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Construction Costs for Municipal Wastewater Treatment Plants: 1973-1982

TECHNICAL REPORT

CONSTRUCTION COSTS FOR WASTEWATER TREATMENT PLANTS: 1973-1982

JUNE 1983

Prepared for

U.S. Environmental Protection Agency
Priority and Needs Assessment Branch
Facility Requirements Division
Washington, D. C. 20460

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1.0 INTRODUCTION

This report presents the results of a study of the costs for construction of municipally owned wastewater treatment facilities. The cost data utilized in this study were extracted from winning bid documents of projects built with funds provided by the Construction Grants Program of the Environmental Protection Agency (EPA). Only facilities funded under the Federal Water Pollution Control Act (PL 92-500) and its amended versions are a part of this study. All data were obtained directly from the Construction Grants Program files at either EPA Regional offices or the offices of States which have been delegated grant program responsibilities.

The EPA has previously published two reports which were prepared using the same types and sources of data and addressed the same subject matter. The reports were entitled "Construction Costs for Municipal Wastewater Treatment Plants: 1973-1977," MCD-37 and "Construction Costs for Municipal Wastewater Treatment Plants: 1973-1978," FRD-11. This report incorporates the majority of the information used in preparing MCD-37 and FRD-11 plus information from an additional 848 facilities. It is believed that an increased accuracy is evident in this report when compared with its predecessors. Readers are encouraged to replace their copies of MCD-37 and FRD-11 with this report and use it for reference.

The data base used to prepare this report contains information from 1,585 individual treatment plant construction projects. Included are a wide variety of treatment schemes from simple lagoon systems to complex mechanical plants.

Data are included on 822 construction projects for new plants. Also represented are several types of plant modification projects including 111 enlargements, 107 upgrades, 460 enlarge and upgrades, 73 replacements, and 12 classified as other modifications.

These 1,585 projects represent approximately $11.3 billion of grant eligible expenditures adjusted to third quarter 1982 dollars. It is estimated this represents approximately $8.5 billion of Federal grant funds. The projects used in this study account for over 30 percent of the treatment projects which have gone to the construction stage (Step 3) since the inception of the Construction Grants Program.

This study, therefore, is certainly the most complete empirical analysis of construction costs developed to date for municipally owned wastewater treatment plants. It can be used, applying engineering judgment, for preliminary estimation of construction costs for individual unit processes or for complete treatment facilities. The reader is cautioned, however, that this report and the costs shown should not be used as a substitute for normal engineering estimating procedures.

The results herein represent national averages calculated using normalized costs. Local conditions must be taken into account because they can drastically affect the costs of construction.

This report discusses the method used to collect and analyze the data, after which the results are presented. Descriptions of usage of the cost curves, along with examples, are part of the main body of the report. Procedures to estimate costs for future years and to adjust costs to various sections of the country are also presented. Included as appendices are an explanation of the cost normalization procedures utilized and a listing of all treatment plant construction projects contained in the data base.

2.0 COST INFORMATION COLLECTION AND ANALYSIS TECHNIQUES

2.1 DATA COLLECTION

Project cost and design data were collected from Construction Grants Program files of active construction projects. The files were reviewed at either EPA Regional offices or State offices which have been delegated Construction Grants Program responsibilities. Information was extracted from the files and recorded on specially designed forms using an alphanumeric coding system.

Design information including unit process train descriptions, design level of treatment, and design flow was obtained from the planning and design files. All construction cost information was extracted from bid documents submitted by the project contractor who was selected by means of competitive bidding. All construction costs used in this study represent the as-bid costs for a facility, which are not necessarily the same as the final as-built costs. However, the difference between the as-bid and the as-built cost of a facility is generally negligible except for projects which undergo a significant change in scope during the construction phase. An effort was made during data collection to exclude projects which were undergoing significant design changes at the time the construction contract was being bid upon.

Only project costs deemed eligible for funding by the Construction Grants Program were collected for this study. Eligibility was determined by EPA and State program personnel based on grant program policy in effect at the time of the grant award. Consequently, some project costs which a municipality is likely to incur are not reflected in the study results. An example of a cost which is commonly excluded from funding eligibility is the cost of land acquisition for the site of a treatment facility.

2.2 PREPROCESSING OF THE DATA

Prior to actual analysis, the data passed through several steps to assure quality and consistency. Three manipulations were performed: quality assurance, cost updating and normalization, and project classification.

Three quality assurance checks were performed on the data. First, each completed data collection form was reviewed for completeness and technical content. Then the information from the collection forms was keypunched and entered into an ADP file. After keypunching, a computer edit check was performed which screened each record for unacceptable code entries, such as an alpha character in a numeric field. The computer edit also checked the correctness of all mathematical calculations which had been performed by data collectors in the field. After all new data passed the edits, the file was merged into the master data base which was used for subsequent analysis. A final quality assurance check occurred as an initial step of the analysis process and is explained below.

After completion of the master data base, the next step was updating and normalizing all cost items. The master data base contains several types of cost items including planning costs (Step 1), design costs (Step 2), and construction costs (Step 3). These cost items were collected from projects located in all areas of the country from 1973 to 1982. Before performing any analysis, all cost items were made comparable to reflect a common time and place. All cost items in the data base were updated from their original time frame to the third quarter of 1982. The updating made use of the EPA Large City Advanced Treatment (LCAT) and Small City Conventional Treatment (SCCT) wastewater facility construction cost indexes. Also during the updating process, all costs were normalized (adjusted) to a common geographical place, the Kansas City/St. Joseph, Missouri area. This area was chosen because it forms the base for the EPA cost indexes. Therefore, all dollar values reported in this study represent third quarter 1982, Kansas City/St. Joseph, Missouri dollars. A more detailed description of the updating and normalizing procedure is contained in Appendix A of this report.

The last step in the data preprocessing was project classification and validation. All projects in the master data base were classified by type of treatment scheme, type of modification, design level of treatment, and design flow. This resulted in identification of 123 separate classes. Within each class, the data were run in a simple regression mode to identify outliers. The outliers were then checked for validity of content. In cases where quality assurance was lacking because of errors in the data collection form completion or the keypunching steps, the data were eliminated. The remainder were retained as quality data points.

By performing all three preprocessing steps, it was assured that only consistent, good quality data were used in the analysis.

2.3 DESCRIPTION OF THE DATA BASE

The data base contains information obtained from 1,585 individual wastewater treatment facility construction projects from the 48 contiguous States. These projects represent a variety of treatment schemes, design flows, and types of modifications. It was noted in Section 1.0 that 822 projects involved the construction of entirely new plants, 111 projects were enlargements of existing facilities, 107 projects were upgrades of existing facilities, 460 were enlargements and upgrades of existing facilities, 73 were facility replacement projects, and 12 were classified as "other." Enlargement is defined as increasing the design flow of a facility while retaining the same level of treatment. Upgrade is defined as an increase in the design treatment efficiency of a facility while retaining the original flow capacity.

A detailed description of the data base contents is presented in Tables 2.1 and 2.2. In addition, Appendix B of the report lists all projects in the data base by State, EPA grant number, design flow, treatment level, and type of modification.

Table 2.1 presents a distribution of the projects used in this report by projected flow and level of treatment. It can be seen from Table 2.1 that 902 of the projects, or 57 percent of the total, were for plants with design

TABLE 2.1

DISTRIBUTION OF WASTEWATER TREATMENT PLANT PROJECTS BY PROJECTED FLOW AND LEVEL OF TREATMENT

	<1.00 MGD Projected Level of Treatment*					1.00-5.00 MGD Projected Level of Treatment*					5.01-10.00 MGD Projected Level of Treatment*					>10.00 MGD Projected Level of Treatment*					
	A	B	C	D	Subtotal	A	B	C	D	Subtotal	A	B	C	D	Subtotal	A	B	C	D	Subtotal	TOTAL
Alabama	0	11	0	0	11	0	2	3	0	5	0	0	0	0	0	0	0	0	0	0	16
Arizona	0	8	3	0	11	0	4	1	0	5	0	0	0	0	0	0	2	0	0	2	18
Arkansas	0	6	6	6	18	0	3	4	2	9	0	0	1	1	2	0	1	1	1	3	32
California	4	37	12	2	55	3	28	7	3	41	1	9	1	5	16	1	12	1	9	23	135
Colorado	0	4	0	1	5	0	6	1	3	10	0	1	1	0	2	0	2	0	0	2	19
Connecticut	0	1	0	0	1	0	2	0	0	2	0	2	0	0	2	0	0	0	1	1	6
Delaware	0	0	1	1	2	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	3
Florida	0	0	1	1	2	2	3	1	2	8	0	0	0	1	1	0	1	2	4	7	18
Georgia	0	4	2	0	6	0	4	5	4	13	0	1	0	1	2	0	0	1	0	1	22
Idaho	2	9	1	0	12	0	4	1	0	5	0	2	0	0	2	0	1	0	0	1	20
Illinois	0	14	2	18	34	0	2	9	14	25	0	0	1	3	4	0	3	1	8	12	75
Indiana	0	11	2	31	44	0	4	1	12	17	0	1	0	0	1	0	0	2	1	3	65
Iowa	1	17	4	2	24	0	6	1	1	8	0	0	0	1	1	0	2	0	0	2	35
Kansas	6	33	2	0	41	0	9	2	0	11	0	1	0	0	1	0	0	0	0	0	53
Kentucky	0	4	2	5	11	0	5	11	3	19	0	0	0	0	0	0	1	0	0	1	31
Louisiana	1	16	1	1	19	0	5	1	0	6	0	0	0	0	0	0	0	0	1	1	26
Maine	0	7	0	0	7	0	2	0	1	3	0	1	0	0	1	0	0	0	0	0	11
Maryland	0	9	4	2	15	0	2	2	2	6	0	0	0	0	0	0	1	1	0	2	23
Massachusetts	0	3	0	0	3	0	2	2	1	5	0	2	0	1	3	0	2	0	1	3	14
Michigan	2	21	0	1	24	0	7	1	2	10	0	1	0	1	2	0	1	0	2	3	39
Minnesota	0	15	2	8	25	0	4	2	4	10	0	0	1	1	2	0	2	2	2	6	43
Mississippi	0	12	3	1	16	0	0	1	0	1	0	0	0	0	0	0	0	1	0	1	18
Missouri	0	32	2	2	36	0	6	3	1	10	0	2	0	0	2	0	3	0	0	3	51
Montana	1	10	0	0	11	0	5	0	0	5	0	0	0	0	0	0	1	0	0	1	17
Nebraska	8	23	0	0	31	0	9	0	0	9	0	2	1	0	3	0	1	0	0	1	44
Nevada	6	2	0	0	8	0	2	0	0	2	0	0	0	0	0	0	0	1	0	1	11
New Hampshire	2	6	2	0	10	0	4	0	0	4	0	0	0	0	0	0	2	0	0	2	16
New Jersey	0	0	0	1	1	0	4	3	0	7	0	3	1	1	5	0	8	0	2	10	23
New Mexico	0	5	1	0	6	1	5	2	1	9	0	2	0	0	2	0	0	0	0	0	17
New York	0	16	4	11	31	0	10	2	4	16	0	1	0	0	1	0	3	0	1	4	52
North Carolina	0	7	1	1	9	0	7	2	2	11	0	0	0	2	2	0	0	1	2	3	25
North Dakota	4	35	0	0	39	0	2	1	0	3	0	1	0	0	1	0	0	0	0	0	43
Ohio	0	11	4	9	24	0	5	2	7	14	0	0	1	3	4	0	3	1	5	9	51
Oklahoma	16	22	14	0	52	0	4	6	1	11	0	0	2	0	2	0	1	0	0	1	66
Oregon	0	13	7	7	27	0	4	2	3	9	0	1	0	1	2	0	1	2	1	4	42
Pennsylvania	1	15	13	5	34	0	15	8	5	28	0	2	3	4	9	0	2	0	0	2	73
Rhode Island	0	2	0	0	2	0	1	1	0	2	0	0	0	0	0	0	0	0	0	0	4
South Carolina	0	0	1	0	1	0	1	0	0	1	0	0	0	0	0	0	1	0	0	1	3
South Dakota	7	6	0	1	14	0	4	0	1	5	0	0	0	0	0	0	0	0	0	0	19
Tennessee	0	5	4	4	13	0	3	2	0	5	0	0	1	1	2	0	1	0	1	2	22
Texas	0	19	22	6	47	0	10	10	1	21	0	2	2	2	6	0	0	0	6	6	80
Utah	4	3	0	2	9	1	2	0	2	5	0	1	1	0	2	0	0	0	1	1	17
Vermont	1	13	4	0	18	0	1	1	0	2	0	0	0	0	0	0	0	0	0	0	20
Virginia	1	12	3	2	18	0	5	3	0	8	0	3	1	0	4	0	3	0	4	7	37
Washington	6	19	2	0	27	0	15	1	0	16	0	2	0	0	2	0	3	0	0	3	48
West Virginia	0	6	3	3	12	0	4	0	1	5	0	1	0	0	1	0	0	0	0	0	18
Wisconsin	1	13	14	4	32	0	4	3	7	14	0	0	0	2	2	0	6	0	1	7	55
Wyoming	0	4	0	0	4	0	1	2	0	3	0	2	0	0	2	0	0	0	0	0	9
TOTALS	74	541	149	138	902	7	237	111	90	445	1	46	18	31	96	1	70	17	54	142	1,585

*Levels of Treatment:
A - No Discharge
B - Secondary Treatment
C - Advanced Secondary Treatment
D - Advanced Wastewater Treatment

TABLE 2.2

DISTRIBUTION OF WASTEWATER TREATMENT PLANT PROJECTS
BY TREATMENT PROCESS

	Activated Sludge	Rotating Biological Contactor	Oxidation Ditch	Aerated Lagoon	Stabilization Pond	Other	Totals
Alabama	6	3	0	3	3	1	16
Arizona	8	0	3	5	2	0	18
Arkansas	12	1	5	5	5	4	32
California	39	6	8	30	10	42	135
Colorado	9	1	0	0	0	9	19
Connecticut	2	0	0	0	0	4	6
Delaware	3	0	0	0	0	0	3
Florida	6	1	0	0	0	11	18
Georgia	8	1	0	2	1	10	22
Idaho	6	0	1	6	4	3	20
Illinois	21	1	0	11	3	39	75
Indiana	35	3	4	4	5	14	65
Iowa	6	5	0	4	10	10	35
Kansas	7	0	12	2	17	15	53
Kentucky	8	3	6	3	2	9	31
Louisiana	8	0	7	3	5	3	26
Maine	3	1	0	7	0	0	11
Maryland	15	2	0	1	1	4	23
Massachusetts	10	0	0	0	0	4	14
Michigan	7	5	0	6	15	6	39
Minnesota	13	2	1	2	10	15	43
Mississippi	2	0	0	2	10	4	18
Missouri	10	0	25	1	9	6	51
Montana	1	1	6	5	4	0	17
Nebraska	11	3	5	1	10	14	44
Nevada	0	0	0	5	3	3	11
New Hampshire	9	0	1	5	1	0	16
New Jersey	9	3	0	0	0	11	23
New Mexico	7	0	1	5	0	4	17
New York	30	6	1	4	0	11	52
North Carolina	8	0	2	0	2	13	25
North Dakota	1	0	0	7	35	0	43
Ohio	24	2	2	1	5	17	51
Oklahoma	20	0	5	5	28	8	66
Oregon	17	2	0	0	15	8	42
Pennsylvania	39	0	0	3	0	31	73
Rhode Island	4	0	0	0	0	0	4
South Carolina	3	0	0	0	0	0	3
South Dakota	2	1	1	2	11	2	19
Tennessee	4	0	5	2	0	11	22
Texas	33	0	33	2	0	12	80
Utah	1	0	2	2	10	2	17
Vermont	5	2	1	12	0	0	20
Virginia	21	2	1	5	0	8	37
Washington	10	5	9	7	9	8	48
West Virginia	5	1	7	1	1	3	18
Wisconsin	16	6	0	7	1	25	55
Wyoming	2	0	0	3	3	1	9
TOTALS	526	69	154	181	250	405	1,585

flows less than 1.0 million gallons per day (mgd). Additionally, 894 projects, or 56 percent of the total, involved secondary treatment plants.

Table 2.2 summarizes the projects by major treatment process employed. It can be seen that 526, or 33 percent of the projects, utilized an activated sludge process as the main treatment process. Also, 405 projects, or 25 percent, involved "other" or undefined types of processes. It should be noted that "other" includes facilities employing processes not listed on the table, as well as facilities using more than one of the listed processes.

The most detailed information available for each project was collected. Up to three levels of detail were available for some projects included in the data base. The levels are referred to as first order, second order, and third order costs. First order costs are the most general and the most available of the three types. They represent the lump sum costs for an entire treatment facility. Second order costs represent the lump sum costs for each individual process, such as reactor basins or digesters, found within a plant. Third order costs represent the lump sum cost for each of the various components which go into a unit process, such as concrete, equipment, or excavation. The availability of each level of detailed information varied considerably by location, size, and type of project. Figure 2.1 illustrates the relationship between the three levels of detail.

2.4 DATA ANALYSIS

Most data analysis for this study took the familiar form of using one parameter as the sole predictor of a second parameter. The method employed was bivariate analysis using linear regression to calculate an estimating equation. Regression analysis is a well known statistical tool employed to compute and evaluate an estimate of the proposed mathematical relationship between or among variables. It entails a minimization procedure (method of least squares) for estimating parameters. In this analysis, the construction cost and the design flow were taken as the dependent variable Y and the independent variable X, respectively. The Statistical Analysis System (SAS), a statistical package program, was utilized to establish the

TYPES OF CONSTRUCTION BID DATA

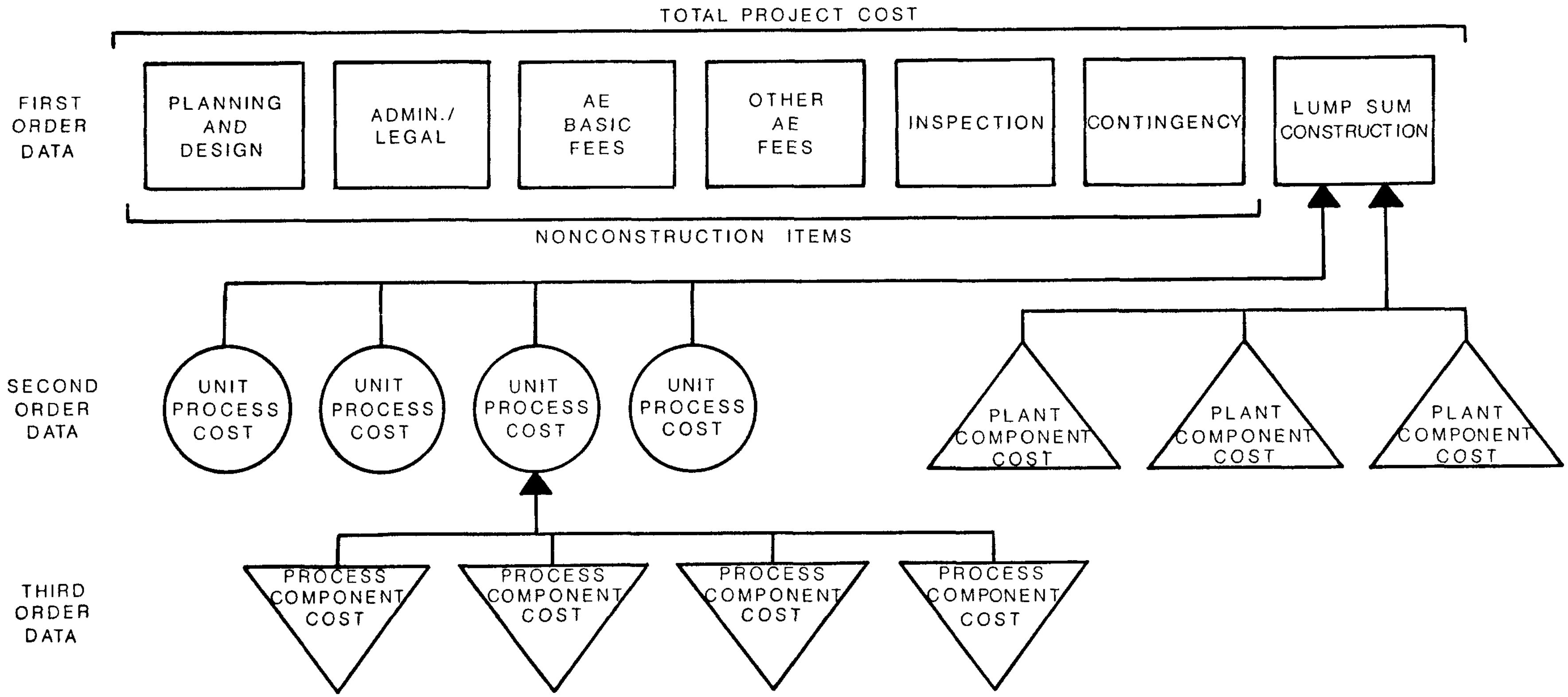


FIGURE 2.1

estimating equation. The Tektronix Graphic Computing System was used to plot the resulting regression equations.

The data were analyzed for all types of plants, processes, and components at all levels of detail that were available. However, if the estimating equations did not possess a certain level of statistical validity, the resulting curves were not reported herein.

The acceptance or rejection of the estimating equations was based largely on the goodness of fit or strength of the linear relationship between variables and on their significance as indicated by the calculated sample correlation coefficient R and the F-value. The formulas and definitions of associated terms to compute the statistics R and F are presented below:

$$R = \sqrt{\frac{SSFE}{SSFE + RSS}}$$

$$\text{F-Value} = \frac{SSFE/K}{RSS/(N - K - 1)}$$

Where: SSFE = Sum of squares due to fitted equations.
RSS = Residual sum of squares.
N = Total number of points (sample size).
K = Degree of freedom due to regression.
N - K - 1 = Degree of freedom due to deviations.

The numerical value of R varies from zero (no relationship between the variables) to ± 1 (completely linear relationship). The square of the correlation coefficient, R^2, which is usually expressed in percent (multiplied by 100), may be interpreted as the proportion of total variability in the dependent variable Y that is explained by the independent variable X. Thus, if $R^2 = \pm 0.70$ for a given relationship, it means that the independent variable X explains 70 percent of variation in the dependent variable Y. The F-value, on the other hand, represents the ratio of the explained variance to the unexplained variance adjusted for the degrees of freedom lost. F statistic tables describe the coefficients (F-values) that may be expected to occur by chance among samples of uncorrelated data. A regression equation may be considered significant at a specified confidence level if calculated F-values, adjusted to degrees of freedom lost for a given sample size or data points, exceed the tabulated F coefficients.

The T-values are also used to measure the fit of the regression line by testing, in turn, the coefficient of each variable to see if, with statistical significance, each can be assumed to be nonzero. If the coefficient of a variable is nonzero, then that particular variable should be a contributing part of the equation. The standard form of the T-test is used and there is significant evidence that the coefficient is considered nonzero if the absolute value of the T-value obtained is greater than some critical T-value.

Bivariate data analyses were conducted for construction and associated costs of wastewater treatment plants to provide the following levels of cost information:

1. Nonconstruction Costs* - Total Step 3 nonconstruction costs, as well as Step 1 and Step 2 planning and engineering costs.
2. First Order - Total plant construction costs.
3. Second Order - Unit process construction costs and total plant construction component costs.
4. Third Order - Unit process component costs.

*Note: Nonconstruction costs were not included in the first, second, or third order relationships, but were analyzed separately as discussed in Section 3.1. These must be added to the other costs as a separate item to arrive at a total project cost.

As mentioned earlier, an estimating equation had to possess a certain level of statistical validity to be included in the results of this study. For this study, an estimating equation was considered statistically valid if it had an $R^2 \geqslant 0.50$ and an F-value that exceeded the critical F-value for the 0.01 level of significance. For equations based on first order costs, the R^2 value in all cases exceeded 0.65.

After the bivariate analyses were completed, several of the data items were compared using a multivariate analysis. The multivariate analysis involved three variables compared in much the same manner as the bivariate linear regression technique to determine if a statistically significant relationship existed among the three variables. The multivariate analyses were conducted with plant design flow, denoted as Q, and projected effluent BOD_5, denoted as E, as the independent variables and, again, construction cost as the dependent variable. This was done for seven classes, and in all cases, it showed that plant design flow was a major contributing factor in the model; in all cases probability of $\leqslant 0.0001$ (T-value > absolute value of T-value obtained).

2.5 RELIABILITY

A sensitivity analysis of the parameters used in preparing these estimating equations for wastewater facilities construction has not been attempted because it was outside the scope of this project. However, general comments on the degree of reliability are in order. The reliability or the accuracy of cost estimates vary with the intended use. As found in the article, "Estimating Accuracy of Your Estimated Costs," published by Consulting Engineer (Vol. 38, No. 2, 1972), five types of estimates are listed with the following probable accuracies:

1.	Order of magnitude	± 40%
2.	Study	± 25%
3.	Preliminary	± 12%
4.	Definitive	± 6%
5.	Detailed	± 3%

The degree of accuracy intended in the cost estimates presented herein is of the study type, i.e., within a probable accuracy of 25 percent. Estimates using cost curves certainly are far less accurate than definitive or detailed estimates, but do provide a means for comparing, on a relative basis, various alternatives without a complete design of each alternative. An exponential function which plots as a straight line on log-log graph paper was assumed for all costs. This is within the accuracy for the intended use of the cost curves. It is agreed that this assumption introduces errors, especially at the lower and upper ends of the curves. The errors arise because the slope of the estimating equation, which is a constant, is calculated to provide the curve of best fit for the majority of the data.

Two distinct types of plant cost estimating approaches are recognized. The first type may be termed the "theoretical" approach. It combines design quantities and current unit costs, such as the cost of steel or concrete, to estimate what a plant should cost before construction. The second, or "empirical" approach, develops cost relationships based on what similar plants have cost in the past. This study presents costs relationships developed in an empirical manner.

The theoretical approach has the potential of better defining a specific treatment facility since detailed design parameters and unit prices are input. While this explicit, detailed input infers that resultant cost estimates are correspondingly accurate, it should be realized that several important variables are sometimes not quantified by theoretical systems. As presented in "An Analysis of Construction Cost Experience For Wastewater Treatment Plants," (MCD-22) published by EPA, the following are among those items:

1. Competition in the contractor and supplier marketplaces.
2. Unpredictable variations in local material and labor costs.
3. Timeliness of construction.
4. Variations in conventional engineering, design, and construction practices.
5. Design requirements imposed by regulatory agencies.
6. Degree to which cost is considered in design and construction phases.
7. Variations in site conditions.

The effect of such variables on cost can usually be quantified only after a construction contract is signed. The empirical system, while not defining the effects of these subjective factors individually, does testify to their cumulative effect on final construction costs. Obviously, each project is unique and the cumulative effects of the above listed factors vary from facility to facility. Because of this variation, cost analysis must utilize average conditions for these subjective parameters.

Using past construction cost information to predict future costs by an empirical approach hinges on the ability to place each sample treatment plant in a precise category of similar plants. This classification can be by design flow, unit processes employed, level of treatment, location, or any combination thereof. There must also be sufficient data to define average cost relationships for particular classifications.

Therefore, when using the estimating equations from this report, the reader must be mindful that the equations represent national averages calculated from information on many projects. There are several important variables, such as site acquisition or unusual site conditions, which must be considered that can cause an individual project's cost to differ drastically from the average value calculated using the estimating equation.

In addition, when using any of the estimating equations, the sample size (N) used in calculating the equation should be considered. An equation based on a large sample, $N \geq 30$, is more reliable and will provide a better approximation of the costs than an equation based on a small sample, e.g., $N = 3$. This is true even though both equations are statistically valid and exhibit the same R^2. The F-test tests the reliability even if R^2 is the same for samples of different sizes.

In order to obtain a consistent scale for all data sets, the policy was set for this report that all curves were to be graphed for a range from 0.01 to 10.0 mgd. Since the actual data points for the regression curves vary from class to class (in Figure 3.51, the range is 0.05 to 0.40 mgd), the reader should be warned that interpreting the curve outside the range where the data points occurred (denoted on the graphs as Data Range) has the potential of giving unreliable interpretations. Similarly, for values substantially outside the data range, considerable judgment must be used in interpretation. The reader is, in all cases, asked to refer to the data range. This is where the fit of the equation has been obtained and where the interpretation is most meaningful. For those graphs where data points occurred beyond the 10.0 mgd value, the graphs are inadequate for representing these situations. However, there are few data points involved.

The 0.01 to 10.0 mgd range was chosen as the standard scale because it is the range which contains most of the plant design flow values for facilities in the data base. Some facilities are built with mgd values incapable of being far from this range. Extended aeration facilities, for example, are not generally built in situations where the average daily flow will exceed 0.50 mgd.

In general, large sample sizes and high values of R^2 and F imply statistically sound correlations. Another indication of the closeness of fit to the model can be inferred from the scatter in the data points used to calculate an equation. As the amount of scatter among the actual data points increases, the accuracy of the estimating equation decreases. To provide an indication of data scatter, each graph includes a set of dashed lines which have been referred to in this report as the standard residual error (SRE).

The standard error of the estimate, or the standard residual error, is defined as:

$$SRE = \sqrt{\frac{RSS}{N - 2}}$$

Where: RSS = Residual sum of squares.

N = Total number of points (sample size).

SRE squared is an unbiased estimate for σ squared, the variance of the residual variables. SRE has a major use in obtaining confidence intervals for various parameters and variables of the regression equation. Although this was not done here, it was desired to give the reader a feel for the fact that the actual cost values need not lie on the actual regression line (it represents only the average costs), but would fall in some interval about that line. The interval cost ± SRE has, therefore, been plotted to indicate an interval in which the costs have a likelihood of being found. Again, let it be stressed that this is not a confidence interval, but serves only as reinforcement for the fact that the costs are within some interval about the line and not necessarily on the line.

3.0 RESULTS OF THE DATA ANALYSIS

The results of all statistically valid relationships discernible from the existing data base are presented in this section. The results are presented in the following order:

Section	3.1.3	Presentation of Nonconstruction Cost Curves
Section	3.2.3	Presentation of First Order Cost Curves
	3.2.3.1	Results - Mechanical Plants by Level of Treatment
	3.2.3.2	Results - Mechanical Plants by Level of Treatment and Main Treatment Process
	3.2.3.3	Results - Lagoon Plants
Section	3.3.3	Presentation of Second Order Cost Curves
	3.3.3.1	Results - Unit Processes and Unit Operations
	3.3.3.2	Results - Mechanical Plant Component Costs
	3.3.3.3	Results - Lagoon Plant Component Costs
Section	3.4.2	Presentation of Third Order Cost Equations
Section	3.5.2	Presentation of Efficiency Cost Curves

Each section contains an introduction, definition of terms, and the results as a series of cost curves. Noted on the cost curves are the equation of the curve, the sample size, the values of the R^2 and F statistics, the SRE, and the data range.

Examples for using these curves are presented in Section 4.0 of this report.

3.1 NONCONSTRUCTION COSTS

3.1.1 Introduction

Associated with all construction projects are expenditures for items other than actual construction items. These other cost items are termed nonconstruction costs. Nonconstruction costs are incurred throughout the life of a construction project, beginning with the initial planning phase and continuing until a facility is in operation. A construction project is usually accomplished in three distinct phases; initial planning, detailed design, and actual construction. In the terminology of the Construction Grants Program, these three phases are referred to as Step 1, Step 2, and Step 3, respectively. There are nonconstruction costs associated with each step which must be added to the construction cost to arrive at a total project cost. This section describes the various nonconstruction costs usually incurred in the course of a project and provides an estimate of their contribution to the total project cost.

3.1.2 Definitions of Nonconstruction Costs

Nonconstruction costs are defined as those monies spent during the course of a construction project which are not paid directly to the building contractor but which must be borne by the owner. They are considered to be part of the total project cost. The nonconstruction costs can be further broken down into the following categories:

- Planning Costs (Step 1). These are costs incurred during the preliminary engineering analysis phase. This phase includes problem identification, alternative selection, cost effective analysis, and preliminary plant design.
- Design Costs (Step 2). These are costs for the preparation of detailed plans and specifications for the project.
- Administrative/Legal Costs. Included are costs incurred by the owner in the administration of a construction project. Some examples are attorney fees for preparing contracts, costs for publishing bid advertisements and legal notices, and the cost of preparing requests for proposals.

- Preliminary Costs. This category includes costs incurred by the owner prior to any financial award for which he is later reimbursed by the awarding agency.

- Right-Of-Way Costs. This category includes legal and administrative expenses necessary for securing rights-of-way and sites for a project.

- A/E Basic Fees. This category includes fees paid by the owner to architectural/engineering (A/E) firms for consultation and assistance during project construction. Examples are preparation and review of bid documents and change orders, construction management, and final inspection of all completed construction.

- Other A/E Fees. These include the costs for special services provided to the owner by an A/E firm during project construction. Included are soil investigations, preparation of additional documents such as operation and maintenance manuals, and facility startup services.

- Project Inspection Costs. These costs are paid by the owner to provide a full time resident engineer on the construction site to inspect all work and to keep a project log.

- Land Development Costs. Included are costs for preparing a project site for a purpose other than the construction of a treatment facility. An example is the cost for providing public recreational facilities at the site of a treatment plant.

- Relocation Expense Costs. The administrative and legal expenses an owner incurs in relocating individuals or businesses affected by a construction project.

- Relocation Payment Costs. Payments made to individuals or businesses forced to relocate due to a construction project.

- Demolition and Removal Costs. The costs for demolishing and removing existing structures at a project site.

- Bond Interest Costs. This covers the interest charges paid by the owner on bonds issued to finance payments during construction.

- Contingency Costs. This is an amount set aside at the start of a project to provide for unexpected expenses during construction.

- Indirect Costs. These are costs for goods or services provided by one department of an owner's organization to another department. An example is a payment made to a city highway department by a city public works department.

- Equipment Costs. These are costs for the purchase or leasing of equipment or materials necessary for the construction or maintenance of a facility which are obtained separately from the construction phase. An example is the advance purchase of process equipment which requires a long lead time before delivery.

- Miscellaneous Costs. Included are any costs not covered in the other nonconstruction cost categories. Two examples are special laboratory equipment purchases and monitoring wells installed at a project site. Land costs, where land is an integral part of the treatment process, are included in this category. Other land costs, such as acquisition of a treatment plant site, are ineligible and are not included in this or any of the categories above.

3.1.3 Presentation of Nonconstruction Cost Curves

Table 3.1 presents the average ratios of all nonconstruction cost categories to construction costs for all projects in the data base. Average ratios were calculated for each EPA Region, as well as for the entire nation. Individual project ratios were calculated by dividing the nonconstruction dollar value by the construction dollar value. The Regional and national average ratios for each category were calculated by dividing the sum of all individual project ratios by the number of projects.

Seventeen nonconstruction cost categories are identified in Table 3.1. By checking the sample size for each category, it can be seen that only seven of these nonconstruction cost categories are common to the majority of projects: planning, design, administration/legal, A/E basic fees, other A/E fees, project inspection, and contingencies. These seven categories equal approximately 32 percent of the construction costs as a national average. The other ten categories are much less frequent in their occurrence and are very project-specific. It is suggested that the reader only consider the seven most common nonconstruction costs when preparing an estimate with the information in this report. The information on the other ten categories is presented in order to make the reader aware that site-specific requirements can greatly affect the cost of a project.

Figures 3.1 through 3.7 present the relationship between construction costs and each of the seven most common nonconstruction costs previously mentioned. The independent variable for each curve is the construction cost in dollars. The dependent variable for each curve is the nonconstruction cost in dollars. All costs are in third quarter 1982 Kansas City/St. Joseph, Missouri dollars.

TABLE 3.1

NONCONSTRUCTION COST AS A PROPORTION OF CONSTRUCTION COST

NONCONSTRUCTION COST/CONSTRUCTION COST
AVERAGES FOR EPA REGIONS AND THE NATION

Nonconstruction Cost Categories	Reg. 01	Reg. 02	Reg. 03	Reg. 04	Reg. 05	Reg. 06	Reg. 07	Reg. 08	Reg. 09	Reg. 10	National Ratios	(Sample Size)
Planning (Step 1)	0.030	0.041	0.028	0.052	0.035	0.034	0.042	0.043	0.043	0.056	0.041	(866)
Design (Step 2)	0.078	0.098	0.057	0.058	0.057	0.063	0.072	0.141	0.081	0.088	0.076	(866)
Administration/Legal	0.012	0.018	0.023	0.008	0.007	0.006	0.009	0.010	0.010	0.011	0.012	(1,995)
Preliminary	0.036	0.015	0.004	0.012	0.006	0.003	0.006	0.011	0.011	0.024	0.015	(145)
Right-of-Way	0.025	0.042	0.018	0.020	0.029	0.035	0.032	0.035	0.084	0.037	0.032	(188)
A/E Basic Fees	0.073	0.059	0.107	0.051	0.065	0.030	0.040	0.057	0.084	0.047	0.063	(2,058)
Other A/E Fees	0.028	0.044	0.037	0.020	0.038	0.015	0.018	0.027	0.042	0.025	0.030	(1,293)
Project Inspection	0.067	0.063	0.046	0.031	0.040	0.029	0.044	0.062	0.055	0.059	0.046	(1,213)
Land Development	---	---	0.010	0.006	0.008	---	0.046	0.042	---	0.011	0.020	(6)
Relocation Expenses	0.016	---	0.003	0.020	0.003	---	---	0.005	0.003	---	0.009	(17)
Relocation Payments	---	---	---	---	0.005	0.108	---	---	0.008	---	0.027	(5)
Demolition & Removal	---	---	0.085	0.014	---	0.011	0.048	---	---	0.046	0.032	(7)
Bond Interest	0.022	0.017	0.056	0.013	---	0.044	---	0.029	---	---	0.041	(36)
Contingencies	0.062	0.070	0.055	0.073	0.034	0.050	0.056	0.056	0.069	0.038	0.054	(2,283)
Indirect Costs	---	0.010	0.003	---	0.017	---	---	---	0.012	---	0.013	(44)
Equipment	0.014	0.006	0.018	0.032	0.011	0.008	0.030	0.017	0.026	0.040	0.020	(219)
Miscellaneous	0.016	0.027	0.033	0.018	0.010	0.033	0.018	0.021	0.011	0.038	0.023	(439)
TOTAL REGIONAL NCC AVERAGES	0.479	0.510	0.583	0.428	0.365	0.469	0.461	0.556	0.539	0.520	0.554	

Table 3.2 contains a summary of Figures 3.1 through 3.7 with associated titles and cost equations.

TABLE 3.2

SUMMARY FOR FIGURES 3.1 THROUGH 3.7
NONCONSTRUCTION COST CURVES

Figure Number	Title	Cost Equation*
3.1	Planning	$NCC = (5.77 \times 10^{-1})C^{0.79}$
3.2	Design	$NCC = (3.45 \times 10^{-1})C^{0.88}$
3.3	Administrative/Legal	$NCC = (9.62 \times 10^{-2})C^{0.80}$
3.4	Architectural/Engineering Basic Fees	$NCC = (1.26 \times 10^{-1})C^{0.93}$
3.5	Other Architectural/Engineering Fees	$NCC = (8.86 \times 10^{-2})C^{0.89}$
3.6	Project Inspection	$NCC = (4.13 \times 10^{-1})C^{0.83}$
3.7	Contingency	$NCC = (6.56 \times 10^{-2})C^{0.98}$

* NCC = Nonconstruction Cost
C = Construction Cost

NONCONSTRUCTION COST
PLANNING

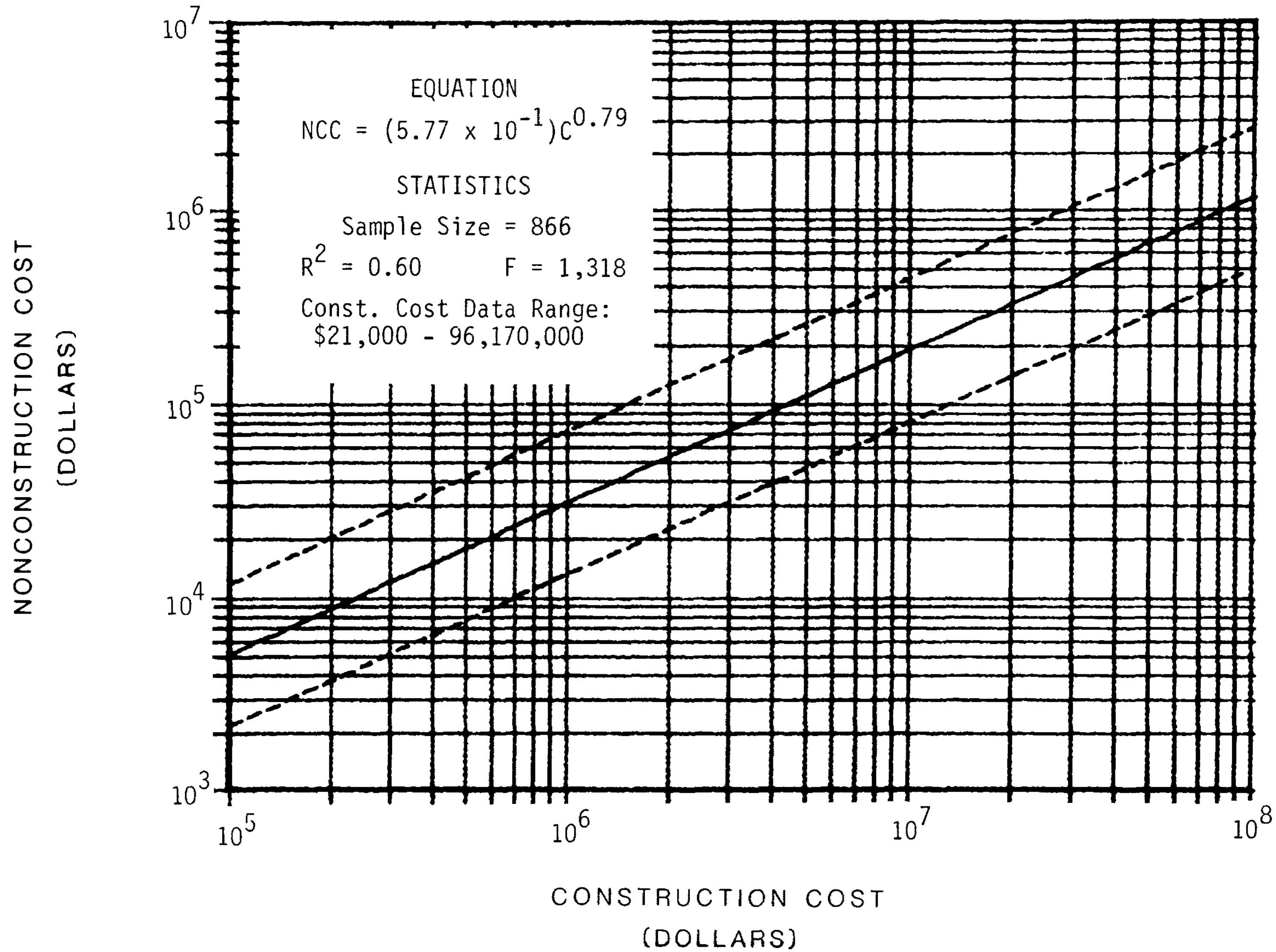


FIGURE 3.1

NONCONSTRUCTION COST
DESIGN

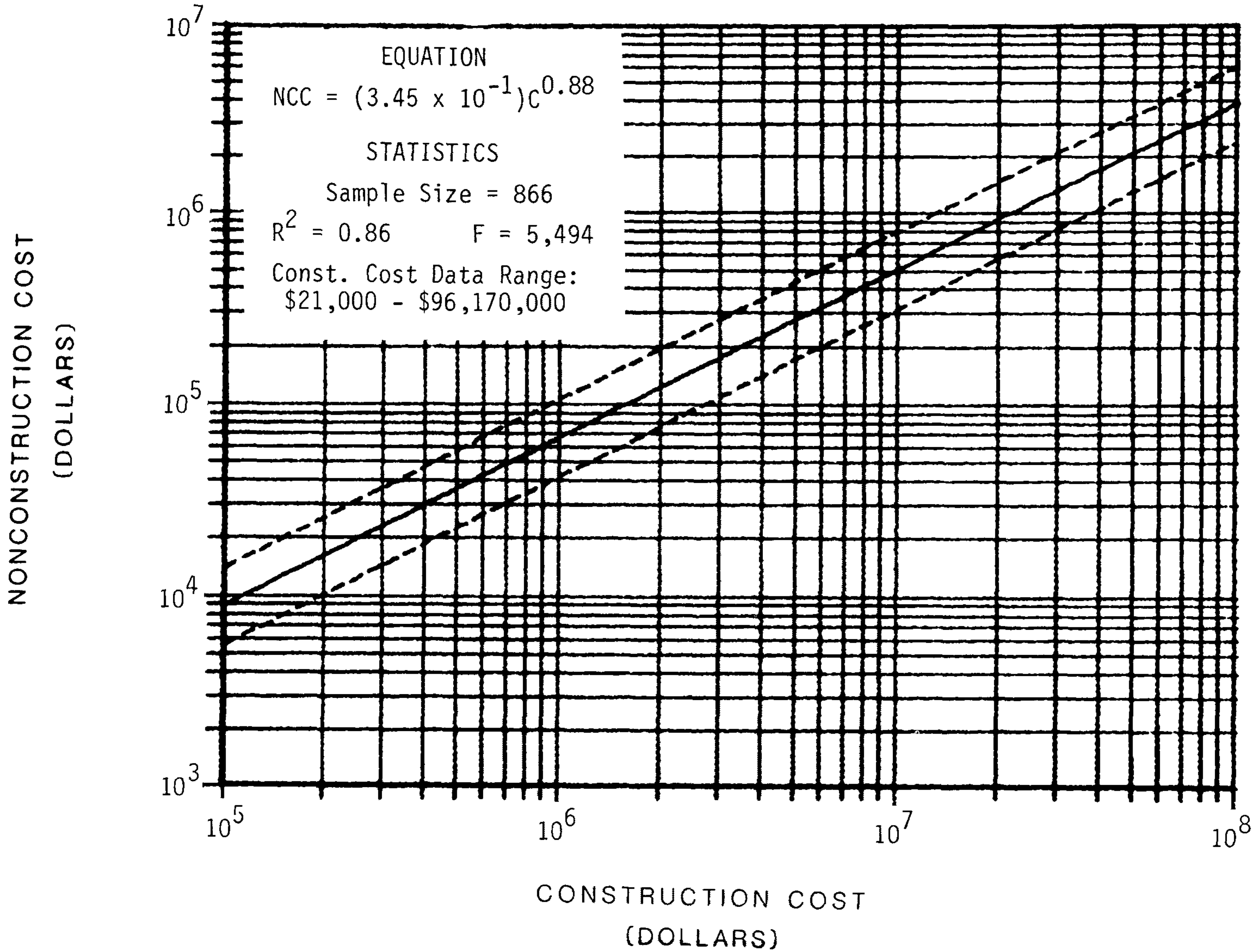


FIGURE 3.2

NONCONSTRUCTION COST
ADMINISTRATIVE/LEGAL

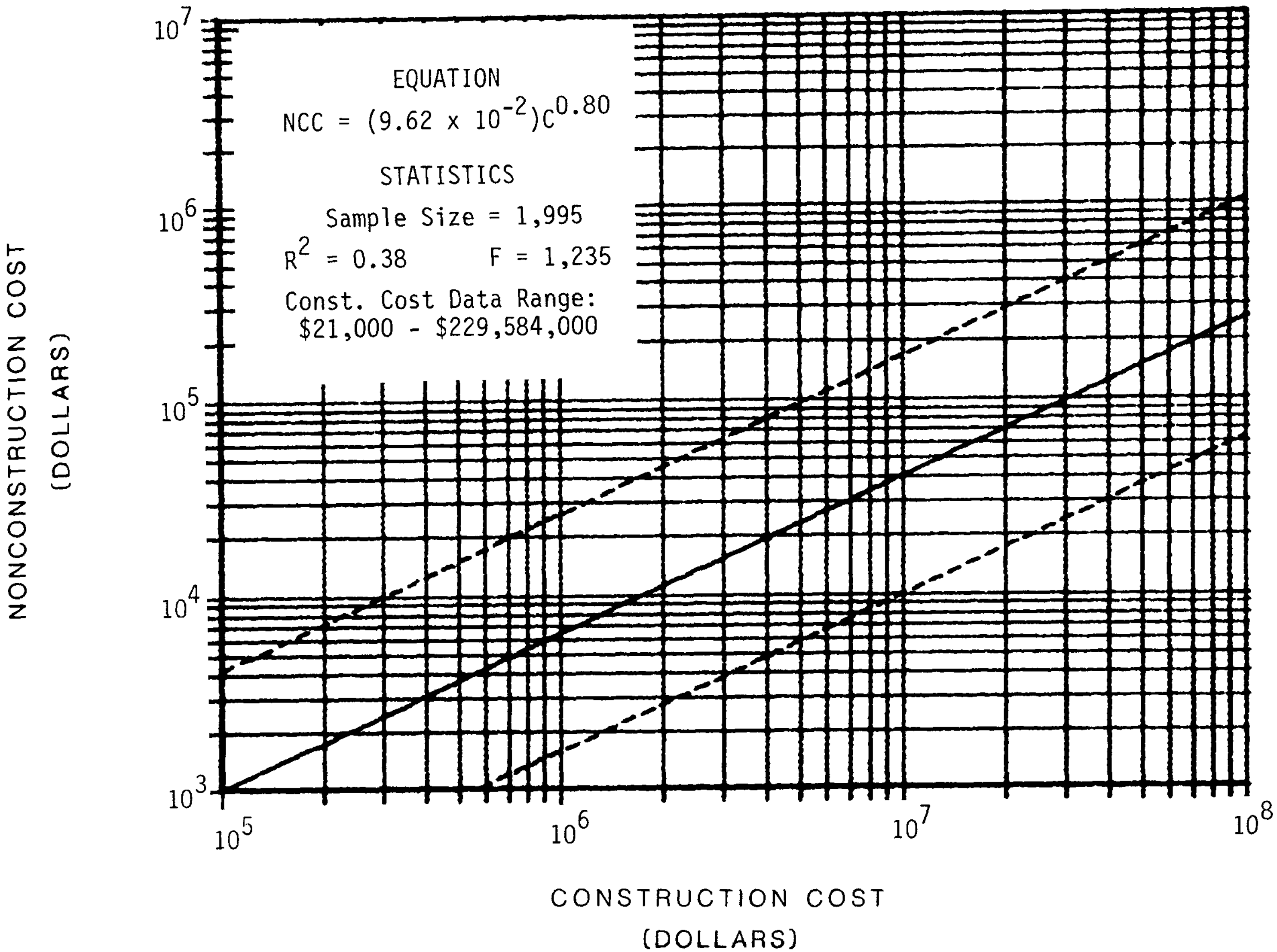


FIGURE 3.3

NONCONSTRUCTION COST
ARCHITECTURAL/ENGINEERING BASIC FEES

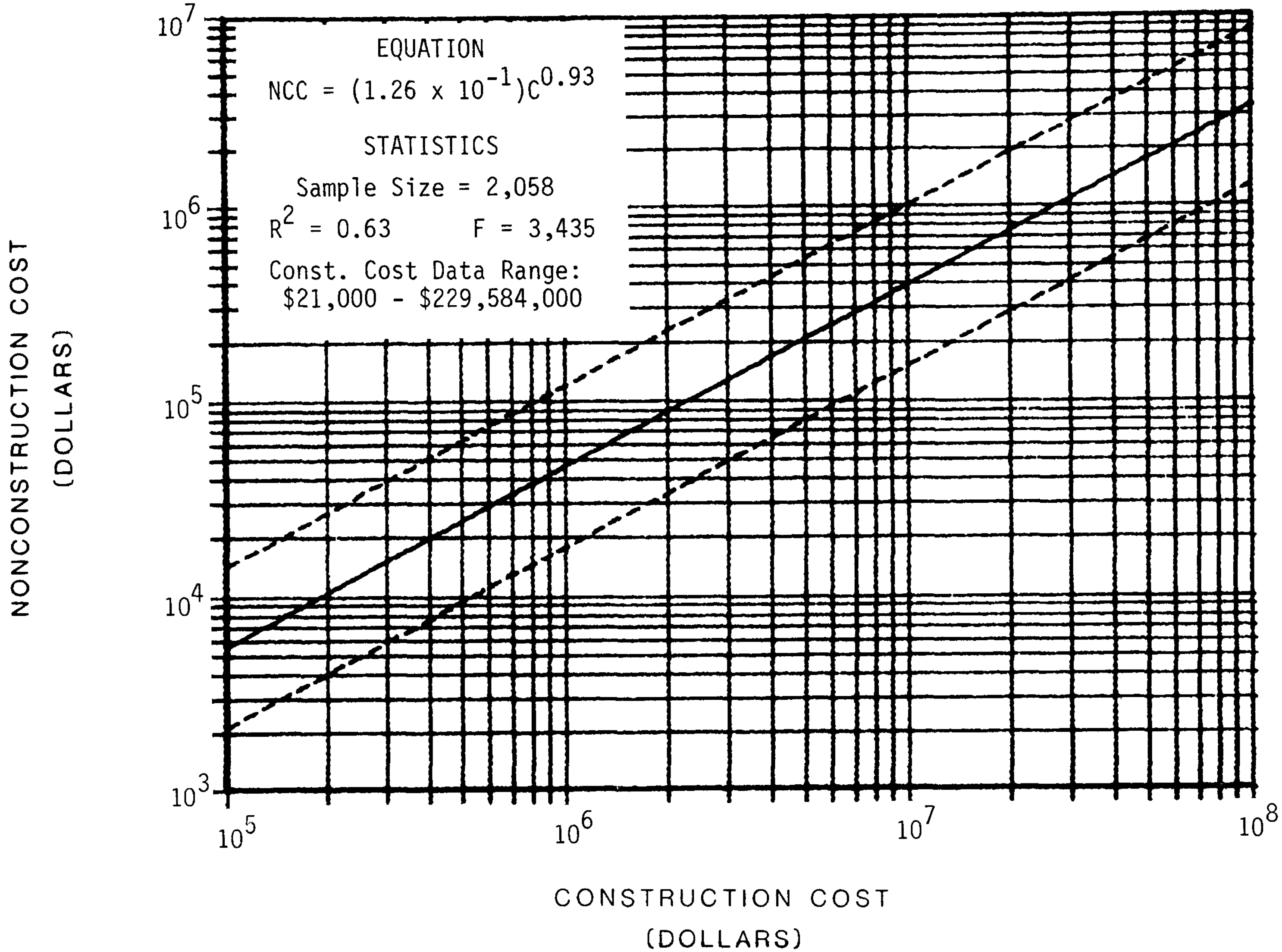


FIGURE 3.4

NONCONSTRUCTION COST
OTHER ARCHITECTURAL/ENGINEERING FEES

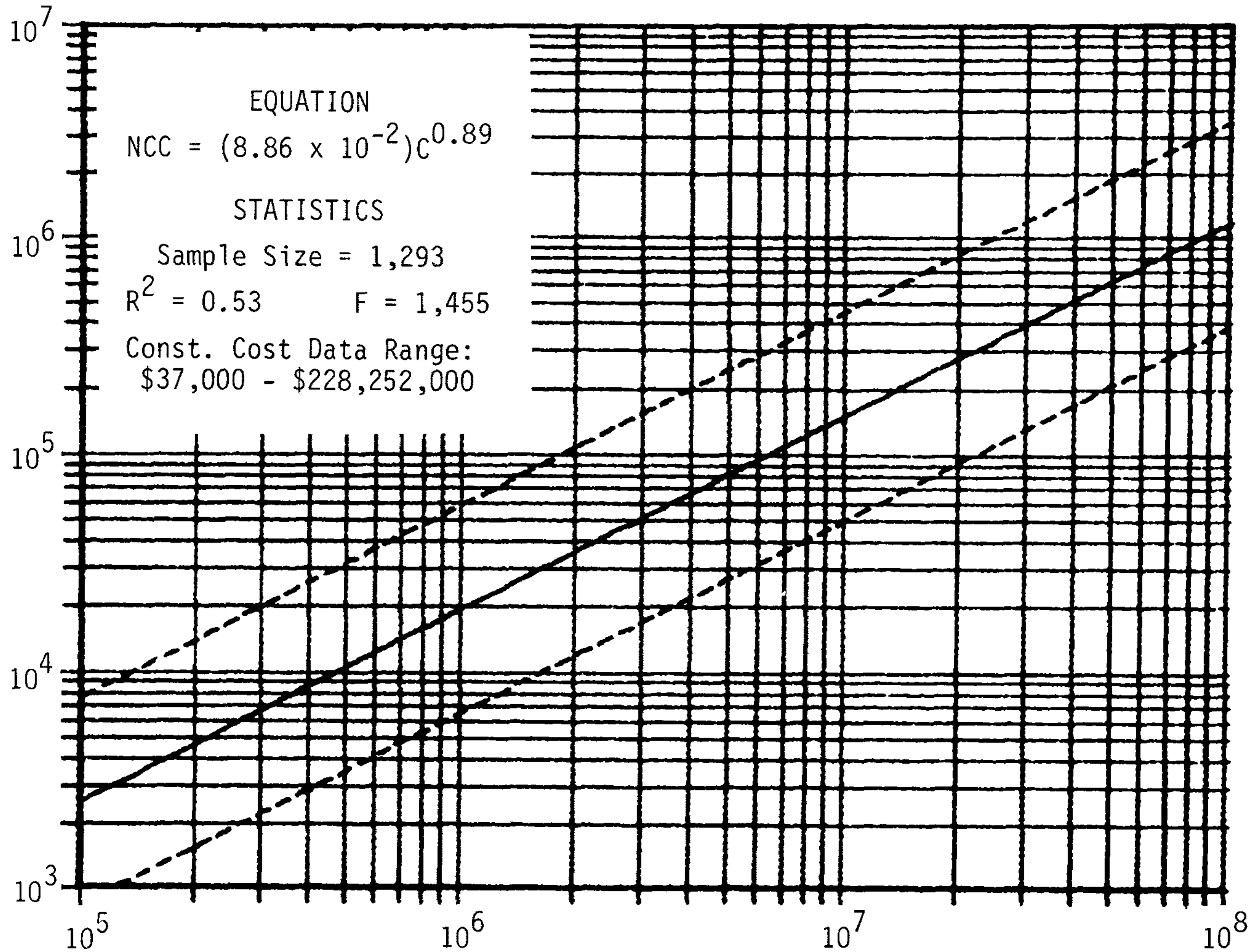


FIGURE 3.5

NONCONSTRUCTION COST
PROJECT INSPECTION

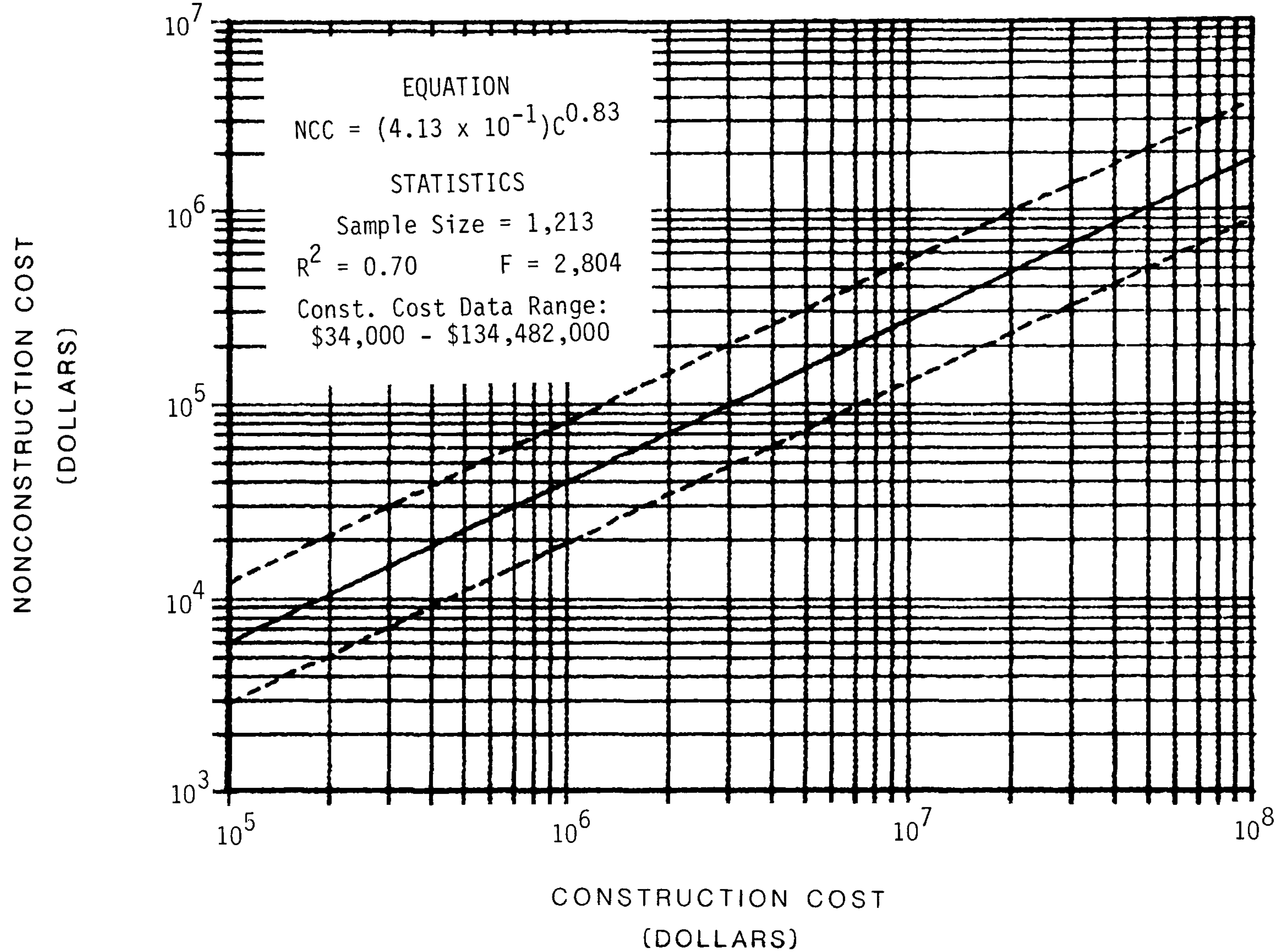


FIGURE 3.6

NONCONSTRUCTION COST CONTINGENCY

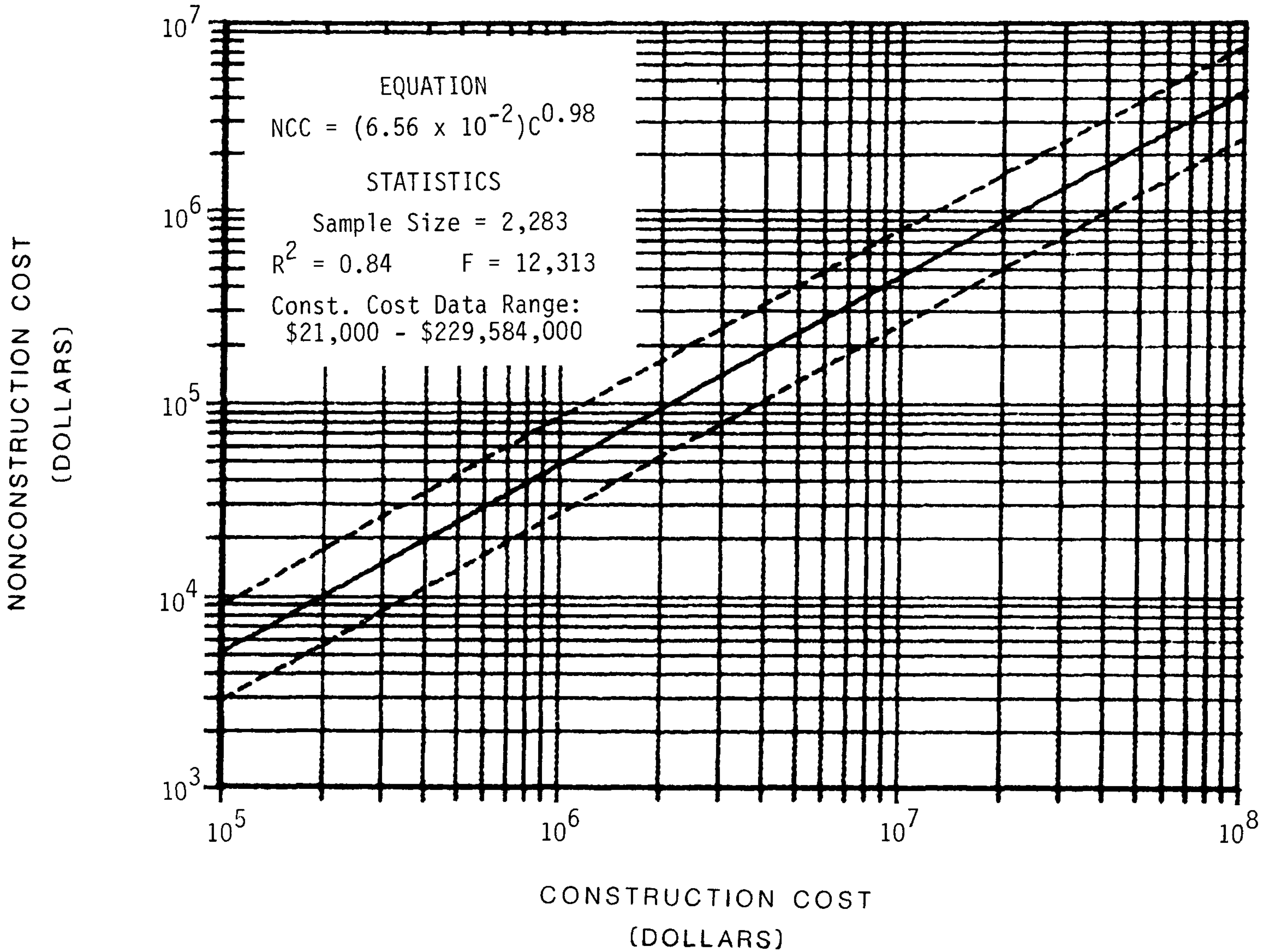


FIGURE 3.7

3.2 FIRST ORDER COSTS

3.2.1 Introduction

First order costs are the sum of monies paid by the owner to contractors and suppliers for all labor and materials necessary to construct the entire planned treatment facility. As noted in Section 2.0, all construction costs used to prepare this report were the as-bid costs which were usually very close to, but not necessarily exactly the same as, the as-built costs. Also, first order costs only represent construction expenditures and do not include any allowance for nonconstruction costs.

All first order cost curves presented in this report are for the construction of entirely new treatment facilities. Also contained in the data base are many projects involving other types of plant modifications such as enlargements, upgrades, and replacements. Due to the greater variations in technical considerations and costs associated with such projects, no cost curves could be produced at a level of statistical confidence great enough for inclusion as first order curves.

3.2.2 Definitions of Terms

- Construction Cost. The sum of monies paid by the owner to contractors and suppliers for all labor and materials necessary to construct the planned facility. The construction cost, expressed in millions of dollars, is the dependent variable in all cost relationships presented in this section.

- Design Flow. The design flow is the hydraulic capacity for which a treatment plant is designed. It is based on the total daily average dry weather flow rate expected from domestic, commercial, and industrial sources. The design flow is the ideal flow at which a facility will operate. It represents the norm and accounts for fluctuations such as peak and low flows. The design flow represents the average daily flow, not monthly or yearly averages which will vary due to wet weather conditions or intermittent industrial flows. The design flow, expressed in mgd, is the independent variable in all cost relationships presented in this section.

- Treatment Levels. All facilities are classified in terms of the treatment level they are designed to achieve. Three basic treatment levels are identified; secondary, advanced secondary, and advanced wastewater treatment. The treatment levels are defined in terms of the five day biochemical oxygen demand (BOD_5) of the plant effluent on a monthly average basis. No other parameters, such as effluent suspended solids, are used in the treatment level classification.

- Secondary Treatment. A plant is considered a secondary treatment plant if it is designed to produce an effluent with a BOD_5 no greater than 30 milligrams per liter (mg/l). However, some States have a more stringent definition of secondary treatment in which the effluent may have a BOD_5 value as low as 25 mg/l. Therefore, a plant capable of producing an effluent with a BOD_5 value in the range of 25 to 30 mg/l (inclusive) is placed in the secondary treatment category. Many types of unit process trains are used in plants which provide secondary treatment. The most common processes are variations of the activated sludge process and variations of the lagoon process.

- Advanced Secondary Treatment (AST). A plant is considered an advanced secondary treatment plant if it is designed to produce an effluent with a BOD_5 in the range of 24 mg/l to 11 mg/l. A variety of unit process trains can be used to achieve advanced secondary treatment. The most widely used processes are extended aeration activated sludge, oxidation ditches, and rotating biological contactors (RBC). To attain very stringent BOD_5 effluent values, many facilities will include chemical addition or filtration processes to their treatment trains.

- Advanced Wastewater Treatment (AWT). A plant is considered an advanced wastewater treatment plant if it is designed to produce an effluent with a BOD_5 less than or equal to 10 mg/l. Plants designed to achieve an advanced wastewater treatment level utilize complex unit process trains. Generally AWT plants use a biological treatment process, such as activated sludge, followed by chemical/physical processes to produce a high quality effluent.

• Nutrient Removal. In addition to meeting BOD_5 effluent values, some plants must control the amount of nutrients in their effluent. This control is achieved by the use of biological and chemical unit processes. Nutrient control requirements are usually associated with plants designed to achieve AST or AWT levels of treatment. However, plants designed to achieve secondary treatment sometimes need to control phosphorus, especially if they dispose of their effluent to nutrient sensitive water bodies such as lakes.

  - Ammonia Removal. A plant designed to produce an effluent with 5.0 mg/l or less of ammonia nitrogen is considered to have ammonia removal capabilities.

  - Phosphorus Removal. A plant designed to produce an effluent with 3.0 mg/l or less of total phosphorus is considered to have phosphorus removal capabilities.

• Mechanical System. A facility which utilizes energy intensive treatment processes. Included are plants with activated sludge processes, rotating biological contactors, trickling filters, and oxidation ditches. Excluded are facilities which utilize a lagoon system, aerated or nonaerated, for their main treatment process.

- Lagoon System. A facility which utilizes either a stabilization pond or an aerated lagoon as the primary treatment process.

- Sludge Handling. The amount of sludge generated and the treatment methods vary considerably from facility to facility. The amount of sludge produced depends on the characteristics of the influent wastewater and the unit process train utilized. The treatment methods used depend on the characteristics of the sludge, the amount of sludge generated, and the disposal methods available. The sludge handling methods can vary from facility to facility even though facilities may have similar design flows and treatment levels. Expenditures for sludge handling are usually a large percentage of the overall construction cost for a facility. In order to account for the variations in sludge handling methods and the resultant impact on the construction cost, all facilities have been classified into three categories. The three general categories of sludge handling are simple, moderate, and complex. These categories are mutually exclusive. Included in each category are all costs for the appropriate sludge handling and sludge treatment equipment. Disposal costs are not included except for sludge disposal equipment which includes sludge hauling vehicles, sludge pipelines, underground injection equipment, pumps and equipment for spraying, and similar items.

  - Simple Sludge Handling. A facility is placed in this category if the sludge generated is treated by air drying and disposed in a landfill. The cost of the landfill is not included.

  - Moderate Sludge Handling. A facility is placed in this category if the sludge generated is treated by digestion, thickening, or mechanical dewatering, as well as any of the treatments included in the "simple" category.

  - Complex Sludge Handling. A facility is placed in this category if the sludge generated is treated by chemical stabilization, heat treatment, or incineration, as well as any of the treatments included in the "simple" and "moderate" categories.

- Equation Block. Located on each graph is a block containing the cost equation and the statistical test results for the relationship displayed.

  - Equation. This is the estimating equation which describes the curve. The "C" term is the construction cost in million dollars and the "Q" term is the design flow in mgd.

  - Sample Size. This refers to the number of projects from the data base used in the calculation of the equation.

- R^2. This is the square of the correlation coefficient of the equation. The statistical significance of R^2 is explained in Section 2.5.

- F. This is the F-value of the equation; the statistical significance of which is explained in Section 2.4.

- T. This is the T-value of the equation; the statistical significance of which is explained in Section 2.4.

- Data Range. This is the actual range of basic data used to calculate the equation.

3.2.3 Presentation of First Order Cost Curves

The results from the first order cost analyses are presented in three sections as follows:

Section 3.2.3.1 - Results - Mechanical Plants by Level of Treatment
Figures 3.8 through 3.27

Section 3.2.3.2 - Results - Mechanical Plants by Level of Treatment and Main Treatment Process
Figures 3.28 through 3.64

Section 3.2.3.3 - Results - Lagoon Plants
Figures 3.65 through 3.70

Each section presents the relationship between the design flow of a facility and the construction cost. This relationship is presented for facilities which have been classified by type of system, level of treatment, and, in some cases, degree of sludge handling.

All cost relationships presented in the following sections represent national averages. Methods for adjusting the national average cost to a specific area of the country are outlined in Section 4.0. Examples of how to use these cost curves to develop estimates are also presented. All national average costs are in third quarter 1982 Kansas City/St. Joseph, Missouri dollars.

3.2.3.1 Results - Mechanical Plants by Level of Treatment

This section contains the results from the analyses of the first order cost relationships between the design flow of a facility and its construction cost. Prior to analysis, facilities were classified by level of treatment and, wherever possible, by the type of sludge handling. Further, only completely new mechanical plants with effluent disposal to nonocean surface waters were included. No distinction was made with regard to the types of unit processes utilized in the liquid line treatment train other than the overall train must be representative of a mechanical plant.

Figures 3.8 through 3.27 contain the results obtained from these analyses. The figures are ordered so that all results pertaining to a specific level of treatment are grouped. Results for secondary treatment plants are shown on Figures 3.8 through 3.12. Results for advanced secondary treatment plants are shown on Figures 3.13 through 3.20. Results for advanced wastewater treatment plants are shown on Figures 3.21 through 3.27.

Each figure contains several important items: title, x-axis label (independent variable), y-axis label (dependent variable), cost equation, equation statistics, regression line (solid line), and the SRE (dashed lines). All these items should be taken into account by the reader.

The regression line and the cost equation derived from the line represent the predicted construction cost for the particular type of facility identified in the title. The cost derived using the line or equation is an estimate for the construction of a complete operational wastewater facility. The cost includes all processes from the headworks to the effluent outfall line. The only additional costs that need to be considered are the various nonconstruction costs.

For several types of plants, it was possible to obtain results which differentiated plants by level of treatment, as well as the type of sludge handling employed. It should be noted that the curves obtained for simple, moderate, and complex sludge handling are all subsets of the curve developed for all types of sludge handling. It is possible to see the effect sludge handling has on construction costs by referring to the results obtained for secondary treatment plants (Figures 3.8, 3.9, 3.10, 3.11). Figure 3.8 contains the results obtained by including all secondary plants without regard to the type of sludge handling. Figure 3.9 contains the results for plants having simple sludge handling techniques. Figure 3.10 contains the results for plants with moderate sludge handling and Figure 3.11 shows the results for plants with complex sludge handling. The predicted costs for a 1.0 mgd plant for each curve are as follows:

Figure	Type of Sludge Handling	Cost for 1.0 mgd Plant
3.8	All Types	\$2,490,000
3.9	Simple	\$1,680,000
3.10	Moderate	\$2,410,000
3.11	Complex	\$3,000,000

By comparing the results, it can be seen that sludge handling can almost double the predicted construction cost (\$1,680,000 vs. \$3,000,000) for plants with similar levels of treatment and design flows.

The results conform to the general principle that more stringent effluent requirements, in terms of BOD_5 and nutrient reduction, result in greater construction costs. Therefore, AST plants cost more than secondary plants, and AWT plants are the most costly of all.

Table 3.3 contains a summary of Figures 3.8 through 3.27 with associated titles and cost equations.

TABLE 3.3

SUMMARY FOR FIGURES 3.8 THROUGH 3.27
FIRST ORDER COST CURVES
MECHANICAL PLANTS CLASSIFIED BY LEVEL OF TREATMENT

Figure Number	Title	Cost Equation*
3.8	Secondary Treatment - All Types of Sludge Handling	$C = (2.49 \times 10^6)Q^{0.72}$
3.9	Secondary Treatment - Simple Sludge Handling	$C = (1.68 \times 10^6)Q^{0.55}$
3.10	Secondary Treatment - Moderate Sludge Handling	$C = (2.41 \times 10^6)Q^{0.69}$
3.11	Secondary Treatment - Complex Sludge Handling	$C = (3.00 \times 10^6)Q^{0.71}$
3.12	Secondary Treatment with Phosphorus Removal - All Types of Sludge Handling	$C = (3.16 \times 10^6)Q^{0.72}$
3.13	Advanced Secondary Treatment (AST) - All Types of Sludge Handling	$C = (2.90 \times 10^6)Q^{0.72}$
3.14	AST - Simple Sludge Handling	$C = (1.98 \times 10^6)Q^{0.57}$
3.15	AST - Moderate Sludge Handling	$C = (2.57 \times 10^6)Q^{0.74}$
3.16	AST with Ammonia Removal - All Types of Sludge Handling	$C = (3.44 \times 10^6)Q^{0.79}$
3.17	AST with Ammonia Removal - Moderate Sludge Handling	$C = (3.01 \times 10^6)Q^{0.74}$
3.18	AST with Ammonia Removal - Complex Sludge Handling	$C = (4.39 \times 10^6)Q^{0.70}$
3.19	AST with Phosphorus Removal - All Types of Sludge Handling	$C = (3.75 \times 10^6)Q^{0.73}$
3.20	AST with Ammonia and Phosphorus Removal All Types of Sludge Handling	$C = (4.14 \times 10^6)Q^{0.82}$
3.21	Advanced Wastewater Treatment (AWT) - All Types of Sludge Handling	$C = (3.38 \times 10^6)Q^{0.74}$

* C = Construction Cost (million dollars)
Q = Plant Design Flow (mgd)

TABLE 3.3 (Concluded)

Figure Number	Title	Cost Equation
3.22	AWT - Moderate Sludge Handling	$C = (3.28 \times 10^6)Q^{0.74}$
3.23	AWT - Complex Sludge Handling	$C = (3.74 \times 10^6)Q^{0.85}$
3.24	AWT with Ammonia Removal - All Types of Sludge Handling	$C = (4.59 \times 10^6)Q^{0.83}$
3.25	AWT with Ammonia Removal - Moderate Sludge Handling	$C = (4.74 \times 10^6)Q^{0.82}$
3.26	AWT with Phosphorus Removal - All Types of Sludge Handling	$C = (3.77 \times 10^6)Q^{0.89}$
3.27	AWT with Phosphorus Removal - Moderate Sludge Handling	$C = (3.53 \times 10^6)Q^{0.86}$

NEW MECHANICAL PLANT
SECONDARY TREATMENT
ALL TYPES OF SLUDGE HANDLING

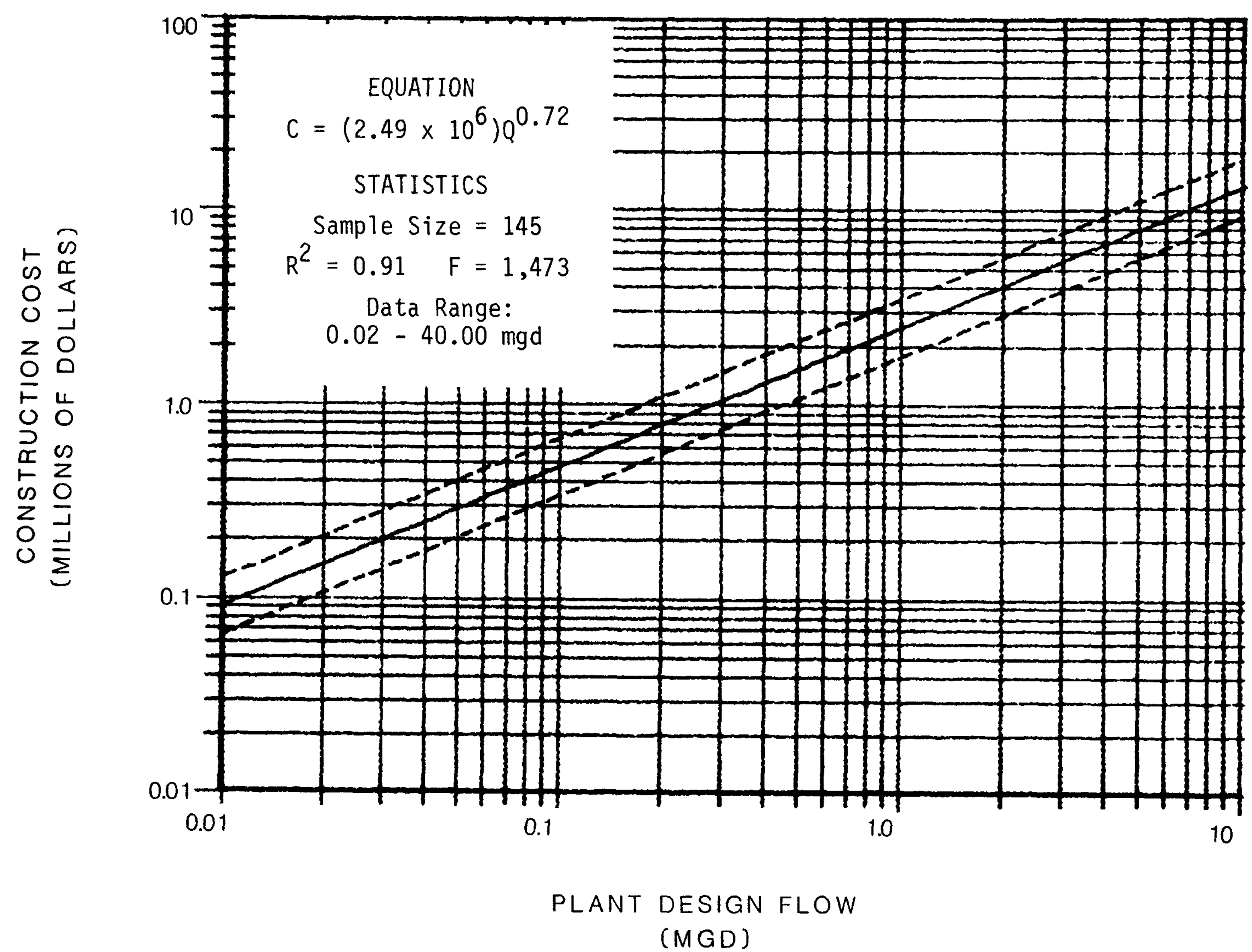


FIGURE 3.8

NEW MECHANICAL PLANT
SECONDARY TREATMENT
SIMPLE SLUDGE HANDLING

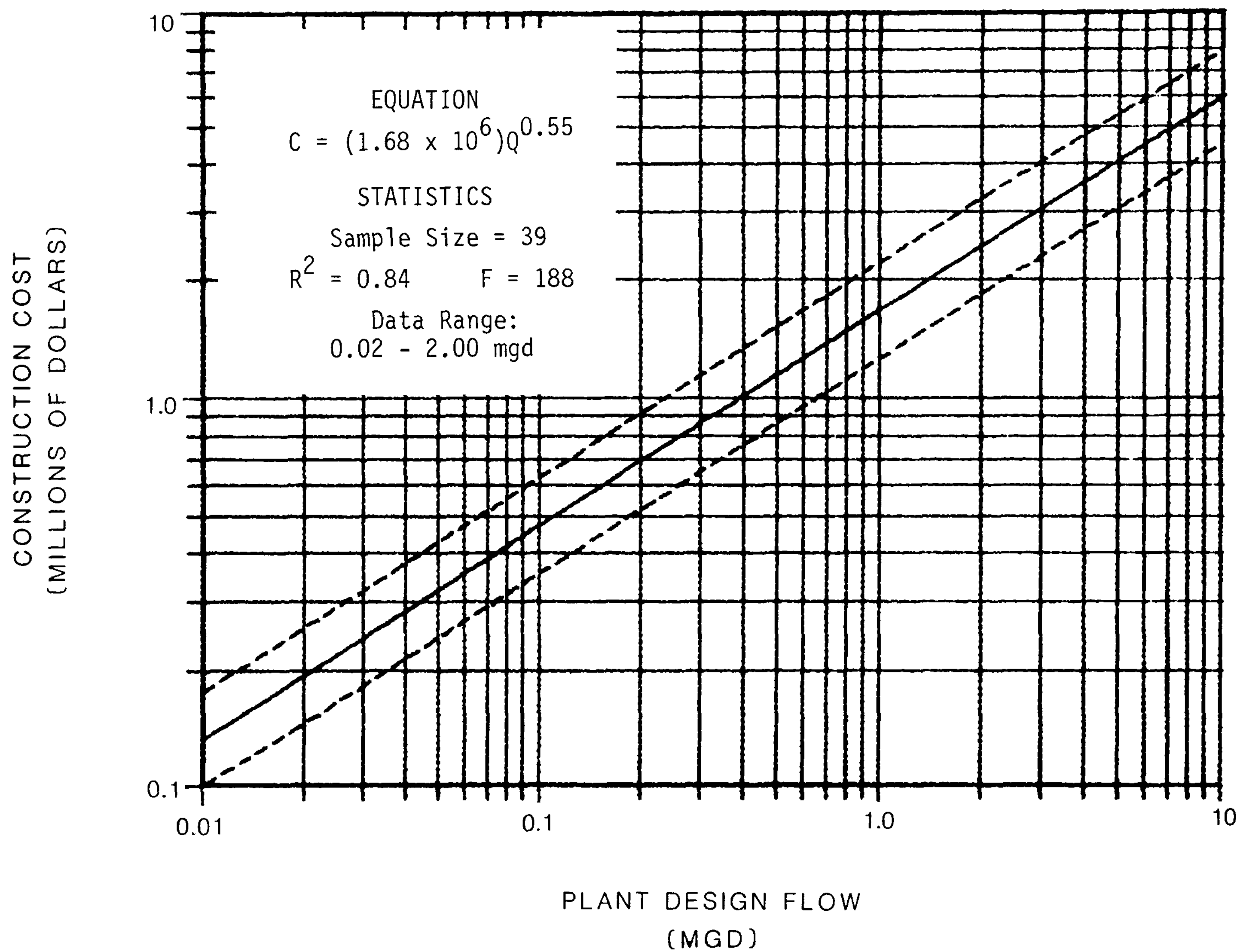


FIGURE 3.9

NEW MECHANICAL PLANT
SECONDARY TREATMENT
MODERATE SLUDGE HANDLING

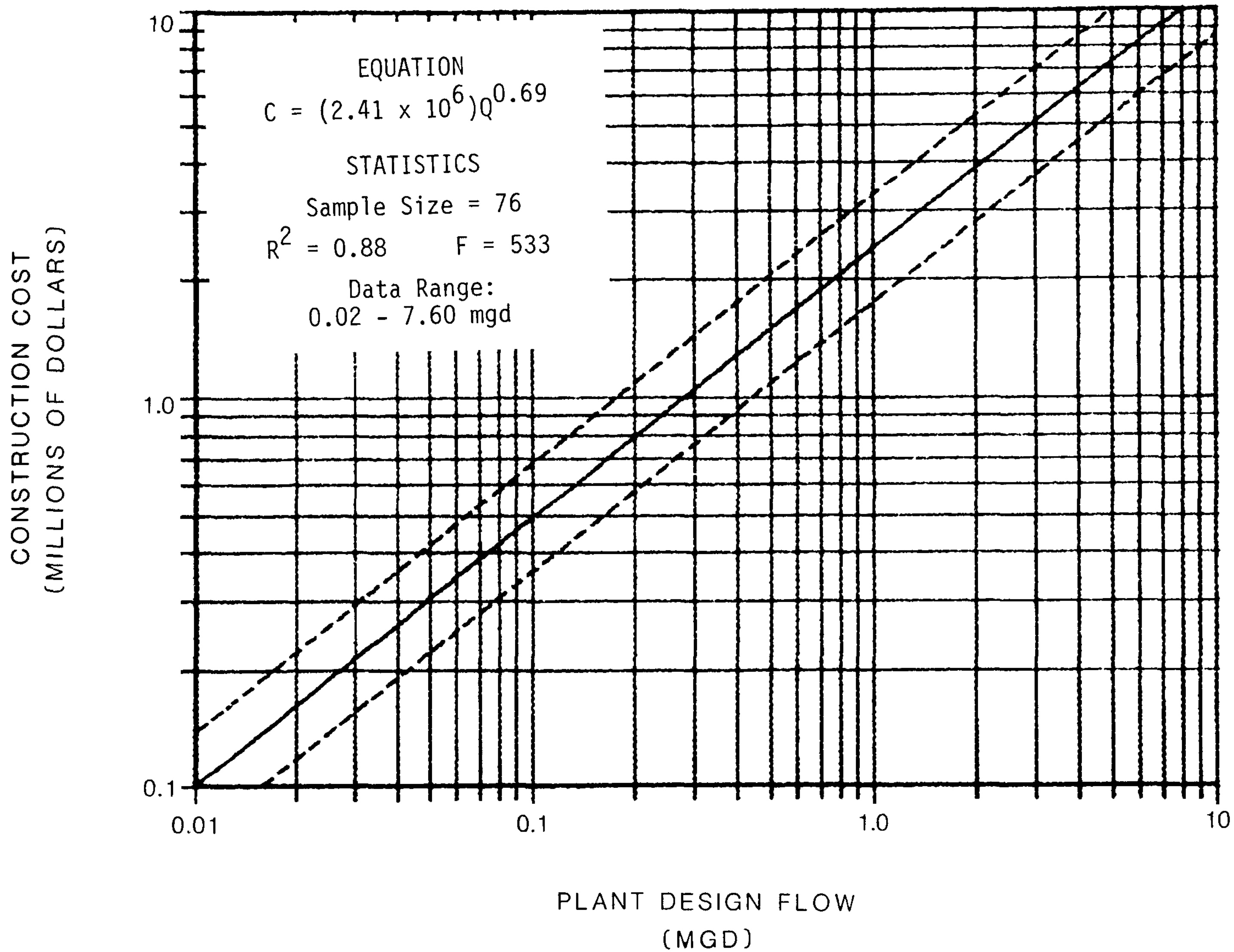


FIGURE 3.10

NEW MECHANICAL PLANT
SECONDARY TREATMENT
COMPLEX SLUDGE HANDLING

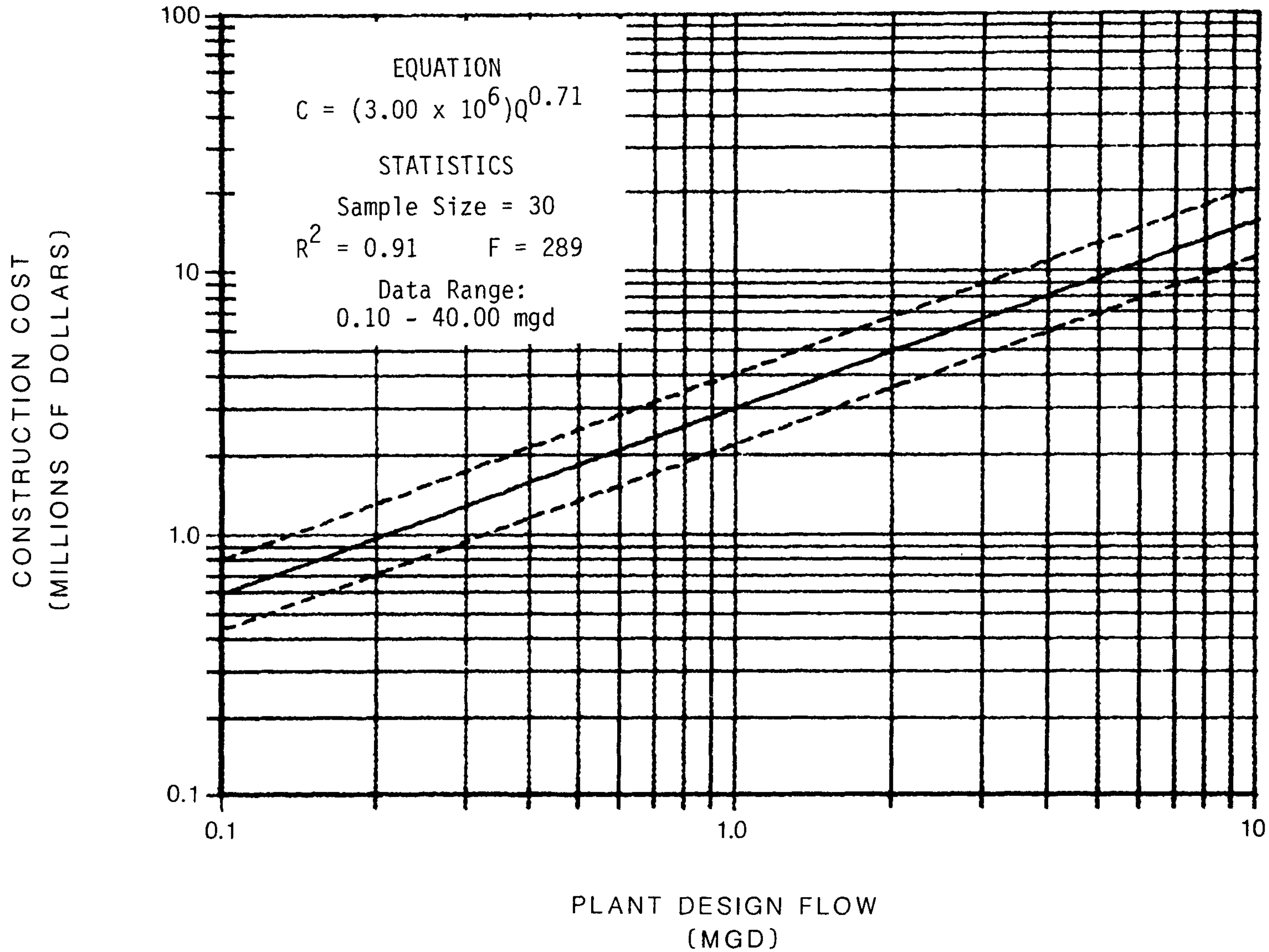


FIGURE 3.11

NEW MECHANICAL PLANT
SECONDARY TREATMENT WITH PHOSPHORUS REMOVAL
ALL TYPES OF SLUDGE HANDLING

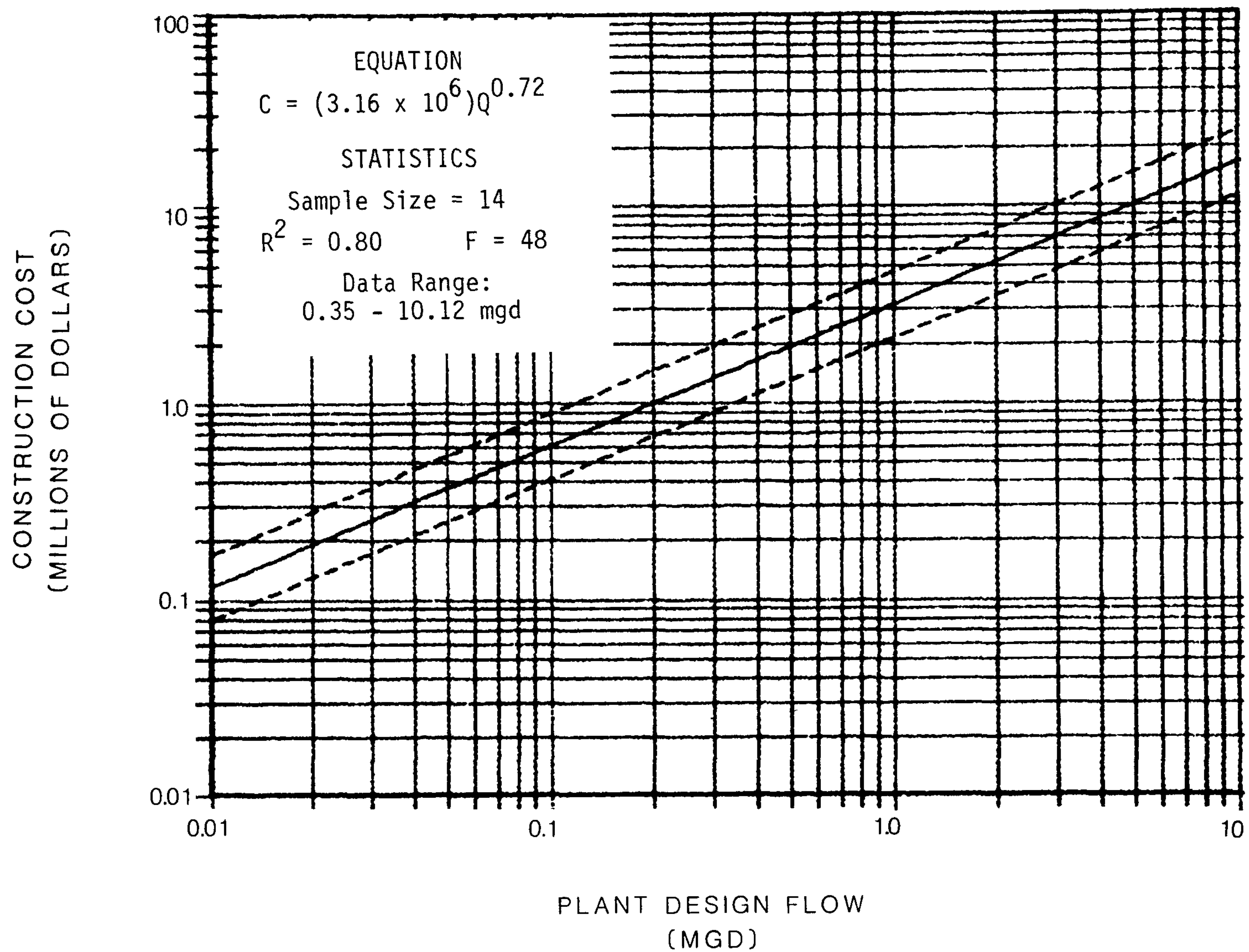


FIGURE 3.12

NEW MECHANICAL PLANT
ADVANCED SECONDARY TREATMENT (AST)
ALL TYPES OF SLUDGE HANDLING

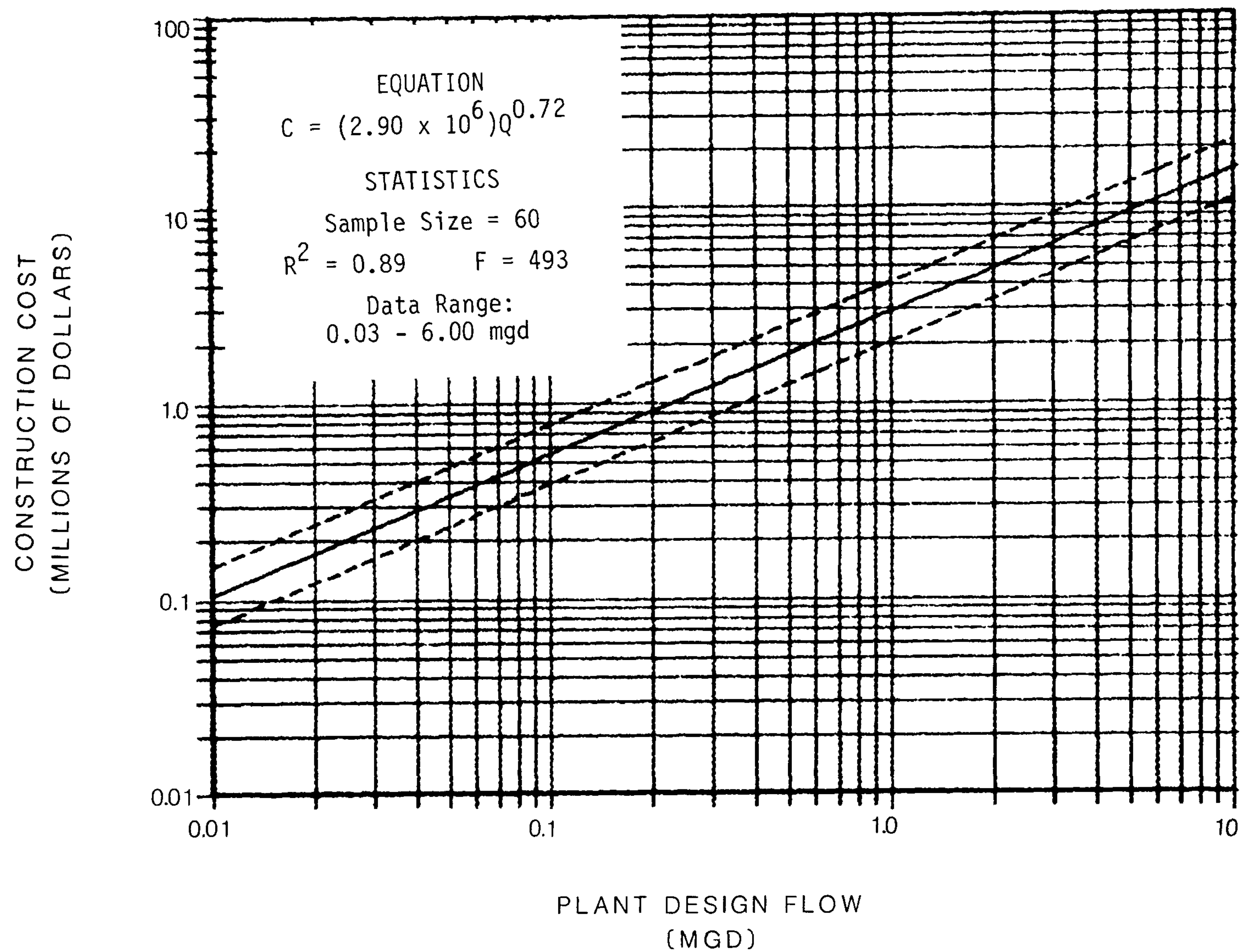


FIGURE 3.13

NEW MECHANICAL PLANT
ADVANCED SECONDARY TREATMENT (AST)
SIMPLE SLUDGE HANDLING

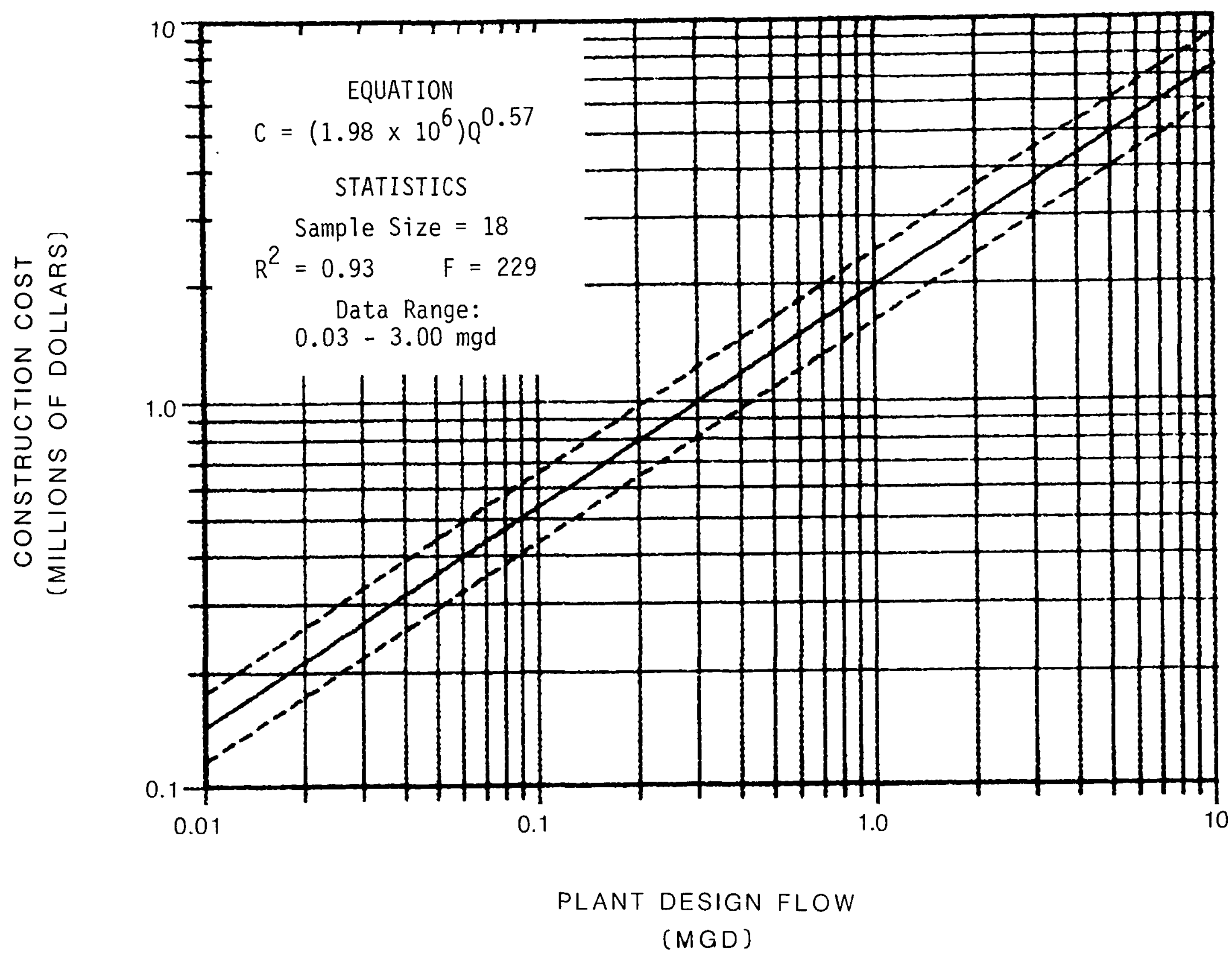
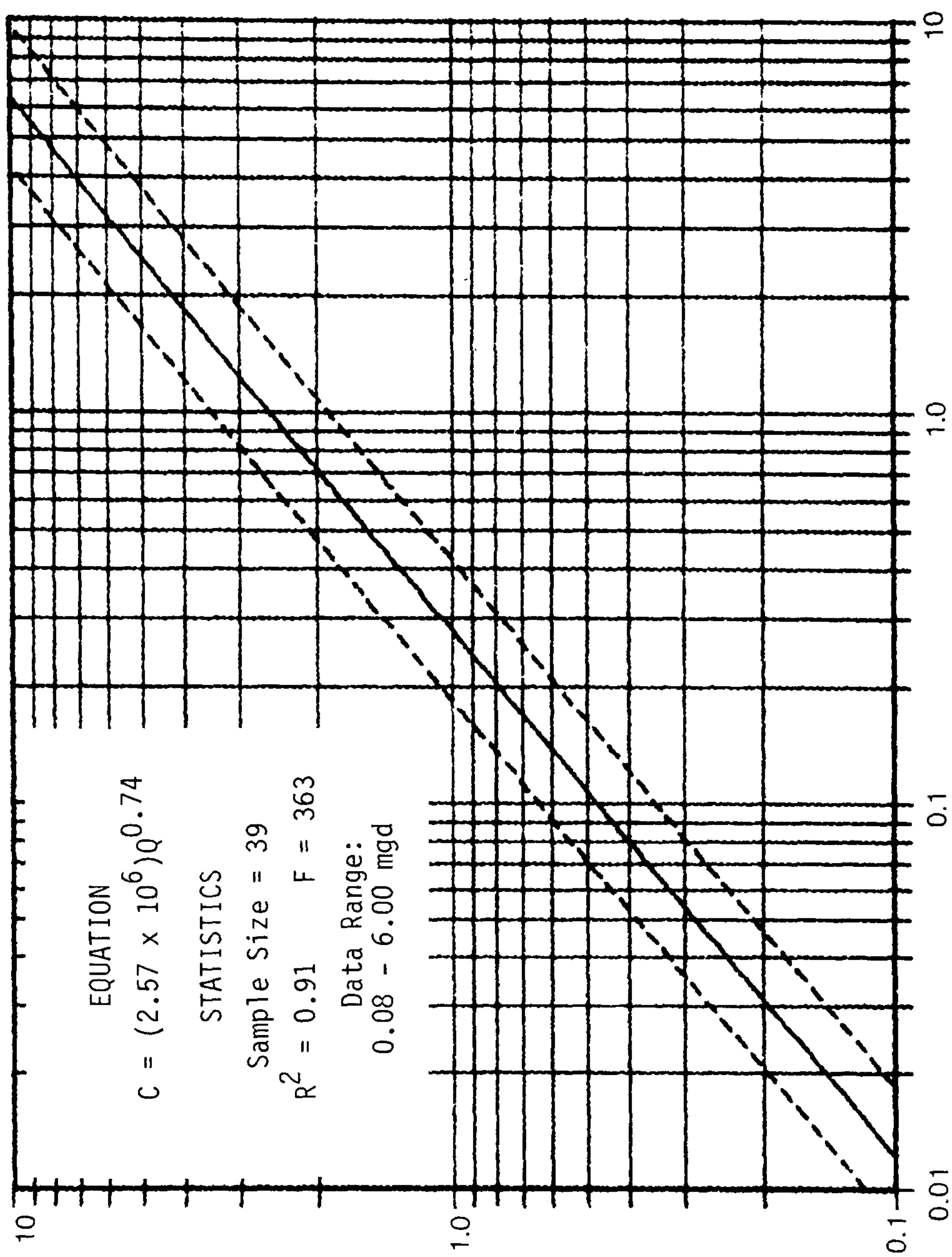


FIGURE 3.14

NEW MECHANICAL PLANT
ADVANCED SECONDARY TREATMENT (AST)
MODERATE SLUDGE HANDLING



PLANT DESIGN FLOW
(MGD)

CONSTRUCTION COST
(MILLIONS OF DOLLARS)

FIGURE 3.15

NEW MECHANICAL PLANT
AST WITH AMMONIA REMOVAL
ALL TYPES OF SLUDGE HANDLING

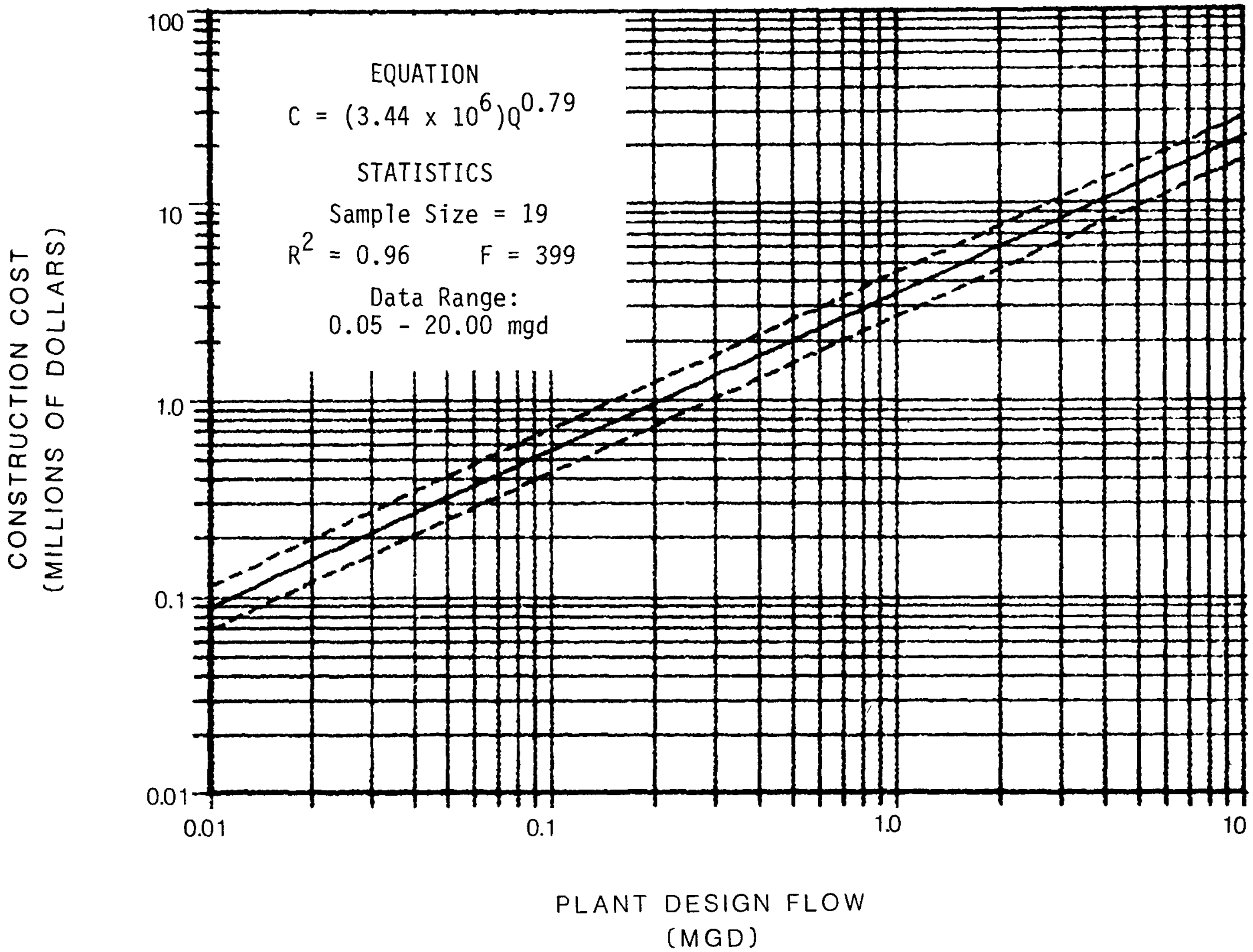


FIGURE 3.16

NEW MECHANICAL PLANT
AST WITH AMMONIA REMOVAL
MODERATE SLUDGE HANDLING

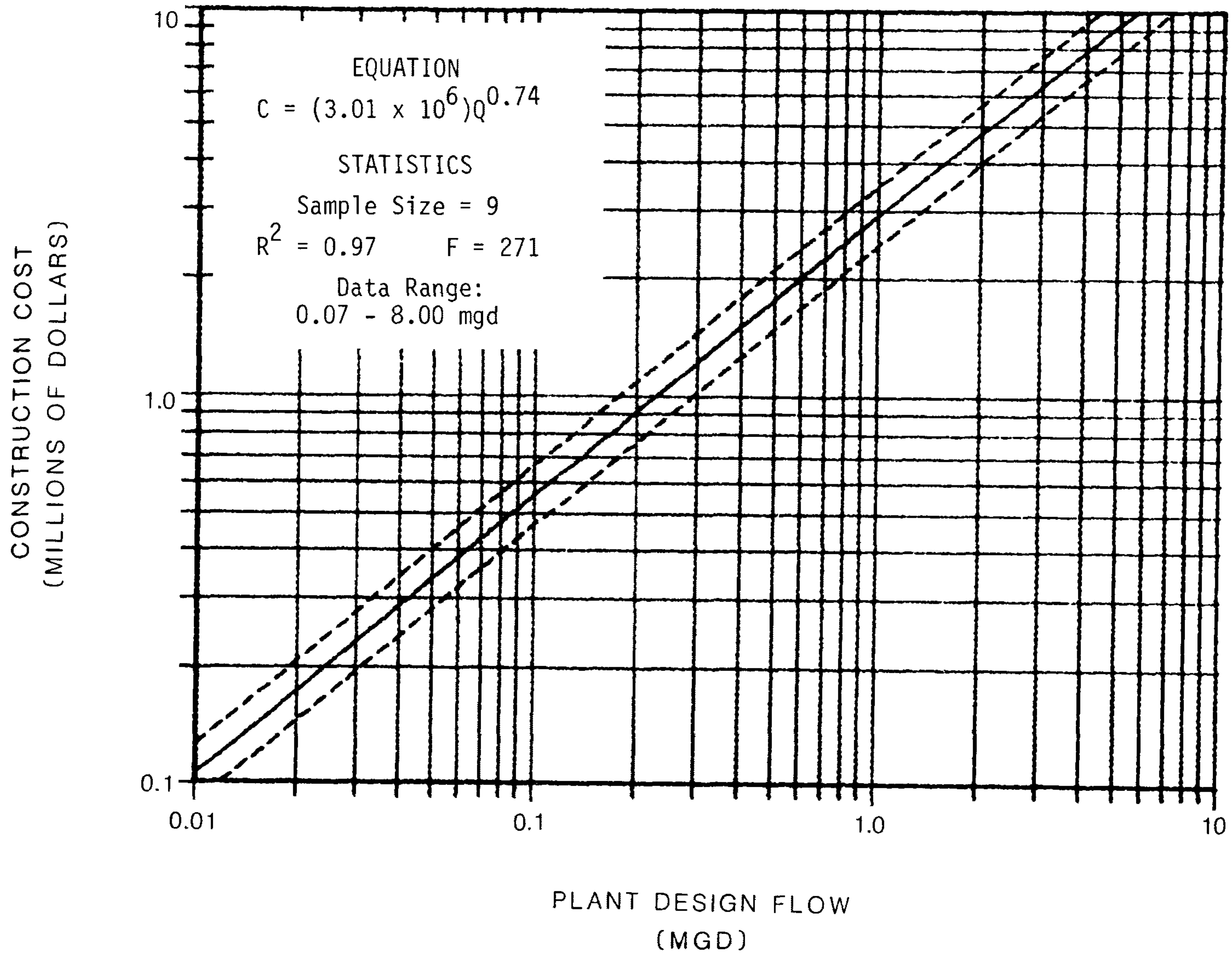


FIGURE 3.17

NEW MECHANICAL PLANT
AST WITH AMMONIA REMOVAL
COMPLEX SLUDGE HANDLING

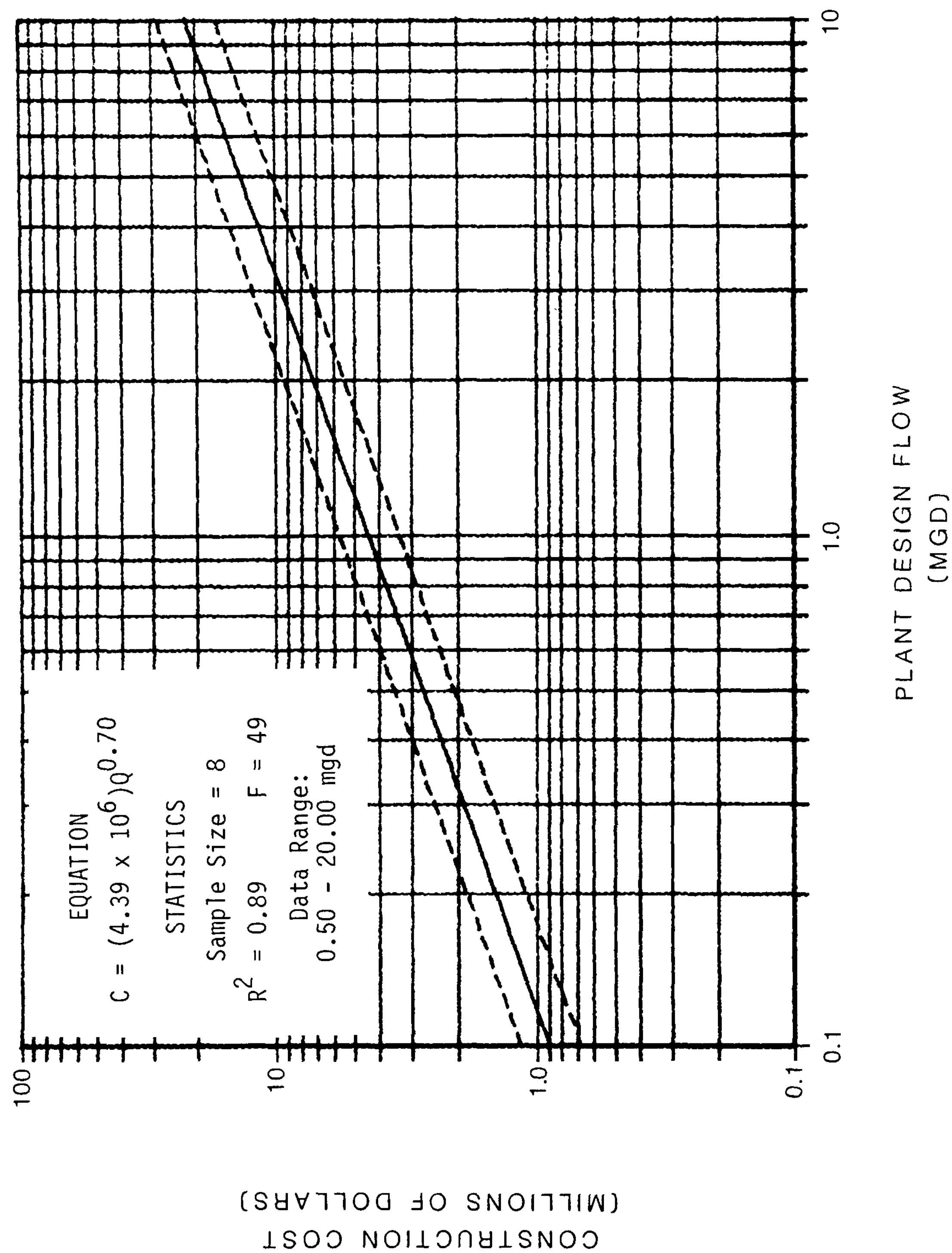


FIGURE 3.18

NEW MECHANICAL PLANT
AST WITH PHOSPHORUS REMOVAL
ALL TYPES OF SLUDGE HANDLING

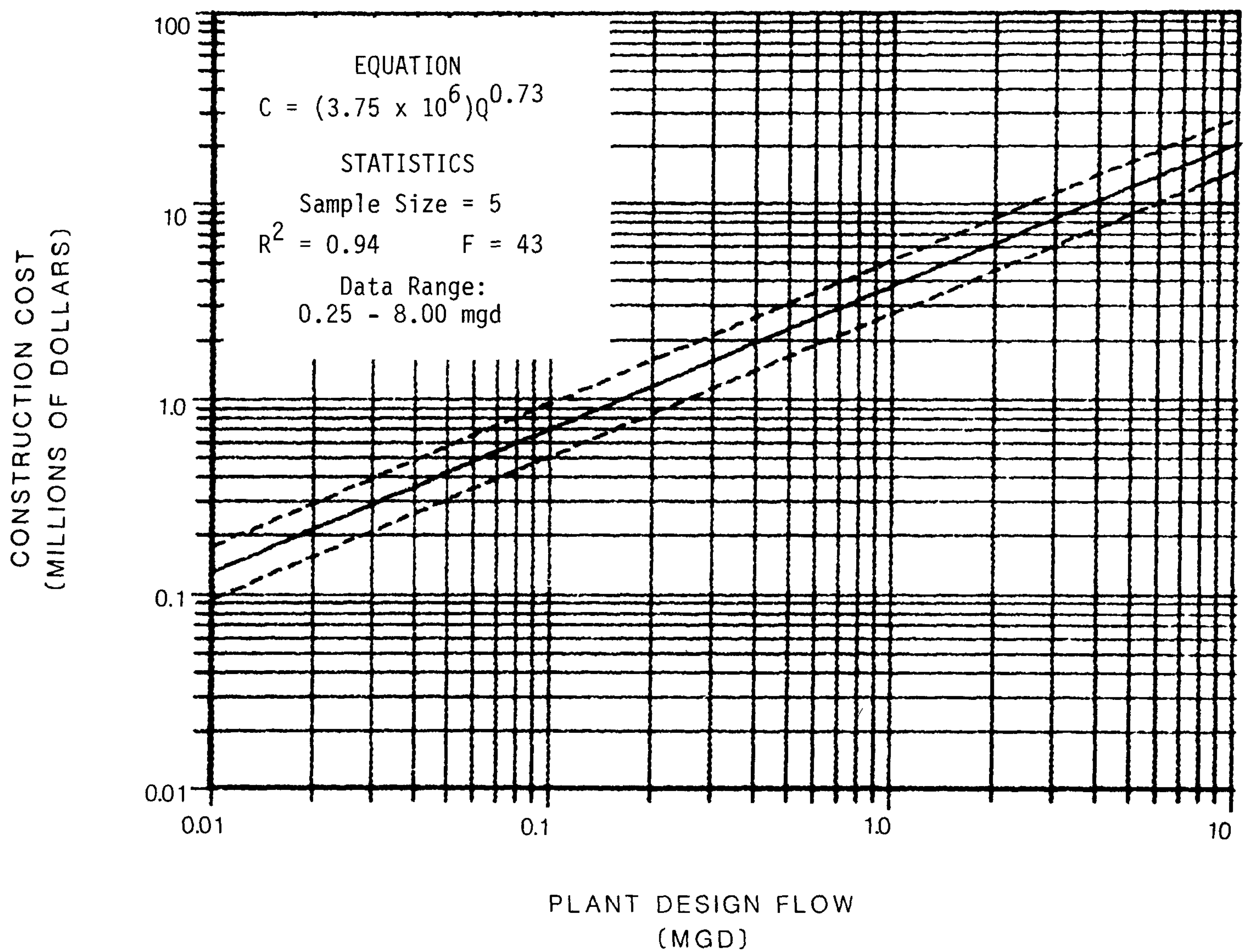


FIGURE 3.19

NEW MECHANICAL PLANT
AST WITH AMMONIA AND PHOSPHORUS REMOVAL
ALL TYPES OF SLUDGE HANDLING

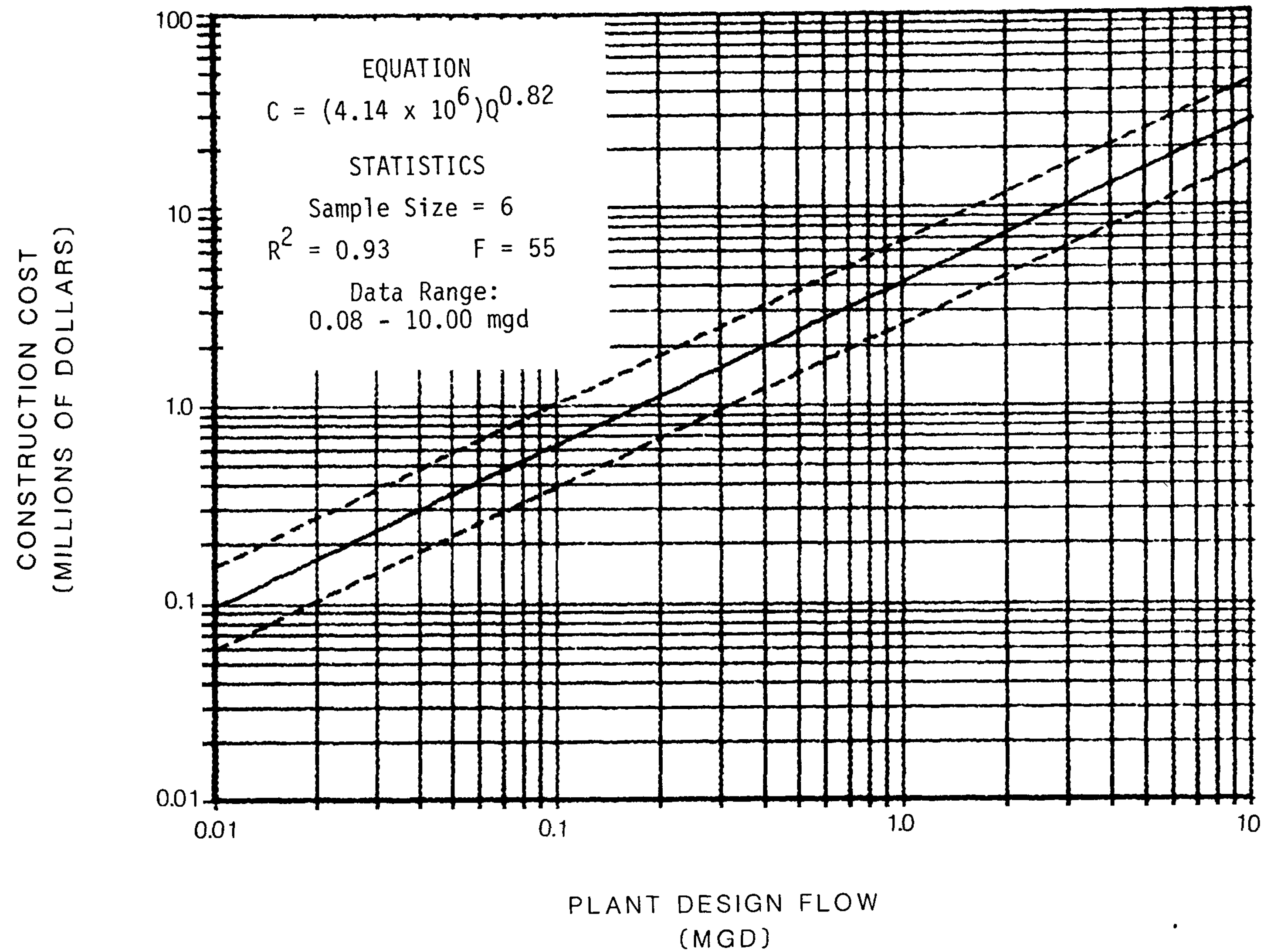


FIGURE 3.20

NEW MECHANICAL PLANT
ADVANCED WASTEWATER TREATMENT (AWT)
ALL TYPES OF SLUDGE HANDLING

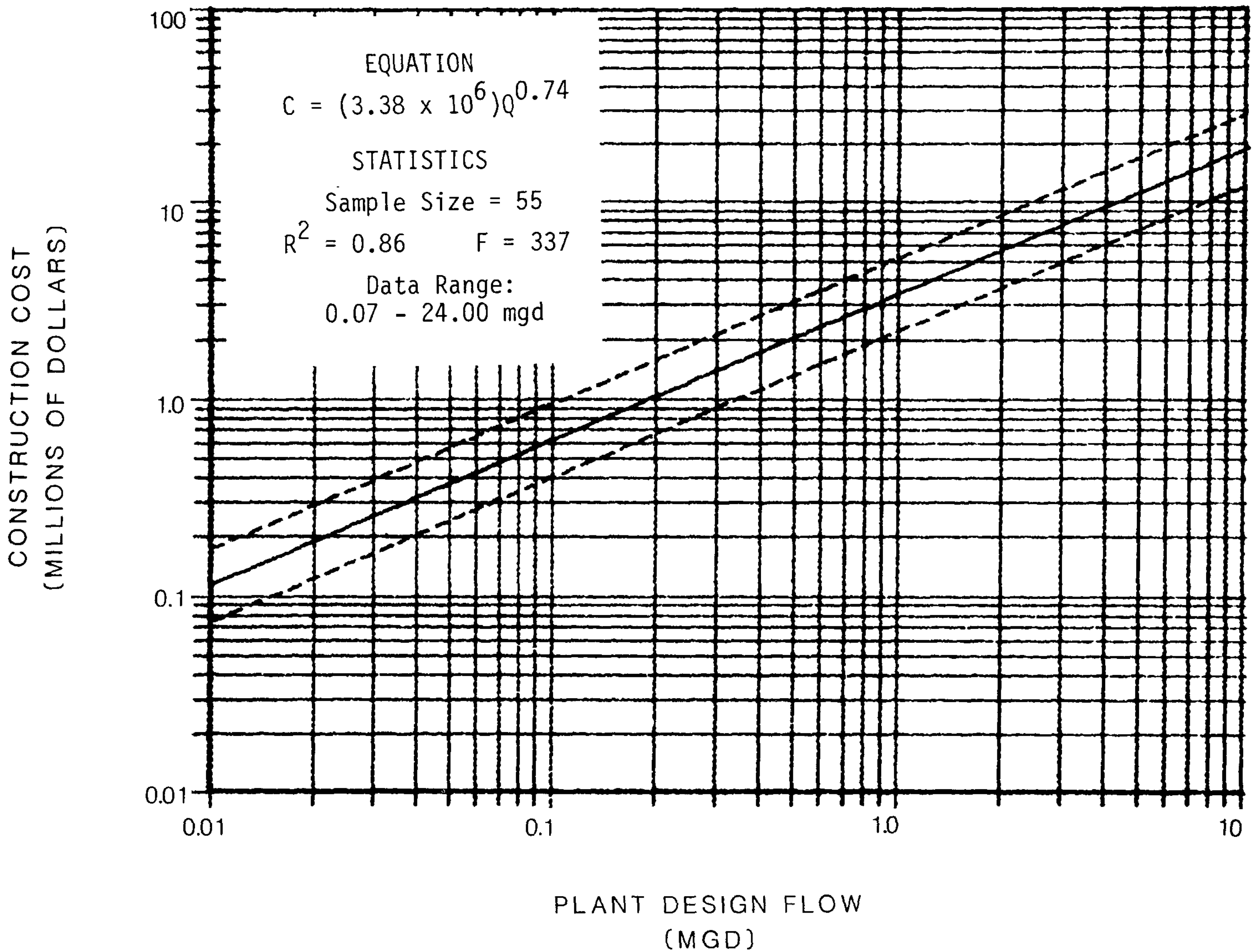
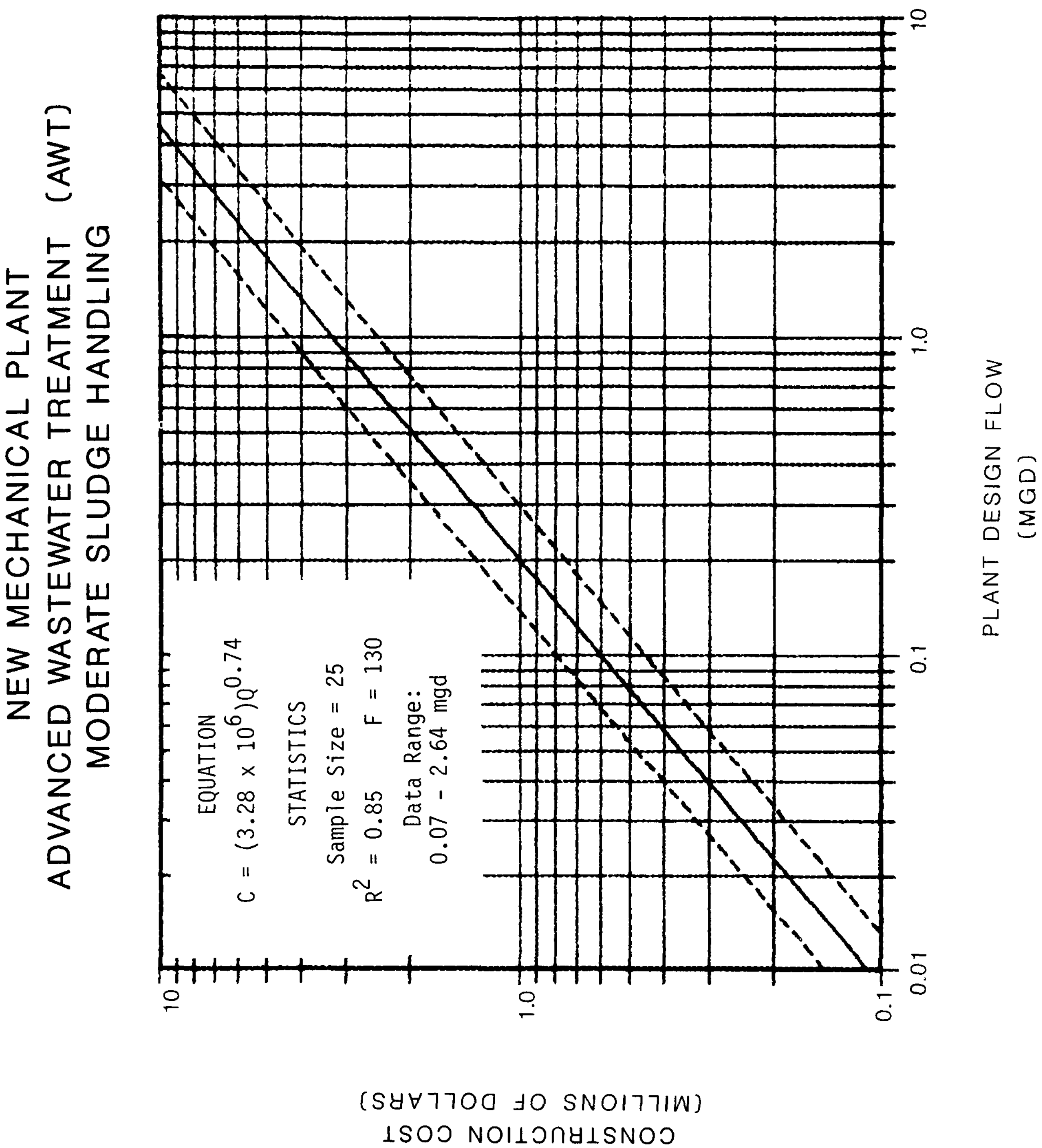


FIGURE 3.21



NEW MECHANICAL PLANT
ADVANCED WASTEWATER TREATMENT (AWT)
MODERATE SLUDGE HANDLING
EQUATION
$C = (3.28 \times 10^6)Q^{0.74}$
STATISTICS
Sample Size = 25
R^2 = 0.85 F = 130
Data Range:
0.07 - 2.64 mgd
10
1.0
0.1
0.01
0.1
1.0
10
PLANT DESIGN FLOW
(MGD)
CONSTRUCTION COST
(MILLIONS OF DOLLARS)

FIGURE 3.22

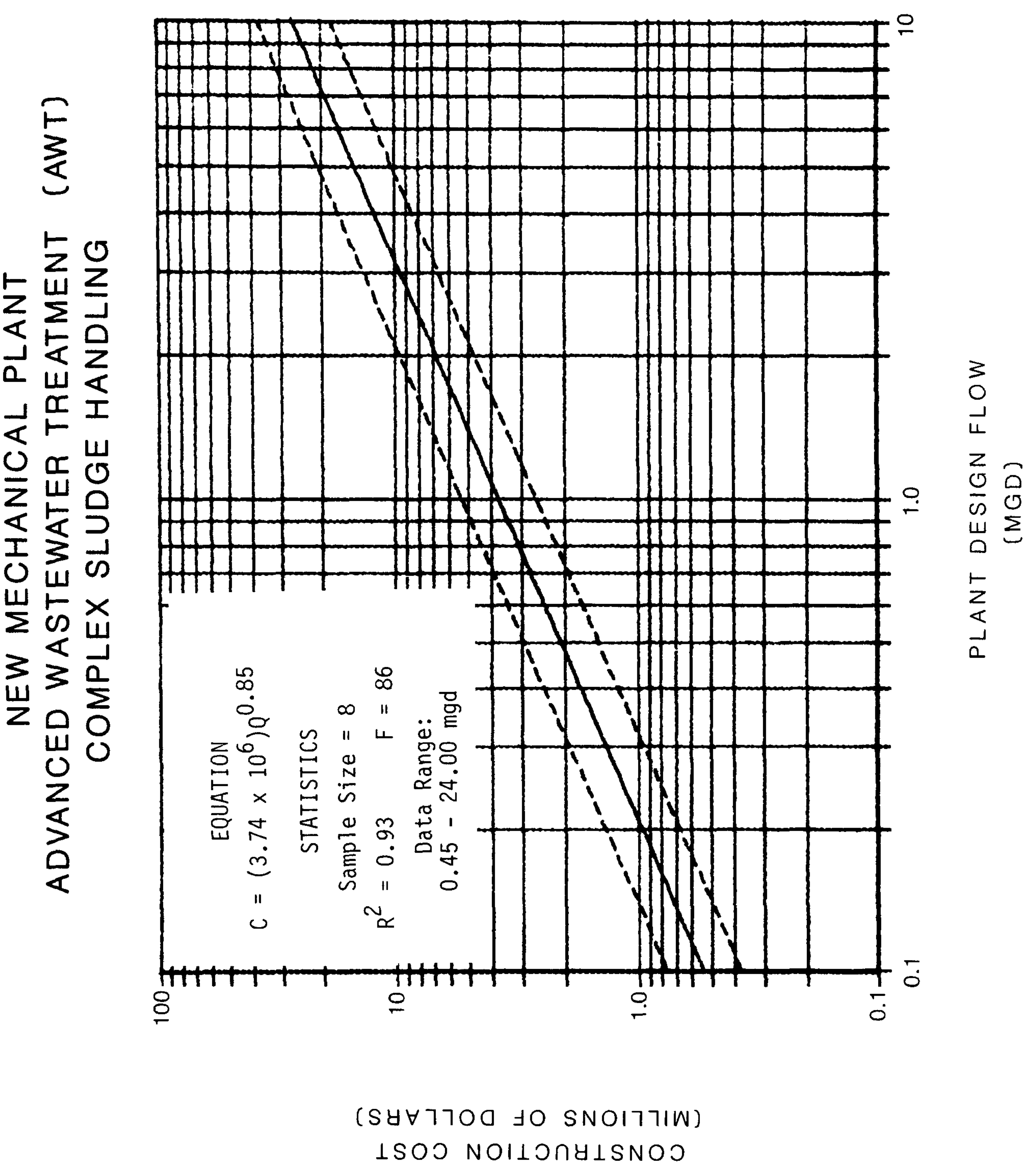

NEW MECHANICAL PLANT
ADVANCED WASTEWATER TREATMENT (AWT)
COMPLEX SLUDGE HANDLING
EQUATION
C = (3.74 x 10^6)Q^0.85
STATISTICS
Sample Size = 8
R^2 = 0.93 F = 86
Data Range:
0.45 - 24.00 mgd
100
10
1.0
0.1
0.1
1.0
10
CONSTRUCTION COST
(MILLIONS OF DOLLARS)
PLANT DESIGN FLOW
(MGD)

FIGURE 3.23

NEW MECHANICAL PLANT
AWT WITH AMMONIA REMOVAL
ALL TYPES OF SLUDGE HANDLING

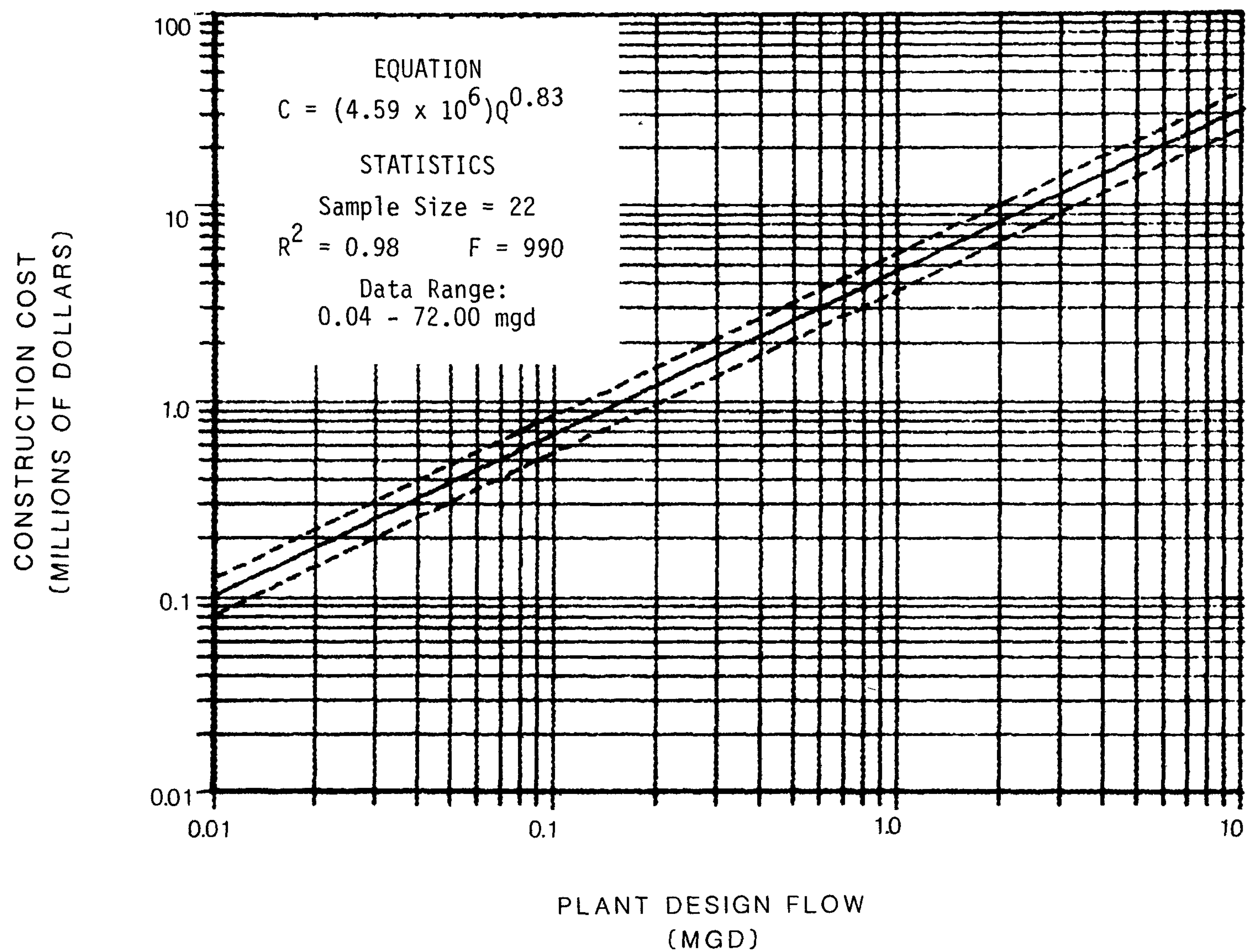


FIGURE 3.24

NEW MECHANICAL PLANT
AWT WITH AMMONIA REMOVAL
MODERATE SLUDGE HANDLING

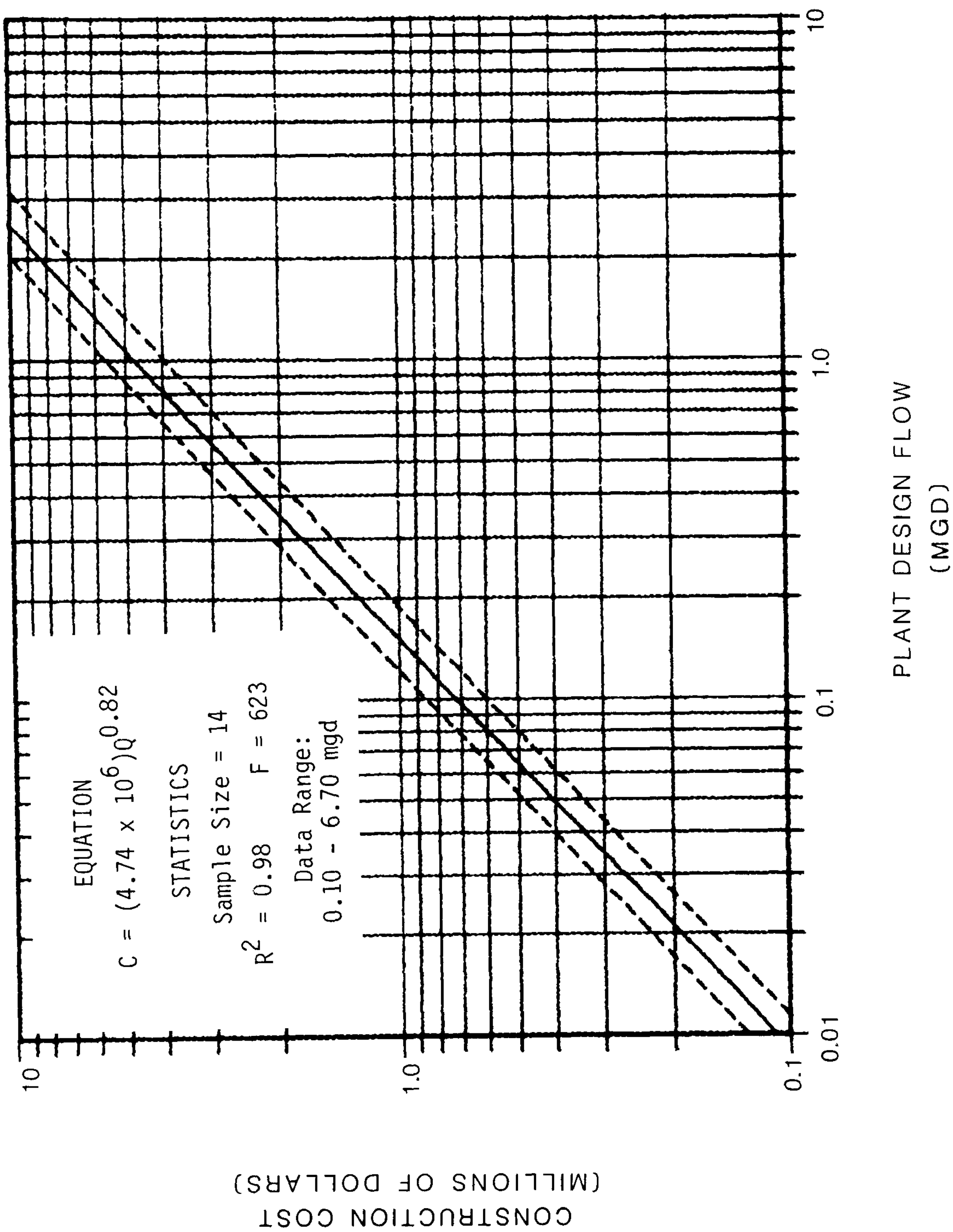


FIGURE 3.25

NEW MECHANICAL PLANT
AWT WITH PHOSPHORUS REMOVAL
ALL TYPES OF SLUDGE HANDLING

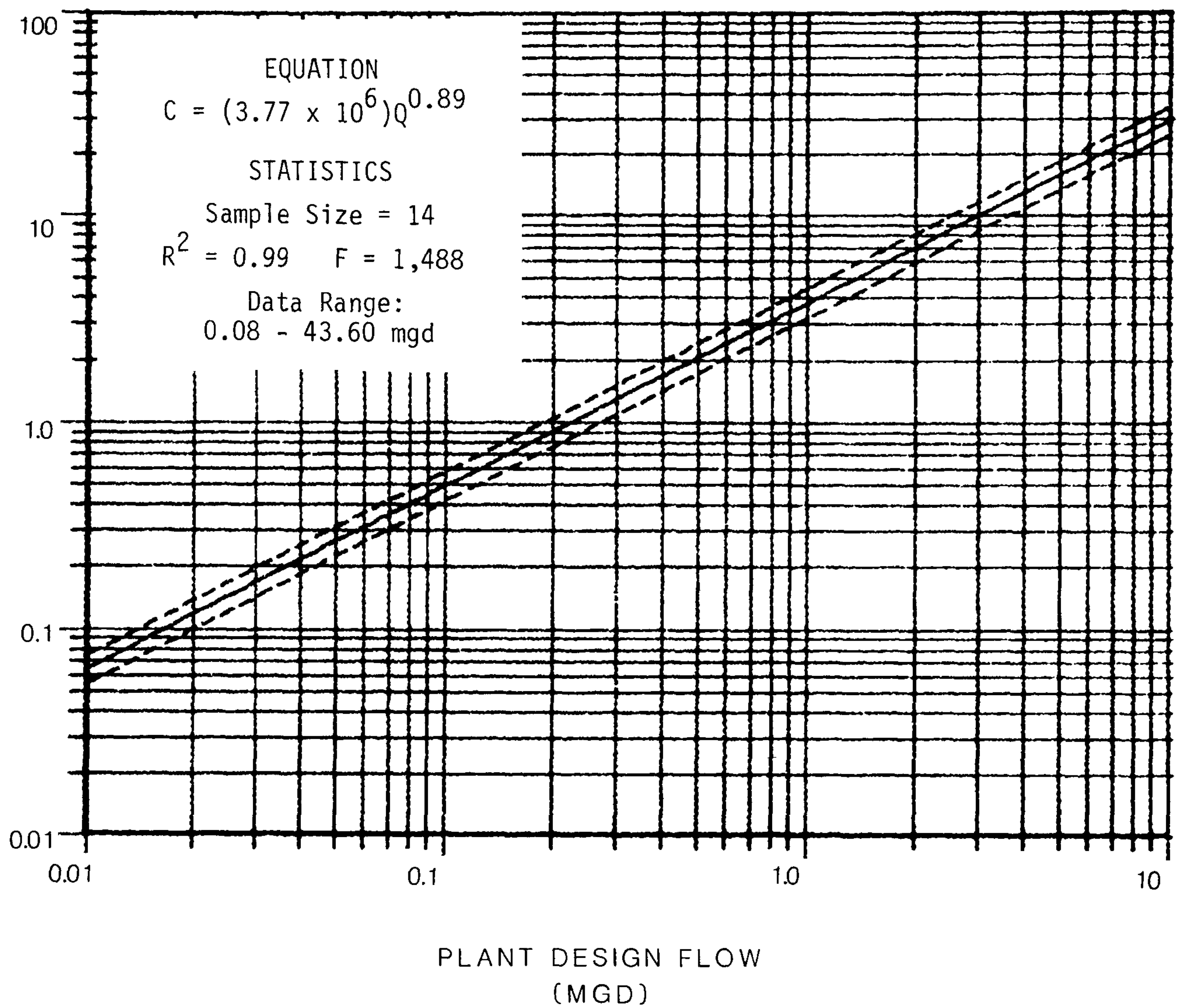


FIGURE 3.26

NEW MECHANICAL PLANT
AWT WITH PHOSPHORUS REMOVAL
MODERATE SLUDGE HANDLING

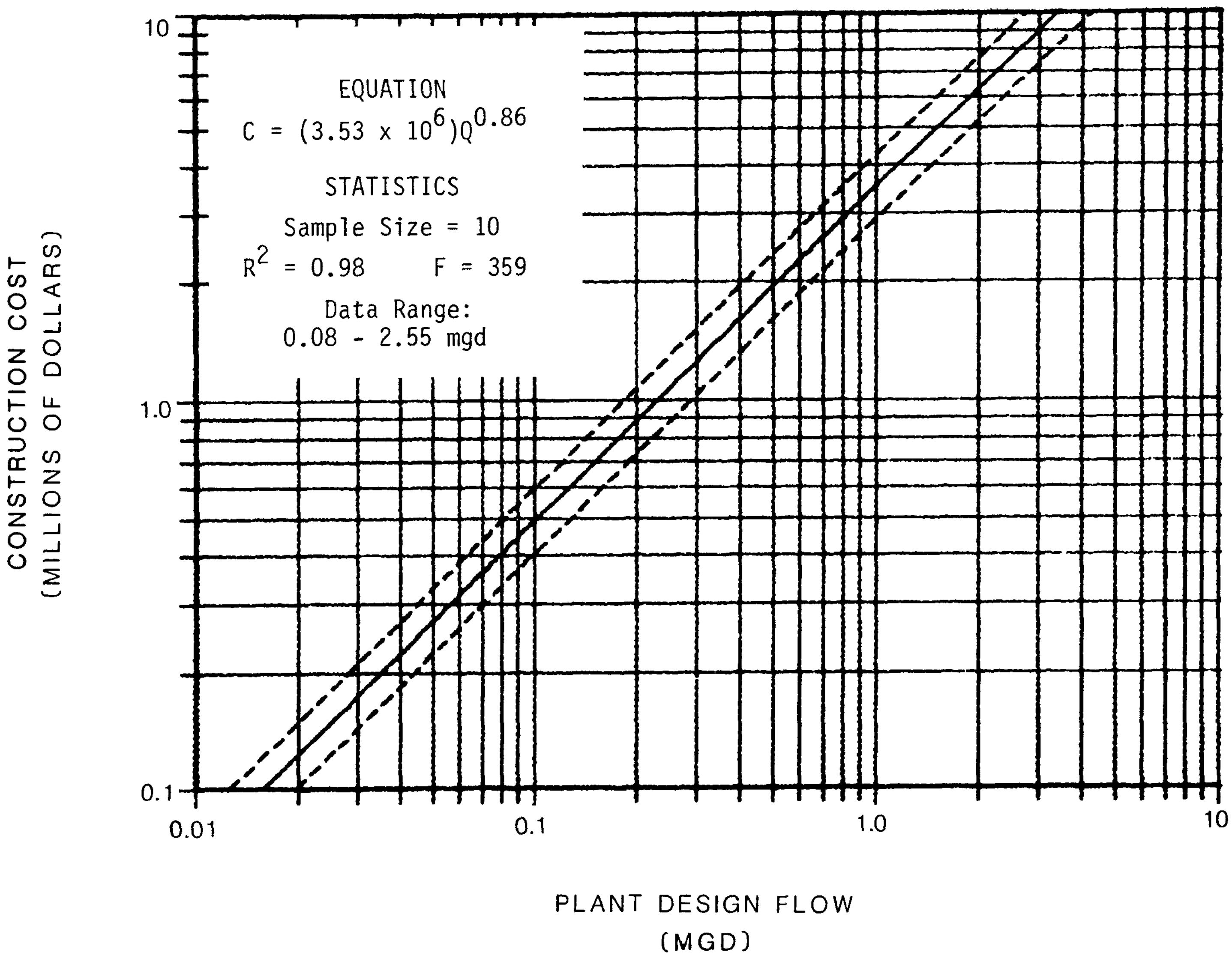


FIGURE 3.27

3.2.3.2 Results - Mechanical Plants by Level of Treatment and Main Treatment Process

This section contains the results from the analyses of the first order cost relationships between the design flow of a facility and its construction cost. Prior to analysis, facilities were classified by level of treatment, main liquid line treatment process, and, wherever possible, by the type of sludge handling. Further, only completely new mechanical plants with effluent disposal to nonocean surface waters were included.

Figures 3.28 through 3.64 contain the results obtained from these analyses. The figures are ordered so that all results pertaining to a specific treatment process are grouped. The major groupings are listed below:

Treatment Process	Figure Numbers
All Types of Activated Sludge	3.28 through 3.37
Conventional Activated Sludge	3.38 through 3.45
Contact Stabilization	3.46 through 3.47
Extended Aeration	3.48 through 3.52
Pure Oxygen Activated Sludge	3.53 through 3.54
Oxidation Ditch Process	3.55 through 3.61
Rotating Biological Contactor	3.62 through 3.64

Within the major groupings of treatment processes, the figures are ordered by treatment level.

Each figure contains several important items: title, x-axis label (independent variable), y-axis (dependent variable), cost equation, equation statistics, regression line (solid line), and the SRE (dashed lines). All these items should be taken into account by the reader.

The regression line and the cost equation derived from the line represent the predicted construction cost for the particular type of facility identified in the title. The cost derived using the line or equation is an estimate for the construction of a complete operational wastewater facility. The cost includes all processes from the headworks to the effluent outfall line. The only additional costs that need to be considered are the various nonconstruction costs.

Facilities were categorized prior to analysis on the basis of their main biological liquid line treatment process. One of the treatment process categories, All Types of Activated Sludge, is a summation of most of the variations of the activated sludge process. Included in this category are conventional, contact stabilization, and extended aeration activated sludge facilities. Facilities utilizing the oxidation ditch process or the pure oxygen activated sludge process are not included.

For some categories of facilities, it was possible to obtain results for differing levels of sludge handling. Four types of sludge handling are identified: all, simple, moderate, and complex. The level, All Types of Sludge Handling, is a summation of the simple, moderate, and complex types.

The reader should note that all facilities represented in this section were also included in the results shown in Section 3.2.3.1. All results in Section 3.2.3.2 were produced using subsets of facilities from the more general categories of facilities from Section 3.2.2.1.

The results show that the construction costs for facilities having similar treatment levels and design flows can vary considerably depending on the main treatment process. A comparison of the costs for facilities with a design flow of 1.0 mgd, secondary treatment level, and all types of sludge handling is shown on the following page:

Main Treatment Process	Cost for 1.0 mgd Plant	Sample Size
Oxidation Ditch	$1,660,000	41
Extended Aeration	$2,420,000	35
Conventional Activated Sludge	$2,580,000	52
Rotating Biological Contactor	$4,500,000	10
Pure Oxygen Activated Sludge	$5,420,000	4

Pure oxygen activated sludge facilities are more expensive than conventional activated sludge facilities. However, the magnitude of the difference may not be as great as the above comparison indicates. The reader should take into consideration the relatively small sample available for pure oxygen facilities. The small sample size might not be truly representative of all pure oxygen facilities which have been constructed.

Table 3.4 contains a summary of Figures 3.28 through 3.64 with associated titles and cost equations.

TABLE 3.4

SUMMARY FOR FIGURES 3.28 THROUGH 3.64
FIRST ORDER COST CURVES
MECHANICAL PLANTS CLASSIFIED BY MAIN TREATMENT PROCESS

Figure Number	Title	Cost Equation*
3.28	Activated Sludge (All Types) - Secondary Treatment - All Types of Sludge Handling	$C = (2.72 \times 10^6)Q^{0.72}$
3.29	Activated Sludge (All Types) - Secondary Treatment - Moderate Sludge Handling	$C = (2.57 \times 10^6)Q^{0.72}$
3.30	Activated Sludge (All Types) - Secondary Treatment - Complex Sludge Handling	$C = (3.60 \times 10^6)Q^{0.70}$
3.31	Activated Sludge (All Types) - Secondary Treatment with Phosphorus Removal - All Types of Sludge Handling	$C = (3.13 \times 10^6)Q^{0.72}$
3.32	Activated Sludge (All Types) - AST - All Types of Sludge Handling	$C = (2.98 \times 10^6)Q^{0.78}$
3.33	Activated Sludge (All Types) - AST - AST/Simple Sludge Handling	$C = (2.72 \times 10^6)Q^{0.75}$
3.34	Activated Sludge (All Types) - AST - Moderate Sludge Handling	$C = (2.77 \times 10^6)Q^{0.77}$
3.35	Activated Sludge (All Types) - AWT - All Types of Sludge Handling	$C = (3.44 \times 10^6)Q^{0.77}$
3.36	Activated Sludge (All Types) - AWT - Moderate Sludge Handling	$C = (4.29 \times 10^6)Q^{0.77}$
3.37	Activated Sludge (All Types) - AWT with Phosphorus Removal - All Types of Sludge Handling	$C = (3.93 \times 10^6)Q^{0.92}$
3.38	Conventional Activated Sludge - Secondary Treatment - All Types of Sludge Handling	$C = (2.58 \times 10^6)Q^{0.74}$

* C = Construction Cost (million dollars)
  Q = Plant Design Flow (mgd)

TABLE 3.4 (Continued)

Figure Number	Title	Cost Equation
3.39	Conventional Activated Sludge - Secondary Treatment - Moderate Sludge Handling	$C = (2.62 \times 10^6)Q^{0.68}$
3.40	Conventional Activated Sludge - Secondary Treatment - Complex Sludge Handling	$C = (3.08 \times 10^6)Q^{0.71}$
3.41	Conventional Activated Sludge - AST - All Types of Sludge Handling	$C = (2.62 \times 10^6)Q^{0.78}$
3.42	Conventional Activated Sludge - AST - Moderate Sludge Handling	$C = (2.65 \times 10^6)Q^{0.75}$
3.43	Conventional Activated Sludge - AWT - All Types of Sludge Handling	$C = (3.35 \times 10^6)Q^{0.78}$
3.44	Conventional Activated Sludge - AWT - Moderate Sludge Handling	$C = (3.12 \times 10^6)Q^{0.78}$
3.45	Conventional Activated Sludge - AWT - Complex Sludge Handling	$C = (2.63 \times 10^6)Q^{0.94}$
3.46	Contact Stabilization - AST - All Types of Sludge Handling	$C = (2.02 \times 10^6)Q^{0.65}$
3.47	Contact Stabilization - AST - Moderate Sludge Handling	$C = (2.04 \times 10^6)Q^{0.68}$
3.48	Extended Aeration - Secondary Treatment All Types of Sludge Handling	$C = (2.42 \times 10^6)Q^{0.68}$
3.49	Extended Aeration - Secondary Treatment Simple Sludge Handling	$C = (2.11 \times 10^6)Q^{0.65}$
3.50	Extended Aeration - Secondary Treatment Moderate Sludge Handling	$C = (2.58 \times 10^6)Q^{0.68}$
3.51	Extended Aeration - AST - All Types of Sludge Handling	$C = (2.51 \times 10^6)Q^{0.70}$
3.52	Extended Aeration - AST - Simple Sludge Handling	$C = (2.23 \times 10^6)Q^{0.68}$
3.53	Pure Oxygen Activated Sludge - Secondary Treatment - All Types of Sludge Handling	$C = (5.42 \times 10^6)Q^{0.66}$

TABLE 3.4 (Concluded)

Figure Number	Title	Cost Equation
3.54	Pure Oxygen Activated Sludge - Secondary Treatment - Complex Sludge Handling	$C = (4.65 \times 10^6)Q^{0.71}$
3.55	Oxidation Ditch - Secondary Treatment - All Types of Sludge Handling	$C = (1.66 \times 10^6)Q^{0.61}$
3.56	Oxidation Ditch - Secondary Treatment - Simple Sludge Handling	$C = (1.48 \times 10^6)Q^{0.57}$
3.57	Oxidation Ditch - Secondary Treatment - Moderate Sludge Handling	$C = (1.70 \times 10^6)Q^{0.58}$
3.58	Oxidation Ditch - AST - All Types of Sludge Handling	$C = (1.99 \times 10^6)Q^{0.60}$
3.59	Oxidation Ditch - AST - Simple Sludge Handling	$C = (1.83 \times 10^6)Q^{0.61}$
3.60	Oxidation Ditch - AST - Moderate Sludge Handling	$C = (2.45 \times 10^6)Q^{0.65}$
3.61	Oxidation Ditch - AWT - All Types of Sludge Handling	$C = (2.29 \times 10^6)Q^{0.62}$
3.62	Rotating Biological Contactor - Secondary Treatment - All Types of Sludge Handling	$C = (4.50 \times 10^6)Q^{0.71}$
3.63	Rotating Biological Contactor - Secondary Treatment - Complex Sludge Handling	$C = (4.68 \times 10^6)Q^{0.67}$
3.64	Rotating Biological Contactor - AWT - All Types of Sludge Handling	$C = (5.37 \times 10^6)Q^{0.86}$

NEW ACTIVATED SLUDGE PLANT (ALL TYPES)
SECONDARY TREATMENT
ALL TYPES OF SLUDGE HANDLING

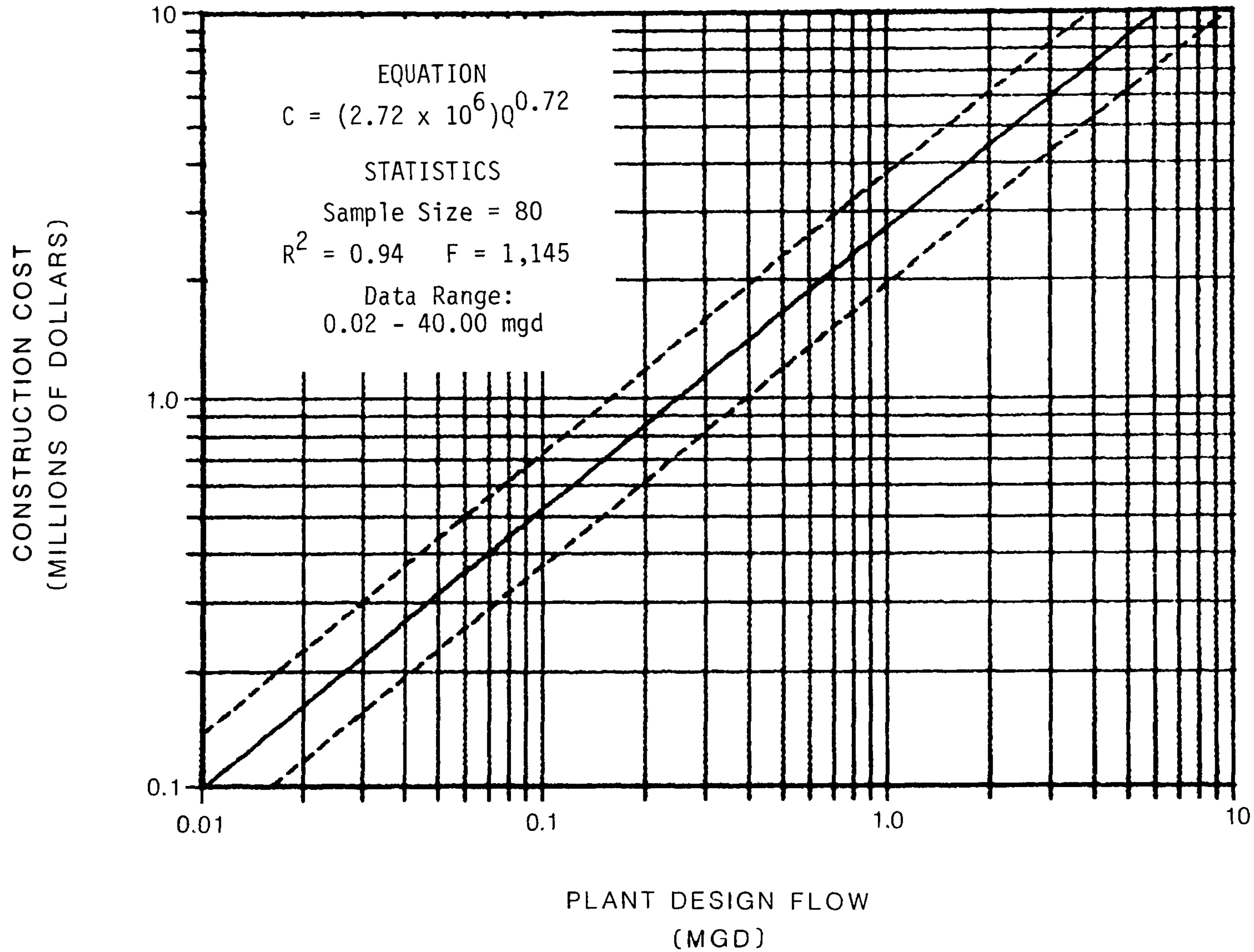


FIGURE 3.28

NEW ACTIVATED SLUDGE PLANT (ALL TYPES)
SECONDARY TREATMENT
MODERATE SLUDGE HANDLING

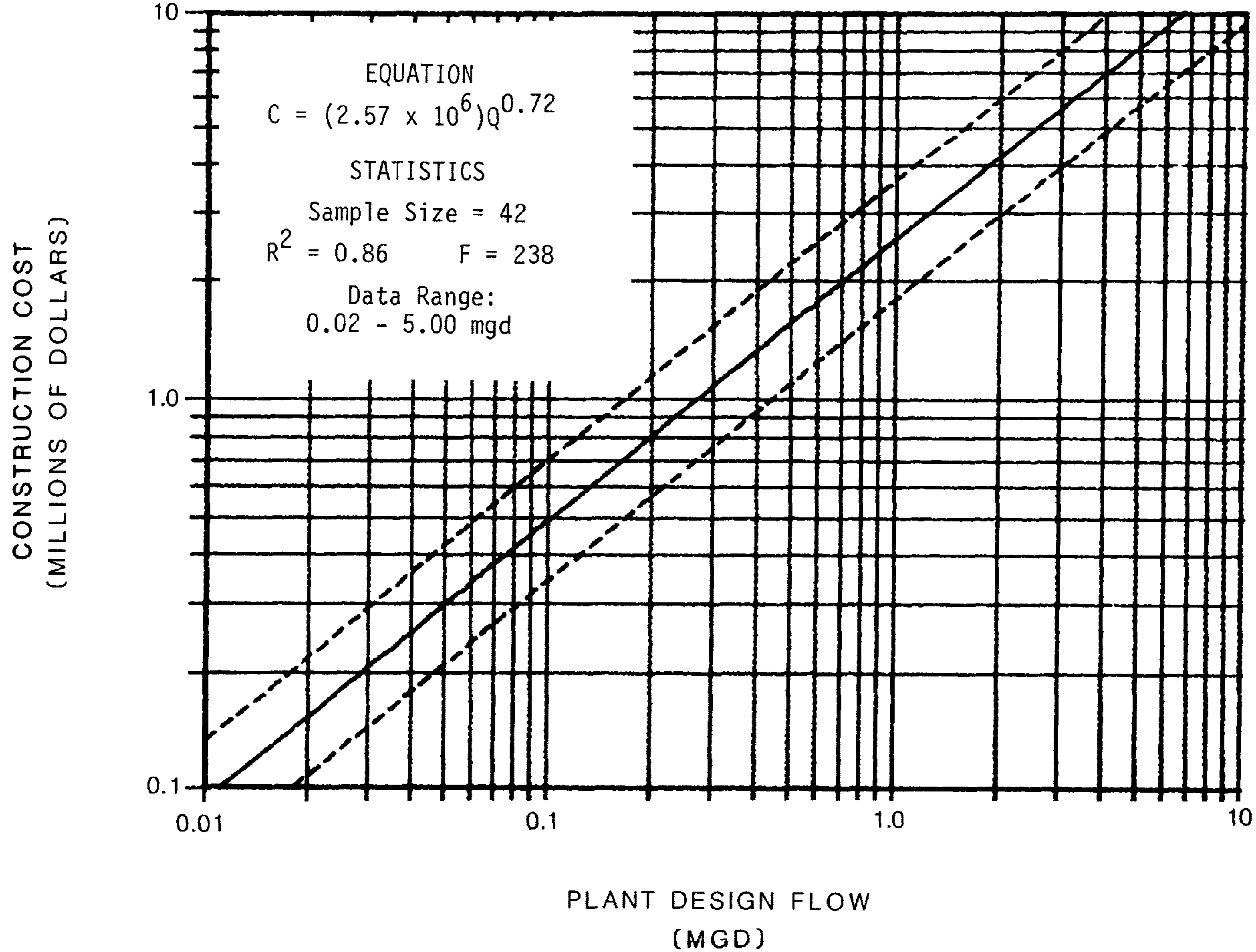


FIGURE 3.29

NEW ACTIVATED SLUDGE PLANT (ALL TYPES)
SECONDARY TREATMENT
COMPLEX SLUDGE HANDLING

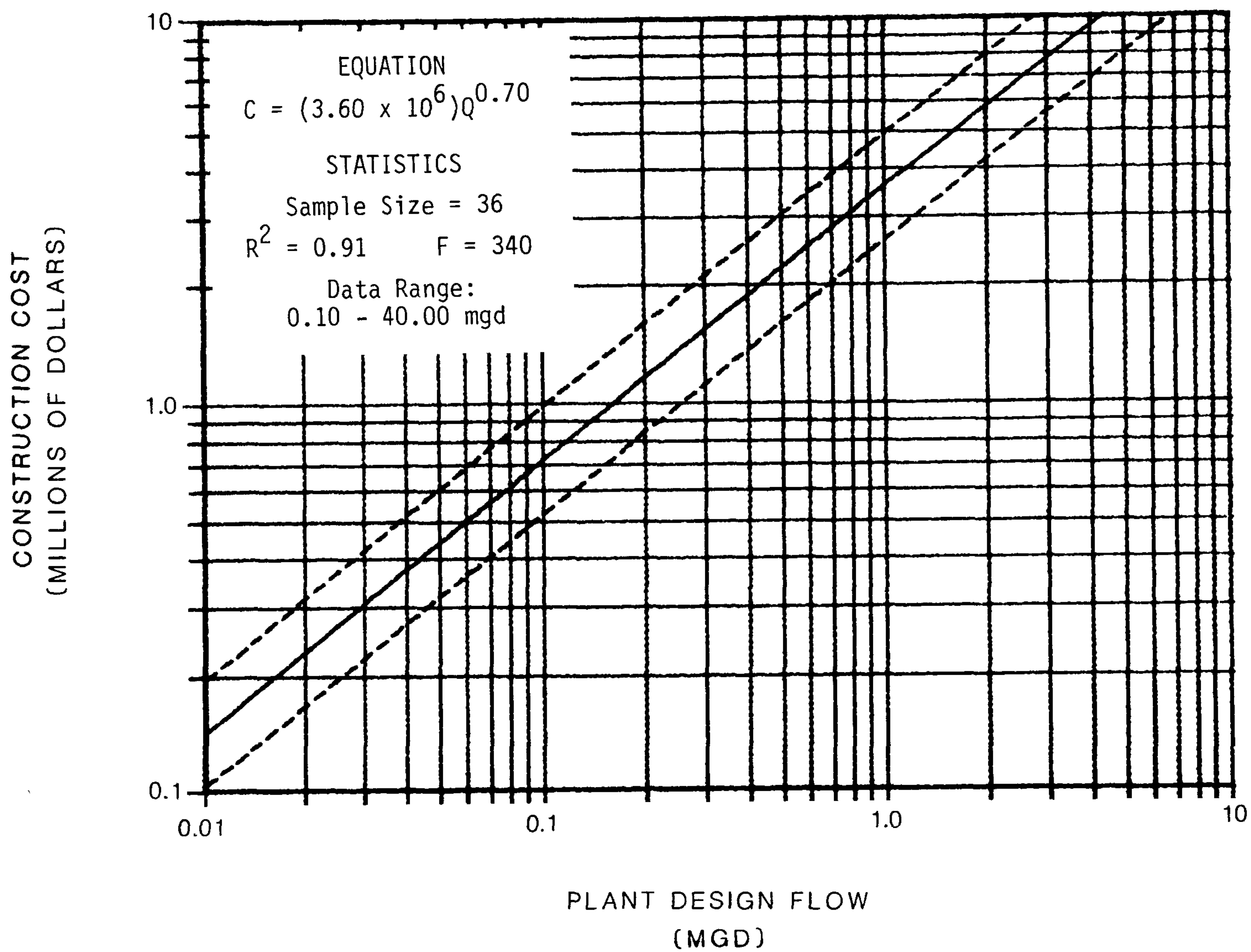


FIGURE 3.30

NEW ACTIVATED SLUDGE PLANT (ALL TYPES)
SECONDARY TREATMENT WITH PHOSPHORUS REMOVAL
ALL TYPES OF SLUDGE HANDLING

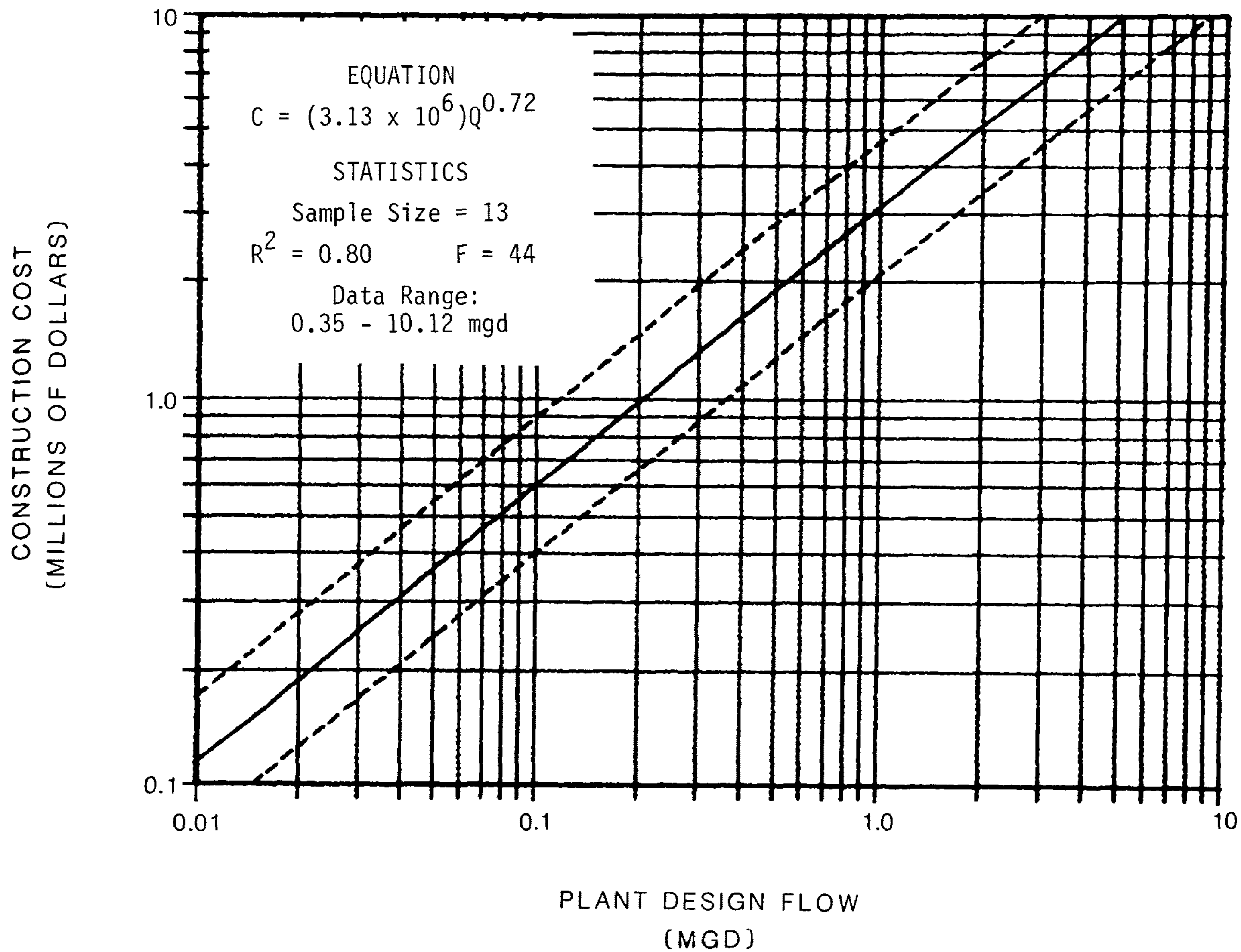


FIGURE 3.31

NEW ACTIVATED SLUDGE PLANT (ALL TYPES)
ADVANCED SECONDARY TREATMENT (AST)
ALL TYPES OF SLUDGE HANDLING

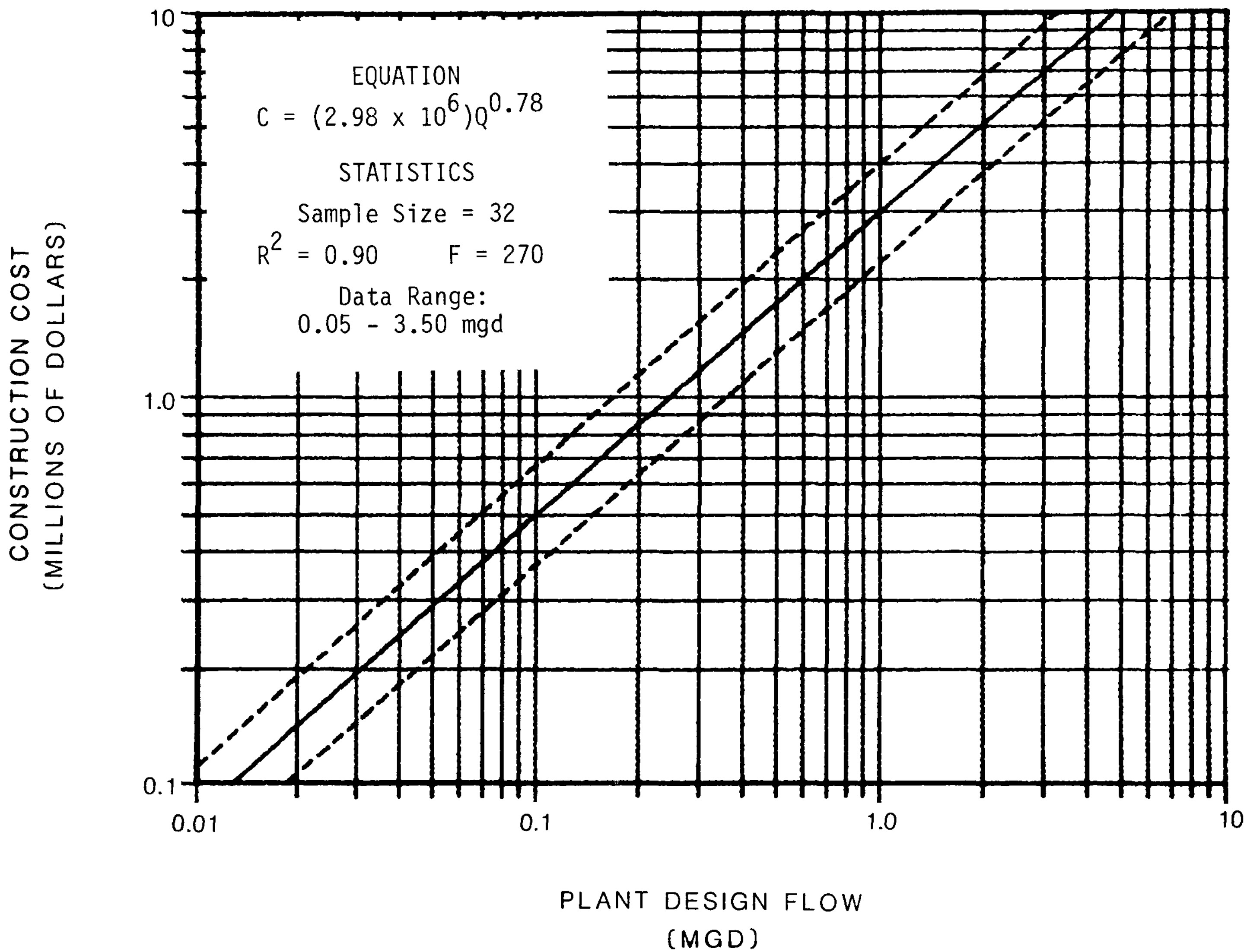


FIGURE 3.32

NEW ACTIVATED SLUDGE PLANT (ALL TYPES)
ADVANCED SECONDARY TREATMENT (AST)
SIMPLE SLUDGE HANDLING

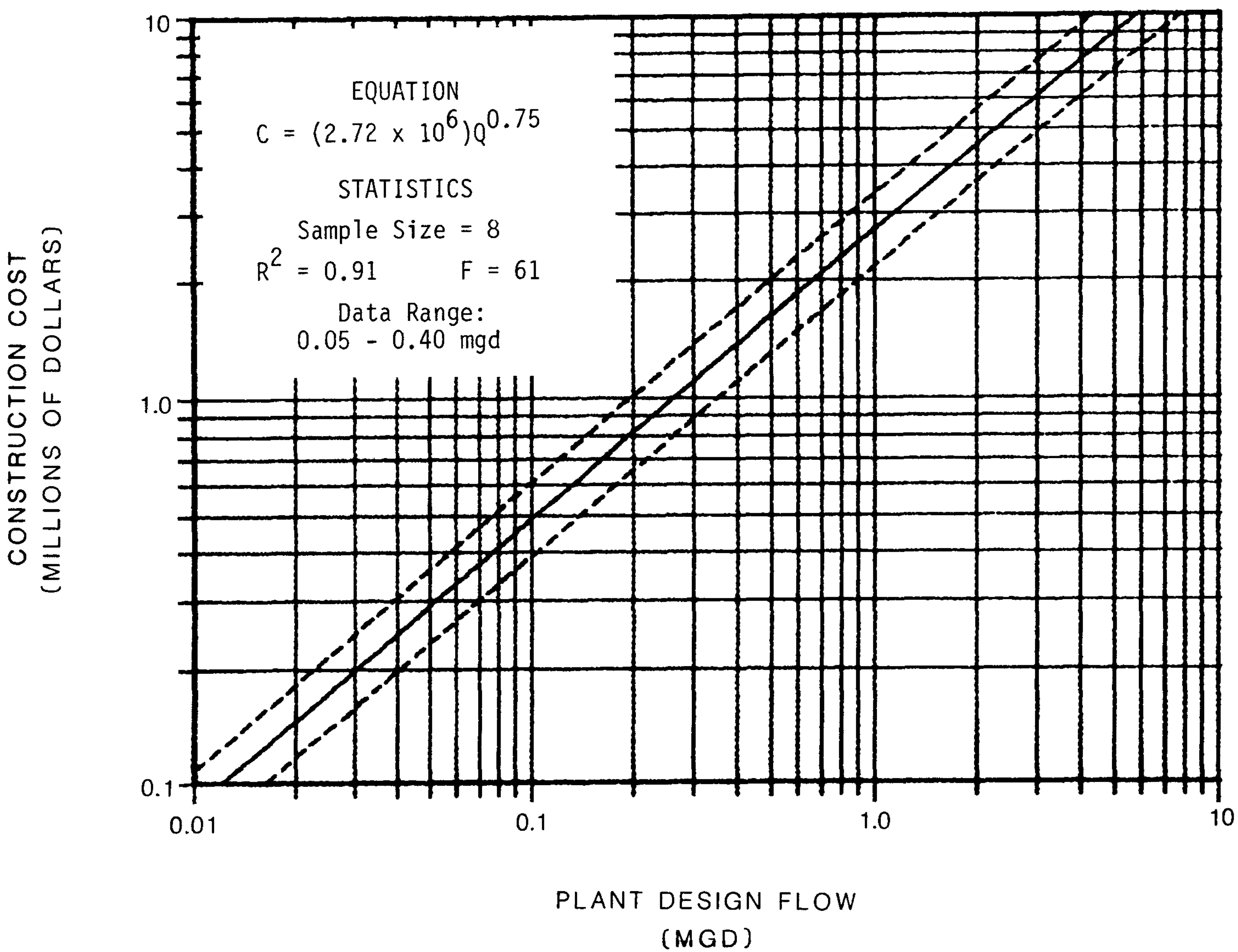


FIGURE 3.33

NEW ACTIVATED SLUDGE PLANT (ALL TYPES)
ADVANCED SECONDARY TREATMENT (AST)
MODERATE SLUDGE HANDLING

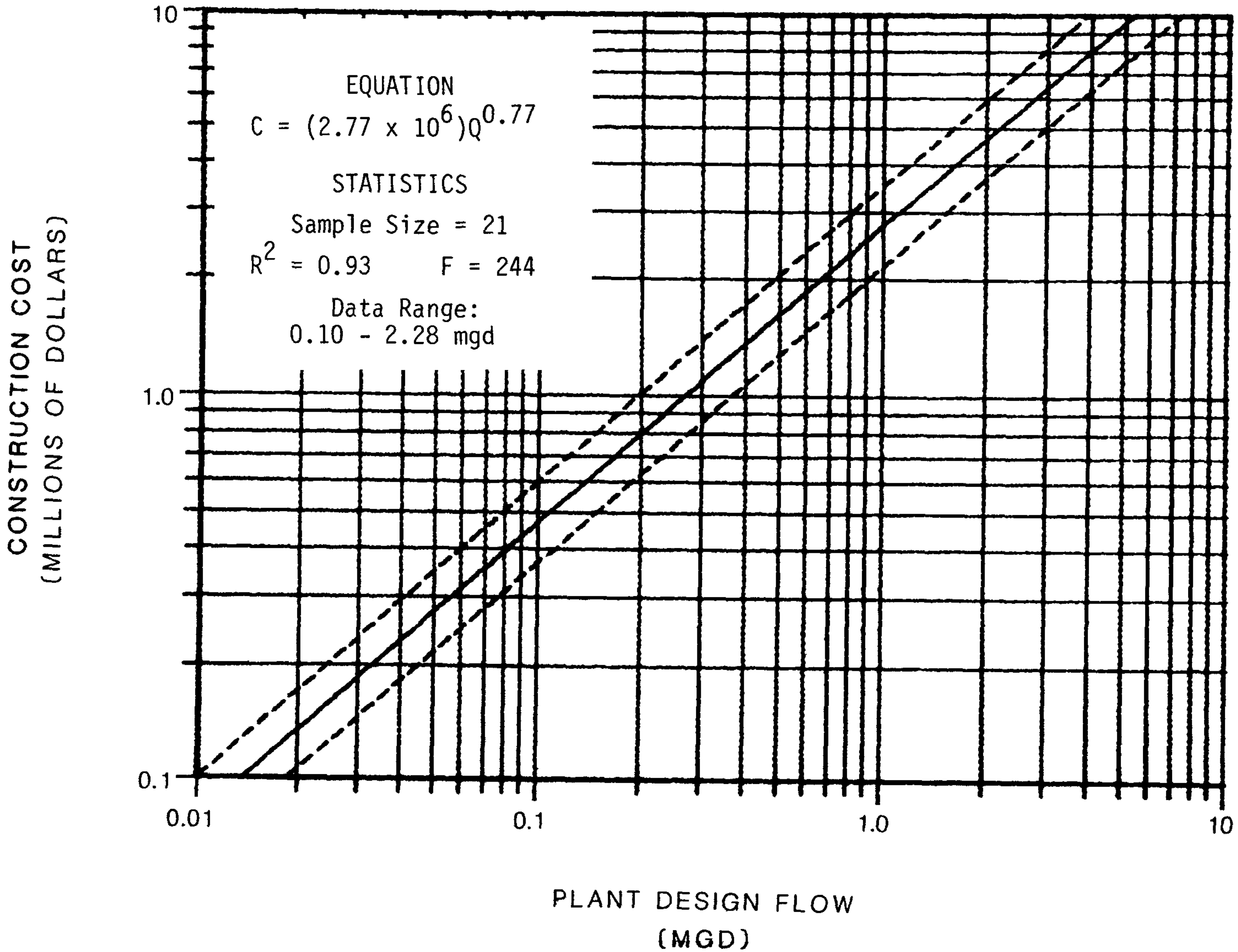


FIGURE 3.34

NEW ACTIVATED SLUDGE PLANT (ALL TYPES)
ADVANCED WASTEWATER TREATMENT (AWT)
ALL TYPES OF SLUDGE HANDLING

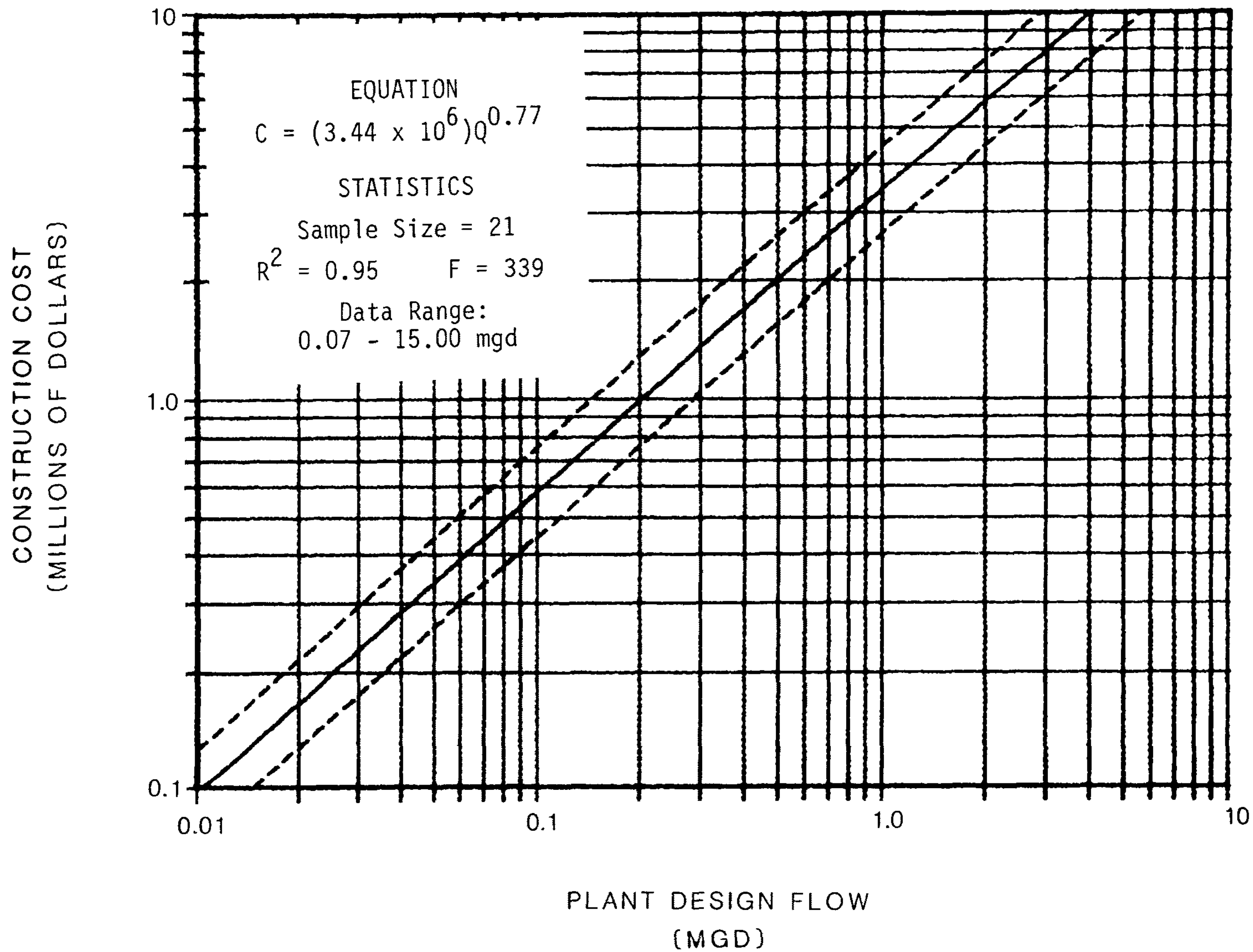


FIGURE 3.35

NEW ACTIVATED SLUDGE PLANT (ALL TYPES)
ADVANCED WASTEWATER TREATMENT (AWT)
MODERATE SLUDGE HANDLING

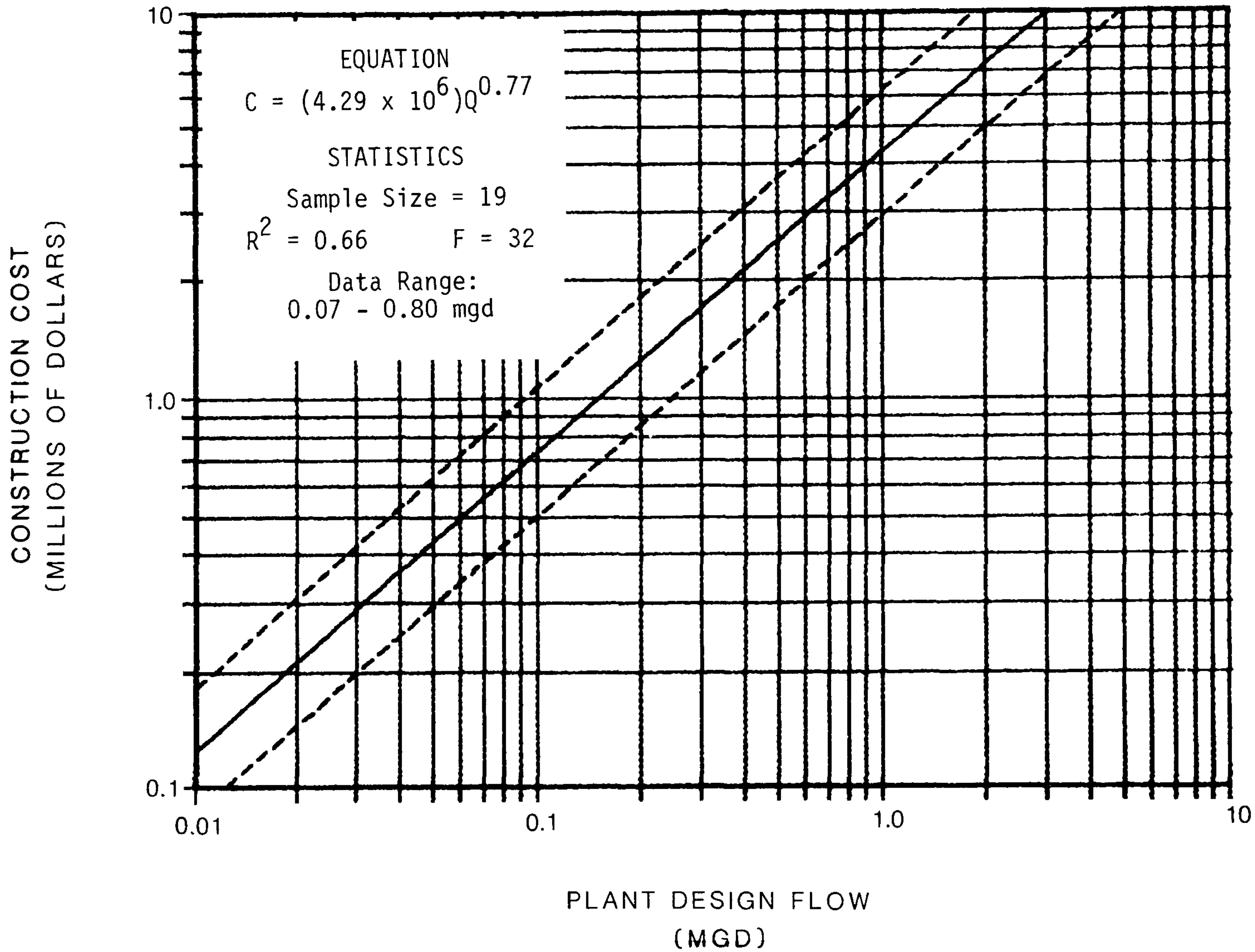


FIGURE 3.36

NEW ACTIVATED SLUDGE PLANT (ALL TYPES)
AWT WITH PHOSPHORUS REMOVAL
ALL TYPES OF SLUDGE HANDLING

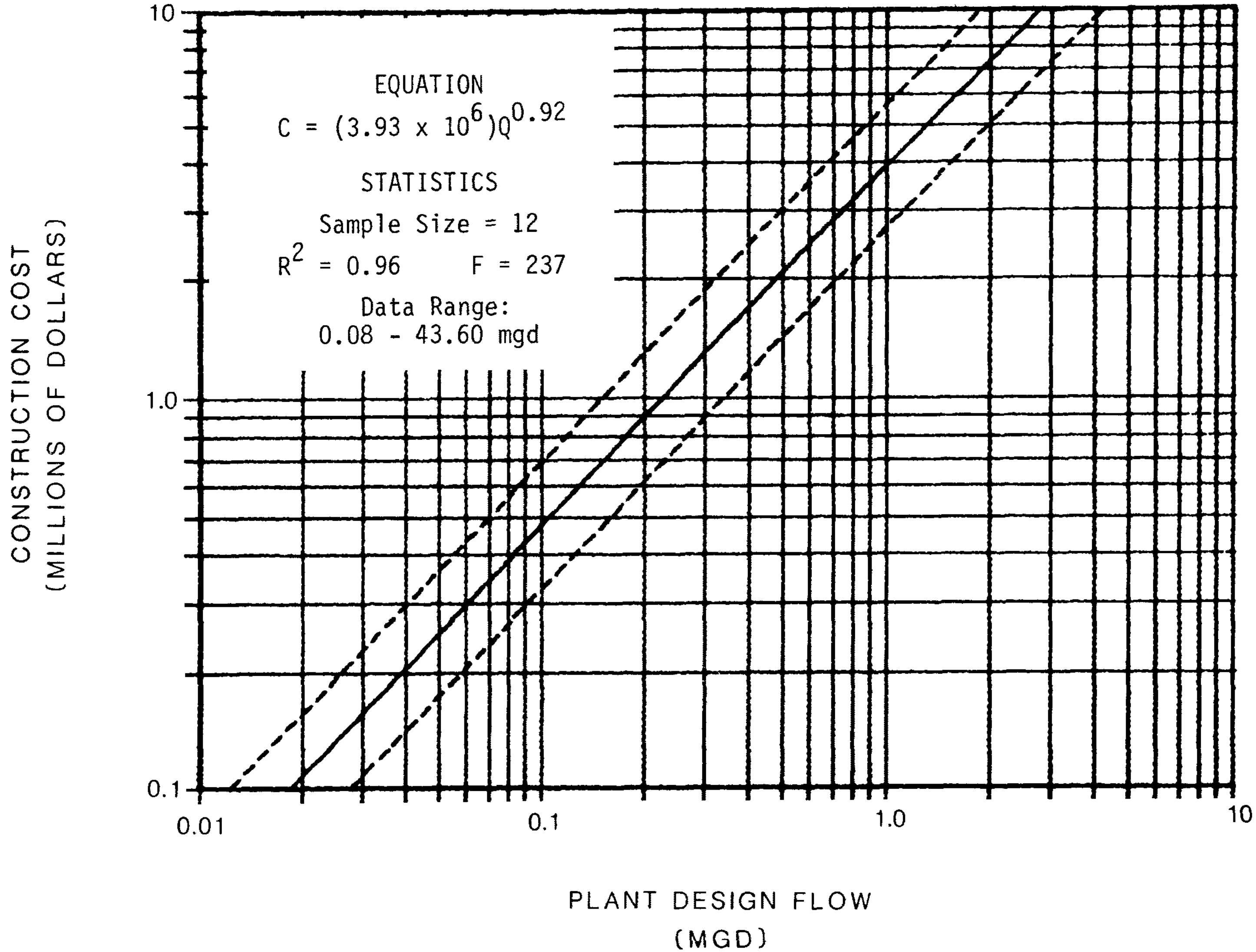


FIGURE 3.37

NEW CONVENTIONAL ACTIVATED SLUDGE PLANT
SECONDARY TREATMENT
ALL TYPES OF SLUDGE HANDLING

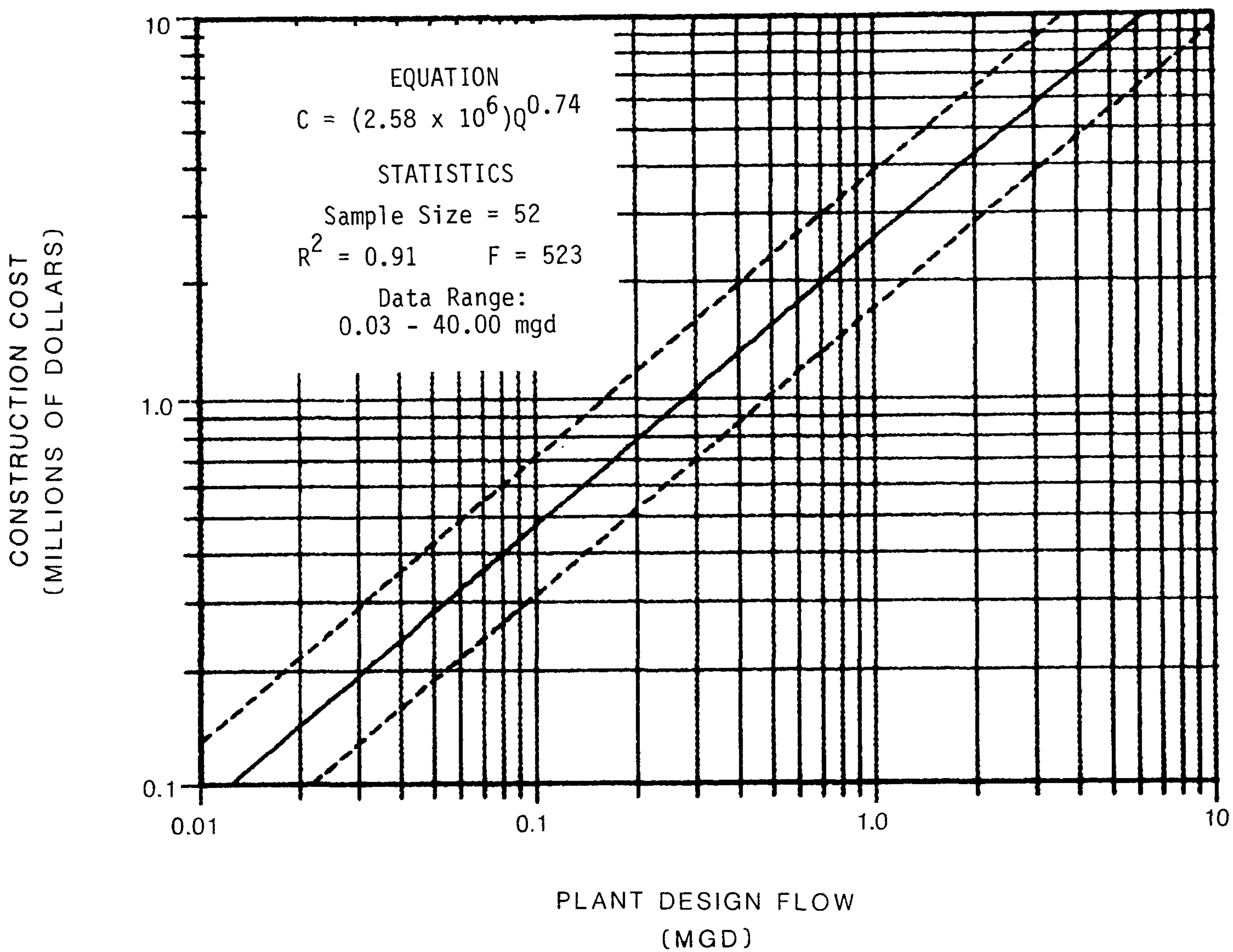


FIGURE 3.38

NEW CONVENTIONAL ACTIVATED SLUDGE PLANT
SECONDARY TREATMENT
MODERATE SLUDGE HANDLING

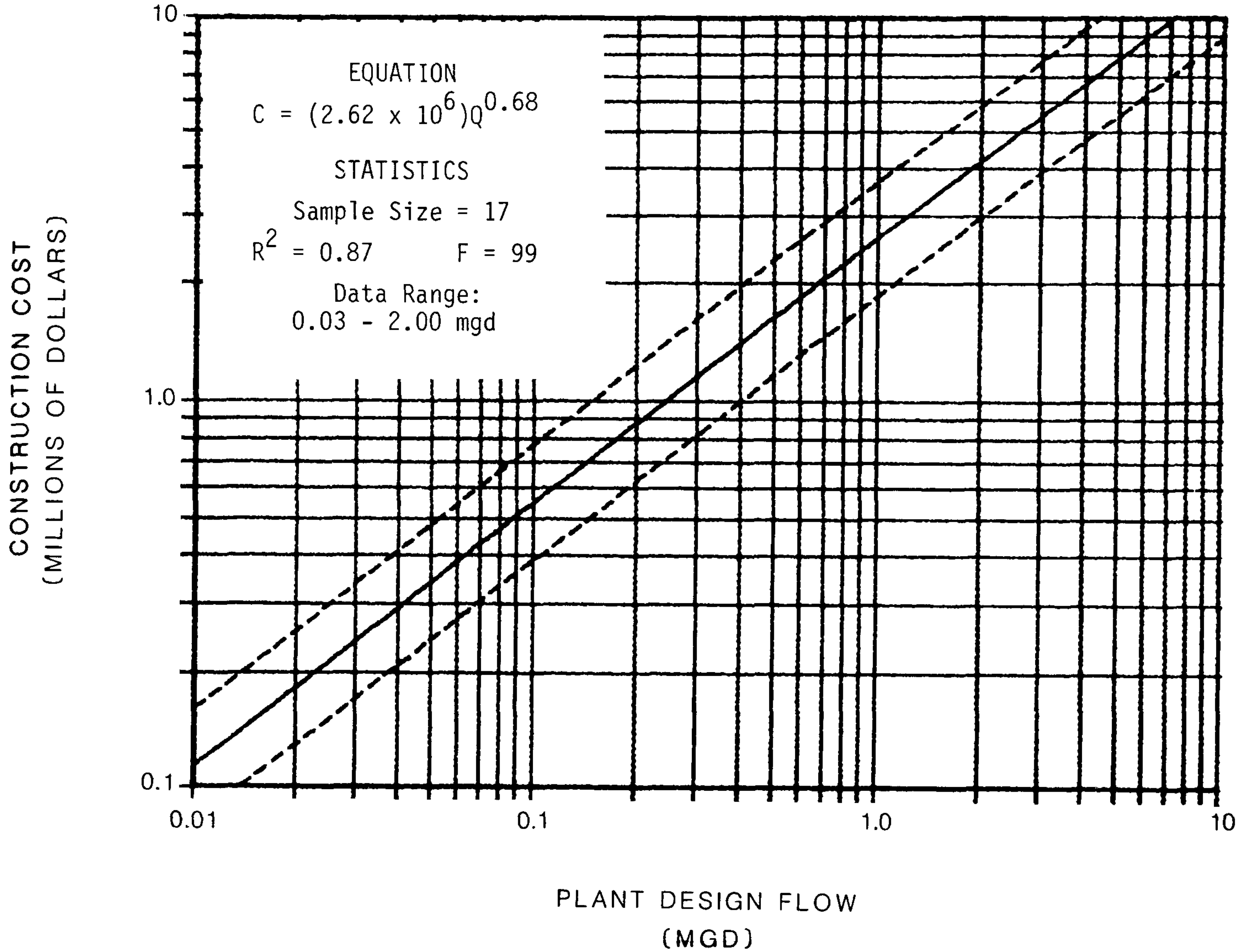


FIGURE 3.39

NEW CONVENTIONAL ACTIVATED SLUDGE PLANT
SECONDARY TREATMENT
COMPLEX SLUDGE HANDLING

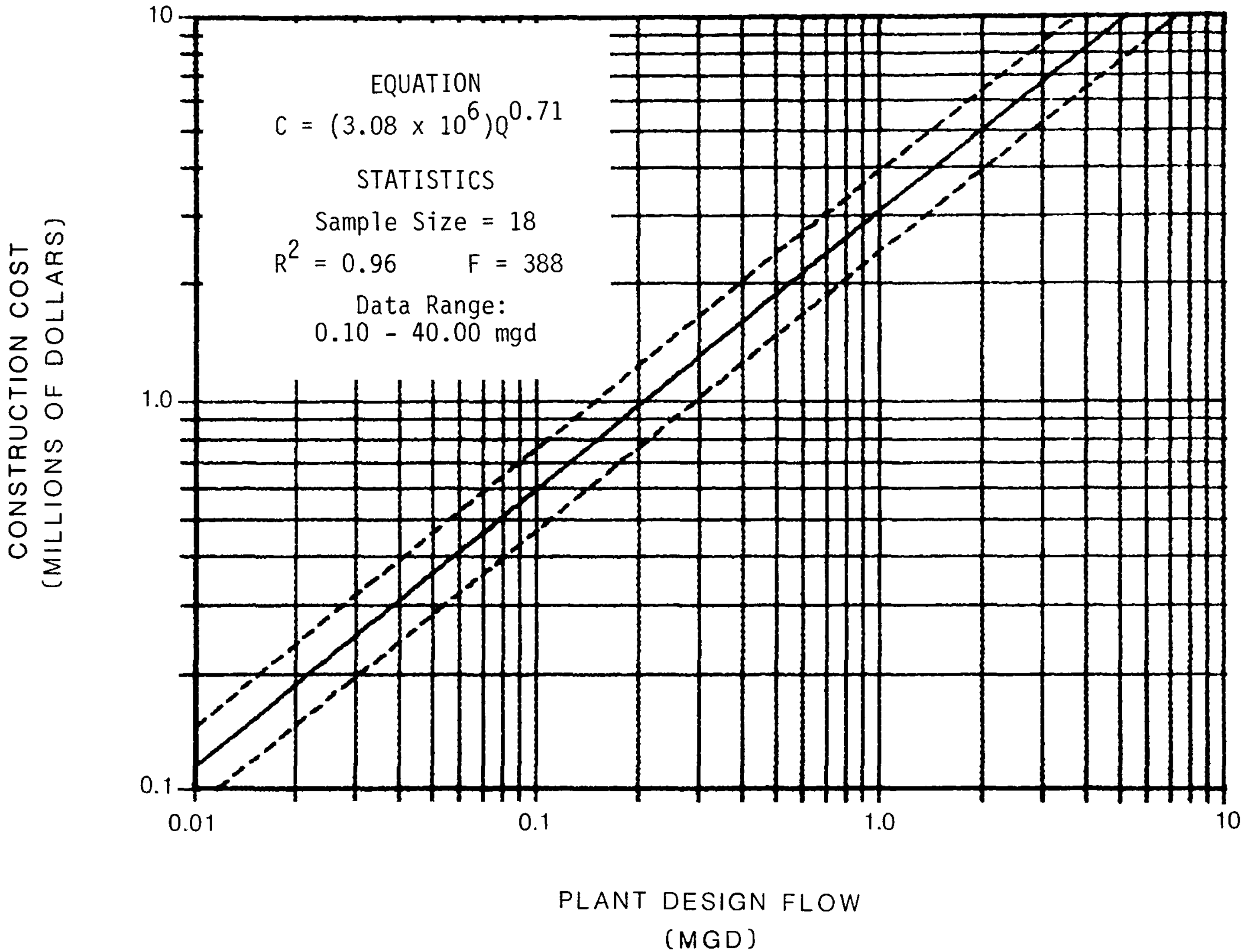


FIGURE 3.40

NEW CONVENTIONAL ACTIVATED SLUDGE PLANT
ADVANCED SECONDARY TREATMENT (AST)
ALL TYPES OF SLUDGE HANDLING

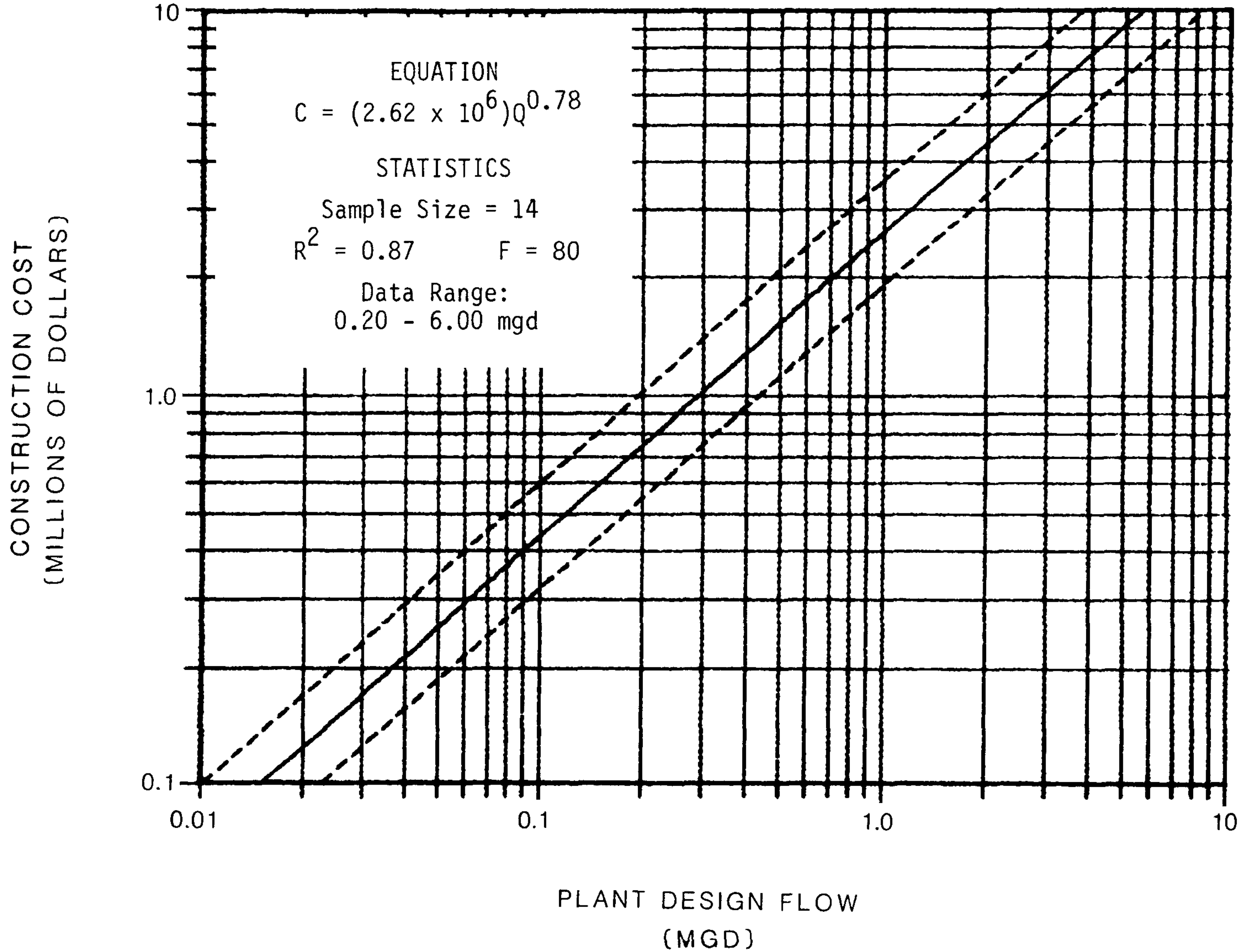


FIGURE 3.41

NEW CONVENTIONAL ACTIVATED SLUDGE PLANT
ADVANCED SECONDARY TREATMENT (AST)
MODERATE SLUDGE HANDLING

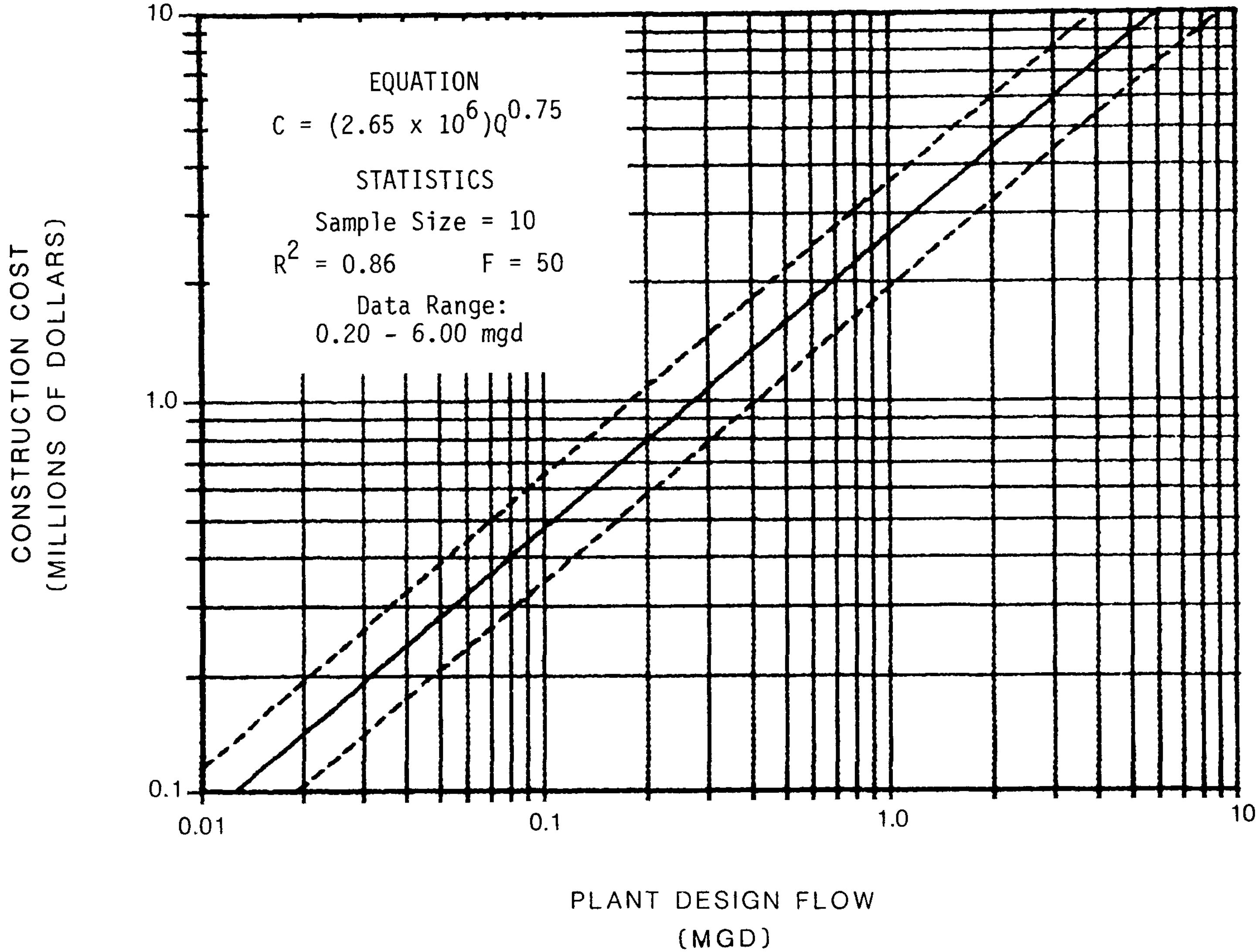


FIGURE 3.42

NEW CONVENTIONAL ACTIVATED SLUDGE PLANT
ADVANCED WASTEWATER TREATMENT (AWT)
ALL TYPES OF SLUDGE HANDLING

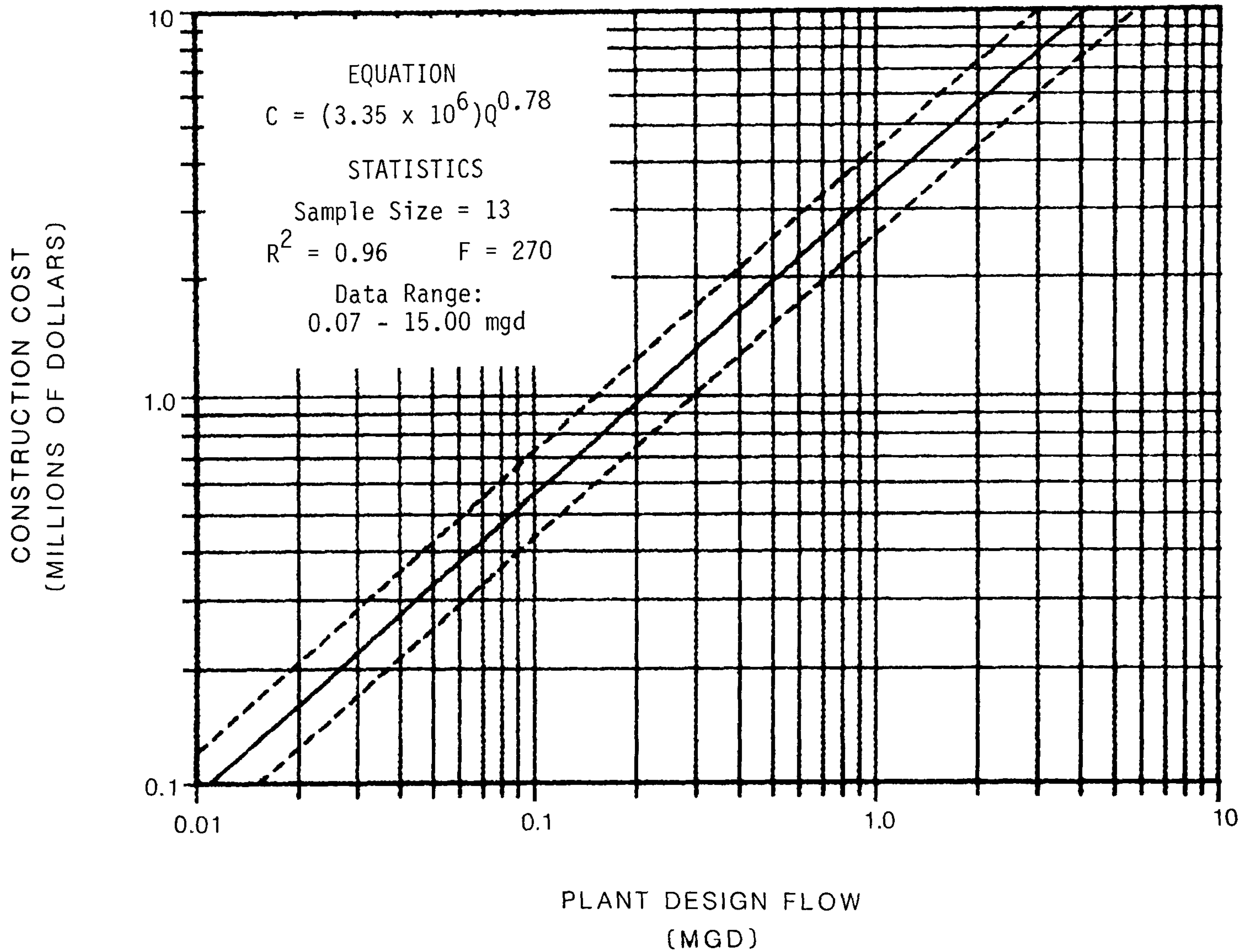


FIGURE 3.43

NEW CONVENTIONAL ACTIVATED SLUDGE PLANT
ADVANCED WASTEWATER TREATMENT (AWT)
MODERATE SLUDGE HANDLING

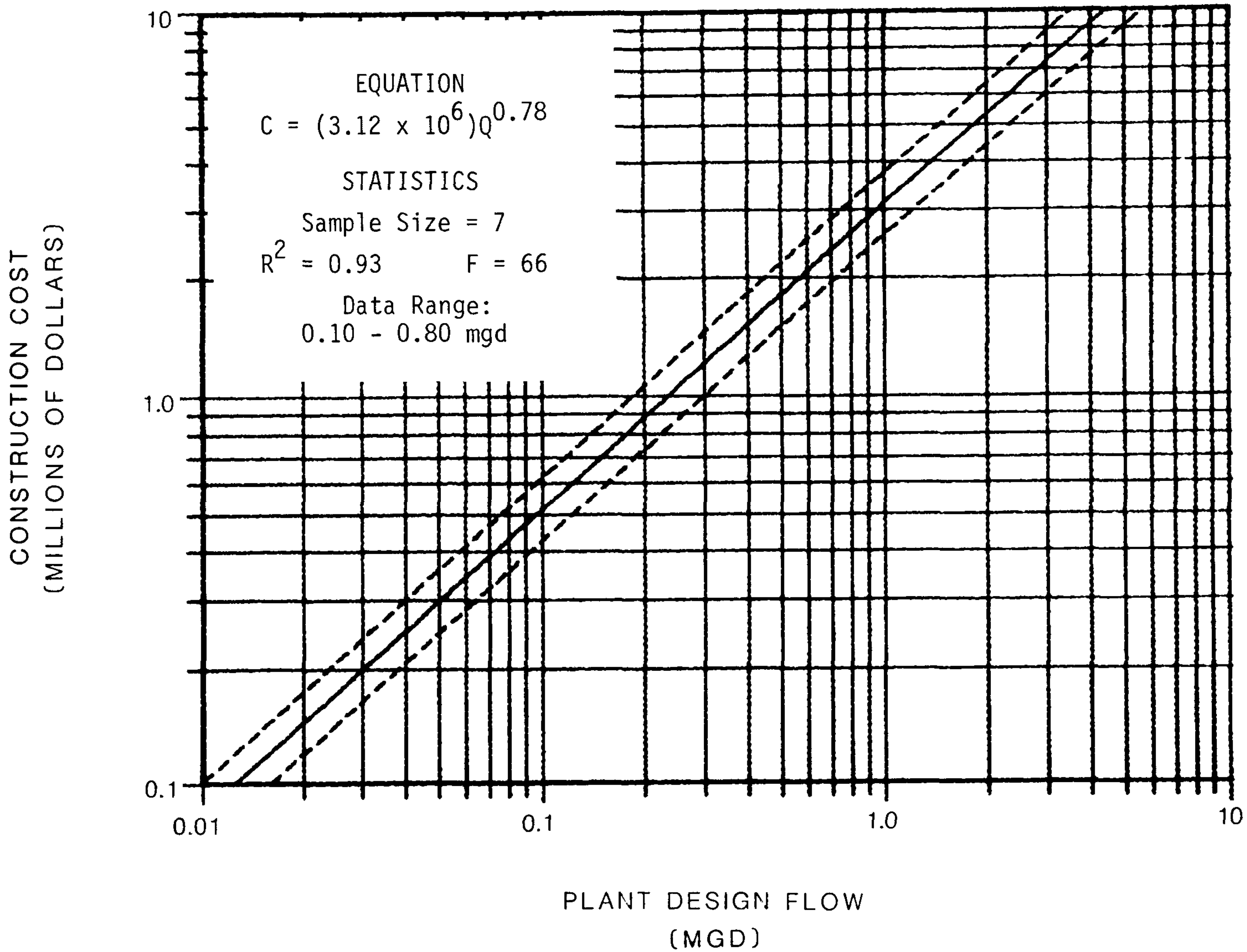


FIGURE 3.44

NEW CONVENTIONAL ACTIVATED SLUDGE PLANT
ADVANCED WASTEWATER TREATMENT (AWT)
COMPLEX SLUDGE HANDLING

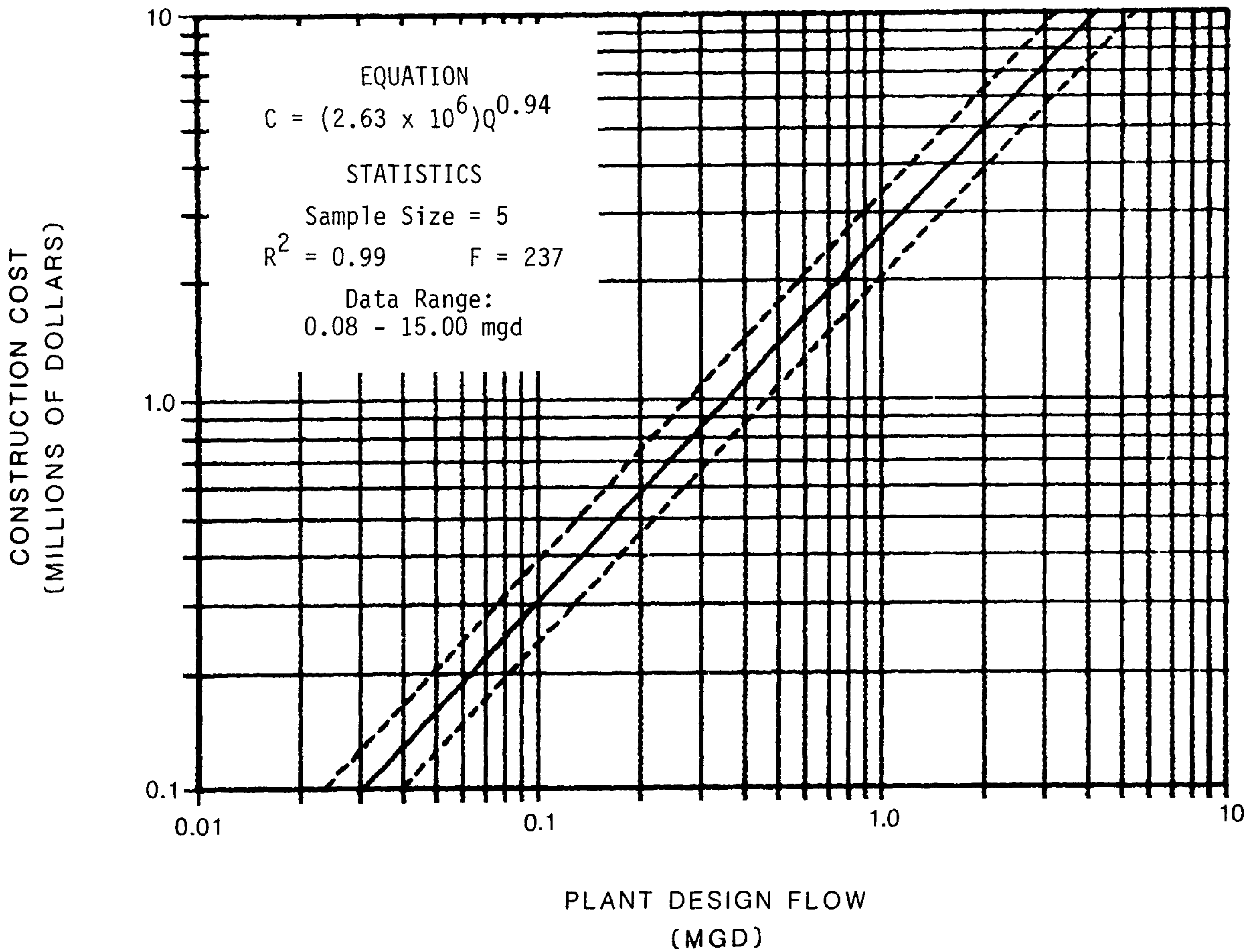


FIGURE 3.45

NEW CONTACT STABILIZATION PLANT
ADVANCED SECONDARY TREATMENT (AST)
ALL TYPES OF SLUDGE HANDLING

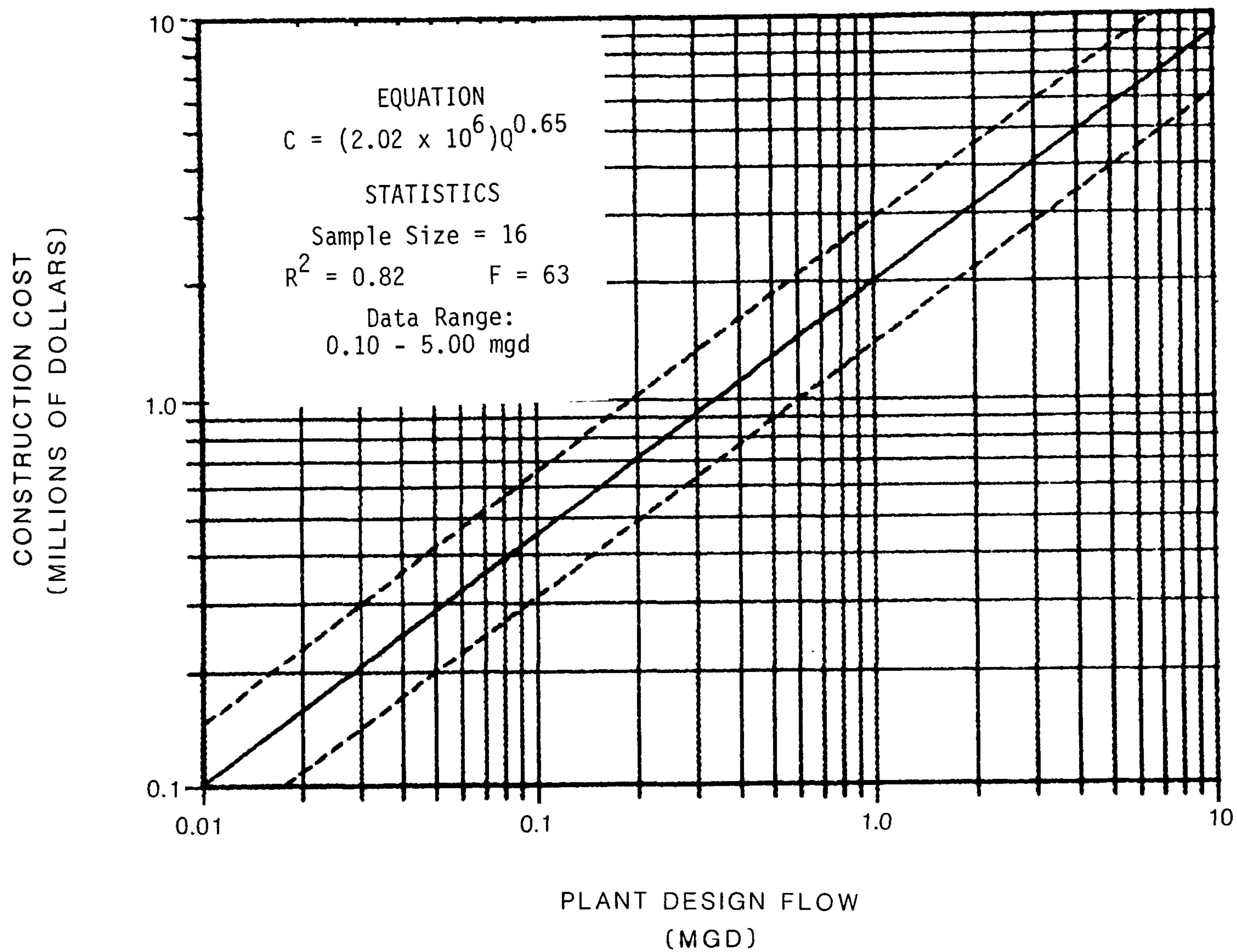


FIGURE 3.46

NEW CONTACT STABILIZATION PLANT
ADVANCED SECONDARY TREATMENT (AST)
MODERATE SLUDGE HANDLING

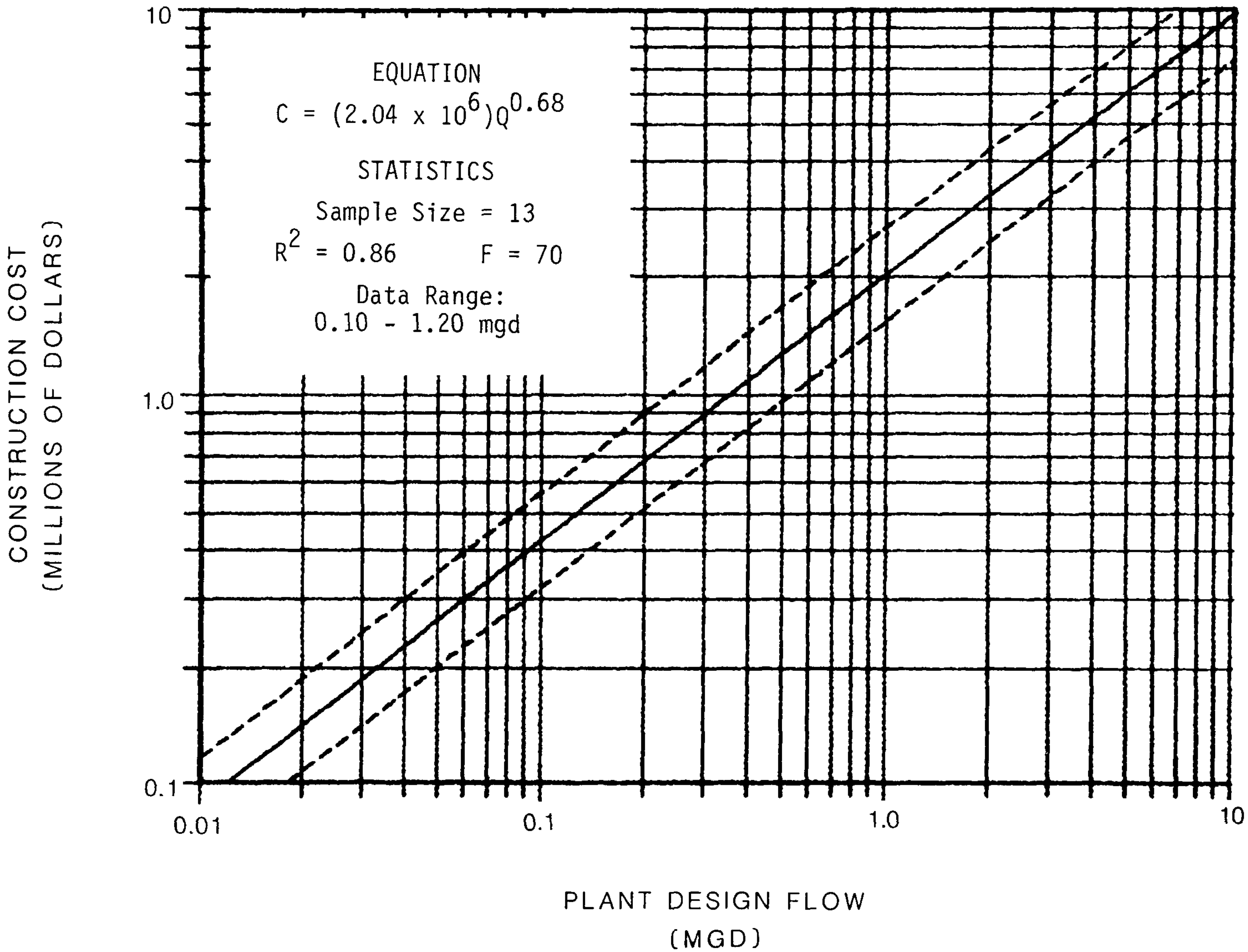


FIGURE 3.47

NEW EXTENDED AERATION PLANT
SECONDARY TREATMENT
ALL TYPES OF SLUDGE HANDLING

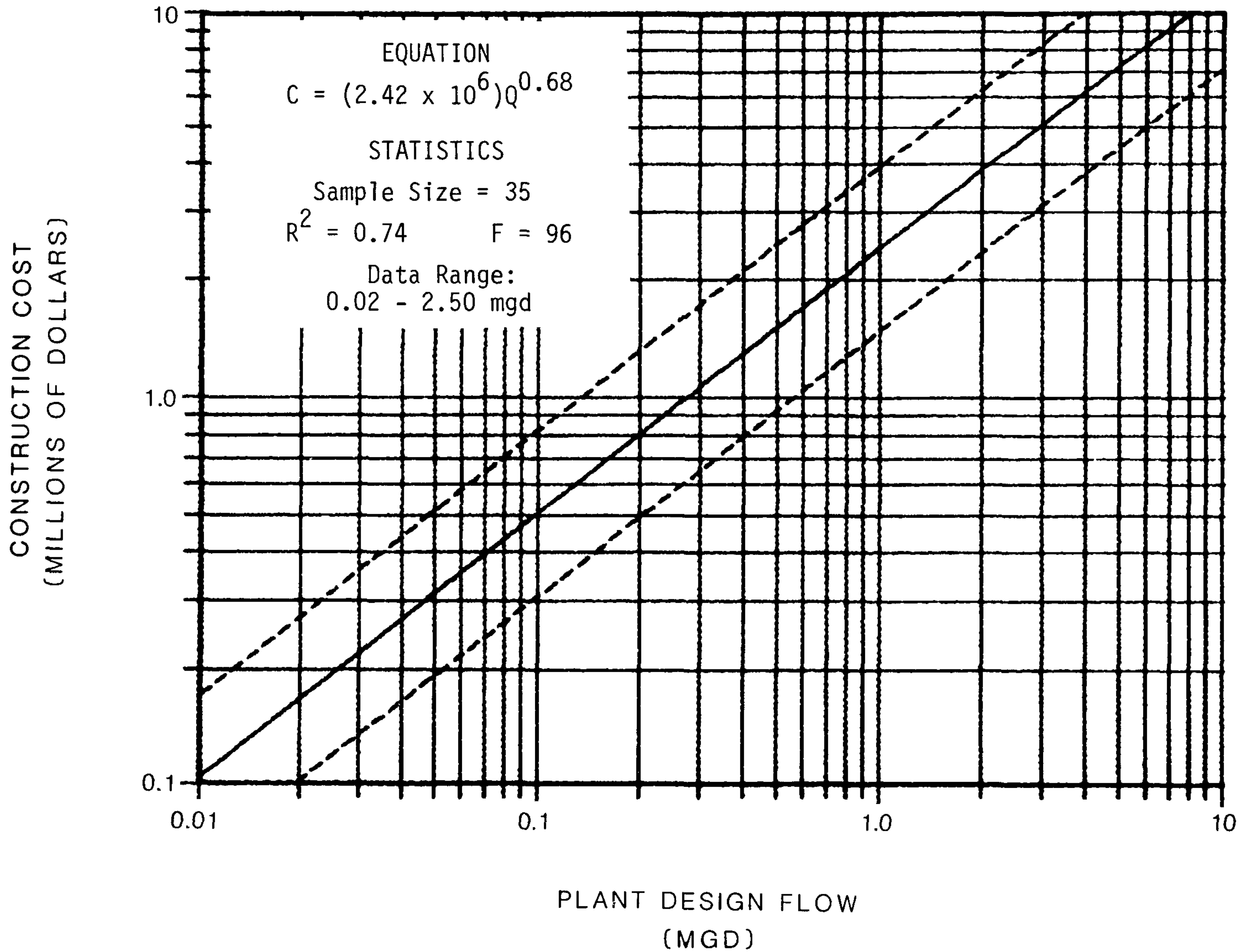


FIGURE 3.48

NEW EXTENDED AERATION PLANT
SECONDARY TREATMENT
SIMPLE SLUDGE HANDLING

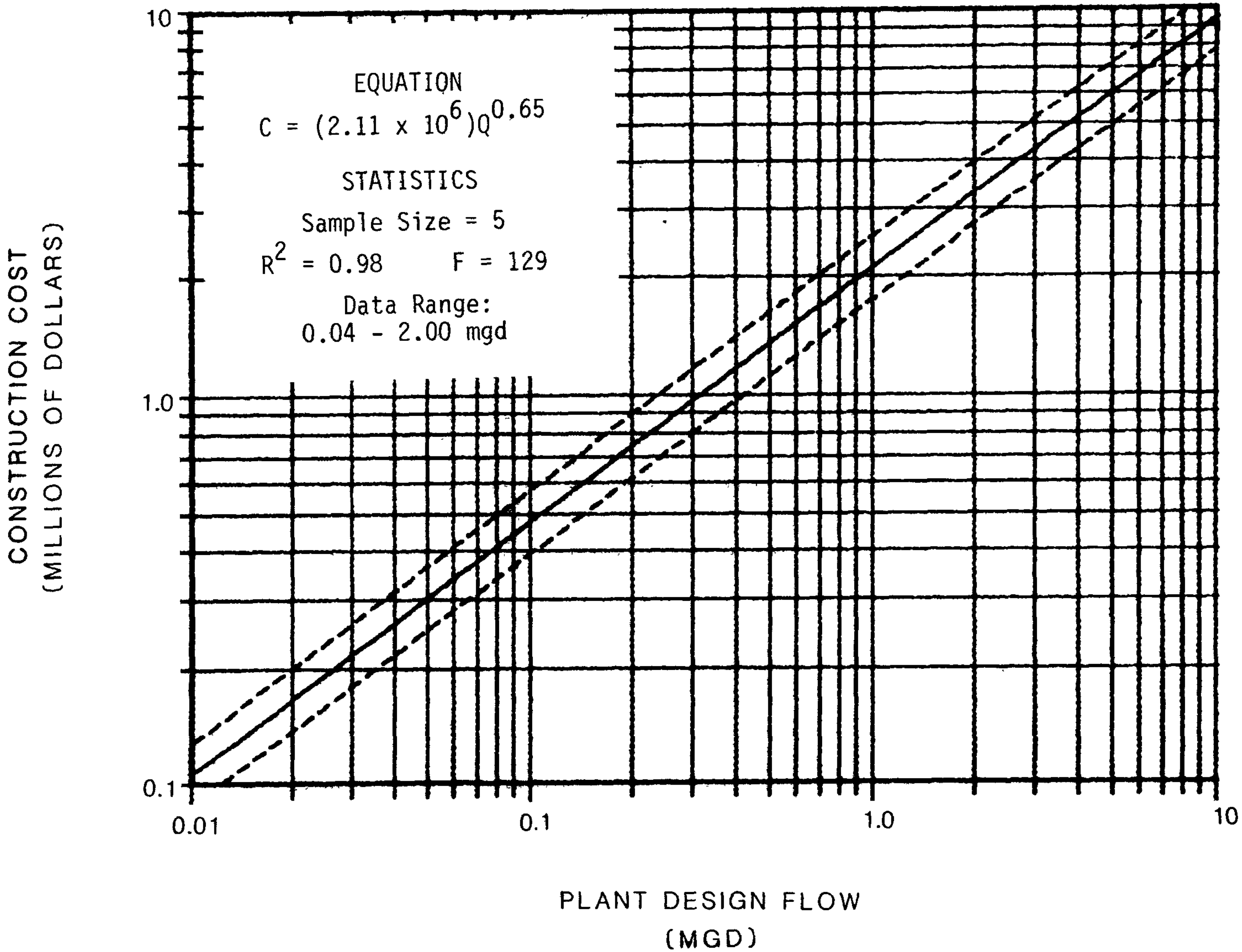


FIGURE 3.49

NEW EXTENDED AERATION PLANT
SECONDARY TREATMENT
MODERATE SLUDGE HANDLING

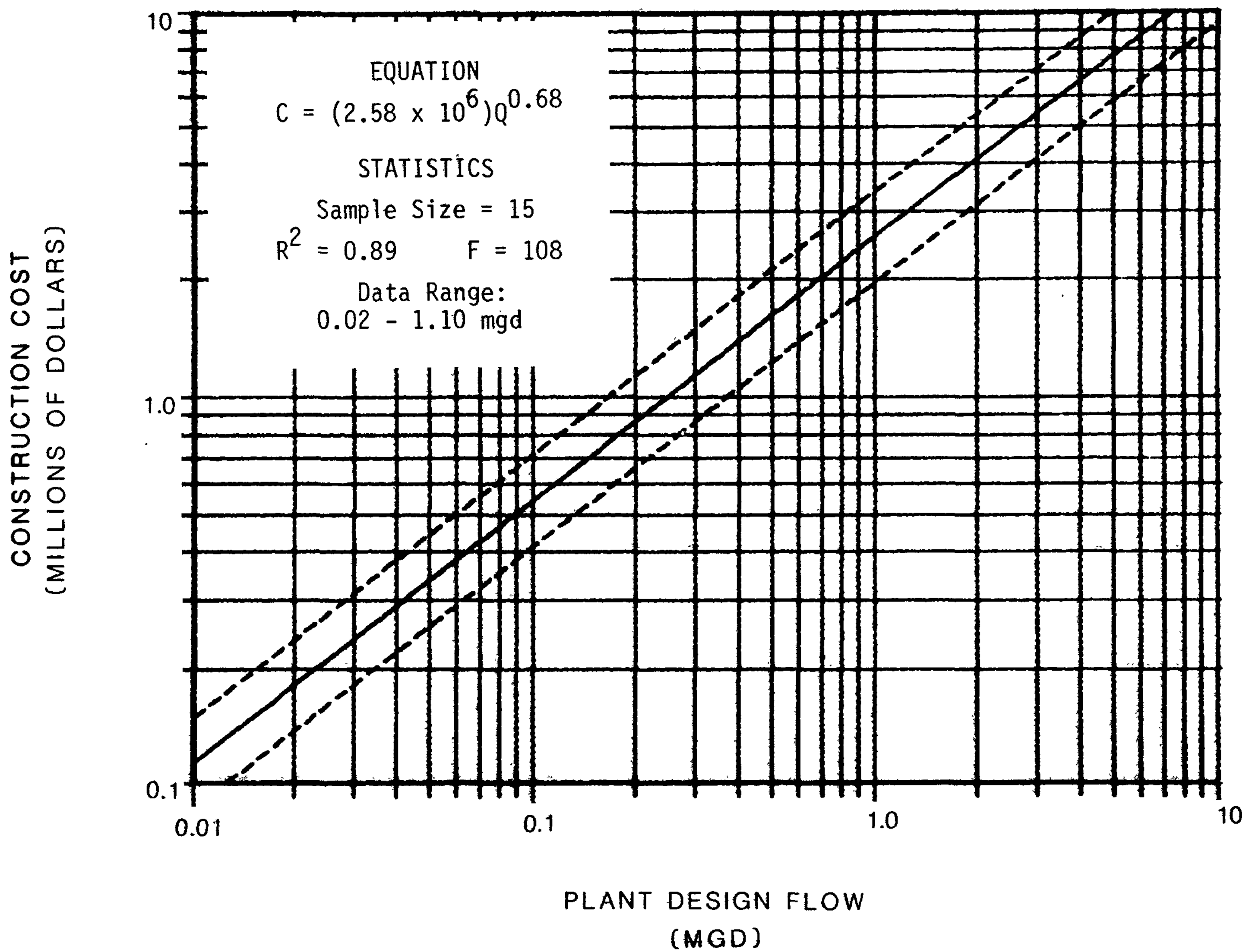


FIGURE 3.50

NEW EXTENDED AERATION PLANT
ADVANCED SECONDARY TREATMENT (AST)
ALL TYPES OF SLUDGE HANDLING

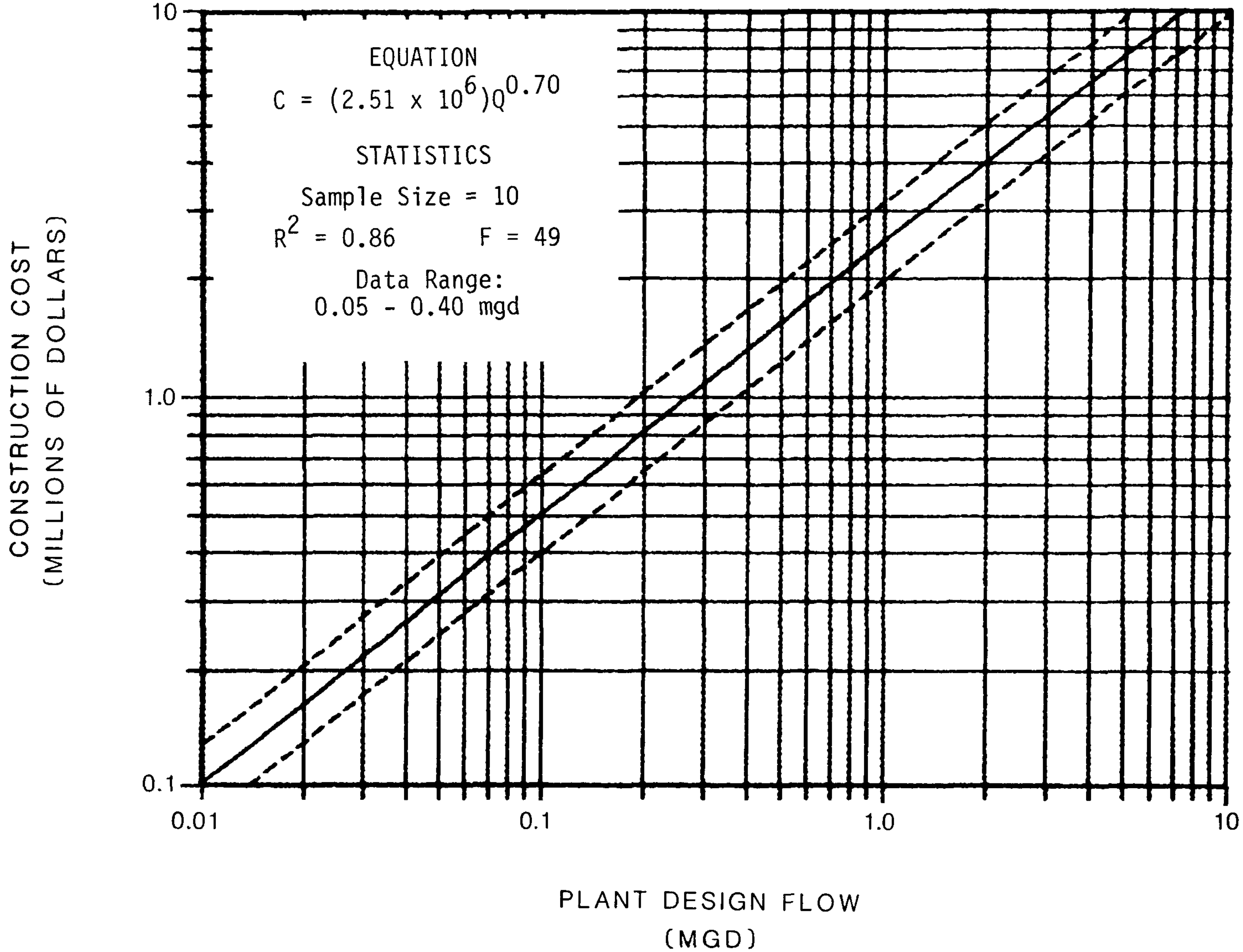


FIGURE 3.51

NEW EXTENDED AERATION PLANT
ADVANCED SECONDARY TREATMENT (AST)
SIMPLE SLUDGE HANDLING

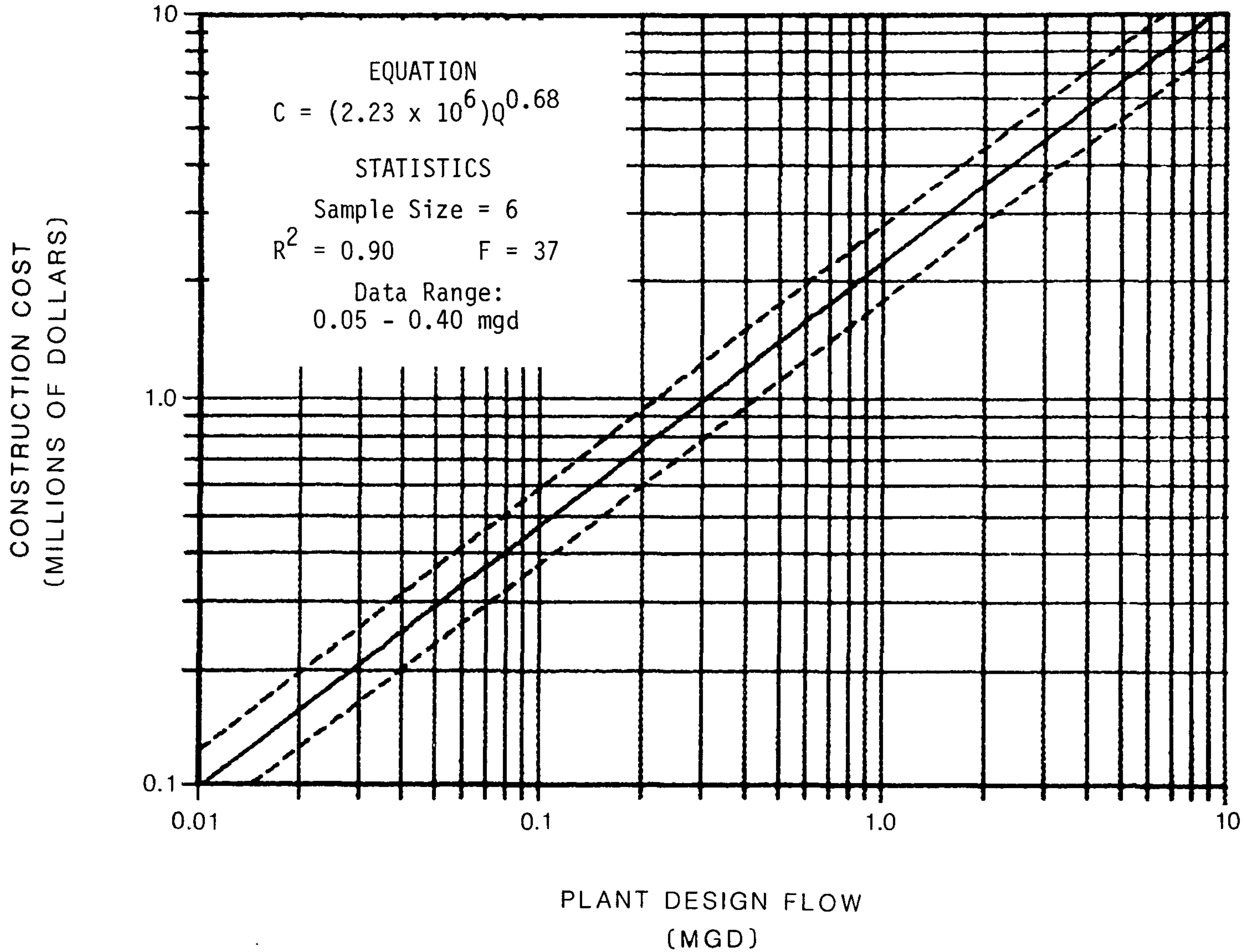


FIGURE 3.52

NEW PURE OXYGEN ACTIVATED SLUDGE PLANT
SECONDARY TREATMENT
ALL TYPES OF SLUDGE HANDLING

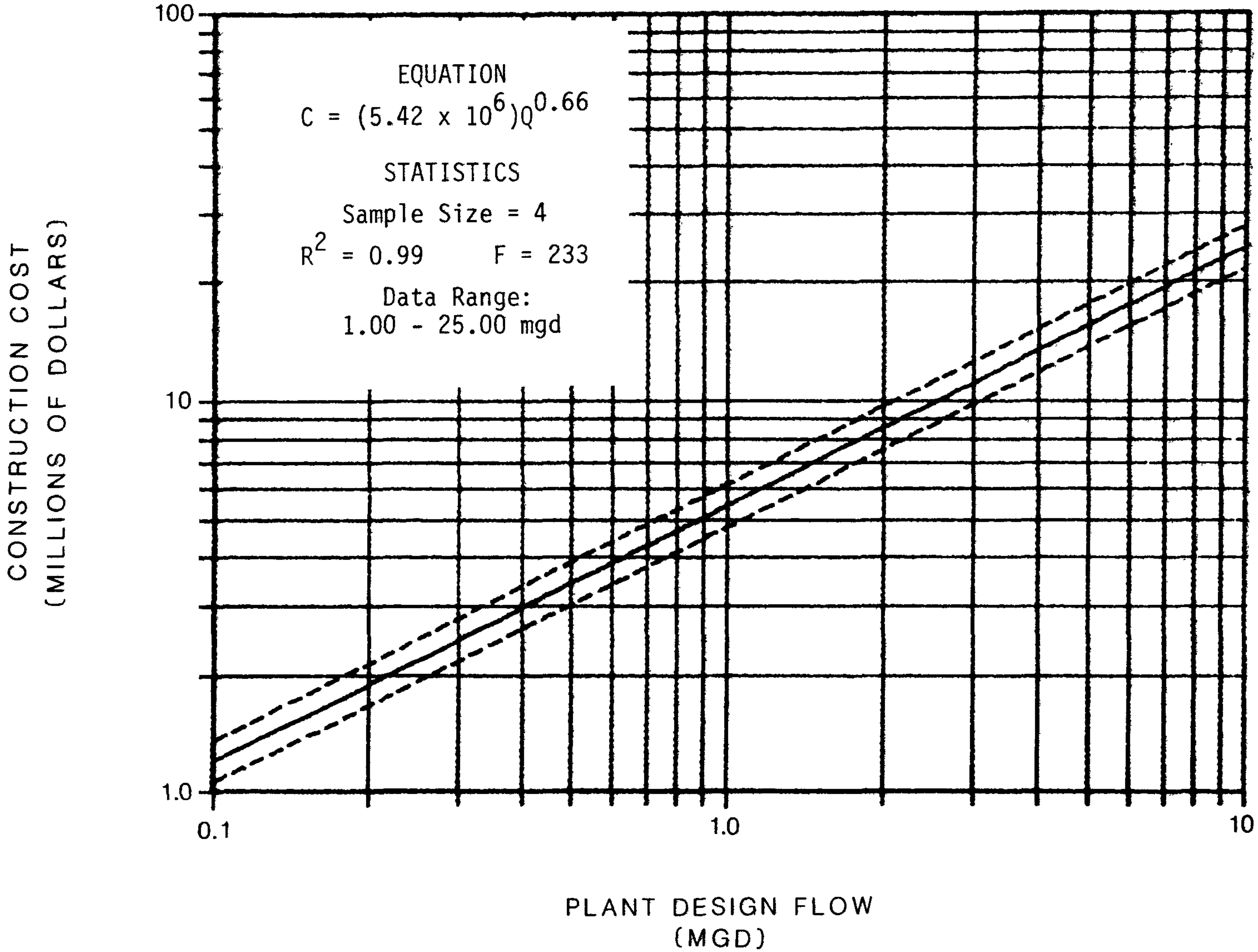


FIGURE 3.53

NEW PURE OXYGEN ACTIVATED SLUDGE PLANT
SECONDARY TREATMENT
COMPLEX SLUDGE HANDLING

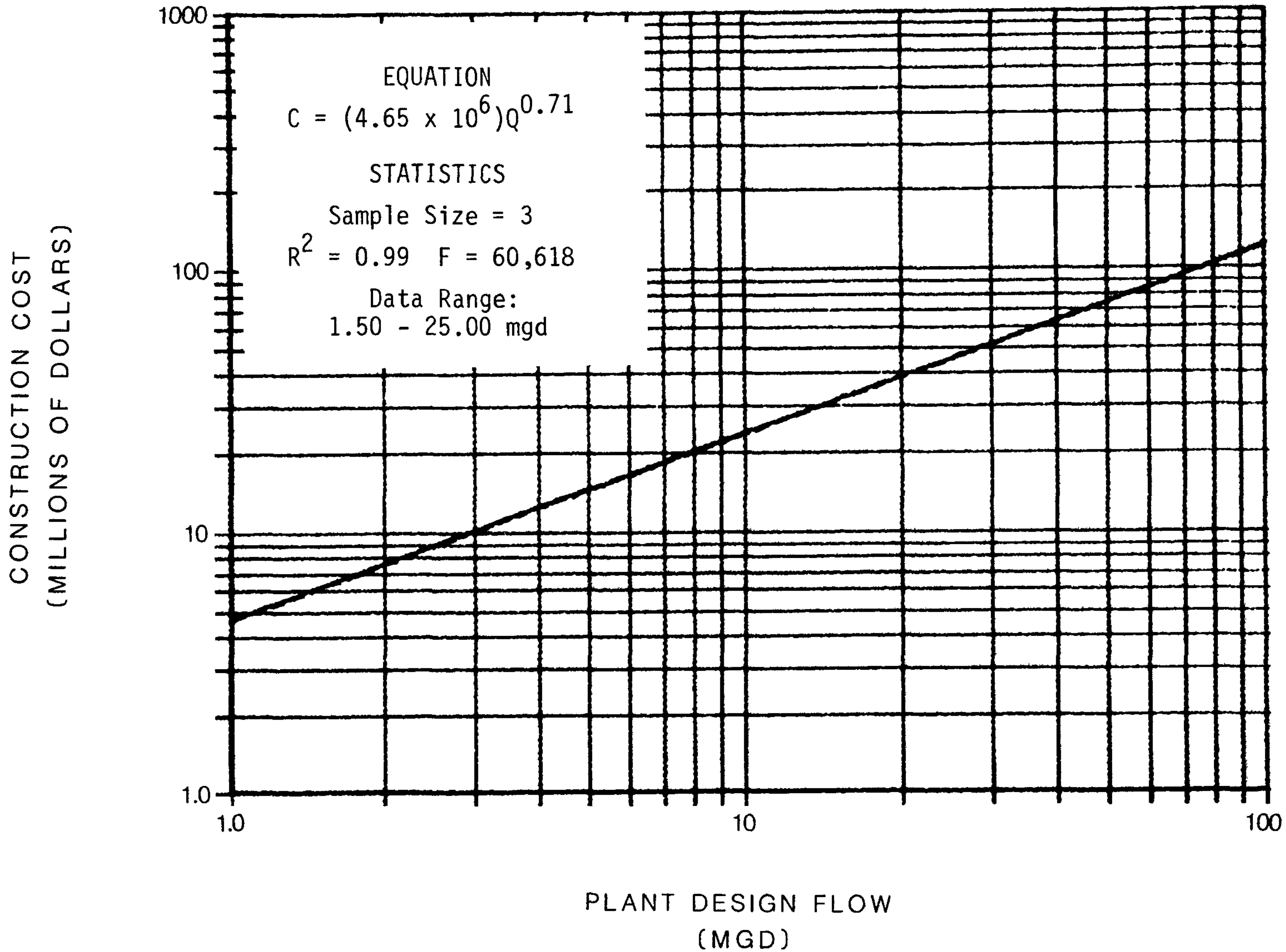


FIGURE 3.54

NEW OXIDATION DITCH PLANT
SECONDARY TREATMENT
ALL TYPES OF SLUDGE HANDLING

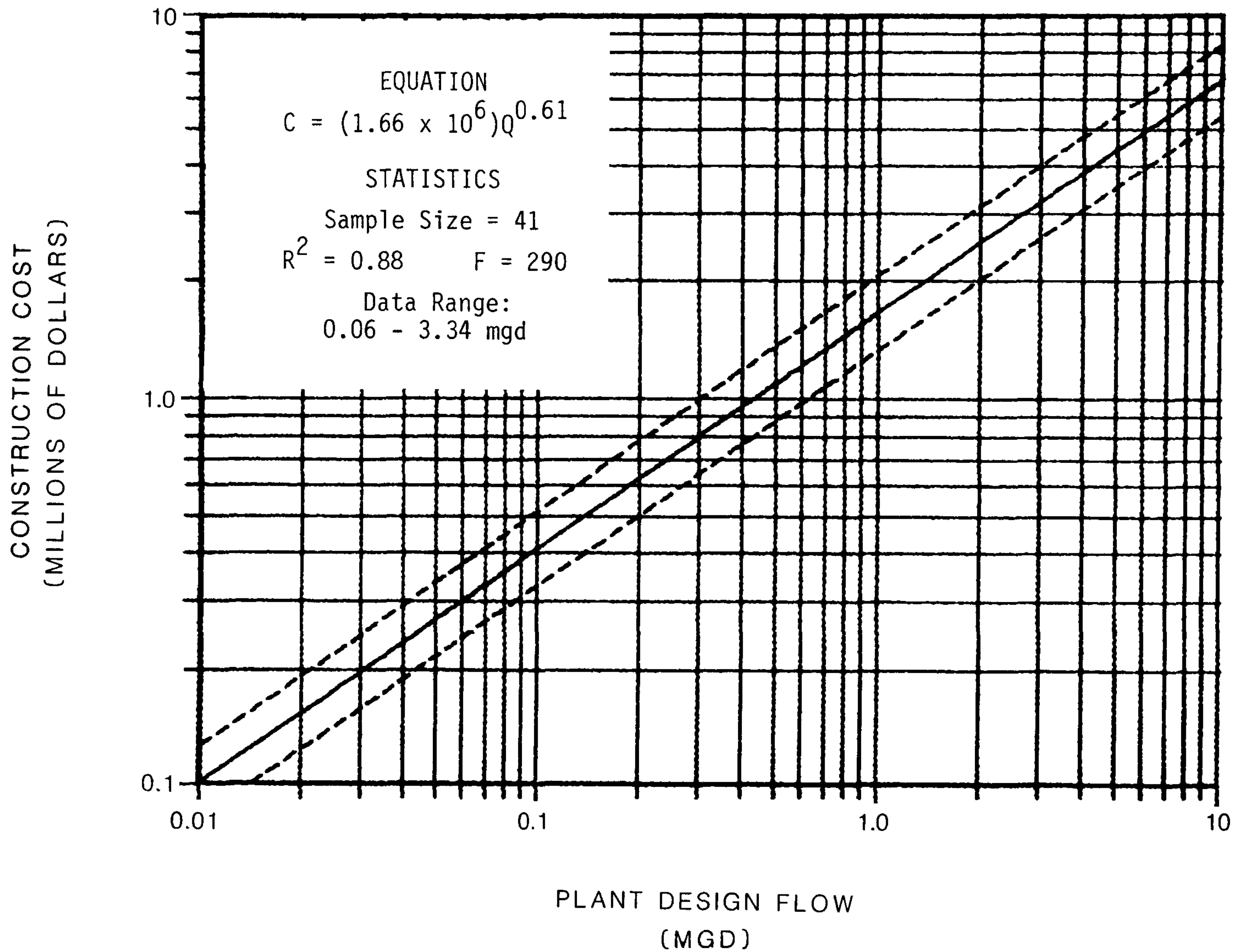


FIGURE 3.55

NEW OXIDATION DITCH PLANT
SECONDARY TREATMENT
SIMPLE SLUDGE HANDLING

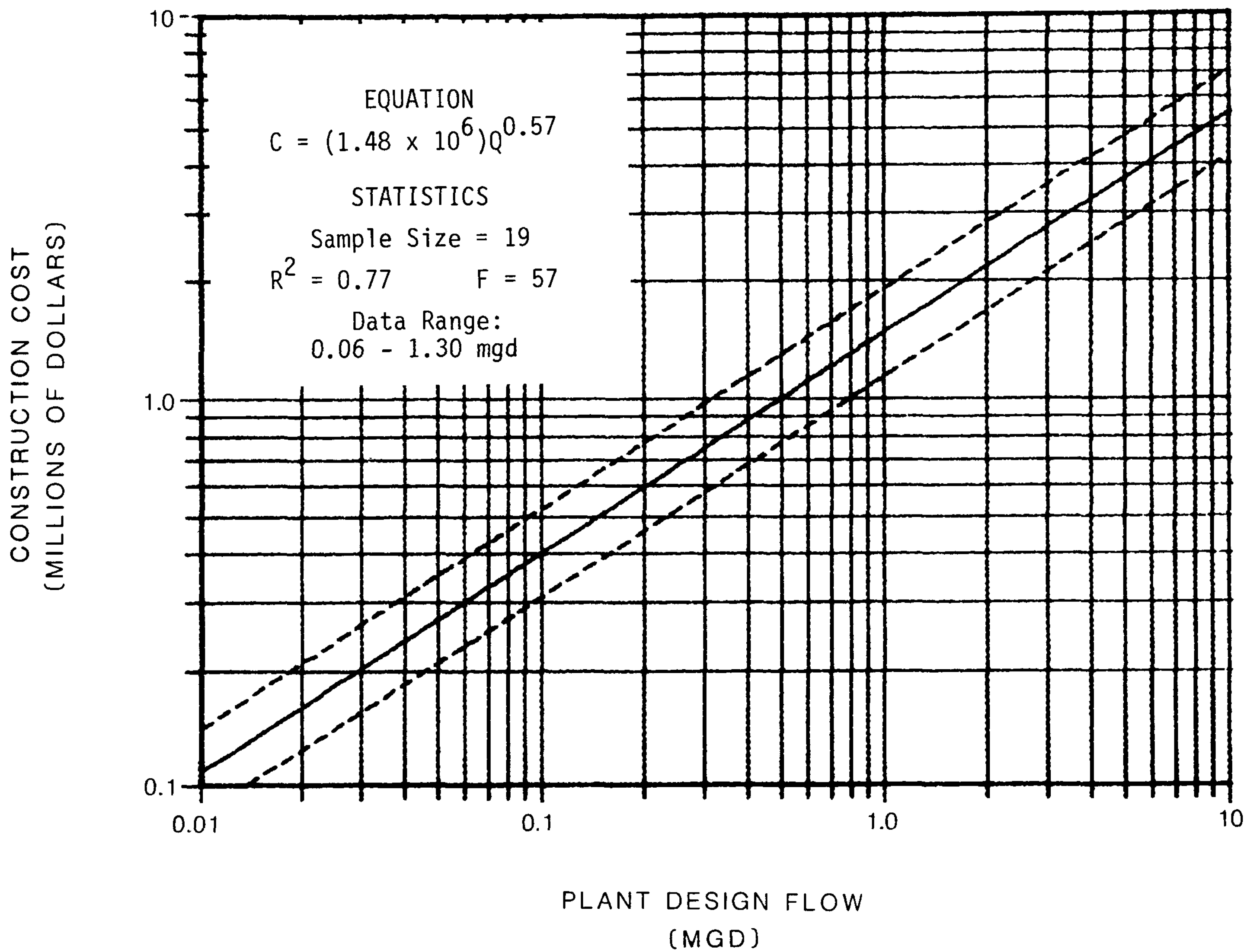


FIGURE 3.56

NEW OXIDATION DITCH PLANT
SECONDARY TREATMENT
MODERATE SLUDGE HANDLING

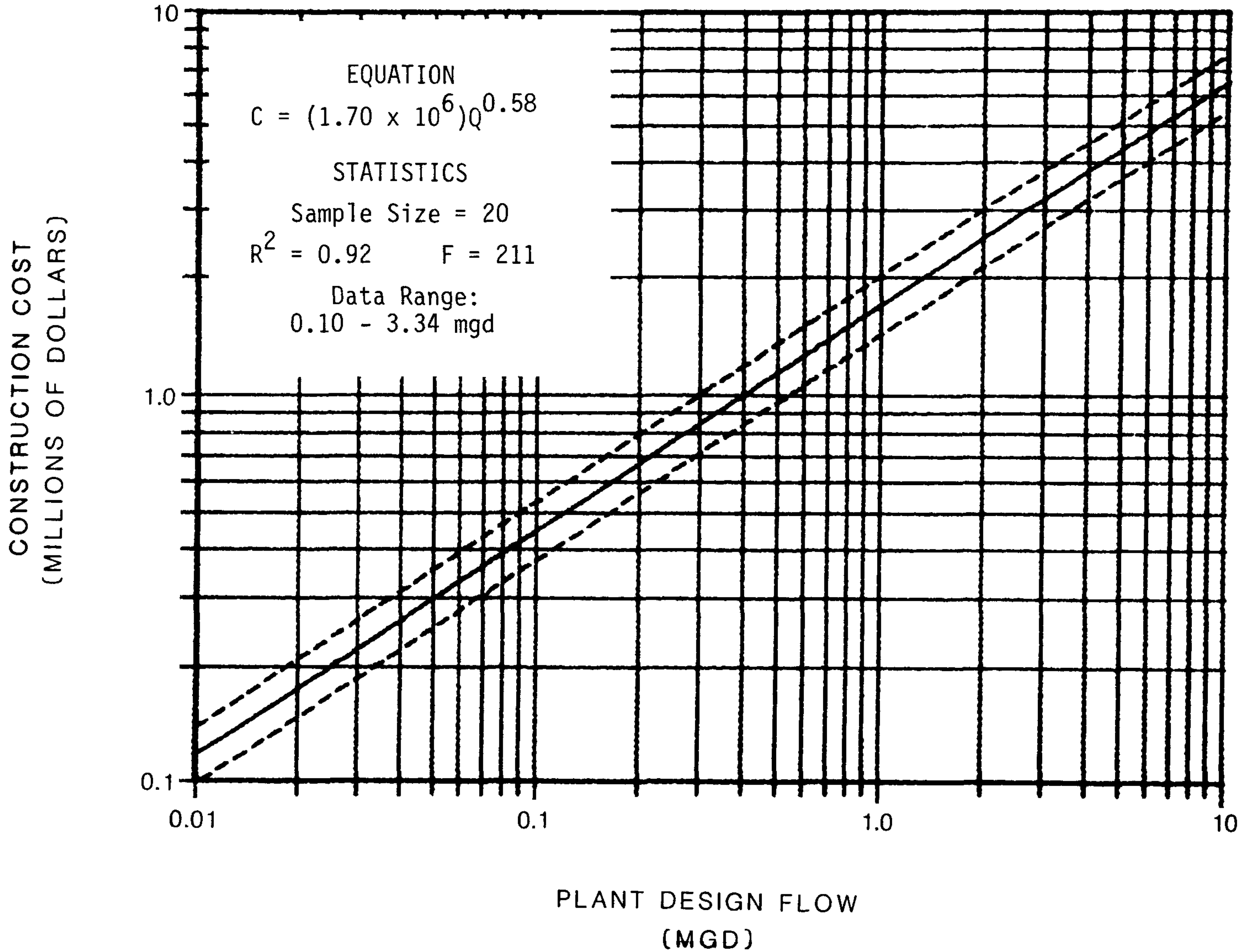


FIGURE 3.57

NEW OXIDATION DITCH PLANT
ADVANCED SECONDARY TREATMENT (AST)
ALL TYPES OF SLUDGE HANDLING

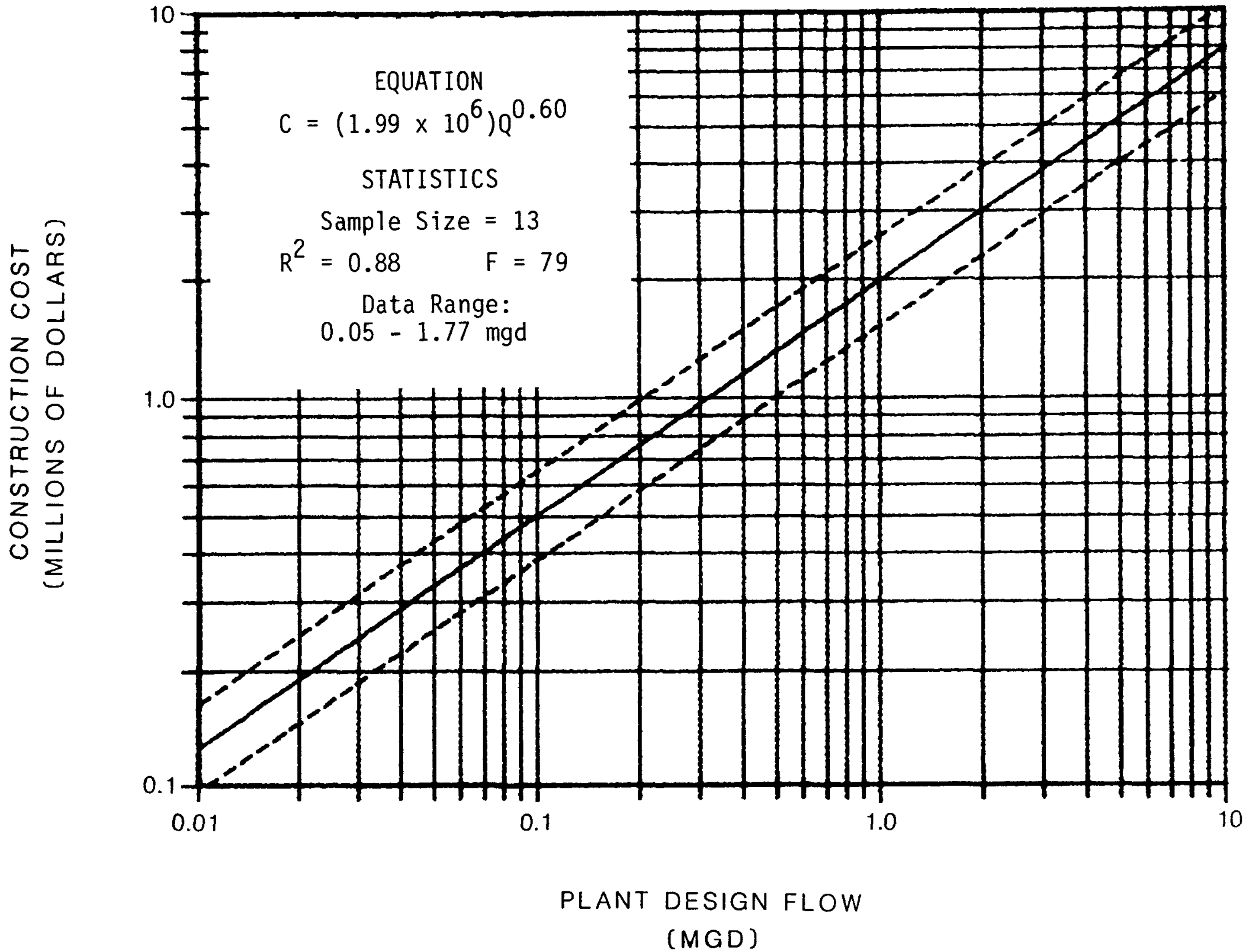


FIGURE 3.58

NEW OXIDATION DITCH PLANT
ADVANCED SECONDARY TREATMENT (AST)
SIMPLE SLUDGE HANDLING

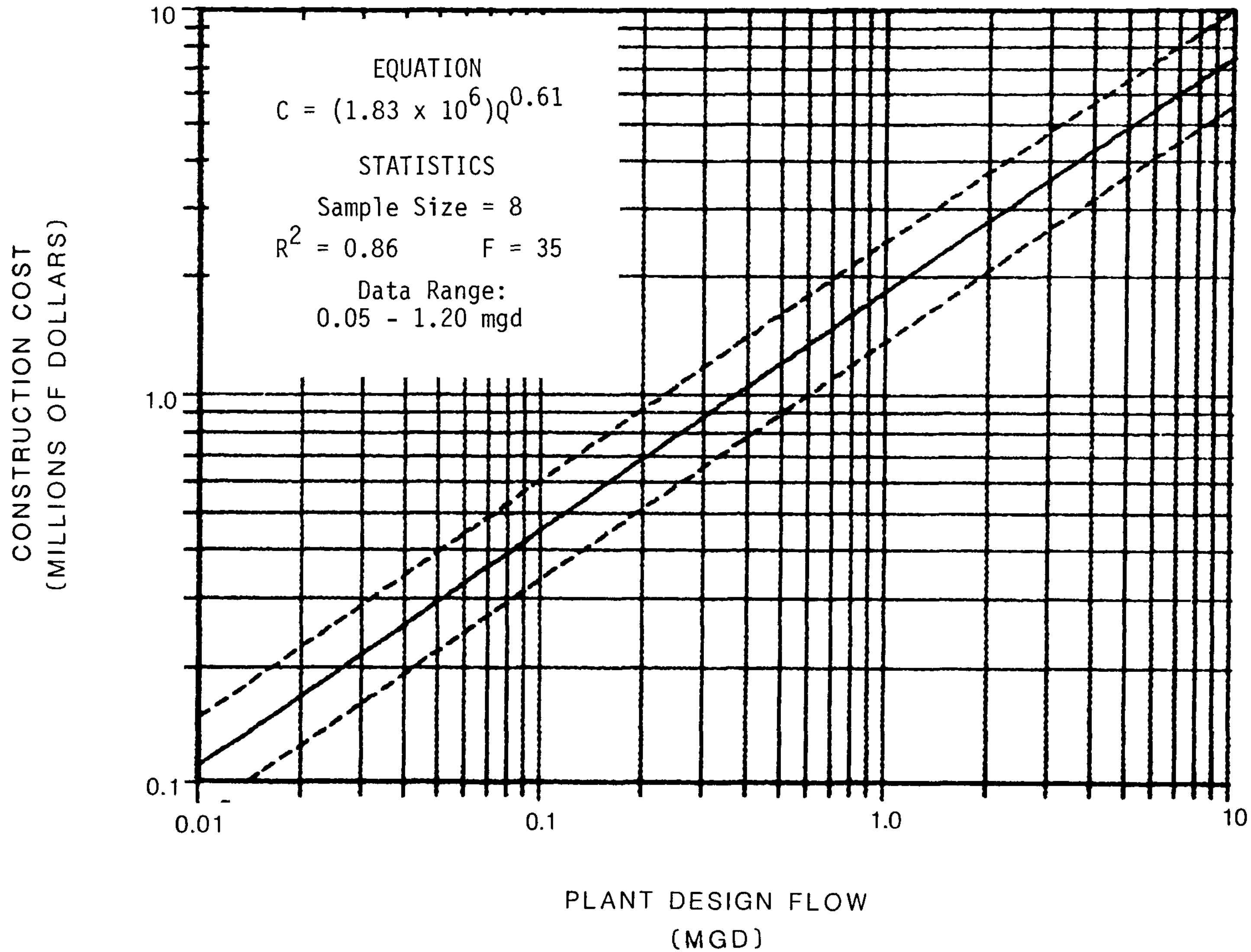


FIGURE 3.59

NEW OXIDATION DITCH PLANT
ADVANCED SECONDARY TREATMENT (AST)
MODERATE SLUDGE HANDLING

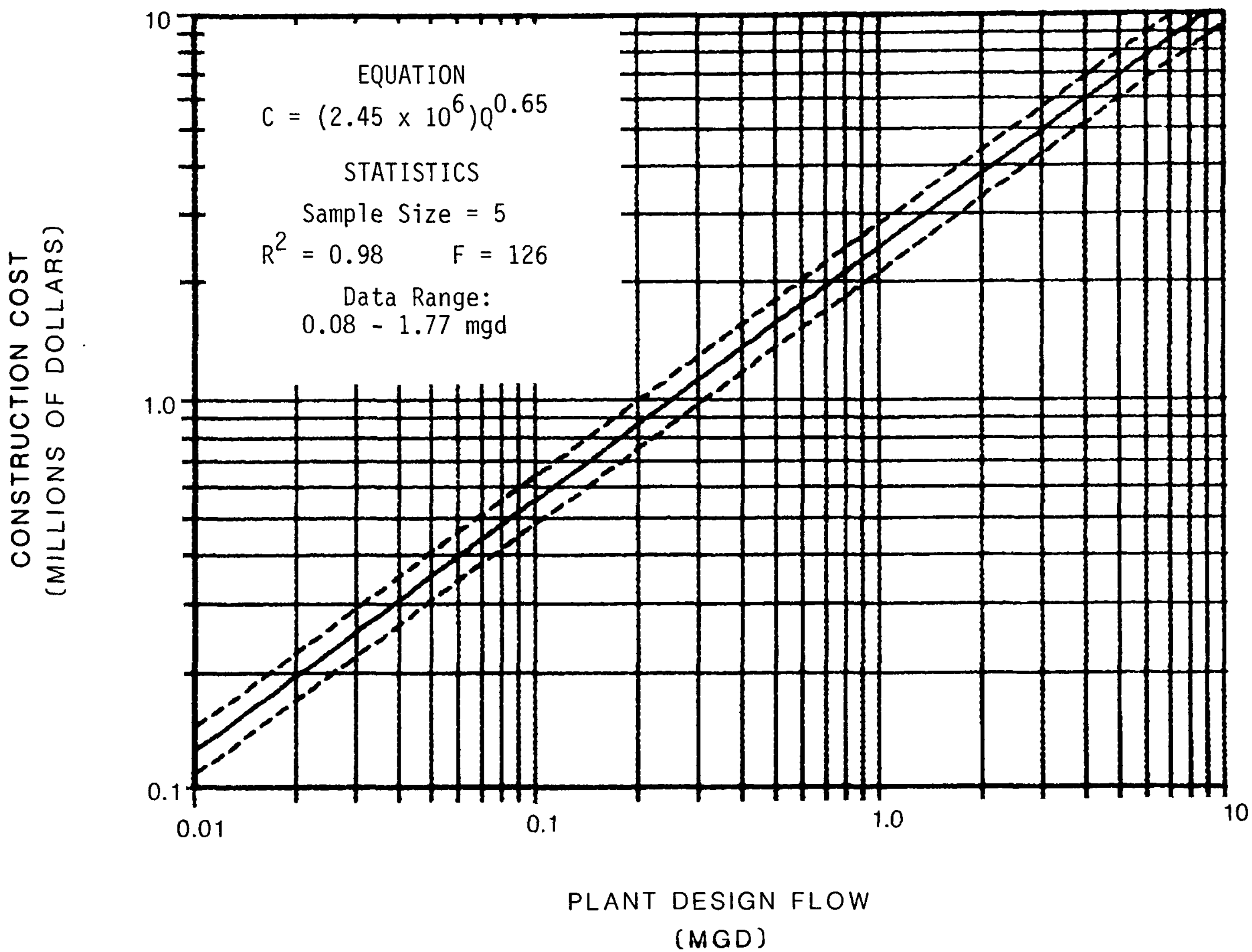


FIGURE 3.60

NEW OXIDATION DITCH PLANT
ADVANCED WASTEWATER TREATMENT (AWT)
ALL TYPES OF SLUDGE HANDLING

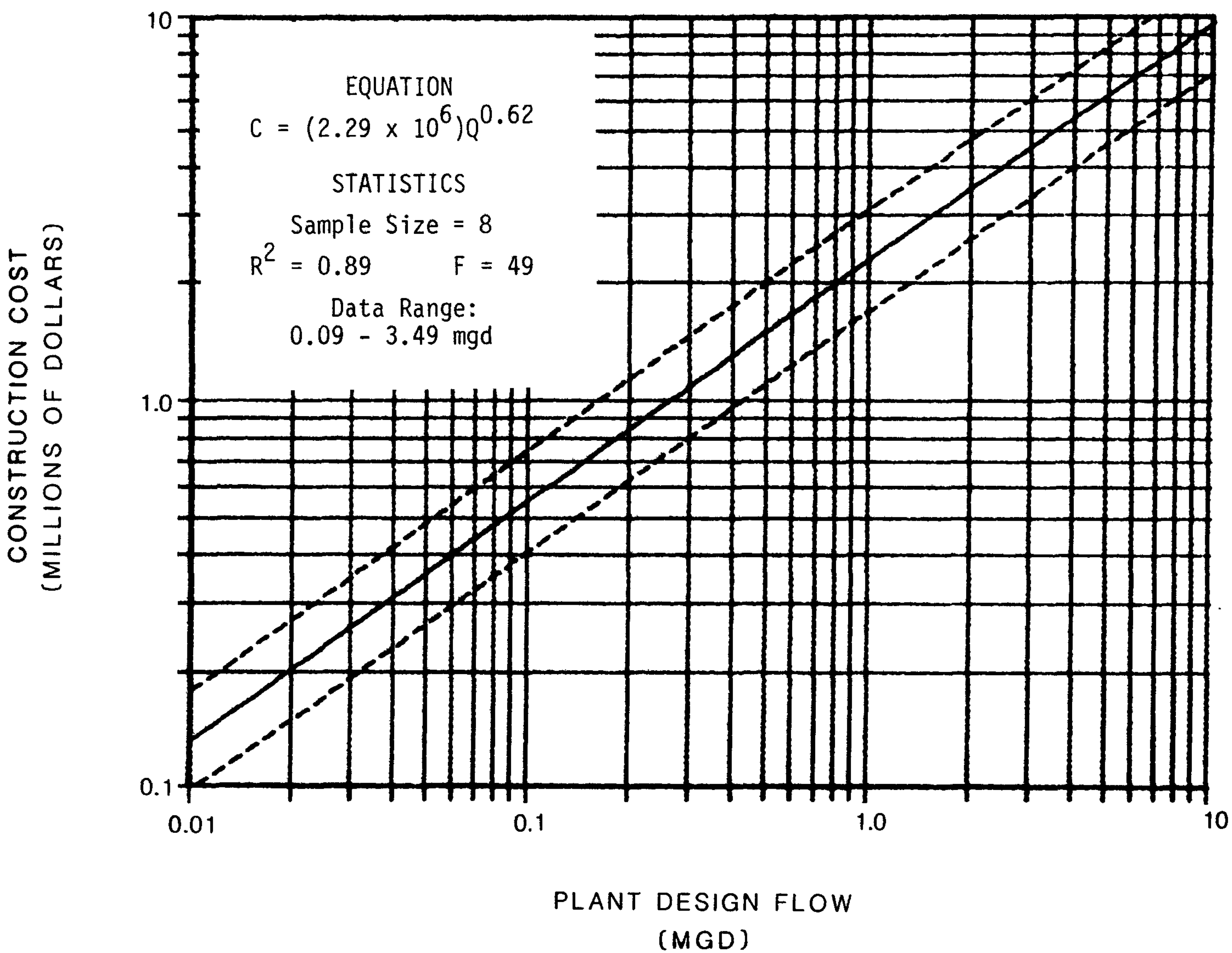


FIGURE 3.61

NEW ROTATING BIOLOGICAL CONTACTOR PLANT
SECONDARY TREATMENT
ALL TYPES OF SLUDGE HANDLING

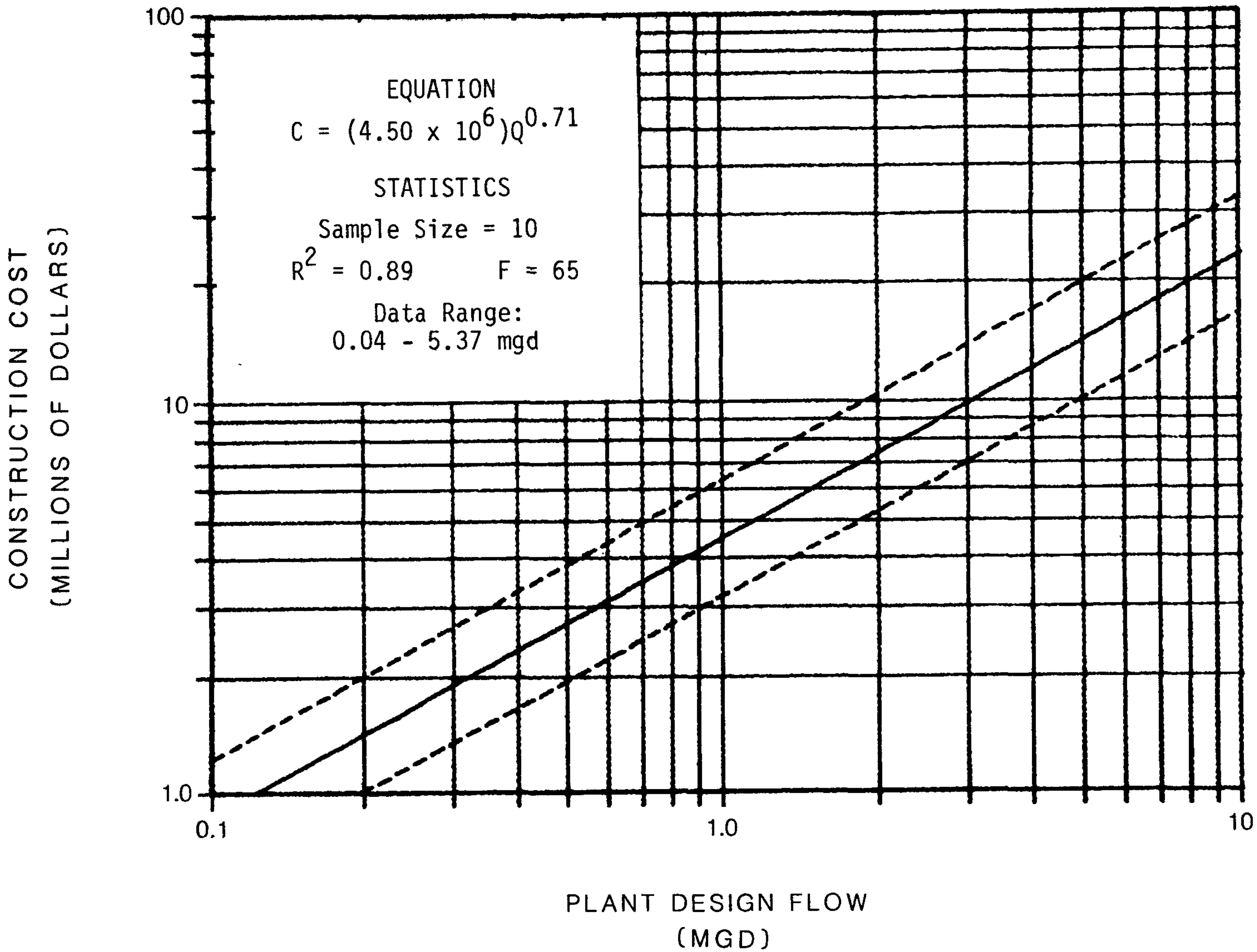


FIGURE 3.62

NEW ROTATING BIOLOGICAL CONTACTOR PLANT
SECONDARY TREATMENT
COMPLEX SLUDGE HANDLING

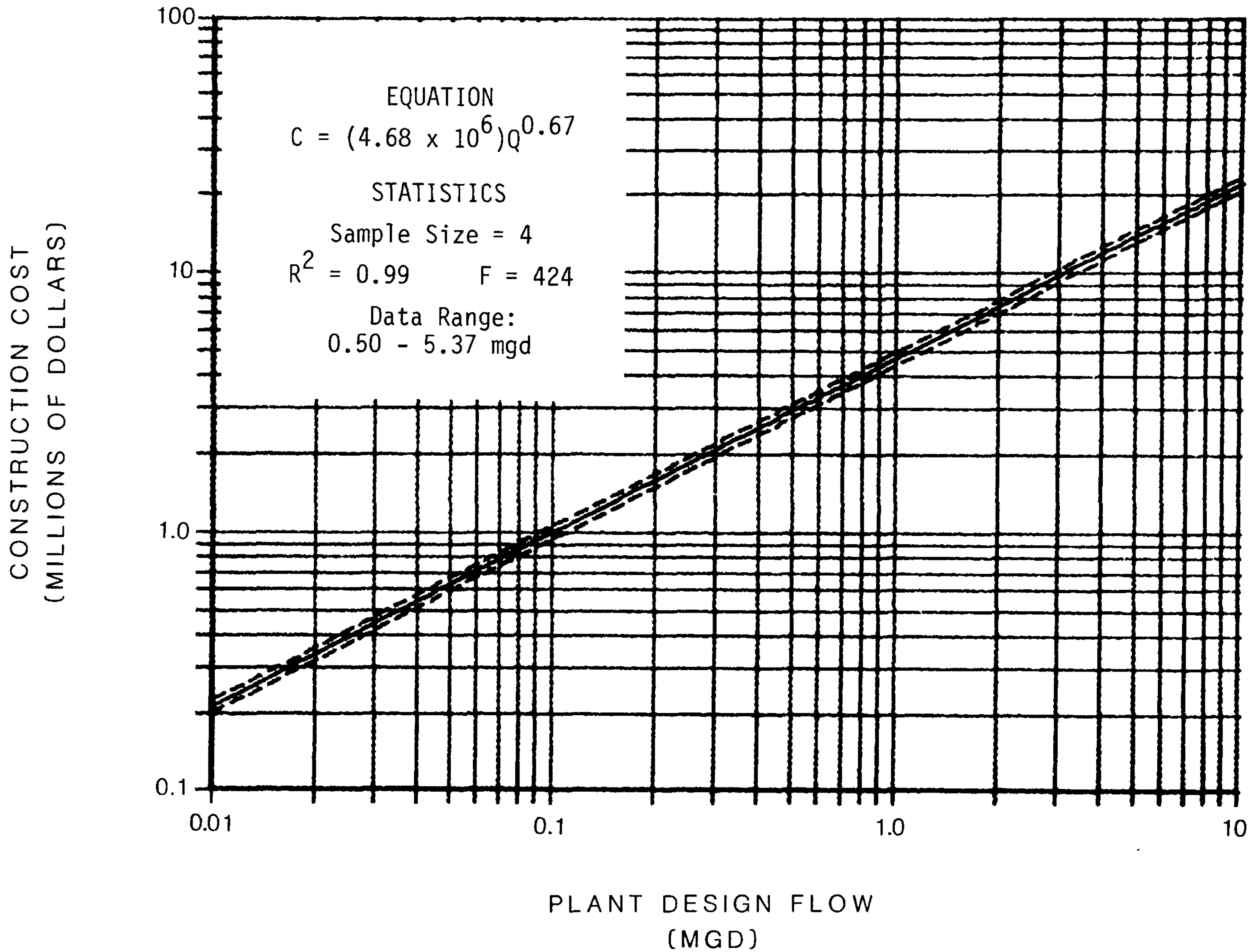


FIGURE 3.63

NEW ROTATING BIOLOGICAL CONTACTOR PLANT
ADVANCED WASTEWATER TREATMENT (AWT)
ALL TYPES OF SLUDGE HANDLING

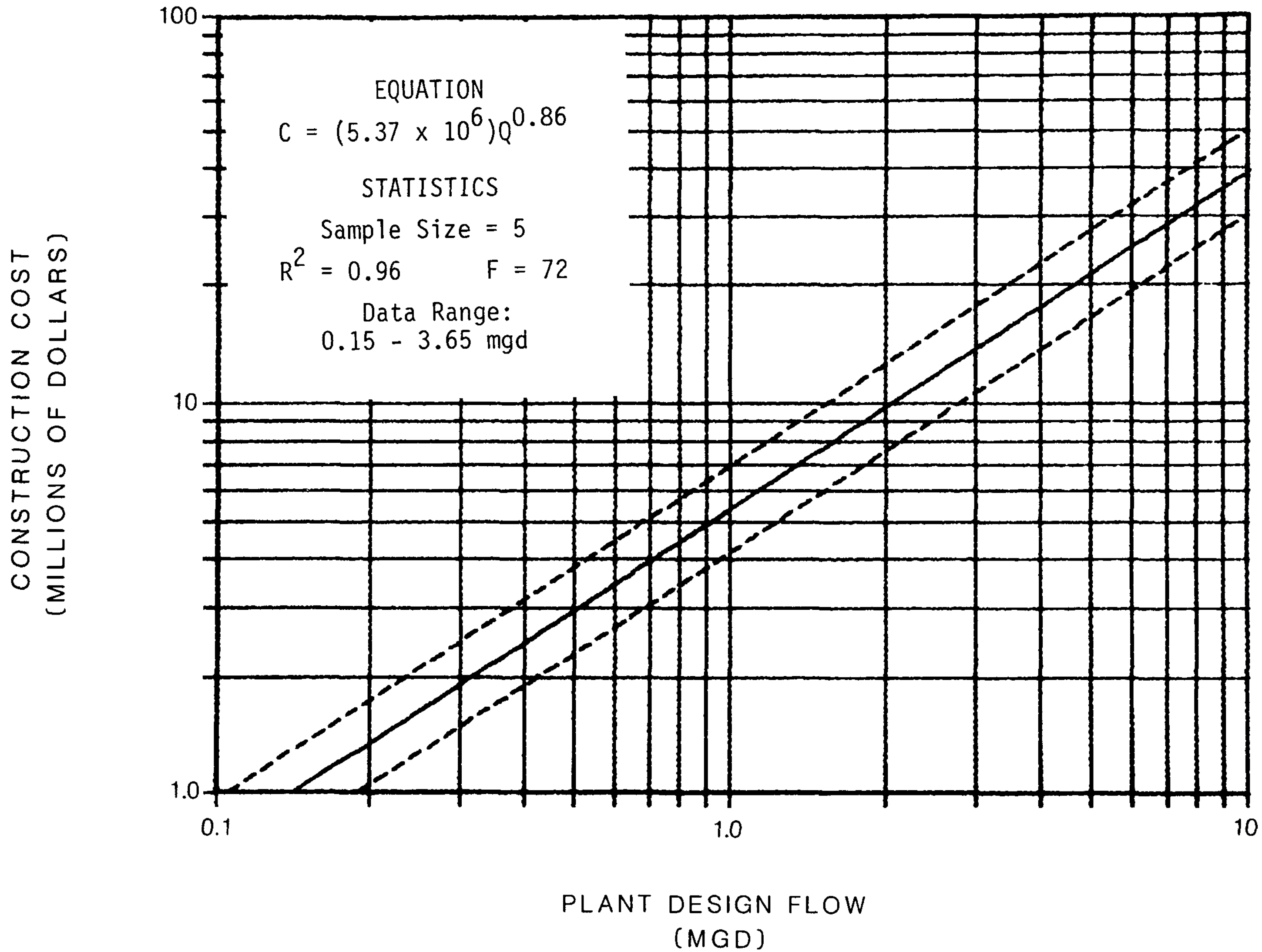


FIGURE 3.64

3.2.3.2 Results - Lagoon Plants

This section contains the results from the analyses of the first order cost relationships between the design flow of a facility and its construction cost. Facilities were classified by level of treatment, type of treatment process, and method of effluent disposal. Further, only completely new lagoon facilities were included.

Figures 3.65 through 3.70 contain the results obtained from these analyses. The figures are divided into two general categories; stabilization ponds (Figures 3.65, 3.66, 3.67) and aerated lagoons (Figures 3.68, 3.69, 3.70).

The cost derived using the regression line or the equation is an estimate for the construction of a complete operational wastewater facility. The cost includes all processes from the headworks to the effluent outfall line. In addition, the costs for land treatment, such as spray irrigation equipment and land purchase, are included (see Figures 3.67 and 3.70). The only other costs that need to be considered are the various nonconstruction costs and land costs for the lagoon sites.

The method of effluent disposal has been used to categorize the lagoon plants. Three methods of disposal have been identified; discharge to surface water, no discharge, and discharge to land treatment. The methods of disposal are differentiated because they have the greatest impact on the construction cost of a lagoon facility.

The type of sludge handling was not addressed in these analyses because only lagoon plants without sludge handling are represented. Figure 3.69 presents the results for aerated lagoons producing an effluent of better than secondary quality. All the facilities represented in this figure employ some method of filtration or screening to reliably produce the better quality effluent.

There are several restrictions which apply to lagoon plants that the reader should take into consideration. The use of lagoon facilities is generally restricted to municipalities with small wastewater flows and sufficient vacant land to allow for the relatively large site required. The no discharge option can only be exercised where either the climate allows for efficient evaporation or the geology allows for percolation into the groundwater system. The land treatment option can only be exercised where sufficient land is available and the effluent does not contain any toxic constituents.

Table 3.5 contains a summary of Figures 3.65 through 3.70 with associated titles and cost equations.

TABLE 3.5

SUMMARY FOR FIGURES 3.65 THROUGH 3.70
FIRST ORDER COSTS
LAGOON PLANTS

Figure Number	Title	Cost Equation*
3.65	Stabilization Pond -Secondary Treatment Discharge to Surface Water	$C = (1.33 \times 10^6)Q^{0.67}$
3.66	Stabilization Pond - No Discharge	$C = (1.02 \times 10^6)Q^{0.64}$
3.67	Stabilization Pond - Discharge to Land Treatment	$C = (1.53 \times 10^6)Q^{0.54}$
3.68	Aerated Lagoon - Secondary Treatment - Discharge to Surface Water	$C = (2.27 \times 10^6)Q^{0.69}$
3.69	Aerated Lagoon - Greater Than Secondary Treatment - Discharge to Surface Water	$C = (2.93 \times 10^6)Q^{0.67}$
3.70	Aerated Lagoon - Discharge to Land Treatment	$C = (2.57 \times 10^6)Q^{0.68}$

* C = Construction Cost (million dollars)
Q = Plant Design Flow (mgd)

NEW STABILIZATION POND
SECONDARY TREATMENT
DISCHARGE TO SURFACE WATER

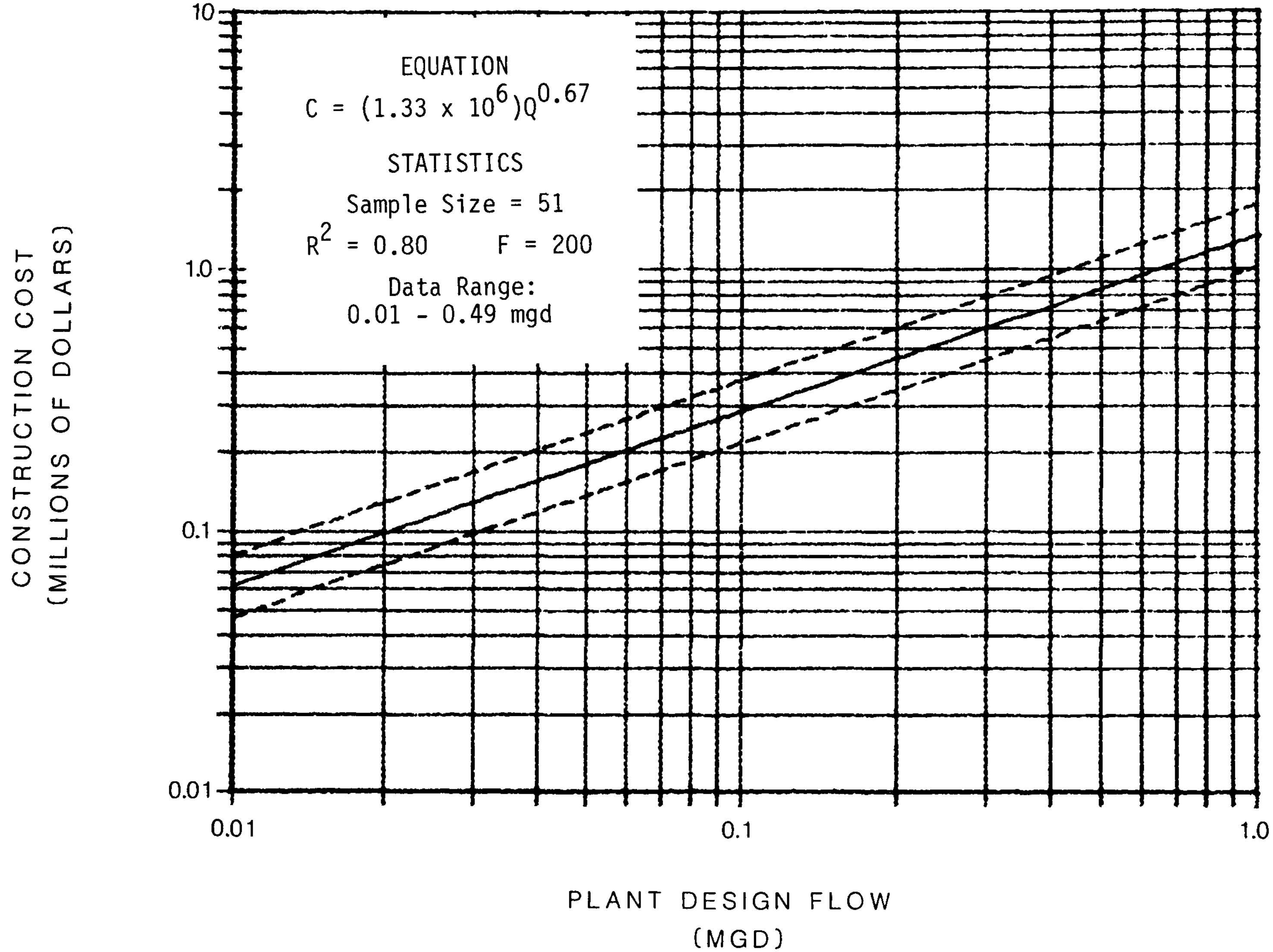


FIGURE 3.65

NEW STABILIZATION POND
NO DISCHARGE

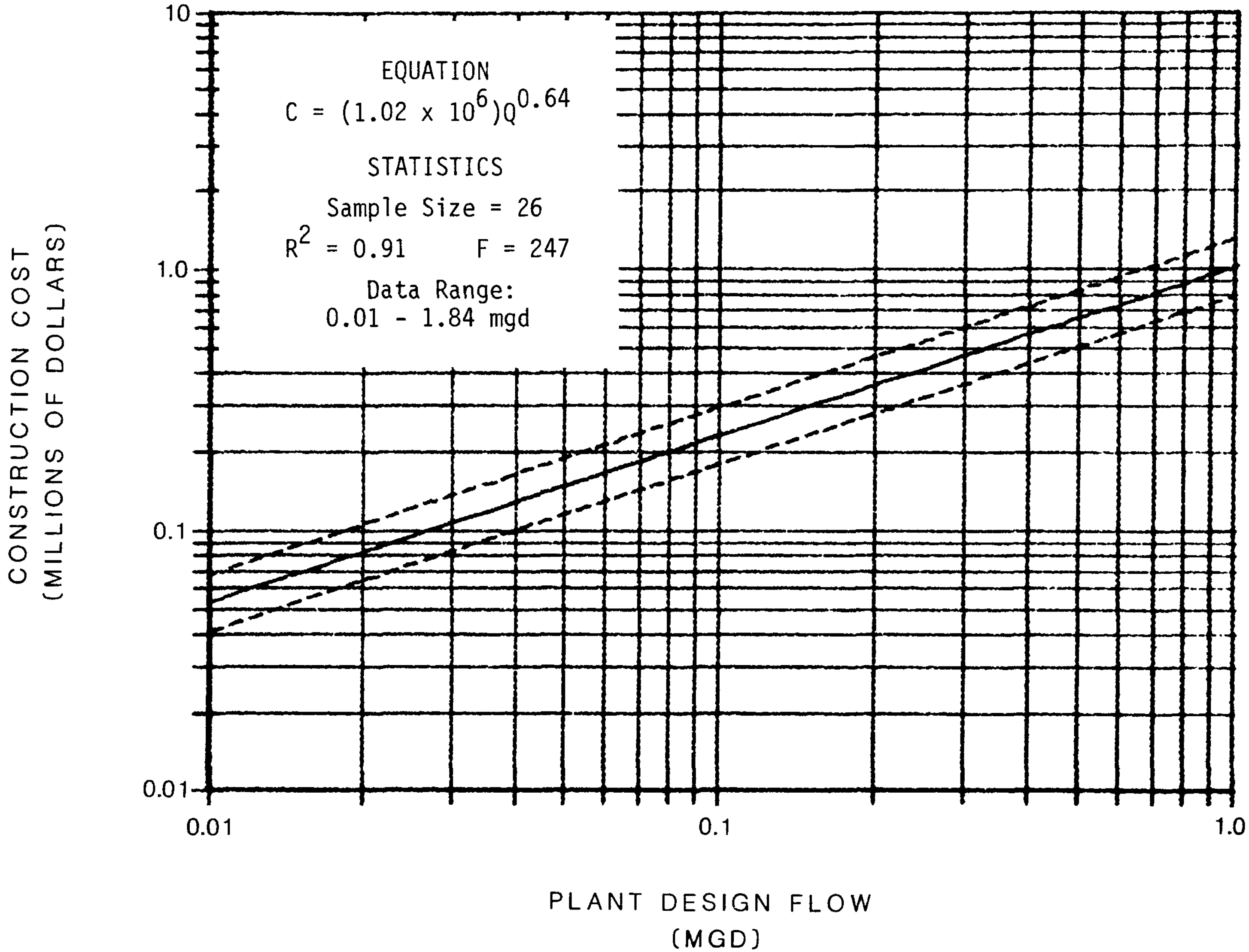
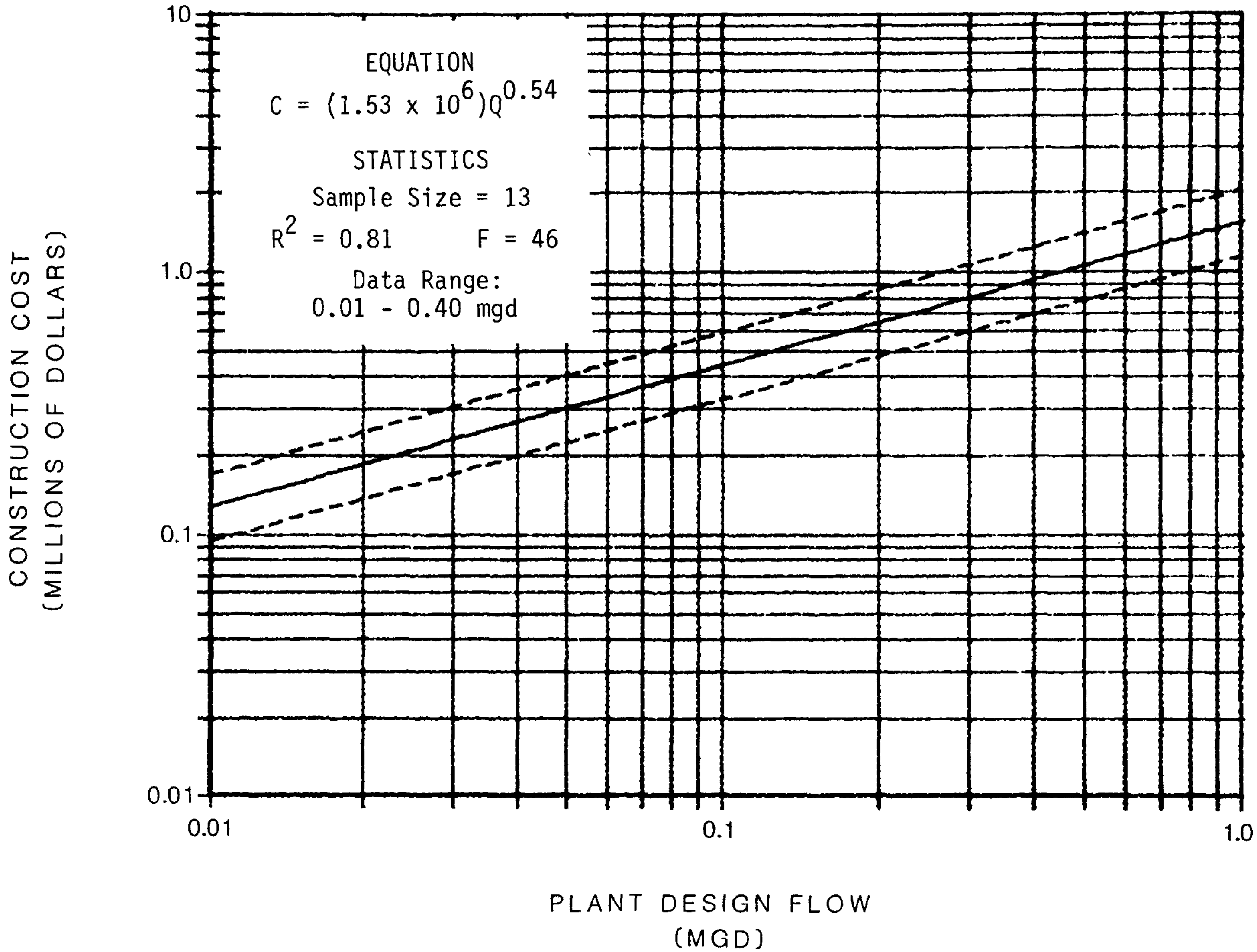


FIGURE 3.66

FIGURE 3.67

NEW STABILIZATION POND DISCHARGE TO LAND TREATMENT



NEW AERATED LAGOON
SECONDARY TREATMENT
DISCHARGE TO SURFACE WATER

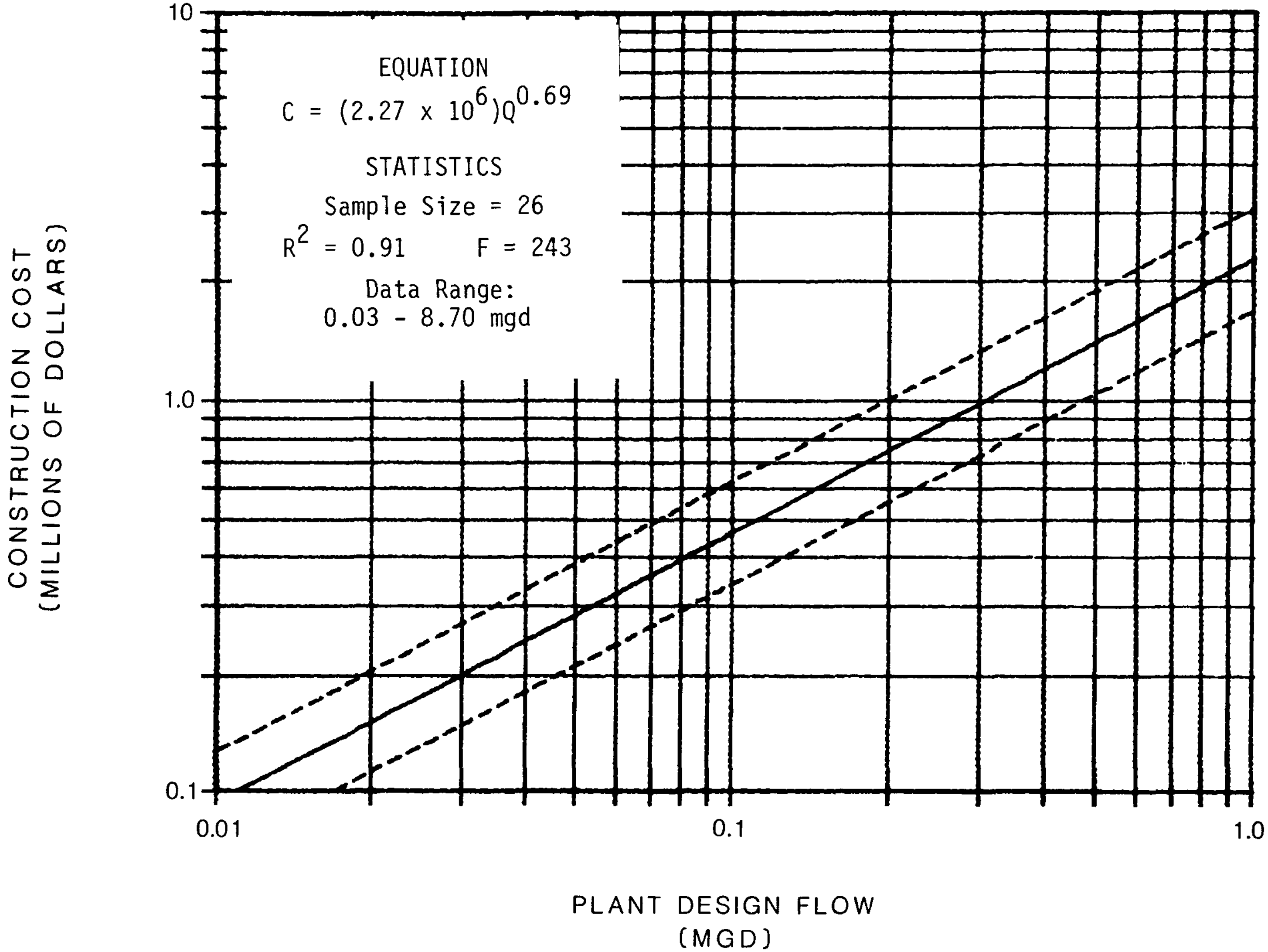


FIGURE 3.68

NEW AERATED LAGOON
GREATER THAN SECONDARY TREATMENT
DISCHARGE TO SURFACE WATER

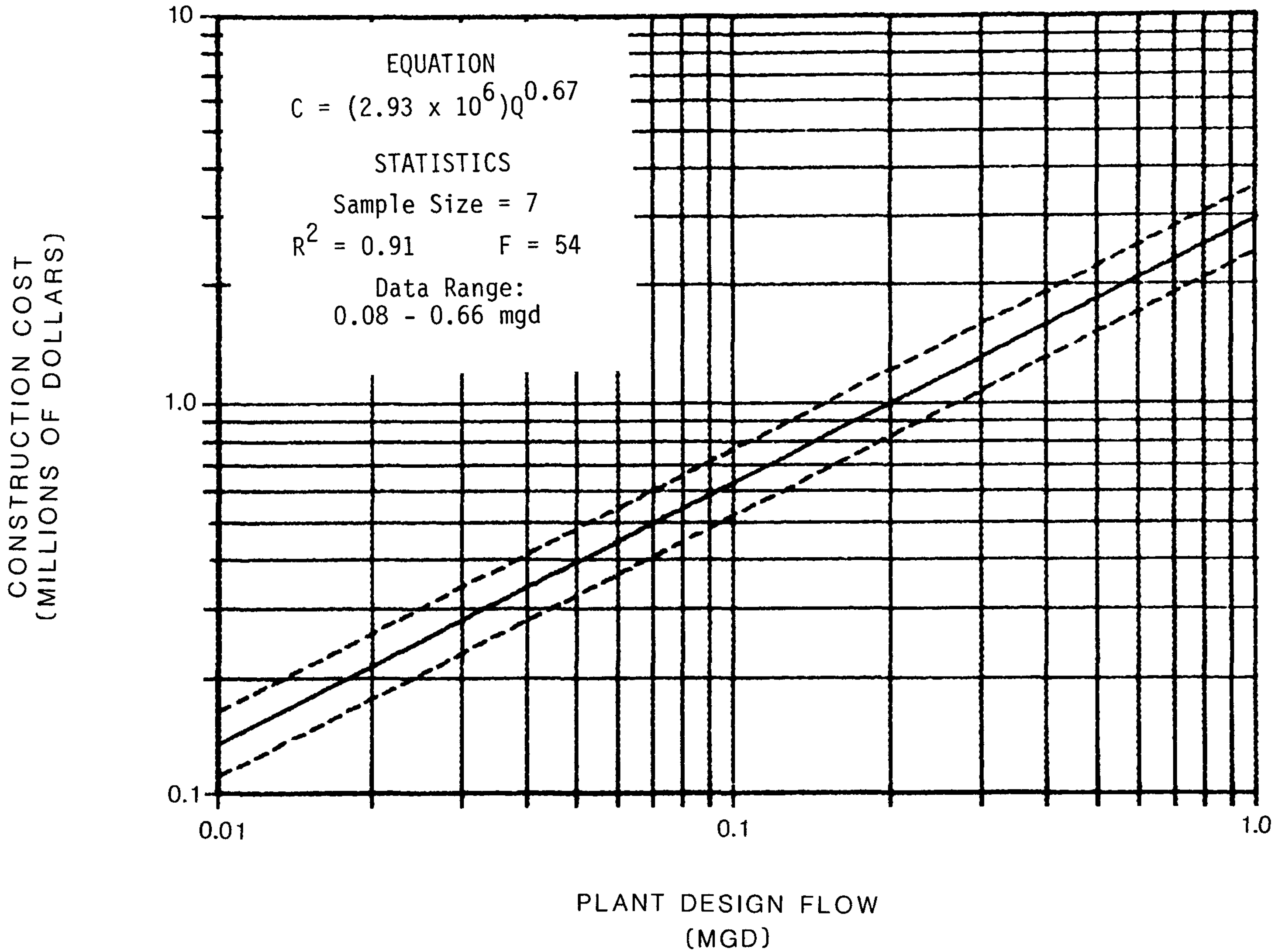


FIGURE 3.69

NEW AERATED LAGOON
DISCHARGE TO LAND TREATMENT

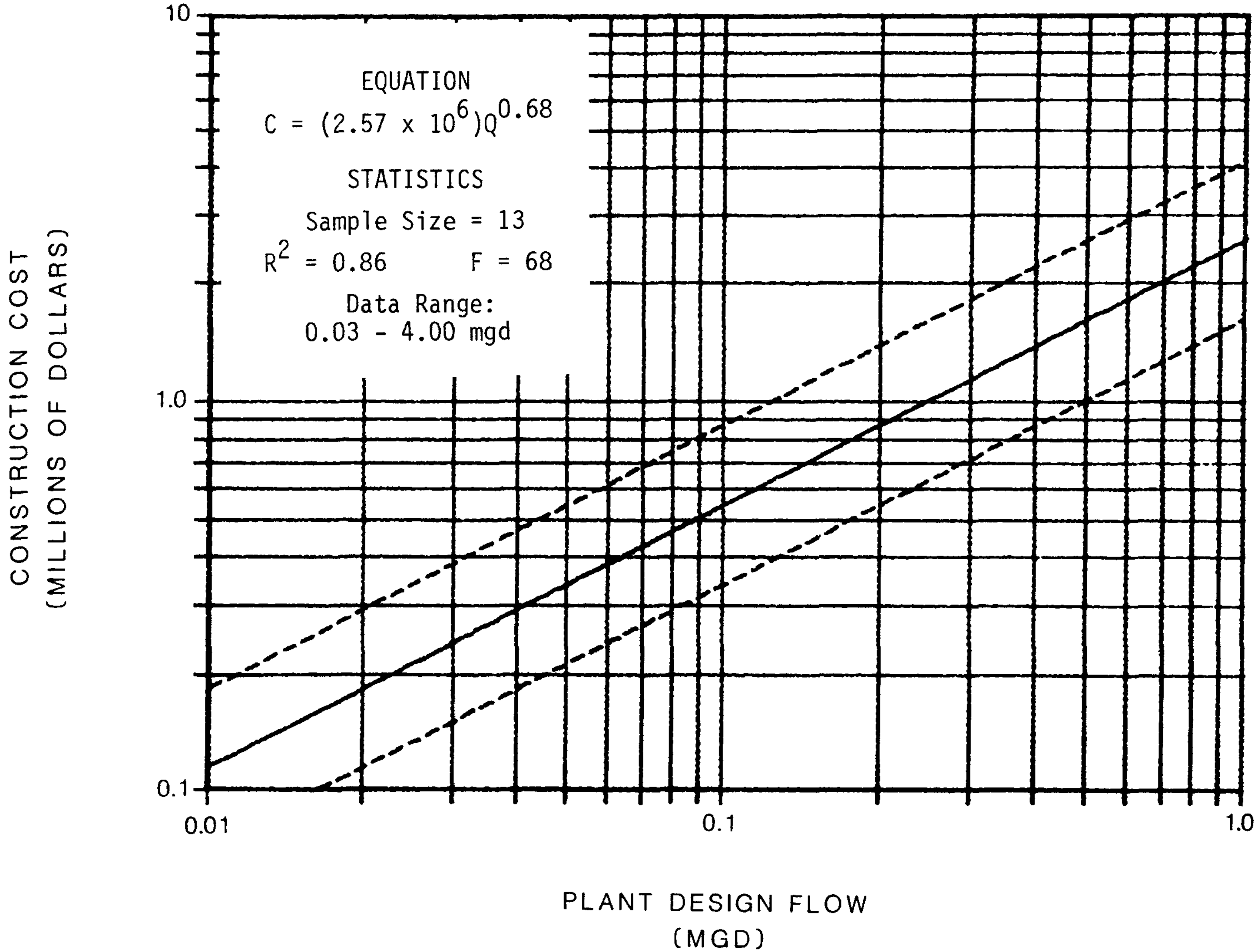


FIGURE 3.70

3.3 SECOND ORDER COSTS

3.3.1 Introduction

Second order costs are the sum of monies paid by the owner to contractors and suppliers for all labor and materials necessary to construct discrete portions of the planned treatment facility. The sum of all second order costs for a project is equivalent to the first order cost for the project.

Two types of second order costs can be identified for a project; unit process costs and plant component costs. All unit process costs presented in this section were derived from data for newly constructed unit processes even though some of these processes were constructed as a part of a facility modification rather than the construction of an entirely new plant. All plant component costs presented were derived only from projects involving the construction of an entirely new plant.

3.3.2 Definition of Terms

- Unit Process Cost. This is the sum of the costs for all labor and materials necessary to construct an entire operational unit process. In order to insure that costs for identical types of unit processes were comparable, each process cost had to include an allowance for the following components:

  - Concrete
  - Equipment
  - Process Piping
  - Steel

  Also, any process which includes clarification as an integral part of its operation, e.g., activated sludge, would have the cost of the clarifier included in the unit process cost.

- Plant Component Cost. This is the lump sum cost for all labor and materials necessary to complete one specialized construction task for an entire facility. The following types of specialized tasks are most commonly identified:

  - Mobilization
  - Site Preparation (sitework)
  - Excavation
  - Piling, Special Foundations, and Dewatering
  - Electrical

- Controls and Instrumentation
- Yard Piping
- Heating, Ventilation, and Air Conditioning

3.3.3 Presentation of Second Order Cost Curves

The results from the second order cost analyses are presented in three sections as follows:

Section 3.3.3.1 - Results - Unit Processes and Unit Operations
Figures 3.71 through 3.106

Section 3.3.3.2 - Results - Mechanical Plant Component Costs
Figures 3.107 through 3.120

Section 3.3.3.3 - Results - Lagoon Plant Component Costs
Figures 3.121 through 3.123

Each section presents the relationship between the design flow of a facility and the construction cost of its various processes and components. Section 3.3.3.1 presents this cost relationship for 36 commonly used unit processes and unit operations. These costs are for newly constructed, complete unit processes. Section 3.3.3.2 presents this cost relationship for 14 plant components which are for mechanical plants only. Section 3.3.3.3 presents this cost relationship for three plant components which are for lagoon plants only.

All cost relationships presented in the following sections represent national averages. Methods for adjusting the national average cost to a specific area of the country are outlined in Section 4.0. Examples of how to use these cost curves to develop estimates are also presented. All national average costs are in third quarter 1982 Kansas City/St. Joseph, Missouri dollars.

3.3.3.1 Results - Unit Processes

This section contains the results from the analyses of the second order cost relationships between the design flow of a treatment plant and the construction cost for the individual unit processes. Both mechanical plants and lagoon facilities are represented. The only restriction placed on the data used in these analyses was that the data were for newly constructed, complete unit processes.

The regression line and the cost equation derived from the line represent the predicted construction costs for the unit process or unit operation identified in the title. The cost derived using the line or equation is an estimate for the construction of a complete operational process. The cost includes all necessary equipment, materials, and labor. In addition, if a process normally includes clarification as an integral part of the process, the clarifier cost is included. The only additional costs that need to be considered are the various nonconstruction costs.

Figure 3.75 contains the cost relationship between facility design flow and the cost for preliminary treatment. Preliminary treatment refers to a plant's headworks excluding influent pumping. Preliminary treatment usually includes bar screens, grit removal, and comminution.

Figure 3.82 illustrates the cost relationship for all types of activated sludge processes. This relationship was developed from the summation of conventional, contact stabilization, and extended aeration unit processes. As mentioned previously, the cost for secondary clarification is included in the unit process cost.

Figure 3.91 illustrates the cost relationship developed for all types of effluent filtrations. Included are filters using sand, mixed media, and other unidentified filter media.

Figure 3.92 represents all chemical addition processes used at a facility, exclusive of chlorine addition. Included are alum, lime, and polymer additions.

Figure 3.94 represents the summation of all land treatment processes. Included are rapid infiltration ponds and spray irrigation networks.

Figure 3.101 represents the summation of all mechanical sludge dewatering processes including vacuum filters and filter presses.

Figure 3.103, Land Application of Liquid Sludge, includes the cost for storage facilities, as well as the application vehicle.

Table 3.6 contains a summary of Figures 3.71 through 3.106 with associated titles and cost equations.

TABLE 3.6

SUMMARY FOR FIGURES 3.71 THROUGH 3.106
SECOND ORDER COSTS
UNIT PROCESSES AND UNIT OPERATIONS

Figure Number	Title	Cost Equation*
3.71	Influent Pumping	$C = (1.63 \times 10^5)Q^{0.59}$
3.72	Bar Screening	$C = (3.99 \times 10^4)Q^{0.59}$
3.73	Grit Removal	$C = (4.94 \times 10^4)Q^{0.34}$
3.74	Comminution	$C = (2.46 \times 10^4)Q^{0.38}$
3.75	Preliminary Treatment	$C = (7.84 \times 10^4)Q^{0.77}$
3.76	Flow Equalization	$C = (1.17 \times 10^5)Q^{0.42}$
3.77	Primary Sedimentation	$C = (1.60 \times 10^5)Q^{0.65}$
3.78	Trickling Filter	$C = (5.27 \times 10^5)Q^{0.44}$
3.79	Conventional Activated Sludge	$C = (6.54 \times 10^5)Q^{0.72}$
3.80	Contact Stabilization	$C = (5.95 \times 10^5)Q^{0.66}$
3.81	Extended Aeration	$C = (6.12 \times 10^5)Q^{0.54}$
3.82	Activated Sludge (All Types)	$C = (6.49 \times 10^5)Q^{0.68}$
3.83	Separate Stage Biological Nitrification	$C = (3.56 \times 10^5)Q^{0.95}$
3.84	Oxidation Ditch	$C = (5.96 \times 10^5)Q^{0.52}$
3.85	Rotating Biological Contactor	$C = (7.17 \times 10^5)Q^{0.75}$
3.86	Stabilization Pond	$C = (9.12 \times 10^5)Q^{0.58}$
3.87	Aerated Lagoon	$C = (9.31 \times 10^5)Q^{0.66}$
3.88	Secondary Microscreening	$C = (1.55 \times 10^5)Q^{0.59}$
3.89	Sand Filtration	$C = (3.15 \times 10^5)Q^{0.55}$
3.90	Mixed Media Filtration	$C = (2.75 \times 10^5)Q^{0.63}$

* C = Process Construction Cost (million dollars)
Q = Plant Design Flow (mgd)

TABLE 3.6 (Concluded)

Figure Number	Title	Cost Equation
3.91	Filtration (All Types)	$C = (2.97 \times 10^5)Q^{0.63}$
3.92	Chemical Additions	$C = (5.78 \times 10^4)Q^{0.93}$
3.93	Chlorination for Disinfection	$C = (8.30 \times 10^4)Q^{0.59}$
3.94	Land Treatment of Secondary Effluent	$C = (5.67 \times 10^5)Q^{0.73}$
3.95	Post Aeration	$C = (4.15 \times 10^4)Q^{0.91}$
3.96	Effluent Outfall Pumping	$C = (8.48 \times 10^4)Q^{0.55}$
3.97	Effluent Outfall Diffuser	$C = (2.75 \times 10^4)Q^{0.59}$
3.98	Aerobic Digestion	$C = (2.46 \times 10^5)Q^{0.87}$
3.99	Anaerobic Digestion	$C = (3.40 \times 10^5)Q^{0.76}$
3.100	Sludge Drying	$C = (9.62 \times 10^4)Q^{0.69}$
3.101	Mechanical Sludge Dewatering	$C = (1.75 \times 10^5)Q^{0.58}$
3.102	Gravity Thickening	$C = (9.09 \times 10^4)Q^{0.66}$
3.103	Land Application of Liquid Sludge	$C = (5.09 \times 10^4)Q^{0.48}$
3.104	Control/Laboratory/Maintenance Building	$C = (2.01 \times 10^5)Q^{0.54}$
3.105	Effluent Outfall to Nonocean Surface Water	$C = (1.00 \times 10^5)Q^{0.76}$
3.106	Effluent Outfall to Ocean	$C = (6.43 \times 10^5)Q^{0.95}$

NEW UNIT OPERATION
INFLUENT PUMPING

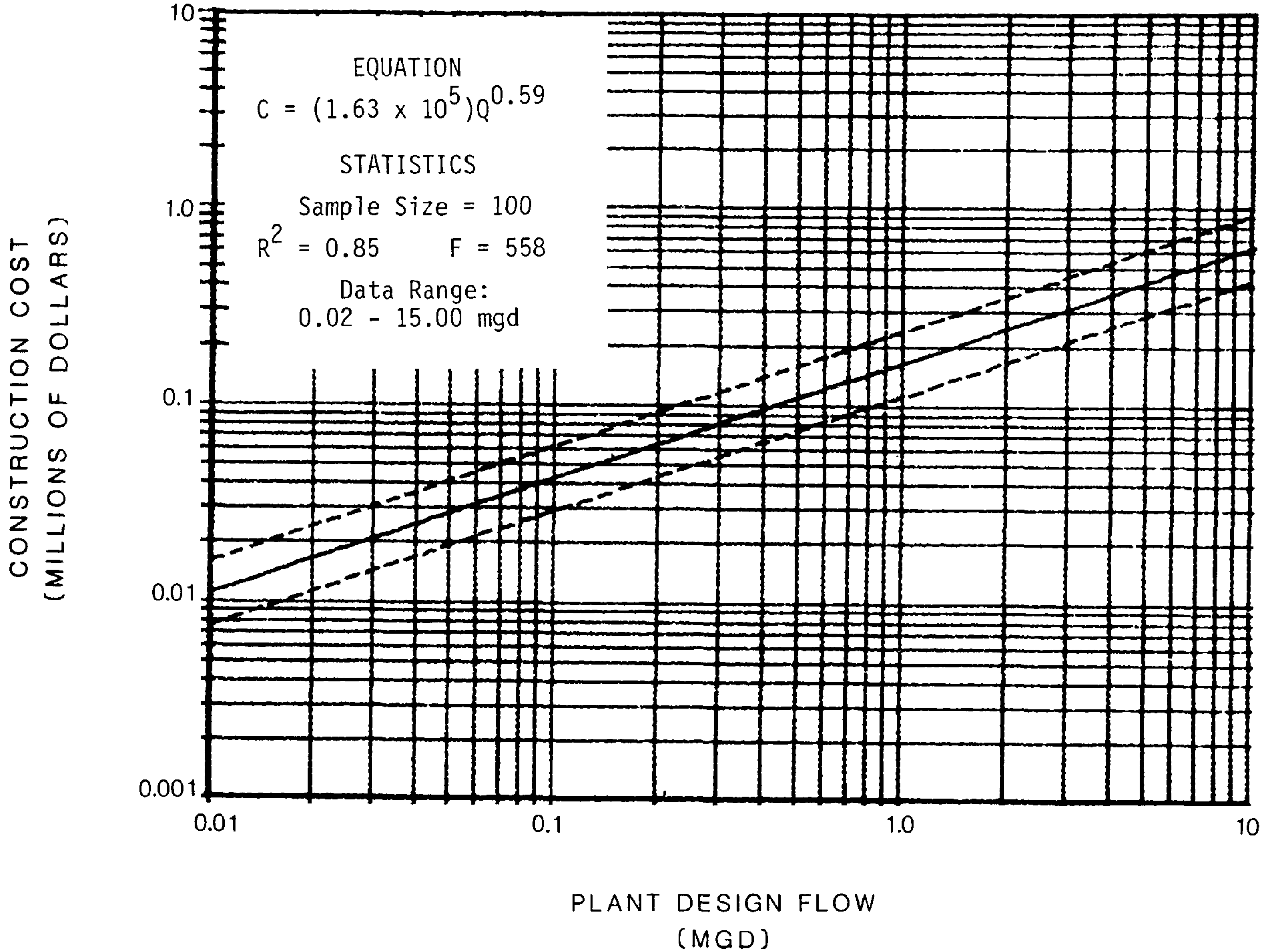


FIGURE 3.71

NEW UNIT OPERATION
BAR SCREENING

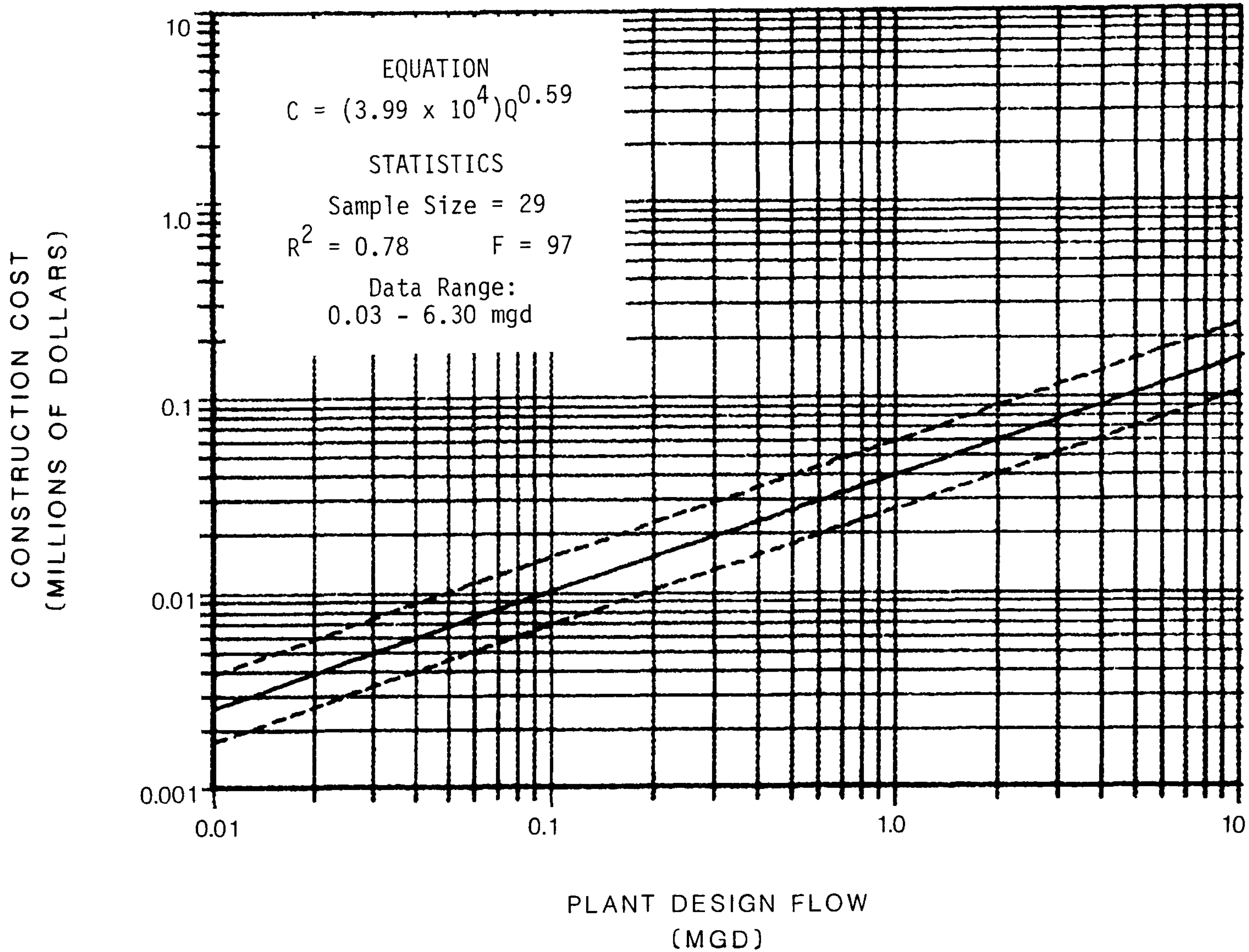


FIGURE 3.72

NEW UNIT OPERATION
GRIT REMOVAL

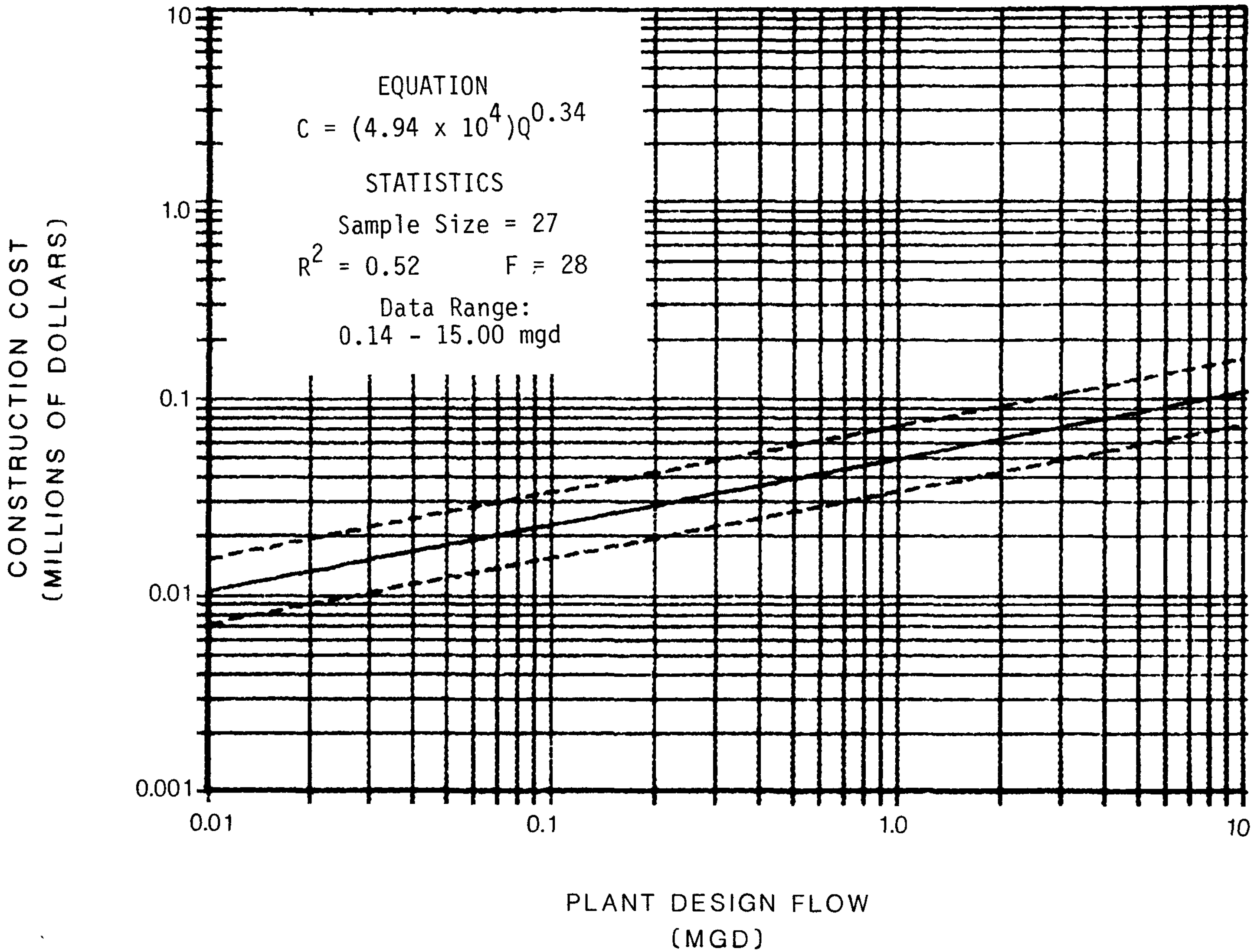
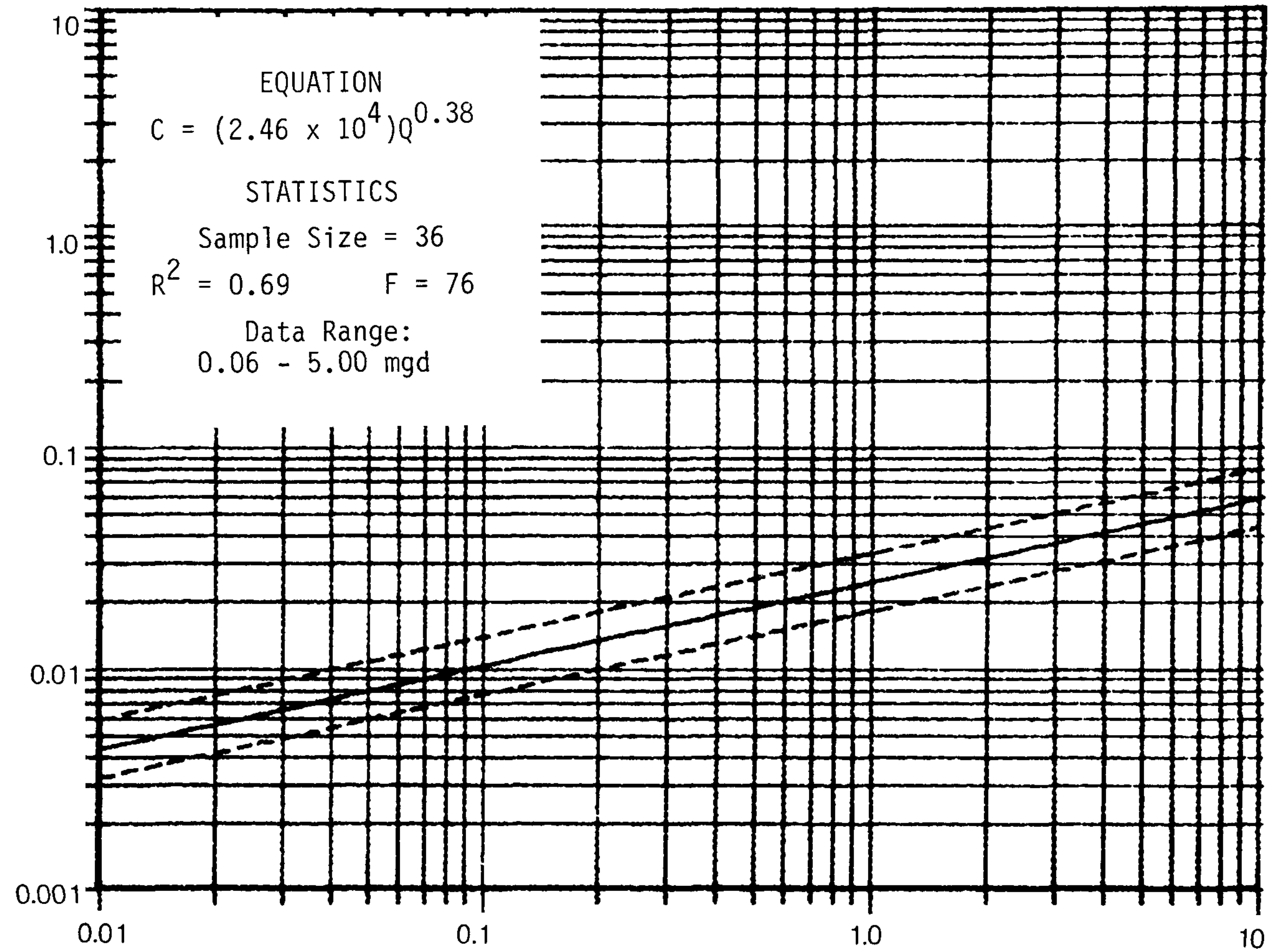


FIGURE 3.73

NEW UNIT OPERATION
COMMINUTION



CONSTRUCTION COST (MILLIONS OF DOLLARS)

PLANT DESIGN FLOW (MGD)

FIGURE 3.74

NEW UNIT OPERATION
PRELIMINARY TREATMENT

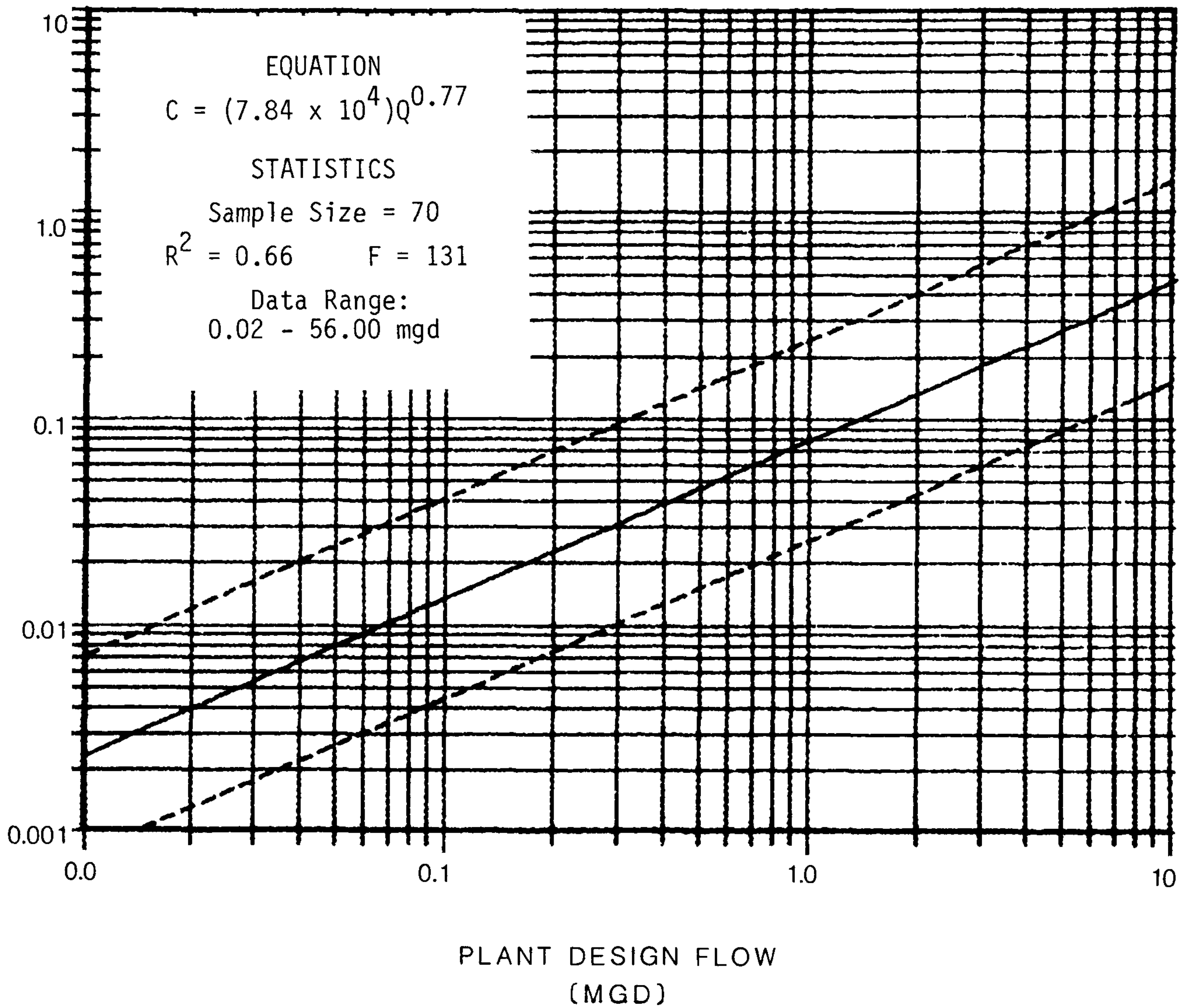


FIGURE 3.75

NEW UNIT OPERATION
FLOW EQUALIZATION

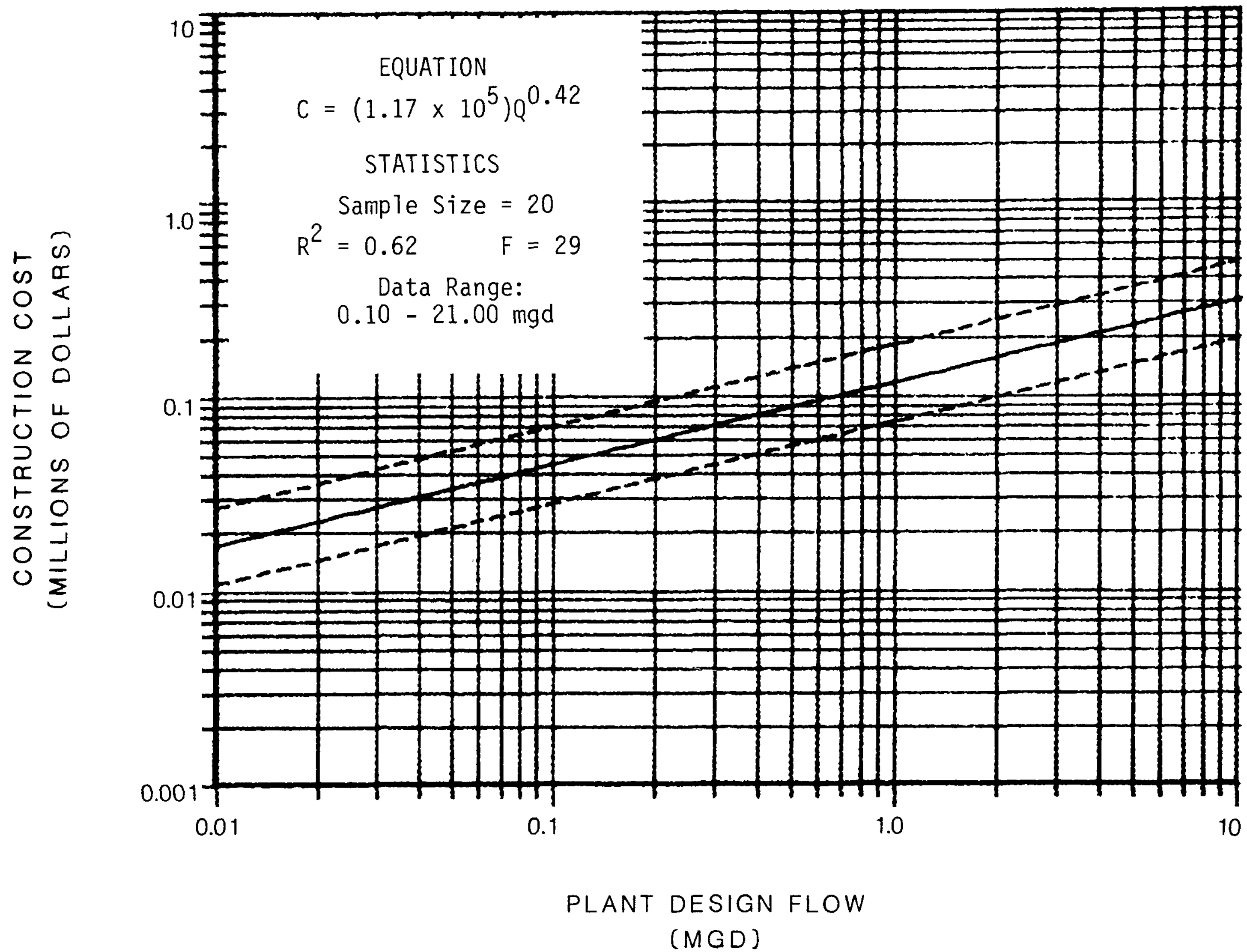


FIGURE 3.76

NEW UNIT OPERATION
PRIMARY SEDIMENTATION

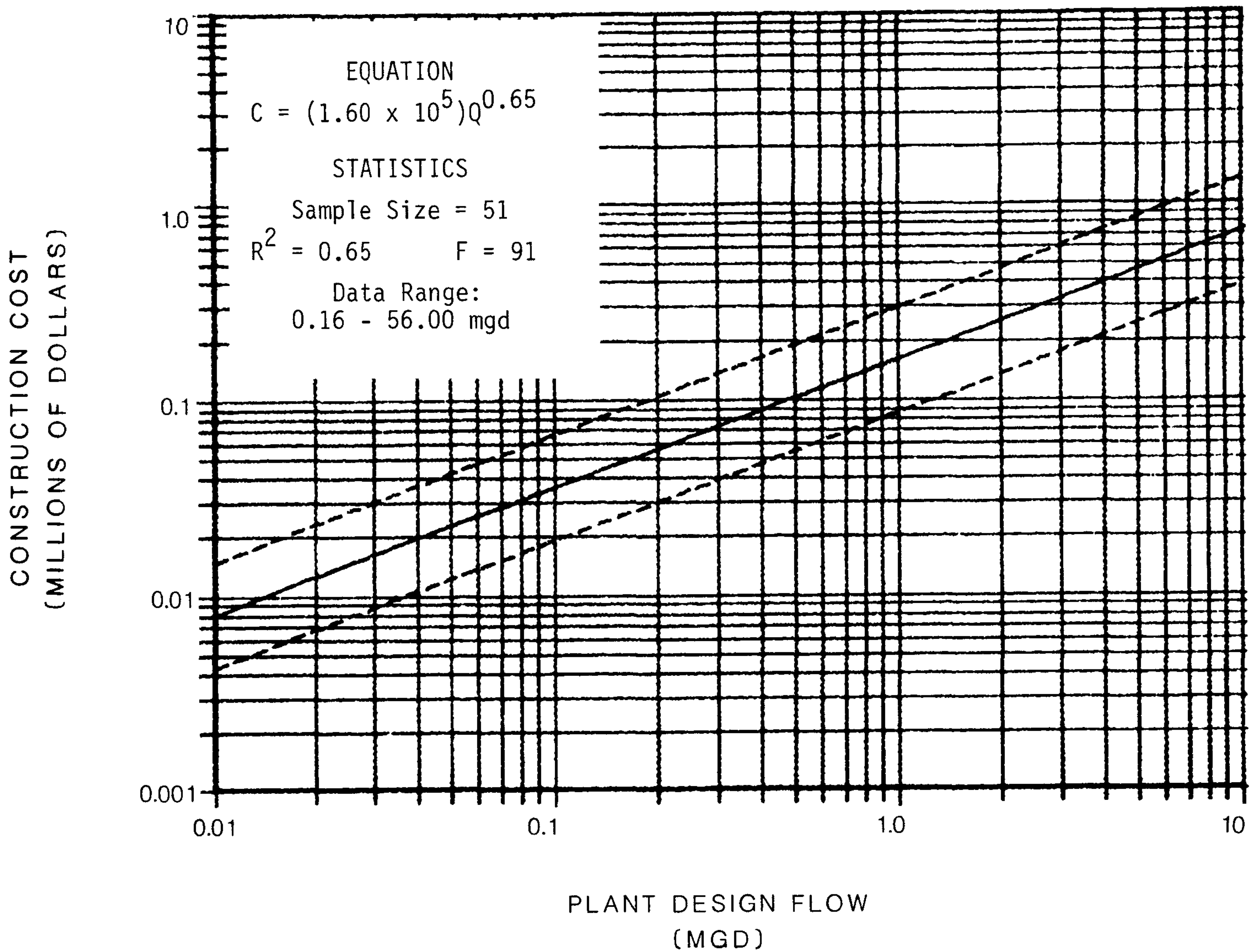


FIGURE 3.77

NEW UNIT PROCESS
TRICKLING FILTER

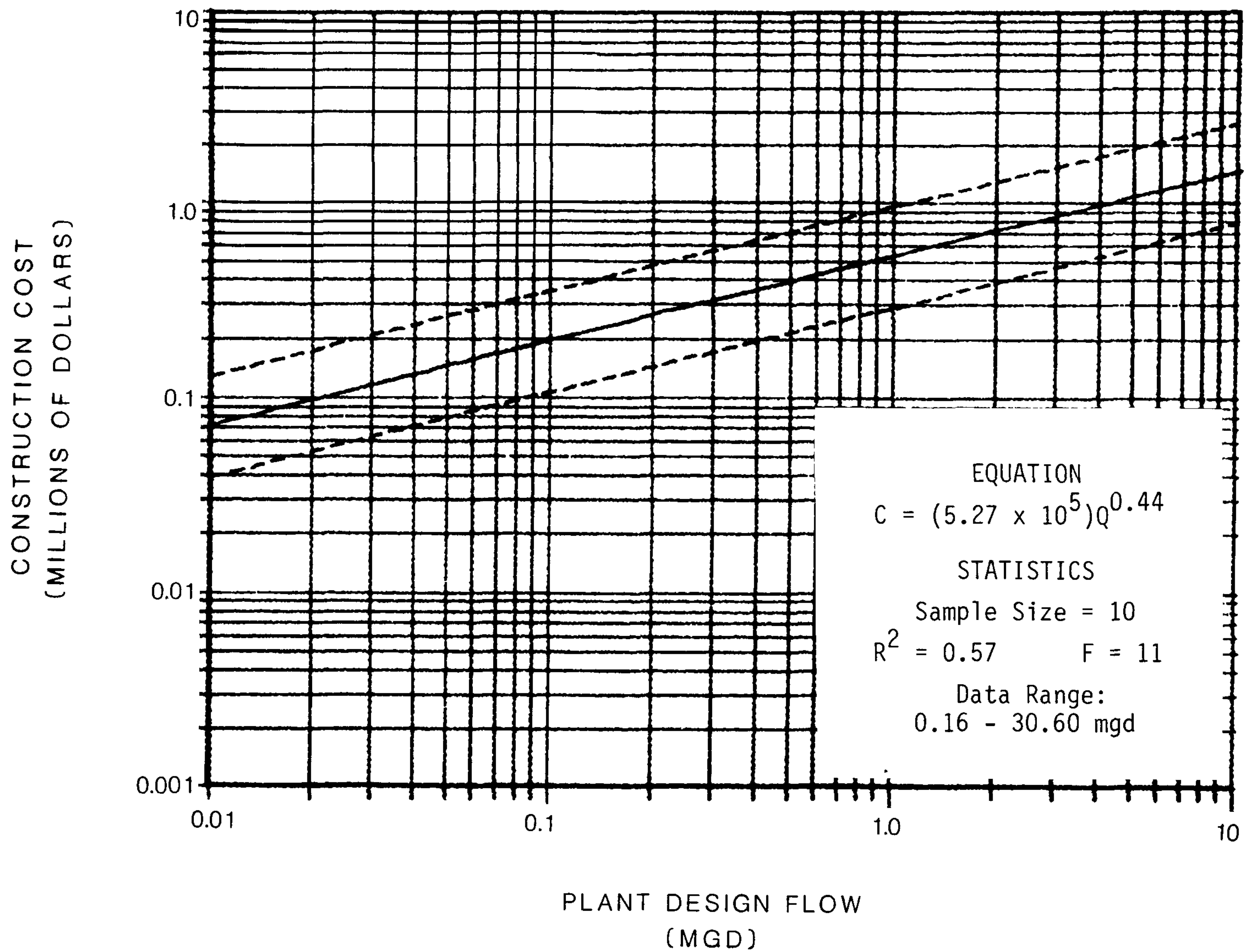


FIGURE 3.78

NEW UNIT PROCESS
CONVENTIONAL ACTIVATED SLUDGE

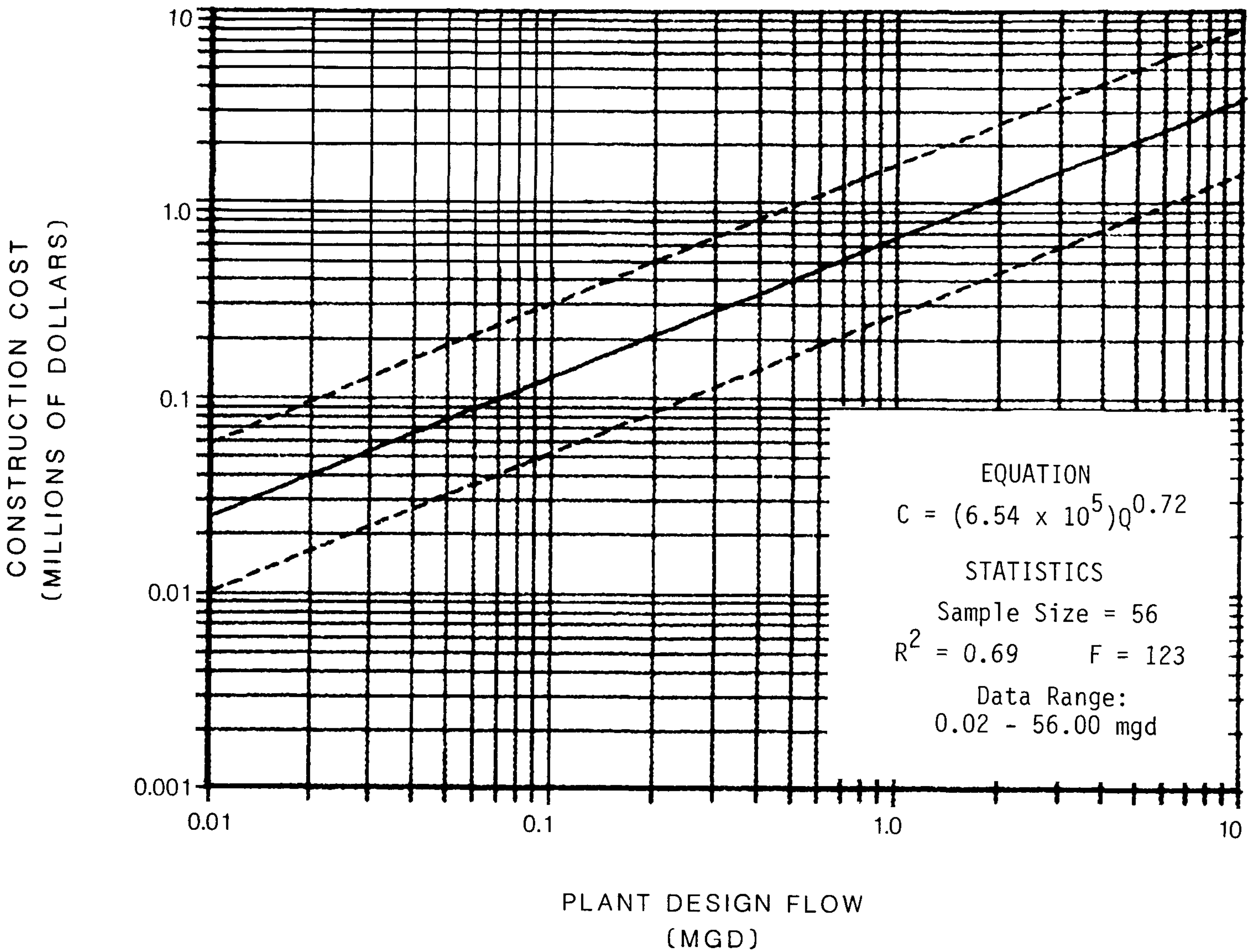


FIGURE 3.79

NEW UNIT PROCESS
CONTACT STABILIZATION

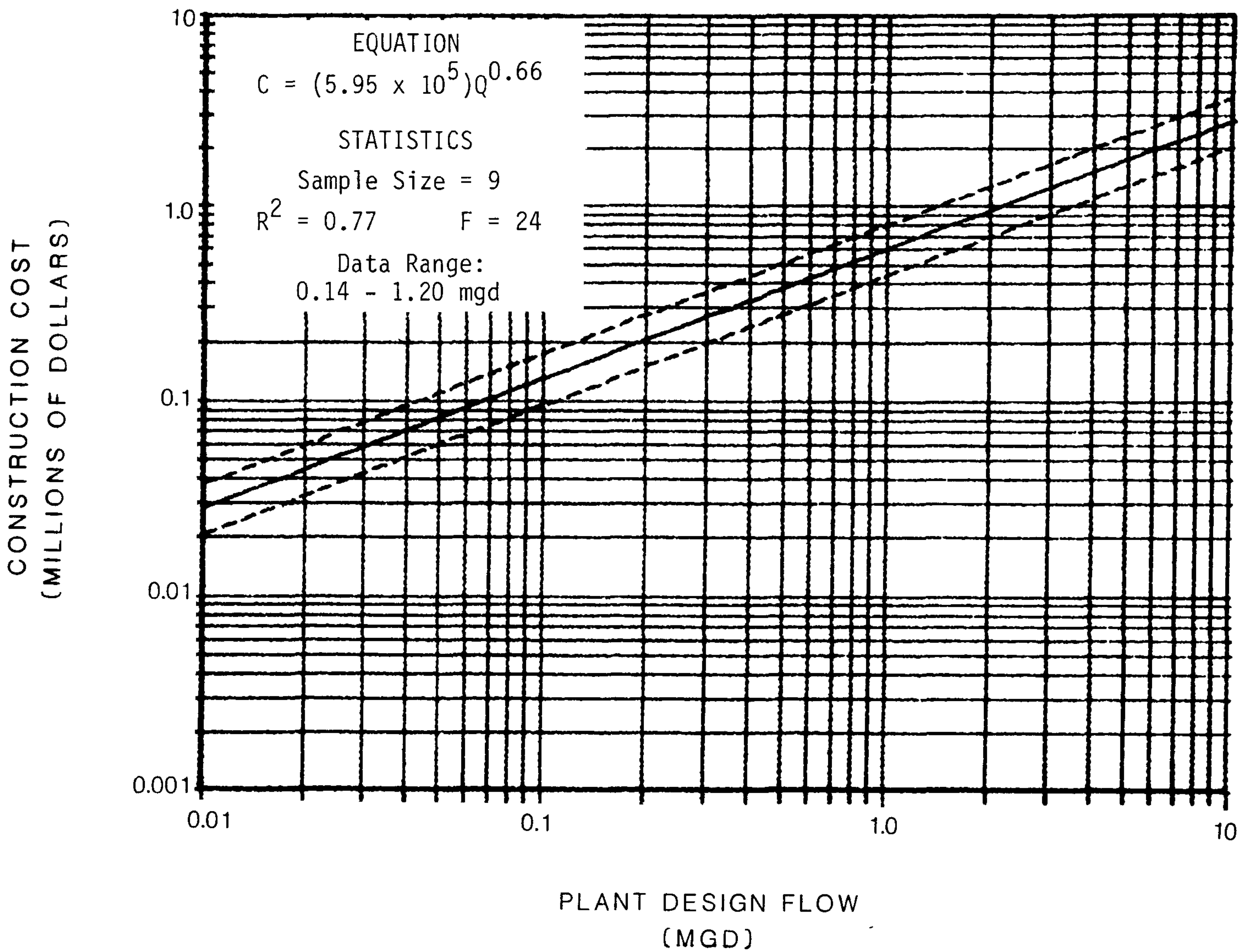


FIGURE 3.80

NEW UNIT PROCESS
EXTENDED AERATION

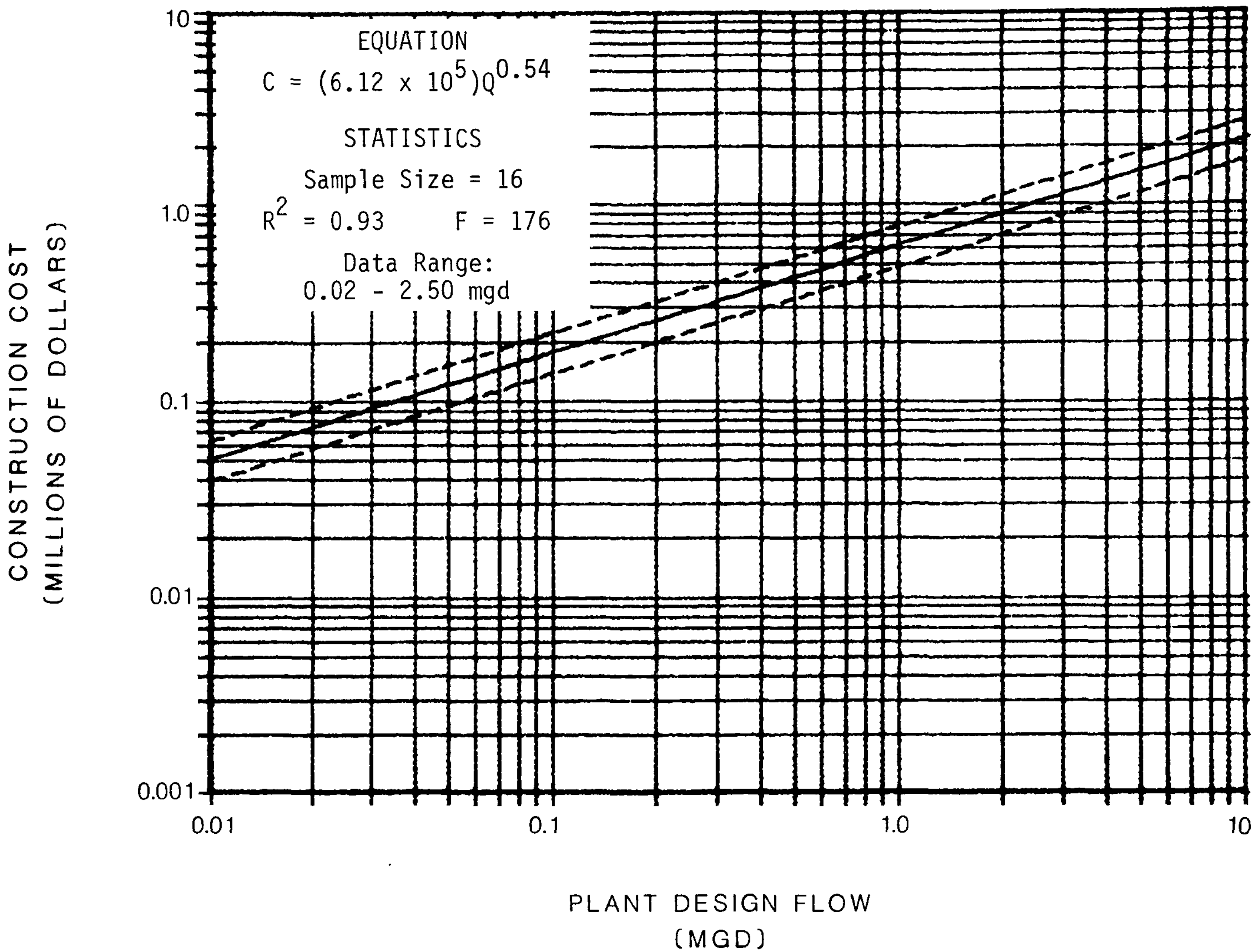


FIGURE 3.81

NEW UNIT PROCESS
ACTIVATED SLUDGE (ALL TYPES)

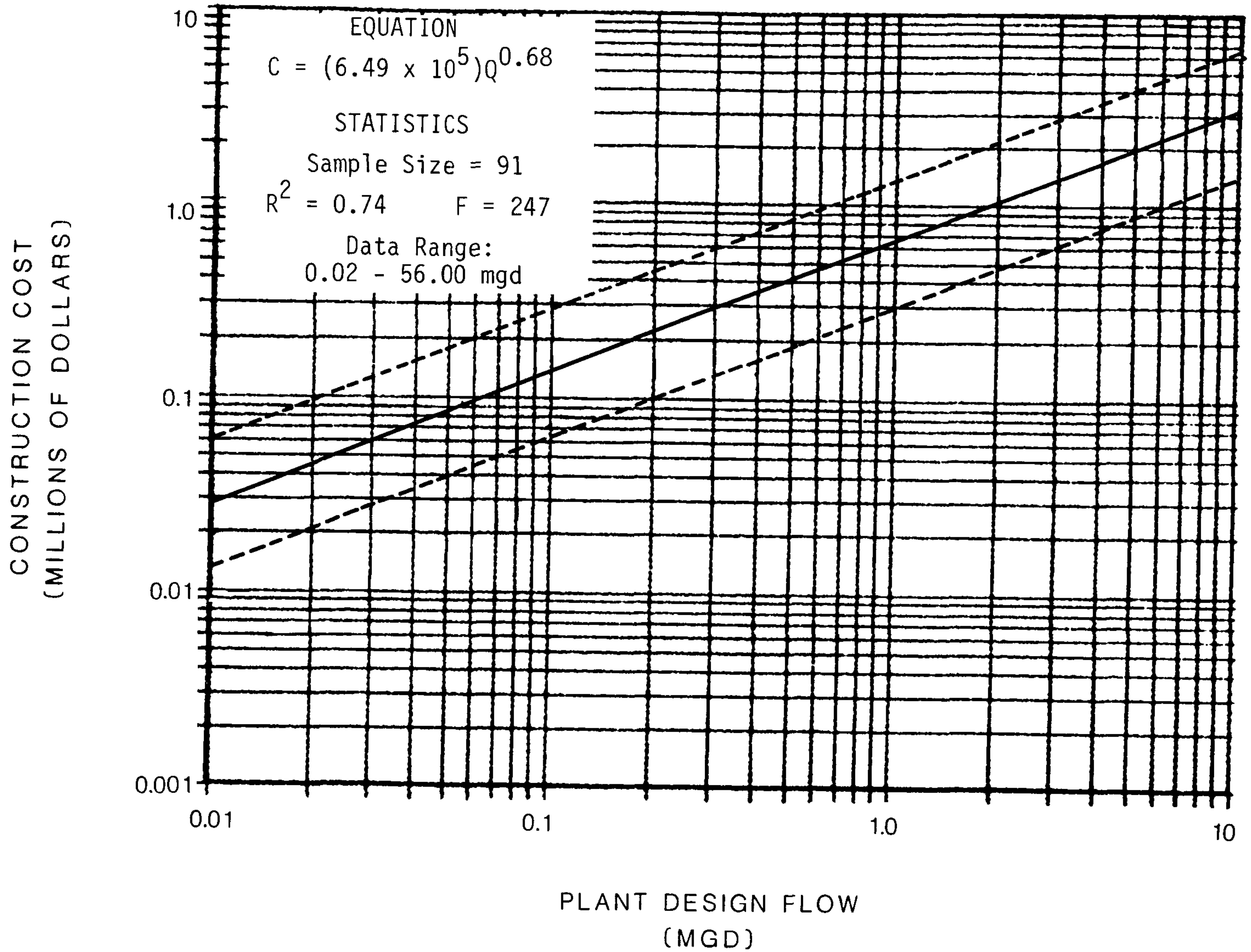


FIGURE 3.82

NEW UNIT PROCESS
SEPARATE STAGE BIOLOGICAL NITRIFICATION

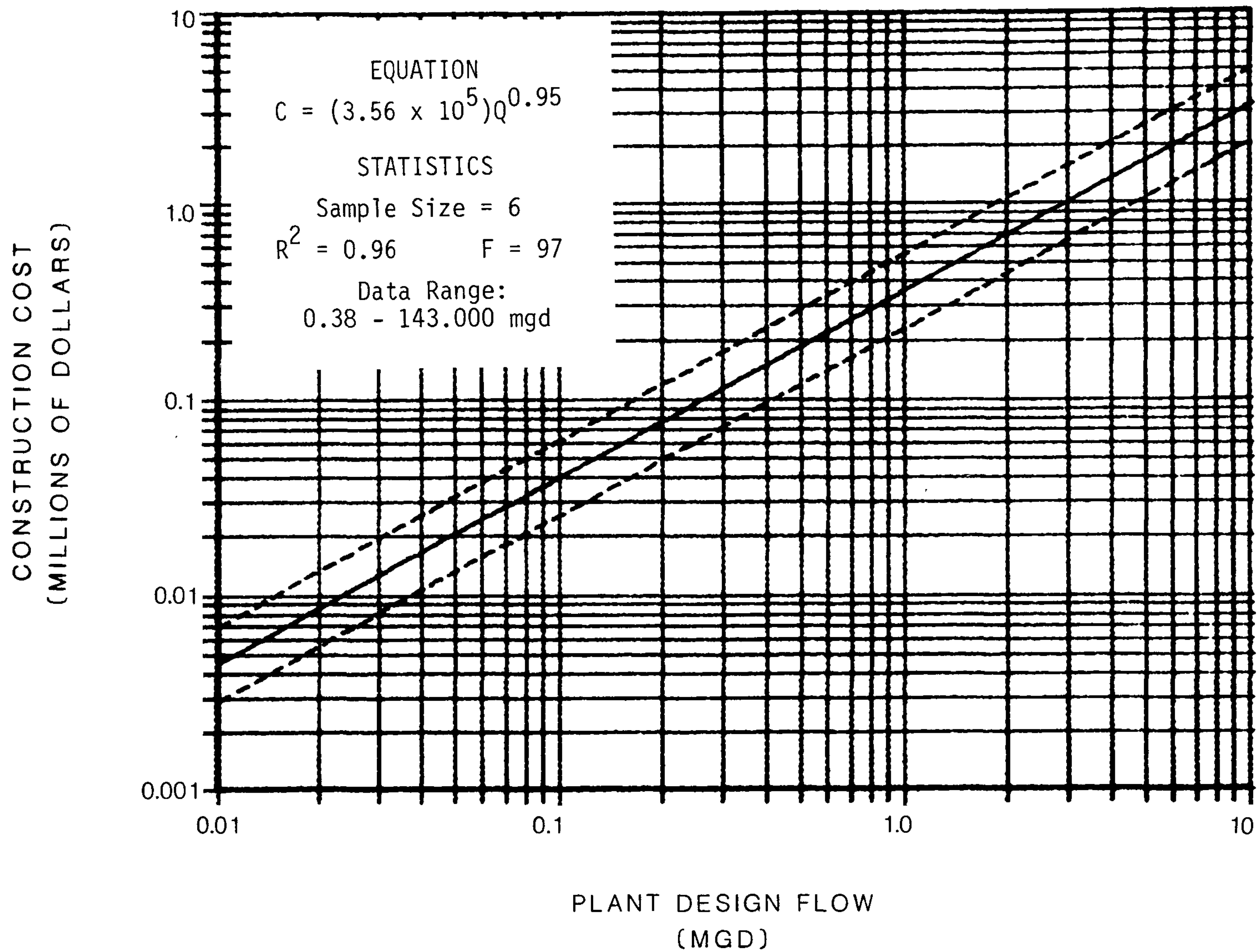


FIGURE 3.83

NEW UNIT PROCESS
OXIDATION DITCH

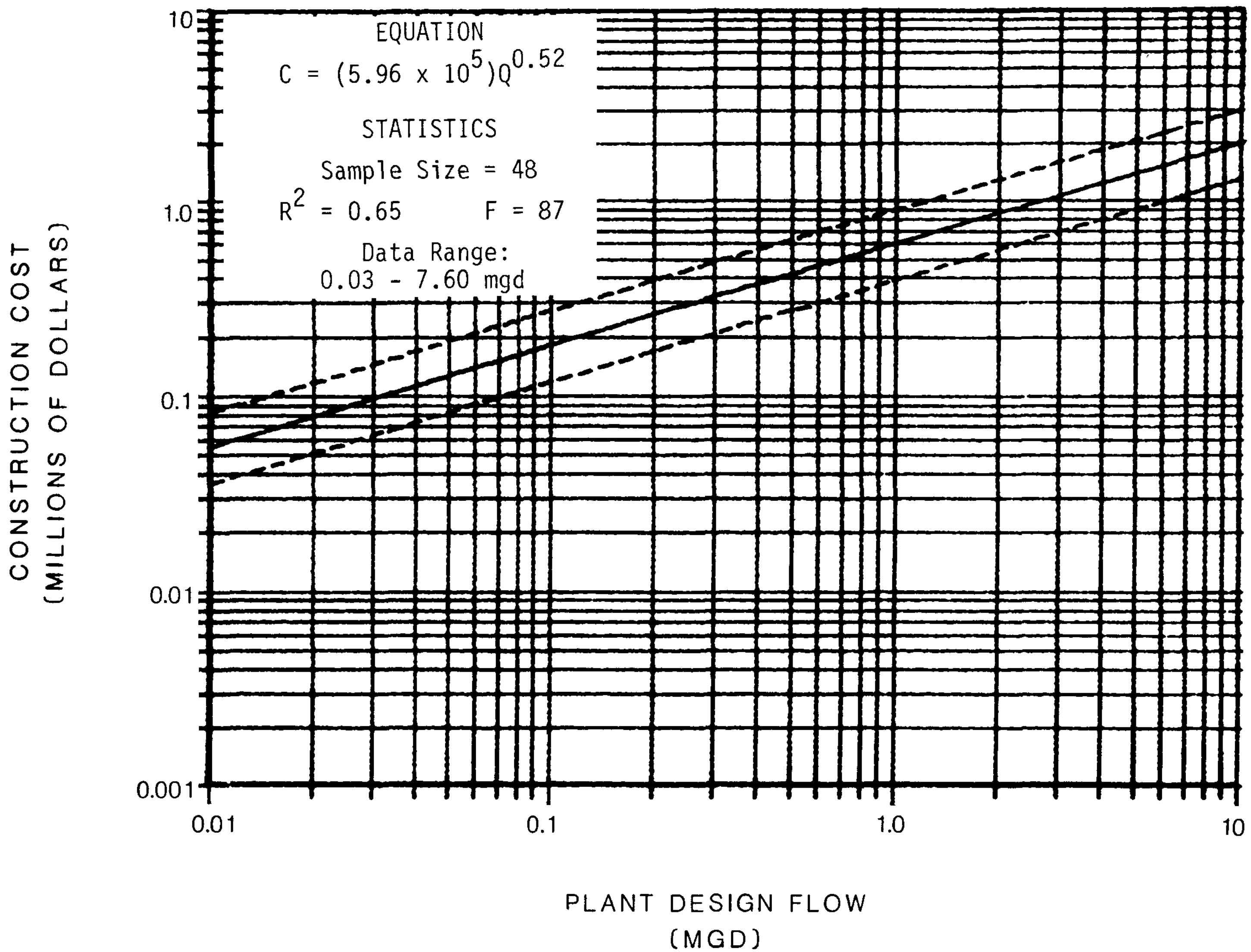


FIGURE 3.84

NEW UNIT PROCESS
ROTATING BIOLOGICAL CONTACTOR

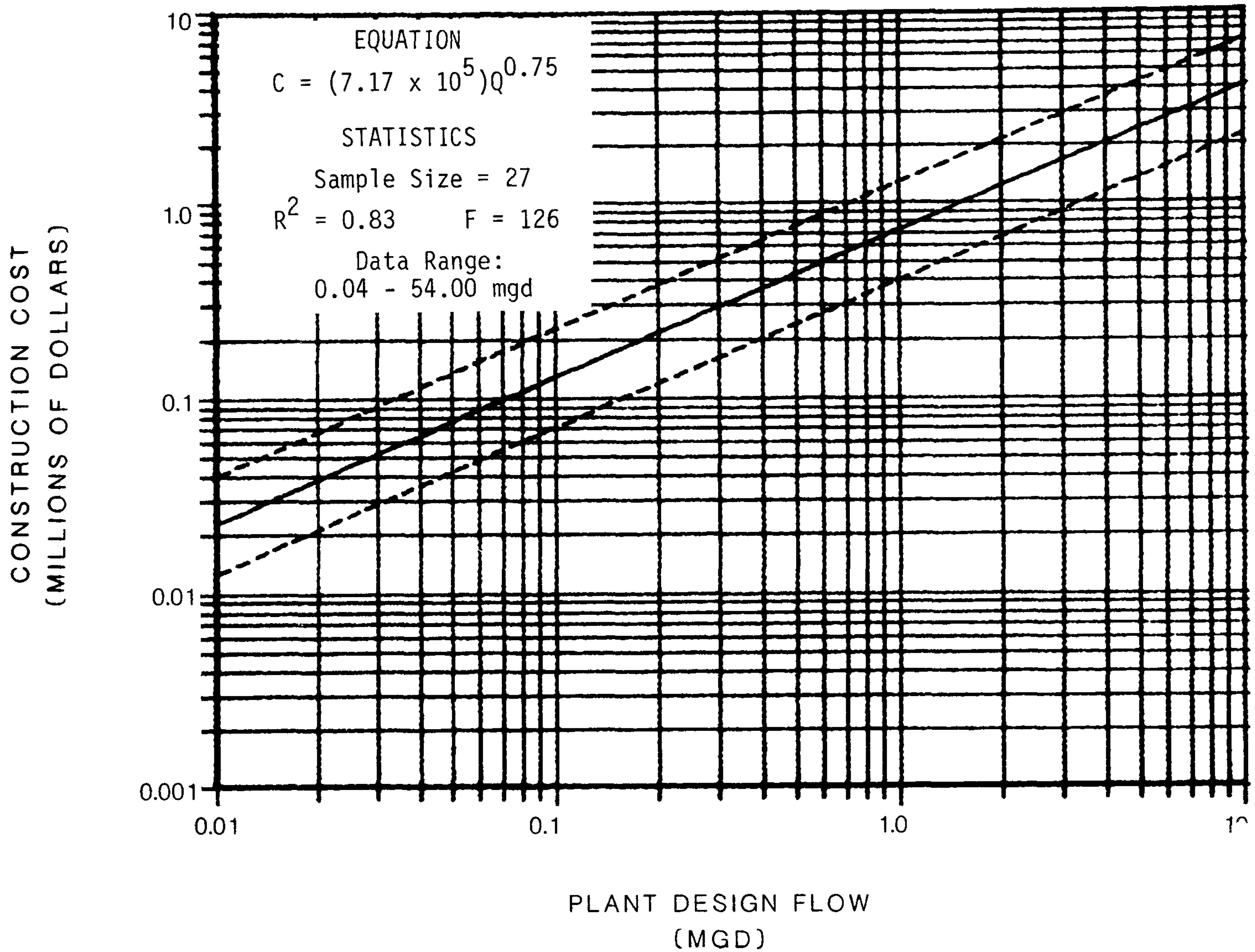


FIGURE 3.85

NEW UNIT PROCESS
STABILIZATION POND

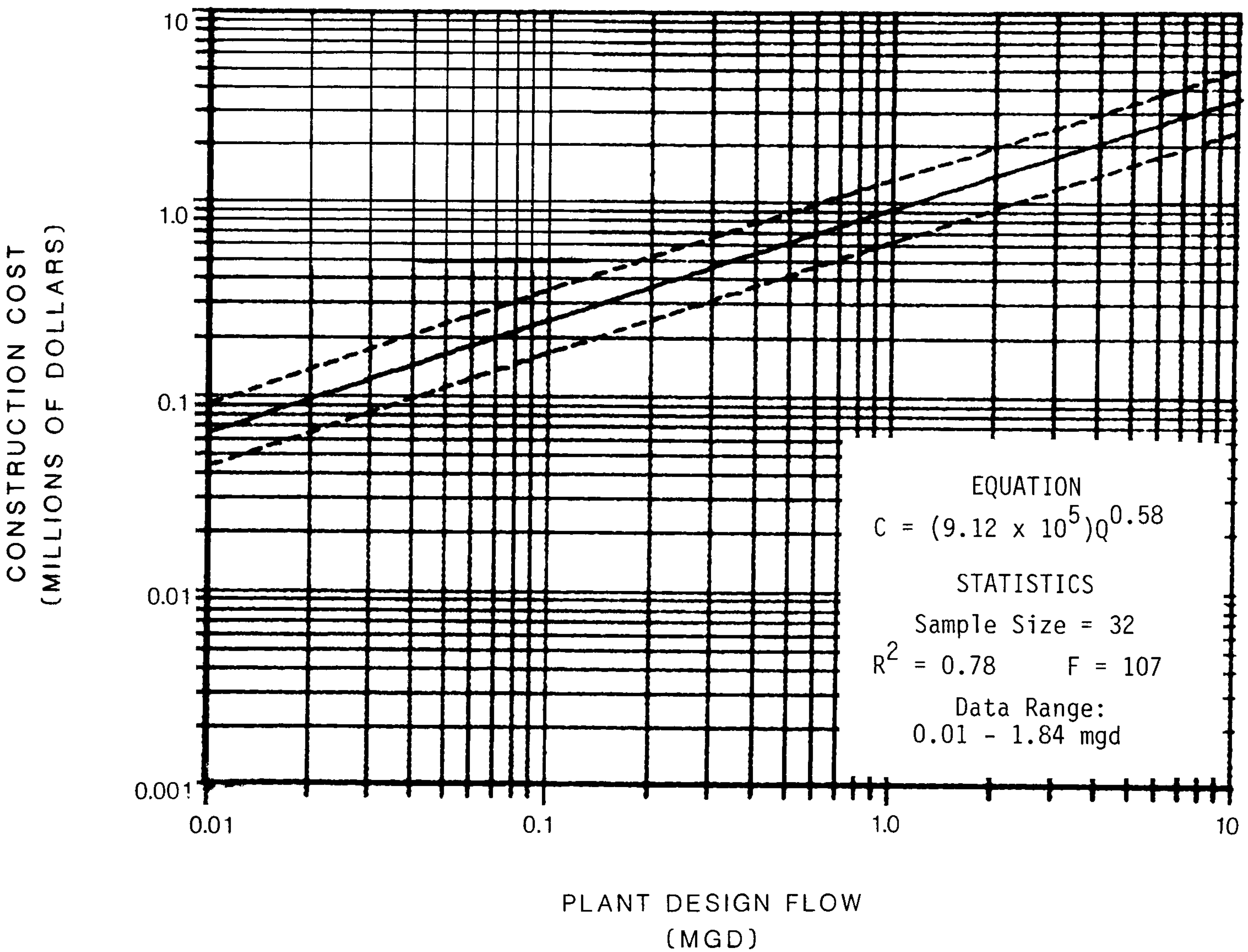


FIGURE 3.86

NEW UNIT PROCESS
AERATED LAGOON

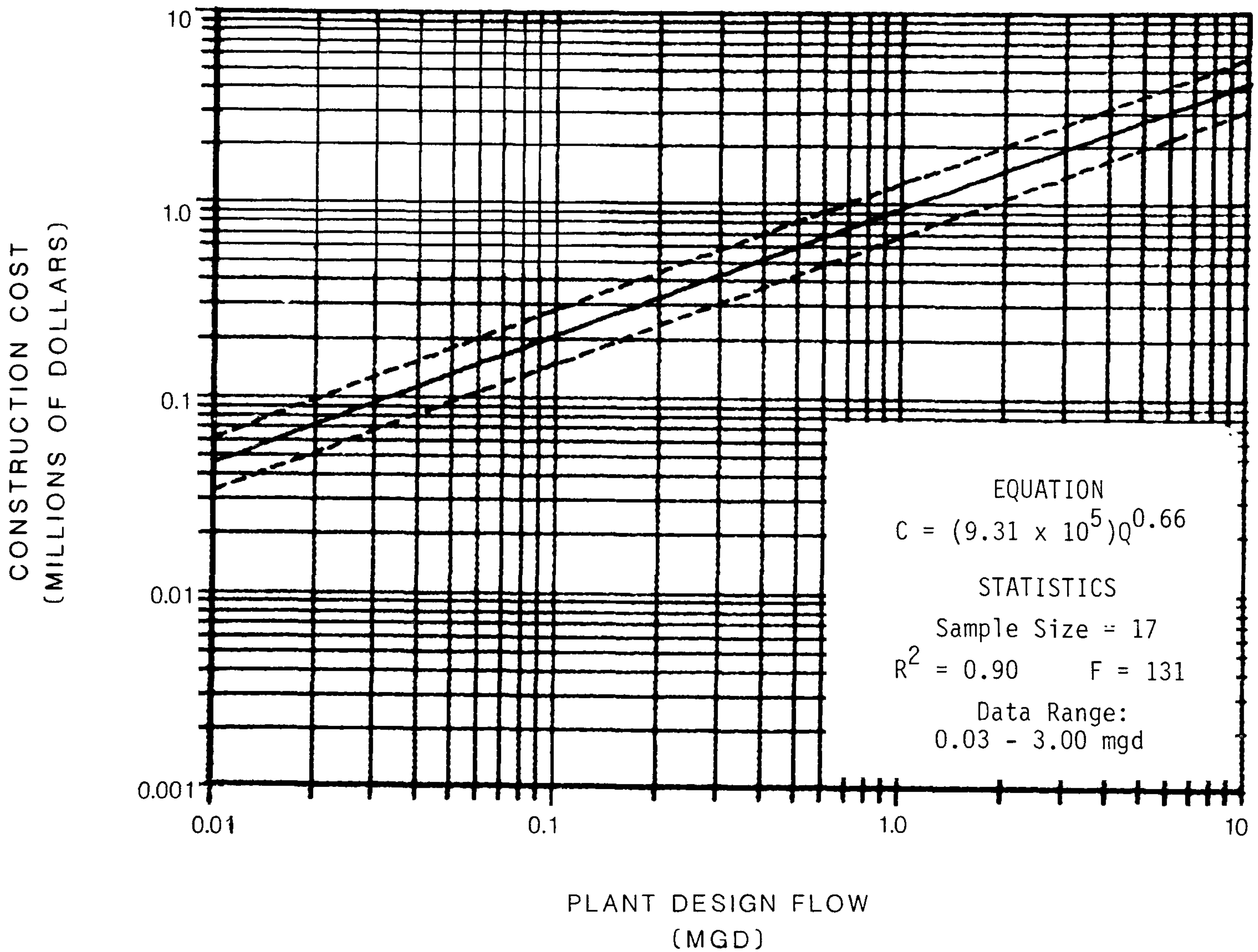


FIGURE 3.87

NEW UNIT OPERATION
SECONDARY MICROSCREENING

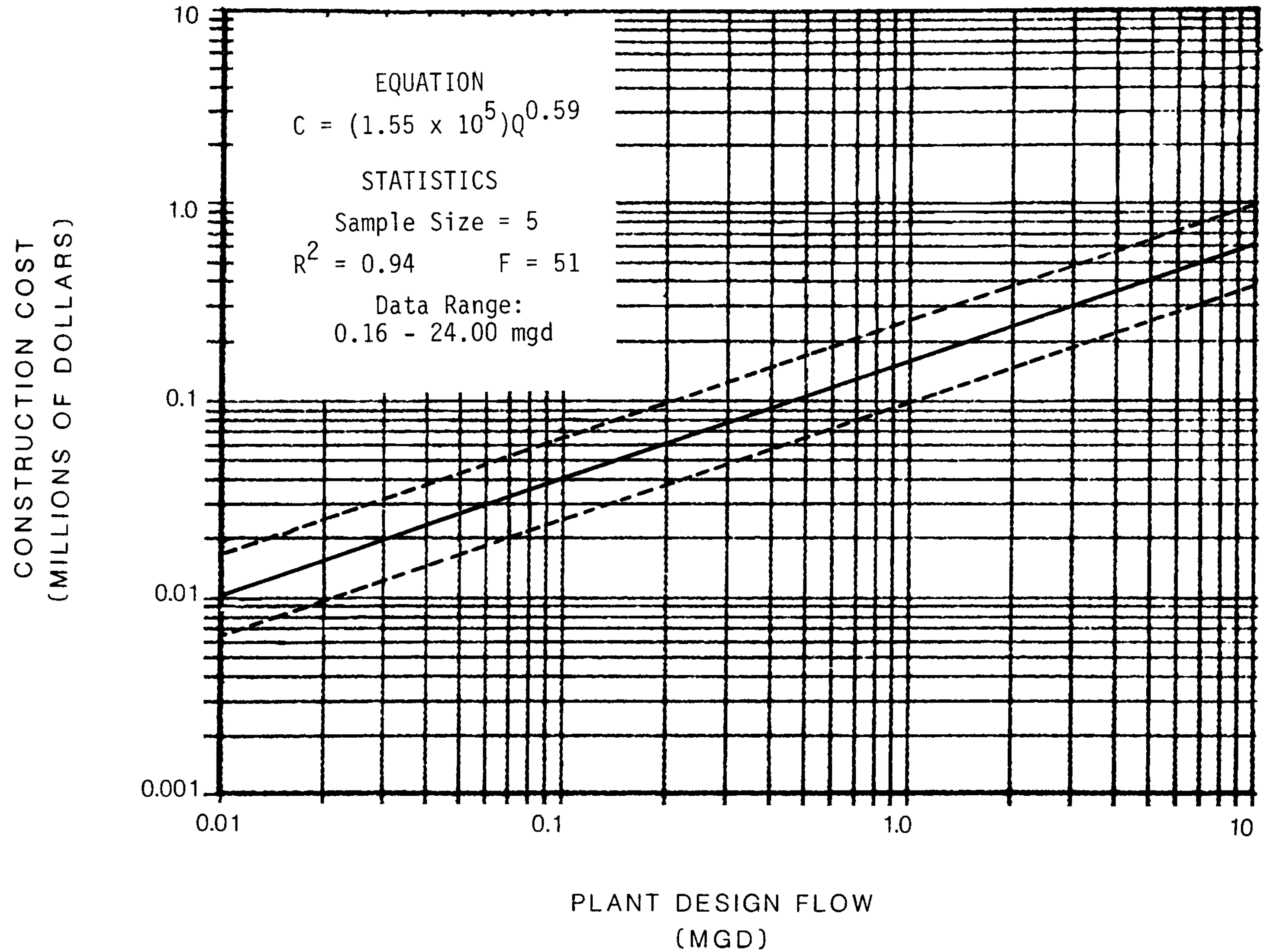


FIGURE 3.88

NEW UNIT OPERATION
SAND FILTRATION

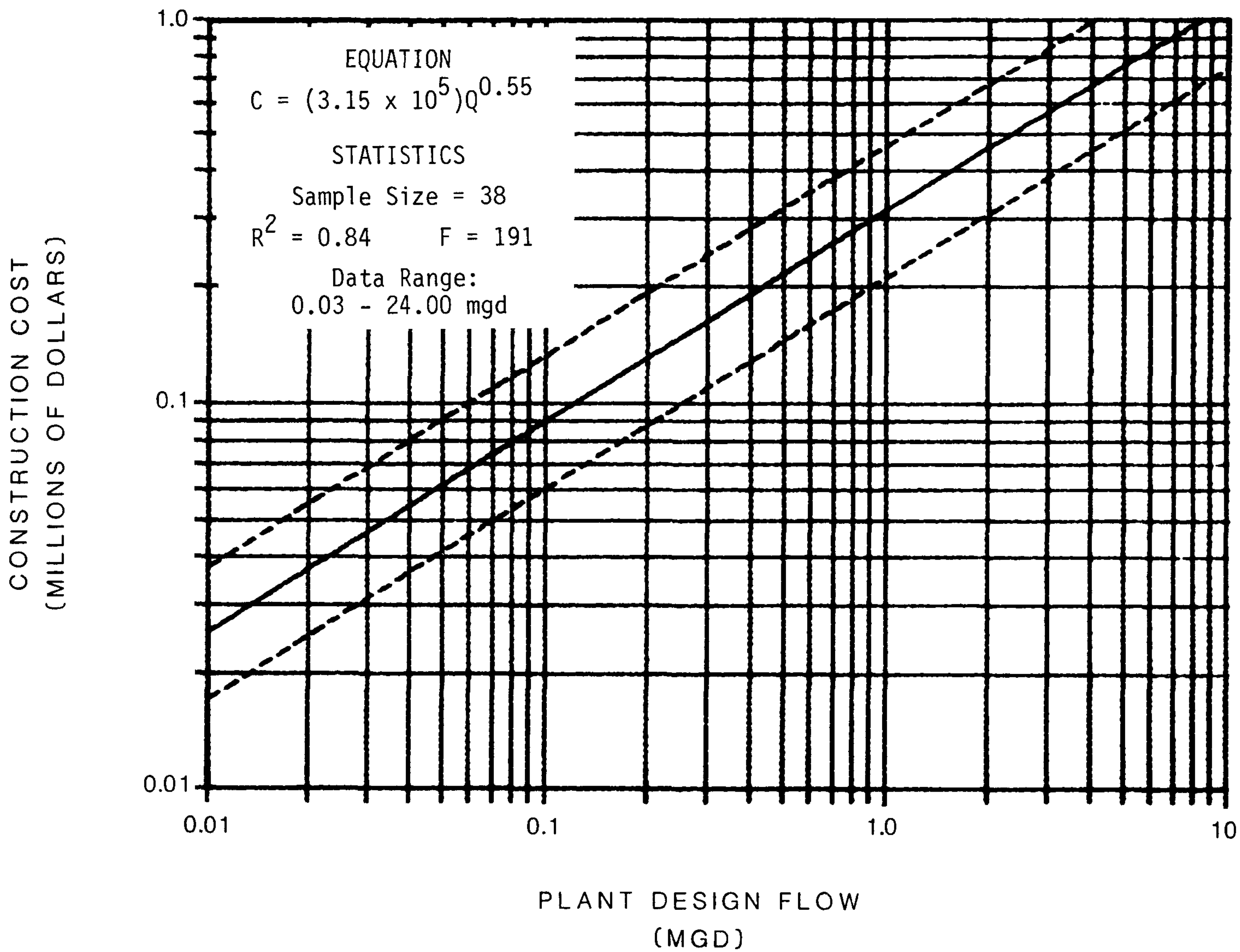


FIGURE 3.89

NEW UNIT OPERATION
MIXED MEDIA FILTRATION

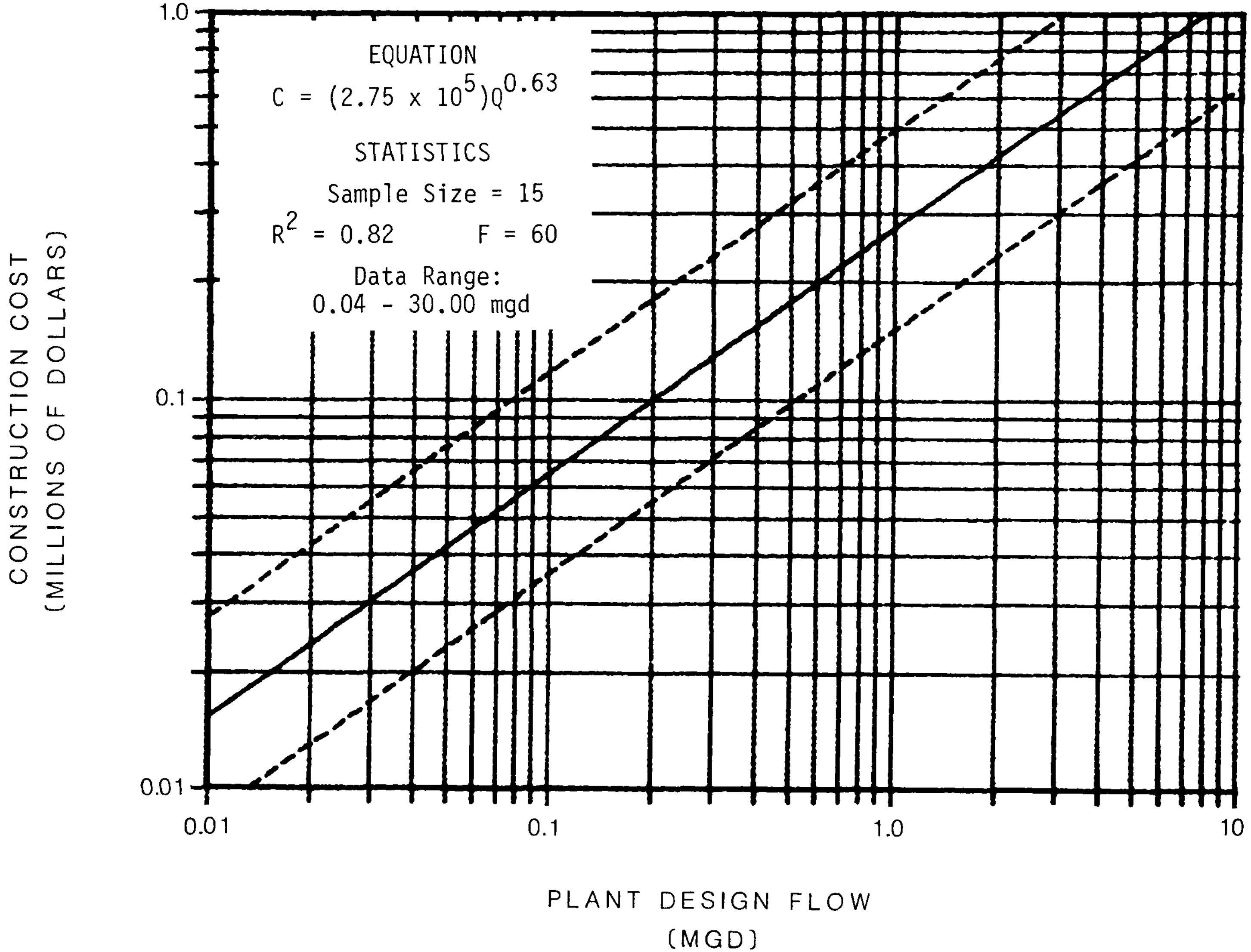


FIGURE 3.90

NEW UNIT OPERATION
FILTRATION (ALL TYPES)

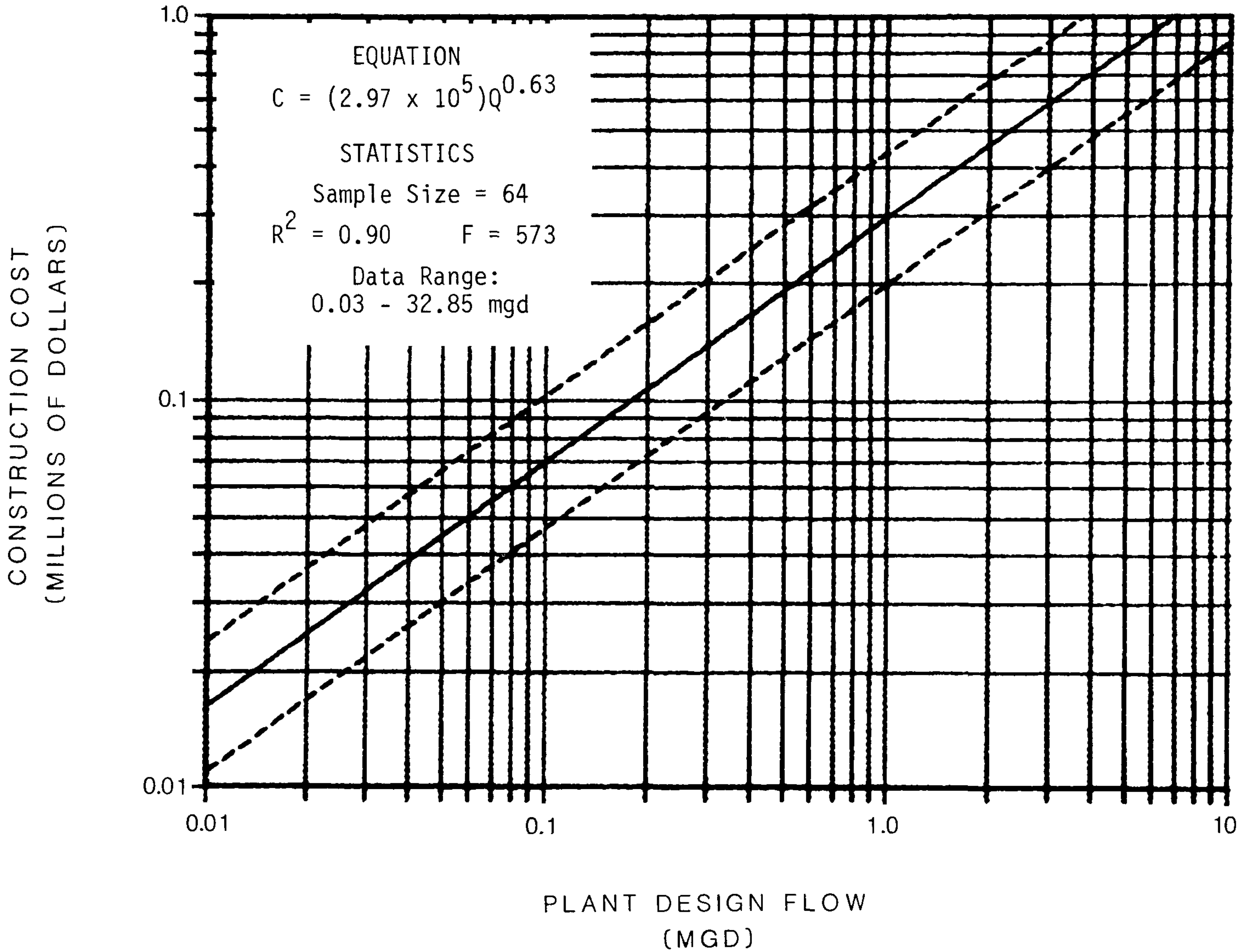


FIGURE 3.91

NEW UNIT PROCESS
CHEMICAL ADDITIONS

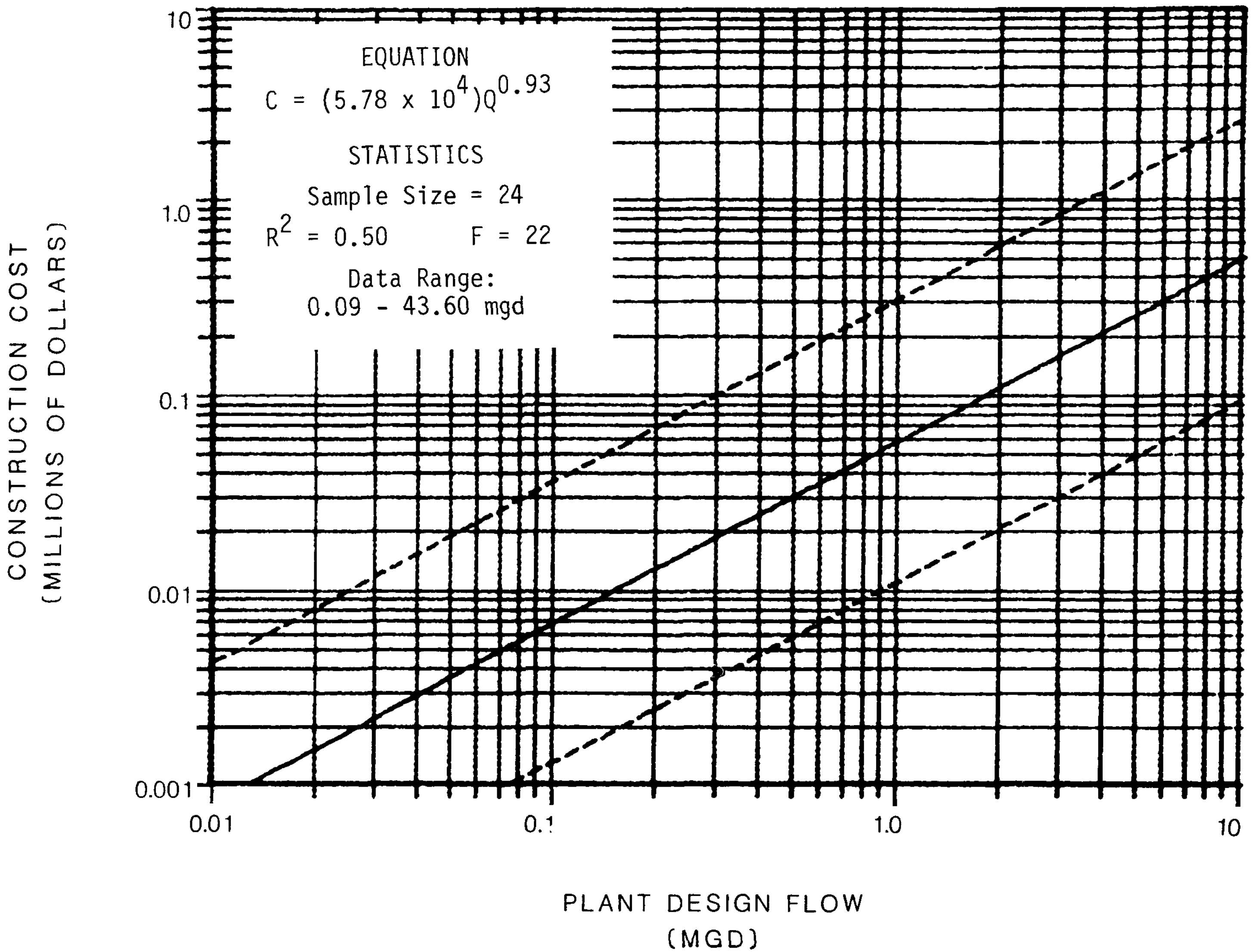


FIGURE 3.92

NEW UNIT PROCESS
CHLORINATION FOR DISINFECTION

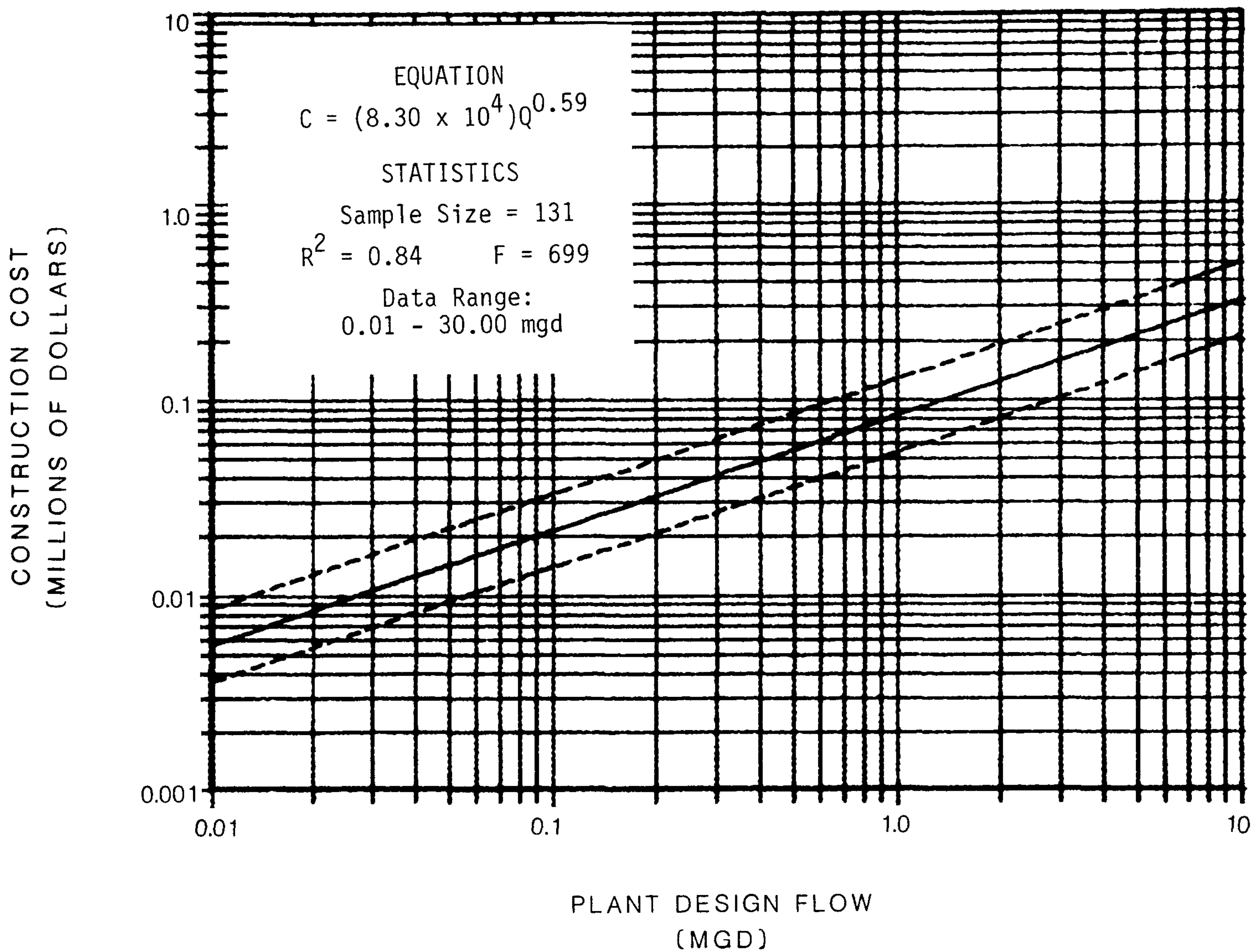


FIGURE 3.93

NEW UNIT OPERATION
LAND TREATMENT OF SECONDARY EFFLUENT

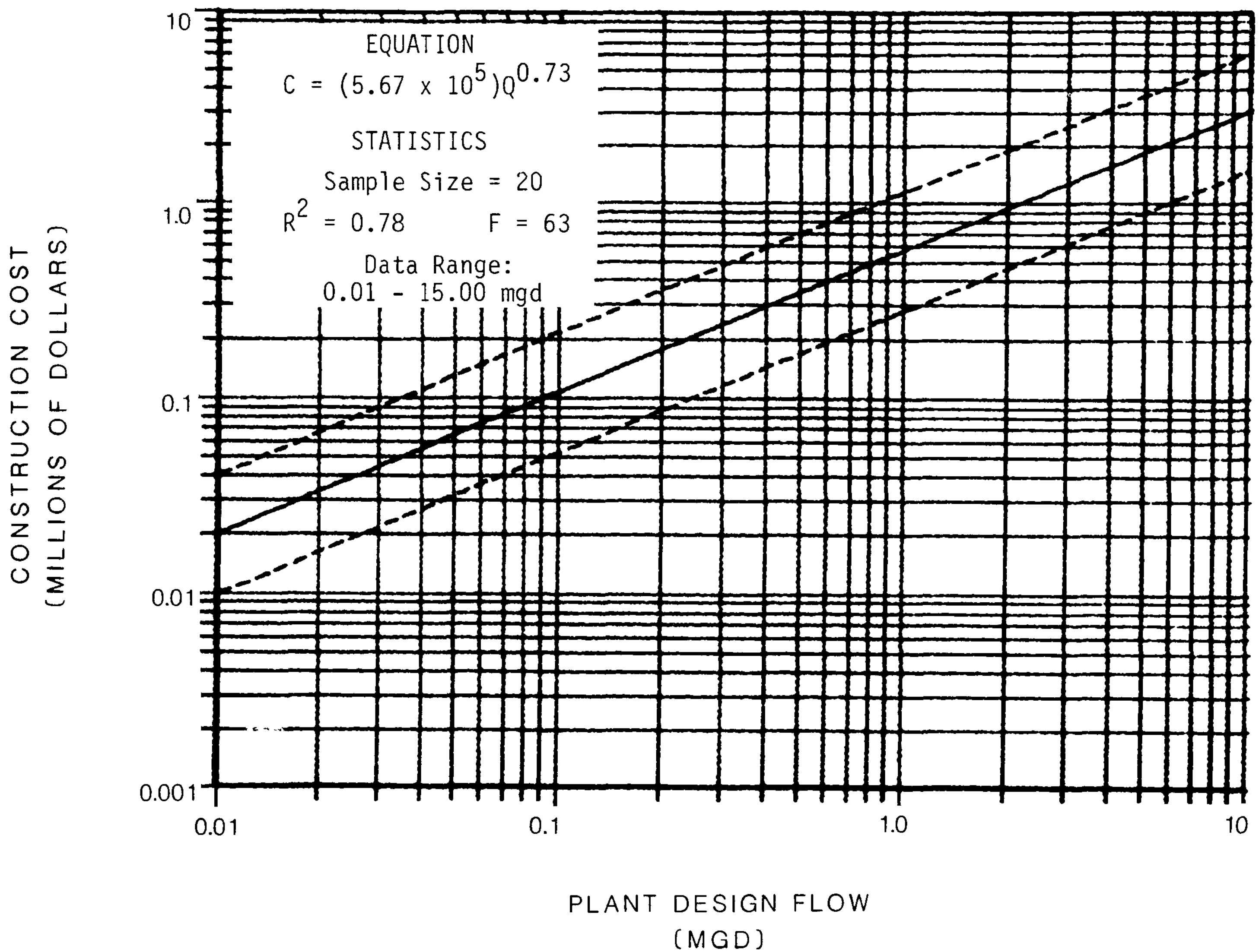


FIGURE 3.94

NEW UNIT OPERATION
POST AERATION

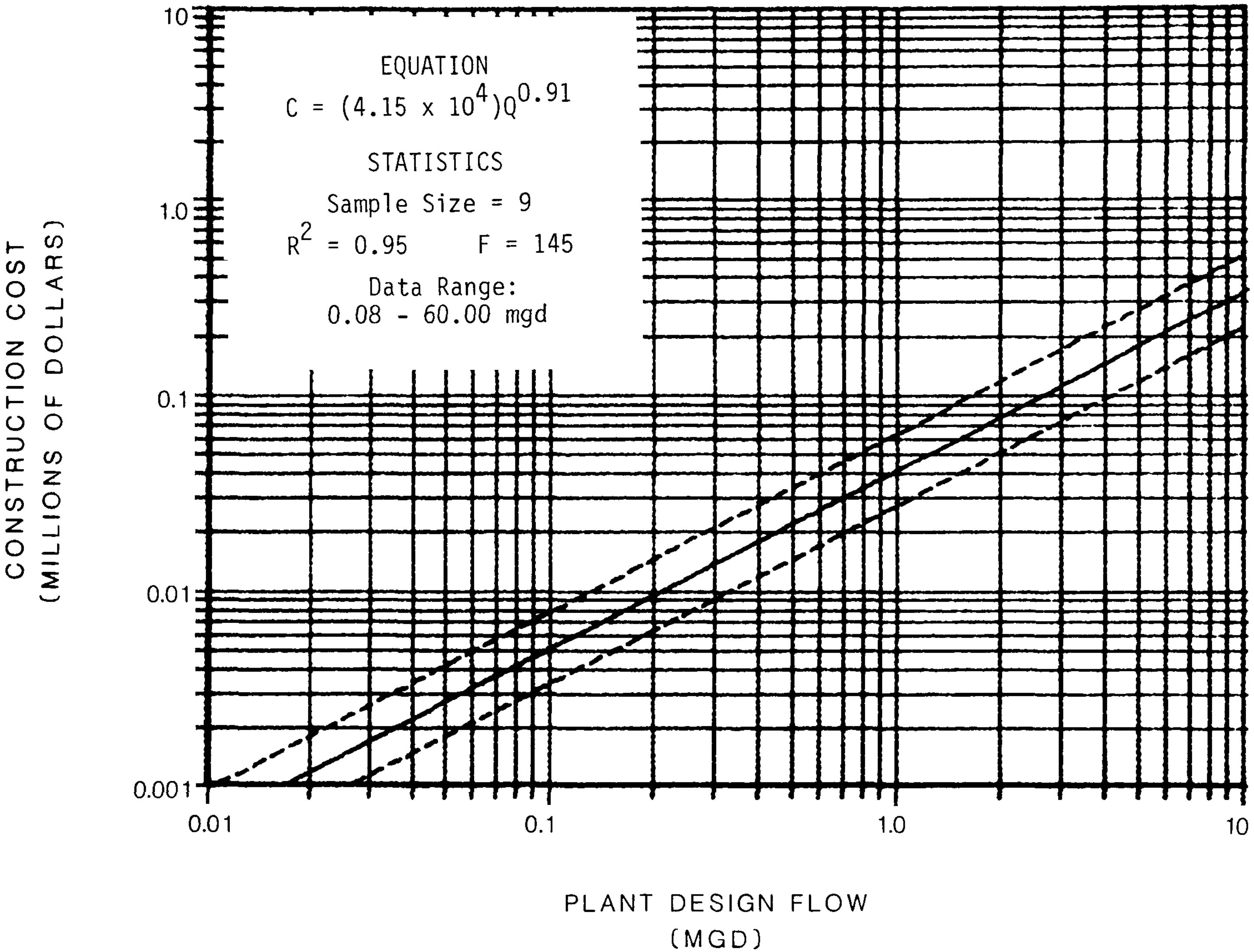


FIGURE 3.95

NEW UNIT OPERATION
EFFLUENT OUTFALL PUMPING

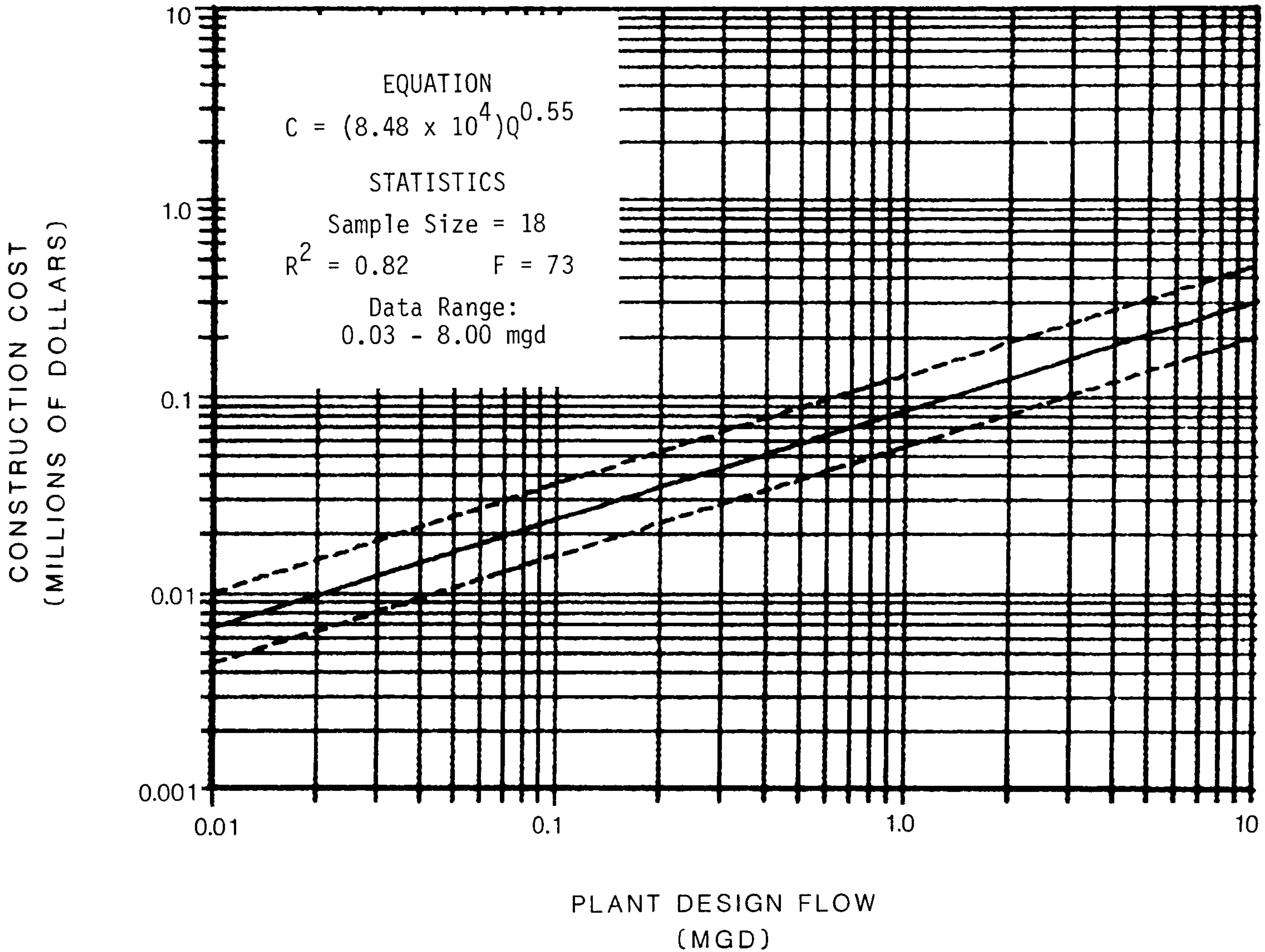


FIGURE 3.96

NEW UNIT OPERATION
EFFLUENT OUTFALL DIFFUSER

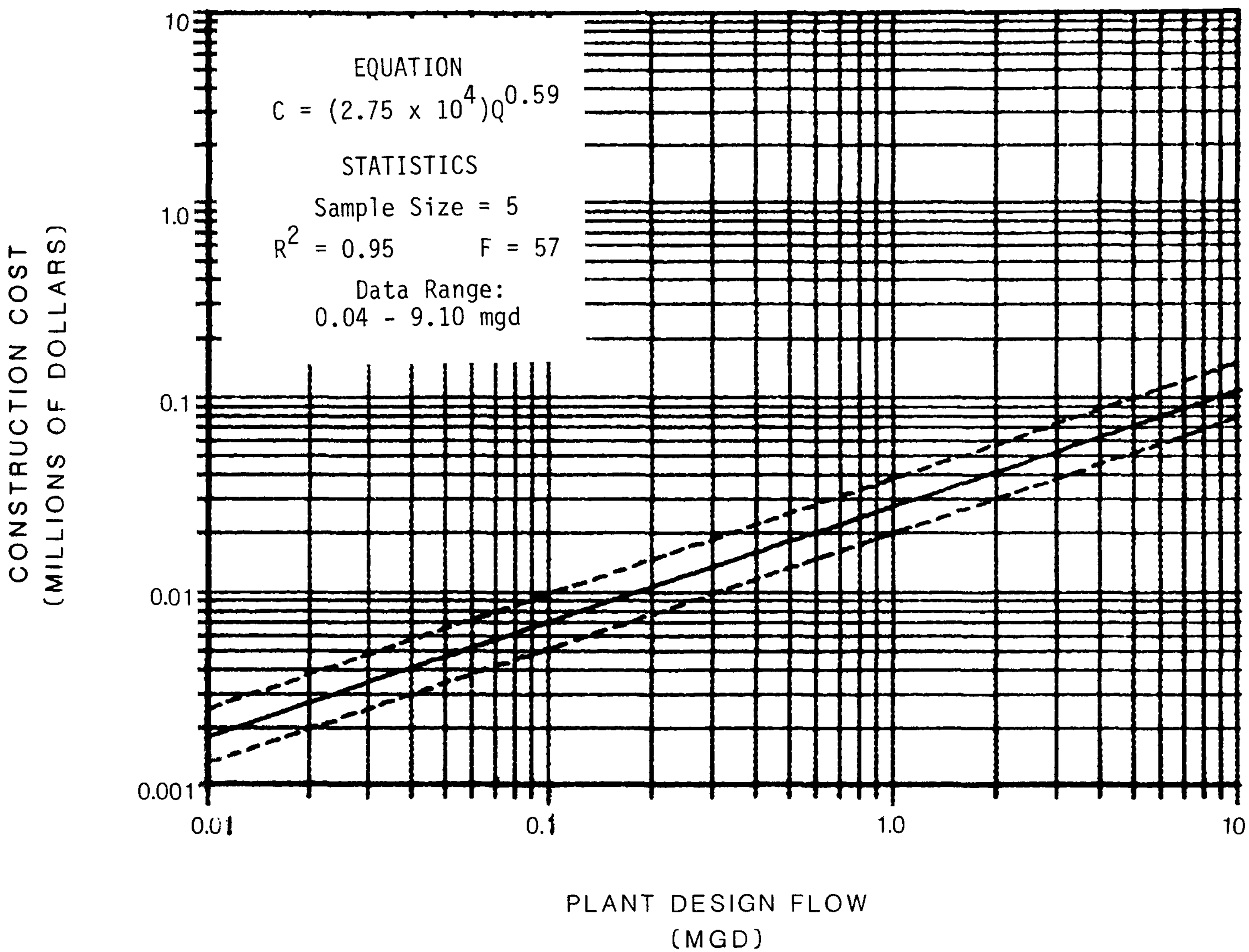


FIGURE 3.97

NEW UNIT PROCESS
AEROBIC DIGESTION

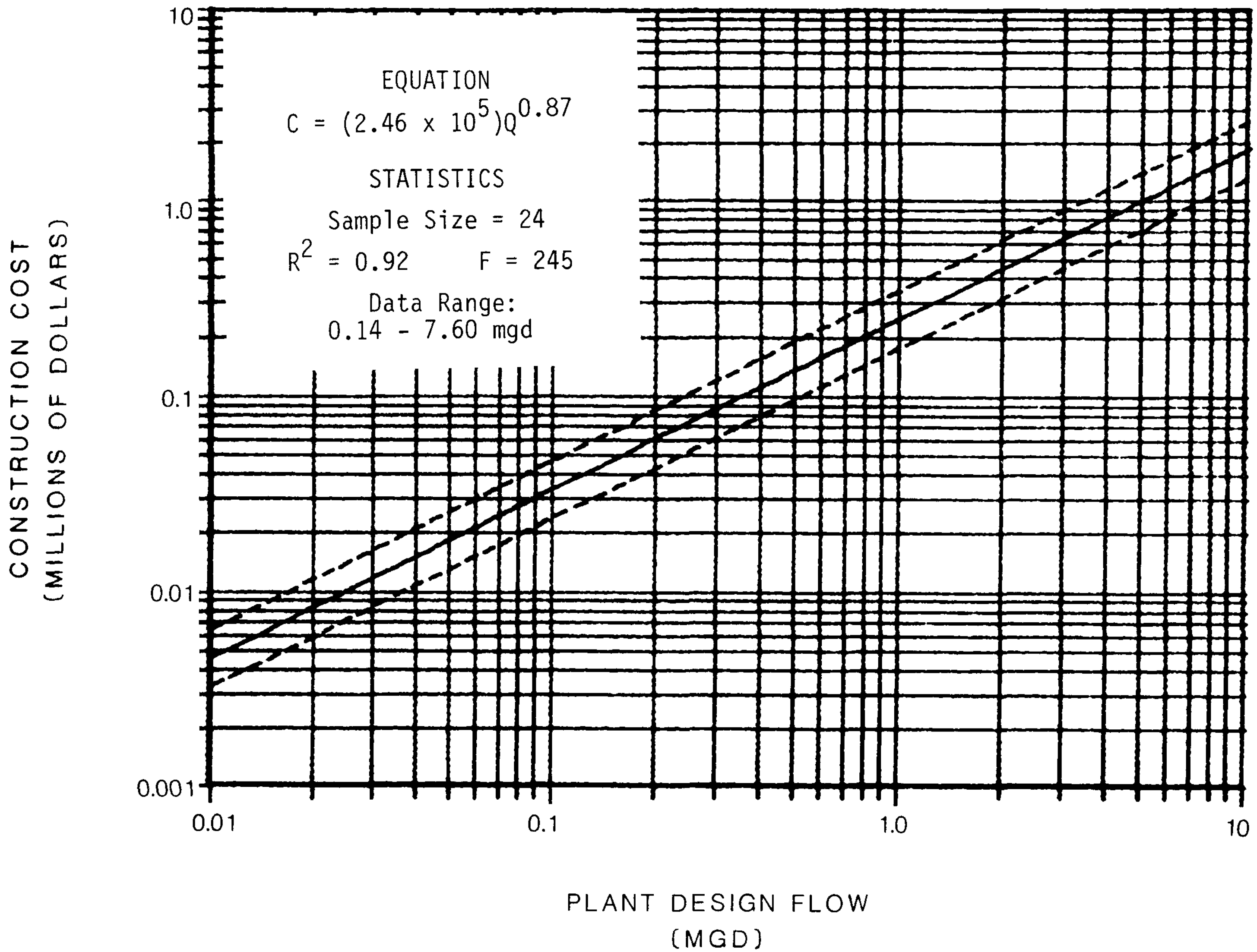


FIGURE 3.98

NEW UNIT PROCESS
ANAEROBIC DIGESTION

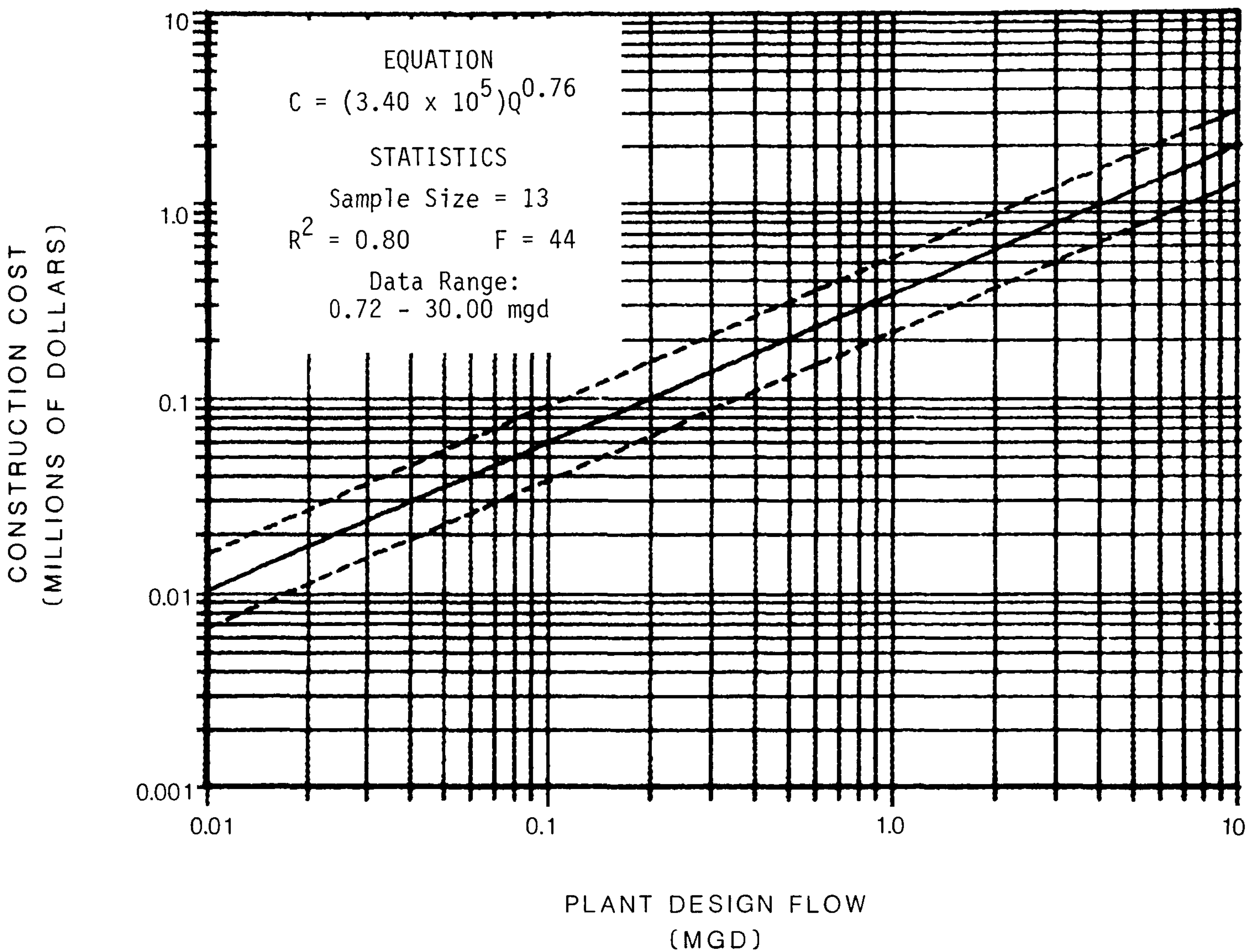


FIGURE 3.99

NEW UNIT OPERATION
SLUDGE DRYING

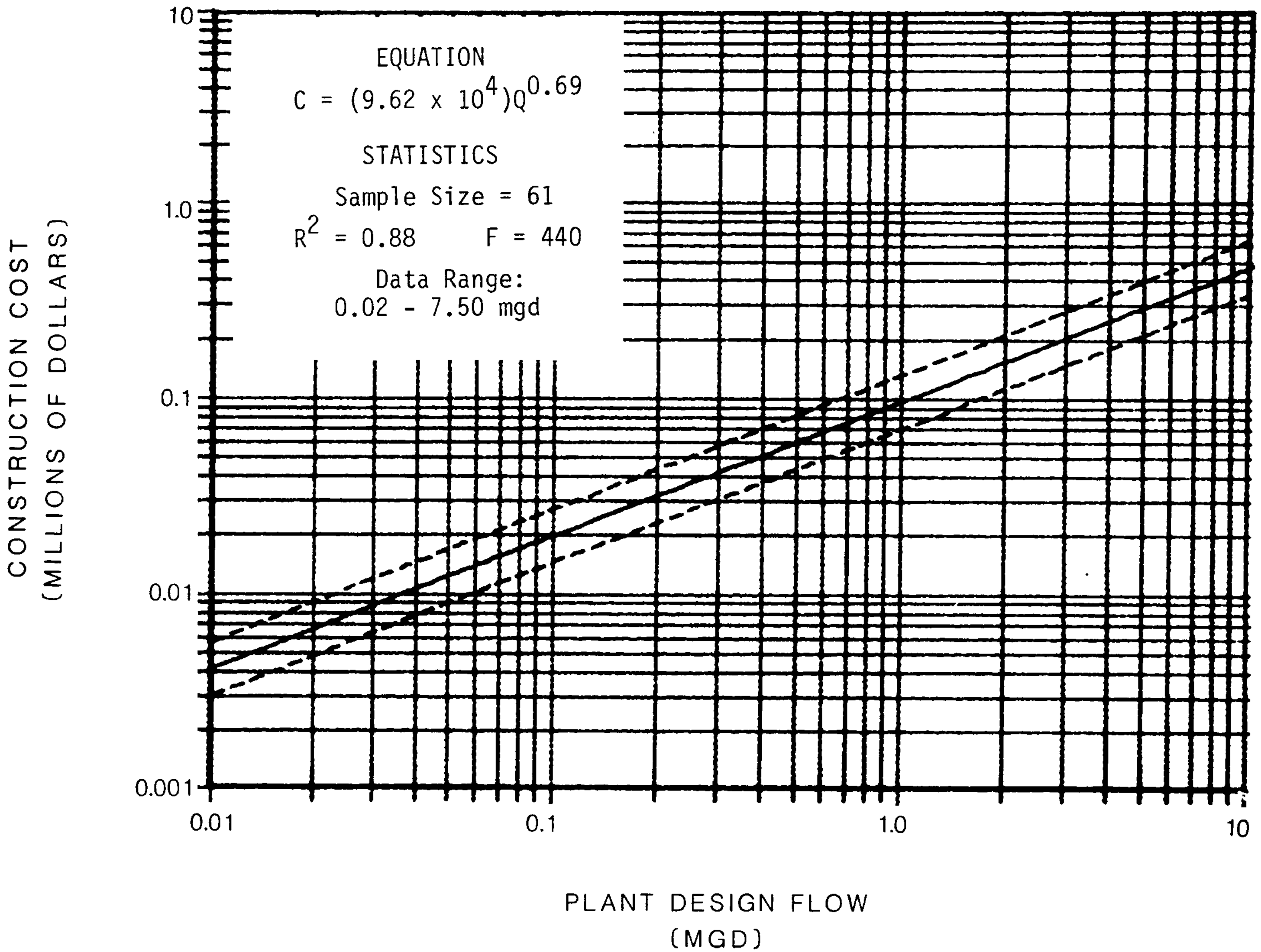


FIGURE 3.100

NEW UNIT OPERATION
MECHANICAL SLUDGE DEWATERING

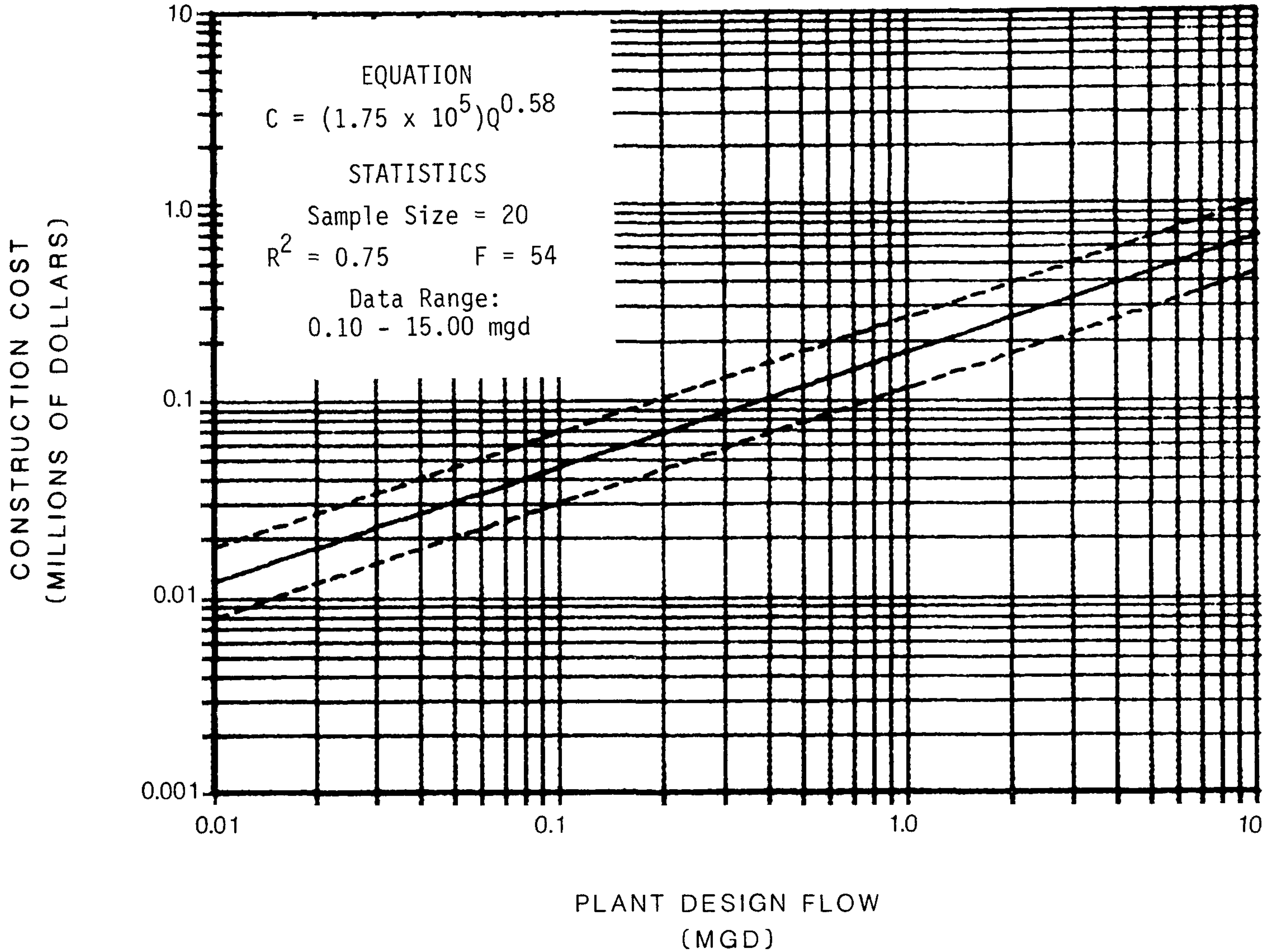


FIGURE 3.101

NEW UNIT OPERATION
GRAVITY THICKENING

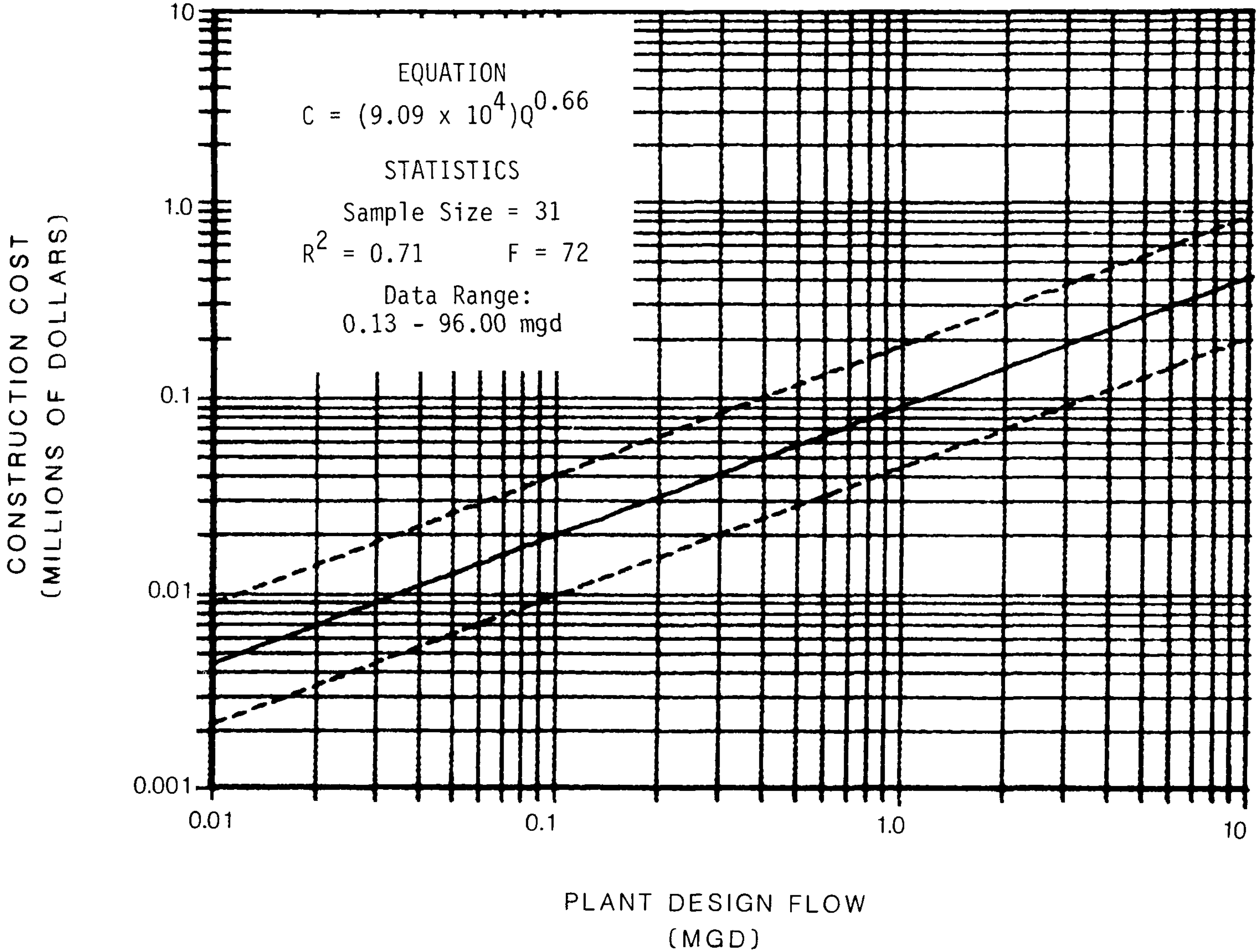


FIGURE 3.102

NEW UNIT OPERATION
LAND APPLICATION OF LIQUID SLUDGE

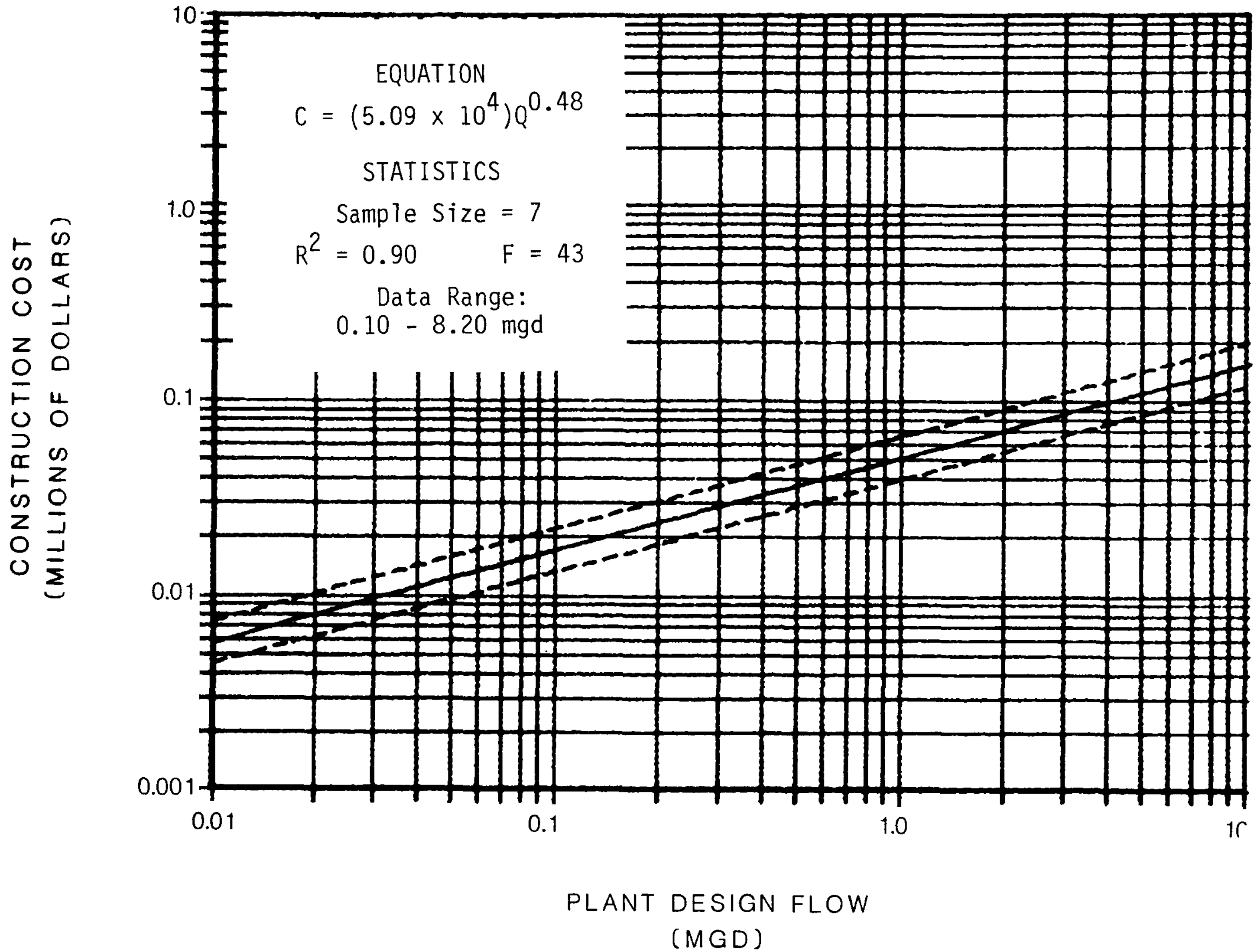


FIGURE 3.103

NEW CONSTRUCTION
CONTROL/LABORATORY/MAINTENANCE BUILDING

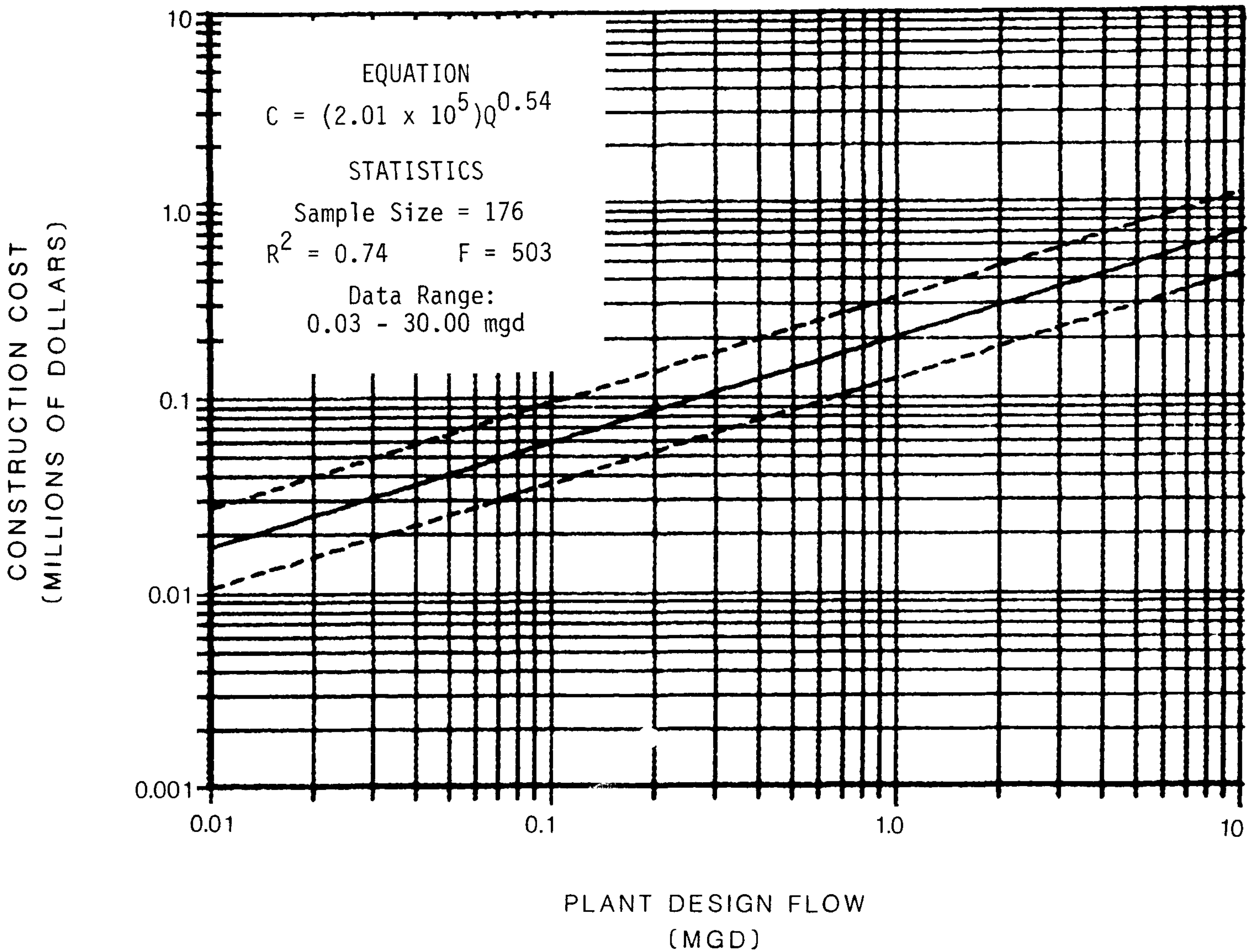


FIGURE 3.104

NEW UNIT OPERATION
EFFLUENT OUTFALL TO NONOCEAN SURFACE WATER

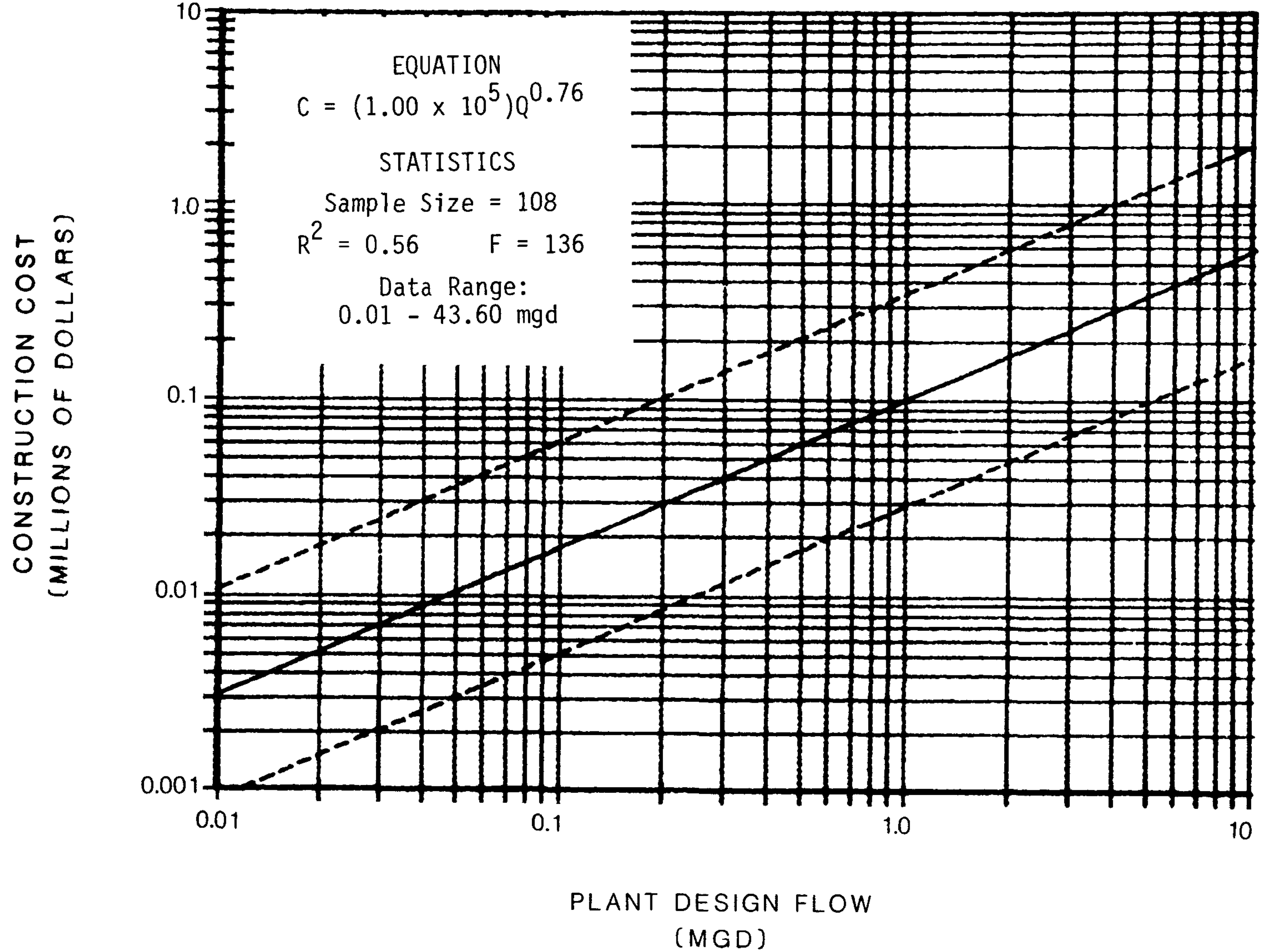


FIGURE 3.105

NEW UNIT OPERATION
EFFLUENT OUTFALL TO OCEAN

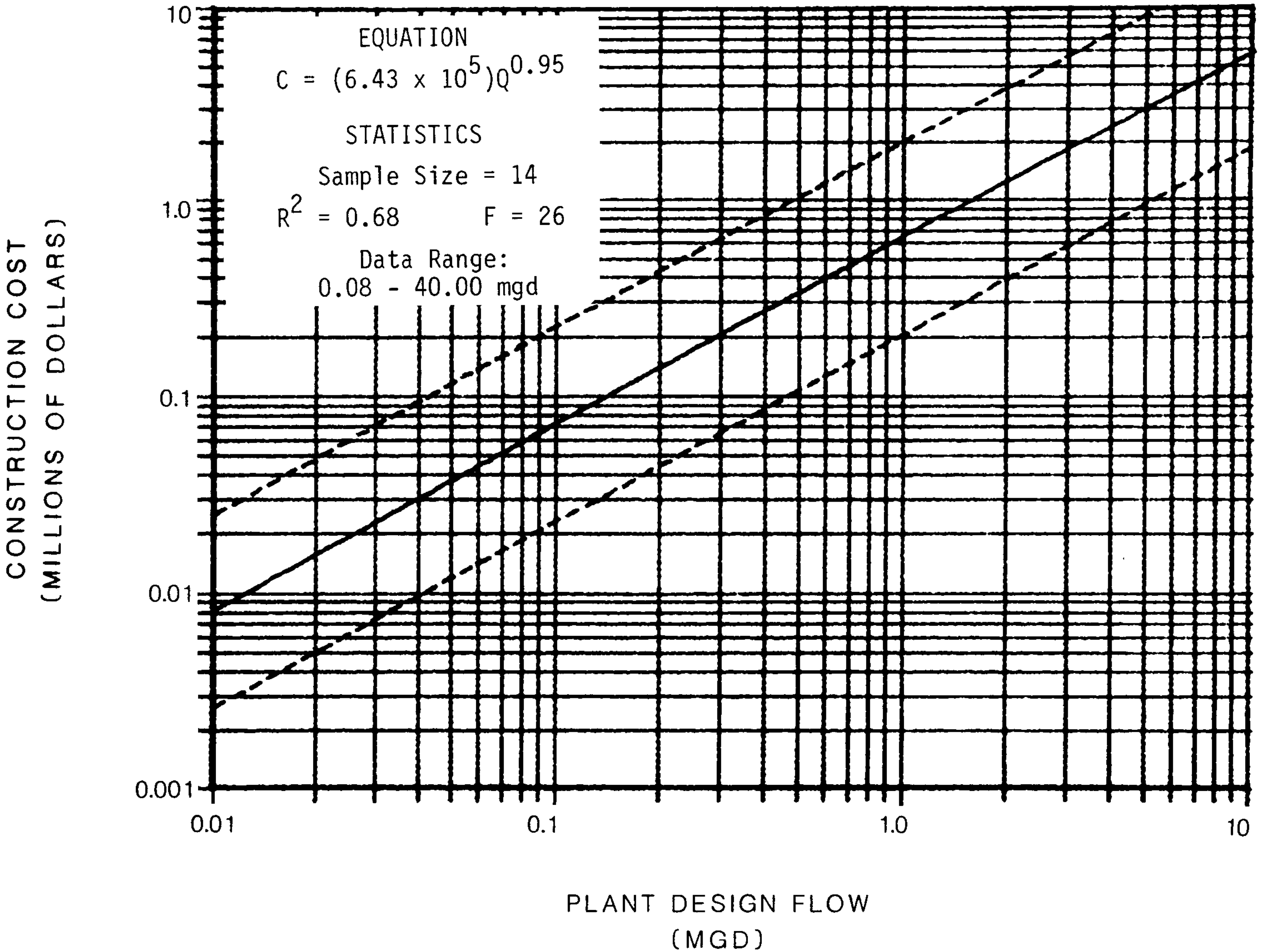


FIGURE 3.106

3.3.3.2 Results - Mechanical Plant Component Costs

This section contains the results from the analyses of the second order cost relationships between the design flow of a treatment plant and the construction cost for its general components. Data for these analyses were obtained from newly constructed mechanical plants.

The regression line and the cost equation derived from the line represent the predicted cost for the component identified in the title. The cost derived using the line or equation is an estimate which contains allowances for all labor, equipment, and materials necessary to complete all tasks associated with the component. For example, Figure 3.110 presents the relationship for excavation. The cost estimated using the curve or equation will be an estimate for all excavation necessary at the facility site. The reader should remember to include the additional costs to provide for the various nonconstruction cost categories.

Table 3.7 contains a summary of Figures 3.107 through 3.120 with associated titles and cost equations.

TABLE 3.7

SUMMARY FOR FIGURES 3.107 THROUGH 3.120
SECOND ORDER COSTS
MECHANICAL PLANT COMPONENT COSTS

Figure Number	Title	Cost Equation*
3.107	Mobilization	$C = (7.13 \times 10^4)Q^{0.74}$
3.108	Sitework Including Excavation	$C = (2.32 \times 10^5)Q^{0.67}$
3.109	Sitework Without Excavation	$C = (1.37 \times 10^5)Q^{0.63}$
3.110	Excavation	$C = (1.53 \times 10^5)Q^{0.69}$
3.111	Pilings, Special Foundations, Dewatering	$C = (8.56 \times 10^4)Q^{0.78}$
3.112	Electrical	$C = (2.09 \times 10^5)Q^{0.77}$
3.113	Controls and Instrumentation	$C = (1.01 \times 10^5)Q^{0.86}$
3.114	All Piping	$C = (3.12 \times 10^5)Q^{0.86}$
3.115	Yard Piping	$C = (1.58 \times 10^5)Q^{0.73}$
3.116	Process Piping	$C = (1.92 \times 10^5)Q^{0.76}$
3.117	Equipment	$C = (7.56 \times 10^5)Q^{0.75}$
3.118	Concrete	$C = (5.86 \times 10^5)Q^{0.83}$
3.119	Steel	$C = (9.18 \times 10^4)Q^{0.89}$
3.120	Heating, Ventilation, and Air Conditioning	$C = (7.49 \times 10^4)Q^{0.86}$

* C = Component Construction Cost (million dollars)
Q = Plant Design Flow (mgd)

MECHANICAL PLANT COMPONENT COST
MOBILIZATION

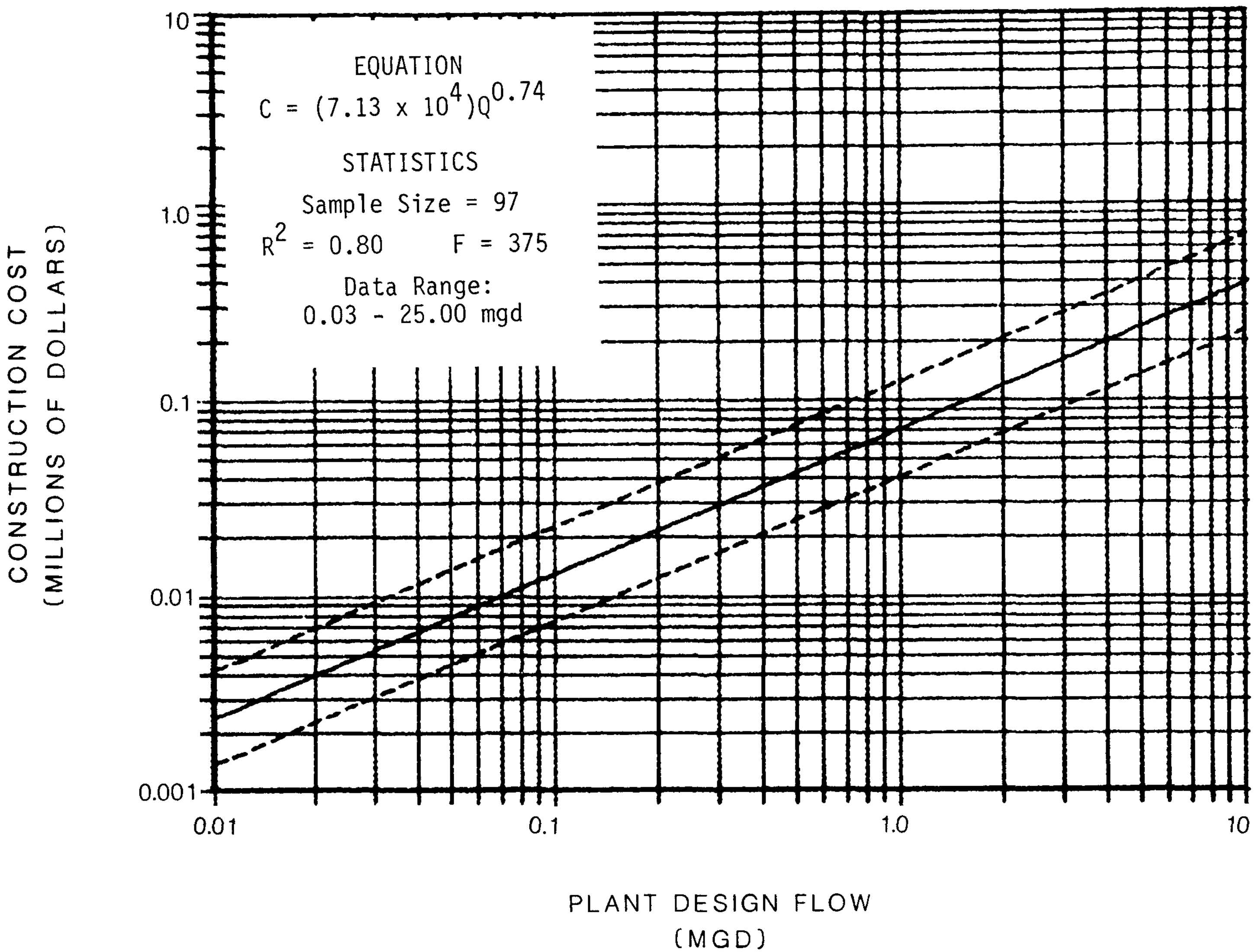


FIGURE 3.107

MECHANICAL PLANT COMPONENT COST
SITEWORK INCLUDING EXCAVATION

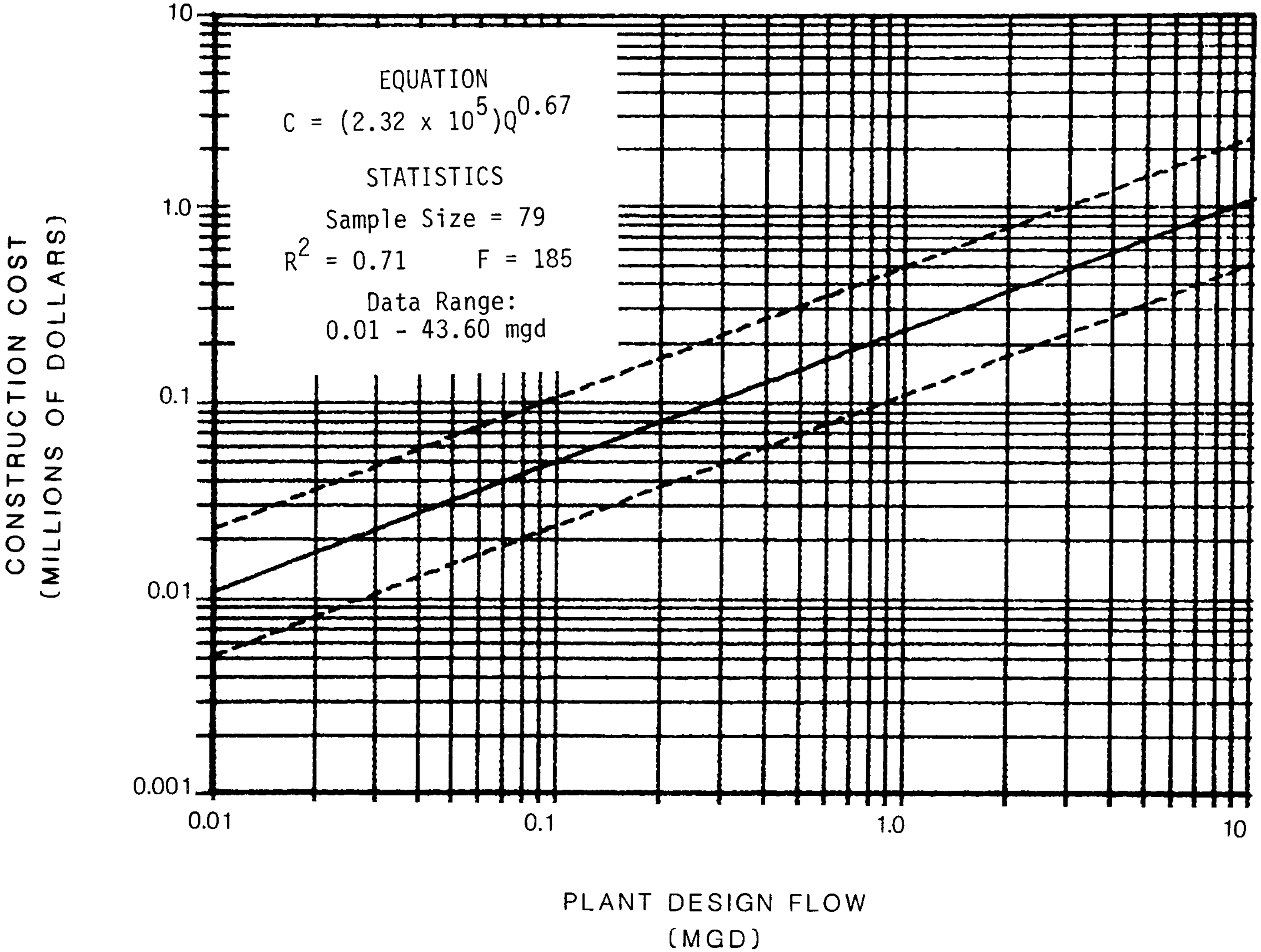


FIGURE 3.108

MECHANICAL PLANT COMPONENT COST
SITEWORK WITHOUT EXCAVATION

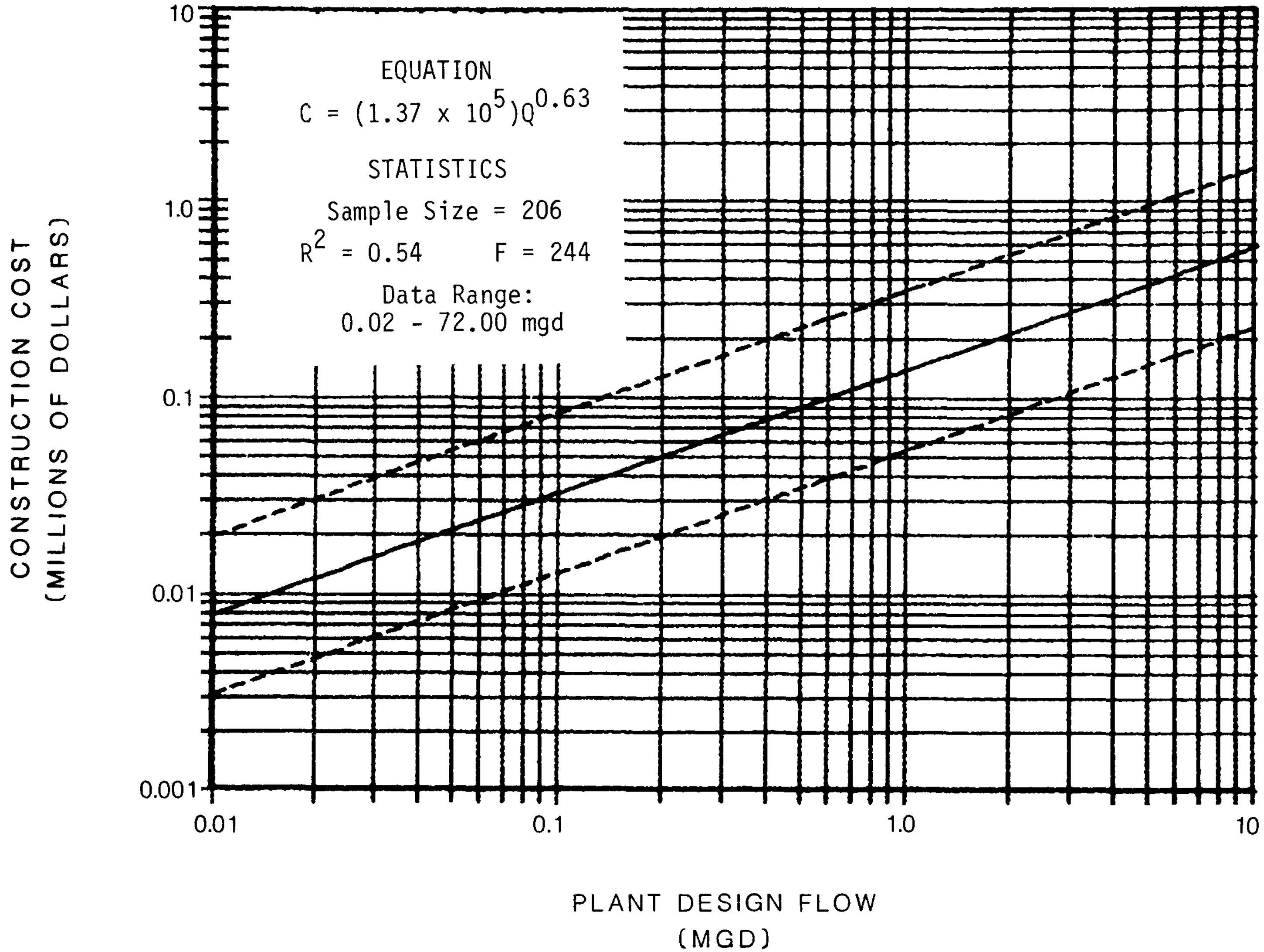


FIGURE 3.109

MECHANICAL PLANT COMPONENT COST
EXCAVATION

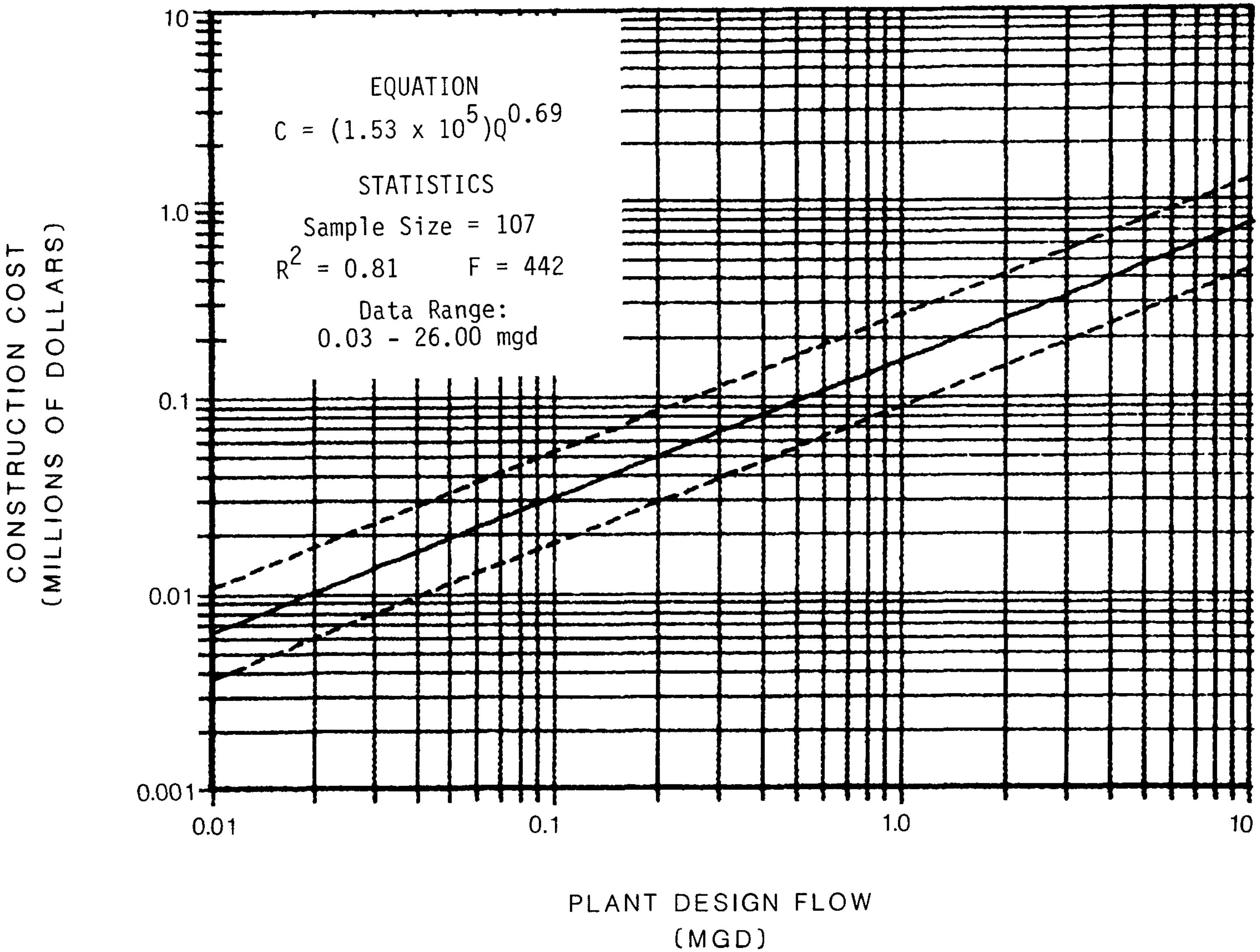


FIGURE 3.110

MECHANICAL PLANT COMPONENT COST
PILINGS, SPECIAL FOUNDATIONS, DEWATERING

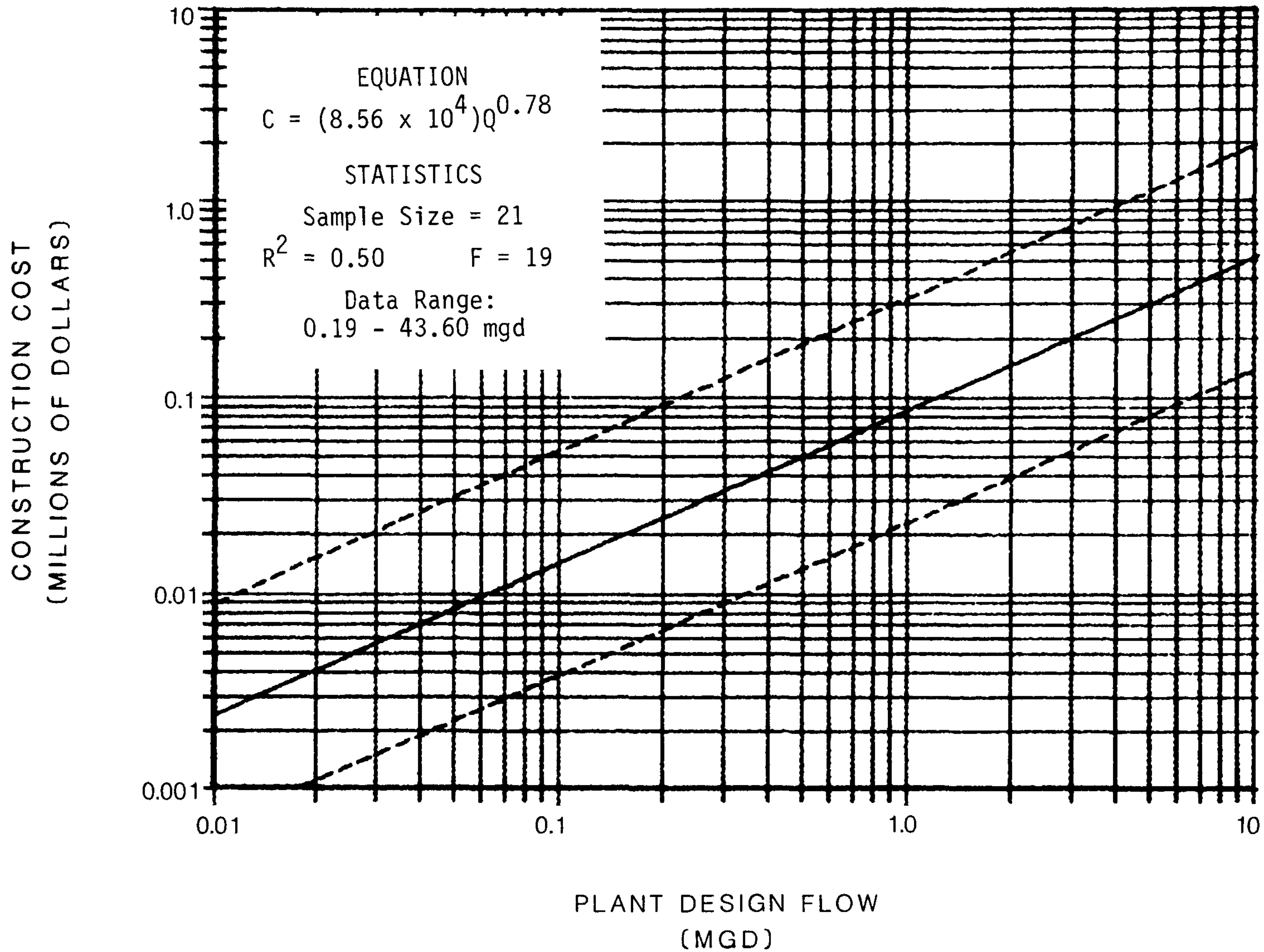


FIGURE 3.111

MECHANICAL PLANT COMPONENT COST
ELECTRICAL

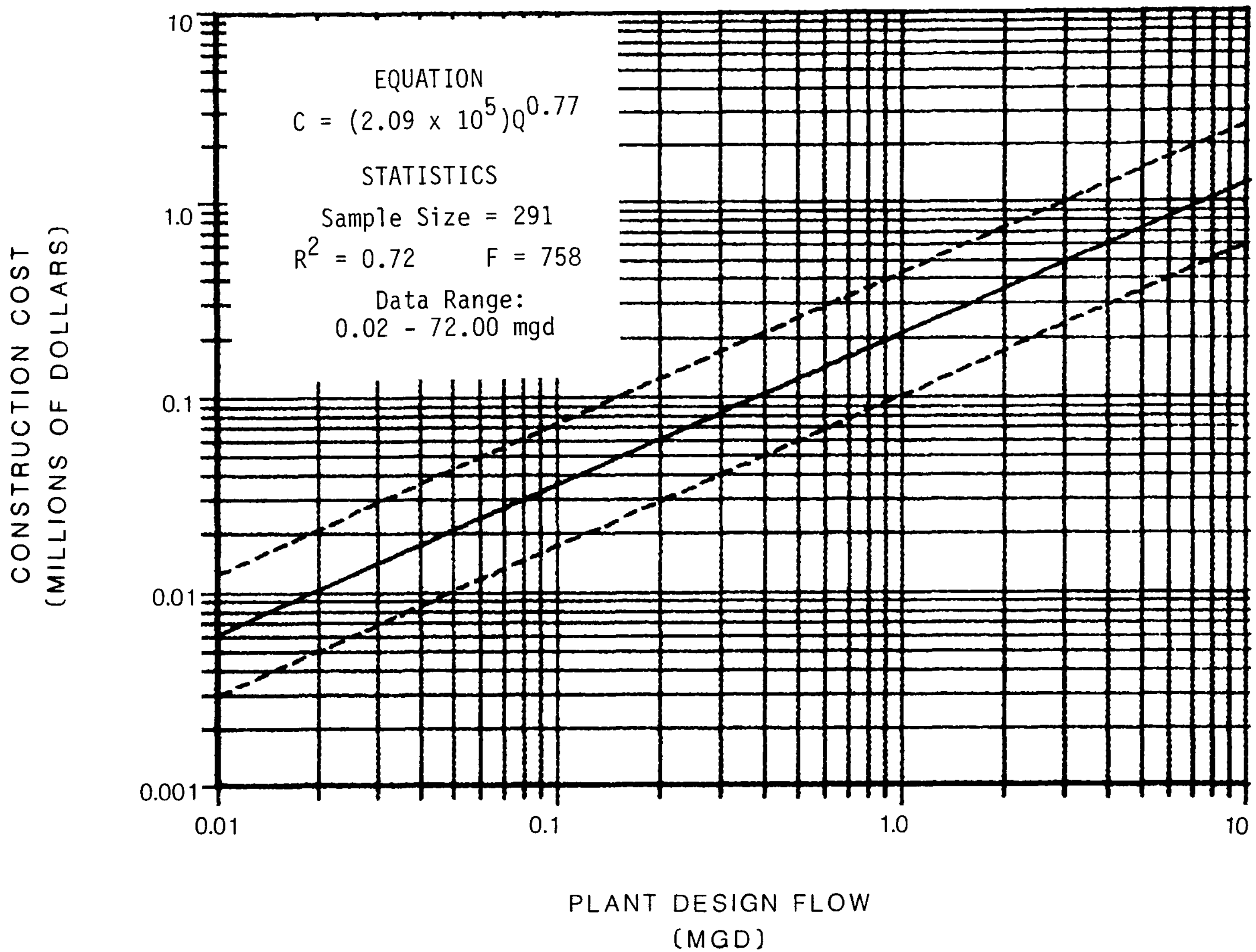


FIGURE 3.112

MECHANICAL PLANT COMPONENT COST
CONTROLS AND INSTRUMENTATION

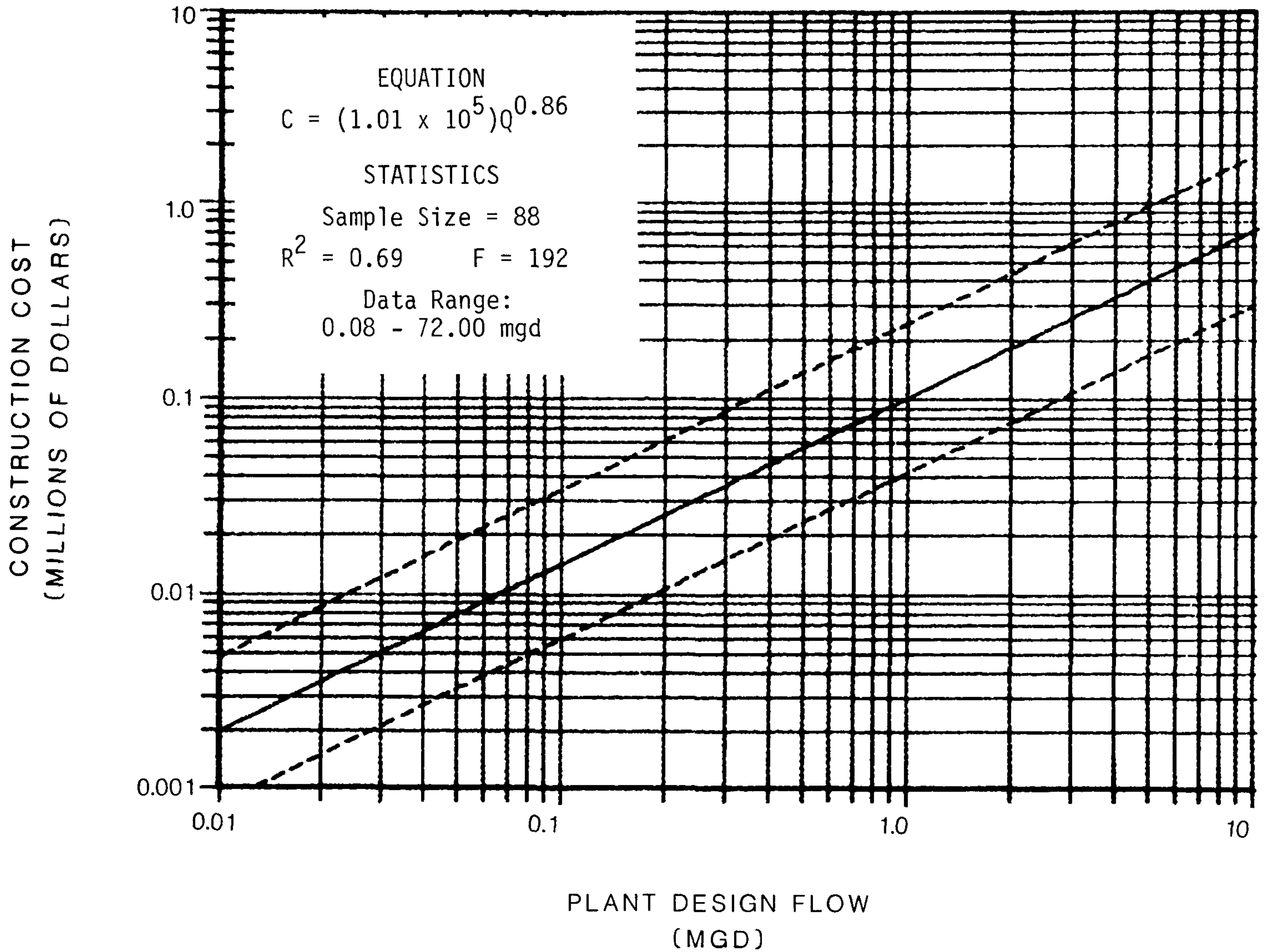


FIGURE 3.113

MECHANICAL PLANT COMPONENT COST
ALL PIPING

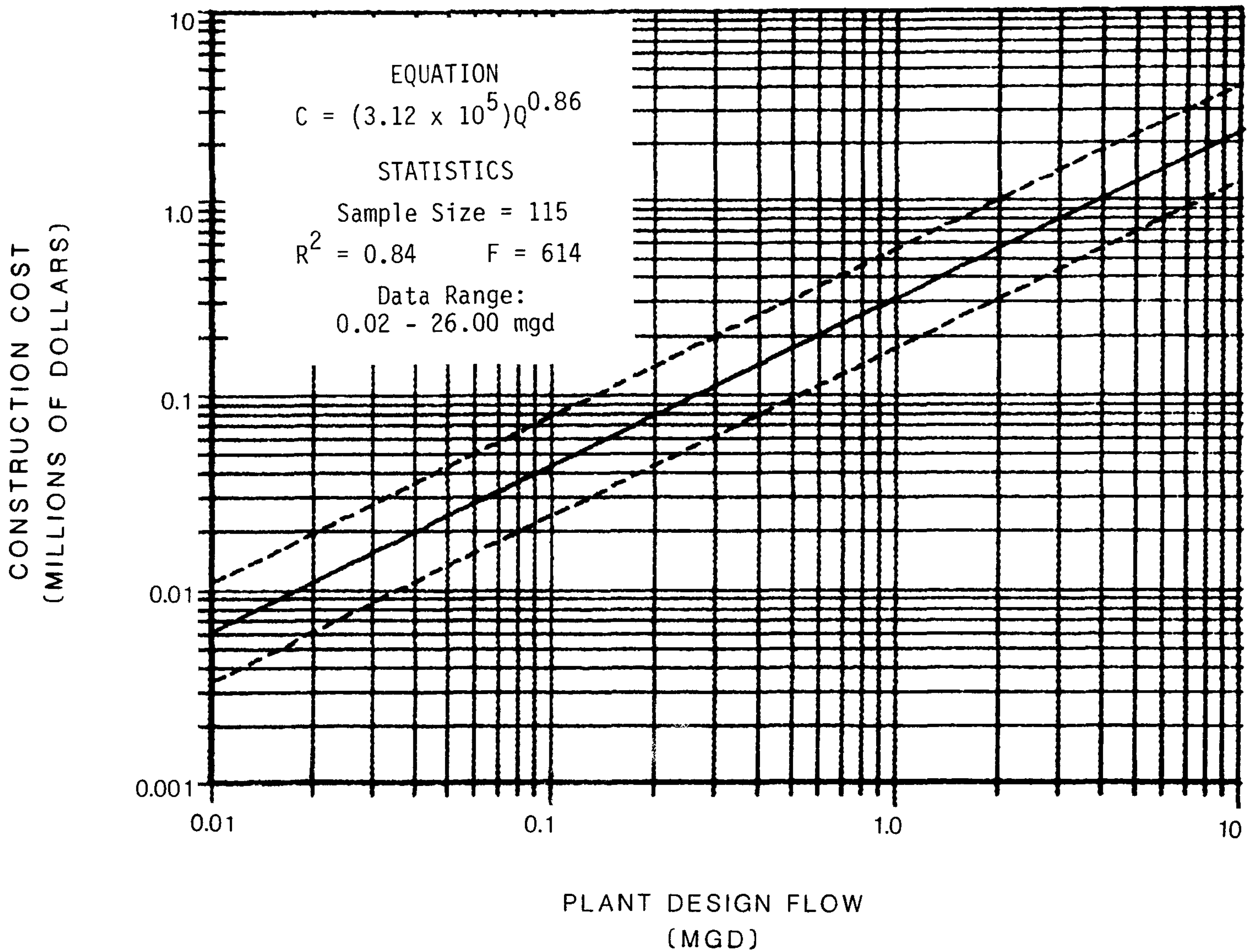


FIGURE 3.114

MECHANICAL PLANT COMPONENT COST
YARD PIPING

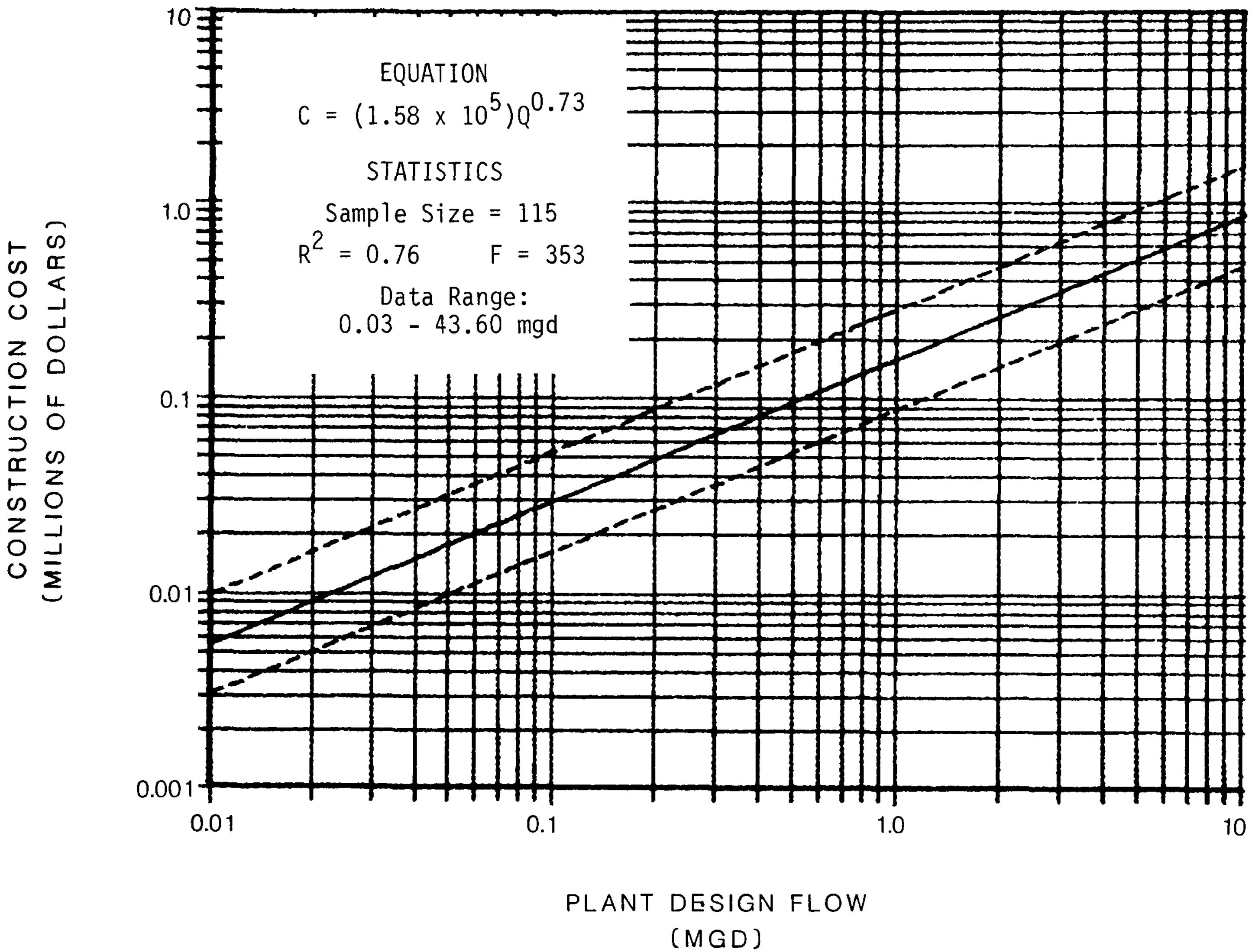


FIGURE 3.115

MECHANICAL PLANT COMPONENT COST
PROCESS PIPING

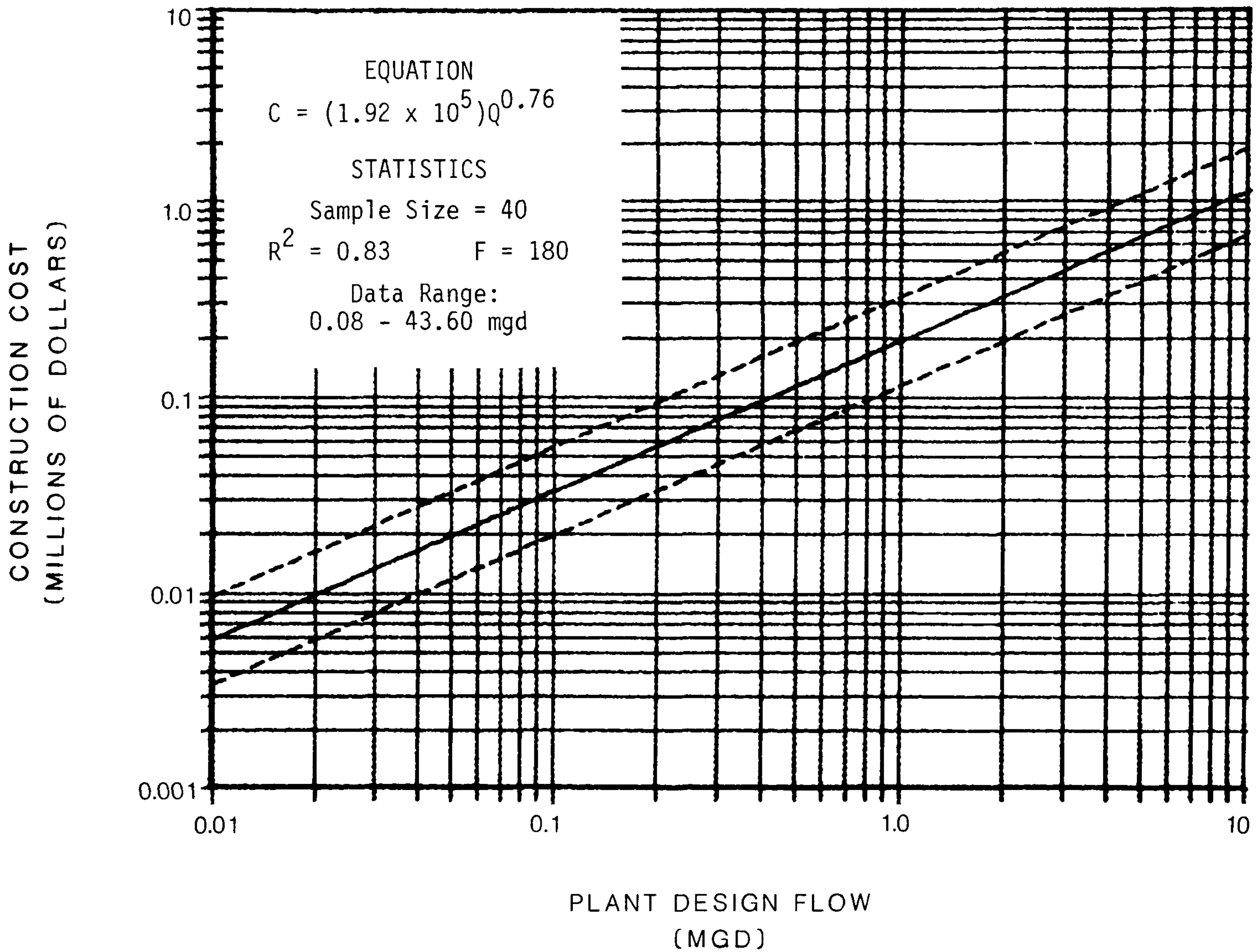


FIGURE 3.116

MECHANICAL PLANT COMPONENT COST
EQUIPMENT

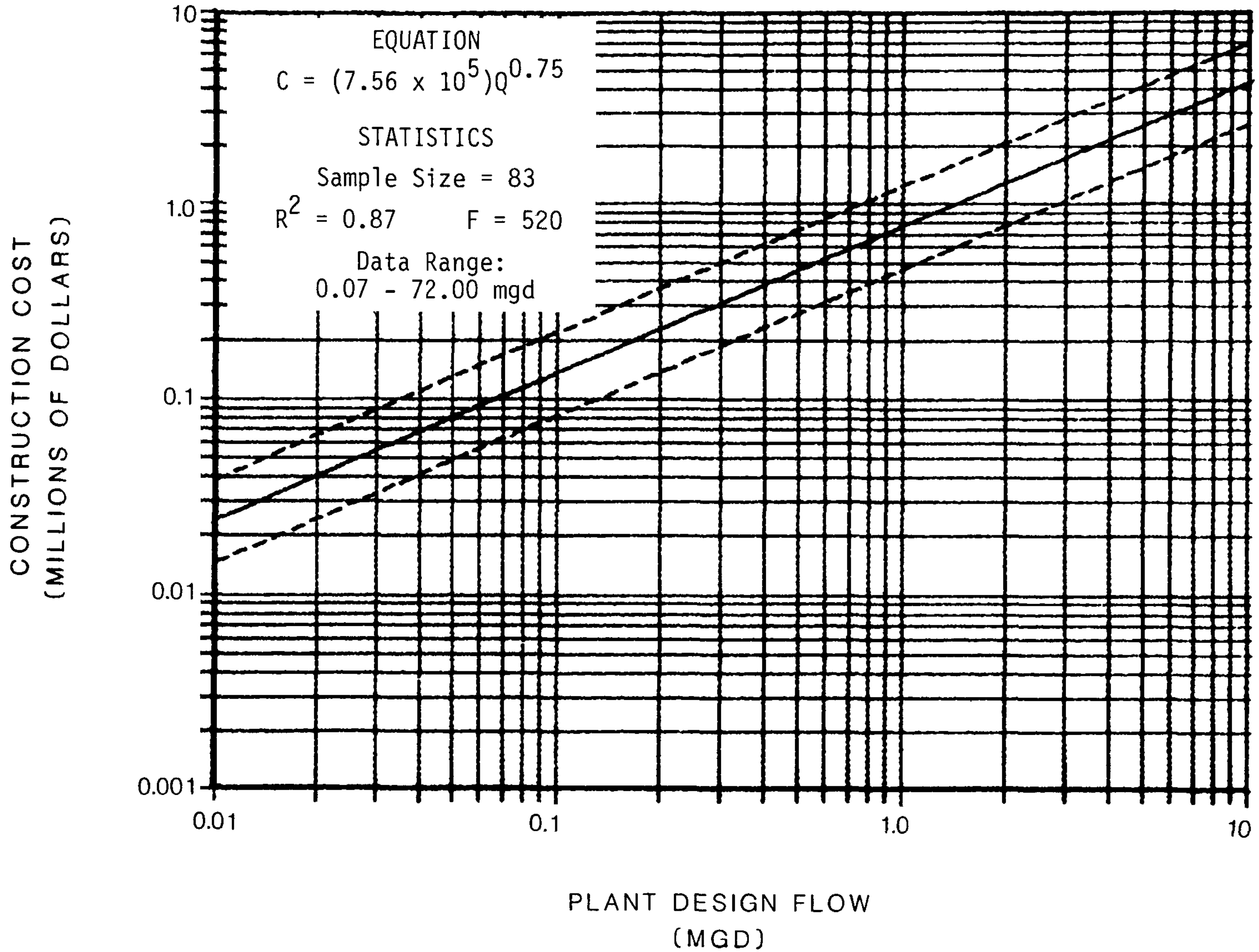


FIGURE 3.117

MECHANICAL PLANT COMPONENT COST
CONCRETE

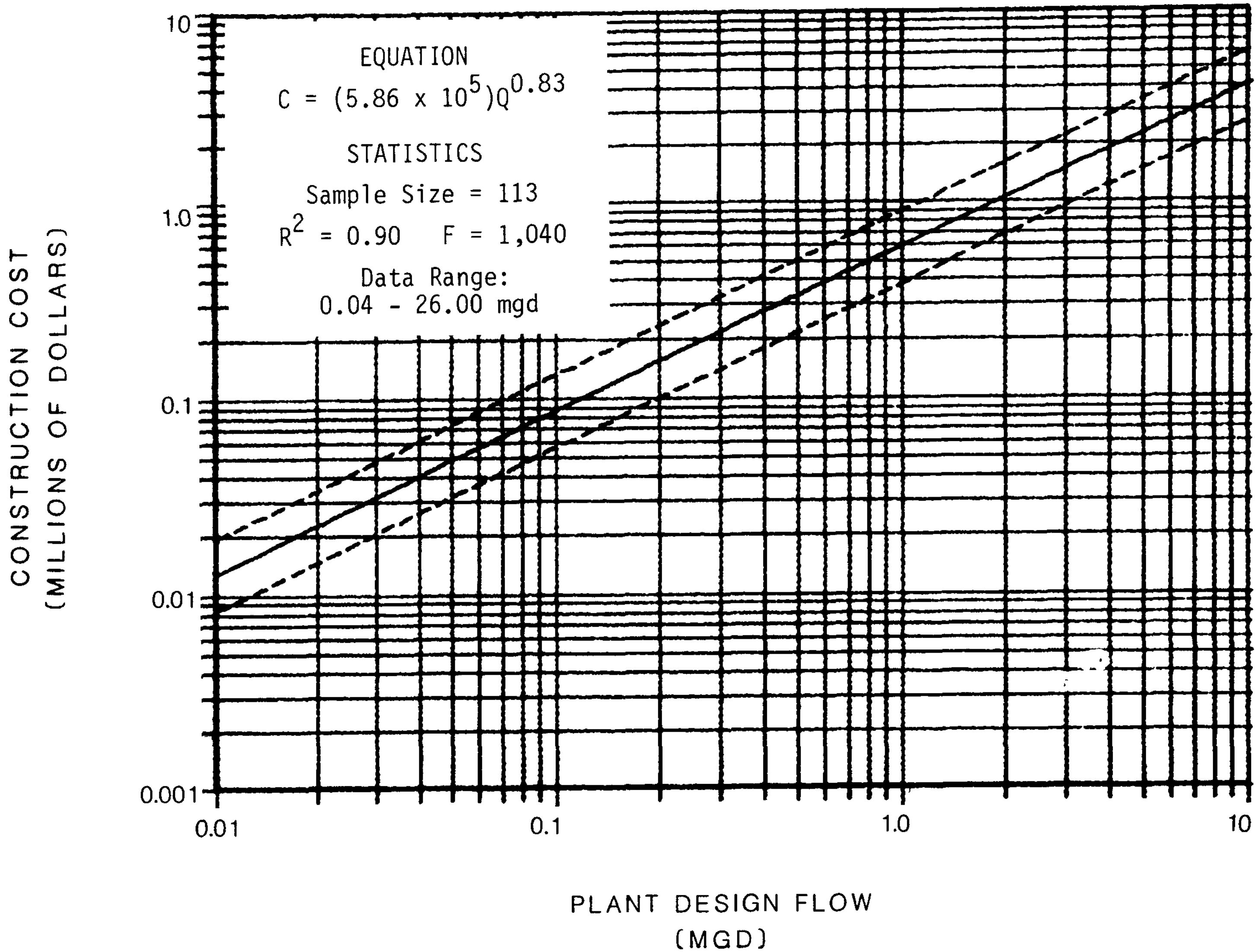


FIGURE 3.118

MECHANICAL PLANT COMPONENT COST
STEEL

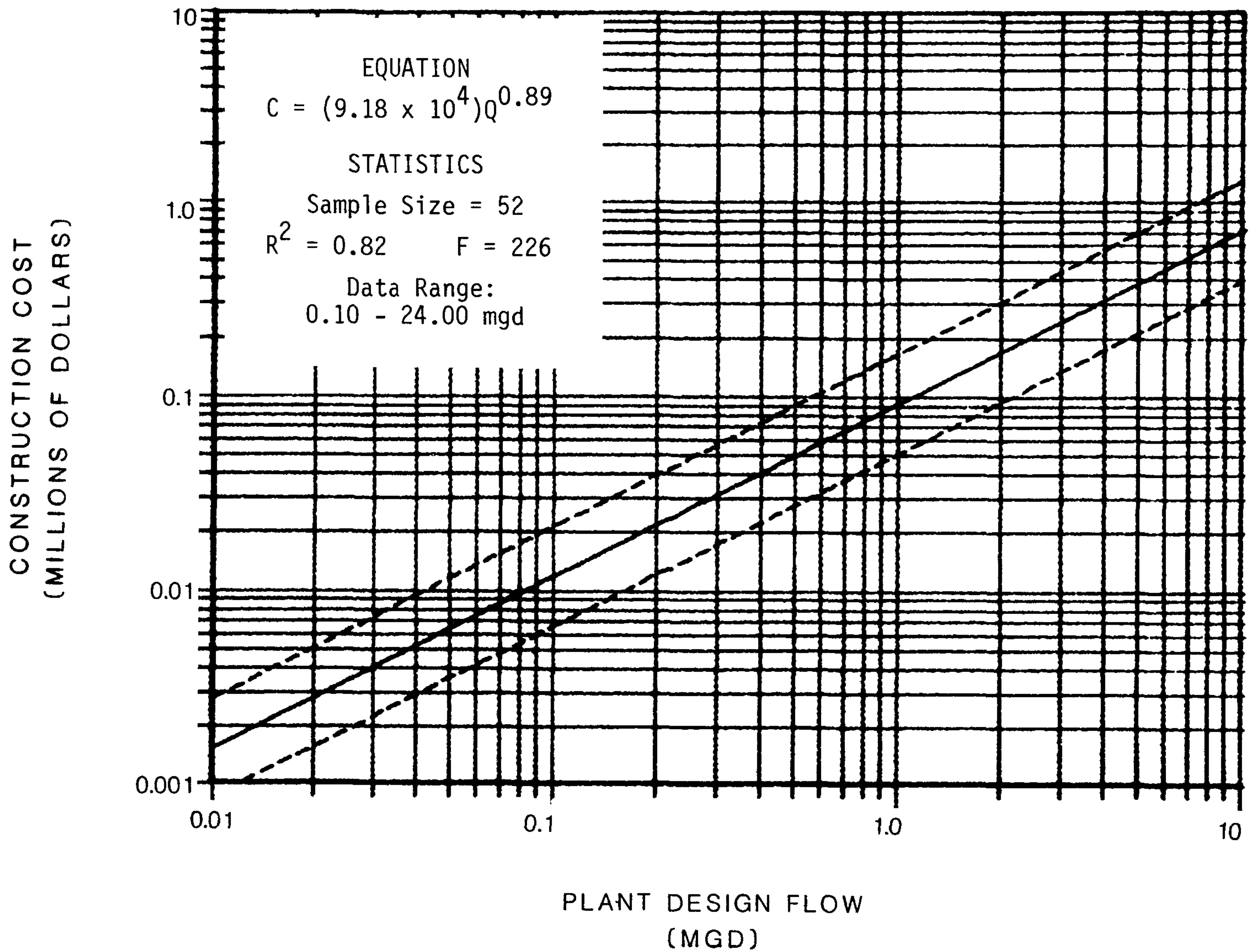


FIGURE 3.119

MECHANICAL PLANT COMPONENT COST
HEATING, VENTILATION, AND AIR CONDITIONING (HVAC)

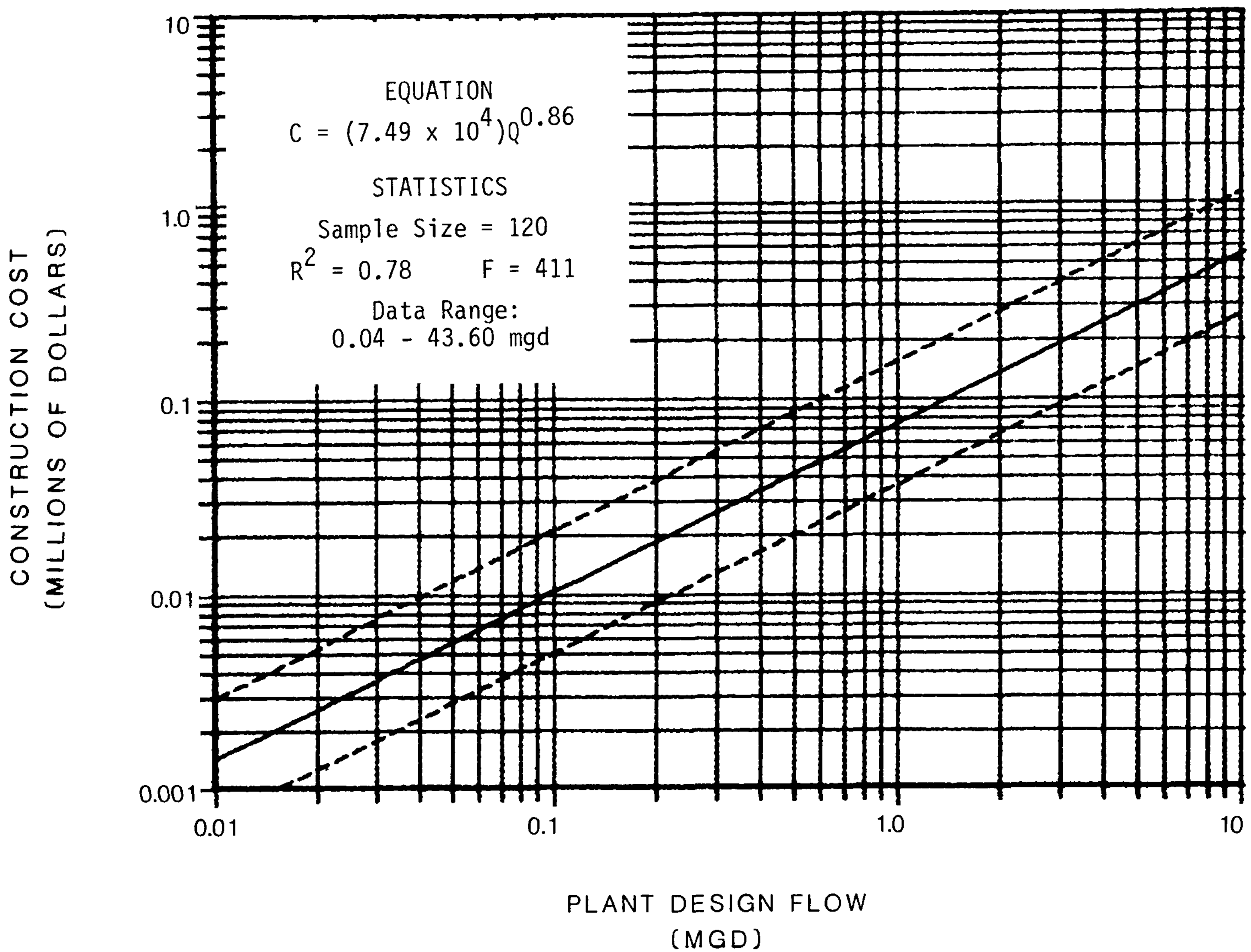


FIGURE 3.120

3.3.3.3 Results - Lagoon Plant Component Costs

This section contains the results from the analysis of the second order cost relationships between the design flow of a treatment plant and the construction cost for its general components. Data for these analyses were obtained from newly constructed lagoon facilities. Both aerated lagoon and stabilization pond systems are included.

The regression line and the cost equation derived from the line represent the predicted cost for the component identified in the title. The cost derived using the line or equation is an estimate which contains allowances for all labor, equipment, and materials necessary to complete all tasks associated with the component. The only additional costs that need to be considered are the various nonconstruction costs.

Table 3.8 contains a summary of Figures 3.121 through 3.123 with associated titles and cost equations.

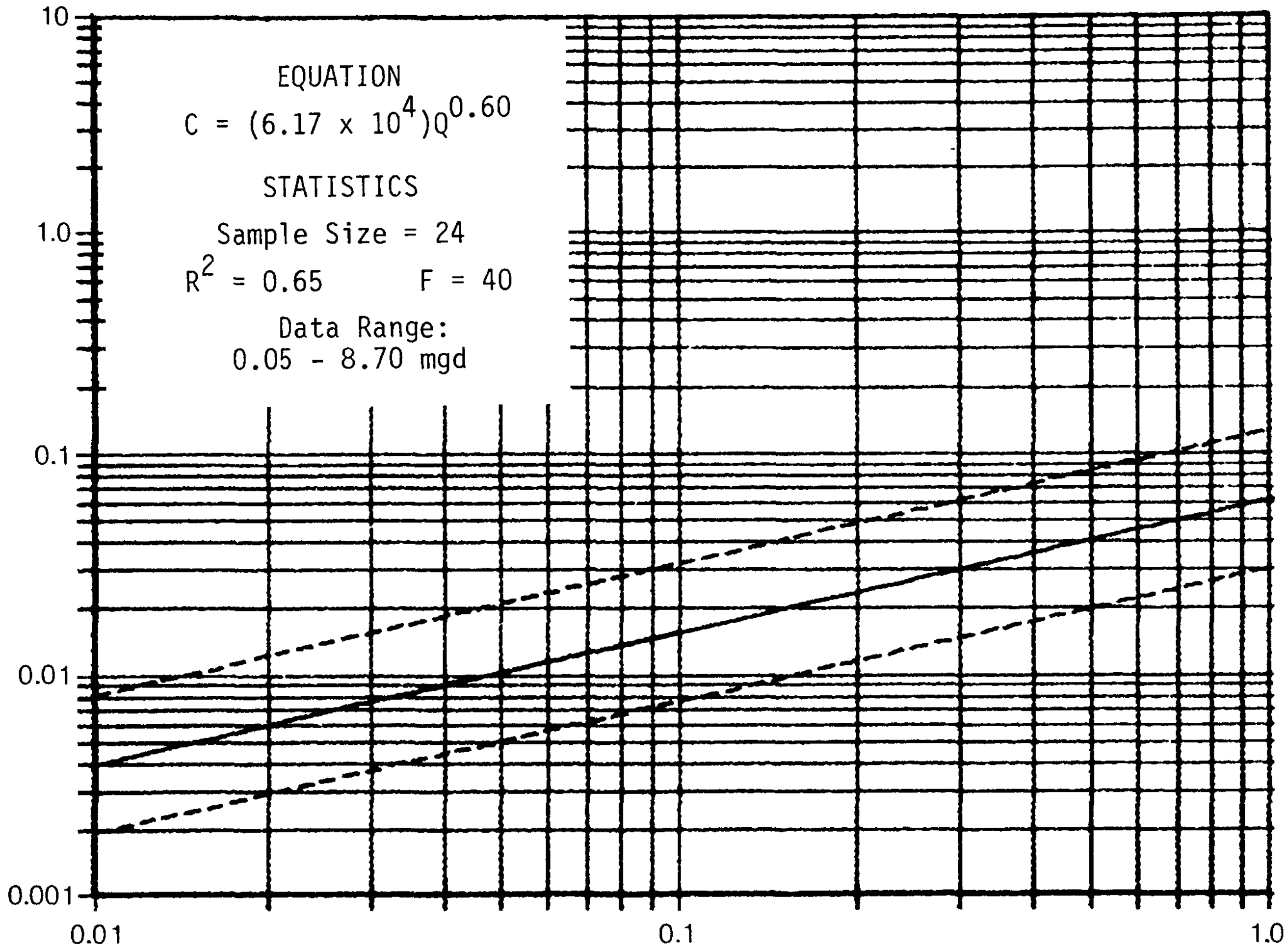
TABLE 3.8

SUMMARY FOR FIGURES 3.121 THROUGH 3.123
SECOND ORDER COSTS
LAGOON PLANT COMPONENT COSTS

Figure Number	Title	Cost Equation*
3.121	Mobilization	$C = (6.17 \times 10^4)Q^{0.60}$
3.122	Sitework Without Excavation	$C = (1.51 \times 10^5)Q^{0.56}$
3.123	Excavation	$C = (2.83 \times 10^5)Q^{0.52}$

* C = Component Construction Cost (million dollars)
Q = Plant Design Flow (mgd)

LAGOON COMPONENT COST
MOBILIZATION



CONSTRUCTION COST
(MILLIONS OF DOLLARS)

PLANT DESIGN FLOW
(MGD)

FIGURE 3.121

LAGOON COMPONENT COST
SITEWORK WITHOUT EXCAVATION

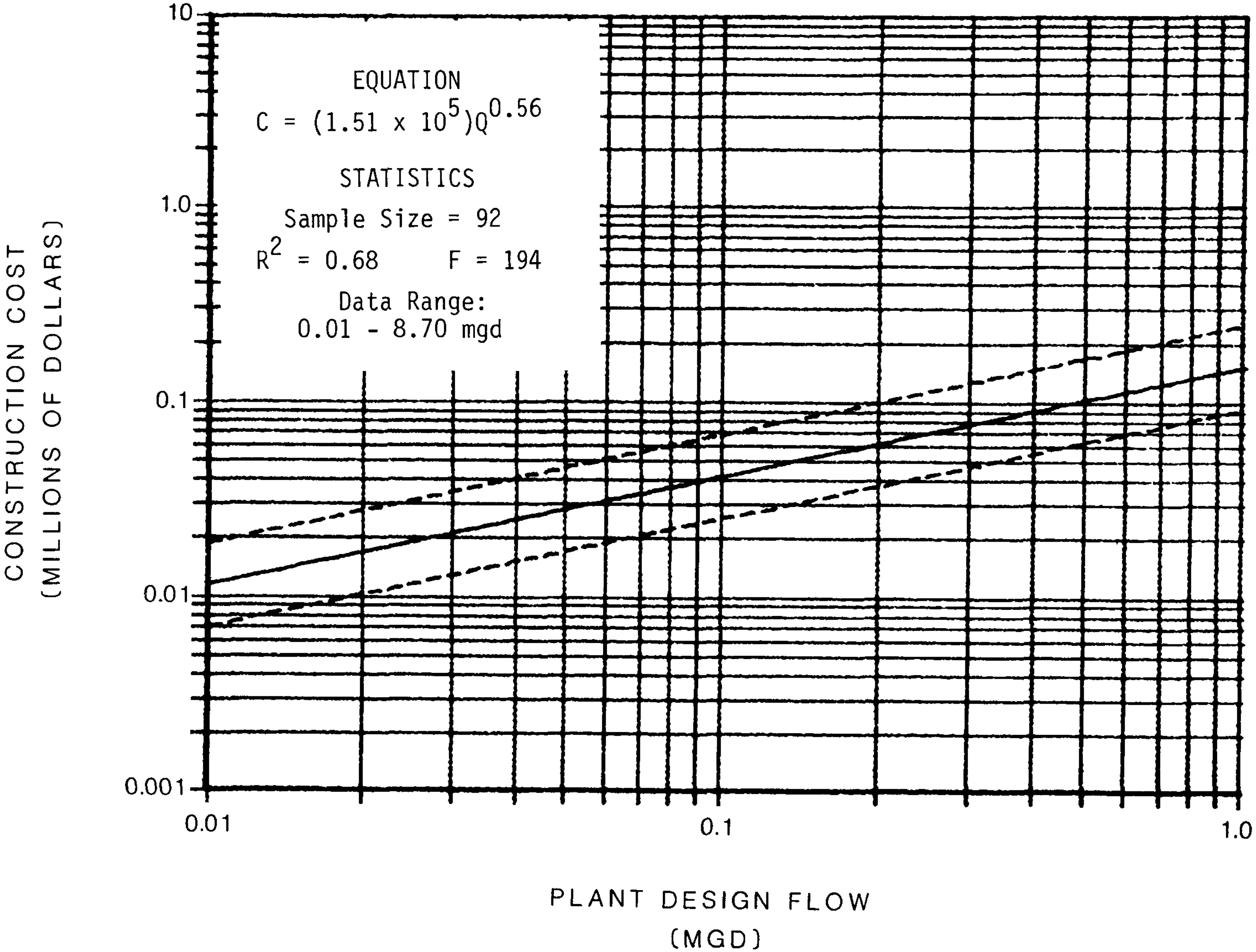


FIGURE 3.122

LAGOON COMPONENT COST
EXCAVATION

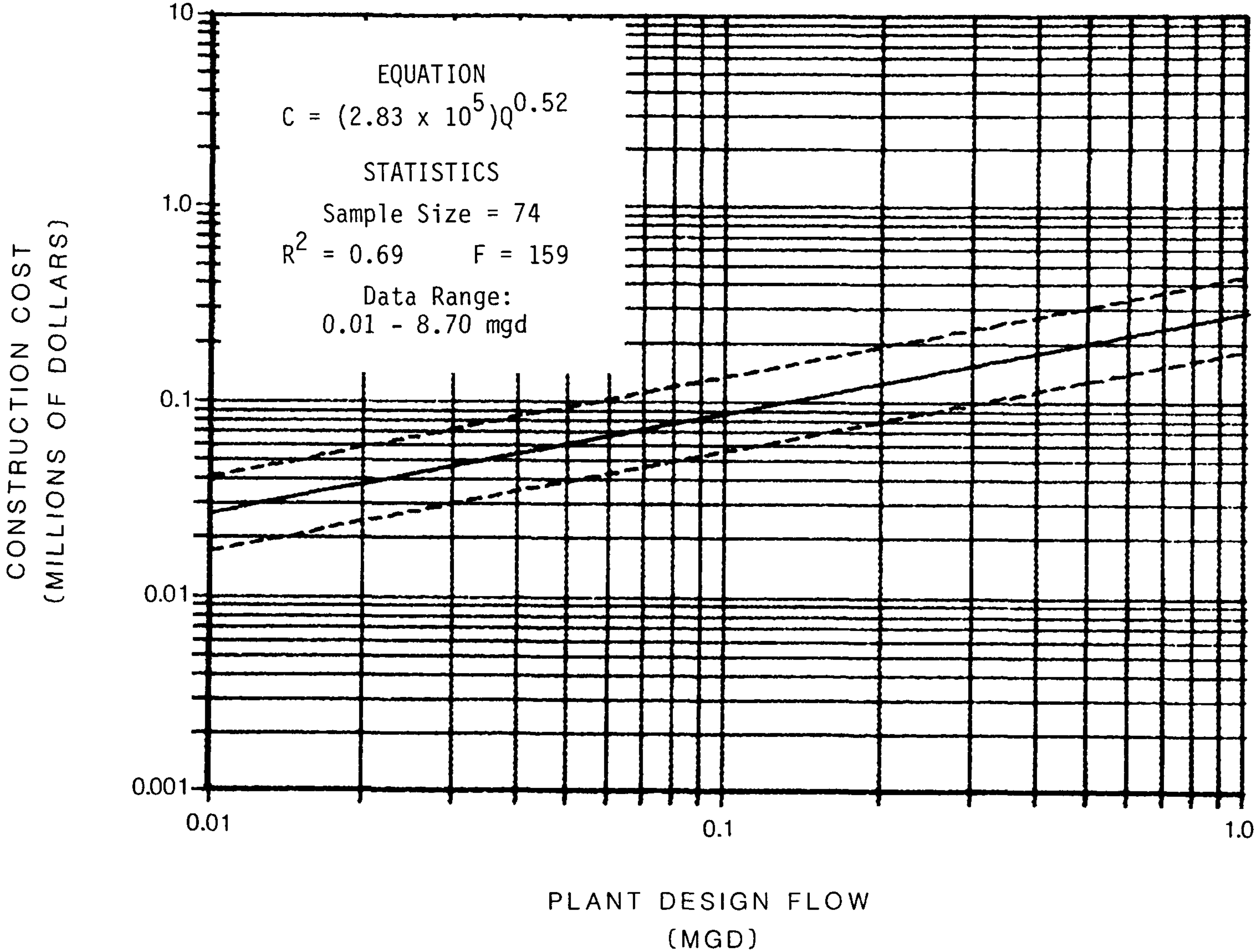


FIGURE 3.123

3.4 THIRD ORDER COSTS

3.4.1 Introduction

Third order costs are those necessary to construct one specific component of a total unit process. The sum of all third order costs for a process equals the second order cost for a complete unit process.

3.4.2 Presentation of Third Order Cost Equations

All component cost relationships presented in this section were derived from data for complete new unit processes. The most commonly identifiable third order, or component costs, were as listed below:

- Excavation
- Concrete
- Steel
- Electrical
- Piping
- Equipment

These component cost relationships were derived from detailed bid tabulations submitted by the building contractor. The component cost includes all materials and labor necessary to complete the construction of each discrete component. The component costs for unit processes which include a reactor basin followed by a clarifier, such as activated sludge, include the cost for both structures.

Table 3.9 presents the relationship between the facility design flow and the component costs for 16 commonly used unit processes. For each process, all available information on component costs is shown. Only those relationships which were considered statistically valid are presented.

All cost equations presented in this section represent national averages. Methods for adjusting the national average cost to a specific area of the country are outlined in Section 4.0. Examples of how to use these cost curves to develop estimates are also presented. All national average costs are in third quarter 1982 Kansas City/St. Joseph, Missouri dollars.

TABLE 3.9

THIRD ORDER COST EQUATIONS

Unit Process	Component	Equation*	Sample Size	R^2	F-Value
Raw Wastewater Pumping:	Equipment	$C = (5.89 \times 10^4)Q^{0.53}$	73	0.65	132
	Process Piping	$C = (3.07 \times 10^4)Q^{0.79}$	6	0.92	47
Preliminary Treatment:	Concrete	$C = (2.94 \times 10^4)Q^{0.70}$	24	0.51	23
	Electrical	$C = (8.15 \times 10^3)Q^{0.67}$	6	0.95	70
	Equipment	$C = (4.85 \times 10^4)Q^{0.62}$	108	0.65	199
	Steel	$C = (4.34 \times 10^3)Q^{0.78}$	5	0.88	22
Primary Sedimentation:	Concrete	$C = (7.09 \times 10^4)Q^{0.65}$	22	0.69	45
	Equipment	$C = (5.24 \times 10^4)Q^{0.64}$	56	0.75	165
	Excavation	$C = (6.15 \times 10^3)Q^{0.85}$	17	0.60	22
	Process Piping	$C = (1.14 \times 10^4)Q^{0.68}$	8	0.64	11
	Steel	$C = (1.60 \times 10^4)Q^{0.36}$	5	0.87	19
Conventional Activated Sludge:	Concrete	$C = (1.95 \times 10^5)Q^{0.79}$	28	0.72	68
	Equipment	$C = (2.18 \times 10^5)Q^{0.56}$	56	0.58	73
	Process Piping	$C = (4.01 \times 10^4)Q^{0.79}$	9	0.77	23
	Steel	$C = (7.63 \times 10^4)Q^{0.52}$	4	0.91	21
Contact Stabilization:	Equipment	$C = (3.21 \times 10^5)Q^{0.53}$	9	0.54	8

* C = Component Construction Cost (million dollars)
Q = Plant Design Flow (mgd)

TABLE 3.9 (Continued)

Unit Process	Component	Equation	Sample Size	R^2	F-Value
Extended Aeration:	Concrete	$C = (2.38 \times 10^5)Q^{1.01}$	5	0.93	39
	Equipment	$C = (2.29 \times 10^5)Q^{0.41}$	16	0.79	56
All Types of Activated Sludge:	Concrete	$C = (1.92 \times 10^5)Q^{0.82}$	28	0.86	158
	Equipment	$C = (2.29 \times 10^5)Q^{0.48}$	77	0.66	151
	Excavation	$C = (3.43 \times 10^4)Q^{0.58}$	9	0.74	20
	Process Piping	$C = (6.17 \times 10^4)Q^{0.57}$	12	0.69	23
Oxidation Ditch:	Concrete	$C = (3.39 \times 10^5)Q^{0.72}$	14	0.80	48
	Equipment	$C = (2.00 \times 10^5)Q^{0.51}$	31	0.55	36
	Excavation	$C = (3.11 \times 10^4)Q^{0.37}$	5	0.88	22
Rotating Biological Contactor:	Equipment	$C = (5.05 \times 10^5)Q^{0.58}$	18	0.82	72
Stabilization Pond:	Excavation	$C = (1.78 \times 10^5)Q^{0.44}$	50	0.50	48
Aerated Lagoon:	Equipment	$C = (1.09 \times 10^5)Q^{0.59}$	42	0.61	66
	Excavation	$C = (2.47 \times 10^5)Q^{0.75}$	9	0.66	14
All Types of Filtration:	Concrete	$C = (7.55 \times 10^4)Q^{0.62}$	9	0.88	50
	Equipment	$C = (1.55 \times 10^5)Q^{0.56}$	51	0.78	180
	Excavation	$C = (2.20 \times 10^4)Q^{0.62}$	7	0.72	13
	Process Piping	$C = (4.92 \times 10^4)Q^{0.55}$	6	0.71	10

TABLE 3.9 (Concluded)

Unit Process	Component	Equation	Sample Size	R^2	F-Value
Chlorination:	Concrete	$C = (3.32 \times 10^4)Q^{0.66}$	45	0.62	69
	Electrical	$C = (1.20 \times 10^4)Q^{0.74}$	7	0.85	28
	Equipment	$C = (2.38 \times 10^4)Q^{0.42}$	199	0.54	235
	Excavation	$C = (7.30 \times 10^3)Q^{0.48}$	17	0.60	22
	Process Piping	$C = (1.32 \times 10^4)Q^{0.61}$	16	0.64	25
	Steel	$C = (4.97 \times 10^3)Q^{0.67}$	8	0.60	9
Aerobic Digestion:	Concrete	$C = (9.28 \times 10^4)Q^{0.87}$	6	0.88	30
	Equipment	$C = (8.77 \times 10^4)Q^{0.59}$	26	0.63	44
	Excavation	$C = (8.61 \times 10^3)Q^{0.96}$	5	0.88	22
	Process Piping	$C = (1.87 \times 10^4)Q^{0.77}$	5	0.94	45
Sludge Drying Beds:	Concrete	$C = (3.82 \times 10^4)Q^{0.61}$	10	0.61	13
	Excavation	$C = (5.99 \times 10^3)Q^{0.77}$	8	0.85	35
Control/Lab/Maintenance Bldg:	Concrete	$C = (8.18 \times 10^4)Q^{0.56}$	17	0.78	53
	Electrical	$C = (3.14 \times 10^4)Q^{0.66}$	10	0.71	20
	Equipment	$C = (2.97 \times 10^4)Q^{0.45}$	107	0.57	142
	Excavation	$C = (8.19 \times 10^3)Q^{0.32}$	8	0.67	12
	Process Piping	$C = (2.48 \times 10^4)Q^{0.73}$	8	0.93	86

3.5 EFFICIENCY CURVES

3.5.1 Introduction

In addition to the standard bivariate analyses of construction costs and plant design flow presented in Sections 3.1 through 3.4, several multivariate analyses of the data were performed. The multivariate analyses used three variables which were the projected plant design flow, projected effluent BOD_5, and construction cost. The purpose of the multivariate analyses was to compare the effect of the projected level of treatment on construction costs for various types of treatment plants. As explained in Section 2.4, the effect of the effluent BOD_5 does not seem to be significant overall; the design flow appears to be the contributing variable to the model.

3.5.2 Presentation of Efficiency Curves

The results of the multivariate analyses that had statistically significant correlations are presented in Figures 3.124 through 3.130. These curves show the relative efficiency, or cost effectiveness, of each treatment type for producing a given level of effluent BOD_5. Each figure gives the construction cost versus plant design flow for three effluent BOD_5 values. These are an effluent BOD_5 of 30 mg/l, an effluent BOD_5 of 15 mg/l, and an effluent BOD_5 of 5 mg/l. Figures 3.131 through 3.133 illustrate the same curves grouped by each of the three levels of effluent BOD_5.

Figure 3.124 shows the construction costs associated with the three effluent BOD_5 values for all mechanical treatment plants. Three types of activated sludge plants, oxidation ditch plants, and rotating biological contactor plants together make up the curves for all mechanical plants in Figure 3.124. The data set includes any mechanical plant without regard to whether the plant uses a simple, moderate, or complex sludge handling system. Figure 3.125 presents the same information for all activated sludge treatment plants, which includes conventional activated sludge plants, contact stabilization plants, and extended aeration plants. Curves for each of these three types of activated sludge treatment are presented individually on Figures 3.126, 3.127, and 3.128, respectively. Oxidation ditch plants are presented separately on Figure 3.129 and rotating biological contactor plants are shown on Figure 3.130. Figure 3.131 illustrates the curves for all mechanical treatment plants together for an effluent BOD_5 of 30 mg/l. Similarly, Figures 3.132 and 3.133 present all the curves for an effluent BOD_5 of 15 mg/l and 5 mg/l, respectively.

The efficiency curves are provided as a means of comparing the effect on the construction costs of various types of unit processes producing differing levels of effluent BOD_5. The multivariate analyses were performed for seven classes of data. In five of the seven classes, the effluent BOD_5 was not significant; although it was significant at the 0.05 level for the other two classes (in no case was it significant at the 0.01 level). The two cases where effluent BOD_5 was significant were all types of mechanical plants combined and oxidation ditch plants.

Figure 3.131 shows that the most inexpensive mechanical plant for producing an effluent BOD_5 of 30 mg/l is an oxidation ditch plant. This is most likely due to the fact that oxidation ditch plants typically do not have complex mechanical components and the reactor basin is less expensive to construct compared with other mechanical treatment plant types. An oxidation ditch producing an effluent BOD_5 of 30 mg/l is less expensive to construct than an extended aeration plant producing the same type of effluent, although extended aeration is less expensive than the other types of mechanical plants. This is due to the fact that extended aeration plants are usually prefabricated or package type treatment units which, in most cases, are less expensive than custom-built plants.

Extended aeration plants were the least expensive type of plant producing an effluent BOD_5 of 15 mg/l and 5 mg/l as shown on Figures 3.132 and 3.133, respectively. Rotating biological contactor plants were found to be the most expensive for any of the treatment levels, followed by conventional activated sludge plants.

The incremental cost of producing an effluent BOD_5 of 5 mg/l over an effluent BOD_5 of 30 mg/l was found to be lowest for rotating biological contactor plants and highest for contact stabilization plants, as shown on Figures 3.130 and 3.127, respectively. The high incremental cost of producing an effluent BOD_5 of 5 mg/l for contact stabilization plants is attributed to the fact that these plants generally produce an effluent BOD_5 of 30 mg/l and require construction of additional unit processes to produce an effluent BOD_5 of 5 mg/l.

Table 3.10 contains a summary of Figures 3.124 through 3.133 with associated titles and cost equations. Statistics information for the grouped curves, Figures 3.131 through 3.133, are not shown since the data are identical to those for the individual plant curves on Figures 3.124 through 3.130.

TABLE 3.10

SUMMARY FOR FIGURES 3.124 THROUGH 3.130
TREATMENT EFFICIENCY CURVES

Figure Number	Title	Cost Equation*
3.124	All Mechanical Treatment Plants - All Types of Sludge Handling - By Effluent BOD_5	$C = (4.48 \times 10^6)Q^{0.73}E^{-0.17}$
3.125	All Activated Sludge Plants - All Types of Sludge Handling - By Effluent BOD_5	$C = (3.24 \times 10^6)Q^{0.73}E^{-0.06}$
3.126	Conventional Activated Sludge Plants All Types of Sludge Handling - By Effluent BOD_5	$C = (4.44 \times 10^6)Q^{0.79}E^{-0.15}$
3.127	Contact Stabilization Plants - All Types of Sludge Handling - By Effluent BOD_5	$C = (6.48 \times 10^6)Q^{0.71}E^{-0.36}$
3.128	Extended Aeration Plants - All Types of Sludge Handling - By Effluent BOD_5	$C = (3.26 \times 10^6)Q^{0.61}E^{-0.11}$
3.129	Oxidation Ditch Plants - All Types of Sludge Handling - By Effluent BOD_5	$C = (4.16 \times 10^6)Q^{0.66}E^{-0.23}$
3.130	Rotating Biological Contactor Plants All Types of Sludge Handling - By Effluent BOD_5	$C = (5.14 \times 10^6)Q^{0.66}E^{-0.05}$
3.131	Mechanical Treatment Plants - All Types of Sludge Handling - Effluent BOD_5 = 30 mg/l	
3.132	Mechanical Treatment Plants - All Types of Sludge Handling - Effluent BOD_5 = 15 mg/l	
3.133	Mechanical Treatment Plants - All Types of Sludge Handling - Effluent BOD_5 = 5 mg/l	

* C = Construction Cost (million dollars)
Q = Plant Design Flow (mgd)
E = Effluent BOD_5 (mg/l)

ALL MECHANICAL TREATMENT PLANTS ALL TYPES OF SLUDGE HANDLING BY EFFLUENT BOD5

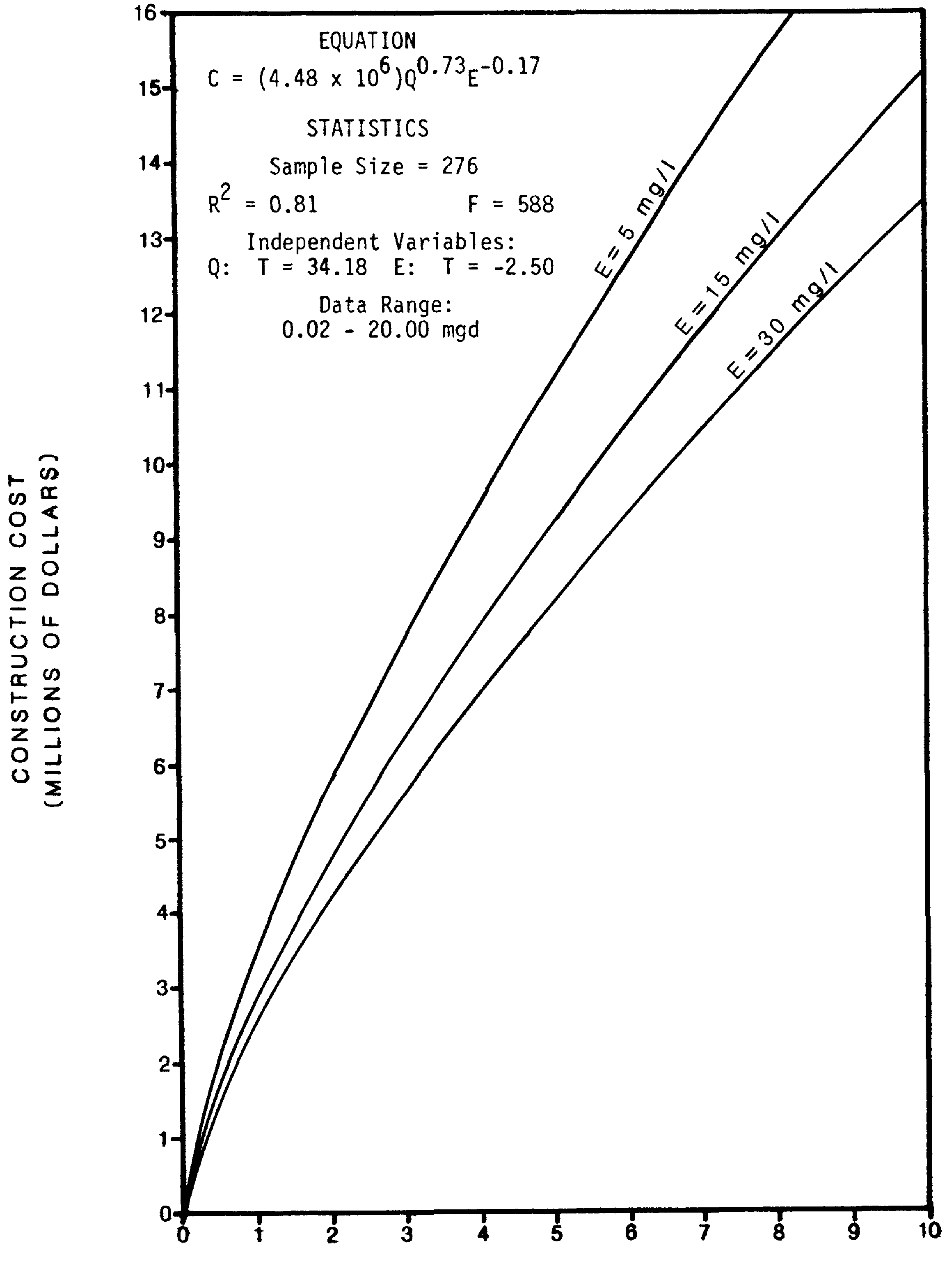


FIGURE 3.124

ALL ACTIVATED SLUDGE PLANTS
ALL TYPES OF SLUDGE HANDLING
BY EFFLUENT BOD5

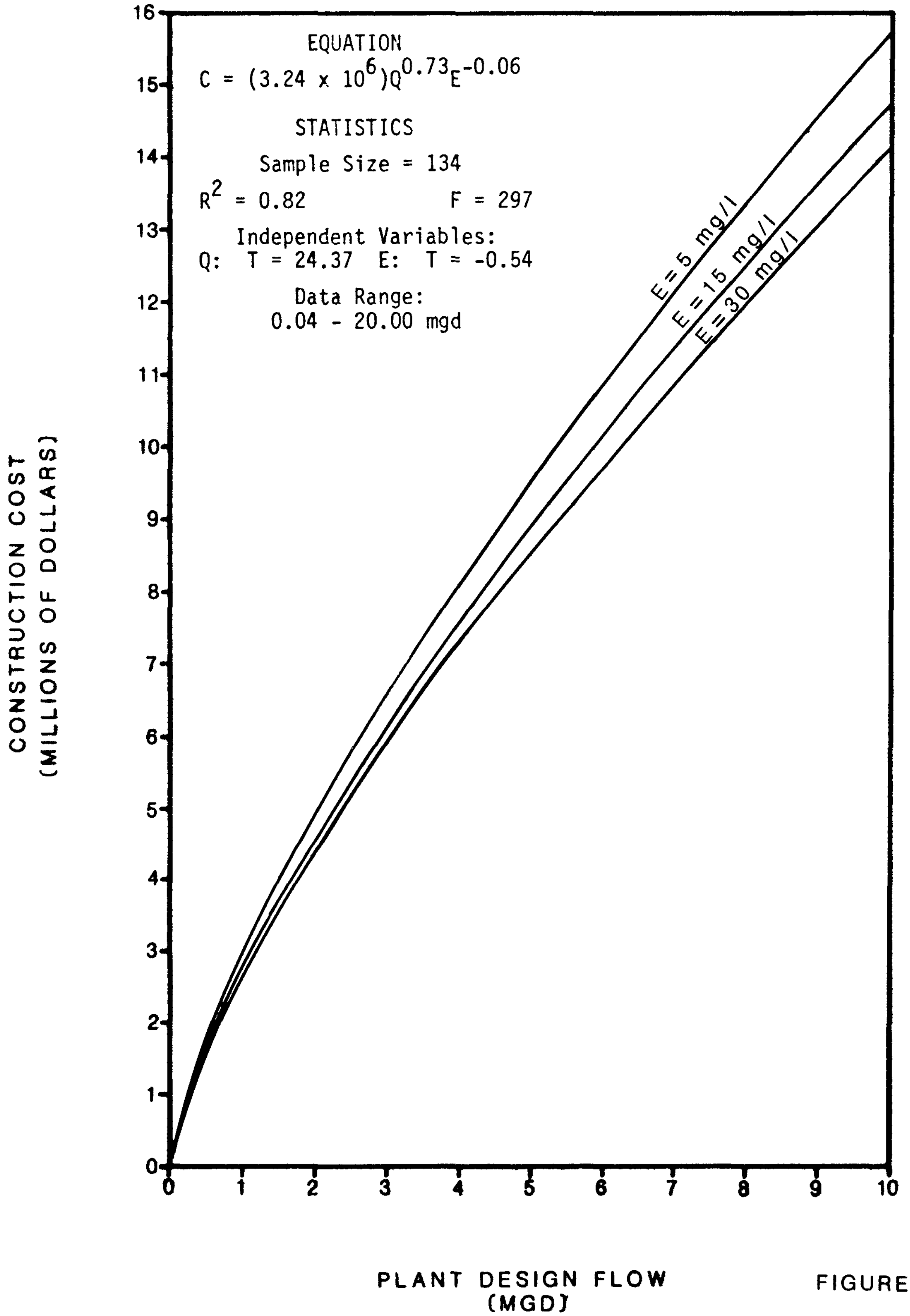


FIGURE 3.125

CONVENTIONAL ACTIVATED SLUDGE PLANTS
ALL TYPES OF SLUDGE HANDLING
BY EFFLUENT BOD5

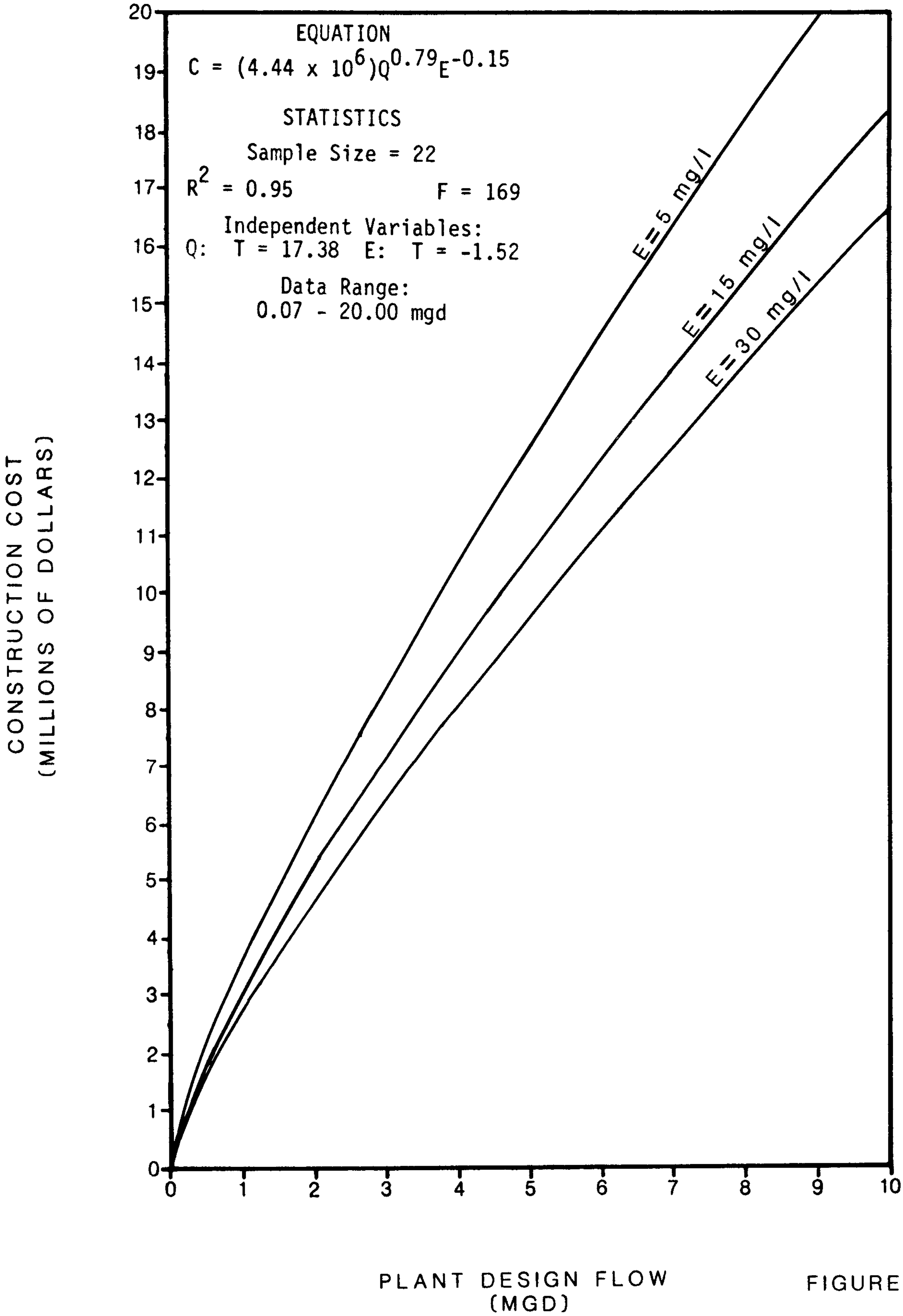


FIGURE 3.126

CONTACT STABILIZATION PLANTS
ALL TYPES OF SLUDGE HANDLING
BY EFFLUENT BOD5

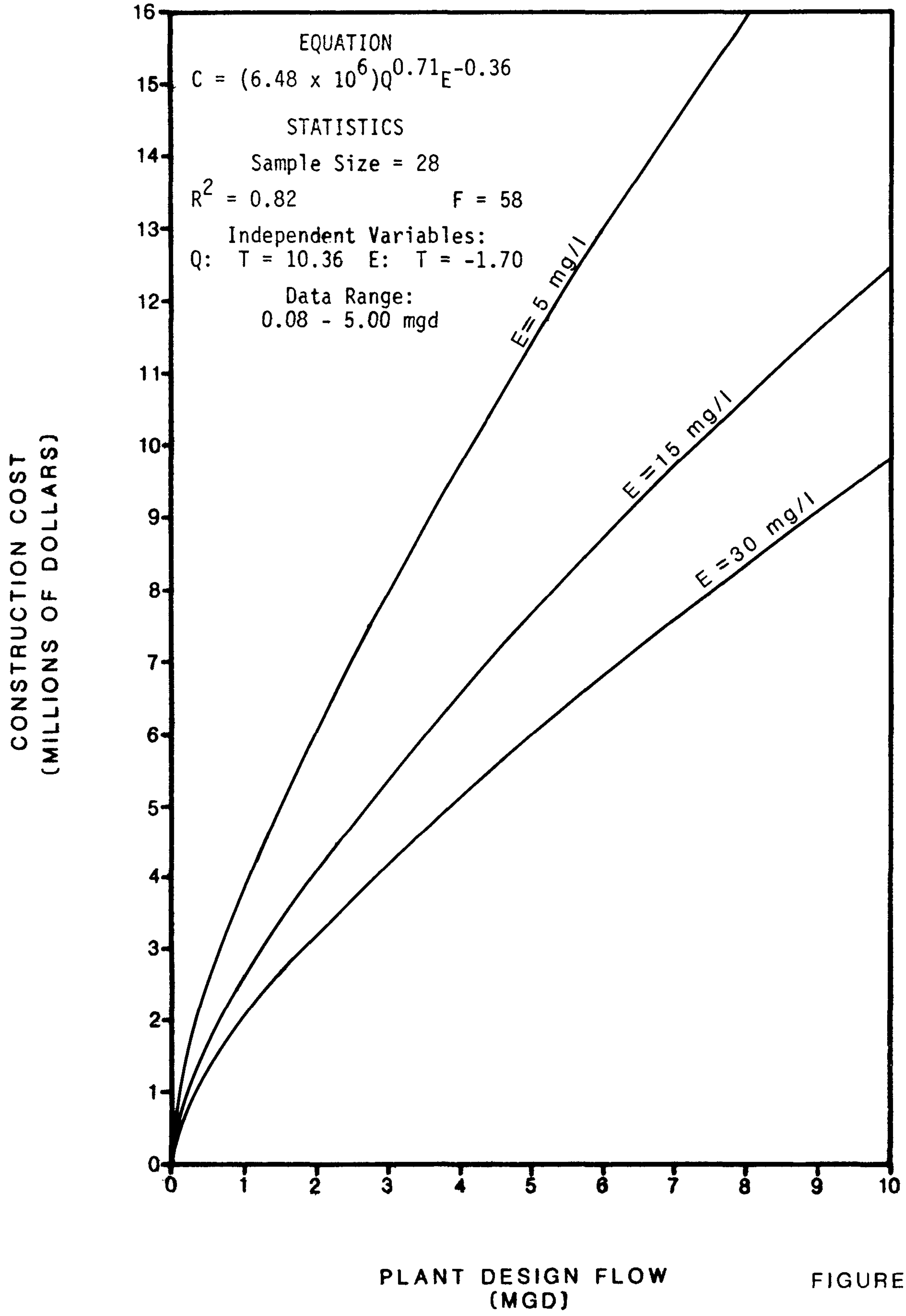


FIGURE 3.127

EXTENDED AERATION PLANTS
ALL TYPES OF SLUDGE HANDLING
BY EFFLUENT BOD5

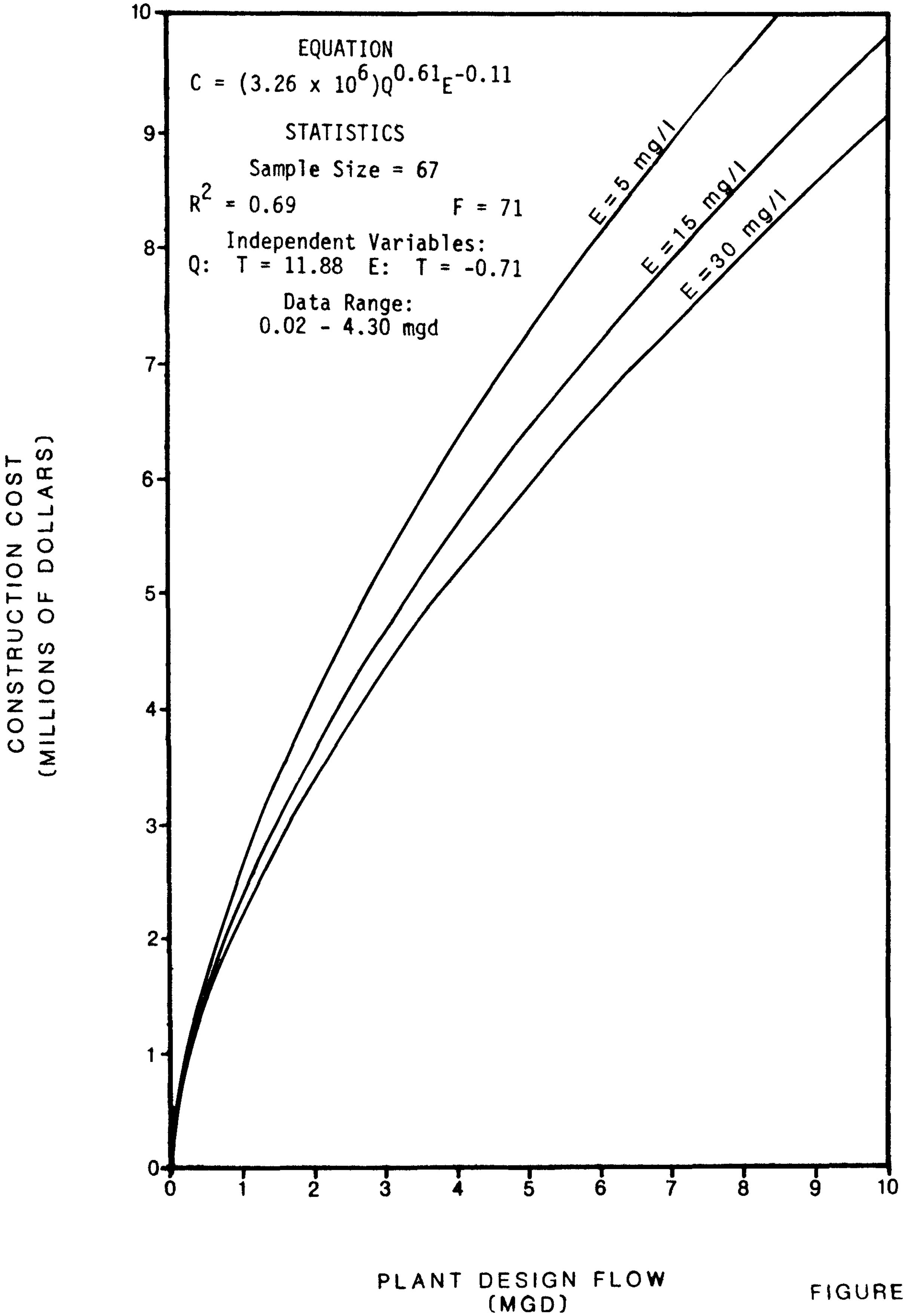


FIGURE 3.128

OXIDATION DITCH PLANTS
ALL TYPES OF SLUDGE HANDLING
BY EFFLUENT BOD5

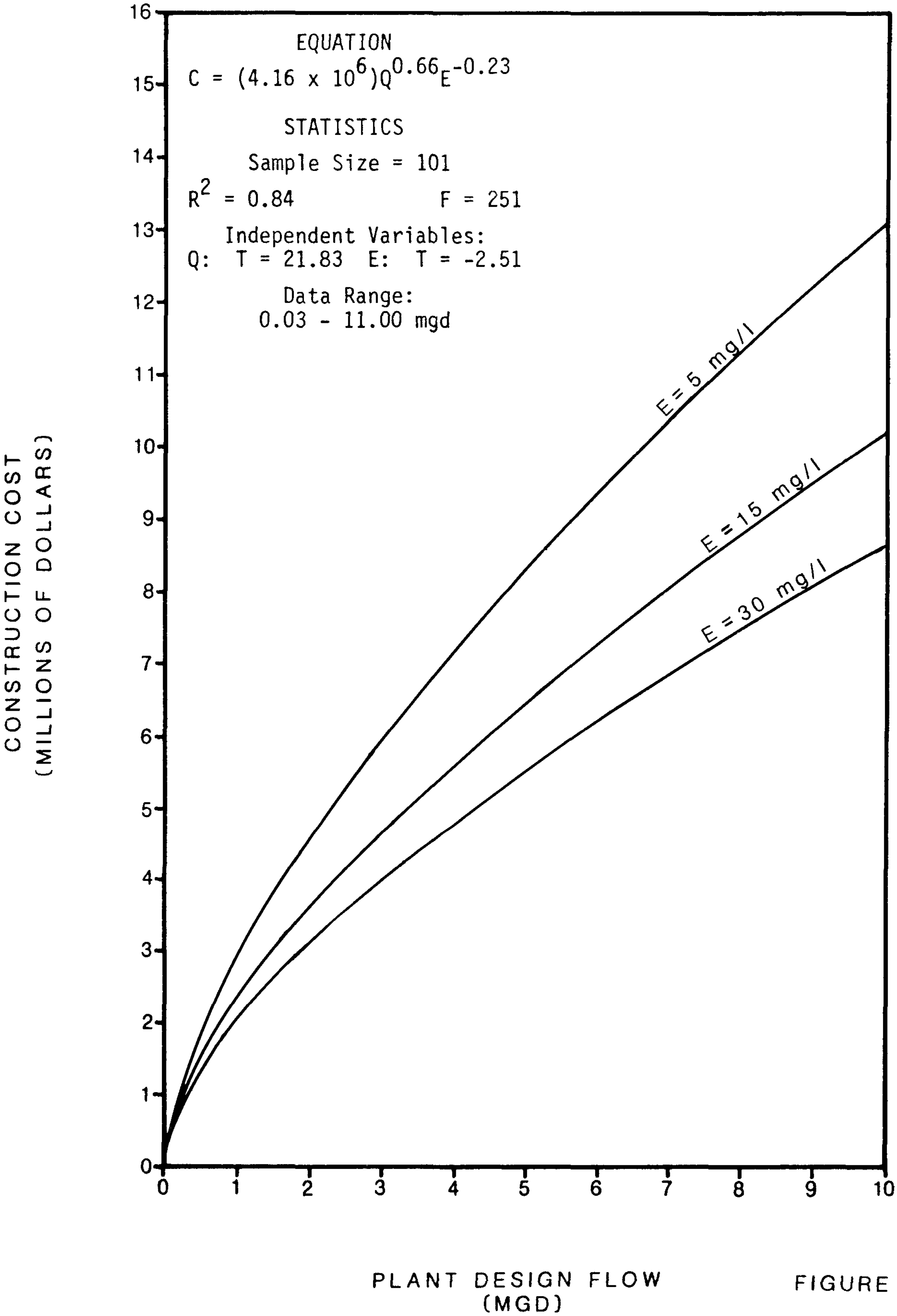


FIGURE 3.129

ROTATING BIOLOGICAL CONTACTOR PLANTS
ALL TYPES OF SLUDGE HANDLING
BY EFFLUENT BOD5

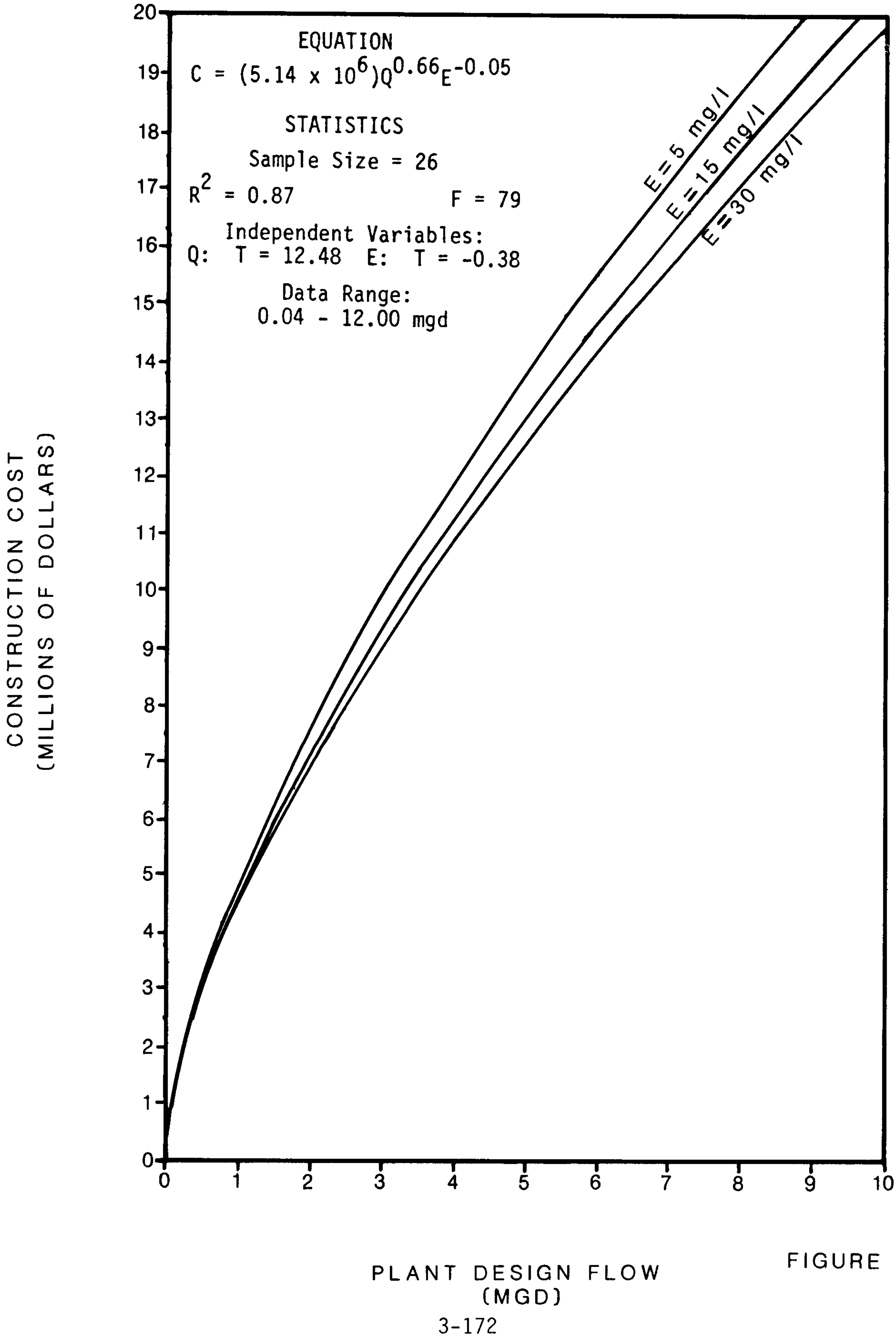


FIGURE 3.130

MECHANICAL TREATMENT PLANTS
ALL TYPES OF SLUDGE HANDLING
EFFLUENT BOD5 = 30 mg/l

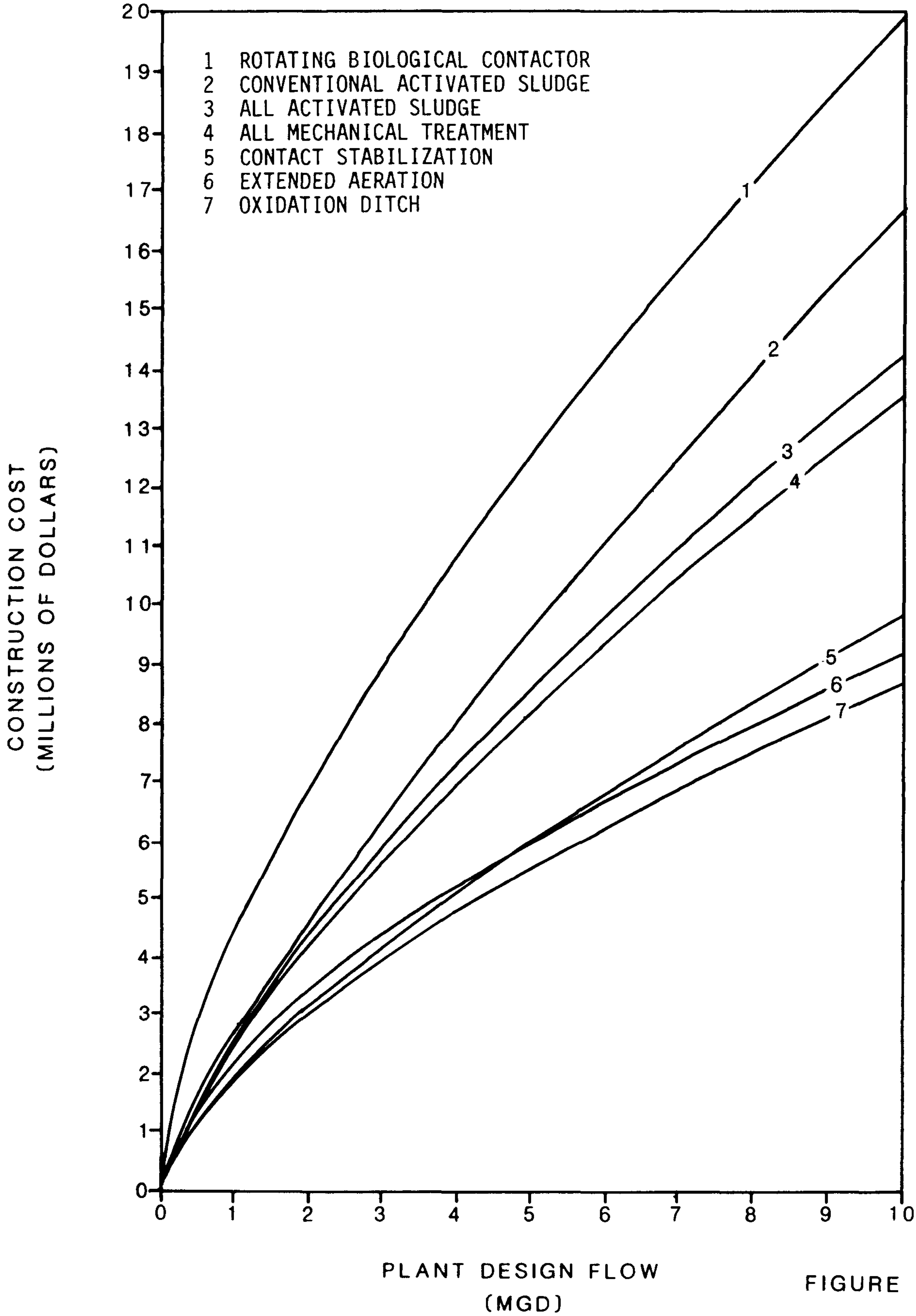


FIGURE 3.131

MECHANICAL TREATMENT PLANTS
ALL TYPES OF SLUDGE HANDLING
EFFLUENT BOD5 = 15 mg/l

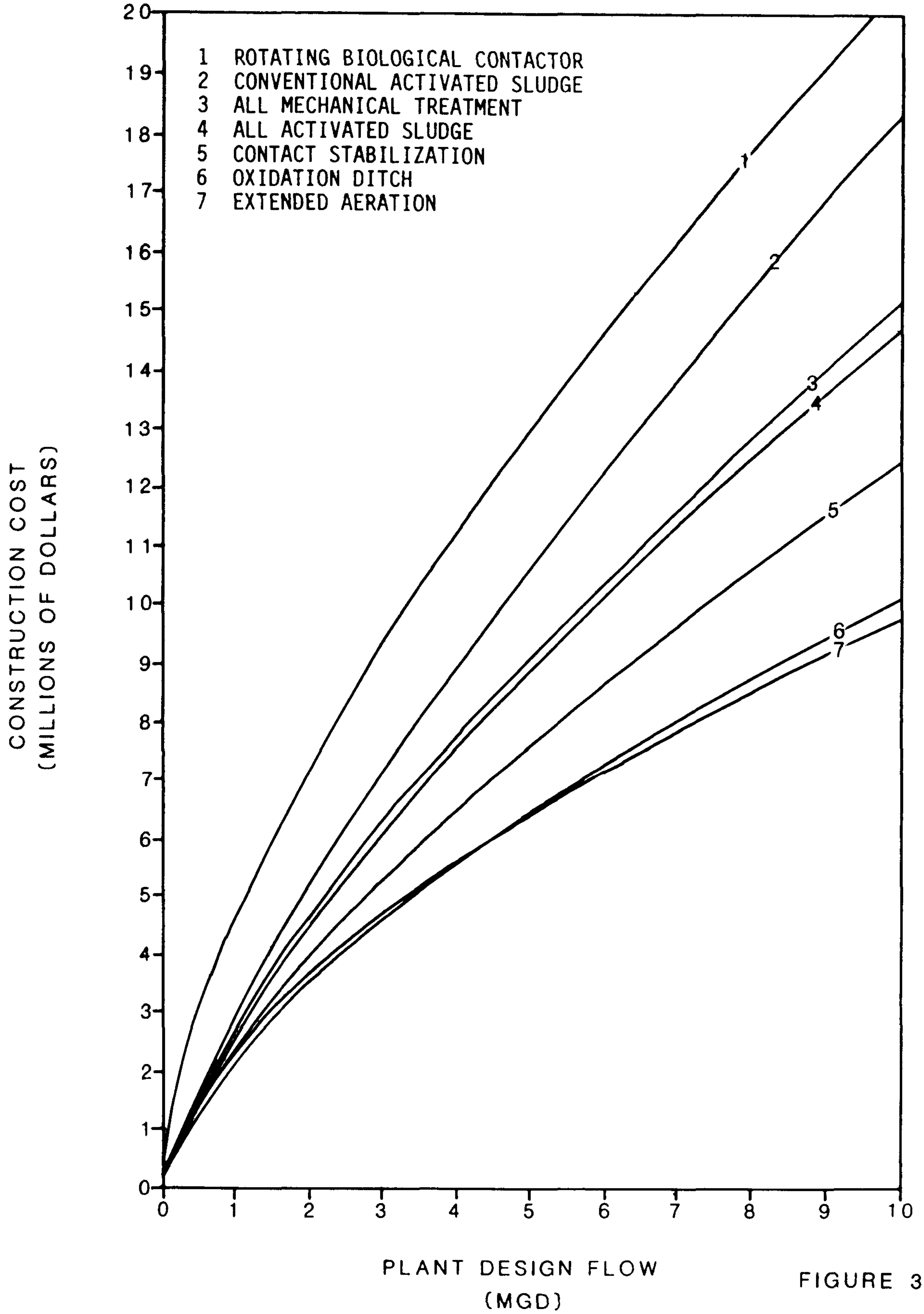


FIGURE 3.132

MECHANICAL TREATMENT PLANTS
ALL TYPES OF SLUDGE HANDLING
EFFLUENT BOD5 = 5 mg/l

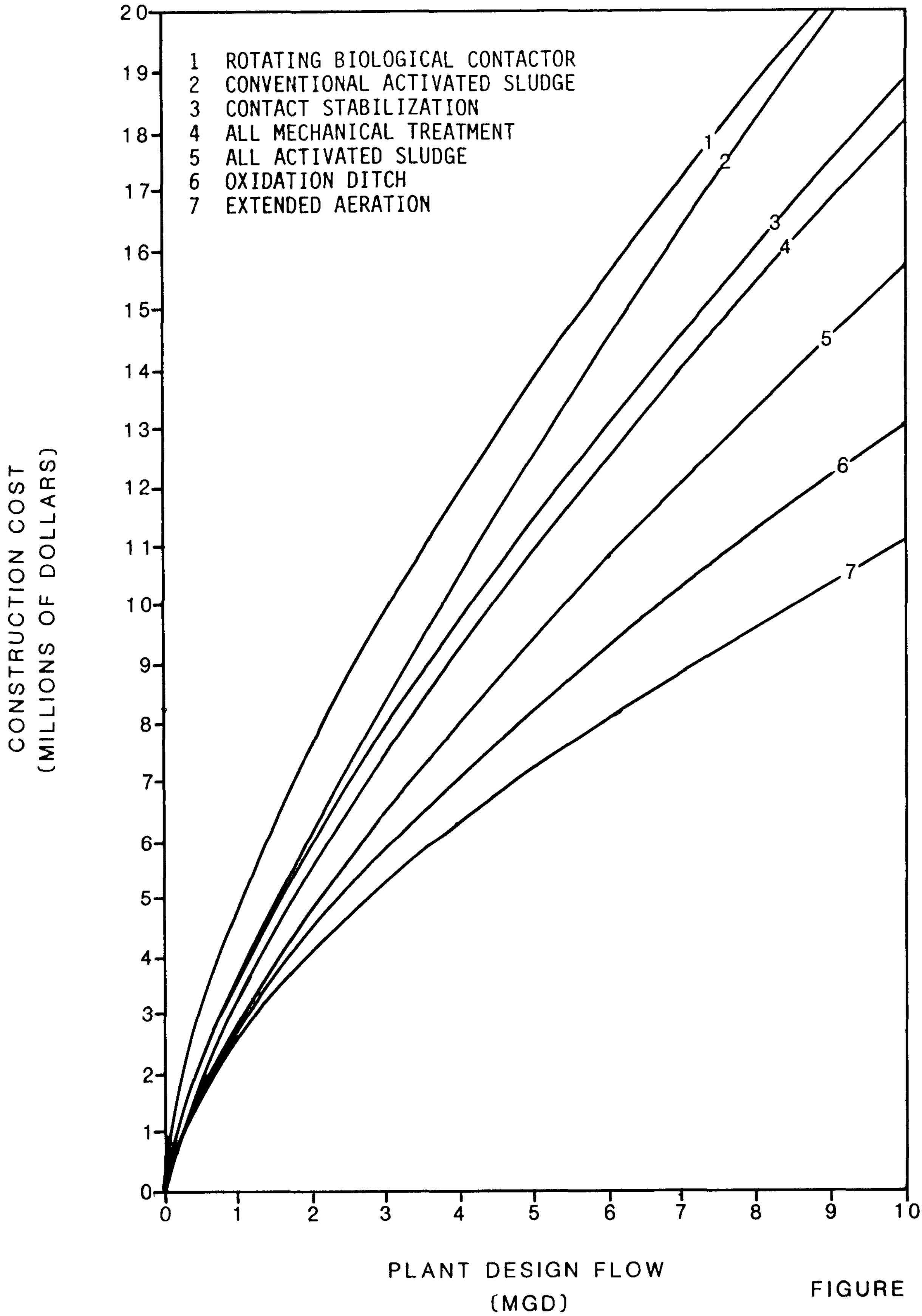


FIGURE 3.133

4.0 SIMPLIFIED TREATMENT PLANT COST ESTIMATING

The large amount of actual construction cost data obtained for this project represents a highly significant and statistically valid data base of detailed cost information. It is expected that these data may be used in various ways by government planning officials, equipment manufacturers, public works contractors, engineers, and others. One of the most obvious uses of the data is to estimate costs of proposed wastewater treatment plants or treatment plant modifications. This section describes the use of the curves presented in Section 3.0 to derive such planning level cost estimates. The techniques described are intended for the use of State and municipal officials, concerned laymen, and others who desire to know approximate capital costs of wastewater treatment facilities.

4.1 COST ESTIMATING TECHNIQUES

As described in Section 3.0, there are three levels of cost information presented. First order costs are for entirely new, complete treatment systems. Second order costs provide information on the various unit processes which comprise a treatment plant. Either of these two cost levels may be employed to obtain a planning level estimate of treatment plant construction costs. Third order costs are the unit process component costs such as concrete and mechanical equipment. These costs are not as conducive to deriving cost estimates of complete treatment plants, but may prove useful in estimating partial costs of proposed modifications to existing unit processes.

Each figure in Section 3.0 represents the best fit logarithmic equation to the actual data in the general form:

$$C = aQ^b$$

Where: C = Construction cost in dollars.

Q = Design wastewater flow in mgd.

a, b = Constants specific to each data set.

An equation in the above form is shown on each figure, including the numeric values for the constants a and b. While the equation is that of a logarithmic curve, it appears on the plots as a straight line due to the logarithmic scales of both the horizontal and vertical axes. The exponent b in the equation is the slope of the line for each plot. A value of b less than one, which is the typical case, represents an economy of scale as unit costs, or costs per mgd, decrease with the larger design flows.

To obtain a cost from any of the figures, the equation shown may be used to compute the construction cost for a given design flow of a proposed treatment plant or unit process. Alternately, the construction cost can be read directly from the graph by locating the given design flow on the horizontal axis. If the design flow is not known, a rule-of-thumb value of 100 gallons per capita per day may be used in preparing preliminary estimates.

In using first order costs, it is merely necessary to select the figure corresponding to the type of treatment plant for which a cost estimate is desired. The cost can be located from the figure as described above. In using second order costs, it will be necessary to know all unit processes in the proposed treatment plant process train to obtain a complete cost estimate, together with the appropriate second order plant component costs. Costs for individual unit processes and plant components should then be obtained from each corresponding figure and added together. Third order costs, if used, should be computed from the appropriate equation. Several examples are given in this section which help demonstrate these estimating techniques.

4.2 ADJUSTING AND UPDATING COST ESTIMATES

When the complete estimate has been obtained, it will then be necessary to adjust for regional and geographic differences in construction costs. As explained in Appendix A, all data used for the figures in Section 3.0 were normalized to reflect average costs in the Kansas City/St. Joseph, Missouri area. Costs may be adjusted to other geographical areas using the area multipliers given in Table 4.1. To adjust costs to other areas, first

TABLE 4.1

AREA MULTIPLIERS
WASTEWATER TREATMENT PLANT CONSTRUCTION

Atlanta	0.85
Baltimore	0.99
Birmingham	0.83
Boston	1.14
Charlotte	0.71
Chicago	1.19
Cincinnati	1.04
Cleveland	1.10
Dallas	0.86
Denver	0.93
Detroit	1.11
Houston	0.95
Kansas City	1.00
Los Angeles	1.16
Miami	0.85
Milwaukee	1.03
Minneapolis	0.95
New Orleans	0.99
New York	1.29
Philadelphia	1.13
Pittsburgh	1.07
St. Louis	1.16
San Francisco	1.23
Seattle	1.16
Trenton	1.05

select the city in Table 4.1 which is nearest the treatment plant location, or where the area of influence of the city encompasses the treatment plant location, and multiply the cost estimate by the corresponding area multiplier for that city.

The resulting geographically adjusted cost estimate will be in third quarter 1982 dollars. To update the cost estimate to current dollars, the EPA Large City Advanced Treatment (LCAT) Index or the Small City Conventional Treatment (SCCT) Index can be used as discussed in Appendix A. Costs may be updated by the following procedure:

$$\text{Total Geographically Adjusted Project Cost} \times \frac{\text{Latest LCAT or SCCT Index for Desired Area}}{\text{3rd Quarter 1982 LCAT or SCCT Index for Desired Area}} = \text{Updated Cost}$$

The LCAT and SCCT Indexes are now published semi-annually by EPA. Costs for plants at or above 15 mgd design flow should be updated using the LCAT Index, while costs for plants below 15 mgd should be updated using the SCCT Index.

Several examples using the cost curves of Section 3.0 to obtain planning level cost estimates are presented below. For each cost item, the appropriate figure to be used from Section 3.0 is provided for reference.

4.3 COST ESTIMATING EXAMPLES

4.3.1 Example No. 1

Assume it is desired to estimate the cost of a new 10.0 mgd secondary treatment plant in the Boston, Massachusetts area. For this example, the total construction cost of the facility is obtained from Figure 3.8. The appropriate nonconstruction costs from Table 3.1 are then added. For purposes of these examples, the seven most common nonconstruction costs will be used (planning, design, administration/legal, A/E basic fees, other A/E fees, inspection, and contingencies) which together average 32 percent of the construction cost nationally. The reader should use appropriate discretion concerning other categories of nonconstruction costs to be included. Any other known costs, such as land, would be added to the final geographically adjusted and updated cost estimate. Although the national average nonconstruction costs are used in these examples, the individual nonconstruction cost item percentages from Table 3.1 could be used for the specific EPA Region in which the project is being built.

The costs for the example given are itemized in Table 4.2.

TABLE 4.2

10 MGD NEW SECONDARY TREATMENT PLANT
BOSTON, MASSACHUSETTS

Total Construction Cost (Figure 3.8)	$13,000,000
Common Nonconstruction Costs (32 percent)	4,200,000
TOTAL PROJECT COST	$17,200,000
Area Multiplier for Boston, MA	x 1.14
TOTAL GEOGRAPHICALLY ADJUSTED PROJECT COST (3rd Quarter 1982 Dollars)	$19,600,000

It should be noted that slight differences in the total adjusted project cost will be produced if total construction cost is geographically adjusted prior to multiplying by 32 percent to obtain the nonconstruction costs. Either technique is valid, however, and each produces a result within the order of accuracy intended for this cost estimating procedure.

4.3.2 Example No. 2

Using similar procedures as described in Example 1, the second order cost curves can be used to estimate the construction of a new 10.0 mgd advanced secondary treatment plant near Dallas, Texas. Assuming an activated sludge treatment plant with phosphorus removal, the facility could have the unit processes shown in Table 4.3. For each, the total construction cost should be obtained from the appropriate figures in Section 3.0, together with the appropriate plant component costs. Finally, the nonconstruction costs, using the factors from Table 3.1, should be added. The costs for this example are listed in Table 4.3.

TABLE 4.3

10 MGD NEW AST TREATMENT PLANT
DALLAS, TEXAS

Comminutors (Figure 3.74)	$ 60,000
Grit Removal (Figure 3.73)	110,000
Primary Sedimentation (Figure 3.77)	770,000
Conventional Activated Sludge (Figure 3.79)	3,400,000
Chemical Additions (Figure 3.92)	490,000
Effluent Chlorination (Figure 3.93)	320,000
Gravity Thickening (Figure 3.102)	420,000
Anaerobic Digestion (Figure 3.99)	1,900,000
Drying Beds (3.100)	470,000
Control/Lab/Maintenance Building (Figure 3.104)	690,000
TOTAL UNIT PROCESS COSTS	$ 8,630,000
Mobilization (Figure 3.107)	$ 390,000
Sitework (Figure 3.109)	580,000
Excavation (Figure 3.110)	750,000
Electrical (Figure 3.112)	1,200,000
Controls and Instrumentation (Figure 3.113)	730,000
Yard Piping (Figure 3.115)	850,000
Heating, Ventilating, & Air Conditioning (Figure 3.120)	550,000
TOTAL PLANT COMPONENT COSTS	$ 5,050,000
TOTAL CONSTRUCTION COST	$13,680,000
Common Nonconstruction Costs (32 percent)	4,400,000
Land Purchase/Plant Site (assumed for example purposes)	100,000
TOTAL PROJECT COST	$18,180,000
Area Multiplier for Dallas, TX	x 0.86
TOTAL GEOGRAPHICALLY ADJUSTED PROJECT COST (3rd Quarter 1982 Dollars)	$15,600,000

4.3.3 Example No. 3

The third order cost relationships may also prove useful for some cost estimating applications. Consider for example the upgrading of a 10.0 mgd primary treatment plant to secondary near Los Angeles, California, where it is desired to replace the mechanical equipment in existing primary clarifiers. Using the third order process cost equation for primary sedimentation equipment, the cost estimate would be derived by solving the equation for 10.0 mgd to obtain the construction cost for primary sedimentation equipment. To this amount would be added the costs for the other unit processes using the second order cost curves in the same manner as described in the previous example. The resulting cost estimate is shown on Table 4.4.

TABLE 4.4

10 MGD PRIMARY TO SECONDARY TREATMENT PLANT UPGRADE
LOS ANGELES, CALIFORNIA

Primary Sedimentation Equipment (Table 3.9)	$ 240,000
Conventional Activated Sludge (Figure 3.79)	$ 3,400,000
Effluent Chlorination (Figure 3.93)	320,000
Ocean Outfall (Figure 3.106)	5,800,000
Gravity Thickening (Figure 3.102)	420,000
Aerobic Digestion (Figure 3.98)	1,800,000
TOTAL UNIT PROCESS COSTS	$11,980,000
Mobilization (Figure 3.107)	$ 390,000
Sitework (Figure 3.109)	580,000
Excavation (Figure 3.110)	750,000
Electrical (Figure 3.112)	1,200,000
Controls and Instrumentation (Figure 3.113)	730,000
Yard Piping (Figure 3.115)	850,000
Heating, Ventilating, & Air Conditioning (Figure 3.120)	550,000
TOTAL PLANT COMPONENT COSTS	$ 5,050,000
TOTAL CONSTRUCTION COST	$17,030,000

Common Nonconstruction Costs (32 percent)	5,450,000
TOTAL PROJECT COST	$22,480,000
Area Multiplier for Los Angeles, CA	$ x 1.16
TOTAL GEOGRAPHICALLY ADJUSTED PROJECT COST (3rd Quarter 1982 Dollars)	$26,100,000

4.4 SUMMARY

Although the efficiency curves presented as the result of the multivariate analyses in Section 3.5 are comparable with first order costs, it is recommended for consistency that the first order cost curves themselves be used for preliminary cost estimating. The efficiency curves may prove useful, however, in making generalized comparisons between the construction cost of various treatment plant types for a given level of treatment.

It should be noted that in addition to the precautions discussed previously in using these curves, some divergence in costs between the three levels of estimating will be apparent even for identical applications. However, tempered with engineering judgment, the data presented in this report should be useful in planning and comparing various proposed treatment alternatives. Since the resultant estimates are considered to be of planning level accuracy only, it should be recognized that actual construction costs of a specific treatment plant could vary from these estimates, either plus or minus, by a wide margin.

APPENDIX A

COST UPDATING AND NORMALIZATION TECHNIQUES

The data base used in this report includes costs from construction projects within the 48 contiguous States of the U.S. They range in time from 1973 through 1982. In order to achieve a meaningful analysis of the data, it was necessary to index all dollar values to a specific time and location.

To accomplish this, the EPA Large City Advanced Treatment (LCAT) Index and Small City Conventional Treatment (SCCT) Index were used. These indexes have been calculated quarterly by EPA since third quarter 1973 for a total of 50 U.S. cities. The LCAT Index is based on a hypothetical 50.0 mgd advanced wastewater treatment facility with a base city of Kansas City, Missouri. The SCCT Index is based on a hypothetical 5.0 mgd activated sludge secondary treatment facility with a base city of St. Joseph, Missouri. The base value for both indexes is 100 for third quarter 1973.

AREAS OF INFLUENCE

EPA publishes the LCAT and SCCT Indexes as indicators of cost trends over time and for comparative purposes by relating one city to another. The areas of cost influence for each of the 50 indexed cities are not defined. Therefore, prior to using the indexes, the area of influence for each index city was assessed and mapped. Two sources of information were employed in this effort: Bureau of Labor Statistics (BLS) labor rate history for 102 U.S. cities and the Bureau of Economic Analysis (BEA) map of U.S. economic areas.

The BLS data consists of union labor rates for various skills, recorded quarterly for 102 U.S. cities. In order to apply this information, a weighted average of four construction crafts - carpenter, electrician, laborer, and plumber - were calculated for 22 calendar quarters from third quarter 1973 to third quarter 1978. Data from each city were then statistically correlated with the 101 other BLS cities. Since the EPA SCCT and LCAT Index cities were included in the list of BLS cities, this process defined the area of economic influence for each of the EPA Index cities.

The BEA map of economic areas was used to define the boundaries of economic influence surrounding the EPA Index cities. A BEA economic area is composed of a central city and the surrounding counties that are economically related to the central city as determined by BEA. Each of these areas includes both the place of work and place of residence of the labor force. The resulting maps for the LCAT and SCCT Index city areas of influence are presented in Figures A.1 and A.2.

LCAT - SCCT CLASSIFICATION

In order to utilize the above mentioned maps, all projects in the data base were classified as either LCAT or SCCT Index related. The following criteria were used for that classification:

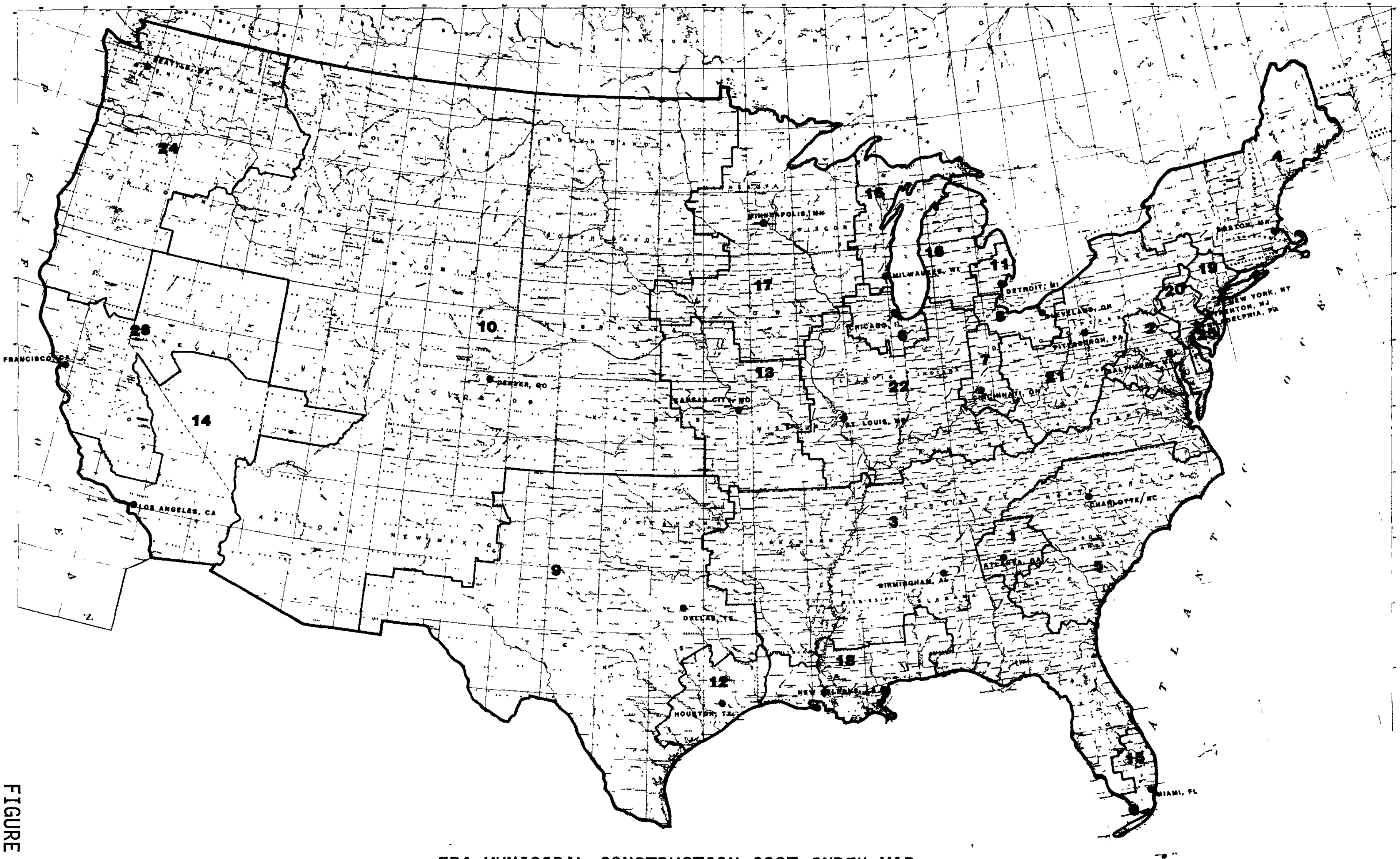
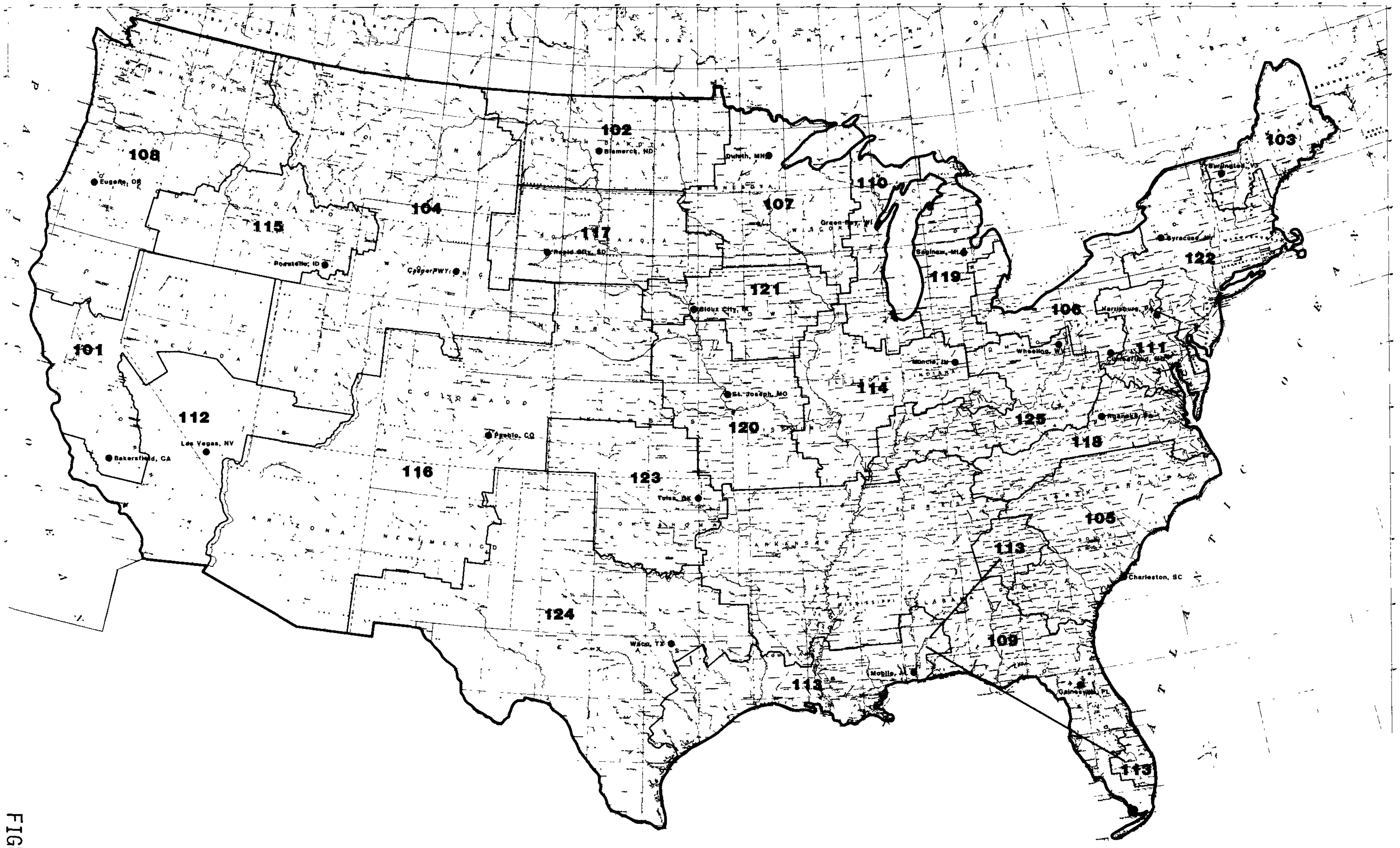


FIGURE A.1

EPA MUNICIPAL CONSTRUCTION COST INDEX MAP
FOR LARGE CITY ADVANCED TREATMENT (LCAT) PLANT INDEXES



EPA MUNICIPAL CONSTRUCTION COST INDEX MAP
FOR SMALL CITY CONVENTIONAL TREATMENT (SCCT) PLANT INDEXES

FIGURE A.2

1. A mechanical treatment plant project with a projected design flow less than 15.0 mgd was related to the SCCT Index.

2. A treatment plant project with a projected design flow of 15.0 mgd or greater was related to the LCAT Index.

3. A lagoon project was related to the SCCT Index.

COST UPDATING

After a project was related to either the LCAT or SCCT Index, Figure A.1 or A.2 were utilized to relate the project to a specific LCAT or SCCT Index city. Using the indexes contained in Tables A.1 and A.2, the costs were then normalized to third quarter 1982 at Kansas City/St. Joseph, Missouri according to the following procedure:

$$\text{Cost of Construction at (Place x)(Time t)} \times \frac{\text{Kansas City/St. Joseph, MO 3rd Quarter 1982 Index}}{\text{(Place x, Time t) Index}} =$$

Cost of Construction at Kansas City/St. Joseph, MO 3rd Quarter 1982

Thus, the data base was normalized to the base cities for the indexes. The effects on the analyses of a large or small quantity of data from different areas of the U.S., or from a particular time period, were thus minimized. Cost relationships resulting from an analysis of the data are, indeed, national averages in this report.

TABLE A.1

EPA LARGE CITY ADVANCED TREATMENT (LCAT) INDEXES

	City	1981 3rd Qtr.	1981 4th Qtr.	1982 1st Qtr.	1982 2nd Qtr.	1982 3rd Qtr.	1982 4th* Qtr.	1983 1st Qtr.
1	Atlanta, GA	162	163	166	166	172	175	178
2	Baltimore, MD	189	190	192	193	198	201	204
3	Birmingham, AL	158	158	160	160	161	163	165
4	Boston, MA	214	222	223	225	232	239	247
5	Charlotte, NC	134	135	138	138	138	138	139
6	Chicago, IL	229	230	233	229	236	241	246
7	Cincinnati, OH	199	200	201	201	206	208	209
8	Cleveland, OH	210	211	214	214	221	224	227
9	Dallas, TX	162	163	166	167	174	179	183
10	Denver, CO	177	178	180	187	190	192	193
11	Detroit, MI	213	214	216	215	218	219	221
12	Houston, TX	181	183	185	184	186	190	195
13	Kansas City, MO	190	190	192	198	202	204	204
14	Los Angeles, CA	221	222	227	228	236	239	242
15	Miami, FL	161	162	165	164	165	169	173
16	Milwaukee, WI	198	199	203	201	200	203	207
17	Minneapolis, MN	180	181	185	185	190	196	203
18	New Orleans, LA	191	192	193	193	194	198	203
19	New York, NY	245	246	255	255	265	272	279
20	Philadelphia, PA	214	216	221	224	231	233	235
21	Pittsburgh, PA	205	206	206	206	215	215	216
22	St. Louis, MO	222	223	225	226	232	240	248
23	San Francisco, CA	235	239	242	242	243	248	253
24	Seattle, WA	225	225	227	227	232	234	236
25	Trenton, NJ	201	203	206	206	210	215	221
NATIONAL AVERAGE		197	198	201	201	206	209	213

* 4th Qtr. 1982 indexes were extrapolated because this quarter was never published.

TABLE A.2

EPA SMALL CITY CONVENTIONAL TREATMENT (SCCT) INDEXES

	City	1981 3rd Qtr.	1981 4th Qtr.	1982 1st Qtr.	1982 2nd Qtr.	1982 3rd Qtr.	1982 4th* Qtr.	1983 1st Qtr.
101	Bakersfield, CA	213	212	220	226	233	237	241
102	Bismarck, ND	169	171	174	175	177	178	178
103	Burlington, VT	167	169	171	171	172	176	183
104	Casper, WY	172	173	180	183	184	185	187
105	Charleston, SC	128	129	132	132	132	132	133
106	Cumberland, MD	204	208	209	209	210	213	217
107	Duluth, MN	173	174	178	178	184	190	197
108	Eugene, OR	204	206	213	220	222	227	233
109	Gainesville, FL	157	156	160	159	160	162	164
110	Green Bay, WI	191	192	197	193	194	200	205
111	Harrisburg, PA	187	188	190	194	194	198	202
112	Las Vegas, NV	212	213	217	216	220	226	232
113	Mobile, AL	179	179	180	181	187	190	193
114	Muncie, IN	182	183	184	184	184	189	194
115	Pocatello, ID	180	181	181	181	185	187	189
116	Pueblo, CO	164	167	171	175	181	184	187
117	Rapid City, SD	155	155	159	164	162	163	163
118	Roanoke, VA	167	169	171	172	169	173	177
119	Saginaw, MI	185	193	196	194	194	195	197
120	St. Joseph, MO	183	183	185	186	191	196	201
121	Sioux City, IA	181	182	185	185	188	190	193
122	Syracuse, NY	208	210	212	212	217	222	226
123	Tulsa, OK	159	157	161	164	168	170	173
124	Waco, TX	151	151	154	153	154	155	157
125	Wheeling, WV	199	198	199	199	199	205	212
NATIONAL AVERAGE		179	180	183	184	186	189	193

* 4th Qtr. 1982 indexes were extrapolated because this quarter was never published.

APPENDIX B

DESCRIPTION OF THE DATA BASE

Data included in this study were collected from 1,585 Federally funded wastewater treatment plant projects in all ten EPA Regions. The 48 contiguous States are represented.

Table B.1 lists the grant number, facility name, State, projected design flow, projected treatment level, and planned change for each of the facilities included. The treatment levels are defined as follows:

	Code	Level of Treatment
First Digit	2	Advanced Primary Treatment
	3	Secondary Treatment
	4	Advanced Secondary Treatment
	5	Advanced Wastewater Treatment
Second Digit	0	No Nutrient Removal Processes
	1	Ammonia Removal
	2	Total Nitrogen Removal
	3	Phosphorus Removal
	4	Both Ammonia Removal and Phosphorus Removal
	5	Both Total Nitrogen and Phosphorus Removal

The change code refers to the type of change specified for the treatment facility. The codes are defined as follows:

Code	Type of Change
1	Enlargement of Treatment Capacity
2	Upgrading Level of Treatment
3	Enlargement and Upgrade
4	New Construction
5	Replacement
8	Other Modifications

TABLE B.1
WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

STATE ALABAMA

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
010246	MARION STP	0.50	30	3
010250	DOUBLE BRANCH STP	1.00	40	4
010254	RUSSELLVILLE STP	1.13	40	4
010255	WASTEWATER T.P. NO. 2	2.00	30	4
010256	NEW HOPE	0.25	30	4
010261	ABBEVILLE S LAGOON	0.50	30	3
010272	ROBERTSDALE STP	0.55	30	4
010277	FLORA, LOCKHART JOINT WTP	0.35	30	4
010289	WALNUT CREEK WWTP	3.00	40	4
010296	TOWN CREEK SEWER SYSTEM	0.15	30	4
010303	EUTAW WTP	0.56	30	4
010311	BRUNDIDGE STP	0.50	30	2
010313	GROVE HILL STP	0.30	30	4
010318	DEMOPOLIS STP	1.30	30	4
010320	YORK STP	0.60	30	3
010327	WIND CREEK PARK STP	0.14	30	4

STATE ARIZONA

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
040125	SUPERIOR WWTP	0.75	40	4
040134	RANDOLPH PARK STP	1.50	40	4
040138	IRON SPRINGS WWTP #1	0.73	30	4
040136	IRON SPRINGS WWTP #2	0.10	30	4
040140	LAKE HAVASU STP	0.20	30	1
040141	CASA GRANDE STP	3.00	30	3
040142	PRESCOTT WWTP	0.75	30	4
040143	PRESCOTT AIRPORT WWTP	3.50	30	1
040150	CLARKDALE	0.35	30	3
040151	INA ROAD STP	25.00	30	4
040155	NAVAJO TRIBAL AUTH STP	0.30	30	3
040175	WINSLOW	1.55	30	1
040183	JOSEPH CITY STP	0.33	30	4
040189	WINKELMAN STP	0.12	40	1
040214	SOMERTON STP	0.60	30	3
040215	SIERRA VISTA WWTP	2.90	30	3
040220	COLORADO CITY/HILDALE STP	0.30	40	4
040222	YUMA WWTP	12.10	30	1

STATE ARKANSAS

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
050305	HOT SPRINGS REGIONAL WWTP	12.00	50	4

TABLE B.1 (CONTINUED)
WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

STATE ARKANSAS

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
050332	BATESVILLE STP	4.50	40	3
050339	SPRINGDALE WWTP	16.00	30	1
050346	PARAGOULD WWTP	2.20	30	1
050347	BOIS D'ARC STP	1.20	40	4
050347	PATE CREEK STP	0.00	40	4
050350	GREENBRIER WWTP	0.12	50	4
050354	CAMDEN STP	3.49	50	4
050367	WEST SIDE WWTMT WORKS	3.00	40	3
050369	CONWAY STP	6.00	40	4
050375	FORDYCE STP	1.00	50	3
050379	CARTHAGE STP	0.09	40	4
050380	MADISON STP	0.30	30	4
050381	FAULKNER LAKE SEWAGE STP	12.00	40	4
050381	WHITE OAK BAYOU STP	1.57	30	4
050383	RUSSELLVILLE STP	6.50	53	3
050384	WYNNE STP	1.60	30	4
050389	SULPHUR SPRINGS STP	0.10	50	4
050390	PARIS STP	0.72	40	4
050393	BRYANT STP	1.00	40	5
050395	BULL SHOALS STP	0.57	40	4
050396	MAGAZINE STP	0.14	50	4
050397	HATFIELD STP	0.07	30	4
050399	HUNTINGTON STP	0.11	30	4
050400	CALION STP	0.12	50	4
050403	TAYLOR STP	0.12	53	4
050405	KEO STP	0.05	30	4
050407	PERRY STP	0.02	30	4
050408	ULM STP	0.04	40	4
050412	DARDANELLE STP	0.52	30	2
050413	STAMPS STP	0.30	50	3
050415	MONETTE STP	0.11	40	5

STATE CALIFORNIA

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
060669	TERMINAL ISLAND STP	30.00	30	3
060696	CENTRAL CONTRA COSTA STP	30.00	54	3
060731	AVALON STP	1.00	30	4
060763	KERMAN WWTP	0.41	30	3
060767	MAIN WQCF	67.00	53	3
060771	PALM DESERT WRP	2.10	30	1
060772	SCOTTS VALLEY STP	0.40	30	1
060775	VISALIA WCP	8.30	30	1
060778	ANGELS CAMP STP	0.32	30	3
060779	ORANGE CO. WWRP #1	46.00	30	1
060786	BOLINAS STP	0.07	30	3

TABLE B.1 (CONTINUED)
WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

STATE CALIFORNIA

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
060787	LIVERMORE	6.00	54	3
060790	LAGUNA WWTP	15.00	30	3
060796	ROSEVILLE WWTF	5.75	40	3
060797	SANTA BARBARA STP	11.00	30	3
060798	ALTURAS STP	0.50	40	2
060800	BASS LAKE STP	0.50	30	4
060801	CALEXICO STP	2.20	30	1
060804	CENTRAL CONTRA COSTA STP	30.00	40	2
060810	FAIRFIELD-SUISON WWTF	10.35	50	4
060813	INYO CA WWTF	0.85	30	4
060816	NORTHWEST CLEAR LAKE REG.	2.45	30	4
060818	LOMPOC REGIONAL WWTF	5.00	40	3
060823	MT. SHASTA WPCF	0.70	30	4
060833	SOLVANG STP	0.54	30	3
060834	SONOMA STP	3.00	40	3
060835	TULARE TREATMENT PLANT	4.50	30	1
060837	VALLEJO STP	13.00	30	3
060840	SOUTH WWTF	7.00	30	3
060849	BAKERSFIELD STP NO.2	21.50	20	3
060854	CALPELLA STP	0.22	30	3
060868	ALVARADO STP	19.70	30	5
060875	FORT BRAGG STP	1.00	30	2
060880	HOLLISTER STP	1.73	40	5
060882	IMPERIAL STP	0.70	30	3
060884	IONE STP	0.45	30	5
060886	JULIAN STP	0.02	30	4
060894	LINDSAY STP	1.32	20	3
060897	TERMINAL ISLAND	30.00	30	8
060909	LOS BANOS STP	2.00	20	3
060911	MCFARLAND STP	1.00	30	3
060913	MODESTO STP	45.00	30	2
060915	NAPA VALLEY STP	15.00	50	3
060925	PACIFICA WPCF	4.30	30	2
060929	PLANADA STP	0.92	40	3
060932	REDWAY WTF	0.20	30	9
060936	SACRAMENTO REGIONAL WWTF	135	54	3
060947	SAN JOSE/SANTA CLARA WPCF	143	51	2
060950	SAN MATEO SUBREGIONAL STP	13.50	50	3
060956	SHASTA DAM AREA STP	0.50	30	4
060964	TRACY WWTF	5.50	30	2
060966	TUOLUMNE STP	0.20	30	2
060967	SONORA STP	2.60	30	3
060974	WASCO STP	1.20	30	3
060976	RIVERSIDE AWWT	30.00	53	4
060979	YOUNTVILLE JOINT STP	0.35	30	3
060980	YUCAIPA STP	3.00	31	4
060984	ATWATER STP	5.00	30	3
060986	BENICIA STP	4.00	30	3
060990	BIG BEAR STP	3.55	30	4

TABLE B.1 (CONTINUED)
WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

STATE CALIFORNIA

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
060991	BLYTHE STP	1.50	30	4
060993	BRAWLEY STP	2.40	30	3
061001	CLOVERDALE STP	0.56	30	5
061002	INDUSTRIAL SHORE WPCF	9.50	30	4
061004	BETHEL ISLAND INTERIM STP	0.29	40	1
061006	COVELO COMMUNITY STP	0.12	30	2
061007	DELANO STP	3.60	40	4
061014	MOTHER LODE WASTE WATERTP	0.68	50	3
061017	FILLMORE STP	1.33	30	1
061019	GILROY WWTF	6.10	20	5
061023	HANFORD STP	3.00	30	3
061024	HEBER STP	0.50	30	5
061041	TRANCAS CANYON STP	0.07	50	5
061048	JOINT WPCP	100	30	2
061063	MODESTO STP	25.00	30	2
061064	MONTAGUE STP	0.24	30	4
061070	NORTH MARIN CNTY WATER DT	0.04	40	4
061076	PALO ALTO STP	30.60	51	2
061079	AUBURN STP	0.70	43	2
061086	REDDING REGIONAL WWTP	8.90	51	4
061118	SOUTH SAN LUIS OBISPO STP	2.50	33	2
061121	TAHOE-TRUCKEE STP	4.83	53	4
061124	EASTERLY VACAVILLE STP	6.50	30	1
061125	DUBLIN - SAN RAMON WWTF	8.00	52	3
061130	EAST YOLO STP	5.00	40	2
061132	WINTERS STP	0.97	30	4
061139	MERCED STP	10.00	30	2
061145	LIVE OAK STP	0.37	40	3
061156	HAPPY CAMP LAGOONS	0.15	30	4
061172	TURLOCK STP	15.00	30	2
061173	BIGGS STP	0.33	40	3
061176	DAVIS STP	4.75	30	8
061177	EL DORADO HILLS WW RECFAC	0.75	30	1
061178	MOCCASIN STP	0.03	30	4
061183	WOODLAND STP	4.60	30	3
061186	LOCKEFORD STP	0.22	20	4
061190	NEWMAN STP	1.14	40	3
061195	RIO DELL STP	0.36	40	2
061200	TAFT STP	1.20	20	2
061206	SUSANVILLE CORR CEN STP	0.30	40	3
061213	RED BLUFF STP	1.90	50	2
061216	CALIF. MENS COLONY STP	2.00	54	2
061218	SIMI VALLEY STP	9.10	50	3
061219	OAK VIEW STP	3.00	41	2
061220	HILL CANYON STP	10.00	50	2
061235	SAN FRANCISCO INTL. AIRPO	9.30	30	2
061235	NORTH BAYSIDE STP	13.00	30	9
061236	RIO COSUMNES CCWTP	0.25	40	3
061238	FIREBAUGH WTP	0.50	30	3

TABLE B.1 (CONTINUED)
WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

STATE CALIFORNIA

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
061243	GRIDLEY STP	0.64	40	5
061245	FORTUNA STP	2.42	30	1
061266	LAKE ELSINORE STP	0.35	30	1
061272	MARIPOSA STP	0.02	30	4
061274	TRONA WWTP	0.48	30	3
061275	KETTLEMAN CITY STP	0.12	30	4
061324	ATASCADERO COUNTY SD STP	1.40	30	4
061326	SANTA MARIA WTP	7.80	30	1
061333	FALL RIVER MILLS COM STP	0.07	60	4
061334	ADIN STP	0.04	30	4
061343	LERDO FACILITY WTP	0.25	30	1
061347	TRANQUILITY STP	0.15	20	2
061355	HILTON CREEK STP	0.08	40	4
061363	BISHOP STP	1.60	30	2
061367	RIPLEY LAGOONS	0.07	30	4
061377	WHISPERING PALMS SAN DIST	0.20	30	5
061385	GEYSERVILLE WTP	1.10	30	4
061410	TAYLORSVILLE STP	0.04	20	4
061413	BRENTWOOD STP	0.63	30	3
061417	HOLTVILLE STP	0.85	30	1
061423	ARCATA WTP	3.27	31	1
061469	MADISON STP	0.12	30	3
061562	PERRIS VALLEY REGION. STP	1.00	30	4
061577	PINOLE STP	2.00	33	2
061620	NYELAND ACRES STP	0.22	30	4
062467	CENTRAL MARIN SA STP	10.00	30	4

STATE COLORADO

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
080322	UPPER THOMPSON WWTP	1.50	33	4
080329	LITTLETON-ENGLEWOOD WWTP	20.00	30	4
080330	W. JEFFERSON COUNTY WWTP	0.50	30	3
080331	REGIONAL WTW	2.50	41	4
080333	FRISCO STP	0.50	53	2
080334	SILVERTHORNE DILLON STP	2.00	53	3
080336	GLENWOOD STP	2.30	30	3
080338	LOVELAND STP	7.70	40	3
080344	ASPEN STP	3.00	51	3
080346	GRANBY STP	0.50	30	4
080348	75THSTREET WWTP	15.60	30	2
080349	SNOWMASS STP	1.60	51	3
080352	LONGMONT WWTP	9.20	31	3
080354	EATON WWTP	0.34	30	1
080356	LAFAYETTE STP	1.50	31	3
080357	LYONS WWTP	0.29	30	5

TABLE B.1 (CONTINUED)
WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

STATE COLORADO

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
080394	VAIL WATER AND SANIT DIST	1.80	30	1
080394	AVON STP	3.10	31	3
080401	BIG DRY CREEK WWTP	2.40	30	1

STATE CONNECTICUT

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
090153	KILLINGLY WWTP	8.00	30	4
090155	STONINGTON WPCF	0.66	30	4
090155	PAWCATUCK WPCF	1.31	30	4
090173	NEW LONDON WPCF	10.00	30	3
090194	BRANFORD WTP	4.50	30	1
090200	MERIDAN STP	11.00	51	5

STATE DELAWARE

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
100061	DELAWARE CITY WWTP	0.50	50	2
100073	SEAFORD STP	0.92	40	2
100088	S. COASTAL REGIONAL STP	3.00	40	4

STATE DISTRICT OF COLUMBIA

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
110034	LORTON STP	1.50	54	3

STATE FLORIDA

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
120264	FORT WALTON BEACH STP	4.50	30	4
120393	WINTER GARDEN STP	2.00	55	5
120399	IRON BRIDGE ROAD STP	24.00	55	4
120424	DELAND WWTP	4.00	50	3
120426	NEW SMYRNA BEACH WTP	4.00	41	3
120428	PENSACOLA WTW	20.00	54	3
120433	SOUTH CROSS BAYOU WTW	27.00	30	1
120437	DAYTONA BEACH WWTP	10.00	51	4

TABLE B.1 (CONTINUED)
WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

STATE FLORIDA

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
120450	BAY CO. STP	3.00	10	4
120457	LEESBURG STP	3.00	60	2
120459	WINTER HAVEN STP	5.00	30	4
120473	HOOKERS POINT STP	60.00	55	3
120474	FORT LAUDERDALE STP	22.00	40	3
120490	SOUTHWEST DISTRICT STP	5.00	30	4
120511	DUNNELLON WTP	0.21	40	2
120523	NORTH WEST STP	16.00	50	3
120563	BELLEAIR STP	0.90	55	3
120574	BROWARD COUNTY STP NO. 2	60.00	40	1

STATE GEORGIA

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
130315	RICHMOND HILL SEWERAGE SY	0.50	30	4
130341	ROCKMART STP	1.20	30	3
130357	ALMA STP	0.75	30	4
130363	VIDALIA NORTHEAST STP	1.90	51	3
130385	ELM CREEK WWTF	5.00	41	3
130395	WEST DALLAS STP	0.25	40	4
130397	R.L. JACKSON WPCP	4.50	30	1
130399	BEAVER RUN STP	3.60	54	4
130403	FAYETT-VILLE STP	1.25	51	4
130404	ADEL WWTP	1.30	41	3
130418	STATESBORO WPCF	4.90	40	3
130425	WITHLACOOCHEE WWTP	4.00	41	4
130425	MUD CREEK WWTP	2.20	50	4
130430	SOUTH COBB STP	24.00	44	3
130436	GLENVILLE CITY STP	0.88	40	3
130479	PUMPKINVINE CR REGIONAL	8.00	55	4
130480	FORT VALLEY STP	2.20	30	3
130489	FLAT CREEK STP	7.00	33	2
130496	SHELLMAN STP	0.15	30	4
130540	PERRY CITY STP	3.00	30	1
130577	GEORGIA STATE PRISON STP	0.25	30	3
130565	CORNELIA STP	3.00	40	3

STATE IDAHO

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
160141	HEYBURN STP	0.46	30	3
160144	PARIS SEWERAGE	0.10	60	4
160171	PAYETTE STP	2.40	30	3

TABLE B.1 (CONTINUED)
WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

STATE IDAHO

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
160174	PAYETTE LAKE WWTP	2.00	30	3
160179	JEROME STP	1.27	30	4
160183	MERIDIAN STP	2.20	41	4
160185	S. FORK COEUR D'ALENE STP	0.13	30	4
160188	POCATELLO STP	7.50	30	3
160189	GARFIELD BAY STP	0.05	30	4
160193	HARRISON STP	0.03	43	4
160194	WEST BOISE STP	5.00	30	4
160195	ST. ANTHONY STP	0.50	30	3
160199	PLUMMER STP	0.25	30	3
160200	NAMPA STP	15.00	31	3
160201	CALDWELL STP	7.50	30	3
160204	CULDESAC WWTP	0.05	30	4
160208	GOWEN FIELD WWTP	0.26	30	4
160209	HAGERMAN STP	0.08	30	4
160219	CHALLIS STP	0.20	30	4
160319	ST CHARLES STP	0.04	60	4

STATE ILLINOIS

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
170397	ILLIOPOLIS LAGOON	0.20	50	4
170508	BUSHNELL STP	0.70	50	3
170561	RIDGEWAY	0.14	50	3
170599	BUREAU JUNCTION LAGOONS	0.07	30	4
170643	ADDIEVILLE STP	0.03	30	4
170660	RICHMOND	0.38	33	3
170680	SPARTA	0.65	50	3
170749	TAYLORVILLE SANITARY DIST	1.92	50	3
170766	MT CARMEL WWTP	2.00	40	2
170802	LINCOLN STP	3.35	40	3
170865	MOMENCE	1.60	40	3
170876	ALGONQUIN	1.25	43	2
170924	SALEM	1.00	40	3
170930	OLMSTED	0.07	30	3
170956	STOCKTON	0.30	40	3
170969	LEROY STP	0.66	50	4
170970	O'FALLON STP	3.00	30	3
170973	DOWNERS GROVE SANITARY D.	9.60	53	3
170979	LENA	0.30	30	1
170983	BREESE STP	0.63	50	4
170992	GRAYVILLE	0.30	30	3
171001	GALVA	0.41	40	3
171001	GALVA	0.42	50	3
171006	BLOOMINGTON-NORMAL STP	15.00	51	3
171014	STERLING STP	3.60	40	4

TABLE B.1 (CONTINUED)
WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

STATE ILLINOIS

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
171023	BELLEVILLE STP NO. 2	0.45	50	2
171059	EFFINGHAM STP	2.50	51	3
171061	COWDEN	0.08	30	3
171092	ELBURN STP	1.30	54	4
171105	BARTLETT	1.54	50	5
171107	ROBINSON STP	1.50	51	5
171116	MOLINE	5.50	40	3
171156	MINONK STP	0.34	50	2
171160	CARBONDALE STP	2.64	40	3
171172	ELGIN	17.00	53	3
171182	ALTON	10.50	30	3
171202	MATCON	4.50	50	3
171215	GRANITE CITY STP	23.00	30	3
171218	BENSENVILLE	4.00	40	3
171226	STILLMAN VALLEY STP	0.20	30	3
171279	CENTRALIA	3.00	50	3
171294	WOODRIDGE WWTP	4.00	50	3
171306	ANNAWAN LAGOONS	0.16	30	4
171310	MT VERNON STP	3.20	53	3
171311	HOOPESTON STP	0.80	53	3
171332	EAST MOLINE	11.10	40	3
171335	SYCAMORE STP	3.50	50	3
171341	FULTON	0.47	30	3
171346	CASEY NORTH WWTP	0.50	51	5
171365	ARTHUR	0.50	53	3
171375	HOYLETON LAGOONS	0.06	30	3
171397	HINSDALE SD STP	12.00	51	3
171399	SALT CREEK SANITARY DIST.	5.00	51	3
171407	AURORA STP	40.00	54	3
171410	CISSNA PARK STP	0.10	50	4
171412	CARPENTERSVILLE WWTP	5.00	53	3
171413	ELWOOD STP	0.40	51	4
171415	ADDISON SOUTH STP	3.20	41	3
171420	BLOOM TOWNSHIP STP	12.10	51	2
171435	FOX RIVER GROVE STP	1.25	33	3
171462	VILLAGE OF BARRINGTON STP	3.68	54	3
171503	NOBLE STP	0.10	30	3
171556	BONE GAP STP	0.04	51	4
171584	LIBERTYVILLE WWTP	4.00	50	3
171635	GRANDWOOD PARK STP	0.50	53	3
171646	WOODRIDGE WWTP	6.00	51	3
171694	LOMBARD STP	58.00	30	5
171594	GLENBARD ADVANCED STP	14.32	51	3
171607	SPRINGFIELD STP	133	51	1
171640	WHEATON SD STP	8.90	51	3
171997	HUMBOLDT STP	0.07	30	4
172078	GOODFIELD STP	0.07	30	4
172150	LEBANON STP	0.70	50	3
172227	MT CARROLL STP	0.39	51	2

TABLE 6.1 (CONTINUED)
WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

STATE ILLINOIS

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
175111	OHARE WATER RECLAM PLANT	72.00	51	4

STATE INDIANA

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
180116	LYNN STP	0.25	50	4
180138	CARLISLE STP	0.08	53	4
180260	NORTH WEBSTER	0.28	53	4
180266	WOLCOTT STP	0.13	53	4
180295	LOGANSPORT	9.00	30	1
180329	LINDEN WWTP	0.10	50	4
180335	ELNORA STP	0.10	50	4
180339	MICHIGANTOWN STP	0.06	30	4
180342	MONTICELLO STP	0.30	53	3
180346	BIRDSEYE STP	0.08	30	4
180347	SHIPSHEWANA STP	0.08	53	4
180350	HAMLET STP	0.10	50	4
180354	WILLIAMSPORT STP	0.22	30	4
180373	ROME CITY LAGOONS	0.45	53	4
180396	HUNTINGTON STP	4.60	31	3
180400	BROOKLYN WWTP	0.24	30	4
180401	LYNNVILLE STP	0.08	50	4
180403	NORTH VERNON STP	1.75	53	3
180410	GREENSBURG	1.60	50	3
180426	HAMILTON LAKE STP	0.30	53	4
180434	CLARKS HILL WWTP	0.15	50	4
180445	CARMEL WWTP	3.00	43	1
180451	JASONVILLE STP	0.46	50	5
180456	BREMEN STP	1.30	54	3
180467	SEYMOUR WWTP	4.30	33	3
180470	PARAGON STP	0.07	50	4
180473	LAUREL	0.15	30	4
180482	YORKTOWN STP	1.00	30	3
180484	CLAY CITY	0.12	50	4
180488	RISING SUN WWTP	0.36	30	3
180494	COVINGTON WWTP	0.35	30	4
180495	DUGGER	0.13	50	4
180499	SALEM	0.90	50	3
180502	SUNMAN	0.19	50	5
180506	MATTHEWS STP	0.11	30	4
180509	HYMERA STP	0.25	50	4
180515	BROCKVILLE	0.60	30	3
180518	TIPTON STP	2.00	53	3
180520	NEW PROVIDENCE WWTP	0.14	40	4
180523	BURLINGTON STP	0.10	30	4
180524	WINCHESTER STP	1.30	51	3

TABLE 3.1 (CONTINUED)
WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

STATE INDIANA

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
180526	STAUNTON STP	0.09	53	4
180528	MARTINSVILLE WWTP	2.20	30	3
180530	CRAWFORDSVILLE STP	3.40	50	3
180532	MUNCIE WWTP	24.00	43	3
180533	PRINCETON WWTP	2.00	50	3
180534	WESTVILLE WWTP	0.35	50	3
180555	PENNVILLE STP	0.16	50	4
180574	BOSWELL	0.13	50	4
180576	DEMOTTE	0.40	50	4
180591	CONVERSE WWTP	0.25	43	4
180595	FREMONT STP	0.30	53	3
180611	GREENFIELD STP	3.20	53	3
180613	LEBANON STP	2.00	50	2
180614	FRANKFORT STP	4.68	50	3
180627	CROWN POINT WWTP	3.60	53	3
180751	PORTLAND STP	2.35	53	3
180760	COLUMBUS	12.40	44	3
180816	SUMMIT SPRINGS STP	0.19	53	4
180840	GARY STP	60.00	54	2
180876	KENNARD STP	0.08	50	4
180888	TRAFALGAR STP	0.11	50	4
180900	ANDERSON STP	0.09	50	4
180915	BROOK STP	0.10	30	4
180959	MONROE CITY STP	0.12	53	2

STATE IOWA

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
190568	WEST LIBERTY STP	1.37	30	3
190579	MASON CITY WWTP	6.50	51	3
190584	SIOUX CITY WWTP	30.00	30	3
190587	JEFFERSON STP	1.10	30	4
190592	MUSCATINE WWTP	13.00	30	3
190594	KEOKUK WWTP	5.00	30	2
190596	SAC STP	0.70	31	4
190603	WEBSTER STP	2.90	41	3
190605	HARLAN WWTP	0.72	51	4
190608	EAGLE GROVE STP	0.60	31	3
190615	AUBURN STP	0.04	30	4
190617	WOOLSTOCK LAGOON	0.04	30	4
190618	FERTILE STP	0.05	30	4
190637	SPENCER WWTP	3.70	51	4
190645	SHELDON STP	0.87	41	3
190646	ROCK RAPIDS STP	0.38	51	2
190653	MOORHEAD WTF	0.04	30	4
190662	EPWORTH WTF	0.34	30	4

TABLE B.1 (CONTINUED)
WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

STATE IOWA

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
190664	IDA GROVE STP	0.39	40	4
190672	WALFORD LAGOON	0.04	30	4
190691	CRYSTAL LAKE STP	0.03	30	4
190706	EMERSON WTF	0.05	30	5
190707	PARK VIEW SAN DIST STP	0.45	40	4
190708	SIBLEY STP	0.67	30	4
190714	MAQUOKETA WTP	1.10	30	3
190720	SEARSBORO WTF	0.03	20	4
190735	IRWIN STP	0.05	30	4
190754	SENTS CREEK WTP	2.00	30	4
190763	JANESVILLE LAGOON	0.17	30	4
190772	DELAWARE WTF	0.02	30	4
190782	NASHUA WTF	0.24	30	3
190800	WAVERLY STP	1.24	30	4
190880	STEAMBOAT ROCK STP	0.05	40	3
190882	WASHTA LAGOON	0.04	30	3
190890	CASCADE STP	0.25	30	3

STATE KANSAS

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
200365	LEAVENWORTH WWTP	6.38	30	3
200422	WELLINGTON STP	1.14	40	4
200429	ATLANTA LAGOONS	0.21	30	4
200432	DESOTO WWTF	0.40	30	3
200434	CLAY CENTER STP	0.81	30	3
200451	HALSTEAD STP	0.43	30	4
200454	SCHOENCHEN STP	0.01	60	4
200455	MUNJOR LAGOON	0.03	60	4
200467	LAKIN LAGOON	0.30	30	4
200476	OGDEN LAGOON	0.40	60	4
200478	JUNCTION CITY WWTP	3.60	30	3
200505	BALDWIN STP	0.43	30	3
200510	TOOLEY CREEK MDS #1 STP	0.53	30	3
200511	MUNICIPAL WWTP NO.14	0.22	30	4
200517	CHANUTE WWTF	2.13	30	4
200518	CONCORDIA STP	1.20	30	3
200523	VALLEY CENTER STP	0.50	30	3
200526	KANSAS CITY STP NO.2	0.30	30	4
200527	MINNEAPOLIS LAGOON	0.21	60	4
200530	WINFIELD STP	2.00	30	1
200534	REEDONIA STP	0.75	30	4
200536	HESSTON STP	0.59	30	4
200537	AMERICUS STP	0.08	30	1
200548	LIBERAL WWTF	5.00	30	4
200550	ONGANOXIE STP	0.40	30	3

TABLE B.1 (CONTINUED)
WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

STATE KANSAS

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
200561	OBERLIN STP	0.45	30	2
200562	ARCADIA STP	0.04	30	4
200569	WEST MINERAL LAGOON	0.02	30	4
200570	WHITEWATER WWTF	0.34	30	3
200576	LA HARPE WWTP	0.14	40	4
200583	BLUE MOUND WWTF	0.04	30	4
200596	SELDEN WWTF	0.03	30	4
200600	PERL WWTF	0.03	60	4
200606	EMPORIA STP	4.00	30	1
200611	INDIAN CREEK MIDDLE BASIN	3.00	40	4
200620	COFFEYVILLE WWTF	3.20	30	5
200623	MARYSVILLE WTP	0.45	30	1
200638	BUHLER WWTF	0.17	30	3
200643	KINCAID WTP	0.03	30	4
200646	GALVA LAGOON	0.06	30	3
200648	DERBY STP	1.64	30	3
200653	BLUE RAPIDS LAGOON	0.16	60	4
200654	WATERVILLE WTP	0.08	30	3
200660	HOLTON STP	0.44	30	2
200661	TOWANDA STP	0.19	30	3
200663	CIMARRON WTP	0.21	30	3
200683	NICKERSON STP	0.15	40	3
200694	BELLE PLAINE WWTF	0.21	30	3
200709	ALMA WTP	0.07	30	2
200710	CARBONDALE WTP	0.16	30	1
200764	LANSING WWTF	1.40	30	4
200766	WINCHESTER STP	0.09	30	1
200783	INMAN STP	0.11	30	1

STATE KENTUCKY

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
210313	MURRAY WWTP	3.50	30	4
210331	ASHLAND CITY STP	11.00	30	4
210332	FRANKFORT WTP	4.30	30	5
210334	STRODES CREEK WWTP	1.00	40	4
210338	WEST POINT CITY STP	0.19	30	4
210339	AUGUSTA WWTF	0.33	30	4
210341	NORTHSIDE WWTP	2.88	50	3
210341	SOUTHSIDE WWTP	3.00	41	4
210342	CYNTHIANA CITY STP	1.50	40	3
210343	VALLEY CREEK WWTP	4.51	40	4
210345	MOREHEAD STP	2.50	30	4
210346	MADISONVILLE STP	4.50	50	3
210349	CLARKS RUN WWTP	2.70	51	4
210350	CAMPBELLSVILLE WWTF	4.30	40	4

TABLE B.1 (CONTINUED)
WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

STATE KENTUCKY

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
210351	JEFFERSONTOWN STP	4.00	41	2
210353	NORTH HINKSTON CREEK STP	2.66	41	3
210354	FLATWOODS STP	2.00	30	4
210357	MILLERSBURG STP	0.22	30	4
210365	BARDSTOWN CITY STP	3.00	41	3
210373	ALBANY STP	0.70	50	4
210374	LEITCHFIELD WWTP	1.17	41	4
210378	LAWRENCEBURG WTP	1.90	41	4
210385	DRAKESBORO WWTP	0.17	40	4
210391	LIVERMORE WWTP PHASE I	0.31	30	4
210400	WICKLIFFE CITY STP	0.17	52	4
210403	CROFTON WTP	0.07	50	4
210404	FORDSVILLE STP	0.11	50	4
210408	FANCY FARM WWTP	0.14	50	4
210452	RUSSELL COUNTY REG WWTP	2.50	30	4
210547	NICHOLASVILLE WWTP	2.71	41	3
210597	NORTONVILLE WTP	0.14	40	4

STATE LOUISIANA

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
220265	CITY OF KENNER WWTP	5.00	30	1
220292	JEANERETTE WWTP	1.32	30	4
220295	TOWN OF BASILE WWTP	0.29	30	4
220305	CITY OF RUSTON WWTP	4.60	30	1
220307	GILBERT WWTP	0.10	30	4
220314	VILLAGE OF ROSEPINE WWTP	0.15	30	4
220321	TOWN OF LIVINGSTON WWTP	0.30	30	4
220322	GONZALES STP	2.41	30	1
220327	MONROE STP	12.00	53	3
220344	COTTON VALLEY STP	0.16	30	4
220347	NORTHEAST OXIDATION POND	0.50	43	8
220347	EAST STP	2.84	40	3
220349	LASALLE REGIONAL STP	1.10	30	5
220390	HAYNESVILLE STP	0.50	30	4
220408	COLUMBIA HEIGHTS STP	0.21	20	4
220415	OBERLIN LAGOON	0.21	30	1
220429	CHENEYVILLE STP	0.15	30	4
220430	YOUNGSVILLE STP	0.19	30	4
220431	MOREAUVILLE STP	0.15	30	4
220450	WALKER STP	0.50	50	4
220451	DUSON STP	0.22	30	4
220456	DOWNSVILLE STP	0.07	30	4
220474	ELTON STP	0.19	30	4
220489	GRAND CANE STP	0.03	30	4
220544	MORSE STP	0.09	30	4

TABLE 8.1 (CONTINUED)
WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

STATE LOUISIANA

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
220561	MERRYVILLE STP	0.25	30	4

STATE MAINE

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
230098	MOOSEHEAD WWTP	0.17	30	4
230102	FORT FAIRFIELD WWTP	0.83	30	4
230114	OLD ORCHARD BEACH STP	1.50	30	3
230117	SOUTH PORTLAND STP	5.50	30	4
230122	PORTLAND WD WPCF	4.54	30	4
230132	SANFORD SEWAGE DIST. WPCF	4.40	53	3
230166	ISLESBORO STP	0.01	30	2
230175	WILLOW STREET STP	0.01	30	4
230176	NORTH MAIN STREET STP	0.02	30	4
230178	EAST VASSALBORO STP	0.02	30	4
230178	SOUTH MAIN STREET STP	0.02	30	4

STATE MARYLAND

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
240152	CALVERT CO SANITARY DIST	0.15	30	4
240130	FRIENDSVILLE STP	0.10	30	4
240243	ACCIDENT TOWN OF	0.05	30	4
240255	WILLARDS WWTP	0.03	30	4
240294	BALLENGER CREEK WTW	2.00	30	4
240298	SAVAGE STP	5.00	30	1
240311	FREEDOM DISTRICT STP	1.50	40	4
240318	CLEAR SPRING STP	0.20	50	4
240338	ST MICHAELS STP	0.50	40	4
240346	ABERDEEN STP	4.00	45	5
240353	NORTHEAST RIVER AWTF	2.00	54	4
240360	CHESAPEAKE STP	0.30	40	4
240383	FLINTSTONE-GILPIN STP	0.05	40	4
240384	OLDTOWN STP	0.40	40	4
240393	TYLERTOWN STP	0.02	30	4
240393	EWELL RHODES POINT STP	0.07	30	4
240409	COX CREEK STP	15.00	30	1
240422	FREDERICK COUNTY METRO ST	0.23	30	4
240447	KENT NARROWS STP	0.79	30	4
240467	CHERRY HILL	0.03	50	4
240508	CHURCH HILL STP	0.09	30	4
240619	WORCESTER COUNTY SAN DIST	12.00	40	3

TABLE B.1 (CONTINUED)
WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

STATE MASSACHUSETTS

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
250253	UPPER BLACKSTONE WPCF	56.00	30	5
250255	ROCKPORT STP	0.80	30	4
250266	REGIONAL STP	18.10	30	4
250270	ORANGE STP	1.10	30	4
250279	PALMER STP	5.60	33	4
250280	NO ATTLEBOROUGH STP	4.61	54	5
250289	UXBRIDGE STP	3.00	43	4
250298	SOUTH HADLEY WWTP	5.10	30	3
250300	HULL WWTP	3.07	30	4
250308	BROCKTON STP	17.95	54	3
250318	HARDWICK WWTP	0.04	30	4
250319	HUNTINGTON WTP	0.20	30	4
250323	AYER STP	1.79	43	4
250336	LEOMINSTER STP	9.30	54	5

STATE MICHIGAN

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
262025	HOUGHTON COUNTY STP	0.23	30	4
262034	HARBOR SPRINGS LAGOONS	0.45	30	4
262041	LANSING WWTP	40.50	50	3
262053	CHATHAM WWTP	0.25	60	4
262073	BRONSON WWTP	0.50	33	2
262127	FLINT WWTP	50.00	54	3
262142	GRAND LEDGE WWTP	1.50	33	3
262143	GRATIOT CO. WWTP	0.70	60	4
262301	CHESANING	0.58	33	3
262314	CHEBOYGAN AREA WW MANAG	2.00	33	1
262326	IRON MOUNTAIN STP	3.00	33	1
262349	DOWAGIAC WWTP	2.50	43	2
262353	EATON RAPIDS	1.20	33	1
262491	MT. CLEMENS STP	4.50	30	1
262501	OWOSSO	6.00	54	3
262503	BIG RAPIDS WWTP	2.40	33	2
262516	CALEDONIA STP	0.14	30	4
262535	MASON	1.00	54	2
262541	IONIA WWTP	2.85	33	3
262543	NEWBERRY STP	1.00	53	3
262640	GLADWIN	0.65	33	2
262724	BRITTON-RIDGEWAY LAGOONS	0.19	30	4
262772	ALLANDALE TP	0.80	33	3
262797	LAWRENCE LAGOONS	0.19	30	4
262839	SAUGATUCK WWTP	0.60	33	4
262853	DETOUR VILLAGE STP	0.09	30	4
262884	CLARENCE TWP-DUCK LAKE TP	0.24	30	4

TABLE B.1 (CONTINUED)
WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

STATE MICHIGAN

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
262887	HESPERIA WWTP	0.16	30	4
262894	SUPERIOR TWP LAGOONS	0.10	30	4
262900	GALIEN WWTP	0.14	30	4
262923	TUSCOLA COUNTY STP	13.00	30	4
262946	HERMANSVILLE LAGOON	0.07	30	4
262979	ELSIE LAGOON	0.13	30	4
263001	KINGSLEY WWTP	0.15	30	4
263002	PEWAMO LAGOONS	0.07	30	4
263015	POTTERVILLE STP	0.40	33	3
263039	INTERIOR TWP LAGOON	0.03	30	4
263271	JONESVILLE STP	0.32	54	2
263279	MARQUETTE CNTY	6.20	33	3

STATE MINNESOTA

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
270663	TWIN CITY PREL.TRT. MOD.	345	30	1
270664	PRELIMINARY TMT FACILITIE	290	30	1
270720	VIRGINIA	2.00	53	3
270725	TWO HARBORS WWTP	1.20	33	3
270741	ROGERS	0.15	30	4
270743	DODGE-EYOTA STP	0.60	50	4
270747	ST CLOUD	13.00	43	4
270748	WESTERN LAKE SUPERIOR SAN	43.60	53	4
270804	ROCHESTER MUN. WWTF	19.10	44	3
270811	CHISHOLM AWWT	0.72	53	3
270815	EVELETH WWTP	0.80	50	3
270816	HOYT LAKES STP	0.50	33	2
270818	STOCKTON LAGOONS	0.07	30	4
270821	MOUNTAIN IRON STP	0.55	33	4
270822	AURORA STP	0.31	53	3
270823	GILBERT STP	0.50	53	3
270830	MARIETTA LAGOONS	0.03	30	4
270831	RED WING STP	3.05	40	3
270832	CLEARWATER-CLEAR LAKE WTP	0.14	30	4
270837	TAUNTON WWTP	0.02	30	4
270838	ZIMMERMAN LAGOONS	0.08	30	4
270839	BEAVER BAY STP	0.04	33	4
270842	NORTHFIELD WWTP	2.50	50	1
270844	ALEXANDRIA LAKE STP	2.55	53	4
270845	BREEZY POINT STP	0.12	30	4
270854	ELK RIVER STP	1.04	30	1
270855	MONTICELLO WWTP	0.91	30	1
270863	BRAINERD STP	3.13	40	4
270870	MOOREHEAD WWTP PHASE II	6.00	40	4
270871	FARIBAULT WWTP	3.50	30	3

TABLE B.1 (CONTINUED)
WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

STATE MINNESOTA

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
270651	WILLMAR WWTF	4.30	30	5
270909	ALBERT LEA WWTP	12.50	51	4
270925	BUFFALO STP	0.80	40	4
270949	MARSHALL WWTP	4.30	50	3
270953	COKATO WWTP	0.38	30	1
270956	ANNANDALE WTF	0.25	50	3
270958	BIG LAKE STP	0.38	40	4
270962	FORESTON STP	0.04	30	4
270970	MADISON LAKE	0.09	50	4
270990	PINE RIVER WWTP	0.22	50	2
271051	ROCKFORD WWTP ADDITIONS	0.36	30	1
271365	ELIZABETH LAGOONS	0.03	30	4
279050	EMPIRE WWTP	6.00	51	4

STATE MISSISSIPPI

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
280373	MERIDIAN STP	13.00	42	3
280379	STARKVILLE STP	5.00	40	4
280396	SUMNER WTF	0.39	30	4
280421	PACE LAGOON	0.08	30	4
280453	BYHALIA STP	0.21	40	3
280457	FALCON STP	0.06	30	4
280482	VAIDEN LAGOON	0.15	30	3
280500	SCHLATER WTP	0.07	30	4
280507	PICKENS STP	0.16	30	1
280510	FRIARS POINT STP	0.20	30	4
280515	CROWDER WASTE WATER TP	0.16	30	4
280522	CROSBY STP	0.06	30	4
280540	MANTACHIE STP	0.12	42	4
280559	MARIETTA STP	0.05	41	4
280578	MAYERSVILLE LAGOON	0.05	30	4
280642	CLEARY HEIGHTS STP	0.10	51	4
280647	HOLCOMB LAGOON	0.06	30	4
280663	ITTA BENA LAGOON	0.49	30	4

STATE MISSOURI

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
290480	ST. JOSEPH WWTP	32.85	30	3
290524	MONETT WWTP	3.07	30	8
290546	LICKING WWTF	0.20	53	4
290560	WENTZVILLE STP	1.10	40	4

TABLE B.1 (CONTINUED)
WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

STATE MISSOURI

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
290587	WESTSIDE STP	22.50	30	2
290599	CARROLLTON STP	1.50	33	3
290603	NEVADA WWTP	2.11	30	4
290629	ROCK CREEK STP	7.50	30	4
290634	CHARLESTON STP	0.75	40	2
290646	WYATT LAGOONS	0.06	30	4
290653	RICHLAND WWTF	0.36	30	4
290655	WARRENSBURG EAST WWTF	1.50	30	4
290655	WARRENSBURG STP	1.70	30	4
290658	CUBA STP	0.46	30	4
290662	BEVIER LAGOON	0.01	30	4
290669	QULIN STP	0.10	30	4
290673	JEFFERSON STP	6.20	30	2
290683	TIPTON STP	0.44	30	4
290685	SLATER STP	0.40	30	4
290691	STOCKTON WTF	0.28	30	1
290701	ST. JAMES STP	0.46	30	4
290703	HANNIBAL WTF	4.00	40	4
290711	BOURBON STP	0.22	30	4
290713	MALTA BEND LAGOON	0.05	30	4
290720	FRANKFORD STP	0.06	30	4
290722	POLO WTP	0.06	30	4
290743	WEST PLAINS WTF	2.50	50	4
290744	PINEVILLE STP	0.08	30	4
290747	BUFFALO STP	0.46	30	4
290750	BUTLER STP	0.70	30	4
290751	WAYNESVILLE STP	1.25	30	3
290752	HIGBEE LAGOON	0.07	30	4
290764	STEELVILLE STP	0.33	30	4
290772	BRECKENRIDGE WTF	0.08	30	4
290777	URBANA LAGOON	0.05	30	4
290779	VERSAILLES STP	0.55	30	4
290781	ARMSTRONG LAGOON	0.05	30	4
290782	CROCKER STP	0.20	30	4
290786	MADISON WTP	0.12	30	2
290794	BUSHY CREEK STP	0.40	30	4
290798	NOEL WWTF	0.20	30	5
290839	MALDEN WWTF	0.85	30	4
290843	NIANGUA STP	0.05	40	4
290846	PIERCE CITY WWTF	0.25	30	4
290874	HINKSON-PERCHE WWTP	13.00	30	4
290891	POTOSI STP	0.58	30	4
290918	LINNEUS LAGOON	0.06	30	4
290960	FESTUS WTP	2.00	40	3
290961	VAN BUREN WWTF	0.13	50	5
290977	ADVANCE STP	0.20	30	4
291065	NAYLOR WWTF	0.06	30	4

TABLE B.1 (CONTINUED)
WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

STATE MONTANA

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
300163	KALISPELL WWTP	2.70	31	2
300194	FLAXVILLE LAGOONS	0.01	60	4
300197	GREAT FALLS STP	21.00	30	3
300202	VICTOR WWTF	0.09	30	4
300203	MILES CITY STP	1.93	30	4
300204	POPLAR WWTF	0.57	30	4
300206	WHITEFISH WWTP	1.25	30	3
300210	LIVINGSTON WTP	2.00	30	1
300218	EUREKA LAGOONS	0.73	30	4
300222	STEVENSVILLE WWTP	0.30	30	4
300228	DARBY LAGOONS	0.15	30	1
300236	HARDIN STP	1.00	30	4
300242	POLSON WWTF	0.65	30	3
300259	FORSYTH WWTF	0.54	30	4
300271	BROADUS LAGOONS	0.10	30	3
300303	CORVALLIS LAGOONS	0.05	30	4
300305	ROY STP	0.01	30	4

STATE NEBRASKA

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
310393	WAKEFIELD LAGOON	0.27	30	3
310398	FREMONT WWTP	10.50	30	3
310407	BLAIR WWTP	2.00	30	4
310421	SPRINGFIELD WWTP	0.22	30	4
310433	YORK WWTP	2.30	31	3
310435	ARLINGTON WWTP	0.17	30	3
310453	GRAND ISLAND STP	10.00	30	1
310457	WEEPING WATER WWTP	0.26	30	5
310466	HEBRON WWTP	0.25	30	3
310467	HUMBOLDT WWTP	0.21	30	2
310472	NEBRASKA CITY STP	2.11	30	3
310473	PLATTSMOUTH STP	1.20	30	4
310476	VALLEY STP	0.48	30	3
310477	DECATUR WWTF	0.09	30	5
310478	MELBETA WWTF	0.04	60	5
310482	NEWMAN GROVE WWTF	0.17	30	5
310489	NORTH BEND STP	0.18	30	4
310491	CAMBRIDGE STP	0.26	30	5
310493	NORTHEAST STP	8.00	41	4
310495	CENTRAL CITY WWTF	0.48	30	3
310497	HICKMAN STP	0.17	30	4
310500	WILBER STP	0.29	30	4
310502	BEATRICE WWTP	1.65	30	3
310506	DUNCAN WTF	0.04	60	5

TABLE 3.1 (CONTINUED)
WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

STATE NEBRASKA

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
310513	RIVERSIDE LAKES WWTF	0.12	30	1
310514	SEWARD WWTF	1.01	30	1
310521	ELMWOOD WWTF	0.06	30	8
310546	COZAD WWTP	1.12	30	3
310547	OSHKOSH STP	0.13	60	4
310550	BLUE HILL STP	0.09	60	4
310556	HASTINGS WWTF	5.37	30	4
310558	SYRACUSE WWTF	0.33	30	8
310564	BROADWATER WWTP	0.02	60	4
310567	MCCOOK STP	2.03	30	3
310574	ARNOLD STP	0.08	30	4
310575	THEDFORD LAGOON	0.03	60	4
310582	HENDERSON STP	0.10	60	4
310590	CLAY CENTER WWTF	0.13	30	3
310593	LAWRENCE STP	0.04	60	4
310601	ELGIN WTF	0.12	30	1
310611	CERESCO WWTF	0.12	30	4
310621	STUART WPCF	0.09	30	3
310631	GERING WWTF	2.85	30	1
310656	FORT CALHOUN WWTF	0.16	30	4

STATE NEVADA

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
320076	YERINGTON STP	0.54	60	3
320078	RENO-STEAD STP	1.00	30	3
320085	FALLON WWTF	0.64	60	3
320086	MINDEN-GARDNERVILLE STP	1.50	30	1
320089	DAYTON WWTF	0.12	30	4
320091	BEATTY STP	0.10	60	4
320097	MCDERMITT STP	0.05	60	1
320107	OVERTON STP	0.15	60	4
320108	SEARCHLIGHT STP	0.03	60	4
320111	WEST WQ CONTROL PLANT	32.00	40	2
320120	LOVELOCK STP	0.50	30	4

STATE NEW HAMPSHIRE

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
330093	MANCHESTER WWTP	26.00	30	4
330104	ALLENSTOWN STP	1.05	30	4
330111	BERLIN STP	4.10	30	4
330119	WARNER VILLAGE STP	0.17	30	4

TABLE B.1 (CONTINUED)
WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

STATE NEW HAMPSHIRE

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
330123	GORHAM STP	0.75	30	4
330124	PITTSFIELD WPCF	0.40	30	4
330128	WOODSVILLE FIRE DIST STP	0.28	40	4
330135	CHARLESTOWN WTP	1.12	30	1
330137	LISBON LAGOONS	0.29	20	4
330139	HINSDALE STP	0.29	30	4
330140	WINCHESTER STP	0.35	33	4
330145	NEWFIELDS STP	0.12	40	4
330148	WEARE STP	0.02	60	4
330157	HALL STREET WWTF	10.12	33	4
330161	DURHAM STP	2.50	30	3
330191	SWANZEY STP	0.16	30	4

STATE NEW JERSEY

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
340251	MOUNT HOLLY SA STP	5.00	41	3
340299	LINDEN-ROSELLE STP	17.00	30	3
340333	PAR-TROY HILLS STP	16.00	52	3
340333	PARSIPPANY-TROY HILL STP	16.00	30	1
340340	UNION & ESSEX JOINT STP	75.00	30	3
340344	ATLANTIC COUNTY S.A.	40.00	30	4
340350	LIVINGSTON WTW UPGRADE	3.50	30	1
340354	LINCOLN PARK STP	7.50	51	4
340356	OCEAN CO. SEW. AUTH.	28.00	30	4
340358	PEMBERTON M Y A	2.50	33	4
340372	OCEAN COUNTY S.A CENTRAL	24.00	30	4
340376	MORRISTOWN STP	3.45	40	2
340377	S MONMOUTH S.A.	9.00	30	4
340383	HAMILTON TOWNSHIP	16.00	30	3
340386	BERGEN CO SEWER AUTHORITY	75.00	30	1
340387	CAPE MAY CO MUA STP	6.30	40	4
340387	OCEAN CITY REGIONAL WTP	6.30	30	3
340388	HANOVER SEWER AUTHORITY	3.00	30	1
340391	EWING LAWRENCE WTP	24.00	50	3
340406	UPPER WALLKILL VALLEY STP	2.50	41	4
340527	LAMBERTVILLE STP	1.50	30	1
340535	READINGTON-LEBANON SA STP	0.80	51	4
340550	CUMBERLAND CO. SEWERAGE A	7.00	30	3

STATE NEW MEXICO

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE

TABLE B.1 (CONTINUED)
WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

STATE NEW MEXICO

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
350171	LAS CRUCES WWTP	6.00	30	1
350168	CITY OF LORDSBURG WWTP	0.80	30	4
351003	DEMING LAGOONS	1.50	30	5
351004	HOBBS STP	4.00	40	4
351005	SILVER CITY STP	2.00	30	4
351010	FARMINGTON STP	7.30	30	3
351015	RATON WWTP	1.20	30	4
351017	RUIDOSO REGIONAL STP	2.64	50	4
351018	TULAROSA STP	0.50	40	5
351025	BERNALILLO STP	0.80	30	3
351029	CITY OF PORTALES WWTP	1.14	30	4
351030	CLOVIS STP	4.00	20	4
351031	LOVINGTON STP	1.53	30	2
351034	LAS VEGAS SS	2.50	40	4
351035	JAL STP	0.40	30	4
351062	EAGLE NEST STP	0.06	30	3
351063	LOS LUNAS STP	0.70	30	4

STATE NEW YORK

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
360326	NUNDA VILLAGE STP	0.29	50	4
360376	OAKFIELD WTP	0.34	50	3
360384	MARION STP	0.13	51	4
360389	RENSSELAER COUNTY S.D.	24.00	30	4
360433	SAG HARBOR SEWAGE SYS	0.10	30	4
360436	HAMMOND VILLAGE STP	0.03	30	4
360446	CLAYTON STP	0.30	30	4
360465	ONTARIO TOWN SEWERAGE SYS	1.00	54	4
360534	SACKETS HARBOR STP	0.60	30	4
360557	DOCK STREET WTP	1.36	30	3
360558	LLOYD STP	1.25	30	3
360567	NEW ROCHELLE S.D.	13.60	30	2
360621	GREENPORT	0.50	30	2
360627	CORFU WTP	0.14	53	4
360640	WALTON STP	1.17	40	4
360641	MONTGOMERY COUNTY SCI STP	1.00	30	4
360644	WATERFORD SEWERAGE SYSTEM	1.50	30	4
360646	COBLESKILL WTW	0.75	50	5
360650	GROTON WTW	0.25	30	3
360652	ADAMS STP	0.45	41	4
360659	SYRACUSE METRO	80.00	53	3
360661	MASSENA STP	2.50	30	2
360680	CHAUTAUQUA LAKE SD STP	4.10	30	4
360691	ORANGE CO. S.D. #1 STP	2.00	51	4
360711	GRAND ISLAND WWTP	3.50	53	3

TABLE B.1 (CONTINUED)
WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

STATE NEW YORK

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
360719	PHILMONT STP	0.25	40	4
360725	CANAJOHARIE STP	2.35	30	3
360732	MINETTO STP	0.60	30	4
360742	LISHAKILL COLONIE	5.00	30	4
360747	NIAGARA FALLS AWT	48.00	33	5
360750	CHAMPLAIN PK S.D.	0.15	40	3
360766	HUDSON CITY STP	3.80	40	2
360771	WESTFIELD STP	2.60	33	4
360783	OCEAN BEACH STP	0.50	32	2
360786	WATKINS GLEN STP	0.70	30	3
360800	GREENPORT STP	0.56	30	3
360806	SYLVAN BEACH STP	1.72	33	4
360811	ALTAMONT STP	0.42	50	3
360812	SODUS POINT STP	0.57	30	4
360814	HANOVER STP	0.50	30	4
360824	ALBION AWT	2.00	53	4
360836	HOLLAND SD#3 STP	0.37	50	4
360843	STONY POINT STP	8.00	30	1
360854	DEPOSIT SEWERAGE SYSTEM	0.40	30	4
360859	MARATHON SEWER SYSTEM	0.20	30	4
360913	NORTH CHAUTAUQUA LAKE STP	0.50	30	3
360914	SHERMAN STP	0.14	50	4
360922	SOMERSET-BARKER STP	0.28	30	4
360949	CARMEL STP	0.20	50	4
360973	PARISH WPCP	0.14	40	4
360981	SENECA CNTY SD#1 STP	0.71	50	4
361000	SKANEATELES STP	0.55	50	4

STATE NORTH CAROLINA

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
370364	TARBORO WTW	3.00	30	3
370377	IRWIN CREEK STP	10.00	50	2
370377	MALLARD STP	3.00	51	4
370377	MCALPINE STP	30.00	51	3
370382	CONCORD WTW	24.00	50	4
370383	FARMVILLE WTW	3.50	51	4
370385	EAST BURLINGTON STP	12.00	40	3
370386	WILSON BAY STP	4.46	30	3
370397	LOUISBURG STP	0.80	30	1
370401	MAGNOLIA STP	0.09	40	5
370411	PARKTON STP	0.12	30	3
370417	DUNN STP	2.28	40	4
370425	CLINTON STP	3.00	44	2
370433	RED SPRINGS STP	1.50	32	3
370435	WILLIAMSTOWN WTP	1.06	30	3

TABLE B.1 (CONTINUED)
WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

STATE NORTH CAROLINA

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
370436	CONOVER CITY STP	0.60	30	1
370437	MAIDEN TOWN STP	1.00	30	4
370438	WOODLAWN STP	0.18	30	3
370441	MOORE COUNTY REG. WTW	6.70	51	4
370442	TRENTON TOWN STP	0.07	30	4
370452	OAKBORO TOWN STP	0.50	30	4
370463	RUTHERFORDTON TOWN STP	0.64	30	3
370470	CHERRYVILLE CITY STP	2.00	30	4
370493	BOONE TOWN STP	3.20	30	1
370584	BENSON TOWN STP	0.83	51	3

STATE NORTH DAKOTA

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
380294	ENDERLIN STP	0.25	30	1
380313	SHELDON LAGOON AND CS	0.03	30	4
380321	BISMARCK WWTP	5.04	30	3
380324	HARVEY LAGOONS	0.28	30	4
380325	MANDAN STP	2.00	30	3
380326	NEW TOWN LAGOON	0.20	30	3
380329	DICKINSON LAGOONS	1.49	30	3
380332	CRARY WWTP	0.02	30	4
380334	MINNEWAUKAN LAGOONS	0.06	30	3
380335	WAHPETON STP	0.83	30	3
380341	ZEELAND STP	0.03	30	4
380342	DOUGLAS LAGOON	0.01	30	3
380350	MARMARTH LAGOON	0.02	60	4
380355	WILLISTON STP	1.74	40	3
380361	ANETA STP	0.10	30	2
380365	HANKINSON STP	0.11	30	4
380367	MICHIGAN STP	0.05	30	4
380368	MINTO STP	0.12	30	3
380370	PETERSBURG LAGOON	0.04	30	3
380371	SCRANTON STP	0.05	30	3
380375	VERONA LAGOON	0.02	30	4
380376	GRANVILLE LAGOON	0.03	30	3
380377	MUNICH LAGOON	0.04	30	3
380379	SOURIS LAGOON	0.01	30	4
380380	STARKWEATHER LAGOON	0.02	30	3
380387	NEW ENGLAND LAGOON	0.12	30	3
380389	REYNOLDS LAGOON	0.03	30	3
380390	RUTLAND LAGOON	0.03	30	3
380394	WOODWORTH LAGOON	0.02	30	4
380395	BERTHOLD LAGOON	0.02	30	3
380397	CARRINGTON STP	0.32	30	3
380399	LIGNITE LAGOON	0.03	30	3

TABLE B.1 (CONTINUED)
WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

STATE NORTH DAKOTA

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
380403	BOWMAN LAGOON	0.33	30	1
380408	THOMPSON STP	0.08	30	4
380409	WASHBURN STP	0.15	30	2
380413	EGELAND STP	0.01	30	4
380416	ALEXANDER STP	0.02	30	3
380419	COURTENAY STP	0.01	60	4
380422	MARTIN STP	0.01	60	4
380437	KRAMER STP	0.01	60	4
380455	EDMORE LAGOON	0.04	30	3
380465	BEULAH LAGOON	0.53	30	3
380474	ZAP STP	0.05	30	3

STATE OHIO

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
390464	VAN WERT	2.75	53	3
390514	RAVENNA	2.80	44	3
390556	LITTLE MIAMI WWTP	38.00	34	3
390586	MINERAL CITY	0.15	30	4
390589	OAK HARBOR WWTP	0.74	30	3
390590	PLEASANT HILL	0.20	30	3
390591	EUCLID	22.00	43	3
390593	MOUNT VERNON WWTP	5.00	43	3
390599	URBANA WWTP	3.00	34	3
390622	CANTON	33.00	51	3
390626	LIMA WWTP	13.50	54	2
390627	MASSILLON	12.00	53	3
390630	BURTON WWTP	0.27	40	5
390644	CIRCLEVILLE	3.50	33	4
390648	OREGON WWTP	8.00	43	4
390654	HAMILTON	24.70	33	1
390657	MEDINA COUNTY REGIONAL TP	2.00	53	4
390663	HASKINS WWTP	0.10	50	4
390680	NEW KNOXVILLE WWTP	0.12	40	4
390683	FRENCH CREEK STP	7.50	54	4
390684	YOUNGSTOWN STP	4.00	53	4
390686	FAIRFIELD	6.00	54	3
390702	MONTGOMERY CO WEST REG PT	20.00	54	4
390705	LEESBURG STP	0.16	51	4
390709	PETTISVILLE STP	0.12	30	4
390711	NEW CARLISLE STP	1.00	54	4
390717	PROSPECT	0.12	30	4
390740	CLARK COUNTY STP	2.00	54	4
390741	SO. CLEVELAND STP	200	33	3
390746	ERIE COUNTY STP	1.20	33	3
390748	LAFAYETTE STP	0.10	50	4

TABLE B.1 (CONTINUED)
WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

STATE OHIO

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
390753	BLOOMINGBURG	0.16	50	4
390754	SHERWOOD WWTP	0.15	30	4
390763	ELDORADO STP	0.10	51	4
390810	NEWCOMERSTOWN STP	1.25	33	3
390821	SANDYVILLE WWTP	0.50	30	4
390830	PIONEER STP	0.16	30	4
390844	MALVERN STP	0.35	30	4
390861	BALTIC STP	0.10	50	4
390871	CARROLLTON STP	0.55	54	3
390902	WARSAW STP	0.17	30	4
390929	WILLARD STP	3.50	53	3
390953	SMITHVILLE STP	0.32	40	3
390957	SWANTON WWTP	0.42	50	3
390982	SOUTH POINT WWTP	1.20	30	3
390996	CANTON STP	33.00	53	2
390999	LIVERPOOL WWTP	10.00	53	3
391001	PREBLE COUNTY WWTP	0.60	54	4
391005	ASHLEY	0.19	44	4
391210	BATAVIA STP	2.00	54	4
391259	PERRYSVILLE STP	0.13	30	4

STATE OKLAHOMA

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
400520	STRINGTOWN STP	0.08	40	5
400537	WEWOKA WWTP	0.75	40	3
400551	BOKOSHE STP	0.07	30	4
400565	HOLDENVILLE SOUTHSIDE STP	0.64	40	4
400572	MANNFORD EAST STP	0.07	40	4
400572	MANNFORD MAIN STP	0.54	40	4
400584	BETHANY - WARR ACRES PLAN	5.00	54	3
400597	DEER CREEK AWTP	10.00	44	4
400608	CYRIL IRRIGATION LAGOON	0.25	30	4
400611	HARTSHORNE STP	0.26	40	5
400612	STONEWALL LAGOONS	0.09	30	4
400616	EL RENO STP	1.20	40	4
400622	LAVERNE STP	0.22	30	4
400625	MARLOW NON-DISCHARGE LAG	0.07	60	4
400625	MARLOW IRRIGATION LAGOON	0.53	30	4
400626	WYANDOTTE STP	0.09	40	4
400627	BOWLEGS STP	0.05	30	4
400630	MCALESTER STP	2.50	40	3
400636	BUTLER STP	0.05	40	4
400638	AMBER LAGOONS	0.04	30	4
400639	CHICKASHA STP	3.00	40	5
400640	KINGSTON STP	0.25	40	4

TABLE 3.1 (CONTINUED)
WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

STATE OKLAHOMA

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
400644	RANDLETT STP	0.05	60	4
400645	ALTUS WWTP	2.00	33	4
400652	PAWNEE STP	0.33	40	4
400653	MANNSVILLE STP	0.05	60	4
400666	MILL CREEK LAGOON	0.04	60	4
400670	WAUKOMIS STP	0.15	40	4
400674	STILLWATER WWTP	6.00	40	3
400676	HOWE STP	0.06	40	4
400679	CAMERON STP	0.05	40	4
400681	YUKON STP	3.00	30	4
400682	PERRY WWTP	0.75	40	4
400686	FOX STP	0.03	60	4
400687	NORTHSIDE STP	1.00	40	4
400688	HAWORTH STP	0.08	30	4
400692	SOUTHSIDE STP	3.00	30	1
400704	ADA STP	4.40	40	1
400705	EUFAULA STP	0.36	30	4
400706	GARVIN LAGOONS	0.02	60	4
400708	OKEMAH STP	0.37	30	4
400712	OKARCHE STP	0.14	60	3
400715	SPRINGER NON-DISCH LAGOON	0.04	60	4
400723	CLINTON STP	2.20	40	4
400727	DAVENPORT LAGOON	0.11	60	4
400736	WILLOW STP	0.02	60	4
400742	LENAPAH STP	0.04	30	4
400743	MARTHA LAGOONS	0.03	60	4
400744	CROWDER STP	0.04	30	4
400745	CANADIAN STP	0.05	30	4
400756	TISHOMINGO STP	0.50	30	3
400769	TEMPLE STP	0.13	60	2
400772	MUNICIPAL STP	0.33	30	3
400775	CARNEY STP	0.07	30	3
400779	NO CANADIAN WWTP	40.00	30	4
400787	MAUD STP	0.20	30	4
400802	CHEROKEE STP	0.42	30	3
400807	CHECOTAH STP	0.45	30	5
400811	FLETCHER STP	0.09	60	2
400812	PRAGUE LAGOON	0.23	30	2
400834	ROOSEVELT NON-DISCH LAG	0.05	60	4
400845	LIMA STP	0.04	30	4
400847	TALALA STP	0.03	20	4
400868	WAURIKA EASTSIDE STP	0.23	30	1
400914	SOUTH PLANT	1.50	30	1
400947	MANCHESTER LAGOON	0.02	60	4

TABLE B.1 (CONTINUED)
WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

STATE OREGON

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
410273	ROCKAWAY STP	0.50	51	3
410320	WILLOW LAKE STP	35.00	30	1
410323	NETARTS-OCEANSIDE STP	0.24	40	4
410341	TRYON CREEK STP	10.50	40	3
410355	CORVALLIS STP	9.70	51	3
410365	DEPOE BAY STP	0.80	30	4
410371	DURHAM WWTP	20.00	41	4
410374	MAUPIN STP	0.13	30	4
410411	REDWOOD SANITARY DISTRICT	0.50	30	4
410416	CLOVERDALE STP	0.04	40	4
410417	PACIFIC CITY STP	0.30	50	4
410423	CAVE JUNCTION STP	0.15	40	3
410424	BOARDMAN LAGOON	0.40	30	4
410427	AUMSVILLE LAGOONS	0.32	50	3
410428	SOUTH LAGOON	0.20	30	3
410428	NORTH LAGOON	0.10	30	3
410430	DAYTON STP	0.21	30	1
410434	GLENDALE STP	0.25	50	4
410436	SUTHERLIN STP	1.30	50	4
410438	JOHN DAY STP	0.60	40	1
410439	MT. VERNON STP	0.10	30	4
410444	MOLALLA STP	0.80	50	4
410446	LEBANON STP	3.00	50	3
410455	SHADY COVE STP	0.45	40	4
410475	LA GRANDE STP	2.60	30	3
410485	HILLSBORO EAST ROCK CREEK	15.00	53	4
410486	BEND STP	6.00	30	4
410488	CANYONVILLE STP	0.38	50	3
410499	PRAIRIE CITY STP	0.33	30	4
410505	TILLAMOOK CITY STP	3.50	30	1
410507	WILLAMINA STP	0.23	40	1
410508	AMITY STP	0.14	30	1
410509	WOODBURN STP	3.40	40	4
410510	JEFFERSON STP	0.40	40	3
410517	HERMISTON STP	2.94	40	4
410523	ST PAUL STP	0.07	30	4
410528	COVE STP	0.05	30	4
410530	LAKESIDE STP	0.50	51	4
410556	REEDSPORT STP	2.24	30	1
410559	LINCOLN CITY STP	3.00	50	3
410537	HAINES STP	0.05	30	4
410640	INDEPENDENCE STP	1.27	30	1

TABLE 6.1 (CONTINUED)
WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

STATE PENNSYLVANIA

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
420572	HICKORY TWP MUNIC.AUTH.	2.00	40	3
420585	LOCK HAVEN STP	3.75	30	3
420600	VALLEY FORGE SEWER AUTH	3.00	30	4
420622	PORTAGE JOINT SEWER AUTH	1.00	30	4
420643	ELIZABETHVILLE BORO	0.28	30	2
420657	TRI-BORO MUN. AUTH. STP	0.50	30	4
420701	MOSHANNON VALLEY J.S.A.	1.50	30	4
420703	GALLITZIN STP	0.40	31	4
420704	OIL CITY GENERAL AUTH.	4.00	30	3
420707	MC CANDLESS TWP SAN.AUTH	3.00	30	4
420711	HAMILTONBAN TWP AUTH	0.03	30	4
420712	OLEY TWP MUNICIPAL AUTH	0.25	40	4
420715	MIDDLETOWN BOROUGH AUTH	2.20	33	3
420718	SHOEMAKERSVILLE MWWTF	0.35	33	3
420719	PORTER TWP WWP	0.12	30	4
420720	MONTGOMERY STP	0.60	40	2
420723	ADAMS TOWNSHIP	0.03	30	4
420724	UPPER STONYCREEK J.M.A.	0.27	30	4
420728	MILTON MUNICIPAL AUTHORIT	2.60	30	3
420733	THOMPSONTOWN MUNICIPAL A.	0.11	30	4
420735	EAST NORRITON STP	9.30	40	3
420737	NEW KENSINGTON M.S.A.	7.00	30	2
420738	YORK CITY SEWER AUTHORITY	25.00	33	3
420739	POINT MARION MUNICIPAL AU	0.30	30	4
420742	TREMONT MUNICIPAL AUTH	0.33	43	4
420749	CORAOPOLIS STP	3.00	30	3
420760	SYKESVILLE STP	0.20	30	4
420775	CARMICHAELS JOINT STP	0.60	30	4
420781	SCHUYLKILL HAVEN MUNIC.A	2.00	33	3
420783	BROWN TWP MUNICIPAL AUTH	0.25	30	4
420793	FREEDOM TWP. STP.	0.20	40	4
420802	LITITZ BOROUGH STP	3.50	54	3
420803	PENN TWNSHP, YORK CO STP	4.20	54	3
420804	CANONSBURG-HOUSTON STP	5.60	54	3
420806	ELIZABETHTOWN STP	3.00	33	3
420808	MOUNT JOY STP	1.30	44	3
420810	SHIPPENSBURG STP	2.75	44	3
420820	MOUNTAINTOP AREA	1.83	30	4
420830	CARLISLE STP	7.00	44	4
420832	EASTON AREA SSA STP	10.00	40	3
420841	GROVE CITY STP	3.00	44	3
420845	MYERSTOWN STP	1.40	44	3
420856	MT HOLLY SPRINGS STP	0.60	44	3
420857	PINE GROVE BOROUGH STP	0.60	50	3
420861	LATROBE STP	5.00	51	3
420874	LEWISTOWN STP	2.40	30	3
420896	MOUNT UNION STP	0.63	30	3
420901	BOYERTOWN STP	0.75	53	2

TABLE 3.1 (CONTINUED)
WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

STATE PENNSYLVANIA

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
420905	MECHANICSBURG STP	2.03	44	3
420917	PORTER-TOWER JT.STP	0.43	33	4
420938	ALLEGHENY TOWNSHIP STP	0.10	40	4
420947	NEW HANOVER STP	0.28	60	4
420976	CLYMER BOROUGH STP	0.24	41	4
420980	PINEY FORK STP	4.10	40	3
420997	WEST GOSHEN STP	4.50	41	3
421002	LYNN TWP STP	0.00	44	4
421004	HARRISBURG SEWERAGE AUTH.	30.90	33	3
421016	MID-CENTRE STP	0.50	54	4
421020	AMBLER STP	6.50	51	3
421030	ALBION BOROUGH STP	1.40	34	3
421042	VANPORT STP	1.56	30	1
421046	ABINGTON TOWNSHIP STP	3.91	51	2
421048	UNITY TWP STP	0.50	41	4
421071	BUTLER AREA STP	10.00	54	3
421074	CHAMBERSBURG STP	5.20	51	3
421088	MAIDENCREEK TOWNSHIP STP	0.45	41	4
421113	NO. LANCASTER CO SA STP	0.35	44	4
421188	FRANKLIN STP	0.50	51	4
421190	ANTRIM TOWNSHIP STP	0.70	41	4
421203	BROWN TOWNSHIP MUNI AUTHO	0.60	40	1
421229	SELINSGROVE STP	2.80	30	4
421270	EXETER STP	2.40	51	3
421282	PETERSBURG STP	0.10	50	4

STATE RHODE ISLAND

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
440074	BLOCK ISLAND WWTP	0.25	30	4
440079	BURRILLVILLE STP	1.50	33	4
440066	SMITHFIELD REGIONAL WWTF	3.50	40	4
440087	JAMESTOWN STP	0.73	30	4

STATE SOUTH CAROLINA

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
450265	SANTEE PUBLIC SERVICE DIS	0.30	40	4
450321	AIKEN WTP	20.00	30	4
450366	OCONEE COUNTY STP	5.00	33	4

TABLE 4.1 (CONTINUED)
WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

STATE SOUTH DAKOTA

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
460222	VIVIAN LAGOON	0.0[illegible]	60	4
460231	LEAD-DEADWOOD STP	2.33	31	4
460234	MITCHELL WWTP	3.00	30	4
460238	RAMONA WWT PONDS	0.03	60	4
460241	BOX ELDER LAGOON	0.26	30	4
460259	HENRY WWT POND	0.02	60	4
460272	BROOKINGS STP	2.99	51	4
460276	BLUNT LAGOON	0.04	60	4
460286	PIERRE STP	1.9[illegible]	30	3
460293	FLANDREAU STP	0.35	60	4
460297	SCOTLAND WWTP	0.13	30	1
460305	LAKE NORDEN STP	0.07	60	2
460310	MARION LAGOON	0.10	30	3
460314	SINAI STP	0.02	30	4
460334	CANTON STP	0.30	30	3
460340	IROQUOIS STP	0.05	30	4
460469	YANKTON STP	4.32	30	3
460472	BRUCE LAGOON	0.03	60	4
460496	SPEARFISH STP	0.78	50	4

STATE TENNESSEE

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
470279	DYER STP	0.68	51	4
470317	CARTHAGE STP	0.50	30	2
470323	OAK RIDGE WTP	5.37	51	5
470326	WOODBURY STP	0.63	40	5
470352	GATLINBURG WWTP	3.00	41	4
470355	MCEWEN STP	0.50	51	3
470362	COVINGTON STP	1.81	30	4
470363	COLLIERVILLE STP	1.50	30	4
470364	LAFAYETTE STP	0.38	40	3
470367	PIGEON FORGE STP	1.25	41	5
470369	CLAIBORNE STP	0.65	30	3
470384	CENTRAL STP	45.50	50	3
470385	THIRD CREEK STP	40.00	31	3
470418	SMYRNA STP NO. 1	2.60	32	3
470451	WESTMORELAND STP	0.23	51	4
470473	DECATUR STP	0.17	30	4
470476	FRIENDSHIP STP	0.09	50	4
470480	BELL BUCKLE STP	0.15	30	4
470485	DYERSBURG WTP	6.30	42	4
470490	SPRING HILL STP	0.15	40	4
470494	MOUNTAIN CITY STP	0.09	30	5
470520	JASPER STP	0.73	43	4

TABLE B.1 (CONTINUED)
WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

STATE TEXAS

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE

STATE TEXAS

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
480638	SAN ANGELO STP	3.00	30	3
480799	BLOOMING GROVE WWTP	0.10	40	3
480356	CROCKETT WWTP	1.00	30	5
480876	MERTZON WWTP	0.05	30	4
480857	NORTHWEST AREA STP	1.20	40	4
480867	NORTHEAST AREA STP	0.80	40	4
480367	SOUTH STP	1.00	40	4
480893	CORSICANA STP	3.55	30	1
480920	DONNA STP	1.56	30	5
480936	KERRVILLE CITY WWTP	2.05	30	1
480952	SULFUR SPRINGS WWTP	2.50	40	3
480970	CENTER STP	1.77	40	4
480960	SAVOY STP	0.13	40	4
480981	CROSBY WWTP	0.25	40	4
480987	GOLDTHWAITE STP	0.23	30	5
480999	SNOOK STP	0.08	30	4
481002	MART STP	0.35	30	4
481017	VILLAGE CREEK WWTP	96.00	51	3
481021	LONGVIEW WWTP	15.60	51	3
481030	GREENVILLE STP	5.29	43	3
481045	BAYTOWN CITY WWTP	3.00	40	1
481049	NUECES COUNTY WCID #5 STP	0.10	30	4
481062	BURKBURNETT WWTP	2.20	30	1
481064	CLEAR LAKE CITY WWTP	4.50	33	3
481088	BEVIL OAKS STP	0.20	40	4
481106	MEDINA COUNTY WCID #3 STP	0.14	30	4
481110	SILVER LAKE WWTP	1.00	40	3
481112	WILLIS STP	0.40	40	4
481113	STEPHENVILLE STP	1.35	30	4
481119	HARLINGEN STP NO.2	3.50	40	3
481121	BLACKHAWK REGIONAL STP	3.25	54	4
481123	TEXAS CITY STP	7.50	53	4
481124	DALLAS SOUTHSIDE STP	30.00	50	1
481125	HOLLIDAY STP	0.20	40	5
481126	MALAKOFF STP	0.32	40	4
481128	NAVASOTA STP	0.85	40	4
481130	WHITNEY STP	0.20	30	4
481134	TRENTON STP	0.12	40	4
481137	POTTSBORO STP	0.21	50	4
481155	NORTH BROWNSVILLE STP	5.00	40	4
481157	MESQUITE STP	12.30	53	3
481165	MOUNT VERNON STP	0.43	30	5

TABLE B.1 (CONTINUED)
WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

STATE TEXAS

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
481169	ALVORD STP	0.11	40	4
481178	PROSPER STP	0.15	40	5
481180	LAKE JACKSON STP	3.30	40	3
481182	HICO STP	0.20	30	4
481183	BRAZORIA STP	0.75	40	4
481188	PECAN CREEK STP	12.00	51	3
481191	LUMBERTON MUD STP	1.50	40	4
481192	BROWNFIELD LAGOONS	1.25	30	4
481197	NACOGDOCHES STP # 2A	9.07	30	1
481200	MANOR STP	0.19	30	4
481216	BROADWAY STP	10.00	40	2
481219	LIVINGSTON STP	0.75	30	5
481223	MERCEDES STP	1.30	30	4
481225	PECOS LAGOONS	1.60	30	4
481231	MOODY STP	0.20	30	5
481235	MONTGOMERY CY WCID #1 STP	0.45	50	4
481236	HARRIS COUNTY STP	0.20	50	4
481244	BELL CNTY STP	15.00	51	3
481253	WEST CEDAR CREEK STP	0.68	40	4
481257	KINGSLAND MUD STP	0.75	53	4
481262	DEVERS STP	0.08	30	4
481263	LAZY RIVER IMPROVEMENTS	0.13	40	4
481266	CEDAR BAYOU STP	0.10	40	4
481270	HALLSVILLE STP	0.32	30	4
481271	SOMERSET STP	0.18	40	4
481273	CITY OF BULLARD STP	0.10	40	4
481274	BROADDUS STP	0.14	50	4
481275	COLORADO CNTY WCID #2 STP	0.10	30	5
481278	DETROIT STP	0.11	30	5
481284	PFLUGERVILLE STP	0.26	40	4
481288	LUFKIN STP	0.55	40	4
481291	ZAPATA CNTY STP	0.80	40	5
481294	LIBERTY - DANVILLE STP	0.03	40	4
481296	AUBREY STP	0.15	30	4
481306	TOM BEAN STP	0.10	30	5
481308	MAGNOLIA STP	0.18	50	4
481314	OYSTER CREEK STP	0.50	30	4
481596	CLEAR LAKE CITY WA STP	6.75	54	1

STATE UTAH

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
490142	CEDAR CITY WWTP	2.26	50	4
490152	HYRUM CITY STP	0.88	50	4
490170	GRANGER-HUNTER STP	7.30	40	2
490171	WELLSVILLE STP	0.20	60	4

TABLE B.1 (CONTINUED)
WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

STATE UTAH

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
490174	LONG VALLEY REGIONAL STP	0.40	30	4
490175	TROPIC TOWN STP	0.04	30	4
490179	TABIONA STP	0.04	30	4
490180	MYTON LAGOON	0.12	60	4
490181	EMERY TOWN PONDS	0.03	60	4
490185	PRICE RIVER STP	1.84	60	4
490189	ASHLEY VALLEY SEW MAN STP	3.90	30	4
490194	PROVO CITY WWTP	21.00	50	3
490197	SNYDERVILLE BASIN STP	2.00	50	4
490207	TIMPANOGOS STP	7.60	30	4
490232	MOUNT PLEASANT LAGOON	0.32	60	4
490244	CASTLE VALLEY STP	0.70	50	4
490264	HEBER VALLEY STP	2.49	30	4

STATE VERMONT

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
500079	BRANDON WWTP	0.70	30	3
500081	HARTFORD WWTP	1.00	30	4
500083	NORTH BRANCH F.C. STP	0.82	30	4
500089	ENOSBURG FALLS	0.26	30	4
500104	STOWE WWTP	0.17	43	4
500105	MANCHESTER STP	0.60	30	4
500111	HYDE PARK SEPTIC SYS	0.05	10	4
500115	READSBORO STP	0.10	30	4
500117	ROYALTON STP	0.07	30	4
500123	ALBURG WTF	0.13	40	4
500126	ORLEANS WPCF	0.19	43	4
500134	ROCK ISLAND STP	0.40	43	3
500138	BARTON STP	0.12	33	4
500140	MIDDLEBURY STP	2.20	40	3
500146	VERGENNES WTF	0.60	33	3
500151	WATERBURY STP	0.51	30	5
500153	MARSHFIELD STP	0.05	30	4
500162	FARFAX STP	0.08	30	4
500164	HARDWICK WTP	0.40	30	4
500165	BRIDGEWATER STP	0.04	30	4

STATE VIRGINIA

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
510259	UPPER SMITH RIVER WWTP	4.00	30	4
510314	GALAX STP	1.50	30	3

TABLE B.1 (CONTINUED)
WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

STATE VIRGINIA

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
510331	UPPER OCCOQUAN REGIONAL	22.50	54	4
510355	CLIFTON FORGE STP	2.00	30	3
510356	ALEXANDRIA STP	54.00	54	3
510357	ARLINGTON COUNTY	30.00	33	2
510370	ROANOKE STP	21.00	30	8
510375	STUART STP	0.30	30	4
510381	FRONT ROYAL STP	2.00	30	5
510383	ROUND HILL	0.10	50	4
510384	WAVERLY STP	0.35	30	3
510394	CLEVELAND STP	0.04	30	4
510396	LEXINGTON STP	2.00	30	3
510442	ROANOKE STP	35.00	54	2
510460	MIDDLEBURG STP	0.14	40	4
510468	ABINGDON STP	1.50	40	2
510471	ARMY BASE STP	18.00	30	3
510475	CRAIGSVILLE STP	0.25	20	4
510484	FALLING CREEK STP	9.00	43	3
510485	CULPEPER STP	3.00	40	3
510486	CHRISTIANSBURG STP	2.00	40	4
510488	LEBANON STP	0.71	40	3
510490	MCKENNEY STP	0.10	30	4
510497	NANSEMOND STP	10.00	30	4
510498	BLACKSBURG STP	6.00	30	4
510500	REEDVILLE STP	0.20	30	4
510502	FINCASTLE STP	0.08	30	4
510509	RIVANNA STP	15.00	50	4
510515	POUND STP	0.18	30	4
510517	MARTINSVILLE STP	6.00	30	3
510518	LURAY STP	0.80	30	4
510521	ST.LOUIS STP	0.09	40	4
510551	CEDAR RUN REGIONAL STP	0.16	30	4
510565	ELKTON STP	0.40	30	4
510594	VERONA STP	0.80	30	4
510595	SCOTTSBURG STP	0.03	30	4
510597	BOYDTON STP	0.15	51	4

STATE WASHINGTON

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
530466	BIRCH BAY STP	1.60	30	4
530488	WESTPORT WWTF	1.00	30	3
530494	KITSAP COUNTY STP	4.80	30	4
530497	OMAK STP	1.89	30	4
530504	OLYMPIA STP	9.10	30	3
530513	ARLINGTON STP	1.00	30	3
530516	BURLINGTON STP	1.20	30	4

TABLE B.1 (CONTINUED)
WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

STATE WASHINGTON

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
530530	WEST LONGVIEW STP	0.20	30	3
530549	STEVENS-PASS-YODELIN STP	0.06	40	4
530553	WHITE SWAN STP	0.10	60	4
530556	ABERDEEN STP	4.73	33	3
530557	YAKIMA STP	19.10	30	3
530560	ENUMCLAW STP	2.50	30	5
530568	GINKGO STP	0.10	30	4
530572	NORTH BEND STP	0.75	30	5
530578	VADER STP	0.71	30	3
530579	LOTT STP	13.00	30	3
530580	SPOKANE WWTF	40.00	33	3
530582	WASHOUGAL STP	1.60	30	3
530584	EATONVILLE STP	0.46	20	4
530588	HARRAH STP	0.10	30	4
530596	LIBERTY LAKE STP	1.00	30	4
530599	GRANITE FALLS	0.19	30	4
530600	WAPATO STP	1.10	30	3
530601	GOLDENDALE STP	1.30	40	4
530604	SHELTON STP	3.34	30	4
530609	MC CLEARY STP	0.25	41	2
530612	REDONDO STP	3.61	30	3
530613	WINLOCK STP	0.30	30	3
530616	OAK HARBOR STP	0.85	30	2
530619	KITTITAS STP	0.28	30	4
530652	CUSICK STP	0.05	30	2
530700	BIG LAKE STP	0.20	30	4
530709	DRYDEN STP	0.03	10	4
530720	COLLEGE PLACE STP	0.91	30	3
530721	CONCONULLY STP	0.40	20	4
530724	RYDERWOOD STP	0.09	30	4
530734	EASTSOUND STP	0.08	30	4
530740	GLENWOOD STP	0.10	30	4
530756	LEAVENWORTH STP	0.40	30	5
530804	WALLA WALLA STP	0.06	60	4
530812	WISHRAN STP PUD #1	0.10	30	4
530824	COLVILLE STP	0.09	60	4
530829	HOQUIAM STP	2.34	30	3
530833	BUCKLEY STP	1.00	30	5
530838	ALMIRA STP	0.04	30	4
530847	CENTRALIA STP	6.90	30	3
530922	BLACK DIAMOND STP	0.32	30	4

STATE WEST VIRGINIA

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
540169	ALDERSON STP	0.45	40	4

TABLE ?.1 (CONTINUED)
WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

STATE WEST VIRGINIA

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
540176	ARBUCKLE STP	0.34	30	4
540196	WEIRTON STP	4.00	30	2
540204	BEVERLY STP	0.35	30	4
540208	BELEARTON	0.12	50	4
540209	GREENBRIER STP	1.30	30	4
540212	BRADLEY PSD STP	0.40	50	4
540213	BLUEFIELD	3.50	54	4
540258	BRUCETON MILLS STP	0.07	41	4
540266	WHEELING STP	10.00	30	2
540275	COLFAX PSD STP	0.07	30	4
540298	WARDENSVILLE STP	0.11	30	4
540326	MOUNTWOOD PARK STP	0.32	51	4
540336	MALDEN STP	1.50	30	4
540339	GLEN ROGERS STP	0.08	40	4
540342	HEPZIBAH STP	0.30	30	4
540351	ELIZABETH STP	0.14	30	4
540424	ST. ALBANS STP	2.50	30	2

STATE WISCONSIN

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
550467	JACKSON AWWT	0.37	54	4
550468	TWO RIVERS	4.40	43	3
550513	LUXEMBURG STP	0.35	20	4
550548	SUPERIOR STP	5.00	33	2
550552	RACINE STP	30.00	34	3
550562	WATERTOWN STP	5.20	50	3
550563	ELLSWORTH STP	0.66	40	3
550573	LOMIRA WWTF	0.49	40	4
550617	COLEMAN STP	0.27	30	5
550625	MONTREAL WWTP	0.20	30	2
550628	EAU CLAIRE REG STP	16.26	30	3
550631	OCONOMOWOC WWTP	4.02	50	4
550646	IOLA STP	0.22	30	3
550648	MANITOWOC WWTP	15.50	33	1
550649	OMRO STP	0.54	33	4
550662	RHINELANDER STP	1.90	30	3
550665	THREE LAKES STP	0.13	40	2
550685	MINERAL POINT STP	0.28	40	2
550686	KEWAUNEE STP	0.58	33	1
550686	KEWAUNEE WWTP	0.58	33	1
550687	RIPON STP	2.00	53	3
550689	HOLLAND STP	0.20	44	3
550694	PLYMOUTH AWWT	1.65	53	4
550701	SHEBOYGAN REG STP	18.39	33	5
550705	WINNECONNE STP	0.99	33	4

TABLE B.1 (CONTINUED)
WASTEWATER TREATMENT PLANT PROJECTS IN DATA BASE

STATE WISCONSIN

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
550706	DEPERE WWTP	14.20	33	3
550711	WEST BEND STP	9.00	54	3
550714	UNION GROVE STP	1.00	44	4
550716	HOWARDS GROVE STP	0.29	54	3
550731	BLACK CREEK STP	0.49	44	3
550734	MADISON MSD	51.30	30	1
550736	TOMAH STP	1.03	51	2
550752	WHITEWATER STP	3.65	50	4
550770	ANTIGO STP	2.47	41	4
550776	MARION STP	0.24	41	3
550781	DELAFIELD HARTLAND WWTP	2.20	51	4
550787	MARSHFIELD STP	3.50	30	2
550789	MONTICELLO STP	0.13	30	5
550790	STOUGHTON STP	1.65	30	5
550791	ALMENA LAGOON	0.14	50	4
550792	DALLAS LAGOON	0.10	30	4
550793	RIDGELAND LAGOON	0.05	30	4
550794	CASCO	0.07	30	8
550797	CEDAR GROVE STP	0.42	40	4
550799	RANDOM LAKE WWWT	0.62	54	4
550800	SPOONER STP	0.75	30	4
550805	VIROQUA STP	0.60	40	4
550807	AUGUSTA STP	0.33	40	3
550808	FENNIMORE STP	0.62	41	4
550809	LANCASTER STP	0.74	41	3
550820	NORTHERN MORAINE UC STP	0.60	30	4
550823	WAUKESHA STP	16.00	54	3
550863	DENMARK STP	0.50	43	4
550875	BRILLION STP	0.71	43	4
550877	WALWORTH STP	3.60	51	4

STATE WYOMING

GRANT NO	FACILITY NAME	PROJECTED FLOW	TREATMENT LEVEL	CHANGE
560104	COWLEY STP	0.05	30	4
560105	ROCK SPRINGS STP	2.00	40	4
560106	RAWLINS STP	8.70	30	4
560109	CASPER WWTP	6.40	30	3
560110	LABARGE WWTP	0.04	30	4
560111	ROCK RIVER STP	0.59	30	4
560114	GREEN RIVER WTP	1.50	40	3
560115	KEMMERER WWTP	1.46	30	1
560119	SOUTH SUPERIOR STP	0.12	30	4

TECHNICAL REPORT DATA

(Please read Instructions on the reverse before completing)

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16. ABSTRACT

This report presents the results of the latest and most comprehensive effort to obtain and analyze construction costs for wastewater treatment works built with construction grant program funds. It summarizes data from 1,585 individual treatment plant construction projects including 822 construction projects for new plants from the 48 contiguous United States in all ten EPA regions. This report contains information on total plant construction, individual unit process construction, and plant and process component construction. Further, non-construction costs, such as planning and design, related to construction of wastewater treatment plants were included.

The basic information for this report was obtained from visits to selected sites, and from earlier studies. The information was assembled into a simple data base, and examined for relationships between construction costs, facility design parameters and unit process parameters. These relationships were developed for the general national level. Also included are guidelines for adjusting costs for smaller geographic units. Where appropriate in analyzing the data, total construction costs were reduced to their major components.

17. KEY WORDS AND DOCUMENT ANALYSIS

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