CITY OF TAMPA, FLORIDA

HOOKERS POINT WASTEWATER TREATMENT PLANT EXPANSION

STUDY MEMORANDUM G
MASTER PLAN

FINAL EDITION

GREELEY AND HANSEN

JANUARY 1989

CITY OF TAMPA, FLORIDA
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I. Introduction

A. General

Expansion of the 60-mgd Hookers Point Wastewater Treatment Plant (WWTP) to 96.44 mgd is recommended in the Central Hillsborough County-Tampa (CHC-T) 201 Facility Plan dated July 1980. Study Memorandum G, Master Plan, is the final document in a series of study memoranda which review and re-evaluate the findings of the CHC-T 201 Facility Plan based on current conditions. The Master Plan, thus, augments the 201 Facility Plan. Study Memorandum G summarizes and integrates the recommendations of Study Memorandums A through F.

The Master Plan encompasses a 20-year planning period, developing an overall plan for the treatment needs of the Hookers Point WWTP through 2008. The current annual average flow at Hookers Point is almost at the plant design capacity of 60 mgd. The City has initiated action to address future treatment needs. As described herein, it is estimated that the raw wastewater flow to be treated at the Hookers Point WWTP will increase to 96 mgd by 2008. The Master Plan describes treatment facilities required to expand the capacity of the Hookers Point WWTP to 96 mgd.

B. Existing Plant

The existing Hookers Point WWTP has an annual average design capacity of 60 mgd. The design peak flow capacity is 140 mgd. A process schematic diagram for the plant is shown on Figure 1. An existing plant site plan is shown on Figure 2. A portion of the plant, principally the Raw Sewage Pumping Station, Screen and Grit Building No. 1, Primary Sedimentation Tanks No. 1-4, and Anaerobic Digestion Tanks No. 1-5, were constructed in the 1950's and 1960's. The remaining facilities were constructed in the 1970's and 1980's. The biological treatment facilities have been in operation since about 1978. The Heat Drying Facility and Dechlorination Facility shown on Figures 1 and 2 are under contract for construction but have not been completed.

C. Effluent Limitations

Wastewater treatment facilities must be designed to provide treatment to meet known and expected effluent limitations. The known and expected future effluent limitations on an annual average and monthly average basis are summarized as follows:

Effluent Parameter	Design Basis	To 4/30/89	5/1/89 to 10/1/90	After 10/1/90
BOD-mg/l	15	8	8	5
-lbs/day	7506	4670	4670	(c)
Suspend Solids - mg/l	13	8	8	5
-lbs/day	6505	4670	4670	(c)
Total Nitrogen-mg/l	3	5	4	3
-lbs/day	1501	2500	2000	(c)
Fecal Coliform-per 100 ml				
-Annual	N/A	200	200	N.D.(a)
-Monthly	N/A	800	800	N.D.(a)
pH	N/A	6-8.5	6-8.5	6-8.5
Chlorine Residual-mg/l	-	-	0.01(b)	0.01

(a) None Detectable
(b) Starting 10/30/89
(c) Concentration basis only

The Grizzle-Figg Act establishes the effluent limitations after October 1, 1990 for discharges to surface waters. It is important to note that the effluent limitations established by the Grizzle-Figg Act are more stringent than in the past. Decisions regarding process planning must be driven by the need to meet limitations lower than they have been in the past and lower than the design bases of the existing plant.

II. Wastewater Quantities and Characteristics

A. General

Wastewater quantities and characteristics for the Hookers Point WWTP have been evaluated in Study Memorandum B. Data were reviewed from daily, monthly, and annual operating reports for the plant from 1977 through 1986. These data were used to estimate future conditions and to develop process performance models.

B. Historical Data

During the period of analysis, annual average influent wastewater flows have ranged from 41.1 to 55.6 mgd. Raw wastewater characteristics have been as follows:

	Range of Annual Average Values		
Characteristics	Low Year	High Year	Average 1977-1986
BOD-mg/l	235	336	264
Suspended Solids-mg/l	183	266	203
Total Kjeldahl Nitrogen-mg/l	27	34	30
Total Phosphorus-mg/l	7.8	11.3	9.1

It is important to note that industrial contributions to the wastewater load have made up about 30 percent of the BOD load and about 20 percent of the suspended solids load.

C. Projected Loads

The Planning Division of the Department of Sanitary Sewers (DSS) has estimated future Hookers Point WWTP raw wastewater flows. These estimates have been used along with historical data to estimate future wastewater loads.

According to DSS estimates, the raw wastewater flow will increase in 20 years to 96 mgd by 2008. Based on an analysis of historical plant flows, the peak flow is estimated to be 2.3 times the annual average flow at 96 mgd or 221 mgd. For a number of years, plant flow records indicate that this flow rate has been sustained for only a matter of one to three hours. Recent wet weather events indicate that in the future these peak rates may be sustained for a full day. This is apparently due to the greater collection system pumping capacity available in recent years. Analyses conducted as part of this Master Plan use 221 mgd as the peak flow rate and as the maximum daily flow.

The historical average concentrations of BOD, suspended solids, and nutrients shown above have been used as the estimate of future concentrations in analyses performed as part of the Master Plan. On this basis it is predicted that the plant load in pounds will increase at the same rate as the flow to the plant. Also industrial loads are predicted to make up a similar proportion of the plant influent load as at present.

D. Process Performance

Analysis of the historical data indicates that the Hookers Point WWTP has performed quite well. The plant has consistently produced effluent concentrations better than that which will be required under the Grizzle-Figg Act, although maximum month values have exceeded the Grizzle-Figg annual average limitations each year. The existing plant, however, was not designed to meet such stringent effluent requirements at maximum month flows. Plant design and effective plant operation and maintenance have been important in producing a high quality effluent.

Models have been developed using historical data relating to process performance and solids production. The models have been used in the Master Plan to predict the performance of those plant processes which, in the expanded plant, would be similar to existing plant processes.

III. Wastewater Treatment Alternatives

A. General

The plant expansion from 60 mgd to 96 mgd is a capacity expansion of 60 percent. Such an increase in capacity affects virtually every plant unit process and support facility. For reasons detailed in other study memoranda as part of this Master Plan, it is recommended that a number of wastewater facilities be expanded in kind. These facilities are as follows:

- Junction Chamber and Meter Vault No. 1. This facility serves as the junction point for all influent force mains and as a pre-aeration facility for stripping and controlling the corrosive and odorous effects of hydrogen sulfide. The capacity of Junction Chamber No. 1 and odor control facilities will need to be increased by 60 percent.

- Screen and Grit Facilities. Screen and Grit Building No. 1 is unavailable having been permanently converted to a storage facility. The existing Screen and Grit Building No. 2 has a capacity to treat a peak flow of up to 116 mgd. A new Screen and Grit Building No. 3 is recommended to essentially duplicate Screen and Grit No. 2 so that peak flows of 221 mgd can be handled by the two facilities. Screen and Grit Building No. 2 has two mechanical screens. It is recommended that three mechanical screens be placed in Screen and Grit Building No. 3 so that one standby screen is available. To remove objectionable small materials and protect the marketability of the sludge product from the proposed Heat Drying Facility, it is recommended that finer screens be installed both in the new facility and as replacement screens in Screen and Grit Building No. 2.

- Main Pumping Station. It is estimated that peak flows could exceed the firm capacity of the Main Pumping Station by about 1993. It is recommended that two new pumps be installed to increase station firm capacity to 250 mgd.
- Denitrification Filters. Twelve new denitrification filters are recommended in addition to the existing 20 filters to increase filter capacity by 60 percent. The existing Filter Control Room in the Filter Building will be expanded for control of all filters from a central location.
- Post-Aeration/Chlorination/Dechlorination. The existing two tanks were designed to be eventually mirrored by two additional tanks. It is recommended that one additional tank be installed sufficient for the expansion to 96 mgd. Chlorination and dechlorination equipment and piping will also need to be expanded.

B. Biological Treatment Alternatives

1. Purpose

Carbonaceous stage biological packed tower trickling filters (bio-towers) are recommended for the plant expansion in the CHC-T 201 Facility Plan. The bio-towers would be followed by the existing high purity oxygen (HPO) system for nitrification. The purpose of the present study is to reassess the findings of the CHC-T 201 Facility Plan in light of several years of operating data with the two-step HPO system. A bio-tower pilot study was conducted to develop a model of bio-tower performance at the Hookers Point WWTP. Several biological wastewater alternatives have been evaluated.

The evaluation considers near-term, design-year, and ultimate facility requirements as follows:

- Case 1. Near-term requirements until 1993 for annual average wastewater flows up to 70 mgd.
- Case 2A. Design-year 2008 requirements in a series treatment arrangement for annual average wastewater flows up to 96 mgd.
- Case 2B. Design-year 2008 requirements in a parallel treatment arrangement for annual average wastewater flows up to 96 mgd.
- Case 3. Ultimate plant requirements for annual average flows up to 120 mgd.

2. Bio-Tower Pilot Study

A bio-tower pilot study was conducted from December 1987 through February 1988. The test equipment and test procedure are described in Study Memorandum F, Volume II. In general, the test results demonstrated that during the testing period the bio-tower performed below expectations and below assumptions used in the CHC-T 201 Facility Plan. The results of the test have been used in the evaluation of bio-tower alternatives.

3. Comparison of Alternative Biological Processes

A number of Case 2A and 2B alternatives have been developed, evaluated, and compared in Volume I of Study Memorandum D and in Study Memorandum E for the design-year 2008. The alternatives compared in Volume I of Study Memorandum D require all new tankage for proposed unit processes. Study Memorandum E considers alternatives which use the existing Aerobic Digestion Tanks as wastewater reactors. The alternatives fall into the following groups:

- Group A - Bio-Tower Alternatives. Three alternatives have been evaluated including the standard process recommended in the CHC-T 201 Facility Plan.
- Group B - Anoxic Reactor Alternatives. Three alternatives have been evaluated for full or partial denitrification as follows: (a) New tankage/methanol requirement eliminated, (b) New tankage/methanol requirement reduced, and (c) Converted aerobic digester/methanol requirement reduced.
- Group C - Two-Stage Nitrification Alternatives. Several alternatives have been evaluated which would use the existing Aerobic Digestion Tanks as wastewater reactors and one alternative which would use all new tankage to supplement the existing high purity oxygen (HPO) system.

A description of each of the evaluated alternatives under each group is as follows (a):

Group A - Bio-Tower Alternatives

a) Alternative 2A-A1. Bio-Tower Standard Process

Alternative 2A-A1 is equivalent to the recommended alternative of the CHC-T 201 Facility Plan. Primary effluent and recycle flows from the Main Pumping Station would be directed to new bio-towers for carbonaceous treatment. A new bio-tower pumping station would pump the bio-tower effluent back to the towers as recycle or to the new instermediate sedimentaiton tanks. Bio-tower intermediate sedimentation tank effluent would be pumped by the expanded Intermediate Pumping Station to new and existing HPO reactors. Flow from the existing final sedimentation tanks would be discharged through new and existing filters for filtration and denitrification.

(a) The nomenclature used for each alternative involves the Case designation (i.e. 2A-), the Group designation (i.e. -A), and the Alternative number.

b) Alternative 2A-A2. Bio-Tower Solids Contact Process

Alternative 2A-A2 is similar to Alternative 2A-A1 except that new bio-towers effluent is pumped to an aerated solids contactor along with return sludge. The aerated solids contactor (essentially an aeration tank) removes soluble BOD and allows the bio-towers to be loaded at a higher rate for equivalent carbonaceous treatment. New nitrification reactors will be required along with the existing reactors, all other portions of the facility would be the same as Alternative 2A-A1.

c) Alternative 2A-A3. Bio-Tower Close Coupled Process

Alternative 2A-A3 is similar to Alternative 2A-A1 except that intermediate sedimentation tanks are not provided. Alternative 2A-A3 is thus a single sludge system where solids produced in the bio-towers are carried with the bio-tower effluent directly to the HPO reactors. Waste sludge is removed only at the final sedimentation tanks.

Group B - Anoxic Reactor Alternatives

a) Alternative 2A-B1. Single Sludge Denitrification with Two Anoxic Stages

Alternative 2A-B1 would reduce or eliminate the need for methanol, now required for denitrification in the Denitrification Filters. Primary effluent and recycle flow from the Main Pumping Station would discharge to all six existing HPO reactors which would be converted to first stage anoxic reactors. Reactor effluent would be pumped by the expanded Intermediate Pumping Station to new aerobic reactors. Aerobic reactor effluent would split between recycle back to the first stage anoxic reactors and discharge to the second stage anoxic reactors. Second stage anoxic reactor effluent would discharge to the existing final sedimentation tanks. New and existing filters would be used only for filtration. A portion of the aerobic reactor effluent would be recycled to the first stage anoxic reactor to provide enough nitrate to keep conditions anoxic.

b) Alternative 2A-B2. Single Sludge Denitrification With One Anoxic Stage

Alternative 2A-B2 is similar to Alternative 2A-B1 except that no second stage anoxic reactor would be provided. The wastewater would be insufficiently denitrified in the first stage anoxic reactor and thus some amount of methanol would be required for denitrification on the filters.

c) Alternative 2B-B3. Parallel Denitrification With One Anoxic Stage

Alternative 2B-B3 is a Case 2B parallel treatment alternative. The existing HPO system would continue to treat annual average flows of up to 60 to 70 mgd. The remaining flow would be treated in a parallel system. The new parallel system would consist of the existing Aerobic Digestion Tanks converted to wastewater reactors. The reactors would have anoxic and aerobic zones to allow partial denitrification. New final sedimentation tanks would also be provided. Effluent from the new and existing portion of the plant would discharge to new and existing denitrification filters.

Group C - Two-Stage Nitrification Alternatives

a) Alternative 2A-C1. High Purity Oxygen Activated Sludge

Alternative 2A-C1 involves expansion of the existing two-stage HPO systems in kind. Primary effluent and recycle flows from the Main Pumping Station would be directed to new carbonaceous stage HPO reactors and new intermediate sedimentation tanks. Carbonaceous intermediate sedimentation tank effluent would be pumped by the expanded Intermediate Pumping Station to the existing HPO reactors and final sedimentation tanks for nitrification. The faciilty would also have the flexibiilty to operate in the step feed or the single-stage nitrification mode.

b) Alternative 2A-C2. Converted Aerobic Digesters as HPO Carbonaceous Reactors

Alternative 2A-C2 is similar to Alternative 2A-C1 except that the existing Aerobic Digestion Tanks would be covered and converted into HPO carbonaceous reactors.

c) Alternative 2A-C3. Converted Aerobic Digesters as Diffused Air Carbonaceous Reactors

Alternative 2A-C3 is similar to Alternative 2A-C1 except that the existing Aerobic Digestion Tanks would be converted to carbonaceous reactors using diffused aeration.

d) Alternative 2A-C4. converted Aerobic Digesters as HPO Nitrification Reactors

Alternative 2A-C4 would use the existing HPO system as the carbonaceous stage and the Aerobic Digestion Tanks would be covered and converted into HPO nitrification reactors. Nitrified effluent would be discharged to new and existing denitrification filters.

e) Alternative 2A-C5. Converted Aerobic Digesters as Diffused Air Nitrification Reactors

Alternative 2A-C5 is similar to Alternative 2A-C4 except the existing Aerobic Digestion Tanks would be converted to diffused air nitrification reactors.

The comparative opinions of cost of the cost-effective alternatives under each group are as follows:

Low Cost Alternative Per Group	Comparative Equivalent Annual Cost ($1,000)	Percent Above Low Cost
A. Bio-Towers (Alt. 2A-A3)	$ 30,707	68
B. Anoxic Reactors		
New Facilities (Alt. 2A-B2)	$ 19,958	9
Use Aer. Dig. (Alt. 2B-B3)	$ 18,587	2
C. Two-Stage Nitrification		
New Facilities (Alt. 2A-C1)	$ 20,209	10
Use Aer. Dig. (Alt. 2A-C5)	$ 18,227	-

Projects which are similar in cost are the two-stage nitrification alternatives (Alt. 2A-C1 and 2A-C5) and the anoxic reactor alternatives (Alt. 2A-B2 and 2B-B3).

Alternatives 2A-C1 and 2A-C5 are shown schematically on Figures 3 and 4. These two-stage alternatives have a history of success at the Hookers Point WWTP. Based on sludge treatment alternatives described herein, the Aerobic Digestion Tanks will be available for other uses. It is recommended, based on cost and efficient use of the plant site, that Alternative 2A-C5 be used for biological treatment. Table 1 shows the bases used to develop Alternatives 2A-Cl and 2A-C5.

Alternative 2B-B3 (Figure 5) would use the modified Aerobic Digestion Tanks in parallel with the existing HPO system. The cost effectiveness of this alternative is sensitive to the price of the methanol saved. Figure 6 shows that the price of methanol would have to rise to about $0.28 per pound for Alternative 2B-B3 to be cost effective. It is not anticipated that the price of methanol will rise to this level in the near future. If methanol costs were to rise to this level the facilities required for operation of anoxic zones in the modified Aerobic Digestion Tanks could be added to those facilities required under Alternative 2A-C5.

C. Wastewater Facility Requirements

1. General

Decisions regarding the timing of construction of new wastewater treatment facilities must based on existing system capacities, effluent requirements, and scheduling and funding constraints. Once planning efforts are complete, time allotments for design and construction appear to make 1993 a reasonable target year to have new biological facilities fully operational. In the interim, flows to the plant are expected to increase above the plant design capacity of 60 mgd. In addition, the new, more stringent effluent requirements under the Grizzle-Figg Act are scheduled to be implemented October 1, 1990.

In addition to near-term treatment requirements, new facilities must be compatible with the ultimate treatment requirements at the site. The CHC-T 201 Facility Plan anticipated an ultimate plant annual average capacity of 120 mgd. For long-range planning beyond 2008, the CHC-T 201 Facility Plan ultimate plant capacity of 120 mgd has been used.

In consideration of the near-term, design-year, and ultimate facility requirements the following cases have been analyzed:

- Case 1. Near-term requirements until 1993 when proposed biological treatment Alternative 2A-C5 is fully operational. Annual average treatment requirements up to 70 mgd. (Figure 7)
- Case 2A. Design-year 2008 requirements incorporating Alternative 2A-C5 biological treatment improvements. Annual average treatment requirements for this series arrangement up to 96 mgd. (Figure 8)

- Case 2B. Design-year 2008 requirements incorporating Alternative 2B-B3 biological treatment improvements. Annual average treatment requirements for this parallel arrangement up to 96 mgd. (Figure 9)
- Case 3. Ultimate plant requirements as a two-stage nitrification plant. Annual average treatment requirements for this series arrangement up to 120 mgd. (Figure 10)

2. Near-Term Requirements (Case 1)

Before new biological treatment facilities under Alternative 2A-C5 are placed in service in 1993, annual average flows to the Hookers Point WWTP may approach 70 mgd. The capacity of the existing facilities will require enhancements in order to meet effluent requirements through 1993.

The existing HPO system is a two-stage nitrification process operating with plug flow reactors. Each reactor has four treatment zones and the wastewater and sludge are reacted in series. Piping has been installed in Reactors No. 1 and 2 to direct the influent wastewater to the second zone. This allows the return sludge to be reaerated in the first zone. This step feed arrangement has several process advantages discussed below.

Figure 11 shows a comparison of plug flow and step feed arrangements using 3 existing carbonaceous reactors and 6 existing carbonaceous final sedimentation tanks. Figure 12 shows a similar comparison for the existing nitrification system. The figures illustrate the estimated clarifier safety factors (a measure of treatment capacity) for annual average, maximum month, and maximum day (peak) conditions. Figure 11 shows the following clarifier safety factors for the carbonaceous system:

Condition	Clarifier Safety Factors 60-mgd Plug Flow	 70-mgd Step Feed
Annual Average	1.09	1.92
Maximum Month	0.58	1.08
Maximum Day	0.50	1.25

NOTE: Based on 8000 mg/l maximum return sludge concentration, 20 mgd minimum return sludge flow rate, 3 reactors, and 6 final tanks.

The above shows that the expected clarifier safety factors will be higher in step feed at 70 mgd than at the 60-mgd design basis of the existing plug flow system. On this basis the same level of treatment could be expected at 70 mgd as currently is achieved at 60 mgd. A basis of design for Case 1 is shown in Appendix A.

The existing plant has the capability of conversion to single-stage nitrification treatment. Operation in this mode in the past has provided lower final sedimentation tank surface overflow rates and has thus been used in wet weather. The step feed mode of operation should reduce the solids loading on the final sedimentation tanks and should improve final tank performance at higher surface overflow rates. Better system performance is expected in wet weather under the two-stage, step feed approach than the single stage, plug flow approach. Capacity enhancement recommendations made herein for the existing HPO system are based on the two-stage mode of operation.

Table 2 compares HPO facility requirements with capacities to treat a flow of 70 mgd. Improvements which would be required to enhance the capacity of the existing HPO system to 70 mgd are as follows:

- Complete the step-feed piping modifications in Reactors No. 3-6.
- Increase reactor aerator horsepower in Reactors No. 1-3 in accordance with Figure 13 including new aerators, moving of existing aerators, and electrical modifications.
- Increase capacity of sludge wasting system by installing waste sludge pumps.

Two deficiencies in fully treating an annual average 70-mgd flow would not be addressed by the above improvements. The Intermediate Pumping Station has an installed capacity of 160 mgd. A capacity of 189 mgd would be required on the maximum day. Figure 11 shows that on the maximum day, about 9 mgd of Main Pumping Station effluent would be sent directly to the nitrification stage and 20 mgd of carbonaceous effluent would bypass nitrification leaving 160 mgd influent to the Intermediate Pumping Station. The bypassed carbonaceous effluent would go directly to Post Aeration/Chlorination on the maximum day. This would temporarily reduce effluent quality on that day but is not expected to impact the ability of the plant to meet monthly effluent limitations (assuming that the monthly limitations are equivalent to the annual average limitations on concentration under the Grizzle-Figg Act).

Additionally, expansion of the oxygen generation system will be required. It is estimated that a generation capacity at maximum month loads of about 150 tons per day will be required as the annual average flows approach 70 mgd as shown in Table 3. The existing capacity is 120 tons per day. The lead time for design, procurement, construction, and installation of additional oxygen generation facilities will not permit them to be in place by October 1, 1990. It is recommended that oxygen be purchased as necessary to supplement the generation capacity during maximum loads. This would be done until new additional generation capacity would be added for the 96-mgd expansion.

3. Design Year 2008 Requirements (Case 2A)

The recommended facilities under Case 2A involve the biological facilities described as Alternative 2A-C5. Figure 8 shows the flow routing required under Case 2A. The existing HPO system would serve as the carbonaceous stage and the converted Aerobic Digestion Tanks, together with 8 new final sedimentation tanks, would serve as the nitrification stage. The basis of design for Case 2A (Alternative 2A-C5) is shown in Appendix A. Two points should be noted about the basis of design for Case 2A as follows:

- No additional primary sedimentation tanks are recommended. The basis of design shown in Appendix A allows 20 percent of the flow to bypass primary treatment in peak or maximum day conditions.
- Aerator horsepower recommendations for oxygen dissolution in the existing HPO system is based on maximum loads and step feed operation. Plug flow would be possible at maximum month conditions only by operating an additional reactor. For instance, the models predict that five reactors could be used at maximum month flows in step feed but that six would be necessary for oxygen dissolution in plug flow. Estimated reactor horsepower and oxygen requirements for Case 2A (Alternative 2A-C5) are shown in Table 3.

Figures 14 and 15 show the clarifier safety factors for step feed and plug flow modes of operation for the carbonaceous and nitrification stages. These figures indicate that having the step feed capability will be important to process performance at maximum conditions. In addition, the aerator modifications started for Case 1 in HPO Reactors No. 1-3 will need to be completed in Reactors No. 4-6 as shown on Figure 13.

A complete description of all facilities recommended for expansion of the Hookers Point WWTP to 96 mgd is included in Section VI, herein.

IV. Sludge Treatment Alternatives

A. General

Existing sludge treatment facilities at the Hookers Point WWTP include the following:

- Thickening of waste activated sludge
- Digestion of primary and waste activated sludge
- Dewatering of digested sludge

A contract hauler removes the dewatered sludge from the plant to final disposal. A heat drying facility is currently under contract for construction. Heat drying of the dewatered sludge and marketing the sludge product will be the future principal method of sludge disposal.

Sludge quantities have been estimated based on the recommended wastewater treatment alternative described in Section III, herein. Estimated 2008 raw sludge quantities from Appendix A, Case 2A, are as follows:

Design Year 2008

Item	Annual Average	Maximum Month
Raw Primary Sludge		
Total Solids - 1000 lbs/day	82.9	112.0
Percent Solids	5.0	5.0
Volume - gpm	138	187
Percent Volatile Solids	79.4	79.4
Volatile Solids - 1000 lbs/day	65.9	88.9
Raw Waste Activated Sludge		
Total Solids - 1000 lbs/day	130.9	215.6
Percent Solids	0.67	0.72
Volume - gpm	1627	2493
Percent Volatile Solids	83.9	83.9
Volatile Solids - 1000 lbs/day	109.8	180.9

B. Thickening

Primary sludge is allowed to thicken in the Primary Sedimentation Tanks to about five percent solids concentration. No additional thickening of primary sludge is recommended.

Waste activated sludge is currently thickened by the existing Gravity Thickeners and the existing DAF Thickeners. Both facilities produce thickened sludge having an approximate 3.0 percent solids concentration. The thickened sludge can be sent to the Aerobic Digestion Tanks or to the Anaerobic Digestion Tanks.

Volume II of Study Memorandum D evaluates several sludge thickening alternatives. The advantages of producing a thicker waste activated sludge (WAS) than the current 3.0 percent include reduction in digestion tank volume and enhancement of dewatering performance.

The existing DAF Thickeners are operated without polymer. Polymer mixing and feed facilities have recently been added. DSS has conducted tests of the DAF Thickeners with polymer. The results indicate that a WAS solids concentration of at least 4.5 percent is achievable using polymer but some improvements to the DAF facility will be required to collect and to pump the thicker sludge. It should be noted that foaming of the Anaerobic Digestion Tanks (discussed under Section IV.C.) has been experienced at Hookers Point when DAF sludge is added. Currently, DAF sludge can be sent to the Aerobic Digestion Tanks which, with limited experience, appears to reduce or eliminate Anaerobic Digestion Tank foaming. Studies are ongoing to resolve the cause of the foaming in the Anaerobic Digestion Tanks.

Depending on the outcome of the studies two options appear to be available for thickening of WAS:

- If wastewater process adjustments can be made which reduce the foaming problem at the Anaerobic Digestion Tanks, then the DAF thickeners may be used as part of the firm capacity for sludge thickening.
- If DAF thickening of itself proves to be the major factor attributing to foaming, then the DAF thickeners should not be considered as thickening capacity, but could be converted to other uses.

As reported in Volume I of Study Memorandum F, pilot testing was conducted with belt thickening and centrifuge thickening equipment. Both types of equipment were capable of producing a thickened sludge with a concentration of at least 5.0 percent solids sludge. The results of the pilot tests were used in the comparison of alternative thickening projects. The results indicate that belt thickening is cost effective when compared to centrifuge and DAF thickening at Hookers Point. A summary of lower cost belt thickening and centrifuge thickening alternatives are as follows:

Item	Comparative Equivalent Annual Cost ($1,000)	Percent Above Low Cost
Belt Thickening with DAF	$ 614	-
Belt Thickening without DAF	790	29
Centrifuge Thickening without DAF	1,637	167

The above indicates that a new belt thickening facility used in conjunction with the existing DAF thickening facility is cost effective compared to other alternatives which do not include the existing DAF thickeners. Three two-meter wide belt thickeners would be required to thicken the maximum month WAS generated in 2008 together with the three existing DAF thickeners. The existing gravity thickeners would be used to thicken final sedimentation tank skimmings as discussed in Section IV.G, herein. The three belt thickeners would have capacity to thicken maximum month sludge quantities through the early 1990's, with the DAF facility as backup. If DAF proves to be the major contributing factor to anaerobic digester foaming, DAF could be phased out by the mid-1990's by the installation of three additional belt thickeners for a total of six.

C. Anaerobic Digestion

Anaerobic digestion is the preferred method of sludge stabilization at Hookers Point for the following reasons:

- Reduces sludge volatile solids which helps sludge dewatering.
- Reduces the total solids quantity which reduces disposal costs.
- Produces sludge gas which can be used in existing engine generators to reduce plant purchased electrical power.

Providing anaerobic digestion volume for all sludge generated allows the existing Aerobic Digestion Tanks to be available for other uses. It has been shown in Section III, herein, that the cost of the recommended wastewater treatment alternative will be reduced by use of the Aerobic Digestion Tanks.

Currently, raw primary sludge and thickened WAS are both sent to the Mixed Sludge Pumping Station (MSPS) wet well where the sludges are blended. Sludge from the MSPS is pumped sequentially to each of the seven existing Anaerobic Digestion Tanks. The estimated future quantity of sludge to be digested is as follows:

Item	Design Year 2008 Annual Average	Design Year 2008 Maximum Month
Primary Sludge		
Total Solids - 1000 lbs/day	82.9	112.0
Percent Solids	5.0	5.0
Volume - gpm	138	187
Percent Volatile Solids	79.4	79.4
Volatile Solids - 1000 lbs/day	65.9	88.9
Waste Activated Sludge		
Total Solids - 1000 lbs/day	130.9	215.6
Percent Solids	5.0	5.0
Volume - gpm	218	359
Percent Volatile Solids	83.9	83.9
Volatile Solids - 1000 lbs/day	109.8	180.9
Combined Thickened Sludge		
Total Solids - 1000 lbs/day	213.8	327.6
Percent Solids	5.0	5.0
Volume - gpm	356	546
Percent Volatile Solids	82.0	82.0
Volatile Solids - 1000 lbs/day	175.7	269.8

Volume II of Study Memorandum D provides a comparison of types of anaerobic digestion tanks as follows:

- Floating cover digestion tanks.
- Fixed cover digestion tanks.
- Egg-shaped digestion tanks.

Floating cover digestion tanks are recommended for reasons as follows:

- Equivalent annual cost less than egg-shaped digestion tanks and similar to fixed-cover digestion tanks.
- Lower height as compared to egg-shaped digestion tanks (a consideration due to proximity to the Peter O. Knight Airport).
- Compatibility with the seven existing floating cover digestion tanks.

Selection of anaerobic digestion tank volume at Hookers Point is based on a number of considerations as follows:

- Volatile solids reduction is important in that it reduces the total solids for disposal and lower volatile solids has a positive impact on the quantity of polymer used for dewatering.
- Anaerobic digester hydraulic detention time is often selected empirically at 15-30 days at annual average conditions and such that it does not fall below 10 days at maximum month loads.
- Analysis of existing digester performance at Hookers Point with primary and WAS was not conclusive. Feed rates and feed compositions have varied often due to foaming problems.
- Averaging over 82 percent, the volatile solids concentration of the combined thickened sludges is relatively high compared to other plants.

- Anaerobic digestion reduces the nitrogen concentration of the sludge solids. The heat dried sludge product needs to have a nitrogen concentration of at least four percent and ideally at least six percent to enhance marketability. The heat drying facility is not yet on line.

Figure 16 shows the expected relationship between volatile solids reduction and hydraulic detention time for anaerobic digesters operating at 35°C as at Hookers Point. The figure shows that a hydraulic detention time of between 15 and 20 days is needed to obtain 50 percent volatile solids reduction at maximum month loading conditions. Figure 17 shows that the existing volume will be sufficient to maintain the 15-day hydraulic detention time through about 1996. At this time, one anaerobic digestion tank with a volume of 2.8 million gallons could be added which would provide adequate digestion volume through the end of the planning period.

The nitrogen concentration of the heat dried product may also be a factor in the timing of construction of digestion facilities. One way to increase the nitrogen concentration is to bypass digestion with a portion of the thickened WAS. After the heat drying facility is placed in service, the quantity of undigested WAS required to supplement the nitrogen concentration of the heat dried product can be determined.

Excessive foaming in the existing anaerobic digestion tanks has been a problem since thickened WAS was introduced to the Anaerobic Digestion Tanks. The formation of foam can be the result of a number of factors including:

- Presence of Nocardia.
- Sludge thickened by DAF.
- High WAS volatile solids loading.
- WAS fed to digestion in batches.

Each of these factors can be affected by design and operational considerations as follows:

1. Nocardia. The presence of the organism Nocardia has been noted in plant mixed liquor foam and in anaerobic digestion foam at the Hookers Point WWTP. Nocardia has been controlled at other plants by adjustment of the activated sludge system solids retention time or by return sludge chlorination. The ability to chlorinate the return sludge has recently been added at Hookers Point. A study of the effect of activated sludge SRT on foam at the final tanks and anaerobic digesters is ongoing.

2. DAF Sludge. Belt thickening as an alternative to DAF thickening is discussed in Section IV.B., above.

3. Volatile Solids Loading of WAS. The volatile solids loading of the WAS portion of the sludge will be about 0.064 pounds volatile solids per cubic foot per day at annual average conditions based on the recommended tank volume. A maximum loading of 0.05 lb-VS/cf has been recommended in the literature to control foaming. At Hookers Point, this would require a volume of 16.4 million gallons which is 28 percent greater than the total recommended volume based on hydraulic detention time. As this method requires a substantial capital

investment with no guarantee of satisfactory results other methods to control foaming will need to be explored before a recommendation could be made to increase the tank volume to this level.

4. <u>Batch Feeding of WAS</u>. Currently, WAS is fed continuously to the Mixed Sludge Pumping Station (MSPS). Primary sludge is withdrawn from the Primary Sedimentation Tanks in batches and also fed to the MSPS. Sludge from the MSPS, which can be mainly WAS or mainly primary sludge, is pumped sequentially to each digestion tank. The batching of the primary sludge works well to thicken the sludge but allows periodic batches of nearly 100 percent WAS to be fed to the digestion tanks. There is evidence in the literature to suggest that feeding 100 percent WAS to anaerobic digestion can significantly contribute to excessive foaming. The evidence also suggests that a continuous blend of primary and WAS will contribute to a reduction in foaming problems. A covered holding tank for the primary sludge is recommended. Primary sludge would be pumped continuously from the tank to the MSPS.

The five existing sludge gas engine generators are used to reduce the amount of purchased electric power required. It is estimated that if all sludge were anaerobically digested, that the current sludge gas production would be sufficient to operate four engine generators continuously. By the 2008 design year it is estimated that the sludge gas production with all sludge digested would be sufficient to operate almost seven engine generators continuously. Several options have been analyzed as follows:

- <u>Option 1</u>. Operate 5 engine generators and flare excess gas when capacity is exceeded.

- Option 2. Provide 2 additional engine generators for a total of seven.
- Option 3. Add 5 engine generators and gas storage sufficient to run 10 engines during peak demand periods and 4 engines continuously.

The estimated equivalent annual costs of these options are as follows:

Item	Equivalent Annual Lost ($1000)	Percent Above Low EAC
Option 1	$4,228	-
Option 2	4,531	7
Option 3	5,249	24

Note: Allows 5 percent per year for inflation; includes operation and maintenance on new facilities required and all plant power costs. The analysis uses all installed engines operating.

The above analysis indicates that Option 1 requiring no new storage or generating equipment is the cost effective approach. Under Option 1 excess gas will be available. Future studies may indicate a cost effective use of the excess sludge gas.

D. Sludge Dewatering

Based on above discussions, there are two options for the digestion of sludge as follows:

- Full anaerobic digestion of all sludge.
- Partial bypass of anaerobic digestion by thickened WAS in order to raise the nitrogen concentration of the heat dried product.

The estimated sludge quantities to be dewatered in 2008, at 50 percent volatile solids destroyed, are as follows:

Item	Annual Average	Maximum Month
Full Anaerobic Digestion		
Total Solids - 1000 lbs/day	126.0	192.7
Percent solids	2.9	2.9
Volume - gpm	356	546
Percent Volatile Solids	69.8	69.8
Volatile Solids - 1000 lbs/day	87.9	134.9
Partial Anaerobic Digestion (a)		
Total Solids - 1000 lbs/day	143.9	220.2
Percent solids	3.4	3.4
Volume - gpm	356	546
Percent Volatile Solids	73.5	73.5
Volatile Solids - 1000 lbs/day	105.8	162.5

(a) Assumes all primary solids digested and 80% of all solids digested. The actual amount bypassing digestion may be more or less depending on the results of the heat drying operation. The values are provided as an example.

Digested sludge is currently dewatered by six belt filter presses, three in the Sludge Control Building and three in the Sludge Dewatering Building. Sludge drying beds serve as backup to the mechanical dewatering facilities. Anaerobically and aerobically digested sludges are pumped to three 150,000-gallon Digested Sludge Storage Tanks located near the Sludge Control Building. Sludge is withdrawn from the tanks to dewatering. The existing belt filter presses produce a sludge cake generally from 15 to 18 percent solids concentration.

In the future, dewatered sludge will be fed to the proposed Heat Drying Facility to be constructed north of the Sludge Dewatering Building. The Heat Drying Facility, with two heat drying trains, will be able to process a maximum of 577,600 pounds of water per day. At this evaporative rate, the sludge cake solids concentration would have to be a minimum of 25 percent solids to handle the maximum month sludge quantity in 2008. In addition, the heat drying and pelletizing process works best when the sludge cake solids concentration is less than 30 percent. Thus, a sludge cake solids concentration of between 25 and 30 percent will be necessary to avoid the construction of a third heat drying train for the 2008 sludge production.

Several sludge dewatering pilot tests were conducted to establish design criteria for mechanical dewatering equipment and to determine if any device could consistently and reliably produce a sludge cake solids concentration between 25 and 30 percent. As reported in Volume I of Study Memorandum F, the following pilot tests were conducted:

- Low speed centrifuge.
- High speed centrifuge (two manufacturers).
- Belt filter press (three manufacturers).
- Plate and frame filter press with polymer.

No dewatering device was able to consistently produce a sludge cake solids concentration of between 25 to 30 percent. The closest to obtaining this result was the plate and frame filter press using polymer; however, several test runs fell short of the 25 percent goal. The data obtained from the pilot tests were used to evaluate dewatering alternatives in Volume III of Study Memorandum D. The evaluation considered the cost of the dewatering facility as well as the cost of heat drying. Comparative cost opinions of the low cost alternatives in each category are as follows:

Category	Comparative Equivalent Annual Cost ($1,000)	Percent Above Low EAC
Belt Filter Press	$ 9,068	7
High Speed Centrifuge	8,489	-
Plate and Frame Filter Press with Polymer	8,456	-

The equivalent annual cost appears to be similar (within 10 percent) for each category of dewatering equipment. Belt filter presses are recommended based on the following:

- Equivalent annual cost similar to other equipment.
- Operation similar to existing equipment.

- Better use of existing belt filter press equipment and facilities.

The existing three belt filter presses in the Sludge Control Building have reached the end of their useful life and have not been considered for reuse under alternatives for the future. The existing three belt filter presses located in the Sludge Dewatering Building are not high quality units but are still viable and can be used for a number of years. Ultimately, eight high quality belt filter presses will be required to handle the maximum month sludge quantity with one of the eight units as standby. This assumes full anaerobic digestion of all sludge solids. One additional belt filter press may be required by 2008 if sludge is partially digested as described above. Initially four units could be installed which, together with the three existing units in the Sludge Dewatering Building, could handle the maximum month sludge quantities through the mid-1990's. When the useful life of the existing units reaches its end, four additional high quality belt filter presses could be installed.

It is recommended that the existing sludge drying beds be retained to back up the mechanical dewatering facility.

E. Sludge Storage

Storage of digested sludge at the existing plant is provided at the Sludge Control Building by three tanks with a total storage volume of 450,000 gallons. Belt filter feed pumps draw directly from these tanks. At times, the storage tanks have become full and have limited sludge wasting options. It is recommended that an additional 1,000,000 gallons of storage be provided to improve sludge handling flexibility. It is recommended that the new sludge storage tank be located in the vicinity of the existing tanks and function in the same way.

F. Heat Drying

The sludge Heat Drying Facility is under contract for construction. The Heat Drying Facility will have an evaporative capacity of about 577,600 pounds of water per day for the total of two drying trains. The evaporative capacity is compared to the estimated sludge quantities as follows:

Item	Annual Average	Maximum Month
Full Anaerobic Digestion		
Total Solids - 1000 lbs/day	126.0	192.7
Percent Solids	18	18
Total Water - 1000 lbs/day	574.0	877.9
Evaporative Capacity Each Train - 1000 lbs/day	288.8	288.8
Number of Trains Required	2.0	3.0
	2	3

Item	Annual Average	Maximum Month
Partial Anaerobic Digestion		
Total Solids - 1000 lbs/day	143.9	220.2
Percent Solids(1)	18	18
Total Water - 1000 lbs/day	655.5	1003.1
Evaporative Capacity Each Train - 1000 lbs/day	288.8	288.8
Number of Trains Required	2.3	3.5
	3	4

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(1) Based on same cake solids concentration as full digestion; no extensive pilot testing has been completed to determine performance at Hookers Point with partially digested sludge.

The above illustrates that with full digestion three heat drying trains should be sufficient for maximum month loads. This would require one heat drying train in addition to the two to be constructed in 1989. In order to reliably meet maximum month loads, the third heat drying train would need to be installed in the early to mid-1990's.

If the sludge fed to the heat driers is only partially digested, a fourth heat drier may be required prior to the 2008 planning year. Figure 18 shows that if 20 percent of the sludge were to bypass digestion, the additional water brought along with the solids may necessitate a fourth heat drying train by the early 2000's.

G. Final Tank Skimming

The existing 12 rectangular Final Sedimentation Tanks are skimmed in the back half but not in the front. Floating solids accumulate on the front half of each tank. It is recommended that the sludge collector flights be extended to the surface and that a skimmings collection system be installed for the front half.

The skimmings from the back half of each tank are currently pumped to either Primary Tank No. 1 or 2. It is recommended that the skimmings from the front and back halves be positively removed from the wastewater system. Belt thickening and DAF thickening of WAS has been recommended above which makes the existing Gravity Thickening Tanks available.

The Gravity Thickening Tanks could be converted to accept the dilute skimmings. The skimmed solids have been shown to settle out at the existing Primary Sedimentation Tanks when re-wetted. The thickened solids would be pumped to the Mixed Sludge Pumping Station or to the other thickening facilities for additional thickening with the WAS.

V. Support Services

A. Electrical Power Distribution

Power distribution is described in Volume VI of Study Memorandum D. The Hookers Point WWTP is served by two 13.2 kv feeders. The capacity of each feeder is 13,700 kva. Power is distributed within the plant to dual substations located near major facilities. The substations transform the 13.2 kv distribution voltage to the utilization voltage, generally 480 volts. On-site generated power is provided by five 480-volt, 500 kw sludge gas fueled engine generators. Two 2800 kw diesel fueled turbine generators provide standby power.

The power distribution system and standby power will be expanded to provide for the plant expansion under Case 2A as follows:

	Estimated Load (kva)	
New Facility	Connected	Operating
Junction Chamber No. 1 Expansion	325	300
Screen and Grit Building No. 3	545	385
Main Sewage Pumps Addition	800	800
Main Pumping Station - Blower	400	400
Filter Building No. 2 & Denitrification Filters	2,000	1,400
Sludge Belt Thickening Building	150	100
Waste Sludge Pumps	150	100
HPO Reactor Modifications	375	375
Lab & Admin. Building	740	740
Control Building & Sludge Dewatering	400	400

New Facility	Estimated Load (kva) Connected	Estimated Load (kva) Operating
New Oxygen Generator	750	700
Intermediate Pumping Station No. 2	1,400	1,250
Filter Building No. 1 & Denitrification Filters	100	100
Aeration Blowers	4,200	3,400
New Final Sedimentation Tanks	1,400	1,000
Anaerobic Digestion Tank No. 8	250	200
Sludge Holding Tank	50	40
Sludge Treatment Aerobic Digestion (a)	(1,415)	(1,415)
Total	12,620	10,275

(a) Aerobic Digestion Tank Mixers removed from service.

B. Computer Systems

Computer systems are described in Volume VII of Study Memorandum D and include the following:

- Process Computer System
- Laboratory Information Management System (LIMS)

The recommendations regarding the Process Computer System consist of the addition of a redundant process computer for the existing system and the addition of remote transmission units (RTU's) for each new facility. The opinion of installed cost for these additions is $600,000.

The LIMS system will help the laboratory staff cope with the increasing number of analyses which will be required for the plant expansion and to comply with regulatory requirements. The number of analyses performed per year by the laboratory staff is presently about 155,000. This is about 400 percent greater than in 1980. The number of analyses required could reach 310,000 by 1998. The recommended LIMS alternative consists of a central minicomputer connected to work station microcomputers. The opinion of installed cost for the LIMS system is $810,000.

C. Service Facilities

The plant expansion will require increased space for the operations, maintenance, and laboratory staff. To provide this space a new Lab and Administrative Building is recommended. The existing Operations and Maintenance Building would be expanded and modified to house maintenance facilities alone.

D. Site and Stormwater Improvements

Site and stormwater improvements required for the plant expansion are described in Volume V of Study Memorandum D. Landscaping and roads will be similar for new facilities as for existing facilities. Stormwater collection, retention, and treatment facilities will be provided in accordance with regulatory requirements.

E. Utilities

1. Process Air

The existing process air system provides low pressure air for channel aeration and for the Post Aeration/Chlorination Tanks. Three blowers are located in the Main Pumping Station with space for one additonal blower. The additional blower will be required for channels at Screen and Grit Building No. 3 and for the Post Aeration/Chlorination Tank No. 3.

2. Plant Air

The existing plant air system provides high pressure air throughout the plant. The air compressors are located in the Main Pumping Station. Additional plant air will be required for most proposed facilities. It is recommended that additional plant air requirements be supplied by new compressors to be located in the proposed Filter Building No. 2. Providing compressors at this location would allow isolation of the north and south plant air systems using existing system valves.

3. Effluent Water

Additional effluent water will be required for the expanded facilities. Major uses will be at the expanded sludge dewatering and thickening facilities for wash-water. Two effluent water pumps at the existing Filter Building No. 1 currently provide all effluent water requirements. It is recommended that one additional pump be provided at Filter Building No. 1. The pump would take the place of one Gravity Thickener Dilution Water Pump. This space would be available due to the proposed conversion of the existing Gravity Thickening Tanks to thickeners for final tank skimmings. The skimmings will be dilute and will not require additional dilution water. One dilution water pump will remain which will allow dilution water to be pumped to the gravity thickeners should they again be used to thicken sludge on an interim basis.

4. Plant Water

The existing plant water supply system located in the Main Pumping Station provides positive separation from the City water system and provides clean non-potable water throughout the plant. The largest need for additional plant water will be for polymer dilution water at expanded sludge dewatering facilities. It is recommended that this facility have its own plant water systems for polymer dilution.

F. Final Effluent Conduit

An existing 96-inch final effluent conduit links Junction Chamber No. 4 to the Overflow Structure and plant outfall. Space has been allocated at Junction

Chamber No. 4 and at the Overflow Structure for a future 84-inch pipe. An analysis of the final effluent hydraulics indicates that the 84-inch pipe will be required by about the year 2000 for peak flows associated with annual average conditions up to about 96-mgd.

VI. Plant Expansion Overview

Recommendations are made above for expansion of the Hookers Point WWTP from 60 mgd to 96 mgd. The 96 mgd annual average flow is expected to occur by the year 2008. The recommendations made herein augment recommendations in the CHC-T 201 Facility Plan dated 1980.

In previous sections of this Master Plan report, several conditions of plant expansion are considered as follows:

- Case 1. Interim condition to 1993 and annual average flow up to 70 mgd. (Figure 7)
- Case 2A. Design year 2008 condition for annual average flows up to 96 mgd. Existing and new biological treatment facilities operated in series. (Figure 8)
- Case 2B. Alternative design year 2008 condition. Existing and new biological treatment facilities operated in parallel for partial biological denitrification to reduce methanol cost. This alternative is not recommended unless methanol prices rise. (Figure 9)
- Case 3. Ultimate condition for annual average flows up to 120 mgd. (Figure 10)

Tables 4 and 5 describe major wastewater and sludge treatment requirements for the Case 2A and Case 3 conditions. Figures 19 and 20 show proposed site plans and locations of facilities for Case 2A and Case 3.

A phasing strategy has been developed to bring facilities into service at the appropriate times to meet the above service conditions. Each facility has been carefully analyzed to determine when expansion is necessary to provide adequate treatment to meet expected effluent requirements. Funding models have also played a part in development of the phasing strategy.

Table 6 shows the recommended construction phasing strategy for the Hookers Point plant expansion to 96 mgd. Table 7 shows the major recommended construction divisions necessary to implement the projects through 1995 and provides construction cost opinions.

TABLES

TABLE 1

CITY OF TAMPA, FLORIDA
HOOKERS POINT WASTEWATER TREATMENT
PLANT EXPANSION

Bases Used to Develop Alternatives 2A-C1 and 2A-C5 (a)

Greeley and Hansen
January 1989

		Carbonaceous Stage		Nitrification Stage	
		AN AV	MAX MO	AN AV	MAX MO
1.	Solids Retention Time (SRT) - days	0.8	0.6	8.0	6.0
2.	Solids Production - Pounds per Pound TSS Applied	1.0	1.2	0.68	0.68
3.	Initial Settling Velocity Parameters (b)				
	a	23	23	23	23
	b	700	700	800	800
4.	Return Sludge Capacity				
	Flow Rate (Minimum) - MGD (c)				
	6 Existing Final Tanks	20	20	20	20
	12 Existing Final Tanks	40	40	-	-
	Concentration (Max.) - mg/l	8000	8000	8000	8000
5.	Required Minimum Clarifier Safety Factor at Maximum Month	-	1.0	-	1.0

(a) Two-stage nitrification alternatives shown on Figures 3 and 4.

(b) For equation $ISV = a \times e^{(-b \times 10^{-6} \times MLSS)}$
Based on settling tests at Hookers Point WWTP.

(c) Minimum based on pumping system.

TABLE 2

CITY OF TAMPA, FLORIDA
HOOKERS POINT WASTEWATER TREATMENT
PLANT EXPANSION

Existing HPO Facility Requirements to Treat 70 MGD (Case 1)

Greeley and Hansen
January 1989

		Required Capacity	Actual Capacity
1.	Aerator Horsepowers		
	Aerators Reactor 1 & 2		
	Zone 1	100	150
	Zone 2	150	75
	Zone 3	75	60
	Zone 4	60	60
	Aerators Reactor 3		
	Zone 1	100	100
	Zone 2	150	75
	Zone 3	75	60
	Zone 4	60	60
	Aerators Reactor 4 - 6		
	Zone 1	100	100
	Zone 2	75	75
	Zone 3	60	60
	Zone 4	60	60
2.	Return Sludge Pumps - MGD		
	Step Feed (Max. Condition)	31.7	45
	Plug Flow (Max. Condition)	87.5 (a)	45
3.	Waste Sludge - MGD	3.0	1.4
4.	Oxygen Generation - TPD	150	120

(a) Process clarifier safety factor too low at 70 MGD at this maximum day condition. Operation at this flow rate is not recommended; thus, return sludge pumping modifications to address this condition is also not recommended.

TABLE 3

CITY OF TAMPA, FLORIDA
HOOKERS POINT WASTEWATER TREATMENT
PLANT EXPANSION

Estimate Oxygen Dissolution Performance
Existing HPO Reactors

Greeley and Hansen
January 1989

	Performance				
		Zone			
Item	General	1	2	3	4
Case 1 (70 MGD)					
1. Carbonaceous/Max. Month/Step Feed					
No. of Reactors	3				
Utilization - %	83				
Oxygen Prod. Req'd - TPD	103				
HP per Zone	-	100	150	75	60
D.O. Conc. - mg/l	-	25.9	3.0	3.5	6.6
2. Carbonaceous/An. Average/Plug Flow					
No. of Reactors	3				
Utilitization - %	80				
Oxygen Prod. Req'd - TPD	88				
HP per Zone	-	100	150	75	60
D.O. Conc. - mg/l	-	3.7	16.7	17.0	16.7
3. Nitrification/Max. Month/Step Feed					
No. of Reactors	3				
Utilization - %	90				
Oxygen Prod. Req'd - TPD	52				
HP per Zone	-	100	75	60	60
D.O. Conc. - mg/l	-	27.7	3.4	7.4	9.8
4 Nitrification/An. Av./Plug Flow					
No. of Reactors	3				
Utilization - %	90				
Oxygen Prod. Req'd - TPD	39				
HP per Zone	-	100	75	60	60
D.O. Conc. - mg/l	-	13.1	16.9	17.1	16.0

TABLE 3 (continued)

CASE 2A (96 MGD) (a)

5. Carbonaceous/Max. Month/Step Feed

No. of Reactors	5				
Utilization - %	86				
Oxygen Prod. Req'd - TPD	138				
HP per Zone	-	100	150	60	60
D.O. Conc. - mg/l	-	24.5	6.1	4.0	7.5

6. Carbonaceous/An. Av./Plug Flow

No. of Reactors	4				
Utilization - %	81				
Oxygen Prod. Req'd - TPD	116				
HP per Zone	-	100	150	60	60
D.O. Conc. - mg/l	-	3.0	15.8	14.5	14.8

(a) Alternative 2A-C5

TABLE 4

City of Tampa, Florida
Hookers Point Wastewater Treatment
Plant Expansion

Wastewater Facility Requirement

Greeley and Hansen
January 1989

Facility	Total Capacity Required @ Given Ann. Avg. Flows			Comments
	Existing 60 MGD	Future 96 MGD Case 2A Alt. 2A-C5	Ultimate 120 MGD Case 3	
Junction Chamber No. 1 (S.F.)	3300	5280	6600	Existing - 2 @ 25′ x 66′; Phase I - 1 @ 30′ x 66′; Ult. - 1 @ 20′ x 66′ Bases; 10 min. Detention @ Avg. Ann. Flow
Screen and Grit Facilities (S.F.) - Existing, 4 Tanks @ 45′ x 45′	8100	16,200	18,480	Phase I - 4 @ 45′ x 45′; Ult. - add at least 2280 SF in vicinity of Screen and Grit Building No. 1.
Junction Chamber No. 2 & Meter Vault No. 2				
- MRC - 1 (Rated 80 MGD)	71.3 MGD	90.0 MGD	93.3 MGD	Modify MRC-1 to 100 MGD capacity about year 2000; Ult. - Modify MRC-2 to 175 MGD capacity.
- MRC - 2 (Rated 144 MGD)	68.7 MGD	86.8 MGD	170.7 MGD	
- MRC - 3 (Rated 100 MGD)	0	44.2	0	
West Primary Sedimentation Tanks - Surface Area (S.F.)	25,232	25,232	25,232	Area Corresponds to 4 Tanks
East Primary Sedimentation Tanks - Surface Area (S.F.)	23,858	23,858	48,958	Existing - 4 Tanks; Ult. - 8 Tanks. Existing 66" conduit to M.P.S. hydraulically limited at peak flows for ultimate condition; need bypass at peak or supplemental conduit.

TABLE 4 (Con't)

Facility	Total Capacity Required @ Given Ann. Avg. Flows			Comments
	Existing 60 MGD	Future 96 MGD Case 2A Alt. 2A-C5	Ultimate 120 MGD Case 3	
Main Pumping Station - Firm Capacity (MGD)	160	250	300	Phase I - Add 2-50 MGD pumps; Ult. - change 5 existing pumps to 50 MGD each.
Carbonaceous Reactors (Number of Reactors @ 169,400 CF Ea.)	3	6	6	Existing Reactors
Carbonaceous Sedimentation Tanks (Number of Tanks @ 16,796 SF Ea.)	6	12	12	Existing Sedimentation Tanks
Oxygen Generation Fac. - TPD	120	150	150	
Intermediate Pumping Station - Firm Capacity (MGD)	160(a)	250(b)	264(b)	Phase II - New Facility
Nitrification Reactors (Number of Reactors @ 169,400 CF. Ea.)	3	4	4	Converted Aerobic Digestion Tanks Existing - 169,400 CF Ea.; Phase II - 283,400 CF/Ea.
Final Sedimentation Tanks (Number of Tanks @ 16,796 SF Ea.)	6	8	12	Phase II - New Sedimentation Tanks
Denitrification Filters (S.F.) Number of Filters	21,000 20	33,600 32	42,000 40	Bases; maintain 2.0 GPM/SF Hydraulic loading @ Ann. Avg. Cond. w/o recycle.
Chlorine Contact Tanks - Total Volume (CF)	212,500	318,750	425,000	Bases; 15 min. Detention Time @ Max. Condition.

(a) Existing Int. P.S. No. 1

(b) Proposed Int. P.S. No. 2

TABLE 5

City of Tampa, Florida
Hookers Point Wastewater Treatment Plant Expansion

Sludge Treatment Facility Requirements

Greeley and Hansen
January 1989

Facility	Total Capacity Required @ Given Ann. Avg. Flows			Comments
	Existing 60 MGD	Future 96 MGD Case 2A Alt. 2A-C5	Ultimate 120 MGD Case 3	
DAF Thickening Facility No. of Tanks	3	3	0	Use of DAF under evaluation.
Gravity Thickeners	2	2	3	For thickening of skimmings in future.
Belt Thickening Facility No. of 2-M Units	-	3	6	
Anaerobic Digestion (MG)	10.0	12.8	15.6	
Sludge Dewatering Facility No. of 2-M Belt Filters	6	8	10	Existing 6 units to be replaced by high quality units.
Heat Drying Facility No. Heat Drying Trains	2	3	4	

TABLE 6

CITY OF TAMPA, FLORIDA
HOOKERS POINT WWTP EXPANSION

Construction Schedule
For Expansion To 96 MGD

Greeley and Hansen
January 1989

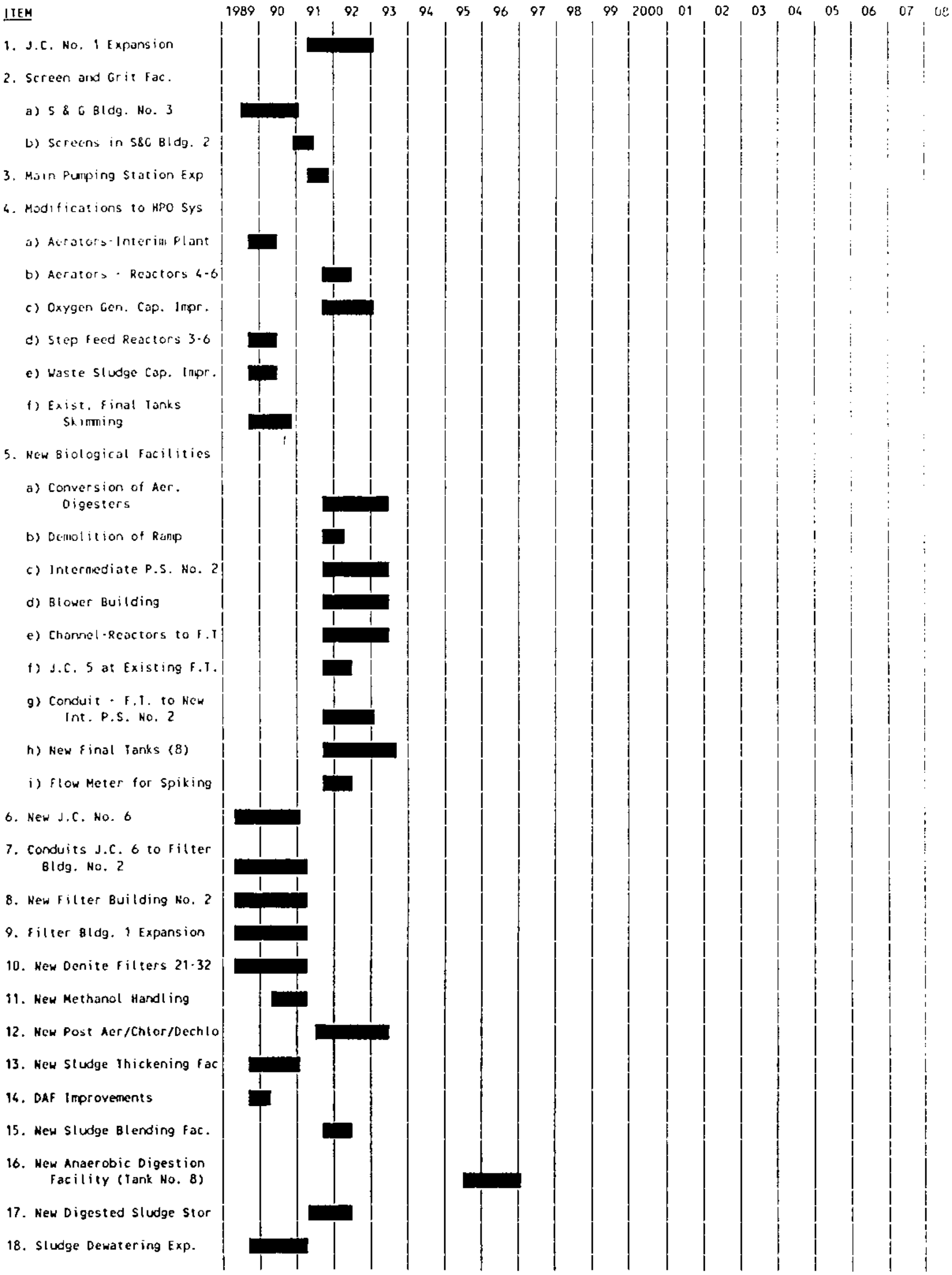


TABLE 6 (Cont'd.)

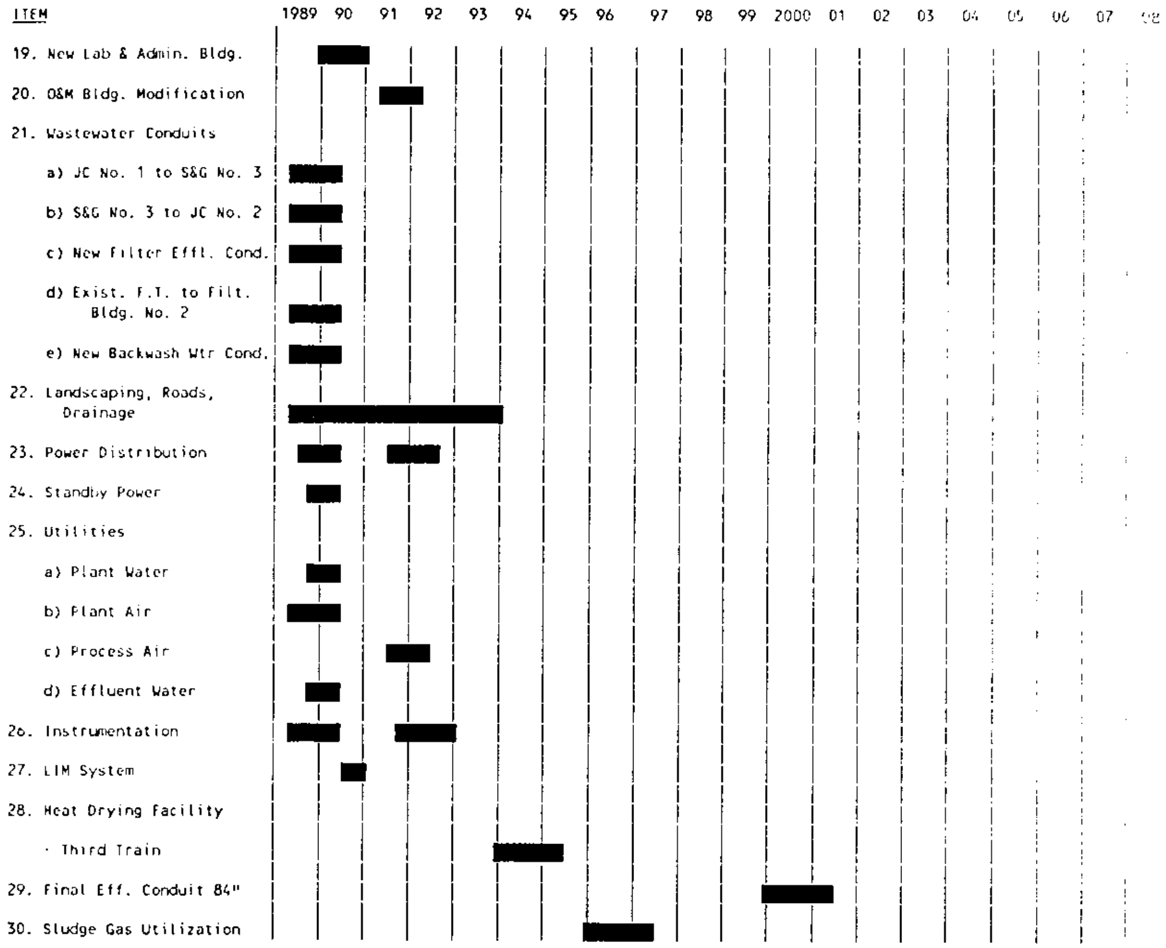


TABLE 7 (continued)

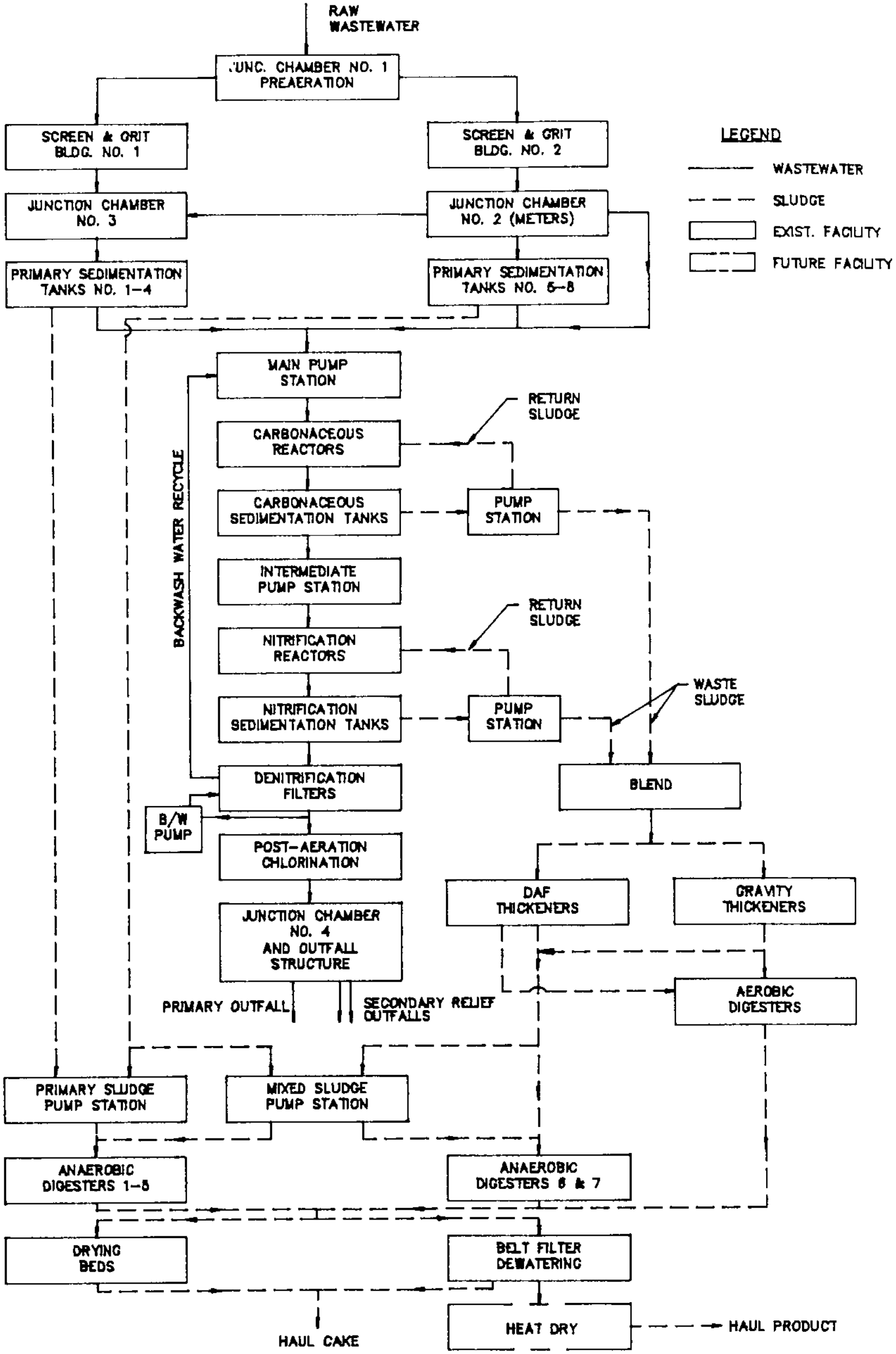
Division/Facility	Construction Cost Opinion ($1,000's)	Proposed Bid Opening Date	Permit Application Date
FIFTH WASTEWATER IMPROVEMENT PROGRAM			
4. Division 5H2C		Aug. 1990	April 1989
a. LIM System	$ 810		
5. Division 5H3A		July 1990	April 1990
a. Junction Chamber No. 1 Exp.	$ 2,378		
b. Pumps for Main P.S.	350		
c. Landscaping & Site Improvements	50		
TOTAL 5H3A	$ 2,778		
6. Division 5H3B		Jan. 1991	Oct. 1990
a. Post Aeration/Chlor. Tank No. 3	$ 1,950		
b. Sludge Holding Tank	442		
c. Sludge Storage Tak	845		
d. Uitlities - Process Air	500		
e. Lanscaping & Site Improvements	100		
TOTAL 5H3B	$ 3,837		
7. Division 5H4		July 1991	April 1991
a. New Biological Facilities			
• Conversion of Aer. Dig.	$ 3,946		
• Ramp Demoliton	245		
• Inter. P.S. No. 2	3,058		
• Blower Building	2,383		
• Junction Chamber No. 5	355		
• Channels & Conduits	700		
• Flow Meter for Spiking	100		
• Final Sed. Tanks (8)	24,730		
b. Modifications to HPO System			
• Aerators-Reactors 4-6	450		
• Oxygen Gen. Cap. Impr.	2,500		
c. Phase II RTU's	200		
d. Landscaping & Site Impr.	300		
e. Power Distribution	866		
TOTAL 5H4	$ 39,923		
8. Division 5H5		July 1995	April 1995
a. Anaerobic Digester No. 8	$ 3,206		
b. Landscaping & Site Impr.	50		
TOTAL 5H5	$ 3,256		
TOTAL FIFTH WW IMPROVEMENT PROGRAM FOR EXPANSION TO 96 MGD	$ 98,095		

TABLE 7 (continued)

Division/Facility	Construction Cost Opinion ($1,000's)	Proposed Bid Opening Date	Permit Application Date
OTHER PROJECTS			
9. Division 4H22		Aug. 1989	N/A
a. Exist. Final Tank Skimming	$ 1,700		
10. Screens for S&G Bldg. No. 2	580	March 1991	N/A
11. Third Heat Drying Train	8,000	Jan. 1994	Oct. 1992
12. Final Effluent Conduit (84")	2,874	Jan. 2000	Oct. 1999
TOTAL OTHER PROJECTS	$ 13,154		
GRAND TOTAL ALL FACILITIES FOR 96-MGD EXPANSION	$111,249		

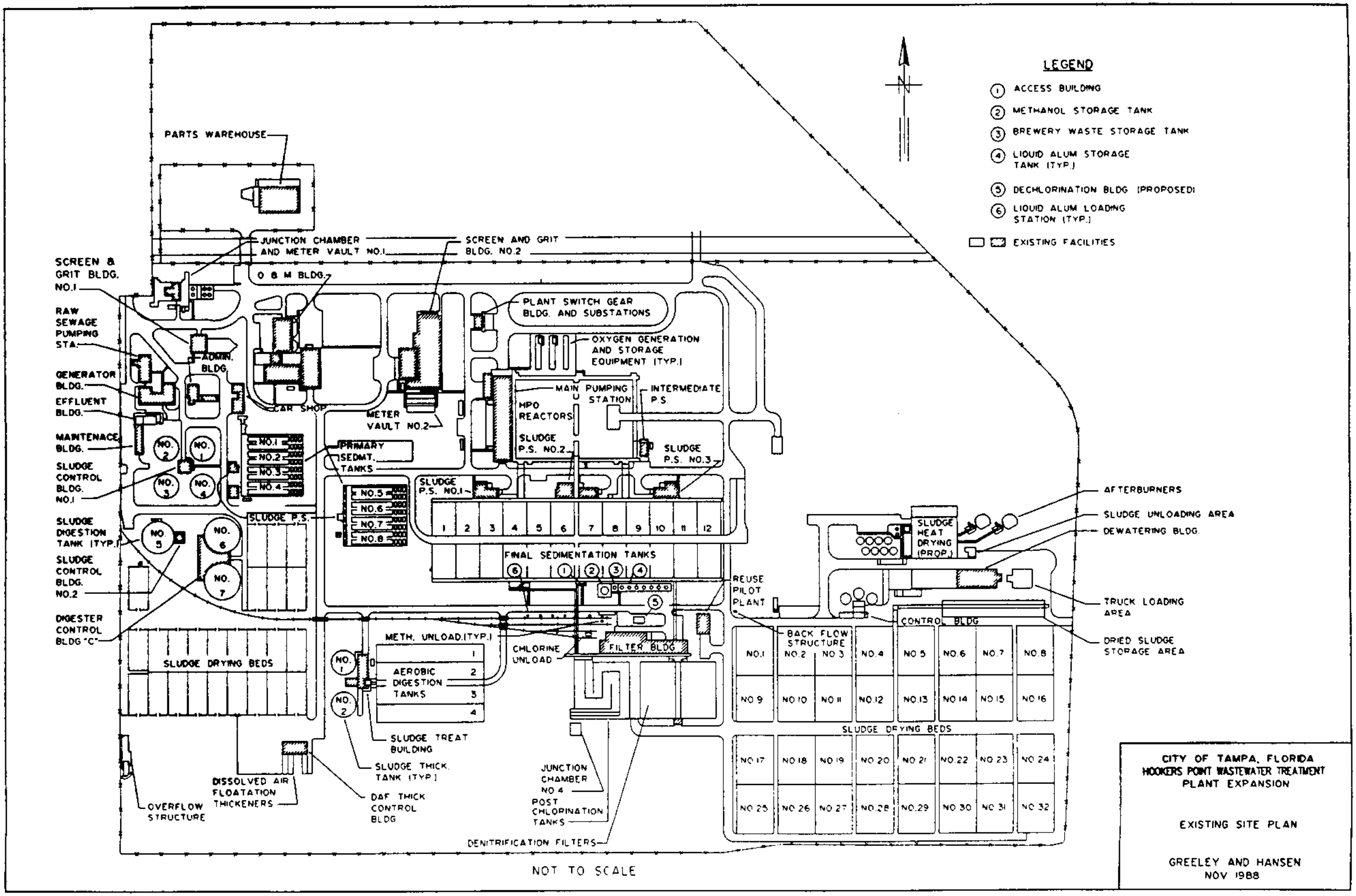
FIGURES

FIGURE 1



HOOKERS POINT WASTEWATER TREATMENT PLANT
EXISTING PROCESS SCHEMATIC

FIGURE 2



CITY OF TAMPA, FLORIDA
HOOKERS POINT WASTEWATER TREATMENT
PLANT EXPANSION

EXISTING SITE PLAN

GREELEY AND HANSEN
NOV 1988

FIGURE 3

ALTERNATIVE 2A-C1

HIGH PURITY OXYGEN ACTIVATED SLUDGE

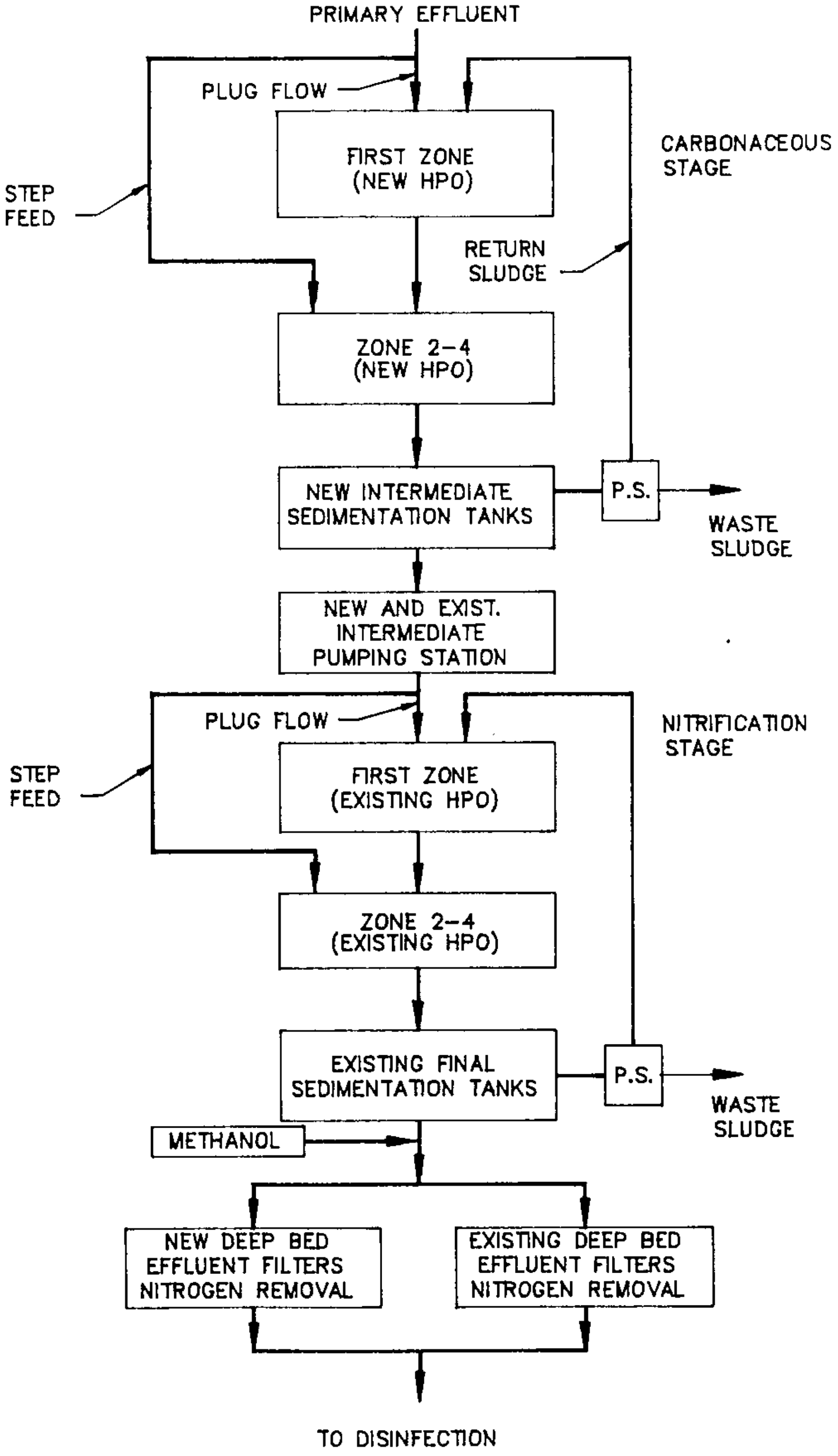


FIGURE 4

ALTERNATIVE 2A-C5

TWO STAGE SERIES ACTIVATED SLUDGE

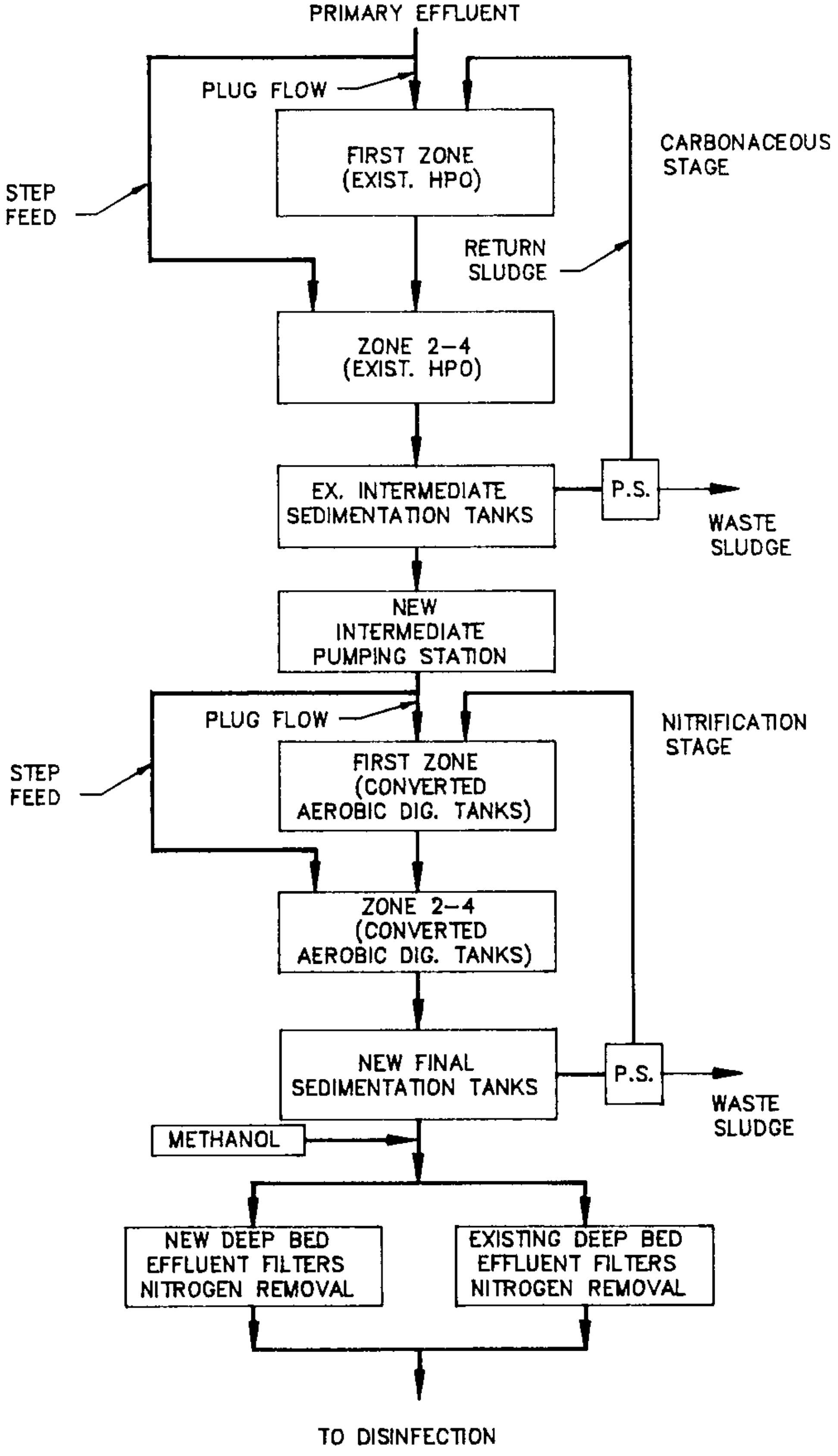
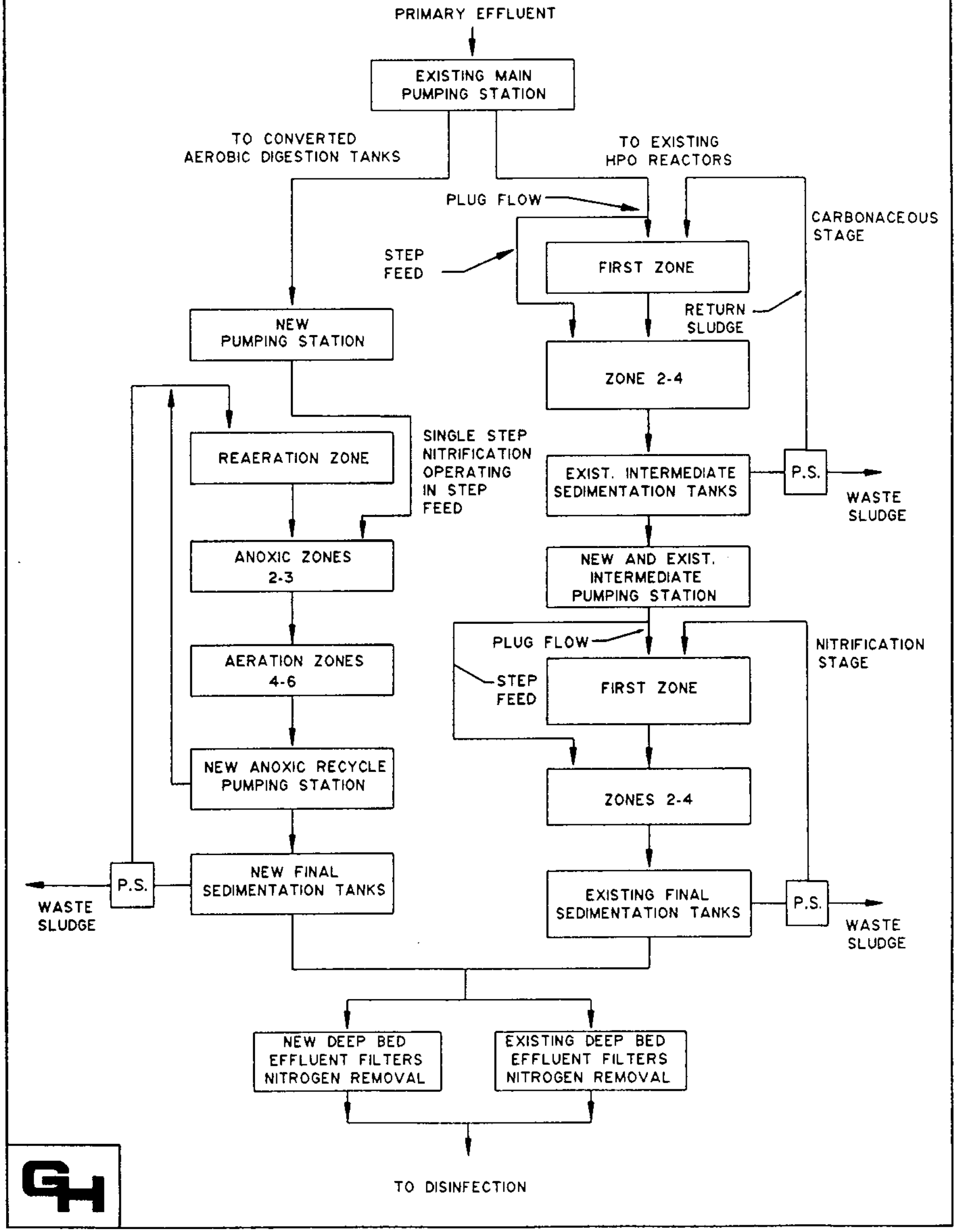
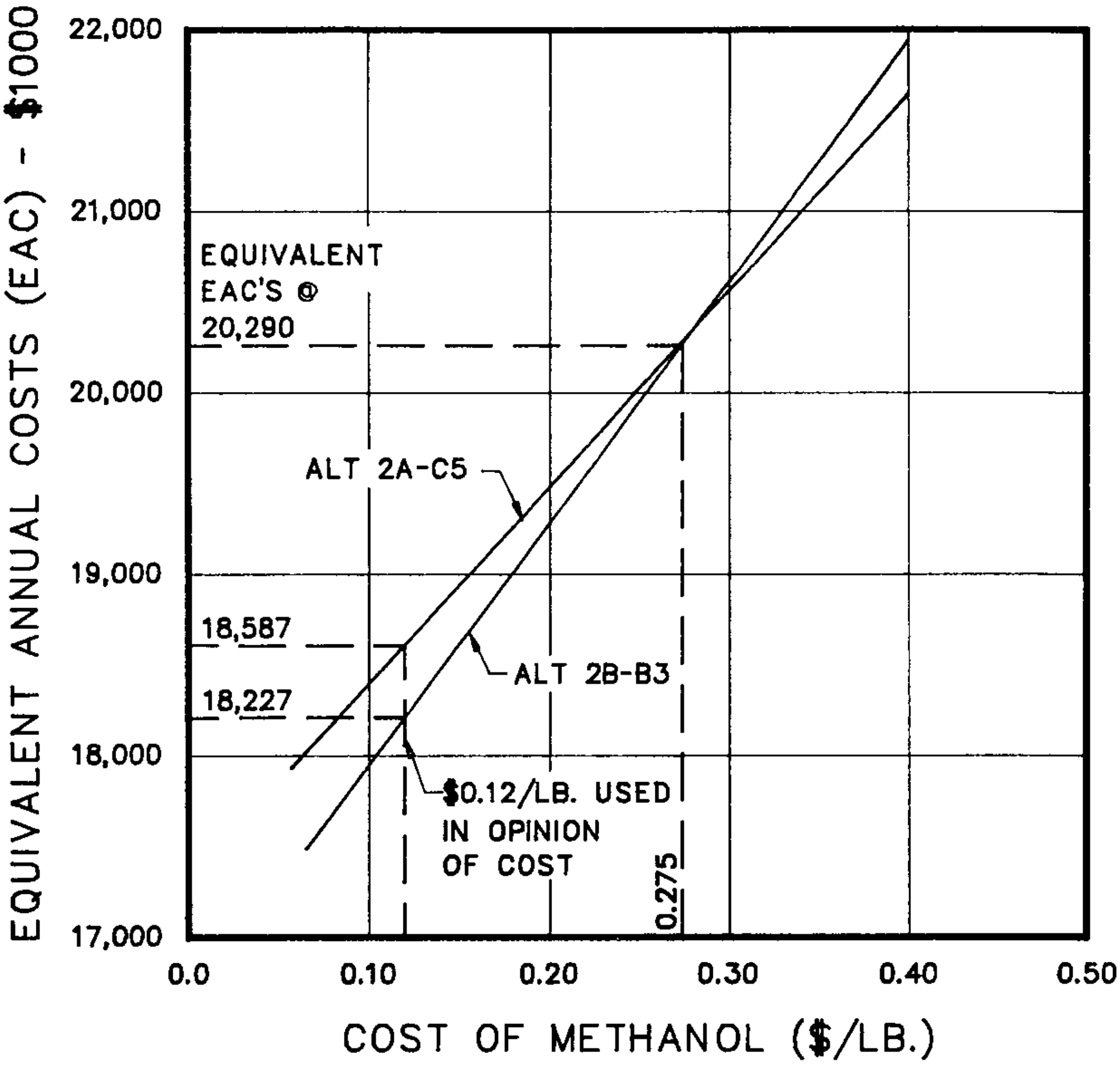


FIGURE 5

ALTERNATIVE 2B-B3

PARALLEL ACTIVATED SLUDGE SYSTEM WITH ANOXIC ZONES



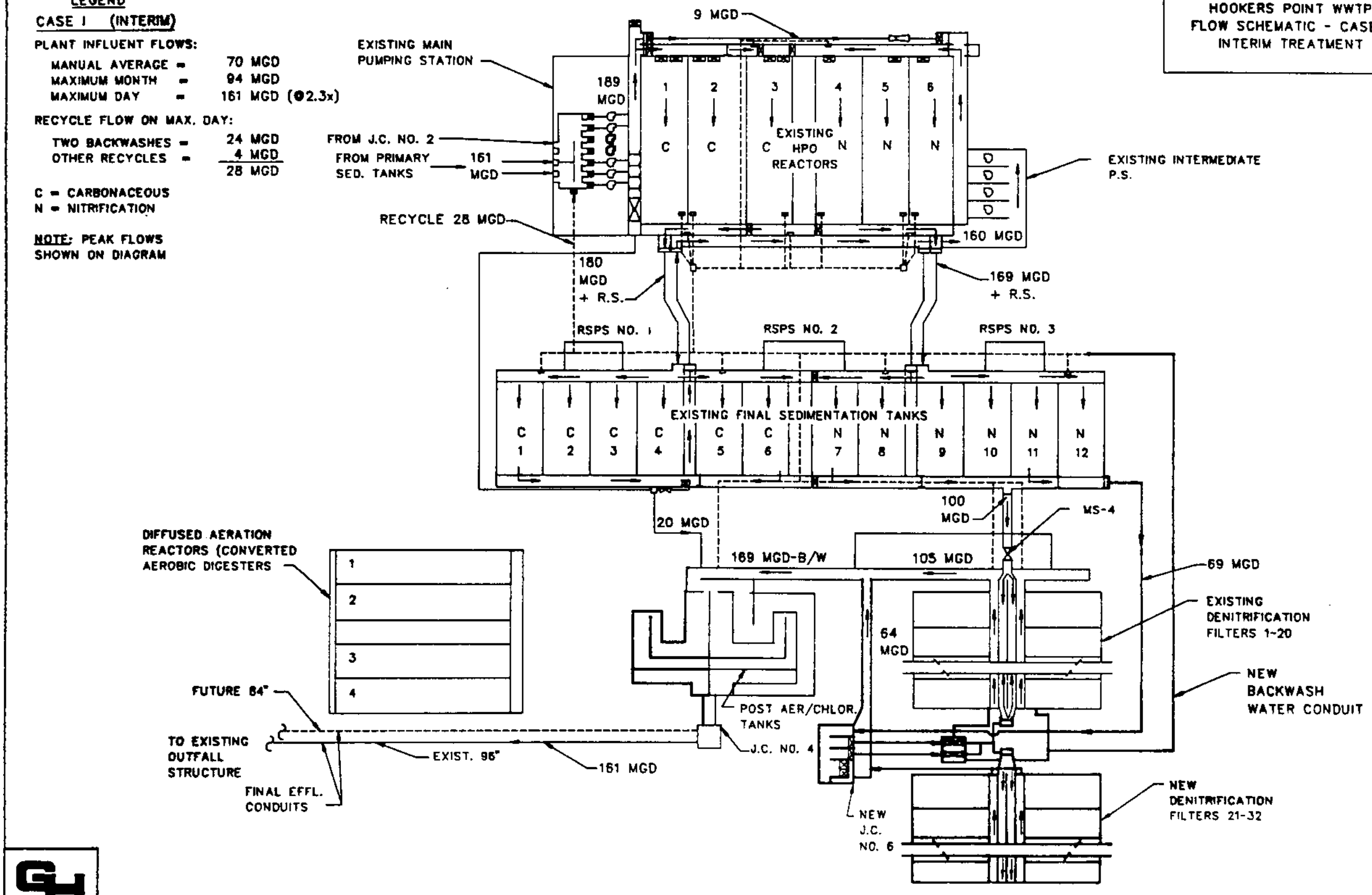


SENSITIVITY OF ALTERNATIVE COSTS TO THE COST OF METHANOL

CITY OF TAMPA, FLORIDA
HOOKERS POINT WWTP
JANUARY 1989

FIGURE 7

CITY OF TAMPA, FLORIDA
HOOKERS POINT WWTP
FLOW SCHEMATIC - CASE 1
INTERIM TREATMENT



LEGEND

CASE I (INTERIM)

PLANT INFLUENT FLOWS:

MANUAL AVERAGE =	70 MGD
MAXIMUM MONTH =	94 MGD
MAXIMUM DAY =	161 MGD (@2.3x)

RECYCLE FLOW ON MAX. DAY:

TWO BACKWASHES =	24 MGD
OTHER RECYCLES =	4 MGD
	28 MGD

C = CARBONACEOUS
N = NITRIFICATION

NOTE: PEAK FLOWS SHOWN ON DIAGRAM

CITY OF TAMPA, FLORIDA
HOOKERS POINT WWTP
FLOW SCHEMATIC - CASE 2A
SERIES TREATMENT
ALTERNATIVE 2A-C5

LEGEND

CASE IIA (2008)

PLANT INFLUENT FLOWS:

MANUAL AVERAGE =	96 MGD
MAXIMUM MONTH =	129 MGD
MAXIMUM DAY =	221 MGD (@2.3 x)

RECYCLE FLOW ON MAX. DAY:

TWO BACKWASHES =	24 MGD
OTHER RECYCLES =	4 MGD
	28 MGD

C = CARBONACEOUS
N = NITRIFICATION

NOTE: PEAK FLOWS SHOWN ON DIAGRAM

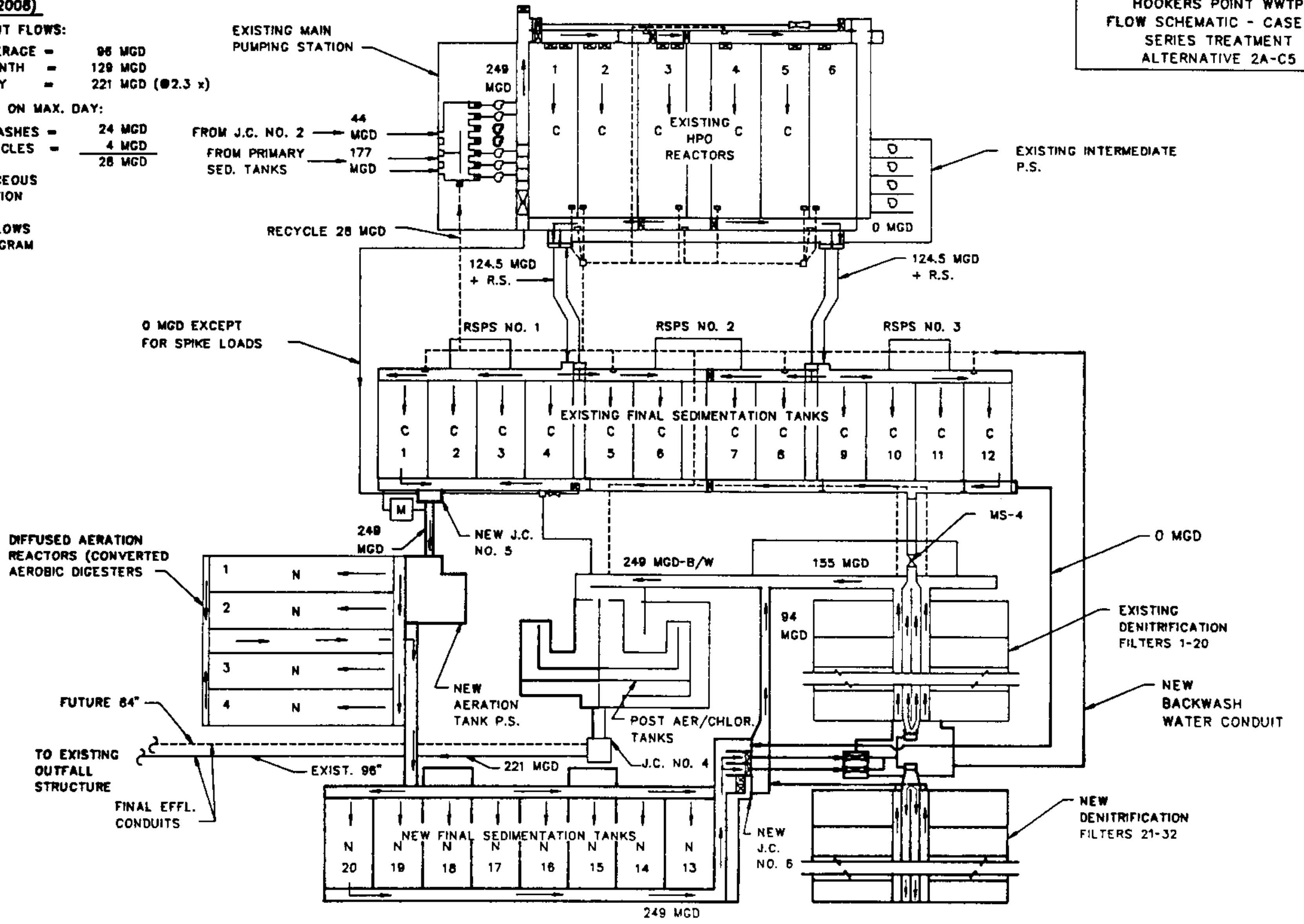


FIGURE 8

CITY OF TAMPA, FLORIDA
HOOKERS POINT WWTP
FLOW SCHEMATIC - CASE 2B
PARALLEL TREATMENT
ALTERNATIVE 2B-B3

LEGEND

CASE IIB (2008)

PLANT INFLUENT FLOWS:

MANUAL AVERAGE	=	96 MGD
MAXIMUM MONTH	=	129 MGD
MAXIMUM DAY	=	221 MGD

RECYCLE FLOW ON MAX. DAY:

TWO BACKWASHES	=	24 MGD
OTHER RECYCLES	=	4 MGD
		28 MGD

C = CARBONACEOUS
N = NITRIFICATION
CN = SINGLE-STAGE PROCESS

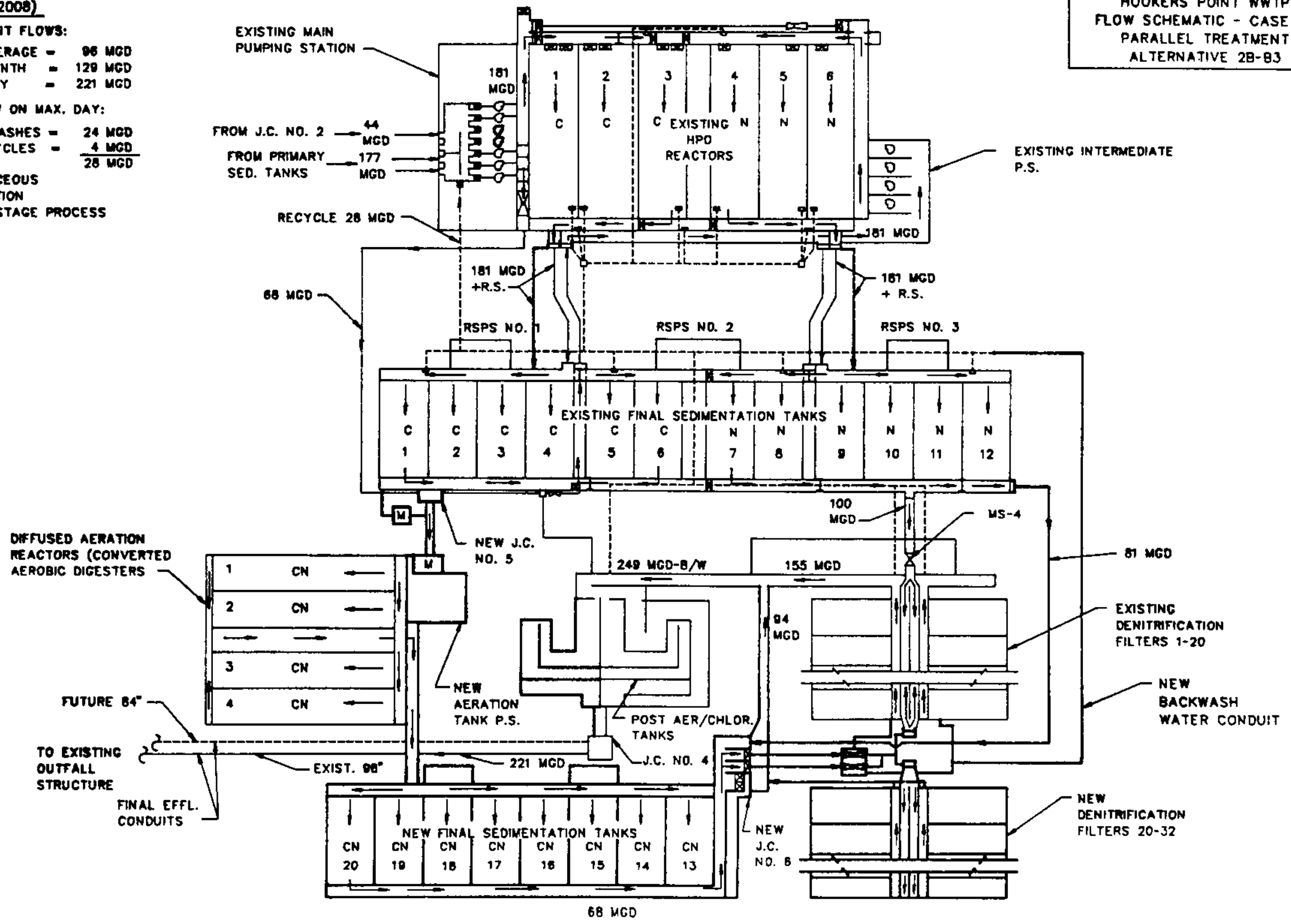


FIGURE 9

CITY OF TAMPA, FLORIDA
HOOKERS POINT WWPT
FLOW SCHEMATIC - CASE 3
ULTIMATE TREATMENT

LEGEND

CASE I (INTERIM)

PLANT INFLUENT FLOWS:

MANUAL AVERAGE = 120 MGD
MAXIMUM MONTH = 161 MGD
MAXIMUM DAY = 264 MGD (@ 2.2 x)

RECYCLE FLOW ON MAX. DAY:

TWO BACKWASHES = 24 MGD
OTHER RECYCLES = 4 MGD
28 MGD

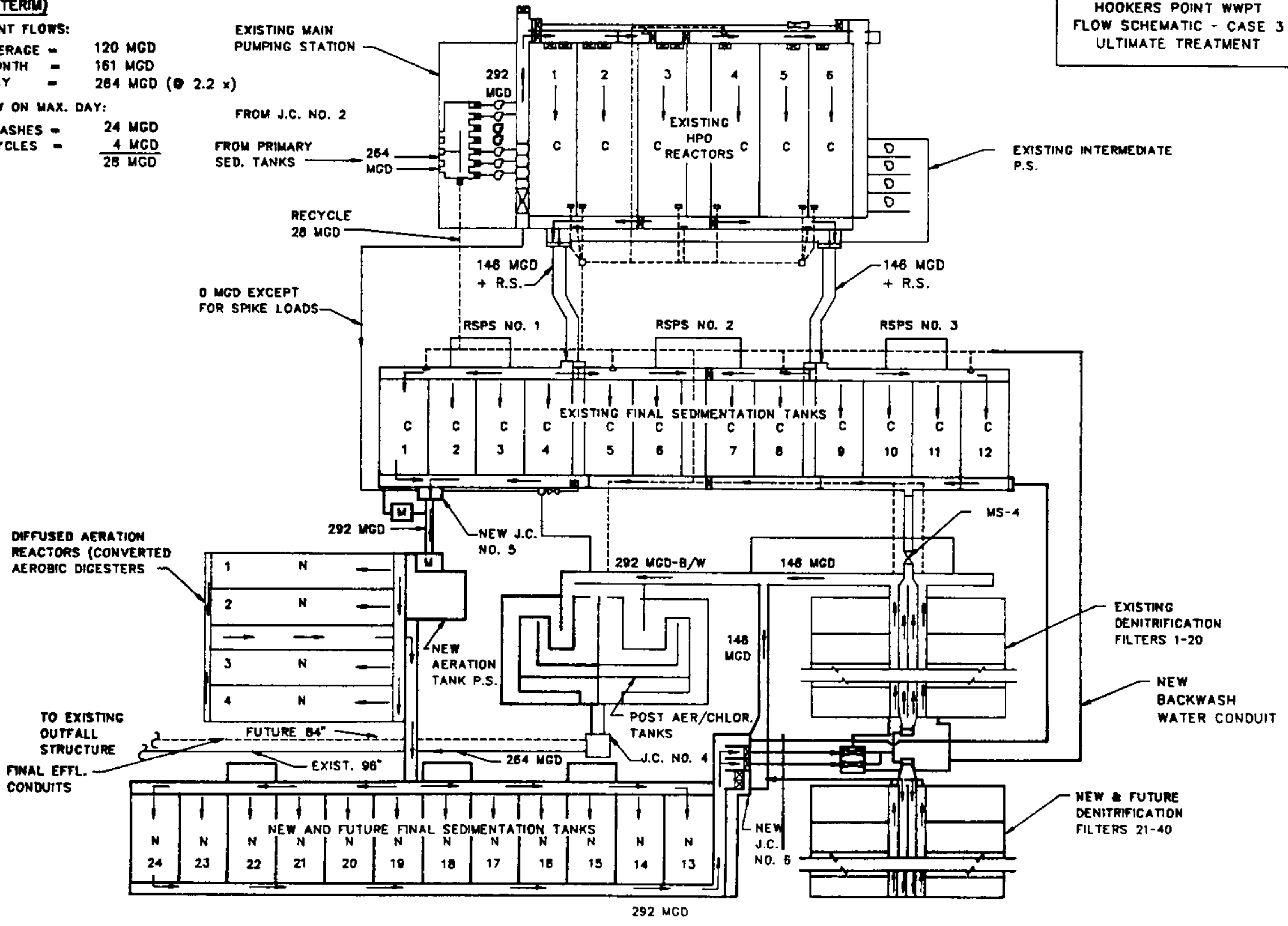


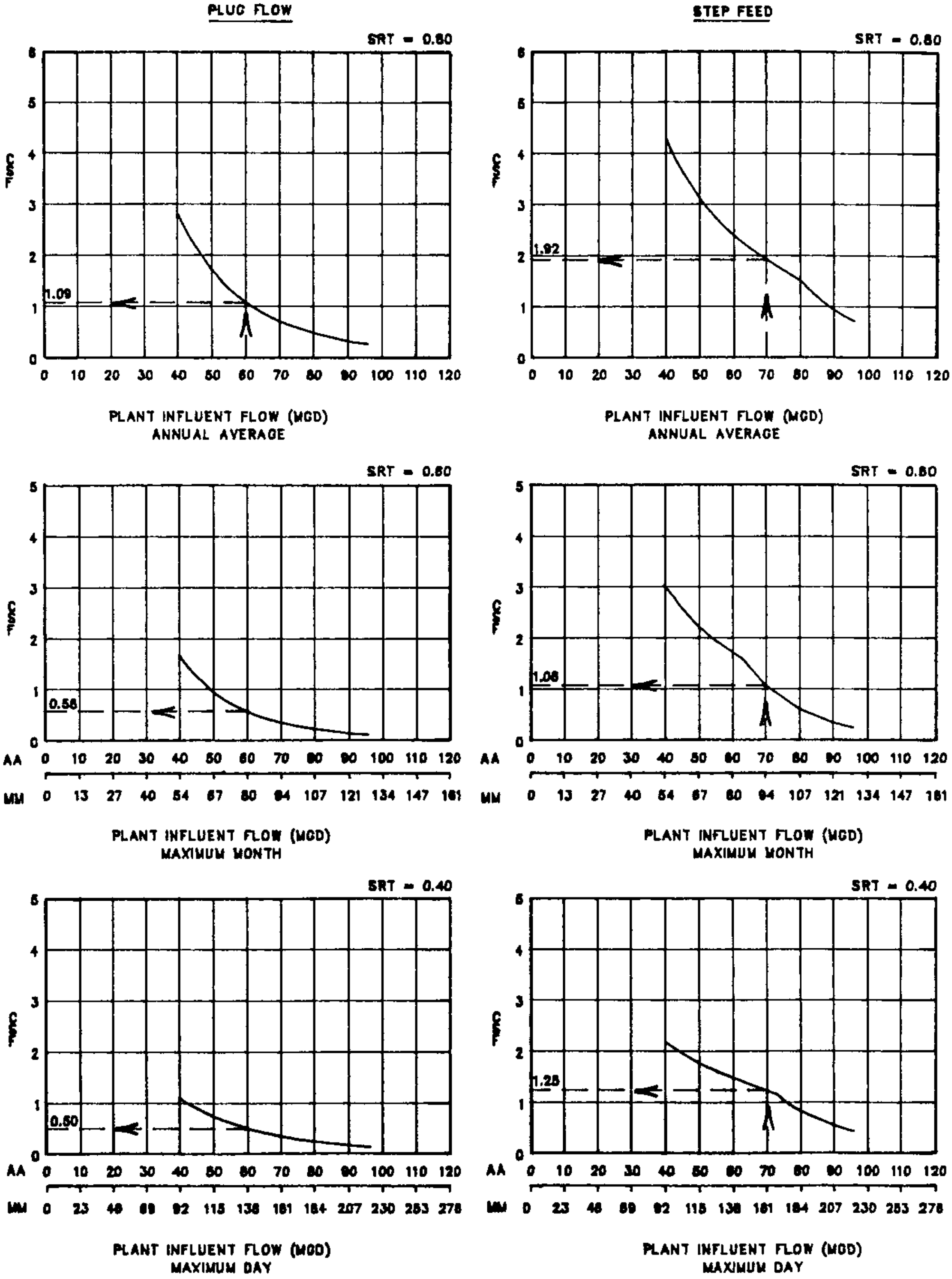
FIGURE 10

FIGURE 11

CLARIFIER SAFETY FACTORS

HIGH PURITY OXYGEN REACTORS

CARBONACEOUS STAGE/ 3 REACTORS/ 8 FINAL TANKS



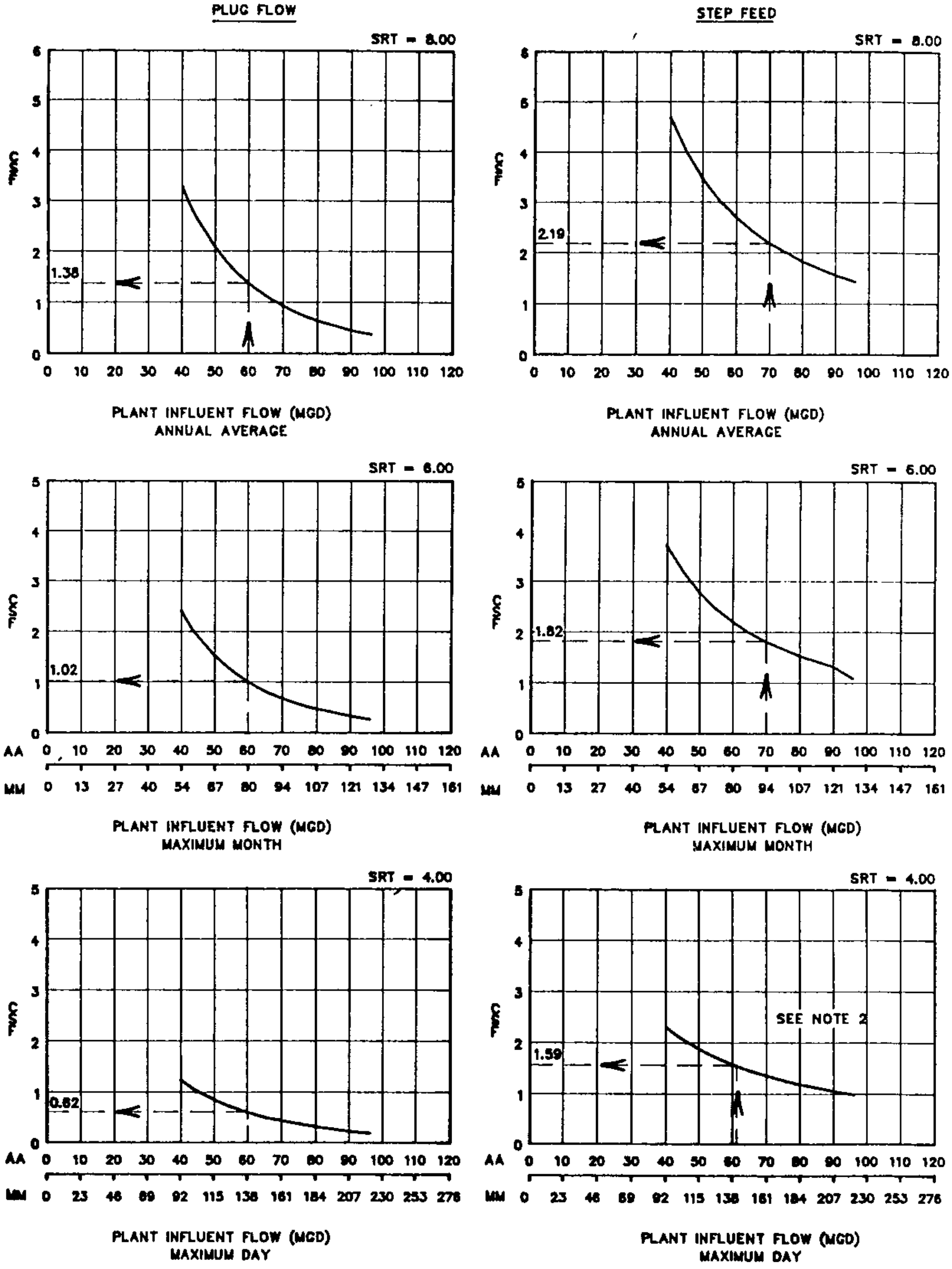
NOTE: THE RETURN SLUDGE CONCENTRATIONS ARE LIMITED BY A MINIMUM RETURN SLUDGE FLOW OF 3.33 MGD/SED. TANK AND A MAXIMUM R.S. CONCENTRATION OF 8000 mg/l.

FIGURE 12

CLARIFIER SAFETY FACTORS

HIGH PURITY OXYGEN REACTORS

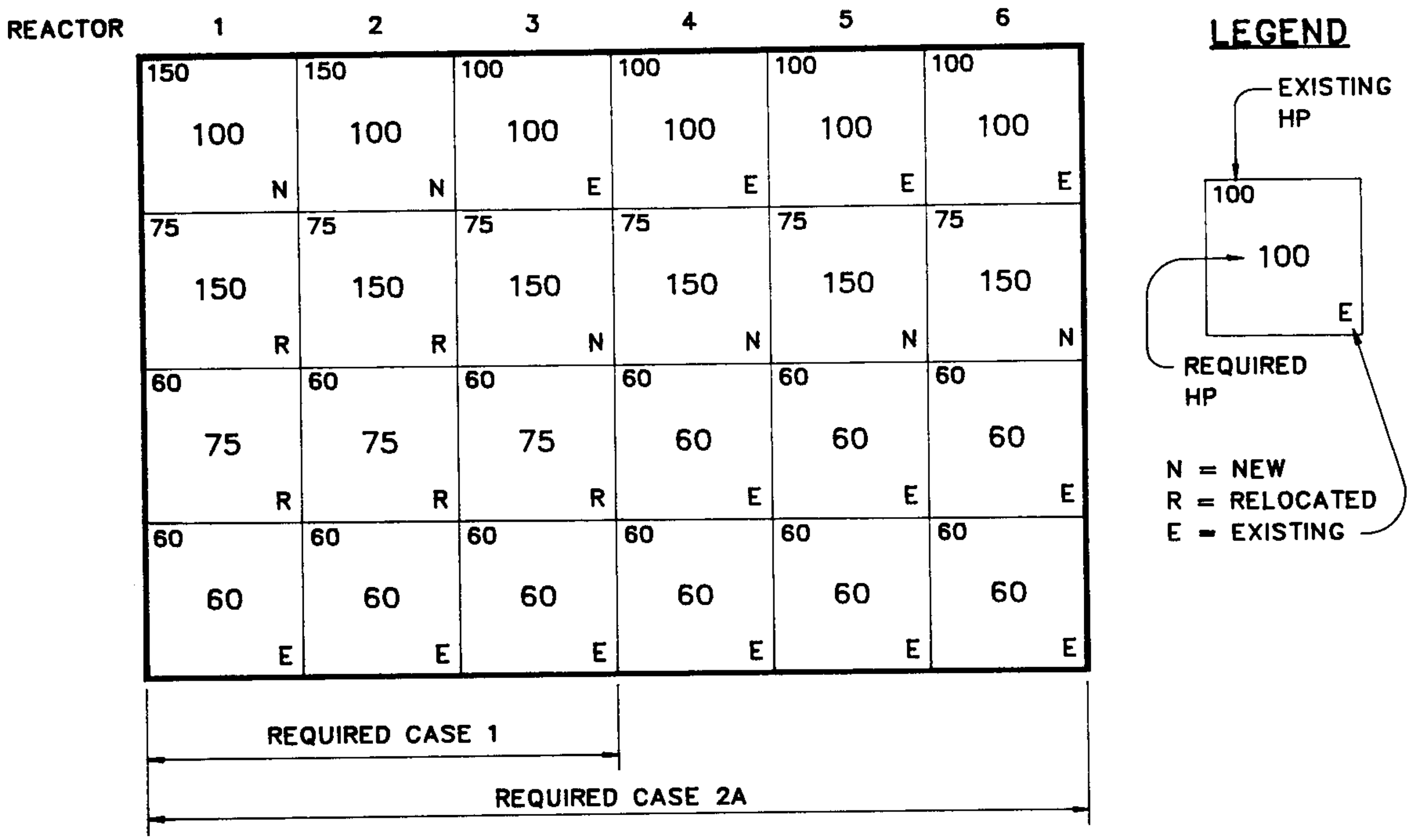
NITRIFICATION STAGE / 3 REACTORS / 6 FINAL TANKS



NOTE: (1.) THE RETURN SLUDGE CONCETRATIONS ARE LIMITED BY A MINIMUM RETURN SLUDGE FLOW OF 3.33 MGD/SED. TANK AND A MAXIMUM R.S. CONCENTRATION OF 8000 mg/l.

(2.) MAXIMUM LOAD TO REACTORS IS LIMITED BY CAPACITY OF THE INTERMEDIATE P.S. (160 MGD + 9 MGD CARB. BYPASS, EQUIVALENT TO 141 MGD PLANT INFLUENT)

FIGURE 13



REACTOR	1	2	3	4	5	6
	150 100 N	150 100 N	100 100 E	100 100 E	100 100 E	100 100 E
	75 150 R	75 150 R	75 150 N	75 150 N	75 150 N	75 150 N
	60 75 R	60 75 R	60 75 R	60 60 E	60 60 E	60 60 E
	60 60 E	60 60 E	60 60 E	60 60 E	60 60 E	60 60 E

NOTE: Required HP based on model of oxygen dissolution at about 80-90% utilization and 4.0 mg/l minimum D.O. in any cell.

HPO REACTOR AERATOR HP REQUIREMENTS

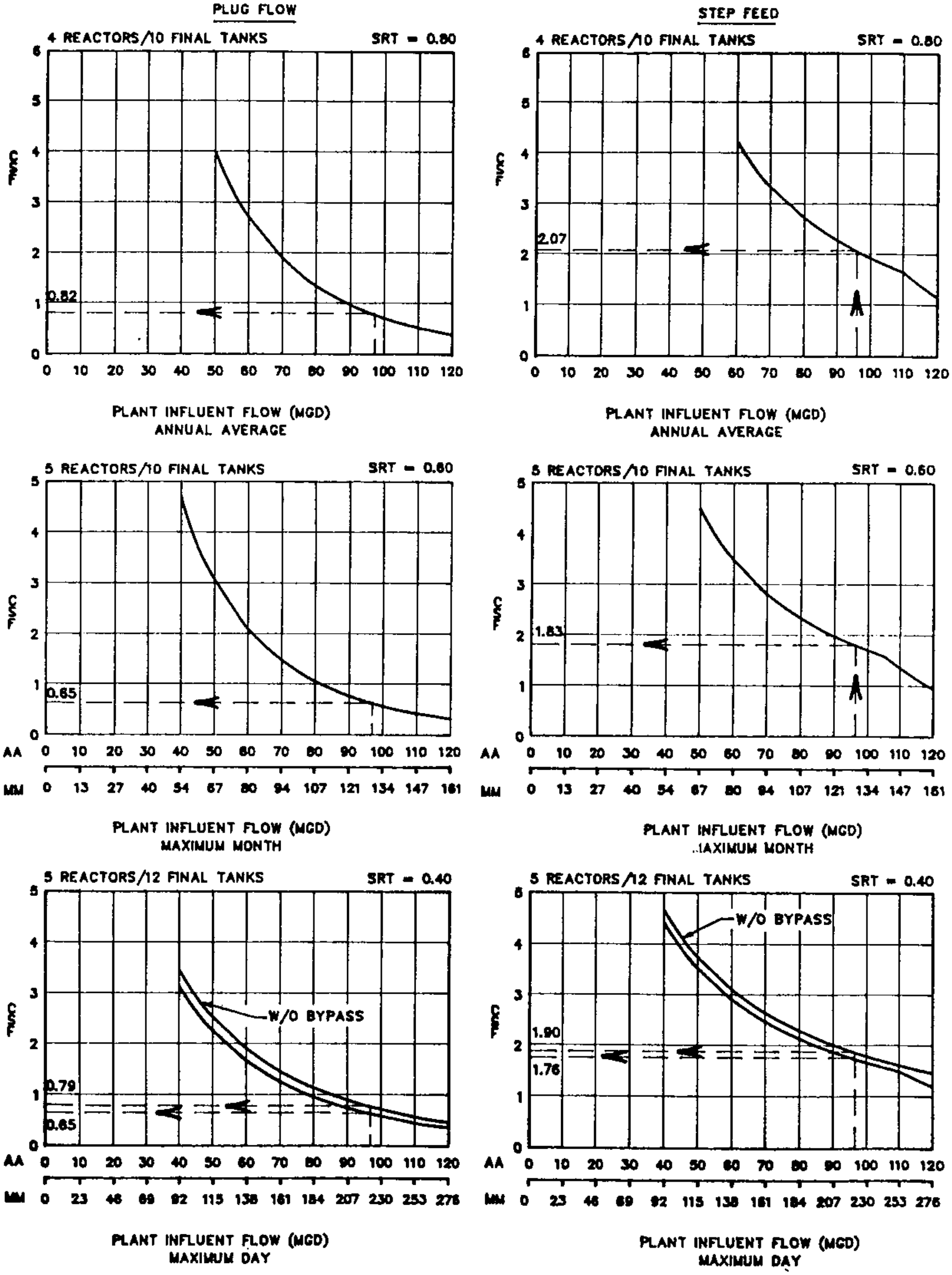
CITY OF TAMPA, FLORIDA
HOOKERS POINT WWTP
JANUARY 1989

FIGURE 14

CLIRIFIER SAFETY FACTORS

HIGH PURITY OXYGEN REACTORS

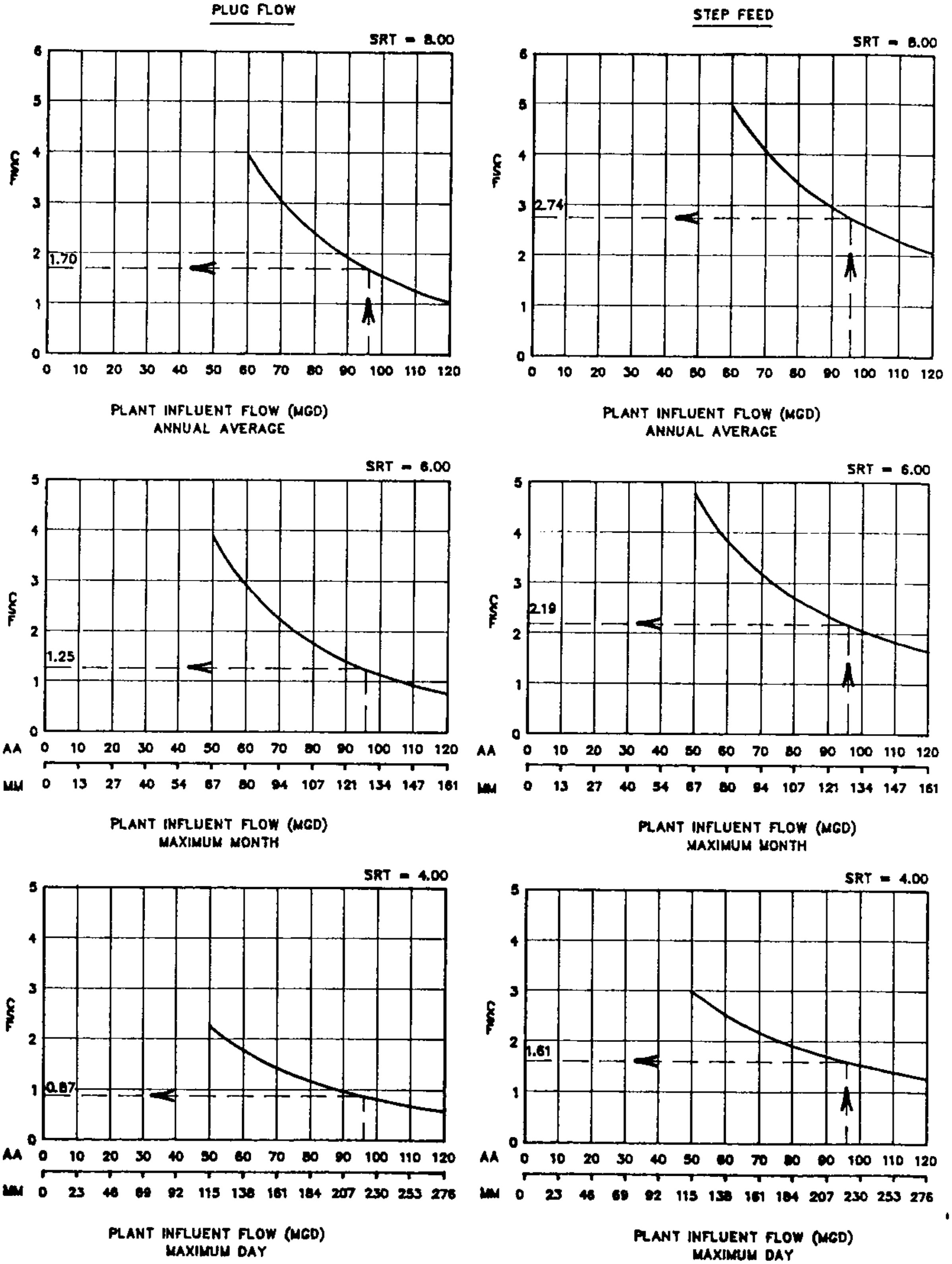
CARBONACEOUS STAGE / UP TO 6 REACTORS / UP TO 12 FINAL TANKS



NOTE: THE RETURN SLUDGE CONCENTRATIONS ARE LIMITED BY A MINIMUM RETURN SLUDGE FLOW OF 3.33 MGD/SED. TANK AND A MAXIMUM R.S. CONCENTRATION OF 8000 mg/l.

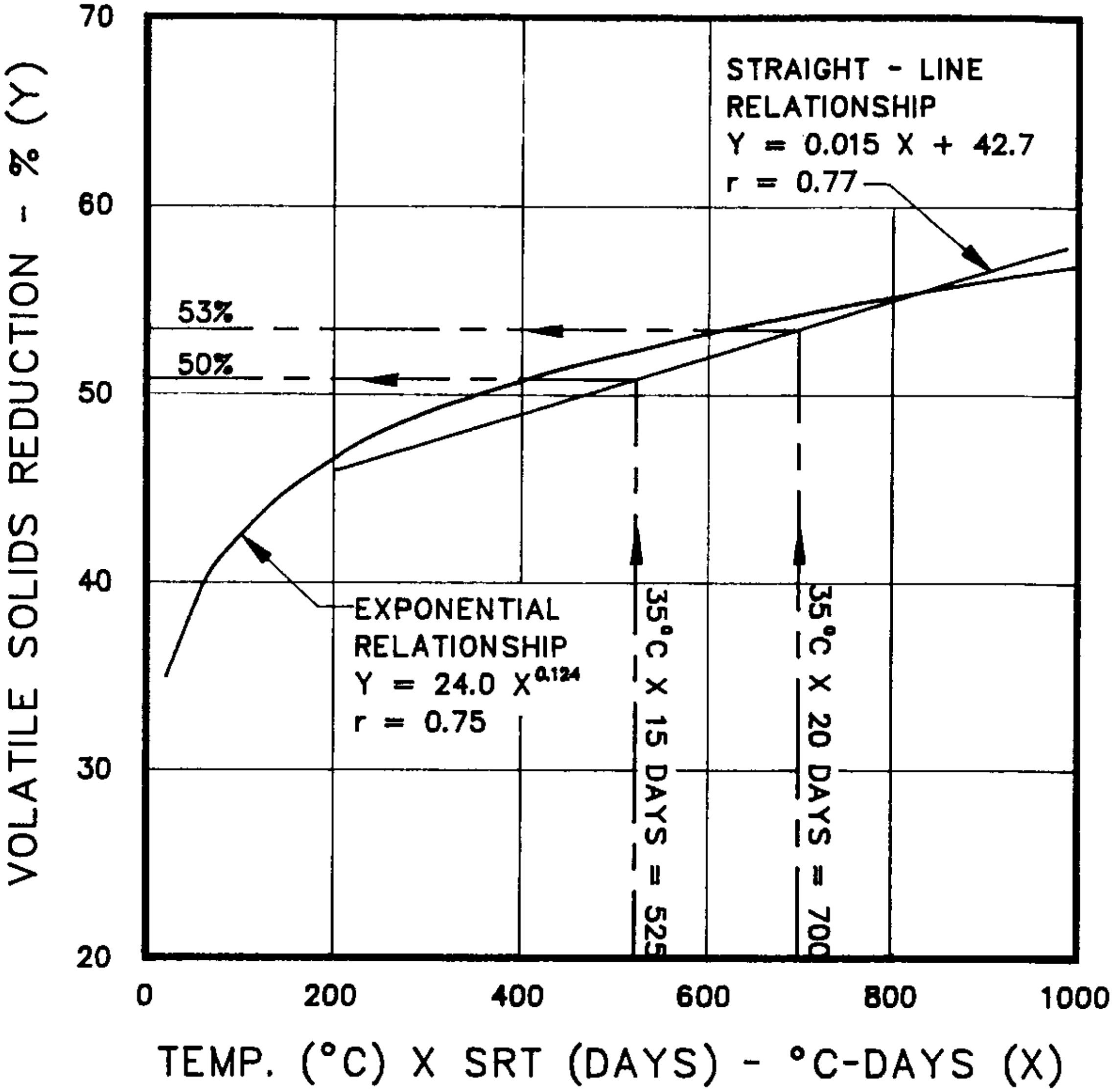
CLARIFIER SAFETY FACTORS

CONVERTED AEROBIC DIGESTION TANKS
NITRIFICATION STAGE / 4 REACTORS / 8 FINAL TANKS



NOTE: THE RETURN SLUDGE CONCENTRATIONS ARE LIMITED BY A MINIMUM RETURN SLUDGE FLOW OF 3.33 MGD/SED. TANK AND A MAXIMUM R.S. CONCENTRATION OF 8000 mg/l.

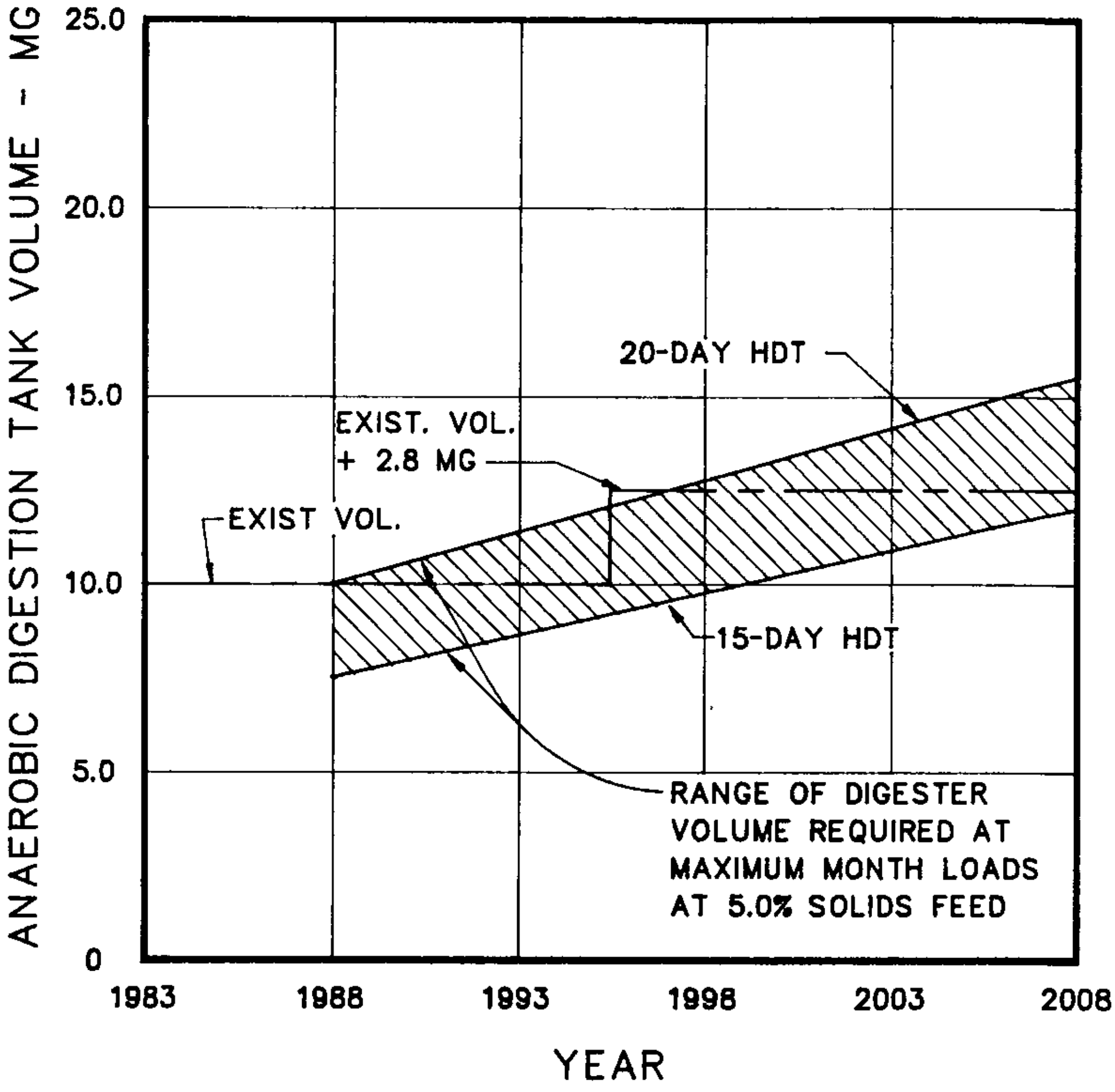
FIGURE 16



Note: Relationship based on best fit to data on Fig. 6-13 of USEPA "Process Design Manual for Sludge Treatment and Disposal."

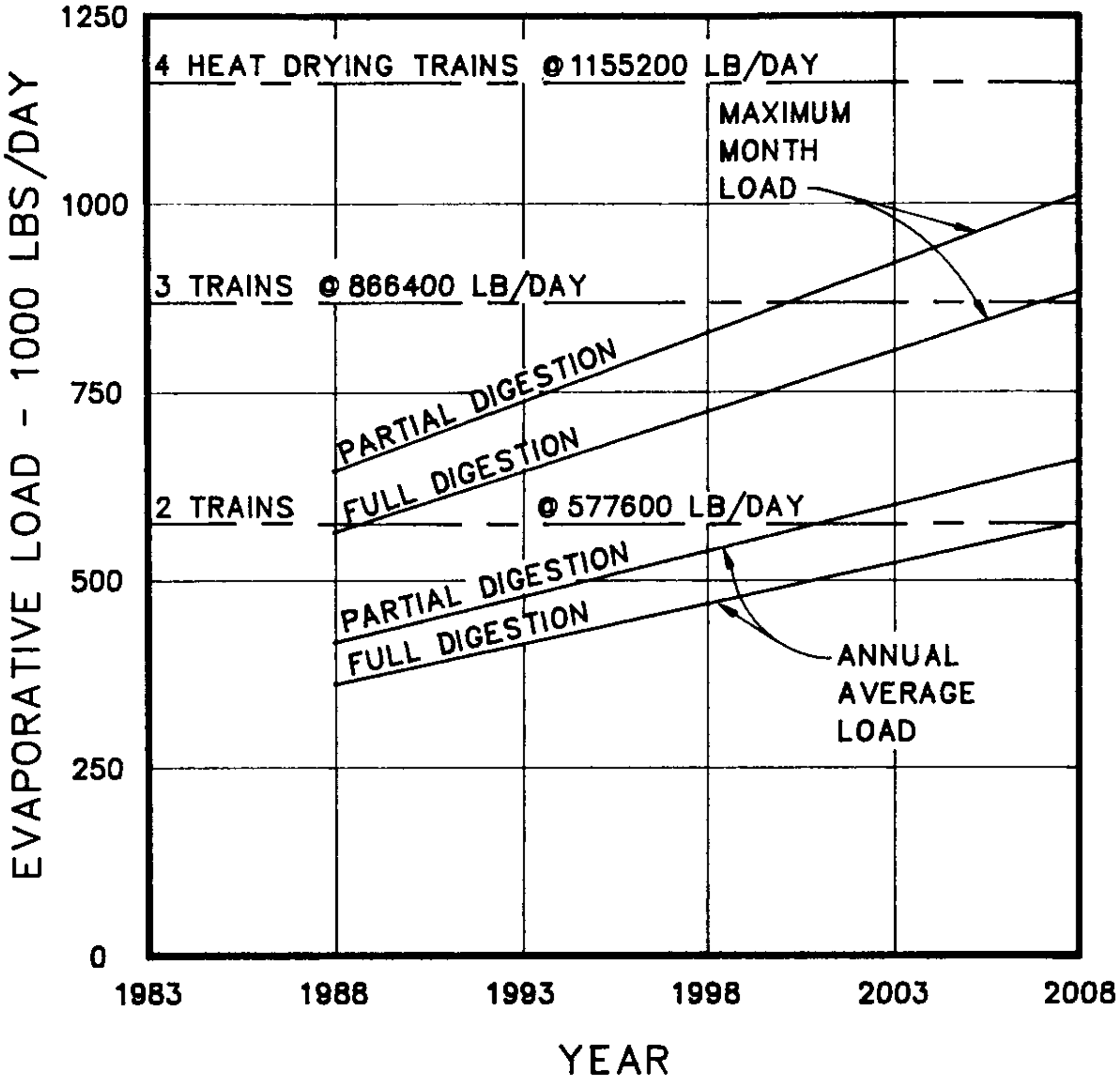
ESTIMATED ANAEROBIC DIGESTION VOLATILE SOLIDS REDUCTION

CITY OF TAMPA, FLORIDA
HOOKERS POINT WWTP
JANUARY 1989



ESTIMATED REQUIRED ANAEROBIC DIGESTION TANK VOLUME BY YEAR

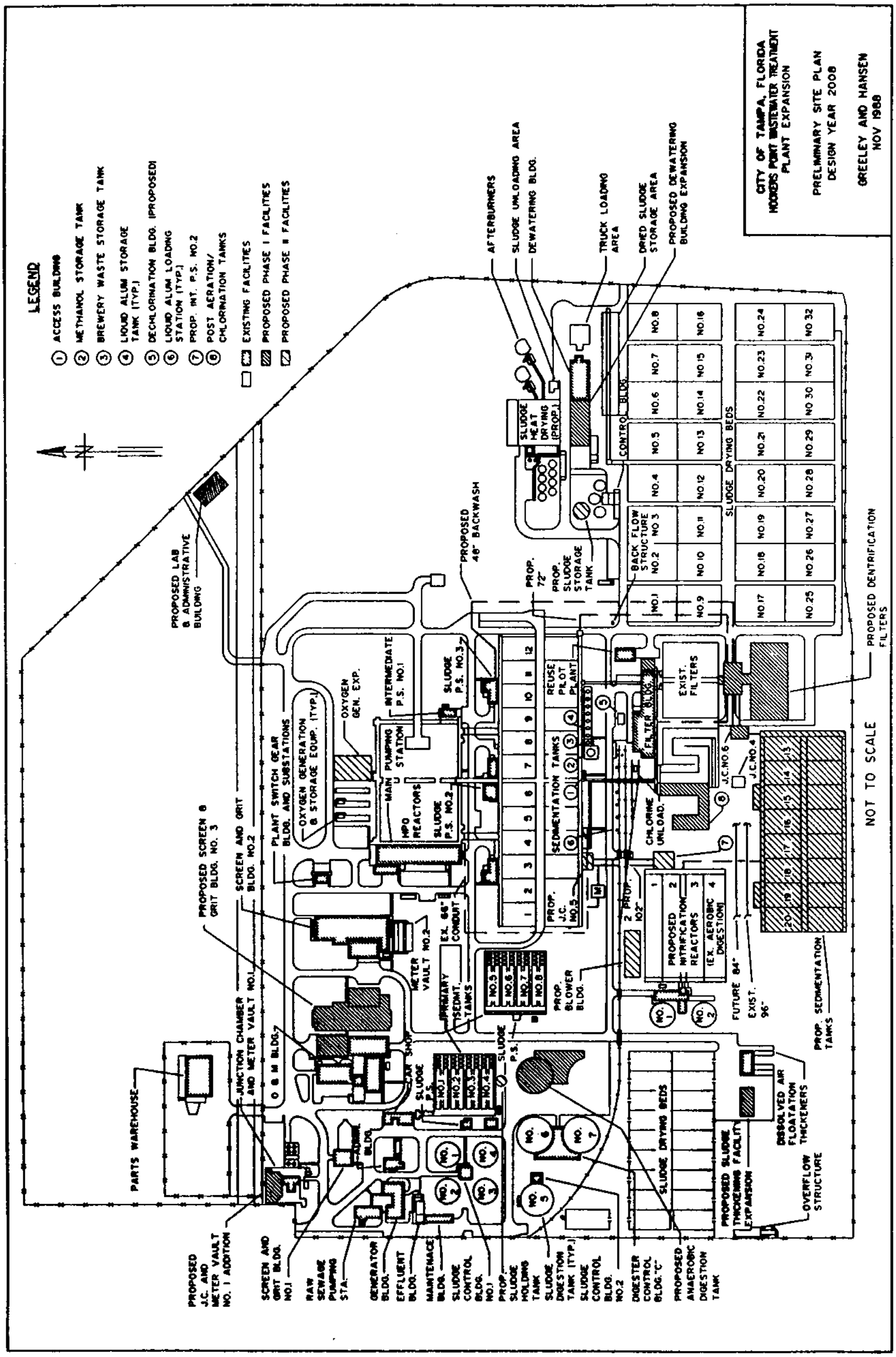
FIGURE 18



ESTIMATED EVAPORATIVE LOADS
AT HEAT DRYING FACILITY BY YEAR
AT 18 PERCENT CAKE SOLIDS

CITY OF TAMPA, FLORIDA
HOOKERS POINT WWTP
JANUARY 1989

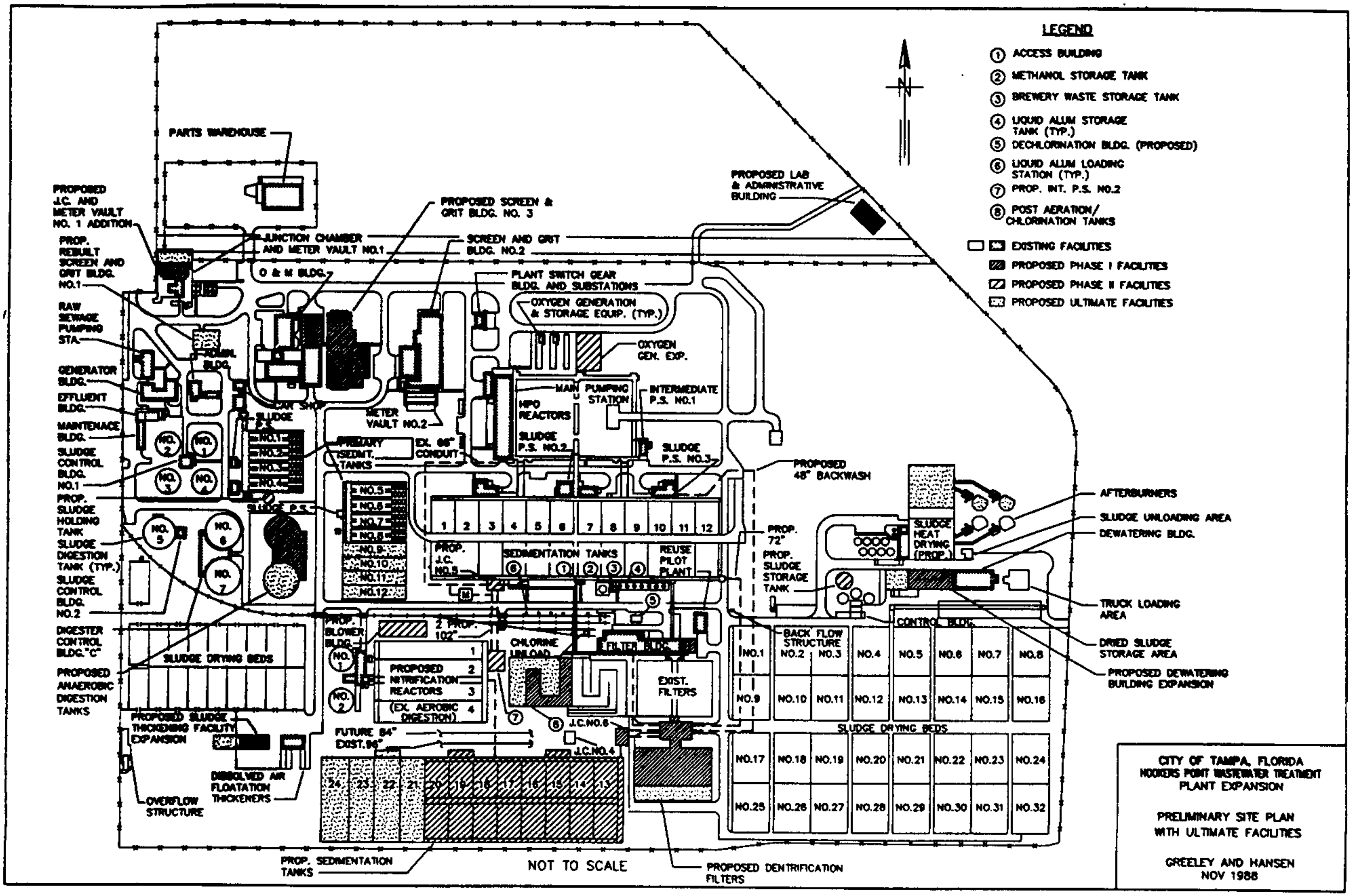
FIGURE 19



CITY OF TAMPA, FLORIDA
HOOKERS POINT WASTEWATER TREATMENT PLANT EXPANSION

PRELIMINARY SITE PLAN
DESIGN YEAR 2008

GREELEY AND HANSEN
NOV 1988



CITY OF TAMPA, FLORIDA
HOOKERS POINT WASTEWATER TREATMENT
PLANT EXPANSION

PRELIMINARY SITE PLAN
WITH ULTIMATE FACILITIES

GREELEY AND HANSEN
NOV 1988

FIGURE 20

APPENDIX A

BASES OF DESIGN

CASE 1

INTERIM TREATMENT
BASES OF DESIGN

70 MGD ANNUAL AVERAGE

12-Jan-89

CASE 1
EXISTING HPO TREATMENT

EXISTING 2-STEP HPO SYSTEM
(STEP FEED)

**** PHASE II (2008) ****

ITEMS	ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
				PEAK CONDITION BASED ON SEPTEMBER 8, 1988
1. BASIC DATA				
WASTEWATER LOADING RATIOS				
- FLOW	1.00	1.34	2.30	Study Memo B
- BOD5	1.00	1.45	1.44	Study Memo B
- TSS	1.00	1.35	1.90	Study Memo B
- NITROGEN	1.00	1.32	1.07	Study Memo B
- PHOSPHORUS	1.00	1.22	1.01	Study Memo B
FLOW RATE (MGD)	70.0	93.8	161.0	Study Memo B
PLANT INFLUENT CHARACTERISTICS				
- BOD-5 (1000 LB/DAY)	154.1	223.5	221.5	Study Memo B
* (mg/L)	264.0	285.7	165.0	
- SUSPENDED SOLIDS (1000 LB/DAY)	118.5	160.0	225.6	Study Memo B
* (mg/L)	203.0	204.5	168.0	
- NITROGEN as TKN (1000 LB/DAY)	17.5	23.1	18.7	Study Memo B
* (mg/L)	30.0	29.6	13.9	
- PHOSPHORUS (1000 LB/DAY)	5.3	6.5	5.4	Study Memo B
* (mg/L)	9.1	8.3	4.0	
2.JUNCTION CHAMBER NO.1 (PREAERATION TANKS)				
JC1 INFLUENT SEWAGE QUANTITIES (MGD)	70.0	93.8	161.0	
NUMBER OF EXISTING TANKS @ 25' x 66'	2	2	2	
NUMBER OF NEW TANKS @ 30' x 66'	1	1	1	
@ 20' x 66'	0	0	0	
WATER DEPTH IN TANKS (FT.)	17.00	17.00	17.00	Basis; prim. treatment hydraulic spreadsheet
TOTAL VOLUME - CUBIC FT.	89760	89760	89760	
- MILLION GAL.	0.67	0.67	0.67	
DETENTION TIME (MINUTES)	13.8	10.3	6.0	
TOTAL BLOWER CAPACITY (SCFM)	11520	11520	11520	
AIR APPLIED				
- INFLUENT AND EFFLUENT CHANNELS (SCFM)	1150	1150	1150	
- PREAERATION TANKS (SCFM)	10370	10370	10370	
* cu.ft./gal	0.21	0.16	0.09	
* scfm/1000 cu.ft.	116	116	116	

12-Jan-89

CASE 1
EXISTING HPO TREATMENT

EXISTING 2-STEP HPO SYSTEM
(STEP FEED)

*** **** PHASE II (2008) **** **

ITEMS	ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
3. SCREEN AND GRIT BUILDING No. 2				
INFLUENT SEWAGE QUANTITIES (mgd)	35.0	46.9	80.5	Based on one half total flow
MECHANICAL SEWAGE SCREENS				
- NUMBER OF SCREENS	3	3	3	2 operating w/ 1 standby
- WIDTH OF EACH SCREEN (ft.)	7.5	7.5	7.5	
- CLEAR BAR SPACING (inches)	0.38	0.38	0.38	
- SCREENING QUAN.,EACH SCREEN (cu.ft./hr.	1.46	1.95	3.35	Each screen at 6.8 cu.ft./mg @ 0.38 spacing
GRIT FACILITIES				
- NUMBER OF GRIT TANKS, TOTAL	4	4	4	
, OPERATING	2	3	4	
- WIDTH OF TANKS (ft.)	45	45	45	
- LENTGH OF TANKS (ft.)	45	45	45	
- SURFACE AREA, EACH TANK (sq.ft.)	2025	2025	2025	
- TOTAL SURFACE AREA (sq.ft.)	4050	6075	8100	
- MIN. SURFACE AREA REQUIRED (sq.ft./mgd)	70	70	70	For 150 mesh grit removal
- SURFACE AREA (sq.ft./mgd)	116	130	101	
- SURFACE LOADING (gpsfpd)	8642	7720	9938	
- WEIR LOADING (mg/ft./day)	0.39	0.35	0.45	weir length = 45 ft. per tank.
- GRIT REMOVED (cu.ft./mg - dry basis)	2.23	3.35	3.35	Study Memo B
* (cu.ft./day - dry basis)	78	157	270	
* (1000 lbs./day - dry basis)	9	19	32	Dry basis at 120 lbs/cu.ft.
* percent solids at 800 gpm	0.16	0.16	0.16	
- WASHED GRIT ; PERCENT SOLIDS	75	75	75	
TONS/DAY (wet grit)	6.23	12.55	21.54	
4. SCREEN AND GRIT BUILDING No. 3				
INFLUENT SEWAGE QUANTITIES (mgd)	35.0	46.9	80.5	Based on one half total flow
MECHANICAL SEWAGE SCREENS				
- NUMBER OF SCREENS	3	3	3	2 operating, 1 standby
- WIDTH OF EACH SCREEN (ft.)	7.5	7.5	7.5	
- CLEAR BAR SPACING (inches)	0.38	0.38	0.38	
- SCREENING QUAN.,EACH SCREEN (cu.ft./hr.	1.46	1.95	3.35	Each screen at 6.8 cu.ft./mg @ 0.38 spacing
GRIT FACILITIES				
- NUMBER OF GRIT TANKS, TOTAL	4	4	4	
, OPERATING	2	3	4	
- WIDTH OF TANKS (ft.)	45	45	45	
- LENTGH OF TANKS (ft.)	45	45	45	
- SURFACE AREA, EACH TANK (sq.ft.)	2025	2025	2025	

CASE 1
EXISTING HPO TREATMENT

EXISTING 2-STEP HPO SYSTEM
(STEP FEED)
**** PHASE II (2008) ****

ITEMS	ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
4. SCREEN AND GRIT BUILDING No. 3 (cont.)				
- TOTAL SURFACE AREA (sq.ft.)	4050	6075	8100	
- SURFACE AREA (sq.ft./mgd)	116	130	101	
- SURFACE LOADING (gpsfpd)	8642	7720	9938	
- WEIR LOADING (mg/ft./day)	0.39	0.35	0.45	weir length = 45 ft. per tank.
- GRIT REMOVED (cu.ft./mg - dry basis)	2.23	3.35	3.35	Study Memo B
* (cu.ft./day - dry basis)	78	157	270	
* (1000 lbs./day - dry basis)	9	19	32	Dry basis at 120 lbs/cu.ft.
* percent solids at 800 gpm	0.16	0.16	0.16	
- WASHED GRIT ; PERCENT SOLIDS	75	75	75	
TONS/DAY (wet grit)	6.23	12.55	21.54	
5. JUNCTION CHAMBER No. 2 AND METER VAULT No. 2				
INFLUENT SEWAGE QUANTITIES (mgd)	70.0	93.8	161.0	
FLOW BYPASSED TO CARB. TREATMENT (mgd)	N/A	N/A	0.0	w/o Primary tanks 9-10; Based on 20% of
FLOW TO PRIMARY SEDIMENTATION TANKS (mgd)	70.0	93.8	161.0	influent bypassed
WEST PRIMARY SEDIMENTATION TANKS METER; MRC-1				
- % OF FLOW TO PRIM.TANKS	51.3	51.3	51.3	
- RATED CAPACITY (mgd)	80	80	80	
- FLOW @ PEAK COND.	N/A	N/A	82.5	
EAST PRIMARY SEDIMENTATION TANKS METER; MRC-2				
- % OF FLOW TO PRIM.TANKS	48.7	48.7	48.7	
- RATED CAPACITY (mgd)	144	144	144	
- FLOW @ PEAK COND.	N/A	N/A	78.5	
MAIN PUMPING STATION WET WELL METER; MRC-4				
- % OF FLOW TO M.P.S. WET WELL	N/A	N/A	0.0	
- RATED CAPACITY (mgd)	100	100	100	
- FLOW @ PEAK COND.	N/A	N/A	0.0	
6. WEST PRIMARY SEDIMENTATION TANKS (No. 1-4)				
PRIMARY INFLUENT QUANTITIES (mgd)	35.9	48.1	82.5	
NUMBER OF TANKS	4	4	4	
AVERAGE WATER DEPTH (ft.)	13.1	13.1	13.1	Average value used.
TOTAL SURFACE AREA (sq.ft.)	25232	25232	25232	
TOTAL VOLUME (cu.ft.)	331044	331044	331044	
* (mg)	2.48	2.48	2.48	
SURFACE LOADING (gpsfpd)	1422	1906	3271	

CASE 1
EXISTING HPO TREATMENT

EXISTING 2-STEP HPO SYSTEM
(STEP FEED)

**** PHASE II (2008) ****

ITEMS	ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
6. WEST PRIMARY SEDIMENTATION TANKS (cont.)				
DETENTION TIME (hrs)	1.66	1.24	0.72	
LENGTH OF WEIR (ft.)	718	718	718	
WEIR LOADING (gals/ft./day)	50006	67008	115014	
BOD LOADING (mg/l)	264.0	285.7	165.0	
* (1000 lbs./day)	79.1	114.7	113.6	
BOD REMOVAL (percent)	36.0	36.0	36.0	Study Memo B
* (1000 lbs./day)	28.5	41.3	40.9	
SUSPENDED SOLIDS LOADING (mg/l)	203.0	204.5	168.0	
* (1000 lbs./day)	60.8	82.1	115.8	
SUSPENDED SOLIDS REMOVAL (percent)	51.0	51.0	51.0	Study Memo B
* (1000 lbs./day)	31.0	41.9	59.0	
VOLATILE SUSPENDED SOLIDS LOADING (percent)	74.8	74.8	74.8	Study Memo B
* (1000 lbs./day)	45.5	61.4	86.6	
NITROGEN LOADING as TKN (mg/l)	30.0	29.6	13.9	
* (1000 lbs./day)	9.0	11.9	9.6	
NITROGEN REMOVAL AS TKN (percent)	20.0	20.0	20.0	Study Memo B
* (1000 lbs./day)	1.8	2.4	1.9	
PHOSPHORUS LOADING as P (mg/l)	9.1	8.3	4.0	
- LBS./DAY	2.73	3.33	2.75	
- IN PARTICULATE FORM (lbs./day)	0.68	0.83	0.69	Based on 25% Phosphorus in particulate form
- PHOSPHORUS PERCENT REMOVAL	51	51	51	Identical to SS removal.
PHOSPHORUS REMOVAL as P (lbs./day)	0.35	0.42	0.35	
PRIMARY EFFLUENT CHARACTERISTICS				
- BOD-5 (1000 lbs/day)	50.6	73.4	72.7	
(mg/L)	169.1	183.0	105.6	
- SUSPENDED SOLIDS (1000 lbs/day)	29.8	40.2	56.7	
(mg/L)	99.5	100.3	82.4	
- NITROGEN AS TKN (1000 lbs/day)	7.2	9.5	7.7	
(mg/L)	24.0	23.7	11.1	
- PHOSPHORUS (1000 lbs/day)	2.4	2.9	2.4	
(mg/L)	7.9	7.2	3.5	
PRIMARY SLUDGE				
- 1000 LBS./DAY (dry solids)	31.0	41.9	59.0	
- PERCENT SOLIDS	5.6	5.6	5.6	Study Memo B
- GPM	46.1	62.2	87.7	
- PERCENT VOLATILE SOLIDS	75	75	75	Study Memo B
- VOLATILE SOLIDS (1000 lbs/day)	23.2	31.3	44.2	
PRIMARY SLUDGE PUMPS				
- NUMBER OF PUMPS	2	2	2	
- FIRM CAPACITY (gpm)	600	600	600	
- % OF FIRM CAPACITY	7.7	10.4	14.6	

12-Jan-89

CASE 1
EXISTING HPO TREATMENT

EXISTING 2-STEP HPO SYSTEM
(STEP FEED)

**** PHASE II (2008) ****

ITEMS	ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
7. EAST PRIMARY SEDIMENTATION TANKS (No. 5-8)				
PRIMARY INFLUENT QUANTITIES (mgd)	34.1	45.7	78.5	
NUMBER OF TANKS	4	4	4	
AVERAGE WATER DEPTH (ft.)	13.1	13.1	13.1	Average value used.
TOTAL SURFACE AREA (sq.ft.)	23858	23858	23858	
TOTAL VOLUME (cu.ft.)	313017	313017	313017	
* (mg)	2.34	2.34	2.34	
SURFACE LOADING (gpsfpd)	1430	1916	3288	
DETENTION TIME (hrs.)	1.65	1.23	0.72	
LENGTH OF WEIR (ft.)	682	682	682	
WEIR LOADING (gals/ft./day)	50006	67008	115014	
BOD LOADING (mg/l)	264.0	285.7	165.0	
* (1000 lbs./day)	75.2	109.0	108.0	
BOD REMOVAL (percent)	36.0	36.0	36.0	Study Memo B
* (1000 lbs./day)	27.1	39.2	38.9	
SUSPENDED SOLIDS LOADING (mg/l)	203.0	204.5	168.0	
* (1000 lbs./day)	57.8	78.0	110.0	
SUSPENDED SOLIDS REMOVAL (percent)	51.0	51.0	51.0	Study Memo B
* (1000 lbs./day)	29.5	39.8	56.1	
NITROGEN LOADING as TKN (mg/l)	30.0	29.6	13.9	
* (1000 lbs./day)	8.5	11.3	9.1	
NITROGEN REMOVAL AS TKN (percent)	20.0	20.0	20.0	Study Memo B
* (1000 lbs./day)	1.7	2.3	1.8	
PHOSPHORUS LOADING as P (mg/l)	9.1	8.3	4.0	
- LBS./DAY	2.59	3.16	2.62	
- IN PARTICULATE FORM (lbs./day)	0.6	0.8	0.7	Based on 25% Phosphorus in particulate form
- PHOSPHORUS PERCENT REMOVAL	51	51	51	Identical to SS removal.
PHOSPHORUS REMOVAL as P (lbs./day)	0.33	0.40	0.33	
PRIMARY EFFLUENT CHARACTERISTICS				
- BOD-5 (1000 lbs/day)	48.1	69.7	69.1	
(mg/L)	169.1	183.0	105.6	
- SUSPENDED SOLIDS (1000 lbs/day)	28.3	38.2	53.9	
(mg/L)	99.5	100.3	82.4	
- NITROGEN AS TKN (1000 lbs/day)	6.8	9.0	7.3	
(mg/L)	24.0	23.7	11.1	
- PHOSPHORUS (1000 lbs/day)	2.3	2.8	2.3	
(mg/L)	7.9	7.2	3.5	

CASE 1
EXISTING HPO TREATMENT

EXISTING 2-STEP HPO SYSTEM
(STEP FEED)

PHASE II (2008)

ITEMS		ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
7. EAST PRIMARY SEDIMENTATION TANKS (cont.)					
PRIMARY SLUDGE					
- 1000 LBS./DAY (dry solids)		29.5	39.8	56.1	
- PERCENT SOLIDS		5.6	5.6	5.6	Study Memo B
- GPM		43.8	59.1	83.4	
- PERCENT VOLATILE SOLIDS		75	75	75	Study Memo B
- VOLATILE SOLIDS (1000 lbs/day)		22.0	29.8	42.0	
PRIMARY SLUDGE PUMPS					
- NUMBER OF PUMPS		2	2	2	
- FIRM CAPACITY (gpm)		190	190	190	
- % OF FIRM CAPACITY		23.1	31.1	43.9	
8. TOTAL PRIMARY EFFLUENT CHARACTERISTICS					
PRIMARY EFFLUENT (MGD)		70.0	93.8	161.0	
PRIMARY EFFLUENT CHARACTERISTICS					
- BOD-5	(1000 lbs/day)	98.7	143.1	141.9	
	(mg/L)	169.1	183.0	105.6	
- SUSPENDED SOLIDS	(1000 lbs/day)	58.1	78.5	110.6	
	(mg/L)	99.5	100.3	82.4	
- NITROGEN AS TKN	(1000 lbs/day)	14.0	18.5	15.0	
	(mg/L)	24.0	23.7	11.1	
- PHOSPHORUS	(1000 lbs/day)	4.6	5.7	4.7	
	(mg/L)	7.9	7.2	3.5	
9. RECYCLE FLOW					
RECYCLE FLOW (@ 26% OF INFLUENT) (MGD)		18.2	24.4	28.0	Study Memo B / Peak @ 2 Backwashes + 4 mgd
CHARACTERISTICS					
- BOD-5	(1000 lbs/day)	1.4	1.8	2.1	
	(mg/L)	9.1	9.1	9.1	Based on Study Memo B
- SUSPENDED SOLIDS	(1000 lbs/day)	49.1	65.8	75.5	
	(mg/L)	323.4	323.4	323.4	Based on Study Memo B
- NITROGEN AS TKN	(1000 lbs/day)	3.7	4.9	5.7	
	(mg/L)	24.3	24.3	24.3	Based on Study Memo B
- PHOSPHORUS	(1000 lbs/day)	N/A	N/A	N/A	
	(mg/L)	N/A	N/A	N/A	

CASE 1
EXISTING HPO TREATMENT

EXISTING 2-STEP HPO SYSTEM
(STEP FEED)

PHASE II (2008)

ITEMS		ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
10. PRIMARY BYPASS FLOW					
BYPASSED FLOW (mgd)		N/A	N/A	0.0	
CHARACTERISTICS OF BYPASSED FLOW					
- BOD-5	(1000 lbs/day)	N/A	N/A	0.0	
	(mg/L)	N/A	N/A	165.0	
- SUSPENDED SOLIDS	(1000 lbs/day)	N/A	N/A	0.0	
	(mg/L)	N/A	N/A	168.0	
- NITROGEN AS TKN	(1000 lbs/day)	N/A	N/A	0.0	
	(mg/L)	N/A	N/A	13.9	
- PHOSPHORUS	(1000 lbs/day)	N/A	N/A	0.0	
	(mg/L)	N/A	N/A	4.0	
11. MAIN PUMPING STATION					
EFFLUENT FLOW RATE (mgd)		88.2	118.2	189.0	
MAIN SEWAGE PUMPS					
- # VARIABLE SPEED @ 40 mgd		3	3	3	
- # CONSTANT SPEED @ 40 mgd		2	2	2	
- # NEW PUMPS @ 50 mgd		2	2	2	
- TOTAL INSTALLED CAPACITY (MGD)		300	300	300	
- FIRM CAPACITY (MGD)		250	250	250	
CHARACTERISTICS OF PRIMARY & RECYCLED FLOW					
- BOD-5	(1000 lbs/day)	100.1	145.0	144.0	
	(mg/L)	136.1	147.1	91.3	
- SUSPENDED SOLIDS	(1000 lbs/day)	107.2	144.2	186.1	
	(mg/L)	145.7	146.3	118.1	
- NITROGEN AS TKN	(1000 lbs/day)	17.7	23.5	20.6	
	(mg/L)	24.1	23.8	13.1	
- PHOSPHORUS	(1000 lbs/day)	4.6	5.7	4.7	
	(mg/L)	7.9	7.2	3.5	
12. CARBONACEOUS REACTORS					
INFLUENT QUANTITIES TO REACTORS (mgd)		88.2	118.2	189.0	
CHARACTERISITICS APPLIED TO REACTORS					
- BOD-5	(1000 lbs/day)	100.1	145.0	144.0	
	(mg/L)	136.1	147.1	91.3	
- SUSPENDED SOLIDS	(1000 lbs/day)	107.2	144.2	186.1	
	(mg/L)	145.7	146.3	118.1	
- NITROGEN TKN	(1000 lbs/day)	17.7	23.5	20.6	
	(mg/L)	24.1	23.8	13.1	
- PHOSPHORUS	(1000 lbs/day)	5.8	7.1	5.5	
	(mg/L)	7.9	7.2	3.5	

CASE 1
EXISTING HPO TREATMENT

EXISTING 2-STEP HPO SYSTEM
(STEP FEED)

**** PHASE II (2008) ****

ITEMS	ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
12. CARBONACEOUS REACTORS (cont.)				
NUMBER OF REACTORS	3	3	3	
AVERAGE WATER DEPTH (ft.)	14.0	14.0	14.0	
AVERAGE VOLUME PER REACTOR (cf)	169400	169400	169400	
AVERAGE VOLUME PER REACTOR (mg)	1.27	1.27	1.27	
NUMBER OF STAGES, EACH TANK	4	4	4	
BOD-a/1000 CF.	197	285	283	
TOTAL VOLUME (CF)	508200	508200	508200	
- (MG)	3.80	3.80	3.80	
DETENTION TIME (hrs.)	1.03	0.77	0.48	
SOLIDS RETENTION TIME, SRT (DAYS)	0.80	0.60	0.40	
TOTAL CARBONACEOUS SOLIDS PRODUCED				
- SOLIDS PRODUCED/TSS APPLIED	1.00	1.20	1.20	Based on Study Memo B
- TSS APPLIED (1000 LB/DAY)	107.2	144.2	186.1	
- SOLIDS PRODUCED (1000 LB/DAY)	107.2	173.1	223.4	
MIXED LIQUOR				
- AVERAGE MLSS (mg/L)	2705	3276	2818	MLSS = SP * SRT / (VOL * 8.34)
- LAST PASS MLSS (mg/l)	1287	1698	1087	(4*MLSS avg/(3+(R+1)/R)
RETURN SLUDGE				
- RETURN RATIO	0.23	0.27	0.16	Input value
- RETURN CONCENTRATION (mg/L)	6958	8009	8012	Xr=((R+1)/R)*MLSS lp
- RETURN FLOW (MGD)	20.0	31.8	29.7	Based on Q return = Q mps x R (20 mgd min.)
CARBONACEOUS WASTE ACTIVATED SLUDGE				
-SOLIDS PRODUCED (1000 lbs/day)	107.2	173.1	223.4	
-EFFLUENT SUSPENDED SOLIDS (1000 lbs/day)	11.8	15.9	22.4	
-CONCENTRATION OF R.A.S.(mg/l)	6958	8009	8012	
-WAS (1000 lbs/day)	95.4	157.2	201.0	
(mgd)	1.6	2.4	3.0	
HIGH PURITY/DIFFUSED OXYGEN SUPPLY				Max.month represents max demand
OXYGEN DEMAND				
- BOD APPLIED (1000 lbs/day)	100.1	145.0	144.0	
- TKN OXIDIZED (1000 lbs/day)	3.2	2.1	0.0	Basis; (TKN inf.-TKN eff.)-(0.07*WAS)
- OXYGEN DISSOLVED (1000 lbs/day)	5.1	6.9	11.0	Basis; (mgd * 7.0 mg/l * 8.34)/1000
- O2 FOR BOD APPLIED (1000 lbs/day)	100.09	144.97	143.97	Based on 1 LB O2 per 1 LB BOD applied.
- O2 FOR TKN (1000 lbs/day)	14.89	9.79	0.00	Based on 4.6 LB O2 per 1 LB NO3 formed.
- O2 DISSOLVED IN WW (1000 lbs/day)	5.1	6.9	11.0	
- TOTAL OXYGEN DEMAND (1000 lbs/day)	120.1	161.7	155.0	

EXISTING 2-STEP HPO SYSTEM
(STEP FEED)
PHASE II (2008)

ITEMS			ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
13. CARBONACEOUS STAGE FINAL TANKS						
CARBONACEOUS INFLUENT QUANTITIES (mgd)			88.2	118.2	189.0	
NUMBER OF TANKS			6	6	6	
TOTAL SURFACE AREA @ 68' x 247' PER TANK			100776	100776	100776	
AVERAGE WATER DEPTH (ft.)			12.0	12.0	12.0	
TOTAL VOLUME (cf)			1209312	1209312	1209312	
- (mg)			9.05	9.05	9.05	
SURFACE OVERFLOW RATE (gpsfpd)			875	1173	1875	
SAFETY FACTOR	a	b				
-ISV (fph)	23.0	700	9.34	7.01	10.75	Study Memo B
-SOR BASED ON ISV (gpsfpd)			1677	1258	1929	
-CLARIFIER SAFETY FACTOR			1.92	1.07	1.03	
DETENTION TIME (hrs.)			2.46	1.84	1.15	
CARBONACEOUS STAGE EFFLUENT CHARACTERISTICS						
- BOD-5 (mg/l)	a		27.0	32.2	18.1	Median BOD5 = 27.0 mg/l ann.avg.
(1000 lb/day)	1.60		19.9	31.8	28.5	Max.mo. lbs/ann.avg. lbs = 1.60
- TSS (mg/l)			16.0	16.1	14.2	Median TSS = 16.0 mg/l ann.avg.
(1000 lbs/day)	1.35		11.8	15.9	22.4	Max.mo. lbs/ann.avg. lbs = 1.35
- TKN PERCENT REMOVAL			56.0	56.0	28.2	Study Memo B
- TKN (mg/l)			10.6	10.5	9.4	Peak data based on Sept. 8, 1988
(1000 lbs/day)			7.8	10.3	14.8	
- NO3-N (mg/l)			4.4	2.2	0.0	
(1000 lbs/day)			3.2	2.1	0.0	TKN in - TKN out - (0.07*WAS)
- PERCENT PHOS. REMOVED			16.3	18.0	29.8	Based on 1% of TSS removed as Phos.
- PHOSPHORUS as P (1000 lb/day)			4.9	5.8	3.9	
* (mg/L)			6.6	5.9	2.5	
14. INTERMEDIATE PUMPING STATION						
INTERMEDIATE SEWAGE PUMPS						
- NUMBER OF VARIABLE SPEED UNITS			2	2	2	
- NUMBER OF CONSTANT SPEED UNITS			3	3	3	
- CAPACITY, EACH PUMPING UNIT (mgd)			40.0	40.0	40.0	
- TOTAL INSTALLED CAPACITY (mgd)			200.0	200.0	200.0	
- FIRM CAPACITY (mgd)			160.0	160.0	160.0	

CASE 1
EXISTING HPO TREATMENT

EXISTING 2-STEP HPO SYSTEM
(STEP FEED)
**** PHASE II (2008) ****

ITEMS	ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
15. NITRIFICATION REACTORS				
INFLUENT QUANTITIES (mgd)	88.2	118.2	189.0	
SEWAGE APPLIED TO NITRIFICATION STAGE				
- BOD-5 (1000 lb/day)	19.9	31.8	28.5	
(mg/L)	27.0	32.2	18.1	
- SUSPENDED SOLIDS (1000 lb/day)	11.8	15.9	22.4	
(mg/L)	16.0	16.1	14.2	
- TKN (1000 lb/day)	7.8	10.3	14.8	
(mg/L)	10.6	10.5	9.4	
- NO3-N (1000 lb/day)	3.2	2.1	0.0	
(mg/l)	4.4	2.2	0.0	
- PHOSPHORUS as P (1000 lb/day)	4.9	5.8	3.9	
(mg/L)	6.6	5.9	2.5	
NUMBER OF REACTORS	3	3	3	
AVERAGE WATER DEPTH (ft.)	14	14	14	
AVERAGE VOLUME PER REACTOR (cf)	169400	169400	169400	
AVERAGE VOLUME PER REACTOR (mg)	1.27	1.27	1.27	
NUMBER OF STAGES, EACH TANK	4	4	4	
TOTAL VOLUME (cf)	508200	508200	508200	
(mg)	3.80	3.80	3.80	
AERATED VOLUME (mg)	3.80	3.80	3.80	
BOD-a/1000 CF.	39	63	56	
DETENTION TIME (hrs.)	1.03	0.77	0.48	
SOLIDS RETENTION TIME - SRT (days)	8.0	6.0	4.0	
TOTAL NITRIFICATION SOLIDS PRODUCTION				
- SOLIDS PRODUCED/TSS APPLIED	0.68	0.68	0.68	0.68 for existing HPO: 0.74-(0.02*SRT) for D.A.
- TSS APPLIED (1000 lb/day)	11.8	15.9	22.4	Based on 0.68*TSS applied (HPO)
- BOD-5 APPLIED (1000 lbs/day)				Based on 0.74-(0.02*SRT)*BOD-5 applied (D.A.)
- SOLIDS PRODUCED (1000 lb/day)	8.0	10.8	15.2	
MIXED LIQUOR				
- AVERAGE MLSS (mg/L)	2020	2045	1922	MLSS = SP * SRT / (VOL * 8.34)
- LAST PASS MLSS (mg/l)	968	831	572	(4*MLSS av/(3+(R+1)/R)
RETURN SLUDGE				
- RETURN RATIO	0.23	0.17	0.11	Input value
- RETURN CONCENTRATION (mg/L)	5175	5687	5972	Xr=((R+1)/R)*MLSS lp
- RETURN FLOW (mgd)	20.3	20.2	20.0	Based on Q return= Q mps x R

12-Jan-89

CASE 1
EXISTING HPO TREATMENT

EXISTING 2-STEP HPO SYSTEM
(STEP FEED)

**** PHASE II (2008) ****

ITEMS	ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
HIGH PURITY OXYGEN/DIFFUSED AIR SUPPLY				
OXYGEN DEMAND				
- BOD APPLIED (1000 lbs/day)	19.9	31.8	28.5	
- TKN OXIDIZED (1000 lbs/day)	6.4	8.5	11.8	Basis; (TKN inf.-TKN eff.)
- OXYGEN DISSOLVED (1000 lbs/day)	5.1	6.9	11.0	Basis; (mgd * 7.0 mg/l * 8.34)/1000
- O2 FOR BOD APPLIED (1000 lbs/day)	23.8	38.1	34.3	Based on 1.2 LB O2 per 1 LB BOD applied.
- O2 FOR TKN (1000 lbs/day)	29.4	38.9	54.5	Based on 4.6 LB O2 per 1 LB NO3 formed.
- O2 DISSOLVED IN WW (1000 lbs/day)	5.1	6.9	11.0	
- CREDIT;NO3 USED FOR OXIDATION (1000lb/day)				Based on 2.86 lb O2 / lb NO3 removed
- TOTAL OXYGEN DEMAND (1000 lbs/day)	58.4	84.0	99.8	
16. NITRIFICATION FINAL TANKS				
NITRIFICATION INFLUENT QUANTITIES (mgd)	88.2	118.2	189.0	
NUMBER OF TANKS	6	6	6	
TOTAL SURFACE AREA @ 68'x 247'	100776	100776	100776	
AVERAGE WATER DEPTH (ft)	12	12	12	
TOTAL VOLUME (cf)	1209312	1209312	1209312	
- (mg)	9.05	9.05	9.05	
SURFACE LOADING (gpsfpd)	875	1173	1875	
SAFETY FACTOR a b				
-ISV (fph) 23.0 800	10.61	11.84	14.55	Study Memo B
-SOR BASED ON ISV (gpsfpd)	1904	2125	2612	
-CLARIFIER SAFETY FACTOR	2.18	1.81	1.39	
DETENTION TIME (hrs.)	2.46	1.84	1.15	
EFFLUENT WEIRS				
- LENGTH (ft.)	3888	3888	3888	Based on 648' of wier per tank
- LOADING (gal/ft/day)	22685	30398	48611	
RETURN SLUDGE				
- NUMBER OF RETURN SLUDGE PUMPS	8	8	8	
- CAPACITY, EACH PUMP (tanks 7-12/4-6, mgd	7.56	7.56	7.56	
- NUMBER OF PUMPS OPERATING	6	6	6	
- FIRM CAPACITY, RETURN SLUDGE PUMPS (mgd)	45	45	45	
- RETURN SLUDGE FLOW (mgd)	20.3	20.2	20.0	
- % OF FIRM CAPACITY:	44.7	44.6	44.2	

CASE 1
EXISTING HPO TREATMENT

EXISTING 2-STEP HPO SYSTEM
(STEP FEED)
**** PHASE II (2008) ****

ITEMS		ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
16. NITRIFICATION FINAL TANKS (cont.)					
NITRIFICATION STAGE EFFLUENT CHARACTERISTICS					
- BOD-5 (mg/l)		5.0	5.0	3.4	Study Memo B
(1000 lb/day)	1.33	3.7	4.9	5.3	peak day lbs/ann.avg = infl.load ratio
- TSS (mg/l)		10.9	11.0	9.7	Exist:based on solids prod./ D.A.:study memo B
(1000 lb/day)	1.66	8.0	10.8	15.2	peak day lbs/ann.avg = infl.load ratio
- TKN PERCENT REMOVAL		82.0	82.0	-	Study Memo B
- TKN (mg/L)		1.9	1.9	1.9	Peak value assume equal to max.month
(1000 lb/day)		1.4	1.9	3.0	
- NITRATE NITROGEN (mg/l)		12.1	10.7	7.5	
(1000 lbs/day)		8.9	10.6	11.8	HPO; MM & Peak = TN in - TKN out (AA; SM-B)
- PERCENT PHOS. REMOVED		0.8	0.9	1.9	Based on 1% of SS removed assumed as Phosphorus.
- PHOSPHORUS as P (1000 lb/day)		4.9	5.8	3.8	
* (mg/L)		6.6	5.9	2.4	
17. DENITRIFICATION FILTERS					
INFLUENT QUANTITIES					
- NITRIFICATION EFFLUENT FLOW (mgd)		88.2	118.2	189.0	
- EXCLUDING RECYCLE		70.0	93.8	161.0	
SEWAGE APPLIED TO DENITRIFICATION FILTERS					
- BOD-5 (1000 lb/day)		3.7	4.9	5.3	
(mg/L)		5.0	5.0	3.4	
- SUSPENDED SOLIDS (1000 lb/day)		8.0	10.8	15.2	
(mg/L)		10.9	11.0	9.7	
- TKN (1000 lb/day)		1.4	1.9	3.0	
(mg/L)		1.9	1.9	1.9	
- NITRATE NITROGEN (1000 lb/day)		8.9	10.6	11.8	
(mg/L)		12.1	10.7	7.5	
- PHOSPHORUS as P (1000 lb/day)		4.9	5.8	3.8	
(mg/L)		6.6	5.9	2.4	
NUMBER OF FILTERS					
- EXISTING		20	20	20	
- NEW		12	12	12	
- TOTAL		32	32	32	
TOTAL SURFACE AREA (sf)		33600	33600	33600	Based on 2.0 gpm/sf at inf.quan.w/o recycle
HYDRAULIC LOADING					
- ACTUAL INFLUENT BASIS (gpm/sf)		1.8	2.4	3.9	
- EXCLUDING RECYCLE (gpm/sf)		2.0	1.9	3.3	

CASE 1
EXISTING HPO TREATMENT

EXISTING 2-STEP HPO SYSTEM
(STEP FEED)
**** PHASE II (2008) ****

ITEMS	ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
17. DENITRIFICATION FILTERS (cont.)				
DENITRIFICATION FILTERS EFFLUENT CHARACTERISTICS				
- BOD-5 (1000 lb/day)	1.5	2.0	2.2	
* (mg/L)	2.0	2.0	1.4	Eff BOD (mg/l)= 0.098+0.385*(BOD appl.(mg/l))
- SUSPENDED SOLIDS (1000 lb/day)	1.7	2.3	3.4	
* (mg/L)	2.3	2.3	2.2	Eff TSS (mg/l)= 1.038+0.117*(TSS appl.(mg/l))
- TKN (1000 lb/day)	1.1	1.4	2.3	
* (mg/L)	1.5	1.5	1.5	Eff TKN (mg/l)= 0.404+0.556*(TKN appl.(mg/l))
- NITRATE NITROGEN; NO3-N (1000 lb/day)	0.7	0.8	0.9	Based on 92% removal
* (mg/L)	1.0	0.9	0.6	
- PHOSPHORUS as P (1000 lb/day)	4.8	5.8	3.8	
* (mg/L)	6.6	5.9	2.4	
18. PLANT EFFLUENT				
SEWAGE QUANTITIES (mgd)	70.0	93.8	161.0	
PLANT EFFLUENT CHARACTERISTICS				
- BOD-5 (1000 lb/day)	1.2	1.6	1.9	
* (mg/L)	2.0	2.0	1.4	
- SUSPENDED SOLIDS (1000 lb/day)	1.3	1.8	2.9	
* (mg/L)	2.3	2.3	2.2	
- NITROGEN as TN (1000 lb/day)	1.4	1.8	2.8	
* (mg/L)	2.4	2.3	2.1	
- PHOSPHORUS as P (1000 lb/day)	3.8	4.6	3.2	
* (mg/L)	6.6	5.9	2.4	

CASE 2A

ALTERNATIVE 2A-C5

DESIGN YEAR 2008

BASES OF DESIGN

EXISTING HPO SYSTEM: CARBONACEOUS/STEP FEED

NEW DIFFUSED AIR SYSTEM: NITRIFICATION/STEP FEED

96 MGD ANNUAL AVERAGE

CASE 2A - SERIES PLANT
EXISTING HPO SYSTEM USED FOR CARBONACEOUS STAGE
NEW DIFFUSED AERATION REACTORS USED FOR NITRIFICATION STAGE
HPO SYSTEM W/ STEP FEED

12-Jan-89

ALT. 2A-C5
DIFF.AERATION
STEP FEED MODE

****** PHASE II (2008) ******

ITEMS	ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
	(96 MGD)			PEAK CONDITION BASED ON SEPTEMBER 8, 1988
1. BASIC DATA				
WASTEWATER LOADING RATIOS				
- FLOW	1.00	1.34	2.30	Study Memo B
- BOD5	1.00	1.45	1.44	Study Memo B
- TSS	1.00	1.35	1.90	Study Memo B
- NITROGEN	1.00	1.32	1.07	Study Memo B
- PHOSPHORUS	1.00	1.22	1.01	Study Memo B
PLANT INFLUENT FLOW (mgd)	96.0	128.6	220.8	
PLANT INFLUENT CHARACTERISTICS				
- BOD-5 (1000 LB/DAY)	211.4	306.5	303.8	
* (mg/L)	264.0	285.7	165.0	Study Memo B
- SUSPENDED SOLIDS (1000 LB/DAY)	162.5	219.4	309.4	
* (mg/L)	203.0	204.5	168.0	Study Memo B
- NITROGEN as TKN (1000 LB/DAY)	24.0	31.7	25.6	
* (mg/L)	30.0	29.6	13.9	Study Memo B
- PHOSPHORUS (1000 LB/DAY)	7.3	8.9	7.4	
* (mg/L)	9.1	8.3	4.0	Study Memo B
2.JUNCTION CHAMBER NO.1 (PREAERATION TANKS)				
JC1 INFLUENT SEWAGE QUANTITIES (MGD)	96.0	128.6	220.8	
NUMBER OF EXISTING TANKS @ 25' x 66'	2	2	2	
NUMBER OF NEW TANKS @ 30' x 66'	1	1	1	
@ 20' x 66'	0	0	0	
WATER DEPTH IN TANKS (FT.)	17.00	17.00	17.00	Downstream hydraulics
TOTAL VOLUME - CUBIC FT.	89760	89760	89760	
- MILLION GAL.	0.67	0.67	0.67	
DETENTION TIME (MINUTES)	10.1	7.5	4.4	
TOTAL BLOWER CAPACITY (SCFM)	11520	11520	11520	
AIR APPLIED				
- INFLUENT AND EFFLUENT CHANNELS (SCFM)	1150	1150	1150	
- PREAERATION TANKS (SCFM)	10370	10370	10370	
* cu.ft./gal	0.16	0.12	0.07	
* scfm/1000 cu.ft.	116	116	116	

CASE 2A - SERIES PLANT 12-Jan-89
EXISTING HPO SYSTEM USED FOR CARBONACEOUS STAGE
NEW DIFFUSED AERATION REACTORS USED FOR NITRIFICATION STAGE ALT. 2A-C5
HPO SYSTEM W/ STEP FEED DIFF.AERATION
STEP FEED MODE

****** PHASE II (2008) ******

ITEMS	ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
3. SCREEN AND GRIT BUILDING No. 2				
INFLUENT SEWAGE QUANTITIES (mgd)	48.0	64.3	110.4	Based on one half total flow
MECHANICAL SEWAGE SCREENS				
- NUMBER OF SCREENS	2	2	2	
- WIDTH OF EACH SCREEN (ft.)	7.5	7.5	7.5	
- CLEAR BAR SPACING (inches)	0.38	0.38	0.38	
- SCREENING QUAN.,EACH SCREEN (cf/hr)	6.80	9.11	15.64	Each screen at 6.8 cu.ft./mg @ 0.38 spacing
GRIT FACILITIES				
- NUMBER OF GRIT TANKS, TOTAL	4	4	4	
, OPERATING	2	3	4	
- WIDTH OF TANKS (ft.)	45	45	45	
- LENTGH OF TANKS (ft.)	45	45	45	
- SURFACE AREA, EACH TANK (sq.ft.)	2025	2025	2025	
- TOTAL SURFACE AREA (sq.ft.)	4050	6075	8100	
- MIN.SURFACE AREA REQ'D (sq.ft./mgd)	70	70	70	For 150 mesh grit removal
- SURFACE AREA (sq.ft./mgd)	84	94	73	
- SURFACE LOADING (gpsfpd)	11852	10588	13630	
- WEIR LOADING (mg/ft./day)	0.53	0.48	0.61	weir length = 45 ft. per tank.
- GRIT REMOVED (cu.ft./mg - dry basis)	2.23	3.35	3.35	Study Memo B
* (cu.ft./day - dry basis)	107	215	370	
* (1000 lbs./day - dry bas	13	26	44	Dry basis at 120 lbs/cu.ft.
- WASHED GRIT ; PERCENT SOLIDS	75	75	75	
TONS/DAY (wet grit)	8.55	17.21	29.54	
4. SCREEN AND GRIT BUILDING No. 3				
INFLUENT SEWAGE QUANTITIES (mgd)	48.0	64.3	110.4	Based on one half total flow
MECHANICAL SEWAGE SCREENS				
- NUMBER OF SCREENS	3	3	3	2 operating, 1 standby
- WIDTH OF EACH SCREEN (ft.)	7.5	7.5	7.5	
- CLEAR BAR SPACING (inches)	0.38	0.38	0.38	
- SCREENING QUAN. (cu.ft./hr./scr)	6.80	9.11	15.64	Each screen at 6.8 cu.ft./mg @ 0.38 spacing
GRIT FACILITIES				
- NUMBER OF GRIT TANKS, TOTAL	4	4	4	
, OPERATING	2	3	4	
- WIDTH OF TANKS (ft.)	45	45	45	
- LENTGH OF TANKS (ft.)	45	45	45	
- SURFACE AREA, EACH TANK (sq.ft.)	2025	2025	2025	
- TOTAL SURFACE AREA (sq.ft.)	4050	6075	8100	
- SURFACE AREA (sq.ft./mgd)	84	94	73	
- SURFACE LOADING (gpsfpd)	11852	10588	13630	
- WEIR LOADING (mg/ft./day)	0.53	0.48	0.61	weir length = 45 ft. per tank.

CASE 2A - SERIES PLANT
EXISTING HPO SYSTEM USED FOR CARBONACEOUS STAGE
NEW DIFFUSED AERATION REACTORS USED FOR NITRIFICATION STAGE
HPO SYSTEM W/ STEP FEED

12-Jan-89

ALT. 2A-C5
DIFF.AERATION
PLUG FLOW MODE

** ****** PHASE II (2008) ****** **

ITEMS			ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
13. CARBONACEOUS STAGE FINAL TANKS (cont.)						
SURFACE OVERFLOW RATE (gpsfpd)			720	965	1234	
SAFETY FACTOR	a	b				
-ISV (fph)	23.0	700	8.32	9.85	12.07	Study Memo B
-SOR BASED ON ISV (gpsfpd)			1494	1769	2167	
-CLARIFIER SAFETY FACTOR			2.07	1.83	1.76	
DETENTION TIME (hrs.)			2.99	2.23	1.75	
CARBONACEOUS STAGE EFFLUENT CHARACTERISTICS						
		a				
- BOD-5 (mg/l)			27.0	32.2	18.9	Median BOD5 = 27.0 mg/l ann.avg.
(1000 lb/day)		1.60	27.2	43.6	39.1	Max.mo. lbs/ann.avg. lbs = 1.60 peak day lbs/ann.av = infl.load ratio
- TSS (mg/l)			16.0	16.1	14.8	Median TSS = 16.0 mg/l ann.avg.
(1000 lbs/day)		1.35	16.1	21.8	30.7	Max.mo. lbs/ann.avg. lbs = 1.35 peak day lbs/ann.av = infl.load ratio
- TKN PERCENT REMOVAL			56.0	56.0	28.3	Study Memo B
- TKN (mg/l)			10.6	10.5	9.4	Peak data based on Sept. 8, 1988 condition
(1000 lbs/day)			10.7	14.2	19.5	
- NO3-N (mg/l)			4.4	2.2	0.0	
(1000 lbs/day)			4.4	2.9	0.0	Basis; TKN in - TKN out - 0.07*WAS
- PERCENT PHOS. REMOVED			16.3	18.0	31.5	Based on 1% of TSS removed
- PHOSPHORUS as P (1000 lb/day)			6.7	8.0	5.0	
* (mg/L)			6.6	5.9	2.4	
14. NITRIFICATION REACTORS						Converted Aerobic Digestion tanks
NITRIFICATION INFLUENT QUANTITIES (mgd)			121.0	162.1	248.8	
SEWAGE APPLIED TO NITRIFICATION STAGE						
- BOD-5 (1000 lb/day)			27.2	43.6	39.1	
(mg/L)			27.0	32.2	18.9	
- SUSPENDED SOLIDS (1000 lb/day)			16.1	21.8	30.7	
(mg/L)			16.0	16.1	14.8	
- TKN (1000 lb/day)			10.7	14.2	19.5	
(mg/L)			10.6	10.5	9.4	
- NO3-N (1000 lbs/day)			4.4	2.9	0.0	
(mg/l)			4.4	2.2	0.0	
- PHOSPHORUS as P (1000 lb/day)			6.7	8.0	5.0	
(mg/L)			6.6	5.9	2.4	

CASE 2A - SERIES PLANT 12-Jan-89
EXISTING HPO SYSTEM USED FOR CARBONACEOUS STAGE
NEW DIFFUSED AERATION REACTORS USED FOR NITRIFICATION STAGE ALT. 2A-C5
HPO SYSTEM W/ STEP FEED DIFF.AERATION
STEP FEED MODE

****** PHASE II (2008) ******

ITEMS	ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
6. WEST PRIMARY SEDIMENTATION TANKS (No.1-4, cont.)				
SUSPENDED SOLIDS REMOVAL (percent)	51.0	51.0	51.0	Study Memo B
* (1000 lbs./day)	42.5	57.4	64.8	
NITROGEN LOADING as TKN (mg/l)	30.0	29.6	13.9	
* (1000 lbs./day)	12.3	16.3	10.5	
NITROGEN REMOVAL AS TKN (percent)	20.0	20.0	20.0	Study Memo B
* (1000 lbs./day)	2.5	3.3	2.1	
PHOSPHORUS LOADING as P (mg/l)	9.1	8.3	4.0	
- LBS./DAY	3.74	4.56	3.02	
- IN PARTICULATE FORM (lbs./day)	0.93	1.14	0.76	Based on 25 percent Phosphorus in part.form
- PART.PHOSPHORUS % REMOVAL	51	51	51	Identical to SS removal.
PHOSPHORUS REMOVAL as P (lbs./day)	0.48	0.58	0.39	
PRIMARY EFFLUENT CHARACTERISTICS				
- BOD-5 (1000 lbs/day)	69.4	100.6	79.8	
(mg/L)	169.1	183.0	105.6	
- SUSPENDED SOLIDS (1000 lbs/day)	40.9	55.2	62.2	
(mg/L)	99.5	100.3	82.4	
- NITROGEN AS TKN (1000 lbs/day)	9.9	13.0	8.4	
(mg/L)	24.0	23.7	11.1	
- PHOSPHORUS (1000 lbs/day)	3.3	4.0	2.6	
(mg/L)	7.9	7.2	3.5	
PRIMARY SLUDGE				
- 1000 LBS./DAY (dry solids)	42.5	57.4	64.8	
- PERCENT SOLIDS	5.0	5.0	5.0	Study Memo B
- GPM	70.8	95.6	107.8	
- PERCENT VOLATILE SOLIDS	79.4	79.4	79.4	Study Memo B
- VOLATILE SOLIDS (1000 lbs/day)	33.8	45.6	51.4	
PRIMARY SLUDGE PUMPS				
- NUMBER OF PUMPS	2	2	2	
- FIRM CAPACITY (gpm)	600	600	600	
- % OF FIRM CAPACITY	11.8	15.9	18.0	
7. EAST PRIMARY SEDIMENTATION TANKS				
PRIMARY INFLUENT QUANTITIES (mgd)	46.8	62.7	86.1	
NUMBER OF TANKS	4	4	4	
AVERAGE WATER DEPTH (ft.)	13.1	13.1	13.1	Average value used.
TOTAL SURFACE AREA (sq.ft.)	23858	23858	23858	
TOTAL VOLUME (cu.ft.)	313017	313017	313017	
* (mg)	2.34	2.34	2.34	
SURFACE LOADING (gpsfpd)	1961	2627	3608	

CASE 2A - SERIES PLANT
EXISTING HPO SYSTEM USED FOR CARBONACEOUS STAGE
NEW DIFFUSED AERATION REACTORS USED FOR NITRIFICATION STAGE
HPO SYSTEM W/ STEP FEED

12-Jan-89

ALT. 2A-C5
DIFF.AERATION
STEP FEED MODE

****** PHASE II (2008) ******

ITEMS	ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
7. EAST PRIMARY SEDIMENTATION TANKS (cont.)				
DETENTION TIME (hrs.)	1.20	0.90	0.65	
LENGTH OF WEIR (ft.)	682	682	682	
WEIR LOADING (gals/ft./day)	68580	91897	126187	
BOD LOADING (mg/l)	264.0	285.7	165.0	
* (1000 lbs./day)	103.1	149.5	118.5	
BOD REMOVAL (percent)	36.0	36.0	36.0	Study Memo B
* (1000 lbs./day)	37.1	53.8	42.7	
SUSPENDED SOLIDS LOADING (mg/l)	203.0	204.5	168.0	
* (1000 lbs./day)	79.3	107.0	120.7	
SUSPENDED SOLIDS REMOVAL (percent)	51.0	51.0	51.0	Study Memo B
* (1000 lbs./day)	40.4	54.6	61.6	
NITROGEN LOADING as TKN (mg/l)	30.0	29.6	13.9	
* (1000 lbs./day)	11.7	15.5	10.0	
NITROGEN REMOVAL AS TKN (percent)	20.0	20.0	20.0	Study Memo B
* (1000 lbs./day)	2.3	3.1	2.0	
PHOSPHORUS LOADING as P (mg/l)	9.1	8.3	4.0	
- LBS./DAY	3.55	4.33	2.87	
- IN PARTICULATE FORM (lbs./day) @ 25%	0.9	1.1	0.7	Based on 25 percent Phosphorus in part.form
- PART.PHOSPHORUS % REMOVAL	51	51	51	Identical to SS removal.
PHOSPHORUS REMOVAL as P (lbs./day)	0.45	0.55	0.37	
PRIMARY EFFLUENT CHARACTERISTICS				
- BOD-5 (1000 lbs/day)	66.0	95.7	75.8	
(mg/L)	169.1	183.0	105.6	
- SUSPENDED SOLIDS (1000 lbs/day)	38.8	52.4	59.1	
(mg/L)	99.5	100.3	82.4	
- NITROGEN AS TKN (1000 lbs/day)	9.4	12.4	8.0	
(mg/L)	24.0	23.7	11.1	
- PHOSPHORUS (1000 lbs/day)	3.1	3.8	2.5	
(mg/L)	7.9	7.2	3.5	
PRIMARY SLUDGE				
- 1000 LBS./DAY (dry solids)	40.4	54.6	61.6	
- PERCENT SOLIDS	5.0	5.0	5.0	Study Memo B
- GPM	67.3	90.8	102.5	
- PERCENT VOLATILE SOLIDS	79.4	79.4	79.4	Study Memo B
- VOLATILE SOLIDS (1000 lbs/day)	32.1	43.3	48.9	

CASE 2A - SERIES PLANT
EXISTING HPO SYSTEM USED FOR CARBONACEOUS STAGE
NEW DIFFUSED AERATION REACTORS USED FOR NITRIFICATION STAGE
HPO SYSTEM W/ STEP FEED

12-Jan-89

ALT. 2A-C5
DIFF.AERATION
STEP FEED MODE

****** PHASE II (2008) ******

ITEMS		ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
8. TOTAL PRIMARY EFFLUENT CHARACTERISTICS					
PRIMARY EFFLUENT (MGD)		96.0	128.6	176.6	
PRIMARY EFFLUENT CHARACTERISTICS					
- BOD-5	(1000 lbs/day)	135.4	196.3	155.6	
	(mg/L)	169.1	183.0	105.6	
- SUSPENDED SOLIDS	(1000 lbs/day)	79.7	107.6	121.4	
	(mg/L)	99.5	100.3	82.4	
- NITROGEN AS TKN	(1000 lbs/day)	19.2	25.4	16.4	
	(mg/L)	24.0	23.7	11.1	
- PHOSPHORUS	(1000 lbs/day)	6.4	7.8	5.1	
	(mg/L)	7.9	7.2	3.5	
9. RECYCLE FLOW					
RECYCLE FLOW (@ 26% OF INFLUENT) (MGD)		25.0	33.4	28.0	Peak at 2 backwashes + 4 MGD
CHARACTERISTICS					
- BOD-5	(1000 lbs/day)	1.9	2.5	2.1	
	(mg/L)	9.1	9.1	9.1	Based on Study Memo B
- SUSPENDED SOLIDS	(1000 lbs/day)	67.3	90.2	75.5	
	(mg/L)	323.4	323.4	323.4	Based on Study Memo B
- NITROGEN AS TKN	(1000 lbs/day)	5.1	6.8	5.7	
	(mg/L)	24.3	24.3	24.3	Based on Study Memo B
- PHOSPHORUS	(1000 lbs/day)	N/A	N/A	N/A	
	(mg/L)	N/A	N/A	N/A	
10. PRIMARY BYPASS FLOW					
BYPASSED FLOW (mgd)		N/A	N/A	44.2	
CHARACTERISTICS OF BYPASSED FLOW					
- BOD-5	(1000 lbs/day)	N/A	N/A	60.8	
	(mg/L)	N/A	N/A	165.0	
- SUSPENDED SOLIDS	(1000 lbs/day)	N/A	N/A	61.9	
	(mg/L)	N/A	N/A	168.0	
- NITROGEN AS TKN	(1000 lbs/day)	N/A	N/A	5.1	
	(mg/L)	N/A	N/A	13.9	
- PHOSPHORUS	(1000 lbs/day)	N/A	N/A	1.5	
	(mg/L)	N/A	N/A	4.0	

CASE 2A - SERIES PLANT
EXISTING HPO SYSTEM USED FOR CARBONACEOUS STAGE
NEW DIFFUSED AERATION REACTORS USED FOR NITRIFICATION STAGE
HPO SYSTEM W/ STEP FEED

12-Jan-89

ALT. 2A-C5
DIFF.AERATION
STEP FEED MODE

****** PHASE II (2008) ******

ITEMS		ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
11. MAIN PUMPING STATION					
EFFLUENT FLOW RATE (mgd)		121.0	162.1	248.8	
MAIN SEWAGE PUMPS					
- # VARIABLE SPEED @ 40 MGD		3	3	3	
- # CONSTANT SPEED @ 40 MGD		2	2	2	
- # NEW PUMPS @ 50 MGD		2	2	2	
- TOTAL INSTALLED CAPACITY (MGD)		300	300	300	
- FIRM CAPACITY (MGD)		250	250	250	
CHARACTERISTICS OF PRIMARY & RECYCLED FLOW					
- BOD-5	(1000 lbs/day)	137.3	198.8	218.5	
	(mg/L)	136.1	147.1	105.3	
- SUSPENDED SOLIDS	(1000 lbs/day)	147.0	197.8	258.8	
	(mg/L)	145.7	146.3	124.7	
- NITROGEN AS TKN	(1000 lbs/day)	24.3	32.2	27.2	
	(mg/L)	24.1	23.8	13.1	
- PHOSPHORUS	(1000 lbs/day)	8.0	9.8	7.2	
	(mg/L)	7.9	7.2	3.5	
12. CARBONACEOUS REACTORS					
CARBONACEOUS INFLUENT QUANTITIES					
- MAIN PUMPING STATION FLOW (mgd)		121.0	162.1	248.8	
CHARACTERISITICS APPLIED TO REACTORS					
- BOD-5	(1000 lbs/day)	137.3	198.8	218.5	
	(mg/L)	136.1	147.1	105.3	
- SUSPENDED SOLIDS	(1000 lbs/day)	147.0	197.8	258.8	
	(mg/L)	145.7	146.3	124.7	
- NITROGEN TKN	(1000 lbs/day)	24.3	32.2	27.2	
	(mg/L)	24.1	23.8	13.1	
- PHOSPHORUS	(1000 lbs/day)	8.0	9.8	7.2	
	(mg/L)	7.9	7.2	3.5	
NUMBER OF REACTORS		4	5	5	
AVERAGE WATER DEPTH (ft.)		14.0	14.0	14.0	
AVERAGE VOLUME PER REACTOR (cf)		169400	169400	169400	
AVERAGE VOLUME PER REACTOR (mg)		1.27	1.27	1.27	
NUMBER OF STAGES, EACH TANK		4	4	4	
BOD-a/1000 CF.		203	235	258	
TOTAL VOLUME (CF)		677600	847000	847000	
- (MG)		5.07	6.34	6.34	

CASE 2A - SERIES PLANT 12-Jan-89
EXISTING HPO SYSTEM USED FOR CARBONACEOUS STAGE
NEW DIFFUSED AERATION REACTORS USED FOR NITRIFICATION STAGE ALT. 2A-C5
HPO SYSTEM W/ STEP FEED DIFF.AERATION
STEP FEED MODE

****** PHASE II (2008) ******

ITEMS	ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
12. CARBONACEOUS REACTORS (cont.)				
DETENTION TIME (hrs.)	1.01	0.94	0.61	
SOLIDS RETENTION TIME, SRT (DAYS)	0.80	0.60	0.40	
TOTAL CARBONACEOUS SOLIDS PRODUCED				
- SOLIDS PRODUCED/TSS APPLIED	1.00	1.20	1.20	Based on Study Memo B
- TSS APPLIED (1000 LB/DAY)	147.0	197.8	258.8	
- SOLIDS PRODUCED (1000 LB/DAY)	147.0	237.4	310.5	
MIXED LIQUOR				
- AVERAGE MLSS (mg/L)	2782	2695	2351	MLSS = SP * SRT / (VOL * 8.34)
- LAST PASS MLSS (mg/l)	1452	1214	921	(4*MLSS avg./(3+(R+1)/R)
RETURN SLUDGE				
- RETURN RATIO	0.27	0.21	0.16	Input value
- RETURN CONCENTRATION (mg/L)	6772	7138	6641	Xr=((R+1)/R)*MLSS lp
- RETURN FLOW (MGD)	33.0	33.2	40.1	Based on Q return = Q mps x R (40 mgd min.)
CARBONACEOUS WASTE ACTIVATED SLUDGE				
-SOLIDS PRODUCED (1000 lbs/day)	147.0	237.4	310.5	
-EFFLUENT SUSPENDED SOLIDS (1000 lbs/day	16.1	21.8	30.7	
-CONCENTRATION OF R.A.S.(mg/l)	6772	7138	6641	
-WAS (1000 lbs/day)	130.9	215.6	279.8	
(mgd)	2.3	3.6	5.1	
(gpm)	1627	2493	3508	
HIGH PURITY/DIFFUSED OXYGEN SUPPLY				Max.Month represents max demand
OXYGEN DEMAND				
- BOD APPLIED (1000 lbs/day)	137.3	198.8	N/A	
- TKN OXIDIZED (1000 lbs/day)	4.4	2.9	N/A	Basis; (TKN inf.-TKN eff.)-(0.07*WAS)
- OXYGEN DISSOLVED (1000 lbs/day)	7.1	9.5	N/A	Basis; (mgd * 7.0 mg/l * 8.34)/1000
- O2 FOR BOD APPLIED (1000 lbs/day)	137.26	198.82	N/A	Based on 1 LB O2 per 1 LB BOD applied.
- O2 FOR TKN (1000 lbs/day)	20.42	13.43	N/A	Based on 4.6 LB O2 per 1 LB NO3 formed.
- O2 DISSOLVED IN WW (1000 lbs/day)	7.1	9.5	N/A	
- TOTAL OXYGEN DEMAND (1000 lbs/day)	164.7	221.7	N/A	
13. CARBONACEOUS STAGE FINAL TANKS				
CARBONACEOUS INFLUENT QUANTITIES (mgd)	121.0	162.1	248.8	
NUMBER OF TANKS	10	10	12	
TOTAL SURFACE AREA @ 68' x 247' PER TANK	167960	167960	201552	
AVERAGE WATER DEPTH (ft.)	12.0	12.0	12.0	
TOTAL VOLUME (cf)	2015520	2015520	2418624	
- (mg)	15.08	15.08	18.09	

CASE 2A - SERIES PLANT 12-Jan-89
EXISTING HPO SYSTEM USED FOR CARBONACEOUS STAGE
NEW DIFFUSED AERATION REACTORS USED FOR NITRIFICATION STAGE ALT. 2A-C5
HPO SYSTEM W/ STEP FEED DIFF.AERATION
STEP FEED MODE

****** PHASE II (2008) ******

ITEMS	ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
13. CARBONACEOUS STAGE FINAL TANKS (cont.)				
SURFACE OVERFLOW RATE (gpsfpd)	720	965	1234	
SAFETY FACTOR a b				
-ISV (fph) 23.0 700	8.32	9.83	12.07	Study Memo B
-SOR BASED ON ISV (gpsfpd)	1494	1765	2167	
-CLARIFIER SAFETY FACTOR	2.07	1.83	1.76	
DETENTION TIME (hrs.)	2.99	2.23	1.75	
CARBONACEOUS STAGE EFFLUENT CHARACTERISTICS				
a				
- BOD-5 (mg/l)	27.0	32.2	18.9	Median BOD5 = 27.0 mg/l ann.avg.
(1000 lb/day) 1.60	27.2	43.6	39.1	Max.mo. lbs/ann.avg. lbs = 1.60 peak day lbs/ann.av = infl.load ratio
- TSS (mg/l)	16.0	16.1	14.8	Median TSS = 16.0 mg/l ann.avg.
(1000 lbs/day) 1.35	16.1	21.8	30.7	Max.mo. lbs/ann.avg. lbs = 1.35 peak day lbs/ann.av = infl.load ratio
- TKN PERCENT REMOVAL	56.0	56.0	28.3	Study Memo B
- TKN (mg/l)	10.6	10.5	9.4	Peak data based on Sept. 8, 1988 condition
(1000 lbs/day)	10.7	14.2	19.5	
- NO3-N (mg/l)	4.4	2.2	0.0	
(1000 lbs/day)	4.4	2.9	0.0	Basis; TKN in - TKN out - 0.07*WAS
- PERCENT PHOS. REMOVED	16.3	18.0	31.5	Based on 1% of TSS removed
- PHOSPHORUS as P (1000 lb/day)	6.7	8.0	5.0	
* (mg/L)	6.6	5.9	2.4	
14. NITRIFICATION REACTORS				Converted Aerobic Digestion tanks
NITRIFICATION INFLUENT QUANTITIES (mgd)	121.0	162.1	248.8	
SEWAGE APPLIED TO NITRIFICATION STAGE				
- BOD-5 (1000 lb/day)	27.2	43.6	39.1	
(mg/L)	27.0	32.2	18.9	
- SUSPENDED SOLIDS (1000 lb/day)	16.1	21.8	30.7	
(mg/L)	16.0	16.1	14.8	
- TKN (1000 lb/day)	10.7	14.2	19.5	
(mg/L)	10.6	10.5	9.4	
- NO3-N (1000 lbs/day)	4.4	2.9	0.0	
(mg/l)	4.4	2.2	0.0	
- PHOSPHORUS as P (1000 lb/day)	6.7	8.0	5.0	
(mg/L)	6.6	5.9	2.4	

CASE 2A - SERIES PLANT
EXISTING HPO SYSTEM USED FOR CARBONACEOUS STAGE
NEW DIFFUSED AERATION REACTORS USED FOR NITRIFICATION STAGE
HPO SYSTEM W/ STEP FEED

12-Jan-89

ALT. 2A-C5
DIFF.AERATION
STEP FEED MODE

****** PHASE II (2008) ******

ITEMS	ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
14. NITRIFICATION REACTORS (cont.)				
NUMBER OF REACTORS	4	4	4	
AVERAGE WATER DEPTH (ft.)	18	18	18	
AVERAGE VOLUME PER REACTOR (cf)	283405	283405	283405	
AVERAGE VOLUME PER REACTOR (mg)	2.12	2.12	2.12	
NUMBER OF STAGES, EACH TANK	6	6	6	
TOTAL VOLUME (cf)	1133620	1133620	1133620	
(mg)	8.48	8.48	8.48	
BOD-a/1000 CF.	24	38	35	
DETENTION TIME (hrs.)	1.68	1.26	0.82	
SOLIDS RETENTION TIME - SRT (days)	8.0	6.0	4.0	
TOTAL NITRIFICATION SOLIDS PRODUCTION				
- SOLIDS PRODUCED/TSS APPLIED	0.68	0.68	0.68	
- TSS APPLIED (1000 lb/day)	16.1	21.8	30.7	
- SOLIDS PRODUCED (1000 lb/day)	11.0	14.8	20.9	
MIXED LIQUOR				
- AVERAGE MLSS (mg/L)	1242	1257	1182	MLSS = SP * SRT / (VOL * 8.34)
- LAST PASS MLSS (mg/l)	642	561	407	MLSS lp = (6*MLSS av/(5+(R+1)/R))
RETURN SLUDGE				
- RETURN RATIO	0.17	0.12	0.08	Input value
- RETURN CONCENTRATION (mg/L)	4533	5081	5435	Xr=((R+1)/R)*MLSS lp
- RETURN FLOW (mgd)	20.0	20.1	20.2	Q =Q mpsxR -(D.A.operating pts.assumed)
WASTE ACTIVATED SLUDGE				
- WAS (1000 lbs/day)	0.0	0.0	0.0	
HIGH PURITY OXYGEN/DIFFUSED AIR SUPPLY				Max.Month represents max demand
OXYGEN DEMAND				
- BOD APPLIED (1000 lbs/day)	27.2	43.6	N/A	
- TKN OXIDIZED (1000 lbs/day)	8.8	11.6	N/A	Basis; (TKN inf.-TKN eff.)
- OXYGEN DISSOLVED (1000 lbs/day)	7.1	9.5	N/A	Basis; (mgd * 7.0 mg/l * 8.34)/1000
- 02 FOR BOD APPLIED (1000 lbs/day)	32.7	52.3	N/A	Based on 1.2 LB 02 per 1 LB BOD applied.
- 02 FOR TKN (1000 lbs/day)	40.3	53.4	N/A	Based on 4.6 LB 02 per 1 LB NO3 formed.
- 02 DISSOLVED IN WW (1000 lbs/day)	7.1	9.5	N/A	
- TOTAL OXYGEN DEMAND (1000 lbs/day)	80.1	115.1	N/A	

#1000

20,000

400

1600

12-Jan-89

CASE 2A - SERIES PLANT
EXISTING HPO SYSTEM USED FOR CARBONACEOUS STAGE
NEW DIFFUSED AERATION REACTORS USED FOR NITRIFICATION STAGE
HPO SYSTEM W/ STEP FEED

ALT. 2A-C5
DIFF.AERATION
STEP FEED MODE

****** PHASE II (2008) ******

ITEMS			ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
15. NITRIFICATION FINAL TANKS (NEW)						
NITRIFICATION INFLUENT QUANTITIES (mgd)			121.0	162.1	248.8	
NUMBER OF TANKS			8	8	8	
TOTAL SURFACE AREA @ 68'x 247'			134368	134368	134368	
AVERAGE WATER DEPTH (ft)			12	12	12	
TOTAL VOLUME (cf)			1612416	1612416	1612416	
- (mg)			12.06	12.06	12.06	
SURFACE LOADING (gpsfpd)			900	1206	1852	
SAFETY FACTOR	a	b				
-ISV (fph)	23.0	800	13.76	14.69	16.61	Study Memo B
-SOR BASED ON ISV (gpsfpd)			2471	2637	2981	
-CLARIFIER SAFETY FACTOR			2.74	2.19	1.61	
DETENTION TIME (hrs.)			2.39	1.79	1.16	
EFFLUENT WEIRS						
- LENGTH (ft.)			5184	5184	5184	Based on 648' of wier per tank
- LOADING (gal/ft/day)			23333	31267	47994	
NITRIFICATION STAGE EFFLUENT CHARACTERISTICS		a				
- BOD-5 (mg/l)			5.0	5.0	3.5	Median BOD5 = 5.0 mg/l ann.avg.
(1000 lb/day)		1.33	5.0	6.7	7.2	Max.mo. lbs/ann.avg. lbs = 1.33 peak day lbs/ann.av = infl.load ratio
- TSS (mg/l)			10.9	11.0	10.1	
(1000 lb/day)			11.0	14.8	20.9	Based on solids produced
- TKN PERCENT REMOVAL			82.0	82.0	-	Study Memo B
- TKN (mg/L)			1.9	1.9	1.9	Peak cond. assume same conc. as max. month
(1000 lb/day)			1.9	2.5	3.9	
- NITRATE NITROGEN (mg/l)			12.1	10.7	7.5	Study Memo B for ann.avg. data
(1000 lbs/day)			12.2	14.5	15.6	Max.Mo. & Peak; TN in - TKN out
- PHOSPHORUS as P (1000 lb/day)			6.7	8.0	5.0	Same as Nitrification influent
* (mg/L)			6.6	5.9	2.4	

CASE 2A - SERIES PLANT
EXISTING HPO SYSTEM USED FOR CARBONACEOUS STAGE
NEW DIFFUSED AERATION REACTORS USED FOR NITRIFICATION STAGE
HPO SYSTEM W/ STEP FEED

12-Jan-89
ALT. 2A-C5
DIFF.AERATION
STEP FEED MODE

****** PHASE II (2008) ******

ITEMS		ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
16. DENITRIFICATION FILTERS					
INFLUENT QUANTITIES					
- NITRIFICATION EFFLUENT FLOW (mgd)		121.0	162.1	248.8	
- EXCLUDING RECYCLE		96.0	128.6	220.8	
SEWAGE APPLIED TO DENITRIFICATION FILTERS					
- BOD-5	(1000 lb/day)	5.0	6.7	7.2	
	(mg/L)	5.0	5.0	3.5	
- SUSPENDED SOLIDS	(1000 lb/day)	11.0	14.8	20.9	
	(mg/L)	10.9	11.0	10.1	
- TKN	(1000 lb/day)	1.9	2.5	3.9	
	(mg/L)	1.9	1.9	1.9	
- NITRATE NITROGEN	(1000 lb/day)	12.2	14.5	15.6	
	(mg/L)	12.1	10.7	7.5	
- PHOSPHORUS as P	(1000 lb/day)	6.7	8.0	5.0	
	(mg/L)	6.6	5.9	2.4	
NUMBER OF FILTERS					
- EXISTING		20	20	20	
- NEW		12	12	12	
- TOTAL		32	32	32	
TOTAL SURFACE AREA (sf)		33600	33600	33600	Based on 2.0 gpm/sf at inf.quan.w/o recycle
HYDRAULIC LOADING					
- ACTUAL INFLUENT BASIS (gpm/sf)		2.5	3.3	5.1	
- EXCLUDING RECYCLE (gpm/sf)		2.0	2.7	4.6	
DENITRIFICATION FILTERS EFFLUENT CHARACTERISTICS					
- BOD-5	(1000 lb/day)	2.0	2.7	3.0	
	* (mg/L)	2.0	2.0	1.4	Eff.BOD(mg/l)= 0.098+0.385*(BOD appl.(mg/l))
- SUSPENDED SOLIDS	(1000 lb/day)	2.3	3.1	4.6	
	* (mg/L)	2.3	2.3	2.2	Eff.TSS(mg/l)= 1.038+0.117*(TSS appl.(mg/l))
- TKN	(1000 lb/day)	1.5	2.0	3.0	
	* (mg/L)	1.5	1.5	1.5	Eff.TKN(mg/l)= 0.404+0.556*(TKN appl.(mg/l))
- NITRATE NITROGEN; NO3-N	(1000 lb/day)	1.0	1.2	1.2	Based on 92% removal
	* (mg/L)	1.0	0.9	0.6	
- PHOSPHORUS as P	(1000 lb/day)	6.7	8.0	4.9	
	* (mg/L)	6.6	5.9	2.4	

CASE 2A - SERIES PLANT
EXISTING HPO SYSTEM USED FOR CARBONACEOUS STAGE
NEW DIFFUSED AERATION REACTORS USED FOR NITRIFICATION STAGE
HPO SYSTEM W/ STEP FEED

12-Jan-89

ALT. 2A-C5
DIFF.AERATION
STEP FEED MODE

** ****** PHASE II (2008) ****** ***

ITEMS		ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
17. PLANT EFFLUENT					
SEWAGE QUANTITIES (mgd)		96.0	128.6	220.8	
PLANT EFFLUENT CHARACTERISTICS					
- BOD-5	(1000 lb/day)	1.6	2.2	2.7	
*	(mg/L)	2.0	2.0	1.4	
- SUSPENDED SOLIDS	(1000 lb/day)	1.9	2.5	4.1	
*	(mg/L)	2.3	2.3	2.2	
- NITROGEN as TN	(1000 lb/day)	1.9	2.5	3.8	
*	(mg/L)	2.4	2.3	2.1	
- PHOSPHORUS as P	(1000 lb/day)	5.3	6.3	4.4	
*	(mg/L)	6.6	5.9	2.4	

CASE 2A

ALTERNATIVE 2A-C5

DESIGN YEAR 2008

BASES OF DESIGN

EXISTING HPO SYSTEM: CARBONACEOUS/STEP FEED

NEW DIFFUSED AIR SYSTEM: NITRIFICATION/PLUG FLOW

96 MGD ANNUAL AVERAGE

12-Jan-89

CASE 2A - SERIES PLANT
EXISTING HPO SYSTEM USED FOR CARBONACEOUS STAGE
NEW DIFFUSED AERATION REACTORS USED FOR NITRIFICATION STAGE
HPO SYSTEM W/ STEP FEED

ALT. 2A-C5
DIFF.AERATION
PLUG FLOW MODE

****** PHASE II (2008) ******

ITEMS		ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
PRIMARY TREATMENT EQUIVALENT TO THAT SHOWN IN CASE 2A, DIFF.AERATION STEP FEED MODE					
11. MAIN PUMPING STATION					
EFFLUENT FLOW RATE (mgd)		121.0	162.1	248.8	
MAIN SEWAGE PUMPS					
- # VARIABLE SPEED @ 40 MGD		3	3	3	
- # CONSTANT SPEED @ 40 MGD		2	2	2	
- # NEW PUMPS @ 50 MGD		2	2	2	
- TOTAL INSTALLED CAPACITY (MGD)		300	300	300	
- FIRM CAPACITY (MGD)		250	250	250	
CHARACTERISTICS OF PRIMARY & RECYCLED FLOW					
- BOD-5	(1000 lbs/day)	137.3	198.8	218.5	
	(mg/L)	136.1	147.1	105.3	
- SUSPENDED SOLIDS	(1000 lbs/day)	147.0	197.8	258.8	
	(mg/L)	145.7	146.3	124.7	
- NITROGEN AS TKN	(1000 lbs/day)	24.3	32.2	27.2	
	(mg/L)	24.1	23.8	13.1	
- PHOSPHORUS	(1000 lbs/day)	8.0	9.8	7.2	
	(mg/L)	7.9	7.2	3.5	
12. CARBONACEOUS REACTORS					
CARBONACEOUS INFLUENT QUANTITIES					
- MAIN PUMPING STATION FLOW (mgd)		121.0	162.1	248.8	
CHARACTERISITICS APPLIED TO REACTORS					
- BOD-5	(1000 lbs/day)	137.3	198.8	218.5	
	(mg/L)	136.1	147.1	105.3	
- SUSPENDED SOLIDS	(1000 lbs/day)	147.0	197.8	258.8	
	(mg/L)	145.7	146.3	124.7	
- NITROGEN TKN	(1000 lbs/day)	24.3	32.2	27.2	
	(mg/L)	24.1	23.8	13.1	
- PHOSPHORUS	(1000 lbs/day)	8.0	9.8	7.2	
	(mg/L)	7.9	7.2	3.5	
NUMBER OF REACTORS		4	5	5	
AVERAGE WATER DEPTH (ft.)		14.0	14.0	14.0	
AVERAGE VOLUME PER REACTOR (cf)		169400	169400	169400	
AVERAGE VOLUME PER REACTOR (mg)		1.27	1.27	1.27	
NUMBER OF STAGES, EACH TANK		4	4	4	
BOD-a/1000 CF.		203	235	258	
TOTAL VOLUME (CF)		677600	847000	847000	
- (MG)		5.07	6.34	6.34	

CASE 2A - SERIES PLANT
EXISTING HPO SYSTEM USED FOR CARBONACEOUS STAGE
NEW DIFFUSED AERATION REACTORS USED FOR NITRIFICATION STAGE
HPO SYSTEM W/ STEP FEED

12-Jan-89
ALT. 2A-C5
DIFF.AERATION
PLUG FLOW MODE

****** PHASE II (2008) ******

ITEMS	ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
12. CARBONACEOUS REACTORS (cont.)				
DETENTION TIME (hrs.)	1.01	0.94	0.61	
SOLIDS RETENTION TIME, SRT (DAYS)	0.80	0.60	0.40	
TOTAL CARBONACEOUS SOLIDS PRODUCED				
- SOLIDS PRODUCED/TSS APPLIED	1.00	1.20	1.20	Based on Study Memo B
- TSS APPLIED (1000 LB/DAY)	147.0	197.8	258.8	
- SOLIDS PRODUCED (1000 LB/DAY)	147.0	237.4	310.5	
MIXED LIQUOR				
- AVERAGE MLSS (mg/L)	2782	2695	2351	MLSS = SP * SRT / (VOL * 8.34)
- LAST PASS MLSS (mg/l)	1452	1211	921	(4*MLSS avg./(3+(R+1)/R)
RETURN SLUDGE				
- RETURN RATIO	0.27	0.20	0.16	Input value
- RETURN CONCENTRATION (mg/L)	6772	7148	6641	Xr=((R+1)/R)*MLSS 1p
- RETURN FLOW (MGD)	33.0	33.1	40.1	Based on Q return = Q mps x R (40 mgd min.)
CARBONACEOUS WASTE ACTIVATED SLUDGE				
-SOLIDS PRODUCED (1000 lbs/day)	147.0	237.4	310.5	
-EFFLUENT SUSPENDED SOLIDS (1000 lbs/day	16.1	21.8	30.7	
-CONCENTRATION OF R.A.S.(mg/l)	6772	7148	6641	
-WAS (1000 lbs/day)	130.9	215.6	279.8	
(mgd)	2.3	3.6	5.1	
(gpm)	1627	2493	3508	
HIGH PURITY/DIFFUSED OXYGEN SUPPLY				Max.Month represents max demand
OXYGEN DEMAND				
- BOD APPLIED (1000 lbs/day)	137.3	198.8	N/A	
- TKN OXIDIZED (1000 lbs/day)	4.4	2.9	N/A	Basis; (TKN inf.-TKN eff.)-(0.07*WAS)
- OXYGEN DISSOLVED (1000 lbs/day)	7.1	9.5	N/A	Basis; (mgd * 7.0 mg/l * 8.34)/1000
- O2 FOR BOD APPLIED (1000 lbs/day)	137.26	198.82	N/A	Based on 1 LB O2 per 1 LB BOD applied.
- O2 FOR TKN (1000 lbs/day)	20.42	13.43	N/A	Based on 4.6 LB O2 per 1 LB NO3 formed.
- O2 DISSOLVED IN WW (1000 lbs/day)	7.1	9.5	N/A	
- TOTAL OXYGEN DEMAND (1000 lbs/day)	164.7	221.7	N/A	
13. CARBONACEOUS STAGE FINAL TANKS				
CARBONACEOUS INFLUENT QUANTITIES (mgd)	121.0	162.1	248.8	
NUMBER OF TANKS	10	10	12	
TOTAL SURFACE AREA @ 68' x 247' PER TANK	167960	167960	201552	
AVERAGE WATER DEPTH (ft.)	12.0	12.0	12.0	
TOTAL VOLUME (cf)	2015520	2015520	2418624	
- (mg)	15.08	15.08	18.09	

CASE 2A - SERIES PLANT
EXISTING HPO SYSTEM USED FOR CARBONACEOUS STAGE
NEW DIFFUSED AERATION REACTORS USED FOR NITRIFICATION STAGE
HPO SYSTEM W/ STEP FEED

12-Jan-89

ALT. 2A-C5
DIFF.AERATION
PLUG FLOW MODE

****** PHASE II (2008) ******

ITEMS			ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
13. CARBONACEOUS STAGE FINAL TANKS (cont.)						
SURFACE OVERFLOW RATE (gpsfpd)			720	965	1234	
SAFETY FACTOR	a	b				
-ISV (fph)	23.0	700	8.32	9.85	12.07	Study Memo B
-SOR BASED ON ISV (gpsfpd)			1494	1769	2167	
-CLARIFIER SAFETY FACTOR			2.07	1.83	1.76	
DETENTION TIME (hrs.)			2.99	2.23	1.75	
CARBONACEOUS STAGE EFFLUENT CHARACTERISTICS		a				
- BOD-5 (mg/l)			27.0	32.2	18.9	Median BOD5 = 27.0 mg/l ann.avg.
(1000 lb/day)		1.60	27.2	43.6	39.1	Max.mo. lbs/ann.avg. lbs = 1.60 peak day lbs/ann.av = infl.load ratio
- TSS (mg/l)			16.0	16.1	14.8	Median TSS = 16.0 mg/l ann.avg.
(1000 lbs/day)		1.35	16.1	21.8	30.7	Max.mo. lbs/ann.avg. lbs = 1.35 peak day lbs/ann.av = infl.load ratio
- TKN PERCENT REMOVAL			56.0	56.0	28.3	Study Memo B
- TKN (mg/l)			10.6	10.5	9.4	Peak data based on Sept. 8, 1988 condition
(1000 lbs/day)			10.7	14.2	19.5	
- NO3-N (mg/l)			4.4	2.2	0.0	
(1000 lbs/day)			4.4	2.9	0.0	Basis; TKN in - TKN out - 0.07*WAS
- PERCENT PHOS. REMOVED			16.3	18.0	31.5	Based on 1% of TSS removed
- PHOSPHORUS as P (1000 lb/day)			6.7	8.0	5.0	
* (mg/L)			6.6	5.9	2.4	
14. NITRIFICATION REACTORS						Converted Aerobic Digestion tanks
NITRIFICATION INFLUENT QUANTITIES (mgd)			121.0	162.1	248.8	
SEWAGE APPLIED TO NITRIFICATION STAGE						
- BOD-5 (1000 lb/day)			27.2	43.6	39.1	
(mg/L)			27.0	32.2	18.9	
- SUSPENDED SOLIDS (1000 lb/day)			16.1	21.8	30.7	
(mg/L)			16.0	16.1	14.8	
- TKN (1000 lb/day)			10.7	14.2	19.5	
(mg/L)			10.6	10.5	9.4	
- NO3-N (1000 lbs/day)			4.4	2.9	0.0	
(mg/l)			4.4	2.2	0.0	
- PHOSPHORUS as P (1000 lb/day)			6.7	8.0	5.0	
(mg/L)			6.6	5.9	2.4	

CASE 2A - SERIES PLANT
EXISTING HPO SYSTEM USED FOR CARBONACEOUS STAGE
NEW DIFFUSED AERATION REACTORS USED FOR NITRIFICATION STAGE
HPO SYSTEM W/ STEP FEED

12-Jan-89

ALT. 2A-C5
DIFF.AERATION
PLUG FLOW MODE

*** ****** PHASE II (2008) ****** ***

ITEMS	ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
14. NITRIFICATION REACTORS (cont.)				
NUMBER OF REACTORS	4	4	4	
AVERAGE WATER DEPTH (ft.)	18	18	18	
AVERAGE VOLUME PER REACTOR (cf)	283405	283405	283405	
AVERAGE VOLUME PER REACTOR (mg)	2.12	2.12	2.12	
NUMBER OF STAGES, EACH TANK	6	6	6	
TOTAL VOLUME (cf)	1133620	1133620	1133620	
(mg)	8.48	8.48	8.48	
BOD-a/1000 CF.	24	38	35	
DETENTION TIME (hrs.)	1.68	1.26	0.82	
SOLIDS RETENTION TIME - SRT (days)	8.0	6.0	4.0	
TOTAL NITRIFICATION SOLIDS PRODUCTION				
- SOLIDS PRODUCED/TSS APPLIED	0.68	0.68	0.68	
- TSS APPLIED (1000 lb/day)	16.1	21.8	30.7	
- SOLIDS PRODUCED (1000 lb/day)	11.0	14.8	20.9	
MIXED LIQUOR				
- AVERAGE MLSS (mg/L)	1242	1257	1182	MLSS = SP * SRT / (VOL * 8.34)
- LAST PASS MLSS (mg/l)	1242	1257	1182	MLSS av = MLSS lp, plug flow
RETURN SLUDGE				
- RETURN RATIO	0.18	0.19	0.17	Input value
- RETURN CONCENTRATION (mg/L)	8008	8016	8013	Xr=((R+1)/R)*MLSS lp
- RETURN FLOW (mgd)	22.2	30.1	43.0	Q =Q mpsxR -(D.A.operating pts.assumed)
WASTE ACTIVATED SLUDGE				
- WAS (1000 lbs/day)	0.0	0.0	0.0	
HIGH PURITY OXYGEN/DIFFUSED AIR SUPPLY				Max.Month represents max demand
OXYGEN DEMAND				
- BOD APPLIED (1000 lbs/day)	27.2	43.6	N/A	
- TKN OXIDIZED (1000 lbs/day)	8.8	11.6	N/A	Basis; (TKN inf.-TKN eff.)
- OXYGEN DISSOLVED (1000 lbs/day)	7.1	9.5	N/A	Basis; (mgd * 7.0 mg/l * 8.34)/1000
- O2 FOR BOD APPLIED (1000 lbs/day)	32.7	52.3	N/A	Based on 1.2 LB O2 per 1 LB BOD applied.
- O2 FOR TKN (1000 lbs/day)	40.3	53.4	N/A	Based on 4.6 LB O2 per 1 LB NO3 formed.
- O2 DISSOLVED IN WW (1000 lbs/day)	7.1	9.5	N/A	
- TOTAL OXYGEN DEMAND (1000 lbs/day)	80.1	115.1	N/A	

12-Jan-89

CASE 2A - SERIES PLANT
EXISTING HPO SYSTEM USED FOR CARBONACEOUS STAGE
NEW DIFFUSED AERATION REACTORS USED FOR NITRIFICATION STAGE
HPO SYSTEM W/ STEP FEED

ALT. 2A-C5
DIFF.AERATION
PLUG FLOW MODE

** ****** PHASE II (2008) ****** **

ITEMS	ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
15. NITRIFICATION FINAL TANKS (NEW)				
NITRIFICATION INFLUENT QUANTITIES (mgd)	121.0	162.1	248.8	
NUMBER OF TANKS	8	8	8	
TOTAL SURFACE AREA @ 68'x 247'	134368	134368	134368	
AVERAGE WATER DEPTH (ft)	12	12	12	
TOTAL VOLUME (cf)	1612416	1612416	1612416	
- (mg)	12.06	12.06	12.06	
SURFACE LOADING (gpsfpd)	900	1206	1852	
SAFETY FACTOR a b				
-ISV (fph) 23.0 800	8.52	8.41	8.94	Study Memo B
-SOR BASED ON ISV (gpsfpd)	1529	1510	1604	
-CLARIFIER SAFETY FACTOR	1.70	1.25	0.87	
DETENTION TIME (hrs.)	2.39	1.79	1.16	
EFFLUENT WEIRS				
- LENGTH (ft.)	5184	5184	5184	Based on 648' of wier per tank
- LOADING (gal/ft/day)	23333	31267	47994	
NITRIFICATION STAGE EFFLUENT CHARACTERISTICS				
a				
- BOD-5 (mg/l)	5.0	5.0	3.5	Median BOD5 = 5.0 mg/l ann.avg.
(1000 lb/day) 1.33	5.0	6.7	7.2	Max.mo. lbs/ann.avg. lbs = 1.33
				peak day lbs/ann.av = infl.load ratio
- TSS (mg/l)	10.9	11.0	10.1	
(1000 lb/day)	11.0	14.8	20.9	Based on solids produced
- TKN PERCENT REMOVAL	82.0	82.0	-	Study Memo B
- TKN (mg/L)	1.9	1.9	1.9	Peak cond. assume same conc. as max. month
(1000 lb/day)	1.9	2.5	3.9	
- NITRATE NITROGEN (mg/l)	12.1	10.7	7.5	Study Memo B for ann.avg. data
(1000 lbs/day)	12.2	14.5	15.6	Max.Mo. & Peak; TN in - TKN out
- PHOSPHORUS as P (1000 lb/day)	6.7	8.0	5.0	Same as Nitrification influent
* (mg/L)	6.6	5.9	2.4	

CASE 2A - SERIES PLANT
EXISTING HPO SYSTEM USED FOR CARBONACEOUS STAGE
NEW DIFFUSED AERATION REACTORS USED FOR NITRIFICATION STAGE
HPO SYSTEM W/ STEP FEED

12-Jan-89

ALT. 2A-C5
DIFF.AERATION
PLUG FLOW MODE

****** PHASE II (2008) ******

ITEMS		ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
16. DENITRIFICATION FILTERS					
INFLUENT QUANTITIES					
- NITRIFICATION EFFLUENT FLOW (mgd)		121.0	162.1	248.8	
- EXCLUDING RECYCLE		96.0	128.6	220.8	
SEWAGE APPLIED TO DENITRIFICATION FILTERS					
- BOD-5	(1000 lb/day)	5.0	6.7	7.2	
	(mg/L)	5.0	5.0	3.5	
- SUSPENDED SOLIDS	(1000 lb/day)	11.0	14.8	20.9	
	(mg/L)	10.9	11.0	10.1	
- TKN	(1000 lb/day)	1.9	2.5	3.9	
	(mg/L)	1.9	1.9	1.9	
- NITRATE NITROGEN	(1000 lb/day)	12.2	14.5	15.6	
	(mg/L)	12.1	10.7	7.5	
- PHOSPHORUS as P	(1000 lb/day)	6.7	8.0	5.0	
	(mg/L)	6.6	5.9	2.4	
NUMBER OF FILTERS					
- EXISTING		20	20	20	
- NEW		12	12	12	
- TOTAL		32	32	32	
TOTAL SURFACE AREA (sf)		33600	33600	33600	Based on 2.0 gpm/sf at inf.quan.w/o recycle
HYDRAULIC LOADING					
- ACTUAL INFLUENT BASIS (gpm/sf)		2.5	3.3	5.1	
- EXCLUDING RECYCLE (gpm/sf)		2.0	2.7	4.6	
DENITRIFICATION FILTERS EFFLUENT CHARACTERISTICS					
- BOD-5	(1000 lb/day)	2.0	2.7	3.0	
	* (mg/L)	2.0	2.0	1.4	Eff.BOD(mg/l)= 0.098+0.385*(BOD appl.(mg/l))
- SUSPENDED SOLIDS	(1000 lb/day)	2.3	3.1	4.6	
	* (mg/L)	2.3	2.3	2.2	Eff.TSS(mg/l)= 1.038+0.117*(TSS appl.(mg/l))
- TKN	(1000 lb/day)	1.5	2.0	3.0	
	* (mg/L)	1.5	1.5	1.5	Eff.TKN(mg/l)= 0.404+0.556*(TKN appl.(mg/l))
- NITRATE NITROGEN; NO3-N	(1000 lb/day)	1.0	1.2	1.2	Based on 92% removal
	* (mg/L)	1.0	0.9	0.6	
- PHOSPHORUS as P	(1000 lb/day)	6.7	8.0	4.9	
	* (mg/L)	6.6	5.9	2.4	

CASE 2A - SERIES PLANT
EXISTING HPO SYSTEM USED FOR CARBONACEOUS STAGE
NEW DIFFUSED AERATION REACTORS USED FOR NITRIFICATION STAGE
HPO SYSTEM W/ STEP FEED

12-Jan-89

ALT. 2A-C5
DIFF.AERATION
PLUG FLOW MODE

****** PHASE II (2008) ******

ITEMS		ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
17. PLANT EFFLUENT					
SEWAGE QUANTITIES (mgd)		96.0	128.6	220.8	
PLANT EFFLUENT CHARACTERISTICS					
- BOD-5	(1000 lb/day)	1.6	2.2	2.7	
*	(mg/L)	2.0	2.0	1.4	
- SUSPENDED SOLIDS	(1000 lb/day)	1.9	2.5	4.1	
*	(mg/L)	2.3	2.3	2.2	
- NITROGEN as TN	(1000 lb/day)	1.9	2.5	3.8	
*	(mg/L)	2.4	2.3	2.1	
- PHOSPHORUS as P	(1000 lb/day)	5.3	6.3	4.4	
*	(mg/L)	6.6	5.9	2.4	

CASE 2B

ALTERNATIVE 2B-B3

DESIGN YEAR 2008

BASES OF DESIGN

EXISTING HPO SYSTEM: TWO-STAGE/STEP FEED

NEW DIFFUSED AIR SYSTEM: SINGLE-STAGE/ANOXIC/STEP FEED

96 MGD ANNUAL AVERAGE

CASE 2B - PARALLEL PLANT
EXISTING HPO SYSTEM PLUS NEW DIFFUSED AERATION REACTORS
W/ A TWO STAGE ANOXIC ZONE

ALT. 2B-B3

ITEMS	EXISTING 2-STEP HPO SYSTEM (STEP FEED) PHASE II (2008)			NEW SINGLE-STEP DIFF.AIR SYSTEM (STEP FEED) PHASE II (2008)			COMMENTS
	ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	
PRIMARY TREATMENT EQUIVALENT TO THAT SHOWN IN CASE 2A, DIFF.AERATION STEP FEED MODE							PEAK CONDITION BASED ON SEPTEMBER 8, 1988
12. CARBONACEOUS REACTORS							
PLANT INFLUENT DIVERTED TO EXISTING SYSTEM (mgd)	69.2	92.7	159.2				
INFLUENT QUANTITIES TO REACTORS (mgd)	87.2	116.8	179.3				
CHARACTERISITICS APPLIED TO REACTORS							
- BOD-5 (1000 lbs/day)	98.9	143.3	157.5				
(mg/L)	136.1	147.1	105.3				
- SUSPENDED SOLIDS (1000 lbs/day)	106.0	142.6	186.5				
(mg/L)	145.7	146.3	124.7				
- NITROGEN TKN (1000 lbs/day)	17.5	23.2	19.6				
(mg/L)	24.1	23.8	13.1				
- PHOSPHORUS (1000 lbs/day)	5.8	7.0	5.2				
(mg/L)	7.9	7.2	3.5				
NUMBER OF REACTORS	3	3	3				
AVERAGE WATER DEPTH (ft.)	14.0	14.0	14.0				
AVERAGE VOLUME PER REACTOR (cf)	169400	169400	169400				
AVERAGE VOLUME PER REACTOR (mg)	1.27	1.27	1.27				
NUMBER OF STAGES, EACH TANK	4	4	4				
BOD-a/1000 CF.	195	282	310				
TOTAL VOLUME (CF)	508200	508200	508200				
- (MG)	3.80	3.80	3.80				
DETENTION TIME (hrs.)	1.05	0.78	0.51				
SOLIDS RETENTION TIME, SRT (DAYS)	0.80	0.60	0.40				
TOTAL CARBONACEOUS SOLIDS PRODUCED							
- SOLIDS PRODUCED/TSS APPLIED	1.00	1.20	1.20				Based on Study Memo B
- TSS APPLIED (1000 LB/DAY)	106.0	142.6	186.5				
- SOLIDS PRODUCED (1000 LB/DAY)	106.0	171.1	223.8				
MIXED LIQUOR							
- AVERAGE MLSS (mg/L)	2674	3238	2824				MLSS = SP * SRT / (VOL * 8.34)
- LAST PASS MLSS (mg/l)	1284	1651	1098				(4*MLSS avg/(3+(R+1)/R)
RETURN SLUDGE							
- RETURN RATIO	0.23	0.26	0.16				Input value
- RETURN CONCENTRATION (mg/L)	6844	8000	8003				Xr=((R+1)/R)*MLSS lp
- RETURN FLOW (MGD)	20.1	30.4	28.5				Based on Q return = Q mps x R (20 mgd min.)

CASE 2B - PARALLEL PLANT
EXISTING HPO SYSTEM PLUS NEW DIFFUSED AERATION REACTORS
W/ A TWO STAGE ANOXIC ZONE

ALT. 2B-B3

	EXISTING 2-STEP HPO SYSTEM (STEP FEED) PHASE II (2008)			NEW SINGLE-STEP DIFF.AIR SYSTEM (STEP FEED) PHASE II (2008)			
ITEMS	ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
12. CARBONACEOUS REACTORS (cont.)							
CARBONACEOUS WASTE ACTIVATED SLUDGE							
-SOLIDS PRODUCED (1000 lbs/day)	106.0	171.1	223.8				
-EFFLUENT SUSPENDED SOLIDS (1000 lbs/day)	11.6	15.7	22.1				
-CONCENTRATION OF R.A.S.(mg/l)	6844	8000	8003				
-WAS (1000 lbs/day)	94.3	155.4	201.7				
(mgd)	1.7	2.3	3.0				
HIGH PURITY/DIFFUSED OXYGEN SUPPLY							Max.month represents max demand
OXYGEN DEMAND							
- BOD APPLIED (1000 lbs/day)	98.9	143.3	157.5				
- TKN OXIDIZED (1000 lbs/day)	3.2	2.1	0.0				Basis; (TKN inf.-TKN eff.)-(0.07*WAS)
- OXYGEN DISSOLVED (1000 lbs/day)	5.1	6.8	10.5				Basis; (mgd * 7.0 mg/l * 8.34)/1000
- O2 FOR BOD APPLIED (1000 lbs/day)	98.94	143.32	157.51				Based on 1 LB O2 per 1 LB BOD applied.
- O2 FOR TKN (1000 lbs/day)	14.72	9.68	0.00				Based on 4.6 LB O2 per 1 LB NO3 formed.
- O2 DISSOLVED IN WW (1000 lbs/day)	5.1	6.8	10.5				
- TOTAL OXYGEN DEMAND (1000 lbs/day)	118.8	159.8	168.0				
13. CARBONACEOUS STAGE FINAL TANKS							
CARBONACEOUS INFLUENT QUANTITIES (mgd)	87.2	116.8	179.3				
NUMBER OF TANKS	6	6	6				
TOTAL SURFACE AREA @ 68' x 247' PER TANK	100776	100776	100776				
AVERAGE WATER DEPTH (ft.)	12.0	12.0	12.0				
TOTAL VOLUME (cf)	1209312	1209312	1209312				
- (mg)	9.05	9.05	9.05				
SURFACE OVERFLOW RATE (gpsfpd)	865	1159	1780				
SAFETY FACTOR a b							
-ISV (fph) 23.0 700	9.36	7.24	10.67				Study Memo B
-SOR BASED ON ISV (gpsfpd)	1681	1300	1915				
-CLARIFIER SAFETY FACTOR	1.94	1.12	1.08				
DETENTION TIME (hrs.)	2.49	1.86	1.21				

CASE 2B - PARALLEL PLANT
EXISTING HPO SYSTEM PLUS NEW DIFFUSED AERATION REACTORS
W/ A TWO STAGE ANOXIC ZONE

ITEMS	EXISTING 2-STEP HPO SYSTEM (STEP FEED) PHASE II (2008) ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	NEW SINGLE-STEP DIFF.AIR SYSTEM (STEP FEED) PHASE II (2008) ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
13. CARBONACEOUS STAGE FINAL TANKS (cont.)							
CARBONACEOUS STAGE EFFLUENT CHARACTERISTICS							
- BOD-5 (mg/l) a	27.0	32.2	18.9				Median BOD5 = 27.0 mg/l ann.avg.
(1000 lb/day) 1.60	19.6	31.4	28.2				Max.mo. lbs/ann.avg. lbs = 1.60
- TSS (mg/l)	16.0	16.1	14.8				Median TSS = 16.0 mg/l ann.avg.
(1000 lbs/day) 1.35	11.6	15.7	22.1				Max.mo. lbs/ann.avg. lbs = 1.35
- TKN PERCENT REMOVAL	56.0	56.0	28.3				Study Memo B
- TKN (mg/l)	10.6	10.5	9.4				Peak data based on Sept. 8, 1988
(1000 lbs/day)	7.7	10.2	14.1				
- NO3-N (mg/l)	4.4	2.2	0.0				
(1000 lbs/day)	3.2	2.1	0.0				TKN in - TKN out - (0.07*WAS)
- PERCENT PHOS. REMOVED	16.3	18.0	31.5				Based on 1% of TSS removed as Phos.
- PHOSPHORUS as P (1000 lb/day)	4.8	5.8	3.6				
* (mg/L)	6.6	5.9	2.4				
14. INTERMEDIATE PUMPING STATION							
INTERMEDIATE SEWAGE PUMPS							
- NUMBER OF VARIABLE SPEED UNITS	2	2	2				
- NUMBER OF CONSTANT SPEED UNITS	3	3	3				
- CAPACITY, EACH PUMPING UNIT (mgd)	40.0	40.0	40.0				
- TOTAL INSTALLED CAPACITY (mgd)	200.0	200.0	200.0				
- FIRM CAPACITY (mgd)	160.0	160.0	160.0				
15. NITRF.HPO REACTORS & DIFFUSED AERATION REACTORS							
PLANT INFLUENT QUANTITIES (mgd)	69.2	92.7	159.2	26.8	35.9	61.6	
ACTUAL INFLUENT QUANTITIES (mgd)	87.2	116.8	179.3	33.8	45.2	69.5	
SEWAGE APPLIED TO NITRIFICATION STAGE							
- BOD-5 (1000 lb/day)	19.6	31.4	28.2	38.3	55.5	61.0	
(mg/L)	27.0	32.2	18.9	136.1	147.1	105.3	
- SUSPENDED SOLIDS (1000 lb/day)	11.6	15.7	22.1	41.0	55.2	72.2	
(mg/L)	16.0	16.1	14.8	145.7	146.3	124.7	
- TKN (1000 lb/day)	7.7	10.2	14.1	6.8	9.0	7.6	
(mg/L)	10.6	10.5	9.4	24.1	23.8	13.1	
- NO3-N (1000 lb/day)	3.2	2.1	0.0				
(mg/l)	4.4	2.2	0.0				
- PHOSPHORUS as P (1000 lb/day)	4.8	5.8	3.6	2.2	2.7	2.0	
(mg/L)	6.6	5.9	2.4	7.9	7.2	3.5	

CASE 2B - PARALLEL PLANT
EXISTING HPO SYSTEM PLUS NEW DIFFUSED AERATION REACTORS
W/ A TWO STAGE ANOXIC ZONE

ALT. 2B-B3

ITEMS	EXISTING 2-STEP HPO SYSTEM (STEP FEED) PHASE II (2008)			NEW SINGLE-STEP DIFF.AIR SYSTEM (STEP FEED) PHASE II (2008)			COMMENTS
	ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	
15. NITRF.HPO REACTORS & DIFFUSED AERATION REACTORS (cont.)							
NUMBER OF REACTORS	3	3	3	4	4	4	
AVERAGE WATER DEPTH (ft.)	14	14	14	18.0	18.0	18.0	
AVERAGE VOLUME PER REACTOR (cf)	169400	169400	169400	283405	283405	283405	
AVERAGE VOLUME PER REACTOR (mg)	1.27	1.27	1.27	2.12	2.12	2.12	
NUMBER OF STAGES, EACH TANK	4	4	4	6	6	6	
TOTAL VOLUME (cf)	508200	508200	508200	1133620	1133620	1133620	
(mg)	3.80	3.80	3.80	8.48	8.48	8.48	
AERATED VOLUME (mg)	3.80	3.80	3.80	5.80	5.80	5.80	
BOD-a/1000 CF.	39	62	56	51	73	81	
DETENTION TIME (hrs.)	1.05	0.78	0.51	6.03	4.50	2.93	
SOLIDS RETENTION TIME - SRT (days)	8.0	6.0	4.0	8.0	6.0	4.0	
TOTAL NITRIFICATION SOLIDS PRODUCTION							
- SOLIDS PRODUCED/TSS APPLIED	0.68	0.68	0.68	0.58	0.62	0.66	0.68 for existing HPO: 0.74-(0.02*SRT) for D.A.
- TSS APPLIED (1000 lb/day)	11.6	15.7	22.1				Based on 0.68*TSS applied (HPO)
- BOD-5 APPLIED (1000 lbs/day)				38.3	55.5	61.0	Based on 0.74-(0.02*SRT)*BOD-5 applied (D.A.)
- SOLIDS PRODUCED (1000 lb/day)	7.9	10.7	15.1	22.2	34.4	40.3	
MIXED LIQUOR							
- AVERAGE MLSS (mg/L)	1996	2021	1900	3673	4266	3327	MLSS = SP * SRT / (VOL * 8.34)
- LAST PASS MLSS (mg/l)	957	821	588	2641	3133	1918	(4*MLSS av/(3+(R+1)/R)
RETURN SLUDGE							
- RETURN RATIO	0.23	0.17	0.11	0.59	0.64	0.32	Input value
- RETURN CONCENTRATION (mg/L)	5116	5622	5837	7102	8028	8006	Xr=((R+1)/R)*MLSS lp
- RETURN FLOW (mgd)	20.1	20.0	20.1	20.0	29.0	21.9	Based on Q return= Q mps x R
WASTE ACTIVATED SLUDGE							
- SOLIDS PRODUCED (1000 lbs/day)				22.2	34.4	40.3	
- EFFLUENT SUSPENDED SOLIDS (1000 lbs/day)				2.8	4.7	4.0	
- CONCENTRATION OF R.A.S.(mg/l)				7102	8028	8006	
- WAS (1000 lbs/day)				19.4	29.7	36.2	
(mgd)				0.3	0.4	0.5	
ANOXIC STAGE ALLOWANCE							
FLOW APPLIED (MPS effluent - mgd)				33.8	45.2	69.5	Based on influent flow
- NO-3 FORMED IN THE ANOXIC STAGE							
TKN INFLUENT (mg/l)				24.1	23.8	13.1	
TKN EFFLUENT (mg/l)				1.9	1.9	1.9	
TN IN SOLIDS REMOVED (mg/l)				4.8	5.5	4.4	Based on (SP-TSS effluent)*0.07
NO-3 FORMED (mg/l)				17.4	16.4	6.8	Based on (TKN in - TKN solids - TKN out)
(1000 lbs/day)				4.9	6.2	4.0	

CASE 2B - PARALLEL PLANT
EXISTING HPO SYSTEM PLUS NEW DIFFUSED AERATION REACTORS
W/ A TWO STAGE ANOXIC ZONE

ALT. 2B-B3

ITEMS	EXISTING 2-STEP HPO SYSTEM (STEP FEED) PHASE II (2008)			NEW SINGLE-STEP DIFF.AIR SYSTEM (STEP FEED) PHASE II (2008)			COMMENTS
	ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	
15. NITRF.HPO REACTORS & DIFFUSED AERATION REACTORS (cont.)							
- NO3-N REMOVED IN 15 MIN. (mg/l)				6.0	6.0	4.0	Not including recycle flows
(1000 lbs/day)				1.34	1.80	2.06	
O2 DEBIT (1000 lbs/day)				0.59	0.72	0.82	At 2 mg/l in recycle and 0.35 lb NO3 per lb O2
NO3-N REMOVED - O2 DEBIT (1000 lbs/day)				0.75	1.07	1.24	Based on load @ 6.0 mg/l-load of the O2 debit
- TOTAL ANOXIC STAGE VOLUME (mg)				2.68	2.68	2.68	First two stages of the four reactors are anoxic
- VOLUME FOR INITIAL NO3-N REMOVAL (mg)				0.47	0.47	0.47	
- VOLUME FOR REMAINING NO3-N REMOVAL (mg)				2.20	2.20	2.20	
- MLSS (mg/l)				2641	3133	1918	Calculated above
(1000 lbs)				48.6	57.6	35.3	
- RATE OF NO3-N REMOVAL (lb NO3/day/lb MLSS)				0.060	0.060	0.040	Removal rate after the initial 15 min.
- NO3-N REMOVED (1000 lbs/day)				2.91	3.46	1.41	
- TOTAL NO3-N REMOVED (1000 lbs/day)				3.66	4.53	2.65	
- EFFLUENT NO3-N (1000 lbs/day)				1.22	1.65	1.31	
(mg/l)				4.3	4.4	2.3	
- RECYCLE REQUIRED (mgd)				101.2	124.1	140.3	
- RETURN SLUDGE (mgd)				20.0	29.0	21.9	
- MLSS RECYCLE REQUIRED (mgd)				81.2	95.1	118.4	
HIGH PURITY OXYGEN/DIFFUSED AIR SUPPLY							
OXYGEN DEMAND							
- BOD APPLIED (1000 lbs/day)	19.6	31.4	28.2	38.3	55.5	61.0	
- TKN OXIDIZED (1000 lbs/day)	6.3	8.4	11.2	6.2	8.3	6.5	Basis; (TKN inf.-TKN eff.)
- OXYGEN DISSOLVED (1000 lbs/day)	5.1	6.8	10.5	2.0	2.6	4.1	Basis; (mgd * 7.0 mg/l * 8.34)/1000
- O2 FOR BOD APPLIED (1000 lbs/day)	23.6	37.7	33.9	46.0	66.6	73.2	Based on 1.2 LB O2 per 1 LB BOD applied.
- O2 FOR TKN (1000 lbs/day)	29.1	38.5	51.7	28.7	38.0	29.9	Based on 4.6 LB O2 per 1 LB NO3 formed.
- O2 DISSOLVED IN WW (1000 lbs/day)	5.1	6.8	10.5	2.0	2.6	4.1	
- CREDIT;NO3 USED FOR OXIDATION (1000lb/day)				10.5	13.0	7.6	Based on 2.86 lb O2 / lb NO3 removed
- TOTAL OXYGEN DEMAND (1000 lbs/day)	57.7	83.0	96.0	66.2	94.3	99.6	

CASE 2B - PARALLEL PLANT
EXISTING HPO SYSTEM PLUS NEW DIFFUSED AERATION REACTORS
W/ A TWO STAGE ANOXIC ZONE

ALT. 2B-B3

ITEMS	EXISTING 2-STEP HPO SYSTEM (STEP FEED) PHASE II (2008) ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	NEW SINGLE-STEP DIFF.AIR SYSTEM (STEP FEED) PHASE II (2008) ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
16. NITRIFICATION FINAL TANKS							
NITRIFICATION INFLUENT QUANTITIES (mgd)	87.2	116.8	179.3	33.8	45.2	69.5	
NUMBER OF TANKS	6	6	6	8	8	8	
TOTAL SURFACE AREA @ 68'x 247'	100776	100776	100776	134368	134368	134368	
AVERAGE WATER DEPTH (ft)	12	12	12	12	12	12	
TOTAL VOLUME (cf)	1209312	1209312	1209312	1612416	1612416	1612416	
- (mg)	9.05	9.05	9.05	12.06	12.06	12.06	
SURFACE LOADING (gpsfpd)	865	1159	1780	251	337	517	
SAFETY FACTOR a b							
-ISV (fph) 23.0 800	10.70	11.93	14.37	2.78	1.88	4.96	Study Memo B
-SOR BASED ON ISV (gpsfpd)	1921	2141	2580	499	337	890	
-CLARIFIER SAFETY FACTOR	2.22	1.85	1.45	1.99	1.00	1.72	
DETENTION TIME (hrs.)	2.49	1.86	1.21	8.57	6.40	4.17	
EFFLUENT WEIRS							
- LENGTH (ft.)	3888	3888	3888	5184	5184	5184	Based on 648' of wier per tank
- LOADING (gal/ft/day)	22426	30051	46127	6514	8729	13398	
RETURN SLUDGE							
- NUMBER OF RETURN SLUDGE PUMPS	8	8	8	10	10	10	
- CAPACITY, EACH PUMP (tanks 7-12/4-6, mgd)	7.56	7.56	7.56	7.56	7.56	7.56	
- NUMBER OF PUMPS OPERATING	6	6	6	8	8	8	
- FIRM CAPACITY, RETURN SLUDGE PUMPS (mgd)	45	45	45	60	60	60	
- RETURN SLUDGE FLOW (mgd)	20.1	20.0	20.1	20.0	29.0	21.9	
- % OF FIRM CAPACITY:	44.2	44.0	44.3	33.1	47.9	36.2	
NITRIFICATION STAGE EFFLUENT CHARACTERISTICS							
- BOD-5 (mg/l)	5.0	5.0	3.5	5.0	5.0	3.5	Study Memo B
(1000 lb/day) 1.33	3.6	4.8	5.2	1.4	1.9	2.0	peak day lbs/ann.avg = infl.load ratio
- TSS (mg/l)	10.9	11.0	10.1	10.0	12.4	7.0	Exist:based on solids prod./ D.A.:study memo B
(1000 lb/day) 1.66	7.9	10.7	15.1	2.8	4.7	4.0	peak day lbs/ann.avg = infl.load ratio
- TKN PERCENT REMOVAL	82.0	82.0	-	92.1	92.0	-	Study Memo B
- TKN (mg/L)	1.9	1.9	1.9	1.9	1.9	1.9	Peak value assume equal to max.month
(1000 lb/day)	1.4	1.8	2.8	0.5	0.7	1.1	
- NITRATE NITROGEN (mg/l)	12.1	10.7	7.5	4.3	4.4	2.3	
(1000 lbs/day)	8.8	10.5	11.2	1.2	1.7	1.3	HPO; MM & Peak = TN in - TKN out (AA; SM-B)
- PERCENT PHOS. REMOVED	0.8	0.9	2.0	17.1	18.5	33.7	Based on 1% of SS removed assumed as Phosphorus.
- PHOSPHORUS as P (1000 lb/day)	4.8	5.7	3.5	1.9	2.2	1.3	
* (mg/L)	6.6	5.9	2.3	6.6	5.9	2.3	

CASE 2B - PARALLEL PLANT
EXISTING HPO SYSTEM PLUS NEW DIFFUSED AERATION REACTORS
W/ A TWO STAGE ANOXIC ZONE

ITEMS	EXISTING 2-STEP HPO SYSTEM (STEP FEED) PHASE II (2008)			NEW SINGLE-STEP DIFF.AIR SYSTEM (STEP FEED) PHASE II (2008)			COMMENTS
	ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	
17. DENITRIFICATION FILTERS							
INFLUENT QUANTITIES							
- NITRIFICATION EFFLUENT FLOW (mgd)	121.0	162.1	248.8				
- EXCLUDING RECYCLE	96.0	128.6	220.8				
SEWAGE APPLIED TO DENITRIFICATION FILTERS							
- BOD-5 (1000 lb/day)	5.0	6.7	7.2				
(mg/L)	5.0	5.0	3.5				
- SUSPENDED SOLIDS (1000 lb/day)	10.7	15.4	19.1				
(mg/L)	10.6	11.4	9.2				
- TKN (1000 lb/day)	1.9	2.6	3.9				
(mg/L)	1.9	1.9	1.9				
- NITRATE NITROGEN (1000 lb/day)	10.0	12.1	12.6				
(mg/L)	9.9	9.0	6.0				
- PHOSPHORUS as P (1000 lb/day)	6.7	8.0	4.8				
(mg/L)	6.6	5.9	2.3				
NUMBER OF FILTERS							
- EXISTING	20	20	20				
- NEW	12	12	12				
- TOTAL	32	32	32				
TOTAL SURFACE AREA (sf)	33600	33600	33600				Based on 2.0 gpm/sf at inf.quan.w/o recycle
HYDRAULIC LOADING							
- ACTUAL INFLUENT BASIS (gpm/sf)	2.5	3.3	5.1				
- EXCLUDING RECYCLE (gpm/sf)	2.0	2.7	4.6				
DENITRIFICATION FILTERS EFFLUENT CHARACTERISTICS							
- BOD-5 (1000 lb/day)	2.0	2.7	3.0				
* (mg/L)	2.0	2.0	1.4				Eff BOD (mg/l)= 0.098+0.385*(BOD appl.(mg/l))
- SUSPENDED SOLIDS (1000 lb/day)	2.3	3.2	4.4				
* (mg/L)	2.3	2.4	2.1				Eff TSS (mg/l)= 1.038+0.117*(TSS appl.(mg/l))
- TKN (1000 lb/day)	1.5	2.0	3.0				
* (mg/L)	1.5	1.5	1.5				Eff TKN (mg/l)= 0.404+0.556*(TKN appl.(mg/l))
- NITRATE NITROGEN; NO3-N (1000 lb/day)	0.7	0.8	0.9				Based on 92% removal
* (mg/L)	0.7	0.6	0.4				
- PHOSPHORUS as P (1000 lb/day)	4.8	5.7	3.5				
* (mg/L)	4.7	4.2	1.7				

CASE 2B - PARALLEL PLANT
EXISTING HPO SYSTEM PLUS NEW DIFFUSED AERATION REACTORS
W/ A TWO STAGE ANOXIC ZONE

ITEMS		EXISTING 2-STEP HPO SYSTEM (STEP FEED) PHASE II (2008)			NEW SINGLE-STEP DIFF.AIR SYSTEM (STEP FEED) PHASE II (2008)			COMMENTS
		ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	
18. PLANT EFFLUENT								
SEWAGE QUANTITIES (mgd)		96.0	128.6	220.8				
PLANT EFFLUENT CHARACTERISTICS								
- BOD-5	(1000 lb/day)	1.6	2.2	2.7				
*	(mg/L)	2.0	2.0	1.4				
- SUSPENDED SOLIDS	(1000 lb/day)	1.8	2.5	3.9				
*	(mg/L)	2.3	2.4	2.1				
- NITROGEN as TN	(1000 lb/day)	1.7	2.2	3.5				
*	(mg/L)	2.2	2.1	1.9				
- PHOSPHORUS as P	(1000 lb/day)	3.8	4.5	3.1				
*	(mg/L)	4.7	4.2	1.7				

CASE 3

ULTIMATE TREATMENT

BASES OF DESIGN

120 MGD ANNUAL AVERAGE

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CASE 3 - HPWWTP ULTIMATE EXPANSION
EXISTING HPO SYSTEM USED FOR CARBONACEOUS STAGE
NEW DIFFUSED AERATION REACTORS USED FOR NITRIFICATION STAGE
HPO SYSTEM W/ STEP FEED <> DIFF.AERATION W/ PLUG FLOW

****** PHASE II (2008) ******

ITEMS	ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
	(120 MGD)			PEAK CONDITION BASED ON
1. BASIC DATA				SEPTEMBER 8, 1988
WASTEWATER LOADING RATIOS				
- FLOW	1.00	1.34	2.20	Study Memo B
- BOD5	1.00	1.45	1.44	Study Memo B
- TSS	1.00	1.35	1.90	Study Memo B
- NITROGEN	1.00	1.32	1.07	Study Memo B
- PHOSPHORUS	1.00	1.22	1.01	Study Memo B
PLANT INFLUENT FLOW (mgd)	120.0	160.8	264.0	
PLANT INFLUENT CHARACTERISTICS				
- BOD-5 (1000 LB/DAY)	264.2	383.1	379.7	
* (mg/L)	264.0	285.7	172.5	Study Memo B
- SUSPENDED SOLIDS (1000 LB/DAY)	203.2	274.3	386.8	
* (mg/L)	203.0	204.5	175.7	Study Memo B
- NITROGEN as TKN (1000 LB/DAY)	30.0	39.6	32.0	
* (mg/L)	30.0	29.6	14.5	Study Memo B
- PHOSPHORUS (1000 LB/DAY)	9.1	11.1	9.2	
* (mg/L)	9.1	8.3	4.2	Study Memo B
2.JUNCTION CHAMBER NO.1 (PREAERATION TANKS)				
JC1 INFLUENT SEWAGE QUANTITIES (MGD)	120.0	160.8	264.0	
NUMBER OF EXISTING TANKS @ 25' x 66'	2	2	2	
NUMBER OF NEW TANKS @ 30' x 66'	1	1	1	
@ 20' x 66'	1	1	1	
WATER DEPTH IN TANKS (FT.)	17.00	17.00	17.00	Downstream hydraulics
TOTAL VOLUME - CUBIC FT.	112200	112200	112200	
- MILLION GAL.	0.84	0.84	0.84	
DETENTION TIME (MINUTES)	10.1	7.5	4.6	
TOTAL BLOWER CAPACITY (SCFM)	11520	11520	11520	
AIR APPLIED				
- INFLUENT AND EFFLUENT CHANNELS (SCFM)	1150	1150	1150	
- PREAERATION TANKS (SCFM)	10370	10370	10370	
* cu.ft./gal	0.12	0.09	0.06	
* scfm/1000 cu.ft.	92	92	92	

CASE 3 - HPWWTP ULTIMATE EXPANSION
EXISTING HPO SYSTEM USED FOR CARBONACEOUS STAGE
NEW DIFFUSED AERATION REACTORS USED FOR NITRIFICATION STAGE
HPO SYSTEM W/ STEP FEED <> DIFF.AERATION W/ PLUG FLOW

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** ****** PHASE II (2008) ****** **

ITEMS	ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
3. SCREEN AND GRIT BUILDING No. 1				
INFLUENT SEWAGE QUANTITIES (mgd)	24.0	32.2	43.2	
MECHANICAL SEWAGE SCREENS				
- NUMBER OF SCREENS	2	2	2	
GRIT FACILITIES				
- NUMBER OF GRIT TANKS, TOTAL	2	2	2	
- WIDTH OF TANKS (ft.)	50	50	50	
- LENTGH OF TANKS (ft.)	50	50	50	
- TOTAL SURFACE AREA (sq.ft.)	5000	5000	5000	
4. SCREEN AND GRIT BUILDING No. 2				
INFLUENT SEWAGE QUANTITIES (mgd)	48.0	64.3	110.4	Same as Case 2A
MECHANICAL SEWAGE SCREENS				
- NUMBER OF SCREENS	2	2	2	
- WIDTH OF EACH SCREEN (ft.)	7.5	7.5	7.5	
- CLEAR BAR SPACING (inches)	0.38	0.38	0.38	
- SCREENING QUAN.,EACH SCREEN (cf/hr)	6.80	9.11	15.64	Each screen at 6.8 cu.ft./mg @ 0.38 spacing
GRIT FACILITIES				
- NUMBER OF GRIT TANKS, TOTAL	4	4	4	
, OPERATING	2	3	4	
- WIDTH OF TANKS (ft.)	45	45	45	
- LENTGH OF TANKS (ft.)	45	45	45	
- SURFACE AREA, EACH TANK (sq.ft.)	2025	2025	2025	
- TOTAL SURFACE AREA (sq.ft.)	4050	6075	8100	
- MIN.SURFACE AREA REQUIRED (sq.ft/mgd)	70	70	70	For 150 mesh grit removal
- SURFACE AREA (sq.ft./mgd)	84	94	73	
- SURFACE LOADING (gpsfpd)	11852	10584	13630	
- WEIR LOADING (mg/ft./day)	0.53	0.48	0.61	weir length = 45 ft. per tank.
- GRIT REMOVED (cu.ft./mg - dry basis)	2.23	3.35	3.35	Study Memo B
* (cu.ft./day - dry basis)	107	215	370	
* (1000lb/day - dry basis)	13	26	44	Dry basis at 120 lbs/cu.ft.
- WASHED GRIT ; PERCENT SOLIDS	75	75	75	
TONS/DAY (wet grit)	8.55	17.20	29.54	

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CASE 3 - HPWWTP ULTIMATE EXPANSION
EXISTING HPO SYSTEM USED FOR CARBONACEOUS STAGE
NEW DIFFUSED AERATION REACTORS USED FOR NITRIFICATION STAGE
HPO SYSTEM W/ STEP FEED <> DIFF.AERATION W/ PLUG FLOW

****** PHASE II (2008) ******

ITEMS	ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
5. SCREEN AND GRIT BUILDING No. 3				
INFLUENT SEWAGE QUANTITIES (mgd)	48.0	64.3	110.4	Same as Case 2A
MECHANICAL SEWAGE SCREENS				
- NUMBER OF SCREENS	3	3	3	2 operating, 1 standby
- WIDTH OF EACH SCREEN (ft.)	7.5	7.5	7.5	
- CLEAR BAR SPACING (inches)	0.38	0.38	0.38	
- SCREENING QUAN. (cu.ft./hr./scr)	6.80	9.11	15.64	Each screen at 6.8 cu.ft./mg @ 0.38 spacing
GRIT FACILITIES				
- NUMBER OF GRIT TANKS, TOTAL	4	4	4	
, OPERATING	2	3	4	
- WIDTH OF TANKS (ft.)	45	45	45	
- LENTGH OF TANKS (ft.)	45	45	45	
- SURFACE AREA, EACH TANK (sq.ft.)	2025	2025	2025	
- TOTAL SURFACE AREA (sq.ft.)	4050	6075	8100	
- SURFACE AREA (sq.ft./mgd)	84	94	73	
- SURFACE LOADING (gpsfpd)	11852	10584	13630	
- WEIR LOADING (mg/ft./day)	0.53	0.48	0.61	weir length = 45 ft. per tank.
- GRIT REMOVED (cu.ft./mg - dry basis)	2.23	3.35	3.35	Study Memo B
* (cu.ft./day - dry basis)	107	215	370	
* (1000 lbs./day - dry bas	13	26	44	Dry basis at 120 lbs/cu.ft.
- WASHED GRIT ; PERCENT SOLIDS	75	75	75	
TONS/DAY (wet grit)	8.55	17.20	29.54	
6. JUNCTION CHAMBER No. 2 AND METER VAULT No. 2				
INFLUENT SEWAGE QUANTITIES (mgd)	120.0	160.8	264.0	
FLOW BYPASSED TO CARB.TREATMENT (mgd)	N/A	N/A	0.0	
FLOW TO PRIMARY SEDIMENTATION TANKS (mgd)	120.0	160.8	264.0	
WEST PRIMARY SEDIMENTATION TANKS METER; MRC-1				
- % OF FLOW TO PRIM.TANKS	34.5	34.5	34.5	
- RATED CAPACITY (mgd)	80	80	80	
- FLOW @ PEAK COND. (mgd)	N/A	N/A	91.0	
EAST PRIMARY SEDIMENTATION TANKS METER; MRC-2				
- % OF FLOW TO PRIM.TANKS	65.5	65.5	65.5	
- RATED CAPACITY (mgd)	144	144	144	
- FLOW @ PEAK COND. (mgd)	N/A	N/A	173.0	
MAIN PUMPING STATION WET WELL METER; MRC-4				
- % OF FLOW TO M.P.S. WET WELL	N/A	N/A	0.0	
- RATED CAPACITY (mgd)	100	100	100	
- FLOW @ PEAK COND. (mgd)	N/A	N/A	0.0	

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CASE 3 - HPWWTP ULTIMATE EXPANSION
EXISTING HPO SYSTEM USED FOR CARBONACEOUS STAGE
NEW DIFFUSED AERATION REACTORS USED FOR NITRIFICATION STAGE
HPO SYSTEM W/ STEP FEED <> DIFF.AERATION W/ PLUG FLOW

****** PHASE II (2008) ******

ITEMS	ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
7. WEST PRIMARY SEDIMENTATION TANKS (No. 1-4)				
PRIMARY INFLUENT QUANTITIES (mgd)	41.4	55.4	91.0	
NUMBER OF TANKS	4	4	4	
AVERAGE WATER DEPTH (ft.)	13.1	13.1	13.1	Average value used.
TOTAL SURFACE AREA (sq.ft.)	25232	25232	25232	
TOTAL VOLUME (cu.ft.)	331044	331044	331044	
* (mg)	2.48	2.48	2.48	
SURFACE LOADING (gpsfpd)	1639	2197	3607	
DETENTION TIME (hrs)	1.44	1.07	0.65	
LENGTH OF WEIR (ft.)	718	718	718	
WEIR LOADING (gals/ft./day)	57638	77235	126804	
BOD LOADING (mg/l)	264.0	285.7	172.5	
* (1000 lbs./day)	91.1	132.2	131.0	
BOD REMOVAL (percent)	36.0	36.0	36.0	Study Memo B
* (1000 lbs./day)	32.8	47.6	47.2	
SUSPENDED SOLIDS LOADING (mg/l)	203.0	204.5	175.7	
* (1000 lbs./day)	70.1	94.6	133.4	
SUSPENDED SOLIDS REMOVAL (percent)	51.0	51.0	51.0	Study Memo B
* (1000 lbs./day)	35.7	48.3	68.0	
NITROGEN LOADING as TKN (mg/l)	30.0	29.6	14.5	
* (1000 lbs./day)	10.4	13.7	11.0	
NITROGEN REMOVAL AS TKN (percent)	20.0	20.0	20.0	Study Memo B
* (1000 lbs./day)	2.1	2.7	2.2	
PHOSPHORUS LOADING as P (mg/l)	9.1	8.3	4.2	
- LBS./DAY	3.14	3.83	3.17	
- IN PARTICULATE FORM (lbs./day) @ 25%	0.79	0.96	0.79	Based on 25 percent Phosphorus in part.form
- PART.PHOSPHORUS % REMOVAL	51	51	51	Identical to SS removal.
PHOSPHORUS REMOVAL as P (lbs./day)	0.40	0.49	0.40	
PRIMARY EFFLUENT CHARACTERISTICS				
- BOD-5 (1000 lbs/day)	58.3	84.6	83.8	
(mg/L)	169.1	183.0	110.4	
- SUSPENDED SOLIDS (1000 lbs/day)	34.3	46.4	65.4	
(mg/L)	99.5	100.3	86.1	
- NITROGEN AS TKN (1000 lbs/day)	8.3	10.9	8.8	
(mg/L)	24.0	23.7	11.6	
- PHOSPHORUS (1000 lbs/day)	2.7	3.3	2.8	
(mg/L)	7.9	7.2	3.6	

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CASE 3 - HPWWTP ULTIMATE EXPANSION
EXISTING HPO SYSTEM USED FOR CARBONACEOUS STAGE
NEW DIFFUSED AERATION REACTORS USED FOR NITRIFICATION STAGE
HPO SYSTEM W/ STEP FEED <> DIFF.AERATION W/ PLUG FLOW

****** PHASE II (2008) ******

ITEMS	ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
7. WEST PRIMARY SEDIMENTATION TANKS (No. 1-4, cont.)				
PRIMARY SLUDGE				
- 1000 LBS./DAY (dry solids)	35.7	48.3	68.0	
- PERCENT SOLIDS	5.0	5.0	5.0	Study Memo B
- GPM	57.8	78.0	110.0	
- PERCENT VOLATILE SOLIDS	79.4	79.4	79.4	Study Memo B
- VOLATILE SOLIDS (1000 lbs/day)	28.4	38.3	54.0	
PRIMARY SLUDGE PUMPS				
- NUMBER OF PUMPS	2	2	2	
- FIRM CAPACITY (gpm)	600	600	600	
- % OF FIRM CAPACITY	9.6	13.0	18.3	
8. EAST PRIMARY SEDIMENTATION TANKS (No.5-12)				
PRIMARY INFLUENT QUANTITIES (mgd)	78.6	105.4	173.0	
NUMBER OF TANKS	8	8	8	
AVERAGE WATER DEPTH (ft.)	13.1	13.1	13.1	Average value used.
TOTAL SURFACE AREA (sq.ft.)	47716	47716	47716	
TOTAL VOLUME (cu.ft.)	626034	626034	626034	
* (mg)	4.68	4.68	4.68	
SURFACE LOADING (gpsfpd)	1648	2208	3625	
DETENTION TIME (hrs.)	1.43	1.07	0.65	
LENGTH OF WEIR (ft.)	1364	1364	1364	2*length of wier 5-8
WEIR LOADING (gals/ft./day)	57638	77235	126804	
BOD LOADING (mg/l)	264.0	285.7	172.5	
* (1000 lbs./day)	173.3	251.2	249.0	
BOD REMOVAL (percent)	36.0	36.0	36.0	Study Memo B
* (1000 lbs./day)	62.4	90.4	89.6	
SUSPENDED SOLIDS LOADING (mg/l)	203.0	204.5	175.7	
* (1000 lbs./day)	133.2	179.8	253.6	
SUSPENDED SOLIDS REMOVAL (percent)	51.0	51.0	51.0	Study Memo B
* (1000 lbs./day)	67.9	91.7	129.3	
NITROGEN LOADING as TKN (mg/l)	30.0	29.6	14.5	
* (1000 lbs./day)	19.7	26.0	21.0	
NITROGEN REMOVAL AS TKN (percent)	20.0	20.0	20.0	Study Memo B
* (1000 lbs./day)	3.9	5.2	4.2	
PHOSPHORUS LOADING as P (mg/l)	9.1	8.3	4.2	
- LBS./DAY	5.97	7.29	6.03	
- IN PARTICULATE FORM (lbs./day)	1.5	1.8	1.5	Based on 25 percent Phosphorus in part.form
- PART.PHOSPHORUS % REMOVAL	51	51	51	Identical to SS removal.
PHOSPHORUS REMOVAL as P (lbs./day)	0.76	0.93	0.77	

CASE 3 - HPWWTP ULTIMATE EXPANSION
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NEW DIFFUSED AERATION REACTORS USED FOR NITRIFICATION STAGE
HPO SYSTEM W/ STEP FEED <> DIFF.AERATION W/ PLUG FLOW

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PHASE II (2008)

ITEMS		ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
8. EAST PRIMARY SEDIMENTATION TANKS (No.5-12, cont.)					
PRIMARY EFFLUENT CHARACTERISTICS					
- BOD-5	(1000 lbs/day)	110.9	160.8	159.3	
	(mg/L)	169.1	183.0	110.4	
- SUSPENDED SOLIDS	(1000 lbs/day)	65.3	88.1	124.3	
	(mg/L)	99.5	100.3	86.1	
- NITROGEN AS TKN	(1000 lbs/day)	15.8	20.8	16.8	
	(mg/L)	24.0	23.7	11.6	
- PHOSPHORUS	(1000 lbs/day)	5.2	6.4	5.3	
	(mg/L)	7.9	7.2	3.6	
PRIMARY SLUDGE					
- 1000 LBS./DAY (dry solids)		67.9	91.7	129.3	
- PERCENT SOLIDS		5.0	5.0	5.0	Study Memo B
- GPM		109.8	148.2	209.1	
- PERCENT VOLATILE SOLIDS		79.4	79.4	79.4	Study Memo B
- VOLATILE SOLIDS (1000 lbs/day)		53.9	72.8	102.7	
9. TOTAL PRIMARY EFFLUENT CHARACTERISTICS					
PRIMARY EFFLUENT (MGD)		120.0	160.8	264.0	
PRIMARY EFFLUENT CHARACTERISTICS					
- BOD-5	(1000 lbs/day)	169.2	245.4	243.2	
	(mg/L)	169.1	183.0	110.4	
- SUSPENDED SOLIDS	(1000 lbs/day)	99.6	134.5	189.6	
	(mg/L)	99.5	100.3	86.1	
- NITROGEN AS TKN	(1000 lbs/day)	24.0	31.7	25.6	
	(mg/L)	24.0	23.7	11.6	
- PHOSPHORUS	(1000 lbs/day)	8.0	9.7	8.0	
	(mg/L)	7.9	7.2	3.6	
10. RECYCLE FLOW					
RECYCLE FLOW (@ 26% OF INFLUENT) (MGD)		31.2	41.8	28.0	Peak at 2 backwashes + 4 MGD
CHARACTERISTICS					
- BOD-5	(1000 lbs/day)	2.4	3.2	2.1	
	(mg/L)	9.1	9.1	9.1	Based on Study Memo B
- SUSPENDED SOLIDS	(1000 lbs/day)	84.2	112.8	75.5	
	(mg/L)	323.4	323.4	323.4	Based on Study Memo B
- NITROGEN AS TKN	(1000 lbs/day)	6.3	8.5	5.7	
	(mg/L)	24.3	24.3	24.3	Based on Study Memo B
- PHOSPHORUS	(1000 lbs/day)	N/A	N/A	N/A	
	(mg/L)	N/A	N/A	N/A	

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NEW DIFFUSED AERATION REACTORS USED FOR NITRIFICATION STAGE
HPO SYSTEM W/ STEP FEED <> DIFF.AERATION W/ PLUG FLOW

****** PHASE II (2008) ******

ITEMS	ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
11. PRIMARY BYPASS FLOW				
BYPASSED FLOW (mgd)	N/A	N/A	0.0	
CHARACTERISTICS OF BYPASSED FLOW				
- BOD-5 (1000 lbs/day)	N/A	N/A	0.0	
(mg/L)	N/A	N/A	172.5	
- SUSPENDED SOLIDS (1000 lbs/day)	N/A	N/A	0.0	
(mg/L)	N/A	N/A	175.7	
- NITROGEN AS TKN (1000 lbs/day)	N/A	N/A	0.0	
(mg/L)	N/A	N/A	14.5	
- PHOSPHORUS (1000 lbs/day)	N/A	N/A	0.0	
(mg/L)	N/A	N/A	4.2	
12. MAIN PUMPING STATION				
EFFLUENT FLOW RATE (mgd)	151.2	202.6	292.0	
MAIN SEWAGE PUMPS				
- # VARIABLE SPEED @ 50 MGD	3	3	3	
- # CONSTANT SPEED @ 50 MGD	4	4	4	
- TOTAL INSTALLED CAPACITY (MGD)	350	350	350	
- FIRM CAPACITY (MGD)	300	300	300	
CHARACTERISTICS OF PRIMARY & RECYCLED FLOW				
- BOD-5 (1000 lbs/day)	171.6	248.5	245.3	
(mg/L)	136.1	147.1	100.7	
- SUSPENDED SOLIDS (1000 lbs/day)	183.8	247.2	265.2	
(mg/L)	145.7	146.3	108.9	
- NITROGEN AS TKN (1000 lbs/day)	30.4	40.2	31.3	
(mg/L)	24.1	23.8	12.9	
- PHOSPHORUS (1000 lbs/day)	8.0	9.7	8.0	
(mg/L)	6.3	5.7	3.3	
13. CARBONACEOUS REACTORS				
CARBONACEOUS INFLUENT QUANTITIES				
- MAIN PUMPING STATION FLOW (mgd)	151.2	202.6	292.0	
CHARACTERISITICS APPLIED TO REACTORS				
- BOD-5 (1000 lbs/day)	171.6	248.5	245.3	
(mg/L)	136.1	147.1	100.7	
- SUSPENDED SOLIDS (1000 lbs/day)	183.8	247.2	265.2	
(mg/L)	145.7	146.3	108.9	
- NITROGEN TKN (1000 lbs/day)	30.4	40.2	31.3	
(mg/L)	24.1	23.8	12.9	
- PHOSPHORUS (1000 lbs/day)	8.0	9.7	8.0	
(mg/L)	6.3	5.7	3.3	

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NEW DIFFUSED AERATION REACTORS USED FOR NITRIFICATION STAGE
HPO SYSTEM W/ STEP FEED <> DIFF.AERATION W/ PLUG FLOW

PHASE II (2008)

ITEMS	ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
13. CARBONACEOUS REACTORS (cont.)				
NUMBER OF REACTORS	4	5	6	
AVERAGE WATER DEPTH (ft.)	14.0	14.0	14.0	
AVERAGE VOLUME PER REACTOR (cf)	169400	169400	169400	
AVERAGE VOLUME PER REACTOR (mg)	1.27	1.27	1.27	
NUMBER OF STAGES, EACH TANK	4	4	4	
BOD-a/1000 CF.	253	293	241	
TOTAL VOLUME (CF)	677600	847000	1016400	
- (MG)	5.07	6.34	7.60	
DETENTION TIME (hrs.)	0.80	0.75	0.62	
SOLIDS RETENTION TIME, SRT (DAYS)	0.80	0.60	0.40	
TOTAL CARBONACEOUS SOLIDS PRODUCED				
- SOLIDS PRODUCED/TSS APPLIED	1.00	1.20	1.20	Based on Study Memo B
- TSS APPLIED (1000 LB/DAY)	183.8	247.2	265.2	
- SOLIDS PRODUCED (1000 LB/DAY)	183.8	296.7	318.2	
MIXED LIQUOR				
- AVERAGE MLSS (mg/L)	3478	3369	2007	MLSS = SP * SRT / (VOL * 8.34)
- LAST PASS MLSS (mg/l)	1968	1824	711	(4*MLSS avg./(3+(R+1)/R)
RETURN SLUDGE				
- RETURN RATIO	0.33	0.30	0.14	Input value
- RETURN CONCENTRATION (mg/L)	8007	8006	5898	Xr=((R+1)/R)*MLSS lp
- RETURN FLOW (MGD)	49.3	59.8	40.0	Based on Q return = Q mps x R (40 mgd min.)
CARBONACEOUS WASTE ACTIVATED SLUDGE				
-SOLIDS PRODUCED (1000 lbs/day)	183.8	296.7	318.2	
-EFFLUENT SUSPENDED SOLIDS (1000lbs/day)	20.2	27.2	38.4	
-CONCENTRATION OF R.A.S.(mg/l)	8007	8006	5898	
-WAS (1000 lbs/day)	163.6	269.5	279.8	
(mgd)	2.4	4.0	5.7	
(gpm)	1701	2803	3950	
HIGH PURITY/DIFFUSED OXYGEN SUPPLY				Max.Month represents max demand
OXYGEN DEMAND				
- BOD APPLIED (1000 lbs/day)	171.6	248.5	N/A	
- TKN OXIDIZED (1000 lbs/day)	5.5	3.7	N/A	Basis; (TKN Inf.-TKN eff.)-(0.07*WAS)
- OXYGEN DISSOLVED (1000 lbs/day)	8.8	11.8	N/A	Basis; (mgd * 7.0 mg/l * 8.34)/1000
- 02 FOR BOD APPLIED (1000 lbs/day)	171.58	248.53	N/A	Based on 1 LB 02 per 1 LB BOD applied.
- 02 FOR TKN (1000 lbs/day)	25.53	16.79	N/A	Based on 4.6 LB 02 per 1 LB N03 formed.
- 02 DISSOLVED IN WW (1000 lbs/day)	8.8	11.8	N/A	
- TOTAL OXYGEN DEMAND (1000 lbs/day)	205.9	277.1	N/A	

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****** PHASE II (2008) ******

ITEMS			ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
14. CARBONACEOUS STAGE FINAL TANKS						
CARBONACEOUS INFLUENT QUANTITIES (mgd)			151.2	202.6	292.0	
NUMBER OF TANKS			12	12	12	
TOTAL SURFACE AREA @ 68' x 247' PER TANK			201552	201552	201552	
AVERAGE WATER DEPTH (ft.)			12.0	12.0	12.0	
TOTAL VOLUME (cf)			2418624	2418624	2418624	
- (mg)			18.09	18.09	18.09	
SURFACE OVERFLOW RATE (gpsfpd)			750	1005	1449	
SAFETY FACTOR	a	b				
-ISV (fph)	23.0	700	5.80	6.42	13.99	Study Memo B
-SOR BASED ON ISV (gpsfpd)			1041	1152	2511	
-CLARIFIER SAFETY FACTOR			1.39	1.15	1.73	
DETENTION TIME (hrs.)			2.87	2.14	1.49	
CARBONACEOUS STAGE EFFLUENT CHARACTERISTICS						
		a				
- BOD-5 (mg/l)			27.0	32.2	20.1	Median BOD5 = 27.0 mg/l ann.avg.
(1000 lb/day)		1.60	34.0	54.5	48.9	Max.mo. lbs/ann.avg. lbs = 1.60 peak day lbs/ann.av = Infl.load ratio
- TSS (mg/l)			16.0	16.1	15.8	Median TSS = 16.0 mg/l ann.avg.
(1000 lbs/day)		1.35	20.2	27.2	38.4	Max.mo. lbs/ann.avg. lbs = 1.35 peak day lbs/ann.av = Infl.load ratio
- TKN PERCENT REMOVAL			56.0	56.0	26.9	Study Memo B
- TKN (mg/l)			10.6	10.5	9.4	
(1000 lbs/day)			13.4	17.7	22.9	
- NO3-N (mg/l)			7.0	6.2	0.0	
(1000 lbs/day)			5.5	3.7	0.0	TKN in - TKN out - (0.07*WAS)
- PERCENT PHOS. REMOVED			20.6	22.7	28.2	Based on 1% of TSS removed
- PHOSPHORUS as P (1000 lb/day)			6.3	7.5	5.8	
* (mg/L)			5.0	4.4	2.4	

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****** PHASE II (2008) ******

ITEMS		ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
15. NITRIFICATION REACTORS					Converted Aerobic Digestion tanks
NITRIFICATION INFLUENT QUANTITIES (mgd)		151.2	202.6	292.0	
SEWAGE APPLIED TO NITRIFICATION STAGE					
- BOD-5	(1000 lb/day)	34.0	54.5	48.9	
	(mg/L)	27.0	32.2	20.1	
- SUSPENDED SOLIDS	(1000 lb/day)	20.2	27.2	38.4	
	(mg/L)	16.0	16.1	15.8	
- TKN	(1000 lb/day)	13.4	17.7	22.9	
	(mg/L)	10.6	10.5	9.4	
- NO3-N	(1000 lbs/day)	5.5	3.7	0.0	
	(mg/l)	7.0	6.2	0.0	
- PHOSPHORUS as P	(1000 lb/day)	6.3	7.5	5.8	
	(mg/L)	5.0	4.4	2.4	
NUMBER OF REACTORS		4	4	4	
AVERAGE WATER DEPTH (ft.)		18	18	18	
AVERAGE VOLUME PER REACTOR (cf)		283405	283405	283405	
AVERAGE VOLUME PER REACTOR (mg)		2.12	2.12	2.12	
NUMBER OF STAGES, EACH TANK		6	6	6	
TOTAL VOLUME (cf)		1133620	1133620	1133620	
(mg)		8.48	8.48	8.48	
BOD-a/1000 CF.		30	48	43	
DETENTION TIME (hrs.)		1.35	1.00	0.70	
SOLIDS RETENTION TIME - SRT (days)		8.0	6.0	4.0	
TOTAL NITRIFICATION SOLIDS PRODUCTION					
- SOLIDS PRODUCED/TSS APPLIED		0.68	0.68	0.68	
- TSS APPLIED (1000 lb/day)		20.2	27.2	38.4	
- SOLIDS PRODUCED (1000 lb/day)		13.7	18.5	26.1	
MIXED LIQUOR					
- AVERAGE MLSS (mg/L)		1552	1571	1477	MLSS = SP * SRT / (VOL * 8.34)
- LAST PASS MLSS (mg/l)		1552	1571	1477	MLSS av = MLSS lp, plug flow
RETURN SLUDGE					
- RETURN RATIO		0.24	0.24	0.23	Input value
- RETURN CONCENTRATION (mg/L)		8019	8012	8014	Xr=((R+1)/R)*MLSS lp
- RETURN FLOW (mgd)		36.3	49.4	66.0	Q =Q mpsxR -(D.A.operating pts.assumed)
WASTE ACTIVATED SLUDGE					
- WAS (1000 lbs/day)		0.0	0.0	0.0	

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****** PHASE II (2008) ******

ITEMS	ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
15. NITRIFICATION REACTORS (cont.)				
HIGH PURITY OXYGEN/DIFFUSED AIR SUPPLY				Max.Month represents max demand
OXYGEN DEMAND				
- BOD APPLIED (1000 lbs/day)	34.0	54.5	N/A	
- TKN OXIDIZED (1000 lbs/day)	11.0	14.5	N/A	Basis; (TKN Inf.-TKN eff.)
- OXYGEN DISSOLVED (1000 lbs/day)	8.8	11.8	N/A	Basis; (mgd * 7.0 mg/l * 8.34)/1000
- 02 FOR BOD APPLIED (1000 lbs/day)	40.9	65.4	N/A	Based on 1.2 LB 02 per 1 LB BOD applied.
- 02 FOR TKN (1000 lbs/day)	50.4	66.7	N/A	Based on 4.6 LB 02 per 1 LB NO3 formed.
- 02 DISSOLVED IN WW (1000 lbs/day)	8.8	11.8	N/A	
- TOTAL OXYGEN DEMAND (1000 lbs/day)	100.1	143.9	N/A	
16. NITRIFICATION FINAL TANKS (NEW)				
NITRIFICATION INFLUENT QUANTITIES (mgd)	151.2	202.6	292.0	
NUMBER OF TANKS	12	12	12	
TOTAL SURFACE AREA @ 68'x 247'	201552	201552	201552	
AVERAGE WATER DEPTH (ft)	12	12	12	
TOTAL VOLUME (cf)	2418624	2418624	2418624	
- (mg)	18.09	18.09	18.09	
SURFACE LOADING (gpsfpd)	750	1005	1449	
SAFETY FACTOR a b				
-ISV (fph) 23.0 800	6.65	6.54	7.06	Study Memo B
-SOR BASED ON ISV (gpsfpd)	1193	1175	1267	
-CLARIFIER SAFETY FACTOR	1.59	1.17	0.87	
DETENTION TIME (hrs.)	2.87	2.14	1.49	
EFFLUENT WEIRS				
- LENGTH (ft.)	7776	7776	7776	Based on 648' of wier per tank
- LOADING (gal/ft/day)	19444	26056	37551	
NITRIFICATION STAGE EFFLUENT CHARACTERISTICS				
- BOD-5 (mg/l) a	5.0	5.0	3.7	Median BOD5 = 5.0 mg/l ann.avg.
(1000 lb/day) 1.33	6.3	8.4	9.1	Max.mo. lbs/ann.avg. lbs = 1.33 peak day lbs/ann.av = infl.load ratio
- TSS (mg/l)	10.9	11.0	10.7	
(1000 lb/day)	13.7	18.5	26.1	Based on solids produced
- TKN PERCENT REMOVAL	82.0	82.0	-	Study Memo B
- TKN (mg/L)	1.9	1.9	1.9	Peak cond. assume same conc. as max.month
(1000 lb/day)	2.4	3.2	4.6	
- NITRATE NITROGEN (mg/l)	12.1	10.7	7.5	Study Memo B for ann.avg. data
(1000 lbs/day)	15.3	18.2	18.3	Max.Mo & Peak data; TN In - TKN out
- PHOSPHORUS as P (1000 lb/day)	6.3	7.5	5.8	Same as Nitrification Influent
* (mg/L)	5.0	4.4	2.4	

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** ****** PHASE II (2008) ****** **

ITEMS	ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
17. DENITRIFICATION FILTERS				
INFLUENT QUANTITIES				
- NITRIFICATION EFFLUENT FLOW (mgd)	151.2	202.6	292.0	
- EXCLUDING RECYCLE	120.0	160.8	264.0	
SEWAGE APPLIED TO DENITRIFICATION FILTERS				
- BOD-5 (1000 lb/day)	6.3	8.4	9.1	
(mg/L)	5.0	5.0	3.7	
- SUSPENDED SOLIDS (1000 lb/day)	13.7	18.5	26.1	
(mg/L)	10.9	11.0	10.7	
- TKN (1000 lb/day)	2.4	3.2	4.6	
(mg/L)	1.9	1.9	1.9	
- NITRATE NITROGEN (1000 lb/day)	15.3	18.2	18.3	
(mg/L)	12.1	10.7	7.5	
- PHOSPHORUS as P (1000 lb/day)	6.3	7.5	5.8	
(mg/L)	5.0	4.4	2.4	
NUMBER OF FILTERS				
- EXISTING	20	20	20	
- NEW	12	12	12	
- TOTAL	32	32	32	
TOTAL SURFACE AREA (sf)	33600	33600	33600	Based on 2.0 gpm/sf at Inf.quan.w/o recycle
HYDRAULIC LOADING				
- ACTUAL INFLUENT BASIS (gpm/sf)	3.1	4.2	6.0	
- EXCLUDING RECYCLE (gpm/sf)	2.0	3.3	5.5	
DENITRIFICATION FILTERS EFFLUENT CHARACTERISTICS				
- BOD-5 (1000 lb/day)	2.6	3.4	3.7	
* (mg/L)	2.0	2.0	1.5	Eff.BOD(mg/l)= 0.098+0.385*(BOD appl.(mg/l))
- SUSPENDED SOLIDS (1000 lb/day)	2.9	3.9	5.6	
* (mg/L)	2.3	2.3	2.3	Eff.TSS(mg/l)= 1.038+0.117*(TSS appl.(mg/l))
- TKN (1000 lb/day)	1.8	2.5	3.5	
* (mg/L)	1.5	1.5	1.5	Eff.TKN(mg/l)= 0.404+0.556*(TKN appl.(mg/l))
- NITRATE NITROGEN; NO3-N (1000 lb/day)	1.2	1.5	1.5	Based on 92% removal
* (mg/L)	1.0	0.9	0.6	
- PHOSPHORUS as P (1000 lb/day)	6.3	7.5	5.7	
* (mg/L)	5.0	4.4	2.3	

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** ****** PHASE II (2008) ****** **

ITEMS		ANNUAL AVERAGE	MAXIMUM MONTHLY	PEAK COND.	COMMENTS
18. PLANT EFFLUENT					
SEWAGE QUANTITIES (mgd)		120.0	160.8	264.0	
PLANT EFFLUENT CHARACTERISTICS					
- BOD-5	(1000 lb/day)	2.0	2.7	3.4	
	* (mg/L)	2.0	2.0	1.5	
- SUSPENDED SOLIDS	(1000 lb/day)	2.3	3.1	5.0	
	* (mg/L)	2.3	2.3	2.3	
- NITROGEN as TN	(1000 lb/day)	2.4	3.1	4.5	
	* (mg/L)	2.4	2.3	2.1	
- PHOSPHORUS as P	(1000 lb/day)	5.0	5.9	5.2	
	* (mg/L)	5.0	4.4	2.3	