHENE
TRANS-BIS (N-PROPYLSULFONYL) ETHENE
TRICARBONYL 2-METHYLCYCLOPENTADIENYL
TRICYCLODECENYL PROPIONATE
TRIDECYL SULFATE, SODIUM SALT
TRITOTYL PHOSPHATE
VAT BLUE 6
* VINYL ETHERS
* XANTHOGENS
XYLENESULFONIC ACID, SODIUM SALT
* XYLENOLS(MIXED)
1-AZIRIDINEETHANOL
1-HYDROXYETHANE-1,1-DIPHOSPHONIC ACID
1-NITRONAPHTHALENE
1,1-DIMETHYLHYDRAZINE
1,1-DIPHENYLHYDRAZINE
1,1'-OXYDI-2-PROPANOL
1,12-BENZOPERYLENE
1,2-DIPHENYLHYDRAZINE

TABLE VII(CONTINUED)

E. OTHER ORGANIC CHEMICALS AND CHEMICAL GROUPS(CONT.)

1,4-DIETHOXYBENZENE
2-(MORPHOLINO-THIO)-BENZOTHIAZOLE
2-AMINO-4-NITROPHENOL
2-METHYLAZIRIDINE
2-NITROPHENOL
* 2-PICOLINES & COGENERS
2-PINANOL
2-PYRIDINETHIONE-N-OXIDE, ZINC SALT
2,2'-DITHIOBISBENZOTHIAZOLE
2,2',4'-TRIHYDROXY-5-CHLORO AZOBENZENE-2,2'-COPPER COMPLEX, SOLUTION
2,4-DINITROPHENOL
* 3-HYDROXY-2-NAPHTHALENE CARBOXAMIDES
3-HYDROXY-2-NAPHTHALENE CARBOXYLIC ACID (HNC)
3-SULFOLENE
3,5-DINITROBENZOIC ACID
4-NITRO-O-PHENYLENEDIAMINE
4-NITROSODIPHENYLAMINE
4-NITROSOPHENOL
4-VINYL-1-CYCLOHEXENE
4,4'-DIAMINO-STILBENE-2,2-DISULFONIC ACID
4,6 DINITRO-O-CRESOL
6-NITROBEZIMIDAZOLE
7-METHYL NADIC ANHYDRIDE

APPENDIX IV-A

RATIONALE FOR THE FORM OF THE BPT BOD_5 REGRESSION MODEL

APPENDIX IV-A

TABLE OF CONTENTS

RATIONALE FOR THE FORM OF THE BPT BOD_5 REGRESSION MODEL

This section contains the general rationale for the use of a logarithmic regression model to develop long-term average BOD_5 effluent values, which are to be applied to production-based subcategories to develop subcategory-specific BOD_5 effluent limitations and plant targets based on each facility's product mix.

A standard approach used in many effluent guidelines to determine average aggregate performance for an industrial subcategory is to estimate the median of a set of plant average treated effluent values. The estimation of the median average performance is performed after it has been determined that each plant in the data set satisfies minimum requirements for BPT treatment system performance. Given the characteristics of the OCPSF industry, there is general recognition that the BOD_5 effluent long-term averages will not necessarily be the same across all seven subcategories. Thus, subcategory-specific estimates are required to be developed for each plant. Most plants in this industry do not confine their OCPSF production to a single OCPSF subcategory. The data base actually used in this analysis contains approximately 40 percent of the plants with 95 percent or more of their OCPSF production concentrated in a single subcategory; about 60 percent are multiple subcategory plant operations.

In the course of developing this regulation, EPA could not practically obtain average BOD_5 effluent concentration data for individual product groups in multiple subcategory facilities, except in a very few cases in which a plant operated a single production process. This is primarily because the general practice in the industry is to treat conventional pollutants (BOD_5 and TSS) in combined wastewaters from the individual product process. Wastewater flow rates, moreover, from the individual product processes within multiple subcategory plants are not available. However, subcategorical (product or product group level) production rates are available and provide a link between the facility's average BOD_5 effluent concentration of the treated OCPSF combined wastewaters and its subcategorical sources of those wastewaters. This link is important to provide estimates of the contributions of BOD_5 effluent specifically attributable to each subcategory.

Because the data available for determining subcategorical specific aggregate BOD_5 effluent performance will not support seven separate analyses for each subcategory, the EPA standard approach was modified. The modification retained the characteristics of the standard approach in two major respects. It provides estimates of long-term average BOD_5 effluent in the form of medians of plant-level averages, and it provides these estimates for each subcategory. Although most plants have multisubcategory operations, the regression model allows aggregate estimates to be made of subcategory-specific BOD_5 contributions to the treated effluent. Moreover, by having the logarithm of plant average BOD_5 effluent as the dependent variable for the BOD_5 regression model, the predicted value is actually an estimate of the median long-term average for the subcategory, as explained in the paragraph below.

Effluent concentration measurements within plants and effluent concentrations across plants behave according to lognormal distributions. Given lognormally distributed data, an estimate of the median is given by the antilogarithm of the arithmetic mean of the logarithms of the measurements. Since the data analyzed are plant averages, the median estimated is a median of plant long-term averages.

The BOD_5 effluent plant means exhibit a highly skewed distribution as illustrated by the histogram in Figure 1. The histogram of the natural logarithm of BOD_5 effluent means, however, is highly symmetric as indicated in Figure 2, indicating that the plant average BOD_5 effluent measurements are lognormally distributed. Accordingly, when the estimated regression function is evaluated for a plant having, for instance, 100 percent of its production in thermosets, it yields a median estimate of plant averages for the thermosets subcategory. In this manner, the estimated regression model yields an appropriate estimate for each of the given subcategories based on existing data.

FIGURE 1

PLANT AVERAGE BOD5 EFFLUENT FREQUENCY DISTRIBUTION

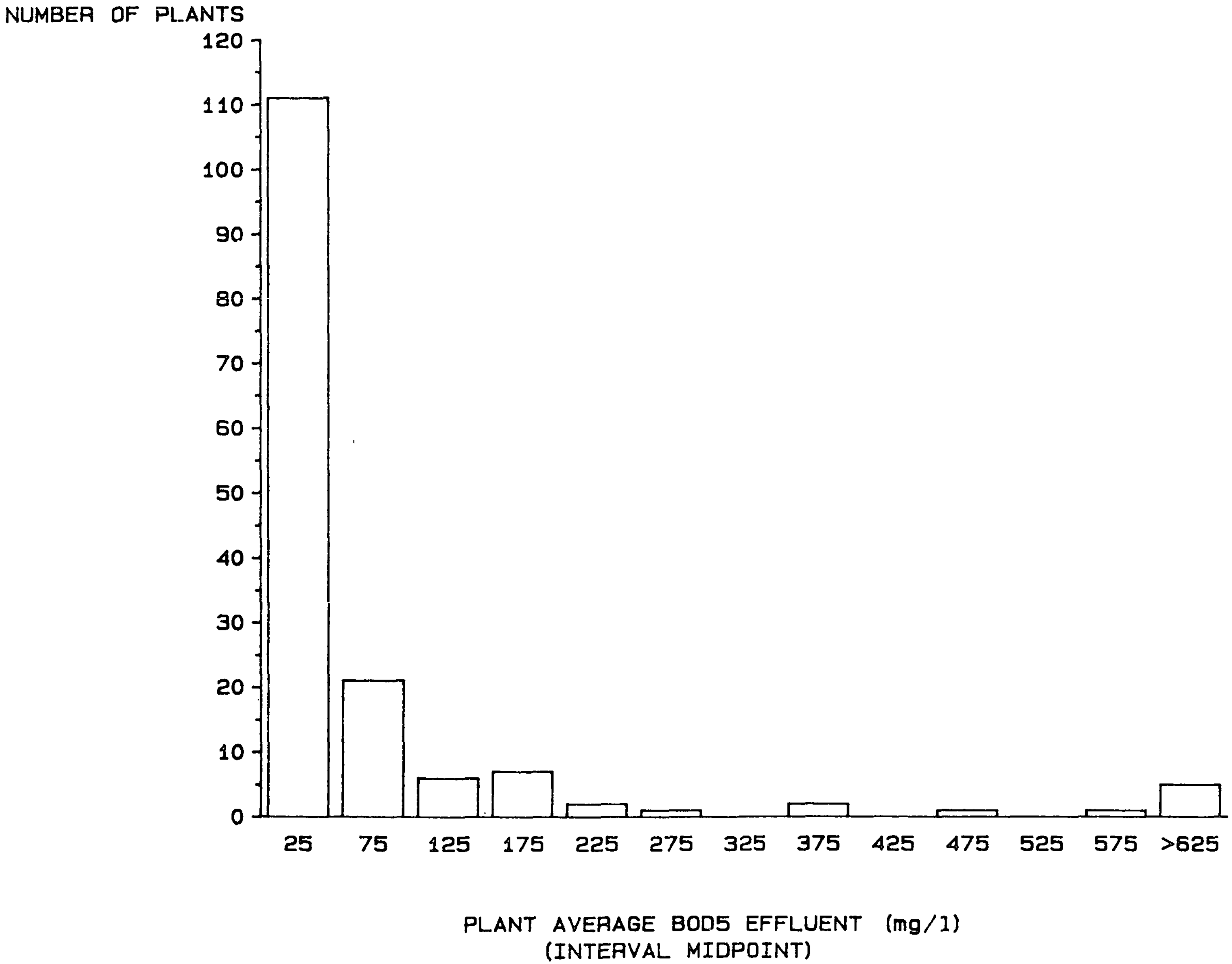

FIGURE 2
NATURAL LOGARITHM OF PLANT AVERAGE BOD5 EFFLUENT
FREQUENCY DISTRIBUTION

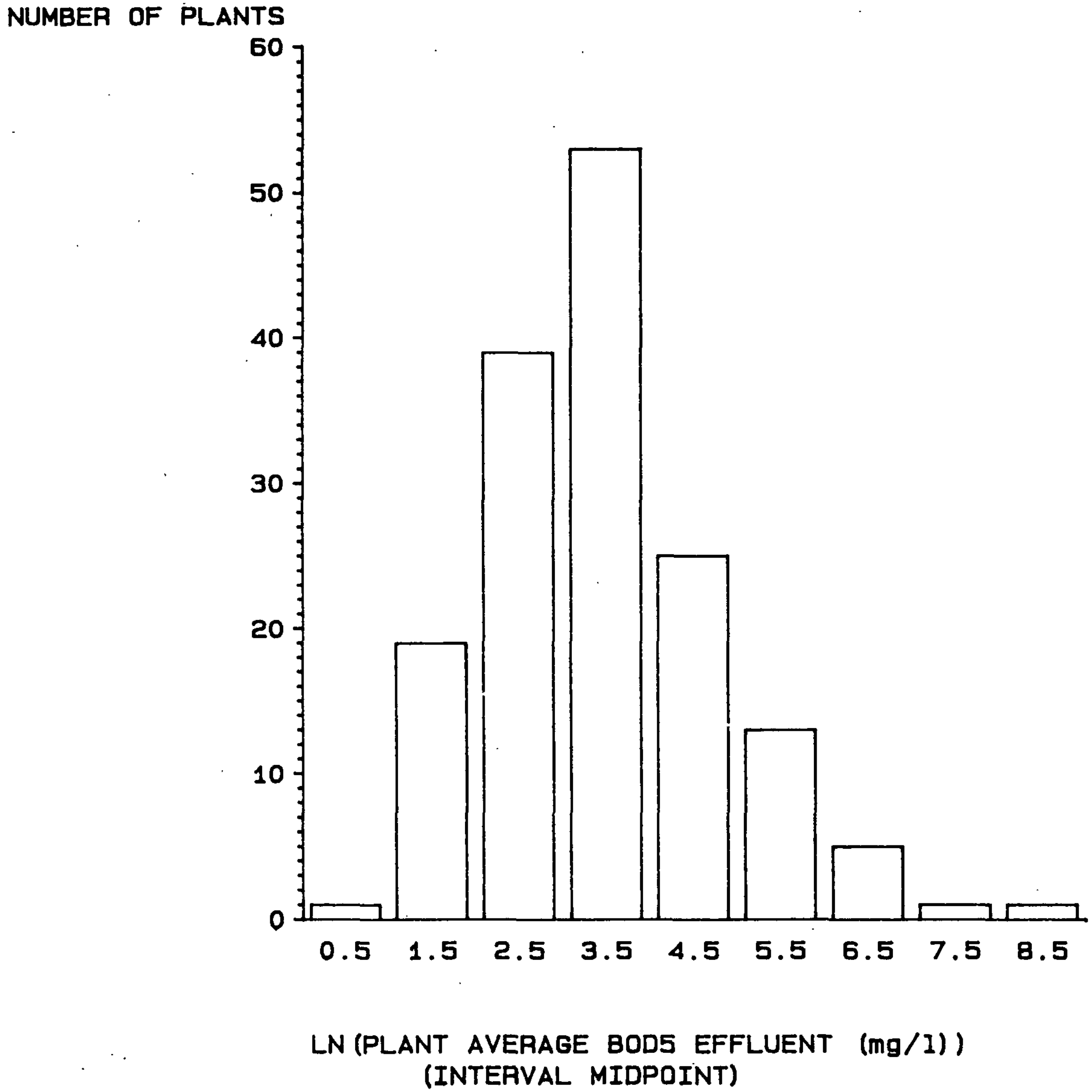

EXHIBIT 1 - BPT BOD_5 REGRESSION MODEL

$$\ln(BOD_i) = a + \sum_{j=1}^{7} w_{ij} \cdot T_j + B \cdot I4_i + C \cdot Ib_i + e_i$$

where:

$\ln(BOD_i)$ = natural logarithm (ln) of the 1980 annual arithmetic average BOD_5 effluent in mg/l, which has been adjusted for dilution with uncontaminated miscellaneous wastewaters (as described in Section VII) for plant i

$I4_i$ = performance indicator variable for plant i

= 1, if plant i meets the 95 percent BOD_5 removal or at most 40 mg/l BOD_5 effluent editing criteria (the final BOD_5 performance editing criteria)

= 0, otherwise

Ib_i = treatment indicator variable for plant i

= 1, if plant i has only biological treatment

= 0, if plant i has treatment in addition to biological treatment

w_{ij} = proportion of OCPSF 1980 production from plant i from subcategory j

e_i = statistical error term associated with plant i

The seven subcategories, represented by the subscript j, are as follows:

j=1: Thermoplastics

j=2: Thermosets

j=3: Rayon

j=4: Other Fibers

j=5: Commodity Organics

j=6: Bulk Organics

j=7: Specialty Organics.

NOTE ON INTERPRETATION OF REGRESSION ANALYSIS

SAS COMPUTER OUTPUTS

The computer regression analysis outputs in this appendix are generated by the SAS computer system, a well-recognized and widely used statistical analysis system. The regression results are, accordingly, represented in the standard SAS output format. Readers not familiar with this format should refer to Chapter 31 of

SAS User's Guide: Statistics
Version 6 Edition
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The reader should take care to observe the parametric form of the regression model being used in this and in other exhibits. In particular, the BPT BOD_5 regression model is stated as

$$\ln(BOD_i) = a + \sum_{j=1}^{7} w_{ij} \cdot T_j + B \cdot I4_i + C \cdot Ib_i + e_i \quad (1)$$

Observe that because

$$\sum_{j=1}^{7} w_{ij} = 1,$$

the regression coefficients (a) and (T_j) can be replaced by (a+x) and (T_j-x) for any value of x, and there is no change in the model. The consequence is that the regression model above is not uniquely specified and the coefficients can not be uniquely estimated by regression methods with the model in this form. It is commonplace, therefore, to add the constraint

$$\sum_{j=1}^{7} T_j = 0$$

to force the regression coefficients in the model to be uniquely defined. In the first regression analysis in this exhibit, the model is implemented with this constraint in the form

$$(2) \qquad \ln(BOD_i) = a + \sum_{j=1}^{6} w_{ij} \cdot T_j + B \cdot I4_i + C \cdot Ib_i + e_i$$

with

$$T_7 = - \sum_{j=1}^{6} T_j$$

In the second regression analysis in this exhibit, the form of the model is

$$(3) \qquad \ln(BOD_i) = \sum_{j=1}^{7} w_{ij} \cdot T_j' + B \cdot I4_i + C \cdot Ib_i + e_i$$

and because there is no intercept term, no constraint is necessary.

These two parameterizations actually result in the same model. The reader may verify from the printouts that

$$a + T_j = T_j'$$

Different parametric forms of models are implemented for different purposes. The model based on the form (3) is best for estimating the coefficients directly; whereas, the model based on (2) is preferred to assess the relative contribution of the subcategorical coefficients.

The reader should also note that standard statistics related to the different parametric forms are not the same. For instance, the coefficient of determination (R-square) is not the same for the two implementations. The value associated with regression model given in (2) is the appropriate one for this BPT BOD_5 regression model.

SUBCATEGORY COEFFICIENTS FOR BIOLOGICAL ONLY TREATMENT (BPT OPTION I)
WITH >= 95% BOD5 REMOVAL OR BOD5 EFFLUENT <= 40 MG/L
REGRESSION ON NATURAL LOGARITHM (LN) OF BOD5 EFFLUENT

DEP VARIABLE: LNBODEFF Ln(BOD5 Effluent)

ANALYSIS OF VARIANCE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	8	160.01064	20.00132974	23.972	0.0001
ERROR	148	123.48726	0.83437337		
C TOTAL	156	283.49790			

ROOT MSE	0.9134404	R-SQUARE	0.5644
DEP MEAN	3.455732	ADJ R-SQ	0.5409
C.V.	26.43262		

PARAMETER ESTIMATES

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > |T|	VARIABLE LABEL
INTERCEP	1	4.56410137	0.20213671	22.579	0.0001	INTERCEPT
X1	1	-0.29139627	0.18899101	-1.542	0.1252	T1: Thermoplastics Deviation
X2	1	0.66475573	0.36929208	1.800	0.0739	T2: Thermosets Deviation
X3	1	-0.23663157	0.56499625	-0.419	0.6760	T3: Rayon Deviation
X5	1	-0.52627652	0.27618759	-1.906	0.0587	T4: Other Fibers Deviation
X7	1	-0.06626001	0.21807278	-0.304	0.7617	T5: Commodity Organics Deviation
X8	1	0.09852574	0.23717796	0.415	0.6784	T6: Bulk Organics Deviation
DPFM40	1	-1.94453768	0.16608368	-11.708	0.0001	B: 95/40 Performance Shift
DTRT	1	0.41834828	0.15299342	2.734	0.0070	C: Biological Only Treatment Shift

SUBCATEGORY COEFFICIENTS FOR BIOLOGICAL ONLY TREATMENT (BPT OPTION I)
WITH >= 95% BOD5 REMOVAL OR BOD5 EFFLUENT <= 40 MG/L
REGRESSION ON NATURAL LOGARITHM (LN) OF BOD5 EFFLUENT

DEP VARIABLE: LNBODEFF Ln(BOD5 Effluent)

ANALYSIS OF VARIANCE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	9	2034.91725	226.10192	270.984	0.0001
ERROR	148	123.48726	0.83437337		
U TOTAL	157	2158.40451			

ROOT MSE	0.9134404	R-SQUARE	0.9428
DEP MEAN	3.455732	ADJ R-SQ	0.9393
C.V.	26.43262		

NOTE: NO INTERCEPT TERM IS USED. R-SQUARE IS REDEFINED.

PARAMETER ESTIMATES

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > |T|	VARIABLE LABEL
Z1	1	4.27270510	0.22750044	18.781	0.0001	a+T1: Thermoplastics
Z2	1	5.22885710	0.44161961	11.840	0.0001	a+T2: Thermosets
Z3	1	4.32746980	0.68493274	6.318	0.0001	a+T3: Rayon
Z5	1	4.03782486	0.33656702	11.997	0.0001	a+T4: Other Fibers
Z7	1	4.49784137	0.24319147	18.495	0.0001	a+T5: Commodity Organics
Z8	1	4.66262711	0.24607213	18.948	0.0001	a+T6: Bulk Organics
Z9	1	4.92138427	0.23840174	20.643	0.0001	a+T7: Specialty Organics
DPFM40	1	-1.94453768	0.16608368	-11.708	0.0001	B: 95/40 Performance Shift
DTRT	1	0.41834828	0.15299342	2.734	0.0070	C: Biological Only Treatment Shift

EXHIBIT 2 - BPT TSS REGRESSION MODEL

$$\ln(TSS_i) = a + b\cdot[\ln(BOD_i)] + e_i$$

where:

$\ln(TSS_i)$ = ln(1980 annual arithmetic average TSS effluent in mg/l, which has been adjusted for dilution with uncontaminated miscellaneous wastewaters, as described in Section VII), for plant i.

$\ln(BOD_i)$ = natural logarithm (ln) of the 1980 annual arithmetic average BOD_5 effluent in mg/l, which has been adjusted for dilution with uncontaminated miscellaneous wastewaters (as described in Section VII) for plant i.

SUBCATEGORY COEFFICIENTS FOR BIOLOGICAL ONLY TREATMENT (BPT OPTION I)
WITH >= 95% BOD5 REMOVAL OR BOD5 EFFLUENT <= 40 MG/L
REGRESSION ON NATURAL LOGARITHM (LN) OF TSS EFFLUENT

DEP VARIABLE: LNTSSEFF LN(TSS EFFLUENT)

ANALYSIS OF VARIANCE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	1	9.34423219	9.34423219	19.149	0.0001
ERROR	59	28.79051861	0.48797489		
C TOTAL	60	38.13475080			

ROOT MSE	0.698552	R-SQUARE	0.2450
DEP MEAN	3.340707	ADJ R-SQ	0.2322
C.V.	20.91031		

PARAMETER ESTIMATES

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > |T|	VARIABLE LABEL
INTERCEP	1	1.84996248	0.35221246	5.252	0.0001	INTERCEPT
LNBODEFF	1	0.52810227	0.12068268	4.376	0.0001	b: Ln(BOD5 Effluent)

EXHIBIT 3 - SIGNIFICANCE OF FLOW

$$\ln(BOD_i) = a + \sum_{j=1}^{7} w_{ij} \cdot T_j + F \cdot [\ln(flow_i)] + e_i$$

where:

$\ln(BOD_i)$ = natural logarithm (ln) of the 1980 annual arithmetic average BOD_5 effluent in mg/l, which has been adjusted for dilution with uncontaminated miscellaneous wastewaters (as described in Section VII) for plant i

$\ln(flow_i)$ = ln(total flow(MGD), corrected for nonprocess waste streams) for plan i, with associated coefficient B

w_{ij} = proportion of OCPSF 1980 production from plant i from subcategory j

The seven subcategories, represented by the subscript j, are as follows:

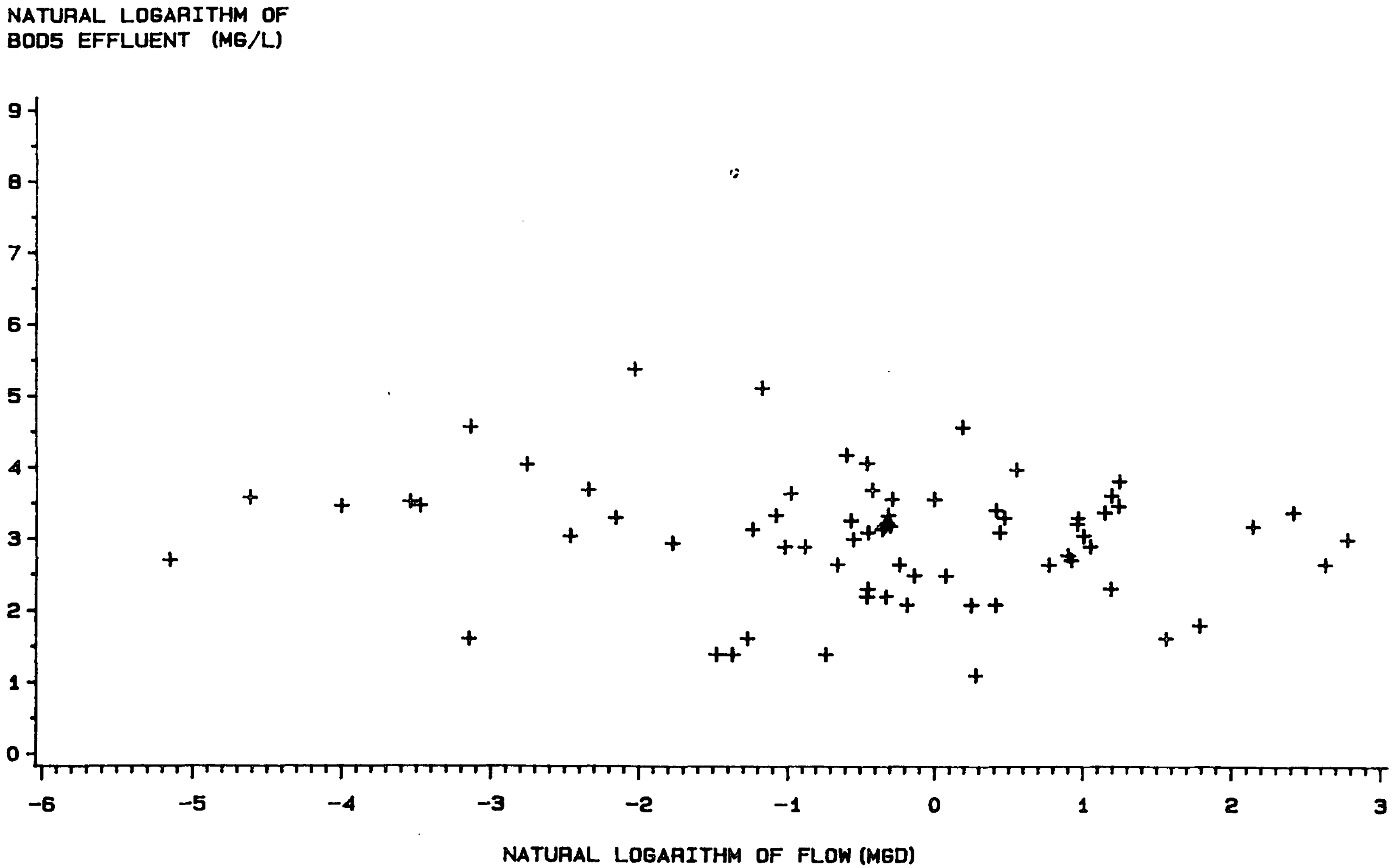
j=1: Thermoplastics
j=2: Thermosets
j=3: Rayon
j=4: Other Fibers
j=5: Commodity Organics
j=6: Bulk Organics
j=7: Specialty Organics.

The model was examined separately for the following four subsets of the data base:

(1) Biological only and 95/40
(2) Biological only and not 95/40
(3) Not biological only and 95/40
(4) Not biological only and not 95/40

FIGURE 3
PLOT OF NATURAL LOGARITHM OF BOD5 EFFLUENT VERSUS NATURAL LOGARITHM OF FLOW

PLANTS WITH BIOLOGICAL ONLY TREATMENT WITH >= 95%
BOD5 REMOVAL OR BOD5 EFFLUENT <= 40 MG/L



TEST FOR SIGNIFICANCE OF NATURAL LOGARITHM OF FLOW
PLANTS WITH BIOLOGICAL ONLY TREATMENT WITH >= 95%
BOD5 REMOVAL OR BOD5 EFFLUENT <= 40 MG/L

DEP VARIABLE: LNBODEFF Ln(BOD5 Effluent)

ANALYSIS OF VARIANCE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	7	6.63489617	0.94784231	1.361	0.2372
ERROR	62	43.17897686	0.69643511		
C TOTAL	69	49.81387303			

ROOT MSE	0.8345269	R-SQUARE	0.1332
DEP MEAN	3.026033	ADJ R-SQ	0.0353
C.V.	27.57825		

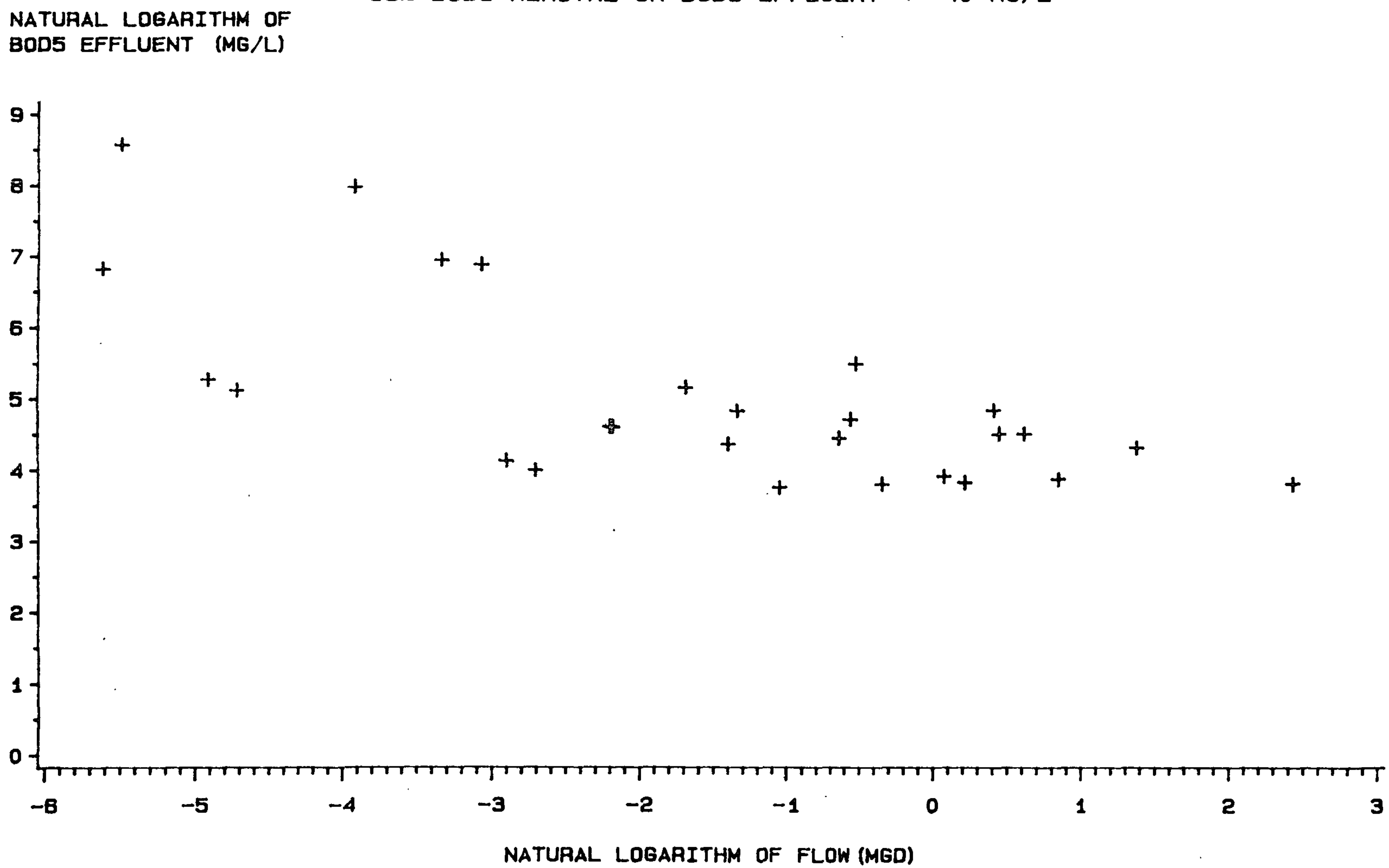
PARAMETER ESTIMATES

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > |T|	VARIABLE LABEL
INTERCEP	1	3.01200421	0.13459565	22.378	0.0001	INTERCEPT
X1	1	-0.41004061	0.23226027	-1.765	0.0824	T1: Thermoplastics Deviation
X2	1	0.04767335	0.44680844	0.107	0.9154	T2: Thermosets Deviation
X3	1	-0.02370051	0.55557003	-0.043	0.9661	T3: Rayon Deviation
X5	1	-0.35944248	0.33255868	-1.081	0.2840	T4: Other Fibers Deviation
X7	1	0.14229816	0.30398275	0.468	0.6413	T5: Commodity Organics Deviation
X8	1	0.30473986	0.34489606	0.884	0.3803	T6: Bulk Organics Deviation
LNFLOW	1	-0.07497803	0.07066758	-1.061	0.2928	F: Ln[Flow(MGD)]

FIGURE 4

PLOT OF NATURAL LOGARITHM OF BOD5 EFFLUENT VERSUS NATURAL LOGARITHM OF FLOW

PLANTS WITH BIOLOGICAL ONLY TREATMENT AND NOT MEETING
95% BOD5 REMOVAL OR BOD5 EFFLUENT <= 40 MG/L



TEST FOR SIGNIFICANCE OF NATURAL LOGARITHM OF FLOW
PLANTS WITH BIOLOGICAL ONLY TREATMENT NOT MEETING
95% BOD5 REMOVAL OR BOD5 EFFLUENT <= 40 MG/L

DEP VARIABLE: LNBODEFF Ln(BOD5 Effluent)

ANALYSIS OF VARIANCE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	6	26.49323674	4.41553946	4.821	0.0034
ERROR	20	18.31711772	0.91585589		
C TOTAL	26	44.81035447			

ROOT MSE	0.9570036	R-SQUARE	0.5912
DEP MEAN	5.008538	ADJ R-SQ	0.4686
C.V.	19.10744		

PARAMETER ESTIMATES

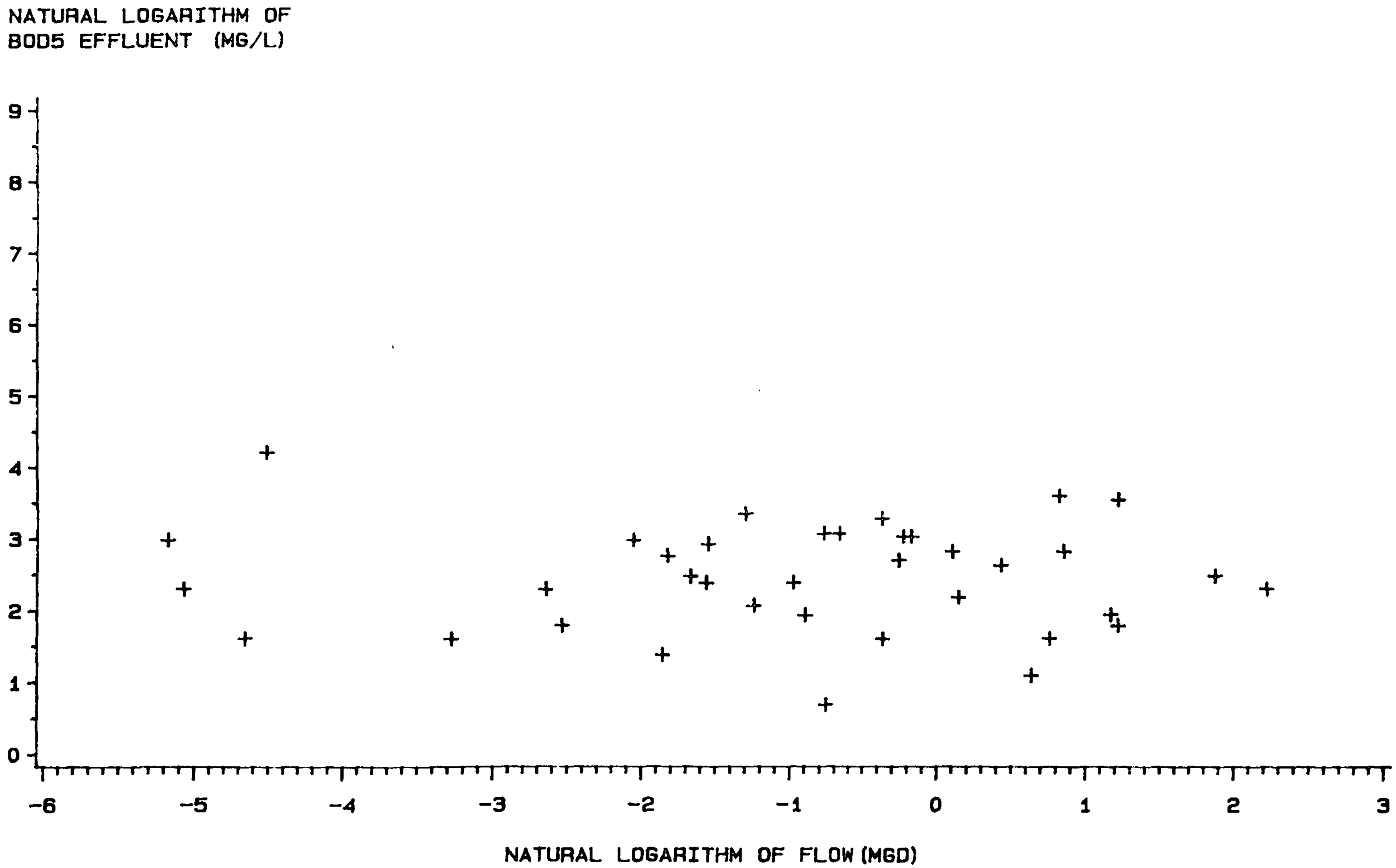
VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > |T|	VARIABLE LABEL
INTERCEP	1	4.12015655	0.35120697	11.731	0.0001	INTERCEPT
X1	1	-0.06475491	0.53121655	-0.122	0.9042	T1: Thermoplastics Deviation
X2	1	1.18957665	0.89585184	1.328	0.1992	T2: Thermosets Deviation
X5	1	-1.76148289	1.16037417	-1.518	0.1447	T4: Other Fibers Deviation
X7	1	0.35608348	0.62707648	0.568	0.5765	T5: Commodity Organics Deviation
X8	1	-0.28471864	0.58398484	-0.488	0.6312	T6: Bulk Organics Deviation
LNFLOW	1	-0.45047057	0.09846494	-4.575	0.0002	F: Ln[Flow(MGD)]

FIGURE 5

PLOT OF NATURAL LOGARITHM OF BOD5 EFFLUENT VERSUS NATURAL LOGARITHM OF FLOW

PLANTS WITH BIOLOGICAL PLUS TERTIARY TREATMENT

WITH >= 95% BOD5 REMOVAL OR BOD5 EFFLUENT <= 40 MG/L



TEST FOR SIGNIFICANCE OF NATURAL LOGARITHM OF FLOW
PLANTS WITH BIOLOGICAL PLUS TERTIARY TREATMENT WITH
>= 95% BOD5 REMOVAL OR BOD5 EFFLUENT <= 40 MG/L

DEP VARIABLE: LNBODEFF Ln(BOD5 Effluent)

ANALYSIS OF VARIANCE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	6	4.69507319	0.78251220	1.472	0.2213
ERROR	30	15.94588334	0.53152944		
C TOTAL	36	20.64095653			

ROOT MSE	0.7290607	R-SQUARE	0.2275
DEP MEAN	2.461709	ADJ R-SQ	0.0730
C.V.	29.61604		

PARAMETER ESTIMATES

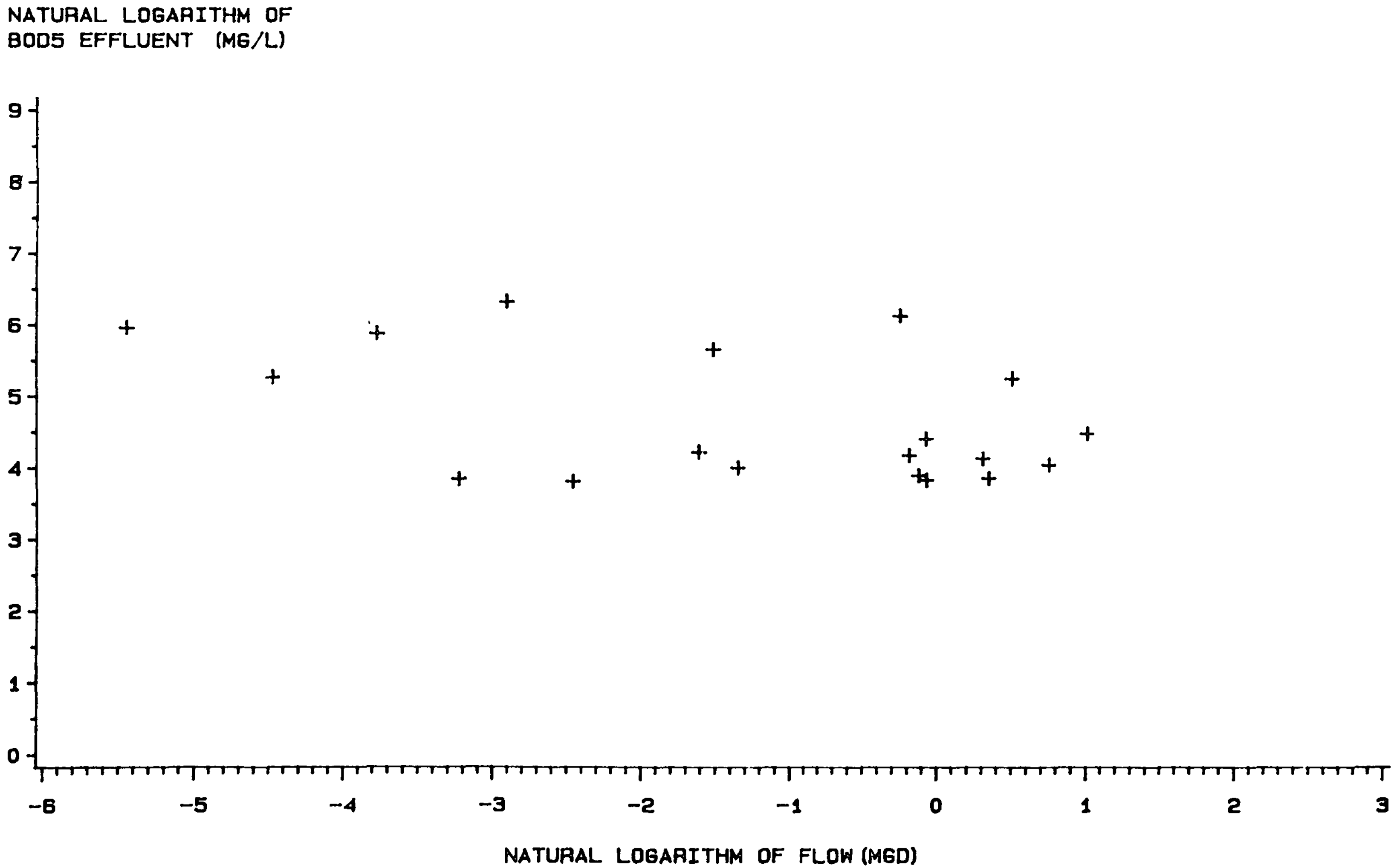
VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > |T|	VARIABLE LABEL
INTERCEP	1	2.70429551	0.19768358	13.680	0.0001	INTERCEPT
X1	1	-0.23137851	0.27529166	-0.840	0.4073	T1: Thermoplastics Deviation
X2	1	1.64432008	0.64816186	2.537	0.0166	T2: Thermosets Deviation
X5	1	-0.73451794	0.34202949	-2.148	0.0400	T4: Other Fibers Deviation
X7	1	-0.02254183	0.34604099	-0.065	0.9485	T5: Commodity Organics Deviation
X8	1	-0.38232423	0.38321655	-0.998	0.3264	T6: Bulk Organics Deviation
LNFLOW	1	0.02885183	0.07744000	0.373	0.7121	F: Ln[Flow(MGD)]

FIGURE 6

PLOT OF NATURAL LOGARITHM OF BOD5 EFFLUENT VERSUS NATURAL LOGARITHM OF FLOW

PLANTS WITH BIOLOGICAL PLUS TERTIARY TREATMENT

NOT MEETING 95% BOD5 REMOVAL OR BOD5 EFFLUENT <= 40 MG/L



TEST FOR SIGNIFICANCE OF NATURAL LOGARITHM OF FLOW
PLANTS WITH BIOLOGICAL PLUS TERTIARY TREATMENT NOT MEETING
95% BOD5 REMOVAL OR BOD5 EFFLUENT <= 40 MG/L

DEP VARIABLE: LNBODEFF Ln(BOD5 Effluent)

ANALYSIS OF VARIANCE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	5	4.24595926	0.84919185	1.055	0.4278
ERROR	13	10.46414322	0.80493409		
C TOTAL	18	14.71010248			

ROOT MSE	0.8971812	R-SQUARE	0.2886
DEP MEAN	4.691448	ADJ R-SQ	0.0150
C.V.	19.12376		

PARAMETER ESTIMATES

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > |T|	VARIABLE LABEL
INTERCEP	1	-1.28922983	6.68971947	-0.193	0.8502	INTERCEPT
X1	1	5.87710801	6.71373016	0.875	0.3972	T1: Thermoplastics Deviation
X2	1	-23.13904413	26.98010482	-0.858	0.4066	T2: Thermosets Deviation
X7	1	5.50741483	6.69871464	0.822	0.4258	T5: Commodity Organics Deviation
X8	1	5.76784669	6.89484919	0.837	0.4180	T6: Bulk Organics Deviation
LNFLOW	1	-0.18492094	0.11755003	-1.573	0.1397	F: Ln[Flow(MGD)]

EXHIBIT 4 - SIGNIFICANCE OF PRODUCTION

$$\ln(BOD_i) = a + \sum_{j=1}^{7} w_{ij} \cdot T_j + G \cdot [\ln(prod_i)] + e_i$$

where:

$\ln(BOD_i)$ = natural logarithm (ln) of the 1980 annual arithmetic average BOD_5 effluent in mg/l, which has been adjusted for dilution with uncontaminated miscellaneous wastewaters (as described in Section VII) for plant i

$\ln(prod_i)$= ln(OCPSF 1980 total production) from plant i, in millions of pounds per year, with associated coefficient G

w_{ij} = proportion of OCPSF 1980 production from plant i from subcategory j

The seven subcategories, represented by the subscript j, are as follows:

j=1: Thermoplastics

j=2: Thermosets

j=3: Rayon

j=4: Other Fibers

j=5: Commodity Organics

j=6: Bulk Organics

j=7: Specialty Organics.

The model was examined separately for the following four subsets of the data base:

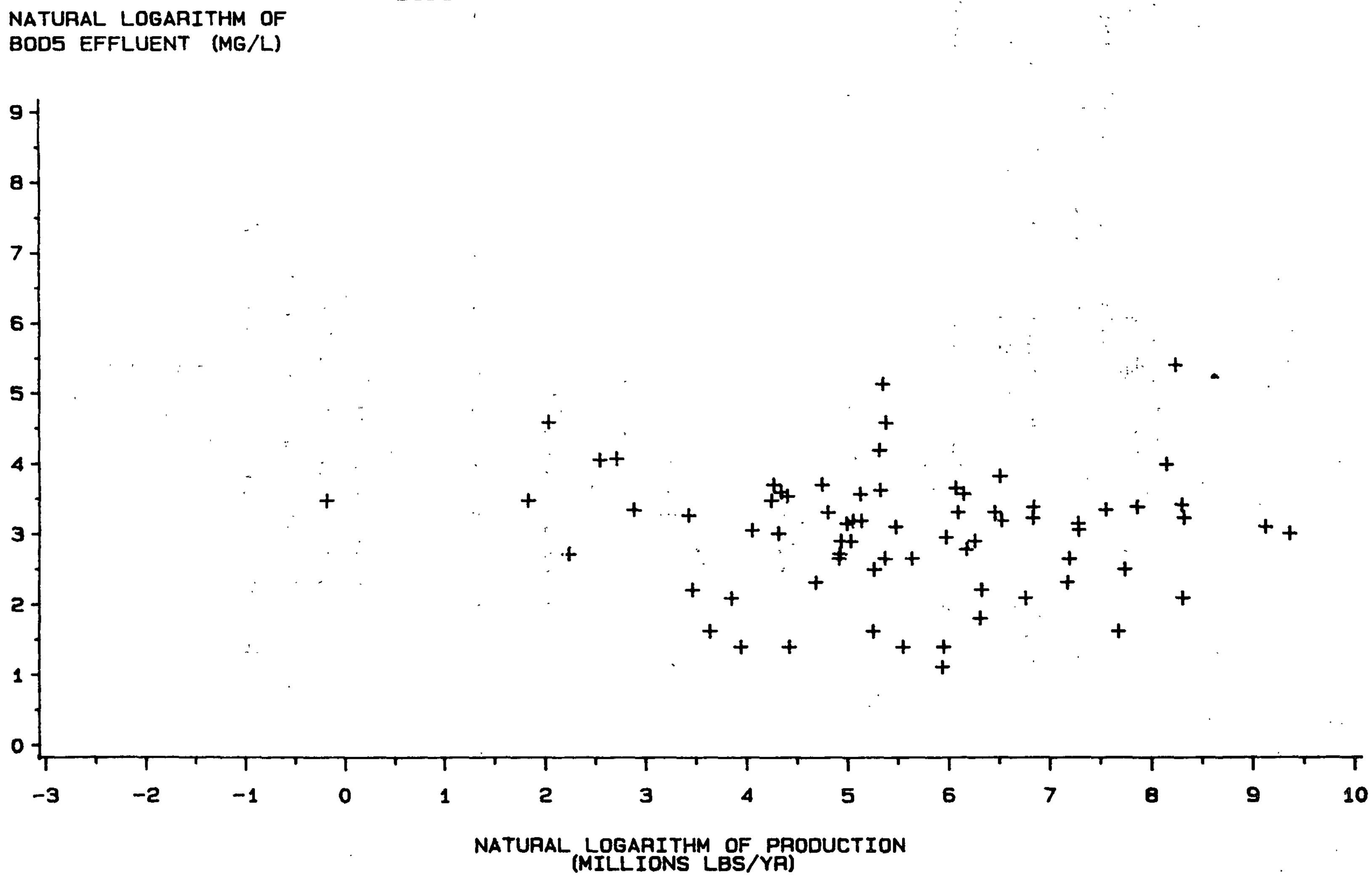
(1) Biological only and 95/40

(2) Biological only and not 95/40

(3) Not biological only and 95/40

(4) Not biological only and not 95/40

FIGURE 7
PLOT OF NATURAL LOGARITHM OF BOD5 EFFLUENT VERSUS NATURAL LOGARITHM OF PRODUCTION
PLANTS WITH BIOLOGICAL ONLY TREATMENT WITH >= 95%
BOD5 REMOVAL OR BOD5 EFFLUENT <= 40 MG/L



TEST FOR SIGNIFICANCE OF NATURAL LOGARITHM OF PRODUCTION
PLANTS WITH BIOLOGICAL ONLY TREATMENT WITH >= 95%
BOD5 REMOVAL OR BOD5 EFFLUENT <= 40 MG/L

DEP VARIABLE: LNBODEFF Ln(BOD5 Effluent)

ANALYSIS OF VARIANCE

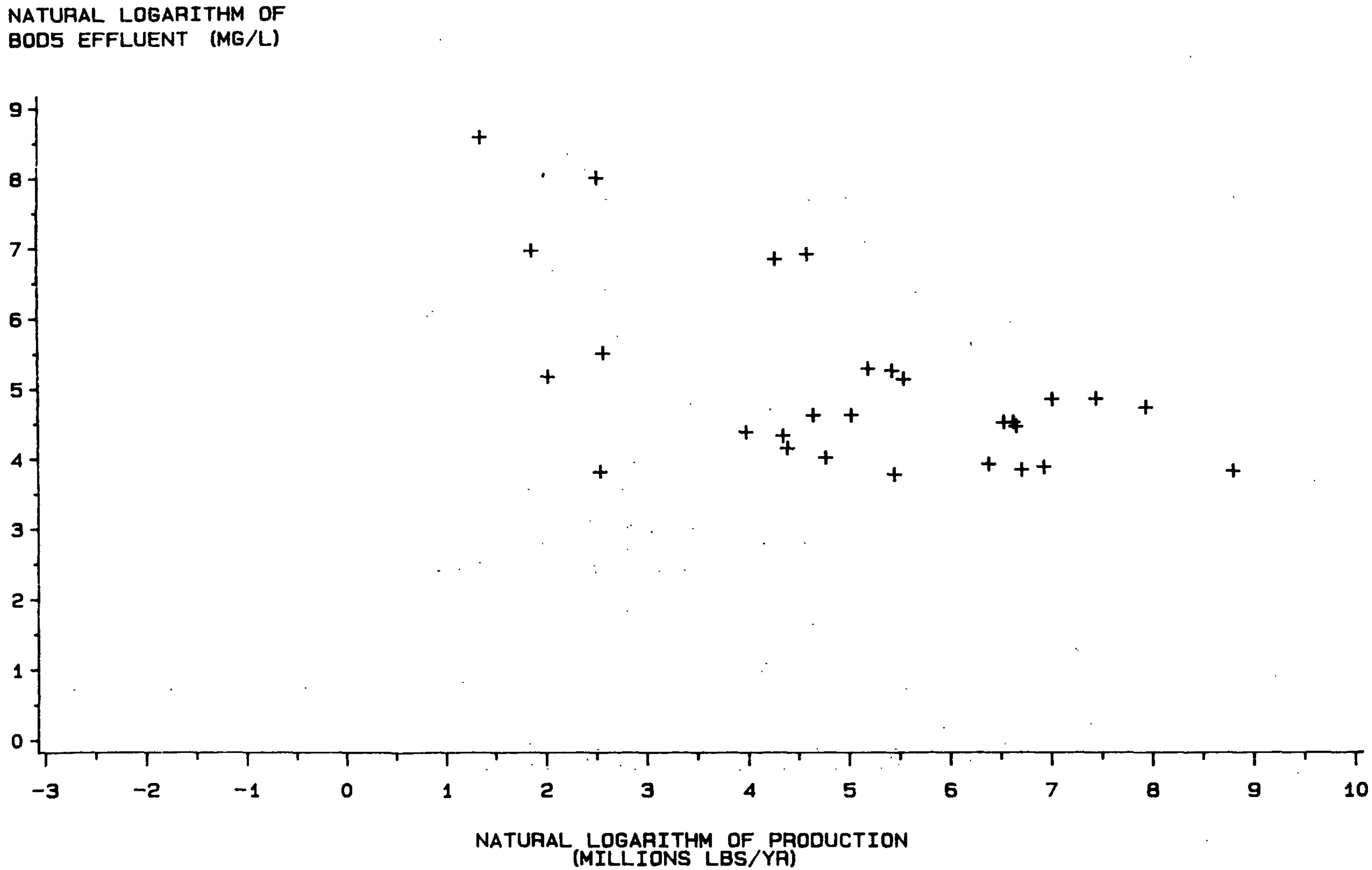
SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	7	7.32787819	1.04683974	1.461	0.1968
ERROR	63	45.13686790	0.71645822		
C TOTAL	70	52.46474609			

ROOT MSE	0.8464386	R-SQUARE	0.1397
DEP MEAN	3.002938	ADJ R-SQ	0.0441
C.V.	28.18701		

PARAMETER ESTIMATES

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > |T|	VARIABLE LABEL
INTERCEP	1	3.34195795	0.48428890	6.901	0.0001	INTERCEPT
X1	1	-0.46102373	0.23042651	-2.001	0.0497	T1: Thermoplastics Deviation
X2	1	0.07105838	0.46961932	0.151	0.8802	T2: Thermosets Deviation
X3	1	-0.22379068	0.52627211	-0.425	0.6721	T3: Rayon Deviation
X5	1	-0.33686822	0.33777848	-0.997	0.3224	T4: Other Fibers Deviation
X7	1	0.29149527	0.41663012	0.700	0.4867	T5: Commodity Organics Deviation
X8	1	0.37019409	0.35604086	1.040	0.3024	T6: Bulk Organics Deviation
LNPROD	1	-0.06073777	0.08841284	-0.687	0.4946	6: Ln[Production (millions lbs./yr.)]

FIGURE 8
PLOT OF NATURAL LOGARITHM OF BOD5 EFFLUENT VERSUS NATURAL LOGARITHM OF PRODUCTION
PLANTS WITH BIOLOGICAL ONLY TREATMENT AND NOT MEETING
95% BOD5 REMOVAL OR BOD5 EFFLUENT <= 40 MG/L



TEST FOR SIGNIFICANCE OF NATURAL LOGARITHM OF PRODUCTION
PLANTS WITH BIOLOGICAL ONLY TREATMENT NOT MEETING
95% BOD5 REMOVAL OR BOD5 EFFLUENT <= 40 MG/L

DEP VARIABLE: LNBODEFF Ln(BOD5 Effluent)

ANALYSIS OF VARIANCE

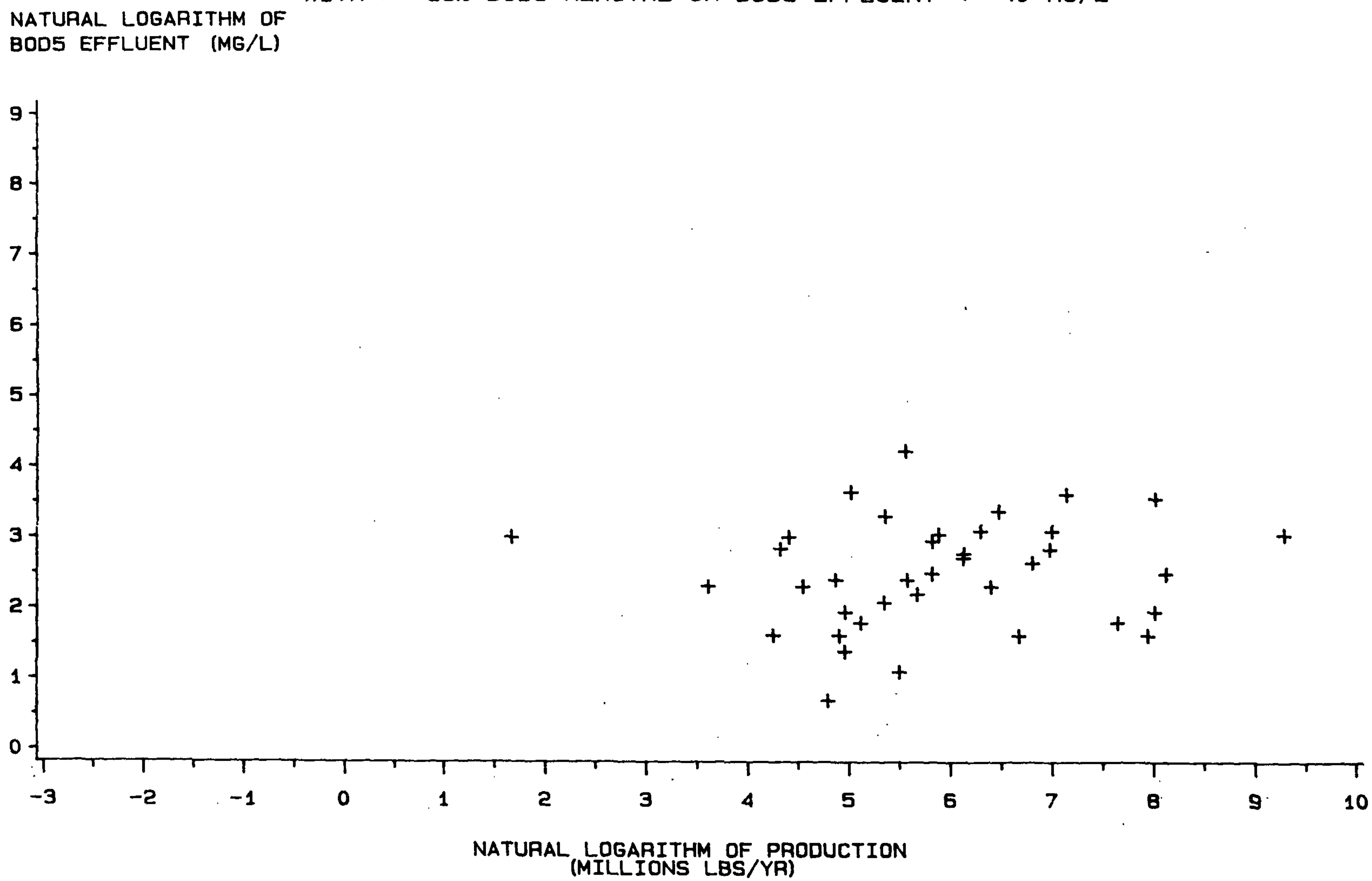
SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	6	25.00212464	4.16702077	4.406	0.0049
ERROR	21	19.86067391	0.94574638		
C TOTAL	27	44.86279855			

ROOT MSE	0.9724949	R-SQUARE	0.5573
DEP MEAN	5.016867	ADJ R-SQ	0.4308
C.V.	19.38451		

PARAMETER ESTIMATES

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > |T|	VARIABLE LABEL
INTERCEP	1	8.46545855	0.83370537	10.154	0.0001	INTERCEPT
X1	1	-0.01619212	0.54260067	-0.030	0.9765	T1: Thermoplastics Deviation
X2	1	0.88678756	0.91074620	0.974	0.3413	T2: Thermosets Deviation
X5	1	-1.62977938	1.17593400	-1.386	0.1803	T4: Other Fibers Deviation
X7	1	1.55445022	0.72721926	2.138	0.0445	T5: Commodity Organics Deviation
X8	1	0.46471597	0.56734719	0.819	0.4219	T6: Bulk Organics Deviation
LNPROD	1	-0.72219739	0.16415482	-4.399	0.0002	G: Ln[Production (millions lbs./yr.)]

FIGURE 9
PLOT OF NATURAL LOGARITHM OF BOD5 EFFLUENT VERSUS NATURAL LOGARITHM OF PRODUCTION
PLANTS WITH BIOLOGICAL PLUS TERTIARY TREATMENT
WITH >= 95% BOD5 REMOVAL OR BOD5 EFFLUENT <= 40 MG/L



TEST FOR SIGNIFICANCE OF NATURAL LOGARITHM OF PRODUCTION
PLANTS WITH BIOLOGICAL PLUS TERTIARY TREATMENT WITH
>= 95% BOD5 REMOVAL OR BOD5 EFFLUENT <= 40 MG/L

DEP VARIABLE: LNBODEFF Ln(BOD5 Effluent)

ANALYSIS OF VARIANCE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	6	4.76300937	0.79383489	1.429	0.2354
ERROR	31	17.22424778	0.55562090		
C TOTAL	37	21.98725715			

ROOT MSE	0.7453998	R-SQUARE	0.2166
DEP MEAN	2.492653	ADJ R-SQ	0.0650
C.V.	29.90387		

PARAMETER ESTIMATES

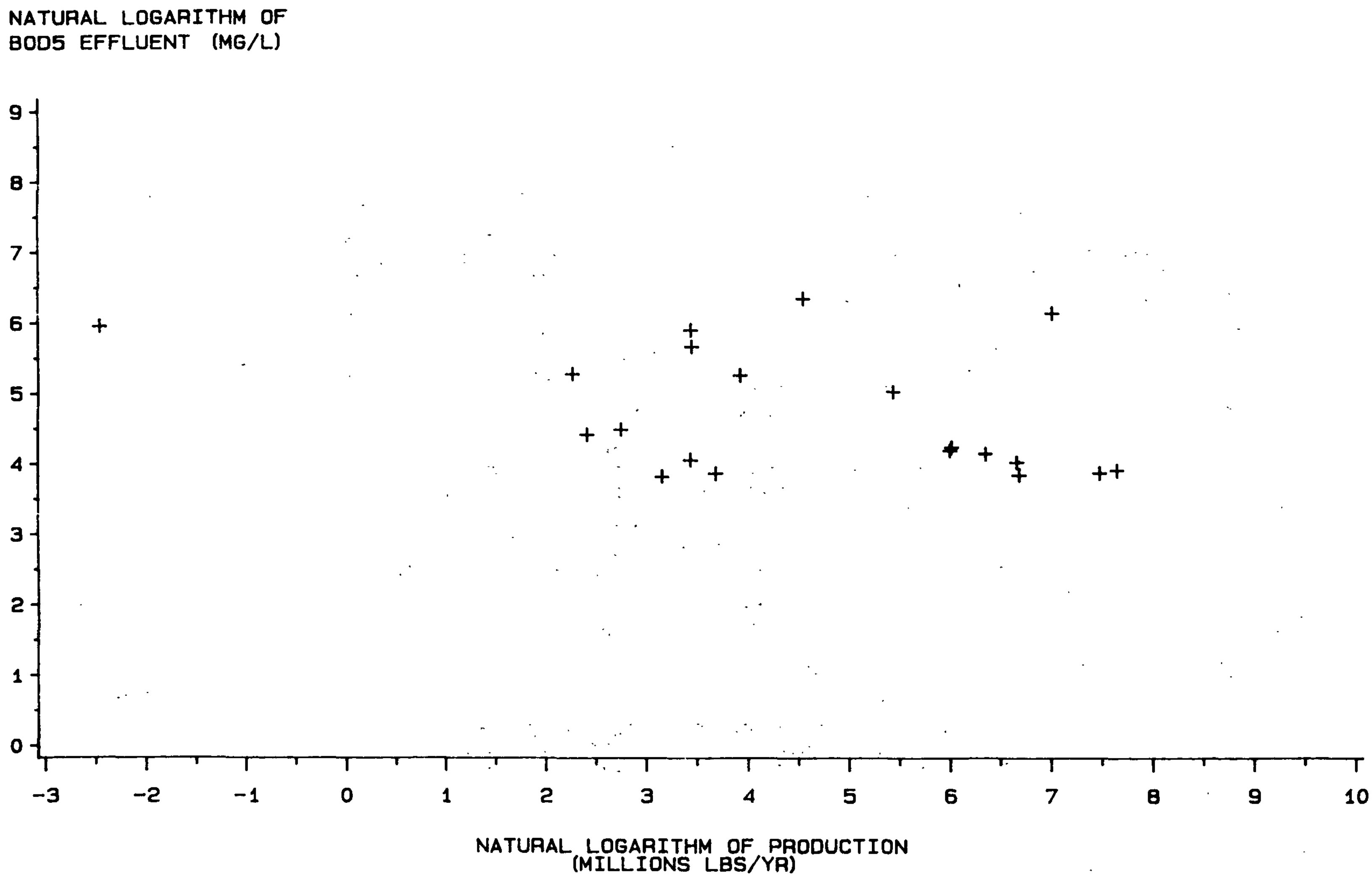
VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > |T|	VARIABLE LABEL
INTERCEP	1	2.34230310	0.86093570	2.721	0.0106	INTERCEPT
X1	1	-0.09180545	0.27408724	-0.335	0.7399	T1: Thermoplastics Deviation
X2	1	1.54530398	0.62978540	2.454	0.0200	T2: Thermosets Deviation
X5	1	-0.71750036	0.34175760	-2.099	0.0440	T4: Other Fibers Deviation
X7	1	-0.16849940	0.52271885	-0.322	0.7494	T5: Commodity Organics Deviation
X8	1	-0.34139324	0.38710469	-0.882	0.3846	T6: Bulk Organics Deviation
LNPROD	1	0.05758375	0.14839957	0.388	0.7006	6: Ln[Production (millions lbs./yr.)]

FIGURE 10

PLOT OF NATURAL LOGARITHM OF BOD5 EFFLUENT VERSUS NATURAL LOGARITHM OF PRODUCTION

PLANTS WITH BIOLOGICAL PLUS TERTIARY TREATMENT

NOT MEETING 95% BOD5 REMOVAL OR BOD5 EFFLUENT <= 40 MG/L



TEST FOR SIGNIFICANCE OF NATURAL LOGARITHM OF PRODUCTION
PLANTS WITH BIOLOGICAL PLUS TERTIARY TREATMENT NOT MEETING
95% BOD5 REMOVAL OR BOD5 EFFLUENT <= 40 MG/L

DEP VARIABLE: LNBODEFF Ln(BOD5 Effluent)

ANALYSIS OF VARIANCE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	5	3.35324294	0.67064859	0.820	0.5556
ERROR	14	11.45364578	0.81811756		
C TOTAL	19	14.80688872			

ROOT MSE	0.9044985	R-SQUARE	0.2265
DEP MEAN	4.707408	ADJ R-SQ	-0.0498
C.V.	19.21436		

PARAMETER ESTIMATES

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > |T|	VARIABLE LABEL
INTERCEP	1	-0.44480084	6.86201534	-0.065	0.9492	INTERCEPT
X1	1	6.27639744	6.75398710	0.929	0.3685	T1: Thermoplastics Deviation
X2	1	-24.25737613	27.16089698	-0.893	0.3869	T2: Thermosets Deviation
X7	1	6.06934582	6.71383449	0.904	0.3813	T5: Commodity Organics Deviation
X8	1	6.14290402	6.92902326	0.887	0.3903	T6: Bulk Organics Deviation
LNPROD	1	-0.18075998	0.14540804	-1.243	0.2342	G: Ln[Production (millions lbs./yr.)]

EXHIBIT 5 - SIGNIFICANCE OF FLOW NORMALIZED BY PRODUCTION

$$\ln(BOD_i) = a + \sum_{j=1}^{7} w_{ij} \cdot T_j + H \cdot [\ln(365*flow_i/prod_i)] + e_i$$

where:

$\ln(BOD_i)$ = natural logarithm (ln) of the 1980 annual arithmetic average BOD_5 effluent in mg/l, which has been adjusted for dilution with uncontaminated miscellaneous wastewaters (as described in Section VII) for plant i

$365*flow_i/prod_i$ = Annual total flow (MGY), corrected for nonprocess waste streams, for plant i, divided by OCPSF 1980 production (in millions of pounds per year) for plant i, with associated coefficient H

w_{ij} = proportion of OCPSF 1980 production from plant i from subcategory j

The seven subcategories, represented by the subscript j, are as follows:

j=1: Thermoplastics
j=2: Thermosets
j=3: Rayon
j=4: Other Fibers
j=5: Commodity Organics
j=6: Bulk Organics
j=7: Specialty Organics.

The model was examined separately for the following four subsets of the data base:

(1) Biological only and 95/40
(2) Biological only and not 95/40
(3) Not biological only and 95/40
(4) Not biological only and not 95/40

TEST FOR SIGNIFICANCE OF NATURAL LOGARITHM OF (365*FLOW/PRODUCTION)
PLANTS WITH BIOLOGICAL ONLY TREATMENT WITH >= 95%
BOD5 REMOVAL OR BOD5 EFFLUENT <= 40 MG/L

DEP VARIABLE: LNBODEFF Ln(BOD5 Effluent)

ANALYSIS OF VARIANCE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	7	6.14722298	0.87817471	1.247	0.2912
ERROR	62	43.66665005	0.70430081		
C TOTAL	69	49.81387303			

ROOT MSE	0.8392263	R-SQUARE	0.1234
DEP MEAN	3.026033	ADJ R-SQ	0.0244
C.V.	27.73355		

PARAMETER ESTIMATES

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > |T|	VARIABLE LABEL
INTERCEP	1	3.05086641	0.13867151	22.001	0.0001	INTERCEPT
X1	1	-0.38196519	0.23151394	-1.650	0.1040	T1: Thermoplastics Deviation
X2	1	0.19476567	0.43069904	0.452	0.6527	T2: Thermosets Deviation
X3	1	-0.08873423	0.56804519	-0.156	0.8764	T3: Rayon Deviation
X5	1	-0.37323100	0.33471779	-1.115	0.2691	T4: Other Fibers Deviation
X7	1	-0.04905026	0.35558781	-0.138	0.8907	T5: Commodity Organics Deviation
X8	1	0.26790416	0.35455304	0.756	0.4527	T6: Bulk Organics Deviation
LNFLPROD	1	-0.05254497	0.08100934	-0.649	0.5190	H: Ln[365*Flow/Production (Gal./lb.)]

TEST FOR SIGNIFICANCE OF NATURAL LOGARITHM OF (365*FLOW/PRODUCTION)
PLANTS WITH BIOLOGICAL ONLY TREATMENT NOT MEETING
95% BOD5 REMOVAL OR BOD5 EFFLUENT <= 40 MG/L

DEP VARIABLE: LNBODEFF Ln(BOD5 Effluent)

ANALYSIS OF VARIANCE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	6	13.56836775	2.26139462	1.448	0.2462
ERROR	20	31.24198672	1.56209934		
C TOTAL	26	44.81035447			

ROOT MSE	1.24984	R-SQUARE	0.3028
DEP MEAN	5.008538	ADJ R-SQ	0.0936
C.V.	24.95418		

PARAMETER ESTIMATES

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > |T|	VARIABLE LABEL
INTERCEP	1	4.73111987	0.40653414	11.638	0.0001	INTERCEPT
X1	1	-0.40156260	0.68406754	-0.587	0.5638	T1: Thermoplastics Deviation
X2	1	1.60881924	1.16657845	1.379	0.1831	T2: Thermosets Deviation
X5	1	-1.31216492	1.50743640	-0.870	0.3944	T4: Other Fibers Deviation
X7	1	-1.10339104	0.76578019	-1.441	0.1651	T5: Commodity Organics Deviation
X8	1	-0.09397531	0.77815216	-0.121	0.9051	T6: Bulk Organics Deviation
LNFLPROD	1	-0.32881103	0.16446326	-1.999	0.0593	H: Ln[365*Flow/Production (Gal./lb.)]

TEST FOR SIGNIFICANCE OF NATURAL LOGARITHM OF (365*FLOW/PRODUCTION)
PLANTS WITH BIOLOGICAL PLUS TERTIARY TREATMENT WITH
>= 95% BOD5 REMOVAL OR BOD5 EFFLUENT <= 40 MG/L

DEP VARIABLE: LNBODEFF Ln(BOD5 Effluent)

ANALYSIS OF VARIANCE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	6	4.62847666	0.77141278	1.445	0.2306
ERROR	30	16.01247987	0.53374933		
C TOTAL	36	20.64095653			

ROOT MSE	0.7305815	R-SQUARE	0.2242
DEP MEAN	2.461709	ADJ R-SQ	0.0691
C.V.	29.67782		

PARAMETER ESTIMATES

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > |T|	VARIABLE LABEL
INTERCEP	1	2.67494890	0.20098260	13.309	0.0001	INTERCEPT
X1	1	-0.22676297	0.28154394	-0.805	0.4269	T1: Thermoplastics Deviation
X2	1	1.59805348	0.66543918	2.402	0.0227	T2: Thermosets Deviation
X5	1	-0.71872894	0.34953856	-2.056	0.0486	T4: Other Fibers Deviation
X7	1	0.04090520	0.32655932	0.125	0.9012	T5: Commodity Organics Deviation
X8	1	-0.36620338	0.40526037	-0.904	0.3734	T6: Bulk Organics Deviation
LNFLPROD	1	0.01081085	0.09318321	0.116	0.9084	H: Ln[365*Flow/Production (Gal./lb.)]

TEST FOR SIGNIFICANCE OF NATURAL LOGARITHM OF (365*FLOW/PRODUCTION)
PLANTS WITH BIOLOGICAL PLUS TERTIARY TREATMENT NOT MEETING
95% BOD5 REMOVAL OR BOD5 EFFLUENT <= 40 MG/L

DEP VARIABLE: LNBODEFF Ln(BOD5 Effluent)

ANALYSIS OF VARIANCE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	5	2.73315539	0.54663108	0.593	0.7057
ERROR	13	11.97694709	0.92130362		
C TOTAL	18	14.71010248			
ROOT MSE		0.9598456	R-SQUARE	0.1858	
DEP MEAN		4.691448	ADJ R-SQ	-0.1274	
C.V.		20.45947			

PARAMETER ESTIMATES

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > |T|	VARIABLE LABEL
INTERCEP	1	-1.93240875	7.14423996	-0.270	0.7910	INTERCEPT
X1	1	6.77638013	7.15206256	0.947	0.3607	T1: Thermoplastics Deviation
X2	1	-26.62021651	28.76609580	-0.925	0.3716	T2: Thermosets Deviation
X7	1	6.03152456	7.15491152	0.843	0.4145	T5: Commodity Organics Deviation
X8	1	6.52042804	7.35634219	0.886	0.3915	T6: Bulk Organics Deviation
LNFLPROD	1	-0.11330832	0.15711270	-0.721	0.4836	H: Ln[365*Flow/Production (Gal./lb.)]

EXHIBIT 6 - SIGNIFICANCE OF DEGREE DAYS

$$\ln(BOD_i) = a + \sum_{j=1}^{7} w_{ij} \cdot T_j + J \cdot (\text{degree days}_i) + e_i$$

where:

$\ln(BOD_i)$ = natural logarithm (ln) of the 1980 annual arithmetic average BOD_5 effluent in mg/l, which has been adjusted for dilution with uncontaminated miscellaneous wastewaters (as described in Section VII) for plant i.

degree days_i = the number of degrees that the mean daily outdoor temperature is below 65°F for a given day, accumulated over the number of days in the year that the mean temperature is below 65°F at plant i (with associated coefficient J)

w_{ij} = proportion of OCPSF 1980 production from plant i from subcategory j

The seven subcategories, represented by the subscript j, are as follows:

j=1: Thermoplastics

j=2: Thermosets

j=3: Rayon

j=4: Other Fibers

j=5: Commodity Organics

j=6: Bulk Organics

j=7: Specialty Organics.

The model was examined separately for the following four subsets of the data base:

(1) Biological only and 95/40

(2) Biological only and not 95/40

(3) Not biological only and 95/40

(4) Not biological only and not 95/40

TEST FOR SIGNIFICANCE OF NATURAL LOGARITHM OF HEATING
PLANTS WITH BIOLOGICAL ONLY TREATMENT WITH >= 95%
BOD5 REMOVAL OR BOD5 EFFLUENT <= 40 MG/L

DEP VARIABLE: LNBODEFF Ln(BOD5 Effluent)

ANALYSIS OF VARIANCE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	7	6.98999760	0.99857109	1.383	0.2274
ERROR	63	45.47474849	0.72182140		
C TOTAL	70	52.46474609			

ROOT MSE	0.8496007	R-SQUARE	0.1332
DEP MEAN	3.002938	ADJ R-SQ	0.0369
C.V.	28.29232		

PARAMETER ESTIMATES

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > |T|	VARIABLE LABEL
INTERCEP	1	3.01816038	0.27443687	10.998	0.0001	INTERCEPT
X1	1	-0.44301621	0.23266861	-1.904	0.0615	T1: Thermoplastics Deviation
X2	1	0.19308259	0.44049708	0.438	0.6626	T2: Thermosets Deviation
X3	1	-0.22621612	0.52857814	-0.428	0.6701	T3: Rayon Deviation
X5	1	-0.35074500	0.33851393	-1.036	0.3041	T4: Other Fibers Deviation
X7	1	0.09644572	0.33263018	0.290	0.7728	T5: Commodity Organics Deviation
X8	1	0.32476822	0.35398886	0.917	0.3624	T6: Bulk Organics Deviation
HEATING	1	.00000119845	0.000065069	0.018	0.9854	J: Heating (Degree Days)

TEST FOR SIGNIFICANCE OF NATURAL LOGARITHM OF HEATING
PLANTS WITH BIOLOGICAL ONLY TREATMENT NOT MEETING
95% BOD5 REMOVAL OR BOD5 EFFLUENT <= 40 MG/L

DEP VARIABLE: LNBODEFF Ln(BOD5 Effluent)

ANALYSIS OF VARIANCE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	6	6.83745585	1.13957597	0.629	0.7052
ERROR	21	38.02534270	1.81073060		
C TOTAL	27	44.86279855			

ROOT MSE	1.345634	R-SQUARE	0.1524
DEP MEAN	5.016867	ADJ R-SQ	-0.0898
C.V.	26.8222		

PARAMETER ESTIMATES

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > |T|	VARIABLE LABEL
INTERCEP	1	4.81733246	0.88034242	5.472	0.0001	INTERCEPT
X1	1	-0.54061606	0.73319766	-0.737	0.4691	T1: Thermoplastics Deviation
X2	1	1.27764864	1.38748242	0.921	0.3676	T2: Thermosets Deviation
X5	1	-1.00556042	1.62975924	-0.617	0.5439	T4: Other Fibers Deviation
X7	1	-0.44945681	0.92269217	-0.487	0.6312	T5: Commodity Organics Deviation
X8	1	0.31185851	0.78784101	0.396	0.6962	T6: Bulk Organics Deviation
HEATING	1	0.000055133	0.000197761	0.279	0.7831	J: Heating (Degree Days)

TEST FOR SIGNIFICANCE OF NATURAL LOGARITHM OF HEATING
PLANTS WITH BIOLOGICAL PLUS TERTIARY TREATMENT WITH
>= 95% BOD5 REMOVAL OR BOD5 EFFLUENT <= 40 MG/L

DEP VARIABLE: LNBODEFF Ln(BOD5 Effluent)

ANALYSIS OF VARIANCE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	6	4.75676488	0.79279415	1.426	0.2363
ERROR	31	17.23049227	0.55582233		
C TOTAL	37	21.98725715			

ROOT MSE	0.7455349	R-SQUARE	0.2163
DEP MEAN	2.492653	ADJ R-SQ	0.0647
C.V.	29.90929		

PARAMETER ESTIMATES

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > |T|	VARIABLE LABEL
INTERCEP	1	2.76610508	0.30405592	9.097	0.0001	INTERCEPT
X1	1	-0.09167350	0.27451913	-0.334	0.7407	T1: Thermoplastics Deviation
X2	1	1.57425802	0.63333553	2.486	0.0185	T2: Thermosets Deviation
X5	1	-0.74462410	0.34551368	-2.155	0.0390	T4: Other Fibers Deviation
X7	1	-0.03399448	0.32806048	-0.104	0.9181	T5: Commodity Organics Deviation
X8	1	-0.36426122	0.38024083	-0.958	0.3455	T6: Bulk Organics Deviation
HEATING	1	-0.000025590	0.000068570	-0.373	0.7115	J: Heating (Degree Days)

TEST FOR SIGNIFICANCE OF NATURAL LOGARITHM OF HEATING
PLANTS WITH BIOLOGICAL PLUS TERTIARY TREATMENT NOT MEETING
95% BOD5 REMOVAL OR BOD5 EFFLUENT <= 40 MG/L

DEP VARIABLE: LNBODEFF Ln(BOD5 Effluent)

ANALYSIS OF VARIANCE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	5	2.61216928	0.52243386	0.600	0.7011
ERROR	14	12.19471944	0.87105139		
C TOTAL	19	14.80688872			

ROOT MSE	0.9333013	R-SQUARE	0.1764
DEP MEAN	4.707408	ADJ R-SQ	-0.1177
C.V.	19.82623		

PARAMETER ESTIMATES

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > |T|	VARIABLE LABEL
INTERCEP	1	0.12748563	7.57112738	0.017	0.9868	INTERCEPT
X1	1	5.29184047	7.35197014	0.720	0.4835	T1: Thermoplastics Deviation
X2	1	-20.19276763	29.65460234	-0.681	0.5070	T2: Thermosets Deviation
X7	1	4.46770741	7.44379277	0.600	0.5580	T5: Commodity Organics Deviation
X8	1	5.00594252	7.55301268	0.663	0.5182	T6: Bulk Organics Deviation
HEATING	1	-0.000129705	0.000167356	-0.775	0.4512	J: Heating (Degree Days)

EXHIBIT 7 - SIGNIFICANCE OF AGE

$$\ln(BOD_i) = a + \sum_{j=1}^{7} w_{ij} \cdot T_j + K \cdot (age_i) + e_i$$

where:

$\ln(BOD_i)$ = natural logarithm (ln) of the 1980 annual arithmetic average BOD_5 effluent in mg/l, which has been adjusted for dilution with uncontaminated miscellaneous wastewaters (as described in Section VII) for plant i.

age_i = the age of the oldest process at plant i (with associated coefficient K)

w_{ij} = proportion of OCPSF 1980 production from plant i from subcategory j

The seven subcategories, represented by the subscript j, are as follows:

j=1: Thermoplastics
j=2: Thermosets
j=3: Rayon
j=4: Other Fibers
j=5: Commodity Organics
j=6: Bulk Organics
j=7: Specialty Organics.

The model was examined separately for the following four subsets of the data base:

(1) Biological only and 95/40
(2) Biological only and not 95/40
(3) Not biological only and 95/40
(4) Not biological only and not 95/40

TEST FOR SIGNIFICANCE OF NATURAL LOGARITHM OF AGE
PLANTS WITH BIOLOGICAL ONLY TREATMENT WITH >= 95%
BOD5 REMOVAL OR BOD5 EFFLUENT <= 40 MG/L

DEP VARIABLE: LNBODEFF Ln(BOD5 Effluent)

ANALYSIS OF VARIANCE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	7	7.59586289	1.08512327	1.524	0.1750
ERROR	63	44.86888320	0.71220450		
C TOTAL	70	52.46474609			

ROOT MSE	0.8439221	R-SQUARE	0.1448
DEP MEAN	3.002938	ADJ R-SQ	0.0498
C.V.	28.10321		

PARAMETER ESTIMATES

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > |T|	VARIABLE LABEL
INTERCEP	1	3.25505128	0.28595747	11.383	0.0001	INTERCEPT
X1	1	-0.47989369	0.23173926	-2.071	0.0425	T1: Thermoplastics Deviation
X2	1	0.25355673	0.43746647	0.580	0.5642	T2: Thermosets Deviation
X3	1	-0.19889892	0.52551235	-0.378	0.7063	T3: Rayon Deviation
X5	1	-0.32906639	0.33699022	-0.976	0.3326	T4: Other Fibers Deviation
X7	1	0.09818071	0.30055238	0.327	0.7450	T5: Commodity Organics Deviation
X8	1	0.27673597	0.35230019	0.786	0.4351	T6: Bulk Organics Deviation
AGE	1	-0.006750249	0.007317224	-0.923	0.3598	K: Age of Oldest Process (years)

TEST FOR SIGNIFICANCE OF NATURAL LOGARITHM OF AGE
PLANTS WITH BIOLOGICAL ONLY TREATMENT NOT MEETING
95% BOD5 REMOVAL OR BOD5 EFFLUENT <= 40 MG/L

DEP VARIABLE: LNBODEFF Ln(BOD5 Effluent)

ANALYSIS OF VARIANCE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	6	14.06990546	2.34498424	1.599	0.1967
ERROR	21	30.79289309	1.46632824		
C TOTAL	27	44.86279855			

ROOT MSE	1.21092	R-SQUARE	0.3136
DEP MEAN	5.016867	ADJ R-SQ	0.1175
C.V.	24.13699		

PARAMETER ESTIMATES

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > |T|	VARIABLE LABEL
INTERCEP	1	6.30329522	0.67445522	9.346	0.0001	INTERCEPT
X1	1	-0.41622968	0.66110237	-0.630	0.5357	T1: Thermoplastics Deviation
X2	1	1.07940679	1.13479119	0.951	0.3523	T2: Thermosets Deviation
X5	1	-2.07531234	1.52396712	-1.362	0.1877	T4: Other Fibers Deviation
X7	1	-1.01868945	0.69430555	-1.467	0.1571	T5: Commodity Organics Deviation
X8	1	1.70148886	0.93261474	1.824	0.0823	T6: Bulk Organics Deviation
AGE	1	-0.04764443	0.02124713	-2.242	0.0359	K: Age of Oldest Process (years)

TEST FOR SIGNIFICANCE OF NATURAL LOGARITHM OF AGE
PLANTS WITH BIOLOGICAL PLUS TERTIARY TREATMENT WITH
>= 95% BOD5 REMOVAL OR BOD5 EFFLUENT <= 40 MG/L

DEP VARIABLE: LNBODEFF Ln(BOD5 Effluent)

ANALYSIS OF VARIANCE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	6	4.77347880	0.79557980	1.433	0.2340
ERROR	31	17.21377835	0.55528317		
C TOTAL	37	21.98725715			

ROOT MSE	0.7451732	R-SQUARE	0.2171
DEP MEAN	2.492653	ADJ R-SQ	0.0656
C.V.	29.89478		

PARAMETER ESTIMATES

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > |T|	VARIABLE LABEL
INTERCEP	1	2.59309825	0.24849495	10.435	0.0001	INTERCEPT
X1	1	-0.09456543	0.27256678	-0.347	0.7310	T1: Thermoplastics Deviation
X2	1	1.57093688	0.63168425	2.487	0.0185	T2: Thermosets Deviation
X5	1	-0.72594996	0.34117745	-2.128	0.0414	T4: Other Fibers Deviation
X7	1	-0.003608846	0.32082296	-0.011	0.9911	T5: Commodity Organics Deviation
X8	1	-0.38212798	0.38076584	-1.004	0.3234	T6: Bulk Organics Deviation
AGE	1	0.002776871	0.006744540	0.412	0.6834	K: Age of Oldest Process (years)

TEST FOR SIGNIFICANCE OF NATURAL LOGARITHM OF AGE
PLANTS WITH BIOLOGICAL PLUS TERTIARY TREATMENT NOT MEETING
95% BOD5 REMOVAL OR BOD5 EFFLUENT <= 40 MG/L

DEP VARIABLE: LNBODEFF Ln(BOD5 Effluent)

ANALYSIS OF VARIANCE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	5	3.80300864	0.76060173	0.968	0.4701
ERROR	14	11.00388008	0.78599143		
C TOTAL	19	14.80688872			

ROOT MSE	0.8865616	R-SQUARE	0.2568
DEP MEAN	4.707408	ADJ R-SQ	-0.0086
C.V.	18.83333		

PARAMETER ESTIMATES

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > |T|	VARIABLE LABEL
INTERCEP	1	-3.41890129	6.62003392	-0.516	0.6136	INTERCEPT
X1	1	9.08977702	6.70275495	1.356	0.1965	T1: Thermoplastics Deviation
X2	1	-34.83939669	26.83984986	-1.298	0.2152	T2: Thermosets Deviation
X7	1	8.09862489	6.64430164	1.219	0.2430	T5: Commodity Organics Deviation
X8	1	8.85532547	6.88049398	1.287	0.2190	T6: Bulk Organics Deviation
AGE	1	-0.01577138	0.01067991	-1.477	0.1619	K: Age of Oldest Process (years)

EXHIBIT 8 - BPT REGRESSION MODEL DATA LISTINGS

BOD_5 EFFLUENT, BOD_5 INFLUENT, PERCENT REMOVAL, AND PRODUCTION PROPORTIONS BY PLANT

TREATMENT TYPE, PERFORMANCE, FLOW, PRODUCTION, DEGREE DAYS AND AGE BY PLANT

BOD_5 AND TSS BY PLANTS FOR PLANTS SATISFYING THE 95/40 BOD_5 PERFORMANCE AND THE TSS $\leq$ 100 mg/l CRITERIA

DATA FOR REGRESSIONS INVOLVING NATURAL LOGARITHM OF BOD5 EFFLUENT -- FULL RESPONSE, DIRECT DISCHARGERS PRODUCTION AND BOD5 EFFLUENT INFORMATION

OBS	PLANT	BOD5 EFFLUENT (MG/L)	BOD5 INFLUENT (MG/L)	BOD5 PERCENT REMOVAL	PROPORTION PRODUCTION THERMOPLASTICS	PROPORTION PRODUCTION THERMOSETS	PROPORTION PRODUCTION RAYON
1	1	91	1237	0.93	0.66542	0.000000	0.00000
2	61	2940	.	.	0.00000	0.000000	0.00000
3	63	6	175	0.97	0.33676	0.000000	0.21156
4	83	38	1516	0.97	0.51972	0.000000	0.00000
5	102	7	1908	1.00	0.00000	0.092319	0.00000
6	154	11	505	0.98	1.00000	0.000000	0.00000
7	177	126	2046	0.94	0.02867	0.000000	0.00000
8	227	88	391	0.77	0.00000	0.000000	0.00000
9	250	127	1212	0.90	0.22951	0.000000	0.00000
10	254	4	1681	1.00	0.00000	0.000000	0.00000
11	267	14	.	.	0.53869	0.015722	0.00000
12	269	168	.	.	0.00000	0.000000	0.00000
13	284	21	104	0.80	0.96922	0.000000	0.00000
14	296	216	4695	0.95	0.00000	0.000000	0.00000
15	352	45	524	0.91	0.01625	0.014475	0.00000
16	384	7	.	.	0.18947	0.000000	0.00000
17	387	14	175	0.92	0.00000	0.000000	1.00000
18	392	34	.	.	0.00000	0.993880	0.00000
19	394	9	2169	1.00	0.95025	0.000000	0.00000
20	399	24	163	0.85	0.00000	0.000000	0.97477
21	415	45	413	0.89	0.09424	0.000000	0.00000
22	443	20	718	0.97	0.00000	0.000000	0.00000

OBS	PLANT	PROPORTION PRODUCTION OTHER FIBERS	PROPORTION PRODUCTION COMMODITY ORGANICS	PROPORTION PRODUCTION BULK ORGANICS	PROPORTION PRODUCTION SPECIALTY ORGANICS
1	1	0.00000	0.334577	0.00000	0.00000
2	61	0.00000	0.000000	0.96965	0.03035
3	63	0.20165	0.064014	0.18602	0.00000
4	83	0.48028	0.000000	0.00000	0.00000
5	102	0.00000	0.000000	0.62509	0.28259
6	154	0.00000	0.000000	0.00000	0.00000
7	177	0.00000	0.520367	0.45097	0.00000
8	227	0.00000	0.000000	0.00000	1.00000
9	250	0.00000	0.767509	0.00298	0.00000
10	254	1.00000	0.000000	0.00000	0.00000
11	267	0.00000	0.263023	0.00550	0.17706
12	269	0.00000	0.000000	1.00000	0.00000
13	284	0.00000	0.000000	0.02042	0.01036
14	296	0.00000	0.046831	0.11464	0.03853
15	352	0.00000	0.000000	0.56554	0.40373
16	384	0.00000	0.794883	0.01564	0.00000
17	387	0.00000	0.000000	0.00000	0.00000
18	392	0.00000	0.000000	0.00000	0.00612
19	394	0.00000	0.000000	0.00000	0.04975
20	399	0.02523	0.000000	0.00000	0.00000
21	415	0.00000	0.774051	0.11765	0.01326
22	443	0.00000	0.000000	0.02793	0.97207

DATA FOR REGRESSIONS INVOLVING NATURAL LOGARITHM OF BOD5 EFFLUENT --
FULL RESPONSE, DIRECT DISCHARGERS
PRODUCTION AND BOD5 EFFLUENT INFORMATION

OBS	PLANT	BOD5 EFFLUENT (MG/L)	BOD5 INFLUENT (MG/L)	BOD5 PERCENT REMOVAL	PROPORTION PRODUCTION THERMOPLASTICS	PROPORTION PRODUCTION THERMOSETS	PROPORTION PRODUCTION RAYON
23	444	24	.	.	0.00000	0.000000	0.000000000
24	481	388	.	.	0.00000	0.000000	0.000000000
25	500	49	.	.	0.00000	0.000000	0.000000000
26	525	9	180	0.95	0.00000	0.064513	0.000000000
27	580	45	.	.	0.00000	0.000000	0.000000000
28	602	1050	9420	0.89	0.00000	0.000000	0.000000000
29	608	46	.	.	0.00000	0.000000	0.000000000
30	659	35	316	0.89	0.78296	0.087033	0.000000000
31	662	29	.	.	0.04711	0.000000	0.000000000
32	682	14	911	0.98	0.60021	0.194664	0.000000000
33	683	12	79	0.85	0.07708	0.000000	0.000000000
34	695	20	.	.	0.07923	0.014039	0.000000000
35	741	96	2271	0.96	0.00000	0.000000	0.000000000
36	802	12	145	0.92	0.00000	0.000000	0.000000000
37	811	22	.	.	0.25871	0.000000	0.000000000
38	825	176	.	.	0.00000	0.000000	0.000000000
39	844	5	.	.	0.09289	0.000000	0.000000000
40	851	30	565	0.95	0.00000	0.013462	0.000000000
41	866	10	3195	1.00	0.72950	0.000000	0.000000000
42	871	35	468	0.93	0.43848	0.000000	0.000781078
43	883	20	300	0.93	1.00000	0.000000	0.000000000
44	908	53	3176	0.98	0.05135	0.000000	0.000000000

OBS	PLANT	PROPORTION PRODUCTION OTHER FIBERS	PROPORTION PRODUCTION COMMODITY ORGANICS	PROPORTION PRODUCTION BULK ORGANICS	PROPORTION PRODUCTION SPECIALTY ORGANICS
23	444	0.00000	0.00000	1.00000	0.00000
24	481	0.00000	0.00000	0.00000	1.00000
25	500	0.00000	0.85174	0.14491	0.00335
26	525	0.00000	0.00000	0.10083	0.83465
27	580	0.00000	0.00000	0.00000	1.00000
28	602	0.00000	0.00000	0.20368	0.79632
29	608	0.00000	0.76972	0.15055	0.07973
30	659	0.00000	0.13000	0.00000	0.00000
31	662	0.00000	0.18491	0.63502	0.13295
32	682	0.02507	0.00000	0.00000	0.18005
33	683	0.00000	0.31834	0.51937	0.08521
34	695	0.00000	0.67997	0.21661	0.01015
35	741	0.00000	0.00000	1.00000	0.00000
36	802	1.00000	0.00000	0.00000	0.00000
37	811	0.00000	0.59744	0.13984	0.00400
38	825	0.00000	0.00000	0.00000	1.00000
39	844	0.00000	0.73837	0.15730	0.01144
40	851	0.00000	0.83300	0.08522	0.06832
41	866	0.00000	0.00000	0.27050	0.00000
42	871	0.36848	0.00000	0.19226	0.00000
43	883	0.00000	0.00000	0.00000	0.00000
44	908	0.00000	0.61066	0.32889	0.00910

DATA FOR REGRESSIONS INVOLVING NATURAL LOGARITHM OF BOD5 EFFLUENT --
FULL RESPONSE, DIRECT DISCHARGERS
PRODUCTION AND BOD5 EFFLUENT INFORMATION

OBS	PLANT	BOD5 EFFLUENT (MG/L)	BOD5 INFLUENT (MG/L)	BOD5 PERCENT REMOVAL	PROPORTION PRODUCTION THERMOPLASTICS	PROPORTION PRODUCTION THERMOSETS	PROPORTION PRODUCTION RAYON
45	909	21	.	.	0.00089	0.00000	0
46	948	12	1366	0.99	0.12674	0.00000	0
47	970	10	401	0.98	0.00000	0.00000	0
48	984	22	.	.	0.97617	0.00000	0
49	990	16	1057	0.98	0.22822	0.00000	0
50	1012	20	.	.	0.00000	0.00000	0
51	1020	12	.	.	1.00000	0.00000	0
52	1038	5	.	.	0.00000	0.00000	0
53	1059	32	120	0.73	0.00000	0.00000	0
54	1061	6	.	.	0.00000	0.00000	0
55	1062	24	878	0.97	1.00000	0.00000	0
56	1067	68	.	.	0.17302	0.00000	0
57	1133	23	1947	0.99	0.00000	0.00000	0
58	1137	23	1698	0.99	0.46457	0.00000	0
59	1139	36	.	.	0.31190	0.00000	0
60	1148	37	.	.	0.00000	0.00000	0
61	1149	21	387	0.95	0.00000	0.00000	0
62	1241	5	.	.	1.00000	0.00000	0
63	1299	10	.	.	0.00000	0.00000	0
64	1319	194	.	.	0.00000	0.00000	0
65	1323	150	.	.	0.00000	0.00000	0
66	1340	6	839	0.99	0.35838	0.00000	0

OBS	PLANT	PROPORTION PRODUCTION OTHER FIBERS	PROPORTION PRODUCTION COMMODITY ORGANICS	PROPORTION PRODUCTION BULK ORGANICS	PROPORTION PRODUCTION SPECIALTY ORGANICS
45	909	0.00000	0.84744	0.151666	0.00000
46	948	0.19949	0.58886	0.069281	0.01563
47	970	1.00000	0.00000	0.000000	0.00000
48	984	0.00000	0.00000	0.000000	0.02383
49	990	0.77178	0.00000	0.000000	0.00000
50	1012	1.00000	0.00000	0.000000	0.00000
51	1020	0.00000	0.00000	0.000000	0.00000
52	1038	0.16947	0.83053	0.000000	0.00000
53	1059	0.00000	0.52868	0.278930	0.19239
54	1061	0.10942	0.00000	0.890581	0.00000
55	1062	0.00000	0.00000	0.000000	0.00000
56	1067	0.00000	0.00000	0.614670	0.21231
57	1133	0.00000	0.00000	0.516403	0.48360
58	1137	0.00000	0.53543	0.000000	0.00000
59	1139	0.00000	0.04296	0.533455	0.11169
60	1148	0.00000	1.00000	0.000000	0.00000
61	1149	0.00000	0.68710	0.298429	0.01447
62	1241	0.00000	0.00000	0.000000	0.00000
63	1299	0.00000	0.00000	0.978261	0.02174
64	1319	0.00000	0.00000	0.000000	1.00000
65	1323	0.00000	0.50724	0.492760	0.00000
66	1340	0.00000	0.63657	0.005048	0.00000

DATA FOR REGRESSIONS INVOLVING NATURAL LOGARITHM OF BOD5 EFFLUENT --
FULL RESPONSE, DIRECT DISCHARGERS
PRODUCTION AND BOD5 EFFLUENT INFORMATION

OBS	PLANT	BOD5 EFFLUENT (MG/L)	BOD5 INFLUENT (MG/L)	BOD5 PERCENT REMOVAL	PROPORTION PRODUCTION THERMOPLASTICS	PROPORTION PRODUCTION THERMOSETS	PROPORTION PRODUCTION RAYON
67	1343	8	183	0.96	0.92587	0.03111	0
68	1407	28	366	0.92	0.00168	0.00000	0
69	1409	8	.	.	0.00000	0.00000	0
70	1438	29	2249	0.99	0.21350	0.00000	0
71	1446	15	.	.	0.00000	0.13234	0
72	1494	62	413	0.85	0.00000	0.02581	0
73	1572	45	1128	0.96	0.09172	0.00000	0
74	1609	65	1972	0.97	0.00000	0.00000	0
75	1616	101	80	-0.26	1.00000	0.00000	0
76	1617	65	469	0.86	1.00000	0.00000	0
77	1624	921	.	.	0.48584	0.51416	0
78	1643	18	483	0.96	1.00000	0.00000	0
79	1647	58	1192	0.95	0.00000	0.00000	0
80	1650	29	.	.	0.26270	0.00000	0
81	1656	97	2456	0.96	0.00000	0.00000	0
82	1695	17	206	0.92	0.43966	0.00000	0
83	1698	68	4706	0.99	0.00000	1.00000	0
84	1714	32	125	0.74	0.00000	1.00000	0
85	1717	38	490	0.92	1.00000	0.00000	0
86	1753	37	435	0.91	0.00000	0.00000	0
87	1766	166	3595	0.95	1.00000	0.00000	0
88	1769	10	115	0.91	0.00000	0.02170	0

OBS	PLANT	PROPORTION PRODUCTION OTHER FIBERS	PROPORTION PRODUCTION COMMODITY ORGANICS	PROPORTION PRODUCTION BULK ORGANICS	PROPORTION PRODUCTION SPECIALTY ORGANICS
67	1343	0.00000	0.000000	0.043013	0.00000
68	1407	0.00000	0.000000	0.000000	0.99832
69	1409	0.00000	0.443905	0.547417	0.00868
70	1438	0.78650	0.000000	0.000000	0.00000
71	1446	0.00000	0.000000	0.617476	0.25019
72	1494	0.00000	0.083860	0.769604	0.12073
73	1572	0.40637	0.000000	0.207825	0.29408
74	1609	0.00000	0.000000	0.550938	0.44906
75	1616	0.00000	0.000000	0.000000	0.00000
76	1617	0.00000	0.000000	0.000000	0.00000
77	1624	0.00000	0.000000	0.000000	0.00000
78	1643	0.00000	0.000000	0.000000	0.00000
79	1647	0.00000	0.000000	0.000000	1.00000
80	1650	0.00000	0.405799	0.331505	0.00000
81	1656	0.00000	0.000000	0.747888	0.25211
82	1695	0.00000	0.560337	0.000000	0.00000
83	1698	0.00000	0.000000	0.000000	0.00000
84	1714	0.00000	0.000000	0.000000	0.00000
85	1717	0.00000	0.000000	0.000000	0.00000
86	1753	0.00000	0.000000	0.000000	1.00000
87	1766	0.00000	0.000000	0.000000	0.00000
88	1769	0.00000	0.000000	0.761269	0.21703

DATA FOR REGRESSIONS INVOLVING NATURAL LOGARITHM OF BOD5 EFFLUENT --
FULL RESPONSE, DIRECT DISCHARGERS
PRODUCTION AND BOD5 EFFLUENT INFORMATION

OBS	PLANT	BOD5 EFFLUENT (MG/L)	BOD5 INFLUENT (MG/L)	BOD5 PERCENT REMOVAL	PROPORTION PRODUCTION THERMOPLASTICS	PROPORTION PRODUCTION THERMOSETS	PROPORTION PRODUCTION RAYON
89	1802	50	.	.	1.00000	0.00000	0
90	1869	18	.	.	0.67125	0.00000	0
91	1881	63	872	0.93	0.25908	0.00000	0
92	1890	47	80	0.41	0.05485	0.00000	0
93	1905	5	.	.	0.00000	0.00000	0
94	1911	25	2442	0.99	0.13388	0.00000	0
95	1943	22	.	.	0.46393	0.00000	0
96	1973	3	375	0.99	1.00000	0.00000	0
97	1977	27	664	0.96	0.54071	0.00000	0
98	2009	82	.	.	0.00000	0.00000	0
99	2026	40	3155	0.99	0.09530	0.00000	0
100	2049	32	.	.	0.00000	0.00000	0
101	2110	112	.	.	0.01232	0.02596	0
102	2148	5	.	.	0.00000	0.00000	0
103	2181	4	351	0.99	1.00000	0.00000	0
104	2221	15	.	.	0.00000	1.00000	0
105	2222	8	253	0.97	1.00000	0.00000	0
106	2227	75	572	0.87	0.00000	0.61198	0
107	2228	5303	.	.	0.00000	0.00000	0
108	2236	55	80	0.31	0.00000	0.00000	0
109	2242	16	456	0.96	0.00000	0.00000	0
110	2254	189	.	.	0.00000	0.00000	0

OBS	PLANT	PROPORTION PRODUCTION OTHER FIBERS	PROPORTION PRODUCTION COMMODITY ORGANICS	PROPORTION PRODUCTION BULK ORGANICS	PROPORTION PRODUCTION SPECIALTY ORGANICS
89	1802	0.0000	0.00000	0.00000	0.00000
90	1869	0.0000	0.32875	0.00000	0.00000
91	1881	0.7132	0.00000	0.02772	0.00000
92	1890	0.0000	0.00068	0.94447	0.00000
93	1905	0.0000	0.00000	0.00000	1.00000
94	1911	0.0000	0.54211	0.31153	0.01247
95	1943	0.0000	0.53607	0.00000	0.00000
96	1973	0.0000	0.00000	0.00000	0.00000
97	1977	0.0000	0.44436	0.01493	0.00000
98	2009	0.0000	0.08108	0.24324	0.67568
99	2026	0.0000	0.00003	0.19892	0.70575
100	2049	0.0000	0.00000	0.00000	1.00000
101	2110	0.0000	0.72633	0.14726	0.08814
102	2148	1.0000	0.00000	0.00000	0.00000
103	2181	0.0000	0.00000	0.00000	0.00000
104	2221	0.0000	0.00000	0.00000	0.00000
105	2222	0.0000	0.00000	0.00000	0.00000
106	2227	0.0000	0.00000	0.00000	0.38802
107	2228	0.0000	0.01432	0.00000	0.98568
108	2236	0.0000	0.00000	0.84823	0.15177
109	2242	0.0000	0.42095	0.31202	0.26704
110	2254	0.0000	0.92827	0.00000	0.07173

DATA FOR REGRESSIONS INVOLVING NATURAL LOGARITHM OF BOD5 EFFLUENT --
FULL RESPONSE, DIRECT DISCHARGERS
PRODUCTION AND BOD5 EFFLUENT INFORMATION

OBS	PLANT	BOD5 EFFLUENT (MG/L)	BOD5 INFLUENT (MG/L)	BOD5 PERCENT REMOVAL	PROPORTION PRODUCTION THERMOPLASTICS	PROPORTION PRODUCTION THERMOSETS	PROPORTION PRODUCTION RAYON
111	2296	18	81	0.78	1.00000	0.000000	0
112	2307	359	.	.	1.00000	0.000000	0
113	2313	244	577	0.58	0.00000	0.033736	0
114	2315	9	444	0.98	0.00000	0.000000	0
115	2328	19	.	.	0.45643	0.000000	0
116	2353	559	.	.	0.00000	0.000000	0
117	2360	2	60	0.97	0.00000	0.000000	0
118	2365	40	1385	0.97	0.00000	0.000000	0
119	2368	46	.	.	0.00000	0.000000	0
120	2376	27	324	0.92	0.92247	0.077527	0
121	2390	57	2317	0.98	0.00000	0.000000	0
122	2394	57	829	0.93	0.00000	0.000000	0
123	2399	47	.	.	0.00000	0.000000	0
124	2430	8	496	0.98	0.02249	0.000000	0
125	2445	48	668	0.93	0.05233	0.244381	0
126	2447	15	71	0.79	0.00000	0.000000	0
127	2450	5	440	0.99	0.00000	0.000000	0
128	2461	43	717	0.94	0.07327	0.000000	0
129	2471	17	110	0.85	0.00000	0.000000	0
130	2474	455	.	.	0.00000	0.000000	0
131	2528	35	679	0.95	0.32052	0.000000	0
132	2536	3	386	0.99	1.00000	0.000000	0

OBS	PLANT	PROPORTION PRODUCTION OTHER FIBERS	PROPORTION PRODUCTION COMMODITY ORGANICS	PROPORTION PRODUCTION BULK ORGANICS	PROPORTION PRODUCTION SPECIALTY ORGANICS
111	2296	0	0.00000	0.00000	0.00000
112	2307	0	0.00000	0.00000	0.00000
113	2313	0	0.00000	0.28629	0.67998
114	2315	1	0.00000	0.00000	0.00000
115	2328	0	0.00000	0.54357	0.00000
116	2353	0	0.00000	0.78543	0.21457
117	2360	1	0.00000	0.00000	0.00000
118	2365	0	0.00000	0.58340	0.41660
119	2368	0	1.00000	0.00000	0.00000
120	2376	0	0.00000	0.00000	0.00000
121	2390	0	0.00000	0.16482	0.83518
122	2394	0	0.00000	0.23256	0.76744
123	2399	0	0.00000	1.00000	0.00000
124	2430	0	0.92573	0.05178	0.00000
125	2445	0	0.43919	0.26410	0.00000
126	2447	0	0.00000	0.00000	1.00000
127	2450	0	0.38819	0.60663	0.00518
128	2461	0	0.09067	0.39060	0.44546
129	2471	0	0.00000	0.79388	0.20612
130	2474	0	0.65708	0.34292	0.00000
131	2528	0	0.57809	0.07129	0.03009
132	2536	0	0.00000	0.00000	0.00000

DATA FOR REGRESSIONS INVOLVING NATURAL LOGARITHM OF BOD5 EFFLUENT --
FULL RESPONSE, DIRECT DISCHARGERS
PRODUCTION AND BOD5 EFFLUENT INFORMATION

OBS	PLANT	BOD5 EFFLUENT (MG/L)	BOD5 INFLUENT (MG/L)	BOD5 PERCENT REMOVAL	PROPORTION PRODUCTION THERMOPLASTICS	PROPORTION PRODUCTION THERMOSETS	PROPORTION PRODUCTION RAYON
133	2551	11	1305	0.99	0.00000	0.000000	0
134	2556	19	210	0.91	0.00000	0.000000	0
135	2573	284	1371	0.79	0.00000	0.000000	0
136	2592	27	1187	0.98	0.00000	0.000000	0
137	2626	14	349	0.96	0.90313	0.000000	0
138	2631	22	694	0.97	0.00000	0.015274	0
139	2633	91	.	.	0.88338	0.000000	0
140	2673	101	.	.	0.00000	0.000000	0
141	2678	79	274	0.71	1.00000	0.000000	0
142	2692	4	510	0.99	1.00000	0.000000	0
143	2693	86	.	.	0.00000	0.000000	0
144	2695	25	.	.	0.00000	0.000000	0
145	2701	28	.	.	0.00000	0.000000	0
146	2711	985	962	-0.02	0.00000	0.528866	0
147	2763	4	150	0.97	1.00000	0.000000	0
148	2764	14	.	.	0.65379	0.000000	0
149	2795	26	.	.	0.00000	0.000000	0
150	2816	10	785	0.99	0.23001	0.000000	0
151	2818	55	.	.	0.00000	0.000000	0
152	3033	190	1688	0.89	0.00000	0.000000	0
153	4017	4	.	.	1.00000	0.000000	0
154	4021	21	1767	0.99	0.96707	0.000000	0

OBS	PLANT	PROPORTION PRODUCTION OTHER FIBERS	PROPORTION PRODUCTION COMMODITY ORGANICS	PROPORTION PRODUCTION BULK ORGANICS	PROPORTION PRODUCTION SPECIALTY ORGANICS
133	2551	0	0.00000	0.055397	0.94460
134	2556	0	1.00000	0.000000	0.00000
135	2573	0	0.00000	0.152415	0.84758
136	2592	1	0.00000	0.000000	0.00000
137	2626	0	0.00000	0.002348	0.09452
138	2631	0	0.85307	0.131654	0.00000
139	2633	0	0.11662	0.000000	0.00000
140	2673	0	0.03132	0.148847	0.81983
141	2678	0	0.00000	0.000000	0.00000
142	2692	0	0.00000	0.000000	0.00000
143	2693	0	0.30625	0.472698	0.22106
144	2695	0	0.16145	0.679490	0.15906
145	2701	0	1.00000	0.000000	0.00000
146	2711	0	0.47113	0.000000	0.00000
147	2763	0	0.00000	0.000000	0.00000
148	2764	0	0.34621	0.000000	0.00000
149	2795	0	0.00000	0.000000	1.00000
150	2816	0	0.76999	0.000000	0.00000
151	2818	0	0.95192	0.048077	0.00000
152	3033	0	0.00000	0.925016	0.07498
153	4017	0	0.00000	0.000000	0.00000
154	4021	0	0.00000	0.032929	0.00000

DATA FOR REGRESSIONS INVOLVING NATURAL LOGARITHM OF BOD5 EFFLUENT --
FULL RESPONSE, DIRECT DISCHARGERS
PRODUCTION AND BOD5 EFFLUENT INFORMATION

OBS	PLANT	BOD5 EFFLUENT (MG/L)	BOD5 INFLUENT (MG/L)	BOD5 PERCENT REMOVAL	PROPORTION PRODUCTION THERMOPLASTICS	PROPORTION PRODUCTION THERMOSETS	PROPORTION PRODUCTION RAYON
155	4037	5	.	.	0	0	0
156	4040	195	.	.	0	0	0
157	4051	27	645	0.96	1	0	0

OBS	PLANT	PROPORTION PRODUCTION OTHER FIBERS	PROPORTION PRODUCTION COMMODITY ORGANICS	PROPORTION PRODUCTION BULK ORGANICS	PROPORTION PRODUCTION SPECIALTY ORGANICS
155	4037	0	0.000000	0.740805	0.259195
156	4040	0	0.760289	0.239711	0.000000
157	4051	0	0.000000	0.000000	0.000000

DATA FOR REGRESSIONS INVOLVING BOD5 EFFLUENT
FULL RESPONSE, DIRECT DISCHARGERS
PRODUCTION AND BOD5 EFFLUENT INFORMATION

OBS	PLANT	BIOLOGICAL ONLY?	95/40 CRITERIA?	BIOLOGICAL ONLY AND 95/40	BIOLOGICAL ONLY AND NOT 95/40	NOT BIOLOGICAL ONLY AND 95/40
1	1	X			X	
2	61	X			X	
3	63	X	X	X		
4	83	X	X	X		
5	102		X			X
6	154		X			X
7	177	X			X	
8	227					
9	250	X			X	
10	254	X	X	X		
11	267		X			X
12	269	X			X	
13	284		X			X
14	296	X	X	X		
15	352					
16	384		X			X
17	387	X	X	X		
18	392	X	X	X		
19	394	X	X	X		
20	399	X	X	X		
21	415	X			X	
22	443		X			X

OBS	NOT BIOLOGICAL ONLY AND NOT 95/40	FLOW (MGD)	PRODUCTION (MILLION LBS. PER YEAR)	HEATING (DEGREE DAYS)	AGE OF OLDEST PROCSESS (YEARS)
1		1.8500	750.2	4680	45
2		0.0200	12.2	5800	37
3		5.9624	548.3	3696	36
4		0.3743	431.0	2598	23
5		0.4116	141.9	6180	29
6		0.3810	263.4	5344	35
7		0.2633	1102.3	1498	22
8	X	2.7438	15.5	2146	14
9		1.5070	1701.5	1670	13
10		0.2530	381.9	4333	45
11		1.5471	900.6	7143	87
12		0.0090	254.1	2844	68
13		0.8500	358.9	1496	21
14		0.1311	3795.9	1465	18
15	X	0.0858	23.2	3163	21
16		3.2440	2997.8	1434	14
17		13.8000	215.0	5231	44
18		0.0290	81.7	5838	29
19		0.7190	32.0	4947	61
20		8.5400	157.0	2626	32
21		11.4439	6636.5	1670	28
22		0.0057	5.3	4947	34

DATA FOR REGRESSIONS INVOLVING BOD5 EFFLUENT
FULL RESPONSE, DIRECT DISCHARGERS
PRODUCTION AND BOD5 EFFLUENT INFORMATION

OBS	PLANT	BIOLOGICAL ONLY?	95/40 CRITERIA?	BIOLOGICAL ONLY AND 95/40	BIOLOGICAL ONLY AND NOT 95/40	NOT BIOLOGICAL ONLY AND 95/40
23	444	X	X	X		
24	481					
25	500					
26	525	X	X	X		
27	580	X			X	
28	602	X			X	
29	608	X			X	
30	659	X	X	X		
31	662	X	X	X		
32	682	X	X	X		
33	683	X	X	X		
34	695	X	X	X		
35	741	X	X	X		
36	802	X	X	X		
37	811		X			X
38	825	X			X	
39	844		X			X
40	851	X	X	X		
41	866		X			X
42	871	X	X	X		
43	883		X			X
44	908	X	X	X		

OBS	NOT BIOLOGICAL ONLY AND NOT 95/40	FLOW (MGD)	PRODUCTION (MILLION LBS. PER YEAR)	HEATING (DEGREE DAYS)	AGE OF OLDEST PROCSESS (YEARS)
23		0.7410	679.6	1224	26
24	X	0.0043	0.1	2598	18
25	X	0.8890	2087.5	2678	30
26		0.6320	558.3	1284	24
27		0.7090	12.6	5753	54
28		0.0358	6.4	2598	16
29		1.2440	819.0	1670	26
30		0.7500	467.3	5070	32
31		3.1496	933.9	4590	41
32		2.1518	280.5	4817	36
33		0.8700	2300.1	5344	31
34		16.0624	11588.0	1224	43
35		1.2050	218.0	2547	19
36		1.0730	192.4	3505	36
37		0.4670	544.6	1513	29
38		0.1860	7.5	6192	36
39		0.0380	787.8	4374	22
40		1.5084	4027.6	1434	22
41		0.0720	93.9	6180	13
42		0.9943	167.7	4237	56
43		0.1300	82.0	6180	19
44		1.7340	3470.6	0	25

DATA FOR REGRESSIONS INVOLVING BOD5 EFFLUENT
FULL RESPONSE, DIRECT DISCHARGERS
PRODUCTION AND BOD5 EFFLUENT INFORMATION

OBS	PLANT	BIOLOGICAL ONLY?	95/40 CRITERIA?	BIOLOGICAL ONLY AND 95/40	BIOLOGICAL ONLY AND NOT 95/40	NOT BIOLOGICAL ONLY AND 95/40
45	909		X			X
46	948		X			X
47	970	X	X	X		
48	984	X	X	X		
49	990		X			X
50	1012	X	X	X		
51	1020		X			X
52	1038		X			X
53	1059	X	X	X		
54	1061		X			X
55	1062	X	X	X		
56	1067					
57	1133	X	X	X		
58	1137	X	X	X		
59	1139	X	X	X		
60	1148		X			X
61	1149	X	X	X		
62	1241	X	X	X		
63	1299		X			X
64	1319					
65	1323					
66	1340		X			X

OBS	NOT BIOLOGICAL ONLY AND NOT 95/40	FLOW (MGD)	PRODUCTION (MILLION LBS. PER YEAR)	HEATING (DEGREE DAYS)	AGE OF OLDEST PROCSESS (YEARS)
45		0.8073	10814.3	1434	27
46		6.5875	3366.0	3695	63
47		0.6350	108.6	4307	43
48		0.6370	239.2	4220	28
49		0.1630	459.4	2566	10
50		0.5790	74.7	3671	26
51		0.1906	335.1	2678	7
52		2.1430	2797.0	2433	16
53		3.4533	69.9	5827	79
54		3.4010	165.5	3939	55
55		0.7120	170.0	6180	17
56	X	0.2000	405.7	4750	77
57		0.7004	147.3	2844	32
58		0.2901	1456.2	2598	18
59		0.0099	76.8	1434	14
60		2.2900	1260.0	3199	18
61		2.7347	1462.7	1465	29
62		0.2800	38.0	1498	30
63		0.0063	36.8	1224	9
64	X	0.0115	9.6	6381	20
65	X	.	227.9	2844	74
66		0.0800	2079.9	6180	15

DATA FOR REGRESSIONS INVOLVING BOD5 EFFLUENT
FULL RESPONSE, DIRECT DISCHARGERS
PRODUCTION AND BOD5 EFFLUENT INFORMATION

OBS	PLANT	BIOLOGICAL ONLY?	95/40 CRITERIA?	BIOLOGICAL ONLY AND 95/40	BIOLOGICAL ONLY AND NOT 95/40	NOT BIOLOGICAL ONLY AND 95/40
67	1343		X			X
68	1407	X	X	X		
69	1409	X	X	X		
70	1438		X			X
71	1446		X			X
72	1494					
73	1572	X	X	X		
74	1609	X	X	X		
75	1616	X			X	
76	1617					
77	1624	X			X	
78	1643	X	X	X		
79	1647	X	X	X		
80	1650	X	X	X		
81	1656	X	X	X		
82	1695		X			X
83	1698		X			X
84	1714	X	X	X		
85	1717		X			X
86	1753	X	X	X		
87	1766	X	X	X		
88	1769		X			X

OBS	NOT BIOLOGICAL ONLY AND NOT 95/40	FLOW (MGD)	PRODUCTION (MILLION LBS. PER YEAR)	HEATING (DEGREE DAYS)	AGE OF OLDEST PROCSESS (YEARS)
67		0.2910	209.24	5558	29
68		0.3401	17.90	3105	14
69		1.2800	860.77	1434	42
70		0.2760	647.30	3679	18
71		0.7820	456.86	1224	14
72	X	1.3640	568.80	5930	30
73		3.4721	668.35	3199	32
74		0.5500	204.05	4947	23
75		0.1110	152.00	4374	23
76	X	0.8313	398.76	4865	67
77		0.0036	71.05	5567	22
78		0.3600	138.73	4699	22
79		0.6320	15.13	5972	30
80		11.1706	2607.20	1498	37
81		0.0434	7.69	4865	29
82		2.3650	1069.00	7277	16
83		0.0110	258.98	4739	20
84		0.0184	0.83	1551	57
85		.	150.60	3514	13
86		3.2900	205.74	4817	29
87		0.3090	211.63	4590	25
88		9.3000	599.00	4947	68

DATA FOR REGRESSIONS INVOLVING BOD5 EFFLUENT
FULL RESPONSE, DIRECT DISCHARGERS
PRODUCTION AND BOD5 EFFLUENT INFORMATION

OBS	PLANT	BIOLOGICAL ONLY?	95/40 CRITERIA?	BIOLOGICAL ONLY AND 95/40	BIOLOGICAL ONLY AND NOT 95/40	NOT BIOLOGICAL ONLY AND 95/40
89	1802	X			X	
90	1869	X	X	X		
91	1881	X			X	
92	1890					
93	1905		X			X
94	1911	X	X	X		
95	1943		X			X
96	1973	X	X	X		
97	1977	X	X	X		
98	2009					
99	2026	X	X	X		
100	2049	X	X	X		
101	2110	X			X	
102	2148		X			X
103	2181	X	X	X		
104	2221	X	X	X		
105	2222	X	X	X		
106	2227	X			X	
107	2228	X			X	
108	2236	X			X	
109	2242	X	X	X		
110	2254	X			X	

OBS	NOT BIOLOGICAL ONLY AND NOT 95/40	FLOW (MGD)	PRODUCTION (MILLION LBS. PER YEAR)	HEATING (DEGREE DAYS)	AGE OF OLDEST PROCSESS (YEARS)
89		1.08000	593.00	1498	23
90		2.86600	523.50	5930	41
91		0.05532	80.44	3163	13
92	X	1.42285	1754.00	1434	36
93		0.00949	69.84	2678	9
94		0.72517	4121.10	2167	32
95		0.52000	1095.00	1434	22
96		1.31700	377.80	2146	11
97		2.63100	636.42	3218	36
98	X	0.93030	11.10	3352	8
99		0.65510	115.42	6224	51
100		0.03103	6.25	1224	12
101		0.57380	2793.08	930	39
102		0.70000	133.80	1743	26
103		0.22800	83.00	6404	24
104		2.50700	138.00	6672	43
105		1.50000	46.90	2566	23
106		3.98100	76.80	5139	32
107		0.00413	3.84	4590	31
108		0.06736	118.07	5017	69
109		2.45829	481.77	4640	33
110			227.65	2433	16

DATA FOR REGRESSIONS INVOLVING BOD5 EFFLUENT
FULL RESPONSE, DIRECT DISCHARGERS
PRODUCTION AND BOD5 EFFLUENT INFORMATION

OBS	PLANT	BIOLOGICAL ONLY?	95/40 CRITERIA?	BIOLOGICAL ONLY AND 95/40	BIOLOGICAL ONLY AND NOT 95/40	NOT BIOLOGICAL ONLY AND 95/40
111	2296	X	X	X		
112	2307					
113	2313	X			X	
114	2315		X			X
115	2328		X			X
116	2353					
117	2360		X			X
118	2365	X	X	X		
119	2368					
120	2376		X			X
121	2390	X	X	X		
122	2394					
123	2399					
124	2430	X	X	X		
125	2445	X			X	
126	2447	X	X	X		
127	2450	X	X	X		
128	2461	X			X	
129	2471		X			X
130	2474					
131	2528		X			X
132	2536		X			X

OBS	NOT BIOLOGICAL ONLY AND NOT 95/40	FLOW (MGD)	PRODUCTION (MILLION LBS. PER YEAR)	HEATING (DEGREE DAYS)	AGE OF OLDEST PROCSESS (YEARS)
111		0.41400	152.40	4940	19
112	X	0.02320	31.03	2300	19
113		0.59380	12.92	5793	38
114		1.16356	290.40	4162	55
115		0.21500	337.40	6180	26
116	X	0.05499	93.86	1670	8
117		0.47000	120.00	3163	16
118		0.09620	71.60	2598	31
119	X	0.93830	792.60	2146	6
120		0.69760	211.54	4817	33
121		0.06357	12.79	6719	31
122	X	2.13136	30.77	3218	48
123	X	0.04000	39.27	4590	54
124		0.83000	4055.70	1670	44
125		2.33320	1022.34	4624	24
126		0.00576	9.38	4290	13
127		4.76600	2163.10	1670	17
128		0.35286	232.72	4220	28
129		1.11900	75.20	5208	19
130	X	0.78130	1101.70	1224	22
131		3.41100	3028.28	930	30
132		1.89000	243.70	4590	27

DATA FOR REGRESSIONS INVOLVING BOD5 EFFLUENT
FULL RESPONSE, DIRECT DISCHARGERS
PRODUCTION AND BOD5 EFFLUENT INFORMATION

OBS	PLANT	BIOLOGICAL ONLY?	95/40 CRITERIA?	BIOLOGICAL ONLY AND 95/40	BIOLOGICAL ONLY AND NOT 95/40	NOT BIOLOGICAL ONLY AND 95/40
133	2551		X			X
134	2556	X	X	X		
135	2573					
136	2592	X	X	X		
137	2626	X	X	X		
138	2631	X	X	X		
139	2633	X			X	
140	2673	X			X	
141	2678	X			X	
142	2692	X	X	X		
143	2693	X			X	
144	2695	X	X	X		
145	2701	X	X	X		
146	2711	X			X	
147	2763	X	X	X		
148	2764	X	X	X		
149	2795	X	X	X		
150	2816	X	X	X		
151	2818					
152	3033					
153	4017		X			X
154	4021	X	X	X		

OBS	NOT BIOLOGICAL ONLY AND NOT 95/40	FLOW (MGD)	PRODUCTION (MILLION LBS. PER YEAR)	HEATING (DEGREE DAYS)	AGE OF OLDEST PROCSESS (YEARS)
133		0.21200	129.61	2311	62
134		0.17000	391.70	1670	15
135	X	0.21985	31.24	4640	27
136		1.59900	442.30	2598	34
137		0.51820	136.30	6098	26
138		1.54798	9152.80	1434	43
139		1.56500	686.00	1518	32
140		0.11318	104.41	1434	24
141		0.24846	53.19	5567	30
142		0.48000	51.40	5012	60
143		0.53149	773.56	4590	53
144		2.61800	927.21	1434	32
145		0.73100	1910.00	1224	17
146		0.04670	98.04	4640	13
147		.	255.50	3514	31
148		0.78700	1332.70	1434	26
149		0.56902	30.84	6890	68
150		3.27800	1306.90	3696	59
151	X	0.26000	773.76	1670	17
152	X	1.65950	50.02	4590	28
153		0.15720	141.50	1670	5
154		0.08540	57.70	4699	37

DATA FOR REGRESSIONS INVOLVING BOD5 EFFLUENT
FULL RESPONSE, DIRECT DISCHARGERS
PRODUCTION AND BOD5 EFFLUENT INFORMATION

OBS	PLANT	BIOLOGICAL ONLY?	95/40 CRITERIA?	BIOLOGICAL ONLY AND 95/40	BIOLOGICAL ONLY AND NOT 95/40	NOT BIOLOGICAL ONLY AND 95/40
155	4037	X	X	X		
156	4040	X			X	
157	4051	X	X	X		

OBS	NOT BIOLOGICAL ONLY AND NOT 95/40	FLOW (MGD)	PRODUCTION (MILLION LBS. PER YEAR)	HEATING (DEGREE DAYS)	AGE OF OLDEST PROCSESS (YEARS)
155		0.0430	191.4	6180	11
156		0.0074	179.8	1434	21
157		0.1160	122.5	1465	6

PLANTS WITH BIOLOGICAL ONLY TREATMENT
WITH >= 95% BOD5 REMOVAL OR BOD5 EFFLUENT
USED FOR NATURAL LOGARITHM OF TSS REGRESSIONS

OBS	PLANT	BOD5 INFLUENT (MG/L)	BOD5 EFFLUENT (MG/L)	TSS EFFLUENT (MG/L)	BOD5 PERCENT REMOVAL
1	63	175	6	6	0.97
2	83	1516	38	18	0.97
3	254	1681	4	25	1.00
4	387	175	14	21	0.92
5	392	.	34	46	.
6	394	2169	9	19	1.00
7	399	163	24	59	0.85
8	444	.	24	40	.
9	525	180	9	33	0.95
10	659	316	35	58	0.89
11	662	.	29	21	.
12	682	911	14	48	0.98
13	683	79	12	12	0.85
14	695	.	20	52	.
15	802	145	12	15	0.92
16	871	468	35	92	0.93
17	908	3176	53	40	0.98
18	915	.	15	13	.
19	970	401	10	46	0.98
20	984	.	22	34	.
21	1012	.	20	9	.
22	1059	120	32	30	0.73
23	1062	878	24	61	0.97
24	1133	1947	23	23	0.99
25	1137	1698	23	76	0.99
26	1139	.	36	33	.
27	1149	387	21	59	0.95
28	1241	.	5	7	.
29	1267	.	24	24	.
30	1407	366	28	13	0.92
31	1409	.	8	11	.
32	1572	1128	45	63	0.96
33	1609	1972	65	61	0.97
34	1650	.	29	48	.
35	1869	.	18	4	.
36	1973	375	3	15	0.99
37	2026	3155	40	52	0.99
38	2049	.	32	68	.
39	2181	351	4	35	0.99
40	2221	.	15	20	.
41	2222	253	8	30	0.97
42	2242	456	16	38	0.96
43	2296	81	18	76	0.78
44	2365	1385	40	92	0.97
45	2390	2317	57	48	0.98
46	2430	496	8	9	0.98
47	2447	71	15	3	0.79
48	2450	440	5	14	0.99
49	2556	210	19	97	0.91
50	2592	1187	27	75	0.98

PLANTS WITH BIOLOGICAL ONLY TREATMENT
WITH >= 95% BOD5 REMOVAL OR BOD5 EFFLUENT
USED FOR NATURAL LOGARITHM OF TSS REGRESSIONS

OBS	PLANT	BOD5 INFLUENT (MG/L)	BOD5 EFFLUENT (MG/L)	TSS EFFLUENT (MG/L)	BOD5 PERCENT REMOVAL
51	2626	349	14	22	0.96
52	2631	694	22	22	0.97
53	2692	510	4	23	0.99
54	2695	.	25	16	.
55	2763	150	4	14	0.97
56	2764	.	14	45	.
57	2795	.	26	55	.
58	2816	785	10	23	0.99
59	4021	1767	21	24	0.99
60	4037	.	5	16	.
61	4051	645	27	95	0.96

APPENDIX VI-A

LIST OF THE 126 PRIORITY POLLUTANTS

LISTING OF PRIORITY POLLUTANTS AND NUMBERS USED
IN THE OCPSF DATA BASE

Organics

001	Acenaphthene
002	Acrolein
003	Acrylonitrile
004	Benzene
005	Benzidine
006	Carbon tetrachloride
007	Chlorobenzene
008	1,2,4-Trichlorobenzene
009	Hexachlorobenzene
010	1,2-Dichloroethane
011	1,1,1-Trichloroethane
012	Hexachloroethane
013	1,1-Dichloroethane
014	1,1,2-Trichloroethane
015	1,1,2,2-Tetrachloroethane
016	Chloroethane
018	Bis(2-chloroethyl) ether
019	2-Chloroethyl vinyl ether
020	2-Chloronaphthalene
021	2,4,6-Trichlorophenol
022	4-Chloro-m-cresol
023	Chloroform
024	2-Chlorophenol
025	1,2-Dichlorobenzene
026	1,3-Dichlorobenzene
027	1,4-Dichlorobenzene
028	3,3'-Dichlorobenzidine
029	1,1-Dichloroethylene
030	1,2-trans-Dichloroethylene
031	2,4-Dichlorophenol
032	1,2-Dichloropropane
033	1,3-Dichloropropene
034	2,4-Dimethylphenol
035	2,4-Dinitrotoluene
036	2,6-Dinitrotoluene
037	1,2-Diphenylhydrazine
038	Ethylbenzene
039	Fluoranthene
040	4-Chlorophenyl phenyl ether
041	4-Bromophenyl phenyl ether
042	Bis(2-chloroisopropyl) ether
043	Bis(2-chloroethoxy) methane
044	Methylene chloride
045	Methyl chloride
046	Methyl bromide
047	Bromoform
048	Dichlorobromomethane
051	Chlorodibromomethane
052	Hexachlorobutadiene
053	Hexachlorocyclopentadiene
054	Isophorone
055	Naphthalene
056	Nitrobenzene
057	2-Nitrophenol
058	4-Nitrophenol
059	2,4-Dinitrophenol
060	4,6-Dinitro-o-cresol
061	N-Nitrosodimethylamine
062	N-Nitrosodiphenylamine
063	N-Nitrosodi-n-propylamine
064	Pentachlorophenol
065	Phenol
066	Bis(2-ethylhexyl) phthalate
067	Butylbenzyl phthalate
068	Di-n-butyl phthalate
069	Di-n-octyl phthalate
070	Diethyl phthalate
071	Dimethyl phthalate
072	Benzo(a)anthracene
073	Benzo(a)pyrene
074	3,4-Benzofluoranthene
075	Benzo(k)fluoranthene
076	Chrysene
077	Acenaphthylene
078	Anthracene
079	Benzo(ghi)perylene
080	Fluorene
081	Phenanthrene
082	Dibenzo(a,h)anthracene
083	Indeno(1,2,3-c,d)pyrene
084	Pyrene
085	Tetrachloroethylene
086	Toluene
087	Trichloroethylene
088	Vinyl chloride
129	2,3,7,8 Tetrachlorodibenzo-p-dioxin

Metals

114	Antimony	119	Chromium	123	Mercury	126	Silver
115	Arsenic	120	Copper	124	Nickel	127	Thallium
117	Beryllium	122	Lead	125	Selenium	128	Zinc
118	Cadmium						

Miscellaneous

121	Cyanide	116	Asbestos

APPENDIX VII-A

BPT LONG-TERM AVERAGE BOD_5
AND TSS PLANT-SPECIFIC TARGETS

304 DIRECT DISCHARGERS -- BOD5 AND TSS EFFLUENT
ACTUAL, IMPUTED, AND TARGET CONCENTRATIONS

OBS	PLANT	PRODUCTION AND RESPONSE SOURCE	BIOLOGICAL? (YES=X)	ACTUAL BOD5 EFFLUENT (PPM)	IMPUTED BOD5 EFFLUENT (PPM)	BOD5 TARGET (PPM)	ACTUAL TSS EFFLUENT (PPM)	IMPUTED TSS EFFLUENT (PPM)	TSS TARGET (PPM)
1	1	1980 - FULL	X	91	.	17	228	.	29
2	12	1980 - FULL	X	.	36	21	.	52	32
3	15	1982 - PART A	X	.	15	24	.	24	34
4	33	1980 - FULL		.	154	28	.	122	37
5	61	1980 - FULL	X	2940	.	23	.	748	33
6	63	1980 - FULL	X	6	.	17	6	.	28
7	76	1982 - PART A		.	35	24	.	44	34
8	83	1980 - FULL	X	38	.	14	18	.	26
9	87	1980 - FULL		929	.	34	44	.	41
10	101	1980 - FULL	X	.	66	41	.	75	45
11	102	1980 - FULL	X	7	.	27	18	.	36
12	105	1982 - PART A		.	35	24	.	44	34
13	112	1982 - PART A	X	.	158	16	.	54	27
14	114	1980 - FULL		15	.	16	89	.	27
15	154	1980 - FULL	X	11	.	16	24	.	27
16	155	1980 - FULL		.	62	23	282	.	33
17	159	1980 - FULL		429	.	20	.	253	31
18	177	1980 - FULL	X	126	.	21	266	.	32
19	180	1980 - FULL		.	1934	40	.	744	44
20	183	1980 - FULL	X	.	37	21	.	52	32
21	190	1982 - PART A	X	.	15	24	.	24	34
22	205	1982 - PART A	X	.	15	24	.	24	34
23	225	1980 - FULL		96	.	23	46	.	34
24	227	1980 - FULL	X	88	.	30	23	.	38
25	250	1980 - FULL	X	127	.	19	230	.	30
26	254	1980 - FULL	X	4	.	12	25	.	24
27	259	1980 - FULL		350	.	19	.	219	30
28	260	1980 - FULL		20	.	23	8	.	33
29	267	1980 - FULL	X	14	.	20	33	.	31
30	269	1980 - FULL	X	168	.	23	53	.	33
31	284	1980 - FULL	X	21	.	16	13	.	28
32	294	1980 - FULL		57	.	21	119	.	32
33	296	1980 - FULL	X	216	.	21	142	.	31
34	301	1982 - PART A	X	.	15	24	.	24	34
35	306	1982 - PART A	X	.	15	24	.	24	34
36	352	1980 - FULL	X	45	.	26	41	.	35
37	373	NONE - FULL		62	.	.	155	.	.
38	384	1980 - FULL	X	7	.	19	19	.	30
39	387	1980 - FULL	X	14	.	16	21	.	27
40	392	1980 - FULL	X	34	.	41	46	.	45
41	394	1980 - FULL	X	9	.	17	19	.	28
42	399	1980 - FULL	X	24	.	16	59	.	27
43	408	NONE - PART A	X	.	.	.	.	.	.
44	412	1980 - FULL		.	35	16	.	42	27
45	415	1980 - FULL	X	45	.	20	63	.	31
46	443	1980 - FULL	X	20	.	30	38	.	38
47	444	1980 - FULL	X	24	.	23	40	.	33
48	446	1982 - PART A		.	34	16	.	43	27
49	447	1980 - FULL		23628	.	30	22898	.	38
50	451	1982 - PART A		.	34	16	.	43	27

304 DIRECT DISCHARGERS -- BOD5 AND TSS EFFLUENT
ACTUAL, IMPUTED, AND TARGET CONCENTRATIONS

OBS	PLANT	PRODUCTION AND RESPONSE SOURCE	BIOLOGICAL? (YES=X)	ACTUAL BOD5 EFFLUENT (PPM)	IMPUTED BOD5 EFFLUENT (PPM)	BOD5 TARGET (PPM)	ACTUAL TSS EFFLUENT (PPM)	IMPUTED TSS EFFLUENT (PPM)	TSS TARGET (PPM)
51	481	1980 - FULL	X	388	.	30	31	.	38
52	485	1982 - PART A	X	.	15	24	.	24	34
53	486	1980 - FULL	X	.	42	23	.	57	33
54	488	1982 - PART A	X	.	15	24	.	24	34
55	500	1980 - FULL	X	49	.	20	79	.	31
56	502	1980 - FULL		93	.	30	38	.	38
57	511	NONE - PART A	X	.	.	.	.	.	.
58	518	1982 - PART A	X	.	56	41	.	37	45
59	523	1982 - FULL	X	.	46	24	.	60	34
60	525	1980 - FULL	X	9	.	30	33	.	38
61	536	1980 - FULL		31	.	16	1	.	27
62	569	1980 - FULL		.	70	20	.	69	31
63	580	1980 - FULL	X	45	.	30	133	.	38
64	586	NONE - PART A	X	.	.	.	.	.	.
65	601	1980 - FULL		.	232	30	.	163	38
66	602	1980 - FULL	X	1050	.	29	.	401	37
67	608	1980 - FULL	X	46	.	21	.	60	32
68	611	1982 - PART A		.	26	41	.	34	45
69	614	1980 - FULL		.	232	30	.	163	38
70	633	1980 - FULL	X	.	33	20	.	50	31
71	657	1980 - FULL		16	.	16	17	.	27
72	659	1980 - FULL	X	35	.	19	58	.	29
73	662	1980 - FULL	X	29	.	23	21	.	33
74	663	1980 - FULL		7	.	16	47	.	27
75	664	1980 - FULL		5	.	12	7	.	24
76	669	1980 - FULL		56	.	20	42	.	31
77	682	1980 - FULL	X	14	.	23	48	.	33
78	683	1980 - FULL	X	12	.	22	12	.	33
79	695	1980 - FULL	X	20	.	21	52	.	31
80	709	1980 - FULL		91	.	23	98	.	33
81	727	1980 - FULL		84	.	20	108	.	31
82	741	1980 - FULL	X	96	.	23	136	.	33
83	758	1982 - FULL	X	.	46	24	.	60	34
84	775	1980 - FULL		.	61	23	6	.	33
85	802	1980 - FULL	X	12	.	12	15	.	24
86	811	1980 - FULL	X	22	.	19	30	.	30
87	814	1982 - PART A		.	35	26	.	44	34
88	819	1980 - FULL		.	215	30	128	.	38
89	825	1980 - FULL	X	176	.	30	168	.	38
90	844	1980 - FULL	X	5	.	20	54	.	31
91	851	1980 - FULL	X	30	.	21	161	.	32
92	859	1980 - FULL		225	.	30	4369	.	38
93	866	1980 - FULL	X	10	.	18	23	.	29
94	871	1980 - FULL	X	35	.	16	92	.	27
95	876	1980 - FULL		90	.	23	76	.	33
96	877	1982 - PART A		.	24	41	.	34	45
97	883	1980 - FULL	X	20	.	16	27	.	27
98	888	1980 - FULL		.	148	25	.	118	34
99	908	1980 - FULL	X	53	.	21	40	.	32
100	909	1980 - FULL	X	21	.	20	41	.	31

304 DIRECT DISCHARGERS -- BOD5 AND TSS EFFLUENT
ACTUAL, IMPUTED, AND TARGET CONCENTRATIONS

OBS	PLANT	PRODUCTION AND RESPONSE SOURCE	BIOLOGICAL? (YES=X)	ACTUAL BOD5 EFFLUENT (PPM)	IMPUTED BOD5 EFFLUENT (PPM)	BOD5 TARGET (PPM)	ACTUAL TSS EFFLUENT (PPM)	IMPUTED TSS EFFLUENT (PPM)	TSS TARGET (PPM)
101	913	1980 - FULL		4	.	21	54	.	32
102	915	NONE - FULL	X	15	.	.	13	.	.
103	938	1980 - FULL		.	99	26	27	.	35
104	942	1980 - FULL		71	.	20	66	.	31
105	948	1980 - FULL	X	12	.	18	33	.	29
106	956	1982 - PART A		.	34	16	.	43	27
107	962	1982 - FULL		17	.	12	25	.	24
108	970	1980 - FULL	X	10	.	12	46	.	24
109	973	1982 - PART A	X	.	15	24	.	24	34
110	984	1980 - FULL	X	22	.	16	34	.	28
111	990	1980 - FULL	X	16	.	13	21	.	25
112	991	1980 - FULL		.	2491	41	.	891	45
113	992	1980 - FULL		.	232	30	.	163	38
114	1012	1980 - FULL	X	20	.	12	9	.	24
115	1020	1980 - FULL	X	12	.	16	43	.	27
116	1033	1982 - PART A		.	35	24	.	44	34
117	1038	1980 - FULL	X	5	.	19	12	.	30
118	1059	1980 - FULL	X	32	.	23	30	.	33
119	1061	1980 - FULL	X	6	.	22	15	.	32
120	1062	1980 - FULL	X	24	.	16	61	.	27
121	1067	1980 - FULL	X	68	.	23	181	.	33
122	1133	1980 - FULL	X	23	.	26	23	.	36
123	1137	1980 - FULL	X	23	.	18	76	.	29
124	1139	1980 - FULL	X	36	.	21	33	.	32
125	1148	1980 - FULL	X	37	.	20	46	.	31
126	1149	1980 - FULL	X	21	.	21	59	.	32
127	1157	1980 - FULL	X	.	34	23	.	51	33
128	1167	NONE - PART A	X	.	.	.	.	.	.
129	1203	1980 - FULL	X	.	18	16	.	34	27
130	1241	1980 - FULL	X	5	.	16	7	.	27
131	1249	1982 - PART A		.	35	24	.	44	34
132	1267	1982 - FULL	X	24	.	16	24	.	27
133	1285	NONE - PART A	X	.	.	.	.	.	.
134	1299	1980 - FULL	X	10	.	23	20	.	33
135	1319	1980 - FULL	X	194	.	30	225	.	38
136	1323	1980 - FULL	X	150	.	21	51	.	32
137	1327	1980 - FULL		.	226	30	.	160	38
138	1340	1980 - FULL	X	6	.	19	20	.	30
139	1342	NONE - PART A	X	.	.	.	.	.	.
140	1343	1980 - FULL	X	8	.	17	36	.	28
141	1348	1982 - PART A	X	.	16	24	.	24	34
142	1349	1980 - FULL	X	.	18	16	.	34	27
143	1389	1980 - FULL		36	.	16	71	.	27
144	1407	1980 - FULL	X	28	.	30	13	.	38
145	1409	1980 - FULL	X	8	.	22	11	.	32
146	1414	1980 - FULL	X	.	52	33	.	65	40
147	1438	1980 - FULL	X	29	.	13	32	.	24
148	1439	1980 - FULL		302	.	23	1463	.	33
149	1446	1980 - FULL	X	15	.	27	50	.	36
150	1464	1980 - FULL	X	.	33	20	.	50	31

304 DIRECT DISCHARGERS -- BOD5 AND TSS EFFLUENT
ACTUAL, IMPUTED, AND TARGET CONCENTRATIONS

OBS	PLANT	PRODUCTION AND RESPONSE SOURCE	BIOLOGICAL? (YES=X)	ACTUAL BOD5 EFFLUENT (PPM)	IMPUTED BOD5 EFFLUENT (PPM)	BOD5 TARGET (PPM)	ACTUAL TSS EFFLUENT (PPM)	IMPUTED TSS EFFLUENT (PPM)	TSS TARGET (PPM)
151	1494	1980 - FULL	X	62	.	24	133	.	34
152	1520	1982 - PART A	X	.	15	24	.	24	34
153	1522	1980 - FULL	X	.	35	21	18	.	31
154	1524	1982 - PART A	X	.	158	16	.	54	27
155	1532	1980 - FULL		110	.	20	.	96	31
156	1569	1980 - FULL		18	.	27	44	.	36
157	1572	1980 - FULL	X	45	.	20	63	.	30
158	1593	1980 - FULL		.	232	30	.	163	38
159	1609	1980 - FULL	X	65	.	26	61	.	36
160	1616	1980 - FULL	X	101	.	16	90	.	27
161	1617	1980 - FULL	X	65	.	16	.	74	27
162	1618	1980 - FULL		4	.	16	11	.	27
163	1624	1980 - FULL	X	921	.	29	100	.	37
164	1643	1980 - FULL	X	18	.	16	154	.	27
165	1647	1980 - FULL	X	58	.	30	275	.	38
166	1650	1980 - FULL	X	29	.	20	48	.	31
167	1656	1980 - FULL	X	97	.	25	147	.	35
168	1670	1982 - PART A		.	35	24	.	44	34
169	1684	1980 - FULL	X	.	27	23	.	43	33
170	1688	1980 - FULL		142	.	23	46	.	33
171	1695	1980 - FULL	X	17	.	18	26	.	29
172	1698	1980 - FULL	X	68	.	41	46	.	45
173	1714	1980 - FULL	X	32	.	41	194	.	45
174	1717	1980 - FULL	X	38	.	16	25	.	27
175	1724	1982 - PART A	X	.	15	24	.	24	34
176	1753	1980 - FULL	X	37	.	30	120	.	38
177	1766	1980 - FULL	X	166	.	16	121	.	27
178	1769	1980 - FULL	X	10	.	25	53	.	35
179	1774	1980 - FULL		8	.	16	5	.	27
180	1776	1980 - FULL		.	61	23	100	.	33
181	1785	1982 - PART A		.	35	23	.	44	33
182	1794	1980 - FULL		.	71	20	.	70	30
183	1802	1980 - FULL	X	50	.	16	99	.	27
184	1839	1980 - FULL		.	35	16	.	42	27
185	1869	1980 - FULL	X	18	.	17	4	.	29
186	1877	1982 - PART A	X	.	15	24	.	24	34
187	1881	1980 - FULL	X	63	.	13	33	.	25
188	1890	1980 - FULL	X	47	.	23	92	.	33
189	1905	1980 - FULL	X	5	.	30	11	.	38
190	1910	1982 - PART A	X	.	15	24	.	24	34
191	1911	1980 - FULL	X	25	.	21	127	.	31
192	1928	1980 - FULL	X	.	53	27	.	66	36
193	1937	1982 - PART A	X	.	15	24	.	24	34
194	1943	1980 - FULL	X	22	.	18	16	.	29
195	1973	1980 - FULL	X	3	.	16	15	.	27
196	1977	1980 - FULL	X	27	.	18	156	.	29
197	1986	1980 - FULL		81	.	16	122	.	27
198	2009	1980 - FULL	X	82	.	27	144	.	37
199	2020	1980 - FULL	X	.	33	20	.	50	31
200	2026	1980 - FULL	X	40	.	27	52	.	36

304 DIRECT DISCHARGERS -- BOD5 AND TSS EFFLUENT
ACTUAL, IMPUTED, AND TARGET CONCENTRATIONS

OBS	PLANT	PRODUCTION AND RESPONSE SOURCE	BIOLOGICAL? (YES=X)	ACTUAL BOD5 EFFLUENT (PPM)	IMPUTED BOD5 EFFLUENT (PPM)	BOD5 TARGET (PPM)	ACTUAL TSS EFFLUENT (PPM)	IMPUTED TSS EFFLUENT (PPM)	TSS TARGET (PPM)
201	2030	1982 - PART A		.	35	24	.	44	34
202	2047	1982 - PART A		.	34	16	.	43	27
203	2049	1980 - FULL	X	32	.	30	68	.	38
204	2055	1980 - FULL		168	.	16	.	130	27
205	2062	1980 - FULL		.	61	23	.	63	33
206	2073	1980 - FULL		6	.	16	40	.	27
207	2090	1980 - FULL		862	.	28	50	.	37
208	2110	1980 - FULL	X	112	.	22	134	.	32
209	2148	1980 - FULL	X	5	.	12	13	.	24
210	2181	1980 - FULL	X	4	.	16	35	.	27
211	2193	1982 - PART A	X	.	151	17	.	53	28
212	2198	1980 - FULL	X	.	64	30	.	74	38
213	2206	1980 - FULL		.	35	16	.	42	27
214	2221	1980 - FULL	X	15	.	41	20	.	45
215	2222	1980 - FULL	X	8	.	16	30	.	27
216	2227	1980 - FULL	X	75	.	37	160	.	43
217	2228	1980 - FULL	X	5303	.	30	737	.	38
218	2236	1980 - FULL	X	55	.	24	3	.	34
219	2242	1980 - FULL	X	16	.	24	38	.	34
220	2254	1980 - FULL	X	189	.	21	240	.	31
221	2268	1980 - FULL		.	72	24	264	.	34
222	2272	1980 - FULL	X	.	30	19	.	46	30
223	2281	1982 - PART A	X	.	15	24	.	24	34
224	2292	1982 - PART A	X	.	15	24	.	24	34
225	2296	1980 - FULL	X	18	.	16	76	.	27
226	2307	1980 - FULL	X	359	.	16	263	.	27
227	2313	1980 - FULL	X	244	.	28	2051	.	37
228	2315	1980 - FULL	X	9	.	12	42	.	24
229	2316	1982 - PART A	X	.	15	24	.	24	34
230	2322	1982 - PART A	X	.	15	24	.	24	34
231	2328	1980 - FULL	X	19	.	20	37	.	31
232	2345	1980 - FULL		50	.	23	29	.	33
233	2353	1980 - FULL	X	559	.	25	195	.	34
234	2360	1980 - FULL	X	2	.	12	6	.	24
235	2364	1980 - FULL	X	.	14	14	.	30	26
236	2365	1980 - FULL	X	40	.	26	92	.	35
237	2368	1980 - FULL	X	46	.	20	39	.	31
238	2376	1980 - FULL	X	27	.	18	32	.	29
239	2390	1980 - FULL	X	57	.	29	48	.	37
240	2394	1980 - FULL	X	57	.	28	35	.	37
241	2399	1980 - FULL	X	47	.	23	36	.	33
242	2400	1980 - FULL		5640	.	31	1175	.	38
243	2419	1982 - PART A	X	.	158	16	.	54	27
244	2429	1982 - PART A	X	.	15	24	.	24	34
245	2430	1980 - FULL	X	8	.	20	9	.	31
246	2445	1980 - FULL	X	48	.	26	114	.	35
247	2447	1980 - FULL	X	15	.	30	3	.	38
248	2450	1980 - FULL	X	5	.	22	14	.	32
249	2461	1980 - FULL	X	43	.	25	75	.	35
250	2471	1980 - FULL	X	17	.	24	25	.	34

304 DIRECT DISCHARGERS -- BOD5 AND TSS EFFLUENT
ACTUAL, IMPUTED, AND TARGET CONCENTRATIONS

OBS	PLANT	PRODUCTION AND RESPONSE SOURCE	BIOLOGICAL? (YES=X)	ACTUAL BOD5 EFFLUENT (PPM)	IMPUTED BOD5 EFFLUENT (PPM)	BOD5 TARGET (PPM)	ACTUAL TSS EFFLUENT (PPM)	IMPUTED TSS EFFLUENT (PPM)	TSS TARGET (PPM)
251	2474	1980 - FULL	X	455	.	21	1309	.	32
252	2481	1982 - PART A	X	.	15	24	.	24	34
253	2527	1980 - FULL	X	.	39	23	.	54	33
254	2528	1980 - FULL	X	35	.	19	79	.	30
255	2531	1980 - FULL		639	.	41	145	.	45
256	2533	1980 - FULL		.	35	16	31	.	27
257	2536	1980 - FULL	X	3	.	16	18	.	27
258	2537	1982 - PART A	X	.	158	16	.	54	27
259	2541	1980 - FULL	X	.	64	30	.	74	38
260	2551	1980 - FULL	X	11	.	30	9	.	38
261	2556	1980 - FULL	X	19	.	20	97	.	31
262	2573	1980 - FULL	X	284	.	29	125	.	38
263	2590	1980 - FULL		16	.	26	13	.	35
264	2592	1980 - FULL	X	27	.	12	75	.	24
265	2606	1980 - FULL		.	61	23	.	63	33
266	2624	NONE - PART A		.	.	.	.	.	.
267	2626	1980 - FULL	X	14	.	17	22	.	29
268	2631	1980 - FULL	X	22	.	21	22	.	31
269	2633	1980 - FULL	X	91	.	16	123	.	28
270	2647	1980 - FULL		47	.	30	51	.	38
271	2660	1982 - PART A		.	24	41	.	34	45
272	2668	1980 - FULL		939	.	16	5866	.	27
273	2673	1980 - FULL	X	101	.	29	92	.	37
274	2678	1980 - FULL	X	79	.	16	96	.	27
275	2680	1980 - FULL		48	.	23	26	.	33
276	2692	1980 - FULL	X	4	.	16	23	.	27
277	2693	1980 - FULL	X	86	.	24	52	.	34
278	2695	1980 - FULL	X	25	.	24	16	.	34
279	2701	1980 - FULL	X	28	.	20	101	.	31
280	2711	1980 - FULL	X	985	.	31	739	.	38
281	2735	1980 - FULL		8	.	16	21	.	27
282	2739	1982 - PART A	X	.	56	20	.	37	30
283	2763	1980 - FULL	X	4	.	16	14	.	27
284	2764	1980 - FULL	X	14	.	17	45	.	29
285	2767	1980 - FULL		16	.	30	31	.	38
286	2770	1980 - FULL		140	.	25	17	.	35
287	2771	1980 - FULL		.	184	28	13	.	37
288	2781	1982 - PART A	X	.	15	24	.	24	34
289	2786	1980 - FULL		80	.	20	55	.	31
290	2795	1980 - FULL	X	26	.	30	55	.	38
291	2816	1980 - FULL	X	10	.	19	23	.	30
292	2818	1980 - FULL	X	55	.	20	319	.	31
293	3033	1980 - FULL	X	190	.	24	21	.	34
294	4002	1980 - FULL		109	.	20	83	.	31
295	4005	NONE - PART A	X	.	.	.	.	.	.
296	4010	1980 - FULL		.	61	23	176	.	33
297	4017	1980 - FULL	X	4	.	16	20	.	27
298	4018	1982 - PART A	X	.	15	24	.	24	34
299	4021	1980 - FULL	X	21	.	16	24	.	28
300	4037	1980 - FULL	X	5	.	25	16	.	35

304 DIRECT DISCHARGERS -- BOD5 AND TSS EFFLUENT
ACTUAL, IMPUTED, AND TARGET CONCENTRATIONS

OBS	PLANT	PRODUCTION AND RESPONSE SOURCE	BIOLOGICAL? (YES=X)	ACTUAL BOD5 EFFLUENT (PPM)	IMPUTED BOD5 EFFLUENT (PPM)	BOD5 TARGET (PPM)	ACTUAL TSS EFFLUENT (PPM)	IMPUTED TSS EFFLUENT (PPM)	TSS TARGET (PPM)
301	4040	1980 - FULL	X	195	.	21	264	.	32
302	4051	1980 - FULL	X	27	.	16	95	.	27
303	4055	1982 - PART A	X	.	15	24	.	24	34
304	4058	NONE - PART A	X	.	.	.	.	.	.

APPENDIX VII-B

RAW WASTEWATER AND TREATED EFFLUENT
BOD_5, TSS, COD, AND TOC DATA BEFORE AND AFTER
ADJUSTMENT BY PLANT-SPECIFIC DILUTION FACTORS

RAW WASTEWATER BOD5, TSS, COD AND TOC
DATA BEFORE AND AFTER ADJUSTMENT WITH PLANT SPECIFIC DILUTION FACTOR

OBS	PLANT NUMBER	REPORTED BOD5	REPORTED COD	REPORTED TSS	REPORTED TOC	DILUTION FACTOR	ADJUSTED BOD5	ADJUSTED COD	ADJUSTED TSS	ADJUSTED TOC
1	63	175	327	0	0	0.0000	175.00	327.00	0.00	0.00
2	154	372	0	17	0	0.3570	504.80	0.00	23.07	0.00
3	177	779	0	0	268	1.6270	2046.43	0.00	0.00	704.04
4	250	300	668	370	0	3.0400	1212.00	2698.72	1494.80	0.00
5	384	0	750	70	77	0.0000	0.00	750.00	70.00	77.00
6	392	.	.	2000	.	0.8320	0.00	0.00	3664.00	0.00
7	394	.	.	.	.	.	0.00	0.00	0.00	0.00
8	443	718	1101	.	.	0.0000	718.00	1101.00	0.00	0.00
9	569	.	.	.	120	0.0000	0.00	0.00	0.00	120.00
10	683	79	.	0	79	0.0030	79.24	0.00	0.00	79.24
11	844	.	1479	269	.	0.5340	0.00	2268.79	412.65	0.00
12	866	2334	3389	629	.	0.3690	3195.25	4639.54	861.10	0.00
13	938	.	.	226	119	0.0000	0.00	0.00	226.00	119.00
14	970	401	637	.	.	0.0000	401.00	637.00	0.00	0.00
15	990	741	1745	109	.	0.4270	1057.41	2490.12	155.54	0.00
16	1059	120	913	23	.	0.0000	120.00	913.00	23.00	0.00
17	1340	819	1386	97	.	0.0240	838.66	1419.26	99.33	0.00
18	1616	48	1861	2966	.	0.6760	80.45	3119.04	4971.02	0.00
19	1617	441	799	59	.	0.0632	468.87	849.50	62.73	0.00
20	1688	.	.	96	.	1.4510	0.00	0.00	235.30	0.00
21	1714	58	348	740	.	1.1600	125.28	751.68	1598.40	0.00
22	1717	248	768	39	264	0.9770	490.30	1518.34	77.10	521.93
23	1776	.	.	.	.	.	0.00	0.00	0.00	0.00
24	1911	2442	.	174	1562	0.0000	2442.00	0.00	174.00	1562.00
25	1943	.	1044	.	.	0.5760	0.00	1645.34	0.00	0.00
26	2222	253	31	302	.	0.0000	253.00	31.00	302.00	0.00
27	2296	54	637	2374	.	0.4950	80.73	952.32	3549.13	0.00
28	2360	60	50	15	.	0.0000	60.00	50.00	15.00	0.00
29	2394	.	.	.	.	.	0.00	0.00	0.00	0.00
30	2445	657	1160	93	310	0.0170	668.17	1179.72	94.58	315.20
31	2450	440	905	234	300	0.0000	440.00	905.00	234.00	300.00
32	2471	79	138	35	.	0.3890	109.73	191.68	48.62	0.00
33	2528	.	.	.	.	.	0.00	0.00	0.00	0.00
34	2556	210	436	92	.	0.0000	210.00	436.00	92.00	0.00
35	2626	349	1425	1604	.	0.0000	349.00	1425.00	1604.00	0.00
36	2631	434	1216	98	.	0.5980	693.53	1943.17	156.60	0.00
37	2692	245	410	41	151	1.0800	509.60	852.80	85.28	314.08
38	2711	.	2850	.	.	0.0870	0.00	3097.95	0.00	0.00
39	3033	1515	.	.	.	0.1140	1687.71	0.00	0.00	0.00

TREATED EFFLUENT BOD5, TSS, COD AND TOC
DATA BEFORE AND AFTER ADJUSTMENT WITH PLANT SPECIFIC DILUTION FACTOR

OBS	PLANT NUMBER	REPORTED BOD5	REPORTED COD	REPORTED TSS	REPORTED TOC	DILUTION FACTOR	ADJUSTED BOD5	ADJUSTED COD	ADJUSTED TSS	ADJUSTED TOC
1	61	196.0	-1.0	-1.0	-1	14.000	2940.0	-1.0	-1.00	-1.0
2	63	5.0	35.0	5.4	-1	0.123	5.6	39.3	6.06	-1.0
3	87	710.0	1079.0	34.0	-1	0.308	928.9	1411.7	44.48	-1.0
4	159	318.0	615.0	-1.0	317	0.348	428.6	828.8	-1.00	427.2
5	225	13.6	22.4	6.5	-1	6.031	95.6	157.5	45.70	-1.0
6	254	4.0	69.0	25.0	-1	0.000	4.0	69.0	25.00	-1.0
7	259	2.0	-1.0	-1.0	-1	174.051	350.1	-1.0	-1.00	-1.0
8	260	12.0	40.0	5.0	-1	0.660	19.9	66.4	8.30	-1.0
9	373	8.0	40.0	20.0	-1	6.730	61.8	309.2	154.60	-1.0
10	392	12.0	46.0	16.0	-1	1.859	34.3	131.5	45.74	-1.0
11	443	20.2	102.0	38.0	.	0.000	20.2	102.0	38.00	0.0
12	447	2492.0	10046.0	2415.0	3442	8.482	23628.1	95252.2	2898.10	32635.7
13	602	105.0	-1.0	-1.0	476	9.000	1050.0	-1.0	-1.00	4760.0
14	663	5.0	54.0	35.0	54	0.341	6.7	72.4	46.95	72.0
15	682	10.0	78.0	35.0	36	0.368	13.7	106.7	47.88	49.0
16	844	3.0	111.0	32.0	23	0.700	5.1	188.7	54.39	39.1
17	851	24.0	182.0	128.0	-1	0.259	30.2	229.2	161.17	-1.0
18	866	7.0	107.0	17.0	-1	0.369	9.6	146.5	23.27	-1.0
19	888	-1.0	1423.0	-1.0	-1	0.629	-1.0	2318.1	-1.00	-1.0
20	909	9.0	115.0	18.0	.	1.288	20.6	263.1	41.18	0.0
21	938	-1.0	.	27.0	45	0.000	-1.0	0.0	27.00	45.0
22	970	10.0	70.0	46.0	.	0.000	10.0	70.0	46.00	0.0
23	990	12.0	126.0	16.0	-1	0.311	15.7	165.2	20.98	-1.0
24	1241	5.0	-1.0	7.0	40	0.000	5.0	-1.0	7.00	40.0
25	1319	19.0	-1.0	22.0	-1	9.217	194.1	-1.0	224.78	-1.0
26	1409	5.0	40.0	7.0	-1	0.625	8.1	65.0	11.38	-1.0
27	1532	10.0	-1.0	-1.0	-1	10.000	110.0	-1.0	-1.00	-1.0
28	1569	9.0	50.0	22.0	-1	1.000	18.0	100.0	44.00	-1.0
29	1579	14.0	99.0	10.0	-1	0.000	14.0	99.0	10.00	-1.0
30	1616	60.0	323.0	54.0	429	0.676	100.5	541.3	90.49	718.0
31	1624	-1.0	1000.0	100.0	-1	0.000	-1.0	1000.0	100.00	-1.0
32	1643	18.0	45.0	154.0	-1	0.000	18.0	45.0	154.00	-1.0
33	1714	15.0	147.0	90.0	-1	1.160	32.4	317.5	194.42	-1.0
34	1717	21.0	198.0	14.0	123	0.808	38.0	357.9	25.31	222.3
35	1776	-1.0	-1.0	7.9	-1	11.670	-1.0	-1.0	100.09	-1.0
36	1890	19.0	230.0	37.0	-1	1.482	47.2	570.8	91.83	-1.0
37	1911	25.0	426.0	127.0	-1	0.000	25.0	426.0	127.00	-1.0
38	1986	12.0	65.0	18.0	-1	5.783	81.4	440.9	122.09	-1.0
39	2055	158.0	565.0	-1.0	-1	0.065	168.2	601.4	-1.00	-1.0
40	2062	.	.	.	140	0.727	0.0	0.0	0.00	241.0
41	2090	690.0	2959.0	40.0	-1	0.250	862.2	3697.4	49.98	-1.0
42	2110	39.0	193.0	47.0	-1	1.861	111.6	552.3	134.49	-1.0
43	2222	8.0	23.0	30.0	.	0.000	8.0	23.0	30.00	0.0
44	2228	842.0	959.0	117.0	793	5.298	5302.9	6039.8	736.87	4994.3
45	2254	89.0	357.0	113.0	-1	1.120	188.7	756.8	239.56	-1.0
46	2353	166.0	258.0	58.0	-1	2.370	559.5	869.6	195.48	-1.0
47	2360	2.0	25.0	6.0	.	0.000	2.0	25.0	6.00	0.0
48	2394	41.0	387.0	25.0	76	0.381	56.6	534.4	34.52	105.0

TREATED EFFLUENT BOD5, TSS, COD AND TOC
DATA BEFORE AND AFTER ADJUSTMENT WITH PLANT SPECIFIC DILUTION FACTOR

OBS	PLANT NUMBER	REPORTED BOD5	REPORTED COD	REPORTED TSS	REPORTED TOC	DILUTION FACTOR	ADJUSTED BOD5	ADJUSTED COD	ADJUSTED TSS	ADJUSTED TOC
49	2450	5	54	14	.	0.000	5.00	54.00	14.00	0.00
50	2471	14	41	21	15	0.194	16.72	48.95	25.07	17.91
51	2474	8	82	23	19	55.926	455.41	4667.93	309.30	1081.59
52	2531	53	80	12	48	11.065	639.45	965.21	144.78	579.12
53	2573	200	304	88	131	0.420	284.02	431.71	124.97	186.03
54	2631	14	170	14	2	0.598	22.37	271.64	22.37	3.00
55	2668	4	17	25	23	233.652	938.61	3989.08	866.29	5396.98
56	2711	16	25	12	-1	60.544	984.70	1538.60	738.53	-1.00
57	2764	14	56	45	-1	0.000	14.00	56.00	45.00	-1.00
58	2795	23	388	49	-1	0.132	26.04	439.22	55.47	-1.00
59	2818	23	174	134	68	1.384	54.83	414.82	319.46	162.11
60	3033	171	645	19	233	0.114	190.43	718.30	21.16	259.48
61	4010	.	83	16	29	9.980	0.00	911.34	175.68	318.00

APPENDIX VII-C

LISTING OF 69 BPT DAILY DATA PLANTS INCLUDED AND EXCLUDED FROM BPT VARIABILITY FACTOR CALCULATIONS

Rationale for Retention of Daily Database Plants for Analysis

Plant No. 0387: This plastics plant manufactures rayon. It utilized an activated sludge system for wastewater treatment. BOD_5 and TSS data were available for 1980 (January-December) but were limited to effluent data. In addition to direct discharge, 0.9 MGD of process wastewater was recycled and 0.8 MGD was evaporated. The plant was contacted regarding the flow metering locations. (Source: Supplemental 308 Questionnaire)

Plant No. 0444: Plant 444 is an organic chemicals plant manufacturing bulk organics. It used a two stage activated sludge system. Only effluent BOD_5 and TSS data were available for 1980 (January-December). Heavy organic wastes were incinerated (0.002 MGD) and deep well injected (0.07 MGD) in addition to the discharge of treated wastewaters. The plant was contacted regarding the flow metering locations and seasonal effects on the treatment plant performance. (Source: Supplemental 308 Questionnaire)

Plant No. 0525: Plant 525 manufactures thermoset resins and bulk and specialty organics. The plant used an activated sludge system for wastewater treatment. BOD_5 and TSS data were available for 1980 (January-December). The BOD_5 data included influent, effluent, and intermediate data. Intermediate sampling was before the aeration basins. All wastewaters were treated and discharged to surface waters. The plant was contacted regarding specific observations in the daily data and slug loadings to the treatment system. (Source: Supplemental 308 Questionnaire)

Plant No. 0682: Plant 682 is a combined organics and plastics plant, manufacturing thermoplastics, thermoset resins, and specialty organics. The plant treated its wastewater in an activated sludge system. BOD_5 and TSS data were available for the period 1/1/79 - 8/1/81 and included both influent and effluent data. In addition to the discharge of treated wastewater to surface waters, 0.223 MGD of wastewater is discharged after neutralization and primary clarification. 3.703 MGD was discharged untreated and 0.003 MGD was deep well injected. The plant was contacted regarding the flow metering locations. (Source: Public Comments on March 1983 Propoasl)

Plant No. 0741: Plant 741 is an organics plant, manufacturing bulk organics. The plant treated its wastewater in an activated sludge system. The data included influent and effluent BOD_5 and effluent TSS. In addition to the discharge of treated wastewater, 0.072 MGD of waste was sold and <0.001 MGD was incinerated. The plant was contacted regarding slug loadings and treatment plant upsets. (Source: Supplemental 308 Questionnaire)

Plant No. 0908: This combined organics and plastics plant manufactures thermoplastics, and commodity, bulk, and specialty organic chemicals. The plant treated its wastewater in an activated sludge system. BODs and TSS data were available for 1980 and included both influent and effluent data. Intermediate BOD_5 data before the aeration basins was available. In addition to the discharge of treated wastewater, 0.08 MGD of untreated wastewater was discharged and an unquantified amount of waste was incinerated. The plant was contacted regarding specific observations in the data. This plant was scheduled to cease all production activities on January 31, 1985. (Source: Supplemental 308 Questionnaire)

Plant No. 0970: Plant 970 is a plastics plant, manufacturing fibers. The plant treated its wastewater in an activated sludge system. BOD_5 and TSS data were available for the period 2/16/78-12/31/79 and included both influent and effluent data. All wastewater was treated and discharged to surface waters. The plant was contacted regarding treatment plant upsets. (Source: Public Comments on March 1983 Proposal)

Plant No. 1012: Plant 1012 is a plastics plant, manufacturing fibers. The plant used a trickling filter followed by an RBC to treat its wastewaters. BOD_5 and TSS data were available for 1980 (January-December) and included influent, effluent, and intermediate BOD_5 and effluent TSS data. Intermediate BOD_5 data was obtained prior to biological treatment. All process wastewater was treated and discharged to surface waters. (Source: Supplemental 308 Questionnaire)

Plant No. 1062: This plastics plant manufactures thermoplatics. It used an activated sludge system to treat its wastewater. BOD_5 and TSS data were available for the period 1/1/79-5/31/80 and included influent and effluent data. All wastewater was treated and discharged to surface waters. (Source: Data Retained from March 1983 Proposal)

Plant No. 1149: This plant is an organics plant, manufacturing commodity organic chemicals. The plant treated its wastewater in a pure oxygen activated sludge system. BOD_5 and TSS data were available for the period 6/1/78-6/29/80 but were limited to effluent data. In addition to the direct discharge of treated wastewater, 0.439 MGD of wastes were deep well injected and 0.0054 MGD were incinerated. (Source: Data Retained from March 1983 Proposal)

Plant No. 1267: This plastics plant manufactures thermoplastics. The wastewater was treated in an aerated lagoon. BOD_5 and TSS data were available for 1980 (January, March-November) but was limited to effluent data. All plant wastewater was treated and discharged to surface waters. The plant was contacted regarding data gaps and specific observations in the data. (Source: Supplemental 308 Questionnaire)

Plant No. 1407: This combined organics and plastics plant manufactures thermoplastics and specialty organic chemicals. It used an activated sludge system for wastewater treatment. BOD_5 and TSS data were available for the period 1/2/80-12/21/82 and included both influent and effluent data. In addition to the discharge of treated wastes to surface waters, 70 gpd are incinerated. The plant was contacted regarding flow metering locations and plant upsets. (Source: Public Comments on March 1983 Proposal)

Plant No. 1647: Plant 1647 is an organics plant manufacturing specialty organic chemicals. The plant used an activated sludge system to treat its wastewater. BOD_5 and TSS data were available for the period 1/1/83 3/31/84 and included influent and effluent waters. An undetermined quantity of wastes were recycled or contract hauled from the plant. The plant's NPDES permit specified a BOD_5 limit during the winter and a TOD limit during the summer months. The plant was contacted regarding slug loadings to the treatment plant. (Source: Data Obtained During 12 Plant Sampling Study)

Plant No. 1973: This plastics plant manufactures thermoplastics and fibers. The plant used an activated sludge system to treat its wastewaters. BOD_5 and TSS data were available for the period 1/1/75-12/31/77 and includes both influent and effluent data. In addition to direct discharge of treated wastewater, 260 gpd of waste was contract hauled for disposal. (Source: Data Retained from March 1983 Proposal)

Plant No. 1977: This plastics plant manufactures cellulosics and commodity and bulk organic chemicals. The plant used an aerated lagoon for wastewater treatment. Data were available for the periods 1/1/79-12/31/80 and 1/1/82-12/31/82 and included influent BOD_5 and effluent BOD_5 and TSS data. All wastewater was treated and discharged to surface waters. The plant was contacted regarding apparent seasonal trends and specific observations in the daily data. (Source: Supplemental 308 Questionnaire and South Carolina Public Comments on the March 1983 Proposal)

Plant No. 2181: Plant 2181 is a plastics plant, manufacturing thermoplastics. It used a two stage activated sludge system to treat its wastewater. BOD_5 and TSS data were available for 1980 (January-December) and included both influent and effluent data. All wastewater generated by the plant was treated and discharged to surface waters. The plant was contacted regarding specific observations in the daily data. (Source: Supplemental 308 Questionnaire)

Plant No. 2430: This plant is a combined organics and plastics plant, manufacturing thermoplastics and bulk and specialty organic chemicals. The plant used a trickling filter followed by a pure oxygen activated sludge system for waste treatment. BOD_5 and TSS data were available for 1980 (January-December) and included influent, effluent, and intermediate data. The intermediate data were obtained after the trickling filter. All wastewater was treated and discharged to surface waters. The plant was contacted regarding plant upsets. (Source: Supplemental 308 Questionnaire)

Plant No. 2445: Plant 2445 is a combined organics and plastics plant, manufacturing thermoplastics, thermoset resins, and bulk and commodity organic chemicals. The plant treated its wastewater in a pure oxygen activated sludge system. BOD_5 and TSS data were available for 1982 (January-December) and included influent, effluent, and intermediate data. The intermediate data was obtained prior to biological treatment. In addition to the discharge of treated wastes to surface waters, an undetermined quantity of wastes were deep well injected or contract-hauled. The plant was contacted regarding specific observations in the daily data. (Source: Supplemental 308 Questionnaire)

Plant No. 2592: Plant 2592 is a plastics plant manufacturing fibers and miscellaneous organic chemicals. The plant treated its wastewater in an activated sludge system. BOD_5 and TSS data were available for the periods 1/2/79-1/21/79 and 1/1/80-7/31/81 and included influent and effluent data except for January-June 1980 during which only effluent data were available. All wastewater was treated and discharged to surface waters. The plant was contacted regarding apparent seasonal trends and specific observations in the daily data. (Source: Supplemental 308 Questionnaire and Public Comments on the March 1983 Proposal)

Plant No. 2626: This combined organics and plastics plant manufactures thermoplastics and bulk and specialty organic chemicals. The plant used an activated sludge system to treat its wastes. BOD_5 and TSS data were available for 1980 (January-December) and included influent, effluent, and intermediate data. The intermediate data was obtained after primary clarification. All wastewater was treated and discharged to surface waters. The plant was contacted regarding plant upsets and large changes in the flow of wastewater to the plant. (Source: Supplemental 308 Questionnaire

Plant No. 2695: This is an organics plant, manufacturing bulk, commodity, and specialty organic chemicals. The plant used an aerated lagoon followed by a facultative lagoon to treat its wastewaters. Data were available for 1980 (January-December) and included influent TSS and effluent BOD_5

and TSS data. All wastewater was treated and discharged to surface waters. The plant was contacted regarding specific observations in the daily data. (Source: Supplemental 308 Questionnaire)

Rationale for Exclusion of Daily Database Plants from Analysis

Plant No. 0063: The plant effluent is the combined discharge from two treatment systems. One system uses an aerobic lagoon to treat process and nonprocess wastewaters. The other system includes equilization, activated sludge, and secondary clarification but also treats both process and nonprocess wastes. The plant was excluded because 1) the effluent data do not represent a single waste treatment system, 2) the influent data represent only the wastewater to the activated sludge system, and 3) more than 25% of the wastewater treated by both systems consists of nonprocess wastewater. (Source: Supplemental 308 Questionnaire)

Plant No. 0083: A telephone conversation with plant personnel revealed that in August 1980, an unauthorized off-site discharger had tapped into their chemical sewer, thereby drastically increasing their treatment system effluent flow. The practice was later terminated. The plant was excluded due to this change in their treatment system data. The plant was contacted for more detailed waste treatment information. (Source: South Carolina Public Comments on March 1983 Proposal)

Plant No. 0093: Sampling was infrequent (less than once per week during operation) so there was insufficient data available for the plant. The plant discharges to a POTW. (Source: Supplemental 308 Questionnaire)

Plant No. 0296: The plant was excluded because it did not meet the BOD_5 editing rule of at least 95% BODs, removal or greater, or 40 mg/l effluent BOD_5 or less. (Source: Supplemental 308 Questionnaire)

Plant No. 0500: No influent BOD_5 or TSS data are available for this plant. The plant has 3 treatment trains (2 biological, 1 physical/chemical) which discharge to a polishing pond after which the effluent is sampled. The effluent data does not reflect the actual performance of any individual treatment system. (Source: Supplemental 308 Questionnaire)

Plant No. 0659: The plant was excluded because it had summer/winter NPDES permit limitations for BOD_5. The plant was contacted for more detailed waste treatment information. (Source: Supplemental 308 Questionnaire)

Plant No. 0662: The plant was excluded because it had summer/winter NPDES permit limitations for BOD_5, TSS, and TOC. The plant was contacted for more detailed waste treatment information. (Source: Supplemental 308 Questionnaire)

Plant No. 0683: The plant was excluded because more than 25% of their treated wastewater flow consists of nonprocess wastewater. (Source: Supplemental 308 Questionnaire)

Plant No. 0851: The plant was excluded because the effluent data included dilution with cooling water and ion exchange wastes which accounted for 60% of the flow. (Source: Supplemental 308 Questionnaire)

Plant No. 0866: The plant was excluded because it had insufficient BOD_5 and TSS data (samples taken once per month). The plant was contacted for more detailed wastewater information. (Source: Supplemental 308 Questionnaire)

Plant No. 0871: The plant was excluded because it had summer/winter NPDES permit limitations. (Source: Supplemental 308 Questionnaire)

Plant No. 0909: The treatment plant included four independent biological treatment systems, each treating a wastestream from a different production unit. No influent BOD_5 or TSS data were available. Effluent BOD_5 data were also not available. The plant was excluded due to the lack of effluent BOD_5 data. (Source: Supplemental 308 Questionnaire)

Plant No. 0913 The plant effluent is the combined discharge from two non-biological treatment systems. The data available for this plant do not reflect the actual process wastewater performance of either treatment systems due to dilution of process wastewaters by nonprocess wastewaters, which account for over 80% of the flow from one system and 30% of the flow from the other. One treatment system consists of steam stripping and chemical oxidation and the other consists of phase separation and steam stripping. (Source: Supplemental 308 Questionnaire)

Plant No. 0942: No influent BOD_5 or TSS data were available for this plant. Nonprocess wastewater introduced midway through the treatment system accounts for 75% of the plant effluent flow. (Source: Supplemental 308 Questionnaire)

Plant No. 1148: The plant was excluded because it had a polishing pond in its treatment train. (Source: Supplemental 308 Questionnnaire)

Plant No. 1323: The data available for this plant include nonprocess wastewater streams introduced before the sampling point which account for over 90% of the flow. Also, no effluent TSS or influent BOD_5 and TSS data were available. (Source: Supplemental 308 Questionnaire)

Plant No. 1343: The plant was excluded because part of the wastestream is treated by chemical oxidation. The plant was contacted for more detailed wastewater information. (Source: Supplemental 308 Questionnaire)

Plant No. 1349: This plant was excluded because it did not submit data for a full year, and because it had polishing pond in its treatment train. (Source: Data Retained from March 1983 Proposal)

Plant No. 1438: The plant was excluded because more than 25% of the wastewater treatment stream flow consists of nonprocess water. The plant was contacted for more detailed wastewater information. (Source: South Carolina Public Comments on the March 1983 Proposal)

Plant No. 1446: The plant was excluded because the effluent data was taken after tertiary treatment (activated carbon columns). The plant was contacted for more detailed wastewater information. (Source: Supplemental 308 Questionnaire)

Plant No. 1494: The plant was excluded due to periods of production cutbacks. The plant was contacted regarding the abrupt changes in its wastewater flow. (Source: Supplemental 308 Questionnaire)

Plant No. 1522: No BOD_5 data were available for this plant. Also, several additional process wastestreams enter the treatment plant midway through the treatment system. No data are available for these sidestreams which account for 70% of the wastewater treated by the system. (Source: Supplemental 308 Questionnaire)

Plant No. 1609: The plant was excluded due to periods of production shutdown during June, July, and August 1980. The plant was contacted for more detailed wastewater information. (Source: Supplemental 308 Questionnaire)

Plant No. 1617: The plant was excluded because it had a summer/winter NPDES permit limitation for BOD_5 and because it had a polishing pond in its treatment train. The plant was contacted for more detailed wastewater information. (Source: Supplemental 308 Questionnaire)

Plant No. 1650: No influent BOD_5 or TSS data were available for this plant. Several side streams enter the treatment plant midway through the treatment train. (Source: Supplemental 308 Questionnaire and Public Comments on the March 1983 Proposal)

Plant No. 1695: A telephone conversation with plant personnel revealed that several events occurred in 1980 which affected the wastewater treatment system operation. They were 1) a 40% increase in production, 2) the addition of new process units, and 3) periods of total production shutdown during the installation of the new units. The plant also has a polishing pond in its treatment train. The plant was excluded due to these factors. The plant was contacted regarding observations in its data. (Source: Supplemental 308 Questionnaire)

Plant No. 1753: The plant was excluded because it had summer/winter NPDES permit limitations for BOD_5 and COD. The plant was contacted for more detailed wastewater information. (Source: Supplemental 308 Questionnaire)

Plant No. 1766: The plant was excluded because it added powdered activated carbon to its wastewater. (Source: Supplemental 308 Questionnaire)

Plant No. 1769: Flow data are reported for the treated process wastewater, but the effluent BOD_5 and TSS samples were collected after dilution of 1:1 with noncontact cooling water in a polishing pond. (Source: Supplemental 308 Questionnaire)

Plant No. 2110: No influent BOD_5 or TSS data were available for this plant. Also, more than 25% of the treated wastewater consists of nonprocess wastewater. (Source: Supplemental 308 Questionnaire)

Plant No. 2222: The data available for this plant do not reflect actual process wastewater treatment system performance. Flow data are reported for the treated process water but the effluent BOD_5 and TSS data were collected after dilution with nonprocess wastewaters (one part treatment plant effluent to eight parts nonprocess wastewater). The plant was contacted for more detailed wastewater treatment information. (Source: Public Comments on March 1983 Proposal)

Plant No. 2227: The plant was excluded because it had a summer/winter NPDES permit limitation for BOD_5. The plant was contacted for more detailed wastewater information. (Source: Supplemental 308 Questionnaire)

Plant No. 2242: This plant had submitted 1982 data instead of 1980 data (with EPA's permission). A telephone conversation with plant personnel revealed that a production change in 1981 had resulted in a 50% decrease in the load to the treatment system. As a result, the plant only operated one of their two aeration basins. The plant was excluded because their 1982 treatment efficiency is not representative of what they could achieve if they operated both basins. The plant was contacted for more detailed wastewater information. (Source: Supplemental 308 Questionnaire)

Plant No. 2260: The plant was excluded due to insufficient information regarding the technical assessment of their treatment system. The plant was contacted for more detailed wastewater information. (Source: Public Comments on the March 1983 Proposal)

Plant No. 2313: The plant was excluded because it had summer/winter NPDES permit limitations. The plant was contacted for more detailed wastewater information. (Source: Data obtained during 12 Plant Sampling Study)

Plant No. 2315: The data available for this plant do not reflect actual process wastewater treatment system performance due to dilution of treated process wastewaters with cooling water and stormwater which accounted for over 75% of the flow. (Source: Supplemental 308 Questionnaire)

Plant No. 2376: The plant was excluded because it used a three-stage, pure oxygen activated sludge system plus tertiary treatment to treat its wastewater. The plant was contacted regarding apparent seasonal effects in the daily data. (Source: Supplemental 308 Questionnaire)

Plant No. 2394: The plant was excluded because it added an aerated lagoon to its system in 1982, and because they employ a polishing pond in their treatment train. The plant was contacted for more detailed wastewater information. (Source: Data obtained during 12 Plant Sampling Study)

Plant No. 2474: Nonprocess wastewaters account for over 95% of the raw wastewater entering the treatment system. Consequently the data are not representative of raw and treated OCPSF wastes. The plant was contacted for more detailed wastewater information. (Source: Supplemental 308 Questionnaire)

Plant No. 2528: The plant was excluded because they employ a polishing pond in their treatment train, and the effluent data is taken after this step. The plant was contacted for more detailed wastewater information. (Source: Supplemental 308 Questionnaire)

Plant No. 2531: No influent BOD_5 or TSS data were available for this plant. Effluent samples were taken once per week and do not reflect process wastewater treatment system performance due to dilution of the treated process wastewaters with noncontact cooling water and stormwater which accounted for over 80% of the flow. The treatment system consists solely of physical/chemical treatment processes. (Source: Supplemental 308 Questionnaire)

Plant No. 2536: The plant was excluded because it had a summer/winter NPDES permit limitation for BOD_5 since 1982, and because its wastewater received tertiary treatment. The plant was contacted for more detailed wastewater information. (Source: Supplemental 308 Questionnaire and Data Obtained During the 12 Plant Sampling Study)

Plant No. 2631: The plant was excluded because its wastestream is diluted by more than 25% nonprocess wastewater. The plant was contacted for more detailed wastewater information. (Source: Supplemental 308 Questionnaire)

Plant No. 2680: No influent BOD_5 or TSS data were available for this plant. Effluent samples were taken once per week and do not reflect process wastewater treatment system performance due to dilution of the treated process wastewater with nonprocess wastes which accounted for over 30% of the flow. The treatment system employs physical/chemical treatment only. (Source: Supplemental 308 Questionnaire)

Plant No. 2693: The plant was excluded because it had summer/winter NPDES permit limitations for BOD_5, TSS, and TOC. The plant was contacted for more detailed wastewater information. (Source: Public Comments on the March 1983 Proposal)

Plant No. 2770: No influent BOD_5 or TSS data were available for this plant. The treatment system employs equilization, neutralization, and clarification only. (Source: Supplemental 308 Questionnaire)

Plant No. 2816: The plant was excluded because its wastestream contains more than 25% nonprocess wastewater, and its effluent data were taken after additional treatment steps. The plant was contacted regarding observations in its daily data. (Source: Public Comments on the March 1983 Proposal)

Plant No. 3033: The plant was excluded because it had a summer/winter NPDES permit limitation for BOD_5, and because they had a polishing pond in their treatment train. The plant was contacted regarding observations in its daily data. (Source: Data Obtained During 12 Plant Sampling Study)

APPENDIX VII-D
BPT STATISTICAL METHODOLOGY

A. VARIABILITY FACTOR DEVELOPMENT FOR BOD_5 AND TSS EFFLUENT CONCENTRATIONS

A.1. DAILY VARIABILITY FACTORS

Assuming that the distribution of concentration values X is lognormal, then Y = ln(X) is normally distributed with mean μ and variance σ^2 (Aitchison and Brown 1957). Thus, the 99th percentile on the natural logarithm (base e) scale is

$$Y_{99} = \mu + 2.326\sigma,$$

and the 99th percentile on the concentration scale is

$$P_{99} = \exp(Y_{99}) = \exp(\mu + 2.326\sigma). \quad (1)$$

The expected value, E(X), and variance, V(X), on the concentration scale are:

$$E(X) = \exp(\mu + 0.5\sigma^2) \quad (2)$$

and

$$V(X) = \exp(2\mu + \sigma^2)(\exp(\sigma^2) - 1). \quad (3)$$

The estimates of any of the above quantities are calculated by substituting the sample mean and variance of the natural logarithms of the observations for μ and σ^2, respectively. Hence, the 99th percentile daily variability factor, VF(1), is

$$VF(1) = \frac{\hat{P}_{99}}{E(X)} = \exp(2.326\hat{\sigma} - 0.5\hat{\sigma}^2), \quad (4)$$

where

$$\hat{\mu} = \frac{1}{n} \sum_{i=1}^{n} y_i , \quad (5)$$

and

$$\hat{\sigma}^2 = \sum_{i=1}^{n} (y_i - \hat{\mu})^2 / (n - 1). \quad (6)$$

A.2 30-DAY MEAN VARIABILITY FACTORS

Variability factors for 30-day average concentrations, VF(30), are based on the distribution of an average of values drawn from the distribution of daily values and take day-to-day correlation into account. Positive autocorrelation between concentrations measured on consecutive days means that such concentrations tend to be similar. An average of positively correlated concentration measurements is more variable than an average of independent concentrations. The following formulas incorporate the autocorrelation between concentration values measured on adjacent days.

Using the first-order autoregressive model commonly found to be appropriate in water pollution modeling, and assuming that these concentration values follow a lognormal distribution with parameters μ and σ, the mean and variance of an average of n daily values, where this average is denoted by $\bar{X}_n$, are approximated by

$$E(\bar{X}_n) = E(X) = \exp(\mu + 0.5\sigma^2) \tag{7}$$

and

$$V(\bar{X}_n) = \frac{V(X)}{n} f_n(\rho), \tag{8}$$

with

$$f_n(\rho) = 1 + [(2/n) \sum_{k=1}^{n-1} (n - k)(\exp(\rho^k \sigma^2) - 1)/(\exp(\sigma^2) - 1)]. \tag{9}$$

It can be seen in (8) that $V(\bar{X}_n)$ equals the variance of an average of n uncorrelated observations, V(X)/n, multiplied by a factor, $f_n(\rho)$, that adjusts for the presence of autocorrelation, with ρ denoting the correlation between adjacent days' measurements (i.e., the lag-1 autocorrelation).

Finally, since $\bar{X}_{30}$ is approximately normally distributed by the Central Limit Theorem, the estimate of 95th percentile ($\hat{P}_{95}$) of a 30-day mean and the corresponding 95th percentile 30-day mean variability factor (VF(30)) are approximately

$$\hat{P}_{95} = \hat{E}(\bar{X}_{30}) + 1.645 \cdot (\hat{V}(\bar{X}_{30}))^{1/2} \tag{10}$$

and $$VF(30) = \hat{P}_{95}/\hat{E}(\bar{X}_{30})$$

$$= 1 + 1.645[(\exp(\hat{\sigma}^2) - 1)f_{30}(\hat{\rho})/30]^{1/2} \qquad (11)$$

where $\hat{E}(\bar{X}_{30})$ and $\hat{V}(\bar{X}_{30})$ are calculated by setting $n = 30$ in equations (7) and (8), using $\hat{\mu}$ and $\hat{\sigma}^2$ as defined in (5) and (6), and defining $\hat{\rho}$ as the Pearson product-moment correlation coefficient between the logarithm of adjacent days' measurements (i.e., the estimated lag-1 autocorrelation).

The sampling patterns of BOD_5 and TSS vary from plant to plant, and certain plants have no or a sparse number of adjacent days' measurements from which to estimate a lag-1 autocorrelation. For these plants, the estimated correlation used in the above formula was set equal to the arithmetic average of the estimated correlations from the other plants. For BOD_5 effluent, this average was 0.610713, based on 16 plants. For TSS effluent , this average was 0.511823, based on 14 plants. The following plants use these arithmetic averages of the estimated correlations:

BOD_5	TSS
908	444
1267	525
1407	908
2181	1267
2695	1407
	2695

APPENDIX VII-D, SECTION B. REFERENCES

Aitchison, J. and J.A.C. Brown, 1957. The Lognormal Distribution, London: Cambridge University Press, pp. 95-6.

APPENDIX VII-E

DISTRIBUTIONAL HYPOTHESIS TESTING

A. GOODNESS-OF-FIT PROCEDURES

The Studentized range test was used to test the assumption that concentration values follow a lognormal distribution (i.e., the natural logarithm of the concentration values follows a normal distribution). This test was used for all plant-pollutant combinations for which variability factors were developed. The pollutants included both priority pollutants and conventional pollutants (BOD_5 and TSS effluent). To conduct this test, let $x_1, x_2, \ldots, x_n$ be a set of n nonzero concentration values for a particular plant-pollutant combination, and let y_i ($i = 1, \ldots, n$) be the natural logarithm of these concentrations (i.e., $y_i = \ln(x_i)$, $i = 1, \ldots, n$). The Studentized range test is based on the test statistic $U = R/S$, where

$R = y_{(n)} - y_{(1)}$, where $y_{(n)}$ is the natural logarithm of the largest concentration value, and $y_{(1)}$ is the natural logarithm of the smallest concentration value,

and $$S = \left[\frac{1}{n-1} \sum_{i=1}^{n} (y_i - \bar{y})^2 \right]^{1/2}, \quad \text{where } \bar{y} = \frac{1}{n} \sum_{i=1}^{n} yi .$$

An upper tail test was used to guard against alternative distributions with heavier tails than the lognormal distribution, and a significance level of $\alpha = 0.01$ was employed for each test.

Critical values for the hypothesis test involving the U statistic are given in David, et al. (1954), and selected values for various sample sizes are shown below (in particular, upper percentage points for $\alpha = 0.01$).

n	$U_{0.99}$	n	$U_{0.99}$
3	2.000	17	4.59
4	2.445	18	4.66
5	2.803	19	4.73
6	3.095	20	4.79
7	3.338	30	5.25
8	3.543	40	5.54
9	3.720	50	5.77
10	3.875	60	5.93
11	4.012	80	6.18
12	4.134	100	6.36
13	4.244	150	6.64
14	4.34	200	6.85
15	4.43	500	7.42
16	4.51	1000	7.80

When the hypothesis of a lognormal distribution is tested at a significance level of $\alpha = 0.01$ for the various plant-pollutant distributions of detected priority pollutant concentration values used for variability factor analysis, only one hypothesis test (out of 40 distinct plant-pollutant combinations investigated) shows a significant result, (Propylene Chloride [32], Plant 415T, n = 15, U = 4.44, p-value <0.01; used for BAT Subcategory One limitations). The remaining 39 distributions corresponding to the various plant-pollutant combinations used in variability factor analyses are nonsignificant at the $\alpha = 0.01$ significance level. Results of hypothesis tests of the lognormality of the distributions of conventional pollutant (BOD_5 and TSS effluent) concentrations, for the plants used for variability factor analyses, are given in Tables E-1 and E-2, respectively.

TABLE E-1.

GOODNESS-OF-FIT TESTS FOR BOD_5 EFFLUENT DAILY DATA: NULL HYPOTHESIS OF LOGNORMAL DISTRIBUTION

Plant	Test Statistic*	n	Significance**
387	5.23	160	N.S.
444	6.36	154	N.S.
525	4.59	203	N.S.
682	4.61	207	N.S.
741	5.85	156	N.S.
908	4.83	96	N.S.
970	6.47	155	N.S.
1012	5.73	357	N.S.
1062	5.86	261	N.S.
1149	7.28	160	<0.005
1267	4.70	84	N.S.
1407	4.68	48	N.S.
1647	6.48	359	N.S.
1973	4.36	157	N.S.
1977	5.36	153	N.S.
2181	3.85	124	N.S.
2430	7.96	366	<0.005
2445	7.48	347	<0.005
2592	6.05	154	N.S.
2626	5.75	363	N.S.
2695	6.25	143	N.S.

*Test Statistic U = R/S (see discussion of Studentized range test)

**N.S. indicates nonsignificant at $\alpha = 0.01$ level of significance; when results are significant at the $\alpha = 0.01$ level, an approximate p-value is given.

TABLE E-2.

GOODNESS-OF-FIT TESTS FOR TSS EFFLUENT DAILY DATA: NULL HYPOTHESIS OF LOGNORMAL DISTRIBUTION

Plant	Test Statistic*	n	Significance**
387	6.02	158	N.S.
444	6.71	159	<0.01
525	4.77	155	N.S.
682	7.32	361	<0.01
908	4.87	99	N.S.
970	6.34	362	N.S.
1012	5.86	366	N.S.
1062	6.00	260	N.S.
1149	6.42	363	N.S.
1267	5.34	130	N.S.
1407	4.99	48	N.S.
1647	6.77	366	N.S.
1973	4.92	347	N.S.
1977	4.35	154	N.S.
2181	6.08	366	N.S.
2430	4.23	366	N.S.
2445	8.39	365	<0.005
2592	6.01	135	N.S.
2626	6.38	366	N.S.
2695	5.54	146	N.S.

*Test Statistic U = R/S (see discussion of Studentized range test)

**N.S. indicates nonsignificant at $\alpha = 0.01$ level of significance; when results are significant at the $\alpha = 0.01$ level, an approximate p-value is given.

APPENDIX VII-E, SECTION B. REFERENCES

David, H.A., H.O. Hartley, and E.S. Pearson. 1954. The Distribution of the Ratio, in a Single Normal Sample, of Range to Standard Deviation. Biometrika 41:482-93.

APPENDIX VII-F
BAT STATISTICAL METHODOLOGY

A. VARIABILITY FACTOR DEVELOPMENT

In the process of developing limitations for effluent concentrations, EPA used a modification of the estimation procedure for the delta-lognormal distribution for determining variability factors. The delta-lognormal distribution (discussed in Aitchison and Brown 1957) can be expressed as a mixture of the lognormal distribution for concentration values greater than zero, and a point distribution for concentration values of zero. That is, the delta-lognormal distribution for concentration values x can be expressed as

$$f(x) = \delta\, I(x_0) + (1 - \delta)\, g(x)$$

where $0 \leq \delta \leq 1$,

$$I(x_0) = 1 \text{ for } x_0 = 0$$
$$= 0 \text{ elsewhere,}$$

and
$$g(x) = (2\pi\sigma^2)^{-1/2} \exp\left[\frac{-(\ln(x) - \mu)^2}{2\sigma^2}\right]\frac{1}{x} \quad \text{for } x > 0$$
$$= 0 \quad \text{elsewhere.}$$

The 99th percentile of this distribution is $P_{99} = \exp(\mu + z^*\sigma)$, where $z^* = \Phi^{-1}\left(\frac{0.99 - \delta}{1 - \delta}\right)$, where Φ^{-1} represents the inverse of the standard normal cumulative distribution function.

The mean or expected value, E(X), and the variance, V(X), of the delta-lognormal distribution, are as follows:

$$E(X) = (1 - \delta)\exp(\mu + 0.5\sigma^2)$$
$$V(X) = (1 - \delta)\exp(2\mu + \sigma^2)[\exp(\sigma^2) - (1 - \delta)].$$

This distribution is appropriate when positive concentration values are lognormally distributed, and a proportion of concentration values equal to zero exist. Note that this distribution is the usual two parameter lognormal distribution when $\delta = 0$.

Consider now a modification of the estimation procedure for this distribution where a certain proportion of values are assumed to be at a non-negative value D. This modification is used for a combination of positive concentration values and observations that can only be quantified as nondetect (ND) at some minimum level (or detection limit), D. All nondetects will be incorporated at this point D. That is:

$$f(x) = \delta\, I(x_0) + (1 - \delta)\, g(x)$$

where $0 \le \delta \le 1$,

$I(x_0) = 1$ for $x_0 = D$ (for nondetected values)

$= 0$ elsewhere,

$$\text{and } g(x) = (2\pi\sigma^2)^{-1/2} \exp\left[\frac{-(\ln(x) - \mu)^2}{2\sigma^2}\right]\frac{1}{x} \quad \text{for } x > 0$$

$$= 0 \qquad \text{elsewhere.}$$

The 99th percentile is:

$$P_{99} = \max(D, \exp(\mu + z^{*}\sigma)),$$

and the mean and variance are:

$$E(X) = \delta D + (1 - \delta)\exp(\mu + 0.5\sigma^2)$$

$$V(X) = (1 - \delta)\exp(2\mu + \sigma^2)(\exp(\sigma^2) - (1 - \delta)) + \delta(1 - \delta) D (D - 2\exp(\mu + 0.5\sigma^2)).$$

B. MODIFICATION OF THE ESTIMATION PROCEDURE FOR THE DELTA-LOGNORMAL DISTRIBUTION

B.1 DAILY VARIABILITY FACTORS

The 99th percentile of daily concentrations was estimated by substituting the sample logmean and logvariance of concentration values and the sample proportion of nondetects into the mathematical formula for the 99th percentile of the modification of the estimation procedure for the delta-lognormal distribution described previously. The expectation of the daily values was estimated by substituting the sample logmean and logvariance of concentration values and the sample proportion of nondetects into the formula for the mean of this distribution.

Let $x_1, x_2, \ldots, x_r, x_{r+1}, \ldots, x_n$ be a random sample of size n, with r observations recorded as nondetects, and n - r observations recorded as concentration values. Assume these n - r observations come from a lognormal distribution, and let $\hat{\mu}$ and $\hat{\sigma}^2$ be the sample mean and variance, respectively, of ln(X). Let $\hat{\delta}$ be the sample proportion of nondetects. Then the estimate of the mean of this distribution, based upon the modification to the estimation procedure for the delta-lognormal distribution, is:

$$\hat{E}(X) = \hat{\delta} D + (1 - \hat{\delta}) \exp(\hat{\mu} + 0.5\hat{\sigma}^2) \qquad \text{(B-1)}$$

$$\text{where } \hat{\mu} = \frac{\sum_{i=r+1}^{n} \ln(x_i)}{n - r} \quad \text{(calculated for } r < n\text{),} \qquad \text{(B-2)}$$

$$\hat{\sigma}^2 = \frac{\sum_{i=r+1}^{n} (\ln(x_i) - \hat{\mu})^2}{n - r - 1} \quad \text{(calculated for } r < n - 1\text{),} \qquad \text{(B-3)}$$

$$\text{and } \hat{\delta} = \frac{r}{n}. \qquad \text{(B-4)}$$

The ln(·) notation presented above represents the natural logarithm (base e), and this notation will be used in subsequent formulas. The estimate of the 99th percentile is:

$$\hat{P}_{99} = \begin{cases} D & \hat{\delta} \geq 0.99 \\ \max\left(D, \exp(\hat{\mu} + z^{*}\hat{\sigma})\right) & \text{elsewhere} \end{cases} \qquad \text{(B-5)}$$

$$\text{where } z^{*} = \Phi^{-1}\left(\frac{0.99 - \hat{\delta}}{1 - \hat{\delta}}\right) .$$

Using expressions (B-1) and (B-5) the 99th percentile daily variability factor, VF(1), is:

$$VF(1) = \frac{\hat{P}_{99}}{\hat{E}(X)} .$$

B.2 VARIABILITY FACTOR OF 4-DAY MEANS

The procedure for estimating the 95th percentile of 4-day means was first to substitute the sample logmean, sample logvariance, and sample proportion of nondetects into the mathematical formulas of the logmean and the logvariance of 4-day means of values, where the modification of the estimation procedure for the delta-lognormal distribution, as described previously, was used. The logmean and the logvariance of 4-day means, in turn, were used to estimate the 95th percentile of the distribution of 4-day means, based on this modification. The estimate of the expectation of 4-day means is the same as the estimate of the expectation of daily values, assuming this modification of the estimation procedure for the delta-lognormal distribution (as in section B.1), where values of the sample logmean, sample logvariance, and sample proportion of nondetects are incorporated. The 95th percentile 4-day mean variability factor was derived as the ratio of this estimate of the 95th percentile of 4-day means to this estimate of the expectation.

The mean of the distribution of concentration values, based on this modification, is

$$E(X) = \delta D + (1 - \delta) \exp(\mu + 0.5\sigma^2) \tag{B-6}$$

Making the assumption that the approximating distribution of $\bar{X}_4$, the sample mean for a random sample of four independent concentrations, is also derived from this modification of the estimation procedure for the delta-lognormal distribution, with the same mean as the distribution of concentration values, and with variance proportional to the variance of the distribution of concentration values (Barakat 1976), it follows that the mean of this distribution is

$$E(\bar{X}_4) = \delta_4 D + (1 - \delta_4) \exp(\mu_4 + 0.5\sigma_4^2) \tag{B-7}$$

Using (B-7), it can be seen that

$$\mu_4 = \ln \left(\frac{E(\bar{X}_4) - \delta_4 D}{1 - \delta_4} \right) - 0.5\sigma_4^2 . \tag{B-8}$$

Since $E(X) = E(\bar{X}_4)$ and $\delta_4 = \delta^4$,

$$\mu_4 = \ln \left(\frac{E(X) - \delta^4 D}{1 - \delta^4} \right) - 0.5\sigma_4^2 . \tag{B-9}$$

To derive an expression for σ_4^2, we use the following relationships:

$$V(X) = (1 - \delta) \exp(2\mu + \sigma^2) [\exp(\sigma^2) - (1 - \delta)] + \delta (1 - \delta) D [D - 2 \exp(\mu + 0.5\sigma^2)] \tag{B-10}$$

$$V(\bar{X}_4) = (1 - \delta_4) \exp(2\mu_4 + \sigma_4^2) [\exp(\sigma_4^2) - (1 - \delta_4)] + \delta_4 (1 - \delta_4) D [D - 2 \exp(\mu_4 + 0.5\sigma_4^2)] . \tag{B-11}$$

Using (B-7) and (B-11) it follows that

$$\sigma_4^2 = \ln \left\{(1 - \delta_4) + \frac{(1 - \delta_4)[V(\bar{X}_4) - \delta_4(1 - \delta_4)D[D - 2\cdot\exp(\mu_4 + 0.5\sigma_4^2)]]}{[E(\bar{X}_4) - \delta_4 D]^2}\right\} \quad \text{(B-12)}$$

From (B-7), by rearranging terms,

$$\exp(\mu_4 + 0.5\sigma_4^2) = \frac{E(\bar{X}_4) - \delta_4 D}{(1 - \delta_4)} \quad \text{(B-13)}$$

using (B-12) and (B-13),

$$\sigma_4^2 = \ln \left\{(1 - \delta_4)\left[1 + \frac{V(\bar{X}_4)}{[E(\bar{X}_4) - \delta_4 D]^2} - \frac{\delta_4(1 - \delta_4)D^2}{[E(\bar{X}_4) - \delta_4 D]^2} + \frac{2\ \delta_4 D}{E(\bar{X}_4) - \delta_4 D}\right]\right\} \quad \text{(B-14)}$$

Since $V(X) = V(\bar{X}_4)/4$, $E(X) = E(\bar{X}_4)$, and $\delta_4 = \delta^4$, expression (B-14) can be rewritten as:

$$\sigma_4^2 = \ln \left\{(1 - \delta^4)\left[1 + \frac{V(X)}{4[E(X) - \delta^4 D]^2} - \frac{\delta^4(1 - \delta^4)D^2}{[E(X) - \delta^4 D]^2} + \frac{2\ \delta^4 D}{E(X) - \delta^4 D}\right]\right\} \quad \text{(B-15)}$$

Using values of $\hat{\delta}$ (sample proportion of nondetects), $\hat{\mu}$ (sample logmean of the concentrations), and $\hat{\sigma}^2$ (sample logvariance), defined in (B-2) through (B-4) as estimates of δ, μ, and σ^2, respectively, in expressions (B-9) and (B-15) yields estimates of μ_4 and σ_4^2, denoted by $\hat{\mu}_4$ and $\hat{\sigma}_4^2$, respectively.

Using these estimates of μ_4, σ_4, and δ^4, the estimate of the 95th percentile of $\bar{X}_4$, is

$$\hat{P}_{95} = \begin{cases} D & \hat{\delta}^4 \geq 0.95 \\ \max(D, \exp(\hat{\mu}_4 + z_4^* \hat{\sigma}_4)) & \text{elsewhere} \end{cases} \quad \text{(B-16)}$$

where $z_4^* = \Phi^{-1}\left(\frac{0.95 - \hat{\delta}^4}{1 - \hat{\delta}^4}\right)$.

Using (B-16) and (B-1), since $E(X) = E(\bar{X}_4)$, the 95th percentile 4-day mean variability factor is

$$VF(1) = \frac{\hat{P}_{95}}{\hat{E}(X)} .$$

C. POLLUTANT VARIABILITY FACTORS

Using the methodology described in section B, daily and 4-day mean variability factors were calculated for plant-pollutant combinations in the 5-plant study and the 12-plant sampling study, which have at least 3 single-day averages for which detected concentration values are recorded. At least seven single-day averages for which concentration values (including detected and nondetected values) are present for all of these plant-pollutant combinations. Plants 267P and 1753P, received from public comments, are also used for determining variability factors for BAT subcategory one. For BAT subcategory two, plant 913P, received from public comments, was used for determining variablity factors, as well as plants from the 5-plant and 12-plant studies. All of the 5-plant study plants, all of the 12-plant study plants, and the plants above from the public comments are subsequently referred to as daily data plants.

Average daily and 4-day mean variability factors for each pollutant were calculated by averaging plant-pollutant variability factors across all plants for each pollutant for which variability factor information was present. For some pollutants, variability information was limited. For these pollutants for BAT subcategory one, variability factors were extrapolated from the variability factors for groups of pollutants with related chemical structure and thus comparable treatment variability. This extrapolation involved using the average variability factor of all existing pollutant variability factors in the group. Variability factors for pollutants for which no group variability factor was available were extrapolated by averaging all pollutant-specific variability factors. The daily variability factor was 4.83045 and the 4-day variability factor was 1.91724. These variability factors are used for the following pollutants for BAT subcategory one:

- 3: Acrylonitrile
- 35: 2,4-Dinitrotoluene
- 36: 2,6-Dinitrotoluene
- 42: Bis(2-chloroisopropyl)Ether
- 52: Hexachlorobutadiene
- 56: Nitrobenzene.

Transfer of variability factors, for pollutants regulated in BAT subcategory two without individual variability factors, was accomplished by the in-plant control technology present. Details on this transfer are given in Chapter VII.

D. LONG-TERM AVERAGES AND LIMITATIONS

To estimate long-term averages for each plant-pollutant combination in the 5-plant study, the 12-plant sampling study, data from public comments, and the verification study, the Agency has estimated long-term averages (m) as follows:

$$m = \delta D + (1 - \delta) \frac{\sum_{i=1}^{n_1} x_i}{n_1} ,$$

where x_i, $i = 1, \ldots, n_1$, denotes the n_1 detected observations, D is the pollutant-specific analytical minimum level, and δ is an estimate of the proportion of nondetects. For those plant-pollutant combinations for which all nondetects are present, m = D, and for those combinations for which all detects are present, m is the arithmetic average of these observations. The Agency believes that the value of δ, derived from the proportion of nondetects present in the daily data (as defined in Section C), is the best estimate of the percent of nondetect values reported. That is, δ, the best estimate of the proportion of nondetect values, is

$$\delta = \frac{\text{total number of reported nondetect values from all daily data plants for a particular pollutant}}{\text{total number of values reported from all daily data plants for a particular pollutant}}$$

For pollutants not present in the daily data base, the value of δ was estimated from the proportion of nondetect values within the associated group.

After estimating plant-pollutant long-term averages in this fashion, the median value of these estimated long-term averages for a given pollutant is determined, and this median of estimated long-term averages is multiplied by the average pollutant daily variability factor to determine daily limitations for each pollutant. The average 4-day mean variability factor is multiplied by this median average value to determine 4-day mean limitations for each pollutant.

E. METHODOLOGY FOR DERIVING 4-DAY VARIABILITY FACTORS FOR TRANSFER OF METAL FINISHING LIMITATIONS

The OCPSF BAT monthly maximum limitations are based on an assumed 4 samples per month, but the metal finishing monthly maxima are based on 10 samples per month. Thus, to transfer the metal finishing limitations (EPA 1983) to the OCPSF industry, 4-day variability factors must be derived to yield equivalent monthly maximum limitations based on an assumed 4 samples per month.

For a particular pollutant, let LTA denote the long-term average and let VF_1 be the daily variability factor from the metal finishing industry. For the OCPSF effluent guideline, the daily maximum is given by $LTA \cdot VF_1$ and the monthly maximum is given by $LTA \cdot VF_4$, where VF_4 is the 4-day variability factor.

To derive VF_4 to complete the transfer of limitations, we assume--consistent with both OCPSF and metal finishing--that the daily samples are lognormally distributed and that the basis of VF_1 is the 99th percentile. If the parameters in the lognormal distribution are μ and σ, then the mean, 99th percentile, and daily variability factors are given by

$$E(X) = \exp(\mu + 0.5\sigma^2),$$

$$\text{99th percentile} = \exp(\mu + Z_{99} \cdot \sigma),$$

and

$$VF_1 = \exp(Z_{99} \cdot \sigma - 0.5\sigma^2),$$

where $Z_{99} = 2.326$. Therefore, given VF_1 from metal finishing,

$$\sigma = Z_{99} - [Z_{99}^2 - 2 \ln (VF_1)]^{1/2}.$$

Now the 4-day variability factor based on the 95th percentile is given by

$$VF_4 = \exp(Z_{95} \cdot \sigma_4 - 0.5\sigma_4^2),$$

where

$$\sigma_4^2 = \ln[1 + (\exp(\sigma^2) - 1)/4], \text{ and } Z_{95} = 1.645. \quad \text{(E-1)}$$

Both of these expressions are based on the Barakat assumption used in section B of this appendix.

For a lognormal distribution, the coefficient of variation is given by $(\exp(\sigma^2) - 1)^{1/2}$. Observe that using this relationship in the form

$$V(X)/[E(X)]^2 = \exp(\sigma^2) - 1$$

and setting $\delta=0$ in equation (B-15) yields equation (E-1).

Intermediate steps in the computation of VF_4 based on the metal finishing LTA and VF_1 are presented in Table F-1 and the daily and monthly maxima are given in Table F-2. The variability factors are derived by substituting the value of $\hat{\sigma}$ presented in Table F-1 in the above equations.

TABLE F-1.

INTERMEDIATE COMPUTATIONS

Pollutant (all total)	LTA - mg/l*	VF_1*	$\hat{\sigma}$	$\hat{\sigma}_4$	VF_4
Chromium	.572	4.85	.825	.467	1.93
Copper	.815	4.15	.725	.399	1.78
Lead	.197	3.52	.625	.336	1.64
Nickel	.942	4.22	.735	.406	1.80
Zinc	.549	4.75	.811	.458	1.91
Cyanide	.18	6.68	1.056	.644	2.34

*From EPA 1983, page A-11.

TABLE F-2.

OCPSF LIMITATIONS

Pollutant	Daily Maximum (mg/l)	Monthly Maximum (mg/l)
Chromium	2.77	1.11
Copper	3.38	1.45
Lead	.69	.32
Nickel	3.98	1.69
Zinc	2.61	1.05
Cyanide	1.20	.42

APPENDIX VII-F, SECTION E. REFERENCES

Aitchison, J., and J.A.C. Brown. 1957. The Lognormal Distribution. London: Cambridge University Press, pp. 95-6.

Barakat, R. 1976. Sums of Independent Lognormally Distributed Random Variables. Journal Optical Society of America, 66:211-16.

U.S. EPA, Development Document for Effluent Limitations Guidelines and Standards for the Metal Finishing Point Source Category, EPA 440/1-83/091, June 1983.

APPENDIX VII-G

EVALUATION OF THE VALIDITY OF
USING FORM 2C DATA TO CHARACTERIZE
PROCESS AND FINAL EFFLUENT WASTEWATER
JUNE 17, 1985

APPENDIX VII-G

FINAL

EVALUATION OF THE VALIDITY OF USING FORM 2C DATA TO CHARACTERIZE PROCESS AND FINAL EFFLUENT WASTEWATER

PREPARED FOR:

The Industrial Technology Division
U.S Environmental Protection Agency
401 M Street, S.W.
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VI. EVALUATION OF THE VALIDITY OF USING FORM 2C DATA TO CHARACTERIZE PROCESS AND FINAL EFFLUENT WASTEWATER

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1.0 INTRODUCTION

1.1 BACKGROUND

Industry comments on the March 21, 1983, proposed OCPSF regulations stated that the toxic pollutant loadings were overestimated and suggested that the Agency rely on the NPDES permit application Form 2C toxic pollutant data for determining toxic pollutant loadings. Industry representatives also questioned the need to establish BAT Limitations on a wide range of toxic pollutants. They maintain that available NPDES Permit application Form 2C data constitute the most appropriate and extensive data base for predicting the extent of occurrence of priority pollutants in the OCPSF industry. They argue that NPDES Form 2C data submitted by OCPSF manufacturers indicate that only a few priority pollutants are detected in treated discharges and conclude that existing treatment systems, installed principally for the control of conventional pollutants, do an excellent job of controlling priority pollutant discharges.

The purpose of this report is to evaluate the validity of the industry's interpretation of effluent data in general and NPDES Form 2C toxic pollutant data in particular.

1.2 SUMMARY AND CONCLUSIONS

Since the OCPSF regulations apply to process wastewater only, the Agency determined the relative contributions of process and nonprocess wastewater at the effluent sample sites. This data was used to calculate plant-by-plant "dilution factors" for use in adjusting or assessing analytical data at effluent sampling locations. This information was used to determine if reported Section 308 and Form 2C final effluent concentration data could be used to adequately characterize actual process wastewater pollutant parameter concentrations. For example, if a pollutant was reported as 30 ppb at the final effluent sampling location with 1 MGD of process wastewater flow and 9 MGD of noncontaminated nonprocess cooling water flow, then the concentration of the pollutant in the process wastewater was actually 300 ppb. Similarly, if the same plant reported that another pollutant was not detected at the same sampling location and the analytical method detection limit was 10 ppb, then the other pollutant concentration in the process wastewater could be as high as 90 ppb without being detected in the diluted final effluent.

One hundred-six plants reported Form 2C toxic pollutant data in the 1983 Section 308 Questionnaire. Of these, 70 plants diluted the process wastewater before the effluent Form 2C sampling point. The following table relates the number of plants with Form 2C data to the range of dilution at the effluent sampling point.

No. of Plants with Form 2C Data (%)	Range of Dilution in Percent
36 (34%)	0
20 (19%)	>0 to 25
20 (19%)	>25 to 100
17 (16%)	>100 to 500
13 (12%)	>500 to 6,054

The Agency was also able to identify 12 facilities that reported measured toxic pollutant concentrations of treated process wastewater both before and after dilution with nonprocess wastewater. In general, analyzing the diluted effluents yielded underestimated or undetected values for organic toxic pollutants that were measured in the undiluted process wastewater. However, this was not generally the case for toxic pollutants metals such as cadmium, chromium, lead, and cyanide. These metals are commonly found in cooling water additives that may be utilized to inhibit biological growth or the formation of rust and scale in cooling equipment. Therefore, the presence of a portion of these metals in the diluted effluent seems to be caused by the nonprocess cooling water. Therefore, the assumption that the nonprocess dilution wastewater is relatively clean seems to apply to the organic toxic pollutants but not necessarily to all of the toxic metal parameters.

In conclusion, the use of unqualified plant effluent data which includes dilution with nonprocess wastewater, does not provide an adequate assessment of process wastewater pollutant constituents and concentrations. The use of unqualified industry supplied Form 2C data tends to underestimate organic toxic pollutant constituents and concentrations in process wastewater and may actually overestimate metal toxic pollutant constituents and concentrations. Furthermore, keeping these constraints in mind, process wastewater pollutant concentrations can be predicted on a case-by-case basis (especially for conventional pollutant parameters) using a dilution factor and the overall plant effluent quality.

1.3 SELECTION OF PLANTS WITH FORM 2C APPLICATION AND 308 QUESTIONNAIRE DATA

308 Questionnaires were reviewed and all direct discharging plants (249) submitting full responses were separated from all other types of plants (indirects, zeros). One hundred and thirteen (113) of these plants did not dilute their process wastewaters at all, while 70 plants that submitted Form 2C application data and 66 plants that submitted questionnaire data had some form of dilution.

There were 100 plants that did not submit toxic pollutant data, (only conventional pollutants) but had their process wastewaters diluted. Conventional pollutants for these plants were adjusted to reflect the changes resulting from dilution.

1.4 SELECTION OF INDUSTRIAL FACILITIES

Industrial facilities were selected for inclusion in this study if data were available for both final effluent (Form 2C), and intermediate process streams. The availability of both sets of data for a facility made it possible to compare overall effluent quality and process effluent quality. In addition facilities showing substantial additions of nonprocess wastewater to process effluents immediately upstream of monitoring points were also included for consideration. These facilities proved useful in demonstrating the effect of nonprocess waters upon the characterization of process effluents.

Facilities meeting the preceding criteria were obtained by reviewing 308 Questionnaire data submitted by organic chemical manufacturers, and Draft Engineering Reports prepared by JRB for the development of BAT and BPT permit limitations for industrial facilities in New Jersey. A total of thirteen industrial facilities were obtained for use in this study. Four of the facilities included are from JRB's permit development files, and the remaining nine are from the OCPSF 308 Questionnaire data.

2.0 METHODOLOGY CALCULATIONS AND DATA ANALYSIS

2.1 GENERAL METHODOLOGY

2.1.1 Sampling Data

The approach used in determining the viability of using overall plant effluent quality to characterize process wastewater discharges was to compare data for process effluents only and total discharges for each facility. In this manner it was possible to discern whether data obtained at a final outfall truly reflected the contribution and strength of process wastewater flow. The comparison was of particular importance if the overall effluent showed a pollutant to be below the level of detection, while the process effluent reported higher levels.

2.1.2 Dilution Factor: Definition and Calculations

In order to collect data that would most accurately characterize process effluents in the absence of actual data, a term called the dilution factor was developed. It is equal to the quotient of the nonprocess flow divided by the process flow. The dilution factor (plus one) for each facility multiplied by the corresponding reported final effluent concentration, generated an adjusted concentration which was considered to characterize, in an approximate manner, the process effluent before the addition of other flows. This assumed no contamination of the nonprocess wastewaters or minimal background of pollutants. Other minor contaminated nonprocess wastewaters, such as boiler blowdown, were not considered appropriate for inclusion because of their unknown quality. Table 1 presents the miscellaneous wastewaters that were considered process and nonprocess wastewaters for the purposes of calculating the dilution factor.

2.1.3 Plants with Dilution of their Process Wastewaters

Two hundred and forty-nine (249) plants in the OCPSF industry that submitted full responses (parts A, B, and C) to the 308 questionnaires are direct dischargers. These plants are presented in Table 2. The purpose of this study was to determine what plants diluted their process wastewaters with nonprocess waters as defined in Table 1. A total of 113 facilities either did not dilute their process wastewaters or did not provide accurate treatment system information to determine if dilution was occurring.

A review of the 308 questionnaires indicates that certain plants submitted Form 2C application data (for toxic pollutants) in questions C13 to C16 of the questionnaire (Table 4). Seventy of these plants diluted their process wastewaters with nonprocess water (Table 5).

Other plants submitted only questionnaire toxic pollutant data for questions C13 to C16 (Table 6). Sixty-six of these plants diluted their process wastewater streams, they are presented in Table 7.

As mentioned earlier, some plants did not report toxic pollutant data when they submitted their 308 Questionnaires, but were found to have diluted their process wastewater streams. There are 100 plants with conventional pollutant data; these are presented in Table 8.

There were 106 plants that submitted Form 2C toxic pollutant data of which 70 diluted their process wastewaters. This represents 66% of all plants that submitted Form 2C data. Likewise 109 plants submitted questionnaire toxics data but only 66 plants with dilution. This represents 61% of all plants that submitted questionnaire data (Tables 9 and 10).

Bar graphs are presented to illustrate the range of percent dilution for the Form 2C, questionnaire, and conventional pollutant data discussed earlier (Bar graphs 1, 2, and 3 and Tables 11 to 13). This data indicates that 29 to 35% of all plants are diluted in the range 0-25 while 33 to 48% of all plants are diluted greater than 100%.

Table 14 presents dilution factors developed from 308 questionnaire data covering a variety of OCPSF product/processes for the parameters TOC, COD, TSS, and BOD_5. Dilution factors range from 0.00031 to 2,519; and the adjusted pollutant concentrations are affected accordingly. This table also shows the variability in concentrations between the adjusted and reported conventional pollutant parameters.

These results indicate that there can be considerable differences between the reported and actual pollutant concentrations submitted by OCPSF plants, and that there is considerable dilution of process wastewaters with nonprocess waters by plants that submitted priority pollutant, and conventional pollutant data. Approximately 55% of all plants that submitted toxic data were found to have diluted their process wastewaters with nonprocess water.

2.1.4 Draft Engineering Permit Report Data

Intermediate and final discharge data were obtained for four industrial facilites from JRB's files. The facilities are listed below:

1. Plant number A - An Oil Refinery Facility
2. Plant number B - A Bulk Organics Facility
3. Plant number C - A Pharmaceuticals Facility
4. Plant number D - A Speciality Organics Plant

Data for these facilities are presented in Tables 15 through 20. In general, the data present for the facilities show that concentrations of pollutant parameters measured at combined outfalls which include nonprocess flow are markedly lower than the levels measured directly at process outfalls. This is a good indication that pollutant data obtained from a final outfall is not truly indicative of the effluent quality of a process discharge.

Data presented in Tables 16 and 18, are of particular importance because several pollutant parameters which were reported in the final outfalls at concentration levels below those of detection were present at concentration levels above detection at isolated process discharge points. Nominal detection levels for pollutant parameters are presented in Appendix B. These occurrences are especially meaningful because they indicate that analyses of combined outfall effluents do not necessarily provide a true characterization of process wastewater quality.

2.1.5 <u>308 Questionnaire Data</u>

308 Questionnaire Data was reviewed to obtain facilities with available intermediate and final effluent data. These facilities are presented in Tables 21 through 28. As mentioned before, facilities were selected on the basis of their process flows undergoing dilution with nonprocess flows immediately preceding sampling sites. The data tabulated includes pollutant levels reported at final outfalls, and calculated adjusted concentrations which represent isolated process flows.

2.2 DATA ANALYSIS

2.2.1 <u>Analysis of OCPSF Section 308 Information</u>

Plant data from the 1983 Section 308 Questionnaires were analyzed by comparing total facility effluent quality with process effluent quality before mixing. Tables 15 through 26 present the data obtained. Examination and comparison of the data for each plant indicates that the final facility effluent quality is not truly indicative of process effluent quality. Final discharge concentrations are noticeably lower than concentrations in undiluted process streams. In those cases where total effluent concentrations are below detection limits, virtually no indication of process quality is provided. This is illustrated in Table 18. Chloroform, ethylbenzene, and 1,4-dichlorobenzene were all reported to be undetected in the overall facility effluent, but were reported in varying quantities in the process effluent. In this case, the overall effluent quality is not indicative of the process effluent quality. Additionally the variations in the concentrations of the three pollutants in the process discharge indicate that the application of a dilution factor based on process and total flows, to project process effluent quality, is not totally accurate for this particular facility. It is also true for Plant A whose data were presented in Table 15. Concentrations reported at Plant A's treatment plant, representative of process effluent, were greater than those reported at the main outfall for BOD_5, TSS, phenols, oil & grease, and zinc. However, calculation of a dilution factor, based on reported concentrations, yields values ranging from 3.12 to 7.39. The actual dilution factor calculated for the facility, based on flow data, is 17.875. For those pollutants reported at higher concentrations in the main outfall than in the treatment plant effluent, it is no longer reasonable to speak about dilution with respect to the process effluent. For these pollutants, which include cadmium, chromium, lead, and cyanide, it is actually the cooling water that is being diluted with process effluent. Table 15 also indicates that pollutant loadings may be primarily caused by contributions from nonprocess sources. The loading attributable to the noncontact cooling water, which mixes with the treatment plant effluent prior to the main outfall sampling point, was calculated using the appropriate flow based dilution factor.

Therefore, the strict use of a dilution factor to project process effluent quality is not reliable in all cases and its limitations should be known on a plant-by-plant basis. It also may not be advisable to assume that noncontact cooling water is devoid of pollutants in all cases.

2.2.2 308 Questionnaire Data Analysis

Data from those industrial facilities obtained from a review of 308 Questionnaire information, were analyzed by projecting adjusted concentrations based on reported concentrations and appropriate dilution factors. Although the dilution factor is not considered rigorously applicable to the accurate calculation of process pollutant concentrations, as discussed in Section 2.2.1, it was deemed reasonable to use it to estimate such concentrations, lacking additional data, and keeping in mind its limitations. Comparison of reported and adjusted concentrations for the nine industrial facilities presented in Tables 21 through 28 shows adjusted concentrations with the degree of difference being dependent upon the associated dilution factor. Large dilution factors resulted in larger adjusted concentrations than smaller dilution factors, given equal reported concentrations. Dilution factors for the facilities that submitted toxic pollutant data ranged from 0.748 to 60.54.

TABLE 1

Miscellaneous Wastewater Generation

#	Process	Non-Process (Dilution)
1	Air Pollution Control Wastewater	Non-Contact Cooling Water (one pass)
2	Sanitary (receiving biological trt.)	Sanitary (no biological trt., direct disch
3	Boiler blowdown	Cooling Tower Blowdown
4	Sanitary (indirect discharge)	Stormwater Site Runoff
5	Steam Condensate	Deionized Water Regeneration
6	Vacuum Pump Seal Water	Miscellaneous Wastewater (conditional)
7	Wastewater Stripper Discharge	Softening Regeneration
8	Biol. from Vertac	Ion Exchange Regeneration
9	Boiler Feedwater Lime	River Water Intake
10	Softener Blowdown	Make-up Water
11	Contaminated Water Offsite	Fire Water Make-up
12	Condensate	Tank Dike Water
13	Storage, Labs, Shops	Demineralizer Regenerant
14	Laboratory Waste	Dilution Water
15	Steam Jet Condensate	Condensate Losses
16	Water Softener Backwashing	Shipping Drains
17	Misc. Lab Wastewater	Water Treatment Blowdown
18	Raw Water Clarification	Cooling Tower Overflow
19	Landfill Leachate	Chilled Water Sump Overflow
20	Water Treatment	Air Compressor and Conditioning Blowdown
21	Technical Center	Firewall Drainings
22	Scrubber Water	Other Non-Contact Cooling
23	Utility Streams	Misc. Leaks and Drains
24	Washdown N-P Equipment	Boiler House Softeners
25	Contact Cooling Water	Fire Pond Overflow
26	Vacuum Steam Jet Blowdown	Boiler Regeneration Backwash
27	Densator Blowdown	Groundwater (Purge)
28	Bottom Ash-Quench Water	Firewater Discharge
29	Demineralizer Washwater	Freeze Protection Water
30	Water Softening Backwash	H_2 and CO Generation
31	Lab Drains	Demineralizer Spent Regenerants
32	Closed Loop Equipment Overflow	Lime Softening of Process
33	HVAC Blowdown	Miscellaneous Service Water
34	Filter Backwash	Recirculating Cooling System
35	Demineralizer Wastewater	
36	Laboratory Offices	
37	Demineralizer Blowdown	
38	Utility Clarifier Blowdown	
39	Steam Generation	
40	RO Rejection Water	

TABLE 1 (Cont.)

Miscellaneous Wastewater Generation

#	Process	Non-Process (Dilution)
41	Power House Blowdown	
42	Inert Gas Gen. Blowdown	
43	Contaminated Groundwater	
44	Potable Water Treatment	
45	Unit Washes	
46	Non-Contact Floor Cleaning	
47	Slop Water from Dist. Facilities	
48	Laboratory and Vacuum Truck	
49	Ion Bed Regeneration	
50	Tankcar Washing (HCN)	
51	Film Wastewater	
52	Generator Blowdown	
53	Ash Sluice Water	
54	Research and Development	
55	Quality Control	
56	Steam Desuperheating	
57	Pilot Plant	
58	Other DuPont Off-site Waste	
59	Ion Exchange Resin Rinse	
60	Iron Filter Backwash	
61	Area Washdown	
62	Vacuum Pump Wastewater	
63	Garment Laundry	
64	Hydraulic Leaks	
65	Grinder Lubricant	
66	Utility Area Process	
67	Contact Rainwater	

TABLE 2
DIRECT DISCHARGERS SUBMITTING FULL 308 QUESTIONNAIRE RESPONSES

PLANT NUMBER

1	387	682	984	1414	1767	2206	2447
12	392	683	990	1438	1774	2221	2450
61	394	695	991	1439	1776	2222	2461
63	399	709	1012	1446	1802	2227	2471.1
83	412	727	1020	1464	1839	2228	2471.2
87	415	741	1038	1494	1869	2236	2474
101	443	758	1059	1520	1881	2241	2527
102	444	775	1061	1522	1890.1	2242	2528
114	447	802	1062	1532	1890.2	2254	2531
154	481	811	1067	1569	1905	2268	2533
155	486	819	1133	1572	1911.1	2272	2536
159	500	825	1137	1593	1911.2	2296	2541
177	502	844	1139	1609	1928	2307	2551
180	523	851	1148	1616	1943	2313	2556
183	525	859	1149	1618	1973	2315	2573
225	536	866	1157	1624	1977	2328.1	2590
227	569	871	1203	1643	1986	2328.2	2592
250	580	876	1241	1647	2009	2345	2606
254	602	883	1267	1650	2020	2353	2626
260	608	888	1299	1656	2026	2360	2631
267	626	908	1319	1684	2049	2364	2633
269	633	909	1323	1688	2055	2365	2668
284	657	913	1327	1695	2062	2368	2673
294	659	915	1340	1698	2073	2376	2678
296	662	938	1343	1714	2090	2390	2680
352	663	942	1389	1717	2110	2394	2692
373	664	948	1407	1753	2148	2399	2693
384	669	970	1409	1766	2181	2400	2695
					2198	2430	
						2445	

TABLE 2 (continued)

2701
2711
2735
2763
2764
2767
2770
2771
2786
2795
2816
2818
3033
4002
4010
4017
4021
4037
4040
4051
4055

TABLE 3
PLANTS WITHOUT DILUTION

PLANT NUMBER

1	741	1624	2307
101	758	1643	2345
102	775	1647	2364
180	825	1650	2365
227	851	1656	2394
254	888	1684	2400
260	942	1714	2447
267	970	1753	2461
296	991	1769	2471.1
373	1059	1774	2471.2
392	1133	1776	2527
412	1139	1881	2541
415	1148	1905	2551
444	1157	1928	2556
481	1203	1973	2573
502	1267	1977	2590
523	1299	1986	2592
536	1327	2020	2606
569	1343	2049	2631
608	1349	2055	2701
626	1407	2073	2770
633	1414	2198	2816
659	1438	2206	3033
662	1446	2221	4002
663.1	1464	2236	4021
663.2	1520	2254	4037
664	1522	2272	4055
669	1572	2296	
683	1593		
709			

TABLE 4

PLANTS WITH 2C DATA

1	844	1656	2450
63	859	1688	2461
83	876	1717	2474
102	883	1753	2531
114	887	1853	2551
154	909	1869	2556
159	913	1881	2573
183	942	1891	2590
269	984	1943	2626
294	990	2009	2633
296	992	2026	2635
352	1012	2055	2668
373	1020	2073	2673
387	1069	2090	2680
394	1137	2148	2692
399	1149	2228	2693
415	1241	2268	2701
500	1319	2272	2711
536	1407	2300	2735
601	1532	2315	2786
657	1569	2328	2795
669	1572	2353	2818
717	1616	2364	3033
722	1617	2390	4010
727	1618	2430	4021
811	1643	2445	4040
	1647		4051

TABLE 5

2C DATA PLANTS WITH DILUTION

Plant #	Dilution Factor
63	.16308
83	.0720
102	.02792
114	.74803
154	.5480
159	.3477
183	3.1667
269	.4440
294	5.61905
352	.31071
373	.730
387	.00091
394	.0011
399	.01590
500	3.9113
657	.2254
727	14.46667
811	.6273
844	.6288
859	6.27
876	2.791
883	.3462
909	2.087
913	.2632
942	3.0
984	.3595
990	.3113
1012	4.6139
1020	.88268
1137	.05932
1149	.02664
1241	2.35163
1319	9.5652
1532	10.00
1569	1.0
1616	.45045
1618	.2210
1688	1.3514
1717	1.346
1869	.0977
1943	.58594
2009	.1111
2090	.2495
2148	.05106
2228	5.298
2268	14.5143
2315	3.62
2328	2.36318/2.35714
2353	2.37
2390	.02812
2430	.28351
2445	.60737
2450	16.7129
2474	52.94

TABLE 5 (continued)

2C DATA PLANTS WITH DILUTION

Plant #	Dilution Factor
2531	11.0651
2626	.1963
2633	.150
2668	33.6515
2673	1.4074
2680	.375
2692	1.0833
2693	.2069
2711	60.5439
2735	.1478
2786	.53127
2795	.1455
2818	1.184
4010	9.9867
4040	2.00
4051	3.30

Note: In addition to 2C data all of the above plants have questionnaire data except: 114
913
2711
4010

TABLE 6

PLANTS WITH ONLY QUESTIONNAIRE DATA

12	682	1323	2026	2678
61	683	1327	2049	2695
87	695	1340	2062	2763
155	709	1343	2110	2764
177	775	1389	2181	2767
225	802	1409	2222	2770
227	819	1414	2227	2774
250	825	1439	2236	2816
254	851	1446	2241	4017
259	866	1464	2242	
267	871	1494	2313	
284	908	1522	2360	
384	915	1593	2368	
417	938	1609	2376	
443	948	1695	2399	
447	970	1698	2447	
486	976	1766	2527	
502	1038	1769	2528	
523	1061	1774	2532	
525	1062	1802	2536	
580	1067	1839	2541	
602	1133	1877	2554	
608	1139	1890	2592	
659	1203	1911	2631	
662	1299	1928	2647	

TABLE 7

QUESTIONNAIRE DATA PLANTS WITH DILUTION

Plant #	Dilution Factor
12	7.147
61	10.0
87	0.308
155	1.215
177	3.67
225	0.530
250	1.190
284	0.2868
384	1.2123
443	48.571
447	84.8165
486	250.0
525	0.0912
580	.00047
602	9.000
682	6.4393
695	0.012
802	0.933
819	0.0591
866	0.8406
871	1.910
908	0.0016
915	0.0645
938	5.5069
948	0.0164
1038	1.0564
1061	0.0113
1062	1.6573
1067	15.90
1323	2.1177
1340	0.1720
1389	0.10337
1409	2.3516
1439	69.333
1494	0.2638
1609	0.0727
1695	0.1543
1698	1.0909
1766	0.6084
1802	1.290
1839	2518.9
1890	1.480/.5174
1911	4.1667

TABLE 8

PLANTS WITH DILUTION THAT DID NOT SUBMIT TOXICS DATA

PLANT NUMBER

30	888	1936	2507
94	944	1977	2556
199	962	1986	2573
203	990	1993	2578
214	1053	2055	2590
220	1059	2073	2609
249	1086	2108	2631
254	1117	2177	2635
259	1139	2221	2679
260	1188	2243	2736
303	1237	2254	2756
312	1238	2261	2776
392	1432	2288	2793
444	1437	2293	3033
449	1438	2296	4002
481	1504	2307	4007
494	1539	2328	4008
543	1579	2345	4017
614	1621	2365	4023
663	1624	2394	4037
669	1643	2400	4040
683	1657	2402	4051
709	1714	2436	
717	1740	2447	
720	1764	2471	
771	1776	2485	
851	1838	2487	
887	1891	2495	

TABLE 9

PLANT TOTALS

		Total Number of Plants
1.	Direct Dischargers	249
2.	Plants Submitting Form 2C Data	106
3.	Plants Submitting Only Questionnaire Data	109
4.	Plants With 2C Data and Questionnaire Data	65

TABLE 10

PERCENT OF TOTAL PLANTS SUBMITTING DATA

	Total Number of Plants	As Percent
1. Form 2C Plants With Dilution	70	66[1]
2. Questionnaire Data Plants With Dilution	66	60.6[2]
3. Plants Submitting Only Conventional Pollutant Data	100	

[1] As percent of total plants submitting Form 2C toxics data.

[2] As percent ot total plants submitting questionnaire data.

TABLE 11

TABLE OF 2C DATA PLANTS WITH DILUTION (AS PERCENT)

0-25%		25-50		50-75		75-100		100-500		>500	
Plant #	%	Plant #	%	Plant #	%	Plant #	%	Plant #	%	Plant #	%
63	16	159	35	114	75	1020	88	183	317	294	562
83	7	269	44	154	55	1569	100	500	391	727	1447
102	3	352	31	373	73			876	279	859	627
387	.09	883	35	811	63			909	209	1319	957
394	.11	913	26	844	63			942	300	1532	1000
399	16	984	36	1943	59			1012	461	2228	530
657	23	990	31	2445	61			1241	235	2268	1451
1137	6	1616	45	2786	53			1688	135	2450	1671
1149	3	2430	28					1717	135	2474	5294
1618	22	2680	38					2315	362	2531	1107
1869	10							2328	236	2668	3365
2009	11							2353	237	2711	6054
2090	25							2673	141	4010	999
2148	5							2692	108		
2390	3							2818	118		
2626	20							4040	200		
2633	15							4051	330		
2693	21										
2735	15										
2795	15										

TABLE 12

TABLE OF QUESTIONNAIRE DATA PLANTS WITH DILUTION
(AS PERCENT)

0-25%		25-50		50-75		75-100		100-500		>500	
Plant #	%	Plant #	%	Plant #	%	Plant #	%	Plant #	%	Plant #	%
525	9.1	87	308	225	53.0	802	933	155	120.15	12	714.7
580	.047	284	28.7	1766	60.8	866	84.1	177	367	61	1000
695	1.2	1494	26.4	1890.2	51.7	2062	81.8	250	119.0	443	4857
819	5.9	2242	25.5	2368	54.6			384	121.2	447	8481.6
908	.16	2763	28.95	2376	50.8			871	191.0	486	25000
915	6.45							1038	105.6	602	900
948	1.64							1062	165.7	682	643.9
1061	1.1							1323	211.8	938	550.7
1340	17.2							1409	235.2	1067	1590
1389	10.3							1698	109.1	1439	6933
1609	7.27							1802	129.0	1839	251900
1695	15.4							1890.1	148	2222	1446.7
2026	1.4							1911	416.7	2678	1156.5
2181	3.95							2110	186.1		
2227	2.51							2360	194.4		
2241	12.3							2399	188		
2313	19.37							2533	108.0		
2528	6.86							2764	118.2		
2536	.031							2767	159.0		
2695	4.66										
2771	8.33										
4016	15.06										

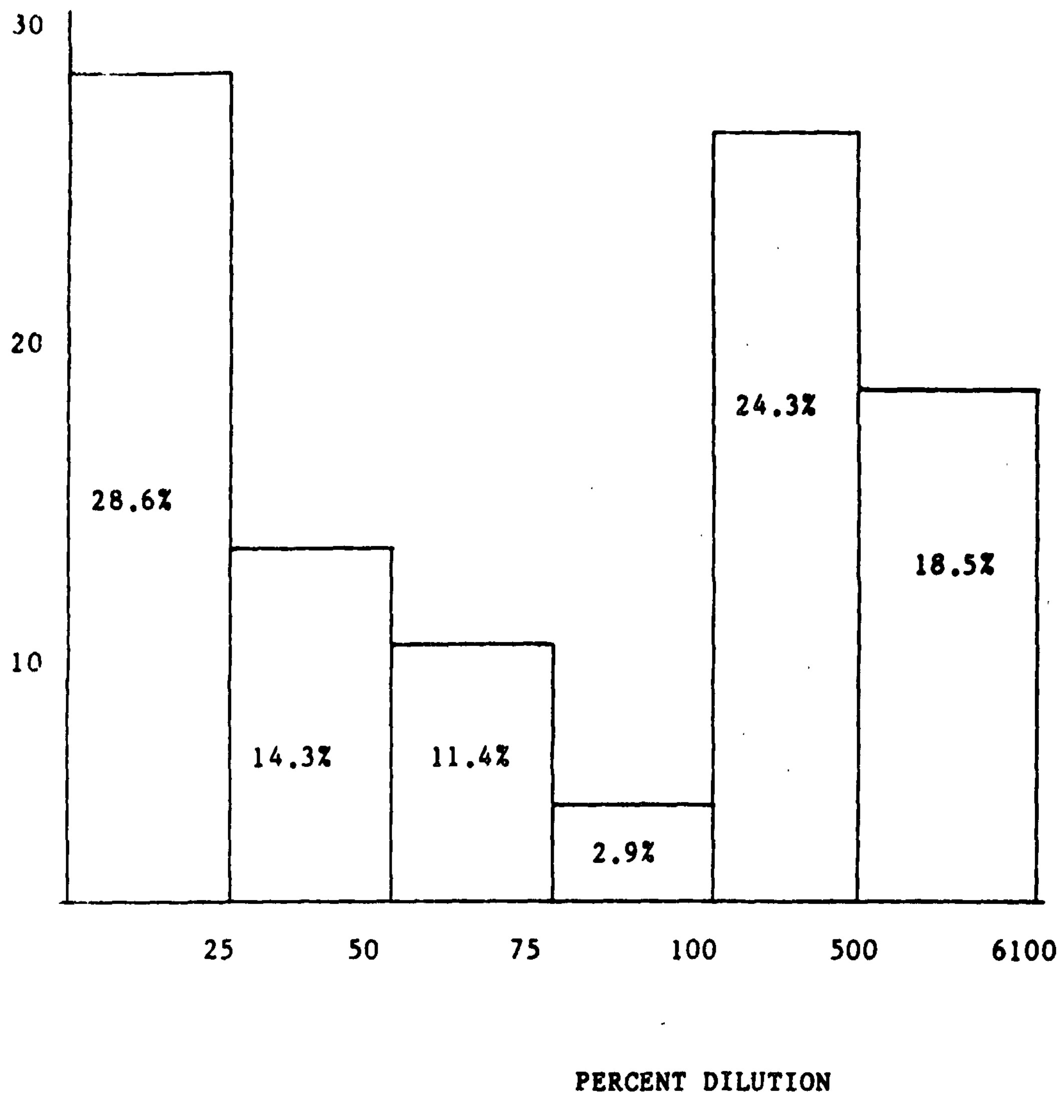
TABLE 13

Table of Questionnaire Data Plants with Dilution of Conventional Pollutants
(as percent)

0 - 25%		25 - 50		50 - 75%		75 - 100%		100 - 500%		>500%	
30	6	203	27	162	74	614	80	249	109	259	17405
199	00	214	30	260	66	2177	83	303	426	481	3000
199	4			444	50	2345	80	392	186	669	916
220	9	494	49	962	66			543	108	709	1532
254	0	663.1	34	2296	50			887	140	944	715
312	20	663.2	34	2394	55			888	163	1624	8929
449	11	771	33	2590	58			1117	150	1776	1167
683	19	851	26	2631	64			1437	140	1986	6063
717	23	990.2	31	2679	50			1438	164	2055.2	2552
720	7	1238	33	4073	60			1643	331	2307	2170
990.1	0	1539	41					1838	217	2400	2250
1053	5	1621	29					2108	192	2447	17400
1059	.2	1657	37					2243	335	2578	654
1086	14	1714	27					2254	112	2776	
1139	1	1740	33					2288	200		
1188	8	1891	33					2328	236		
1237	2	1936	42					2365	100		
1432	6	2073	40					2556	212		
1504	20	2293	35					2635	119		
1579	17	2471.1	25					2793	325		
1764	7	2471.2	39					4002	167		
1977	8	2573	42					4040	200		
1993	12	2609	43					4051	330		
2055.1	7										
2221	.5										
2261	18										
2402	.4										
2436	14										
2485	20										
2487	10										
2495	21										
2507	5										
2736	3										
2756	2										
3033	5										
4007	.1										
4008	24										
4017	15										
4023	.2										

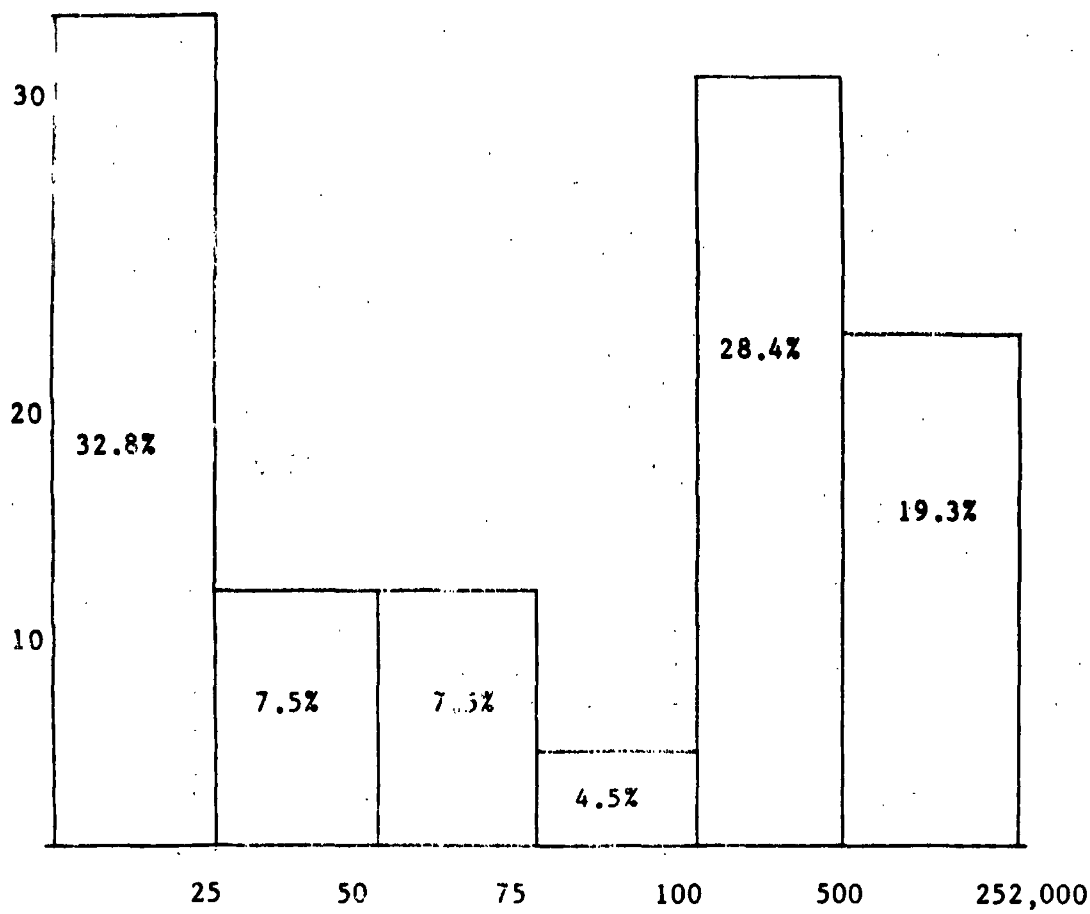
GRAPH 1

2C Data Plants



GRAPH 2

Questionnaire Data Plants



PERCENT DILUTION

GRAPH 3

Questionnaire Data Plants with Dilution of Conventional Pollutants Only

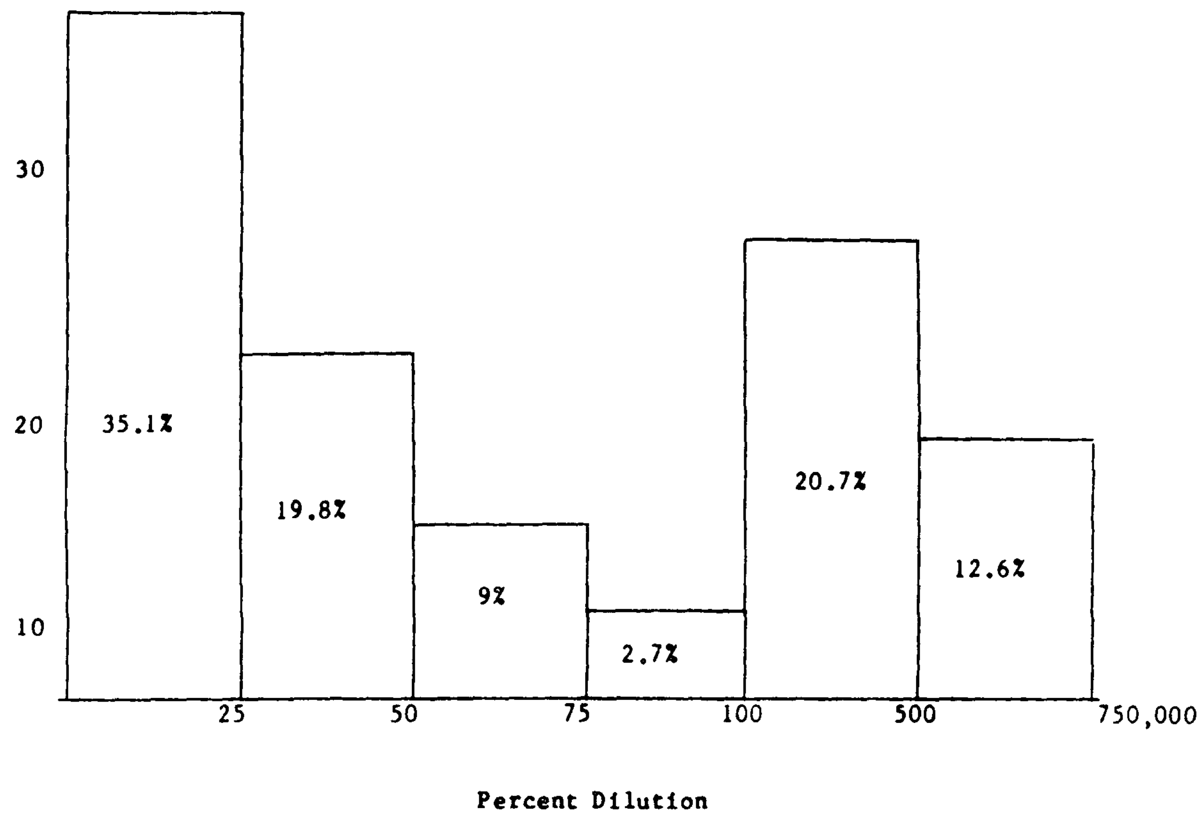


Table 14

RAW WATER QUALITY PARAMETERS, DILUTION FACTOR AND ADJUSTED WATER QUALITY PARAMETERS.

PLANT #	ACTUAL BOD	ACTUAL COD	ACTUAL TSS	ACTUAL TOC	DILUTION FACTOR	ADJUSTED BOD	ADJUSTED COD	ADJUSTED TSS	ADJUSTED TOC
12	-1.0	-1.0	-1.0	66.0	7.14700	-1.0	-1.0	-1.0	537.7
30	1218.0	-1.0	1024.0	-1.0	0.05720	1287.6	-1.0	1082.5	-1.0
61	196.0	-1.0	-1.0	-1.0	10.00000	2156.0	-1.0	-1.0	-1.0
63	5.0	35.0	5.4	-1.0	0.16306	5.8	40.7	6.2	-1.0
83	35.0	144.0	17.0	-1.0	0.07200	37.5	154.3	18.2	-1.0
87	710.0	1079.0	34.1	-1.0	0.30830	928.8	1411.6	44.6	-1.0
94	-1.0	1761.0	234.0	-1.0	0.20000	-1.0	2113.2	280.8	-1.0
102	6.4	261.0	17.2	-1.0	0.02790	6.5	268.2	17.6	-1.0
114	8.6	31.0	51.0	-1.0	0.74803	15.0	54.1	89.1	-1.0
154	7.0	-1.0	15.4	28.0	0.54800	10.8	-1.0	23.8	43.3
155	-1.0	900.0	128.0	-1.0	1.20150	-1.0	1981.3	281.7	-1.0
159	318.0	615.0	-1.0	317.0	0.34770	428.5	828.8	-1.0	427.2
162	-1.0	-1.0	30.0	-1.0	0.73600	-1.0	-1.0	52.0	-1.0
177	27.0	-1.0	57.0	27.0	3.67000	126.0	-1.0	266.1	126.0
183	-1.0	-1.0	-1.0	-1.0	3.16667	-1.0	-1.0	-1.0	-1.0
199	549.0	-1.0	372.0	0.0	0.03920	570.5	-1.0	386.5	0.0
203	30.0	90.0	28.0	-1.0	0.26700	38.0	114.0	35.4	-1.0
214	648.0	-1.0	800.0	-1.0	0.29500	839.1	-1.0	1036.0	-1.0
220	58297.0	16097.0	23.0	-1.0	0.09200	63660.3	17577.9	25.1	-1.0
225	13.6	22.4	6.5	-1.0	0.53000	20.8	34.2	9.9	-1.0
249	986.0	2058.0	47.0	-1.0	1.08500	2055.8	4290.9	97.9	-1.0
250	58.0	220.0	105.0	-1.0	1.19000	127.0	262.8	229.9	-1.0
254	0.0	0.0	0.0	-1.0	0.00000	0.0	0.0	0.0	-1.0
259	1.8	-1.0	-1.0	-1.0	174.05060	315.0	-1.0	-1.0	-1.0
260	11.8	40.3	5.4	9.0	0.66034	19.5	66.9	8.9	14.9
269	116.0	259.0	37.0	104.0	0.44400	167.5	373.9	53.4	150.1
284	16.0	43.0	10.0	-1.0	0.28680	20.5	55.3	12.8	-1.0
294	8.6	55.0	18.0	9.2	5.61905	56.9	364.0	119.1	60.8
303	401.0	718.0	96.0	-1.0	4.26000	2109.2	3776.6	504.9	-1.0
312	340.0	9781.0	3181.0	-1.0	0.19500	406.3	11688.2	3801.2	-1.0
352	34.0	800.0	31.0	-1.0	0.31071	44.5	1048.5	40.6	-1.0
373	8.2	39.9	20.1	-1.0	5.73000	63.3	308.4	155.3	-1.0
384	3.0	45.3	8.6	-1.0	1.21231	6.6	100.2	19.0	-1.0
387	14.0	83.0	21.0	-1.0	0.00091	14.0	83.0	21.0	-1.0
392	12.0	46.0	16.0	-1.0	1.85900	34.3	131.5	45.7	-1.0
394	8.8	62.5	19.4	21.4	0.00110	8.8	62.5	19.4	21.4
399	24.0	79.0	58.0	30.0	0.01590	24.3	80.2	58.9	30.4
443	20.2	102.0	37.5	-1.0	48.57140	1001.3	5056.2	1858.9	-1.0
444	16.0	-1.0	27.0	19.0	0.49670	23.9	-1.0	40.4	28.4
447	2492.0	10046.0	2415.0	3442.0	84.81646	213854.6	862112.1	207246.7	295380.2
449	-1.0	10370.0	3616.0	-1.0	0.11100	-1.0	11521.0	4017.3	-1.0
481	12.5	-1.0	1.0	-1.0	30.00000	387.5	-1.0	31.0	-1.0
486	-1.0	845.0	-1.0	-1.0	250.00000	-1.0	212095.0	-1.0	-1.0
494	-1.0	770.0	65.0	-1.0	0.49100	-1.0	1148.0	96.9	-1.0
500	10.0	67.0	16.0	38.0	3.91130	49.1	329.0	78.5	186.6
525	8.0	-1.0	30.0	-1.0	0.09120	8.7	-1.0	32.7	-1.0
543	-1.0	3942.0	40.0	-1.0	1.08000	-1.0	8199.3	83.2	-1.0
580	45.0	283.0	133.0	-1.0	0.00047	45.0	283.1	133.0	-1.0

Table 14 (Cont.)

RAW WATER QUALITY PARAMETERS, DILUTION FACTOR AND ADJUSTED WATER QUALITY PARAMETERS.

PLANT #	ACTUAL BOD	ACTUAL COD	ACTUAL TSS	ACTUAL TOC	DILUTION FACTOR	ADJUSTED BOD	ADJUSTED COD	ADJUSTED TSS	ADJUSTED TOC
602	105.2	-1.0	-1.0	476.0	9.00000	1052.0	-1.0	-1.0	4760.0
614	-1.0	-1.0	-1.0	-1.0	0.79274	-1.0	-1.0	-1.0	-1.0
657	13.0	60.0	14.0	19.0	0.22540	15.9	73.5	17.1	23.2
663	5.0	54.0	35.0	54.0	0.34100	6.7	72.4	46.9	72.4
663	4.0	54.0	35.0	53.0	0.33870	5.3	72.2	46.8	70.9
669	56.0	-1.0	42.0	-1.0	9.15790	568.8	-1.0	426.6	-1.0
682	9.8	77.6	35.3	36.0	6.43930	72.9	577.2	262.6	267.8
683	10.0	-1.0	10.0	20.0	0.19178	11.9	-1.0	11.9	23.8
695	20.0	153.0	51.0	74.0	0.01200	20.2	154.8	51.6	74.8
709	5.7	69.3	6.0	17.0	15.32353	93.0	1131.2	97.9	277.5
717	25.0	83.0	11.0	-1.0	0.22500	30.6	101.6	13.4	-1.0
720	268.0	500.0	18.0	-1.0	0.07140	287.1	535.7	19.2	-1.0
727	5.4	-1.0	7.0	-1.0	14.46667	83.5	-1.0	108.2	-1.0
771	374.0	598.0	149.0	-1.0	0.33300	498.5	797.1	198.6	-1.0
802	6.0	21.0	8.0	-1.0	0.93300	11.5	40.5	15.4	-1.0
811	13.6	92.1	18.4	35.6	0.62730	22.1	149.6	29.9	57.9
819	-1.0	-1.0	121.0	-1.0	0.05910	-1.0	-1.0	128.1	-1.0
844	3.0	111.0	32.0	23.0	0.62880	4.8	180.7	52.1	37.4
851	23.5	182.4	128.1	-1.0	0.25913	29.5	229.6	161.2	-1.0
859	31.0	-1.0	601.0	-1.0	6.27000	225.3	-1.0	4369.2	-1.0
866	6.5	107.0	17.3	-1.0	0.84060	11.9	196.9	31.8	-1.0
871	12.0	52.6	31.6	-1.0	1.91000	34.9	153.0	91.9	-1.0
876	24.0	245.0	20.0	47.0	2.79100	90.9	928.7	75.8	178.1
883	15.0	-1.0	20.0	-1.0	0.34620	20.1	-1.0	26.9	-1.0
887	14733.0	5697.0	104.0	-1.0	1.39500	35285.5	13644.3	249.0	-1.0
888	-1.0	1423.0	-1.0	-1.0	1.63000	-1.0	3742.4	-1.0	-1.0
908	53.0	335.0	40.0	80.0	0.00160	53.0	335.5	40.0	80.1
909	9.0	115.0	18.0	-1.0	2.08757	27.7	355.0	55.5	-1.0
913	3.0	103.0	43.0	1.2	0.26320	3.7	130.1	54.3	1.5
915	14.0	69.0	12.0	-1.0	0.06450	14.9	73.4	12.7	-1.0
938	-1.0	-1.0	27.0	45.0	5.50690	-1.0	-1.0	175.6	292.8
942	17.8	93.1	16.4	28.1	3.00000	71.2	372.4	65.6	112.4
944	28.0	467.0	7.0	-1.0	7.15000	228.2	3806.0	57.0	-1.0
948	12.1	-1.0	32.2	59.0	0.01640	12.2	-1.0	32.7	59.9
962	10.0	-1.0	15.0	-1.0	0.66000	16.6	-1.0	24.9	-1.0
984	16.0	182.0	25.0	92.0	0.35950	21.7	247.4	33.9	125.0
990	0.0	0.0	0.0	0.0	0.00000	0.0	0.0	0.0	0.0
990	12.4	126.0	15.9	-1.0	0.31130	16.3	165.2	20.8	-1.0
990	15.9	0.0	0.0	0.0	0.00000	15.9	0.0	0.0	0.0
1012	3.6	22.0	-1.0	-1.0	4.61392	20.2	123.5	-1.0	-1.0
1038	5.0	56.0	11.0	-1.0	1.05640	10.2	115.1	22.6	-1.0
1053	-1.0	8610.0	321.0	-1.0	0.05370	-1.0	9072.3	338.2	-1.0
1059	32.0	354.0	30.0	-1.0	0.00203	32.0	354.7	30.0	-1.0
1061	6.1	29.5	15.1	-1.0	0.01130	6.1	29.8	15.2	-1.0
1062	9.0	80.0	23.0	-1.0	1.65730	23.9	212.5	61.1	-1.0
1067	4.0	90.0	10.7	-1.0	15.90000	67.6	1521.0	180.6	-1.0
1086	-1.0	-1.0	321.0	-1.0	0.14200	-1.0	-1.0	366.5	-1.0
1117	650.0	-1.0	13.3	-1.0	1.50000	1625.0	-1.0	33.2	-1.0

Table 14 (Cont.)

RAW WATER QUALITY PARAMETERS. DILUTION FACTOR AND ADJUSTED WATER QUALITY PARAMETERS.

PLANT #	ACTUAL BOD	ACTUAL COD	ACTUAL TSS	ACTUAL TOC	DILUTION FACTOR	ADJUSTED BOD	ADJUSTED COD	ADJUSTED TSS	ADJUSTED TOC
1137	22.0	-1.0	72.0	56.0	0.05930	23.3	-1.0	76.2	59.3
1139	36.0	197.0	33.0	-1.0	0.01010	36.3	198.9	33.3	-1.0
1149	20.0	157.0	57.0	40.0	0.02664	20.5	161.1	58.5	41.0
1188	345.0	607.0	12.5	-1.0	0.07750	371.7	654.0	13.4	-1.0
1237	69.0	-1.0	42.0	-1.0	0.01500	70.0	-1.0	42.6	-1.0
1238	-1.0	9100.0	-1.0	-1.0	0.33200	-1.0	12121.2	-1.0	-1.0
1241	19.4	-1.0	38.7	100.6	0.62300	31.4	-1.0	62.8	163.2
1319	19.0	-1.0	22.0	-1.0	9.56522	200.7	-1.0	232.4	-1.0
1323	48.1	135.4	16.2	-1.0	2.11765	149.9	422.1	50.5	-1.0
1340	5.4	68.0	17.4	-1.0	0.17204	6.3	79.6	20.3	-1.0
1389	33.0	303.0	65.0	-1.0	0.10337	36.4	334.3	71.7	-1.0
1409	5.0	40.0	7.0	-1.0	2.35163	16.7	134.0	23.4	-1.0
1432	-1.0	2446.0	104.0	-1.0	0.06160	-1.0	2596.6	110.4	-1.0
1437	142.5	-1.0	29.1	-1.0	1.40000	342.0	-1.0	69.8	-1.0
1438	11.0	114.0	12.0	-1.0	1.63768	29.0	300.6	31.6	-1.0
1439	4.3	-1.0	20.8	-1.0	69.33333	302.4	-1.0	1462.9	-1.0
1494	49.0	285.0	105.0	85.0	0.26380	61.9	360.1	132.6	107.4
1504	-1.0	921.0	114.0	-1.0	0.20000	-1.0	1105.2	136.8	-1.0
1532	10.1	-1.0	-1.0	-1.0	10.00000	111.1	-1.0	-1.0	-1.0
1539	1637.0	-1.0	336.6	-1.0	0.40770	2304.4	-1.0	473.8	-1.0
1569	9.2	50.0	21.7	-1.0	1.00000	18.4	100.0	43.4	-1.0
1579	13.7	99.0	9.8	-1.0	0.17400	16.0	116.2	11.5	-1.0
1609	61.0	-1.0	57.0	100.0	0.07273	65.4	-1.0	61.1	107.2
1616	60.0	323.0	54.0	429.0	0.45045	87.0	468.4	78.3	622.2
1618	3.0	14.0	9.3	8.0	0.22100	3.6	17.0	11.3	9.7
1621	1011.0	2882.0	31.0	-1.0	0.28500	1299.1	3703.3	39.8	-1.0
1624	10.2	63.8	16.0	-1.0	89.28571	920.9	5760.2	1444.5	-1.0
1643	18.0	154.0	45.0	0.0	3.31000	77.5	663.7	193.9	0.0
1657	1641.0	-1.0	119.0	-1.0	0.37330	2253.5	-1.0	163.4	-1.0
1688	60.5	171.8	19.5	177.0	1.35140	142.2	403.9	45.8	416.1
1695	14.3	-1.0	22.6	-1.0	0.15429	16.5	-1.0	26.0	-1.0
1698	32.6	274.0	21.9	-1.0	1.09091	68.1	572.9	45.7	-1.0
1714	14.6	147.0	90.0	-1.0	0.26900	18.5	186.5	114.2	-1.0
1717	21.0	198.0	14.4	123.0	1.34615	49.2	464.5	33.7	288.5
1740	11.0	38.0	18.0	-1.0	0.33100	14.6	50.5	23.9	-1.0
1764	242.0	4130.0	2863.0	-1.0	0.06590	257.9	4402.1	3051.6	-1.0
1766	103.0	419.0	75.0	220.0	0.60841	165.6	673.9	120.6	353.8
1776	0.0	0.0	7.9	-1.0	11.66667	0.0	0.0	100.0	-1.0
1802	22.0	51.0	43.0	-1.0	1.29000	50.3	116.7	98.4	-1.0
1838	-1.0	-1.0	3495.0	-1.0	2.17000	-1.0	-1.0	11079.1	-1.0
1839	0.0	0.0	0.0	20.0	2518.86730	0.0	0.0	0.0	50397.3
1869	16.0	57.0	4.0	-1.0	0.09770	17.5	62.5	4.3	-1.0
1890	19.0	230.0	37.0	-1.0	1.48196	47.1	570.8	91.8	-1.0
1890	8.0	71.0	6.0	-1.0	0.51736	12.1	107.7	9.1	-1.0
1891	45.0	339.0	-1.0	-1.0	0.32900	59.8	450.5	-1.0	-1.0
1911	14.0	195.0	74.0	72.0	4.16667	72.3	1007.5	382.3	372.0
1936	110.0	-1.0	30.0	-1.0	0.41900	156.0	-1.0	42.5	-1.0
1943	14.0	58.0	10.0	-1.0	0.58594	22.2	91.9	15.8	-1.0

Table 14 (Cont.)

RAW WATER QUALITY PARAMETERS, DILUTION FACTOR AND ADJUSTED WATER QUALITY PARAMETERS.

PLANT #	ACTUAL BOD	ACTUAL COD	ACTUAL TSS	ACTUAL TOC	DILUTION FACTOR	ADJUSTED BOD	ADJUSTED COD	ADJUSTED TSS	ADJUSTED TOC
1977	25.0	186.0	145.0	130.0	0.07605	26.9	200.1	156.0	139.8
1986	12.4	65.3	17.6	-1.0	60.62500	764.1	4024.1	1084.6	-1.0
1993	-1.0	3075.0	68.2	-1.0	0.11800	-1.0	3437.8	76.2	-1.0
2009	74.0	3480.0	130.0	-1.0	0.11111	82.2	3866.6	144.4	-1.0
2026	39.0	133.0	51.0	-1.0	0.01353	39.5	134.7	51.6	-1.0
2055	158.0	565.0	-1.0	-1.0	0.06452	168.1	601.4	-1.0	-1.0
2055	120.0	27.0	-1.0	-1.0	25.51950	3182.3	716.0	-1.0	-1.0
2062	-1.0	-1.0	-1.0	140.0	0.81818	-1.0	-1.0	-1.0	254.5
2073	4.4	12.8	28.6	8.5	0.39996	6.1	17.9	40.0	11.8
2090	690.0	2959.0	40.0	-1.0	0.24953	862.1	3697.3	49.9	-1.0
2108	183.0	509.0	61.0	-1.0	1.92000	534.3	1486.2	178.1	-1.0
2118	38.5	193.3	46.9	-1.0	1.86140	110.1	553.1	134.1	-1.0
2148	5.0	114.0	12.0	42.0	0.05106	5.2	119.8	12.6	44.1
2177	190.0	410.0	110.0	-1.0	0.83300	348.2	751.5	201.6	-1.0
2181	4.0	154.0	34.0	74.0	0.03947	4.1	160.0	35.3	76.9
2221	15.0	-1.0	20.0	-1.0	0.00522	15.0	-1.0	20.1	-1.0
2222	7.6	23.2	29.5	-1.0	14.46670	117.5	358.8	456.2	-1.0
2227	73.2	-1.0	155.6	165.5	0.02513	75.0	-1.0	159.5	169.6
2228	841.8	959.0	117.1	793.0	5.29801	5301.6	6039.7	737.4	4994.3
2241	-1.0	23819.0	37.0	-1.0	0.12300	-1.0	26748.7	41.5	-1.0
2242	13.0	125.0	30.0	52.0	0.25530	16.3	156.9	37.6	65.2
2243	2550.0	-1.0	155.0	-1.0	3.35000	11092.5	-1.0	674.2	-1.0
2254	89.0	357.0	113.0	-1.0	1.12000	188.6	756.8	239.5	-1.0
2261	1728.0	1690.0	-1.0	-1.0	0.17500	2030.4	1985.7	-1.0	-1.0
2268	-1.0	193.0	17.0	-1.0	14.51429	-1.0	2994.2	263.7	-1.0
2288	757.0	2013.0	27.0	-1.0	2.00000	2271.0	6039.0	81.0	-1.0
2293	-1.0	2709.0	187.0	-1.0	0.34800	-1.0	3651.7	252.0	-1.0
2296	12.0	64.0	51.0	-1.0	0.49517	17.9	95.6	76.2	-1.0
2307	15.8	-1.0	11.6	-1.0	21.70000	358.6	-1.0	263.3	-1.0
2313	204.0	1098.0	1718.0	108.0	0.19372	243.5	1310.7	2050.8	128.9
2315	2.0	46.0	9.0	16.0	3.62000	9.2	212.5	41.5	73.9
2328	6.0	88.0	11.0	39.0	2.36318	20.1	295.9	36.9	131.1
2328	3.0	9.1	10.0	9.0	2.35714	10.0	30.5	33.5	30.2
2345	28.0	-1.0	15.9	90.0	0.79484	50.2	-1.0	28.5	161.5
2353	166.0	258.0	58.0	-1.0	12.37000	2219.4	3449.4	775.4	-1.0
2360	2.0	25.0	6.0	-1.0	1.94444	5.8	73.6	17.6	-1.0
2365	20.0	263.0	46.0	-1.0	1.00100	40.0	526.2	92.0	-1.0
2368	30.0	-1.0	25.0	48.0	0.54598	46.3	-1.0	38.6	74.2
2376	18.0	46.0	21.0	-1.0	0.50849	27.1	69.3	31.6	-1.0
2390	55.0	528.0	46.4	495.0	0.02812	56.5	542.8	47.7	508.9
2394	41.0	387.0	25.0	76.0	0.55200	63.6	600.6	38.8	117.9
2399	25.0	64.0	19.0	21.0	1.88000	72.0	184.3	54.7	60.4
2400	240.0	1200.0	50.0	-1.0	22.50000	5640.0	28200.0	1175.0	-1.0
2402	12592.0	37329.0	110.0	-1.0	0.00400	12642.3	37478.3	110.4	-1.0
2430	6.0	81.0	6.8	33.0	0.28351	7.7	103.9	8.7	42.3
2436	-1.0	-1.0	147.0	-1.0	0.13900	-1.0	-1.0	167.4	-1.0
2445	30.1	165.0	71.0	36.0	0.60737	48.3	265.2	114.1	57.8
2447	13.1	43.3	13.3	-1.0	174.00000	2292.5	7577.5	2327.5	-1.0

Table 14 (Cont.)

RAW WATER QUALITY PARAMETERS, DILUTION FACTOR AND ADJUSTED WATER QUALITY PARAMETERS.

PLANT #	ACTUAL BOD	ACTUAL COD	ACTUAL TSS	ACTUAL TOC	DILUTION FACTOR	ADJUSTED BOD	ADJUSTED COD	ADJUSTED TSS	ADJUSTED TOC
2450	5.0	54.0	14.0	-1.0	16.71290	88.5	956.4	247.9	-1.0
2471	42.9	-1.0	52.0	-1.0	0.24560	53.4	-1.0	64.7	-1.0
2471	13.8	41.0	21.0	14.7	0.38890	19.1	56.9	29.1	20.4
2474	8.0	82.0	23.0	19.0	52.94000	431.5	4423.0	1240.6	1024.8
2485	2302.0	4503.0	109.0	-1.0	0.19700	2755.4	5390.0	130.4	-1.0
2487	390.5	-1.0	336.5	-1.0	0.09980	429.4	-1.0	370.0	-1.0
2495	1200.0	1596.0	880.0	-1.0	0.20600	1447.2	1924.7	1061.2	-1.0
2507	464.0	-1.0	1477.0	-1.0	0.05000	487.2	-1.0	1550.8	-1.0
2528	33.0	158.0	74.0	88.0	0.06860	35.2	168.8	79.0	94.0
2531	53.0	80.0	12.0	48.0	11.06510	639.4	965.2	144.7	579.1
2533	-1.0	51.0	15.0	-1.0	1.08000	-1.0	106.0	31.2	-1.0
2536	3.3	48.4	17.9	-1.0	0.00031	3.3	48.4	17.9	-1.0
2556	6.0	49.0	31.0	-1.0	2.11765	18.7	152.7	96.6	-1.0
2573	200.0	304.0	88.0	131.0	0.42009	284.0	431.7	124.9	186.0
2578	3209.0	-1.0	9.9	-1.0	7500.00000	0.0	-1.0	74259.9	-1.0
2590	10.0	22.0	8.0	139.0	0.57730	15.7	34.7	12.6	219.2
2609	694.0	1435.0	26.5	-1.0	0.42800	991.0	2049.1	37.8	-1.0
2626	11.5	247.0	18.5	-1.0	0.19630	13.7	295.4	22.1	-1.0
2631	14.0	170.0	14.0	2.0	0.63630	22.9	278.1	22.9	3.2
2633	79.0	123.0	107.0	-1.0	0.15000	90.8	141.4	123.0	-1.0
2635	10.6	70.9	23.3	-1.0	1.16500	23.1	154.9	50.9	-1.0
2668	4.1	16.9	25.0	230.0	233.65152	962.0	3965.6	5866.2	53969.8
2673	42.0	235.0	38.0	72.0	1.40741	101.1	565.7	91.4	173.3
2678	6.3	-1.0	7.6	-1.0	11.56540	79.1	-1.0	95.4	-1.0
2679	233.0	-1.0	124.0	-1.0	0.50000	349.5	-1.0	186.0	-1.0
2680	34.9	104.8	19.2	-1.0	0.37500	47.9	144.1	26.4	-1.0
2692	2.0	4.0	11.0	26.0	1.08330	4.1	8.3	22.9	54.1
2693	71.0	166.0	43.0	68.0	0.20690	85.6	200.3	51.8	82.0
2695	24.0	42.0	15.0	19.0	0.04660	25.1	43.9	15.6	19.8
2711	16.0	25.0	12.0	-1.0	60.54390	984.7	1538.5	738.5	-1.0
2735	7.0	52.0	18.0	-1.0	0.14780	8.0	59.6	20.6	-1.0
2736	-1.0	3648.0	931.0	-1.0	0.03040	-1.0	3758.8	959.3	-1.0
2756	562.0	1316.0	-1.0	-1.0	0.02380	575.3	1347.3	-1.0	-1.0
2763	3.0	-1.0	11.0	-1.0	0.28946	3.8	-1.0	14.1	-1.0
2764	14.0	56.0	45.0	-1.0	1.18200	30.5	122.1	98.1	-1.0
2767	6.3	-1.0	12.1	22.0	1.59000	16.3	-1.0	31.3	56.9
2771	-1.0	67.0	12.0	19.0	0.08333	-1.0	72.5	12.9	20.5
2776	4600.0	10870.0	-1.0	-1.0	6.53600	34665.6	81916.3	-1.0	-1.0
2786	52.0	216.0	36.0	53.0	0.53127	79.6	330.7	55.1	81.1
2793	-1.0	1005.0	51.0	-1.0	3.25000	-1.0	4271.2	216.7	-1.0
2795	23.0	388.0	49.0	-1.0	0.14550	26.3	444.4	56.1	-1.0
2818	23.0	174.0	134.0	68.0	1.18400	50.2	380.0	292.6	148.5
3033	171.0	645.0	19.2	233.0	0.05396	180.2	679.8	20.2	245.5
4002	41.0	267.0	31.0	-1.0	1.67000	109.4	712.8	82.7	-1.0
4007	2358.0	-1.0	151.6	-1.0	0.00125	2360.9	-1.0	151.9	-1.0
4008	-1.0	550.0	83.0	-1.0	0.24100	-1.0	682.5	103.0	-1.0
4010	-1.0	83.0	16.0	29.0	9.98669	-1.0	911.8	175.7	318.6
4017	3.6	33.3	17.4	-1.0	0.15063	4.1	38.3	20.0	-1.0

Table 14 (Cont.)

RAW WATER QUALITY PARAMETERS, DILUTION FACTOR AND ADJUSTED WATER QUALITY PARAMETERS.

PLANT #	ACTUAL BOD	ACTUAL COD	ACTUAL TSS	ACTUAL TOC	DILUTION FACTOR	ADJUSTED BOD	ADJUSTED COD	ADJUSTED TSS	ADJUSTED TOC
4023	1179.0	-1.0	538.0	-1.0	0.00151	1180.7	-1.0	538.8	-1.0
4037	3.0	-1.0	10.0	-1.0	0.59620	4.7	-1.0	15.9	-1.0
4040	65.0	85.0	88.0	-1.0	2.00000	195.0	255.0	264.0	-1.0
4051	6.2	36.0	22.0	-1.0	3.30000	26.6	154.8	94.6	-1.0

TABLE 15

Plant A

Parameter	DISCHARGE 001 (MAIN OUTFALL) Mass Load (kg/day)	DISCHARGE 001 (MAIN OUTFALL) Concentration (mg/l)	DISCHARGE 002 (TREATMENT PLANT EFFLUENT) Mass Load (kg/day)	DISCHARGE 002 (TREATMENT PLANT EFFLUENT) Concentration (mg/l)	COOLING WATER(1) Mass Load (kg/day)	COOLING WATER(1) Concentration (mg/l)
BOD_5	5,949.58	10.00	1,041.80	31.3	4,907.78	8.73
COD	-	NA	-	NA	-	-
TSS	11,304.20	19.00	2,962.31	89.00	8,341.89	14.85
Oil and Grease	1,368.40	2.30	565.83	17.00	802.57	1.43
Phenols	11.30	0.019	3.66	0.110	7.64	0.014
TOC	-	NA	-	NA	-	-
Arsenic	-	NA	3.33	0.100	-	-
Aluminum	-	NA	0.07	0.002	-	-
Beryllium	-	NA	0.13	0.004	-	-
Cadmium	16.06	0.027	0.07	0.002	15.99	0.028
Chromium(2)	60.69	0.102	0.77	0.023	59.92	0.107
Copper	-	NA	0.90	0.027	-	-
Lead(2)	113.04	0.190	2.66	0.080	110.38	0.20
Mercury	-	NA	0.03	0.001	-	-
Nickel	-	NA	1.36	0.041	-	-
Selenium	-	NA	5.33	0.160	-	-
Zinc(2)(3)	83.89	0.141	14.68	0.441	69.21	0.123
Cyanide(2)(3)	8.33	0.014	0.43	0.013	7.89	0.014

Flows: Discharge 001: 157.3 MGD;
Discharge 002: 8.8 MGD

(1) Calculated by mass balance
(2) 1977 Data for Discharge 001
(3) 1977 Data for Discharge 002

TABLE 16

Plant A

Parameters (ug/l)	Discharge 002 (WWTP Effluent)			Discharge 001 (Main Outfall)			Salt Water Inlet		
	6/79	12/79	2/81	6/79	12/79	2/81	6/79	12/79	2/81
Bromoform	<1	<0.1	39	<10	<0.1	<10	<10	<10	<10
Chlorobenzene	<0.1	<0.1	19	<1	<0.1	<10	<1	<0.1	<10
Chlorodibromomethane	<10	<0.1	60	<0.1	<1	<10	<1	<0.1	<10
Chloroform	<10	23	<10	<10	<10	<10	<10	<10	<10
Dichlorobromomethane	<1.0	<0.1	25	<0.1	<0.1	<10	<0.1	<0.1	<10
Toluene	<0.1	<0.1	<10	<0.1	<0.1	38	<10	<0.1	<10
2,4,6-Trichlorophenol	<10	21	<10	<1	<1	<10	<1	<1	<10
Bis(2-Ethylhexyl) phthalate	<10	16	<10	<1	<10	16	<1	<10	60
Diethyl phthalate	<1	<10	<10	<1	<1	14	<1	<1	<10
Isophorone	35	180	<10	<10	<1	<10	<1	<1	<10
Antimony	NT	500	<50	NT	800	<50	NT	700	<50
Cadmium	NT	<5	<10	NT	20	<10	NT	30	<10
Chromium	NT	<20	36	NT	<20	13	NT	<20	18
Copper	NT	<20	69	NT	<20	47	NT	<20	34
Lead	NT	<50	25	NT	<50	<15	NT	<50	<15
Nickel	50	<40	41	200	<40	52	200	120	34
Silver	NT	<20	<3	NT	30	8	NT	30	8
Thallium	NT	<100	20	NT	<100	<10	NT	<100	110
Zinc	670	70	360	1300	80	250	1300	120	110

NT: Not Tested

TABLE 17

Discharge Monitoring Report (DMR) Data

Plant A

		DISCHARGE 001 (MAIN OUTFALL)			DISCHARGE 002 (TREATMENT PLANT EFFLUENT)		
Month	Parameter	Mean Flow (MGD)	Mass Load (kg/day)	Concentration (mg/l))	Mean Flow (MGD)	Mass Load (kg/day)	Concentratin (mg/l)
Feb. 1982	Total Organic Carbon (TOC)	132	1,110	2.22	10.05	783	20.60
March 1982	TOC	132	1,231	2.46	9.41	1,336	37.54
April 1982	TOC	130	956	1.94	9.54	1,010	27.99
May 1982	TOC	132	549	1.10	7.50	748	26.37
June 1982	TOC	147	1,009	1.81	9.01	756	22.18
July 1982	TOC	151	740	1.30	7.76	516	17.79
August 1982	TOC	150	655	1.15	7.76	554	18.87
Sept. 1982	TOC	141	549	1.03	7.98	589	19.51
Oct. 1982	TOC	126	593	1.24	7.37	536	19.23
Nov. 1982	TOC	122	725	1.57	8.32	776	24.65
Dec. 1982	TOC	129	860	1.76	9.5	827	23.01
Jan. 1983	TOC	143	909	1.68	10.01	888	23.45
Average	TOC	136.3	824	1.61	8.68	776	23.43

TABLE 18

Plant B

Parameter	Wastewater Treatment Plant Effluent Stream (ug/l)	Outfall 001 (ug/l)
Bromoform	100.0	19.0
Chloroform	51.0	ND
Ethylbenzene	6.5	ND
Methylene Chloride	18.0	7.6
Toluene	4.1	2.2
1,4-dichlorobenzene	470.0	ND
Phenol	17.7	1.4

ND - Not Detected; Limit of Detection is 5 ppb.

TABLE 19

Plant C

Month (1980)	Parameter	INDUSTRIAL PLANT EFFLUENT Mean Flow[1] (MGD)	Concentration (mg/l)	Mass Load (kg/day)	DISCHARGE 001 Mean flow (MGD)	Concentration (mg/l)	Mass Load (kg/day)
Jan.	Chemical Oxygen Demand (COD)	0.072	117	31.9	0.41	0.02	0.3
Feb.	COD	0.072	140	38.2	0.41	NA	-
March	COD	0.072	126	34.3	0.40	38	57.4
April	COD	0.072	119	32.4	0.39	25	36.8
May	COD	0.072	123	33.4	0.43	NA	-
June	COD	0.072	137	37.3	0.36	21	28.5
July	COD	0.072	169	46.0	0.39	41	60.4
August	COD	0.072	158	43.1	0.31	30	35.1
September	COD	0.072	110	29.9	0.36	18	24.5
October	COD	0.072	94	25.5	0.31	32	37.6
November	COD	0.072	80	21.8	0.30	42	47.6
December	COD	0.072	103	28.1	0.29	42	46.1
Average	COD	0.072	123	33.5	0.36	28.1	37.4

(1) Estimated

TABLE 20

Plant D
Final and Intermediate Wastewater Data

Parameter	Treatment Plant Effluent (1) (mg/l)	Treatment Plant Effluent (1) (kg/day)	Final Effluent (2) (mg/l)	Final Effluent (2) (kg/day)	Calculated Cooling Water Quality(3) (mg/l)	Calculated Cooling Water Quality(3) (kg/day)
BOD	169.67	76.77	145.82	115.51	132.69	104.69
TSS	94.69	42.85	47.15	37.34	-	-
COD	396.14	179.25	145.12	114.95	1.47	1.16

(1) Flow: 119,633 GPD
(2) Flow: 329,058 GPD
(3) Dilution Factor = 1.7505

TABLE 21

308 Questionnaire Data
Plant E

Pollutant	Reported Concentration (ug/l)	Actual Concentration (ug/l)(1)
Aluminum	140	245
Boron	ND	16
Barium	70	122
BOD_5	8,600	15,033
Cobalt	ND	16
COD	31,000	54,188
Iron	570	996
Magnesium	5,300	9,264
Manganese	40	70
Molybdenum	ND	16
Nitrogen, Ammonia	70	122
Nitrogen, Nitrate	850	1,486
Oil & Grease	2,600	4,545
Phenols	ND	0.80
Tin	140	245
Ti	10	18
Organic Nitrogen	430	752
TSS	51,000	89,148
Antimony	28	49
Arsenic	60	105
Cadmium	8	14
Chromium (Total)	5	.9
Copper	65	114
Lead	6	11
Nickel	27	47
Selenium	7	12
Thallium	3	5
Zinc	78	136
Toluene	15	26
Vinyl Chloride	19	33
Priority Pollutants reported as ND (2)	ND	1.6-399.3

(1) Adjusted concentrations were generated through a mass balance, using the reported concentrations for combined process and dilution waters; and calculating an actual process water concentration through the use of a term designated as the dilution factor. The dilution factor was calculated by dividing dilution water flow by the process flow. The equation developed is as follows: Actual Concentration = Reported Concentration (1 + Dilution Factor)

The dilution factor for this plant is 0.748

(2) Priority pollutants reported as ND are presented in Appendix A. Detection levels are presented in Appendix B.

TABLE 22

308 Questionnaire Data
Plant F

Pollutant	Reported Concentration (ug/l)	Actual Concentration (ug/l)(1)
BOD_5	25,000	165,475
COD	55,000	364,045
Oil & Grease	1,000	6,619
TOC	9,700	64,204
TSS	29,000	191,951
Antimony	11	73
Arsenic	36	238
Beryllium	3.8	25
Cadmium	7.4	49
Chromium (Total)	74	490
Copper	37	245
Lead	28	185
Mercury	3	20
Nickel	21	139
Selenium	28	185
Silver	8	53
Thallium	72	477

(1) Adjusted concentrations were generated through a mass balance, using the reported concentrations for combined process and dilution waters; and calculating an actual process water concentration through the use of a term designated as the dilution factor. The dilution factor was calculated by dividing dilution water flow by the process flow. The equation developed is as follows: Actual Concentration = Reported Concentration (1 + Dilution Factor)

The dilution factor for this facility is 5.619

TABLE 23

308 Questionnaire Data
Plant G

Pollutant	Reported Concentration (ug/l)	Actual Concentration (ug/l)(1)
Mercury	0.20	1.45
Zinc	190	1,378
Acrylonitrile	49,000	355,250
Ethylbenzene	640	4,640
Benzene	54	392
Bis(2-ethylhexyl)phthalate	12	87
Toluene	270	1,958

(1) Adjusted concentrations were generated through a mass balance, using the reported concentrations for combined process and dilution waters; and calculating an actual process water concentration through the use of a term designated as the dilution factor. The dilution factor was calculated by dividing dilution water flow by the process flow. The equation developed is as follows: Actual Concentration = Reported Concentration (1 + Dilution Factor)

The dilution factor for this facility is 6.27

TABLE 24

308 Questionnaire Data
Plant H

Pollutant	Reported Concentration (ug/l)	Actual Concentration (ug/l)(1)
Mercury	0.4	2.1
Ethylbenzene	10	56
Bis(2-ethylhexyl)phthalate	36	202

(1) Adjusted concentrations were generated through a mass balance, using the reported concentrations for combined process and dilution waters; and calculating an actual process water concentration through the use of a term designated as the dilution factor. The dilution factor was calculated by dividing dilution water flow by the process flow. The equation developed is as follows: Actual Concentration = Reported Concentration (1 + Dilution Factor)

The dilution factor for this facility is 4.6139

TABLE 25

308 Questionnaire Data
Plant I

Pollutant	Reported Concentration (ug/l)	Actual Concentration (ug/l)(1)
Arsenic	10	46
Cadmium	3	14
Chromium (Total)	340	1,571
Copper	70	323
Nickel	50	231
Selenium	12	55
Silver	40	185
TCDD(2)	26	120

(1) Adjusted concentrations were generated through a mass balance, using the reported concentrations for combined process and dilution waters; and calculating an actual process water concentration through the use of a term designated as the dilution factor. The dilution factor was calculated by dividing dilution water flow by the process flow. The equation developed is as follows: Actual Concentration = Reported Concentration (1 + Dilution Factor)

The dilution factor for this facility is 3.620

(2) 2,3,7,8-Tetrachlorodibenzo-p-dioxin

TABLE 26

308 Questionnaire Data
Plant J

Pollutant	Reported Concentration (ug/l)	Actual Concentration (ug/l) (1)
Cyanide (Total)	366	4,416
Mercury	300	3,620
Selenium	100	1,207
Thallium	400	4,826
Antimony	<110	1,328
Beryllium	<110	1,328
Cadmium	<110	1,328
Chromium	<110	1,328
Copper	<110	1,328
Lead	<110	1,328
Nickel	<110	1,328
Silver	<100	1,207
Zinc	<110	1,328
2,4-Dinitrophenol	<250	3,016
4,6-Dinitro-o-cresol	<250	3,016
Priority Pollutant Organics(2)	<10	121
Priority Pollutant Organics(3)	<25	302

(1) Adjusted concentrations were generated through a mass balance, using the reported concentrations for combined process and dilution waters; and calculating an actual process water concentration through the use of a term designated as the dilution factor. The dilution factor was calculated by dividing dilution water flow by the process flow. The equation developed is as follows: Actual Concentration = Reported Concentration (1 + Dilution Factor)

The dilution factor for this facility is 11.065

(2) Pollutants are presented in Appendix A.

(3) Pollutants are presented in Appendix A.

TABLE 27

308 Questionnaire Data
Plant K

Pollutant	Reported Concentration (ug/l)	Actual Concentration (ug/l)(1)
Barium	100	3,465
Iron	580	20,998
Magnesium	520	18,019
Manganese	50	1,733
NO_2 as N	100	3,465
NO_3 as N	900	31,186
Oil & Grease	1,400	48,512
Phosphorous	280	9,702
SO_4	29,000	1,004,894
Total Kjeldahl Nitrogen	1,200	41,582
TOC	23,000	796,985
1,1,1-Trichloroethane	9	312
Cadmium	0.9	31
Chromium (Total)	1.1	38
Copper	6.5	225
Benzene	9	312
N-nitrosodiphenylamine	1	35
Phenol	8	277
Bis(2-ethylhexyl)phthalate	4	139
Diethyl phthalate	0.1	4

(1) Adjusted concentrations were generated through a mass balance, using the reported concentrations for combined process and dilution waters; and calculating an actual process water concentration through the use of a term designated as the dilution factor. The dilution factor was calculated by dividing dilution water flow by the process flow. The equation developed is as follows: Actual Concentration = Reported Concentration (1 + Dilution Factor)

The dilution factor for this facility is 33.6515

TABLE 28

308 Questionnaire Data
Plant L

Pollutant	Reported Concentration (ug/l)	Actual Concentration (ug/l)(1)
BOD_5	16,000	984,640
COD	25,000	1,538,500
TSS	12,000	738,480
Phenol	15	923

(1) Adjusted concentrations were generated through a mass balance, using the reported concentrations for combined process and dilution waters; and calculating an actual process water concentration through the use of a term designated as the dilution factor. The dilution factor was calculated by dividing dilution water flow by the process flow. The equation developed is as follows: Actual Concentration = Reported Concentration (1 + Dilution Factor)

The dilution factor for this facility is 60.54

APPENDIX A

Pollutants Reported at or below Levels of Detection

Industrial Facility	Pollutants[1]
Plant E	1-8; 10-16; 18-26; 28-49; 51-85; 87; 89-113; 117; 121; 123; 126
Plant J Reported as <10 ug/l	1; 4; 5; 7-30; 32; 33; 35-56; 61-63; 66-78; 80; 81; 84-113
Reported as <25 ug/l	31; 34; 57; 58; 64; 65; 79; 82; 83

(1) Pollutants are presented by number in Appendix C

APPENDIX B

Limits of Detection for Priority Pollutants

Code No.	Pollutants	Detection Limit (ug/l) Plant 114	2531
1	Acenaphthene	10	<10
2	Acrolein	100	-
3	Acrylonitrile	100	-
4	Benzene	10	<10
5	Benzidene	10	<10
6	Carbon tetrachloride (tetrachloromethane)	10	-
7	Chlorobenzene	10	<10
8	1,2,4-trichlorobenzene	10	<10
9	Hexachlorobenzene	-	<10
10	1,2-dichloroethane	10	<10
11	1,1,1-trichloroethane	10	<10
12	Hexachloroethane	10	<10
13	1,1-dichloroethane	10	<10
14	1,1,2-trichloroethane	10	<10
15	1,1,2,2-tetrachloroethane	10	<10
16	Chloroethane	10	<10
17*	~~bis-(chloromethyl)-ether~~	-	<10
18	Bis (2-chloroethyl) ether	10	<10
19	2-chloroethyl vinyl ether (mixed)	20	<10
20	2-chloronaphthalene	10	<10
21	2,4,6-trichlorophenol	25	<10
22	Para-chloro meta-cresol	25	<10
23	Chloroform (trichloromethane)	10	<10
24	2-chlorophenol	25	<10
25	1,2-dichlorobenzene	10	<10
26	1,3-dichlorobenzene	10	<10
27	1,4-dichlorobenzene	-	<10
28	3,3'-dichlorobenzidine	10	<10
29	1,1-dichloroethylene	10	<10
30	1,2-trans-dichloroethylene	10	<10
31	2,4-dichlorophenol	25	<25
32	1,2-dichloropropane	10	<10
33	1,3-dichloropropylene (1,3-dichloropropene)	10	<10
34	2,4-dimethylphenol	25	<25
35	2,4-dinitrotoluene	10	<10
36	2,6-dinitrotoluene	10	<10
37	1,2-diphenylhydrazine	10	<10
38	Ethylbenzene	10	<10
39	Fluoranthene	10	<10
40	4-chlorophenyl phenyl ether	10	<10
41	4-bromophenyl phenyl ether	10	<10
42	Bis (2-chloroisopropyl) ether	10	<10
43	Bis (2-chloroethoxy) methane	10	<10
44	Methylene chloride (dichloromethane)	10	<10

* Delisted 46 FR 10723

Code No.	Pollutants	Detection Limit (ug/l) Plant 114	Detection Limit (ug/l) Plant 2531
45	Methyl chloride (chloromethane)	10	<10
46	methyl bromide (bromomethane)	10	<10
47	Bromoform (tribromemethane)	10	<10
48	Dichlorobromomethane	10	<10
49**	Trichlorofluoromethane	10	<10
50**	Dichlorodifluoromethane	-	<10
51	Chlorodibromomethane	10	<10
52	Hexachlorobutadiene	10	<10
53	Hexachlorocyclopentadiene	10	<10
54	Isophorone	10	<10
55	Naphthalene	10	<10
56	Nitrobenzene	10	<10
57	2-nitrophenol	25	<25
58	4-nitrophenol	25	<25
59	2,4-dinitrophenol	25	-
60	4,6-dinitro-o-cresol	250	-
61	N-nitrosodimethylamine	10	<10
62	N-nitrosodiphenylamine	10	<10
63	N-nitrosodi-n-propylamine	10	<10
64	Pentachlorophenol	25	<25
65	Phenol	25	<25
66	Bis (2-ethylhexyl) phthalate	10	<10
67	Butyl benzyl phthalate	10	<10
68	Di-n-butyl phthalate	10	<10
69	Di-n-octyl phthalate	10	<10
70	Diethyl phthalate	10	<10
71	Dimethyl phthalate	10	<10
72	Benzo (a)anthracene (1,2-benzanthracene)	10	<10
73	Benzo (a)pyrene (3,4-benzopyrene)	10	<10
74	3,4-benzofluoranthene	10	<10
75	Benzo(k)fluoranthene (11,12-benzofluoranthene)	10	<10
76	Chrysene	10	<10
77	Acenaphthylene	10	<10
78	Anthracene	10	<10
79	Benzo(ghi)perylene (1,12-benzoperylene)	25	<25
80	Fluorene	10	<10
81	Phenanthrene	10	<10
82	Dibenzo (a,h)anthracene (1,2,5,6-dibenzanthracene)	25	<25
83	Indeno (1,2,3-cd)pyrene (2,3-o-phenylenepyrene)	25	<25
84	Pyrene	10	<10
85	Tetrachloroethylene	10	<10
86	Toluene	-	<10
87	Trichloroethylene	10	<10
88	Vinyl chloride (chloroethylene)	-	<10
89	Aldrin	10	<10

** Delisted 46 FR 2266

APPENDIX B (Cont.)

Code No.	Pollutants	Detection Limit (ug/l) Plant 114	2531
90	Dieldrin	10	<10
91	Chlorodane (technical mixture and metabolities)	10	<10
92	4,4'-DDT	10	<10
93	4,4'-DDE (p,p'DDX)	10	<10
94	4,4'-DDD (p,p'TDE)	10	<10
95	A-endosulfan-Alpha	10	<10
96	A-endosulfan-Beta	10	<10
97	Endosulfan sulfate	10	<10
98	Endrin	10	<10
99	Endrin aldehyde	10	<10
100	Heptachlor	10	<10
101	Heptachlor epoxide	10	<10
102	A-BHC-Alpha	10	<10
103	B-BHC-Beta	10	<10
104	R-BHC (lindane)-Gamma	10	<10
105	G-BHC-Delta	10	<10
106	PCB-1242 (Arochlor 1242)	10	<10
107	PCB-1254 (Arochlor 1254)	10	<10
108	PCB-1221 (Arochlor 1221)	10	<10
109	PCB-1232 (Arochlor 1232)	10	<10
110	PCB-1248 (Arochlor 1248)	10	<10
111	PCB-1260 (Arochlor 1260)	10	<10
112	PCB-1016 (Arochlor 1016)	10	<10
113	Toxaphene	10	<10
114	Antimony	-	-
115	Arsenic	-	-
116	Asbestos (Fibrous)	-	-
117	Beryllium	1	-
118	Cadmium	-	-
119	Chromium (Total)	-	-
120	Copper	-	-
121	Cyanide (Total)	50	-
122	Lead	-	-
123	Mercury	5	-
124	Nickel	-	-
125	Selenium	-	-
126	Silver	1	-
127	Thallium	-	-
128	Zinc	-	-
129	2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD)	-	-

APPENDIX C

List of 129 Priority Toxic Pollutants

Code No.	Pollutant
1	Acenaphthene
2	Acrolein
3	Acrylonitrile
4	Benzene
5	Benzidene
6	Carbon tetrachloride (tetrachloromethane)
7	Chlorobenzene
8	1,2,4-trichlorobenzene
9	Hexachlorobenzene
10	1,2-dichloroethane
11	1,1,1-trichloroethane
12	Hexachloroethane
13	1,1-dichloroethane
14	1,1,2-trichloroethane
15	1,1,2,2-tetrachloroethane
16	Chloroethane
17*	~~bis-(chloromethyl)-ether~~
18	Bis (2-chloroethyl) ether
19	2-chloroethyl vinyl ether (mixed)
20	2-chloronaphthalene
21	2,4,6-trichlorophenol
22	Para-chloro meta-cresol
23	Chloroform (trichloromethane)
24	2-chlorophenol
25	1,2-dichlorobenzene
26	1,3-dichlorobenzene
27	1,4-dichlorobenzene
28	3,3'-dichlorobenzidine
29	1,1-dichloroethylene
30	1,2-trans-dichloroethylene
31	2,4-dichlorophenol
32	1,2-dichloropropane
33	1,3-dichloropropylene (1,3-dichloropropene)
34	2,4-dimethylphenol
35	2,4-dinitrotoluene
36	2,6-dinitrotoluene
37	1,2-diphenylhydrazine
38	Ethylbenzene
39	Fluoranthene
40	4-chlorophenyl phenyl ether
41	4-bromophenyl phenyl ether
42	Bis (2-chloroisopropyl) ether
43	Bis (2-chloroethoxy) methane
44	Methylene chloride (dichloromethane)
45	Methyl chloride (chloromethane)
46	methyl bromide (bromomethane)

* Delisted 46 FR 10723

APPENDIX C (Cont.)

Code No.	Pollutant
47	Bromoform (tribromemethane)
48	Dichlorobromomethane
49**	Trichlorofluoromethane
50**	Dichlorodifluoromethane
51	Chlorodibromomethane
52	Hexachlorobutadiene
53	Hexachlorocyclopentadiene
54	Isophorone
55	Naphthalene
56	Nitrobenzene
57	2-nitrophenol
58	4-nitrophenol
59	2,4-dinitrophenol
60	4,6-dinitro-o-cresol
61	N-nitrosodimethylamine
62	N-nitrosodiphenylamine
63	N-nitrosodi-n-propylamine
64	Pentachlorophenol
65	Phenol
66	Bis (2-ethylhexyl) phthalate
67	Butyl benzyl phthalate
68	Di-n-butyl phthalate
69	Di-n-octyl phthalate
70	Diethyl phthalate
71	Dimethyl phthalate
72	Benzo (a)anthracene (1,2-benzanthracene)
73	Benzo (a)pyrene (3,4-benzopyrene)
74	3,4-benzofluoranthene
75	Benzo(k)fluoranthene (11,12-benzofluoranthene)
76	Chrysene
77	Acenaphthylene
78	Anthracene
79	Benzo(ghi)perylene (1,12-benzoperylene)
80	Fluorene
81	Phenanthrene
82	Dibenzo (a,h)anthracene (1,2,5,6-dibenzanthracene)
83	Indeno (1,2,3-cd)pyrene (2,3-o-phenylenepyrene)
84	Pyrene
85	Tetrachloroethylene
86	Toluene
87	Trichloroethylene
88	Vinyl chloride (chloroethylene)
89	Aldrin
90	Dieldrin
91	Chlorodane (technical mixture and metabolities)

** Delisted 46 FR 2266

APPENDIX C (Cont.)

Code No.	Pollutant
92	4,4'-DDT
93	4,4'-DDE (p,p'DDX)
94	4,4'-DDD (p,p'TDE)
95	A-endosulfan-Alpha
96	A-endosulfan-Beta
97	Endosulfan sulfate
98	Endrin
99	Endrin aldehyde
100	Heptachlor
101	Heptachlor epoxide
102	A-BHC-Alpha
103	B-BHC-Beta
104	R-BHC (lindane)-Gamma
105	G-BHC-Delta
106	PCB-1242 (Arochlor 1242)
107	PCB-1254 (Arochlor 1254)
108	PCB-1221 (Arochlor 1221)
109	PCB-1232 (Arochlor 1232)
110	PCB-1248 (Arochlor 1248)
111	PCB-1260 (Arochlor 1260)
112	PCB-1016 (Arochlor 1016)
113	Toxaphene
114	Antimony
115	Arsenic
116	Asbestos (Fibrous)
117	Beryllium
118	Cadmium
119	Chromium (Total)
120	Copper
121	Cyanide (Total)
122	Lead
123	Mercury
124	Nickel
125	Selenium
126	Silver
127	Thallium
128	Zinc
129	2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD)

APPENDIX VIII-A

METHODOLOGY FOR CALCULATING BPT TARGETS AND IMPUTING MISSING ACTUAL BOD_5 AND TSS EFFLUENT VALUES

METHODOLOGY FOR CALCULATING BPT TARGETS AND IMPUTING MISSING ACTUAL BOD_5 AND TSS EFFLUENT VALUES

The following discussion describes the methodology for determining costing targets for 304 direct discharge plants (both full response and Part A) for BOD_5 effluent and TSS effluent, and imputed values of BOD_5 effluent and TSS effluent when no actual concentration information is available. The estimates are based on the Master Analysis File with revisions through September 11, 1987, using the statistical methodology for determining targets as given in Chapter IV of the Development Document.

A. Targets

Estimation of the parameters for the regression model used for determining BOD_5 effluent targets required knowledge of BOD_5 effluent and percentage of total 1980 OCPSF production in each of the seven categories: 1) thermoplastics; 2) thermosets; 3) rayon; 4) other fibers; 5) commodity organics; 6) bulk organics; and 7) specialty organics. Only full response direct discharge plants with biological treatment having BOD_5 effluent and production information were used in the regression (157 plants). Two "shift" parameters are present in the model also: (a) whether the plant has a BOD_5 effluent less than or equal to 40 mg/l or a BOD_5 percent removal of at least 95 percent ("performance shift"), and (b) whether the plant has biological treatment only ("treatment shift"). There are 109 plants meeting condition (a) and 99 plants meeting condition (b)--71 plants meet both (a) and (b).

The estimated coefficients for the model are given below:

$a = 4.56410137$
$T_1 = -0.29139627$
$T_2 = 0.66475573$
$T_3 = -0.23663157$
$T_4 = -0.52627652$
$T_5 = -0.06626001$
$T_6 = 0.09852574$
$T_7 = 0.35728290$
$B = -1.94453768$
$D = 0.41834828$,

or alternatively,

$a + T_1 = 4.27270510$ (Thermoplastics)
$a + T_2 = 5.22885710$ (Thermosets)
$a + T_3 = 4.32746980$ (Rayon)
$a + T_4 = 4.03782486$ (Other Fibers)
$a + T_5 = 4.49782486$ (Commodity Organics)
$a + T_6 = 4.66262711$ (Bulk Organics)
$a + T_7 = 4.92138427$ (Specialty Organics)
$B = -1.94453768$ (Performance Shift)
$D = 0.41834828$ (Treatment Shift).

BOD_5 effluent targets for an individual subcategory j ($j = 1,\ldots,7$) are found by rounding results from the following formula to the nearest mg/l:

$$C_j = \exp(a + T_j + B + D) \qquad (1)$$

These BOD_5 targets for each category (C_j) are as follows:

C_1 - Thermoplastics: 16 mg/l
C_2 - Thermosets: 41 mg/l
C_3 - Rayon: 16 mg/l
C_4 - Other Fibers: 12 mg/l
C_5 - Commodity Organics: 20 mg/l
C_6 - Bulk Organics: 23 mg/l
C_7 - Specialty Organics: 30 mg/l

BOD_5 effluent targets for an individual plant (P_i) are calculated by rounding, to the nearest mg/l, results from the following equation:

$$P_i = \sum_{j=1}^{7} w_{ij} * C_j \qquad (2)$$

where w_{ij} is the proportion of total 1980 OCPSF production in the j^{th} category (as defined above) from the i^{th} plant, with $\sum_{j=1}^{7} w_{ij} = 1$.

These BOD_5 effluent targets are termed "implementation" targets, and are weighted averages of the subcategory BOD_5 effluent targets.

Of the 304 direct discharge plants, 250 are full response plants and 54 are "Part A" plants. It can be seen from (2) that only production information is needed to calculate a target, given the results from formula (1). Of the 250 full response plants, 244 have 1980 OCPSF production information in the seven subcategories, and this is used as the basis for the w_{ij}'s in formula (2). Of the 6 remaining full response plants, 4 have 1982 production information, and 2 have neither 1982 nor 1980 production. Production from 1982 is used as the basis of the w_{ij}'s in these 4 plants, and targets are not calculated for the other 2 plants. Production from 1982 is not divided separately into commodity, bulk, and specialty organics, however--only an overall organics production is given. For plants with organics production, the proportion of total organics production is divided equally among the commodity, bulk, and specialty categories; that is,

$$w_{i5} = w_{i6} = w_{i7} = 1/3 \text{ of the proportion of total 1982}$$

OCPSF production in the organics designation.

Only total 1982 OCPSF production is available for the Part A direct discharge plants, and only 45 of the 54 Part A direct dischargers have production information. BOD_5 effluent targets are calculated similar to the 4 full-response direct discharge plants which do not have 1980 OCPSF production but do have 1982 OCPSF production, and the methodology for determining targets for these 45 plants has been described above. Targets are not calculated for the 9 Part A direct dischargers without 1982 production information.

In summary, BOD_5 effluent targets are calculated for 293 out of 304 direct discharge plants. Production information is summarized for the 304 plants below.

Production Information Used	Full Response	Part A	Total
1980	244	0	244
1982	4	45	49
Not Available	2	9	11
	250	54	304

Estimation of the parameters for the regression model used for determining TSS effluent targets required knowledge of the BOD_5 effluent level and the TSS effluent level. Only full-response direct dischargers with only biological treatment that have BOD_5 effluent and TSS effluent and meeting the 95/40 editing criteria for BOD_5 and the 100 mg/l editing criterion for TSS effluent (as described in Chapter IV and Chapter VII of the Development Document) were used (61 plants).

The coefficients for the model are given below:

a = 1.84996248

b = 0.52810227

TSS effluent targets for an individual category j are found by rounding results from the following formula to the nearest mg/l.

$$F_j = \exp(a + b*C_j) \quad (3)$$

These TSS targets for each category (F_j) are as follows:

F_1 - Thermoplastics:	27 mg/l
F_2 - Thermosets:	45 mg/l
F_3 - Rayon:	27 mg/l
F_4 - Other Fibers:	24 mg/l
F_5 - Commodity Organics:	31 mg/l
F_6 - Bulk Organics:	33 mg/l
F_7 - Specialty Organics:	38 mg/l

TSS effluent targets for an individual plant R_i are calculated by rounding, to the nearest mg/l, results from the following equation:

$$R_i = \sum_{j=1}^{7} w_{ij}*F_j \quad (4)$$

These TSS effluent implementation targets are weighted averages of the subcategory TSS effluent targets.

As can be seen from equation (3), only the BOD_5 effluent subcategory target is needed to calculate a TSS effluent target, and only subcategory production information is needed in equation (4) to determine a plant-specific target. Consequently, TSS targets are calculated for 293 direct discharge plants, using the same rules for assigning subcategory production from either 1980 or 1982, as described previously for BOD_5 effluent targets.

B. Actual BOD_5 and TSS Effluent Information

Of the 304 direct discharge plants, 204 have actual BOD_5 effluent information and 206 plants have actual TSS information. The following table describes the number of plants with actual BOD_5 and TSS effluent information by response (full response or Part A) and production information used (1980, 1982, or not available).

Response	Production Information Used	Number of Plants	Plants with BOD_5 Effluent	Plants with TSS Effluent	Plants With Both BOD_5 and TSS Effluent
Full	1980	244	200	202	192
Full	1982	4	2	2	2
Full	Not available	2	2	2	2
Part A	1982	45	0	0	0
Part A	Not available	9	0	0	0
		304	204	206	196

C. BOD_5 and TSS Effluent Imputed Values

1. Full Response Plants

As can be seen from the table above, 204 out of 250 full response direct discharge plants have BOD_5 effluent concentration values, and 206 of these plants have TSS effluent concentration values. For the remaining 46 plants for BOD_5 effluent and 44 for TSS effluent, concentration values are imputed. These estimates of the actual values are used for comparison with targets for estimating cost of compliance to BPT Standards.

The imputations for the full-response direct discharge plants are done separately by presence of biological treatment (yes or no). The following regression equations are used for imputing BOD_5 effluent and TSS effluent:

$$\ln(BOD_i) = a + \sum_{j=1}^{7} w_{ij} * T_j + e_i, \text{ and} \quad (5)$$

$$\ln(TSS_i) = a + b * \ln(BOL_i) + e_i \quad (6)$$

Separate equations are estimated for plants with biological treatment and for plants without biological treatment. Plants with BOD_5 effluent and 1980 production information are used for equation (5) and plants with TSS and BOD_5 effluent information are used for equation (6). Below is a table describing the number of plants and the estimates of these equations for plants with biological treatment and without biological treatment.

	Biological Treatment	No Biological Treatment
	BOD_5 Effluent	
# Plants	157	43
$a + T_1$	2.90633792	3.54696580
$a + T_2$	4.19053443	7.82045895
$a + T_3$	2.78329807	2.07944154
$a + T_4$	2.38146232	1.60943791
$a + T_5$	3.50845226	4.24986735
$a + T_6$	3.79345998	4.11536832
$a + T_7$	4.16274198	5.44690773
	TSS Effluent	
# Plants	155	41
a	1.78022967	1.19856018
b	0.60571767	0.71533813

Imputation of the 46 missing BOD_5 effluent concentration values and 44 missing TSS effluent concentration values comes from these parameter estimates. Of the 46 plants for BOD_5 effluent, 21 are biological and 25 are not biological plants. Of the 44 plants for TSS effluent, 24 are biological and 20 are not biological plants. Imputations for BOD_5 effluent for a particular plant (B_i) are calculated as follows:

$$B_i = \exp[\sum_{j=1}^{7} w_{ij}(a + T_j)], \text{ or} \tag{7}$$

$$\exp[a + \sum_{j=1}^{7} w_{ij} * T_j], \text{ since}$$

$$\sum_{j=1}^{7} w_{ij} = 1.$$

TSS imputations for a particular plant (S_i) are calculated from the BOD imputations using the following formula:

$$S_i = \exp[a + b*\ln(B_i)] \qquad (8)$$

Both B_i and S_i are rounded to the nearest mg/l. The values for these parameters depend upon whether the plant for which the imputation is necessary has biological treatment or not. Imputations for mixed plants are based on subcategory parameter estimates and plant-specific BOD_5 effluent estimates, rather than from subcategory long-term averages, as is done with the "implementation" targets.

2. Part A Only Plants

Equations (5) and (6) were also used to impute actual BOD_5 and TSS effluent values for plants which only submitted Part A responses. This was necessary because BOD_5 and TSS effluent data submitted in Question No. A21a of the Section 308 Questionnaire was obtained from the final outfall which contains over 25 percent non-OCPSF wastewater flow. As noted previously, Part A only plants submitted 1982 OCPSF production data which did not allow the separation of organic chemicals into commodity, bulk and specialty and, therefore, required the proportion of total organics to be used for parameter estimates rather than separate proportions for commodity, bulk, and specialty organics. Also, to estimate equation parameters a, T_j and b, BOD and TSS effluent values were obtained from Question No. A21a of the questionnaire, rather than some estimate of effluent values from the full-response plants; this was done to retain some continuity between plant product mix and effluent quality. Finally, as with full response plants, separate parameter estimates were derived for biological and nonbiological treatment systems to account for the difference in effluent quality between these systems.

There are a total of 24 biological plants and 5 nonbiological plants with BOD_5 effluent and 1982 production information, which are direct dischargers, in question A21a. All of these plants have TSS effluent information. These plants produce either thermoplastics, thermosets, or organics -- no rayon or other fibers plants are present. The coefficients used in formulas (5) and (6) are given below (T_8 is used to represent organics production).

APPENDIX VIII-B

BPT, BAT, AND PSES COMPLIANCE COST ESTIMATES AND TECHNOLOGY BASIS

APPENDIX VIII-B

Appendix VIII-B contains computer listings of BPT, BAT and PSES compliance cost estimates and the corresponding technology basis costed for the final regulation (starting on page VIII-B53). The compliance cost column headings in the computer listings are defined as follows:

Total Capital Costs - total of capital costs for all technologies (except sludge handling)

Total O&M Costs - total of operation and maintenance costs for all technologies (except sludge handling)

Total Land Costs - total of land costs for all technologies (including sludge handling)

Capital Sludge Costs - total of capital costs for all sludge handling and disposal technologies

O&M Sludge Costs - total of operation and maintenance costs for all sludge handling and disposal technologies

Annual Monitoring Costs - total of annual monitoring costs for toxic pollutants (no BPT annual monitoring costs were estimated).

These cost estimates were summarized in section VIII as follows:

BPT Capital Costs = Total Capital Costs + Total Land Costs + Capital Sludge Costs

BPT O&M Costs = Total O&M Costs + O&M Sludge Costs + Contract Hauling Costs

No BPT annual monitoring costs were estimated.

BAT Capital Costs = Total Capital Costs + Total Land Costs + Capital Sludge Costs

BAT O&M Costs = Total O&M Costs + O&M Sludge Costs + Contract Hauling Costs

BAT annual monitoring costs were estimated.

PSES Capital Costs = Total Capital Costs + Total Land Costs + Capital Sludge Costs

PSES O&M Costs = Total O&M Costs + O&M Sludge Costs + Contract Hauling Costs

PSES annual monitoring costs were estimated.

LIST OF BPT COST DATA -- BY OPTION

-- OPTION=I --

OBS	PLANT	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS
1	1	2148497	184672	141330	1100630	390896	.
2	12	180874	18790	2797	63274	13627	.
3	15	0	0	0	0	0	.
4	33	749380	68731	42819	566440	140784	.
5	61	84151	33440	1347	37220	8016	.
6	63	0	0	0	0	0	.
7	76	281469	34471	4672	744400	160320	.
8	83	381862	42663	2044	746261	160721	.
9	87	265566	42407	1936	539690	116232	.
10	101	.	.	.	.	.	4453
11	102	0	0	0	0	0	.
12	105	323707	40812	38018	578275	143725	.
13	112	.	.	.	.	.	111325
14	114	241351	28357	6566	472694	101803	.
15	154	0	0	0	0	0	.
16	155	338881	47365	7506	898363	193586	.
17	159	358407	69134	2006	139389	30020	.
18	177	818190	77191	82527	816179	202855	.
19	180	.	.	.	.	.	44530
20	183	357748	40346	7774	658794	141883	.
21	190	0	0	0	0	0	.
22	205	0	0	0	0	0	.
23	225	229464	39653	2693	388949	83767	.
24	227	1935676	185623	88293	1138637	404394	.
25	250	866127	82093	87754	910350	226260	.
26	254	0	0	0	0	0	.
27	259	276458	43077	8326	580632	125050	.
28	260	0	0	0	0	0	.
29	267	0	0	0	0	0	.
30	269	68749	33280	661	22332	4810	.
31	284	113202	8618	0	0	0	.
32	294	106642	33670	2038	67368	14509	.
33	296	2425129	299145	301084	1057344	375522	.
34	301	0	0	0	0	0	.
35	352	249389	28887	1520	289013	62244	.
36	384	0	0	0	0	0	.
37	387	0	0	0	0	0	.
38	392	0	0	0	0	0	.
39	394	0	0	0	0	0	.
40	399	2289537	262234	7000	1685950	627888	.
41	412	117697	33793	27282	83745	18036	.
42	415	1872048	201524	34159	1117344	416125	.
43	443	0	0	0	0	0	.
44	444	296959	36804	8590	857921	184769	.
45	446	87942	33470	1798	42877	9234	.
46	447	233064	39920	4320	401976	86573	.
47	451	834724	62589	48915	333145	118319	.
48	481	27229	32795	944	1861	401	.
49	485	0	0	0	0	0	.
50	486	194555	21206	9336	101611	21884	.
51	488	0	0	0	0	0	.
52	500	1373260	124032	284601	933028	331371	.
53	502	40391	32974	1659	5397	1162	.

LIST OF BPT COST DATA -- BY OPTION

OPTION=I

OBS	PLANT	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS
54	518	3746	2001	0	0	0	.
55	523	256452	29711	6170	311717	67134	.
56	525	0	0	0	0	0	.
57	536	56877	33157	1858	13585	2926	.
58	569	200730	37442	9882	292177	62926	.
59	580	604454	57750	3630	711084	176734	.
60	601	72640	33317	1744	26054	5611	.
61	602	106642	33674	1576	66475	14317	.
62	608	785303	76098	12794	336260	119425	.
63	611	0	0	0	0	0	.
64	614	117697	33782	2843	87095	18757	.
65	633	188254	20688	5061	106077	22846	.
66	657	0	0	0	0	0	.
67	659	631575	59683	3424	758625	188550	.
68	662	584467	20379	0	0	0	.
69	663	179503	24522	5161	124687	26854	.
70	664	0	0	0	0	0	.
71	669	110338	33721	5931	70718	15230	.
72	682	1085016	152559	18792	951020	354182	.
73	683	0	0	0	0	0	.
74	695	3099055	439795	97195	2533003	1231398	.
75	709	.	.	.	.	.	133590
76	727	1507133	137189	85264	791820	281220	.
77	741	899892	82239	101117	298780	106114	.
78	758	381354	42615	8132	744400	160320	.
79	775	342597	47565	4059	915612	197194	.
80	802	0	0	0	0	0	.
81	811	0	0	0	0	0	.
82	814	654241	89646	6845	607062	215602	.
83	819	1092319	109426	42427	268163	95240	.
84	825	218681	38745	2875	346146	74549	.
85	844	26890	70000	0	0	0	.
86	851	1109521	116141	21610	722008	256426	.
87	859	1015264	97928	19782	809200	201120	.
88	866	0	0	0	0	0	.
89	871	909184	84912	5348	398813	141641	.
90	876	313017	46650	9504	761149	163927	.
91	877	0	0	0	0	0	.
92	883	13128	3379	0	0	0	.
93	888	302005	44924	6651	707180	152304	.
94	908	233064	40018	7070	407559	87775	.
95	909	513324	68914	15085	396174	140704	.
96	913	893264	124634	24811	996373	353868	.
97	938	265566	42407	1936	539690	116232	.
98	942	236664	40150	11486	413142	88978	.
99	948	0	0	0	0	0	.
100	956	.	.	.	.	.	71248
101	962	99208	33598	1499	55830	12024	.
102	970	466572	62014	5701	330717	117456	
103	973	0	0	0	0	0	.
104	984	429711	50874	5650	644325	160142	.
105	990	0	0	0	0	0	.
106	991	.	.	.	.	.	26718

LIST OF BPT COST DATA -- BY OPTION

OPTION=I

OBS	PLANT	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS
54	518	3746	2001	0	0	0	.
55	523	256452	29711	6170	311717	67134	.
56	525	0	0	0	0	0	.
57	536	56877	33157	1858	13585	2926	.
58	569	200730	37442	9882	292177	62926	.
59	580	604454	57750	3630	711084	176734	.
60	601	72640	33317	1744	26054	5611	.
61	602	106642	33674	1576	66475	14317	.
62	608	785303	76098	12794	336260	119425	.
63	611	0	0	0	0	0	.
64	614	117697	33782	2843	87095	18757	.
65	633	188254	20688	5061	106077	22846	.
66	657	0	0	0	0	0	.
67	659	631575	59683	3424	758625	188550	.
68	662	584467	20379	0	0	0	.
69	663	179503	24522	5161	124687	26854	.
70	664	0	0	0	0	0	.
71	669	110338	33721	5931	70718	15230	.
72	682	1085016	152559	18792	951020	354182	.
73	683	0	0	0	0	0	.
74	695	3099055	439795	97195	2533003	1231398	.
75	709	.	.	.	.	.	133590
76	727	1507133	137189	85264	791820	281220	.
77	741	899892	82239	101117	298780	106114	.
78	758	381354	42615	8132	744400	160320	.
79	775	342597	47565	4059	915612	197194	.
80	802	0	0	0	0	0	.
81	811	0	0	0	0	0	.
82	814	654241	89646	6845	607062	215602	.
83	819	1092319	109426	42427	268163	95240	.
84	825	218681	38745	2875	346146	74549	.
85	844	26890	70000	0	0	0	.
86	851	1109521	116141	21610	722008	256426	.
87	859	1015264	97928	19782	809200	201120	.
88	866	0	0	0	0	0	.
89	871	909184	84912	5348	398813	141641	.
90	876	313017	46650	9504	761149	163927	.
91	877	0	0	0	0	0	.
92	883	13128	3379	0	0	0	.
93	888	302005	44924	6651	707180	152304	.
94	908	233064	40018	7070	407559	87775	.
95	909	513324	68914	15085	396174	140704	.
96	913	893264	124634	24811	996373	353868	.
97	938	265566	42407	1936	539690	116232	.
98	942	236664	40150	11486	413142	88978	.
99	948	0	0	0	0	0	.
100	956	.	.	.	.	.	71248
101	962	99208	33598	1499	55830	12024	.
102	970	466572	62014	5701	330717	117456	.
103	973	0	0	0	0	0	.
104	984	429711	50874	5650	644325	160142	.
105	990	0	0	0	0	0	.
106	991	.	.	.	.	.	26718

LIST OF BPT COST DATA -- BY OPTION

-- OPTION=I --

OBS	PLANT	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS
107	992	60872	33204	1452	16042	3455	.
108	1012	572058	63566	4965	969017	240841	.
109	1020	0	4312	0	0	0	.
110	1033	.	.	.	.	.	89060
111	1038	0	0	0	0	0	.
112	1059	617533	21643	0	0	0	.
113	1061	0	0	0	0	0	.
114	1062	498529	55630	7275	738395	183522	.
115	1067	225869	39313	8224	372200	80160	.
116	1133	0	0	0	0	0	.
117	1137	553812	68369	3342	314458	111682	.
118	1139	2647	1733	0	0	0	.
119	1148	876578	83708	2078	393271	139673	.
120	1149	697317	95967	19203	674763	239646	.
121	1157	10000	14000	0	0	0	.
122	1203	11640	19000	0	0	0	.
123	1241	0	0	0	0	0	.
124	1249	184239	19037	5002	148880	32064	.
125	1267	58679	6428	0	0	0	.
126	1299	0	0	0	0	0	.
127	1319	64828	33202	1059	21401	4609	.
128	1323	110338	33703	899	74626	16072	.
129	1327	796198	82652	73103	617015	153354	.
130	1340	0	0	0	0	0	.
131	1343	284565	34938	5721	766732	165130	.
132	1348	0	0	0	0	0	.
133	1349	17680	44500	0	0	0	.
134	1389	653985	48654	19703	636233	158131	.
135	1407	0	0	0	0	0	.
136	1409	0	0	0	0	0	.
137	1414	170074	15107	4700	20471	4409	.
138	1438	15000	30000	3428	625107	155365	.
139	1439	236664	40244	11767	418725	90180	.
140	1446	409598	53586	11954	976806	242777	.
141	1464	908830	91177	15421	469813	166857	.
142	1494	1174531	101012	105959	592545	210446	.
143	1520	0	0	0	0	0	.
144	1522	795838	37783	0	0	0	.
145	1524	215088	38487	6486	334980	72144	.
146	1532	1023159	101572	124128	399869	142016	.
147	1569	225316	25861	2165	374061	80561	.
148	1572	1392807	140903	3493	915872	325278	.
149	1593	189968	36598	2550	260540	56112	.
150	1609	734465	59464	81394	768740	191064	.
151	1616	261944	42102	7911	521080	112224	.
152	1617	975301	81895	33603	400001	142063	.
153	1618	0	0	0	0	0	.
154	1624	157632	34229	2775	169351	36473	.
155	1643	453201	60038	12533	312505	110988	.
156	1647	688818	52168	44999	759636	188801	.
157	1650	1835050	260709	56409	1348463	655544	.
158	1656	117697	33787	6406	85606	18437	.
159	1670	.	.	.	.	.	4453

LIST OF BPT COST DATA -- BY OPTION

OPTION=I

OBS	PLANT	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS
160	1684	10000	13000	0	0	0	.
161	1688	1068593	106304	112509	349457	124112	.
162	1695	0	0	0	0	0	.
163	1698	68750	33252	7520	24193	5210	.
164	1714	168984	15610	4523	65135	14028	.
165	1717	188703	20581	1774	98633	21242	.
166	1724	0	0	0	0	0	.
167	1753	1685179	169888	18180	1266912	449952	.
168	1766	305671	45132	9258	722068	155510	.
169	1769	322330	1300000	0	0	0	.
170	1774	0	0	0	0	0	.
171	1776	68749	33280	1597	22332	4810	.
172	1785	364027	46822	6082	758625	188550	.
173	1794	22597	32694	15232	1228	265	.
174	1802	810485	65222	97501	282416	100302	.
175	1839	243874	40790	11905	447198	96312	.
176	1869	0	0	0	0	0	.
177	1877	0	0	0	0	0	.
178	1881	135942	33984	1904	120034	25852	.
179	1890	1032804	109344	20182	1369268	340320	.
180	1905	0	0	0	0	0	.
181	1910	0	0	0	0	0	.
182	1911	956147	117666	23834	800087	246695	.
183	1928	132307	33947	3085	111660	24048	.
184	1937	0	0	0	0	0	.
185	1943	46613	5812	0	0	0	.
186	1973	0	0	0	0	0	.
187	1977	1869736	207459	9856	1216685	453122	.
188	1986	56877	33124	2547	14888	3206	.
189	2009	806271	70103	44444	930580	231288	.
190	2020	171655	16343	4700	37220	8016	.
191	2026	942791	80047	4565	351040	124674	.
192	2030	342907	43678	9236	662532	164667	.
193	2047	225869	39313	10966	372200	80160	.
194	2049	200321	21837	5756	232625	50100	.
195	2055	99208	33586	2564	57691	12425	.
196	2062	72640	33317	2837	26054	5611	.
197	2073	0	9530	0	0	0	.
198	2090	168427	34578	3188	193544	41683	.
199	2110	676510	59533	71352	508784	126454	.
200	2148	0	0	0	0	0	.
201	2181	250595	29778	1137	532246	114629	.
202	2193	27229	32795	944	1861	401	.
203	2198	218681	38887	4082	353590	76152	.
204	2206	110338	33703	2100	74440	16032	.
205	2221	0	0	0	0	0	.
206	2222	0	0	0	0	0	.
207	2227	1871009	163118	316833	1090072	387146	.
208	2228	48749	33057	2374	9305	2004	.
209	2236	154027	34191	7870	156324	33667	.
210	2242	0	0	0	0	0	.
211	2254	839183	82156	28434	671636	166930	.
212	2268	117697	33781	6334	87467	18838	.

LIST OF BPT COST DATA -- BY OPTION

OPTION=I

OBS	PLANT	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS
213	2272	1073402	109277	20036	640582	227507	.
214	2281	0	0	0	0	0	.
215	2292	0	0	0	0	0	.
216	2296	316205	39690	3060	546210	135756	.
217	2307	106642	33853	3178	42059	9058	.
218	2313	324073	46472	7337	826284	177955	.
219	2315	20180	54000	0	0	0	.
220	2316	0	0	0	0	0	.
221	2322	0	0	0	0	0	.
222	2328	179597	35630	3270	26054	5611	.
223	2345	204318	37634	10761	299249	64449	.
224	2353	128667	33900	6785	107938	23246	.
225	2360	0	0	0	0	0	.
226	2364	397686	51820	4836	918442	228271	.
227	2365	329541	37851	1863	576724	124208	.
228	2368	828090	66044	27970	308810	109676	.
229	2376	154750	9942	0	0	0	.
230	2390	172020	34986	3267	206199	44409	.
231	2394	1187913	104361	69897	641110	227694	.
232	2399	1356450	118223	11726	659850	234350	.
233	2400	233064	40049	4355	409420	88176	.
234	2419	189968	36510	5802	256818	55310	.
235	2429	0	0	0	0	0	.
236	2430	0	0	0	0	0	.
237	2445	1690705	152499	6636	979217	347775	.
238	2447	0	0	0	0	0	.
239	2450	0	0	0	0	0	.
240	2461	1029598	86321	8598	390631	138735	.
241	2471	0	0	0	0	0	.
242	2474	251092	41370	13248	479394	103246	.
243	2481	0	0	0	0	0	.
244	2527	309342	45427	16361	744400	160320	.
245	2528	1758608	134850	382142	1227321	435891	.
246	2531	236664	40244	4400	418725	90180	.
247	2533	276458	43180	14583	588076	126653	.
248	2536	0	0	0	0	0	.
249	2537	150420	34148	2064	150741	32465	.
250	2541	656361	53354	26126	556325	138270	.
251	2551	0	0	0	0	0	.
252	2556	218670	24812	5833	334980	72144	.
253	2573	276458	43256	8415	593659	127855	.
254	2590	0	0	0	0	0	.
255	2592	908572	87132	3922	421512	149703	.
256	2606	.	.	.	.	.	4453
257	2626	0	0	0	0	0	.
258	2631	0	0	0	0	0	.
259	2633	1086614	101045	146635	450282	159920	.
260	2647	952532	78105	137946	447906	159077	.
261	2660	0	0	0	0	0	.
262	2668	218681	38745	4776	346146	74549	.
263	2673	189968	36556	10129	258679	55711	.
264	2678	916456	75978	35720	304824	108260	.
265	2680	172020	34947	5300	204710	44088	.

LIST OF BPT COST DATA -- BY OPTION

OPTION=I

OBS	PLANT	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS
266	2692	0	0	0	0	0	.
267	2693	712482	59792	45282	642302	159639	.
268	2695	0	0	0	0	0	.
269	2701	374284	45170	8897	508784	126454	.
270	2711	143192	34072	4498	131573	28337	.
271	2735	0	0	0	0	0	.
272	2739	797094	63463	56810	981155	243858	.
273	2763	0	0	0	0	0	.
274	2764	416596	54622	12164	1011500	251400	.
275	2767	0	0	0	0	0	.
276	2770	258323	41792	7778	502470	108216	.
277	2771	327767	46704	16473	844894	181963	.
278	2781	0	0	0	0	0	.
279	2786	995226	88807	78256	409450	145419	.
280	2795	298203	36991	1927	867226	186773	.
281	2816	0	0	0	0	0	.
282	2818	294684	44545	14525	681126	146693	.
283	3033	236664	40150	7113	413142	88978	.
284	4002	247481	41173	12166	468972	101002	.
285	4010	324070	46534	6110	831867	179158	.
286	4017	0	0	0	0	0	.
287	4018	0	0	0	0	0	.
288	4021	11582	3205	0	0	0	.
289	4037	0	0	0	0	0	.
290	4040	52838	33114	4237	11166	2405	.
291	4051	227522	26136	1422	215876	46493	.
292	4055	0	0	0	0	0	.
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OPTION		99574289	13202017	4687175	88326328	25068308	489830

OPTION=III

OBS	PLANT	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS
293	1	3093191	267051	151936	1100630	390896	.
294	12	398258	44260	5266	63274	13627	.
295	15	207097	21506	585	0	0	.
296	33	1148227	113515	47467	566440	140784	.
297	61	293703	57204	2409	37220	8016	.
298	63	0	0	0	0	0	.
299	76	638913	75589	8731	744400	160320	.
300	83	739583	83807	3820	746261	160721	.
301	87	590491	80473	2808	539690	116232	.
302	101	.	.	.	.	.	4453
303	102	437025	47991	6319	0	0	.
304	105	725381	85838	71086	578275	143725	.
305	112	.	.	.	.	.	111325
306	114	554583	65280	12271	472694	101803	.
307	154	368874	42152	5109	0	0	.
308	155	718497	90473	10679	898863	193586	.
309	159	598840	98005	3157	139389	30020	.

LIST OF BPT COST DATA -- BY OPTION

OPTION=III

OBS	PLANT	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS
310	177	1272554	126593	91382	816179	202855	.
311	180	.	.	.	.	.	44530
312	183	702100	80256	14528	658794	141883	.
313	190	266540	32011	4690	0	0	.
314	205	294354	35012	8691	0	0	.
315	225	527094	75003	3966	388949	83767	.
316	227	2897190	268978	94835	1138637	404394	.
317	250	1339627	133022	97093	910350	226260	.
318	254	359932	41345	2380	0	0	.
319	259	608240	81802	12037	580632	125050	.
320	260	0	0	0	0	0	.
321	267	681822	66011	3642	0	0	.
322	269	275846	55762	1246	22332	4810	.
323	284	113202	8618	0	0	0	.
324	294	325331	59370	3431	67368	14509	.
325	296	3350445	380390	324013	1057344	375522	.
326	301	1005773	85889	8968	0	0	.
327	352	526524	62072	2842	289013	62244	.
328	384	837048	75948	21540	0	0	.
329	387	1641582	118195	22947	0	0	.
330	392	214445	24915	1387	0	0	.
331	394	472291	50833	9479	0	0	.
332	399	3725982	370699	13305	1685950	627888	.
333	412	341577	60341	44915	83745	18036	.
334	415	3009491	294686	64671	1117344	416125	.
335	443	207102	22518	3996	0	0	.
336	444	670859	79405	16057	857921	184769	.
337	446	299039	57649	3166	42877	9234	.
338	447	533203	75527	6351	401976	86573	.
339	451	1376375	118733	53918	333145	118319	.
340	481	234326	52886	2006	1861	401	.
341	485	921029	80993	24559	0	0	.
342	486	423958	48577	17527	101611	21884	.
343	488	282989	33817	9984	0	0	.
344	500	2241474	201877	307247	933028	331371	.
345	502	247488	53399	3459	5397	1162	.
346	518	211321	25003	585	0	0	.
347	523	538459	63423	11537	311717	67134	.
348	525	504690	53356	10936	0	0	.
349	536	56877	33157	1858	13585	2926	.
350	569	478553	70702	14781	292177	62926	.
351	580	1036413	105324	6790	711084	176734	.
352	601	279970	56151	3238	26054	5611	.
353	602	325046	59324	2657	66475	14317	.
354	608	1329040	132397	23980	336260	119425	.
355	611	207097	20635	1368	0	0	.
356	614	342626	60491	4663	87095	18757	.
357	633	419007	48252	9499	106077	22846	.
358	657	572356	58395	11970	0	0	.
359	659	1073820	108102	6406	758625	188550	.
360	662	1592502	106396	15980	0	0	.
361	663	775130	94137	16792	124687	26854	.
362	664	0	0	0	0	0	.

LIST OF BPT COST DATA -- BY OPTION

OPTION=III

OBS	PLANT	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS
363	669	330094	59603	9933	70718	15230	.
364	682	2127312	240504	35528	951020	354182	.
365	683	0	0	0	0	0	.
366	695	5404826	586437	186360	2533003	1231398	.
367	709	.	.	.	.	.	133590
368	727	2307419	210861	92419	791820	281220	.
369	741	1418025	136620	111617	298780	106114	.
370	758	738798	83733	15198	744400	160320	.
371	775	342597	47565	4059	915612	197194	.
372	802	525644	54948	3730	0	0	.
373	811	396412	44574	6252	0	0	.
374	814	1359182	157195	12868	607062	215602	.
375	819	1588623	162137	46889	268163	95240	.
376	825	507821	73213	4260	346146	74549	.
377	844	490214	120120	3166	0	0	.
378	851	1874765	187601	40670	722008	256426	.
379	859	1468177	147213	21906	809200	201120	.
380	866	256687	30874	3387	0	0	.
381	871	1493406	144162	10031	398813	141641	.
382	876	672949	87995	13598	761149	163927	.
383	877	252931	30427	1695	0	0	.
384	883	283096	35775	3565	0	0	.
385	888	653836	85528	9542	707180	152304	.
386	908	534269	75733	10387	407559	87775	.
387	909	1095887	128045	28295	396174	140704	.
388	913	1790857	204240	46800	996373	353868	.
389	938	590491	80473	2808	539690	116232	.
390	942	538928	75973	16864	413142	88978	.
391	948	2144055	140074	25995	0	0	.
392	956	.	.	.	.	.	71248
393	962	314235	58628	2576	55830	12024	.
394	970	1006592	118037	10684	330717	117456	.
395	973	539488	55983	11071	0	0	.
396	984	846757	97205	10566	644325	160142	.
397	990	475709	51103	2543	0	0	.
398	991	.	.	.	.	.	26718
399	992	267969	55021	2820	16042	3455	.
400	1012	1057093	115401	9296	969017	240841	.
401	1020	256965	35219	4874	0	0	.
402	1033	.	.	.	.	.	89060
403	1038	0	0	0	0	0	.
404	1059	1485128	99450	5680	0	0	.
405	1061	0	0	0	0	0	.
406	1062	936429	103693	13610	738395	183522	.
407	1067	520223	74325	12139	372200	80160	.
408	1133	572356	58395	1785	0	0	.
409	1137	1082794	123568	6262	314458	111682	.
410	1139	209744	23951	4230	0	0	.
411	1148	1457312	142707	3897	393271	139673	.
412	1149	1438201	165864	36125	674763	239646	.
413	1157	262931	44427	4800	0	0	.
414	1203	324538	55890	2130	0	0	.
415	1241	0	0	0	0	0	.

LIST OF BPT COST DATA -- BY OPTION

OPTION=III

OBS	PLANT	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS
416	1249	427307	48247	9374	148880	32064	.
417	1267	427179	48547	7334	0	0	.
418	1299	213349	24690	4230	0	0	.
419	1319	271925	55591	2004	21401	4609	.
420	1323	331337	59792	1497	74626	16072	.
421	1327	1206967	128453	81034	617015	153354	.
422	1340	675949	65617	11212	0	0	.
423	1343	645322	76358	10693	766732	165130	.
424	1348	207097	21684	4230	0	0	.
425	1349	513215	97151	10088	0	0	.
426	1389	1069182	94830	21840	636233	158131	.
427	1407	0	0	0	0	0	.
428	1409	0	0	0	0	0	.
429	1414	377171	37402	8930	20471	4409	.
430	1438	427640	75960	6410	625107	155365	.
431	1439	539982	76174	17265	418725	90180	.
432	1446	896143	105539	22381	976806	242777	.
433	1464	1536285	153479	28949	469813	166857	.
434	1494	1871590	168039	115608	592545	210446	.
435	1520	332396	38783	6475	0	0	.
436	1522	2285652	148833	44519	0	0	.
437	1524	501947	72715	9627	334980	72144	.
438	1532	1608043	160870	136447	399869	142016	.
439	1569	520037	60911	4047	374061	80561	.
440	1572	2252955	218260	6585	915872	325278	.
441	1593	460781	69088	3841	260540	56112	.
442	1609	1178865	108058	90159	768740	191064	.
443	1616	583683	79859	11490	521080	112224	.
444	1617	1560268	141198	36938	400001	142063	.
445	1618	0	0	0	0	0	.
446	1624	406213	64128	4302	169351	36473	.
447	1643	980843	115136	23483	312505	110988	.
448	1647	1131279	100604	49848	759636	188801	.
449	1650	3389647	374845	107366	1348463	655544	.
450	1656	342161	60425	10524	85606	18437	.
451	1670	.	.	.	.	.	4453
452	1684	244020	41018	620	0	0	.
453	1688	1621088	163249	123933	349457	124112	.
454	1695	707365	67709	2698	0	0	.
455	1698	275914	55913	14063	24193	5210	.
456	1714	386961	41185	8513	65135	14028	.
457	1717	417198	47821	3331	98633	21242	.
458	1724	207097	21460	2943	0	0	.
459	1753	2702235	256415	34358	1266912	449952	.
460	1766	659761	85943	13271	722068	155510	.
461	1769	4056790	1497958	168391	0	0	.
462	1774	0	0	0	0	0	.
463	1776	275846	55762	3010	22332	4810	.
464	1785	806272	95241	11379	758625	188550	.
465	1794	229694	52785	32368	1228	265	.
466	1802	1317062	118723	107696	282416	100302	.
467	1839	552482	77252	17412	447198	96312	.
468	1869	0	0	0	0	0	.

LIST OF BPT COST DATA -- BY OPTION

OPTION=III

OBS	PLANT	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS
469	1877	351831	40604	2448	0	0	.
470	1881	370835	62121	3033	120034	25852	.
471	1890	1883704	203362	37750	1369268	340320	.
472	1905	0	0	0	0	0	.
473	1910	417276	46350	1184	0	0	.
474	1911	1892125	215117	44724	800087	246695	.
475	1928	364731	61745	4946	111660	24048	.
476	1937	312329	36833	5584	0	0	.
477	1943	477907	53331	8931	0	0	.
478	1973	562160	57654	3164	0	0	.
479	1977	3062027	303545	18674	1216685	453122	.
480	1986	263974	54808	4977	14888	3206	.
481	2009	1283780	121348	49164	930580	231288	.
482	2020	381207	40107	8930	37220	8016	.
483	2026	1496329	137069	8558	351040	124674	.
484	2030	764078	90355	17274	662532	164667	.
485	2047	520223	74325	16186	372200	80160	.
486	2049	464678	53600	10770	232625	50100	.
487	2055	314821	58729	4390	57691	12425	.
488	2062	279970	56151	5267	26054	5611	.
489	2073	592129	69346	12522	0	0	.
490	2090	423249	65231	4895	193544	41683	.
491	2110	1061233	103090	79087	508784	126454	.
492	2148	624169	62073	11277	0	0	.
493	2181	574251	67722	2125	532246	114629	.
494	2193	234326	52886	2006	1861	401	.
495	2198	509326	73513	6041	353590	76152	.
496	2206	331278	59782	3498	74440	16032	.
497	2221	767462	71602	8143	0	0	.
498	2222	589010	59593	3365	0	0	.
499	2227	2810999	245223	340694	1090072	387146	.
500	2228	255846	54034	4804	9305	2004	.
501	2236	154027	34191	7870	156324	33667	.
502	2242	823934	75141	12110	0	0	.
503	2254	1262400	129004	31513	671636	166930	.
504	2268	342743	60508	10384	87467	18838	.
505	2272	1796302	178006	37680	640582	227507	.
506	2281	208245	23320	585	0	0	.
507	2292	217384	25470	3987	0	0	.
508	2296	710165	84052	5721	546210	135756	.
509	2307	317506	57974	5608	42059	9058	.
510	2313	693480	88672	10467	826284	177955	.
511	2315	570235	110766	5106	0	0	.
512	2316	207097	20451	1062	0	0	.
513	2322	909057	80286	22376	0	0	.
514	2328	724475	97736	10801	26054	5611	.
515	2345	483667	71060	16073	299249	64449	.
516	2353	359979	61543	10909	107938	23246	.
517	2360	0	0	0	0	0	.
518	2364	872794	102876	9052	918442	228271	.
519	2365	660677	76514	3481	576724	124208	.
520	2368	1353187	120951	30862	308810	109676	.
521	2376	591118	57879	2932	0	0	.

LIST OF BPT COST DATA -- BY OPTION

OPTION=III

OBS	PLANT	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS
522	2390	429999	66012	4995	206199	44409	.
523	2394	1911093	173108	76132	641110	227694	.
524	2399	2089527	187614	22055	659850	234350	.
525	2400	534623	75800	6397	409420	88176	.
526	2419	459936	68906	8745	256818	55310	.
527	2429	207575	23002	7839	0	0	.
528	2430	0	0	0	0	0	.
529	2445	2580401	231634	12515	979217	347775	.
530	2447	0	0	0	0	0	.
531	2450	0	0	0	0	0	.
532	2461	1608665	145200	16126	390631	138735	.
533	2471	760701	86263	8774	0	0	.
534	2474	565522	78411	19314	479394	103246	.
535	2481	477509	51245	5846	0	0	.
536	2527	666786	86545	23427	744400	160320	.
537	2528	2758712	220417	409656	1227321	435891	.
538	2531	539982	76174	6456	418725	90180	.
539	2533	609466	82022	21072	588076	126653	.
540	2536	656587	64306	8903	0	0	.
541	2537	393998	63423	3228	150741	32465	.
542	2541	1052773	97928	28962	556325	138270	.
543	2551	0	0	0	0	0	.
544	2556	505529	59040	10905	334980	72144	.
545	2573	610381	82185	12155	593659	127855	.
546	2590	0	0	0	0	0	.
547	2592	1506898	147388	7358	421512	149703	.
548	2606	.	.	.	.	.	4453
549	2626	406286	45421	5761	0	0	.
550	2631	1246584	98924	37374	0	0	.
551	2633	1702426	162535	160858	450282	159920	.
552	2647	1566916	139494	151340	447906	159077	.
553	2660	645975	63581	6452	0	0	.
554	2668	507821	73213	7076	346146	74549	.
555	2673	460359	68999	15261	258679	55711	.
556	2678	1438796	130677	39419	304824	108260	.
557	2680	429631	65930	8107	204710	44088	.
558	2692	493220	52472	4426	0	0	.
559	2693	1129066	106084	50191	642302	159639	.
560	2695	772687	71934	19313	0	0	.
561	2701	759007	88727	16632	508784	126454	.
562	2711	381415	62654	7111	131573	28337	.
563	2735	687656	66401	16492	0	0	.
564	2739	1284481	115481	62814	981155	243858	.
565	2763	645975	63581	5355	0	0	.
566	2764	909816	107094	22778	1011500	251400	.
567	2767	254351	30597	4559	0	0	.
568	2770	576829	79234	11315	502470	108216	.
569	2771	327767	46704	16473	844894	181963	.
570	2781	209086	23620	3996	0	0	.
571	2786	1586092	148532	85989	409450	145419	.
572	2795	673412	79709	3602	867226	186773	.
573	2816	1205671	96790	11537	0	0	.
574	2818	642514	84779	20867	681126	146693	.

LIST OF BPT COST DATA -- BY OPTION

-- OPTION=III --

OBS	PLANT	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS
575	3033	538928	75973	10443	413142	88978	.
576	4002	560044	78029	17754	468972	101002	.
577	4010	694275	88806	8715	831867	179158	.
578	4017	322539	37835	5797	0	0	.
579	4018	230192	27484	4110	0	0	.
580	4021	263270	33483	4513	0	0	.
581	4037	0	0	0	0	0	.
582	4040	259935	54339	8467	11166	2405	.
583	4051	487869	57438	2662	215876	46493	.
584	4055	207097	21460	4230	0	0	.
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OPTION		223286748	25543997	6696206	88326328	25068308	489830
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		322861037	38746014	11383381	176652656	50136615	979660

BAT COST DATA -- OPTION I (09/09/87)

OBS	PLANT NUMBER	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS	ANNUAL MONITORING COSTS
1	1	0	0	0	0	0	0	29539.2
2	12	0	0	0	0	0	0	29539.2
3	15	0	0	0	0	0	0	29539.2
4	33	0	0	0	0	0	0	51259.2
5	61	0	0	0	0	0	0	29539.2
6	63	0	0	0	0	0	0	33782.4
7	76	1431660	1561007	44796	193544	41683	0	29539.2
8	83	0	0	0	0	0	0	33782.4
9	87	0	0	0	0	0	0	26827.2
10	101	0	0	0	0	0	222650	26827.2
11	102	0	0	0	0	0	0	29539.2
12	105	1079744	2052382	319782	276731	59599	0	41205.6
13	112	0	0	0	0	0	111325	26827.2
14	114	1020130	367341	28062	472694	101803	0	26827.2
15	154	0	0	0	0	0	0	26827.2
16	155	0	0	0	0	0	0	29539.2
17	159	0	0	0	0	0	0	29539.2
18	177	0	0	0	0	0	0	29539.2
19	180	0	0	0	0	0	222650	26827.2
20	183	0	0	0	0	0	0	29539.2
21	190	0	0	0	0	0	0	41205.6
22	205	0	0	0	0	0	0	29539.2
23	225	0	0	0	0	0	0	29539.2
24	227	0	0	0	0	0	0	41205.6
25	250	0	0	0	0	0	0	33782.4
26	254	0	0	0	0	0	0	26827.2
27	259	0	0	0	0	0	0	33782.4
28	260	963834	143474	22681	81884	17635	0	29539.2
29	267	0	0	0	0	0	0	51259.2
30	269	0	0	0	0	0	0	29539.2
31	284	0	0	0	0	0	0	26827.2
32	294	0	0	0	0	0	0	29539.2
33	296	0	0	0	0	0	0	41205.6
34	301	0	0	0	0	0	0	41205.6
35	352	0	0	0	0	0	0	29539.2
36	384	0	0	0	0	0	0	51259.2
37	387	0	0	0	0	0	0	65286.0
38	392	0	0	0	0	0	0	26827.2
39	394	0	0	0	0	0	0	26827.2
40	399	0	0	0	0	0	0	36573.6
41	412	572195	81880	62487	0	0	0	26827.2
42	415	0	0	0	0	0	0	51259.2
43	443	0	0	0	0	0	0	29539.2
44	444	0	0	0	0	0	0	29539.2
45	446	870824	81870	5165	28101	6052	0	26827.2
46	447	0	0	0	0	0	0	41205.6
47	451	0	0	0	0	0	44530	26827.2
48	481	0	0	0	0	0	0	29539.2
49	485	0	0	0	0	0	0	41205.6
50	486	0	0	0	0	0	0	29539.2
51	488	0	0	0	0	0	0	29539.2
52	500	0	0	0	0	0	0	29539.2
53	502	0	0	0	0	0	12468	29539.2
54	518	0	0	0	0	0	0	26827.2

BAT COST DATA -- OPTION I (09/09/87)

OBS	PLANT NUMBER	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS	ANNUAL MONITORING COSTS
55	523	0	0	0	0	0	0	29539.2
56	525	0	0	0	0	0	0	29539.2
57	536	944486	239229	16051	13529	2914	0	26827.2
58	569	0	0	0	0	0	0	29539.2
59	580	0	0	0	0	0	0	29539.2
60	602	0	0	0	0	0	57889	29539.2
61	608	0	0	0	0	0	0	41205.6
62	611	887896	143612	10093	2419	521	0	26827.2
63	614	0	0	0	0	0	0	29539.2
64	633	0	0	0	0	0	0	29539.2
65	657	0	0	0	0	0	0	29539.2
66	659	0	0	0	0	0	0	33782.4
67	662	0	0	0	0	0	0	29539.2
68	663	858500	692391	18605	115382	24850	0	26827.2
69	664	919793	530584	10537	716485	154308	0	26827.2
70	669	0	0	0	0	0	0	29539.2
71	682	0	0	0	0	0	0	51259.2
72	683	0	0	0	0	0	0	51259.2
73	695	0	0	0	0	0	0	51259.2
74	709	0	0	0	0	0	151402	29539.2
75	727	0	0	0	0	0	0	51259.2
76	741	0	0	0	0	0	0	41205.6
77	758	0	0	0	0	0	0	29539.2
78	775	0	0	0	0	0	0	29539.2
79	802	0	0	0	0	0	0	29539.2
80	811	0	0	0	0	0	0	33782.4
81	814	2940266	1197374	47702	604877	150337	0	41205.6
82	819	0	0	0	0	0	0	41205.6
83	825	0	0	0	0	0	0	29539.2
84	844	0	0	0	0	0	0	33782.4
85	851	0	0	0	0	0	0	41205.6
86	859	0	0	0	0	0	0	41205.6
87	866	0	0	0	0	0	0	33782.4
88	871	0	0	0	0	0	0	33782.4
89	876	0	0	0	0	0	0	29539.2
90	877	1204208	929219	21308	65879	14188	0	26827.2
91	883	0	0	0	0	0	0	29539.2
92	888	0	0	0	0	0	0	26827.2
93	908	0	0	0	0	0	0	51259.2
94	909	0	0	0	0	0	0	41205.6
95	913	965727	195760	38423	464270	164889	0	41205.6
96	938	0	0	0	0	0	0	29539.2
97	942	0	0	0	0	0	0	29539.2
98	948	0	0	0	0	0	0	51259.2
99	956	0	0	0	0	0	71248	26827.2
100	962	782986	67022	2865	55830	12024	0	26827.2
101	970	0	0	0	0	0	0	29539.2
102	973	0	0	0	0	0	0	41205.6
103	984	0	0	0	0	0	0	26827.2
104	990	0	0	0	0	0	0	33782.4
105	991	0	0	0	0	0	4453	26827.2
106	992	0	0	0	0	0	0	29539.2
107	1012	0	0	0	0	0	0	29539.2
108	1020	0	0	0	0	0	0	29539.2

BAT COST DATA -- OPTION I (09/09/87)

OBS	PLANT NUMBER	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS	ANNUAL MONITORING COSTS
109	1033	0	0	0	0	0	89060	29539.2
110	1038	0	0	0	0	0	0	51259.2
111	1059	0	0	0	0	0	0	41205.6
112	1061	0	0	0	0	0	0	26827.2
113	1062	0	0	0	0	0	0	29539.2
114	1067	0	0	0	0	0	0	29539.2
115	1133	0	0	0	0	0	0	29539.2
116	1137	0	0	0	0	0	0	51259.2
117	1139	0	0	0	0	0	0	33782.4
118	1148	0	0	0	0	0	0	41205.6
119	1149	0	0	0	0	0	0	41205.6
120	1157	0	0	0	0	0	44530	33782.4
121	1203	0	0	0	0	0	0	26827.2
122	1241	635556	99018	24064	521080	112224	0	26827.2
123	1249	974879	123424	22049	24565	5291	0	33782.4
124	1299	0	0	0	0	0	0	29539.2
125	1323	0	0	0	0	0	0	26827.2
126	1327	0	0	0	0	0	0	41205.6
127	1340	0	0	0	0	0	0	33782.4
128	1343	0	0	0	0	0	0	33782.4
129	1348	0	0	0	0	0	0	26827.2
130	1389	0	0	0	0	0	0	26827.2
131	1407	0	0	0	0	0	0	29539.2
132	1409	0	0	0	0	0	0	41205.6
133	1414	0	0	0	0	0	0	26827.2
134	1438	0	0	0	0	0	0	33782.4
135	1439	0	0	0	0	0	0	29539.2
136	1446	0	0	0	0	0	0	26827.2
137	1464	0	0	0	0	0	0	29539.2
138	1494	0	0	0	0	0	0	41205.6
139	1520	0	0	0	0	0	0	29539.2
140	1522	0	0	0	0	0	0	57597.2
141	1524	0	0	0	0	0	0	26827.2
142	1532	0	0	0	0	0	0	29539.2
143	1569	962196	173358	7399	186100	40080	0	29539.2
144	1572	0	0	0	0	0	0	51259.2
145	1593	0	0	0	0	0	0	29539.2
146	1609	0	0	0	0	0	0	29539.2
147	1616	0	0	0	0	0	0	26827.2
148	1617	0	0	0	0	0	0	29539.2
149	1618	599718	103666	11604	0	0	0	26827.2
150	1624	0	0	0	0	0	0	33782.4
151	1647	0	0	0	0	0	0	29539.2
152	1650	20575507	4527482	1058825	1732309	645153	0	57597.2
153	1656	0	0	0	0	0	0	29539.2
154	1670	0	0	0	0	0	4453	29539.2
155	1684	0	0	0	0	0	133590	33782.4
156	1688	0	0	0	0	0	0	26827.2
157	1695	0	0	0	0	0	0	51259.2
158	1698	0	0	0	0	0	0	26827.2
159	1714	0	0	0	0	0	0	26827.2
160	1717	0	0	0	0	0	0	26827.2
161	1724	0	0	0	0	0	0	29539.2
162	1753	0	0	0	0	0	0	41205.6

BAT COST DATA -- OPTION I (09/09/87)

OBS	PLANT NUMBER	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS	ANNUAL MONITORING COSTS
163	1766	0	0	0	0	0	0	26827.2
164	1769	0	0	0	0	0	0	41205.6
165	1774	1035891	243484	13226	871002	309342	0	29539.2
166	1785	804355	136003	19563	758625	188550	0	51259.2
167	1802	0	0	0	0	0	0	29539.2
168	1839	782792	44868	8886	9863	2124	0	26827.2
169	1869	0	0	0	0	0	0	51259.2
170	1877	0	0	0	0	0	0	29539.2
171	1881	0	0	0	0	0	0	33782.4
172	1890	0	0	0	0	0	0	33782.4
173	1905	0	0	0	0	0	0	33782.4
174	1910	0	0	0	0	0	0	41205.6
175	1911	0	0	0	0	0	0	33782.4
176	1928	826194	75304	5583	7072	1523	0	26827.2
177	1937	0	0	0	0	0	0	29539.2
178	1943	0	0	0	0	0	0	33782.4
179	1973	0	0	0	0	0	0	29539.2
180	1977	0	0	0	0	0	0	51259.2
181	1986	0	0	0	0	0	0	26827.2
182	2009	0	0	0	0	0	0	29539.2
183	2020	0	0	0	0	0	0	29539.2
184	2026	0	0	0	0	0	0	33782.4
185	2030	0	0	0	0	0	0	41205.6
186	2047	0	0	0	0	0	0	26827.2
187	2049	0	0	0	0	0	0	29539.2
188	2055	0	0	0	0	0	0	26827.2
189	2062	785051	50058	5652	14330	3086	0	29539.2
190	2073	1341764	2106075	47319	878392	189178	0	29539.2
191	2090	0	0	0	0	0	0	29539.2
192	2110	0	0	0	0	0	0	29539.2
193	2148	0	0	0	0	0	0	29539.2
194	2181	0	0	0	0	0	0	26827.2
195	2193	0	0	0	0	0	89060	33782.4
196	2198	0	0	0	0	0	0	29539.2
197	2206	674950	135546	5916	0	0	0	26827.2
198	2221	0	0	0	0	0	0	26827.2
199	2222	0	0	0	0	0	0	29539.2
200	2227	0	0	0	0	0	0	29539.2
201	2228	0	0	0	0	0	0	29539.2
202	2236	0	0	0	0	0	0	29539.2
203	2242	0	0	0	0	0	0	29539.2
204	2254	0	0	0	0	0	0	29539.2
205	2268	0	0	0	0	0	0	29539.2
206	2272	0	0	0	0	0	0	51259.2
207	2281	0	0	0	0	0	0	29539.2
208	2292	0	0	0	0	0	0	29539.2
209	2296	0	0	0	0	0	0	26827.2
210	2307	0	0	0	0	0	0	26827.2
211	2313	0	0	0	0	0	0	29539.2
212	2315	0	0	0	0	0	0	26827.2
213	2316	0	0	0	0	0	0	29539.2
214	2322	0	0	0	0	0	0	41205.6
215	2328	0	0	0	0	0	0	33782.4
216	2345	0	0	0	0	0	0	29539.2

BAT COST DATA -- OPTION I (09/09/87)

OBS	PLANT NUMBER	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS	ANNUAL MONITORING COSTS
217	2353	0	0	0	0	0	0	29539.2
218	2360	0	0	0	0	0	0	26827.2
219	2364	0	0	0	0	0	0	33782.4
220	2365	0	0	0	0	0	0	29539.2
221	2368	0	0	0	0	0	0	41205.6
222	2376	0	0	0	0	0	0	33782.4
223	2390	0	0	0	0	0	0	29539.2
224	2394	0	0	0	0	0	0	41205.6
225	2399	0	0	0	0	0	0	29539.2
226	2400	0	0	0	0	0	0	26827.2
227	2419	0	0	0	0	0	0	26827.2
228	2429	0	0	0	0	0	0	29539.2
229	2430	0	0	0	0	0	0	41205.6
230	2445	0	0	0	0	0	0	33782.4
231	2447	0	0	0	0	0	0	29539.2
232	2450	0	0	0	0	0	0	41205.6
233	2461	0	0	0	0	0	0	33782.4
234	2471	0	0	0	0	0	0	41205.6
235	2474	0	0	0	0	0	0	26827.2
236	2481	0	0	0	0	0	0	51259.2
237	2527	0	0	0	0	0	0	51259.2
238	2528	0	0	0	0	0	0	51259.2
239	2531	0	0	0	0	0	0	26827.2
240	2533	0	0	0	0	0	0	26827.2
241	2536	0	0	0	0	0	0	29539.2
242	2537	0	0	0	0	0	0	26827.2
243	2541	0	0	0	0	0	0	29539.2
244	2551	0	0	0	0	0	0	26827.2
245	2556	0	0	0	0	0	0	26827.2
246	2573	0	0	0	0	0	0	29539.2
247	2590	812266	73371	12660	1861	401	0	29539.2
248	2592	0	0	0	0	0	0	26827.2
249	2606	0	0	0	0	0	4453	29539.2
250	2626	0	0	0	0	0	0	29539.2
251	2631	0	0	0	0	0	0	41205.6
252	2633	0	0	0	0	0	0	41205.6
253	2660	12586	18853	6437	0	0	178120	26827.2
254	2667	394955	63313	6140	21774	4689	0	29539.2
255	2668	0	0	0	0	0	0	26827.2
256	2673	0	0	0	0	0	0	29539.2
257	2678	0	0	0	0	0	0	26827.2
258	2680	0	0	0	0	0	0	29539.2
259	2692	0	0	0	0	0	0	26827.2
260	2693	0	0	0	0	0	0	29539.2
261	2695	0	0	0	0	0	0	41205.6
262	2701	0	0	0	0	0	0	41205.6
263	2711	0	0	0	0	0	0	26827.2
264	2735	5761104	909911	198687	571430	202947	0	29539.2
265	2739	0	0	0	0	0	0	51259.2
266	2763	0	0	0	0	0	0	29539.2
267	2764	0	0	0	0	0	0	41205.6
268	2767	66487	32015	4494	0	0	0	29539.2
269	2770	0	0	0	0	0	0	29539.2
270	2771	0	0	0	0	0	0	33782.4

BAT COST DATA -- OPTION I (09/09/87)

OBS	PLANT NUMBER	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS	ANNUAL MONITORING COSTS
271	2781	0	0	0	0	0	0	29539
272	2786	0	0	0	0	0	0	29539
273	2795	0	0	0	0	0	0	41206
274	2816	0	0	0	0	0	0	41206
275	2818	0	0	0	0	0	0	29539
276	3033	0	0	0	0	0	0	29539
277	4002	0	0	0	0	0	0	29539
278	4010	0	0	0	0	0	0	29539
279	4017	0	0	0	0	0	0	26827
280	4018	0	0	0	0	0	0	29539
281	4021	0	0	0	0	0	0	26827
282	4037	0	0	0	0	0	0	29539
283	4040	0	0	0	0	0	0	29539
284	4051	0	0	0	0	0	0	26827
285	4055	0	0	0	0	0	0	29539
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		52488500	17198894	2107061	8690029	2455391	1441881	9394810

BAT COST DATA -- BY OPTION

OPTION=IIA

OBS	PLANT NUMBER	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS	ANNUAL MONITORING COSTS
1	1	0	0	0	0	0	0	29539
2	12	583831	166496	20085	0	0	0	29539
3	15	849624	96840	3804	3536	762	0	29539
4	33	0	0	0	0	0	0	51259
5	61	829916	83145	3306	37220	8016	0	29539
6	63	0	0	0	0	0	0	33782
7	76	1277396	1524624	39928	193544	41683	0	29539
8	83	328468	31298	310	11724	2525	0	33782
9	87	531156	188588	3666	0	0	0	26827
10	101	0	0	0	0	0	222650	26827
11	102	0	0	0	0	0	0	29539
12	105	898841	2014544	280375	276731	59599	0	41206
13	112	0	0	0	0	0	111325	26827
14	114	1207525	893544	59607	472694	101803	0	26827
15	154	328468	33389	2412	74440	16032	0	26827
16	155	2116382	6663637	44618	738817	159118	0	29539
17	159	0	0	0	0	0	0	29539
18	177	867448	283504	12928	48386	10421	0	29539
19	180	0	0	0	0	0	222650	26827
20	183	1495492	3114221	78243	0	0	0	29539
21	190	551965	1033337	57051	0	0	0	41206
22	205	667323	721441	73642	193544	41683	0	29539
23	225	951120	2650463	14101	375178	80801	0	29539
24	227	454726	28989	2124	0	0	0	41206
25	250	354104	50601	8063	385227	82966	0	33782
26	254	366729	54659	3248	470833	101402	0	26827
27	259	0	0	0	0	0	0	33782
28	260	1055789	790125	50184	81884	17635	0	29539
29	267	1610056	1447952	20844	776832	193075	0	51259
30	269	524563	114698	4383	0	0	0	29539
31	284	390373	121071	15347	111660	24048	0	26827
32	294	0	0	0	0	0	0	29539
33	296	473934	85115	15344	661521	164416	0	41206
34	301	6243569	3547114	62641	329397	116988	0	41206
35	352	436361	193736	6915	3908	842	0	29539
36	384	1616191	12320661	59820	358431	127299	0	51259
37	387	2969660	841368	37964	1827258	888306	0	65286
38	392	450142	33874	2736	0	0	0	26827
39	394	461491	47794	8211	0	0	0	26827
40	399	0	0	0	0	0	0	36574
41	412	666327	743001	174569	0	0	0	26827
42	415	1661701	3470415	53539	660906	234725	0	51259
43	443	868974	154617	28737	7816	1683	0	29539
44	444	459701	44146	8658	0	0	0	29539
45	446	913050	409860	12623	28101	6052	0	26827
46	447	4965706	1649624	42878	545805	135655	0	41206
47	451	0	0	0	0	0	44530	26827
48	481	498115	37693	2374	0	0	0	29539
49	485	1594567	2908387	100132	0	0	0	41206
50	486	878280	140147	59242	10608	2285	0	29539
51	488	1047576	434293	97858	82256	17715	0	29539
52	500	328709	38823	5380	163396	35190	0	29539
53	502	0	0	0	0	0	12468	29539

BAT COST DATA -- BY OPTION

OPTION=IIA

OBS	PLANT NUMBER	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS	ANNUAL MONITORING COSTS
54	518	1698814	2240039	12602	329397	70942	0	26827
55	523	72315	42686	7095	0	0	0	29539
56	525	0	0	0	0	0	0	29539
57	536	889183	207438	14194	13529	2914	0	26827
58	569	0	0	0	0	0	0	29539
59	580	211640	131825	12224	0	0	0	29539
60	602	0	0	0	0	0	57889	29539
61	608	655540	1052470	14970	0	0	0	41206
62	611	854017	111834	8867	2419	521	0	26827
63	614	328468	34168	1578	87095	18757	0	29539
64	633	783186	41680	9000	2680	577	0	29539
65	657	5941450	1097543	128317	374795	133111	0	29539
66	659	454557	52002	2826	0	0	0	33782
67	662	1851491	2943165	51150	764871	164729	0	29539
68	663	858500	692391	18605	115382	24850	0	26827
69	664	919793	530584	10537	716485	154308	0	26827
70	669	0	0	0	0	0	124684	29539
71	682	697987	146981	15825	429694	152609	0	51259
72	683	1133412	735789	26359	866855	215450	0	51259
73	695	0	0	0	0	0	0	51259
74	709	0	0	0	0	0	151402	29539
75	727	471403	84419	5792	651406	161902	0	51259
76	741	0	0	0	0	0	0	41206
77	758	0	0	0	0	0	0	29539
78	775	540068	644016	3151	0	0	0	29539
79	802	551554	106422	6680	984189	244612	0	29539
80	811	0	0	0	0	0	0	33782
81	814	1462857	1074671	22443	604877	150337	0	41206
82	819	5841784	2826628	66614	268163	95240	0	41206
83	825	837227	151315	4430	346146	74549	0	29539
84	844	0	0	0	0	0	0	33782
85	851	926723	2996038	42517	0	0	0	41206
86	859	0	0	0	0	0	0	41206
87	866	0	0	0	0	0	0	33782
88	871	451103	39242	6002	0	0	0	33782
89	876	552177	305539	6730	0	0	0	29539
90	877	1081607	894569	18818	65879	14188	0	26827
91	883	0	0	0	0	0	0	29539
92	888	0	0	0	0	0	0	26827
93	908	448303	78050	8660	560371	139276	0	51259
94	909	991512	937986	23914	372200	80160	0	41206
95	913	1410215	3638271	79665	464270	164889	0	41206
96	938	115653	84916	1951	0	0	0	29539
97	942	0	0	0	0	0	0	29539
98	948	1681279	842980	27175	850671	211427	0	51259
99	956	0	0	0	0	0	71248	26827
100	962	782986	67022	2865	55830	12024	0	26827
101	970	469119	83791	6785	642302	159639	0	29539
102	973	569496	233249	32421	604825	130260	0	41206
103	984	328468	32299	1695	55830	12024	0	26827
104	990	328468	35924	1112	115382	24850	0	33782
105	991	0	0	0	0	0	4453	26827
106	992	454718	22868	2736	0	0	0	29539

BAT COST DATA -- BY OPTION

---------- OPTION=IIA ----------

OBS	PLANT NUMBER	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS	ANNUAL MONITORING COSTS
107	1012	454779	79839	6443	585658	145561	0	29539
108	1020	349821	49140	8310	355451	76553	0	29539
109	1033	0	0	0	0	0	89060	29539
110	1038	1295098	528181	28492	524713	186355	0	51259
111	1059	0	0	0	0	0	0	41206
112	1061	458705	113196	8284	488885	105290	0	26827
113	1062	0	0	0	0	0	0	29539
114	1067	521385	362868	24813	37220	8016	0	29539
115	1133	286180	549524	5395	0	0	0	29539
116	1137	3287518	363035	25280	278325	98849	0	51259
117	1139	454732	29133	8460	0	0	0	33782
118	1148	835903	185891	4611	604423	214665	0	41206
119	1149	833465	4798387	23760	0	0	0	41206
120	1157	0	0	0	0	0	44530	33782
121	1203	332097	41724	2210	214015	46092	0	26827
122	1241	1001546	367938	22055	521080	112224	0	26827
123	1249	1087887	911826	49471	24565	5291	0	33782
124	1267	0	0	0	0	0	0	26827
125	1299	0	0	0	0	0	0	29539
126	1319	0	0	0	0	0	0	29539
127	1323	499807	73195	3984	0	0	0	26827
128	1327	4710868	1565503	120778	617015	153354	0	41206
129	1340	923980	423844	14793	409104	88108	0	33782
130	1343	1740987	2625061	58497	541551	116633	0	33782
131	1348	0	0	0	0	0	0	26827
132	1349	0	0	0	0	0	0	26827
133	1389	411405	67752	3220	772315	166332	0	26827
134	1407	1002773	580864	9225	772315	166332	0	29539
135	1409	1303663	2141931	41565	287695	102177	0	41206
136	1414	449882	14197	8460	0	0	0	26827
137	1438	373116	56619	3606	513636	110621	0	33782
138	1439	1470942	1876635	68080	195405	42084	0	29539
139	1446	350850	718244	42480	0	0	0	26827
140	1464	465892	89871	8602	0	0	0	29539
141	1494	8463828	2288557	84297	340219	120831	0	41206
142	1520	933530	220262	40549	30334	6533	0	29539
143	1522	811772	4092048	22573	0	0	0	57597
144	1524	328468	36119	2583	118546	25531	0	26827
145	1532	332452	41931	5860	217737	46894	0	29539
146	1569	1066193	472198	16906	186100	40080	0	29539
147	1572	0	0	0	0	0	0	51259
148	1593	0	0	0	0	0	0	29539
149	1609	867565	288820	19941	502470	108216	0	29539
150	1616	331423	41307	3524	206571	44489	0	26827
151	1617	576429	1291980	4296	0	0	0	29539
152	1618	742283	1097559	33142	0	0	0	26827
153	1624	778350	41593	2855	1359	293	0	33782
154	1643	0	0	0	0	0	0	26827
155	1647	912609	479951	10155	232625	50100	0	29539
156	1650	44924177	13885082	427954	1732309	645153	0	57597
157	1656	0	0	0	0	0	0	29539
158	1670	0	0	0	0	0	4453	29539
159	1684	98341	145514	3599	0	0	133590	33782

BAT COST DATA -- BY OPTION

OPTION=IIA

OBS	PLANT NUMBER	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS	ANNUAL MONITORING COSTS
160	1688	343107	46699	7103	307065	66132	0	26827
161	1695	1356394	3501039	7001	276873	98333	0	51259
162	1698	449882	13302	13086	0	0	0	26827
163	1714	778350	56004	9912	33684	7254	0	26827
164	1717	328468	31437	826	36848	7936	0	26827
165	1724	807902	74204	18408	3350	721	0	29539
166	1753	671437	139572	15144	397230	141079	0	41206
167	1766	378121	58125	6076	547134	117835	0	26827
168	1769	7875173	9689672	157155	0	0	0	41206
169	1774	1035891	243484	13226	871002	309342	0	29539
170	1785	1506055	6051564	49643	758625	188550	0	51259
171	1802	444655	77041	13785	546210	135756	0	29539
172	1839	782792	44868	8886	9863	2124	0	26827
173	1869	544531	705348	3628	0	0	0	51259
174	1877	1238476	845461	24115	183867	39599	0	29539
175	1881	328468	31617	631	41872	9018	0	33782
176	1890	653805	548225	49374	290316	62525	0	33782
177	1905	393974	122286	24192	15204	3275	0	33782
178	1910	945647	1217596	9998	308740	66493	0	41206
179	1911	395837	63313	11808	666238	143486	0	33782
180	1928	824791	122465	12105	7072	1523	0	26827
181	1937	1125226	593334	55202	121523	26172	0	29539
182	1943	0	0	0	0	0	0	33782
183	1973	599338	119580	5777	311449	110613	0	29539
184	1977	0	0	0	0	0	0	51259
185	1986	0	0	0	0	0	0	26827
186	2009	1031252	1456023	28563	0	0	0	29539
187	2020	0	0	0	0	0	0	29539
188	2026	454718	17720	2736	0	0	0	33782
189	2030	1120249	1349140	69884	0	0	0	41206
190	2047	328468	34770	3724	96772	20842	0	26827
191	2049	378242	59210	6012	57691	12425	0	29539
192	2055	0	0	0	0	0	0	26827
193	2062	785051	50058	5652	14330	3086	0	29539
194	2073	2541426	9302657	98879	878392	189178	0	29539
195	2090	63318	35647	1953	0	0	0	29539
196	2110	783186	42100	10725	34801	7495	0	29539
197	2148	657716	216786	28974	816280	202880	0	29539
198	2181	0	0	0	0	0	0	26827
199	2193	0	0	0	0	0	89060	33782
200	2198	355187	50962	3103	392671	84569	0	29539
201	2206	881043	1594703	17082	0	0	0	26827
202	2221	861504	222780	7759	320092	68938	0	26827
203	2222	670350	139270	6606	395910	140610	0	29539
204	2227	1717297	1113595	57123	1047842	372148	0	29539
205	2228	783186	42842	5329	5620	1210	0	29539
206	2236	585005	508123	36335	10515	2265	0	29539
207	2242	820138	130368	9467	280267	60360	0	29539
208	2254	627915	184929	27213	622275	154661	0	29539
209	2268	1430431	2902047	61784	65135	14028	0	29539
210	2272	1242271	2229997	38446	814763	202503	0	51259
211	2281	370204	86736	2901	9119	1964	0	29539
212	2292	567188	128311	31533	0	0	0	29539

BAT COST DATA -- BY OPTION

OPTION=IIA

OBS	PLANT NUMBER	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS	ANNUAL MONITORING COSTS
213	2296	0	0	0	0	0	0	26827
214	2307	0	0	0	0	0	0	26827
215	2313	0	0	0	0	0	0	29539
216	2315	424577	90041	6312	411281	88577	0	26827
217	2316	840396	85276	6288	1489	321	0	29539
218	2322	1842569	2484507	96802	566116	121923	0	41206
219	2328	0	0	0	0	0	0	33782
220	2345	341793	46190	7518	297202	64008	0	29539
221	2353	0	0	0	0	0	0	29539
222	2360	426189	71906	3452	874670	188376	0	26827
223	2364	328468	31298	624	16563	3567	0	33782
224	2365	581822	221285	9374	0	0	0	29539
225	2368	543298	104153	5081	948787	235813	0	41206
226	2376	454821	52884	2830	0	0	0	33782
227	2390	0	0	0	0	0	0	29539
228	2394	1228402	182965	13864	524449	186261	0	41206
229	2399	0	0	0	0	0	0	29539
230	2400	0	0	0	0	0	0	26827
231	2419	328468	32929	1874	66810	14389	0	26827
232	2429	536321	84761	54895	0	0	0	29539
233	2430	1497273	6300412	48393	344970	122518	0	41206
234	2445	415461	68897	3285	800230	172344	0	33782
235	2447	0	0	0	0	0	0	29539
236	2450	1059679	1420471	31753	691866	171958	0	41206
237	2461	346669	55348	10154	15446	3327	0	33782
238	2471	0	0	0	0	0	0	41206
239	2474	661183	422004	23500	0	0	0	26827
240	2481	1068738	320795	17744	930580	231288	0	51259
241	2527	870231	417182	56775	329925	117175	0	51259
242	2528	1369101	2174059	44681	363445	129080	0	51259
243	2531	521479	190457	3733	0	0	0	26827
244	2533	366452	54573	9703	468972	101002	0	26827
245	2536	0	0	0	0	0	0	29539
246	2537	328468	32169	723	53411	11503	0	26827
247	2541	1718347	2295209	31514	465250	100200	0	29539
248	2551	0	0	0	0	0	0	26827
249	2556	0	0	0	0	0	0	26827
250	2573	974373	335447	16631	407559	87775	0	29539
251	2590	802217	69156	24943	1861	401	0	29539
252	2592	422449	70859	3394	848616	182765	0	26827
253	2606	0	0	0	0	0	4453	29539
254	2626	0	0	0	0	0	0	29539
255	2631	1094136	2629712	28470	289758	62405	0	41206
256	2633	672524	139875	26412	398549	141547	0	41206
257	2660	12586	18853	6437	0	0	178120	26827
258	2668	0	0	0	0	0	0	26827
259	2673	811229	89648	27069	4094	882	0	29539
260	2678	339927	45444	2365	282872	60922	0	26827
261	2680	1018611	490372	26144	11166	2405	0	29539
262	2692	0	0	0	0	0	0	26827
263	2693	0	0	0	0	0	0	29539
264	2695	1257905	1803263	39263	990258	246121	0	41206
265	2701	613699	669010	14248	0	0	0	41206

BAT COST DATA -- BY OPTION

OPTION=IIA

OBS	PLANT NUMBER	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS	ANNUAL MONITORING COSTS
266	2711	451459	40786	4960	0	0	0	26827
267	2735	13085442	8598676	194719	571430	202947	0	29539
268	2739	117139	86578	8235	0	0	0	51259
269	2763	464278	82458	5650	623084	154862	0	29539
270	2764	506987	94189	18345	796050	197852	0	41206
271	2767	411670	236087	24882	21774	4689	0	29539
272	2770	778726	67022	6555	55830	12024	0	29539
273	2771	458155	40786	8157	0	0	0	33782
274	2781	872021	125684	30052	9119	1964	0	29539
275	2786	328468	31404	1321	35731	7695	0	29539
276	2795	1080229	865104	6742	575543	143047	0	41206
277	2816	1792522	855118	32079	792876	281595	0	41206
278	2818	454718	17720	7848	0	0	0	29539
279	3033	471100	1066005	27722	0	0	0	29539
280	4002	0	0	0	0	0	0	29539
281	4010	0	0	0	0	0	0	29539
282	4017	0	0	0	0	0	0	26827
283	4018	925107	206194	36632	27171	5852	0	29539
284	4021	720401	735096	49103	158929	34228	0	26827
285	4037	1028742	711796	33788	72579	15631	0	29539
286	4040	559580	178322	32115	0	0	0	29539
287	4051	332273	41828	1578	215876	46493	0	26827
288	4055	22055	28903	16932	0	0	0	29539
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OPTION		262337721	201492139	5895830	57547664	15354187	1566565	9475252

OPTION=IIB

OBS	PLANT NUMBER	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS	ANNUAL MONITORING COSTS
289	1	0	0	0	0	0	0	29539
290	12	583211	77154	8994	0	0	0	29539
291	15	881543	128618	4324	3536	762	0	29539
292	33	0	0	0	0	0	0	51259
293	61	912273	115757	4653	37220	8016	0	29539
294	63	0	0	0	0	0	0	33782
295	76	1431660	1561007	44796	193544	41683	0	29539
296	83	328468	31298	310	11724	2525	0	33782
297	87	541052	196316	1937	0	0	0	26827
298	101	0	0	0	0	0	222650	26827
299	102	0	0	0	0	0	0	29539
300	105	1079744	2052382	319782	276731	59599	0	41206
301	112	0	0	0	0	0	111325	26827
302	114	1020130	367341	28062	472694	101803	0	26827
303	154	328468	33389	2412	74440	16032	0	26827
304	155	1406902	668691	22693	738817	159118	0	29539
305	159	0	0	0	0	0	0	29539
306	177	1011495	103592	21556	48386	10421	0	29539
307	180	0	0	0	0	0	222650	26827
308	183	862959	451849	27831	0	0	0	29539
309	190	731177	1071083	66000	0	0	0	41206

BAT COST DATA -- BY OPTION

-- OPTION=IIB --

OBS	PLANT NUMBER	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS	ANNUAL MONITORING COSTS
310	205	821587	757824	86733	193544	41683	0	29539
311	225	610771	115960	5036	375178	80801	0	29539
312	227	454726	28989	2124	0	0	0	41206
313	250	354104	50601	8063	385227	82966	0	33782
314	254	366729	54659	3248	470833	101402	0	26827
315	259	0	0	0	0	0	0	33782
316	260	963834	143474	22681	81884	17635	0	29539
317	267	1411929	651263	13206	776832	193075	0	51259
318	269	60026	31856	626	0	0	0	29539
319	284	384432	67491	5018	111660	24048	0	26827
320	294	0	0	0	0	0	0	29539
321	296	594489	119654	21801	661521	164416	0	41206
322	301	8973044	3754917	96349	329397	116988	0	41206
323	352	405958	63704	1466	3908	842	0	29539
324	384	6856767	3047519	248419	358431	127299	0	51259
325	387	2969660	841368	37964	1827258	888306	0	65286
326	392	450142	33874	2736	0	0	0	26827
327	394	461491	47794	8211	0	0	0	26827
328	399	0	0	0	0	0	0	36574
329	412	572195	81880	62487	0	0	0	26827
330	415	3551871	3621418	129088	660906	234725	0	51259
331	443	868974	154617	28737	7816	1683	0	29539
332	444	110889	34022	6542	0	0	0	29539
333	446	870824	81870	5165	28101	6052	0	26827
334	447	2745254	1026242	41564	545805	135655	0	41206
335	451	0	0	0	0	0	44530	26827
336	481	498115	37693	2374	0	0	0	29539
337	485	1866959	2951008	114488	0	0	0	41206
338	486	872186	102024	27793	10608	2285	0	29539
339	488	893795	109571	34598	82256	17715	0	29539
340	500	328709	38823	5380	163396	35190	0	29539
341	502	0	0	0	0	0	12468	29539
342	518	1950998	2281636	14440	329397	70942	0	26827
343	523	72315	42686	7095	0	0	0	29539
344	525	0	0	0	0	0	0	29539
345	536	944486	239229	16051	13529	2914	0	26827
346	569	0	0	0	0	0	0	29539
347	580	116439	34318	2395	0	0	0	29539
348	602	0	0	0	0	0	57889	29539
349	608	655540	1052470	14970	0	0	0	41206
350	611	887896	143612	10093	2419	521	0	26827
351	614	328468	34168	1578	87095	18757	0	29539
352	633	809134	73458	12751	2680	577	0	29539
353	657	4149193	393797	141987	374795	133111	0	29539
354	659	454557	52002	2826	0	0	0	33782
355	662	1247646	428399	22673	764871	164729	0	29539
356	663	858500	692391	18605	115382	24850	0	26827
357	664	919793	530584	10537	716485	154308	0	26827
358	669	0	0	0	0	0	124684	29539
359	682	697987	146981	15825	429694	152609	0	51259
360	683	1403937	781729	40680	866855	215450	0	51259
361	695	2383893	184490	94475	0	0	0	51259
362	709	0	0	0	0	0	151402	29539

OPTION=IIB

OBS	PLANT NUMBER	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS	ANNUAL MONITORING COSTS
363	727	471403	84419	5792	651406	161902	0	51259
364	741	0	0	0	0	0	0	41206
365	758	0	0	0	0	0	0	29539
366	775	540068	644016	3151	0	0	0	29539
367	802	551554	106422	6680	984189	244612	0	29539
368	811	0	0	0	0	0	0	33782
369	814	2940266	1197374	47702	604877	150337	0	41206
370	819	8484607	3028592	109041	268163	95240	0	41206
371	825	837227	151315	4430	346146	74549	0	29539
372	844	0	0	0	0	0	0	33782
373	851	3377409	3155331	138805	0	0	0	41206
374	859	0	0	0	0	0	0	41206
375	866	0	0	0	0	0	0	33782
376	871	451103	39242	6002	0	0	0	33782
377	876	552177	305539	6730	0	0	0	29539
378	877	1204208	929219	21308	65879	14188	0	26827
379	883	0	0	0	0	0	0	29539
380	888	0	0	0	0	0	0	26827
381	908	448303	78050	8660	560371	139276	0	51259
382	909	2743896	1079582	101930	372200	80160	0	41206
383	913	965727	195760	38423	464270	164889	0	41206
384	938	115653	84916	1951	0	0	0	29539
385	942	0	0	0	0	0	0	29539
386	948	1291236	448579	13690	850671	211427	0	51259
387	956	0	0	0	0	0	71248	26827
388	962	782986	67022	2865	55830	12024	0	26827
389	970	469119	83791	6785	642302	159639	0	29539
390	973	828624	275200	45089	604825	130260	0	41206
391	984	328468	32299	1695	55830	12024	0	26827
392	990	328468	35924	1112	115382	24850	0	33782
393	991	0	0	0	0	0	4453	26827
394	992	454718	22868	2736	0	0	0	29539
395	1012	454779	79839	6443	585658	145561	0	29539
396	1020	349821	49140	8310	355451	76553	0	29539
397	1033	0	0	0	0	0	89060	29539
398	1038	972717	207113	14621	524713	186355	0	51259
399	1059	0	0	0	0	0	0	41206
400	1061	458705	113196	8284	488885	105290	0	26827
401	1062	0	0	0	0	0	0	29539
402	1067	438206	65409	6155	37220	8016	0	29539
403	1133	139529	35574	1079	0	0	0	29539
404	1137	2219293	246146	24383	278325	98849	0	51259
405	1139	479801	60911	12220	0	0	0	33782
406	1148	835903	185891	4611	604423	214665	0	41206
407	1149	833465	4798387	23760	0	0	0	41206
408	1157	0	0	0	0	0	44530	33782
409	1203	332097	41724	2210	214015	46092	0	26827
410	1241	635556	99018	24064	521080	112224	0	26827
411	1249	974879	123424	22049	24565	5291	0	33782
412	1267	0	0	0	0	0	0	26827
413	1299	0	0	0	0	0	0	29539
414	1319	0	0	0	0	0	0	29539
415	1323	501356	44739	1736	0	0	0	26827

BAT COST DATA -- BY OPTION

OPTION=IIB

OBS	PLANT NUMBER	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS	ANNUAL MONITORING COSTS
416	1327	2953691	1186459	117597	617015	153354	0	41206
417	1340	1199794	466637	24908	409104	88108	0	33782
418	1343	1740987	2625061	58497	541551	116633	0	33782
419	1348	0	0	0	0	0	0	26827
420	1349	0	0	0	0	0	0	26827
421	1389	411405	67752	3220	772315	166332	0	26827
422	1407	1002773	580864	9225	772315	166332	0	29539
423	1409	4106377	2354667	147923	287695	102177	0	41206
424	1414	454718	14197	8460	0	0	0	26827
425	1438	373116	56619	3606	513636	110621	0	33782
426	1439	1470942	1876635	68080	195405	42084	0	29539
427	1446	350850	718244	42480	0	0	0	26827
428	1464	482849	89871	8602	0	0	0	29539
429	1494	8463828	2288557	84297	340219	120831	0	41206
430	1520	1004494	252421	45473	30334	6533	0	29539
431	1522	811772	4092048	22573	0	0	0	57597
432	1524	328468	36119	2583	118546	25531	0	26827
433	1532	425575	75044	11239	217737	46894	0	29539
434	1569	962196	173358	7399	186100	40080	0	29539
435	1572	0	0	0	0	0	0	51259
436	1593	0	0	0	0	0	0	29539
437	1609	905355	288820	19941	502470	108216	0	29539
438	1616	331423	41307	3524	206571	44489	0	26827
439	1617	576429	1291980	4296	0	0	0	29539
440	1618	599718	103666	11604	0	0	0	26827
441	1624	778350	41593	2855	1359	293	0	33782
442	1643	0	0	0	0	0	0	26827
443	1647	912609	479951	10155	232625	50100	0	29539
444	1650	20575507	4527482	1058825	1732309	645153	0	57597
445	1656	0	0	0	0	0	0	29539
446	1670	0	0	0	0	0	4453	29539
447	1684	73357	32245	694	0	0	133590	33782
448	1688	343107	46699	7103	307065	66132	0	26827
449	1695	4893992	1257500	26851	276873	98333	0	51259
450	1698	449882	13302	13086	0	0	0	26827
451	1714	778350	56004	9912	33684	7254	0	26827
452	1717	328468	31437	826	36848	7936	0	26827
453	1724	841149	105982	21038	3350	721	0	29539
454	1753	671437	139572	15144	397230	141079	0	41206
455	1766	378121	58125	6076	547134	117835	0	26827
456	1769	7875173	9689672	157155	0	0	0	41206
457	1774	1035891	243484	13226	871002	309342	0	29539
458	1785	804355	136003	19563	758625	188550	0	51259
459	1802	444655	77041	13785	546210	135756	0	29539
460	1839	782792	44868	8886	9863	2124	0	26827
461	1869	618340	705348	3628	0	0	0	51259
462	1877	1389291	881655	27052	183867	39599	0	29539
463	1881	328468	31617	631	41872	9018	0	33782
464	1890	529854	113692	19606	290316	62525	0	33782
465	1905	386297	63117	5875	15204	3275	0	33782
466	1910	1135742	1255931	11405	308740	66493	0	41206
467	1911	686981	106868	27170	666238	143486	0	33782
468	1928	826194	75304	5583	7072	1523	0	26827

OPTION=IIB

OBS	PLANT NUMBER	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS	ANNUAL MONITORING COSTS
469	1937	1251214	628168	61880	121523	26172	0	29539
470	1943	0	0	0	0	0	0	33782
471	1973	599338	119580	5777	311449	110613	0	29539
472	1977	0	0	0	0	0	0	51259
473	1986	0	0	0	0	0	0	26827
474	2009	674383	80766	9318	0	0	0	29539
475	2020	0	0	0	0	0	0	29539
476	2026	454718	17720	2736	0	0	0	33782
477	2030	1312598	1387596	79420	0	0	0	41206
478	2047	328468	34770	3724	96772	20842	0	26827
479	2049	378242	59210	6012	57691	12425	0	29539
480	2055	0	0	0	0	0	0	26827
481	2062	785051	50058	5652	14330	3086	0	29539
482	2073	1341764	2106075	47319	878392	189178	0	29539
483	2090	63318	35647	1953	0	0	0	29539
484	2110	362960	63158	6065	34801	7495	0	29539
485	2148	657716	216786	28974	816280	202880	0	29539
486	2181	0	0	0	0	0	0	26827
487	2193	0	0	0	0	0	89060	33782
488	2198	355187	50962	3103	392671	84569	0	29539
489	2206	674950	135546	5916	0	0	0	26827
490	2221	861504	222780	7759	320092	68938	0	26827
491	2222	670350	139270	6606	395910	140610	0	29539
492	2227	1717297	1113595	57123	1047842	372148	0	29539
493	2228	783186	42842	5329	5620	1210	0	29539
494	2236	458966	66378	8085	10515	2265	0	29539
495	2242	794312	66472	9040	280267	60360	0	29539
496	2254	564000	115855	12674	622275	154661	0	29539
497	2268	1430431	2902047	61784	65135	14028	0	29539
498	2272	1521382	2272954	53161	814763	202503	0	51259
499	2281	414832	118514	3459	9119	1964	0	29539
500	2292	623152	160108	35602	0	0	0	29539
501	2296	0	0	0	0	0	0	26827
502	2307	0	0	0	0	0	0	26827
503	2313	0	0	0	0	0	0	29539
504	2315	424577	90041	6312	411281	88577	0	26827
505	2316	864596	117054	7232	1489	321	0	29539
506	2322	2093797	2526055	109087	566116	121923	0	41206
507	2328	0	0	0	0	0	0	33782
508	2345	341793	46190	7518	297202	64008	0	29539
509	2353	0	0	0	0	0	0	29539
510	2360	426189	71906	3452	874670	188376	0	26827
511	2364	328468	31298	624	16563	3567	0	33782
512	2365	537220	47124	3521	0	0	0	29539
513	2368	543298	104153	5081	948787	235813	0	41206
514	2376	464098	52884	2830	0	0	0	33782
515	2390	0	0	0	0	0	0	29539
516	2394	1228402	182965	13864	524449	186261	0	41206
517	2399	0	0	0	0	0	0	29539
518	2400	0	0	0	0	0	0	26827
519	2419	328468	32929	1874	66810	14389	0	26827
520	2429	577550	116539	62203	0	0	0	29539
521	2430	6501134	6661361	215084	344970	122518	0	41206

BAT COST DATA -- BY OPTION

OPTION=IIB

OBS	PLANT NUMBER	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS	ANNUAL MONITORING COSTS
522	2445	415461	68897	3285	800230	172344	0	33782
523	2447	0	0	0	0	0	0	29539
524	2450	1160796	1420471	31753	691866	171958	0	41206
525	2461	356565	63076	2973	15446	3327	0	33782
526	2471	0	0	0	0	0	0	41206
527	2474	740217	423814	28735	0	0	0	26827
528	2481	1068738	320795	17744	930580	231288	0	51259
529	2527	870231	417182	56775	329925	117175	0	51259
530	2528	1614132	1128181	57991	363445	129080	0	51259
531	2531	521479	190457	3733	0	0	0	26827
532	2533	366452	54573	9703	468972	101002	0	26827
533	2536	0	0	0	0	0	0	29539
534	2537	328468	32169	723	53411	11503	0	26827
535	2541	1718347	2295209	31514	465250	100200	0	29539
536	2551	0	0	0	0	0	0	26827
537	2556	0	0	0	0	0	0	26827
538	2573	1207405	376056	23701	407559	87775	0	29539
539	2590	812266	73371	12660	1861	401	0	29539
540	2592	422449	70859	3394	848616	182765	0	26827
541	2606	0	0	0	0	0	4453	29539
542	2626	0	0	0	0	0	0	29539
543	2631	1268164	2667176	37870	289758	62405	0	41206
544	2633	672524	139875	26412	398549	141547	0	41206
545	2660	12586	18853	6437	0	0	178120	26827
546	2668	0	0	0	0	0	0	26827
547	2673	818853	84752	12964	4094	882	0	29539
548	2678	339927	45444	2365	282872	60922	0	26827
549	2680	1018611	490372	26144	11166	2405	0	29539
550	2692	0	0	0	0	0	0	26827
551	2693	0	0	0	0	0	0	29539
552	2695	1257905	1803263	39263	990258	246121	0	41206
553	2701	613699	669010	14248	0	0	0	41206
554	2711	458155	40786	4960	0	0	0	26827
555	2735	5761104	909911	198687	571430	202947	0	29539
556	2739	117139	86578	8235	0	0	0	51259
557	2763	464278	82458	5650	623084	154862	0	29539
558	2764	506987	94189	18345	796050	197852	0	41206
559	2767	394955	63313	6140	21774	4689	0	29539
560	2770	778726	67022	6555	55830	12024	0	29539
561	2771	458155	40786	8157	0	0	0	33782
562	2781	828212	75750	12825	9119	1964	0	29539
563	2786	591020	73529	9269	35731	7695	0	29539
564	2795	1080229	865104	6742	575543	143047	0	41206
565	2816	1236899	268670	16958	792876	281595	0	41206
566	2818	62529	31909	4280	0	0	0	29539
567	3033	189850	38322	5836	0	0	0	29539
568	4002	0	0	0	0	0	0	29539
569	4010	0	0	0	0	0	0	29539
570	4017	0	0	0	0	0	0	26827
571	4018	992915	238249	41090	27171	5852	0	29539
572	4021	542838	109519	17926	158929	34228	0	26827
573	4037	1137313	745696	38271	72579	15631	0	29539
574	4040	553898	72254	14185	0	0	0	29539

BAT COST DATA -- BY OPTION

OPTION=11B

OBS	PLANT NUMBER	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS	ANNUAL MONITORING COSTS
575	4051	332273	41828	1578	215876	46493	0	26827
576	4055	53273	60681	20687	0	0	0	29539
OPTION		250822705	128259096	6792303	57547664	15354187	1566565	9475252
		513160426	329751235	12688133	115095328	30708374	3133130	18950504

BAT COST DATA -- OPTION III (OCT 1, 1987)

OBS	PLANT NUMBER	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS	ANNUAL MONITORING COSTS
1	1	4248267	390909	40970	0	0	0	29539.2
2	12	705873	160134	25196	0	0	0	29539.2
3	15	906533	145614	6687	3536	762	0	29539.2
4	33	3513417	254677	45036	0	0	0	51259.2
5	61	1030953	195753	11650	37220	8016	0	29539.2
6	63	1231307	1400125	23447	0	0	0	33782.4
7	76	1778108	1840121	68982	193544	41683	0	29539.2
8	83	384575	67499	5732	11724	2525	0	33782.4
9	87	1083677	683039	8952	0	0	0	26827.2
10	101	0	0	0	0	0	222650	26827.2
11	102	282560	218086	26981	0	0	0	29539.2
12	105	1533138	2441148	510333	276731	59599	0	29539.2
13	112	0	0	0	0	0	111325	26827.2
14	114	1786874	1122873	83634	472694	101803	0	26827.2
15	154	520106	171222	25588	74440	16032	0	26827.2
16	155	2504489	1872370	51415	738817	159118	0	29539.2
17	159	211647	154772	8690	0	0	0	29539.2
18	177	1732501	801802	74692	48386	10421	0	29539.2
19	180	0	0	0	0	0	222650	26827.2
20	183	1849396	1498714	93520	0	0	0	29539.2
21	190	1177610	1452446	109354	0	0	0	29539.2
22	205	1168035	1036938	151767	193544	41683	0	29539.2
23	225	1249957	714703	17186	375178	80801	0	29539.2
24	227	7027184	820590	38112	0	0	0	41205.6
25	250	1006653	665313	58964	385227	82966	0	33782.4
26	254	1131079	807161	22872	470833	101402	0	33782.4
27	259	554660	500353	29411	0	0	0	33782.4
28	260	1168880	292611	56871	81884	17635	0	29539.2
29	267	6475516	1185481	39126	776832	193075	0	51259.2
30	269	130270	77402	3839	0	0	0	29539.2
31	284	5460601	603890	71816	111660	24048	0	29539.2
32	294	400524	333446	14450	0	0	0	29539.2
33	296	6957558	875968	151538	661521	164416	0	41205.6
34	301	13342682	4167471	129043	329397	116988	0	41205.6
35	352	544476	158775	8869	3908	842	0	29539.2
36	384	14528456	4022459	408877	358431	127299	0	51259.2
37	387	26823520	4247475	171057	1827258	888306	0	65286.0
38	392	603156	140279	12630	0	0	0	26827.2
39	394	4504485	401720	96263	0	0	0	29539.2
40	399	15615418	2222373	34841	0	0	0	36573.6
41	412	780550	233836	201851	0	0	0	26827.2
42	415	16086565	5374536	334178	660906	234725	0	57597.2
43	443	912743	182964	47626	7816	1683	0	29539.2
44	444	1436677	1577837	81491	0	0	0	29539.2
45	446	1071043	226915	16121	28101	6052	0	26827.2
46	447	6218427	1272967	68798	545805	135655	0	41205.6
47	451	0	0	0	0	0	44530	26827.2
48	481	542510	66432	7416	0	0	0	29539.2
49	485	2775269	3891344	177832	0	0	0	29539.2
50	486	924919	136049	67037	10608	2285	0	29539.2
51	488	1079986	242868	95654	82256	17715	0	29539.2
52	500	902712	561285	57327	163396	35190	0	29539.2
53	502	0	0	0	0	0	12468	29539.2
54	518	2730885	3053861	22636	329397	70942	0	26827.2

BAT COST DATA -- OPTION III (OCT 1, 1987)

OBS	PLANT NUMBER	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS	ANNUAL MONITORING COSTS
55	523	564882	473768	55791	0	0	0	29539.2
56	525	3508463	253703	78240	0	0	0	29539.2
57	536	1005847	278862	25509	13529	2914	0	26827.2
58	569	526401	468502	46454	0	0	0	29539.2
59	580	328086	189090	14619	0	0	0	29539.2
60	602	0	0	0	0	0	57889	29539.2
61	608	4394224	1350313	93918	0	0	0	41205.6
62	611	910173	159035	15462	2419	521	0	26827.2
63	614	542737	191192	16081	87095	18757	0	29539.2
64	633	832703	89627	29587	2680	577	0	29539.2
65	657	9055023	900606	246631	374795	133111	0	29539.2
66	659	4267753	363759	31019	0	0	0	29539.2
67	662	4888532	707737	69943	764871	164729	0	51259.2
68	663	2182102	2232838	93498	115382	24850	0	41205.6
69	664	1990336	1695555	38942	716485	154308	0	26827.2
70	669	184821	132162	30477	0	0	0	26827.2
71	682	6567631	819634	91249	429694	152609	0	29539.2
72	683	6189236	1267510	127966	866855	215450	0	51259.2
73	695	14933550	1939928	315719	0	0	0	51259.2
74	709	0	0	0	0	0	151402	57597.2
75	727	4117262	364706	34906	651406	161902	0	29539.2
76	741	4563316	446827	97846	0	0	0	51259.2
77	758	875476	896509	57820	0	0	0	41205.6
78	775	1848355	2160918	19795	0	0	0	29539.2
79	802	4739541	486524	37984	984189	244612	0	29539.2
80	811	552104	497450	39790	0	0	0	29539.2
81	814	6380877	1437592	74558	604877	150337	0	33782.4
82	819	12742634	3421247	150108	269163	95240	0	41205.6
83	825	1437478	704170	17723	346146	74549	0	41205.6
84	844	1277578	1470001	23838	0	0	0	29539.2
85	851	9609589	3889523	276437	0	0	0	33782.4
86	859	3904078	328553	20021	0	0	0	41205.6
87	866	265522	202429	26321	0	0	0	41205.6
88	871	1442344	1092759	51803	0	0	0	41205.6
89	876	1371251	1128109	41509	0	0	0	33782.4
90	877	1434973	1100569	33951	65879	14188	0	33782.4
91	883	455531	391046	32790	0	0	0	29539.2
92	888	122662	82980	11762	0	0	0	26827.2
93	908	4075929	354854	55705	560371	139276	0	29539.2
94	909	6638072	1406314	191286	372200	80160	0	26827.2
95	913	6707689	846641	158082	464270	164889	0	51259.2
96	938	1423940	1601818	12254	0	0	0	41205.6
97	942	674702	641424	51637	0	0	0	41205.6
98	948	8277120	1309501	62200	850671	211427	0	29539.2
99	956	0	0	0	0	0	71248	29539.2
100	962	939639	176313	10614	55830	12024	0	51259.2
101	970	4100060	361229	40977	642302	159639	0	26827.2
102	973	1645333	1094708	101179	604825	130260	0	26827.2
103	984	1353689	1133193	40081	55830	12024	0	29539.2
104	990	870323	521778	13839	115382	24850	0	29539.2
105	991	0	0	0	0	0	4453	26827.2
106	992	556915	90747	11281	0	0	0	33782.4
107	1012	3992985	339370	39461	585658	145561	0	26827.2
108	1020	962607	616663	61724	355451	76553	0	29539.2

BAT COST DATA -- OPTION III (OCT 1, 1987)

OBS	PLANT NUMBER	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS	ANNUAL MONITORING COSTS
109	1033	0	0	0	0	0	89060	29539.2
110	1038	7001801	906880	61990	524713	186355	0	51259.2
111	1059	4842464	495764	27990	0	0	0	41205.6
112	1061	1246220	895154	33102	488885	105290	0	26827.2
113	1062	3758564	301570	59600	0	0	0	29539.2
114	1067	694472	259447	32108	37220	8016	0	29539.2
115	1133	426303	257574	6474	0	0	0	29539.2
116	1137	6749693	687169	50681	278325	98849	0	51259.2
117	1139	640783	173656	43400	0	0	0	33782.4
118	1148	7089413	923692	23696	604423	214665	0	41205.6
119	1149	7334693	5577998	155639	0	0	0	41205.6
120	1157	58301	37628	21862	0	0	0	33782.4
121	1203	458693	127673	12286	214015	46092	0	26827.2
122	1241	1464078	933853	84909	521080	112224	0	26827.2
123	1249	1063536	181645	45799	24565	5291	0	33782.4
124	1267	1127885	1247460	69713	0	0	0	26827.2
125	1299	29138	19435	17795	0	0	0	29539.2
126	1319	82256	53753	5474	0	0	0	29539.2
127	1323	547724	74716	4550	0	0	0	26827.2
128	1327	6543206	1455943	193881	617015	153354	0	41205.6
129	1340	2381010	1792206	74421	409104	88108	0	33782.4
130	1343	2595391	3493745	101402	541551	116633	0	33782.4
131	1348	65178	42157	22667	0	0	0	26827.2
132	1349	1325788	1543815	70802	0	0	0	26827.2
133	1389	1613937	1424908	21231	772315	166332	0	26827.2
134	1407	2140729	1842972	33945	772315	166332	0	29539.2
135	1409	8484428	2768716	249212	287695	102177	0	41205.6
136	1414	509151	49316	29849	0	0	0	26827.2
137	1438	1192190	879189	24989	513636	110621	0	33782.4
138	1439	2167652	2544890	121396	195405	42084	0	29539.2
139	1446	1502882	2000906	112855	0	0	0	26827.2
140	1464	831009	370669	47737	0	0	0	29539.2
141	1494	13161537	2759005	146575	340219	120831	0	41205.6
142	1520	1098925	314727	71171	30334	6533	0	29539.2
143	1522	17926750	6537094	268934	0	0	0	57597.2
144	1524	913606	571420	32670	118546	25531	0	26827.2
145	1532	846077	429145	53529	217737	46894	0	29539.2
146	1569	1335788	479451	21903	186100	40080	0	29539.2
147	1572	6924428	850646	20610	0	0	0	51259.2
148	1593	345305	277992	10556	0	0	0	29539.2
149	1609	2209262	1799007	90215	502470	108216	0	29539.2
150	1616	735522	378426	29286	206571	44489	0	26827.2
151	1617	4491231	1622504	26867	0	0	0	29539.2
152	1618	880466	320075	38515	0	0	0	26827.2
153	1624	808196	61448	8648	1359	293	0	33782.4
154	1643	1013839	1084961	62812	0	0	0	26827.2
155	1647	2209941	1980074	49160	232625	50100	0	29539.2
156	1650	37668957	6969356	1324207	1732309	645153	0	57597.2
157	1656	89107	58537	23792	0	0	0	29539.2
158	1670	0	0	0	0	0	4453	29539.2
159	1684	227466	139517	4936	0	0	0	33782.4
160	1688	890091	538348	54317	307065	66132	0	26827.2
161	1695	11560287	2064875	49661	276873	98333	0	51259.2
162	1698	498538	44725	45031	0	0	0	26827.2

BAT COST DATA -- OPTION III (OCT 1, 1987)

OBS	PLANT NUMBER	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS	ANNUAL MONITORING COSTS
163	1714	889320	130284	35149	33684	7254	0	26827.2
164	1717	470378	129136	11333	36848	7936	0	26827.2
165	1724	867847	123976	33134	3350	721	0	29539.2
166	1753	8431311	1129089	108068	397230	141079	0	41205.6
167	1766	1274580	982575	42256	547134	117835	0	26827.2
168	1769	18623709	11162721	346990	0	0	0	46670.4
169	1774	8810706	1235468	65609	871002	309342	0	29539.2
170	1785	1160477	424663	44022	758625	188550	0	33782.4
171	1802	4806524	488214	107400	546210	135756	0	29539.2
172	1839	833216	77415	28257	9863	2124	0	26827.2
173	1869	6264654	1339884	35573	0	0	0	51259.2
174	1877	1722826	1148150	41694	183867	39599	0	29539.2
175	1881	569718	212218	9776	41872	9018	0	33782.4
176	1890	1202101	752142	75182	290316	62525	0	33782.4
177	1905	452349	105855	28641	15204	3275	0	33782.4
178	1910	1628833	1687587	18143	308740	66493	0	29539.2
179	1911	1696262	1185466	93528	666238	143486	0	33782.4
180	1928	867409	102063	13773	7072	1523	0	26827.2
181	1937	1497499	813250	95946	121523	26172	0	29539.2
182	1943	1215826	1376960	72091	0	0	0	33782.4
183	1973	5341677	597846	33235	311449	110613	0	29539.2
184	1977	5392081	590933	30747	0	0	0	51259.2
185	1986	321364	254730	23460	0	0	0	26827.2
186	2009	1367191	744242	35432	0	0	0	29539.2
187	2020	65178	42157	22667	0	0	0	29539.2
188	2026	529868	66589	10421	0	0	0	33782.4
189	2030	1815629	1830166	124994	0	0	0	29539.2
190	2047	963683	628790	54041	96772	20842	0	26827.2
191	2049	538505	171380	37140	57691	12425	0	29539.2
192	2055	140406	96532	12610	0	0	0	26827.2
193	2062	865908	102843	19646	14330	3086	0	29539.2
194	2073	5697157	2516096	140794	878392	189178	0	29539.2
195	2090	414896	319814	16912	0	0	0	29539.2
196	2110	689845	323209	47185	34801	7495	0	29539.2
197	2148	4573343	547461	98999	816280	202880	0	29539.2
198	2181	704016	677226	44148	0	0	0	26827.2
199	2193	0	0	0	0	0	89060	33782.4
200	2198	1017600	677531	22608	392671	84569	0	29539.2
201	2206	1048542	441639	19958	0	0	0	26827.2
202	2221	1999460	1484888	37542	320092	68938	0	26827.2
203	2222	5702459	668029	35576	395910	140610	0	29539.2
204	2227	10490229	2269244	223391	1047842	372148	0	29539.2
205	2228	819151	66378	16170	5620	1210	0	29539.2
206	2236	734139	277643	44334	10515	2265	0	29539.2
207	2242	6588626	726287	83686	280267	60360	0	41205.6
208	2254	4162129	386999	59212	622275	154661	0	29539.2
209	2268	2333865	3835837	120407	65135	14028	0	29539.2
210	2272	5434534	2603175	143019	814763	202503	0	51259.2
211	2281	457970	146468	6212	9119	1964	0	29539.2
212	2292	686774	201233	56464	0	0	0	29539.2
213	2296	1135719	1258851	23359	0	0	0	26827.2
214	2307	131258	89494	16607	0	0	0	26827.2
215	2313	1063765	1155324	28903	0	0	0	29539.2
216	2315	4903503	521971	49511	411281	88577	0	29539.2

BAT COST DATA -- OPTION III (OCT 1, 1987)

OBS	PLANT NUMBER	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS	ANNUAL MONITORING COSTS
217	2316	880598	128920	11094	1489	321	0	29539.2
218	2322	2885359	3313189	164418	566116	121923	0	29539.2
219	2328	356689	289222	29642	0	0	0	33782.4
220	2345	875160	522494	57874	297202	64008	0	29539.2
221	2353	111791	74885	25304	0	0	0	29539.2
222	2360	1686170	1515220	21843	874670	188376	0	26827.2
223	2364	398213	76508	10290	16563	3567	0	33782.4
224	2365	690965	154107	11216	0	0	0	29539.2
225	2368	4674115	473966	29032	948787	235813	0	41205.6
226	2376	1140271	696093	20849	0	0	0	33782.4
227	2390	358388	290907	15077	0	0	0	29539.2
228	2394	7018100	841992	59728	524449	186261	0	41205.6
229	2399	191638	137833	19137	0	0	0	29539.2
230	2400	122662	82980	9961	0	0	0	26827.2
231	2419	489450	145674	19786	66810	14389	0	26827.2
232	2429	616122	141668	97893	0	0	0	29539.2
233	2430	14583387	7704006	369464	344970	122518	0	41205.6
234	2445	6546964	786040	37405	800230	172344	0	51259.2
235	2447	53303	34391	12206	0	0	0	29539.2
236	2450	6599524	2019422	146186	691666	171958	0	41205.6
237	2461	423281	106257	16094	15446	3327	0	33782.4
238	2471	4117730	367452	54618	0	0	0	41205.6
239	2474	4390220	704891	111289	0	0	0	29539.2
240	2481	1799901	1031630	50849	930580	231288	0	33782.4
241	2527	8090968	1317283	210431	329925	117175	0	51259.2
242	2528	8711659	2007745	209738	363445	129080	0	51259.2
243	2531	1119217	740382	22399	0	0	0	26827.2
244	2533	1128407	804046	68369	468972	101002	0	26827.2
245	2536	5640134	633479	73029	0	0	0	29539.2
246	2537	526846	175660	9198	53411	11503	0	26827.2
247	2541	2475506	3038629	52178	465250	100200	0	29539.2
248	2551	484686	422480	44869	0	0	0	26827.2
249	2556	559764	506163	47678	0	0	0	26827.2
250	2573	1889458	1026410	55827	407559	87775	0	29539.2
251	2590	831586	87104	28703	1861	401	0	29539.2
252	2592	5610035	626540	33144	848616	182765	0	29539.2
253	2606	0	0	0	0	0	4453	29539.2
254	2626	1124525	1242584	48438	0	0	0	29539.2
255	2631	5021759	2967815	123394	289758	62405	0	41205.6
256	2633	5806809	686339	143852	398549	141547	0	41205.6
257	2660	27363	30040	12874	0	0	0	26827.2
258	2668	958906	1008970	27054	0	0	0	26827.2
259	2673	1026547	236144	47324	4094	882	0	29539.2
260	2678	853374	499525	18391	282872	60922	0	26827.2
261	2680	1246491	659197	46607	11166	2405	0	29539.2
262	2692	1281972	1476686	30786	0	0	0	26827.2
263	2693	250041	188441	21222	0	0	0	29539.2
264	2695	5498035	2192715	137313	990258	246121	0	41205.6
265	2701	4320895	960928	98459	0	0	0	41205.6
266	2711	641259	171528	23766	0	0	0	26827.2
267	2735	11823843	1615391	333392	571430	202947	0	29539.2
268	2739	3535611	322331	51491	0	0	0	51259.2
269	2763	4063732	353857	34276	623084	154862	0	29539.2
270	2764	4389607	418792	107394	796050	197852	0	41205.6

BAT COST DATA -- OPTION III (OCT 1, 1987)

OBS	PLANT NUMBER	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS	ANNUAL MONITORING COSTS
271	2767	478138	117709	29376	21774	4689	0	29539
272	2770	935379	176313	24285	55830	12024	0	29539
273	2771	641259	171528	39083	0	0	0	33782
274	2781	872607	104489	31795	9119	1964	0	29539
275	2786	5454095	572888	73561	35731	7695	0	41206
276	2795	4601906	1121401	24314	575543	143047	0	41206
277	2816	8978842	1255224	69186	792876	281595	0	41206
278	2818	137679	80778	26325	0	0	0	29539
279	3033	671902	457938	33558	0	0	0	29539
280	4002	761955	749473	54422	0	0	0	29539
281	4010	1178103	1320972	25105	0	0	0	29539
282	4017	526918	469079	46474	0	0	0	26827
283	4018	1080670	295836	64330	27171	5852	0	29539
284	4021	874931	374613	57021	158929	34228	0	26827
285	4037	1325553	880696	61289	72579	15631	0	29539
286	4040	615947	112340	36491	0	0	0	29539
287	4051	750052	393096	12993	215876	46493	0	26827
288	4055	77381	77163	37619	0	0	0	29539
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		836000756	269439332	18887628	57547664	15354187	1085641	9467282

PSES COST DATA -- BY OPTION

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OBS	PLANT NUMBER	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS	ANNUAL MONITORING COSTS
1	2	328468	31298	451	3722	802	0	29539
2	5	454351	32339	7848	0	0	0	26827
3	10	488548	70475	25511	3461	745	0	26827
4	22	783187	57541	2528	52666	11343	0	26827
5	30	527873	211506	3608	0	0	0	29539
6	33	4877037	959685	51693	139575	30060	0	41206
7	49	898469	857073	224668	0	0	0	26827
8	51	1084971	931710	50677	116126	25010	0	29539
9	52	837000	159199	21233	4224	910	0	29539
10	58	454719	10720	2988	0	0	0	26827
11	71	0	0	0	0	0	222650	33782
12	72	73322	75798	17643	0	0	0	29539
13	79	511928	138122	122302	0	0	0	33782
14	88	0	0	0	0	0	89060	26827
15	93	165266	511958	7906	0	0	0	29539
16	94	825690	126041	118436	7444	1603	0	26827
17	110	852438	108282	18782	3722	802	0	29539
18	111	0	0	0	0	0	44530	26827
19	119	483858	59809	40612	0	0	0	26827
20	120	831449	143654	9765	9305	2004	0	29539
21	122	454324	22613	34272	29218	6293	0	29539
22	143	854924	114931	9684	3722	802	0	29539
23	149	884486	196224	31189	14330	3086	0	29539
24	158	0	0	0	0	0	89060	26827
25	161	1391702	2253528	68794	298690	64328	0	29539
26	162	0	0	0	0	0	133590	29539
27	163	881017	185923	30464	11166	2405	0	29539
28	166	97912	254896	14951	0	0	0	29539
29	196	1274893	1732918	61506	227414	48978	0	29539
30	199	333811	1291428	13412	0	0	0	26827
31	203	479315	49992	103499	0	0	0	26827
32	206	555210	279103	34724	0	0	0	26827
33	209	0	0	0	0	0	0	29539
34	212	26699	43342	4365	0	0	356240	33782
35	214	1249747	1812224	19594	182378	39278	0	29539
36	220	493292	83951	112289	0	0	0	33782
37	221	1656951	4489517	16863	133061	28657	0	33782
38	232	489168	103636	7899	0	0	0	29539
39	240	6376117	2480608	81595	213084	45892	0	41206
40	244	0	0	0	0	0	0	29539
41	249	886230	327282	15450	30148	6493	0	26827
42	257	1387665	5802891	67317	74440	16032	0	29539
43	262	846923	96240	104185	2419	521	0	29539
44	266	805465	75291	13438	2419	521	0	26827
45	276	655540	1052470	15244	0	0	0	41206
46	283	3455858	496628	70825	0	0	0	29539
47	285	0	0	0	0	0	8906	26827
48	292	1008647	639667	46988	64018	13788	0	29539
49	293	1058805	2252275	23212	0	0	0	29539
50	297	783187	43797	11108	76301	16433	22265	26827
51	299	340166	45542	1843	284733	61322	0	29539
52	302	618553	542539	12939	0	0	0	29539
53	310	578958	377841	21138	0	0	0	26827

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OBS	PLANT NUMBER	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS	ANNUAL MONITORING COSTS
54	321	478828	48007	102866	0	0	0	33782
55	326	896516	233095	28322	19354	4168	0	29539
56	334	824403	120532	10071	1675	361	0	33782
57	348	0	0	0	0	0	0	26827
58	354	999341	781615	39094	84303	18156	0	26827
59	357	0	0	0	0	0	89060	29539
60	417	454982	31332	34272	0	0	0	26827
61	423	901018	436183	8888	55830	12024	0	29539
62	428	0	0	0	0	0	222650	26827
63	430	7910326	3768411	155484	748510	186036	0	41206
64	433	954381	431484	13592	46525	10020	0	29539
65	438	691971	835393	11140	0	0	0	26827
66	449	0	0	0	0	0	0	26827
67	451	0	0	0	0	0	44530	26827
68	458	5810843	2563147	481491	0	0	0	51259
69	468	866827	148334	9989	16377	3527	0	33782
70	492	31081	53514	12601	0	0	102419	29539
71	494	1000112	2245633	21374	0	0	0	33782
72	508	0	0	0	0	0	89060	29539
73	522	1128622	1119251	53079	120965	26052	0	29539
74	529	454324	11526	2736	0	0	0	26827
75	543	534636	212633	11557	0	0	0	26827
76	544	0	0	0	0	0	22265	26827
77	567	802508	69156	6263	1861	401	0	26827
78	592	620341	541790	27813	0	0	0	33782
79	605	0	0	0	0	0	164761	26827
80	607	918665	304874	26317	29032	6252	0	29539
81	618	0	0	0	0	0	222650	29539
82	624	6797785	2391354	120184	263145	56673	0	41206
83	658	1187612	1721124	46783	50433	10862	0	33782
84	661	845487	93338	5648	1787	385	0	29539
85	667	0	0	0	0	0	13359	29539
86	702	45017	89075	6522	0	0	0	29539
87	706	493962	86653	23200	0	0	0	26827
88	717	790577	1647789	27017	0	0	0	26827
89	720	460286	45359	3062	0	0	0	29539
90	722	1963987	8563516	50222	472694	101803	0	41206
91	724	479710	49992	21309	0	0	0	26827
92	743	826957	129598	6577	7816	1683	0	29539
93	749	905054	390095	12464	26426	5691	0	26827
94	768	842587	87726	23257	1489	321	0	29539
95	771	1008640	818740	44226	61599	13266	0	29539
96	777	0	0	0	0	0	44530	29539
97	791	491242	78475	19074	0	0	0	26827
98	796	0	0	0	0	0	133590	26827
99	797	856509	118042	9849	4839	1042	0	29539
100	814	1202754	870926	16193	604877	150337	0	41206
101	830	15277	19766	23561	0	0	142496	33782
102	845	408855	226882	6529	20657	4449	0	29539
103	846	0	0	0	0	0	133590	26827
104	862	1053095	1010080	47717	111697	24056	0	26827
105	874	866397	335120	21295	478277	103006	0	26827
106	880	0	0	0	0	0	26718	29539

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OBS	PLANT NUMBER	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS	ANNUAL MONITORING COSTS
107	887	961483	2996506	15084	198755	42805	0	29539
108	905	479710	49992	9024	0	0	0	26827
109	912	0	0	0	0	0	129137	26827
110	917	328468	31351	2095	33498	7214	0	29539
111	929	471485	33608	97536	0	0	0	26827
112	931	0	0	0	0	0	218197	26827
113	932	0	0	0	0	0	4453	29539
114	944	454719	10295	7992	0	0	200385	33782
115	958	113832	311801	27454	0	0	0	29539
116	975	534636	213496	8216	0	0	0	33782
117	976	902271	1908599	23201	0	0	0	26827
118	987	16003	21114	4974	0	0	400770	26827
119	988	0	0	0	0	0	178120	26827
120	992	556914	292807	11281	0	0	0	29539
121	997	815399	98630	25967	4652	1002	0	29539
122	1006	356808	78386	4597	3722	802	0	26827
123	1011	333002	42241	6053	223320	48096	0	29539
124	1018	1061841	846505	16588	88584	19078	0	29539
125	1026	0	0	0	0	0	222650	29539
126	1047	929054	1962111	52852	0	0	0	33782
127	1052	960408	616533	9700	45408	9780	0	26827
128	1053	822696	126523	2667	6588	1419	0	33782
129	1057	14778	18853	3380	0	0	89060	33782
130	1064	0	0	0	0	0	66795	29539
131	1069	422716	70934	4781	850477	183166	0	29539
132	1076	0	0	0	0	0	62342	26827
133	1083	817593	103209	19290	3536	762	0	26827
134	1085	21324	31661	15515	0	0	267180	33782
135	1086	758835	541111	196546	0	0	0	26827
136	1091	1135689	1139686	32958	145158	31262	0	29539
137	1094	282550	1038091	38779	0	0	0	29539
138	1107	457746	39842	2167	0	0	8906	26827
139	1117	470722	34147	3297	0	0	0	26827
140	1126	1072994	2323057	46200	0	0	0	29539
141	1162	475122	126133	8948	0	0	0	26827
142	1163	982400	559349	29057	9863	2124	0	29539
143	1172	1033940	927467	34267	101797	21924	0	26827
144	1173	14778	18853	61284	0	0	223986	33782
145	1175	0	0	0	0	0	178120	26827
146	1181	466983	436826	30377	46711	10060	0	29539
147	1188	792566	84182	7428	26054	5611	0	29539
148	1191	884501	196313	8294	14516	3126	0	29539
149	1194	480573	51745	24278	0	0	51210	33782
150	1195	29139	48940	8254	0	0	0	26827
151	1197	819710	108525	19538	3908	842	0	26827
152	1202	552631	279038	34485	0	0	0	26827
153	1219	912680	4763494	59968	0	0	0	26827
154	1220	475058	41415	6201	0	0	0	33782
155	1223	361421	89318	7990	4839	1042	0	29539
156	1224	434036	1819206	11597	0	0	0	26827
157	1234	529869	196331	22419	0	0	0	33782
158	1236	1227218	1934961	48401	57133	12305	0	33782
159	1237	514640	146579	123620	0	0	0	29539

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OBS	PLANT NUMBER	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS	ANNUAL MONITORING COSTS
160	1249	1064805	899695	45675	24565	5291	0	33782
161	1253	454324	15794	8460	0	0	0	29539
162	1255	454719	27484	2124	0	0	0	29539
163	1264	846923	96240	24296	2419	521	0	29539
164	1277	1176246	1650240	17672	24193	5210	0	29539
165	1310	1632568	13525071	33935	148880	32064	0	41206
166	1313	13738	16988	3743	0	0	115778	33782
167	1314	14395	18160	4866	0	0	0	26827
168	1320	481418	53925	9128	0	0	48983	26827
169	1322	1007975	829775	43164	23262	5010	0	26827
170	1326	483059	70058	6558	0	0	0	33782
171	1351	870354	154617	10744	7816	1683	0	29539
172	1352	13738	16988	14084	0	0	115778	33782
173	1356	855723	116050	26063	3908	842	0	29539
174	1357	487672	68315	18694	0	0	0	33782
175	1361	1096293	977368	17624	122454	26373	0	29539
176	1371	0	0	0	0	0	222650	26827
177	1386	0	0	0	0	0	44530	26827
178	1426	1232310	1570098	59527	174190	37515	0	29539
179	1432	927748	483496	39089	65879	14188	0	26827
180	1433	0	0	0	0	0	14250	29539
181	1437	885936	1533852	11844	0	0	0	29539
182	1450	13738	16988	27628	0	0	115778	26827
183	1478	845905	94175	8998	2233	481	0	29539
184	1504	885382	328343	11952	29776	6413	0	26827
185	1507	1063864	2640732	47746	0	0	0	33782
186	1528	476043	41966	23507	0	0	0	26827
187	1534	514640	141787	9869	0	0	0	26827
188	1535	0	0	0	0	0	8906	26827
189	1539	1454722	3200303	67312	253468	54589	0	29539
190	1548	0	0	0	0	0	75701	29539
191	1556	454479	34298	2736	0	0	0	29539
192	1560	846923	96240	21449	2419	521	0	29539
193	1562	795401	95553	3438	136970	29499	0	29539
194	1564	0	0	0	0	0	75701	29539
195	1566	0	0	0	0	0	44530	29539
196	1575	13738	16988	14084	0	0	262727	26827
197	1595	599618	460436	17816	0	0	0	29539
198	1601	47664	25803	2420	0	0	0	29539
199	1608	923900	322580	12444	31451	6774	0	29539
200	1621	784293	69261	11491	93050	20040	0	29539
201	1622	1079221	1159013	34913	33312	7174	0	33782
202	1628	862410	132953	117233	5583	1202	0	29539
203	1645	866490	143887	24784	6700	1443	0	29539
204	1653	657531	1074092	15332	0	0	0	41206
205	1657	4346374	919657	26826	546210	135756	0	41206
206	1659	995468	585218	43711	67740	14589	0	29539
207	1666	907857	269209	147540	24193	5210	0	29539
208	1667	1399229	2647128	64847	304273	65531	0	26827
209	1706	4709136	1663426	31878	0	0	0	41206
210	1716	959060	448973	40183	48944	10541	0	29539
211	1718	454719	22358	2988	0	0	13359	29539
212	1740	705738	1196835	52162	722068	155510	0	26827

OPTION=IVA

OBS	PLANT NUMBER	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS	ANNUAL MONITORING COSTS
213	1742	917560	450175	162930	44664	9619	0	29539
214	1743	865893	142260	27463	6532	1407	0	26827
215	1744	846923	96240	24296	2419	521	0	29539
216	1748	2257611	7860591	98815	660655	142284	0	29539
217	1751	348201	59691	15291	1303	281	222650	26827
218	1764	902665	391860	13570	28473	6132	0	33782
219	1773	497222	94743	9988	0	0	0	26827
220	1788	654096	683418	42283	0	0	0	29539
221	1793	845319	91646	111472	19354	4168	0	29539
222	1797	0	0	0	0	0	0	29539
223	1801	782792	42739	3270	5397	1162	0	29539
224	1805	803024	1392036	42397	0	0	0	26827
225	1808	0	0	0	0	0	155855	26827
226	1812	0	0	0	0	0	89060	33782
227	1826	948595	412789	14493	37220	8016	0	29539
228	1832	497222	93363	19675	0	0	0	33782
229	1833	1033269	920173	20488	100494	21643	0	29539
230	1838	454719	10410	8460	0	0	129137	29539
231	1843	0	0	0	0	0	44530	26827
232	1848	43397	25019	289	0	0	396317	29539
233	1853	6038074	2307948	131180	748004	185910	0	41206
234	1861	375681	57177	3426	40384	8697	0	29539
235	1876	906833	265958	11731	23635	5090	0	29539
236	1887	0	0	0	0	0	178120	29539
237	1888	0	0	0	0	0	71248	29539
238	1891	1209391	3723375	17135	0	0	0	26827
239	1894	888403	208119	33638	16005	3447	0	29539
240	1899	1009381	823503	39683	89328	19238	0	26827
241	1904	5762116	5139145	129238	273759	97227	0	41206
242	1924	459292	43282	2798	0	0	0	29539
243	1931	840396	166304	126388	8188	1764	0	26827
244	1936	471124	452466	29913	24379	5250	0	29539
245	1945	454324	17894	8460	0	0	0	26827
246	1948	455222	39756	4957	0	0	0	26827
247	1970	454324	12406	2124	0	0	0	26827
248	1971	884987	322401	9032	9491	2044	0	29539
249	1974	77072	184798	22641	0	0	0	29539
250	1988	0	0	0	0	0	178120	26827
251	1993	524963	180342	11194	0	0	111325	26827
252	2001	454324	15971	3600	0	0	0	26827
253	2004	482849	89871	37565	0	0	0	29539
254	2007	867148	145777	30024	8188	1764	0	26827
255	2018	875984	2428793	14540	297760	64128	0	26827
256	2022	0	0	0	0	0	31171	26827
257	2033	0	0	0	0	0	84607	33782
258	2037	852932	203585	130943	4094	882	0	33782
259	2050	0	0	0	0	0	222650	26827
260	2057	458694	41989	7208	0	0	0	33782
261	2070	1723136	3956729	82990	446640	96192	0	29539
262	2075	793256	85650	10493	36922	7952	0	29539
263	2080	328468	32940	3087	66996	14429	0	29539
264	2084	672941	768592	176150	0	0	0	33782
265	2093	1359587	2371343	66069	232625	50100	0	29539

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OPTION=IVA

OBS	PLANT NUMBER	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS	ANNUAL MONITORING COSTS
266	2108	0	0	0	0	0	0	26827
267	2117	957992	621709	41548	65135	14028	0	29539
268	2123	340647	45736	1856	288455	62124	0	26827
269	2129	906833	265958	34268	23635	5090	0	29539
270	2147	0	0	0	0	0	178120	26827
271	2176	865511	253660	11236	21588	4649	0	29539
272	2177	742090	2351856	19326	0	0	0	41206
273	2184	597938	301975	11801	0	0	0	29539
274	2191	28340	47088	6238	0	0	0	29539
275	2214	0	0	0	0	0	138043	29539
276	2232	1739682	4394874	54459	26054	5611	0	29539
277	2241	2070962	6543198	378140	660655	142284	0	29539
278	2243	1853773	4666559	30222	524802	113026	0	29539
279	2250	834772	148897	15766	2419	521	0	33782
280	2253	0	0	0	0	0	222650	26827
281	2259	831844	143654	30195	9305	2004	0	26827
282	2261	1070061	1084381	18223	120593	25972	0	29539
283	2262	0	0	0	0	0	44530	29539
284	2288	481334	53729	21544	0	0	111325	29539
285	2293	505143	118636	118865	0	0	0	26827
286	2300	1809652	4769981	28561	649489	139879	0	26827
287	2311	842570	174476	128838	13827	2978	0	26827
288	2318	855411	211538	11518	4280	922	0	33782
289	2341	2060275	3236493	75702	277289	59719	0	33782
290	2346	577963	113686	7760	286771	101849	0	41206
291	2348	428959	295226	26522	29032	6252	0	29539
292	2350	835348	154041	10850	10422	2244	0	26827
293	2359	469102	29148	13550	0	0	0	26827
294	2402	0	0	0	0	0	35624	29539
295	2411	402421	65201	11567	710902	153106	0	29539
296	2426	0	0	0	0	0	0	29539
297	2432	121867	341512	26581	0	0	0	29539
298	2436	703983	148658	26272	437085	155233	0	29539
299	2442	800795	65770	15941	1563	337	0	29539
300	2459	848364	194630	131805	14888	3206	0	29539
301	2462	789713	101712	4355	120965	26052	0	33782
302	2465	905832	262616	9074	23262	5010	0	29539
303	2469	812326	90533	8663	2605	561	0	26827
304	2485	4833515	1575701	96403	452223	97394	0	41206
305	2487	1013815	842119	6622	91561	19719	0	33782
306	2495	1237188	1975716	56328	78162	16834	0	29539
307	2498	847329	187551	26795	9863	2124	0	26827
308	2501	847660	191980	11477	14814	3190	8906	26827
309	2507	454719	22017	5886	0	0	0	26827
310	2517	984568	723016	31535	54527	11743	0	26827
311	2521	0	0	0	0	0	142496	26827
312	2524	844707	178154	9662	3350	721	0	33782
313	2539	1000544	797822	43939	60669	13066	0	26827
314	2548	986198	550491	31485	62902	13547	0	29539
315	2565	1371922	2510087	63700	288455	62124	0	26827
316	2571	0	0	0	0	0	222650	29539
317	2578	0	0	0	0	0	0	29539
318	2581	0	0	0	0	0	4453	26827

PSES COST DATA -- BY OPTION

OPTION=IVA

OBS	PLANT NUMBER	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS	ANNUAL MONITORING COSTS
319	2608	0	0	0	0	0	89060	33782
320	2609	328468	32496	988	59347	12782	0	29539
321	2634	84565	209379	8736	0	0	0	26827
322	2635	4929099	971202	51988	139575	30060	0	29539
323	2636	782792	44626	9033	2978	641	0	29539
324	2641	704302	918580	16056	0	0	0	29539
325	2642	0	0	0	0	0	28499	26827
326	2646	1182468	1594754	36993	3722	802	0	29539
327	2647	0	0	0	0	0	0	29539
328	2666	497222	92632	7100	0	0	0	33782
329	2677	1073587	886151	13250	109799	23647	0	29539
330	2679	328468	36211	4277	120034	25852	0	29539
331	2685	505281	143156	6960	0	0	0	29539
332	2699	39243	73800	6260	0	0	0	29539
333	2714	799190	62707	22864	1303	281	0	29539
334	2736	939874	958181	20251	0	0	0	29539
335	2741	938894	540782	39874	55458	11944	0	26827
336	2748	972677	2207430	12918	0	0	0	29539
337	2756	4907104	1616385	113738	535083	132991	0	41206
338	2776	12079413	7845356	205575	523103	185783	0	41206
339	2779	485880	96366	8849	0	0	0	29539
340	2793	681796	750424	15245	0	0	0	26827
341	2794	4171026	838656	76755	0	0	0	41206
342	2796	510827	2248541	16518	0	0	0	26827
343	2805	0	0	0	0	0	0	29539
344	2810	0	0	0	0	0	218197	26827
345	2814	0	0	0	0	0	89060	33782
346	4001	866969	257380	29084	22016	4741	0	33782
347	4003	1067237	1071940	51416	119104	25651	0	29539
348	4006	890603	214819	52555	16935	3647	0	29539
349	4007	724556	974076	24257	0	0	0	29539
350	4008	990448	570567	183211	55830	12024	0	29539
351	4009	0	0	0	0	0	89060	29539
352	4014	343868	51290	5046	1210	261	0	29539
353	4022	39243	73800	18285	0	0	0	29539
354	4023	738562	2282384	6771	0	0	0	41206
355	4024	346732	56758	5229	1117	240	178120	26827
356	4026	976865	515627	41905	58063	12505	0	29539
357	4027	1036330	746265	46561	76673	16513	0	29539
358	4032	847908	98283	25860	2233	481	0	29539
359	4042	454763	29640	7992	0	0	0	26827
360	4043	328468	34584	2744	93794	20200	0	29539
361	4044	1266139	1720825	16331	191869	41322	0	29539
362	4046	0	0	0	0	0	44530	33782
363	4047	442486	219374	6589	16749	3607	0	29539
364	4048	0	0	0	0	0	24046	26827
365	4050	817593	103209	6194	3536	762	0	26827
366	4052	0	0	0	0	0	133590	26827
367	4057	832967	144486	28484	6588	1419	0	26827
368	4064	0	0	0	0	0	22265	29539
369	4066	0	0	0	0	0	93513	29539
370	4070	822096	114532	9109	1563	337	0	33782
371	4072	864481	138536	9542	7258	1563	0	29539

PSES COST DATA -- BY OPTION

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OBS	PLANT NUMBER	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS	ANNUAL MONITORING COSTS
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OPTION		295963650	240435489	10632111	20891825	4817591	9911488	11082936

OPTION=IVB

OBS	PLANT NUMBER	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS	ANNUAL MONITORING COSTS
372	2	328468	31298	451	3722	802	0	29539
373	5	454351	32339	7848	0	0	0	26827
374	10	821645	73389	12244	3461	745	0	26827
375	22	1091340	736108	11512	52666	11343	0	26827
376	30	527873	211506	3608	0	0	0	29539
377	33	2350087	950037	68628	139575	30060	0	41206
378	49	649607	155106	77656	0	0	0	26827
379	51	1208479	966409	57374	116126	25010	0	29539
380	52	834084	76216	9316	4224	910	0	29539
381	58	34492	31778	1342	0	0	0	26827
382	71	0	0	0	0	0	222650	33782
383	72	108989	107576	21252	0	0	0	29539
384	79	507323	46421	51643	0	0	0	33782
385	88	0	0	0	0	0	89060	26827
386	93	100445	33479	1532	0	0	0	29539
387	94	869915	157819	134731	7444	1603	0	26827
388	110	885032	140060	21406	3722	802	0	29539
389	111	0	0	0	0	0	44530	26827
390	119	489412	42647	18979	0	0	0	26827
391	120	830819	76378	4422	9305	2004	0	29539
392	122	529030	54909	54795	0	0	0	29539
393	143	860681	99621	4788	3722	802	0	29539
394	149	937793	228003	35249	14330	3086	0	29539
395	158	0	0	0	0	0	89060	26827
396	161	845849	185652	16526	298690	64328	0	29539
397	162	0	0	0	0	0	133590	29539
398	163	932438	217701	34467	11166	2405	0	29539
399	166	97912	254896	14951	0	0	0	29539
400	196	1440592	1769928	69861	227414	48978	0	29539
401	199	486518	1327726	16130	0	0	0	26827
402	203	486243	42240	49516	0	0	0	26827
403	206	529234	47464	13519	0	0	0	26827
404	209	0	0	0	0	0	0	29539
405	212	33247	31778	949	0	0	356240	33782
406	214	1066945	305263	9581	182378	39278	0	29539
407	220	496397	43653	50293	0	0	0	33782
408	221	1067727	149166	6213	133061	28657	0	33782
409	232	489168	103636	7899	0	0	0	29539
410	240	3280353	1536781	82113	213084	45892	0	41206
411	244	0	0	0	0	0	0	29539
412	249	858441	86674	6528	30148	6493	0	26827
413	257	963374	1571485	57301	74440	16032	0	29539
414	262	875020	128018	119323	2419	521	0	29539
415	266	812520	73405	6681	2419	521	0	26827

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-- OPTION=IVB --

OBS	PLANT NUMBER	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS	ANNUAL MONITORING COSTS
416	276	655540	1052470	15244	0	0	0	41206
417	283	1929490	153681	68756	0	0	0	29539
418	285	0	0	0	0	0	8906	26827
419	292	939307	132131	21204	64018	13788	0	29539
420	293	694026	180783	7103	0	0	0	29539
421	297	353746	65280	6748	76301	16433	22265	26827
422	299	340166	45542	1843	284733	61322	0	29539
423	302	554638	69876	4754	0	0	0	29539
424	310	538978	60478	7994	0	0	0	26827
425	321	485542	42188	49485	0	0	0	33782
426	326	956023	264941	31986	19354	4168	0	29539
427	334	826589	73371	4548	1675	361	0	33782
428	348	0	0	0	0	0	0	26827
429	354	1115023	815892	44723	84303	18156	0	26827
430	357	0	0	0	0	0	89060	29539
431	417	91684	33044	23250	0	0	0	26827
432	423	901018	436183	8888	55830	12026	0	29539
433	428	0	0	0	0	0	222650	26827
434	430	4211794	812682	159159	748510	186036	0	41206
435	433	1038550	464177	15350	46525	10020	0	29539
436	438	579776	87484	3957	0	0	0	26827
437	449	0	0	0	0	0	0	26827
438	451	0	0	0	0	0	44530	26827
439	458	2952934	1705805	477159	0	0	0	51259
440	468	869474	104593	4984	16377	3527	0	33782
441	492	36508	31778	2669	0	0	102419	29539
442	494	320686	44996	5493	0	0	0	33782
443	508	0	0	0	0	0	89060	29539
444	522	1263725	1154582	60262	120965	26052	0	29539
445	529	454324	11526	2736	0	0	0	26827
446	543	519222	50557	4648	0	0	0	26827
447	544	0	0	0	0	0	22265	26827
448	567	829723	100934	7207	1861	401	0	26827
449	592	540727	61166	9730	0	0	0	33782
450	605	0	0	0	0	0	164761	26827
451	607	418470	258962	19007	29032	6252	0	29539
452	618	0	0	0	0	0	222650	29539
453	626	3540705	1389209	122363	263145	56673	0	41206
454	658	954556	101069	17102	50433	10862	0	33782
455	661	872335	125116	6488	1787	385	0	29539
456	667	0	0	0	0	0	13359	29539
457	702	45804	31778	1315	0	0	0	29539
458	706	496443	44631	10364	0	0	0	26827
459	717	254220	41701	6073	0	0	0	26827
460	720	460286	45359	3062	0	0	0	29539
461	722	1445400	4788154	31161	472694	101803	0	41206
462	726	486243	42240	10194	0	0	0	26827
463	743	871982	161376	7481	7816	1683	0	29539
464	749	866867	81254	5116	26426	5691	0	26827
465	768	866787	119504	26809	1489	321	0	29539
466	771	614579	589223	39346	61599	13266	0	29539
467	777	0	0	0	0	0	44530	29539
468	791	494632	43391	8614	0	0	0	26827

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OPTION=IVB

OBS	PLANT NUMBER	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS	ANNUAL MONITORING COSTS
469	796	0	0	0	0	0	133590	26827
470	797	358393	82077	6596	4839	1042	0	29539
471	814	2680151	993629	41452	604877	150337	0	41206
472	830	23508	31778	5816	0	0	142496	33782
473	845	408855	226882	6529	20657	4449	0	29539
474	846	0	0	0	0	0	133590	26827
475	862	1183612	1045160	54707	111697	24056	0	26827
476	874	866397	335120	21295	478277	103006	0	26827
477	880	0	0	0	0	0	26718	29539
478	887	1042092	287019	7160	198755	42805	0	29539
479	905	511629	81770	10353	0	0	0	26827
480	912	0	0	0	0	0	129137	26827
481	917	328468	31351	2095	33498	7214	0	29539
482	929	479602	42073	49504	0	0	0	26827
483	931	0	0	0	0	0	218197	26827
484	932	0	0	0	0	0	4453	29539
485	944	26279	31778	3552	0	0	200385	33782
486	958	80319	32524	5284	0	0	0	29539
487	975	519617	51420	3304	0	0	0	33782
488	976	650748	156492	8019	0	0	0	26827
489	987	24200	31778	1216	0	0	400770	26827
490	988	0	0	0	0	0	178120	26827
491	992	529993	55186	4381	0	0	0	29539
492	997	820505	74182	12327	4652	1002	0	29539
493	1006	391300	110164	5551	3722	802	0	26827
494	1011	333002	42241	6053	223320	48096	0	29539
495	1018	963115	147770	7505	88584	19078	0	29539
496	1026	0	0	0	0	0	222650	29539
497	1047	667320	136480	18046	0	0	0	33782
498	1052	887916	88677	3880	45408	9780	0	26827
499	1053	825086	83813	1236	6588	1419	0	33782
500	1057	23024	31778	840	0	0	89060	33782
501	1064	0	0	0	0	0	66795	29539
502	1069	422716	70934	4781	850477	183166	0	29539
503	1076	0	0	0	0	0	62342	26827
504	1083	822046	73405	9029	3536	762	0	26827
505	1085	28933	31778	3532	0	0	267180	33782
506	1086	605207	108521	68634	0	0	0	26827
507	1091	1271690	1175067	37349	145158	31262	0	29539
508	1094	420856	1073598	46526	0	0	0	29539
509	1107	457746	39842	2167	0	0	8906	26827
510	1117	478747	44829	1690	0	0	0	26827
511	1126	1264676	2361477	53330	0	0	0	29539
512	1162	475122	126133	8948	0	0	0	26827
513	1163	923546	110346	11796	9863	2124	0	29539
514	1172	787371	91247	8989	101797	21924	0	26827
515	1173	23024	31778	15232	0	0	223986	33782
516	1175	0	0	0	0	0	178120	26827
517	1181	557347	469806	35748	46711	10060	0	29539
518	1188	792566	84182	7428	26054	5611	0	29539
519	1191	839997	78013	3581	14516	3126	0	29539
520	1194	486918	42078	11555	0	0	51210	33782
521	1195	35088	31778	1767	0	0	0	26827

PSES COST DATA -- BY OPTION

OPTION=IVB

OBS	PLANT NUMBER	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS	ANNUAL MONITORING COSTS
522	1197	823495	73441	9078	3908	842	0	26827
523	1202	527681	56387	13475	0	0	0	26827
524	1219	1189322	4806328	73744	0	0	0	26827
525	1220	489991	43565	3083	0	0	0	33782
526	1223	366311	63076	1924	4839	1042	0	29539
527	1224	612461	1856909	14010	0	0	0	26827
528	1234	516853	49629	9096	0	0	0	33782
529	1236	964872	104914	17649	57133	12305	0	33782
530	1237	508835	46872	51844	0	0	0	29539
531	1249	952502	111293	18253	24565	5291	0	33782
532	1253	454324	15794	8460	0	0	0	29539
533	1255	454719	27484	2124	0	0	0	29539
534	1264	875020	128018	27826	2419	521	0	29539
535	1277	951038	88756	6286	24193	5210	0	29539
536	1310	1464100	13051604	20425	148880	32064	0	41206
537	1313	21995	31778	944	0	0	115778	33782
538	1314	22649	31778	1216	0	0	0	26827
539	1320	454324	10583	2988	0	0	48983	26827
540	1322	851032	93852	14255	23262	5010	0	26827
541	1326	530181	43045	3403	0	0	0	33782
542	1351	915379	186395	12173	7816	1683	0	29539
543	1352	21995	31778	3552	0	0	115778	33782
544	1356	890811	147828	29662	3908	842	0	29539
545	1357	492562	42073	8574	0	0	0	33782
546	1361	1222672	1012223	19958	122454	26373	0	29539
547	1371	0	0	0	0	0	222650	26827
548	1386	0	0	0	0	0	44530	26827
549	1426	551261	111915	18729	174190	37515	0	29539
550	1432	873254	91591	16410	65879	14188	0	26827
551	1433	0	0	0	0	0	14250	29539
552	1437	687049	154945	4255	0	0	0	29539
553	1450	21995	31778	6968	0	0	115778	26827
554	1478	873120	125953	10326	2233	481	0	29539
555	1504	858461	90722	5052	29776	6413	0	26827
556	1507	719480	207735	16527	0	0	0	33782
557	1528	483733	42085	11524	0	0	0	26827
558	1534	509230	42080	4139	0	0	0	26827
559	1535	0	0	0	0	0	8906	26827
560	1539	1037816	219900	27074	253468	54589	0	29539
561	1548	0	0	0	0	0	75701	29539
562	1556	454479	34298	2736	0	0	0	29539
563	1560	875020	128018	24566	2419	521	0	29539
564	1562	795401	95553	3438	136970	29499	0	29539
565	1564	0	0	0	0	0	75701	29539
566	1566	0	0	0	0	0	44530	29539
567	1575	21995	31778	3552	0	0	262727	26827
568	1595	547788	65016	6605	0	0	0	29539
569	1601	47664	25803	2420	0	0	0	29539
570	1608	995874	354775	14049	31451	6774	0	29539
571	1621	784293	69261	11491	93050	20040	0	29539
572	1622	925380	91209	12936	33312	7174	0	33782
573	1628	902244	164731	133070	5583	1202	0	29539
574	1645	869137	100146	11877	6700	1443	0	29539

PSES COST DATA -- BY OPTION

OPTION=IVB

OBS	PLANT NUMBER	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS	ANNUAL MONITORING COSTS
575	1653	657531	1074092	15332	0	0	0	41206
576	1657	2124901	295903	25893	546210	135756	0	41206
577	1659	488007	521563	32462	67740	14589	0	29539
578	1666	408385	225344	105779	24193	5210	0	29539
579	1667	1059836	251394	27147	304273	65531	0	26827
580	1706	2337627	984420	30730	0	0	0	41206
581	1716	455843	394172	29601	48944	10541	0	29539
582	1718	74324	32282	1784	0	0	0	29539
583	1740	547859	101476	20347	722068	155510	0	26827
584	1742	871947	94278	67586	44664	9619	0	29539
585	1743	868747	100066	13178	6532	1407	0	26827
586	1744	875020	128018	27826	2419	521	0	29539
587	1748	2257611	7860591	98815	660655	142284	0	29539
588	1751	356042	63076	3823	1303	281	222650	26827
589	1764	865878	91874	5602	28473	6132	0	33782
590	1773	498944	44184	4409	0	0	0	26827
591	1788	566688	61373	15066	0	0	0	29539
592	1793	871403	123424	126704	19354	4168	0	29539
593	1797	0	0	0	0	0	0	29539
594	1801	782792	42739	3270	5397	1162	0	29539
595	1805	619821	122359	14725	0	0	0	26827
596	1808	0	0	0	0	0	155855	26827
597	1812	0	0	0	0	0	89060	33782
598	1826	1030952	445401	16388	37220	8016	0	29539
599	1832	498549	42804	8685	0	0	0	33782
600	1833	920530	128879	8370	100494	21643	0	29539
601	1838	454719	10410	8460	0	0	129137	29539
602	1843	0	0	0	0	0	44530	26827
603	1848	43397	25019	289	0	0	592249	29539
604	1853	3325536	1503725	129308	748004	185910	0	41206
605	1861	375681	57177	3426	40384	8697	0	29539
606	1876	971267	297915	13245	23635	5090	0	29539
607	1887	0	0	0	0	0	178120	29539
608	1888	0	0	0	0	0	71248	29539
609	1891	734548	290010	5986	0	0	0	26827
610	1894	943792	239910	38005	16005	3447	0	29539
611	1899	904492	118983	16206	89328	19238	0	26827
612	1904	4333388	2425659	158900	273759	97227	0	41206
613	1924	459292	43282	2798	0	0	0	29539
614	1931	836186	74603	55729	8188	1764	0	26827
615	1936	540640	484576	34513	24379	5250	0	29539
616	1945	454324	17894	8460	0	0	0	26827
617	1948	455222	39756	4957	0	0	0	26827
618	1970	454324	12406	2124	0	0	0	26827
619	1971	858066	84780	3676	9491	2044	0	29539
620	1974	63491	31933	4391	0	0	0	29539
621	1988	0	0	0	0	0	178120	26827
622	1993	514350	49141	4586	0	0	111325	26827
623	2001	454324	15971	3600	0	0	0	26827
624	2004	606246	50452	68167	0	0	0	29539
625	2007	910129	177555	34013	8188	1764	0	26827
626	2018	1077706	2467752	17236	297760	64128	0	26827
627	2022	0	0	0	0	0	31171	26827

PSES COST DATA -- BY OPTION

OPTION=IVB

OBS	PLANT NUMBER	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS	ANNUAL MONITORING COSTS
628	2033	0	0	0	0	0	84607	33782
629	2037	842954	73942	55342	4094	882	0	33782
630	2050	0	0	0	0	0	222650	26827
631	2057	525695	62236	11176	0	0	0	33782
632	2070	1921510	3997863	95106	446640	96192	0	29539
633	2075	793256	85650	10493	36922	7952	0	29539
634	2080	328468	32940	3087	66996	14429	0	29539
635	2084	573334	64072	62118	0	0	0	33782
636	2093	1097853	545712	29225	232625	50100	0	29539
637	2108	0	0	0	0	0	0	26827
638	2117	887300	105463	17081	65135	14028	0	29539
639	2123	340647	45736	1856	288455	62124	0	26827
640	2129	407442	222266	24552	23635	5090	0	29539
641	2147	0	0	0	0	0	178120	26827
642	2176	849055	82411	4833	21588	4649	0	29539
643	2177	742090	2351856	19326	0	0	0	41206
644	2184	572988	79324	5006	0	0	0	29539
645	2191	34492	31778	1342	0	0	0	29539
646	2214	0	0	0	0	0	138043	29539
647	2232	1050903	396647	18899	26054	5611	0	26827
648	2241	1216450	525848	164920	660655	142284	0	29539
649	2243	2115976	4708666	34691	524802	113026	0	29539
650	2250	832954	73405	6914	2419	521	0	33782
651	2253	0	0	0	0	0	222650	26827
652	2259	879871	175432	34327	9305	2004	0	26827
653	2261	1204983	1119702	20906	120593	25972	0	29539
654	2262	0	0	0	0	0	44530	29539
655	2288	487507	42354	10208	0	0	111325	29539
656	2293	503406	46420	51142	0	0	0	26827
657	2300	1169155	514664	12732	649489	139879	0	26827
658	2311	847853	76545	58753	13827	2978	0	26827
659	2318	844231	74120	4847	4280	922	0	33782
660	2341	1162583	335800	29891	277289	59719	0	33782
661	2346	577963	113686	7760	286771	101849	0	41206
662	2348	503474	327515	31481	29032	6252	0	29539
663	2350	885453	185819	12332	10422	2244	0	26827
664	2359	477348	42073	7020	0	0	0	26827
665	2402	0	0	0	0	0	35624	29539
666	2411	402421	65201	11567	710902	153106	0	29539
667	2426	0	0	0	0	0	0	29539
668	2432	121867	341512	26581	0	0	0	29539
669	2436	703983	148658	26272	437085	155233	0	29539
670	2442	826482	97548	18381	1563	337	0	29539
671	2459	840551	79082	57941	14888	3206	0	29539
672	2462	789713	101712	4355	120965	26052	0	33782
673	2465	969797	294561	10245	23262	5010	0	29539
674	2469	818275	73371	4140	2605	561	0	26827
675	2485	2579322	939894	92929	452223	97394	0	41206
676	2487	1133643	876619	7580	91561	19719	0	33782
677	2495	985375	222026	21924	78162	16834	0	29539
678	2498	839997	75155	11671	9863	2124	0	26827
679	2501	839991	77377	5048	14814	3190	8906	26827
680	2507	73357	32245	3489	0	0	0	26827

OPTION=IVB

OBS	PLANT NUMBER	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS	ANNUAL MONITORING COSTS
681	2517	896224	92285	12528	54527	11743	0	26827
682	2521	0	0	0	0	0	142496	26827
683	2524	838576	73672	4146	3350	721	0	33782
684	2539	1118786	832152	50420	60669	13066	0	26827
685	2548	1081565	583715	35583	62902	13547	0	29539
686	2565	1570748	2548891	73710	288455	62124	0	26827
687	2571	0	0	0	0	0	222650	29539
688	2578	0	0	0	0	0	0	29539
689	2581	0	0	0	0	0	4453	26827
690	2608	0	0	0	0	0	89060	33782
691	2609	328468	32496	988	59347	12782	0	29539
692	2634	151717	241414	10425	0	0	0	26827
693	2635	2287933	193123	50626	139575	30060	0	29539
694	2636	782792	44626	9033	2978	641	0	29539
695	2641	586342	92574	5671	0	0	0	29539
696	2642	0	0	0	0	0	28499	26827
697	2646	976295	164794	13110	3722	802	0	29539
698	2647	0	0	0	0	0	0	29539
699	2666	498549	42073	3134	0	0	0	33782
700	2677	913257	123267	5026	109799	23647	0	29539
701	2679	328468	36211	4277	120034	25852	0	29539
702	2685	505281	143156	6960	0	0	0	29539
703	2699	39243	73800	6260	0	0	0	29539
704	2714	807387	73371	11885	1303	281	0	29539
705	2736	661868	170538	6998	0	0	0	29539
706	2741	879977	100137	16397	55458	11944	0	26827
707	2748	677059	135373	4376	0	0	0	29539
708	2756	6440246	1742933	182506	535083	132991	0	41206
709	2776	927294	207907	33901	10105	2177	0	29540
710	2779	485880	96366	8849	0	0	0	29539
711	2793	579023	118246	5590	0	0	0	26827
712	2794	4171026	838656	76755	0	0	0	41206
713	2796	196476	38678	3501	0	0	0	26827
714	2805	0	0	0	0	0	0	29539
715	2810	0	0	0	0	0	218197	26827
716	2814	0	0	0	0	0	89060	33782
717	4001	933745	289403	33061	22016	4741	0	33782
718	4003	932857	135969	20975	119104	25651	0	29539
719	4006	947133	246622	59369	16935	3647	0	29539
720	4007	590595	95992	8541	0	0	0	29539
721	4008	931076	127010	82363	55830	12024	0	29539
722	4009	0	0	0	0	0	89060	29539
723	4014	352094	63076	1328	1210	261	0	29539
724	4022	42119	31778	3747	0	0	0	29539
725	4023	738562	2282384	6771	0	0	0	41206
726	4024	354747	63076	1323	1117	240	178120	26827
727	4026	1069128	548699	47349	58063	12505	0	29539
728	4027	951763	140146	21028	76673	16513	0	29539
729	4032	876841	130061	29599	2233	481	0	29539
730	4042	88716	32902	5308	0	0	0	26827
731	4043	328468	34584	2744	93794	20200	0	29539
732	4044	1431624	1757823	18590	191869	41322	0	29539
733	4046	0	0	0	0	0	44530	33782

PSES COST DATA -- BY OPTION

OPTION=IVB

OBS	PLANT NUMBER	TOTAL CAPITAL COSTS	TOTAL O&M COSTS	TOTAL LAND COSTS	CAPITAL SLUDGE COSTS	O & M SLUDGE COSTS	CONTRACT HAULING COSTS	ANNUAL MONITORING COSTS
734	4047	432268	88173	1892	16749	3607	0	29539
735	4048	0	0	0	0	0	24046	26827
736	4050	822046	73405	2899	3536	762	0	26827
737	4052	0	0	0	0	0	133590	26827
738	4057	831886	74078	12759	6588	1419	0	26827
739	4064	0	0	0	0	0	22265	29539
740	4066	0	0	0	0	0	93513	29539
741	4070	825086	73371	4146	1563	337	0	33782
742	4072	204416	74951	4316	7258	1563	0	29539
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OPTION		240426863	119673805	7347380	20349609	4627692	10094061	11068558
		=========	=========	========	========	=======	========	========
		536390513	360109294	17979491	41241434	9445283	20005549	22151494

PLANT #	TECNOLOGY COSTED BPT OPTION I				
1		2SB			
12			BU	CAC	
15					
33	AS				
61		2SB			
63					
76				CAC	
83			BU	CAC	
87	AS				
101					CH
102					
105				CAC	
112					CH
114				CAC	
154					
155	AS				
159	AS				
177		2SB			
180					CH
183			BU	CAC	
190					
205					
225	AS				
227		2SB			
250		2SB			
254					
259	AS				
260					
267					
269		2SB			
284			BU		
294	AS				
296		2SB			
301					
352			BU	CAC	
384					
387					
392					
394					
399			BU	CAC	
412	AS				
415			BU	CAC	
443					
444				CAC	

PLANT #	TECNOLOGY COSTED BPT OPTION I					
446	AS					
447	AS					
451	AS					
481		2SB				
485						
486			BU	CAC		
488						
500		2SB				
502	AS					
518			BU			
523			BU	CAC		
525						
536	AS					
569	AS					
580			BU	CAC		
601	AS					
602		2SB				
608			BU	CAC		
611						
614	AS					
633			BU	CAC		
657						
659			BU	CAC		
662			BU			
663.1					CTPP	
663.2				CAC		
664						
669	AS					
682				CAC		
683						
695				CAC		
709						CH
727	AS					
741		2SB				
758			BU	CAC		
775	AS					
802						
811						
814				CAC		
819	AS					
825		2SB				
844					CTPP	
851			BU	CAC		
859	AS					

PLANT #	TECNOLOGY COSTED BPT OPTION I					
866						
871			BU	CAC		
876	AS					
877						
883			BU			
888		2SB				
908		2SB				
909				CAC		
913				CAC		
938	AS					
942	AS					
948						
956						CH
962	AS					
970				CAC		
973						
984			BU	CAC		
990						
991						CH
992	AS					
1012			BU	CAC		
1020					CTPP	
1033						CH
1038						
1059			BU			
1061						
1062			BU	CAC		
1067		2SB				
1133						
1137			BU	CAC		
1139			BU			
1148			BU	CAC		
1149				CAC		
1157			BU		CTPP	
1203					CTPP	
1241						
1249				CAC		
1267			BU			
1299						
1319		2SB				
1323		2SB				
1327	AS					
1340						
1343				CAC		

PLANT #	TECNOLOGY COSTED BPT OPTION I					
1348						
1349					CTPP	
1389	AS					
1407						
1409						
1414			BU	CAC		
1438			BU	CAC	CTPP	
1439	AS					
1446				CAC		
1464			BU	CAC		
1494		2SB				
1520						
1522			BU			
1524		2SB				
1532	AS					
1569				CAC		
1572			BU	CAC		
1593	AS					
1609		2SB				
1616		2SB				
1617		2SB				
1618						
1624		2SB				
1643				CAC		
1647		2SB				
1650				CAC		
1656		2SB				
1670						CH
1684			BU		CTPP	
1688	AS					
1695						
1698		2SB				
1714				CAC		
1717			BU	CAC		
1724						
1753			BU	CAC		
1766		2SB				
1769					CTPP	
1774						
1776	AS					
1785				CAC		
1794	AS					
1802		2SB				
1839	AS					

PLANT #	TECNOLOGY COSTED BPT OPTION I				
1869					
1877					
1881		2SB			
1890.1			BU	CAC	
1890.2			BU	CAC	
1905					
1910					
1911.1			BU	CAC	
1911.2			BU	CAC	
1928	AS				
1937					
1943			BU		
1973					
1977			BU	CAC	
1986	AS				
2009		2SB			
2020			BU	CAC	
2026			BU	CAC	
2030				CAC	
2047	AS				
2049				CAC	
2055	AS				
2062	AS				
2073					CTPP
2090	AS				
2110		2SB			
2148					
2181				CAC	
2193		2SB			
2198		2SB			
2206	AS				
2221					
2222					
2227		2SB			
2228		2SB			
2236		2SB			
2242					
2254		2SB			
2268	AS				
2272			BU	CAC	
2281					
2292					
2296				CAC	
2307		2SB			

PLANT #	TECNOLOGY COSTED BPT OPTION I					
2313		2SB				
2315					CTPP	
2316						
2322						
2328.1					CTPP	
2328.2				CAC		
2345	AS					
2353		2SB				
2360						
2364				CAC		
2365			BU	CAC		
2368		2SB				
2376			BU			
2390		2SB				
2394		2SB				
2399			BU	CAC		
2400	AS					
2419	AS					
2429						
2430						
2445			BU	CAC		
2447						
2450						
2461			BU	CAC		
2471.1						
2471.2						
2474		2SB				
2481						
2527	AS					
2528	AS					
2531	AS					
2533	AS					
2536						
2537		2SB				
2541		2SB				
2551						
2556				CAC		
2573	AS					
2590						
2592			BU	CAC		
2606						CH
2626						
2631						
2633		2SB				

PLANT #	TECNOLOGY COSTED BPT OPTION I			
2647	AS			
2660				
2668	AS			
2673		2SB		
2678		2SB		
2680	AS			
2692				
2693		2SB		
2695				
2701			BU	CAC
2711	AS			
2735				
2739		2SB		
2763				
2764				CAC
2767				
2770	AS			
2771	AS			
2781				
2786	AS			
2795				CAC
2816				
2818		2SB		
3033		2SB		
4002		2SB		
4010	AS			
4017				
4018				
4021			BU	
4037				
4040		2SB		
4051			BU	CAC
4055				

NOTES:

AS- ACTIVATED SLUDGE
2SB- SECONDARY STAGE BIOLOGICAL
BU- BIOLOGICAL UPGRADES
CAC- CHEMICALLY ASSISTED CLARIFICATION
CTPP- CHEMICAL TREATMENT OF POLISHING PONDS
CH- CONTRACT HAULING

PLANT #	TECNOLOGY COSTED BAT OPTION IIB					
1						
12		SS		CN	BP	
15	CP	SS	AC	CN	BP	
33						
61	CP	SS		CN	BP	
63						
76	CP	SS	AC	CN	BP	
83	CP					
87		SS			BP	
101						CH
102						
105	CP		AC	CN	BP	
112						CH
114	CP	SS			BP	
154	CP					
155	CP	SS		CN	BP	
159						
177	CP	SS			BP	
180						CH
183		SS			BP	
190			AC	CN	BP	
205	CP		AC		BP	
225	CP			CN	BP	
227		SS				
250	CP					
254	CP					
259						
260	CP	SS		CN	BP	
267	CP	SS		CN	BP	
269					BP	
284	CP				BP	
294						
296	CP				BP	
301	CP	SS	AC	CN	BP	
352	CP				BP	
384	CP	SS			BP	
387	CP					
392		SS				
394		SS				
399						
412		SS			BP	
415	CP	SS			BP	
443	CP	SS	AC	CN		
444					BP	

PLANT #	TECNOLOGY COSTED BAT OPTION IIB					
446	CP	SS			BP	
447	CP	SS		CN	BP	
451						CH
481		SS		CN		
485		SS	AC	CN	BP	
486	CP	SS		CN	BP	
488	CP	SS	AC	CN	BP	
500	CP					
502						CH
518	CP	SS	AC	CN	BP	
523				CN		
525						
536	CP	SS	AC	CN	BP	
569						
580					BP	
602						CH
608		SS				
611	CP	SS	AC	CN	BP	
614	CP					
633	CP	SS			BP	
657	CP				BP	
659		SS				
662	CP	SS			BP	
663	CP	SS				
664	CP	SS				
669						CH
682	CP					
683	CP	SS			BP	
695					BP	
709						CH
727	CP					
741						
758						
775		SS				
802	CP					
811						
814	CP	SS		CN	BP	
819	CP	SS	AC	CN	BP	
825	CP	SS				
844						
851		SS		CN	BP	
859						
866						
871		SS				

PLANT #	TECNOLOGY COSTED BAT OPTION IIB					
876		SS				
877	CP	SS	AC	CN	BP	
883						
888						
908	CP					
909	CP	SS			BP	
913	CP				BP	
938				CN		
942						
948	CP	SS			BP	
956						CH
962	CP	SS				
970	CP					
973	CP			CN	BP	
984	CP					
990	CP					
991						CH
992		SS				
1012	CP					
1020	CP					
1033						CH
1038	CP				BP	
1059						
1061	CP			CN		
1062						
1067	CP				BP	
1133					BP	
1137	CP				BP	
1139		SS			BP	
1148	CP					
1149		SS				
1157						CH
1203	CP					
1241	CP				BP	
1249	CP	SS		CN	BP	
1267						
1299						
1319						
1323		SS		CN	BP	
1327	CP	SS		CN	BP	
1340	CP	SS			BP	
1343	CP	SS	AC			
1348						
1349			AC			

PLANT #	TECNOLOGY COSTED BAT OPTION IIB					
1389	CP					
1407	CP	SS				
1409	CP	SS			BP	
1414		SS				
1438	CP					
1439	CP	SS				
1446			AC			
1464		SS				
1494	CP	SS	AC			
1520	CP	SS	AC	CN	BP	
1522		SS				
1524	CP					
1532	CP				BP	
1569	CP	SS			BP	
1572						
1593						
1609	CP	SS				
1616	CP					
1617		SS				
1618		SS			BP	
1624	CP	SS				
1643						
1647	CP	SS				
1650	CP	SS		CN	BP	
1656						
1670						CH
1684					BP	CH
1688	CP					
1695	CP	SS			BP	
1698		SS				
1714	CP	SS				
1717	CP					
1724	CP	SS	AC		BP	
1753	CP					
1766	CP					
1769		SS	AC			
1774	CP					
1785	CP				BP	
1802	CP					
1839	CP	SS				
1869		SS				
1877	CP	SS	AC	CN	BP	
1881	CP					
1890	CP			CN	BP	

PLANT #	TECNOLOGY COSTED BAT OPTION IIB					
1905	CP				BP	
1910	CP		AC	CN	BP	
1911	CP				BP	
1928	CP	SS			BP	
1937	CP	SS	AC	CN	BP	
1943						
1973	CP					
1977						
1986						
2009		SS			BP	
2020						
2026		SS				
2030		SS	AC	CN	BP	
2047	CP					
2049	CP			CN		
2055						
2062	CP	SS				
2073	CP	SS			BP	
2090				CN		
2110	CP				BP	
2148	CP			CN		
2181						
2193						CH
2198	CP					
2206		SS			BP	
2221	CP	SS				
2222	CP					
2227	CP	SS				
2228	CP	SS				
2236	CP				BP	
2242	CP	SS				
2254	CP				BP	
2268	CP	SS	AC			
2272	CP	SS			BP	
2281	CP		AC		BP	
2292		SS	AC	CN	BP	
2296						
2307						
2313						
2315	CP			CN		
2316	CP	SS	AC	CN	BP	
2322	CP	SS	AC	CN	BP	
2328						
2345	CP					

PLANT #	TECNOLOGY COSTED BAT OPTION IIB					
2353						
2360	CP					
2364	CP					
2365		SS			BP	
2368	CP					
2376		SS				
2390						
2394	CP	SS				
2399						
2400						
2419	CP					
2429		SS	AC	CN	BP	
2430	CP	SS			BP	
2445	CP					
2447						
2450	CP	SS				
2461	CP				BP	
2471						
2474		SS		CN	BP	
2481	CP	SS				
2527	CP			CN		
2528	CP	SS			BP	
2531		SS				
2533	CP					
2536						
2537	CP					
2541	CP	SS	AC	CN		
2551						
2556						
2573	CP	SS		CN	BP	
2590	CP	SS			BP	
2592	CP					
2606						CH
2626						
2631	CP	SS			BP	
2633	CP					
2660			AC			CH
2668						
2673	CP	SS			BP	
2678	CP					
2680	CP	SS	AC			
2692						
2693						
2695	CP	SS				

PLANT #	TECNOLOGY COSTED BAT OPTION IIB				
2701		SS			
2711		SS			
2735	CP	SS			BP
2739				CN	
2763	CP				
2764	CP				
2767	CP				BP
2770	CP	SS			
2771		SS			
2781	CP	SS	AC	CN	BP
2786	CP				BP
2795	CP	SS			
2816	CP				BP
2818					BP
3033					BP
4002					
4010					
4017					
4018	CP	SS	AC	CN	BP
4021	CP			CN	BP
4037	CP	SS	AC	CN	BP
4040		SS		CN	BP
4051	CP				
4055			AC		BP

NOTES:

CP- CHEMICAL PRECIPITATION
SS- STEAM STRIPPING
AC- ACTIVATED CARBON
CN- CYANIDE DESTRUCTION
BP- BIOLOGICAL PACKAGE
CH- CONTRACT HAULING

PLANT #	TECNOLOGY COSTED PSES OPTION IVB					
2	CP					
5		SS				
10	CP	SS			BP	
22	CP	SS	AC		BP	
30		SS				
33	CP		AC		BP	
49		SS			BP	
51	CP	SS	AC	CN	BP	
52	CP	SS			BP	
58					BP	
71						CH
72			AC	CN	BP	
79		SS			BP	
88						CH
93					BP	
94	CP	SS	AC		BP	
110	CP	SS	AC	CN	BP	
111						CH
119		SS			BP	
120	CP	SS			BP	
122		SS			BP	
143	CP	SS		CN	BP	
149	CP	SS	AC	CN	BP	
158						CH
161	CP	SS	AC	CN	BP	
162						CH
163	CP	SS	AC	CN	BP	
166			AC			
196	CP	SS	AC	CN	BP	
199			AC		BP	
203		SS			BP	
206		SS			BP	
209						
212					BP	CH
214	CP	SS			BP	
220		SS			BP	
221	CP	SS			BP	
232		SS				
240	CP	SS			BP	
244						
249	CP	SS			BP	
257	CP		AC		BP	
262	CP	SS	AC	CN	BP	
266	CP	SS			BP	

PLANT #	TECNOLOGY COSTED PSES OPTION IVB					
276		SS				
283					BP	
285						CH
292	CP	SS		CN	BP	
293		SS	AC	CN	BP	
297	CP				BP	CH
299	CP					
302		SS			BP	
310		SS			BP	
321		SS			BP	CH
326	CP	SS	AC	CN	BP	
334	CP	SS			BP	
348						
354	CP	SS	AC		BP	
357						CH
417					BP	
423	CP	SS				
428						CH
430	CP	SS		CN	BP	
433	CP	SS	AC	CN	BP	
438		SS			BP	
449						
451						CH
458		SS		CN	BP	
468	CP	SS		CN	BP	
492					BP	CH
494					BP	
508						CH
522	CP	SS	AC	CN	BP	
529		SS				
543		SS			BP	
544						CH
567	CP	SS	AC		BP	
592		SS			BP	
605						CH
607	CP	SS	AC	CN	BP	
618						CH
624	CP	SS			BP	
658	CP	SS			BP	
661	CP	SS	AC	CN	BP	
667						CH
702					BP	
706		SS			BP	
717					BP	

PLANT #	TECNOLOGY COSTED PSES OPTION IVB					
720		SS				
722	CP	SS		CN	BP	
724		SS			BP	
743	CP	SS	AC		BP	
749	CP	SS			BP	
768	CP	SS	AC	CN	BP	
771	CP		AC		BP	
777						CH
791		SS			BP	
796						CH
797	CP	SS	AC	CN	BP	
814	CP	SS		CN	BP	
830					BP	CH
845	CP		AC			
846						CH
862	CP	SS	AC		BP	
874	CP	SS				
880						CH
887	CP	SS			BP	
905		SS	AC		BP	
912						CH
917	CP					
929		SS			BP	
931						CH
932						CH
944					BP	CH
958					BP	
975		SS			BP	
976		SS			BP	
987					BP	CH
988						CH
992		SS			BP	
997	CP	SS			BP	
1006	CP		AC		BP	
1011	CP					
1018	CP	SS		CN	BP	
1026						CH
1047		SS			BP	
1052	CP	SS			BP	
1053	CP	SS			BP	
1057					BP	CH
1064						CH
1069	CP					
1076						CH

PLANT #	TECNOLOGY COSTED PSES OPTION IVB					
1083	CP	SS			BP	
1085					BP	CH
1086		SS			BP	
1091	CP	SS	AC	CN	BP	
1094			AC		BP	
1107		SS				CH
1117		SS			BP	
1126		SS	AC	CN	BP	
1162		SS				
1163	CP	SS		CN	BP	
1172	CP	SS			BP	
1173					BP	CH
1175						CH
1181	CP		AC		BP	
1188	CP	SS				
1191	CP	SS	AC	CN	BP	
1194		SS			BP	CH
1195					BP	
1197	CP	SS			BP	
1202		SS			BP	
1219			AC		BP	
1220		SS			BP	
1223	CP				BP	
1224			AC		BP	
1234		SS			BP	
1236	CP	SS			BP	
1237		SS			BP	
1249	CP	SS		CN	BP	
1253		SS				
1255		SS				
1264	CP	SS	AC	CN	BP	
1277	CP	SS			BP	
1310	CP	SS			BP	
1313					BP	CH
1314					BP	
1320		SS			BP	CH
1322	CP	SS			BP	
1326		SS			BP	
1351	CP	SS	AC	CN	BP	
1352					BP	CH
1356	CP	SS	AC	CN	BP	
1357		SS			BP	
1361	CP	SS	AC	CN	BP	
1371						CH

PLANT #	TECNOLOGY COSTED PSES OPTION IVB					
1386						CH
1426	CP			CN	BP	
1432	CP	SS			BP	
1433						CH
1437		SS		CN	BP	
1450					BP	CH
1478	CP	SS	AC	CN	BP	
1504	CP	SS			BP	
1507		SS			BP	
1528		SS			BP	
1534		SS			BP	
1535						CH
1539	CP	SS			BP	
1548						CH
1556		SS				
1560	CP	SS	AC	CN	BP	
1562	CP	SS				
1564						CH
1566						CH
1575					BP	CH
1595		SS			BP	
1601				CN		
1608	CP	SS	AC	CN	BP	
1621	CP	SS				
1622	CP	SS			BP	
1628	CP	SS	AC	CN	BP	
1645	CP	SS		CN	BP	
1653		SS				
1657	CP			CN	BP	
1659	CP	SS	AC	CN	BP	
1666	CP	SS	AC	CN	BP	
1667	CP	SS			BP	
1706		SS			BP	
1716	CP	SS	AC	CN	BP	
1718					BP	CH
1740	CP				BP	
1742	CP	SS			BP	
1743	CP	SS		CN	BP	
1744	CP	SS	AC	CN	BP	
1748	CP	SS	AC			
1751	CP				BP	CH
1764	CP	SS			BP	
1773		SS			BP	
1788		SS			BP	

PLANT #	TECNOLOGY COSTED PSES OPTION IVB					
1793	CP	SS	AC	CN	BP	
1797						
1801	CP	SS				
1805		SS			BP	
1808						CH
1812						CH
1826	CP	SS	AC	CN	BP	
1832		SS			BP	
1833	CP	SS			BP	
1838		SS			BP	CH
1843						CH
1848				CN		CH
1853	CP	SS		CN	BP	
1861	CP			CN		
1876	CP	SS	AC	CN	BP	
1887						CH
1888						CH
1891		SS			BP	
1894	CP	SS	AC	CN	BP	
1899	CP	SS			BP	
1904	CP	SS			BP	
1924		SS				
1931	CP	SS			BP	
1936	CP		AC		BP	
1945		SS				
1948		SS				
1970		SS				
1971	CP	SS			BP	
1974					BP	
1988						CH
1993		SS			BP	CH
2001		SS				
2004		SS			BP	
2007	CP	SS	AC	CN	BP	
2018	CP		AC		BP	
2022						CH
2033						CH
2037	CP	SS			BP	
2050						CH
2057		SS			BP	
2070	CP	SS	AC	CN	BP	
2075	CP	SS				
2080	CP					
2084		SS			BP	

PLANT #	TECNOLOGY COSTED PSES OPTION IVB					
2093	CP	SS			BP	
2108						
2117	CP	SS			BP	
2123	CP					
2129	CP	SS	AC	CN	BP	
2147						CH
2176	CP	SS			BP	
2177		SS				
2184		SS		CN	BP	
2191					BP	
2214						CH
2232	CP	SS		CN	BP	
2241	CP	SS			BP	
2243	CP	SS	AC	CN	BP	
2250	CP	SS			BP	
2253						CH
2259	CP	SS	AC		BP	
2261	CP	SS	AC		BP	
2262						CH
2288		SS			BP	CH
2293		SS			BP	
2300	CP	SS			BP	
2311	CP	SS			BP	
2318	CP	SS			BP	
2341	CP	SS			BP	
2346	CP					
2348	CP		AC		BP	
2350	CP	SS	AC		BP	
2359		SS			BP	
2402						CH
2411	CP					
2426						
2432			AC			
2436	CP					
2442	CP	SS	AC		BP	
2459	CP	SS			BP	
2462	CP	SS				
2465	CP	SS	AC	CN	BP	
2469	CP	SS			BP	
2485	CP	SS			BP	
2487	CP	SS	AC		BP	
2495	CP	SS			BP	
2498	CP	SS			BP	
2501	CP	SS			BP	CH

PLANT #	TECNOLOGY COSTED PSES OPTION IVB					
2507					BP	
2517	CP	SS			BP	
2521						CH
2524	CP	SS			BP	
2539	CP	SS	AC		BP	
2548	CP	SS	AC	CN	BP	
2565	CP	SS	AC		BP	
2571						CH
2578						
2581						CH
2608						CH
2609	CP					
2634			AC		BP	
2635	CP				BP	
2636	CP	SS				
2641		SS			BP	
2642						CH
2646	CP	SS			BP	
2647						
2666		SS			BP	
2677	CP	SS	AC	CN	BP	
2679	CP					
2685		SS				
2699			AC			
2714	CP	SS			BP	
2736		SS			BP	
2741	CP	SS			BP	
2748		SS			BP	
2756	CP	SS	AC	CN	BP	
2776	CP	SS	AC	CN	BP	
2779		SS				
2793		SS			BP	
2794			AC			
2796					BP	
2805						
2810						CH
2814						CH
4001	CP	SS	AC		BP	
4003	CP	SS			BP	
4006	CP	SS	AC	CN	BP	
4007		SS			BP	
4008	CP	SS		CN	BP	
4009						CH
4014	CP				BP	

PLANT #	TECNOLOGY COSTED PSES OPTION IVB					
4022					BP	
4023		SS				
4024	CP				BP	CH
4026	CP	SS	AC	CN	BP	
4027	CP	SS		CN	BP	
4032	CP	SS	AC	CN	BP	
4042					BP	
4043	CP					
4044	CP	SS	AC	CN	BP	
4046						CH
4047	CP			CN	BP	
4048						CH
4050	CP	SS			BP	
4052						CH
4057	CP	SS			BP	
4064						CH
4066						CH
4070	CP	SS			BP	
4072	CP	SS	AC	CN	BP	

NOTES:

CP- CHEMICAL PRECIPITATION
SS- STEAM STRIPPING
AC- ACTIVATED CARBON
CN- CYANIDE DESTRUCTION
BP- BIOLOGICAL PACKAGE
CH- CONTRACT HAULING

APPENDIX VIII-C

BPT PLANT-BY-PLANT BOD_5 AND TSS LOADINGS

BPT LOADING REVISED(09/08/87)

PLANT	BOD CURRENT (LBS/YR)	TSS CURRENT (LBS/YR)	BOD OPTION 1 (LBS/YR)	TSS OPTION 1 (LBS/YR)	BOD OPTION 3 (LBS/YR)	TSS OPTION 3 (LBS/YR)
1	1155893	2896082	215936	368361	215936	133372
12	3728	5385	2175	3314	2175	1486
15	329	526	329	526	329	345
33	262693	208108	47762	64820	47762	22090
61	179109	45508	1401	2071	1401	874
63	127204	127204	127204	127204	127204	127204
76	42645	53611	29242	42645	29242	15779
83	46416	21987	17101	21987	17101	11970
87	820642	38868	30034	37101	30034	11440
101	2	2	1	1	1	1
102	15480	39806	15480	39806	15480	28638
105	60950	76623	41795	60950	41795	22552
112	120	41	12	21	12	21
114	11606	68859	11606	21664	11606	8395
154	14810	32313	14810	32313	14810	14608
155	91218	414893	33839	50023	33839	18023
159	97877	57722	4563	7301	4563	2875
177	309692	653795	51615	81110	51615	30969
180	589	227	12	14	12	14
183	39897	57150	22644	35584	22644	13587
190	5940	9504	5940	9504	5940	5405
205	9138	14621	9138	14621	9138	8316
225	61116	29285	14642	22282	14642	8022
227	1156386	302237	394223	302237	394223	170173
250	348166	630537	52088	84985	52088	31664
254	4983	31146	4983	29900	4983	11337
259	332631	208132	18057	28511	18057	10644
260	2120	848	2120	848	2120	848
267	91260	215114	91260	202076	91260	73008
269	6141	1937	841	1243	841	537
284	86996	53855	66283	53855	66283	53855
294	6285	13122	2316	3529	2316	1467
296	2635753	-1732764	256254	390482	256254	162294
301	214748	343597	214748	343597	214748	165356
352	21287	19395	12299	17503	12299	6623
384	70066	190178	70066	190178	70066	112105
387	475449	713174	475449	713174	475449	356587
392	3003	4063	3003	4063	3003	1237
394	24509	51741	24509	51741	24509	28593
399	651372	1601289	434248	759934	434248	284975
412	4798	5757	2193	3838	2193	1631
415	809417	1133184	359741	575586	359741	195159
443	743	1412	743	1412	743	637
444	33702	56170	32297	47744	32297	16710
446	2386	3018	1123	1965	1123	860
447	15546074	15065770	19739	26318	19739	9672
451	130722	165324	61516	107653	61516	39024
481	1182	94	91	94	91	53
485	181394	290230	181394	290230	181394	143906

BPT LOADING REVISED(09/08/87)

PLANT	BOD CURRENT (LBS/YR)	TSS CURRENT (LBS/YR)	BOD OPTION 1 (LBS/YR)	TSS OPTION 1 (LBS/YR)	BOD OPTION 3 (LBS/YR)	TSS OPTION 3 (LBS/YR)
486	6985	9646	3825	5655	3825	2270
488	7767	12428	7767	12428	7767	7068
500	527625	850661	215357	344572	215357	131906
502	822	336	265	336	265	186
518	2559	1691	1873	1691	1873	656
523	23470	31123	12245	17858	12245	6964
525	29060	106552	29060	106552	29060	44074
536	689	22	356	22	356	22
569	33476	32998	9565	15303	9565	6361
580	96362	284805	64242	85656	64242	29979
601	9894	6951	1279	1706	1279	702
602	114246	43631	3155	4243	3155	1676
608	178512	236722	81495	128063	81495	47539
611	270	382	270	382	270	173
614	33073	23237	4277	5702	4277	2245
633	5730	8681	3473	5556	3473	2856
657	70181	74568	70181	74568	70181	44521
659	79959	132504	43407	68537	43407	24787
662	416946	301927	330681	301927	330681	166060
663	10107	67860	10107	39611	10107	15160
664	5864	8209	5864	8209	5864	8209
669	6482	4862	2315	3704	2315	1661
682	214334	734859	214334	520525	214334	155392
683	148405	148405	148405	148405	148405	148405
695	1165427	3030110	1165427	1864683	1165427	611849
709	83	90	21	31	21	31
727	767610	986927	182764	283285	182764	95951
741	331023	468949	79308	117237	79308	41033
758	56048	74324	29242	42645	29242	16205
775	91419	8992	34469	8992	34469	8992
802	42876	53596	42876	53596	42876	30014
811	36857	50260	31831	50260	31831	19937
814	245209	308262	168143	245209	168143	85823
819	665384	396135	92844	120698	92844	42244
825	99716	95184	16997	22663	16997	8329
844	12946	139815	12946	82853	12946	36248
851	249976	1341537	174983	274973	174983	99157
859	548293	10646627	73106	97474	73106	34116
866	3290	7566	3290	7566	3290	3915
871	161091	423440	73642	128873	73642	45106
876	112126	94684	28654	42359	28654	15698
877	7311	10357	7311	10357	7311	4051
883	8407	11350	6726	11350	6726	4708
888	171311	136586	28938	40513	28938	15395
908	35356	26684	14009	21347	14009	7705
909	96015	187458	91443	146309	91443	56009
913	45996	620942	45996	379464	45996	136837
938	87453	23851	22967	23851	22967	11749
942	48012	44631	13525	21639	13525	8757

BPT LOADING REVISED(09/08/87)

PLANT	BOD CURRENT (LBS/YR)	TSS CURRENT (LBS/YR)	BOD OPTION 1 (LBS/YR)	TSS OPTION 1 (LBS/YR)	BOD OPTION 3 (LBS/YR)	TSS OPTION 3 (LBS/YR)
948	625054	1718898	625054	1562634	625054	528691
956	17	21	8	14	8	14
962	1553	2285	1097	2193	1097	896
970	38167	175569	38167	91601	38167	33396
973	57114	91382	57114	91382	57114	47976
984	42688	65972	31046	54330	31046	20374
990	44400	58274	36075	58274	36075	26223
991	455	163	7	9	7	9
992	6092	4280	788	1050	788	404
1012	58363	107971	35018	70035	35018	25534
1020	3970	14225	3970	9262	3970	3705
1033	21	27	15	21	15	21
1038	35639	85534	35639	85534	35639	85534
1059	344084	322579	247311	322579	247311	124193
1061	127350	318375	127350	318375	127350	318375
1062	53367	135642	35578	62262	35578	23348
1067	41427	110268	14012	20713	14012	7889
1133	100886	100886	100886	100886	100886	56803
1137	83469	275811	65324	108873	65324	43186
1139	1162	1066	678	1066	678	463
1148	167930	208778	90773	145237	90773	54010
1149	163533	459450	163533	256980	163533	89943
1157	10357	15535	7006	10357	7006	4478
1203	13872	26973	12330	21578	12330	8631
1241	2426	3397	2426	3397	2426	3397
1249	8529	10722	5848	8529	5848	3412
1267	32210	32210	21474	32210	21474	14092
1299	825	1651	825	1651	825	1242
1319	6796	7882	1051	1401	1051	589
1323	18322	6230	2565	4031	2565	1881
1327	419931	297297	55743	72466	55743	31866
1340	38380	127935	38380	127935	38380	82838
1343	10040	45179	10040	36394	10040	13617
1348	390	585	390	585	390	384
1349	55487	107892	49322	86313	49322	32368
1389	68975	136034	30656	53647	30656	20118
1407	35395	16434	35395	16434	35395	16434
1409	50662	69661	50662	69661	50662	69661
1414	1742	2178	1106	1374	1106	493
1438	54592	60239	24472	47062	24472	17789
1439	206981	1002690	15763	23302	15763	8636
1446	44124	147080	44124	108839	44124	37064
1464	178926	271100	108440	173504	108440	72113
1494	423983	909511	164122	239345	164122	81377
1520	14347	22955	14347	22955	14347	12721
1522	1010685	519781	606411	519781	606411	313312
1524	86630	29608	8773	15352	8773	6141
1532	507628	443021	92296	147674	92296	59762
1569	11021	26939	11021	22654	11021	8572

BPT LOADING REVISED(09/08/87)

PLANT	BOD CURRENT (LBS/YR)	TSS CURRENT (LBS/YR)	BOD OPTION 1 (LBS/YR)	TSS OPTION 1 (LBS/YR)	BOD OPTION 3 (LBS/YR)	TSS OPTION 3 (LBS/YR)
1572	475644	665902	211397	327666	211397	107284
1593	98936	69511	12793	17058	12793	6567
1609	150476	141216	60190	85656	60190	29979
1616	86143	76761	13646	23881	13646	9552
1617	300061	346224	73861	129257	73861	46856
1618	1011	2781	1011	2781	1011	2781
1624	255294	27719	8039	10533	8039	3978
1643	64918	555408	57705	100983	57705	39131
1647	132681	629090	68628	91504	68628	32026
1650	899614	1489017	620424	992678	620424	325722
1656	13592	20598	3503	5044	3503	2011
1670	1	1	1	1	1	1
1684	5173	8430	4407	6514	4407	2414
1688	572686	185518	92759	137122	92759	46581
1695	119982	183501	119982	183501	119982	76577
1698	2693	1822	1624	1822	1624	582
1714	3412	20683	3412	5011	3412	1530
1717	6135	4036	2583	4036	2583	1978
1724	320	512	320	512	320	336
1753	540982	1754537	438634	584846	438634	189344
1766	196191	143007	18910	33093	18910	12823
1769	1178829	6247796	1178829	4243786	1178829	1320289
1774	80416	50260	80416	50260	80416	50260
1776	2230	3655	841	1243	841	537
1785	79959	100520	52545	77675	52545	27986
1794	143	141	40	62	40	29
1802	162965	322670	52149	91260	52149	33082
1839	25619	30743	11712	20495	11712	9479
1869	128301	28511	121173	28511	121173	28511
1877	17363	27780	17363	27780	17363	15395
1881	12378	6484	2554	4912	2554	1994
1890	193803	379359	94840	140198	94840	47626
1905	152	335	152	335	152	335
1910	29151	46641	29151	46641	29151	25167
1911	164488	835598	138170	210544	138170	78296
1928	9687	12062	4935	6945	4935	2815
1937	11482	18371	11482	18371	11482	10181
1963	46909	34116	38380	34116	38380	24627
1973	12611	63054	12611	63054	12611	42666
1977	528828	3055453	352552	587587	352552	205655
1986	1974	2973	390	682	390	281
2009	229796	403543	75664	106491	75664	37272
2020	2010	3533	1218	1949	1218	938
2026	162051	210666	109384	149897	109384	53882
2030	69831	87788	47884	69831	47884	25838
2047	20713	26196	9747	17058	9747	6610
2049	12184	25892	11423	15230	11423	6130
2055	15864	12276	1511	2644	1511	1025
2062	2601	2687	981	1450	981	657

BPT LOADING REVISED(09/08/87)

PLANT	BOD CURRENT (LBS/YR)	TSS CURRENT (LBS/YR)	BOD OPTION 1 (LBS/YR)	TSS OPTION 1 (LBS/YR)	BOD OPTION 3 (LBS/YR)	TSS OPTION 3 (LBS/YR)
2073	28493	189953	28493	132967	28493	48201
2090	273074	15840	8870	12038	8870	4546
2110	171603	205311	33708	50562	33708	19305
2148	26790	69655	26790	69655	26790	46883
2181	3485	30491	3485	24393	3485	9452
2193	460	161	52	88	52	43
2198	37040	42828	17363	23150	17363	8508
2206	4264	5117	1949	3412	1949	1365
2221	125742	167656	125742	167656	125742	96821
2222	37528	140728	37528	131347	37528	47613
2227	943520	2012844	465470	553532	465470	149705
2228	80767	11225	457	594	457	267
2236	14073	768	6141	768	6141	768
2242	155130	368434	155130	339348	155130	115378
2254	382270	485422	42474	64723	42474	25485
2268	10308	37796	3436	5011	3436	1804
2272	221784	347462	140463	229177	140463	82800
2281	777	1243	777	1243	777	779
2292	1553	2486	1553	2486	1553	1522
2296	29608	125011	26318	46057	26318	17271
2307	24714	18105	1101	1928	1101	843
2313	329999	2773886	37869	51393	37869	17988
2315	35913	167595	35913	95768	35913	33519
2316	137	219	137	219	137	150
2322	176824	282919	176824	282919	176824	140281
2328	19967	38883	19967	32578	19967	12506
2345	24490	14204	11266	14204	11266	6343
2353	98760	34451	4417	6184	4417	2473
2360	1621	4862	1621	4862	1621	4862
2364	38722	82975	38722	71912	38722	31945
2365	37759	86846	24543	33983	24543	13216
2368	163940	138992	71278	114045	71278	43658
2376	59462	70474	39642	66069	39642	23124
2390	19238	16200	9788	13163	9788	5079
2394	421738	258962	207169	258962	207169	95816
2399	357913	274146	175149	258916	175149	103947
2400	3779565	787409	20774	26805	20774	9616
2419	66417	22699	6726	11770	6726	4708
2429	685	1097	685	1097	685	704
2430	101861	114593	101861	114593	101861	114593
2445	542444	1288305	293824	406833	293824	130526
2447	338	68	338	68	338	68
2450	94428	264399	94428	264399	94428	264399
2461	193852	338114	112705	162295	112705	59959
2471	50748	74629	50748	74629	50748	36568
2474	357024	1027130	16478	25894	16478	9612
2481	42036	67257	42036	67257	42036	35310
2527	47519	67014	28024	41427	28024	13646
2528	495748	1118974	269120	439091	269120	153682

BPT LOADING REVISED(09/08/87)

PLANT	BOD CURRENT (LBS/YR)	TSS CURRENT (LBS/YR)	BOD OPTION 1 (LBS/YR)	TSS OPTION 1 (LBS/YR)	BOD OPTION 3 (LBS/YR)	TSS OPTION 3 (LBS/YR)
2531	437949	99378	28100	32212	28100	8875
2533	33690	29839	15401	26952	15401	10444
2536	18002	108014	18002	108014	18002	58807
2537	38984	13324	3948	6908	3948	2850
2541	107222	123975	50260	67014	50260	24627
2551	27543	22535	27543	22535	27543	22535
2556	10418	53184	10418	17545	10418	7292
2573	275962	121462	28179	37896	28179	13944
2590	7164	5821	7164	5821	7164	5821
2592	131344	364843	58375	116750	58375	40862
2606	2	2	1	1	1	1
2626	25203	39605	25203	39605	25203	19532
2631	466548	466548	445342	466548	445342	252360
2633	472890	639181	83146	150701	83146	52745
2647	242952	263628	155075	206767	155075	72369
2660	138901	196776	138901	196776	138901	66846
2668	532008	3323495	9065	15864	9065	6147
2673	42764	38953	12279	16513	12279	6224
2678	277915	337719	56287	98501	56287	38169
2680	16083	8712	7707	8712	7707	4456
2692	12184	70060	12184	70060	12184	31984
2693	166346	100581	46422	67699	46422	24372
2695	212540	136025	204038	136025	204038	98193
2701	42901	154750	30643	49030	30643	18769
2711	212127	159149	6676	8614	6676	3015
2735	53123	139449	53123	139449	53123	65076
2739	165463	109323	59094	91595	59094	33093
2763	23150	81025	23150	81025	23150	56718
2764	42645	137073	42645	88336	42645	33050
2767	5020	9726	5020	9726	5020	4722
2770	115141	13981	20561	13981	20561	11226
2771	254457	17978	38722	17978	38722	17978
2781	868	1389	868	1389	868	871
2786	378030	259895	94507	151212	94507	61194
2795	36906	78071	36906	56779	36906	19873
2816	199822	459591	199822	459591	199822	223801
2818	61317	355641	22297	35676	22297	14437
3033	128483	14201	16229	14201	16229	7810
4002	83669	63712	15352	24564	15352	9941
4010	83057	239640	31317	46294	31317	15726
4017	3442	17210	3442	17210	3442	9638
4018	2559	4094	2559	4094	2559	2448
4021	6230	7120	4747	7120	4747	3427
4037	1386	4435	1386	4435	1386	4435
4040	3564	4825	384	585	384	275
4051	9540	33568	5654	9894	5654	3957
4055	320	512	320	512	320	336
	========	========	========	========	========	========
	61488963	99587031	19758290	33319780	19758290	13602190

APPENDIX VIII-D

BAT AND PSES PLANT-BY-PLANT
TOXIC POLLUTANT WASTEWATER LOADINGS

SUMMATION FOR WATER LOADING -- PLANT BY PLANT
DIRECT DISCHARGERS (PART A ONLY)

OBS	PLANT NUMBER	CURRENT LOAD (LBS/YR)	RAW WASTE LOAD (LBS/YR)	BAT LOAD OPT I	BAT LOAD OPT II	BAT LOAD OPT III
1	15	70.8	18399	70.8	55.8	46.9
2	76	5051.9	1022155	3934.4	3101.2	2603.4
3	105	7279.4	1460711	5467.4	4367.9	3711.0
4	112	0.7	48	0.7	0.7	0.7
5	190	1278.7	332200	1278.7	1007.9	846.1
6	205	1967.2	511077	1967.2	1550.6	1301.7
7	301	46229.3	12010318	46229.3	36439.6	30590.2
8	306	.	.	.	.	.
9	408	289.0	547045	289.0	289.0	235.5
10	446	701.7	4422	133.0	127.9	124.8
11	451	3652.2	242237	3652.2	3652.2	3481.3
12	485	39049.0	10144886	39049.0	30779.8	25839.0
13	488	776.1	56924	776.1	688.4	653.0
14	511	628.3	1189227	628.3	628.3	512.0
15	518	28.6	8284	18.4	18.3	14.9
16	586	12.6	23785	12.6	12.6	10.2
17	611	7.2	2041	7.2	6.0	4.0
18	814	34376.5	5876511	21956.1	17532.7	14889.8
19	877	196.3	55323	196.3	163.9	108.0
20	956	0.5	31	0.5	0.5	0.4
21	973	12295.0	3194234	12295.0	9691.4	8135.7
22	1033	1.5	511	1.5	1.5	1.2
23	1167	2.5	4757	2.5	2.5	2.0
24	1249	680.6	74237	631.1	563.9	516.4
25	1285	.	.	.	.	.
26	1342	.	.	.	.	.
27	1348	59.7	20443	59.7	59.7	49.8
28	1520	3088.5	802391	3088.5	2434.5	2043.7
29	1524	1316.0	31882	802.9	802.9	800.4
30	1670	0.1	26	0.1	0.1	0.1
31	1724	68.9	17888	68.9	54.3	45.6
32	1785	8285.9	695794	5776.2	5146.1	4750.4
33	1877	3737.7	971047	3737.7	2946.2	2473.3
34	1910	6275.4	1630337	6275.4	4946.5	4152.5
35	1937	2471.8	642169	2471.8	1948.4	1635.6
36	2030	37344.7	1673545	5729.7	4470.0	3717.4
37	2047	1688.0	38001	1230.3	1186.2	1159.1
38	2193	2.9	192	2.9	2.9	2.8
39	2281	167.2	43442	167.2	131.8	110.6
40	2292	334.4	86883	334.4	263.6	221.3
41	2316	29.5	7666	29.5	23.3	19.5
42	2322	38065.4	9889347	38065.4	30004.5	25188.1
43	2419	1009.0	24443	615.6	615.6	613.7
44	2429	147.5	38331	147.5	116.3	97.6
45	2481	8870.3	2350956	8870.3	6954.0	5821.8
46	2537	1255.4	15060	438.5	438.5	437.4
47	2624	0.1	250	0.1	0.1	0.1
48	2660	3730.0	1051133	3730.0	3113.3	2051.3

SUMMATION FOR WATER LOADING -- PLANT BY PLANT
DIRECT DISCHARGERS (PART A ONLY)

OBS	PLANT NUMBER	CURRENT LOAD (LBS/YR)	RAW WASTE LOAD (LBS/YR)	BAT LOAD OPT I	BAT LOAD OPT II	BAT LOAD OPT III
49	2739	20523	898783	7100	6285	5810
50	2781	87	6362	87	77	73
51	4005	201	380553	201	201	164
52	4018	551	143102	551	434	364
53	4055	69	17888	69	54	46
54	4058	38	71354	38	38	31
		======	========	======	======	======
		293992	58328628	228285	183431	155508

SUMMATION FOR WATER LOADING -- PLANT BY PLANT
DIRECT DISCHARGERS (FULL RESPONSE)

OBS	PLANT NUMBER	CURRENT LOAD (LBS/YR)	RAW WASTE LOAD (LBS/YR)	BAT LOAD OPT I	BAT LOAD OPT II	BAT LOAD OPT III
1	1	481	4457	481	480.8	249.8
2	12	10	82683	9	9.0	8.0
3	33	2505	379937	2505	2504.7	1398.3
4	61	1160	86386	14	13.8	13.8
5	63	8520	4071186	8520	8519.9	8519.9
6	83	375	14642	119	118.6	110.0
7	87	272	84657	8	7.9	7.9
8	102	9	468	9	9.4	9.4
9	114	1340	1374	1340	1340.0	1324.1
10	154	2861	2924	2861	2860.6	2826.7
11	155	3390	382927	1258	937.8	857.1
12	159	11	2631	11	11.3	7.7
13	177	492	161404	98	97.6	96.9
14	180	0	2	0	0.0	0.0
15	183	147	43112	95	95.0	93.4
16	225	24	316037	6	6.3	6.3
17	250	2151	64319	99	98.9	70.7
18	254	41	765	41	40.9	40.9
19	259	133	33715	133	132.8	132.8
20	260	4	80150	4	4.1	4.0
21	267	995	542959	992	991.6	976.2
22	269	10	3197	2	2.2	2.2
23	284	9799	12405	9663	9663.2	9495.2
24	294	6287	6288	46	45.8	44.9
25	296	4376	16008439	1814	1814.4	1814.4
26	352	46	189957	34	33.8	33.8
27	373	5	1822	5	5.1	3.1
28	384	1766	683867	1766	1766.0	1738.5
29	387	134482	6994631	134468	24266.5	24266.5
30	392	8	213591	8	7.9	7.9
31	394	446	30199	446	446.5	446.5
32	399	541970	541996	14901	14900.9	14719.8
33	412	9	1352	5	5.3	5.3
34	415	76033	6078568	25344	14357.0	11353.7
35	443	11	9252	11	11.4	8.0
36	444	540	2918	483	482.6	482.6
37	447	1026	3192	2	1.7	1.7
38	481	0	0	0	0.0	0.0
39	486	42	18323	31	31.2	30.5
40	500	2731	1725797	1226	1226.1	1071.1
41	502	1	18	1	0.8	0.6
42	523	123	210897	81	80.5	80.5
43	525	576	7710	104	104.1	61.1
44	536	8	641	8	4.9	4.6
45	569	101	18309	101	100.7	69.3
46	580	386	10452	274	274.4	233.8
47	601	6	87	6	6.0	5.7
48	602	1	1	1	0.7	0.7

SUMMATION FOR WATER LOADING -- PLANT BY PLANT
DIRECT DISCHARGERS (FULL RESPONSE)

OBS	PLANT NUMBER	CURRENT LOAD (LBS/YR)	RAW WASTE LOAD (LBS/YR)	BAT LOAD OPT I	BAT LOAD OPT II	BAT LOAD OPT III
49	608	6994.8	158229	3345.32	1292.62	648.73
50	633	0.2	95	0.19	0.19	0.19
51	657	87.7	263	87.72	87.72	87.72
52	659	481.9	224825	219.06	219.06	219.06
53	662	2696.0	2103554	1673.36	1673.36	1652.70
54	663	39.9	3012	39.93	39.93	39.93
55	664	33.1	3600	33.06	33.06	33.06
56	669	79.4	79	6.46	6.46	6.46
57	682	650.6	207545	604.08	604.08	604.08
58	683	982.1	102024	982.07	982.07	966.81
59	695	7408.5	488350	5981.93	5981.93	5061.64
60	709	0.2	292	0.23	0.23	0.19
61	727	625.3	1101	111.66	111.66	111.66
62	741	74.8	43357	74.81	74.81	74.81
63	758	170.3	314919	170.28	170.28	119.77
64	775	36.3	39	13.09	13.09	13.09
65	802	139.8	118033	139.79	139.79	139.79
66	811	96.3	2706	96.32	96.32	63.02
67	819	8542.7	468870	1324.18	781.41	558.87
68	825	851.2	24127	183.78	183.78	176.71
69	844	130.8	18575	130.85	130.85	128.00
70	851	5670.1	103539	4403.77	4373.56	3736.54
71	859	23.4	523	23.37	23.37	23.37
72	866	12.8	3908	12.80	12.80	12.80
73	871	408.4	57095	140.03	140.03	140.03
74	876	557.9	50551	142.58	142.58	67.29
75	883	0.2	50	0.10	0.10	0.10
76	888	3.2	7	3.21	3.21	3.21
77	908	1815.8	38310	338.73	338.73	334.55
78	909	68034.7	68040	635.59	624.76	613.92
79	913	4280.0	2092956	4279.97	1829.20	1154.35
80	915	47.0	1802	46.97	46.97	29.06
81	938	597.2	10184	174.93	174.93	174.93
82	942	181.4	56740	47.87	47.87	47.87
83	948	5180.6	2147255	4985.87	4985.87	4061.30
84	962	5.2	399	3.67	3.67	3.67
85	970	96.4	79461	77.15	77.15	77.15
86	984	58.1	3628	39.66	58.10	36.89
87	990	1214.1	2749	1214.07	1209.94	1113.36
88	991	0.0	5	0.00	0.00	0.00
89	992	69.5	954	13.18	13.18	6.52
90	1012	2703.8	573299	1081.53	1081.53	1081.53
91	1020	11.1	33	11.10	11.10	11.10
92	1038	3772.8	3773	3583.55	3583.55	3583.55
93	1059	87.6	564	87.61	87.61	87.61
94	1061	231.2	32687	231.19	231.19	231.19
95	1062	162.6	186786	162.56	162.56	162.56
96	1067	9843.9	9844	291.96	291.96	288.24

SUMMATION FOR WATER LOADING -- PLANT BY PLANT
DIRECT DISCHARGERS (FULL RESPONSE)

OBS	PLANT NUMBER	CURRENT LOAD (LBS/YR)	RAW WASTE LOAD (LBS/YR)	BAT LOAD OPT I	BAT LOAD OPT II	BAT LOAD OPT III
97	1133	40	379859	40	39.5	39.5
98	1137	822	208985	751	750.6	724.0
99	1139	3	811	3	2.8	2.7
100	1148	129	1665	70	69.9	69.9
101	1149	1214	26267	1098	678.2	221.1
102	1157	3	720	3	2.7	2.4
103	1203	1	1	0	0.1	0.0
104	1241	17	51	17	17.1	17.1
105	1267	69	2651	69	69.1	42.8
106	1299	0	848	0	0.1	0.1
107	1319	12	12	1	1.3	1.3
108	1323	7	34492	2	1.1	1.0
109	1327	14	37920	4	2.4	2.1
110	1340	200	50714	200	200.0	195.1
111	1343	627	296026	627	626.6	598.1
112	1349	33	3305	33	33.0	29.3
113	1389	600	78264	250	250.1	250.1
114	1407	109	443	109	108.5	108.5
115	1409	458	195210	458	458.3	450.3
116	1414	1	6561	1	1.0	1.0
117	1438	386	624	133	133.2	133.2
118	1439	650	385527	54	53.8	34.7
119	1446	828	380402	583	583.2	180.3
120	1464	30	24045	26	26.1	26.1
121	1494	3563	861158	1207	1206.8	499.6
122	1522	0	0	0	0.0	0.0
123	1532	2543	117168	954	654.4	587.8
124	1569	949	1891	73	73.0	35.2
125	1572	6423	2316834	6423	6423.0	6423.0
126	1609	225	17216	94	93.5	67.3
127	1616	55	1059	10	9.7	9.7
128	1617	92	6923	20	19.9	19.9
129	1618	8	2049	8	8.0	8.0
130	1624	19	1688	1	0.7	0.7
131	1643	75	2895	75	75.5	46.7
132	1647	1598	4715	1526	1526.3	1453.6
133	1650	5902	345099	4249	4249.4	4249.4
134	1656	16	58	16	16.3	9.5
135	1684	3	226700	3	3.0	3.0
136	1688	10635	1512743	1498	1497.9	1497.9
137	1695	1295	336809	1295	1295.3	1274.1
138	1698	2	5307	1	0.9	0.9
139	1714	18	39195	18	8.2	4.5
140	1717	36	15672	21	21.0	21.0
141	1753	6353	607590	774	774.0	735.5
142	1766	72	3852	7	6.5	6.5
143	1769	109922	1346145	109922	94767.3	84815.7
144	1774	31233	2606334	31233	5472.9	5472.9

SUMMATION FOR WATER LOADING -- PLANT BY PLANT
DIRECT DISCHARGERS (FULL RESPONSE)

OBS	PLANT NUMBER	CURRENT LOAD (LBS/YR)	RAW WASTE LOAD (LBS/YR)	BAT LOAD OPT I	BAT LOAD OPT II	BAT LOAD OPT III
145	1794	0.2	281	0.2	0.2	0.2
146	1839	50.3	50	50.3	50.3	50.3
147	1869	938.4	194506	611.1	611.1	611.1
148	1881	33.8	6004	7.0	7.0	7.0
149	1890	803.6	846831	363.3	363.3	363.3
150	1911	3929.1	92287	3300.4	3300.4	3266.2
151	1928	0.3	46	0.3	0.3	0.2
152	1943	168.5	6431	168.5	168.5	110.3
153	1973	330.6	170013	330.6	330.6	330.6
154	1977	17704.2	43993	17704.2	17704.2	17593.5
155	1986	7.6	86	7.6	7.6	7.6
156	2009	210.1	892825	69.2	69.2	69.2
157	2020	0.2	20	0.2	0.2	0.2
158	2026	235.5	4407	164.9	96.7	34.1
159	2049	89.9	1061	89.9	69.3	63.6
160	2055	95.9	35066	95.9	95.9	95.9
161	2062	35.4	189095	25.0	8.3	5.1
162	2073	21499.6	21501	3716.9	3716.9	3716.9
163	2090	1062.8	992277	44.4	44.4	44.4
164	2110	76.2	9397	16.3	16.3	16.3
165	2148	580.2	306063	580.2	580.2	580.2
166	2181	104.9	15429	104.9	104.9	104.9
167	2206	20.6	1297	10.6	10.6	10.6
168	2221	1247.9	266248	1247.9	719.6	665.6
169	2222	856.6	716885	856.6	856.6	856.6
170	2227	2303.6	713042	230.2	209.3	209.3
171	2228	43.7	2510	0.5	0.5	0.5
172	2236	323.4	91482	182.3	182.3	182.3
173	2242	512.2	10575	512.2	512.2	512.2
174	2254	454.5	2398	57.7	57.7	45.6
175	2268	1505.5	717634	501.8	501.8	244.6
176	2272	3362.9	208079	2017.8	2017.8	1984.7
177	2296	112.9	3837	112.9	112.9	69.9
178	2307	6.2	2235	6.2	6.2	3.8
179	2313	432.5	102349	432.5	432.5	237.1
180	2315	282.8	106252	282.8	282.8	282.8
181	2328	27.6	1361	27.6	27.6	27.6
182	2345	153.0	211441	79.6	79.6	79.6
183	2353	8.9	478	8.9	8.9	5.6
184	2360	67.6	58814	67.6	67.6	67.6
185	2364	4.3	20	4.3	4.3	4.3
186	2365	3.8	73896	3.1	3.1	3.1
187	2368	43.1	457	20.6	20.6	20.6
188	2376	510.9	264836	264.9	264.9	206.1
189	2390	0.5	118	0.5	0.5	0.5
190	2394	965.8	21542	370.3	370.3	266.8
191	2399	2.6	1248	2.6	2.6	2.6
192	2400	1.4	4089	1.4	1.4	1.4

SUMMATION FOR WATER LOADING -- PLANT BY PLANT
DIRECT DISCHARGERS (FULL RESPONSE)

OBS	PLANT NUMBER	CURRENT LOAD (LBS/YR)	RAW WASTE LOAD (LBS/YR)	BAT LOAD OPT I	BAT LOAD OPT II	BAT LOAD OPT III
193	2430	2414.8	830000	2369.55	2369.55	2363.64
194	2445	21498.4	147779	2296.20	952.34	740.71
195	2447	6.3	14	6.33	6.33	6.33
196	2450	1373.1	126872	1373.05	1373.05	1339.56
197	2461	36030.2	36030	53.89	53.89	53.89
198	2471	87.4	105955	87.40	87.40	87.40
199	2474	3332.9	37038	161.15	161.15	146.50
200	2527	16920.6	64307	7809.50	7809.50	7809.50
201	2528	1886.7	171981	862.48	862.48	853.94
202	2531	223.1	175406	9.08	9.08	9.08
203	2536	441.6	507421	441.62	441.62	441.62
204	2541	1497.7	1255397	865.88	865.88	865.88
205	2551	1502.1	1951575	1502.06	1502.06	1152.61
206	2556	3.5	2220	3.46	3.46	3.46
207	2573	1067.5	24584	131.56	131.56	131.56
208	2590	2.6	4424	2.58	1.24	0.44
209	2592	1381.1	109529	371.49	371.49	371.49
210	2606	0.0	0	0.00	0.00	0.00
211	2626	107.1	2700	107.09	107.09	75.89
212	2631	6293.0	1589667	6268.73	5116.57	3383.81
213	2647	167.2	13288015	167.20	167.20	167.20
214	2668	30.7	349	30.70	30.70	30.70
215	2673	46.2	5299	41.23	41.23	41.23
216	2678	498.9	2825	101.03	101.03	101.03
217	2680	147.3	295060	85.90	85.90	42.22
218	2692	14.7	852	14.66	14.66	14.66
219	2693	28.9	29	10.69	10.69	10.69
220	2695	5250.3	854806	5250.28	3057.12	2488.53
221	2701	1952.0	1431692	1603.44	698.17	491.07
222	2711	21.4	79208	4.99	4.99	4.99
223	2735	263.8	2656	263.80	263.80	263.80
224	2763	0.0	0	0.00	0.00	0.00
225	2764	177.9	34588	177.91	177.91	177.91
226	2767	0.6	1	0.64	0.64	0.64
227	2770	1267.2	170004	271.54	271.54	271.54
228	2771	981.8	982	19.41	19.41	11.42
229	2786	4452.6	512879	1391.45	757.61	576.21
230	2795	965.6	226709	965.58	965.58	928.45
231	2816	805.3	31078	805.29	805.29	710.55
232	2818	120.8	1516	57.11	57.11	57.11
233	3033	635.4	386205	66.89	66.89	66.89
234	4002	226.8	101161	226.78	226.78	161.50
235	4010	20.7	1837	20.66	20.66	20.66
236	4017	44.5	1708	44.54	44.54	27.55
237	4021	160.7	323	145.41	145.41	145.41
238	4037	129.9	27958	129.94	129.94	129.94
239	4040	20.1	70961	4.22	2.18	1.93
240	4051	43.2	1151	10.57	10.57	10.57
		=======	========	======	======	======
		1303948	93517424	482031	306914	280752

SUMMATION FOR WATER LOADING -- PLANT BY PLANT
INDIRECT DISCHARGERS (PART A ONLY)

OBS	PLANT NUMBER	CURRENT LOAD (LBS/YR)	RAW WASTE LOAD (LBS/YR)	PSES LOAD OPT IV
1	10	.	.	.
2	22	132093	132093	418.94
3	51	338528	338528	2043.75
4	71	92	12875	92.20
5	72	14105	14105	85.15
6	85	.	.	.
7	110	10579	10579	63.87
8	149	48522	48522	292.94
9	161	144286	144286	1836.35
10	196	662950	662950	4002.35
11	206	49535	49535	157.10
12	212	.	.	.
13	221	224701	224701	1609.24
14	262	28211	28211	170.31
15	293	136764	136764	482.25
16	326	56421	56421	340.63
17	334	2937	2937	21.03
18	433	135411	135411	817.50
19	468	106519	106519	643.07
20	508	9	1411	8.51
21	544	0	3	0.09
22	605	2	611	1.94
23	607	11481	11481	187.67
24	618	4	705	4.26
25	658	350048	350048	1110.20
26	749	3187	3187	78.46
27	768	4232	4232	25.55
28	777	1	141	0.85
29	796	1	24	0.59
30	797	1913	1913	31.28
31	987	2378	2378	7.54
32	988	.	.	.
33	1026	4	705	4.26
34	1052	5498	5498	135.34
35	1057	353	353	2.53
36	1064	1	212	1.28
37	1083	438	438	10.79
38	1085	3301	3301	19.92
39	1091	1703	1703	55.72
40	1126	719371	719371	4342.97
41	1191	7846	7846	95.76
42	1197	34	34	1.11
43	1236	96559	96559	691.53
44	1264	7053	7053	42.58
45	1313	1651	1651	5.24
46	1352	402	402	2.88
47	1357	8173	8173	25.92
48	1361	276464	276464	1669.06

SUMMATION FOR WATER LOADING -- PLANT BY PLANT
INDIRECT DISCHARGERS (PART A ONLY)

OBS	PLANT NUMBER	CURRENT LOAD (LBS/YR)	RAW WASTE LOAD (LBS/YR)	PSES LOAD OPT IV
49	1386	1	165	0.52
50	1450	1651	1651	5.24
51	1478	6347	6347	38.32
52	1560	7053	7053	42.58
53	1575	80	80	1.96
54	1608	91685	91685	553.52
55	1622	131222	231164	615.29
56	1659	34442	34442	563.01
57	1664	2640	437265	2639.85
58	1666	9338	9338	152.64
59	1716	142464	142464	860.08
60	1744	7053	7053	42.58
61	1751	159	159	3.92
62	1793	5642	5642	34.06
63	1808	5	1486	4.71
64	1812	1	80	0.58
65	1843	0	1	0.02
66	1848	2821	2821	17.03
67	1876	69116	69116	417.27
68	1888	1	226	1.36
69	1894	46548	46548	281.02
70	1931	19979	19979	63.37
71	1988	.	.	.
72	2007	23979	23979	144.77
73	2033	25	1004	24.71
74	2037	6840	6840	48.98
75	2129	9376	9376	153.26
76	2153	0	0	0.00
77	2250	4208	4208	30.14
78	2253	.	.	.
79	2262	.	.	.
80	2311	1673	1673	41.19
81	2318	2920	29721	50.96
82	2446	12	1730	12.39
83	2465	18337	18337	110.70
84	2469	319	319	7.85
85	2497	.	.	.
86	2498	24768	24768	78.55
87	2505	0	3	0.10
88	2517	33273	33273	238.29
89	2524	5633	5633	40.34
90	2539	7330	7330	180.45
91	2548	767329	767329	4632.51
92	2642	0	106	0.33
93	2677	54004	54004	358.56
94	4006	49369	49369	298.05
95	4009	5	846	5.11
96	4024	2939	2939	9.32

SUMMATION FOR WATER LOADING -- PLANT BY PLANT
INDIRECT DISCHARGERS (PART A ONLY)

OBS	PLANT NUMBER	CURRENT LOAD (LBS/YR)	RAW WASTE LOAD (LBS/YR)	PSES LOAD OPT IV
97	4026	169264	169264	1021.9
98	4031	.	.	.
99	4048	0	89	0.3
100	4050	430	430	10.6
101	4052	2	495	1.6
102	4057	57	57	1.9
103	4064	0	71	0.4
104	4066	7	1128	6.8
105	4070	10898	10898	34.6
106	4072	4021	4021	49.9
		=======	=======	=======
		5369025	5954336	35573.9

SUMMATION FOR WATER LOADING -- PLANT BY PLANT
INDIRECT DISCHARGERS (FULL RESPONSE)

OBS	PLANT NUMBER	CURRENT LOAD (LBS/YR)	RAW WASTE LOAD (LBS/YR)	PSES LOAD OPT IV
1	5	199	199	3.38
2	30	62	62	2.18
3	49	506	506	24.35
4	52	63	63	1.35
5	58	304	304	17.70
6	79	3159	3159	4.76
7	88	0	55	0.12
8	93	16	22	1.09
9	94	4010	4010	6.56
10	111	0	167	0.03
11	119	3393	3393	0.35
12	120	1929	1929	21.12
13	122	496	496	0.17
14	143	1296	1296	1.37
15	158	0	4	0.01
16	162	0	12	0.09
17	163	1703	1703	81.20
18	166	7	7	0.60
19	199	449	449	28.55
20	203	151	151	1.73
21	209	0	51	0.02
22	214	29261	29261	123.21
23	220	2002	2002	1.30
24	232	44129	44129	192.77
25	240	355842	355842	661.76
26	244	1	331	0.89
27	249	4624	4624	7.14
28	257	1025928	1025928	30.67
29	266	25	25	6.62
30	276	253005	253005	1105.21
31	283	2598	2598	195.52
32	285	0	19	0.00
33	292	194	194	5.19
34	297	112	112	2.98
35	310	1706	1706	1.64
36	321	145	145	0.65
37	354	45307	45307	235.27
38	357	0	10	0.04
39	417	3737	3737	6.43
40	423	131655	131655	625.12
41	428	3	1869	3.43
42	430	1727732	1727732	3304.60
43	438	5393	5393	26.36
44	458	689649	689649	462.56
45	492	4458	4458	10.86
46	494	19042	19042	299.77
47	522	610	610	24.79
48	529	23	23	0.77

SUMMATION FOR WATER LOADING -- PLANT BY PLANT
INDIRECT DISCHARGERS (FULL RESPONSE)

OBS	PLANT NUMBER	CURRENT LOAD (LBS/YR)	RAW WASTE LOAD (LBS/YR)	PSES LOAD OPT IV
49	543	355768	355768	0.47
50	592	14757	14757	12.58
51	624	266174	266174	2704.09
52	661	3302	3302	2.01
53	667	0	0	0.00
54	702	13139	13139	8.61
55	706	4076	4076	0.55
56	717	2500	2500	73.24
57	720	17321	17321	75.66
58	722	67092	67092	5486.73
59	724	2453	2453	1.62
60	743	3089	3089	15.61
61	771	2799	2799	13.93
62	791	3300	3300	0.40
63	830	40	40	0.07
64	845	5	5	3.21
65	862	61759	61759	132.43
66	874	2565	2565	83.99
67	880	0	2	0.24
68	887	13665	13665	27.08
69	912	0	94	0.10
70	929	12	25	0.29
71	931	0	27	0.14
72	944	58	58	0.38
73	958	1	1	0.10
74	975	58590	58590	144.27
75	976	1429	1429	41.59
76	997	676	676	0.05
77	1006	182	182	0.27
78	1018	48	48	43.84
79	1047	42677	42677	41.54
80	1053	3973	3973	2.52
81	1069	4168977	4168977	4433.45
82	1076	0	9	0.15
83	1086	822	822	24.09
84	1094	3	3	1.59
85	1107	1150	1150	5.04
86	1117	621	621	0.40
87	1162	3459	3459	113.29
88	1163	1398	1398	25.70
89	1172	976896	976896	74.04
90	1173	150	150	0.23
91	1181	9265	9265	2.39
92	1188	31122	31122	173.27
93	1194	615	615	0.78
94	1195	24	24	0.04
95	1202	3564	3564	3.14
96	1219	1910	1910	732.03

SUMMATION FOR WATER LOADING -- PLANT BY PLANT
INDIRECT DISCHARGERS (FULL RESPONSE)

OBS	PLANT NUMBER	CURRENT LOAD (LBS/YR)	RAW WASTE LOAD (LBS/YR)	PSES LOAD OPT-IV
97	1220	653	653	1.50
98	1223	1323	1323	13.01
99	1224	159	159	10.22
100	1234	1296	1296	123.48
101	1237	439	439	2.14
102	1253	26	26	0.52
103	1255	220	220	32.15
104	1277	9805	9805	21.14
105	1310	2804	2804	113.86
106	1314	6	6	0.01
107	1320	815	815	0.21
108	1322	3956	3956	11.85
109	1326	1974	1974	8.39
110	1351	6992	6992	4.97
111	1356	176	176	4.42
112	1426	53	53	0.22
113	1432	422865	422865	107.65
114	1433	0	37	0.03
115	1437	96493	96493	40.68
116	1504	265127	265127	6.14
117	1507	51596	51596	42.16
118	1528	1033	1033	0.56
119	1534	18099	18099	58.23
120	1535	0	4	0.01
121	1539	9006	9006	58.23
122	1548	0	28	0.02
123	1556	266	266	1.01
124	1562	19774	19774	305.58
125	1564	0	186	0.49
126	1566	0	18	0.01
127	1595	16095	16095	28.28
128	1601	262681	262681	9.09
129	1621	8523	8523	186.16
130	1628	26106	26106	13.75
131	1645	127	127	3.54
132	1653	244684	244684	1068.86
133	1657	35414	35414	90.08
134	1667	193038	193038	16.48
135	1706	91113	91113	487.91
136	1718	209	209	0.55
137	1740	9202	9202	438.77
138	1748	325669	325669	1411.58
139	1764	73054	73054	6.75
140	1773	29690	29690	0.12
141	1788	2035	2035	9.28
142	1797	12	2616799	11.52
143	1801	29	29	0.95
144	1805	1102	1102	16.60

SUMMATION FOR WATER LOADING -- PLANT BY PLANT
INDIRECT DISCHARGERS (FULL RESPONSE)

OBS	PLANT NUMBER	CURRENT LOAD (LBS/YR)	RAW WASTE LOAD (LBS/YR)	PSES LOAD OPT IV
145	1826	99	99	3.46
146	1832	433	433	0.62
147	1833	149322	149322	3.96
148	1838	912	912	1.21
149	1853	90186	90186	247.01
150	1861	4652	4652	126.27
151	1891	1923	1923	141.54
152	1899	42272	42272	4.21
153	1904	43139	74036	1590.05
154	1924	3429	3429	14.98
155	1936	15	15	3.76
156	1945	74	74	1.32
157	1948	368	368	1.38
158	1970	28	28	0.11
159	1971	195	195	5.57
160	1974	134	134	2.21
161	1993	8046	8046	3.37
162	2001	49	49	1.33
163	2004	334	334	17.82
164	2018	19967	19967	30.05
165	2022	0	1	0.00
166	2050	0	814	0.32
167	2057	2055	2055	9.78
168	2070	81494	81494	852.71
169	2075	4148	4148	26.00
170	2084	9571	9571	14.61
171	2093	12395	12395	275.85
172	2108	2	2268059	2.49
173	2117	648	648	0.53
174	2147	0	0	0.00
175	2177	264269	264269	1154.41
176	2184	123351	123351	3.74
177	2191	276	276	0.85
178	2214	12	10112	11.86
179	2232	17172	17172	85.10
180	2241	173414	173414	126.80
181	2243	157030	157030	4682.75
182	2259	6905	6905	12.55
183	2261	55858	55858	1197.76
184	2288	14	14	0.10
185	2293	4225	4225	0.72
186	2300	37754	37754	1893.43
187	2341	3397	3397	565.03
188	2348	296	296	3.58
189	2350	5887	5887	14.54
190	2359	2	2	0.02
191	2432	10	10	0.82
192	2436	8217	8217	362.72

SUMMATION FOR WATER LOADING -- PLANT BY PLANT
INDIRECT DISCHARGERS (FULL RESPONSE)

OBS	PLANT NUMBER	CURRENT LOAD (LBS/YR)	RAW WASTE LOAD (LBS/YR)	PSES LOAD OPT IV
193	2442	156	156	3.8
194	2459	31270	31270	1.5
195	2462	616	616	20.2
196	2485	326315	326315	154.1
197	2487	16976	16976	95.5
198	2495	3170	3170	70.6
199	2501	730	730	0.5
200	2507	2097	2097	8.3
201	2521	0	3	0.1
202	2565	1514	1514	101.0
203	2571	2	2725	1.7
204	2578	0	26	0.0
205	2608	0	196	0.2
206	2609	13661	13661	65.7
207	2634	64	64	7.0
208	2635	19227	19227	283.5
209	2636	82	82	0.3
210	2641	2137	2137	19.5
211	2646	164852	164852	135.2
212	2666	20	316	0.9
213	2685	50003	50003	218.4
214	2699	2	2	0.1
215	2714	21	21	0.4
216	2736	1445	1445	104.1
217	2741	9156	9156	31.6
218	2745	35	6768	35.3
219	2748	61636	61636	56.9
220	2756	7171	7171	563.8
221	2776	1622	1622	31.0
222	2779	7198	7198	34.9
223	2793	27892	27892	10.0
224	2796	35595	35595	102.0
225	2810	0	316	0.0
226	4007	1009693	1009693	5.1
227	4008	606680	606680	291.7
228	4014	4	4	0.2
229	4022	1	1	0.4
230	4023	690579	690579	3016.7
231	4027	8098	8098	15.5
232	4042	3355	3355	5.0
233	4047	22369	22369	3.9
		========	========	=======
		17199515	22139400	45804.6

APPENDIX VIII-E

BAT AND PSES PLANT-BY-PLANT
AIR EMISSION LOADINGS

SUMMATION FOR AIR LOADING OF ALL INDIRECT DISCHARGERS--PART A
(PLANT BY PLANT)

OBS	PLANT	CURRENT LOADING (LBS/YR)	PSES OPTION IV LOADING
1	22	3175.3	43.9
2	51	28741.3	342.8
3	71	21.6	21.6
4	72	1197.3	14.5
5	110	897.9	10.7
6	149	4119.5	49.1
7	161	25334.4	180.3
8	196	56284.8	671.6
9	206	1190.7	16.5
10	221	25162.4	379.2
11	262	2395.3	28.2
12	293	34715.8	404.4
13	326	4790.2	57.6
14	334	329.0	4.8
15	433	11496.5	136.9
16	468	9043.6	108.3
17	508	1.4	1.4
18	544	0.0	0.0
19	605	0.0	0.0
20	607	98.1	6.1
21	618	0.7	0.7
22	658	8414.4	117.0
23	749	480.9	16.0
24	768	359.1	4.0
25	777	0.0	0.0
26	796	0.0	0.0
27	797	16.3	1.0
28	987	57.1	0.6
29	1026	0.7	0.7
30	1052	829.7	27.5
31	1057	39.2	0.6
32	1064	0.0	0.0
33	1083	66.2	2.2
34	1085	280.2	2.9
35	1091	1362.0	44.6
36	1126	61075.2	729.5
37	1191	981.0	10.7
38	1197	27.2	0.8
39	1236	10812.6	162.8
40	1264	599.0	7.2
41	1313	39.4	0.5
42	1352	45.0	0.6
43	1357	196.3	2.7
44	1361	23472.0	280.5
45	1386	0.0	0.0
46	1450	39.4	0.5
47	1478	538.9	7.1

SUMMATION FOR AIR LOADING OF ALL INDIRECT DISCHARGERS--PART A
(PLANT BY PLANT)

OBS	PLANT	CURRENT LOADING (LBS/YR)	PSES OPTION IV LOADING
48	1560	599.0	7.2
49	1575	12.0	0.3
50	1608	7784.1	93.0
51	1622	5556.6	77.2
52	1659	294.3	18.3
53	1664	443.3	443.3
54	1666	79.8	5.0
55	1716	12095.3	144.6
56	1744	599.0	7.2
57	1751	24.1	0.7
58	1793	479.1	5.8
59	1808	0.5	0.5
60	1812	0.0	0.0
61	1843	0.0	0.0
62	1848	239.4	2.6
63	1876	5868.0	70.5
64	1888	0.0	0.0
65	1894	3951.8	47.6
66	1931	480.2	6.6
67	2007	2035.9	24.3
68	2033	5.1	5.1
69	2037	765.9	11.5
70	2129	80.1	5.0
71	2153	0.0	0.0
72	2250	471.2	7.1
73	2311	252.6	8.3
74	2318	567.8	9.8
75	2446	3.0	3.0
76	2465	1557.2	18.3
77	2469	48.1	1.7
78	2498	595.4	8.2
79	2505	0.0	0.0
80	2517	3725.9	56.1
81	2524	630.9	9.7
82	2539	1106.3	36.7
83	2548	65146.9	777.6
84	2642	0.0	0.0
85	2677	6312.9	14.8
86	4006	4191.3	50.4
87	4009	0.8	0.8
88	4024	70.7	0.9
89	4026	14370.5	171.9
90	4048	0.0	0.0
91	4050	65.0	2.1
92	4052	0.0	0.0
93	4057	45.4	1.5
94	4064	0.0	0.0

SUMMATION FOR AIR LOADING OF ALL INDIRECT DISCHARGERS--PART A
(PLANT BY PLANT)

OBS	PLANT	CURRENT LOADING (LBS/YR)	PSES OPTION IV LOADING
95	4066	1	1.2
96	4070	262	3.7
97	4072	752	7.8
		======	======
		460298	6066.5

SUMMATION FOR AIR LOADING OF ALL INDIRECT DISCHARGERS--FULL RESPONSE
(PLANT BY PLANT)

OBS	PLANT	CURRENT LOADING (LBS/YR)	PSES OPTION IV LOADING
1	5	159	2.7
2	30	37	1.3
3	49	422	17.3
4	52	6	0.4
5	58	10	0.4
6	79	86	2.4
7	88	0	0.0
8	93	0	0.0
9	94	89	0.2
10	111	0	0.0
11	119	265	0.1
12	120	231	0.5
13	122	1	0.1
14	143	70	0.2
15	158	0	0.0
16	162	0	0.0
17	163	1172	25.0
18	166	6	0.5
19	199	179	20.9
20	203	119	1.3
21	209	0	0.0
22	214	1714	12.9
23	220	244	0.7
24	232	189	8.5
25	240	5768	320.0
26	244	1	0.7
27	249	35	1.6
28	257	36	13.9
29	266	4	0.3
30	276	1085	49.0
31	283	2169	110.8
32	285	0	0.0
33	292	113	4.3
34	297	4	0.4
35	310	61	0.9
36	321	27	0.3
37	334	419	3.1
38	357	0	0.0
39	417	128	0.2
40	423	565	27.7
41	428	2	1.5
42	430	162880	308.6
43	438	4236	13.7
44	458	132190	238.0
45	492	31	4.9
46	494	4108	100.8
47	522	410	3.1

SUMMATION FOR AIR LOADING OF ALL INDIRECT DISCHARGERS--FULL RESPONSE
(PLANT BY PLANT)

OBS	PLANT	CURRENT LOADING (LBS/YR)	PSES OPTION IV LOADING
48	529	18	0.6
49	543	870	0.1
50	592	1508	6.2
51	624	44014	483.2
52	661	2158	0.8
53	667	0	0.0
54	702	10	3.9
55	706	647	0.2
56	717	2289	41.5
57	720	74	3.4
58	722	5162	68.1
59	724	18	0.2
60	743	2016	5.2
61	771	30	3.1
62	791	524	0.1
63	830	1	0.0
64	845	4	2.6
65	862	3472	5.9
66	874	2052	67.2
67	880	0	0.0
68	887	10776	15.9
69	912	0	0.0
70	929	9	0.2
71	931	0	0.0
72	944	2	0.0
73	958	0	0.0
74	975	2456	72.1
75	976	1111	30.4
76	997	1	0.0
77	1006	1	0.1
78	1018	0	0.0
79	1047	1148	20.7
80	1053	674	1.0
81	1069	146786	655.1
82	1076	0	0.0
83	1086	753	13.6
84	1094	2	1.0
85	1107	5	0.2
86	1117	100	0.2
87	1162	2767	90.7
88	1163	119	3.7
89	1172	13470	37.2
90	1173	4	0.1
91	1181	0	0.0
92	1188	134	7.7
93	1194	16	0.3
94	1195	0	0.0

SUMMATION FOR AIR LOADING OF ALL INDIRECT DISCHARGERS--FULL RESPONSE (PLANT BY PLANT)

OBS	PLANT	CURRENT LOADING (LBS/YR)	PSES OPTION IV LOADING
95	1202	2696	1.3
96	1219	535	88.2
97	1220	25	0.6
98	1223	0	0.0
99	1224	43	7.4
100	1234	494	29.5
101	1237	344	1.1
102	1255	21	0.4
103	1259	38	2.0
104	1277	962	9.6
105	1310	1643	68.3
106	1314	0	0.0
107	1320	126	0.1
108	1322	585	4.2
109	1326	74	1.0
110	1351	871	1.1
111	1354	120	0.3
112	1426	3	0.2
113	1432	2953	6.2
114	1437	0	0.0
115	1487	29569	9.9
116	1506	2902	2.5
117	1507	1398	21.1
118	1526	125	0.2
119	1534	5	2.5
120	1535	0	0.0
121	1539	6959	31.6
122	[illegible]	0	0.0
123	1574	213	0.8
124	[illegible]	95	13.5
125	1564	0	0.0
126	1566	5	0.0
127	1595	[illegible]	21.5
128	1601	0	0.0
129	[illegible]	37	8.3
130	[illegible]	[illegible]	4.6
131	[illegible]	73	0.1
132	[illegible]	[illegible]	47.4
133	1647	1726	1.7
134	[illegible]	[illegible]	6.7
135	[illegible]	[illegible]	354.3
136	[illegible]	7	0.0
137	[illegible]	[illegible]	321.0
138	[illegible]	247672	51.3
139	[illegible]	68	1.0
140	[illegible]	299	0.0
141	[illegible]	1089	4.7

SUMMATION FOR AIR LOADING OF ALL INDIRECT DISCHARGERS--FULL RESPONSE
(PLANT BY PLANT)

OBS	PLANT	CURRENT LOADING (LBS/YR)	PSES OPTION IV LOADING
142	1797	0.0	0.0
143	1801	23.1	0.8
144	1805	865.8	12.2
145	1826	76.6	2.5
146	1832	11.6	0.3
147	1833	225.0	1.8
148	1838	45.6	0.1
149	1853	5979.2	90.0
150	1861	1929.2	17.6
151	1891	1743.4	80.2
152	1899	6708.6	1.7
153	1904	9141.8	867.9
154	1924	14.7	0.7
155	1936	5.4	2.5
156	1945	59.0	1.1
157	1948	294.4	1.1
158	1970	22.5	0.1
159	1971	33.9	3.0
160	1974	0.0	0.0
161	1993	1279.6	1.4
162	2001	39.2	1.1
163	2004	285.6	12.3
164	2018	136.1	20.6
165	2022	0.0	0.0
166	2050	0.2	0.2
167	2057	199.3	1.1
168	2070	9845.1	58.2
169	2075	17.8	1.2
170	2084	252.3	7.3
171	2093	9597.7	150.1
172	2108	1.0	1.0
173	2117	0.0	0.0
174	2147	0.0	0.0
175	2177	1133.5	51.2
176	2184	39998.4	0.9
177	2191	0.0	0.0
178	2214	0.0	0.0
179	2232	2432.8	44.9
180	2241	16039.4	74.8
181	2243	72163.7	1257.1
182	2259	312.7	1.4
183	2261	30441.7	240.0
184	2288	0.1	0.0
185	2293	670.8	0.3
186	2300	536.4	155.9
187	2341	2717.9	452.0
188	2348	3.2	1.0

SUMMATION FOR AIR LOADING OF ALL INDIRECT DISCHARGERS--FULL RESPONSE
(PLANT BY PLANT)

OBS	PLANT	CURRENT LOADING (LBS/YR)	PSES OPTION IV LOADING
189	2350	331	1.6
190	2359	1	0.0
191	2432	8	0.7
192	2436	6574	290.2
193	2442	64	0.1
194	2459	18	0.7
195	2462	493	16.2
196	2485	59836	85.7
197	2487	0	0.0
198	2495	613	36.2
199	2501	1	0.4
200	2507	72	0.2
201	2521	0	0.0
202	2565	1120	28.0
203	2571	1	0.8
204	2578	0	0.0
205	2608	0	0.0
206	2609	1051	10.4
207	2634	25	5.1
208	2635	4389	107.8
209	2636	65	0.2
210	2641	199	8.9
211	2646	32708	103.6
212	2666	4	0.1
213	2685	215	9.7
214	2699	1	0.1
215	2714	0	0.0
216	2736	1323	59.0
217	2741	68	7.2
218	2745	0	0.0
219	2748	6732	29.9
220	2756	3213	138.7
221	2776	231	4.3
222	2779	31	1.5
223	2793	4434	4.1
224	2796	2365	53.9
225	2810	0	0.0
226	4007	7096	2.1
227	4008	50700	72.3
228	4014	0	0.0
229	4022	0	0.0
230	4023	2962	133.7
231	4027	20	0.5
232	4042	115	0.1
233	4047	0	0.0
		=======	======
		1413677	8899.5

SUMMATION FOR AIR LOADING OF ALL DIRECT DISCHARGERS--PART A
(PLANT BY PLANT)

OBS	PLANT	CURRENT LOADING (LBS/YR)	BAT OPTION I LOADING	BAT OPTION II LOADING	BAT OPTION III LOADING
1	1	.	.	.	.
2	15	1545	1545	451	451
3	76	85854	366	366	366
4	105	491	491	491	491
5	112	3	3	3	3
6	190	119	119	119	119
7	205	183	183	183	183
8	301	1008779	1008779	294785	294785
9	446	328	3	3	3
10	451	17977	17977	17977	17977
11	485	852096	852096	248999	248999
12	488	10401	10401	3067	3067
13	518	636	636	140	140
14	611	158	2	2	2
15	814	493249	1975	1975	1975
16	877	4284	35	35	35
17	956	2	0	0	0
18	973	1144	1144	1144	1144
19	1033	43	0	0	0
20	1249	20366	59	59	59
21	1348	8	8	8	8
22	1520	67395	67395	19694	19694
23	1524	2314	2314	2314	2314
24	1670	2	0	0	0
25	1724	1502	1502	439	439
26	1785	499	499	499	499
27	1877	81561	81561	23834	23834
28	1910	584	584	584	584
29	1937	53937	53937	15761	15761
30	2030	140469	140469	40965	40965
31	2047	2849	2849	2849	2849
32	2193	14	14	14	14
33	2281	16	16	16	16
34	2292	7297	7297	2132	2132
35	2316	644	644	188	188
36	2322	830633	830633	242728	242728
37	2419	1774	1774	1774	1774
38	2429	3220	3220	941	941
39	2481	197463	197463	57703	57703
40	2537	1041	1041	1041	1041
41	2660	81405	657	657	657
42	2739	645	645	645	645
43	2781	1162	1162	343	343
44	4018	12020	12020	3512	3512
45	4055	6	6	6	6
		=======	=======	======	======
		3986120	3303525	988447	988447

SUMMATION FOR AIR LOADING OF ALL DIRECT DISCHARGERS--FULL RESPONSE
(PLANT BY PLANT)

OBS	PLANT	CURRENT LOADING (LBS/YR)	BAT OPTION I LOADING	BAT OPTION II LOADING	BAT OPTION III LOADING
1	1	1738	1738	1737.6	1737.6
2	12	29385	29385	409.7	409.7
3	33	206797	0	0.0	0.0
4	61	26460	26460	434.0	434.0
5	63	712	712	712.5	712.5
6	83	12396	12396	12396.1	12396.1
7	87	19113	19113	912.4	912.4
8	102	0	0	0.0	0.0
9	114	1254	0	0.0	0.0
10	154	2677	2677	2676.7	2676.7
11	155	185859	185859	8024.9	8024.9
12	159	3	3	2.7	2.7
13	177	141082	141082	5696.0	5696.0
14	180	0	0	0.0	0.0
15	183	27640	27640	3277.5	3277.5
16	225	3	3	2.5	2.5
17	250	0	0	0.0	0.0
18	254	565	565	565.0	565.0
19	259	3069	3069	3069.4	3069.4
20	260	25990	1	0.6	0.6
21	267	90800	90800	19062.7	19062.7
22	269	902	902	902.0	902.0
23	284	8922	8922	8922.3	8922.3
24	294	1032	1032	1032.5	1032.5
25	296	153	153	153.2	153.2
26	352	88	88	87.8	87.8
27	384	376433	376433	58006.9	58006.9
28	387	0	0	0.0	0.0
29	392	2702	2702	608.9	608.9
30	394	7516	7516	7055.3	7055.3
31	399	605	605	605.4	605.4
32	412	1065	3	3.3	3.3
33	415	4432218	4432218	34260.6	34260.6
34	443	1921	1921	50.8	50.8
35	444	0	0	0.0	0.0
36	447	2553	2553	381.6	381.6
37	481	0	0	0.0	0.0
38	486	5897	5897	1045.6	1045.6
39	500	28	28	28.5	28.5
40	502	14	0	0.2	0.2
41	523	896	896	896.1	896.1
42	525	77	77	76.8	76.8
43	536	493	1	0.7	0.7
44	569	16109	16109	16108.9	16108.9
45	580	0	0	0.0	0.0
46	602	0	0	0.0	0.0
47	608	122057	122057	41692.3	41692.3

SUMMATION FOR AIR LOADING OF ALL DIRECT DISCHARGERS--FULL RESPONSE
(PLANT BY PLANT)

OBS	PLANT	CURRENT LOADING (LBS/YR)	BAT OPTION I LOADING	BAT OPTION II LOADING	BAT OPTION III LOADING
48	633	49	49	5.9	5.9
49	657	0	0	0.0	0.0
50	659	17788	17788	6088.1	6088.1
51	662	733527	733527	53147.3	53147.3
52	663	2410	32	31.8	31.8
53	664	2880	26	26.4	26.4
54	669	2	2	2.5	2.5
55	682	4822	4822	4822.2	4822.2
56	683	60707	60707	28979.0	28979.0
57	695	1233	1233	1233.1	1233.1
58	709	59	0	0.0	0.0
59	727	991	991	990.7	990.7
60	741	33233	33233	33233.2	33233.2
61	758	142	142	142.4	142.4
62	775	35	35	35.3	35.3
63	802	841	841	841.2	841.2
64	811	1096	1096	1096.4	1096.4
65	819	274973	274973	24398.2	24398.2
66	825	104	104	103.5	103.5
67	844	8889	8889	8889.3	8889.3
68	851	10768	10768	10767.7	10767.7
69	859	0	0	0.0	0.0
70	866	461	461	460.7	460.7
71	871	23086	23086	14387.7	14387.7
72	876	38060	38060	4852.2	4852.2
73	883	4	4	3.9	3.9
74	888	6	6	5.7	5.7
75	908	80	80	79.5	79.5
76	909	44772	44772	18998.7	18998.7
77	913	1517	1517	1516.6	1516.6
78	938	132	132	131.5	131.5
79	942	16	16	16.2	16.2
80	948	271655	271655	68048.2	68048.2
81	962	319	3	3.0	3.0
82	970	541	541	541.4	541.4
83	984	3304	3304	3304.0	3304.0
84	990	551	551	550.6	550.6
85	991	0	0	0.0	0.0
86	992	635	635	587.6	587.6
87	1012	0	0	0.0	0.0
88	1020	0	0	0.0	0.0
89	1038	0	0	0.0	0.0
90	1059	451	451	450.9	450.9
91	1061	0	0	0.0	0.0
92	1062	9532	9532	9532.3	9532.3
93	1067	6519	6519	6518.9	6518.9
94	1133	301	301	301.4	301.4

SUMMATION FOR AIR LOADING OF ALL DIRECT DISCHARGERS--FULL RESPONSE
(PLANT BY PLANT)

OBS	PLANT	CURRENT LOADING (LBS/YR)	BAT OPTION I LOADING	BAT OPTION II LOADING	BAT OPTION III LOADING
95	1137	1557	1557	1557	1557
96	1139	542	542	180	180
97	1148	1332	1332	1332	1332
98	1149	23640	23640	23640	23640
99	1157	61	61	61	61
100	1203	0	0	0	0
101	1241	0	0	0	0
102	1267	2427	2427	2427	2427
103	1299	0	0	0	0
104	1319	9	9	9	9
105	1323	11199	11199	54	54
106	1327	831	831	55	55
107	1340	26949	26949	9856	9856
108	1343	3	3	3	3
109	1349	2336	2336	2336	2336
110	1389	603	603	603	603
111	1407	0	0	0	0
112	1409	100812	100812	14607	14607
113	1414	1041	1041	74	74
114	1438	0	0	0	0
115	1439	204	204	204	204
116	1446	140	140	140	140
117	1464	17687	17687	2563	2563
118	1494	114303	114303	2819	2819
119	1522	1823069	1823069	27718	27718
120	1532	149	149	149	149
121	1569	1655	56	56	56
122	1572	283	283	283	283
123	1609	8465	8465	1904	1904
124	1616	847	847	847	847
125	1617	5538	5538	4603	4603
126	1618	1614	5	5	5
127	1624	302	302	27	27
128	1643	2650	2650	2650	2650
129	1647	595	595	595	595
130	1650	41150	895	895	895
131	1656	24	24	24	24
132	1684	2	2	2	2
133	1688	13	13	13	13
134	1695	189471	189471	42322	42322
135	1698	842	842	70	70
136	1714	7537	7537	231	231
137	1717	132	132	132	132
138	1753	485092	485092	485092	485092
139	1766	0	0	0	0
140	1769	215436	215436	215436	215436
141	1774	0	0	0	0

SUMMATION FOR AIR LOADING OF ALL DIRECT DISCHARGERS--FULL RESPONSE
(PLANT BY PLANT)

OBS	PLANT	CURRENT LOADING (LBS/YR)	BAT OPTION I LOADING	BAT OPTION II LOADING	BAT OPTION III LOADING
142	1839	48	.	.	.
143	1869	145299	145299	49617.4	49617.4
144	1881	65	65	64.6	64.6
145	1890	69	69	69.1	69.1
146	1911	179	179	179.0	179.0
147	1928	0	0	0.0	0.0
148	1943	4643	4643	4642.8	4642.8
149	1973	1314	1314	1313.9	1313.9
150	1977	8013	8013	8013.4	8013.4
151	1986	71	71	71.1	71.1
152	2009	5438	5438	5438.5	5438.5
153	2020	16	16	16.3	16.3
154	2026	3947	3947	3114.6	3114.6
155	2049	362	362	361.7	361.7
156	2055	28	28	28.2	28.2
157	2062	152636	7	7.3	7.3
158	2073	110	26	26.3	26.3
159	2090	0	0	0.0	0.0
160	2110	0	0	0.0	0.0
161	2148	15138	15138	15138.2	15138.2
162	2181	879	879	879.2	879.2
163	2206	901	6	6.3	6.3
164	2221	44376	44376	11213.8	11213.8
165	2222	5357	5357	5357.2	5357.2
166	2227	162883	162883	16446.5	16446.5
167	2228	0	0	0.0	0.0
168	2236	266	266	265.7	265.7
169	2242	5568	5568	5568.4	5568.4
170	2254	255	255	255.3	255.3
171	2268	95607	95607	7546.0	7546.0
172	2272	118291	118291	28673.2	28673.2
173	2296	55	55	55.3	55.3
174	2307	1755	1755	1755.4	1755.4
175	2313	53299	53299	53299.0	53299.0
176	2315	4716	4716	4716.1	4716.1
177	2328	1079	1079	1079.4	1079.4
178	2345	3	3	3.1	3.1
179	2353	271	271	271.2	271.2
180	2360	401	401	400.7	400.7
181	2364	0	0	0.0	0.0
182	2365	1319	1319	361.9	361.9
183	2368	366	366	365.8	365.8
184	2376	83597	83597	15233.5	15233.5
185	2390	0	0	0.0	0.0
186	2394	13606	13606	13605.6	13605.6
187	2399	116	116	116.4	116.4
188	2400	649	649	648.9	648.9

SUMMATION FOR AIR LOADING OF ALL DIRECT DISCHARGERS--FULL RESPONSE
(PLANT BY PLANT)

OBS	PLANT	CURRENT LOADING (LBS/YR)	BAT OPTION I LOADING	BAT OPTION II LOADING	BAT OPTION III LOADING
189	2430	482502	482502	74013	74013
190	2445	51920	51920	51920	51920
191	2447	0	0	0	0
192	2450	94837	94837	61162	61162
193	2461	28142	28142	28142	28142
194	2471	2932	2932	2932	2932
195	2474	10290	10290	8824	8824
196	2527	2061	2061	2061	2061
197	2528	115472	115472	43803	43803
198	2531	27831	27831	1049	1049
199	2536	25895	25895	25895	25895
200	2541	35263	35263	4193	4193
201	2551	289	289	289	289
202	2556	0	0	0	0
203	2573	0	0	0	0
204	2590	7	1	1	1
205	2592	5855	5855	5855	5855
206	2606	0	0	0	0
207	2626	2242	2242	2242	2242
208	2631	32059	32059	7533	7533
209	2668	287	287	287	287
210	2673	41	41	41	41
211	2678	2543	2543	2543	2543
212	2680	29189	29189	561	561
213	2692	0	0	0	0
214	2693	0	0	0	0
215	2695	229795	229795	58687	58687
216	2701	1288209	1288209	26326	26326
217	2711	3493	3493	577	577
218	2735	1815	106	106	106
219	2763	0	0	0	0
220	2764	1648	1648	1648	1648
221	2767	0	0	0	0
222	2770	159931	159931	1312	1312
223	2771	730	730	730	730
224	2786	526	526	526	526
225	2795	972	972	972	972
226	2816	5043	5043	5043	5043
227	2818	799	799	799	799
228	3033	2440	2440	2440	2440
229	4002	190	190	190	190
230	4010	0	0	0	0
231	4017	1564	1564	1564	1564
232	4021	62	62	62	62
233	4037	0	0	0	0
234	4040	23013	23013	86	86
235	4051	921	921	921	921

SUMMATION FOR AIR LOADING OF ALL DIRECT DISCHARGERS--FULL RESPONSE
(PLANT BY PLANT)

OBS	PLANT	CURRENT LOADING (LBS/YR)	BAT OPTION I LOADING	BAT OPTION II LOADING	BAT OPTION III LOADING
		========	========	=======	=======
		14008062	13568012	2063161	2063161

*U.S GOVERNMENT PRINTING OFFICE. 1993 -715-003/ 87030