Final Phase 2 Report

Lahaina WWRF Process Study

Steady State Process Modeling and Alternatives Evaluation

Prepared for

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September 2005

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Executive Summary

This document represents Phase 2 of a two-part process study of the Lahaina Wastewater Reclamation Facility (Lahaina WWRF). Phase 1 of the study involved a review of the existing facilities, setup and calibration of a steady-state process model, and preliminary screening of various process alternatives. The objective of Phase 2 was to produce a recommended alternative based on process and hydraulic modeling results, and develop capital costs for improvements and modifications associated with the modeled alternatives. In addition, operating and maintenance and total (on a Net Present Value basis) costs for each of the screened alternatives were also developed. Phase 1 of this process study developed a preliminary list of eight candidate alternatives. Through a screening process based on weighted scores and various evaluation criteria, six alternatives were carried forward for further evaluation in Phase 2 of the study. These six alternatives were modeled using the steady-state model developed in Phase 1. The six alternatives include:

- Alternative 1 – Status Quo (the "do nothing" alternative)
- Alternative 2 – Operational Improvements Only
- Alternative 3 – Restore the 1975 Plant to Original Design
- Alternative 4 – Install Membrane Bioreactors (MBRs) in Portion of 1975 Plant
- Alternative 5 – Use 1975 Plant with Modifications to Provide Parallel Nitrogen Removal
- Alternative 7 – Demolish 1975 Plant and Expand 1985 Plant

The methodology used to model each of the six alternatives was to increase influent plant flow to the average dry weather (ADW) flows of 9- and 12-mgd, or until the design criteria of any one unit process in the 1985 and 1975 plant was exceeded, thus establishing maximum allowable flow through each plant. The ADW capacity of the six, modeled alternatives are shown in Table ES- 1.

TABLE ES- 1

ADW Flow Capacity of Modeled Alternatives
Lahaina Phase 2 Process Study

Alternative	ADW Capacity (mgd)		
	1985 Plant	1975 Plant	Total
1 – Status Quo (Do Nothing)	4.2	-	4.2
2 – Operational Improvements Only	6.7	-	6.7
3 – Restore 1975 Plant to Original Design	5.9	3.1	9.0
4 – Install MBRs in Portion of 1975 Plant	4.6	7.4	12.0
5 – Restore 1975 Plant with Nitrification Capability	5.9	3.1	9.0
7 – Demolish 1975 Plant and Expand 1985 Plant	5.5	6.5[(a)]	12.0

(a) Represents flow through the expanded plant located in current 1975 plant location.

(b) Note: The varying capacity of the 1985 plant is a result of operation at different SRTs and modes (Step Feed vs. Plug flow). They range between the minimum SRT of 5 days for Alterative 2 to the current operational SRT of 11.3 days. The SRT of the 1985 plant was varied to meet the capacity needs based on a 5 day SRT in the 1975 plant (when included).

Table ES- 2 contains the major improvements/additions required for each of the six, modeled alternatives to achieve the capacities shown in Table ES- 1. Alternatives 4 and 7 could also be constructed to only achieve a total plant capacity of 9-mgd. As a result, Table ES- 2 also includes improvements and costs associated with Alternatives 4 and 7 to achieve 9-mgd of capacity.

TABLE ES- 2

Improvements/Additions Required For Modeled Alternatives
Lahaina Phase 2 Process Study

Alternative	Improvements/Additions	Capital Cost[(1,2,3,4)]
1 – Status Quo (Do Nothing)	Electrical system improvements only	$50,000
2 – Operational Improvements Only	New thickening facility	$5.45M
3 – Restore 1975 Plant to Original Design	Refurbishment of 1975 plant transfer pump station	$15.25M
	New 75-ft diameter secondary clarifier in 1985 plant	
	New fine bubble aeration and blower system in 1975 plant	
	Refurbishment of 1975 secondary clarifier and sludge pumping system	
	New GBT WAS thickening system	
4 – Install MBRs in Portion of 1975 Plant	New MBR system located in 1975 plant	$76.5M

TABLE ES- 2

Improvements/Additions Required For Modeled Alternatives
Lahaina Phase 2 Process Study

Alternative	Improvements/Additions	Capital Cost(1,2,3,4)
	secondary clarifiers	($54.5M)
	New 75-ft diameter secondary clarifier in 1985 plant	
	New GBT WAS thickening system	
5 – Restore 1975 Plant with Nitrification Capability	New 75-ft diameter secondary clarifier in 1985 plant	$14.75M
	New fine bubble aeration and blower system in 1975 plant	
	New interior walls and nitrified recycle pumping system in the 1975 plant aeration basin	
	Refurbishment of 1975 secondary clarifier and sludge pumping system	
	New GBT WAS thickening system	
7 – Demolish 1975 Plant and Expand 1985 Plant	New 75-ft diameter clarifier in the 1985 plant	$59.25M ($45.25M)
	Demolition of 1975 plant	
	New 3.5 MG MLE aeration basin	
	Three new 80-ft diameter secondary clarifiers in 1975 plant location	
	New filtration system	

(1) 20% construction contingency; 10% engineering; 10% SDC, Commissioning, and Startup.
(2) Costs in parentheses () represent costs associated with achieving 9-mgd of capacity.
(3) Costs are in millions.
(4) Includes electrical system upgrades.

The hydraulics of Alternatives 3, 4, and 7 were evaluated using CH2M HILL's proprietary hydraulic model HYDRO. Alternative 5 is hydraulically similar to Alternative 3 and, as a result, was not modeled. Alternatives 1 and 2 were not modeled because neither of these two alternatives provides capacity to ADW flows of 9- or 12-mgd. As shown in Table ES- 1, Alternatives 3 and 5 provide a maximum ADW capacity of 9-mgd. However, the hydraulic profiles for these two alternatives were still evaluated at the ADW flow of 12-mgd and the peak of 26.4-mgd.

The intent of the hydraulic modeling was to determine if water surface elevations exceeded tops of walls at the ADW flow conditions of 9- and 12-mgd, and at the respective peak flow conditions of 19.8- and 26.4-mgd. Flow splits were similar to those shown in Table ES- 1. Hydraulic modeling results indicate that Alternatives 3, 4, 5, and 7 can hydraulically pass, with several small improvements, ADW flows of 9- and 12-mgd, and the 9-mgd peak of 19.8-mgd without overtopping walls. At the 12-mgd peak flow of 26.4-mgd the water

surface overtops the walls of the influent structure in all alternatives and overtops the walls of the 1975 CCBs in Alternative 4.

Based on the results of work conducted in Phase 2 of this study it is recommended that Alternative 4 be carried forward for further evaluation if 12-mgd of ADW capacity is required. This alternative is recommended over Alternative 7, even though the cost is higher, as a result of the flexibility it gives plant operations for future expansion. Alternative 7 uses practically the entire available plant site, making future expansion difficult. Refer to the report conclusions for a more detailed discussion. If only 9-mgd of ADW capacity is required, then Alternative 7 is recommended for future expansion needs.

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1 Background

The Lahaina Wastewater Reclamation Facility (Lahaina WWRF) is one of three wastewater treatment and reclamation facilities owned and operated on the island of Maui by the County of Maui, Department of Public Works and Environmental Management, Wastewater Reclamation Division. A process evaluation of this facility was conducted to develop a long-term process and capacity improvement "roadmap" and to achieve other objectives as described below. The evaluation was conducted in two major phases. Phase 1 involved review of existing facilities and information, setup and calibration of a steady-state process model, and preliminary screening of various process alternatives. Phase 2 involved development and evaluation of screened alternatives, including process and equipment sizing, hydraulic profiling, and capital and operating cost estimation.

This report describes Phase 2 of the process study.

1.1 Lahaina WWRF Phase 1 Summary

The Phase 1 report resulted in the following:

- A detailed sampling schedule was developed to help collect samples to calibrate the process model to be used as part of this process study.
- A steady-state process model was developed and calibrated.
- The installed treatment capacity of the 1975 plant was determined to be 3.0-mgd at ADW. The limiting element was the transfer pumps. Assuming that these could be upgraded relatively easily then the treatment capacity becomes 4.0-mgd at ADW (limited by the aeration basins and secondary clarifiers). The treatment capacity of the 1985 plant at ADW is 5.5-mgd, limited by the grit basins.
- Eight preliminary alternatives for future expansion were developed and evaluated. From the eight alternatives, six were carried forward for further evaluation in Phase 2. The two alternatives that were eliminated (alternatives 6 and 8) contained the lowest evaluation scores and, as a result, further analysis was not recommended.

1.2 Phase 2 Objectives

The objective of the Phase 2 analysis was to produce a recommended alternative from the list of alternatives developed in Phase 1. To achieve this goal three tasks associated with the Phase 2 analysis were conducted. An intermediate review of the Phase 2 results was conducted with Maui staff. As a result of this meeting it was decided to primarily focus on options 2, 3 and 5 for achieving the needed capacity improvements. This focus resulted in the decision to do a more comprehensive analysis of Options 2 and 3, while summarizing the results to date for the other alternatives. The goals of the phase of the project were to:

- Utilize the process model developed in Phase 1 to model the six alternatives selected in Phase 1 for further evaluation.
- Utilize results generated from the process model and plant as-builts to perform a hydraulic analysis of the alternatives. The hydraulic analysis is to be conducted through the use of software proprietary to CH2M HILL.
- Based on the results of the process and hydraulic modeling develop capital costs associated with each of the alternatives.

2 Alternatives Sizing and Development

Two models were used to help determine which of the six alternatives would be recommended as the preferred alternative for future expansion at the Lahaina WWRF. The first model is the process model, Pro2D, developed in Phase 1. The second is the hydraulic model HYDRO

2.1 Process Modeling

The process model developed and calibrated during Task 1 was used to model the six alternatives selected in Task 1 for further evaluation. The key elements and process modifications associated with the modeling of each of the alternatives are described below.

2.1.1 Alternative 1: Status Quo

This is the "do nothing" alternative. No operational, capital improvements or modifications to the 1975 or 1985 plants are made.

2.1.2 Alternative 2: Operational Improvements Only

This alternative would involve operational improvements without any major capital improvements to increase plant performance. Improvements are made only to the 1985 plant and not the 1975 plant. The major components of this alternative include:

- Move from plug flow to step-feed operation of the flexible (FAB) and conventional (CAB) aeration basins in the 1985 plant.
- Operate at a lower SRT in the secondary clarifiers.

2.1.3 Alternative 3: Restore 1975 Plant to Original Design

This alternative involves restoring/rehabilitating most of the 1975 plant to it's original design. Significant modifications include:

- Rehab or upgrade transfer pump station to provide the needed capacity.
- Restore aeration basins, secondary clarifiers, RAS/WAS pump station, and chlorine contact chambers to 1975 design.
- Expand/upgrade 1985 plant components as needed.

2.1.4 Alternative 4: Install Membrane Bioreactors (MBRs) in Portion of 1975 Plant

This alternative involves retrofitting membrane bioreactors (MBRs) in a portion of the 1975 plant and includes nitrification/denitrification capabilities. Significant modifications include:

- Rehab or upgrade transfer pump station to provide needed capacity, or provide capability to gravity to 1975 Plant from influent box.
- Retrofit MBRs in 1975 secondary clarifiers. Provide diffused aeration and internal recycles for N-removal as needed.
- Use 1975 CCB in parallel with UV.
- Convert 1975 aeration basin to reclaimed water storage.
- Expand/upgrade 1985 plant components as needed.

2.1.5 Alternative 5: Use 1975 Plant with Modifications to Provide Parallel Nitrogen Removal

This alternative involves modifying/upgrading the 1975 plant to provide nitrogen removal in parallel with the 1985 plant. Significant modifications include:

- Rehab or upgrade transfer pump station to provide needed capacity.
- Retrofit 1975 aeration basin with baffles, diffused aeration, and internal recycles or step feed for N-removal as needed.
- Use 1975 CCB in parallel with UV.
- Expand/upgrade 1985 plant components as needed.

2.1.6 Alternative 7: Demolish 1975 Plant, Capital Improvements to 1985 Plant

This alternative would completely abandon and demolish the currently idle 1975 plant and expand the 1985 plant to provide the desired capacity.

2.1.7 Modeling Basis

The process modeling was based on the data developed during Task 1. Plant treatment capacity is normally modeled based on the maximum month flows and loads to the treatment plant, rather than the average. This is necessary since the bioreactors will normally equilibrate with the higher loads over a month period and thus represent the worst case-operating scenario. Since this data was not available the maximum month raw sewage flows and loads were estimated as shown in Table 1.

TABLE 1

Estimated Maximum Month Flows and Loads
Lahaina Phase 2 Process Study

	9 mgd ADW Flow	12 mgd ADW Flow
Maximum Month Flow, mgd	13.5	18.0
$CBOD_5$, mg/L	140	
TSS, mg/L	149	
TKN, mg N/L	23	

TABLE 1

Estimated Maximum Month Flows and Loads
Lahaina Phase 2 Process Study

	9 mgd ADW Flow	12 mgd ADW Flow
Ammonia, mg N/L	14	
Total Phosphorus, mg P/L	4	
Alkalinity, mg/L as $CaCO_3$	167	

Notes: The concentrations are the same for both maximum month flow conditions

The maximum month flow data is based on an estimated 1.5 peaking factor as compared to the average dry weather flow. The 1.5 peaking factor was chosen based on the flow data given on the Brown & Caldwell drawing G-10. The Maximum Month flow was not explicitly listed, but the ratio of the average dry weather flow and the peak day dry weather flow was 1.5. This was taken as equivalent to the max month flow since a 1.5 value is also consistent with CH2M HILL experience. The loads are based on a 1.4 peaking factor on a mass basis. For example, at a 9-mgd ADW flow, the BOD load was listed as 11,300 lbs/day. The maximum month BOD load would therefore be 1.4 x 11,300 = 15,800 lbs/day. At a flow of 13.5-mgd, a BOD load of 15,800 lbs/day results in a BOD concentration of 140 mg/L.

In two cases, Alternative 3 and Alternative 5, which involved retaining the basic functionality of the 1975 plant, it was not feasible to increase the plant capacity to the levels shown in Table 1. In that case, the maximum raw sewage flow rate at the concentrations shown in Table 1was determined for the facility.

The unit process capacities used to determine the size and quantity of the various treatment systems are shown in Table 2 for maximum month conditions.

TABLE 2

Maximum Month Unit Process Capacities
Lahaina Phase 2 Process Study

Unit Process	Controlling Parameter	Maximum Month Capacity
Headworks Screens	Hydraulics	18.3 mgd[(2)]
Grit Removal	Hydraulics	4.8mgd
1985 Aeration Basins	Aeration Capacity	6,400 scfm
1975 Aeration Basins	Aeration Capacity	1.5 lbs oxygen/hp/hour
Secondary Clarifiers	Solids Loading Rate	23 lbs/day/ft^2
	Hydraulic Loading Rate	600 gpd/ft^2
Filters	Hydraulic Loading Rate	6 gpm/ft^2 (Peak)
Gravity Belt Thickeners	Hydraulic Loading Rate	200 gpm/m of Belt Width
Centrifuges	Solids Loading Rate	700 lbs DS/hour[1]

TABLE 2

Maximum Month Unit Process Capacities
Lahaina Phase 2 Process Study

Unit Process	Controlling Parameter	Maximum Month Capacity

1 The centrifuge capacity is based on conversations with Bird Centrifuge (the supplier of Humbolt centrifuges) for the model at Lahaina.
2 Installed unit capacity (all units online)

One other parameter of note is the SRT at which the bioreactors are run. Based on Task 1, the 1985 plant was run at an SRT of 11.3 days. This SRT was used in the subsequent modeling runs. Since the 1975 plant is currently not in operation, it was assumed that a 5-day SRT would be adequate to meet the treatment needs. Additional capacity would be obtained by reducing the 1985 plant SRT to 5 days, but at the cost of additional solids production. The existing DAFT system does not have the capacity to handle these solids loads, so in all cases a new gravity belt thickener system was assumed to prethicken the sludge prior to dewatering. However, rehab and upgrade of the existing DAFT could achieve the same objectives. Conversations with Bird Centrifuge indicate that the existing centrifuges have a capacity of 700 lbs dry solids/hour each. As a result, SRT reduction was applied in each applicable run to the degree necessary to achieve the target capacity goals, normally in combination with Step-Feed implementation at the 1985 plant.

In Alternatives 2 – 7 a new secondary clarifier was added as part of the upgrade. This clarifier was needed to meet the hydraulic and solids loading criteria described in Table 2. The reasons why this was not included in the original design are included in Section 2.1.8.3.

Each alternative is capable of meeting the 10-mg/L TN effluent value at the flow rates listed.

Based on these assumptions the model was run for each alternative. Process equipment was added to achieve the maximum month capacities.

2.1.8 Modeling Results

The following section lists and discusses the findings for each modeling run. Unless noted otherwise, the capacity numbers given in this section refer to the Maximum Month capacity.

2.1.8.1 Alternative 1: Status Quo

The status quo model was run using only the existing equipment and configurations. It is based on the calibration effort that was done in Phase 1 of this project.

It was found that the limiting design criterion was the secondary clarifier solids loading rate (SLR). At the limiting rate of 23 lbs/day/ft^2, the raw sewage flow rate was 6.3 mgd. A summary of the operating criteria at this flow is given in Table 3.

TABLE 3

Alternative 1 Operating Criteria at Maximum Month Conditions
Lahaina Phase 2 Process Study

Criteria	Units	Value
Raw Sewage Flow Rate[1,2]	mgd	6.3
1985 Plant:		
MLSS	mg/l	3,600
Air Rate	scfm	5,300
Secondary Clarifier SLR	lbs/day/ft^2	23
Secondary Clarifier Overflow Rate	gpd/ft^2	519
WAS Rate	lbs DS/day	7,800
Dewatered Biosolids Production	tons DS/day	3.6
Filtration Loading Rate	gpm/ft^2	1.8

Notes:

1) Raw Sewage concentrations are given in Table 1.

2) 6.3 mgd MM flow = 4.2 mgd ADW flow (6.3/1.5 peaking factor)

This option has no capital improvements associated with it.

The original (90's) design of the 1985 plant rated it at 7.4 mgd. It is unsure whether this rating is equivalent to a maximum month rate of 6.3 (or average dry weather of 4.2). It may be that the original rate is a maximum day flow rate, which would be consistent with the predicted capacities.

2.1.8.2 Alternative 2: Operational Improvements Only

In this alternative, operational changes would be made to improve process capacity in the 1985 plant. Of specific interest was to change the bioreactor system from plug flow to a step feed configuration. Another possible operational change would be to reduce the operating SRT from 11.3 days down to 5 days. However, this latter option would increase solids production and may be impractical with the existing solids handling system. If a new thickening system were installed, the 1985 plant would be able to operate at sustained feed rates up to 10 mgd with a 5-day SRT. At these flows, the 1985 plant existing secondary clarifiers have a fairly high hydraulic load, which may cause higher TSS levels in the filter feed. Table 4 summarizes the results from the step feed modification at the 11.3 day SRT and at a reduced SRT.

TABLE 4

Alternative 2 Operating Criteria at Maximum Month Conditions
Lahaina Phase 2 Process Study

Criteria	Units	**11.3-d SRT**	9.7-d SRT	5-d SRT[3]
Raw Sewage Flow Rate (MM, Ave)[1,2]	mgd	6.9, 4.6	7.4, 4.9	10, 6.7
1985 Plant:				
MLSS	mg/l	4,100	3,800	2,900
Air Rate	scfm	6,000	6,200	7,100
Secondary Clarifier SLR	lbs/day/ft^2	23	23	23
Secondary Clarifier Overflow Rate	gpd/ft^2	565	604	804
WAS Rate	lbs DS/day	8,900	9,800	14,200
Dewatered Biosolids Production	tons DS/day	4.0	4.2	6.4
Filtration Loading Rate	gpm/ft^2	2.0	2.1	2.9

Notes:

1) Raw Sewage concentrations are given in Table 1.

2) Ave Flow = MM Flow/1.5

3) Assumes New WAS Thickening Facility

Note that while the 9.7 day SRT option only gave a capacity increase of 0.5 mgd. This was a result of being limited by the hydraulic limit on the secondary clarifiers, rather than the solids loading rate. Lower SRTs would further lower the SLR. It is expected that SRTs down to 5 days will maintain nitrification in the bioreactors. As mentioned above, the higher flows possible with the 5-d SRT option may exceed the design standard for this project. An additional secondary clarifier would alleviate this limitation and allow sustained MM feed rates of between 11 and 12 mgd.

This option had no capital improvements associated with it. However, the 5-day SRT option would require a new thickening facility and could possibly benefit from an additional secondary clarifier. The need for a secondary clarifier is based on the TSS removal performance of the existing system. The capacity criteria given in Table 2 list a maximum month hydraulic load of 600 gpd/ft^2. The 5-d SRT option is in at 800 gpd/ft^2, so it is beyond the recommended hydraulic loading and therefore could use an additional clarifier. One was not included in this option since operational improvements only were considered.

2.1.8.3 Alternative 3: Restore 1975 Plant to Original Design

In this alternative, the 1975 plant is restored to its original functionality and the 1985 plant is expanded to increase capacity. It should be noted that it was assumed that the 1975 aeration basin would be refitted with a fine bubble diffuser system. This assumption was made based on the operations cost savings that would be realized as compared to mechanical surface aeration. While CH2M HILL did not complete a specific analysis on the use of fine bubble aeration in the 1975 basin, it has been our experience on a number of projects that fine bubble diffuser systems, while more capital expensive, normally pay for themselves

within 5 to 10 years, especially where power costs are high. Table 5 summarizes the results from these modeling runs.

TABLE 5

Alternative 3 Operating Criteria at Maximum Month Conditions
Lahaina Phase 2 Process Study

Criteria	Units	Run 1	Run 2	Run 3
Raw Sewage Flow Rate (MM, Ave)[1,2]	mgd	10.8, 7.2	11.6, 7.7	13.5, 9.0
1985 Plant (MM conditions):				
Bioreactor Configuration		Plug Flow	Step Feed	Step Feed
Feed Rate	mgd	7.4	8.3	10.3
SRT	days	11.3	11.3	6.9
MLSS	mg/l	4,300	4,700	3,800
Air Rate	scfm	7,400	7,100	7,900
Secondary Clarifier SLR	lbs/day/ft^2	23	23	23
Secondary Clarifier Overflow Rate	gpd/ft^2	430	482	597
WAS Rate	lbs DS/day	9,300	10,200	13,600
Filtration Loading Rate	gpm/ft^2	3.1	3.4	3.9
1975 Plant (MM conditions):				
Bioreactor Configuration		Aerobic	Aerobic	Aerobic
Feed Rate	mgd	4.6	4.5	4.6
SRT	days	5.0	5.0	5.0
MLSS	mg/l	2,900	2,900	2,900
Air Rate	scfm	3,000	3,000	3,000
Secondary Clarifier SLR	lbs/day/ft^2	23	22	23
Secondary Clarifier Overflow Rate	gpd/ft^2	572	564	573
WAS Rate	lbs DS/day	4,900	4,800	4,900
Dewatered Biosolids Production	tons DS/day	6.4	6.8	8.3

Notes:
1) Raw Sewage concentrations are given in Table 1.
2) Ave Flow = MM Flow/1.5

Of note in Table 5 is that only the Run 3 configuration was able to meet the 9-mgd ADW flow condition. The Run 3 air rate was a bit higher than the anticipated capacity of the aeration system under maximum month conditions, but it is within the accuracy of the model.

Alternative 3 included the following capital improvements:

- Refurbishment of 1975 Plant pump station
- A new 75' diameter clarifier for the 1985 plant
- A new fine bubble aeration and blower system for the 1975 plant
- Refurbishment of 1975 secondary clarifier and sludge pumping system
- New GBT WAS Thickening system

The rated capacity of the facility is approximately 9-mgdADW with both plants in service, according to plant documentation. In contrast to the rated capacity, this analysis indicates that the plant may not be able to effectively treat an average annual flow and load at this level in its current configuration and operating SRT. As discussed earlier, this analysis is based on an estimated maximum month flow and load given a 9 mgd average flow. In all cases, the model indicates that the plant can handle a sustained flow and load in excess of 9 mgd. However, normal variations in flow and load will cause extended periods where the flows and loads will be higher than the average, and it is at these conditions that a plant should actually be rated for.

In order to determine the reasons for the discrepancy between this analysis and the previous documentation, an examination of the prior design basis documents was completed. This comparison resulted in the following findings:

1. The previous analysis may not have taken into account recycle streams back into the processes, i.e. dewatering and thickening recycles as well as filter backwash water. Not accounting for these high solids and high nutrient streams has a significant effect on the plant capacity. There was no documentation of this being accounted for. However, if it was included, it indicates that the there are even more significant effects by the following items.
2. The secondary clarification hydraulic and solids loading capacity most often control the plant capacity. It appears that the design basis only used the hydraulic design basis, and did not account for secondary clarifier solids loading rate. In the current analysis, the solids loading rate was actually found to be the controlling parameter, through the use of state-point analysis of clarifier operation.
3. There was no indication in the design basis documentation that maximum month flows and loads factored into the design. This is the critical loading condition when considering the maximum sustained operating conditions.

2.1.8.4 Alternative 4: Retrofit Membrane Bioreactors (MBRs) in Portion of 1975 Plant

This alternative investigates the effects of retrofitting MBRs into the secondary clarifiers of the 1975 plant. The existing 1975 plant aeration basin would be used as a storage basin. The benefit of the MBR system is that it is able to provide the needed capacity and is easily expandable to provide additional capacity. Another advantage is that all flow through the MBR would not need filtration and is of a higher quality as compared to the granular media filters. Table 6 summarizes the results of this modeling.

TABLE 6

Alternative 4 Operating Criteria at Maximum Month Conditions
Lahaina Phase 2 Process Study

Criteria	Units	9 mgd ADW	12 mgd ADW
Raw Sewage Flow Rate (MM, Ave)[1,2]	mgd	13.5, 9	18.0, 12
1985 Plant (MM conditions):			
Bioreactor Configuration		Step Feed	Step Feed
Feed Rate	mgd	8.4	8.2
SRT	days	11.3	11.3
MLSS	mg/l	4,700	4,900
Air Rate	scfm	7,200	7,300
Secondary Clarifier SLR	lbs/day/ft^2	23	23
Secondary Clarifier Overflow Rate	gpd/ft^2	474	463
WAS Rate	lbs DS/day	10,300	10,700
Filtration Loading Rate	gpm/ft^2	2.2	2.2
1975 Plant (MM conditions):			
Bioreactor Configuration		MBR	MBR
Feed Rate	mgd	6.4	11.1
SRT	days	5.0	5.0
MLSS	mg/l	4,800	8,400
Air Rate	scfm	9,100	23,300
Secondary Clarifier SLR	lbs/day/ft^2	#N/A	#N/A
Secondary Clarifier Overflow Rate	gpd/ft^2	#N/A	#N/A
WAS Rate	lbs DS/day	7,700	13,400
Dewatered Biosolids Production	tons DS/day	8.1	10.9

Notes:
1) Raw Sewage concentrations are given in Table 1.
2) Ave Flow = MM Flow/1.5

Note that the MBR option allows treatment of the 12-mgd ADW flow within the 1975 plant secondary clarifier basins.

Alternative 4 included the following capital improvements:

- New MBR System located in the 1975 plant secondary clarifiers
- A new 75′ diameter clarifier for the 1985 plant
- New GBT WAS Thickening system

2.1.8.5 Alternative 5: Use 1975 Plant with Modifications to Provide Parallel Nitrogen Removal

Alternative 5 includes upgrading the 1975 plant with full nitrification/denitrification facilities to better meet the plant's needs for TN removal. It was configured as Modified-Ludzack-Ettinger (MLE) Process. It is essentially Alternative 3 with a denitrification zone and nitrified recycle. Table 7 summarizes the results of these modeling runs.

TABLE 7

Alternative 5 Operating Criteria at Maximum Month Conditions
Lahaina Phase 2 Process Study

Criteria	Units	Std SRT	Low SRT
Raw Sewage Flow Rate (MM, Ave)[1,2]	mgd	11.90, 7.9	13.50, 9.0
1985 Plant (MM conditions):			
Bioreactor Configuration		Step Feed	Step Feed
Feed Rate	mgd	8.0	10.4
SRT	days	11.3	7.0
MLSS	mg/l	4,800	3,800
Air Rate	scfm	7,300	8,200
Secondary Clarifier SLR	lbs/day/ft^2	23	23
Secondary Clarifier Overflow Rate	gpd/ft^2	466	603
WAS Rate	lbs DS/day	10,465	13,500
Filtration Loading Rate	gpm/ft^2	3.4	3.9
1975 Plant (MM conditions):			
Bioreactor Configuration		MLE	MLE
Feed Rate	mgd	4.3	4.5
SRT	days	5.0	5.0
MLSS	mg/l	3,100	3,000
Air Rate	scfm	3,000	2,900
Secondary Clarifier SLR	lbs/day/ft^2	23	23
Secondary Clarifier Overflow Rate	gpd/ft^2	544	560
WAS Rate	lbs DS/day	5,289	5,100
Dewatered Biosolids Production	tons DS/day	7.1	8.4

Notes:
1) Raw Sewage concentrations are given in Table 1.
2) Ave Flow = MM Flow/1.5

Similar to Alternative 3, this configuration is able to meet the 9-mgd ADW flow as long as the SRT in the 1985 basin is reduced. Refer to the discussion in Alternative 3 for the reasons behind the capacity limitations.

Another possible alternative to the MLE process is the IFAS (Integrated Fixed Film Activated Sludge) system. IFAS systems normally introduce a suspended plastic media into the mixed liquor to provide additional surface area for biological growth. This system allows nitrification to occur in significantly smaller volumes than would otherwise be possible. However, this system also requires significant changes to the aeration system (which operates at a lower efficiency as compared to a diffused aeration system) as well as a screening system between the bioreactor and the clarifier. Given that the MLE process can achieve the needed nitrogen removals in the existing volumes, it is not necessary to implement the IFAS system to further improve nitrification, and its associated costs.

The addition of IFAS or the addition of addition bioreactor and clarifier volume may be able to bring this Alternative's capacity to 12 mgd. However, the goal of this option was to improve nitrogen removal, in the short term and did not include future capacity. The clarifier and thickening improvements were required to bring the capacity up to the minimum 9 mgd level.

Alternative 5 included the following capital improvements:

- A new 75' diameter clarifier for the 1985 plant
- A new fine bubble aeration and blower system for the 1975 plant
- New interior walls and nitrified recycle pumping system in the 1975 plant aeration basin
- Refurbishment of 1975 secondary clarifier and sludge pumping system
- New GBT WAS Thickening system

2.1.8.6 Alternative 7: Demolish 1975 Plant, Capital Improvements to 1985 Plant

In this alternative, the 1975 plant is demolished and the land space recovered for a new expansion of secondary treatment capacity. The new secondary treatment system would be configured as an MLE-type system to provide adequate nitrogen removal. Table 8 summarizes the results from modeling at 9- and 12-mgd ADW.

For the 9-mgd case, it is possible to fit all new facilities in the area where the 1975 secondary clarifiers are located. The 12-mgd case requires more area and would involve placing a new aeration basin in the area currently occupied by the 1975 basin and clarifiers in the area of the existing 1975 secondary clarifiers.

TABLE 8

Alternative 7 Operating Criteria at Maximum Month Conditions
Lahaina Phase 2 Process Study

Criteria	Units	9-mgd ADW	12-mgd ADW
Raw Sewage Flow Rate (MM, Ave)[1,2]	mgd	13.5, 9	18.0, 12
1985 Plant (MM conditions):			
Bioreactor Configuration		Step Feed	Step Feed
Feed Rate	mgd	8.5	8.2
SRT	days	11.3	11.3
MLSS	mg/l	4,800	5,000
Air Rate	scfm	7,300	7,300
Secondary Clarifier SLR	lbs/day/ft^2	23	23
Secondary Clarifier Overflow Rate	gpd/ft^2	479	465
WAS Rate	lbs DS/day	10,600	10,900
Filtration Loading Rate	gpm/ft^2	2.3	2.2
New Plant (MM conditions):			
Bioreactor Configuration		MLE	MLE
Feed Rate	mgd	6.2	11.0
SRT	days	10.0	10.0
MLSS	mg/l	4,000	4,400
Air Rate	scfm	3,200	5,800
Secondary Clarifier SLR	lbs/day/ft^2	23	26
Secondary Clarifier Overflow Rate	gpd/ft^2	412	433
WAS Rate	lbs DS/day	6,600	11,900
Filtration Loading Rate	gpm/ft^2	1.6	3.0
Dewatered Biosolids Production	tons DS/day	7.8	10.3

Notes:
1) Raw Sewage concentrations are given in Table 1.
2) Ave Flow = MM Flow/1.5

One significant difference in this option is that the SLR for the new plant is allowed to go up to 26 lbs/day/ft^2. This is a result of the more efficient clarifier design that would be built as part of the new plant.

The Alternative 7, 9-mgd plant includes the following capital improvements:

- A new 75′ diameter clarifier for the 1985 plant

- Demolition of 1975 plant
- A new 2.1 MG MLE aeration basin
- Three new 75′ diameter secondary clarifiers

The Alternative 7, 12-mgd plant includes the following capital improvements:

- A new 75′ diameter clarifier for the 1985 plant
- Demolition of 1975 plant
- A new 3.5 MG MLE aeration basin
- Three new 80′ diameter secondary clarifiers
- A new filtration system

It should be noted that these two options are not exclusive of each other. It should be possible to develop a construction sequence that allows progressive expansion of the plant to meet the treatment needs. Should this option be selected, the construction sequencing determination will be part of that work. This would minimize the initial capital outlay for a 12 mgd plant, but may increase the overall cost to get to 12 mgd capacity.

2.2 Hydraulic Evaluation

2.2.1 Hydraulic Model Setup

CH2M HILL's proprietary hydraulic modeling software, HYDRO, was used in evaluating the hydraulics associated with the alternatives selected in Phase 1 for further evaluation. HYRDO performs backwater calculations beginning at the end of a selected flow path and performs calculations upstream to the front-end of the plant. The model was developed through the review of plant as-builts and results from the process modeling detailed in the previous section.

The base flow path selected for the hydraulic model was from the reuse clearwell up through the 1985 plant to the influent collection box of the influent flow structure. Flow through the 1975 plant was also modeled for Alternatives 3 and 4. The longest flow path through any process was modeled. Four flow conditions were modeled for each of the modeled alternatives, the average dry weather (ADW) flows of 9- and 12-mgd and their associated peak flows of 19.8- and 26.4-mgd. Flow splits and other assumptions are detailed in the following section.

2.2.2 Hydraulic Model Methodology

From the six alternatives selected in Phase 1 three were modeled hydraulically. Alternatives 1 and 2 were not modeled because these alternatives do not provide adequate capacity to pass the four, modeled flow conditions. The three alternatives modeled were Alternative 3 – Restore 1975 Plant, Alternative 4 – Retrofit the 1975 Plant with MBRs, and Alternative 7 – Demolish 1975 Plant and Expand the 1985 Plant. Alternative 5 – Nitrification is hydraulically similar to Alternative 3 and was consequently not modeled. As detailed in

Section 2.1, Alternatives 3 and 5 provide a maximum ADW capacity of 9-mgd. However, for comparative purposes the hydraulic profiles for these two alternatives were still evaluated at the ADW flow of 12-mgd and the peak of 26.4-mgd. The three hydraulically modeled alternatives are discussed in more detail below. Key assumptions common to all hydraulically modeled alternatives are:

- The water surface elevation in the reuse clearwell is 27.0-ft.
- The water surface elevation in the 1985 and 1975 filter feed wet wells are 21.2- and 25.5-ft, respectively.
- The water surface elevation in the 1975 transfer pump station is 30.0-ft
- Headloss through the mechanical screens are 7.91-inches. This is based on calculations performed by the manufacturer (Huber) of the newest screen at a flow of 9.9-mgd and the screen being dirty (35-percent binding, 51-percent open surface area).
- Headloss through the grit removal system is 3-inches (based on Pista Grit manufacturer Smith & Loveless data).
- The effluent filters have a headloss of 4-feet during average conditions and 7-feet during peak conditions.
- All control gates are fully open and all unit processes are operating. There are no standby units.
- The adjustable weir in the 1985 CAB is at its' highest elevation of 26.76-ft.
- A maximum of 3-mgd of flow is routed through UV and to reuse.
- The 8-inch notch currently existing in the wall of the screenings channel has been patched.
- Four new effluent filters are installed for the 12-mgd ADW and associated peak flow conditions in Alternatives 3 and 7. The filters are assumed to be similar in size to the existing units.
- Pumping capacity is available. Thus new transfer pumps and filter feed pumps are provided as needed.
- Flows are routed through elements even if hydraulic capacity is exceeded to illustrate the hydraulic limitations of individual elements.

For specific details on assumed minor losses of individual elements (i.e., bends, tees, etc.) see the model outputs included in Appendix C.

2.2.2.1 Alternative 3 – Restore 1975 Plant

This alternative represents existing physical and process conditions in the 1985 plant, along with the modifications detailed in Section 2.1, and restoring the functionality of the 1975 plant. Key assumptions used in the modeling of this alternative are:

- The flow split between the 1985 and 1975 plant is 65- and 35-percent, respectively. This is based on the process modeling conducted as part of Section 2.1.
- Four new effluent filters are online for the 12-mgd ADW and 26.4-mgd PWW conditions, for a total of twelve filters.
- Addition of a fourth secondary clarifier in the 1985 plant.
- Results of Alternative 3 are also representative of Alternative 5.

Table 9 indicates the flows to the 1985 and 1975 plants.

TABLE 9

Alternative 3 Flows to the 1985 and 1975 Plants
Lahaina Phase 2 Process Study

Flow Condition	1985 Plant Flow (mgd)	1975 Plant Flow (mgd)
9 mgd ADW	5.85	3.15
19.8 mgd PWW	12.87	6.93
12 mgd ADW	7.80	4.20
26.4 mgd PWW	17.16	9.24

2.2.2.2 Alternative 4 – Retrofit 1975 Plant with MBRs

This alternative represents the expansion of the 1985 plant and the retrofit of the 1975 secondary clarifiers with MBR technology. Key hydraulic assumptions associated with this alternative include:

- The MBRs are loaded at 15 gfd (gallons/sf-day) under maximum month conditions and 20 gfd under peak conditions. The remaining flow passes through the 1985 plant.
- A fourth secondary clarifier is added to the 1985 plant.
- No new filters are added as part of this alternative.

Table 10 indicates the flows to the 1985 and 1975 plants.

TABLE 10

Alternative 4 Flows to the 1985 and 1975 Plants
Lahaina Phase 2 Process Study

Flow Condition	1985 Plant Flow (mgd)	1975 Plant Flow (mgd)
9 mgd ADW	5.53	3.47
19.8 mgd PWW	11.5	8.30
12 mgd ADW	4.60	7.40

TABLE 10

Alternative 4 Flows to the 1985 and 1975 Plants
Lahaina Phase 2 Process Study

Flow Condition	1985 Plant Flow (mgd)	1975 Plant Flow (mgd)
26.4 mgd PWW	11.70	14.70

2.2.2.3 Alternative 7 – Demolish 1975 Plant and Expand the 1985 Plant

This alternative represents the demolishing of the 1975 plant with the expansion of the 1985 in the footprint of the 1975 plant. Key hydraulic assumptions associated with this alternative include:

- The expanded 1985 plant is on a separate process train beginning at the downstream end of the screenings buildings to the effluent filters.
- Four new effluent filters are online for the 12-mgd ADW and 26.4-mgd PWW conditions, for a total of twelve filters.
- Addition of a fourth secondary clarifier in the 1985 plant.
- The maximum ADW flow to the existing 1985 plant is 5.53-mgd (based on a capacity of 8.3-mgd MM, determined from the work conducted in Section 2.1).

Table 11 indicates the flows to the existing 1985 and expanded 1985 plants.

TABLE 11

Alternative 7 Flows to the Existing 1985 and Expanded 1985 Plants
Lahaina Phase 2 Process Study

Flow Condition	1985 Plant Flow (mgd)	1975 Plant Flow (mgd)
9 mgd ADW	5.53	3.47
19.8 mgd PWW	12.17	7.60
12 mgd ADW	5.53	6.47
26.4 mgd PWW	12.17	14.23

2.2.3 Hydraulic Model Results

Appendix B contains the hydraulic profiles for each of the modeled alternatives. Figure 1 illustrates the hydraulic profile for Alternative 3 (also representative of Alternative 5), Figure 2 for Alternative 4, and Figure 3 for Alternative 7.

Using the flow splits and assumptions identified in the previous section, key results of the hydraulic analysis are identified below.

- The influent structure needs to be enlarged for the 26.4-mgd peak event. All three alternatives resulted in water surface elevations exceeding the influent structures top of wall at the peak flow condition of 26.4-mgd.
- For Alternatives 3 and 7, no process downstream of the influent structure resulted in overtopping of walls.
- For Alternative 4, the water surface elevation overtopped the 1975 CCB walls at the peak flow condition of 26.4-mgd.
- The existing notch in the wall of the screenings channel must be patched.
- Alternatives 3 and 5 are process limited and not hydraulically limited.

2.2.4 Hydraulic Modeling Conclusions

Given the available data and the assumptions made during Phase 2 of the process study the following conclusions can be made with regards to the hydraulics of the Lahaina WWRF.

- Of the six alternatives evaluated only four (3, 4, 5, & 7) are able to hydraulically pass the 9-mgd and 12-mgd ADW flow conditions.
- Alternatives 3 and 5 are clearly limited by process capacity and not by hydraulic capacity. This is based on comparing process modeling results presented in Section 2.1 to the hydraulic modeling results presented in this section (2.2).
- The hydraulically limiting structure in all three of the modeled alternatives is the influent structure.
- The most limiting alternative is Alternative 4, based on the limitations of the CCBs in the 1975 plant at the peak flow of 26.4-mgd.

3 Cost Estimates

3.1 Capital Costs

The capital costs of each of the evaluated alternatives were estimated using CH2M HILL's proprietary estimating program CPES. This program is suitable for cost estimates in the rage of –30 percent to +50%. The cost estimates developed for each of the alternatives represent overall project costs, including estimated costs to upgrade the plant electrical system. The components of project costs, along with their values, are identified in Table 12.

TABLE 12

Cost Estimate Cost Components
Lahaina Phase 2 Process Study

Component	Value (% of Total Cost)
Contractor:	
Overhead	10%
Profit	5%
Mob/Bonds/Insurance	5%
Contingency	20%
Non-Construction Costs:	
Permitting	0%
Engineering	10%
SDC	5%
Commissioning & Startup	5%
Land ROW	0%
Legal/Admin	0%

Notes: Cost Estimate is based on construction starting in Mid 2005

Appendix D includes detailed printouts of each cost estimate. Table 13 summarizes the costs for each of the alternatives.

TABLE 13

Alternative Capital Costs
Lahaina Phase 2 Process Study

Alternative	ADW Capacity	Capital Project Cost[1,3]
1	4.2 mgd	$50,000
2[2]	4.9 (6.7) mgd	$150,000 ($5,450,000)
3	9 mgd	$15,250,000
4	9 mgd	$54,500,000
4	12 mgd	$76,500,000
5	9 mgd	$14,750,000
7	9 mgd	$45,250,000
7	12 mgd	$59,250,000

Notes:

1) This is the project cost, including electrical improvements and the adders as shown in Table 9
2) The plant capacity/cost with the addition of a new thickening facility and new 1985 plant secondary clarifier is in ()
3) These costs do not include a parallel UV channel for the existing UV system. It is estimated that a parallel channel will add another $500,000 to the project costs

3.2 Operations and Maintenance Cost with Net Present Value

Appendix E (Technical Memorandum 2: Operation and Maintenance Cost with NPV) includes detailed calculations of the operation and maintenance costs of each alternative, including a 20-year net present value estimate.

The following assumptions were used in estimating annual O&M costs for each alternative:

- Each alternative was modeled against Alternative 1 (Status Quo) at the current flow of 5.09 mgd and annual budgets provided by the County for the Lahaina WWRF.
- Lahaina WWRF will continue to truck dewatered solids to the landfill for disposal.
- Costing was based on additional vehicles or manpower required for the additional solids that will be generated.
- Labor costs were estimated for additional maintenance and solids generated at the 9 and 12 mgd facilities, based on operating the facility 2 shifts per day (16 hours) 5 days per week for thickening and dewatering operations. Total manpower was calculated as follows:
    - Alternatives 3 and 7 added one position for additional solids handling at the 9 mgd flow and 3 positions at the 12 mgd flow for a total of 9 and 11 positions respectively.

- Alternative 4 and 5 added 2 positions for the 9 mgd flow and 3 for the 12 mgd flow rates for a total of 10 and 11 positions respectively. The additional manpower is due to the increased solids, clean in place requirements for the MBR facility and the more complex operations of the Modified-Ludzack-Ettinger (MLE) process proposed for Alternative 5.

- Labor cost were estimated with standard benefits and manpower estimations for the different alternatives proposed.
- Major maintenance will continue to be handled through a centralized maintenance center and only the current 4 person maintenance staff will remain on site for minor maintenance issues.
- Hours of operations for each thickening unit was based on 200 gpm/meter for GBTs and 200 gpm/unit for DAFTs with a minimum of 2 units in operations to maintain operations hours within the 2 shift 5 day per week operations assumption stated above.
- This type of facility is classified as a "J" Medium Power Use Business. Average kWH power cost is $0.1925 with a $8.50 per kW added on during peak demand and a $8.00 per kW added on during off peak demand.
- Maintenance repair costs were based on utilizing some of the existing structures and equipment and based on OMI's average costs for the type of equipment proposed for each alternative.
- Variable costs were estimated as shown in Table 14.

TABLE 14

Variable Costs
Lahaina Phase 2 Process Study

Cost Basis for Modeling	Quantity	Units
Grit truck	10.00	yd^3/load
Miles to Land fill / disposal site for Grit only	25.00	miles
Vehicles average miles per gallon of truck	9.00	miles/gal
Miles to Land fill / disposal site for sludge only	25.00	miles
Sodium Hypo Chloride	800.00	$/ton
Thickening Polymer	2.35	$/lbs
Dewatering Polymer	3.25	$/lbs
Water (Potable)	1.81	$/100 cubic feet
Fuel Cost (Diesel)	2.09	$/gal
Grit Hauling Fee	79.00	$/trip
Grit Tipping Fee	29.00	$/$yd^3$
Sludge Hauling Fee	26.00	$/ton
Sludge Tipping Fee	29.00	$/ton

TABLE 14

Variable Costs
Lahaina Phase 2 Process Study

Cost Basis for Modeling	Quantity	Units
Grit truck	10.00	yd^3/load
Miles to Land fill / disposal site for Grit only	25.00	miles

Note: Total sludge disposal cost is figured at $55.00/ton. Model used hauling and tipping fee separately.

3.2.1 Cost exclusions:

The costing models were run based on direct operations and maintenance cost and did not consider the following;

- Administration cost
- Pump stations outside of the plant
- Groundskeeping
- Insurance costs
- General operations supplies, i.e. computers, papers etc.

The following table summarizes the annual operations cost for each alternative. The total estimation of the construction and O&M cost is one (1) year estimated O&M cost plus total construction cost for that alternative as presented in Table 13.

TABLE 15

Lahaina WWTP Secondary Clarifier Capacity Analysis
Lahaina WWRF Cost Comparison

Alternative	TOTAL OF ESTIMATED CONSTRUCTION AND O&M COSTS	ESTIMATED ANNUAL O&M COSTS
Status Quo "do nothing " alternative Base Cost Estimation (estimation at 5.09 mgd average)	$ 2,175,942	$2,125,924
Operational Improvements (New Thickening Facility)		
Alt 2 – 9 mgd 5 day SRT GBTs	$ 8,307,370	$2,888,567
Alt 2 – 12 mgd 5 day SRT GBTs (not achievable)	$ 8,685,219	$3,254,722
Alt 2 – 9 mgd 10 day SRT GBTs (not achievable)	$ 8,184,323	$2,740,431
Alt 2 – 12 mgd 10 day SRT GBTs (not achievable)	$ 8,629,103	$3,186,011
Alt 2 9 mgd 5 day SRT DAFTs	$10,356,602	$2,857,370
Alt 2 – 12 mgd 5 day SRT DAFTs (not achievable)	$10,734,451	$3,235,219

TABLE 15

Lahaina WWTP Secondary Clarifier Capacity Analysis
Lahaina WWRF Cost Comparison

Alternative	TOTAL OF ESTIMATED CONSTRUCTION AND O&M COSTS	ESTIMATED ANNUAL O&M COSTS
Alt 2 – 9 mgd 10 day SRT DAFTs (not achievable)	$10,233,555	$2,734,323
Alt 2 – 12 mgd 10 day SRT DAFTs (not achievable)	$10,678,335	$3,179,103
Restore 1975 plant to original design		
Alt 3 – 9 mgd 5 day SRT GBTs	$ 18,119,624	$2,869,624
Alt 3 – 12 mgd 5 day SRT GBTs	$ 18,700,563	$3,450,563
Alt 3 – 9 mgd 5 day SRT DAFTs	$ 18,124,105	$2,874,105
Alt 3 – 12 mgd 5 day SRT DAFTs	$ 18,650,772	$3,400,772
Install Membrane Bioreactors in Portion of 1975 Plant		
Alt 4 – 9 mgd MBR 11.3 / 5 day SRT GBTs	$ 57,935,417	$3,435,417
Alt 4 – 12 mgd MBR 11.3 / 5 day SRT GBTs	$ 80,426,698	$3,926,698
Alt 4 – 9 mgd MBR 11.3 / 5 day SRT DAFTs	$ 57,933,604	$3,433,604
Alt 4 – 12 mgd MBR 11.3 / 5 day SRT DAFTs	$ 80,420,897	$3,920,897
Restore the 1975 Plant to Original Design		
Alt 5 – 9 mgd 11.3 / 5 day SRT GBTs	$ 17,696,739	$2,946,739
Alt 5 – 9 mgd 11.3 / 5 day SRT DAFTs	$ 18,640,491	$2,890,491
Replace 1975 plant with New		
Alt 7 – 9 mgd 11.3 / 10 day SRT GBTs	$ 48,078,085	$2,828,085
Alt 7 – 12 mgd 11.3 / 10 day SRT GBTs	$ 62,632,125	$3,382,125
Alt 7 – 9 mgd 11.3 / 10 day SRT DAFTs	$ 48,078,813	$2,828,813
Alt 7 – 12 mgd 11.3 / 10 day SRT DAFTs	$ 62,628,647	$3,378,647

3.2.2 Twenty-Year Life Cycle / Net Present Value

Based on the annual O&M and construction cost for each alternative, a 20 year life cycle / NPV was calculated for each alternative. The NPV for each alternative included:

- Estimated construction cost spread out equally over the anticipated construction period of 1 or 2 years depending on the alternative evaluated.
    - Alternatives 2,3 and 5 at one (1) year construction period;
    - Alternatives 4 and 7 at two (2) years construction period.
- Annual operations cost for each alternative process evaluated for 20 years were used in the NPV.
- Projected inflation for the four main cost types (Labor, Power, Chemicals and Maintenance) based on the average inflation of these items over the last 20 years, for the next 20 years as shown in Table 16.
- NPV calculation was then applied to the anticipated 20 year escalated O&M and construction cost and discounted to present day value at 3.5%.

TABLE 16

Cost Escalation for O&M Model
Lahaina Phase 2 Process Study

Years out	Labor	Electrical	Chemicals	Maintenance	Other	Avg CPI
Year 1	3.50%	3.60%	3.57%	3.71%	3.22%	3.52%
Year 2	3.42%	3.52%	3.49%	3.63%	3.15%	3.44%
Year 3	3.34%	3.44%	3.41%	3.54%	3.07%	3.36%
Year 4	3.26%	3.36%	3.33%	3.46%	3.00%	3.28%
Year 5	3.18%	3.28%	3.25%	3.38%	2.93%	3.20%
Year 6	3.11%	3.20%	3.17%	3.29%	2.86%	3.12%
Year 7	3.03%	3.12%	3.09%	3.21%	2.79%	3.05%
Year 8	2.95%	3.04%	3.01%	3.13%	2.71%	2.97%
Year 9	2.87%	2.96%	2.93%	3.04%	2.64%	2.89%
Year 10	2.79%	2.88%	2.85%	2.96%	2.57%	2.81%
Year 11	2.71%	2.80%	2.77%	2.88%	2.50%	2.73%
Year 12	2.64%	2.71%	2.69%	2.79%	2.42%	2.65%
Year 13	2.56%	2.63%	2.61%	2.71%	2.35%	2.57%
Year 14	2.48%	2.55%	2.53%	2.63%	2.28%	2.49%
Year 15	2.40%	2.47%	2.45%	2.54%	2.21%	2.41%
Year 16	2.32%	2.39%	2.37%	2.46%	2.14%	2.34%
Year 17	3.00%	3.09%	3.06%	3.18%	2.76%	3.02%

TABLE 16

Cost Escalation for O&M Model
Lahaina Phase 2 Process Study

Years out	Labor	Electrical	Chemicals	Maintenance	Other	Avg CPI
Year 18	3.16%	3.25%	3.22%	3.35%	2.91%	3.18%
Year 19	2.09%	2.15%	2.13%	2.21%	1.92%	2.10%
Year 20	2.90%	2.99%	2.96%	3.07%	2.67%	2.92%

Alternative 2 for the 9 mgd 10 day SRT and both Alternative 2 for the 12 mgd 5 and 10 day facilities, though evaluated, will not meet the required quality based on CH2M HILL's PRO2D modeling.

Table 17 summarizes the NPV for each alternative in ascending order.

TABLE 17

Lahaina WWTP Secondary Clarifier Capacity Analysis
20 Year NPV of Alternatives in Ascending Order

Alternative	NPV @ 3.5%
Status Quo "do nothing " alternative Base Cost Estimation (estimation at 5.09 mgd average)	$ 41,621,584
Alt 2 9 mgd 5 day SRT GBTs	$ 60,089,960
Alt 2 9 mgd 5 day SRT DAFTs	$ 60,684,399
Alt 3 9 mgd 5 day SRT GBTs	$ 70,047,098
Alt 5 9 mgd 11.3 / 5 day SRT GBTs	$ 70,138,911
Alt 3 9 mgd 5 day SRT DAFTs	$ 70,231,127
Alt 5 9 mgd 11.3 / 5 day SRT DAFT	$ 71,122,325
Alt 3 12 mgd 5 day SRT GBTs	$ 80,247,398
Alt 3 12 mgd 5 day SRT DAFTs	$ 81,195,597
Alt 7 9 mgd 11.3 / 10 day SRT GBTs	$ 99,208,729
Alt 7 9 mgd 11.3 / 10 day SRT DAFTs	$ 99,227,237
Alt 4 9 mgd MBR 11.3 / 5 day SRT GBTs	$ 120,069,746
Alt 7 12 mgd 11.3 / 10 day SRT GBTs	$ 120,098,480
Alt 4 9 mgd MBR 11.3 / 5 day SRT DAFTs	$ 123,633,632
Alt 7 12 mgd 11.3 / 10 day SRT DAFTs	$ 123,694,274
Alt 4 12 mgd MBR 11.3 / 5 day SRT GBTs	$ 151,221,282
Alt 4 12 mgd MBR 11.3 / 5 day SRT DAFTs	$ 151,324,825

Note: Status Quo is based on 5.09 mgd vs. the 9 and 12 mgd costs for other alternatives and thus does not reflect the NPV to meet the objectives of this evaluation.

4 Clarifier Stress Testing

4.1 Testing Protocol

On June 22 and 23, 2005, stress testing was conducted on the secondary clarifiers at the plant to better determine actual capacity. As secondary clarifiers 3 and 4 are similar in design, it was determined that Clarifiers 3 and 5 would serve as the test units. The flow to the subject clarifier was adjusted by removing parallel clarifiers from service. The test runs were conducted as shown in Table 18.

TABLE 18

Stress Testing Runs
Lahaina Phase 2 Process Study

Test Run	Day 1 Wednesday, June 22, 2005	Day 2 Thursday, June 23, 2005
1	All 3 clarifiers in service - 5 hours long - parallel test observations on Clarifiers 3 and 5	All 3 clarifiers in service - 4 hours long - parallel test observations on Clarifiers 3 and 5
2	2 clarifiers in service (Clarifier 4 out of service) - 6 hours long - parallel test observations on Clarifiers 3 and 5	2 clarifiers in service (Clarifier 4 out of service) - 5.5 hours long - parallel test observations on Clarifiers 3 and 5
3	1 clarifier in service (Clarifier 5) -5 hours long - observations made on Clarifier 5	1 clarifier in service (Clarifier 3) - 3.5 hours long* - observations made on Clarifier 3

*Was not able to achieve the full 4 to 5 hour duration needed for the analyses as the stress testing was halted by the plant supervisor, due to increasing effluent turbidity levels.

All three clarifiers were operational during the stress testing. As shown in Table 18, for the first test run, all three clarifiers were in service. For all subsequent test runs, the influent gates to each of the non-test clarifiers were closed and their corresponding RAS pump was taken off line, and all of the flow was directed to the remaining test clarifier(s).

The parameters measured are summarized in 19. The plant influent flow rate and RAS flow rate for the test clarifiers were recorded on a 30 minute basis using the facility's SCADA system. Each test run was maintained between 4 to 6 hours, or until excessive effluent turbidity levels were observed.

TABLE 19

Test Parameters and Sampling Schedule
Lahaina Phase 2 Process Study

Characteristic	Sampling Method	Sampling Frequency	Parameter Analyzed
Influent (combined)	Grab	30-60 minutes Each test run 30-60minutes 30 Minutes	TSS (Maui) SVI (Maui) DSS/FSS Flow rate
Effluent (for each test clarifier)	Grab	30 minutes 30 minutes	TSS Turbidity
RAS	Grab	30 minutes 30 minutes	TSS Flow rate
Sludge blanket (for each test clarifier)	Sludge judge	30-60 minutes	Depth

Grab samples of the combined clarifier influent were collected for each test run to determine the mixed liquor settling characteristics (SVI). These grab samples were collected from the secondary clarifier splitter box, using the manual sampler. On selected runs, influent samples were also collected to measure dispersed suspended solids (DSS) and flocculated suspended solids (FSS) as specified in WERF/CRTC Protocols for Evaluating Secondary Clarifier Performance (WERF Project 00-CTS-1, 2001). To measure DSS, a settlemeter was used instead of a Kemmerer Sampler.

4.2 Results

Appendix F (Technical Memorandum 3: Secondary Clarifier Stress Testing) includes complete details of the tests and graphical results.

The capacity of a clarifier is determined from two aspects, the hydraulic and the solids handling capacity. One of these will always be controlling. In most wastewater treatment plants the solids handling capacity is the limitation. Data from the testing appears to support this for the Lahaina WWRF, but there was evidence of increased effluent TSS prior to the solids handling limit of Clarifier 5.

Since Clarifier 3 and Clarifier 5 have the same area, they should have similar operating characteristics. However, one important difference is that Clarifier 5 was operated with a RAS rate of approximately 2.4 mgd and Clarifier 3 at a RAS rate of approximately 1.0 mgd. While this will not have a large effect on the hydraulic capacity, it has a major effect on the solids loading rate capacity of the unit. The lower RAS rate will result in a much lower solids handling capacity.

1. The hydraulic capacity of the clarifiers does not appear to be limiting (up to about 1,400 gpd/ft or approximately 6 mgd per clarifier, but a judgment by plant staff needs to be made relative to what an acceptable effluent quality is from the facilities).

2. The solids loading rate capacity of the clarifiers appears to be approximately 35 lbs/d/ft^2 at an SVI of about 120 and a RAS rate of about 40% of the influent flow or greater. A 6 mgd feed to one clarifier and 40% RAS ratio, results in a maximum MLSS of about 2,200 mg/L.

3. Overall, the results of this testing indicate that the capacity of the 1985 portion of the Lahaina WWRF, based on current operating MLSS levels, is 4.2 mgd ADW (6.3 mgd MM).

4. These results are consistent with previous assumptions about clarifier capacities. However, these loading rates need to be used in conjunction with the detailed influent flow profile to determine what the design load should be. Normally the maximum month conditions are used to determine this and then the peak day conditions are used in conjunction with the results from this work to ensure that the system is not overloaded unless it is a peak event. At the Lahaina WWRF it is estimated that a 9 mgd ADW flow equates to a 19.8 mgd peak flow. Since all three clarifiers together, at the higher RAS rates, can only treat up to about 18 mgd, the plant would be overloaded during that period. In order to treat this level of flow for a longer period, it would be necessary to convert the FAB over to step feed or contact stabilization mode to protect the solids during such a high flow event.

5. The clarifiers appear to be run at a constant RAS flow rate. If possible, improved operation and reduced operating costs (through reduced pumping) could be achieved if the RAS pumps were controlled to supply RAS as a fixed percentage of the influent flow rate.

6. This study was not able to provide data on what benefits might be realized through the implementation of clarifier improvements, such as baffles and improved flocculation wells. However, it is believed that the plant will see improvement in effluent quality as a result of improvements such as these. Note that these improvements will not increase solids handling capacity.

5 Electrical Assessment

A separate assessment of the condition of the plant electrical system has also been conducted. Visual and analytical methods were used as the basis for the condition assessment. For historical reference, digital photographs and electronically recorded data were incorporated for detailed and future analysis. Testing data such as voltage, current, power (KW and KVAR), power factor, insulation resistance, infrared imaging, and vibration were obtained on a majority of the equipment during this assessment. A copy of this assessment report is included as Appendix G to this report.

This electrical assessment also evaluated the impact of the proposed alternatives on the existing electrical system, and produced order-of-magnitude capital cost estimates by alternative for required upgrades. These findings are summarized below.

5.1 Alternative 1 – "Status Quo"

In this alternative, no electrical work will be undertaken at the 1975 plant. Those items identified in the assessment relating to operational areas of the treatment facility will be addressed.

The present electrical system at the 1975 plant is approximately 30 years of age. The electrical conductors have an estimated life of 30 to 50 years while the equipment is 50 years or based on availability of replacement parts, whichever is sooner. Most of the motors have not been operated and maintenance will be required to make this area operational.

The estimated electrical capital upgrade budget for Alternative 1 is $50,000.

5.2 Alternative 2 – Operational Improvements

In this alternative, only electrical work in conjunction with improvements to process capacity at the 1985 plant will be undertaken. From the Load Summary Spreadsheet, the present power requirements at the 1985 Plant show that it is fully capable of handling the improvements described.

The estimated electrical capital upgrade budget for Alternative 2 is $150,000.

5.3 Alternative 3 – Restoration of 1975 Plant

The existing electrical system is capable of handling the power requirements for restoring the 1975 Plant facilities. The electrical wiring and equipment at the 1975 portion of the plant is approximately 30 years old with an estimated remaining life of 20 years. Many of the existing motors require servicing such as replacement of bearings and seals, conductor and motor insulation checks, motor servicing and lubrication, cleaning and painting, replacement of couplings, alignment, cleaning and testing of drive controllers, and verification and checking of the protective devices.

Although most major electrical suppliers stock replacement parts for switchboards and equipment, control and electronic devices become obsolete after a few years. Replacement of 20+ year old parts often requires research for upgrade modifications or procurement of reconditioned parts through an after-market supplier.

Many of the original installations used above ground rigid metallic raceways. These raceways show signs of corrosion at the transition interfaces. It appears that water has entered the raceways and hence internal corrosion would be evident and require re-routing and replacement.

To improve the reliability of the older electrical system, the redesign of the electrical system is planned where an alternative feeder would be installed and the motor control centers divided into two sections with a tie breaker. The consequent motor starters and equipment panels would be divided into two sections such that the loss of one feeder would not seriously affect plant operations.

Although the goal is to maintain the status quo, the addition of the second feeder is necessary to improve reliability due to the age of the original cables. This is costlier than installing new equipment that could be equipped with this design improvement.

Motor control centers MCC-C (Control Building at 50% capacity), MCC-D (Backwash Basin and Filter at 60% capacity), and MCC-E (Chlorine Building at 66% capacity) are near to their design capacity limits and any improvements affecting these areas need further investigation and study.

The estimated electrical capital upgrade budget for Alternative 3 is $1,250,000.

5.4 Alternative 4 – Membrane Bioreactors (MBR) Installation at Portion of 1975 Plant

The addition of Membrane Bioreactor (MBR) units to the 1975 Plant will increase the loading by approximately 70 KVA. The main distribution board is fully capable of handling this additional load.

The power for the MBR units will be incorporated into the design for this alternative.

As covered earlier, the original plant was designed as a radial system providing little redundancy at the motor control centers. A redundant back-up system would be incorporated into the upgrade design.

The estimated electrical capital upgrade budget for Alternative 4 is $500,000.

5.5 Alternative 5 – 1975 Plant with Parallel Nitrogen Removal Modifications

In this alternative, both portions of the 1975 and 1985 Plant equipment will be upgraded. This should have little impact on the ability of the electrical system to handle the additional load over the present measurements or affect the design capacity.

The estimated electrical capital upgrade budget for Alternative 5 is $750,000.

5.6 Alternative 7 – Demolish 1975 Plant and Expand 1985 Plant

This involves the demolition of the 1975 Plant electrical system with re-design to provide main and redundant power feeds to the motor control centers remaining in operation, and inclusion of new 15 KV and 480 volt power feeders to new switchboards and motor control centers to handle the plant expansion.

Depending on the routing and scheduling, the present underground 12.47 KV service to the plant may be in jeopardy as it crosses between the clarifiers and chlorine contact chambers. This need be considered in the design phase of the planned improvement.

The estimated electrical capital upgrade budget for Alternative 7 is $2,250,000.

6 Recommendations and Conclusions

There were several unknowns encountered during the Phase 2 analysis of this process study. The first unknown was related to the determination of the flow and load variations normal to the Lahaina WWRF. Assumptions were made based on best engineering practice and experience. However, it may provide significant monetary savings and less risk if these values are better quantified through a study of raw sewage flows and loads. The second unknown was the actual process capacity of the existing secondary clarifiers. This was resolved, however, through supplemental clarifier stress testing.

Hydraulically, the biggest hydraulic bottleneck occurs in the influent structure at the peak flow condition of 26.4-mgd. All modeled alternatives produced water surface elevations exceeding the top of wall elevation of the influent structure. The influent structure, however, can be modified to pass this peak event. The modeling results also assumed that the existing notch in the screenings channel of the headworks was repaired. It is recommended that this repair be made. If not repaired, elevated water surfaces at peak events will pass through this opening. Comparing results between process and hydraulic modeling indicates that Alternatives 3 and 5 are clearly limited by process capacity. Hydraulically, Alternatives 3 and 5 can pass the ADW flow of 12-mgd and its' associated peak flow of 26.4-mgd.

If it is assumed that it is necessary to meet the 12-mgd capacity, then only Alternatives 4 and 7 should be considered further. The lower cost option is Alternative 7, a new conventional plant, by approximately 20-percent on a 20-year Net Present Value basis (including O&M). However, the site is limited and the footprint required may produce a crowded final site layout with little room for future expansion. Alternative 4, membrane bioreactors, is feasible if a percentage of flow is bypassed around the 1975 CCBs at the 12-mgd peak of 26.4-mgd. Membrane reactors takes very little room, do not require additional filtration capacity to be built, and may produce an effluent that already meets the needed disinfection requirements.

Membrane bioreactors of the size required at the Lahaina WWRF are now being built across the world, so there is very little process risk in implementing this process. **For these reasons, if a 12-mgd capacity is needed, CH2M HILL recommends Alternative 4 for future expansion purposes**, but also recommends further detailed evaluation of Alternatives 4 and 7 to better quantify the costs and benefits at the Lahaina WWRF.

If a 12-mgd capacity is not a requirement, the lowest capital cost option is either Alternative 3 or 5. Of these two, Alternative 5 will result in a better operating plant, as a result of the anoxic selector in the 1975 plant. However, because of the potential operational complexities attendant to operating two "separate" plants, Alternative 7 should also be considered. While capital costs for Alternative 7 are approximately 35% higher than for Alternative 5, estimated annual O&M costs are actually fractionally lower. Additionally, of these 2 alternatives, only Alternative 7 provides opportunity for potential future expansion

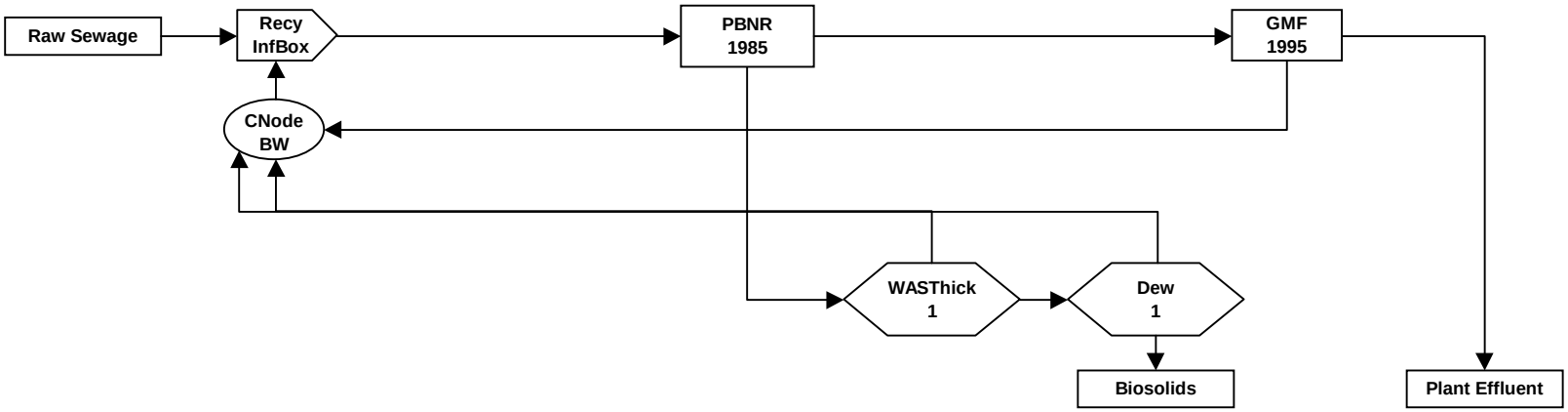
to 12 mgd ADW. **For these reasons, CH2M HILL recommends Alternative 7 if obtaining a 9-mgd ADW capacity is required.**

Alternative 2 provides two lower cost options for achieving somewhat more capacity out of the 1985 facility. The base case is to convert to step feed and reduce the SRT. This increases capacity from 3.5-mgd to approximately 4.9-mgd at no additional capital cost. The second option includes adding WAS thickening capacity and a fourth clarifier at the 1985 plant. This would improve the ADW capacity to 6.7-mgd.

Not included in the above costs were improvements to the existing 1985 secondary clarifiers. In conversations with plant staff, the observed effects of flow upon TSS removal were noted to be characteristic of poorly flocculated MLSS and possible density currents within the clarifiers (i.e. flow increases result in large increases in effluent TSS). It has been CH2M HILL's experience that in a properly flocculated and baffled clarifier feed will result in effluent TSS levels that are less variable and consistently lower as flow increases to a clarifier. Installing such improvements should result in peak flow TSS levels only slightly higher than normal operating conditions. Quantification of this effect is not possible without an extensive sampling program to determine the degree of non-ideality present in the existing system.

Discussions with staff indicated that improvements to those processes could be done by existing staff. Based on discussions during the site visit, it was recommended that Clarifiers 3 and 4 be retrofitted with flocculation wells and Stamford baffles. In addition, it was recommended that Clarifier 5 should be retrofitted with Stamford baffles. These recommendations are focused on improving the effluent quality of the clarifiers and do not directly address capacity.

Appendix A – Process Modeling



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Model Convergence 0.45%

Facility Operating Parameters			Project	First Assumptions
Item		**Value**	**Notes**	**US**
Influent Wastewater	(US)	(US)		
Flow	MG/day			
Design Average		**6.30**	4.2	
Design Diurnal Peak		**12**	Max Month Conditions	
Design Peaking Factor for WW Diurnal flow		1.904761905		
Design Peaking Factor for WW Diurnal loads		**1.3**		
Carbonaceous Five-Day Biochemical Oxygen Demand (CBOD5)				
Design Average Concentration	mg/L	140	140	
Design Average Mass Loading	lb/day	**7,360**		
Design Diurnal Peak Mass Loading	lb/day	9,568		
Total Suspended Solids (TSS)				
Design Average Concentration	mg/L	149	149	
Design Average Mass Loading	lb/day	**7,833**		
Design Diurnal Peak Mass Loading	lb/day	10,183		
Volatile Suspended Solids (VSS)				
Percent VSS	%	**87%**		
Design Average Concentration	mg/L	130		
Design Average Mass Loading	lb/day	6,818		
Design Diurnal Peak Mass Loading	lb/day	8,864		
Total Kjeldahl Nitrogen (TKN as N)				
Design Average Concentration	mg/L	23	23	
Design Average Mass Loading	lb/day	**1,209**		
Design Diurnal Peak Mass Loading	lb/day	1,572		
Ammonia-Nitrogen (NH3-N as N)			TKN/ammonia Ratio	
Design Average Concentration	mg/L	14	1.66	
Design Average Mass Loading	lb/day	**730**		
Design Diurnal Peak Mass Loading	lb/day	949		
Total Phosphorus (as P)				
Design Average Concentration	mg/L	4		
Design Average Mass Loading	lb/day	**210**	Estimated	
Design Diurnal Peak Mass Loading	lb/day	273		
Alkalinity (as CaCO3)				
Design Average Concentration	mg/L	167	167	
Design Average Mass Loading	lb/day	**8,780**		
Design Diurnal Peak Mass Loading	lb/day	11,414		
Hydrogen Sulfide (H2S)				
Design Average Concentration	mg/L	1		
Design Average Mass Loading	lb/day	**53**	Estimated	
Design Diurnal Peak Mass Loading	lb/day	68		
Chemical Addition:				
Select the Metal Salt (if used)		3		
Biological Process - PBNR: 1985				
Total SRT (anaerobic + anoxic + aerobic)	days	**11.3**		
Nitrifier Minimum SRT (SRT_{min})	days	1.0		
DO	mg/L	2.0		
Temperature in the Biological Process	oF	**80**		
SVI	mL/g	**120**		
Biosolids Production Rates				
Net Yield (mg TSS/mg BOD_5)	lb/lb	1.07		
Volatile Fraction	%	80.3%		
Active Fraction	%	32.2%		
Nitrifier Fraction	%	1.1%		
Nitrogen Content, N/VSS	%	6.4%		
Phosphorus Content, P/VSS	%	2.6%		
Process Oxygen Requirements				
Carbonaceous AOR/BOD5 - wt/wt	lb/lb	1.2		
Total AOR/BOD% - wt/wt	lb/lb	1.5		
AOR (wt/day)	lb/day			
Average		11,172		
Diurnal Peak		15,803		
AOR	mg/L-hr			
Average		18		
Diurnal Peak		26		
Bioreactor **With Secondary Clarifier**				
Total Bioreactor Volume	MG	**3.04**	0.05channel+0.8FAB+2.19CAB	
HRT	hr	10.6		
% non-aerobic		2%		
% aerobic		98%		

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Average MLSS Concentration	mg/L	3,580		
Bioreactor Clarifier				
Total Area	sq.ft.	**13,254**		
Overflow Rate	gpd-sq.ft.			
Average		519		
Diurnal Peak		949		<1000 gpd/sq.ft.; <900 gpd/sq.ft
Effluent TSS	mg/L			
Average		**3**		
Diurnal Peak		**20**		
Underflow Rate				
Average Flow Ratio		**50%**	0.67	
Average Rate	gpd-sq.ft.	260		
Peak Flow Ratio		**50%**		Default RAS = 100%
Peak Rate	gpd-sq.ft.	475		Adjust underflow rate to vary RA
Solids Loading Rate	lb/day-sq.ft.			
Average		23		
Diurnal Peak		43		<50 lb/day-sq.ft.; <25 lb/day-sq.
Limiting Solids Loading Rate	lb/day-sq.ft.	49		
Return sludge rate at which limiting solids rate can be achieved				
RAS Flow Rate	MGD	6.9		
Percent of Influent to Bioreactor	%	100%		
RAS Concentration	mg/L			
Average		10,390		
Diurnal Peak		10,667		
No Membrane Bioreactor Selected				
Effluent TSS	mg/L			
Average		**1**		
Diurnal Peak		**1**		
Chemical Compound Applied before Secondary Clarifier				
Chemical Added? **No**				
Chemical Type		0		
Chemical Dosage (as chemical)	lb/day	**200**		
Chemical Dosage (mg chemical/L treated)	mg/L	N/A		
Molar Ratio Dosage Applied (M+:PO4-P)		N/A		
Effluent PO4-P	lb/day	N/A		
Effluent PO4-P	mg/L	N/A		
Filters: 1995				
Filters? **Yes**				
Total Area	ft2	**2,400**		
Hydraulic Loading Rate	gpm/ft2			
Average		1.82		
Diurnal Peak		3.47		
Solids Loading Rate	lb/day-sq.ft.			
Average		0.02		
Diurnal Peak		0.18		
Filter Run Time	hr	**24**		
Instantaneous Backwash Rate	gpm/ft2	**0.14**		
Duration of Backwash Flow	minutes	**1,440**		
Backwash Operating Time (%cycle)	%	100.00%		
Backwash Flow Rate	MGD	0.48		
Ratio of Backwash Production to Filter Influent	%	7.1%		
TSS Removal Efficiency at Average Conditions		**85%**		
TSS Removal Efficiency at Diurnal Peak Conditions		**75%**		
Chemical Compound Applied to Filter Influent **No**				
Chemical Formula		Al2(SO4)3*14H20		
Chemical Dosage (mg chemical/L treated)	mg/L	**10**		
Chemical Dosage (as chemical)	lb/day	565.3		
Molar Ratio of Metal to Phosphate		0.0		
Percent of Soluble P that is ortho-P		***100%***		
Effective TSS Removal with Chemical Addition - Average Conditions(%)		85%		
Effective TSS Removal with Chemical Addition - Peak Conditions(%)		75%		
Backwash Concentration	mg/L	40		
WAS Thickening: 1				
WAS Thickener? **Yes**				
Solids Capture	%	**95%**		
Thickened Sludge Concentration	mg/L	**60,000**		
Belt Wash Water Flow Rate	gpm	**0**		
Hours/Day of Operation		**24**		
Days/Week of Operation		**7**		
Dewatering: 1				
Dewatering? **Yes**				
Solids Capture	%	**95%**		
Dewatered Sludge Concentration	%	**15%**		
Belt Wash Water Flow Rate	gpm	**0**		
Hours/Day of Operation		**24**		
Days/Week of Operation		**7**		

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Mass Balance for Average Flow Conditions

Constituent	Raw Wastewater (RW)	InfBox Recycle Influent (RecyI)	InfBox Recycled Stream (Recycle)	InfBox Combined Recycle Effluent (RecyE)	1985 Bioreactor Influent (BI)	1985 Secondary Clarifier Influent (SI)	1985 Secondary Clarifier Effluent (SE)	1995 Granular Media Filter Influent (GMFI)	1995 Granular Media Filter Effluent (GMFE)	Plant Effluent (PLE)	1985 WAS	1 WAS Thickener Influent (TWASI)	1 Thickened WAS (TWAS)	1 Dewatering Influent (DWI)	1 Dewatered Sludge (DWE)	Biosolids to Dispoal	1995 Filter Backwash (BW)	1 WAS Thickening Recycle (TWASR)	1 Dewatering Recycle (DWR)	BW Combined Discharge
Flow (gallons/day)	6,300,000	6,300,000	578,757	6,878,759	6,878,759	10,318,141	6,774,436	6,774,436	6,294,464	6,294,464	104,325	104,325	14,866	14,866	5,540	5,540	479,973	89,458	9,327	578,757
Carbonaceous BOD_5 (lbs/day)	7,360	7,360	124	7,484	7,484	40,650	34	34	12	12	1,040	1,040	988	988	939	939	22	52	49	124
COD (lbs/day)	18,618	18,618	1,197	19,815	19,815	347,344	2,031	2,031	1,721	1,721	8,846	8,846	8,381	8,381	7,960	7,960	310	465	421	1,197
TSS (lbs/day)	7,834	7,834	925	8,759	8,759	306,192	190	190	28	28	7,836	7,836	7,444	7,444	7,072	7,072	161	392	372	925
VSS (lbs/day)	6,818	6,818	760	7,578	7,578	251,582	156	156	23	23	6,438	6,438	6,116	6,116	5,811	5,811	133	322	306	760
TKN (lbs/day)	1,209	1,209	54	1,263	1,263	15,756	91	91	77	77	401	401	380	380	361	361	14	21	19	54
NH_3-N (lbs-N/day)	730	730	1	732	732	25	16	16	15	15	0	0	0	0	0	0	1	0	0	1
NO_3-N (lbs-N/day)	0	0	23	23	23	408	268	268	249	249	4	4	1	1	0	0	19	4	0	23
TP (lbs-P/day)	210	210	26	236	236	7,512	46	46	39	39	191	191	181	181	172	172	7	10	9	26
Alkalinity (lbs/day as $CaCO_3$)	8,780	8,780	584	9,364	9,364	10,416	6,839	6,839	6,354	6,354	105	105	15	15	6	6	485	90	9	584
H_2S (lbs/day)	53	53	0	53	53	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BOD_5 (mg/L)	140	140	26	130	130	472	1	1	0	0	1,195	1,195	7,963	7,963	20,301	20,301	5	70	635	26
COD (mg/L)	354	354	248	345	345	4,034	36	36	33	33	10,160	10,160	67,554	67,554	172,170	172,170	77	623	5,414	248
TSS (mg/L)	149	149	192	153	153	3,556	3	3	1	1	9,000	9,000	60,000	60,000	152,963	152,963	40	525	4,782	192
VSS (mg/L)	130	130	157	132	132	2,922	0	0	0	0	7,395	7,395	49,299	49,299	125,682	125,682	33	431	3,929	157
TKN (mg-N/L)	23.0	23	11	22	22	183	2	2	1	1	461	461	3,065	3,065	7,811	7,811	3	28	246	11
NH_3-N (mg-N/L)	13.9	14	0	13	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NO_3-N (mg-N/L)	0.0	0	5	0	0	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
TP (mg-P/L)	4.0	4	5	4	4	87	1	1	1	1	220	220	1,460	1,460	3,722	3,722	2	13	117	5
Alkalinity (mg/L as $CaCO_3$)	167	167	121	163	163	121	121	121	121	121	121	121	121	121	121	121	121	121	121	121
H_2S (mg/L)	1.0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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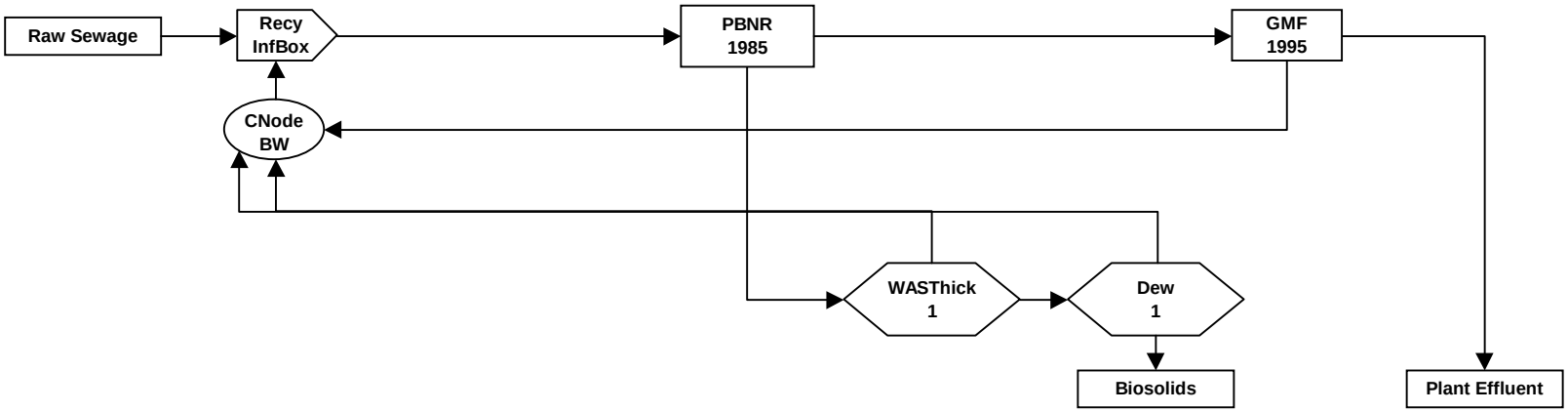

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Facility Operating Parameters			Project	First Assumptions
Item		**Value**	**Notes**	**US**
Influent Wastewater	(US)	(US)		
Flow	MG/day			
Design Average		**9.00**	6	
Design Diurnal Peak		**12**	Max Month Conditions	peak hourly flow
Design Peaking Factor for WW Diurnal flow		1.333		
Design Peaking Factor for WW Diurnal loads		**1.3**		
Carbonaceous Five-Day Biochemical Oxygen Demand (CBOD5)				
Design Average Concentration	mg/L	140	140	
Design Average Mass Loading	lb/day	**10,515**		
Design Diurnal Peak Mass Loading	lb/day	13,669		
Total Suspended Solids (TSS)				
Design Average Concentration	mg/L	149	149	
Design Average Mass Loading	lb/day	**11,191**		
Design Diurnal Peak Mass Loading	lb/day	14,548		
Volatile Suspended Solids (VSS)				
Percent VSS	%	**87%**		
Design Average Concentration	mg/L	130		
Design Average Mass Loading	lb/day	9,740		
Design Diurnal Peak Mass Loading	lb/day	12,662		
Total Kjeldahl Nitrogen (TKN as N)				
Design Average Concentration	mg/L	23.0	23	
Design Average Mass Loading	lb/day	**1,727**		
Design Diurnal Peak Mass Loading	lb/day	2,246		
Ammonia-Nitrogen (NH3-N as N)			TKN/ammonia Ratio	
Design Average Concentration	mg/L	13.9	1.6560	
Design Average Mass Loading	lb/day	**1,043**		
Design Diurnal Peak Mass Loading	lb/day	1,356		
Total Phosphorus (as P)				
Design Average Concentration	mg/L	4.00		
Design Average Mass Loading	lb/day	**300**	Estimated	
Design Diurnal Peak Mass Loading	lb/day	391		
Alkalinity (as CaCO3)				
Design Average Concentration	mg/L	167	167	
Design Average Mass Loading	lb/day	**12,543**		
Design Diurnal Peak Mass Loading	lb/day	16,305		
Hydrogen Sulfide (H2S)				
Design Average Concentration	mg/L	1		
Design Average Mass Loading	lb/day	**75**	Estimated	
Design Diurnal Peak Mass Loading	lb/day	98		
Chemical Addition:				
Select the Metal Salt (if used)		3		
Biological Process - PBNR: 1985				
Total SRT (anaerobic + anoxic + aerobic)	days	**5.0**		
Nitrifier Minimum SRT (SRT_{min})	days	1.2		
DO	mg/L	2.0		
Temperature in the Biological Process	oF	**80**		
SVI	mL/g	**120**		
Biosolids Production Rates				
Net Yield (mg TSS/mg BOD_5)	lb/lb	1.25		
Volatile Fraction	%	80.6%		
Active Fraction	%	45.1%		
Nitrifier Fraction	%	1.0%		
Nitrogen Content, N/VSS	%	6.7%		
Phosphorus Content, P/VSS	%	2.8%		
Process Oxygen Requirements				
Carbonaceous AOR/BOD5 - wt/wt	lb/lb	1.0		
Total AOR/BOD% - wt/wt	lb/lb	1.2		
AOR (wt/day)	lb/day			
Average		13,495		
Diurnal Peak		19,875		
AOR	mg/L-hr			
Average		22		
Diurnal Peak		33		
Bioreactor **With Secondary Clarifier**				
Total Bioreactor Volume	MG	**3.04**	0.05channel+0.8FAB+2.19CAB	
HRT	hr	7.6		
% non-aerobic		28%		
% aerobic		72%		

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Average MLSS Concentration	mg/L	2,658		
Bioreactor Clarifier				
Total Area	sq.ft.	**13,254**		
Overflow Rate	gpd-sq.ft.			
Average		728		
Diurnal Peak		954		<1000 gpd/sq.ft.; <900 gpd/sq.ft
Effluent TSS	mg/L			
Average		**5**		
Diurnal Peak		**20**		
Underflow Rate				
Average Flow Ratio		**50%**	0.67	Max RAS Capacity, gpm
Average Rate	gpd-sq.ft.	364	3,349	3600
Peak Flow Ratio		**50%**	RAS, gpm	6400
Peak Rate	gpd-sq.ft.	477	4,391	
Solids Loading Rate	lb/day-sq.ft.			
Average		20		
Diurnal Peak		32		<50 lb/day-sq.ft.; <25 lb/day-sq.
Limiting Solids Loading Rate	lb/day-sq.ft.	49	41	
Return sludge rate at which limiting solids rate can be achieved				
RAS Flow Rate	MGD	6.9		
Percent of Influent to Bioreactor	%	71%		
RAS Concentration	mg/L			
Average		6,153		
Diurnal Peak		6,486		
No Membrane Bioreactor Selected				
Effluent TSS	mg/L			
Average		**1**		
Diurnal Peak		**1**		
Chemical Compound Applied before Secondary Clarifier				
Chemical Added? **No**				
Chemical Type		0		
Chemical Dosage (as chemical)	lb/day	**200**		
Chemical Dosage (mg chemical/L treated)	mg/L	N/A		
Molar Ratio Dosage Applied (M+:PO4-P)		N/A		
Effluent PO4-P	lb/day	N/A		
Effluent PO4-P	mg/L	N/A		
Filters: 1995				
Filters? **Yes**				
Total Area	ft2	**2,400**		
Hydraulic Loading Rate	gpm/ft2			
Average		2.60		
Diurnal Peak		3.45		
Solids Loading Rate	lb/day-sq.ft.			
Average		0.03		
Diurnal Peak		0.18		
Filter Run Time	hr	**24**		
Instantaneous Backwash Rate	gpm/ft2	**0.14**		
Duration of Backwash Flow	minutes	**1,440**		
Backwash Operating Time (%cycle)	%	100.00%		
Backwash Flow Rate	MGD	0.48		
Ratio of Backwash Production to Filter Influent	%	5.1%		
TSS Removal Efficiency at Average Conditions		**85%**		
TSS Removal Efficiency at Diurnal Peak Conditions		**75%**		
Chemical Compound Applied to Filter Influent **No**				
Chemical Formula		Al2(SO4)3*14H20		
Chemical Dosage (mg chemical/L treated)	mg/L	**10**		
Chemical Dosage (as chemical)	lb/day	790.4		
Molar Ratio of Metal to Phosphate		0.0		
Percent of Soluble P that is ortho-P		***100%***		
Effective TSS Removal with Chemical Addition - Average Conditions(%)		85%		
Effective TSS Removal with Chemical Addition - Peak Conditions(%)		75%		
Backwash Concentration	mg/L	84		
WAS Thickening: 1				
WAS Thickener? **Yes**				
Solids Capture	%	**95%**		
Thickened Sludge Concentration	mg/L	**60,000**		
Belt Wash Water Flow Rate	gpm	**0**		
Hours/Day of Operation		**24**		
Days/Week of Operation		**7**		
Dewatering: 1				
Dewatering? **Yes**				
Solids Capture	%	**95%**		
Dewatered Sludge Concentration	%	**15%**		
Belt Wash Water Flow Rate	gpm	**0**		
Hours/Day of Operation		**24**		
Days/Week of Operation		**7**		

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Mass Balance for Average Flow Conditions

Constituent	Raw Wastewater (RW)	InfBox Recycle Influent (RecyI)	InfBox Recycled Stream (Recycle)	InfBox Combined Recycle Effluent (RecyE)	1985 Bioreactor Influent (BI)	1985 Secondary Clarifier Influent (SI)	1985 Secondary Clarifier Effluent (SE)	1995 Granular Media Filter Influent (GMFI)	1995 Granular Media Filter Effluent (GMFE)	Plant Effluent (PLE)	1985 WAS	1 WAS Thickener Influent (TWASI)	1 Thickened WAS (TWAS)	1 Dewatering Influent (DWI)	1 Dewatered Sludge (DWE)	Biosolids to Dispoal	1995 Filter Backwash (BW)	1 WAS Thickening Recycle (TWASR)	1 Dewatering Recycle (DWR)	BW Combined Discharge
Flow (gallons/day)	9,000,000	9,000,000	645,017	9,644,972	9,644,972	14,467,392	9,470,628	9,470,628	8,990,656	8,990,656	174,300	174,300	24,838	24,838	9,255	9,255	479,973	149,462	15,582	645,017
Carbonaceous BOD_5 (lbs/day)	10,515	10,515	294	10,809	10,809	47,463	93	93	31	31	2,379	2,379	2,260	2,260	2,147	2,147	62	119	113	294
COD (lbs/day)	26,598	26,598	1,972	28,570	28,570	295,007	3,000	3,000	2,496	2,496	14,647	14,647	13,876	13,876	13,179	13,179	504	770	698	1,972
TSS (lbs/day)	11,191	11,191	1,612	12,803	12,803	261,027	395	395	59	59	13,092	13,092	12,437	12,437	11,815	11,815	336	655	622	1,612
VSS (lbs/day)	9,740	9,740	1,339	11,079	11,079	216,759	328	328	49	49	10,871	10,871	10,328	10,328	9,811	9,811	279	544	516	1,339
TKN (lbs/day)	1,727	1,727	100	1,828	1,828	14,360	220	220	192	192	709	709	670	670	636	636	28	38	34	100
NH_3-N (lbs-N/day)	1,043	1,043	7	1,050	1,050	166	108	108	103	103	2	2	0	0	0	0	5	2	0	7
NO_3-N (lbs-N/day)	0	0	20	20	20	456	299	299	284	284	5	5	1	1	0	0	15	5	0	20
TP (lbs-P/day)	300	300	41	341	341	6,595	12	12	4	4	331	331	314	314	298	298	9	17	16	41
Alkalinity (lbs/day as $CaCO_3$)	12,543	12,543	700	13,242	13,242	15,697	10,275	10,275	9,755	9,755	189	189	27	27	10	10	521	162	17	700
H_2S (lbs/day)	75	75	0	75	75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BOD_5 (mg/L)	140	140	55	134	134	393	1	1	0	0	1,636	1,636	10,903	10,903	27,795	27,795	16	96	869	55
COD (mg/L)	354	354	366	355	355	2,443	38	38	33	33	10,069	10,069	66,944	66,944	170,616	170,616	126	618	5,365	366
TSS (mg/L)	149	149	300	159	159	2,162	5	5	1	1	9,000	9,000	60,000	60,000	152,963	152,963	84	525	4,782	300
VSS (mg/L)	130	130	249	138	138	1,795	0	0	1	1	7,474	7,474	49,824	49,824	127,021	127,021	70	436	3,971	249
TKN (mg-N/L)	23.0	23	19	23	23	119	3	3	3	3	487	487	3,233	3,233	8,239	8,239	7	31	260	19
NH_3-N (mg-N/L)	13.9	14	1	13	13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
NO_3-N (mg-N/L)	0.0	0	4	0	0	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
TP (mg-P/L)	4.0	4	8	4	4	55	0	0	0	0	227	227	1,515	1,515	3,863	3,863	2	13	121	8
Alkalinity (mg/L as $CaCO_3$)	167	167	130	165	165	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130
H_2S (mg/L)	1.0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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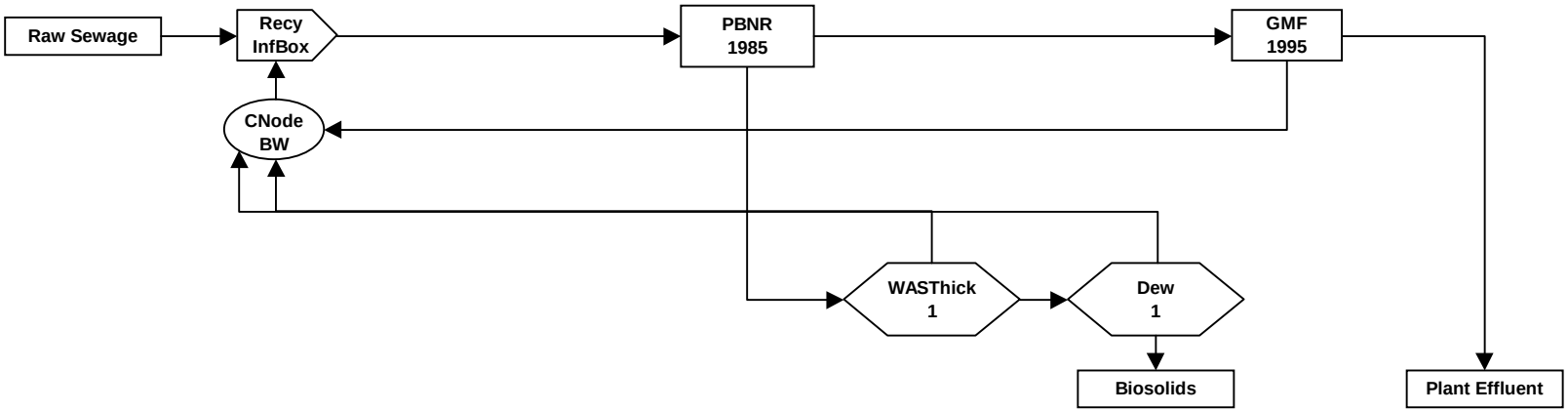

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Facility Operating Parameters			Project	First Assumptions
Item		**Value**	**Notes**	**US**
Influent Wastewater	(US)	(US)		
Flow	MG/day			
Design Average		**7.40**	4.933333333	
Design Diurnal Peak		**12**	Max Month Conditions	peak hourly flow
Design Peaking Factor for WW Diurnal flow		1.621621622		
Design Peaking Factor for WW Diurnal loads		**1.3**		
Carbonaceous Five-Day Biochemical Oxygen Demand (CBOD5)				
Design Average Concentration	mg/L	140	140	
Design Average Mass Loading	lb/day	**8,645**		
Design Diurnal Peak Mass Loading	lb/day	11,239		
Total Suspended Solids (TSS)				
Design Average Concentration	mg/L	149	149	
Design Average Mass Loading	lb/day	**9,201**		
Design Diurnal Peak Mass Loading	lb/day	11,962		
Volatile Suspended Solids (VSS)				
Percent VSS	%	**87%**		
Design Average Concentration	mg/L	130		
Design Average Mass Loading	lb/day	8,009		
Design Diurnal Peak Mass Loading	lb/day	10,411		
Total Kjeldahl Nitrogen (TKN as N)				
Design Average Concentration	mg/L	23.0	23	
Design Average Mass Loading	lb/day	**1,420**		
Design Diurnal Peak Mass Loading	lb/day	1,846		
Ammonia-Nitrogen (NH3-N as N)			TKN/ammonia Ratio	
Design Average Concentration	mg/L	13.9	1.656023222	
Design Average Mass Loading	lb/day	**858**		
Design Diurnal Peak Mass Loading	lb/day	1,115		
Total Phosphorus (as P)				
Design Average Concentration	mg/L	4.00		
Design Average Mass Loading	lb/day	**247**	Estimated	
Design Diurnal Peak Mass Loading	lb/day	321		
Alkalinity (as CaCO3)				
Design Average Concentration	mg/L	167	167	
Design Average Mass Loading	lb/day	**10,313**		
Design Diurnal Peak Mass Loading	lb/day	13,407		
Hydrogen Sulfide (H2S)				
Design Average Concentration	mg/L	1		
Design Average Mass Loading	lb/day	**62**	Estimated	
Design Diurnal Peak Mass Loading	lb/day	80		
Chemical Addition:				
Select the Metal Salt (if used)		3		
Biological Process - PBNR: 1985				
Total SRT (anaerobic + anoxic + aerobic)	days	**9.7**		
Nitrifier Minimum SRT (SRT_{min})	days	1.2		
DO	mg/L	2.0		
Temperature in the Biological Process	oF	**80**		
SVI	mL/g	**120**		
Biosolids Production Rates				
Net Yield (mg TSS/mg BOD_5)	lb/lb	1.13		
Volatile Fraction	%	80.0%		
Active Fraction	%	37.0%		
Nitrifier Fraction	%	1.0%		
Nitrogen Content, N/VSS	%	6.5%		
Phosphorus Content, P/VSS	%	2.9%		
Process Oxygen Requirements				
Carbonaceous AOR/BOD5 - wt/wt	lb/lb	1.1		
Total AOR/BOD% - wt/wt	lb/lb	1.4		
AOR (wt/day)	lb/day			
Average		11,909		
Diurnal Peak		17,293		
AOR	mg/L-hr			
Average		20		
Diurnal Peak		28		
Bioreactor **With Secondary Clarifier**				
Total Bioreactor Volume	MG	**3.04**	0.05channel+0.8FAB+2.19CAB	
HRT	hr	9.1		
% non-aerobic		26%		
% aerobic		74%		

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Average MLSS Concentration	mg/L	3,815		
Bioreactor Clarifier				
Total Area	sq.ft.	**13,254**		
Overflow Rate	gpd-sq.ft.			
Average		604		
Diurnal Peak		951		<1000 gpd/sq.ft.; <900 gpd/sq.ft. with chem
Effluent TSS	mg/L			
Average		**3**		
Diurnal Peak		**20**		
Underflow Rate				
Average Flow Ratio		**50%**	0.67	Max RAS Capacity, gpm
Average Rate	gpd-sq.ft.	302	2,779	3600
Peak Flow Ratio		**50%**	RAS, gpm	6400
Peak Rate	gpd-sq.ft.	475	4,376	
Solids Loading Rate	lb/day-sq.ft.			
Average		23		
Diurnal Peak		45		<50 lb/day-sq.ft.; <25 lb/day-sq.ft. with nit.
Limiting Solids Loading Rate	lb/day-sq.ft.	49	41	
Return sludge rate at which limiting solids rate can be achieved				
RAS Flow Rate	MGD	6.9		
Percent of Influent to Bioreactor	%	86%		
RAS Concentration	mg/L			
Average		8,969		
Diurnal Peak		9,267		
No Membrane Bioreactor Selected				
Effluent TSS	mg/L			
Average		**1**		
Diurnal Peak		**1**		
Chemical Compound Applied before Secondary Clarifier				
Chemical Added? **No**				
Chemical Type		0		
Chemical Dosage (as chemical)	lb/day	**200**		
Chemical Dosage (mg chemical/L treated)	mg/L	N/A		
Molar Ratio Dosage Applied (M+:PO4-P)		N/A		
Effluent PO4-P	lb/day	N/A		
Effluent PO4-P	mg/L	N/A		
Filters: 1995				
Filters? **Yes**				
Total Area	ft2	**2,400**		
Hydraulic Loading Rate	gpm/ft2			
Average		2.14		
Diurnal Peak		3.47		
Solids Loading Rate	lb/day-sq.ft.			
Average		0.02		
Diurnal Peak		0.18		
Filter Run Time	hr	**24**		
Instantaneous Backwash Rate	gpm/ft2	**0.14**		
Duration of Backwash Flow	minutes	**1,440**		
Backwash Operating Time (%cycle)	%	100.00%		
Backwash Flow Rate	MGD	0.48		
Ratio of Backwash Production to Filter Influent	%	6.1%		
TSS Removal Efficiency at Average Conditions		**85%**		
TSS Removal Efficiency at Diurnal Peak Conditions		**75%**		
Chemical Compound Applied to Filter Influent **No**				
Chemical Formula		Al2(SO4)3*14H20		
Chemical Dosage (mg chemical/L treated)	mg/L	**10**		
Chemical Dosage (as chemical)	lb/day	657.0		
Molar Ratio of Metal to Phosphate		0.0		
Percent of Soluble P that is ortho-P		***100%***		
Effective TSS Removal with Chemical Addition - Average Conditions(%)		85%		
Effective TSS Removal with Chemical Addition - Peak Conditions(%)		75%		
Backwash Concentration	mg/L	47		
WAS Thickening: 1				
WAS Thickener? **Yes**				
Solids Capture	%	**95%**		
Thickened Sludge Concentration	mg/L	**60,000**		
Belt Wash Water Flow Rate	gpm	**0**		
Hours/Day of Operation		**24**		
Days/Week of Operation		**7**		
Dewatering: 1				
Dewatering? **Yes**				
Solids Capture	%	**95%**		
Dewatered Sludge Concentration	%	**15%**		
Belt Wash Water Flow Rate	gpm	**0**		
Hours/Day of Operation		**24**		
Days/Week of Operation		**7**		

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Mass Balance for Average Flow Conditions

Constituent	Raw Wastewater (RW)	InfBox Recycle Influent (RecyI)	InfBox Recycled Stream (Recycle)	InfBox Combined Recycle Effluent (RecyE)	1985 Bioreactor Influent (BI)	1985 Secondary Clarifier Influent (SI)	1985 Secondary Clarifier Effluent (SE)	1995 Granular Media Filter Influent (GMFI)	1995 Granular Media Filter Effluent (GMFE)	Plant Effluent (PLE)	1985 WAS	1 WAS Thickener Influent (TWASI)	1 Thickened WAS (TWAS)	1 Dewatering Influent (DWI)	1 Dewatered Sludge (DWE)	Biosolids to Dispoal	1995 Filter Backwash (BW)	1 WAS Thickening Recycle (TWASR)	1 Dewatering Recycle (DWR)	BW Combined Discharge
Flow (gallons/day)	7,400,000	7,400,000	602,990	8,002,902	8,002,902	12,004,221	7,872,899	7,872,899	7,392,926	7,392,926	129,916	129,916	18,513	18,513	6,899	6,899	479,973	111,403	11,614	602,990
Carbonaceous BOD_5 (lbs/day)	8,646	8,646	157	8,803	8,803	42,511	45	45	18	18	1,340	1,340	1,273	1,273	1,209	1,209	27	67	64	157
COD (lbs/day)	21,869	21,869	1,431	23,299	23,299	347,875	2,367	2,367	2,028	2,028	10,902	10,902	10,329	10,329	9,809	9,809	338	573	519	1,431
TSS (lbs/day)	9,201	9,201	1,139	10,340	10,340	309,465	221	221	33	33	9,758	9,758	9,270	9,270	8,807	8,807	187	488	464	1,139
VSS (lbs/day)	8,009	8,009	932	8,940	8,940	253,162	180	180	27	27	7,983	7,983	7,583	7,583	7,204	7,204	153	399	379	932
TKN (lbs/day)	1,420	1,420	69	1,489	1,489	16,224	146	146	128	128	507	507	480	480	456	456	18	27	24	69
NH_3-N (lbs-N/day)	858	858	5	862	862	90	59	59	55	55	1	1	0	0	0	0	4	1	0	5
NO_3-N (lbs-N/day)	0	0	9	9	9	172	113	113	106	106	2	2	0	0	0	0	7	2	0	9
TP (lbs-P/day)	247	247	31	278	278	8,308	18	18	12	12	262	262	248	248	236	236	6	13	12	31
Alkalinity (lbs/day as $CaCO_3$)	10,313	10,313	676	10,989	10,989	13,467	8,832	8,832	8,294	8,294	146	146	21	21	8	8	538	125	13	676
H_2S (lbs/day)	62	62	0	62	62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BOD_5 (mg/L)	140	140	31	132	132	424	1	1	0	0	1,236	1,236	8,238	8,238	21,002	21,002	7	72	657	31
COD (mg/L)	354	354	284	349	349	3,472	36	36	33	33	10,055	10,055	66,852	66,852	170,382	170,382	84	617	5,358	284
TSS (mg/L)	149	149	226	155	155	3,089	3	3	1	1	9,000	9,000	60,000	60,000	152,963	152,963	47	525	4,782	226
VSS (mg/L)	130	130	185	134	134	2,527	0	0	0	0	7,363	7,363	49,084	49,084	125,133	125,133	38	429	3,912	185
TKN (mg-N/L)	23.0	23	14	22	22	162	2	2	2	2	468	468	3,108	3,108	7,920	7,920	4	29	250	14
NH_3-N (mg-N/L)	13.9	14	1	13	13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
NO_3-N (mg-N/L)	0.0	0	2	0	0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
TP (mg-P/L)	4.0	4	6	4	4	83	0	0	0	0	241	241	1,607	1,607	4,098	4,098	1	14	128	6
Alkalinity (mg/L as $CaCO_3$)	167	167	134	165	165	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134
H_2S (mg/L)	1.0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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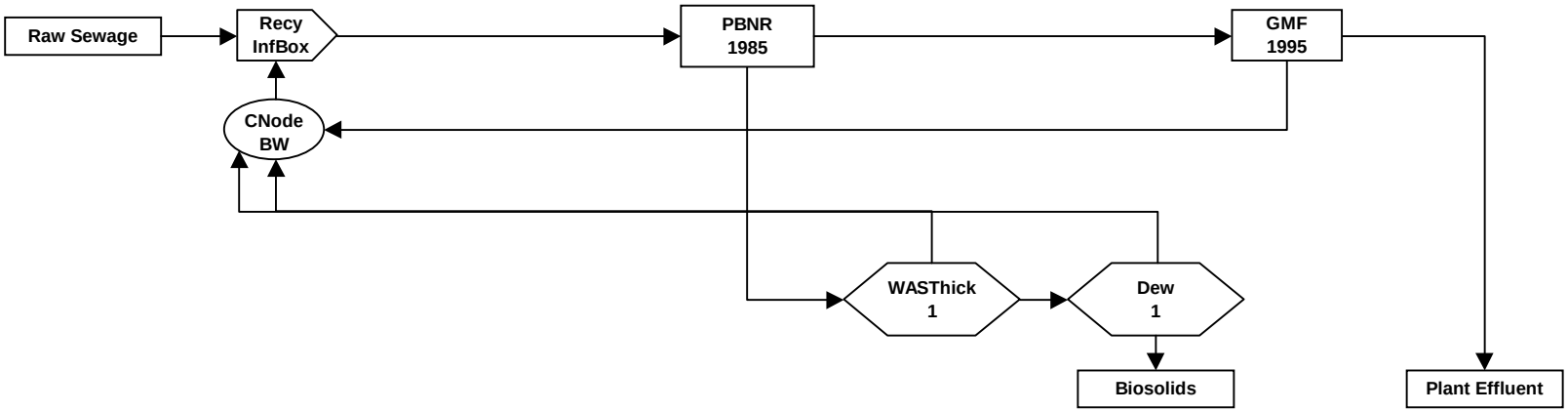

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Model Convergence 0.17%

Facility Operating Parameters			Project	First Assumptions
Item		**Value**	**Notes**	**US**
Influent Wastewater	(US)	(US)		
Flow	MG/day			
Design Average		**6.90**	4.6	
Design Diurnal Peak		**12**	Max Month Conditions	peak hourly flow
Design Peaking Factor for WW Diurnal flow		1.74		
Design Peaking Factor for WW Diurnal loads		**1.3**		
Carbonaceous Five-Day Biochemical Oxygen Demand (CBOD5)				
Design Average Concentration	mg/L	140	140	
Design Average Mass Loading	lb/day	**8,061**		
Design Diurnal Peak Mass Loading	lb/day	10,480		
Total Suspended Solids (TSS)				
Design Average Concentration	mg/L	149	149	
Design Average Mass Loading	lb/day	**8,579**		
Design Diurnal Peak Mass Loading	lb/day	11,153		
Volatile Suspended Solids (VSS)				
Percent VSS	%	**87%**		
Design Average Concentration	mg/L	130		
Design Average Mass Loading	lb/day	7,467		
Design Diurnal Peak Mass Loading	lb/day	9,708		
Total Kjeldahl Nitrogen (TKN as N)				
Design Average Concentration	mg/L	23.0	23	
Design Average Mass Loading	lb/day	**1,324**		
Design Diurnal Peak Mass Loading	lb/day	1,722		
Ammonia-Nitrogen (NH3-N as N)			TKN/ammonia Ratio	
Design Average Concentration	mg/L	13.9	1.656023222	
Design Average Mass Loading	lb/day	**800**		
Design Diurnal Peak Mass Loading	lb/day	1,040		
Total Phosphorus (as P)				
Design Average Concentration	mg/L	4.00		
Design Average Mass Loading	lb/day	**230**	Estimated	
Design Diurnal Peak Mass Loading	lb/day	299		
Alkalinity (as CaCO3)				
Design Average Concentration	mg/L	167	167	
Design Average Mass Loading	lb/day	**9,616**		
Design Diurnal Peak Mass Loading	lb/day	12,501		
Hydrogen Sulfide (H2S)				
Design Average Concentration	mg/L	1		
Design Average Mass Loading	lb/day	**58**	Estimated	
Design Diurnal Peak Mass Loading	lb/day	75		
Chemical Addition:				
Select the Metal Salt (if used)		3		
Biological Process - PBNR: 1985				
Total SRT (anaerobic + anoxic + aerobic)	days	**11.3**		
Nitrifier Minimum SRT (SRT_{min})	days	1.2		
DO	mg/L	2.0		
Temperature in the Biological Process	oF	**80**		
SVI	mL/g	**120**		
Biosolids Production Rates				
Net Yield (mg TSS/mg BOD_5)	lb/lb	1.11		
Volatile Fraction	%	79.6%		
Active Fraction	%	34.8%		
Nitrifier Fraction	%	1.0%		
Nitrogen Content, N/VSS	%	6.4%		
Phosphorus Content, P/VSS	%	3.0%		
Process Oxygen Requirements				
Carbonaceous AOR/BOD5 - wt/wt	lb/lb	1.2		
Total AOR/BOD% - wt/wt	lb/lb	1.4		
AOR (wt/day)	lb/day			
Average		11,373		
Diurnal Peak		16,367		
AOR	mg/L-hr			
Average		19		
Diurnal Peak		27		
Bioreactor **With Secondary Clarifier**				
Total Bioreactor Volume	MG	**3.04**	0.05channel+0.8FAB+2.19CAB	
HRT	hr	9.7		
% non-aerobic		26%		
% aerobic		74%		

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Average MLSS Concentration	mg/L	4,059		
Bioreactor Clarifier				
Total Area	sq.ft.	**13,254**		
Overflow Rate	gpd-sq.ft.			
Average		565		
Diurnal Peak		950		<1000 gpd/sq.ft.; <900 gpd/sq.ft
Effluent TSS	mg/L			
Average		**3**		
Diurnal Peak		**20**		
Underflow Rate				
Average Flow Ratio		**50%**	0.67	Max RAS Capacity, gpm
Average Rate	gpd-sq.ft.	283	2,602	3600
Peak Flow Ratio		**50%**	RAS, gpm	6400
Peak Rate	gpd-sq.ft.	475	4,372	
Solids Loading Rate	lb/day-sq.ft.			
Average		23		
Diurnal Peak		48		<50 lb/day-sq.ft.; <25 lb/day-sq.
Limiting Solids Loading Rate	lb/day-sq.ft.	49	41	
Return sludge rate at which limiting solids rate can be achieved				
RAS Flow Rate	MGD	6.9		
Percent of Influent to Bioreactor	%	92%		
RAS Concentration	mg/L			
Average		9,562		
Diurnal Peak		9,852		
No Membrane Bioreactor Selected				
Effluent TSS	mg/L			
Average		**1**		
Diurnal Peak		**1**		
Chemical Compound Applied before Secondary Clarifier				
Chemical Added? **No**				
Chemical Type		0		
Chemical Dosage (as chemical)	lb/day	**200**		
Chemical Dosage (mg chemical/L treated)	mg/L	N/A		
Molar Ratio Dosage Applied (M+:PO4-P)		N/A		
Effluent PO4-P	lb/day	N/A		
Effluent PO4-P	mg/L	N/A		
Filters: 1995				
Filters? **Yes**				
Total Area	ft2	**2,400**		
Hydraulic Loading Rate	gpm/ft2			
Average		1.99		
Diurnal Peak		3.47		
Solids Loading Rate	lb/day-sq.ft.			
Average		0.02		
Diurnal Peak		0.18		
Filter Run Time	hr	**24**		
Instantaneous Backwash Rate	gpm/ft2	**0.14**		
Duration of Backwash Flow	minutes	**1,440**		
Backwash Operating Time (%cycle)	%	100.00%		
Backwash Flow Rate	MGD	0.48		
Ratio of Backwash Production to Filter Influent	%	6.5%		
TSS Removal Efficiency at Average Conditions		**85%**		
TSS Removal Efficiency at Diurnal Peak Conditions		**75%**		
Chemical Compound Applied to Filter Influent **No**				
Chemical Formula		Al2(SO4)3*14H20		
Chemical Dosage (mg chemical/L treated)	mg/L	**10**		
Chemical Dosage (as chemical)	lb/day	615.4		
Molar Ratio of Metal to Phosphate		0.0		
Percent of Soluble P that is ortho-P		***100%***		
Effective TSS Removal with Chemical Addition - Average Conditions(%)		85%		
Effective TSS Removal with Chemical Addition - Peak Conditions(%)		75%		
Backwash Concentration	mg/L	44		
WAS Thickening: 1				
WAS Thickener? **Yes**				
Solids Capture	%	**95%**		
Thickened Sludge Concentration	mg/L	**60,000**		
Belt Wash Water Flow Rate	gpm	**0**		
Hours/Day of Operation		**24**		
Days/Week of Operation		**7**		
Dewatering: 1				
Dewatering? **Yes**				
Solids Capture	%	**95%**		
Dewatered Sludge Concentration	%	**15%**		
Belt Wash Water Flow Rate	gpm	**0**		
Hours/Day of Operation		**24**		
Days/Week of Operation		**7**		

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Mass Balance for Average Flow Conditions

Constituent	Raw Wastewater (RW)	InfBox Recycle Influent (RecyI)	InfBox Recycled Stream (Recycle)	InfBox Combined Recycle Effluent (RecyE)	1985 Bioreactor Influent (BI)	1985 Secondary Clarifier Influent (SI)	1985 Secondary Clarifier Effluent (SE)	1995 Granular Media Filter Influent (GMFI)	1995 Granular Media Filter Effluent (GMFE)	Plant Effluent (PLE)	1985 WAS	1 WAS Thickener Influent (TWASI)	1 Thickened WAS (TWAS)	1 Dewatering Influent (DWI)	1 Dewatered Sludge (DWE)	Biosolids to Dispoal	1995 Filter Backwash (BW)	1 WAS Thickening Recycle (TWASR)	1 Dewatering Recycle (DWR)	BW Combined Discharge
Flow (gallons/day)	6,900,000	6,900,000	592,079	7,492,220	7,492,220	11,238,543	7,373,969	7,373,969	6,893,997	6,893,997	118,393	118,393	16,871	16,871	6,287	6,287	479,973	101,522	10,584	592,079
Carbonaceous BOD_5 (lbs/day)	8,061	8,061	134	8,195	8,195	39,213	39	39	16	16	1,132	1,132	1,075	1,075	1,021	1,021	23	57	54	134
COD (lbs/day)	20,392	20,392	1,320	21,713	21,713	345,937	2,216	2,216	1,891	1,891	9,932	9,932	9,410	9,410	8,937	8,937	325	522	473	1,320
TSS (lbs/day)	8,580	8,580	1,043	9,624	9,624	307,998	207	207	31	31	8,892	8,892	8,448	8,448	8,025	8,025	176	445	422	1,043
VSS (lbs/day)	7,467	7,467	849	8,318	8,318	250,901	168	168	25	25	7,244	7,244	6,882	6,882	6,538	6,538	143	362	344	849
TKN (lbs/day)	1,324	1,324	62	1,387	1,387	15,944	122	122	106	106	457	457	433	433	411	411	16	24	22	62
NH_3-N (lbs-N/day)	800	800	3	803	803	62	41	41	38	38	1	1	0	0	0	0	3	1	0	3
NO_3-N (lbs-N/day)	0	0	8	8	8	160	105	105	98	98	2	2	0	0	0	0	7	1	0	8
TP (lbs-P/day)	230	230	29	260	260	8,393	19	19	14	14	242	242	230	230	218	218	6	12	12	29
Alkalinity (lbs/day as $CaCO_3$)	9,616	9,616	660	10,276	10,276	12,533	8,223	8,223	7,688	7,688	132	132	19	19	7	7	535	113	12	660
H_2S (lbs/day)	58	58	0	58	58	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BOD_5 (mg/L)	140	140	27	131	131	418	1	1	0	0	1,145	1,145	7,635	7,635	19,465	19,465	6	67	609	27
COD (mg/L)	354	354	267	347	347	3,688	36	36	33	33	10,052	10,052	66,834	66,834	170,335	170,335	81	617	5,356	267
TSS (mg/L)	149	149	211	154	154	3,284	3	3	1	1	9,000	9,000	60,000	60,000	152,963	152,963	44	525	4,782	211
VSS (mg/L)	130	130	172	133	133	2,675	0	0	0	0	7,332	7,332	48,877	48,877	124,607	124,607	36	427	3,895	172
TKN (mg-N/L)	23.0	23	13	22	22	170	2	2	2	2	463	463	3,075	3,075	7,836	7,836	4	29	247	13
NH_3-N (mg-N/L)	13.9	14	1	13	13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
NO_3-N (mg-N/L)	0.0	0	2	0	0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
TP (mg-P/L)	4.0	4	6	4	4	89	0	0	0	0	245	245	1,631	1,631	4,158	4,158	1	14	130	6
Alkalinity (mg/L as $CaCO_3$)	167	167	134	164	164	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134
H_2S (mg/L)	1.0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

3.5

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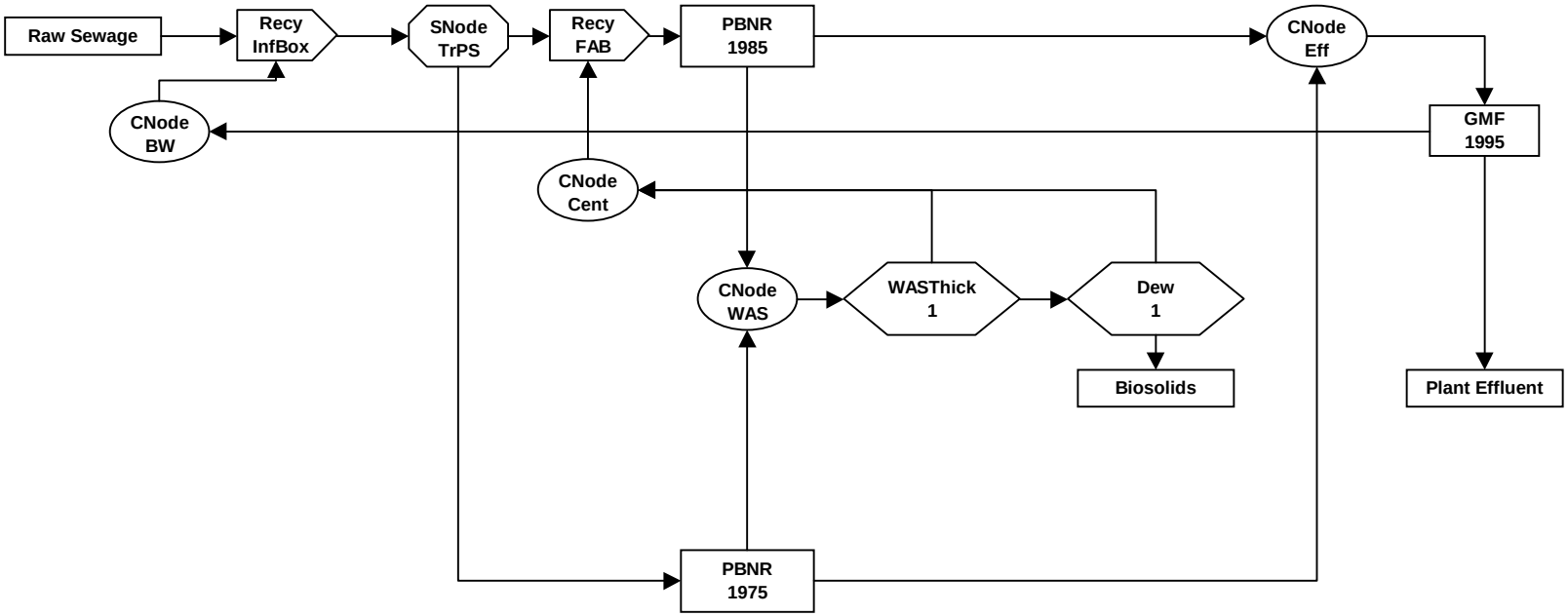

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Model Convergence 0.19%

Facility Operating Parameters			Project	First Assumptions
Item		**Value**	**Notes**	**US**
Influent Wastewater	(US)	(US)		
Flow	MG/day			
Design Average		**10.80**	MM	MM/Peak PF
Design Diurnal Peak		**16.2**		1.5
Design Peaking Factor for WW Diurnal flow		1.5		
Design Peaking Factor for WW Diurnal loads		**1.4**		
Carbonaceous Five-Day Biochemical Oxygen Demand (CBOD5)			Maximum Month Conditions	
Design Average Concentration	mg/L	140	140	
Design Average Mass Loading	lb/day	**12,618**		
Design Diurnal Peak Mass Loading	lb/day	17,665		
Total Suspended Solids (TSS)				
Design Average Concentration	mg/L	149	149	
Design Average Mass Loading	lb/day	**13,429**		
Design Diurnal Peak Mass Loading	lb/day	18,800		
Volatile Suspended Solids (VSS)				
Percent VSS	%	**87%**		
Design Average Concentration	mg/L	130		
Design Average Mass Loading	lb/day	11,688		
Design Diurnal Peak Mass Loading	lb/day	16,363		
Total Kjeldahl Nitrogen (TKN as N)				
Design Average Concentration	mg/L	23	23	
Design Average Mass Loading	lb/day	**2,073**		
Design Diurnal Peak Mass Loading	lb/day	2,902		
Ammonia-Nitrogen (NH3-N as N)			TKN/ammonia Ratio	
Design Average Concentration	mg/L	14	1.66	
Design Average Mass Loading	lb/day	**1,252**		
Design Diurnal Peak Mass Loading	lb/day	1,752		
Total Phosphorus (as P)				
Design Average Concentration	mg/L	4		
Design Average Mass Loading	lb/day	**361**	Estimated	
Design Diurnal Peak Mass Loading	lb/day	505		
Alkalinity (as CaCO3)				
Design Average Concentration	mg/L	167	167	
Design Average Mass Loading	lb/day	**15,051**		
Design Diurnal Peak Mass Loading	lb/day	21,071		S
Hydrogen Sulfide (H2S)				
Design Average Concentration	mg/L	1		
Design Average Mass Loading	lb/day	**90**	Estimated	
Design Diurnal Peak Mass Loading	lb/day	126		
Chemical Addition:				
Select the Metal Salt (if used)		3		
Flow Splitter: TrPS				
Splitter Influent Flow	MGD	12.0		
Flow Splits			1985 Plant Flow, mgd	
TrPS Splitter Effluent (SplitE) RecyFAB	%	62%	**7.40**	S
TrPS Splitter Effluent (SplitE) PBNR1975	%	**38%**		
	%	**0%**		
	%	**0%**		
	%	**0%**		
	%	**0%**		
	%	**0%**		
	%	**0%**		
	%	**0%**		
Biological Process - PBNR: 1975				
Total SRT (anaerobic + anoxic + aerobic)	days	**5.0**		
Nitrifier Minimum SRT (SRT_{min})	days	1.1		
DO	mg/L	2.0		
Temperature in the Biological Process	oF	**80.6**		
SVI	mL/g	**120**		
Biosolids Production Rates				
Net Yield (mg TSS/mg BOD_5)	lb/lb	1.09		
Volatile Fraction	%	80.6%		
Active Fraction	%	43.5%		
Nitrifier Fraction	%	1.1%		
Nitrogen Content, N/VSS	%	6.8%		
Phosphorus Content, P/VSS	%	1.3%		
Process Oxygen Requirements				
Carbonaceous AOR/BOD5 - wt/wt	lb/lb	1.1		

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Total AOR/BOD% - wt/wt	lb/lb	1.4		
AOR (wt/day)	lb/day			
Average		6,943		
Diurnal Peak		10,596		
AOR	mg/L-hr			
Average		32		
Diurnal Peak		49		
Bioreactor With Secondary Clarifier				
Total Bioreactor Volume	MG	**1.09**		
HRT	hr	5.7		
% non-aerobic		0%		
% aerobic		100%		
Average MLSS Concentration	mg/L	2,899		
Bioreactor Clarifier				
Total Area	sq.ft.	**8,000**		
Overflow Rate	gpd-sq.ft.			
Average		572		
Diurnal Peak		830		<1000 gpd/sq.ft.; <900 gpd/sq.ft
Effluent TSS	mg/L			
Average		**10**		
Diurnal Peak		**20**		
Underflow Rate				
Average Flow Ratio		**67%**	0.67	
Average Rate	gpd-sq.ft.	383		
Peak Flow Ratio		**50%**		Default RAS = 100%
Peak Rate	gpd-sq.ft.	415		Adjust underflow rate to vary RA
Solids Loading Rate	lb/day-sq.ft.			
Average		23		
Diurnal Peak		30		<50 lb/day-sq.ft.; <25 lb/day-sq.
Limiting Solids Loading Rate	lb/day-sq.ft.	49		
Return sludge rate at which limiting solids rate can be achieved				
RAS Flow Rate	MGD	4.1		
Percent of Influent to Bioreactor	%	91%		
RAS Concentration	mg/L			
Average		7,019		
Diurnal Peak		8,696		
No Membrane Bioreactor Selected				
Effluent TSS	mg/L			
Average		**1**		
Diurnal Peak		**1**		
Chemical Compound Applied before Secondary Clarifier				
Chemical Added? **No**				
Chemical Type		0		
Chemical Dosage (as chemical)	lb/day	**200**		
Chemical Dosage (mg chemical/L treated)	mg/L	N/A		
Molar Ratio Dosage Applied (M+:PO4-P)		N/A		
Effluent PO4-P	lb/day	N/A		
Effluent PO4-P	mg/L	N/A		
Biological Process - PBNR: 1985				
Total SRT (anaerobic + anoxic + aerobic)	days	**11.3**		
Nitrifier Minimum SRT (SRT_{min})	days	1.0		
DO	mg/L	2.0		
Temperature in the Biological Process	oF	**80**		
SVI	mL/g	**120**		
Biosolids Production Rates				
Net Yield (mg TSS/mg BOD_5)	lb/lb	1.18		
Volatile Fraction	%	79.6%		
Active Fraction	%	36.0%		
Nitrifier Fraction	%	1.0%		
Nitrogen Content, N/VSS	%	6.5%		
Phosphorus Content, P/VSS	%	3.0%		
Process Oxygen Requirements				
Carbonaceous AOR/BOD5 - wt/wt	lb/lb	1.1		
Total AOR/BOD% - wt/wt	lb/lb	1.4		
AOR (wt/day)	lb/day			
Average		11,547		
Diurnal Peak		17,534		
AOR	mg/L-hr			
Average		19		
Diurnal Peak		29		
Bioreactor With Secondary Clarifier				
Total Bioreactor Volume	MG	**3.04**	0.05channel+0.8FAB+2.19CAB	
HRT	hr	9.6		
% non-aerobic		28%		
% aerobic		72%		
Average MLSS Concentration	mg/L	4,253		
Bioreactor Clarifier				

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Total Area	sq.ft.	**17,671**	4	Number of 75' diam SCs
Overflow Rate	gpd-sq.ft.			
Average		430		
Diurnal Peak		619		<1000 gpd/sq.ft.; <900 gpd/sq.ft
Effluent TSS	mg/L			
Average		**3**		
Diurnal Peak		**20**		
Underflow Rate				
Average Flow Ratio		**50%**	0.67	
Average Rate	gpd-sq.ft.	215		
Peak Flow Ratio		**50%**		Default RAS = 100%
Peak Rate	gpd-sq.ft.	309		Adjust underflow rate to vary RA
Solids Loading Rate	lb/day-sq.ft.			
Average		23		
Diurnal Peak		33		<50 lb/day-sq.ft.; <25 lb/day-sq.
Limiting Solids Loading Rate	lb/day-sq.ft.	40		
Return sludge rate at which limiting solids rate can be achieved				
RAS Flow Rate	MGD	7.5		
Percent of Influent to Bioreactor	%	99%		
RAS Concentration	mg/L			
Average		12,433		
Diurnal Peak		12,734		
No Membrane Bioreactor Selected				
Effluent TSS	mg/L			
Average		**1**		
Diurnal Peak		**1**		
Chemical Compound Applied before Secondary Clarifier				
Chemical Added? **No**				
Chemical Type		0		
Chemical Dosage (as chemical)	lb/day	**200**		
Chemical Dosage (mg chemical/L treated)	mg/L	N/A		
Molar Ratio Dosage Applied (M+:PO4-P)		N/A		
Effluent PO4-P	lb/day	N/A		
Effluent PO4-P	mg/L	N/A		
Filters: 1995				
Filters? **Yes**				
Total Area	ft2	**2,400**		
Hydraulic Loading Rate	gpm/ft2			
Average		3.12		
Diurnal Peak		4.69		
Solids Loading Rate	lb/day-sq.ft.			
Average		0.05		
Diurnal Peak		0.25		
Filter Run Time	hr	**24**		
Instantaneous Backwash Rate	gpm/ft2	**0.34**		
Duration of Backwash Flow	minutes	**1,440**		
Backwash Operating Time (%cycle)	%	100.00%		
Backwash Flow Rate	MGD	1.18		
Ratio of Backwash Production to Filter Influent	%	9.8%		
TSS Removal Efficiency at Average Conditions		**85%**		
TSS Removal Efficiency at Diurnal Peak Conditions		**75%**		
Chemical Compound Applied to Filter Influent **No**				
Chemical Formula		Al2(SO4)3*14H20		
Chemical Dosage (mg chemical/L treated)	mg/L	**10**		
Chemical Dosage (as chemical)	lb/day	998.5		
Molar Ratio of Metal to Phosphate		0.0		
Percent of Soluble P that is ortho-P		***100%***		
Effective TSS Removal with Chemical Addition - Average Conditions(%)		85%		
Effective TSS Removal with Chemical Addition - Peak Conditions(%)		75%		
Backwash Concentration	mg/L	51		
WAS Thickening: 1				
WAS Thickener? **Yes**				
Solids Capture	%	**95%**		
Thickened Sludge Concentration	mg/L	**60,000**		
Belt Wash Water Flow Rate	gpm	**0**		
Hours/Day of Operation		**24**		
Days/Week of Operation		**7**		
Dewatering: 1				
Dewatering? **Yes**				
Solids Capture	%	**95%**		
Dewatered Sludge Concentration	%	**15%**		
Belt Wash Water Flow Rate	gpm	**0**		
Hours/Day of Operation		**24**		
Days/Week of Operation		**7**		

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Mass Balance for Average Flow Conditions

Constituent	Raw Wastewater (RW)	InfBox Recycle Influent (RecyI)	InfBox Recycled Stream (Recycle)	InfBox Combined Recycle Effluent (RecyE)	TrPS Splitter Influent (SplitI)	TrPS Splitter Effluent (SplitE) RecyFAB	TrPS Splitter Effluent (SplitE) PBNR1975	FAB Recycle Influent (RecyI)	FAB Recycled Stream (Recycle)	FAB Combined Recycle Effluent (RecyE)	1975 Bioreactor Influent (BI)	1975 Secondary Clarifier Influent (SI)	1975 Secondary Clarifier Effluent (SE)	1985 Bioreactor Influent (BI)	1985 Secondary Clarifier Influent (SI)	1985 Secondary Clarifier Effluent (SE)	Eff Combined Discharge	1995 Granular Media Filter Influent (GMFI)	1995 Granular Media Filter Effluent (GMFE)	Plant Effluent (PLE)	1975 WAS	1985 WAS	WAS Combined Discharge	1 WAS Thickener Influent (TWASI)	1 Thickened WAS (TWAS)
Flow (gallons/day)	10,800,000	10,800,000	1,174,973	11,974,973	11,974,973	7,400,000	4,574,973	7,400,000	197,716	7,597,682	4,574,973	7,640,205	4,491,342	7,597,682	11,396,473	7,473,508	11,964,850	11,964,850	10,789,877	10,789,877	83,631	124,140	207,772	207,772	26,985
Carbonaceous BOD_5 (lbs/day)	12,618	12,618	95	12,713	12,713	7,856	4,857	7,856	215	8,070	4,857	41,226	97	8,070	47,865	38	135	135	40	40	1,092	1,105	2,198	2,198	2,087
Particulate	6,618	6,618	3	6,621	6,621	4,092	2,530	4,092	6	4,097	2,530	1,485	3	4,097	912	0	3	3	1	1	39	21	60	60	57
Heterotrophs	0	0	83	83	83	51	32	51	175	226	32	39,630	80	226	32,379	17	97	97	15	15	1,050	748	1,798	1,798	1,708
PAOs	0	0	7	7	7	4	3	4	33	37	3	88	0	37	14,552	8	8	8	1	1	2	336	338	338	322
PHA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
Filtrate	6,000	6,000	3	6,002	6,002	3,709	2,293	3,709	0	3,710	2,293	23	14	3,710	20	13	27	27	24	24	0	0	0	0	0
COD (lbs/day)	31,917	31,917	884	32,801	32,801	20,270	12,531	20,270	1,616	21,884	12,531	216,426	1,655	21,884	450,748	2,244	3,899	3,899	3,015	3,015	5,704	10,374	16,078	16,078	15,228
Particulate Bio	11,618	11,618	6	11,624	11,624	7,183	4,441	7,183	12	7,195	4,441	3,002	6	7,195	1,844	1	7	7	1	1	80	43	122	122	116
Particulate Non-Bio	4,979	4,979	329	5,308	5,308	3,280	2,028	3,280	938	4,218	2,028	119,444	242	4,218	279,532	145	387	387	58	58	3,166	6,456	9,622	9,622	9,141
Heterotrophs	0	0	185	185	185	115	71	115	394	508	71	89,013	181	508	72,727	38	218	218	33	33	2,359	1,680	4,039	4,039	3,837
Autotrophs	0	0	6	6	6	4	2	4	16	20	2	2,352	5	20	4,364	2	7	7	1	1	62	101	163	163	155
PAOs	0	0	40	40	40	25	15	25	202	227	15	538	1	227	89,196	46	47	47	7	7	14	2,060	2,074	2,074	1,971
PHA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0
Soluble Bio	6,319	6,319	5	6,324	6,324	3,908	2,416	3,908	1	3,909	2,416	44	26	3,909	36	24	50	50	45	45	0	0	1	1	0
Colloidal Bio	4,213	4,213	0	4,213	4,213	2,603	1,610	2,603	0	2,603	1,610	0	0	2,603	0	0	0	0	0	0	0	0	0	0	0
Soluble Non-Bio	2,873	2,873	313	3,185	3,185	1,968	1,217	1,968	53	2,021	1,217	2,032	1,195	2,021	3,031	1,988	3,182	3,182	2,870	2,870	22	33	55	55	7
Colloidal Non-Bio	1,915	1,915	0	1,915	1,915	1,183	732	1,183	0	1,183	732	0	0	1,183	0	0	0	0	0	0	0	0	0	0	0
TSS (lbs/day)	13,429	13,429	497	13,925	13,925	8,605	5,320	8,605	1,387	9,991	5,320	184,833	375	9,991	403,692	209	584	584	88	88	4,899	9,324	14,223	14,223	13,512
Biodegradable	9,091	9,091	5	9,095	9,095	5,621	3,475	5,621	9	5,630	3,475	2,349	5	5,630	1,443	1	6	6	1	1	62	33	96	96	91
Non-Biodegradable	4,338	4,338	274	4,613	4,613	2,850	1,762	2,850	782	3,631	1,762	99,693	202	3,631	232,664	121	323	323	48	48	2,642	5,374	8,016	8,016	7,615
Metal Hydroxide	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Metal Phosphate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heterotrophs	0	0	166	166	166	103	64	103	353	456	64	79,848	162	456	65,239	34	196	196	29	29	2,116	1,507	3,623	3,623	3,442
Autotrophs	0	0	5	5	5	3	2	3	14	18	2	2,110	4	18	3,915	2	6	6	1	1	56	90	146	146	139
PAOs	0	0	36	36	36	22	14	22	181	204	14	482	1	204	80,012	42	42	42	6	6	13	1,848	1,861	1,861	1,768
PHA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0
Poly-P	0	0	10	10	10	6	4	6	47	53	4	350	1	53	20,409	11	11	11	2	2	9	471	481	481	457
VSS (lbs/day)	11,688	11,688	421	12,109	12,109	7,483	4,626	7,483	1,154	8,636	4,626	160,184	325	8,636	328,559	170	495	495	74	74	4,246	7,589	11,835	11,835	11,243
Biodegradable	8,182	8,182	4	8,186	8,186	5,059	3,127	5,059	8	5,067	3,127	2,114	4	5,067	1,299	1	5	5	1	1	56	30	86	86	82
Non-Biodegradable	3,506	3,506	230	3,736	3,736	2,309	1,427	2,309	651	2,960	1,427	83,873	170	2,960	193,001	100	270	270	41	41	2,223	4,458	6,681	6,681	6,347
Metal Hydroxide	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heterotrophs	0	0	150	150	150	92	57	92	318	410	57	71,863	146	410	58,715	30	176	176	26	26	1,905	1,356	3,261	3,261	3,098
Autotrophs	0	0	5	5	5	3	2	3	13	16	2	1,899	4	16	3,524	2	6	6	1	1	50	81	132	132	125
PAOs	0	0	32	33	33	20	12	20	163	183	12	434	1	183	72,011	37	38	38	6	6	12	1,663	1,675	1,675	1,591
PHA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0
TKN (lbs/day)	2,073	2,073	44	2,117	2,117	1,308	809	1,308	76	1,384	809	10,309	96	1,384	20,888	111	207	207	163	163	271	481	752	752	712
NH_3-N (lbs-N/day)	1,252	1,252	6	1,258	1,258	777	481	777	1	778	481	55	32	778	44	29	61	61	55	55	1	0	1	1	0
Particulate Bio Org N	450	450	0	450	450	278	172	278	0	278	172	80	0	278	49	0	0	0	0	0	2	1	3	3	3
Non-Bio Part Org N	193	193	12	205	205	127	78	127	36	163	78	4,536	9	163	10,615	6	15	15	2	2	120	245	365	365	347
Heterotrophs	0	0	11	11	11	7	4	7	24	31	4	5,391	11	31	4,405	2	13	13	2	2	143	102	245	245	232
Autotrophs	0	0	0	0	0	0	0	0	1	1	0	142	0	1	264	0	0	0	0	0	4	6	10	10	9
PAOs	0	0	2	2	2	2	1	2	12	14	1	33	0	14	5,402	3	3	3	0	0	1	125	126	126	119
Non-Bio Soluble Org. N	103	103	11	115	115	71	44	71	2	73	44	73	43	73	109	72	115	115	103	103	1	1	2	2	0
Non-Bio Colloidal Org. N	69	69	0	69	69	43	26	43	0	43	26	0	0	43	0	0	0	0	0	0	0	0	0	0	0
Soluble Bio Org N	4	4	0	4	4	2	1	2	0	2	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Colloidal Bio Org N	2	2	0	2	2	1	1	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
NO_3-N (lbs-N/day)	0	0	63	63	63	39	24	39	11	50	24	562	330	50	479	314	645	645	581	581	6	5	11	11	1
TP (lbs-P/day)	361	361	17	377	377	233	144	233	33	266	144	2,686	74	266	11,082	10	85	85	68	68	69	256	325	325	308
Bio Particulate	82	82	0	82	82	51	31	51	0	51	31	14	0	51	9	0	0	0	0	0	0	0	1	1	1
Non-Bio Particulate	35	35	2	37	37	23	14	23	5	27	14	608	1	27	1,422	1	2	2	0	0	16	33	49	49	46
Metal Phosphate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heterotrophs	0	0	4	4	4	2	1	2	8	10	1	1,780	4	10	1,455	1	4	4	1	1	47	34	81	81	77
Autotrophs	0	0	0	0	0	0	0	0	0	0	0	47	0	0	87	0	0	0	0	0	1	2	3	3	3
PAOs	0	0	1	1	1	0	0	0	4	5	0	11	0	5	1,784	1	1	1	0	0	0	41	41	41	39
Poly-P	0	0	3	3	3	2	1	2	15	16	1	108	0	16	6,318	3	3	3	1	1	3	146	149	149	141
Ortho-PO4	244	244	7	251	251	155	96	155	1	156	96	118	69	156	7	4	74	74	67	67	1	0	1	1	0
Alkalinity (lbs/day as $CaCO_3$)	15,051	15,051	1,141	16,192	16,192	10,006	6,186	10,006	191	10,197	6,186	6,903	4,058	10,197	11,526	7,558	11,616	11,616	10,475	10,475	76	126	201	201	26
H_2S (lbs/day)	90	90	0	90	90	56	34	56	0	56	34	0	0	56	0	0	0	0	0	0	0	0	0	0	0
BOD_5 (mg/L)	140	140	10	127	127	127	127	127	130	127	127	647	3	127	503	1	1	1	0	0	1,565	1,067	1,267	1,267	9,269
COD (mg/L)	354	354	90	328	328	328	328	328	979	345	328	3,394	44	345	4,739	36	39	39	33	33	8,173	10,013	9,272	9,272	67,619
TSS (mg/L)	149	149	51	139	139	139	139	139	840	158	139	2,899	10	158	4,245	3	6	6	1	1	7,019	9,000	8,203	8,203	60,000
VSS (mg/L)	130	130	43	121	121	121	121	121	699	136	121	2,512	0	136	3,455	0	0	0	1	1	6,083	7,325	6,825	6,825	49,923
TKN (mg-N/L)	23.0	23	4	21	21	21	21	21	46	22	21	162	3	22	220	2	2	2	2	2	389	464	434	434	3,160
NH_3-N (mg-N/L)	13.9	14	1	13	13	13	13	13	1	12	13	1	1	12	0	0	1	1	1	1	1	0	1	1	1
NO_3-N (mg-N/L)	0.0	0	6	1	1	1	1	1	7	1	1	9	9	1	5	5	6	6	6	6	9	5	7	7	7
TP (mg-P/L)	4.0	4	2	4	4	4	4	4	20	4	4	42	2	4	117	0	1	1	1	1	99	247	188	188	1,367
Alkalinity (mg/L as $CaCO_3$)	167	167	116	162	162	162	162	162	116	161	162	108	108	161	121	121	116	116	116	116	108	121	116	116	116
H_2S (mg/L)	1.0	1	0	1	1	1	1	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0

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Mass Balance for Average Flow

Constituent	1 Dewatering Influent (DWI)	1 Dewatered Sludge (DWE)	Biosolids to Dispoal	1995 Filter Backwash (BW)	1 WAS Thickening Recycle (TWASR)	1 Dewatering Recycle (DWR)	BW Combined Discharge	Cent Combined Discharge
Flow (gallons/day)	26,985	10,056	10,056	1,174,973	180,787	16,929	1,174,973	197,716
Carbonaceous BOD_5 (lbs/day)	2,087	1,983	1,983	95	110	104	95	215
Particulate	57	55	55	3	3	3	3	6
Heterotrophs	1,708	1,623	1,623	83	90	85	83	175
PAOs	322	305	305	7	17	16	7	33
PHA	0	0	0	0	0	0	0	0
Filtrate	0	0	0	3	0	0	3	0
COD (lbs/day)	15,228	14,462	14,462	884	850	766	884	1,616
Particulate Bio	116	110	110	6	6	6	6	12
Particulate Non-Bio	9,141	8,684	8,684	329	481	457	329	938
Heterotrophs	3,837	3,645	3,645	185	202	192	185	394
Autotrophs	155	147	147	6	8	8	6	16
PAOs	1,971	1,872	1,872	40	104	99	40	202
PHA	0	0	0	0	0	0	0	0
Soluble Bio	0	0	0	5	1	0	5	1
Colloidal Bio	0	0	0	0	0	0	0	0
Soluble Non-Bio	7	3	3	313	48	5	313	53
Colloidal Non-Bio	0	0	0	0	0	0	0	0
TSS (lbs/day)	13,512	12,836	12,836	497	711	676	497	1,387
Biodegradable	91	86	86	5	5	5	5	9
Non-Biodegradable	7,615	7,235	7,235	274	401	381	274	782
Metal Hydroxide	0	0	0	0	0	0	0	0
Metal Phosphate	0	0	0	**0**	0	0	**0**	0
Heterotrophs	3,442	3,270	3,270	166	181	172	166	353
Autotrophs	139	132	132	5	7	7	5	14
PAOs	1,768	1,679	1,679	36	93	88	36	181
PHA	0	0	0	0	0	0	0	0
Poly-P	457	434	434	10	24	23	10	47
VSS (lbs/day)	11,243	10,681	10,681	421	592	562	421	1,154
Biodegradable	82	78	78	4	4	4	4	8
Non-Biodegradable	6,347	6,029	6,029	230	334	317	230	651
Metal Hydroxide	0	0	0	0	0	0	0	0
Heterotrophs	3,098	2,943	2,943	150	163	155	150	318
Autotrophs	125	119	119	5	7	6	5	13
PAOs	1,591	1,511	1,511	32	84	80	32	163
PHA	0	0	0	0	0	0	0	0
TKN (lbs/day)	712	676	676	44	40	36	44	76
NH_3-N (lbs-N/day)	0	0	0	6	1	0	6	1
Particulate Bio Org N	3	3	3	0	0	0	0	0
Non-Bio Part Org N	347	330	330	12	18	17	12	36
Heterotrophs	232	221	221	11	12	12	11	24
Autotrophs	9	9	9	0	0	0	0	1
PAOs	119	113	113	2	6	6	2	12
Non-Bio Soluble Org. N	0	0	0	11	2	0	11	2
Non-Bio Colloidal Org. N	0	0	0	0	0	0	0	0
Soluble Bio Org N	0	0	0	0	0	0	0	0
Colloidal Bio Org N	0	0	0	0	0	0	0	0
NO_3-N (lbs-N/day)	1	1	1	63	10	1	63	11
TP (lbs-P/day)	308	292	292	17	17	15	17	33
Bio Particulate	1	1	1	0	0	0	0	0
Non-Bio Particulate	46	44	44	2	2	2	2	5
Metal Phosphate	0	0	0	0	0	0	0	0
Heterotrophs	77	73	73	4	4	4	4	8
Autotrophs	3	3	3	0	0	0	0	0
PAOs	39	37	37	1	2	2	1	4
Poly-P	141	134	134	3	7	7	3	15
Ortho-PO4	0	0	0	7	1	0	7	1
Alkalinity (lbs/day as $CaCO_3$)	26	10	10	1,141	175	16	1,141	191
H_2S (lbs/day)	0	0	0	0	0	0	0	0
BOD_5 (mg/L)	9,269	23,630	23,630	10	73	739	10	130
COD (mg/L)	67,619	172,336	172,336	90	563	5,419	90	979
TSS (mg/L)	60,000	152,963	152,963	51	471	4,782	51	840
VSS (mg/L)	49,923	127,274	127,274	43	392	3,979	43	699
TKN (mg-N/L)	3,160	8,054	8,054	4	27	254	4	46
NH_3-N (mg-N/L)	1	1	1	1	1	1	1	1
NO_3-N (mg-N/L)	7	7	7	6	7	7	6	7
TP (mg-P/L)	1,367	3,484	3,484	2	12	110	2	20
Alkalinity (mg/L as $CaCO_3$)	116	116	116	116	116	116	116	116
H_2S (mg/L)	0	0	0	0	0	0	0	0

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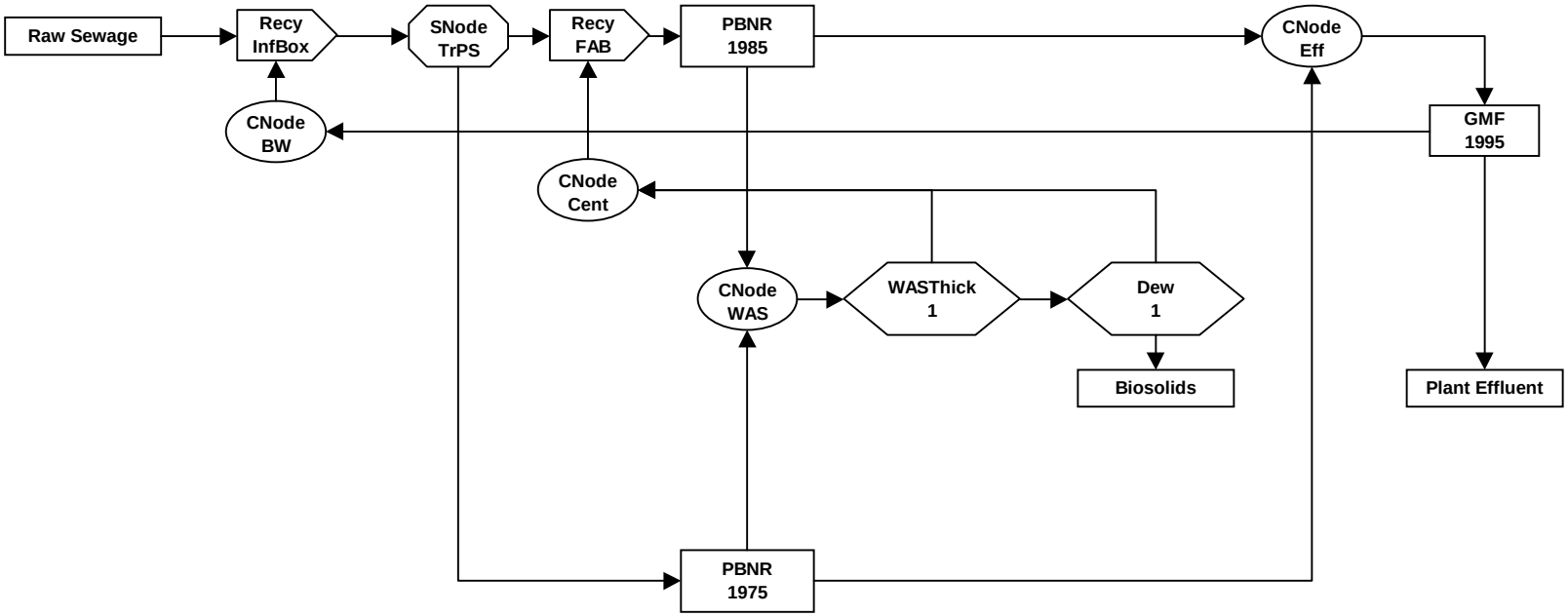

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Model Convergence 0.49%

Facility Operating Parameters			Project	First Assumptions	
Item		Value	Notes	US	
Influent Wastewater	(US)	(US)			
Flow	MG/day				
Design Average		**11.60**	MM	MM/Peak PF	
Design Diurnal Peak		**19.8**		1.5	
Design Peaking Factor for WW Diurnal flow		1.71			
Design Peaking Factor for WW Diurnal loads		**1.4**			
Carbonaceous Five-Day Biochemical Oxygen Demand (CBOD5)			Maximum Month Conditions		
Design Average Concentration	mg/L	140	140		
Design Average Mass Loading	lb/day	**13,552**			
Design Diurnal Peak Mass Loading	lb/day	18,973			
Total Suspended Solids (TSS)					
Design Average Concentration	mg/L	149	149		
Design Average Mass Loading	lb/day	**14,423**			
Design Diurnal Peak Mass Loading	lb/day	20,193			
Volatile Suspended Solids (VSS)					
Percent VSS	%	**87%**			
Design Average Concentration	mg/L	130			
Design Average Mass Loading	lb/day	12,554			
Design Diurnal Peak Mass Loading	lb/day	17,576			E
Total Kjeldahl Nitrogen (TKN as N)					
Design Average Concentration	mg/L	23	23		
Design Average Mass Loading	lb/day	**2,226**			
Design Diurnal Peak Mass Loading	lb/day	3,117			
Ammonia-Nitrogen (NH3-N as N)			TKN/ammonia Ratio		
Design Average Concentration	mg/L	14	1.66		
Design Average Mass Loading	lb/day	**1,344**			
Design Diurnal Peak Mass Loading	lb/day	1,882			
Total Phosphorus (as P)					
Design Average Concentration	mg/L	4			
Design Average Mass Loading	lb/day	**387**	Estimated		
Design Diurnal Peak Mass Loading	lb/day	542			
Alkalinity (as CaCO3)					
Design Average Concentration	mg/L	167	167		
Design Average Mass Loading	lb/day	**16,166**			Se
Design Diurnal Peak Mass Loading	lb/day	22,632			Secondary (
Hydrogen Sulfide (H2S)					
Design Average Concentration	mg/L	1			F
Design Average Mass Loading	lb/day	**97**	Estimated		
Design Diurnal Peak Mass Loading	lb/day	136			
Chemical Addition:					
Select the Metal Salt (if used)		3			
Flow Splitter: TrPS					
Splitter Influent Flow	MGD	12.8			
Flow Splits			1985 Plant Flow, mgd		Se
TrPS Splitter Effluent (SplitE) RecyFAB	%	65%	**8.30**		Secondary (
TrPS Splitter Effluent (SplitE) PBNR1975	%	**35%**			
	%	**0%**			
	%	**0%**			
	%	**0%**			
	%	**0%**			
	%	**0%**			
	%	**0%**			
	%	**0%**			
Biological Process - PBNR: 1975					
Total SRT (anaerobic + anoxic + aerobic)	days	**5.0**			
Nitrifier Minimum SRT (SRT_{min})	days	1.1			
DO	mg/L	2.0			
Temperature in the Biological Process	oF	**80.6**			
SVI	mL/g	**120**			
Biosolids Production Rates					
Net Yield (mg TSS/mg BOD_5)	lb/lb	1.08			
Volatile Fraction	%	80.7%			
Active Fraction	%	43.5%			
Nitrifier Fraction	%	1.2%			
Nitrogen Content, N/VSS	%	6.8%			
Phosphorus Content, P/VSS	%	1.3%			
Process Oxygen Requirements					
Carbonaceous AOR/BOD5 - wt/wt	lb/lb	1.1			

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Total AOR/BOD% - wt/wt	lb/lb	1.4		
AOR (wt/day)	lb/day			
Average		6,876		
Diurnal Peak		10,461		
AOR	mg/L-hr			
Average		31		
Diurnal Peak		48		
Bioreactor With Secondary Clarifier				
Total Bioreactor Volume	MG	**1.09**		
HRT	hr	5.8		
% non-aerobic		0%		
% aerobic		100%		
Average MLSS Concentration	mg/L	2,864		
Bioreactor Clarifier				
Total Area	sq.ft.	**8,000**		
Overflow Rate	gpd-sq.ft.			
Average		564		
Diurnal Peak		925		<1000 gpd/sq.ft.; <900 gpd/sq.ft. with chem
Effluent TSS	mg/L			
Average		**10**		
Diurnal Peak		**20**		
Underflow Rate				
Average Flow Ratio		**67%**	0.67	
Average Rate	gpd-sq.ft.	378		
Peak Flow Ratio		**50%**		Default RAS = 100%
Peak Rate	gpd-sq.ft.	462		Adjust underflow rate to vary RAS
Solids Loading Rate	lb/day-sq.ft.			
Average		22		
Diurnal Peak		33		<50 lb/day-sq.ft.; <25 lb/day-sq.ft. with nit.
Limiting Solids Loading Rate	lb/day-sq.ft.	49		
Return sludge rate at which limiting solids rate can be achieved				
RAS Flow Rate	MGD	4.1		
Percent of Influent to Bioreactor	%	92%		
RAS Concentration	mg/L			
Average		6,931		
Diurnal Peak		8,591		
No Membrane Bioreactor Selected				
Effluent TSS	mg/L			
Average		**1**		
Diurnal Peak		**1**		
Chemical Compound Applied before Secondary Clarifier				
Chemical Added? **No**				
Chemical Type		0		
Chemical Dosage (as chemical)	lb/day	**200**		
Chemical Dosage (mg chemical/L treated)	mg/L	N/A		
Molar Ratio Dosage Applied (M+:PO4-P)		N/A		
Effluent PO4-P	lb/day	N/A		
Effluent PO4-P	mg/L	N/A		
Biological Process - PBNR: 1985				
Total SRT (anaerobic + anoxic + aerobic)	days	**11.3**		
Nitrifier Minimum SRT (SRT_{min})	days	1.2		
DO	mg/L	2.0		
Temperature in the Biological Process	oF	**80**		
SVI	mL/g	**120**		
Biosolids Production Rates				
Net Yield (mg TSS/mg BOD_5)	lb/lb	1.15		
Volatile Fraction	%	79.6%		
Active Fraction	%	33.6%		
Nitrifier Fraction	%	1.0%		
Nitrogen Content, N/VSS	%	6.4%		
Phosphorus Content, P/VSS	%	2.9%		
Process Oxygen Requirements				
Carbonaceous AOR/BOD5 - wt/wt	lb/lb	1.2		
Total AOR/BOD% - wt/wt	lb/lb	1.4		
AOR (wt/day)	lb/day			
Average		12,539		
Diurnal Peak		18,980		
AOR	mg/L-hr			
Average		21		
Diurnal Peak		31		
Bioreactor With Secondary Clarifier				
Total Bioreactor Volume	MG	**3.04**	0.05channel+0.8FAB+2.19CAB	
HRT	hr	8.6		
% non-aerobic		26%		
% aerobic		74%		
Average MLSS Concentration	mg/L	4,651		
Bioreactor Clarifier				

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Total Area	sq.ft.	**17,671**	4	Number of 75' diam SCs
Overflow Rate	gpd-sq.ft.			
Average		482		
Diurnal Peak		782		<1000 gpd/sq.ft.; <900 gpd/sq.ft. with chem
Effluent TSS	mg/L			
Average		**3**		
Diurnal Peak		**20**		
Underflow Rate				
Average Flow Ratio		**50%**	0.67	
Average Rate	gpd-sq.ft.	241		
Peak Flow Ratio		**50%**		Default RAS = 100%
Peak Rate	gpd-sq.ft.	391		Adjust underflow rate to vary RAS
Solids Loading Rate	lb/day-sq.ft.			
Average		23		
Diurnal Peak		46		<50 lb/day-sq.ft.; <25 lb/day-sq.ft. with nit.
Limiting Solids Loading Rate	lb/day-sq.ft.	49		
Return sludge rate at which limiting solids rate can be achieved				
RAS Flow Rate	MGD	9.1		
Percent of Influent to Bioreactor	%	107%		
RAS Concentration	mg/L			
Average		10,985		
Diurnal Peak		11,278		
No Membrane Bioreactor Selected				
Effluent TSS	mg/L			
Average		**1**		
Diurnal Peak		**1**		
Chemical Compound Applied before Secondary Clarifier				
Chemical Added? **No**				
Chemical Type		0		
Chemical Dosage (as chemical)	lb/day	**200**		
Chemical Dosage (mg chemical/L treated)	mg/L	N/A		
Molar Ratio Dosage Applied (M+:PO4-P)		N/A		
Effluent PO4-P	lb/day	N/A		
Effluent PO4-P	mg/L	N/A		
Filters: 1995				
Filters? **Yes**				
Total Area	ft2	**2,400**		
Hydraulic Loading Rate	gpm/ft2			
Average		3.35		
Diurnal Peak		5.73		
Solids Loading Rate	lb/day-sq.ft.			
Average		0.05		
Diurnal Peak		0.30		
Filter Run Time	hr	**24**		
Instantaneous Backwash Rate	gpm/ft2	**0.35**		
Duration of Backwash Flow	minutes	**1,440**		
Backwash Operating Time (%cycle)	%	100.00%		
Backwash Flow Rate	MGD	1.21		
Ratio of Backwash Production to Filter Influent	%	9.5%		
TSS Removal Efficiency at Average Conditions		**85%**		
TSS Removal Efficiency at Diurnal Peak Conditions		**75%**		
Chemical Compound Applied to Filter Influent **No**				
Chemical Formula		Al2(SO4)3*14H20		
Chemical Dosage (mg chemical/L treated)	mg/L	**10**		
Chemical Dosage (as chemical)	lb/day	1068.1		
Molar Ratio of Metal to Phosphate		0.0		
Percent of Soluble P that is ortho-P		***100%***		
Effective TSS Removal with Chemical Addition - Average Conditions(%)		85%		
Effective TSS Removal with Chemical Addition - Peak Conditions(%)		75%		
Backwash Concentration	mg/L	51		
WAS Thickening: 1				
WAS Thickener? **Yes**				
Solids Capture	%	**95%**		
Thickened Sludge Concentration	mg/L	**60,000**		
Belt Wash Water Flow Rate	gpm	**0**		
Hours/Day of Operation		**24**		
Days/Week of Operation		**7**		
Dewatering: 1				
Dewatering? **Yes**				
Solids Capture	%	**95%**		
Dewatered Sludge Concentration	%	**15%**		
Belt Wash Water Flow Rate	gpm	**0**		
Hours/Day of Operation		**24**		
Days/Week of Operation		**7**		

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Mass Balance for Average Flow Conditions

Constituent	Raw Wastewater (RW)	InfBox Recycle Influent (RecyI)	InfBox Recycled Stream (Recycle)	InfBox Combined Recycle Effluent (RecyE)	TrPS Splitter Influent (SplitI)	TrPS Splitter Effluent (SplitE) RecyFAB	TrPS Splitter Effluent (SplitE) PBNR1975	FAB Recycle Influent (RecyI)	FAB Recycled Stream (Recycle)	FAB Combined Recycle Effluent (RecyE)	1975 Bioreactor Influent (BI)	1975 Secondary Clarifier Influent (SI)	1975 Secondary Clarifier Effluent (SE)	1985 Bioreactor Influent (BI)	1985 Secondary Clarifier Influent (SI)	1985 Secondary Clarifier Effluent (SE)	Eff Combined Discharge	1995 Granular Media Filter Influent (GMFI)	1995 Granular Media Filter Effluent (GMFE)	Plant Effluent (PLE)	1975 WAS	1985 WAS	WAS Combined Discharge	1 WAS Thickener Influent (TWASI)	1 Thickened WAS (TWAS)
Flow (gallons/day)	11,600,000	11,600,000	1,209,531	12,809,501	12,809,501	8,300,000	4,509,501	8,300,000	208,754	8,508,757	4,509,501	7,530,815	4,425,787	8,508,757	12,763,140	8,373,060	12,798,847	12,798,847	11,589,316	11,589,316	83,683	135,699	219,383	219,383	28,521
Carbonaceous BOD_5 (lbs/day)	13,553	13,553	98	13,651	13,651	8,845	4,806	8,845	230	9,076	4,806	40,244	96	9,076	50,111	45	141	141	43	43	1,082	1,275	2,357	2,357	2,239
Particulate	7,108	7,108	3	7,112	7,112	4,608	2,504	4,608	7	4,615	2,504	1,449	3	4,615	1,241	1	4	4	1	1	39	32	71	71	67
Heterotrophs	0	0	87	87	87	56	31	56	197	254	31	38,706	79	254	38,425	23	102	102	15	15	1,041	978	2,019	2,019	1,918
PAOs	0	0	5	5	5	3	2	3	26	29	2	65	0	29	10,419	6	6	6	1	1	2	265	267	267	254
PHA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
Filtrate	6,444	6,444	3	6,447	6,447	4,177	2,270	4,177	0	4,178	2,270	23	14	4,178	23	15	29	29	26	26	0	0	1	1	0
COD (lbs/day)	34,281	34,281	914	35,196	35,196	22,806	12,391	22,806	1,712	24,520	12,391	211,116	1,631	24,520	449,452	2,517	4,148	4,148	3,235	3,235	5,646	11,389	17,035	17,035	16,135
Particulate Bio	12,479	12,479	6	12,485	12,485	8,090	4,395	8,090	14	8,104	4,395	2,930	6	8,104	2,509	1	7	7	1	1	79	64	143	143	136
Particulate Non-Bio	5,348	5,348	347	5,696	5,696	3,691	2,005	3,691	1,022	4,714	2,005	116,492	239	4,714	288,832	169	408	408	61	61	3,133	7,352	10,485	10,485	9,961
Heterotrophs	0	0	195	195	195	127	69	127	442	570	69	86,939	178	570	86,307	51	229	229	34	34	2,338	2,197	4,535	4,535	4,308
Autotrophs	0	0	6	6	6	4	2	4	17	21	2	2,310	5	21	4,487	3	7	7	1	1	62	114	176	176	168
PAOs	0	0	32	32	32	21	11	21	160	181	11	400	1	181	63,862	37	38	38	6	6	11	1,626	1,636	1,636	1,554
PHA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	0	0	0	0	0	0	0	0	0	0
Soluble Bio	6,788	6,788	5	6,793	6,793	4,401	2,391	4,401	1	4,402	2,391	43	25	4,402	43	28	54	54	49	49	0	0	1	1	0
Colloidal Bio	4,525	4,525	0	4,525	4,525	2,932	1,593	2,932	0	2,932	1,593	0	0	2,932	0	0	0	0	0	0	0	0	0	0	0
Soluble Non-Bio	3,085	3,085	322	3,407	3,407	2,208	1,199	2,208	56	2,263	1,199	2,003	1,177	2,263	3,395	2,227	3,404	3,404	3,082	3,082	22	36	58	58	8
Colloidal Non-Bio	2,057	2,057	0	2,057	2,057	1,333	724	1,333	0	1,333	724	0	0	1,333	0	0	0	0	0	0	0	0	0	0	0
TSS (lbs/day)	14,424	14,424	513	14,939	14,939	9,680	5,259	9,680	1,466	11,148	5,259	179,980	369	11,148	400,418	235	604	604	91	91	4,841	10,192	15,033	15,033	14,281
Biodegradable	9,764	9,764	5	9,769	9,769	6,330	3,439	6,330	11	6,341	3,439	2,292	5	6,341	1,963	1	6	6	1	1	62	50	112	112	106
Non-Biodegradable	4,660	4,660	288	4,949	4,949	3,207	1,742	3,207	848	4,057	1,742	96,984	199	4,057	239,375	140	339	339	51	51	2,608	6,093	8,702	8,702	8,266
Metal Hydroxide	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Metal Phosphate	0	0	**0**	**0**	**0**	**0**	**0**	**0**	0	**0**	**0**	0	0	**0**	0	0	0	0	**0**	**0**	0	0	0	0	0
Heterotrophs	0	0	175	175	175	113	62	113	397	511	62	77,987	160	511	77,420	45	205	205	31	31	2,098	1,971	4,068	4,068	3,865
Autotrophs	0	0	6	6	6	4	2	4	15	19	2	2,072	4	19	4,025	2	7	7	1	1	56	102	158	158	150
PAOs	0	0	29	29	29	19	10	19	143	162	10	359	1	162	57,287	34	34	34	5	5	10	1,458	1,468	1,468	1,394
PHA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0
Poly-P	0	0	11	11	11	7	4	7	51	58	4	285	1	58	20,338	12	13	13	2	2	8	518	525	525	499
VSS (lbs/day)	12,554	12,554	435	12,990	12,990	8,417	4,573	8,417	1,219	9,638	4,573	156,232	321	9,638	326,103	191	512	512	77	77	4,202	8,301	12,503	12,503	11,877
Biodegradable	8,788	8,788	4	8,792	8,792	5,697	3,095	5,697	10	5,707	3,095	2,063	4	5,707	1,767	1	5	5	1	1	55	45	100	100	95
Non-Biodegradable	3,766	3,766	242	4,009	4,009	2,598	1,411	2,598	710	3,308	1,411	81,792	168	3,308	199,467	117	285	285	43	43	2,200	5,077	7,277	7,277	6,913
Metal Hydroxide	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heterotrophs	0	0	157	158	158	102	55	102	357	460	55	70,189	144	460	69,678	41	185	185	28	28	1,888	1,774	3,661	3,661	3,478
Autotrophs	0	0	5	5	5	3	2	3	14	17	2	1,865	4	17	3,623	2	6	6	1	1	50	92	142	142	135
PAOs	0	0	26	26	26	17	9	17	129	146	9	323	1	146	51,558	30	31	31	5	5	9	1,312	1,321	1,321	1,255
PHA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0
TKN (lbs/day)	2,226	2,226	46	2,272	2,272	1,472	800	1,472	80	1,552	800	10,057	94	1,552	20,585	133	227	227	181	181	268	521	790	790	747
NH_3-N (lbs-N/day)	1,344	1,344	7	1,351	1,351	876	476	876	1	877	476	54	32	877	62	41	72	72	65	65	1	1	1	1	0
Particulate Bio Org N	483	483	0	483	483	313	170	313	0	314	170	78	0	314	66	0	0	0	0	0	2	2	4	4	4
Non-Bio Part Org N	207	207	13	220	220	143	78	143	39	182	78	4,424	9	182	10,968	6	16	16	2	2	119	279	398	398	378
Heterotrophs	0	0	12	12	12	8	4	8	27	35	4	5,265	11	35	5,227	3	14	14	2	2	142	133	275	275	261
Autotrophs	0	0	0	0	0	0	0	0	1	1	0	140	0	1	272	0	0	0	0	0	4	7	11	11	10
PAOs	0	0	2	2	2	1	1	1	10	11	1	24	0	11	3,868	2	2	2	0	0	1	98	99	99	94
Non-Bio Soluble Org. N	111	111	12	123	123	79	43	79	2	81	43	72	42	81	122	80	123	123	111	111	1	1	2	2	0
Non-Bio Colloidal Org. N	74	74	0	74	74	48	26	48	0	48	26	0	0	48	0	0	0	0	0	0	0	0	0	0	0
Soluble Bio Org N	4	4	0	4	4	2	1	2	0	2	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Colloidal Bio Org N	3	3	0	3	3	2	1	2	0	2	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0
NO_3-N (lbs-N/day)	0	0	40	41	41	26	14	26	7	34	14	541	318	34	168	110	428	428	388	388	6	2	8	8	1
TP (lbs-P/day)	387	387	18	405	405	262	143	262	35	297	143	2,606	75	297	10,894	22	96	96	79	79	68	277	345	345	327
Bio Particulate	88	88	0	88	88	57	31	57	0	57	31	14	0	57	12	0	0	0	0	0	0	0	1	1	1
Non-Bio Particulate	38	38	2	39	39	26	14	26	5	31	14	592	1	31	1,469	1	2	2	0	0	16	37	53	53	51
Metal Phosphate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heterotrophs	0	0	4	4	4	3	1	3	9	11	1	1,739	4	11	1,726	1	5	5	1	1	47	44	91	91	86
Autotrophs	0	0	0	0	0	0	0	0	0	0	0	46	0	0	90	0	0	0	0	0	1	2	4	4	3
PAOs	0	0	1	1	1	0	0	0	3	4	0	8	0	4	1,277	1	1	1	0	0	0	33	33	33	31
Poly-P	0	0	3	3	3	2	1	2	16	18	1	88	0	18	6,297	4	4	4	1	1	2	160	163	163	155
Ortho-PO4	262	262	8	270	270	175	95	175	1	176	95	118	69	176	24	16	85	85	77	77	1	0	2	2	0
Alkalinity (lbs/day as $CaCO_3$)	16,166	16,166	1,263	17,429	17,429	11,293	6,136	11,293	216	11,509	6,136	6,837	4,018	11,509	14,244	9,345	13,363	13,363	12,100	12,100	76	151	227	227	30
H_2S (lbs/day)	97	97	0	97	97	63	34	63	0	63	34	0	0	63	0	0	0	0	0	0	0	0	0	0	0
BOD_5 (mg/L)	140	140	10	128	128	128	128	128	132	128	128	640	3	128	470	1	1	1	0	0	1,549	1,126	1,287	1,287	9,406
COD (mg/L)	354	354	91	329	329	329	329	329	982	345	329	3,359	44	345	4,220	36	39	39	33	33	8,084	10,057	9,305	9,305	67,787
TSS (mg/L)	149	149	51	140	140	140	140	140	841	157	140	2,864	10	157	3,759	3	6	6	1	1	6,931	9,000	8,211	8,211	60,000
VSS (mg/L)	130	130	43	122	122	122	122	122	700	136	122	2,486	0	136	3,062	0	0	0	1	1	6,017	7,330	6,829	6,829	49,901
TKN (mg-N/L)	23.0	23	5	21	21	21	21	21	46	22	21	160	3	22	193	2	2	2	2	2	384	460	431	431	3,140
NH_3-N (mg-N/L)	13.9	14	1	13	13	13	13	13	1	12	13	1	1	12	1	1	1	1	1	1	1	1	1	1	1
NO_3-N (mg-N/L)	0.0	0	4	0	0	0	0	0	4	0	0	9	9	0	2	2	4	4	4	4	9	2	4	4	4
TP (mg-P/L)	4.0	4	2	4	4	4	4	4	20	4	4	41	2	4	102	0	1	1	1	1	98	245	189	189	1,372
Alkalinity (mg/L as $CaCO_3$)	167	167	125	163	163	163	163	163	124	162	163	109	109	162	134	134	125	125	125	125	109	134	124	124	124
H_2S (mg/L)	1.0	1	0	1	1	1	1	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0

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Mass Balance for Average Flow

Constituent	1 Dewatering Influent (DWI)	1 Dewatered Sludge (DWE)	Biosolids to Dispoal	1995 Filter Backwash (BW)	1 WAS Thickening Recycle (TWASR)	1 Dewatering Recycle (DWR)	BW Combined Discharge	Cent Combined Discharge
Flow (gallons/day)	28,521	10,628	10,628	1,209,531	190,862	17,893	1,209,531	208,754
Carbonaceous BOD_5 (lbs/day)	2,239	2,127	2,127	98	118	112	98	230
Particulate	67	64	64	3	4	3	3	7
Heterotrophs	1,918	1,822	1,822	87	101	96	87	197
PAOs	254	241	241	5	13	13	5	26
PHA	0	0	0	0	0	0	0	0
Filtrate	0	0	0	3	0	0	3	0
COD (lbs/day)	16,135	15,324	15,324	914	900	811	914	1,712
Particulate Bio	136	129	129	6	7	7	6	14
Particulate Non-Bio	9,961	9,463	9,463	347	524	498	347	1,022
Heterotrophs	4,308	4,093	4,093	195	227	215	195	442
Autotrophs	168	159	159	6	9	8	6	17
PAOs	1,554	1,477	1,477	32	82	78	32	160
PHA	0	0	0	0	0	0	0	0
Soluble Bio	0	0	0	5	1	0	5	1
Colloidal Bio	0	0	0	0	0	0	0	0
Soluble Non-Bio	8	3	3	322	51	5	322	56
Colloidal Non-Bio	0	0	0	0	0	0	0	0
TSS (lbs/day)	14,281	13,567	13,567	513	752	714	513	1,466
Biodegradable	106	101	101	5	6	5	5	11
Non-Biodegradable	8,266	7,853	7,853	288	435	413	288	848
Metal Hydroxide	0	0	0	0	0	0	0	0
Metal Phosphate	0	0	0	**0**	0	0	**0**	0
Heterotrophs	3,865	3,672	3,672	175	203	193	175	397
Autotrophs	150	143	143	6	8	8	6	15
PAOs	1,394	1,325	1,325	29	73	70	29	143
PHA	0	0	0	0	0	0	0	0
Poly-P	499	474	474	11	26	25	11	51
VSS (lbs/day)	11,877	11,284	11,284	435	625	594	435	1,219
Biodegradable	95	91	91	4	5	5	4	10
Non-Biodegradable	6,913	6,568	6,568	242	364	346	242	710
Metal Hydroxide	0	0	0	0	0	0	0	0
Heterotrophs	3,478	3,304	3,304	157	183	174	157	357
Autotrophs	135	128	128	5	7	7	5	14
PAOs	1,255	1,192	1,192	26	66	63	26	129
PHA	0	0	0	0	0	0	0	0
TKN (lbs/day)	747	710	710	46	42	38	46	80
NH_3-N (lbs-N/day)	0	0	0	7	1	0	7	1
Particulate Bio Org N	4	3	3	0	0	0	0	0
Non-Bio Part Org N	378	359	359	13	20	19	13	39
Heterotrophs	261	248	248	12	14	13	12	27
Autotrophs	10	10	10	0	1	1	0	1
PAOs	94	89	89	2	5	5	2	10
Non-Bio Soluble Org. N	0	0	0	12	2	0	12	2
Non-Bio Colloidal Org. N	0	0	0	0	0	0	0	0
Soluble Bio Org N	0	0	0	0	0	0	0	0
Colloidal Bio Org N	0	0	0	0	0	0	0	0
NO_3-N (lbs-N/day)	1	0	0	40	7	1	40	7
TP (lbs-P/day)	327	310	310	18	19	16	18	35
Bio Particulate	1	1	1	0	0	0	0	0
Non-Bio Particulate	51	48	48	2	3	3	2	5
Metal Phosphate	0	0	0	0	0	0	0	0
Heterotrophs	86	82	82	4	5	4	4	9
Autotrophs	3	3	3	0	0	0	0	0
PAOs	31	30	30	1	2	2	1	3
Poly-P	155	147	147	3	8	8	3	16
Ortho-PO4	0	0	0	8	1	0	8	1
Alkalinity (lbs/day as $CaCO_3$)	30	11	11	1,263	198	19	1,263	216
H_2S (lbs/day)	0	0	0	0	0	0	0	0
BOD_5 (mg/L)	9,406	23,980	23,980	10	74	750	10	132
COD (mg/L)	67,787	172,766	172,766	91	565	5,432	91	982
TSS (mg/L)	60,000	152,963	152,963	51	472	4,782	51	841
VSS (mg/L)	49,901	127,216	127,216	43	392	3,977	43	700
TKN (mg-N/L)	3,140	8,003	8,003	5	27	252	5	46
NH_3-N (mg-N/L)	1	1	1	1	1	1	1	1
NO_3-N (mg-N/L)	4	4	4	4	4	4	4	4
TP (mg-P/L)	1,372	3,497	3,497	2	12	110	2	20
Alkalinity (mg/L as $CaCO_3$)	124	124	124	125	124	124	125	124
H_2S (mg/L)	0	0	0	0	0	0	0	0

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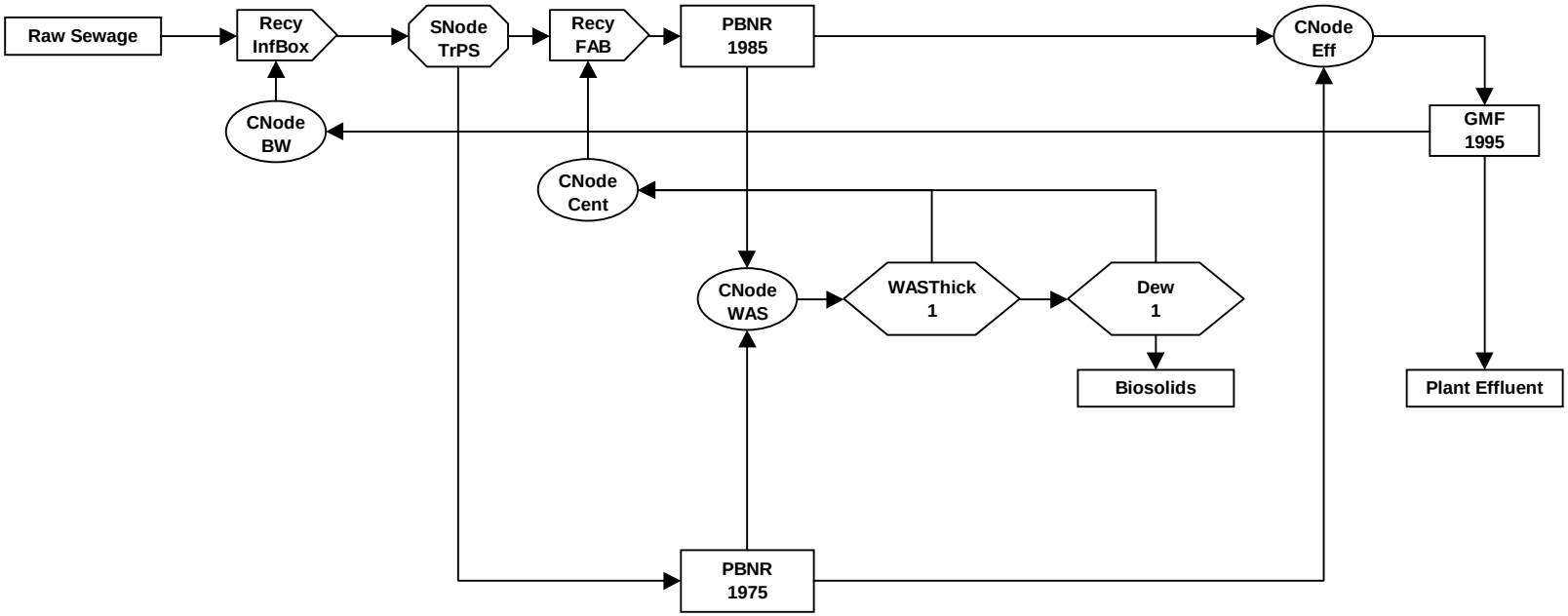

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Model Convergence 0.46%

Facility Operating Parameters			Project	First Assumptions
Item		**Value**	**Notes**	**US**
Influent Wastewater	(US)	(US)		
Flow	MG/day			
Design Average		**13.50**	MM	MM/Peak PF
Design Diurnal Peak		**19.8**		1.5
Design Peaking Factor for WW Diurnal flow		1.466666667		
Design Peaking Factor for WW Diurnal loads		**1.4**		
Carbonaceous Five-Day Biochemical Oxygen Demand (CBOD5)			Maximum Month Conditions	
Design Average Concentration	mg/L	140	140	
Design Average Mass Loading	lb/day	**15,772**		
Design Diurnal Peak Mass Loading	lb/day	22,081		
Total Suspended Solids (TSS)				
Design Average Concentration	mg/L	149	149	
Design Average Mass Loading	lb/day	**16,786**		
Design Diurnal Peak Mass Loading	lb/day	23,500		
Volatile Suspended Solids (VSS)				
Percent VSS	%	**87%**		
Design Average Concentration	mg/L	130		
Design Average Mass Loading	lb/day	14,610		
Design Diurnal Peak Mass Loading	lb/day	20,454		
Total Kjeldahl Nitrogen (TKN as N)				
Design Average Concentration	mg/L	23	23	
Design Average Mass Loading	lb/day	**2,591**		
Design Diurnal Peak Mass Loading	lb/day	3,628		
Ammonia-Nitrogen (NH3-N as N)			TKN/ammonia Ratio	
Design Average Concentration	mg/L	14	1.66	
Design Average Mass Loading	lb/day	**1,565**		
Design Diurnal Peak Mass Loading	lb/day	2,191		
Total Phosphorus (as P)				
Design Average Concentration	mg/L	4		
Design Average Mass Loading	lb/day	**451**	Estimated	
Design Diurnal Peak Mass Loading	lb/day	631		
Alkalinity (as CaCO3)				
Design Average Concentration	mg/L	167	167	
Design Average Mass Loading	lb/day	**18,814**		
Design Diurnal Peak Mass Loading	lb/day	26,339		S
Hydrogen Sulfide (H2S)				
Design Average Concentration	mg/L	1		
Design Average Mass Loading	lb/day	**113**	Estimated	
Design Diurnal Peak Mass Loading	lb/day	158		
Chemical Addition:				
Select the Metal Salt (if used)		3		
Flow Splitter: TrPS				
Splitter Influent Flow	MGD	14.9		
Flow Splits			1985 Plant Flow, mgd	
TrPS Splitter Effluent (SplitE) RecyFAB	%	69%	**10.30**	S
TrPS Splitter Effluent (SplitE) PBNR1975	%	**31%**		
	%	**0%**		
	%	**0%**		
	%	**0%**		
	%	**0%**		
	%	**0%**		
	%	**0%**		
	%	**0%**		
Biological Process - PBNR: 1975				
Total SRT (anaerobic + anoxic + aerobic)	days	**5.0**		
Nitrifier Minimum SRT (SRT_{min})	days	1.1		
DO	mg/L	2.0		
Temperature in the Biological Process	oF	**80.6**		
SVI	mL/g	**120**		
Biosolids Production Rates				
Net Yield (mg TSS/mg BOD_5)	lb/lb	1.08		
Volatile Fraction	%	80.6%		
Active Fraction	%	43.5%		
Nitrifier Fraction	%	1.1%		
Nitrogen Content, N/VSS	%	6.8%		
Phosphorus Content, P/VSS	%	1.3%		
Process Oxygen Requirements				
Carbonaceous AOR/BOD5 - wt/wt	lb/lb	1.1		

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Total AOR/BOD% - wt/wt	lb/lb	1.4		
AOR (wt/day)	lb/day			
Average		7,002		
Diurnal Peak		10,690		
AOR	mg/L-hr			
Average		32		
Diurnal Peak		49		
Bioreactor With Secondary Clarifier				
Total Bioreactor Volume	MG	**1.09**		
HRT	hr	5.7		
% non-aerobic		0%		
% aerobic		100%		
Average MLSS Concentration	mg/L	2,911		
Bioreactor Clarifier				
Total Area	sq.ft.	**8,000**		
Overflow Rate	gpd-sq.ft.			
Average		573		
Diurnal Peak		815		<1000 gpd/sq.ft.; <900 gpd/sq.ft
Effluent TSS	mg/L			
Average		**10**		
Diurnal Peak		**20**		
Underflow Rate				
Average Flow Ratio		**67%**	0.67	
Average Rate	gpd-sq.ft.	384		
Peak Flow Ratio		**50%**		Default RAS = 100%
Peak Rate	gpd-sq.ft.	408		Adjust underflow rate to vary RA
Solids Loading Rate	lb/day-sq.ft.			
Average		23		
Diurnal Peak		30		<50 lb/day-sq.ft.; <25 lb/day-sq.
Limiting Solids Loading Rate	lb/day-sq.ft.	49		
Return sludge rate at which limiting solids rate can be achieved				
RAS Flow Rate	MGD	4.1		
Percent of Influent to Bioreactor	%	90%		
RAS Concentration	mg/L			
Average		7,049		
Diurnal Peak		8,733		
No Membrane Bioreactor Selected				
Effluent TSS	mg/L			
Average		**1**		
Diurnal Peak		**1**		
Chemical Compound Applied before Secondary Clarifier				
Chemical Added? **No**				
Chemical Type		0		
Chemical Dosage (as chemical)	lb/day	**200**		
Chemical Dosage (mg chemical/L treated)	mg/L	N/A		
Molar Ratio Dosage Applied (M+:PO4-P)		N/A		
Effluent PO4-P	lb/day	N/A		
Effluent PO4-P	mg/L	N/A		
Biological Process - PBNR: 1985				
Total SRT (anaerobic + anoxic + aerobic)	days	**6.9**		
Nitrifier Minimum SRT (SRT_{min})	days	1.2		
DO	mg/L	2.0		
Temperature in the Biological Process	oF	**80**		
SVI	mL/g	**120**		
Biosolids Production Rates				
Net Yield (mg TSS/mg BOD_5)	lb/lb	1.22		
Volatile Fraction	%	80.8%		
Active Fraction	%	40.5%		
Nitrifier Fraction	%	1.0%		
Nitrogen Content, N/VSS	%	6.5%		
Phosphorus Content, P/VSS	%	2.8%		
Process Oxygen Requirements				
Carbonaceous AOR/BOD5 - wt/wt	lb/lb	1.1		
Total AOR/BOD% - wt/wt	lb/lb	1.3		
AOR (wt/day)	lb/day			
Average		14,228		
Diurnal Peak		22,266		
AOR	mg/L-hr			
Average		23		
Diurnal Peak		37		
Bioreactor With Secondary Clarifier				
Total Bioreactor Volume	MG	**3.04**	0.05channel+0.8FAB+2.19CAB	
HRT	hr	6.9		
% non-aerobic		26%		
% aerobic		74%		
Average MLSS Concentration	mg/L	3,766		
Bioreactor Clarifier				

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Total Area	sq.ft.	**17,671**	4	Number of 75' diam SCs
Overflow Rate	gpd-sq.ft.			
Average		597		
Diurnal Peak		844		<1000 gpd/sq.ft.; <900 gpd/sq.ft
Effluent TSS	mg/L			
Average		**3**		
Diurnal Peak		**20**		
Underflow Rate				
Average Flow Ratio		**50%**	0.67	
Average Rate	gpd-sq.ft.	299		
Peak Flow Ratio		**50%**		Default RAS = 100%
Peak Rate	gpd-sq.ft.	422		Adjust underflow rate to vary RA
Solids Loading Rate	lb/day-sq.ft.			
Average		23		
Diurnal Peak		40		<50 lb/day-sq.ft.; <25 lb/day-sq.
Limiting Solids Loading Rate	lb/day-sq.ft.	49		
Return sludge rate at which limiting solids rate can be achieved				
RAS Flow Rate	MGD	9.1		
Percent of Influent to Bioreactor	%	87%		
RAS Concentration	mg/L			
Average		8,842		
Diurnal Peak		9,155		
No Membrane Bioreactor Selected				
Effluent TSS	mg/L			
Average		**1**		
Diurnal Peak		**1**		
Chemical Compound Applied before Secondary Clarifier				
Chemical Added? **No**				
Chemical Type		0		
Chemical Dosage (as chemical)	lb/day	**200**		
Chemical Dosage (mg chemical/L treated)	mg/L	N/A		
Molar Ratio Dosage Applied (M+:PO4-P)		N/A		
Effluent PO4-P	lb/day	N/A		
Effluent PO4-P	mg/L	N/A		
Filters: 1995				
Filters? **Yes**				
Total Area	ft2	**2,400**		
Hydraulic Loading Rate	gpm/ft2			
Average		3.90		
Diurnal Peak		5.72		
Solids Loading Rate	lb/day-sq.ft.			
Average		0.06		
Diurnal Peak		0.30		
Filter Run Time	hr	**24**		
Instantaneous Backwash Rate	gpm/ft2	**0.40**		
Duration of Backwash Flow	minutes	**1,440**		
Backwash Operating Time (%cycle)	%	100.00%		
Backwash Flow Rate	MGD	1.38		
Ratio of Backwash Production to Filter Influent	%	9.3%		
TSS Removal Efficiency at Average Conditions		**85%**		
TSS Removal Efficiency at Diurnal Peak Conditions		**75%**		
Chemical Compound Applied to Filter Influent **No**				
Chemical Formula		Al2(SO4)3*14H20		
Chemical Dosage (mg chemical/L treated)	mg/L	**10**		
Chemical Dosage (as chemical)	lb/day	1240.7		
Molar Ratio of Metal to Phosphate		0.0		
Percent of Soluble P that is ortho-P		***100%***		
Effective TSS Removal with Chemical Addition - Average Conditions(%)		85%		
Effective TSS Removal with Chemical Addition - Peak Conditions(%)		75%		
Backwash Concentration	mg/L	49		
WAS Thickening: 1				
WAS Thickener? **Yes**				
Solids Capture	%	**95%**		
Thickened Sludge Concentration	mg/L	**60,000**		
Belt Wash Water Flow Rate	gpm	**0**		
Hours/Day of Operation		**24**		
Days/Week of Operation		**7**		
Dewatering: 1				
Dewatering? **Yes**				
Solids Capture	%	**95%**		
Dewatered Sludge Concentration	%	**15%**		
Belt Wash Water Flow Rate	gpm	**0**		
Hours/Day of Operation		**24**		
Days/Week of Operation		**7**		

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Mass Balance for Average Flow Conditions

Constituent	Raw Wastewater (RW)	InfBox Recycle Influent (RecyI)	InfBox Recycled Stream (Recycle)	InfBox Combined Recycle Effluent (RecyE)	TrPS Splitter Influent (SplitI)	TrPS Splitter Effluent (SplitE) RecyFAB	TrPS Splitter Effluent (SplitE) PBNR1975	FAB Recycle Influent (RecyI)	FAB Recycled Stream (Recycle)	FAB Combined Recycle Effluent (RecyE)	1975 Bioreactor Influent (BI)	1975 Secondary Clarifier Influent (SI)	1975 Secondary Clarifier Effluent (SE)	1985 Bioreactor Influent (BI)	1985 Secondary Clarifier Influent (SI)	1985 Secondary Clarifier Effluent (SE)	Eff Combined Discharge	1995 Granular Media Filter Influent (GMFI)	1995 Granular Media Filter Effluent (GMFE)	Plant Effluent (PLE)	1975 WAS	1985 WAS	WAS Combined Discharge	1 WAS Thickener Influent (TWASI)	1 Thickened WAS (TWAS)
Flow (gallons/day)	13,500,000	13,500,000	1,382,321	14,881,440	14,881,440	10,300,000	4,581,440	10,300,000	251,088	10,551,136	4,581,440	7,649,534	4,496,912	10,551,136	15,826,777	10,370,680	14,867,592	14,867,592	13,485,271	13,485,271	83,648	180,505	264,152	264,152	35,058
Carbonaceous BOD_5 (lbs/day)	15,772	15,772	114	15,886	15,886	10,995	4,891	10,995	316	11,311	4,891	41,523	98	11,311	63,548	68	166	166	52	52	1,099	2,137	3,236	3,236	3,073
Particulate	8,273	8,273	4	8,276	8,276	5,728	2,548	5,728	10	5,739	2,548	1,497	3	5,739	1,960	1	4	4	1	1	40	66	106	106	100
Heterotrophs	0	0	99	99	99	69	31	69	268	336	31	39,926	81	336	50,241	36	117	117	18	18	1,057	1,690	2,747	2,747	2,610
PAOs	0	0	7	7	7	5	2	5	37	42	2	76	0	42	11,307	8	8	8	1	1	2	380	382	382	363
PHA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0
Filtrate	7,500	7,500	3	7,503	7,503	5,193	2,310	5,193	1	5,194	2,310	23	14	5,194	35	23	36	36	33	33	0	0	1	1	0
COD (lbs/day)	39,896	39,896	1,019	40,914	40,914	28,318	12,596	28,318	2,098	30,416	12,596	217,542	1,657	30,416	453,640	3,125	4,781	4,781	3,762	3,762	5,728	15,163	20,891	20,891	19,788
Particulate Bio	14,523	14,523	8	14,530	14,530	10,057	4,473	10,057	21	10,078	4,473	3,027	6	10,078	3,961	3	9	9	1	1	80	133	213	213	203
Particulate Non-Bio	6,224	6,224	364	6,588	6,588	4,560	2,028	4,560	1,159	5,718	2,028	119,907	242	5,718	258,892	187	429	429	64	64	3,175	8,708	11,883	11,883	11,289
Heterotrophs	0	0	223	223	223	154	69	154	602	755	69	89,680	181	755	112,847	81	262	262	39	39	2,375	3,796	6,170	6,170	5,862
Autotrophs	0	0	7	7	7	5	2	5	20	25	2	2,383	5	25	4,321	3	8	8	1	1	63	145	208	208	198
PAOs	0	0	43	43	43	30	13	30	228	259	13	467	1	259	69,309	50	51	51	8	8	12	2,331	2,344	2,344	2,226
PHA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	0	0	0	0	0	0	1	1	1	1
Soluble Bio	7,899	7,899	6	7,906	7,906	5,472	2,434	5,472	1	5,473	2,434	44	26	5,473	65	42	68	68	62	62	0	1	1	1	0
Colloidal Bio	5,266	5,266	0	5,266	5,266	3,645	1,621	3,645	0	3,645	1,621	0	0	3,645	0	0	0	0	0	0	0	0	0	0	0
Soluble Non-Bio	3,591	3,591	368	3,958	3,958	2,740	1,219	2,740	67	2,806	1,219	2,035	1,196	2,806	4,210	2,758	3,954	3,954	3,587	3,587	22	48	70	70	9
Colloidal Non-Bio	2,394	2,394	0	2,394	2,394	1,657	737	1,657	0	1,657	737	0	0	1,657	0	0	0	0	0	0	0	0	0	0	0
TSS (lbs/day)	16,786	16,786	566	17,352	17,352	12,010	5,342	12,010	1,802	13,811	5,342	185,845	375	13,811	403,083	291	666	666	100	100	4,921	13,558	18,479	18,479	17,555
Biodegradable	11,363	11,363	6	11,369	11,369	7,869	3,500	7,869	16	7,886	3,500	2,368	5	7,886	3,100	2	7	7	1	1	63	104	167	167	159
Non-Biodegradable	5,423	5,423	304	5,726	5,726	3,963	1,763	3,963	965	4,927	1,763	100,169	202	4,927	215,321	155	357	357	54	54	2,652	7,242	9,895	9,895	9,400
Metal Hydroxide	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Metal Phosphate	0	0	**0**	**0**	**0**	**0**	**0**	**0**	0	**0**	**0**	0	0	**0**	0	0	0	0	**0**	**0**	0	0	0	0	0
Heterotrophs	0	0	200	200	200	138	62	138	540	678	62	80,446	162	678	101,228	73	235	235	35	35	2,130	3,405	5,535	5,535	5,258
Autotrophs	0	0	6	6	6	4	2	4	18	22	2	2,137	4	22	3,877	3	7	7	1	1	57	130	187	187	178
PAOs	0	0	39	39	39	27	12	27	205	232	12	419	1	232	62,172	45	46	46	7	7	11	2,091	2,102	2,102	1,997
PHA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	0	0	0	0	0	0	1	1	1	1
Poly-P	0	0	11	11	11	8	3	8	58	65	3	306	1	65	17,365	13	13	13	2	2	8	584	592	592	563
VSS (lbs/day)	14,610	14,610	480	15,090	15,090	10,444	4,646	10,444	1,506	11,950	4,646	161,049	325	11,950	332,424	240	565	565	85	85	4,264	11,181	15,445	15,445	14,673
Biodegradable	10,227	10,227	5	10,233	10,233	7,082	3,150	7,082	15	7,097	3,150	2,131	4	7,097	2,790	2	6	6	1	1	56	94	150	150	143
Non-Biodegradable	4,383	4,383	254	4,637	4,637	3,209	1,428	3,209	805	4,014	1,428	84,215	170	4,014	179,064	129	299	299	45	45	2,230	6,023	8,253	8,253	7,840
Metal Hydroxide	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heterotrophs	0	0	180	180	180	124	55	124	486	610	55	72,401	146	610	91,105	66	212	212	32	32	1,917	3,064	4,981	4,981	4,732
Autotrophs	0	0	5	5	5	4	2	4	16	20	2	1,923	4	20	3,489	3	6	6	1	1	51	117	168	168	160
PAOs	0	0	35	35	35	24	11	24	184	209	11	377	1	209	55,955	40	41	41	6	6	10	1,882	1,892	1,892	1,797
PHA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	0	0	0	0	0	0	1	1	1	1
TKN (lbs/day)	2,591	2,591	61	2,652	2,652	1,835	816	1,835	101	1,937	816	10,366	96	1,937	21,607	263	359	359	298	298	272	718	991	991	937
NH_3-N (lbs-N/day)	1,565	1,565	17	1,581	1,581	1,095	487	1,095	3	1,098	487	55	32	1,098	226	148	180	180	164	164	1	3	3	3	0
Particulate Bio Org N	562	562	0	563	563	389	173	389	1	390	173	80	0	390	105	0	0	0	0	0	2	4	6	6	5
Non-Bio Part Org N	241	241	14	255	255	176	78	176	44	220	78	4,553	9	220	9,831	7	16	16	2	2	121	331	451	451	429
Heterotrophs	0	0	14	13	13	9	4	9	36	46	4	5,431	11	46	6,834	5	16	16	2	2	144	230	374	374	355
Autotrophs	0	0	0	0	0	0	0	0	1	2	0	144	0	2	262	0	0	0	0	0	4	9	13	13	12
PAOs	0	0	3	3	3	2	1	2	14	16	1	28	0	16	4,198	3	3	3	0	0	1	141	142	142	135
Non-Bio Soluble Org. N	129	129	13	142	142	99	44	99	2	101	44	73	43	101	152	99	142	142	129	129	1	2	3	3	0
Non-Bio Colloidal Org. N	86	86	0	86	86	60	27	60	0	60	27	0	0	60	0	0	0	0	0	0	0	0	0	0	0
Soluble Bio Org N	4	4	0	4	4	3	1	3	0	3	1	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Colloidal Bio Org N	3	3	0	3	3	2	1	2	0	2	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0
NO_3-N (lbs-N/day)	0	0	42	42	42	29	13	29	8	37	13	551	324	37	191	125	449	449	408	408	6	2	8	8	1
TP (lbs-P/day)	451	451	18	469	469	324	144	324	42	367	144	2,688	75	367	10,456	17	92	92	74	74	69	351	421	421	398
Bio Particulate	102	102	0	102	102	71	31	71	0	71	31	14	0	71	19	0	0	0	0	0	0	1	1	1	1
Non-Bio Particulate	44	44	2	46	46	32	14	32	6	38	14	610	1	38	1,317	1	2	2	0	0	16	44	60	60	57
Metal Phosphate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heterotrophs	0	0	4	4	4	3	1	3	12	15	1	1,794	4	15	2,257	2	5	5	1	1	47	76	123	123	117
Autotrophs	0	0	0	0	0	0	0	0	0	0	0	48	0	0	86	0	0	0	0	0	1	3	4	4	4
PAOs	0	0	1	1	1	1	0	1	5	5	0	9	0	5	1,386	1	1	1	0	0	0	47	47	47	45
Poly-P	0	0	3	3	3	2	1	2	18	20	1	95	0	20	5,376	4	4	4	1	1	3	181	183	183	174
Ortho-PO4	305	305	7	312	312	216	96	216	1	217	96	118	69	217	14	9	79	79	72	72	1	0	1	1	0
Alkalinity (lbs/day as $CaCO_3$)	18,814	18,814	1,497	20,310	20,310	14,057	6,253	14,057	271	14,328	6,253	6,953	4,088	14,328	18,331	12,012	16,099	16,099	14,602	14,602	76	209	285	285	38
H_2S (lbs/day)	113	113	0	113	113	78	35	78	0	78	35	0	0	78	0	0	0	0	0	0	0	0	0	0	0
BOD_5 (mg/L)	140	140	10	128	128	128	128	128	151	128	128	650	3	128	481	1	1	1	0	0	1,575	1,418	1,468	1,468	10,505
COD (mg/L)	354	354	88	329	329	329	329	329	1,001	345	329	3,408	44	345	3,435	36	39	39	33	33	8,205	10,066	9,477	9,477	67,634
TSS (mg/L)	149	149	49	140	140	140	140	140	860	157	140	2,911	10	157	3,052	3	5	5	1	1	7,049	9,000	8,382	8,382	60,000
VSS (mg/L)	130	130	42	122	122	122	122	122	719	136	122	2,523	0	136	2,517	0	0	0	1	1	6,109	7,422	7,006	7,006	50,151
TKN (mg-N/L)	23.0	23	5	21	21	21	21	21	48	22	21	162	3	22	164	3	3	3	3	3	390	477	449	449	3,201
NH_3-N (mg-N/L)	13.9	14	1	13	13	13	13	13	1	12	13	1	1	12	2	2	1	1	1	1	1	2	1	1	1
NO_3-N (mg-N/L)	0.0	0	4	0	0	0	0	0	4	0	0	9	9	0	1	1	4	4	4	4	9	1	4	4	4
TP (mg-P/L)	4.0	4	2	4	4	4	4	4	20	4	4	42	2	4	79	0	1	1	1	1	99	233	191	191	1,362
Alkalinity (mg/L as $CaCO_3$)	167	167	130	164	164	164	164	164	129	163	164	109	109	163	139	139	130	130	130	130	109	139	129	129	129
H_2S (mg/L)	1.0	1	0	1	1	1	1	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0

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Mass Balance for Average Flow

Constituent	1 Dewatering Influent (DWI)	1 Dewatered Sludge (DWE)	Biosolids to Dispoal	1995 Filter Backwash (BW)	1 WAS Thickening Recycle (TWASR)	1 Dewatering Recycle (DWR)	BW Combined Discharge	Cent Combined Discharge
Flow (gallons/day)	35,058	13,064	13,064	1,382,321	229,094	21,994	1,382,321	251,088
Carbonaceous BOD_5 (lbs/day)	3,073	2,920	2,920	114	162	154	114	316
Particulate	100	95	95	4	5	5	4	10
Heterotrophs	2,610	2,479	2,479	99	137	130	99	268
PAOs	363	345	345	7	19	18	7	37
PHA	0	0	0	0	0	0	0	0
Filtrate	0	0	0	3	1	0	3	1
COD (lbs/day)	19,788	18,793	18,793	1,019	1,103	995	1,019	2,098
Particulate Bio	203	193	193	8	11	10	8	21
Particulate Non-Bio	11,289	10,724	10,724	364	594	564	364	1,159
Heterotrophs	5,862	5,569	5,569	223	309	293	223	602
Autotrophs	198	188	188	7	10	10	7	20
PAOs	2,226	2,115	2,115	43	117	111	43	228
PHA	1	1	1	0	0	0	0	0
Soluble Bio	0	0	0	6	1	0	6	1
Colloidal Bio	0	0	0	0	0	0	0	0
Soluble Non-Bio	9	3	3	368	61	6	368	67
Colloidal Non-Bio	0	0	0	0	0	0	0	0
TSS (lbs/day)	17,555	16,677	16,677	566	924	878	566	1,802
Biodegradable	159	151	151	6	8	8	6	16
Non-Biodegradable	9,400	8,930	8,930	304	495	470	304	965
Metal Hydroxide	0	0	0	0	0	0	0	0
Metal Phosphate	0	0	0	**0**	0	0	**0**	0
Heterotrophs	5,258	4,995	4,995	200	277	263	200	540
Autotrophs	178	169	169	6	9	9	6	18
PAOs	1,997	1,897	1,897	39	105	100	39	205
PHA	1	1	1	0	0	0	0	0
Poly-P	563	534	534	11	30	28	11	58
VSS (lbs/day)	14,673	13,940	13,940	480	772	734	480	1,506
Biodegradable	143	136	136	5	8	7	5	15
Non-Biodegradable	7,840	7,448	7,448	254	413	392	254	805
Metal Hydroxide	0	0	0	0	0	0	0	0
Heterotrophs	4,732	4,496	4,496	180	249	237	180	486
Autotrophs	160	152	152	5	8	8	5	16
PAOs	1,797	1,708	1,708	35	95	90	35	184
PHA	1	1	1	0	0	0	0	0
TKN (lbs/day)	937	889	889	61	54	47	61	101
NH_3-N (lbs-N/day)	0	0	0	17	3	0	17	3
Particulate Bio Org N	5	5	5	0	0	0	0	1
Non-Bio Part Org N	429	407	407	14	23	21	14	44
Heterotrophs	355	337	337	14	19	18	14	36
Autotrophs	12	11	11	0	1	1	0	1
PAOs	135	128	128	3	7	7	3	14
Non-Bio Soluble Org. N	0	0	0	13	2	0	13	2
Non-Bio Colloidal Org. N	0	0	0	0	0	0	0	0
Soluble Bio Org N	0	0	0	0	0	0	0	0
Colloidal Bio Org N	0	0	0	0	0	0	0	0
NO_3-N (lbs-N/day)	1	0	0	42	7	1	42	8
TP (lbs-P/day)	398	378	378	18	22	20	18	42
Bio Particulate	1	1	1	0	0	0	0	0
Non-Bio Particulate	57	55	55	2	3	3	2	6
Metal Phosphate	0	0	0	0	0	0	0	0
Heterotrophs	117	111	111	4	6	6	4	12
Autotrophs	4	4	4	0	0	0	0	0
PAOs	45	42	42	1	2	2	1	5
Poly-P	174	165	165	3	9	9	3	18
Ortho-PO4	0	0	0	7	1	0	7	1
Alkalinity (lbs/day as $CaCO_3$)	38	14	14	1,497	247	24	1,497	271
H_2S (lbs/day)	0	0	0	0	0	0	0	0
BOD_5 (mg/L)	10,505	26,780	26,780	10	85	837	10	151
COD (mg/L)	67,634	172,374	172,374	88	577	5,420	88	1,001
TSS (mg/L)	60,000	152,963	152,963	49	483	4,782	49	860
VSS (mg/L)	50,151	127,855	127,855	42	404	3,997	42	719
TKN (mg-N/L)	3,201	8,157	8,157	5	28	258	5	48
NH_3-N (mg-N/L)	1	1	1	1	1	1	1	1
NO_3-N (mg-N/L)	4	4	4	4	4	4	4	4
TP (mg-P/L)	1,362	3,471	3,471	2	12	109	2	20
Alkalinity (mg/L as $CaCO_3$)	129	129	129	130	129	129	130	129
H_2S (mg/L)	0	0	0	0	0	0	0	0

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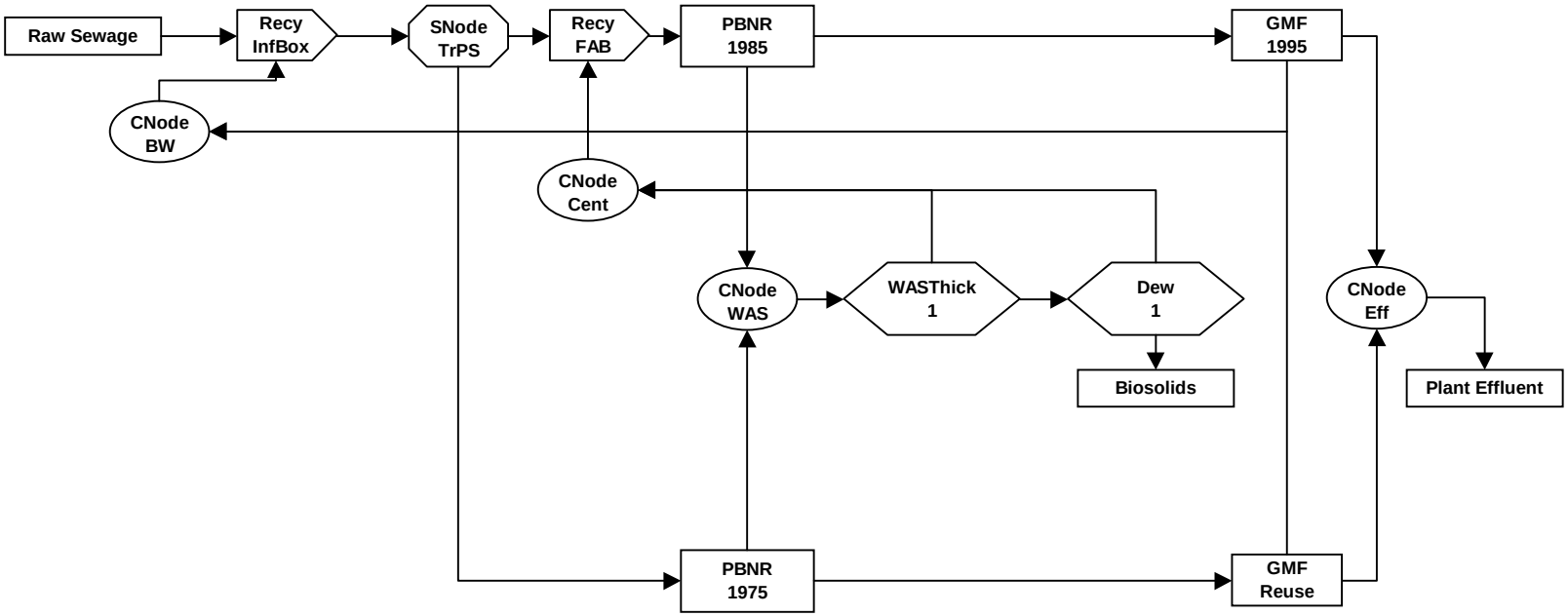

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Model Convergence 0.33%

Facility Operating Parameters			Project	First Assumptions	
Item		Value	Notes	US	
Influent Wastewater	(US)	(US)			
Flow	MG/day				
Design Average		**13.50**	MM	MM/Peak PF	
Design Diurnal Peak		**19.8**		1.5	
Design Peaking Factor for WW Diurnal flow		1.466666667			
Design Peaking Factor for WW Diurnal loads		**1.4**			
Carbonaceous Five-Day Biochemical Oxygen Demand (CBOD5)			Maximum Month Conditions		
Design Average Concentration	mg/L	140	140		
Design Average Mass Loading	lb/day	**15,772**			
Design Diurnal Peak Mass Loading	lb/day	22,081			
Total Suspended Solids (TSS)					
Design Average Concentration	mg/L	149	149		
Design Average Mass Loading	lb/day	**16,786**			
Design Diurnal Peak Mass Loading	lb/day	23,500			
Volatile Suspended Solids (VSS)					
Percent VSS	%	**87%**			
Design Average Concentration	mg/L	130			
Design Average Mass Loading	lb/day	14,610			
Design Diurnal Peak Mass Loading	lb/day	20,454			E
Total Kjeldahl Nitrogen (TKN as N)					
Design Average Concentration	mg/L	23	23		
Design Average Mass Loading	lb/day	**2,591**			
Design Diurnal Peak Mass Loading	lb/day	3,628			
Ammonia-Nitrogen (NH3-N as N)			TKN/ammonia Ratio		
Design Average Concentration	mg/L	14	1.66		
Design Average Mass Loading	lb/day	**1,565**			
Design Diurnal Peak Mass Loading	lb/day	2,191			
Total Phosphorus (as P)					
Design Average Concentration	mg/L	4			
Design Average Mass Loading	lb/day	**451**	Estimated		
Design Diurnal Peak Mass Loading	lb/day	631			
Alkalinity (as CaCO3)					
Design Average Concentration	mg/L	167	167		
Design Average Mass Loading	lb/day	**18,814**			Se
Design Diurnal Peak Mass Loading	lb/day	26,339			Secondary C
Hydrogen Sulfide (H2S)					
Design Average Concentration	mg/L	1			F
Design Average Mass Loading	lb/day	**113**	Estimated		
Design Diurnal Peak Mass Loading	lb/day	158			
Chemical Addition:					
Select the Metal Salt (if used)		3			
Flow Splitter: TrPS					
Splitter Influent Flow	MGD	14.5			
Flow Splits			1985 Plant Flow, mgd		Se
TrPS Splitter Effluent (SplitE) Recy1	%	56%	**8.10**		Secondary C
TrPS Splitter Effluent (SplitE) PBNR1975	%	**44%**			
	%	**0%**			F
	%	**0%**			
	%	**0%**			
	%	**0%**			
	%	**0%**			
	%	**0%**			
	%	**0%**			
Biological Process - PBNR: 1975					
Total SRT (anaerobic + anoxic + aerobic)	days	**5.0**			
Nitrifier Minimum SRT (SRT_{min})	days	0.8			
DO	mg/L	2.0			
Temperature in the Biological Process	oF	**80.6**			
SVI	mL/g	**120**			
Biosolids Production Rates					
Net Yield (mg TSS/mg BOD_5)	lb/lb	1.11			
Volatile Fraction	%	83.8%			
Active Fraction	%	43.3%			
Nitrifier Fraction	%	1.1%			
Nitrogen Content, N/VSS	%	6.4%			
Phosphorus Content, P/VSS	%	2.2%			
Process Oxygen Requirements					
Carbonaceous AOR/BOD5 - wt/wt	lb/lb	1.1			

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Total AOR/BOD% - wt/wt	lb/lb	1.3		
AOR (wt/day)	lb/day			
Average		9,325		
Diurnal Peak		14,441		
AOR	mg/L-hr			
Average		49		
Diurnal Peak		75		
Bioreactor **Membrane Bioreactor**				
Total Bioreactor Volume	MG	**0.96**		
HRT	hr	3.6		
% non-aerobic		14%		
% aerobic		86%		
Average MLSS Concentration	mg/L	4,820		
Biorector Clarifier NOT SELECTED - not included in calculations				
Total Area	sq.ft.	**8,000**		
Overflow Rate	gpd-sq.ft.			
Average		#N/A		
Diurnal Peak		#N/A		<1000 gpd/sq.ft.; <900 gpd/sq.ft. with chem
Effluent TSS	mg/L			
Average		**10**		
Diurnal Peak		**20**		
Underflow Rate				
Average Flow Ratio		**67%**	0.67	
Average Rate	gpd-sq.ft.	#N/A		
Peak Flow Ratio		**50%**		Default RAS = 100%
Peak Rate	gpd-sq.ft.	#N/A		Adjust underflow rate to vary RAS
Solids Loading Rate	lb/day-sq.ft.			
Average		#N/A		
Diurnal Peak		#N/A		<50 lb/day-sq.ft.; <25 lb/day-sq.ft. with nit.
Limiting Solids Loading Rate	lb/day-sq.ft.	#N/A		
Return sludge rate at which limiting solids rate can be achieved				
RAS Flow Rate	MGD	#N/A		
Percent of Influent to Bioreactor	%	#N/A		
RAS Concentration	mg/L			
Average		#N/A		
Diurnal Peak		#N/A		
Membrane Performance				
Effluent TSS	mg/L			
Average		**1**		
Diurnal Peak		**1**		
Chemical Compound Applied in Bioreactor				
Chemical Added? **No**				
Chemical Type		0		
Chemical Dosage (as chemical)	lb/day	**200**		
Chemical Dosage (mg chemical/L treated)	mg/L	N/A		
Molar Ratio Dosage Applied (M+:PO4-P)		N/A		
Effluent PO4-P	lb/day	N/A		
Effluent PO4-P	mg/L	N/A		
Biological Process - PBNR: 1985				
Total SRT (anaerobic + anoxic + aerobic)	days	**11.3**		
Nitrifier Minimum SRT (SRT_{min})	days	1.2		
DO	mg/L	2.0		
Temperature in the Biological Process	oF	**80**		
SVI	mL/g	**120**		
Biosolids Production Rates				
Net Yield (mg TSS/mg BOD_5)	lb/lb	1.15		
Volatile Fraction	%	79.4%		
Active Fraction	%	33.7%		
Nitrifier Fraction	%	1.0%		
Nitrogen Content, N/VSS	%	6.4%		
Phosphorus Content, P/VSS	%	3.0%		
Process Oxygen Requirements				
Carbonaceous AOR/BOD5 - wt/wt	lb/lb	1.2		
Total AOR/BOD% - wt/wt	lb/lb	1.4		
AOR (wt/day)	lb/day			
Average		12,654		
Diurnal Peak		19,152		
AOR	mg/L-hr			
Average		21		
Diurnal Peak		31		
Bioreactor **With Secondary Clarifier**				
Total Bioreactor Volume	MG	**3.04**	0.05channel+0.8FAB+2.19CAB	
HRT	hr	8.7		
% non-aerobic		26%		
% aerobic		74%		
Average MLSS Concentration	mg/L	4,701		
Bioreactor Clarifier				

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Total Area	sq.ft.	**17,671**	4	Number of 75' diam SCs
Overflow Rate	gpd-sq.ft.			
Average		474		
Diurnal Peak		674		<1000 gpd/sq.ft.; <900 gpd/sq.ft. with chem
Effluent TSS	mg/L			
Average		**3**		
Diurnal Peak		**20**		
Underflow Rate				
Average Flow Ratio		**50%**	0.67	
Average Rate	gpd-sq.ft.	237		
Peak Flow Ratio		**50%**		Default RAS = 100%
Peak Rate	gpd-sq.ft.	337		Adjust underflow rate to vary RAS
Solids Loading Rate	lb/day-sq.ft.			
Average		23		
Diurnal Peak		40		<50 lb/day-sq.ft.; <25 lb/day-sq.ft. with nit.
Limiting Solids Loading Rate	lb/day-sq.ft.	48		
Return sludge rate at which limiting solids rate can be achieved				
RAS Flow Rate	MGD	9.0		
Percent of Influent to Bioreactor	%	108%		
RAS Concentration	mg/L			
Average		11,100		
Diurnal Peak		11,401		
No Membrane Bioreactor Selected				
Effluent TSS	mg/L			
Average		**1**		
Diurnal Peak		**1**		
Chemical Compound Applied before Secondary Clarifier				
Chemical Added? **No**				
Chemical Type		0		
Chemical Dosage (as chemical)	lb/day	**200**		
Chemical Dosage (mg chemical/L treated)	mg/L	N/A		
Molar Ratio Dosage Applied (M+:PO4-P)		N/A		
Effluent PO4-P	lb/day	N/A		
Effluent PO4-P	mg/L	N/A		
Filters: Reuse				
Filters? **Yes**				
Total Area	ft2	**2,400**		
Hydraulic Loading Rate	gpm/ft2			
Average		1.66		
Diurnal Peak		2.43		
Solids Loading Rate	lb/day-sq.ft.			
Average		0.00		
Diurnal Peak		0.01		
Filter Run Time	hr	**24**		
Instantaneous Backwash Rate	gpm/ft2	**0.14**		
Duration of Backwash Flow	minutes	**1,440**		
Backwash Operating Time (%cycle)	%	100.00%		
Backwash Flow Rate	MGD	0.48		
Ratio of Backwash Production to Filter Influent	%	7.7%		
TSS Removal Efficiency at Average Conditions		**85%**		
TSS Removal Efficiency at Diurnal Peak Conditions		**75%**		
Chemical Compound Applied to Filter Influent **No**				
Chemical Formula		Al2(SO4)3*14H20		
Chemical Dosage (mg chemical/L treated)	mg/L	**10**		
Chemical Dosage (as chemical)	lb/day	518.2		
Molar Ratio of Metal to Phosphate		0.0		
Percent of Soluble P that is ortho-P		***100%***		
Effective TSS Removal with Chemical Addition - Average Conditions(%)		85%		
Effective TSS Removal with Chemical Addition - Peak Conditions(%)		75%		
Backwash Concentration	mg/L	11		
Filters: 1995				
Filters? **Yes**				
Total Area	ft2	**2,400**		
Hydraulic Loading Rate	gpm/ft2			
Average		2.25		
Diurnal Peak		3.27		
Solids Loading Rate	lb/day-sq.ft.			
Average		0.02		
Diurnal Peak		0.17		
Filter Run Time	hr	**24**		
Instantaneous Backwash Rate	gpm/ft2	**0.14**		
Duration of Backwash Flow	minutes	**1,440**		
Backwash Operating Time (%cycle)	%	100.00%		
Backwash Flow Rate	MGD	0.48		
Ratio of Backwash Production to Filter Influent	%	5.8%		
TSS Removal Efficiency at Average Conditions		**85%**		
TSS Removal Efficiency at Diurnal Peak Conditions		**75%**		

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Chemical Compound Applied to Filter Influent	**No**				
Chemical Formula			Al2(SO4)3*14H20		
Chemical Dosage (mg chemical/L treated)		mg/L	**10**		
Chemical Dosage (as chemical)		lb/day	687.6		
Molar Ratio of Metal to Phosphate			0.0		
Percent of Soluble P that is ortho-P			***100%***		
Effective TSS Removal with Chemical Addition - Average Conditions(%)			85%		
Effective TSS Removal with Chemical Addition - Peak Conditions(%)			75%		
Backwash Concentration		mg/L	49		
WAS Thickening: 1					
WAS Thickener?	**Yes**				
Solids Capture		%	**95%**		
Thickened Sludge Concentration		mg/L	**60,000**		
Belt Wash Water Flow Rate		gpm	**0**		
Hours/Day of Operation			**24**		
Days/Week of Operation			**7**		
Dewatering: 1					
Dewatering?	**Yes**				
Solids Capture		%	**95%**		
Dewatered Sludge Concentration		%	**15%**		
Belt Wash Water Flow Rate		gpm	**0**		
Hours/Day of Operation			**24**		
Days/Week of Operation			**7**		

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Mass Balance for Average Flow Conditions

Constituent	Raw Wastewater (RW)	InfBox Recycle Influent (RecyI)	InfBox Recycled Stream (Recycle)	InfBox Combined Recycle Effluent (RecyE)	TrPS Splitter Influent (SplitI)	TrPS Splitter Effluent (SplitE) Recy1	TrPS Splitter Effluent (SplitE) PBNR1975	FAB Recycle Influent (RecyI)	FAB Recycled Stream (Recycle)	FAB Combined Recycle Effluent (RecyE)	1975 Bioreactor Influent (BI)	1975 Secondary Clarifier Influent (SI)	1975 Secondary Clarifier Effluent (SE)	1985 Bioreactor Influent (BI)	1985 Secondary Clarifier Influent (SI)	1985 Secondary Clarifier Effluent (SE)	Reuse Granular Media Filter Influent (GMFI)	Reuse Granular Media Filter Effluent (GMFE)	1995 Granular Media Filter Influent (GMFI)	1995 Granular Media Filter Effluent (GMFE)	Eff Combined Discharge	Plant Effluent (PLE)	1975 WAS	1985 WAS	WAS Combined Discharge
Flow (gallons/day)	13,500,000	13,500,000	959,945	14,459,945	14,459,945	8,100,000	6,359,945	8,100,000	275,412	8,376,074	6,359,945	6,359,945	6,209,076	8,376,074	12,565,106	8,239,497	6,209,076	5,729,104	8,239,497	7,759,524	13,488,628	13,488,628	150,869	137,240	288,109
Carbonaceous BOD_5 (lbs/day)	15,772	15,772	36	15,808	15,808	8,855	6,953	8,855	285	9,141	6,953	68,972	23	9,141	49,747	44	23	13	44	18	31	31	1,636	1,286	2,923
Particulate	8,273	8,273	1	8,274	8,274	4,635	3,639	4,635	8	4,643	3,639	2,326	0	4,643	1,226	1	0	0	1	0	0	0	55	32	87
Heterotrophs	0	0	28	28	28	15	12	15	246	262	12	65,053	10	262	37,950	22	10	2	22	3	5	5	1,543	982	2,525
PAOs	0	0	5	5	5	3	2	3	30	33	2	1,578	0	33	10,546	6	0	0	6	1	1	1	37	273	310
PHA	0	0	0	0	0	0	0	0	0	0	0	2	0	0	3	0	0	0	0	0	0	0	0	0	0
Filtrate	7,500	7,500	2	7,501	7,501	4,202	3,299	4,202	1	4,203	3,299	13	12	4,203	23	15	12	11	15	14	25	25	0	0	1
COD (lbs/day)	39,896	39,896	527	40,423	40,423	22,644	17,780	22,644	2,035	24,678	17,780	365,496	1,733	24,678	447,059	2,477	1,733	1,554	2,477	2,129	3,682	3,682	8,670	11,514	20,184
Particulate Bio	14,523	14,523	2	14,524	14,524	8,136	6,388	8,136	17	8,153	6,388	4,702	1	8,153	2,478	1	1	0	1	0	0	0	112	64	176
Particulate Non-Bio	6,224	6,224	168	6,392	6,392	3,581	2,812	3,581	1,184	4,765	2,812	199,238	32	4,765	286,849	166	32	5	166	25	30	30	4,726	7,420	12,146
Heterotrophs	0	0	62	62	62	35	27	35	553	588	27	146,118	23	588	85,240	49	23	4	49	7	11	11	3,466	2,205	5,671
Autotrophs	0	0	3	3	3	2	1	2	21	22	1	4,039	1	22	4,449	3	1	0	3	0	0	0	96	115	211
PAOs	0	0	33	33	33	19	15	19	185	204	15	9,672	2	204	64,642	37	2	0	37	6	6	6	229	1,672	1,902
PHA	0	0	0	0	0	0	0	0	0	0	0	12	0	0	16	0	0	0	0	0	0	0	0	0	1
Soluble Bio	7,899	7,899	3	7,903	7,903	4,427	3,476	4,427	1	4,428	3,476	23	23	4,428	43	28	23	21	28	26	47	47	1	0	1
Colloidal Bio	5,266	5,266	0	5,266	5,266	2,950	2,316	2,950	0	2,950	2,316	0	0	2,950	0	0	0	0	0	0	0	0	0	0	0
Soluble Non-Bio	3,591	3,591	255	3,846	3,846	2,154	1,692	2,154	73	2,228	1,692	1,692	1,651	2,228	3,342	2,192	1,651	1,524	2,192	2,064	3,588	3,588	40	37	77
Colloidal Non-Bio	2,394	2,394	0	2,394	2,394	1,341	1,053	1,341	0	1,341	1,053	0	0	1,341	0	0	0	0	0	0	0	0	0	0	0
TSS (lbs/day)	16,786	16,786	240	17,027	17,027	9,538	7,489	9,538	1,751	11,289	7,489	322,584	52	11,289	398,495	231	52	8	231	35	42	42	7,652	10,308	17,960
Biodegradable	11,363	11,363	1	11,365	11,365	6,366	4,999	6,366	13	6,380	4,999	3,679	1	6,380	1,939	1	1	0	1	0	0	0	87	50	137
Non-Biodegradable	5,423	5,423	140	5,563	5,563	3,116	2,447	3,116	986	4,102	2,447	167,061	27	4,102	237,642	138	27	4	138	21	25	25	3,963	6,147	10,110
Metal Hydroxide	0	0	**0**	**0**	**0**	**0**	**0**	**0**	0	**0**	**0**	0	0	**0**	0	0	0	**0**	0	**0**	**0**	**0**	0	0	0
Metal Phosphate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heterotrophs	0	0	56	56	56	31	24	31	496	527	24	131,073	21	527	76,463	44	21	3	44	7	10	10	3,109	1,978	5,087
Autotrophs	0	0	2	2	2	1	1	1	18	20	1	3,623	1	20	3,991	2	1	0	2	0	0	0	86	103	189
PAOs	0	0	30	30	30	17	13	17	166	183	13	8,676	1	183	57,986	34	1	0	34	5	5	5	206	1,500	1,706
PHA	0	0	0	0	0	0	0	0	0	0	0	7	0	0	10	0	0	0	0	0	0	0	0	0	0
Poly-P	0	0	11	11	11	6	5	6	71	78	5	8,464	1	78	20,464	12	1	0	12	2	2	2	201	529	730
VSS (lbs/day)	14,610	14,610	196	14,807	14,807	8,294	6,512	8,294	1,445	9,739	6,512	272,266	44	9,739	323,232	187	44	7	187	28	35	35	6,459	8,361	14,820
Biodegradable	10,227	10,227	1	10,228	10,228	5,730	4,499	5,730	12	5,742	4,499	3,311	1	5,742	1,745	1	1	0	1	0	0	0	79	45	124
Non-Biodegradable	4,383	4,383	116	4,499	4,499	2,520	1,979	2,520	820	3,340	1,979	139,912	22	3,340	196,880	114	22	3	114	17	20	20	3,319	5,093	8,412
Metal Hydroxide	0	0	**0**	**0**	**0**	**0**	**0**	**0**	0	**0**	**0**	0	0	**0**	0	0	0	**0**	0	**0**	**0**	**0**	0	0	0
Heterotrophs	0	0	50	50	50	28	22	28	446	474	22	117,966	19	474	68,817	40	19	3	40	6	9	9	2,798	1,780	4,578
Autotrophs	0	0	2	2	2	1	1	1	17	18	1	3,261	1	18	3,592	2	1	0	2	0	0	0	77	93	170
PAOs	0	0	27	27	27	15	12	15	150	165	12	7,809	1	165	52,188	30	1	0	30	5	5	5	185	1,350	1,535
PHA	0	0	0	0	0	0	0	0	0	0	0	7	0	0	10	0	0	0	0	0	0	0	0	0	0
TKN (lbs/day)	2,591	2,591	26	2,617	2,617	1,466	1,151	1,466	95	1,561	1,151	17,458	88	1,561	20,486	130	88	79	130	113	193	193	414	527	941
NH_3-N (lbs-N/day)	1,565	1,565	4	1,569	1,569	879	690	879	1	880	690	26	26	880	60	40	26	24	40	37	61	61	1	1	1
Particulate Bio Org N	562	562	0	563	563	315	247	315	0	316	247	125	0	316	66	0	0	0	0	0	0	0	3	2	5
Non-Bio Part Org N	241	241	6	247	247	139	109	139	45	184	109	7,566	1	184	10,893	6	1	0	6	1	1	1	179	282	461
Heterotrophs	0	0	4	4	4	2	2	2	33	36	2	8,849	1	36	5,162	3	1	0	3	0	1	1	210	134	343
Autotrophs	0	0	0	0	0	0	0	0	1	1	0	245	0	1	269	0	0	0	0	0	0	0	6	7	13
PAOs	0	0	2	2	2	1	1	1	11	12	1	586	0	12	3,915	2	0	0	2	0	0	0	14	101	115
Non-Bio Soluble Org. N	129	129	9	138	138	78	61	78	3	80	61	61	59	80	120	79	59	55	79	74	129	129	1	1	3
Non-Bio Colloidal Org. N	86	86	0	86	86	48	38	48	0	48	38	0	0	48	0	0	0	0	0	0	0	0	0	0	0
Soluble Bio Org N	4	4	0	4	4	3	2	3	0	3	2	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Colloidal Bio Org N	3	3	0	3	3	2	1	2	0	2	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0
NO_3-N (lbs-N/day)	0	0	21	21	21	12	9	12	6	18	9	196	192	18	166	109	192	177	109	102	279	279	5	2	6
TP (lbs-P/day)	451	451	10	461	461	258	203	258	44	302	203	6,889	36	302	10,916	21	36	32	21	15	48	48	163	282	445
Bio Particulate	102	102	0	102	102	57	45	57	0	57	45	23	0	57	12	0	0	0	0	0	0	0	1	0	1
Non-Bio Particulate	44	44	1	45	45	25	20	25	6	31	20	1,013	0	31	1,459	1	0	0	1	0	0	0	24	38	62
Metal Phosphate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heterotrophs	0	0	1	1	1	1	1	1	11	12	1	2,922	0	12	1,705	1	0	0	1	0	0	0	69	44	113
Autotrophs	0	0	0	0	0	0	0	0	0	0	0	81	0	0	89	0	0	0	0	0	0	0	2	2	4
PAOs	0	0	1	1	1	0	0	0	4	4	0	193	0	4	1,293	1	0	0	1	0	0	0	5	33	38
Poly-P	0	0	3	3	3	2	2	2	22	24	2	2,620	0	24	6,336	4	0	0	4	1	1	1	62	164	226
Ortho-PO4	305	305	4	308	308	173	136	173	1	174	136	36	35	174	23	15	35	32	15	14	46	46	1	0	1
Alkalinity (lbs/day as $CaCO_3$)	18,814	18,814	1,046	19,860	19,860	11,125	8,735	11,125	300	11,425	8,735	6,749	6,589	11,425	14,045	9,210	6,589	6,079	9,210	8,673	14,753	14,753	160	153	313
H_2S (lbs/day)	113	113	0	113	113	63	50	63	0	63	50	0	0	63	0	0	0	0	0	0	0	0	0	0	0
BOD_5 (mg/L)	140	140	4	131	131	131	131	131	124	131	131	1,299	0	131	474	1	0	0	1	0	0	0	1,299	1,123	1,216
COD (mg/L)	354	354	66	335	335	335	335	335	885	353	335	6,886	33	353	4,263	36	33	32	36	33	33	33	6,886	10,053	8,395
TSS (mg/L)	149	149	30	141	141	141	141	141	762	161	141	6,078	1	161	3,800	3	1	0	3	1	0	0	6,078	9,000	7,470
VSS (mg/L)	130	130	25	123	123	123	123	123	629	139	123	5,130	0	139	3,082	0	0	0	0	0	0	0	5,130	7,300	6,164
TKN (mg-N/L)	23.0	23	3	22	22	22	22	22	41	22	22	329	2	22	195	2	2	2	2	2	2	2	329	460	392
NH_3-N (mg-N/L)	13.9	14	1	13	13	13	13	13	1	13	13	0	0	13	1	1	0	0	1	1	1	1	0	1	1
NO_3-N (mg-N/L)	0.0	0	3	0	0	0	0	0	3	0	0	4	4	0	2	2	4	4	2	2	2	2	4	2	3
TP (mg-P/L)	4.0	4	1	4	4	4	4	4	19	4	4	130	1	4	104	0	1	1	0	0	0	0	130	246	185
Alkalinity (mg/L as $CaCO_3$)	167	167	131	165	165	165	165	165	130	163	165	127	127	163	134	134	127	127	134	134	131	131	127	134	130
H_2S (mg/L)	1.0	1	0	1	1	1	1	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
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Mass Balance for Average Flow

Constituent	1 WAS Thickener Influent (TWASI)	1 Thickened WAS (TWAS)	1 Dewatering Influent (DWI)	1 Dewatered Sludge (DWE)	Biosolids to Dispoal	Reuse Filter Backwash (BW)	1995 Filter Backwash (BW)	1 WAS Thickening Recycle (TWASR)	1 Dewatering Recycle (DWR)	1 Combined Discharge	Cent Combined Discharge
Flow (gallons/day)	288,109	34,075	34,075	12,698	12,698	479,973	479,973	254,035	21,377	959,945	275,412
Carbonaceous BOD_5 (lbs/day)	2,923	2,776	2,776	2,637	2,637	10	25	147	139	36	285
Particulate	87	83	83	78	78	0	1	4	4	1	8
Heterotrophs	2,525	2,399	2,399	2,279	2,279	9	19	126	120	28	246
PAOs	310	295	295	280	280	0	5	16	15	5	30
PHA	0	0	0	0	0	0	0	0	0	0	0
Filtrate	1	0	0	0	0	1	1	0	0	2	1
COD (lbs/day)	20,184	19,110	19,110	18,149	18,149	179	348	1,074	961	527	2,035
Particulate Bio	176	167	167	159	159	1	1	9	8	2	17
Particulate Non-Bio	12,146	11,539	11,539	10,962	10,962	27	141	607	577	168	1,184
Heterotrophs	5,671	5,388	5,388	5,118	5,118	20	42	284	269	62	553
Autotrophs	211	200	200	190	190	1	2	11	10	3	21
PAOs	1,902	1,806	1,806	1,716	1,716	1	32	95	90	33	185
PHA	1	1	1	1	1	0	0	0	0	0	0
Soluble Bio	1	0	0	0	0	2	2	1	0	3	1
Colloidal Bio	0	0	0	0	0	0	0	0	0	0	0
Soluble Non-Bio	77	9	9	3	3	128	128	68	6	255	73
Colloidal Non-Bio	0	0	0	0	0	0	0	0	0	0	0
TSS (lbs/day)	17,960	17,062	17,062	16,209	16,209	44	196	898	853	240	1,751
Biodegradable	137	131	131	124	124	1	1	7	7	1	13
Non-Biodegradable	10,110	9,605	9,605	9,124	9,124	23	117	506	480	140	986
Metal Hydroxide	0	0	0	0	0	**0**	**0**	0	0	**0**	0
Metal Phosphate	0	0	0	0	0	0	0	0	0	0	0
Heterotrophs	5,087	4,833	4,833	4,591	4,591	18	38	254	242	56	496
Autotrophs	189	180	180	171	171	0	2	9	9	2	18
PAOs	1,706	1,620	1,620	1,539	1,539	1	29	85	81	30	166
PHA	0	0	0	0	0	0	0	0	0	0	0
Poly-P	730	694	694	659	659	1	10	37	35	11	71
VSS (lbs/day)	14,820	14,079	14,079	13,375	13,375	37	159	741	704	196	1,445
Biodegradable	124	117	117	112	112	0	1	6	6	1	12
Non-Biodegradable	8,412	7,991	7,991	7,592	7,592	19	97	421	400	116	820
Metal Hydroxide	0	0	0	0	0	**0**	**0**	0	0	**0**	0
Heterotrophs	4,578	4,350	4,350	4,132	4,132	16	34	229	217	50	446
Autotrophs	170	162	162	154	154	0	2	9	8	2	17
PAOs	1,535	1,458	1,458	1,386	1,386	1	26	77	73	27	150
PHA	0	0	0	0	0	0	0	0	0	0	0
TKN (lbs/day)	941	891	891	846	846	9	17	50	45	26	95
NH_3-N (lbs-N/day)	1	0	0	0	0	2	2	1	0	4	1
Particulate Bio Org N	5	4	4	4	4	0	0	0	0	0	0
Non-Bio Part Org N	461	438	438	416	416	1	5	23	22	6	45
Heterotrophs	343	326	326	310	310	1	3	17	16	4	33
Autotrophs	13	12	12	12	12	0	0	1	1	0	1
PAOs	115	109	109	104	104	0	2	6	5	2	11
Non-Bio Soluble Org. N	3	0	0	0	0	5	5	2	0	9	3
Non-Bio Colloidal Org. N	0	0	0	0	0	0	0	0	0	0	0
Soluble Bio Org N	0	0	0	0	0	0	0	0	0	0	0
Colloidal Bio Org N	0	0	0	0	0	0	0	0	0	0	0
NO_3-N (lbs-N/day)	6	1	1	0	0	15	6	6	0	21	6
TP (lbs-P/day)	445	422	422	401	401	4	6	23	21	10	44
Bio Particulate	1	1	1	1	1	0	0	0	0	0	0
Non-Bio Particulate	62	59	59	56	56	0	1	3	3	1	6
Metal Phosphate	0	0	0	0	0	0	0	0	0	0	0
Heterotrophs	113	108	108	102	102	0	1	6	5	1	11
Autotrophs	4	4	4	4	4	0	0	0	0	0	0
PAOs	38	36	36	34	34	0	1	2	2	1	4
Poly-P	226	215	215	204	204	0	3	11	11	3	22
Ortho-PO4	1	0	0	0	0	3	1	1	0	4	1
Alkalinity (lbs/day as $CaCO_3$)	313	37	37	14	14	509	536	276	23	1,046	300
H_2S (lbs/day)	0	0	0	0	0	0	0	0	0	0	0
BOD_5 (mg/L)	1,216	9,762	9,762	24,887	24,887	3	6	69	778	4	124
COD (mg/L)	8,395	67,201	67,201	171,272	171,272	45	87	506	5,386	66	885
TSS (mg/L)	7,470	60,000	60,000	152,963	152,963	11	49	424	4,782	30	762
VSS (mg/L)	6,164	49,508	49,508	126,216	126,216	9	40	350	3,946	25	629
TKN (mg-N/L)	392	3,133	3,133	7,984	7,984	2	4	24	251	3	41
NH_3-N (mg-N/L)	1	1	1	1	1	0	1	1	1	1	1
NO_3-N (mg-N/L)	3	3	3	3	3	4	2	3	3	3	3
TP (mg-P/L)	185	1,485	1,485	3,785	3,785	1	2	11	119	1	19
Alkalinity (mg/L as $CaCO_3$)	130	130	130	130	130	127	134	130	130	131	130
H_2S (mg/L)	0	0	0	0	0	0	0	0	0	0	0

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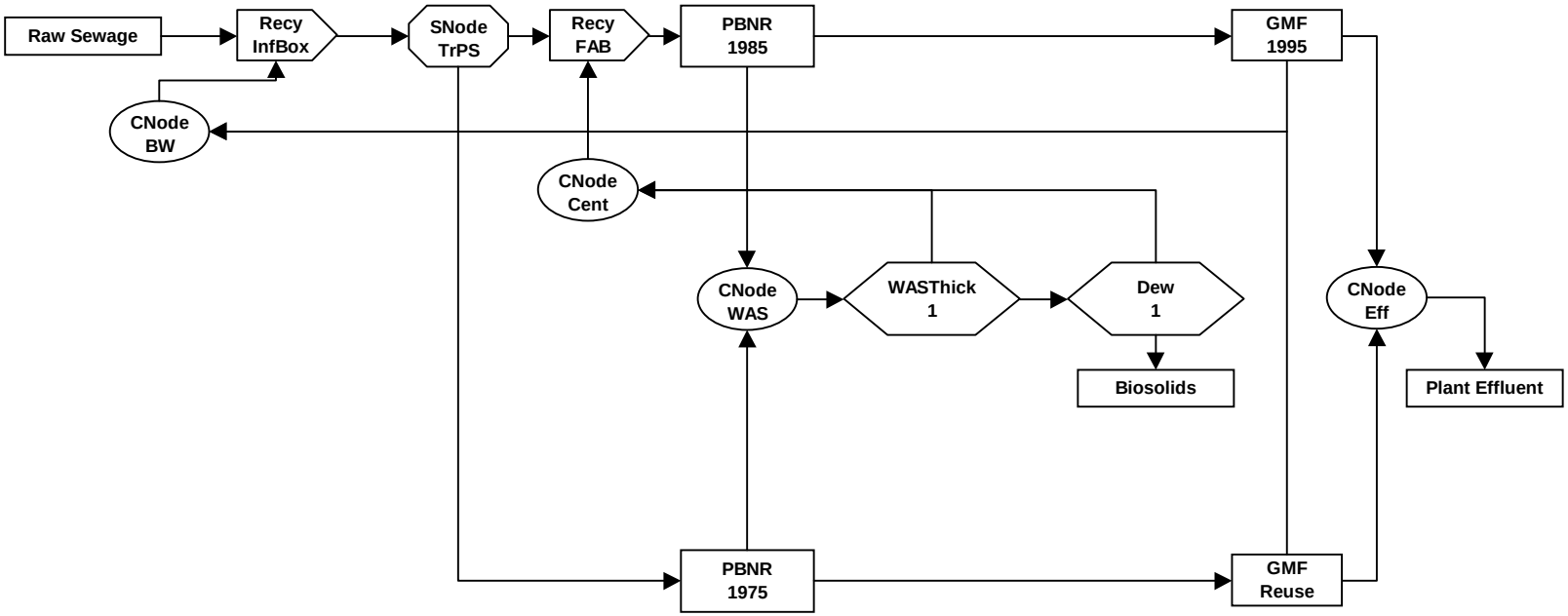

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Model Convergence 0.50%

Facility Operating Parameters			Project	First Assumptions
Item		**Value**	**Notes**	**US**
Influent Wastewater	(US)	(US)		
Flow	MG/day			
Design Average		**18.00**	MM	MM/Peak PF
Design Diurnal Peak		**26.4**		1.5
Design Peaking Factor for WW Diurnal flow		1.467		
Design Peaking Factor for WW Diurnal loads		**1.4**		
Carbonaceous Five-Day Biochemical Oxygen Demand (CBOD5)			Maximum Month Conditions	
Design Average Concentration	mg/L	140	140	
Design Average Mass Loading	lb/day	**21,029**		
Design Diurnal Peak Mass Loading	lb/day	29,441		
Total Suspended Solids (TSS)				
Design Average Concentration	mg/L	149	149	
Design Average Mass Loading	lb/day	**22,381**		
Design Diurnal Peak Mass Loading	lb/day	31,334		
Volatile Suspended Solids (VSS)				
Percent VSS	%	**87%**		
Design Average Concentration	mg/L	130		
Design Average Mass Loading	lb/day	19,480		
Design Diurnal Peak Mass Loading	lb/day	27,272		
Total Kjeldahl Nitrogen (TKN as N)				
Design Average Concentration	mg/L	23	23	
Design Average Mass Loading	lb/day	**3,455**		
Design Diurnal Peak Mass Loading	lb/day	4,837		
Ammonia-Nitrogen (NH3-N as N)			TKN/ammonia Ratio	
Design Average Concentration	mg/L	14	1.66	
Design Average Mass Loading	lb/day	**2,086**		
Design Diurnal Peak Mass Loading	lb/day	2,921		
Total Phosphorus (as P)				
Design Average Concentration	mg/L	4		
Design Average Mass Loading	lb/day	**601**	Estimated	
Design Diurnal Peak Mass Loading	lb/day	841		
Alkalinity (as CaCO3)				
Design Average Concentration	mg/L	167	167	
Design Average Mass Loading	lb/day	**25,085**		
Design Diurnal Peak Mass Loading	lb/day	35,119		
Hydrogen Sulfide (H2S)				
Design Average Concentration	mg/L	1		
Design Average Mass Loading	lb/day	**150**	Estimated	
Design Diurnal Peak Mass Loading	lb/day	210		
Chemical Addition:				
Select the Metal Salt (if used)		3		
Flow Splitter: TrPS				
Splitter Influent Flow	MGD	19.0		
Flow Splits			1985 Plant Flow, mgd	
TrPS Splitter Effluent (SplitE) Recy1	%	42%	**7.90**	
TrPS Splitter Effluent (SplitE) PBNR1975	%	**58%**		
	%	**0%**		
	%	**0%**		
	%	**0%**		
	%	**0%**		
	%	**0%**		
	%	**0%**		
	%	**0%**		
Biological Process - PBNR: 1975				
Total SRT (anaerobic + anoxic + aerobic)	days	**5.0**		
Nitrifier Minimum SRT (SRT_{min})	days	0.8		
DO	mg/L	2.0		
Temperature in the Biological Process	oF	**80.6**		
SVI	mL/g	**120**		
Biosolids Production Rates				
Net Yield (mg TSS/mg BOD_5)	lb/lb	1.10		
Volatile Fraction	%	84.5%		
Active Fraction	%	43.4%		
Nitrifier Fraction	%	1.1%		
Nitrogen Content, N/VSS	%	6.4%		
Phosphorus Content, P/VSS	%	1.9%		
Process Oxygen Requirements				
Carbonaceous AOR/BOD5 - wt/wt	lb/lb	1.1		

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Total AOR/BOD% - wt/wt	lb/lb	1.3		
AOR (wt/day)	lb/day			
Average		16,515		
Diurnal Peak		25,566		
AOR	mg/L-hr			
Average		86		
Diurnal Peak		133		
Bioreactor **Membrane Bioreactor**				
Total Bioreactor Volume	MG	**0.96**		
HRT	hr	2.1		
% non-aerobic		14%		
% aerobic		86%		
Average MLSS Concentration	mg/L	8,428		
Biorector Clarifier NOT SELECTED - not included in calculations				
Total Area	sq.ft.	**8,000**		
Overflow Rate	gpd-sq.ft.			
Average		#N/A		
Diurnal Peak		#N/A		<1000 gpd/sq.ft.; <900 gpd/sq.ft. with chem
Effluent TSS	mg/L			
Average		**10**		
Diurnal Peak		**20**		
Underflow Rate				
Average Flow Ratio		**67%**	0.67	
Average Rate	gpd-sq.ft.	#N/A		
Peak Flow Ratio		**50%**		Default RAS = 100%
Peak Rate	gpd-sq.ft.	#N/A		Adjust underflow rate to vary RAS
Solids Loading Rate	lb/day-sq.ft.			
Average		#N/A		
Diurnal Peak		#N/A		<50 lb/day-sq.ft.; <25 lb/day-sq.ft. with nit.
Limiting Solids Loading Rate	lb/day-sq.ft.	#N/A		
Return sludge rate at which limiting solids rate can be achieved				
RAS Flow Rate	MGD	#N/A		
Percent of Influent to Bioreactor	%	#N/A		
RAS Concentration	mg/L			
Average		#N/A		
Diurnal Peak		#N/A		
Membrane Performance				
Effluent TSS	mg/L			
Average		**1**		
Diurnal Peak		**1**		
Chemical Compound Applied in Bioreactor				
Chemical Added? **No**				
Chemical Type		0		
Chemical Dosage (as chemical)	lb/day	**200**		
Chemical Dosage (mg chemical/L treated)	mg/L	N/A		
Molar Ratio Dosage Applied (M+:PO4-P)		N/A		
Effluent PO4-P	lb/day	N/A		
Effluent PO4-P	mg/L	N/A		
Biological Process - PBNR: 1985				
Total SRT (anaerobic + anoxic + aerobic)	days	**11.3**		
Nitrifier Minimum SRT (SRT_{min})	days	1.2		
DO	mg/L	2.0		
Temperature in the Biological Process	oF	**80**		
SVI	mL/g	**120**		
Biosolids Production Rates				
Net Yield (mg TSS/mg BOD_5)	lb/lb	1.19		
Volatile Fraction	%	79.5%		
Active Fraction	%	33.1%		
Nitrifier Fraction	%	1.0%		
Nitrogen Content, N/VSS	%	6.4%		
Phosphorus Content, P/VSS	%	2.9%		
Process Oxygen Requirements				
Carbonaceous AOR/BOD5 - wt/wt	lb/lb	1.2		
Total AOR/BOD% - wt/wt	lb/lb	1.4		
AOR (wt/day)	lb/day			
Average		12,722		
Diurnal Peak		19,143		
AOR	mg/L-hr			
Average		21		
Diurnal Peak		31		
Bioreactor **With Secondary Clarifier**				
Total Bioreactor Volume	MG	**3.04**	0.05channel+0.8FAB+2.19CAB	
HRT	hr	8.9		
% non-aerobic		26%		
% aerobic		74%		
Average MLSS Concentration	mg/L	4,871		
Bioreactor Clarifier				

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Total Area	sq.ft.	**17,671**	4	Number of 75' diam SCs
Overflow Rate	gpd-sq.ft.			
Average		463		
Diurnal Peak		661		<1000 gpd/sq.ft.; <900 gpd/sq.ft. with chem
Effluent TSS	mg/L			
Average		**3**		
Diurnal Peak		**20**		
Underflow Rate				
Average Flow Ratio		**50%**	0.67	
Average Rate	gpd-sq.ft.	231		
Peak Flow Ratio		**50%**		Default RAS = 100%
Peak Rate	gpd-sq.ft.	330		Adjust underflow rate to vary RAS
Solids Loading Rate	lb/day-sq.ft.			
Average		23		
Diurnal Peak		40		<50 lb/day-sq.ft.; <25 lb/day-sq.ft. with nit.
Limiting Solids Loading Rate	lb/day-sq.ft.	46		
Return sludge rate at which limiting solids rate can be achieved				
RAS Flow Rate	MGD	8.6		
Percent of Influent to Bioreactor	%	105%		
RAS Concentration	mg/L			
Average		11,496		
Diurnal Peak		11,814		
No Membrane Bioreactor Selected				
Effluent TSS	mg/L			
Average		**1**		
Diurnal Peak		**1**		
Chemical Compound Applied before Secondary Clarifier				
Chemical Added? **No**				
Chemical Type		0		
Chemical Dosage (as chemical)	lb/day	**200**		
Chemical Dosage (mg chemical/L treated)	mg/L	N/A		
Molar Ratio Dosage Applied (M+:PO4-P)		N/A		
Effluent PO4-P	lb/day	N/A		
Effluent PO4-P	mg/L	N/A		
Filters: Reuse				
Filters? **Yes**				
Total Area	ft2	**2,400**		
Hydraulic Loading Rate	gpm/ft2			
Average		3.02		
Diurnal Peak		4.41		
Solids Loading Rate	lb/day-sq.ft.			
Average		0.01		
Diurnal Peak		0.01		
Filter Run Time	hr	**24**		
Instantaneous Backwash Rate	gpm/ft2	**0.14**		
Duration of Backwash Flow	minutes	**1,440**		
Backwash Operating Time (%cycle)	%	100.00%		
Backwash Flow Rate	MGD	0.48		
Ratio of Backwash Production to Filter Influent	%	4.4%		
TSS Removal Efficiency at Average Conditions		**85%**		
TSS Removal Efficiency at Diurnal Peak Conditions		**75%**		
Chemical Compound Applied to Filter Influent **No**				
Chemical Formula		Al2(SO4)3*14H20		
Chemical Dosage (mg chemical/L treated)	mg/L	**10**		
Chemical Dosage (as chemical)	lb/day	910.4		
Molar Ratio of Metal to Phosphate		0.0		
Percent of Soluble P that is ortho-P		***100%***		
Effective TSS Removal with Chemical Addition - Average Conditions(%)		85%		
Effective TSS Removal with Chemical Addition - Peak Conditions(%)		75%		
Backwash Concentration	mg/L	19		
Filters: 1995				
Filters? **Yes**				
Total Area	ft2	**2,400**		
Hydraulic Loading Rate	gpm/ft2			
Average		2.19		
Diurnal Peak		3.20		
Solids Loading Rate	lb/day-sq.ft.			
Average		0.02		
Diurnal Peak		0.17		
Filter Run Time	hr	**24**		
Instantaneous Backwash Rate	gpm/ft2	**0.14**		
Duration of Backwash Flow	minutes	**1,440**		
Backwash Operating Time (%cycle)	%	100.00%		
Backwash Flow Rate	MGD	0.48		
Ratio of Backwash Production to Filter Influent	%	6.0%		
TSS Removal Efficiency at Average Conditions		**85%**		
TSS Removal Efficiency at Diurnal Peak Conditions		**75%**		

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Chemical Compound Applied to Filter Influent	**No**				
Chemical Formula			Al2(SO4)3*14H20		
Chemical Dosage (mg chemical/L treated)		mg/L	**10**		
Chemical Dosage (as chemical)		lb/day	670.6		
Molar Ratio of Metal to Phosphate			0.0		
Percent of Soluble P that is ortho-P			***100%***		
Effective TSS Removal with Chemical Addition - Average Conditions(%)			85%		
Effective TSS Removal with Chemical Addition - Peak Conditions(%)			75%		
Backwash Concentration		mg/L	48		
WAS Thickening: 1					
WAS Thickener?	**Yes**				
Solids Capture		%	**95%**		
Thickened Sludge Concentration		mg/L	**60,000**		
Belt Wash Water Flow Rate		gpm	**0**		
Hours/Day of Operation			**24**		
Days/Week of Operation			**7**		
Dewatering: 1					
Dewatering?	**Yes**				
Solids Capture		%	**95%**		
Dewatered Sludge Concentration		%	**15%**		
Belt Wash Water Flow Rate		gpm	**0**		
Hours/Day of Operation			**24**		
Days/Week of Operation			**7**		

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Mass Balance for Average Flow Conditions

Constituent	Raw Wastewater (RW)	InfBox Recycle Influent (RecyI)	InfBox Recycled Stream (Recycle)	InfBox Combined Recycle Effluent (RecyE)	TrPS Splitter Influent (SplitI)	TrPS Splitter Effluent (SplitE) Recy1	TrPS Splitter Effluent (SplitE) PBNR1975	FAB Recycle Influent (RecyI)	FAB Recycled Stream (Recycle)	FAB Combined Recycle Effluent (RecyE)	1975 Bioreactor Influent (BI)	1975 Secondary Clarifier Influent (SI)	1975 Secondary Clarifier Effluent (SE)	1985 Bioreactor Influent (BI)	1985 Secondary Clarifier Influent (SI)	1985 Secondary Clarifier Effluent (SE)	Reuse Granular Media Filter Influent (GMFI)	Reuse Granular Media Filter Effluent (GMFE)	1995 Granular Media Filter Influent (GMFI)	1995 Granular Media Filter Effluent (GMFE)	Eff Combined Discharge	Plant Effluent (PLE)	1975 WAS	1985 WAS	WAS Combined Discharge
Flow (gallons/day)	18,000,000	18,000,000	959,945	18,959,945	18,959,945	7,900,000	11,059,945	7,900,000	275,711	8,176,667	11,059,945	11,059,945	10,909,592	8,176,667	12,266,433	8,035,245	10,909,592	10,429,620	8,035,245	7,555,272	17,984,892	17,984,892	150,353	142,377	292,730
Carbonaceous BOD_5 (lbs/day)	21,030	21,030	42	21,072	21,072	8,780	12,292	8,780	412	9,192	12,292	213,945	42	9,192	49,481	42	42	25	42	18	42	42	2,908	1,312	4,221
Particulate	11,030	11,030	1	11,031	11,031	4,596	6,435	4,596	13	4,610	6,435	7,687	1	4,610	1,190	1	1	0	1	0	0	0	105	32	136
Heterotrophs	0	0	34	34	34	14	20	14	367	381	20	202,829	19	381	37,926	21	19	3	21	3	6	6	2,757	1,006	3,763
PAOs	0	0	5	5	5	2	3	2	31	33	3	3,399	0	33	10,341	6	0	0	6	1	1	1	46	274	321
PHA	0	0	0	0	0	0	0	0	0	0	0	7	0	0	3	0	0	0	0	0	0	0	0	0	0
Filtrate	10,000	10,000	2	10,001	10,001	4,167	5,834	4,167	1	4,168	5,834	23	23	4,168	22	14	23	22	14	13	35	35	0	0	1
COD (lbs/day)	53,195	53,195	560	53,755	53,755	22,398	31,357	22,398	2,719	25,117	31,357	1,121,617	3,047	25,117	452,577	2,415	3,047	2,830	2,415	2,072	4,902	4,902	15,248	11,956	27,204
Particulate Bio	19,363	19,363	2	19,366	19,366	8,069	11,297	8,069	27	8,096	11,297	15,539	1	8,096	2,405	1	1	0	1	0	0	0	211	64	275
Particulate Non-Bio	8,299	8,299	188	8,486	8,486	3,536	4,950	3,536	1,574	5,110	4,950	614,181	57	5,110	293,761	164	57	9	164	25	33	33	8,349	7,792	16,142
Heterotrophs	0	0	76	76	76	32	44	32	824	856	44	455,578	42	856	85,186	48	42	6	48	7	13	13	6,193	2,260	8,453
Autotrophs	0	0	3	3	3	1	2	1	28	30	2	12,461	1	30	4,520	3	1	0	3	0	1	1	169	120	289
PAOs	0	0	32	32	32	13	19	13	192	205	19	20,836	2	205	63,386	35	2	0	35	5	6	6	283	1,681	1,965
PHA	0	0	0	0	0	0	0	0	0	0	0	37	0	0	16	0	0	0	0	0	0	0	1	0	1
Soluble Bio	10,532	10,532	3	10,536	10,536	4,390	6,146	4,390	1	4,391	6,146	43	42	4,391	41	27	42	40	27	25	66	66	1	0	1
Colloidal Bio	7,022	7,022	0	7,022	7,022	2,926	4,096	2,926	0	2,926	4,096	0	0	2,926	0	0	0	0	0	0	0	0	0	0	0
Soluble Non-Bio	4,788	4,788	255	5,043	5,043	2,101	2,942	2,101	73	2,175	2,942	2,942	2,902	2,175	3,263	2,137	2,902	2,774	2,137	2,010	4,784	4,784	40	38	78
Colloidal Non-Bio	3,192	3,192	0	3,192	3,192	1,330	1,862	1,330	0	1,330	1,862	0	0	1,330	0	0	0	0	0	0	0	0	0	0	0
TSS (lbs/day)	22,382	22,382	269	22,651	22,651	9,438	13,213	9,438	2,347	11,785	13,213	984,180	91	11,785	403,146	225	91	14	225	34	47	47	13,379	10,694	24,073
Biodegradable	15,151	15,151	2	15,153	15,153	6,314	8,839	6,314	21	6,335	8,839	12,159	1	6,335	1,882	1	1	0	1	0	0	0	165	50	215
Non-Biodegradable	7,230	7,230	156	7,386	7,386	3,078	4,309	3,078	1,312	4,389	4,309	514,493	48	4,389	243,458	136	48	7	136	20	28	28	6,994	6,458	13,452
Metal Hydroxide	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0
Metal Phosphate	0	0	**0**	**0**	**0**	**0**	**0**	**0**	0	**0**	**0**	0	0	**0**	0	0	0	**0**	0	0	**0**	**0**	0	0	0
Heterotrophs	0	0	68	68	68	29	40	29	739	768	40	408,670	38	768	76,415	43	38	6	43	6	12	12	5,556	2,027	7,583
Autotrophs	0	0	3	3	3	1	2	1	25	26	2	11,178	1	26	4,055	2	1	0	2	0	0	0	152	108	260
PAOs	0	0	28	28	28	12	17	12	172	184	17	18,691	2	184	56,860	32	2	0	32	5	5	5	254	1,508	1,762
PHA	0	0	0	0	0	0	0	0	0	0	0	22	0	0	9	0	0	0	0	0	0	0	0	0	1
Poly-P	0	0	11	11	11	5	7	5	78	83	7	18,967	2	83	20,468	11	2	0	11	2	2	2	258	543	801
VSS (lbs/day)	19,480	19,480	221	19,701	19,701	8,209	11,492	8,209	1,955	10,164	11,492	837,255	77	10,164	326,969	183	77	12	183	27	39	39	11,382	8,673	20,055
Biodegradable	13,636	13,636	2	13,638	13,638	5,682	7,955	5,682	19	5,701	7,955	10,943	1	5,701	1,694	1	1	0	1	0	0	0	149	45	194
Non-Biodegradable	5,844	5,844	130	5,974	5,974	2,489	3,485	2,489	1,094	3,582	3,485	431,605	40	3,582	201,670	113	40	6	113	17	23	23	5,867	5,350	11,217
Metal Hydroxide	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0
Heterotrophs	0	0	62	62	62	26	36	26	665	691	36	367,803	34	691	68,773	38	34	5	38	6	11	11	5,000	1,824	6,824
Autotrophs	0	0	3	3	3	1	1	1	23	24	1	10,060	1	24	3,649	2	1	0	2	0	0	0	137	97	234
PAOs	0	0	26	26	26	11	15	11	155	165	15	16,822	2	165	51,174	29	2	0	29	4	5	5	229	1,357	1,586
PHA	0	0	0	0	0	0	0	0	0	0	0	22	0	0	9	0	0	0	0	0	0	0	0	0	1
TKN (lbs/day)	3,455	3,455	27	3,482	3,482	1,451	2,031	1,451	128	1,578	2,031	53,493	154	1,578	20,662	124	154	143	124	107	250	250	727	546	1,273
NH_3-N (lbs-N/day)	2,086	2,086	4	2,090	2,090	871	1,219	871	1	872	1,219	45	44	872	54	35	44	42	35	33	75	75	1	1	1
Particulate Bio Org N	750	750	0	750	750	313	438	313	1	313	438	412	0	313	64	0	0	0	0	0	0	0	6	2	7
Non-Bio Part Org N	321	321	7	329	329	137	192	137	60	197	192	23,323	2	197	11,155	6	2	0	6	1	1	1	317	296	613
Heterotrophs	0	0	5	5	5	2	3	2	50	52	3	27,591	3	52	5,159	3	3	0	3	0	1	1	375	137	512
Autotrophs	0	0	0	0	0	0	0	0	2	2	0	755	0	2	274	0	0	0	0	0	0	0	10	7	18
PAOs	0	0	2	2	2	1	1	1	12	12	1	1,262	0	12	3,839	2	0	0	2	0	0	0	17	102	119
Non-Bio Soluble Org. N	172	172	9	182	182	76	106	76	3	78	106	106	104	78	117	77	104	100	77	72	172	172	1	1	3
Non-Bio Colloidal Org. N	115	115	0	115	115	48	67	48	0	48	67	0	0	48	0	0	0	0	0	0	0	0	0	0	0
Soluble Bio Org N	6	6	0	6	6	2	3	2	0	2	3	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Colloidal Bio Org N	4	4	0	4	4	2	2	2	0	2	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0
NO_3-N (lbs-N/day)	0	0	21	21	21	9	12	9	6	15	12	347	342	15	160	105	342	327	105	99	426	426	5	2	7
TP (lbs-P/day)	601	601	12	613	613	255	357	255	55	310	357	18,945	97	310	10,928	22	97	92	22	16	107	107	258	290	547
Bio Particulate	136	136	0	136	136	57	80	57	0	57	80	74	0	57	12	0	0	0	0	0	0	0	1	0	1
Non-Bio Particulate	58	58	1	59	59	25	35	25	8	33	35	3,124	0	33	1,494	1	0	0	1	0	0	0	42	40	82
Metal Phosphate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heterotrophs	0	0	2	2	2	1	1	1	16	17	1	9,112	1	17	1,704	1	1	0	1	0	0	0	124	45	169
Autotrophs	0	0	0	0	0	0	0	0	1	1	0	249	0	1	90	0	0	0	0	0	0	0	3	2	6
PAOs	0	0	1	1	1	0	0	0	4	4	0	417	0	4	1,268	1	0	0	1	0	0	0	6	34	39
Poly-P	0	0	3	3	3	1	2	1	24	26	2	5,872	1	26	6,337	4	1	0	4	1	1	1	80	168	248
Ortho-PO4	406	406	5	411	411	171	240	171	1	173	240	97	96	173	24	16	96	91	16	15	106	106	1	0	2
Alkalinity (lbs/day as $CaCO_3$)	25,085	25,085	1,042	26,127	26,127	10,886	15,241	10,886	299	11,186	15,241	11,668	11,509	11,186	13,686	8,965	11,509	11,003	8,965	8,430	19,433	19,433	159	159	317
H_2S (lbs/day)	150	150	0	150	150	63	88	63	0	63	88	0	0	63	0	0	0	0	0	0	0	0	0	0	0
BOD_5 (mg/L)	140	140	5	133	133	133	133	133	179	135	133	2,318	0	135	483	1	0	0	1	0	0	0	2,318	1,104	1,728
COD (mg/L)	354	354	70	340	340	340	340	340	1,182	368	340	12,152	33	368	4,421	36	33	33	36	33	33	33	12,152	10,062	11,135
TSS (mg/L)	149	149	34	143	143	143	143	143	1,020	173	143	10,663	1	173	3,938	3	1	0	3	1	0	0	10,663	9,000	9,854
VSS (mg/L)	130	130	28	125	125	125	125	125	850	149	125	9,071	0	149	3,194	0	0	0	0	0	0	0	9,071	7,299	8,209
TKN (mg-N/L)	23.0	23	3	22	22	22	22	22	55	23	22	580	2	23	202	2	2	2	2	2	2	2	580	459	521
NH_3-N (mg-N/L)	13.9	14	1	13	13	13	13	13	1	13	13	0	0	13	1	1	0	0	1	1	1	1	0	1	1
NO_3-N (mg-N/L)	0.0	0	3	0	0	0	0	0	3	0	0	4	4	0	2	2	4	4	2	2	3	3	4	2	3
TP (mg-P/L)	4.0	4	1	4	4	4	4	4	24	5	4	205	1	5	107	0	1	1	0	0	1	1	205	244	224
Alkalinity (mg/L as $CaCO_3$)	167	167	130	165	165	165	165	165	130	164	165	126	126	164	134	134	126	126	134	134	129	129	126	134	130
H_2S (mg/L)	1.0	1	0	1	1	1	1	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
													5			3						5			

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Mass Balance for Average Flow

Constituent	1 WAS Thickener Influent (TWASI)	1 Thickened WAS (TWAS)	1 Dewatering Influent (DWI)	1 Dewatered Sludge (DWE)	Biosolids to Dispoal	Reuse Filter Backwash (BW)	1995 Filter Backwash (BW)	1 WAS Thickening Recycle (TWASR)	1 Dewatering Recycle (DWR)	1 Combined Discharge	Cent Combined Discharge
Flow (gallons/day)	292,730	45,672	45,672	17,019	17,019	479,973	479,973	247,058	28,653	959,945	275,711
Carbonaceous BOD_5 (lbs/day)	4,221	4,009	4,009	3,809	3,809	18	24	211	201	42	412
Particulate	136	129	129	123	123	1	1	7	6	1	13
Heterotrophs	3,763	3,575	3,575	3,396	3,396	16	18	188	179	34	367
PAOs	321	304	304	289	289	0	5	16	15	5	31
PHA	0	0	0	0	0	0	0	0	0	0	0
Filtrate	1	0	0	0	0	1	1	0	0	2	1
COD (lbs/day)	27,204	25,781	25,781	24,485	24,485	217	343	1,423	1,296	560	2,719
Particulate Bio	275	261	261	248	248	1	1	14	13	2	27
Particulate Non-Bio	16,142	15,335	15,335	14,568	14,568	48	139	807	767	188	1,574
Heterotrophs	8,453	8,030	8,030	7,629	7,629	36	40	423	402	76	824
Autotrophs	289	275	275	261	261	1	2	14	14	3	28
PAOs	1,965	1,866	1,866	1,773	1,773	2	30	98	93	32	192
PHA	1	1	1	1	1	0	0	0	0	0	0
Soluble Bio	1	0	0	0	0	2	2	1	0	3	1
Colloidal Bio	0	0	0	0	0	0	0	0	0	0	0
Soluble Non-Bio	78	12	12	5	5	128	128	66	8	255	73
Colloidal Non-Bio	0	0	0	0	0	0	0	0	0	0	0
TSS (lbs/day)	24,073	22,870	22,870	21,726	21,726	77	191	1,204	1,143	269	2,347
Biodegradable	215	204	204	194	194	1	1	11	10	2	21
Non-Biodegradable	13,452	12,780	12,780	12,141	12,141	40	116	673	639	156	1,312
Metal Hydroxide	0	0	0	0	0	0	**0**	0	0	0	0
Metal Phosphate	0	0	0	0	0	**0**	0	0	0	**0**	0
Heterotrophs	7,583	7,203	7,203	6,843	6,843	32	36	379	360	68	739
Autotrophs	260	247	247	234	234	1	2	13	12	3	25
PAOs	1,762	1,674	1,674	1,591	1,591	1	27	88	84	28	172
PHA	1	1	1	0	0	0	0	0	0	0	0
Poly-P	801	761	761	723	723	1	10	40	38	11	78
VSS (lbs/day)	20,055	19,052	19,052	18,100	18,100	66	155	1,003	953	221	1,955
Biodegradable	194	184	184	175	175	1	1	10	9	2	19
Non-Biodegradable	11,217	10,656	10,656	10,123	10,123	34	96	561	533	130	1,094
Metal Hydroxide	0	0	0	0	0	0	**0**	0	0	0	0
Heterotrophs	6,824	6,483	6,483	6,159	6,159	29	33	341	324	62	665
Autotrophs	234	222	222	211	211	1	2	12	11	3	23
PAOs	1,586	1,507	1,507	1,431	1,431	1	24	79	75	26	155
PHA	1	1	1	0	0	0	0	0	0	0	0
TKN (lbs/day)	1,273	1,206	1,206	1,145	1,145	11	16	67	61	27	128
NH_3-N (lbs-N/day)	1	0	0	0	0	2	2	1	0	4	1
Particulate Bio Org N	7	7	7	7	7	0	0	0	0	0	1
Non-Bio Part Org N	613	582	582	553	553	2	5	31	29	7	60
Heterotrophs	512	486	486	462	462	2	2	26	24	5	50
Autotrophs	18	17	17	16	16	0	0	1	1	0	2
PAOs	119	113	113	107	107	0	2	6	6	2	12
Non-Bio Soluble Org. N	3	0	0	0	0	5	5	2	0	9	3
Non-Bio Colloidal Org. N	0	0	0	0	0	0	0	0	0	0	0
Soluble Bio Org N	0	0	0	0	0	0	0	0	0	0	0
Colloidal Bio Org N	0	0	0	0	0	0	0	0	0	0	0
NO_3-N (lbs-N/day)	7	1	1	0	0	15	6	6	1	21	6
TP (lbs-P/day)	547	518	518	492	492	6	6	29	26	12	55
Bio Particulate	1	1	1	1	1	0	0	0	0	0	0
Non-Bio Particulate	82	78	78	74	74	0	1	4	4	1	8
Metal Phosphate	0	0	0	0	0	0	0	0	0	0	0
Heterotrophs	169	161	161	153	153	1	1	8	8	2	16
Autotrophs	6	5	5	5	5	0	0	0	0	0	1
PAOs	39	37	37	35	35	0	1	2	2	1	4
Poly-P	248	236	236	224	224	0	3	12	12	3	24
Ortho-PO4	2	0	0	0	0	4	1	1	0	5	1
Alkalinity (lbs/day as $CaCO_3$)	317	50	50	18	18	506	536	268	31	1,042	299
H_2S (lbs/day)	0	0	0	0	0	0	0	0	0	0	0
BOD_5 (mg/L)	1,728	10,518	10,518	26,815	26,815	4	6	103	839	5	179
COD (mg/L)	11,135	67,638	67,638	172,384	172,384	54	86	690	5,420	70	1,182
TSS (mg/L)	9,854	60,000	60,000	152,963	152,963	19	48	584	4,782	34	1,020
VSS (mg/L)	8,209	49,985	49,985	127,432	127,432	16	39	486	3,984	28	850
TKN (mg-N/L)	521	3,164	3,164	8,063	8,063	3	4	32	254	3	55
NH_3-N (mg-N/L)	1	1	1	1	1	0	1	1	1	1	1
NO_3-N (mg-N/L)	3	3	3	3	3	4	2	3	3	3	3
TP (mg-P/L)	224	1,360	1,360	3,467	3,467	1	2	14	109	1	24
Alkalinity (mg/L as $CaCO_3$)	130	130	130	130	130	126	134	130	130	130	130
H_2S (mg/L)	0	0	0	0	0	0	0	0	0	0	0

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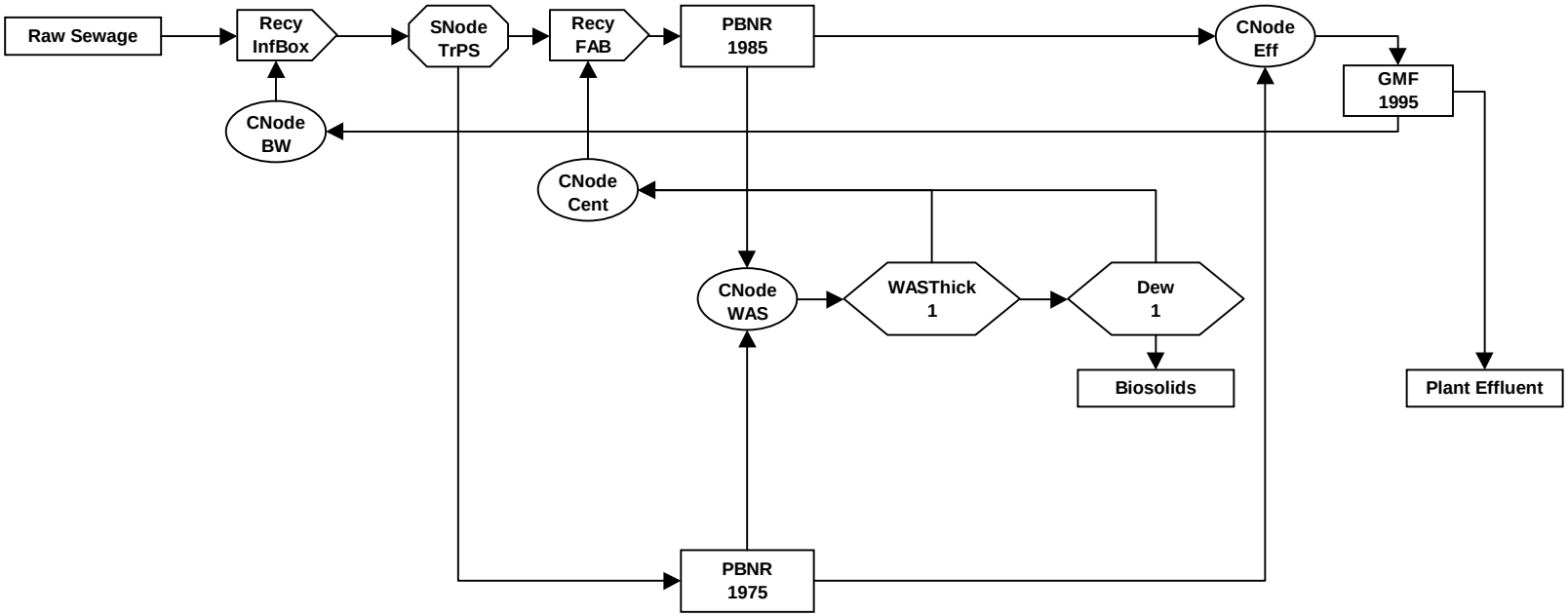

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Model Convergence 0.38%

Facility Operating Parameters			Project	First Assumptions
Item		**Value**	**Notes**	**US**
Influent Wastewater	(US)	(US)		
Flow	MG/day			
Design Average		**13.50**	MM	MM/Peak PF
Design Diurnal Peak		**19.8**		1.5
Design Peaking Factor for WW Diurnal flow		1.466666667		
Design Peaking Factor for WW Diurnal loads		**1.4**		
Carbonaceous Five-Day Biochemical Oxygen Demand (CBOD5)			Maximum Month Conditions	
Design Average Concentration	mg/L	140	140	
Design Average Mass Loading	lb/day	**15,772**		
Design Diurnal Peak Mass Loading	lb/day	22,081		
Total Suspended Solids (TSS)				
Design Average Concentration	mg/L	149	149	
Design Average Mass Loading	lb/day	**16,786**		
Design Diurnal Peak Mass Loading	lb/day	23,500		
Volatile Suspended Solids (VSS)				
Percent VSS	%	**87%**		
Design Average Concentration	mg/L	130		
Design Average Mass Loading	lb/day	14,610		
Design Diurnal Peak Mass Loading	lb/day	20,454		
Total Kjeldahl Nitrogen (TKN as N)				
Design Average Concentration	mg/L	23	23	
Design Average Mass Loading	lb/day	**2,591**		
Design Diurnal Peak Mass Loading	lb/day	3,628		
Ammonia-Nitrogen (NH3-N as N)			TKN/ammonia Ratio	
Design Average Concentration	mg/L	14	1.66	
Design Average Mass Loading	lb/day	**1,565**		
Design Diurnal Peak Mass Loading	lb/day	2,191		
Total Phosphorus (as P)				
Design Average Concentration	mg/L	4		
Design Average Mass Loading	lb/day	**451**	Estimated	
Design Diurnal Peak Mass Loading	lb/day	631		
Alkalinity (as CaCO3)				
Design Average Concentration	mg/L	167	167	
Design Average Mass Loading	lb/day	**18,814**		
Design Diurnal Peak Mass Loading	lb/day	26,339		
Hydrogen Sulfide (H2S)				
Design Average Concentration	mg/L	1		
Design Average Mass Loading	lb/day	**113**	Estimated	
Design Diurnal Peak Mass Loading	lb/day	158		
Chemical Addition:				
Select the Metal Salt (if used)		3		
Flow Splitter: TrPS				
Splitter Influent Flow	MGD	14.9		
Flow Splits			1985 Plant Flow, mgd	
TrPS Splitter Effluent (SplitE) RecyFAB	%	70%	**10.40**	
TrPS Splitter Effluent (SplitE) PBNR1975	%	**30%**		
	%	**0%**		
	%	**0%**		
	%	**0%**		
	%	**0%**		
	%	**0%**		
	%	**0%**		
	%	**0%**		
Biological Process - PBNR: 1975				
Total SRT (anaerobic + anoxic + aerobic)	days	**5.0**		
Nitrifier Minimum SRT (SRT_{min})	days	1.2		
DO	mg/L	2.0		
Temperature in the Biological Process	oF	**80.6**		
SVI	mL/g	**120**		
Biosolids Production Rates				
Net Yield (mg TSS/mg BOD_5)	lb/lb	1.14		
Volatile Fraction	%	77.9%		
Active Fraction	%	43.6%		
Nitrifier Fraction	%	1.1%		
Nitrogen Content, N/VSS	%	6.9%		
Phosphorus Content, P/VSS	%	2.8%		
Process Oxygen Requirements				
Carbonaceous AOR/BOD5 - wt/wt	lb/lb	1.0		

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Total AOR/BOD% - wt/wt	lb/lb	1.3		
AOR (wt/day)	lb/day			
Average		6,119		
Diurnal Peak		9,455		
AOR	mg/L-hr			
Average		28		
Diurnal Peak		43		
Bioreactor With Secondary Clarifier				
Total Bioreactor Volume	MG	**1.09**		
HRT	hr	5.8		
% non-aerobic		20%		
% aerobic		80%		
Average MLSS Concentration	mg/L	3,008		
Bioreactor Clarifier				
Total Area	sq.ft.	**8,000**		
Overflow Rate	gpd-sq.ft.			
Average		560		
Diurnal Peak		797		<1000 gpd/sq.ft.; <900 gpd/sq.ft. with chem
Effluent TSS	mg/L			
Average		**10**		
Diurnal Peak		**20**		
Underflow Rate				
Average Flow Ratio		**67%**	0.67	
Average Rate	gpd-sq.ft.	375		
Peak Flow Ratio		**50%**		Default RAS = 100%
Peak Rate	gpd-sq.ft.	399		Adjust underflow rate to vary RAS
Solids Loading Rate	lb/day-sq.ft.			
Average		23		
Diurnal Peak		30		<50 lb/day-sq.ft.; <25 lb/day-sq.ft. with nit.
Limiting Solids Loading Rate	lb/day-sq.ft.	49		
Return sludge rate at which limiting solids rate can be achieved				
RAS Flow Rate	MGD	4.1		
Percent of Influent to Bioreactor	%	92%		
RAS Concentration	mg/L			
Average		7,263		
Diurnal Peak		9,004		
No Membrane Bioreactor Selected				
Effluent TSS	mg/L			
Average		**1**		
Diurnal Peak		**1**		
Chemical Compound Applied before Secondary Clarifier				
Chemical Added? **No**				
Chemical Type		0		
Chemical Dosage (as chemical)	lb/day	**200**		
Chemical Dosage (mg chemical/L treated)	mg/L	N/A		
Molar Ratio Dosage Applied (M+:PO4-P)		N/A		
Effluent PO4-P	lb/day	N/A		
Effluent PO4-P	mg/L	N/A		
Biological Process - PBNR: 1985				
Total SRT (anaerobic + anoxic + aerobic)	days	**7.0**		
Nitrifier Minimum SRT (SRT_{min})	days	1.2		
DO	mg/L	2.0		
Temperature in the Biological Process	oF	**80**		
SVI	mL/g	**120**		
Biosolids Production Rates				
Net Yield (mg TSS/mg BOD_5)	lb/lb	1.21		
Volatile Fraction	%	80.3%		
Active Fraction	%	39.4%		
Nitrifier Fraction	%	1.1%		
Nitrogen Content, N/VSS	%	6.5%		
Phosphorus Content, P/VSS	%	2.8%		
Process Oxygen Requirements				
Carbonaceous AOR/BOD5 - wt/wt	lb/lb	1.1		
Total AOR/BOD% - wt/wt	lb/lb	1.4		
AOR (wt/day)	lb/day			
Average		15,434		
Diurnal Peak		23,393		
AOR	mg/L-hr			
Average		25		
Diurnal Peak		38		
Bioreactor With Secondary Clarifier				
Total Bioreactor Volume	MG	**3.04**	0.05channel+0.8FAB+2.19CAB	
HRT	hr	6.9		
% non-aerobic		34%		
% aerobic		66%		
Average MLSS Concentration	mg/L	3,809		
Bioreactor Clarifier				

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Total Area	sq.ft.	**17,671**	4	Number of 75' diam SCs
Overflow Rate	gpd-sq.ft.			
Average		603		
Diurnal Peak		852		<1000 gpd/sq.ft.; <900 gpd/sq.ft. with chem
Effluent TSS	mg/L			
Average		**3**		
Diurnal Peak		**20**		
Underflow Rate				
Average Flow Ratio		**50%**	0.67	
Average Rate	gpd-sq.ft.	301		
Peak Flow Ratio		**50%**		Default RAS = 100%
Peak Rate	gpd-sq.ft.	426		Adjust underflow rate to vary RAS
Solids Loading Rate	lb/day-sq.ft.			
Average		23		
Diurnal Peak		41		<50 lb/day-sq.ft.; <25 lb/day-sq.ft. with nit.
Limiting Solids Loading Rate	lb/day-sq.ft.	49		
Return sludge rate at which limiting solids rate can be achieved				
RAS Flow Rate	MGD	9.1		
Percent of Influent to Bioreactor	%	86%		
RAS Concentration	mg/L			
Average		8,940		
Diurnal Peak		9,249		
No Membrane Bioreactor Selected				
Effluent TSS	mg/L			
Average		**1**		
Diurnal Peak		**1**		
Chemical Compound Applied before Secondary Clarifier				
Chemical Added? **No**				
Chemical Type		0		
Chemical Dosage (as chemical)	lb/day	**200**		
Chemical Dosage (mg chemical/L treated)	mg/L	N/A		
Molar Ratio Dosage Applied (M+:PO4-P)		N/A		
Effluent PO4-P	lb/day	N/A		
Effluent PO4-P	mg/L	N/A		
Filters: 1995				
Filters? **Yes**				
Total Area	ft2	**2,400**		
Hydraulic Loading Rate	gpm/ft2			
Average		3.90		
Diurnal Peak		5.72		
Solids Loading Rate	lb/day-sq.ft.			
Average		0.06		
Diurnal Peak		0.30		
Filter Run Time	hr	**24**		
Instantaneous Backwash Rate	gpm/ft2	**0.40**		
Duration of Backwash Flow	minutes	**1,440**		
Backwash Operating Time (%cycle)	%	100.00%		
Backwash Flow Rate	MGD	1.38		
Ratio of Backwash Production to Filter Influent	%	9.3%		
TSS Removal Efficiency at Average Conditions		**85%**		
TSS Removal Efficiency at Diurnal Peak Conditions		**75%**		
Chemical Compound Applied to Filter Influent **No**				
Chemical Formula		Al2(SO4)3*14H20		
Chemical Dosage (mg chemical/L treated)	mg/L	**10**		
Chemical Dosage (as chemical)	lb/day	1240.9		
Molar Ratio of Metal to Phosphate		0.0		
Percent of Soluble P that is ortho-P		***100%***		
Effective TSS Removal with Chemical Addition - Average Conditions(%)		85%		
Effective TSS Removal with Chemical Addition - Peak Conditions(%)		75%		
Backwash Concentration	mg/L	49		
WAS Thickening: 1				
WAS Thickener? **Yes**				
Solids Capture	%	**95%**		
Thickened Sludge Concentration	mg/L	**60,000**		
Belt Wash Water Flow Rate	gpm	**0**		
Hours/Day of Operation		**24**		
Days/Week of Operation		**7**		
Dewatering: 1				
Dewatering? **Yes**				
Solids Capture	%	**95%**		
Dewatered Sludge Concentration	%	**15%**		
Belt Wash Water Flow Rate	gpm	**0**		
Hours/Day of Operation		**24**		
Days/Week of Operation		**7**		

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Mass Balance for Average Flow Conditions

Constituent	Raw Wastewater (RW)	InfBox Recycle Influent (RecyI)	InfBox Recycled Stream (Recycle)	InfBox Combined Recycle Effluent (RecyE)	TrPS Splitter Influent (SplitI)	TrPS Splitter Effluent (SplitE) RecyFAB	TrPS Splitter Effluent (SplitE) PBNR1975	FAB Recycle Influent (RecyI)	FAB Recycled Stream (Recycle)	FAB Combined Recycle Effluent (RecyE)	1975 Bioreactor Influent (BI)	1975 Secondary Clarifier Influent (SI)	1975 Secondary Clarifier Effluent (SE)	1985 Bioreactor Influent (BI)	1985 Secondary Clarifier Influent (SI)	1985 Secondary Clarifier Effluent (SE)	Eff Combined Discharge	1995 Granular Media Filter Influent (GMFI)	1995 Granular Media Filter Effluent (GMFE)	Plant Effluent (PLE)	1975 WAS	1985 WAS	WAS Combined Discharge	1 WAS Thickener Influent (TWASI)	1 Thickened WAS (TWAS)
Flow (gallons/day)	13,500,000	13,500,000	1,382,321	14,882,321	14,882,321	10,400,000	4,482,321	10,400,000	250,980	10,650,989	4,482,321	7,485,476	4,398,087	10,650,989	15,976,497	10,471,088	14,869,176	14,869,176	13,486,855	13,486,855	84,234	179,910	264,144	264,144	35,324
Carbonaceous BOD_5 (lbs/day)	15,772	15,772	106	15,879	15,879	11,096	4,782	11,096	313	11,410	4,782	38,116	84	11,410	66,100	66	150	150	44	44	1,038	2,172	3,210	3,210	3,049
COD (lbs/day)	39,896	39,896	998	40,895	40,895	28,578	12,317	28,578	2,092	30,670	12,317	211,094	1,597	30,670	462,673	3,147	4,744	4,744	3,745	3,745	5,716	15,116	20,832	20,832	19,732
TSS (lbs/day)	16,786	16,786	561	17,348	17,348	12,123	5,225	12,123	1,815	13,938	5,225	187,496	367	13,938	411,080	293	660	660	99	99	5,106	13,513	18,619	18,619	17,688
VSS (lbs/day)	14,610	14,610	465	15,075	15,075	10,535	4,540	10,535	1,496	12,031	4,540	156,445	306	12,031	337,064	241	547	547	82	82	4,260	11,080	15,340	15,340	14,573
TKN (lbs/day)	2,591	2,591	48	2,639	2,639	1,844	795	1,844	99	1,943	795	10,137	88	1,943	21,749	139	227	227	180	180	274	711	985	985	933
NH_3-N (lbs-N/day)	1,565	1,565	5	1,569	1,569	1,097	473	1,097	1	1,098	473	44	26	1,098	36	24	50	50	45	45	1	0	1	1	0
NO_3-N (lbs-N/day)	0	0	42	42	42	29	13	29	8	37	13	161	95	37	546	358	453	453	411	411	2	6	8	8	1
TP (lbs-P/day)	451	451	16	466	466	326	140	326	47	373	140	4,690	12	373	10,793	20	32	32	16	16	128	354	482	482	458
Alkalinity (lbs/day as $CaCO_3$)	18,814	18,814	1,459	20,273	20,273	14,167	6,106	14,167	265	14,432	6,106	8,224	4,832	14,432	16,575	10,863	15,695	15,695	14,236	14,236	93	187	279	279	37
H_2S (lbs/day)	113	113	0	113	113	79	34	79	0	79	34	0	0	79	0	0	0	0	0	0	0	0	0	0	0
BOD_5 (mg/L)	140	140	9	128	128	128	128	128	150	128	128	610	2	128	496	1	1	1	0	0	1,476	1,447	1,456	1,456	10,343
COD (mg/L)	354	354	87	329	329	329	329	329	999	345	329	3,379	44	345	3,470	36	38	38	33	33	8,131	10,068	9,450	9,450	66,935
TSS (mg/L)	149	149	49	140	140	140	140	140	867	157	140	3,001	10	157	3,083	3	5	5	1	1	7,263	9,000	8,446	8,446	60,000
VSS (mg/L)	130	130	40	121	121	121	121	121	714	135	121	2,504	0	135	2,528	0	0	0	1	1	6,060	7,380	6,959	6,959	49,434
TKN (mg-N/L)	23.0	23	4	21	21	21	21	21	47	22	21	162	2	22	163	2	2	2	2	2	390	473	447	447	3,165
NH_3-N (mg-N/L)	13.9	14	0	13	13	13	13	13	0	12	13	1	1	12	0	0	0	0	0	0	1	0	0	0	0
NO_3-N (mg-N/L)	0.0	0	4	0	0	0	0	0	4	0	0	3	3	0	4	4	4	4	4	4	3	4	4	4	4
TP (mg-P/L)	4.0	4	1	4	4	4	4	4	23	4	4	75	0	4	81	0	0	0	0	0	182	236	219	219	1,553
Alkalinity (mg/L as $CaCO_3$)	167	167	126	163	163	163	163	163	127	162	163	132	132	162	124	124	126	126	126	126	132	124	127	127	127
H_2S (mg/L)	1.0	1	0	1	1	1	1	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0

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Mass Balance for Average Flow

Constituent	1 Dewatering Influent (DWI)	1 Dewatered Sludge (DWE)	Biosolids to Dispoal	1995 Filter Backwash (BW)	1 WAS Thickening Recycle (TWASR)	1 Dewatering Recycle (DWR)	BW Combined Discharge	Cent Combined Discharge
Flow (gallons/day)	35,324	13,163	13,163	1,382,321	228,820	22,161	1,382,321	250,980
Carbonaceous BOD_5 (lbs/day)	3,049	2,897	2,897	106	161	152	106	313
COD (lbs/day)	19,732	18,740	18,740	998	1,100	992	998	2,092
TSS (lbs/day)	17,688	16,803	16,803	561	931	884	561	1,815
VSS (lbs/day)	14,573	13,844	13,844	465	767	729	465	1,496
TKN (lbs/day)	933	886	886	48	52	47	48	99
NH_3-N (lbs-N/day)	0	0	0	5	1	0	5	1
NO_3-N (lbs-N/day)	1	0	0	42	7	1	42	8
TP (lbs-P/day)	458	435	435	16	24	23	16	47
Alkalinity (lbs/day as $CaCO_3$)	37	14	14	1,459	242	23	1,459	265
H_2S (lbs/day)	0	0	0	0	0	0	0	0
BOD_5 (mg/L)	10,343	26,367	26,367	9	84	825	9	150
COD (mg/L)	66,935	170,594	170,594	87	576	5,364	87	999
TSS (mg/L)	60,000	152,963	152,963	49	488	4,782	49	867
VSS (mg/L)	49,434	126,027	126,027	40	402	3,940	40	714
TKN (mg-N/L)	3,165	8,066	8,066	4	27	254	4	47
NH_3-N (mg-N/L)	0	0	0	0	0	0	0	0
NO_3-N (mg-N/L)	4	4	4	4	4	4	4	4
TP (mg-P/L)	1,553	3,958	3,958	1	13	124	1	23
Alkalinity (mg/L as $CaCO_3$)	127	127	127	126	127	127	126	127
H_2S (mg/L)	0	0	0	0	0	0	0	0

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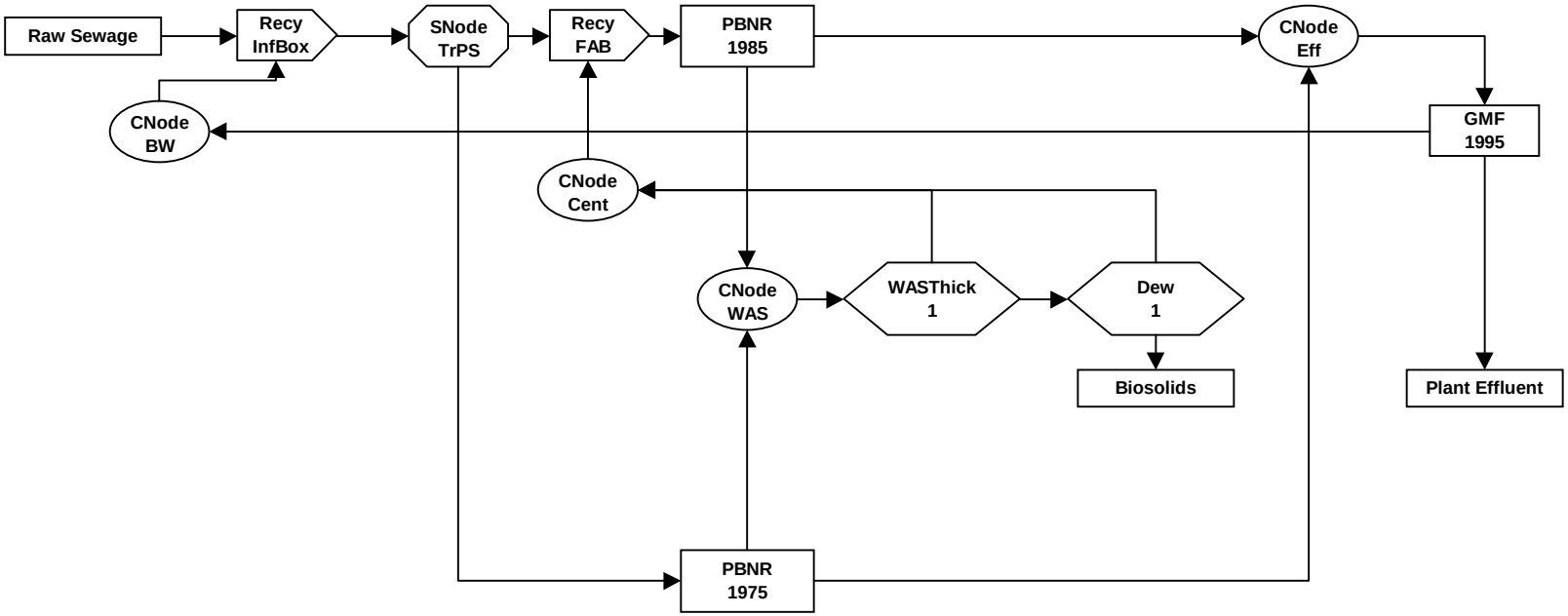

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Model Convergence 0.49%

Facility Operating Parameters			Project	First Assumptions	
Item		Value	Notes	US	
Influent Wastewater	(US)	(US)			
Flow	MG/day				
Design Average		**11.90**	MM	MM/Peak PF	
Design Diurnal Peak		**17.85**		1.5	
Design Peaking Factor for WW Diurnal flow		1.5			
Design Peaking Factor for WW Diurnal loads		**1.4**			
Carbonaceous Five-Day Biochemical Oxygen Demand (CBOD5)			Maximum Month Conditions		
Design Average Concentration	mg/L	140	140		
Design Average Mass Loading	lb/day	**13,903**			
Design Diurnal Peak Mass Loading	lb/day	19,464			
Total Suspended Solids (TSS)					
Design Average Concentration	mg/L	149	149		
Design Average Mass Loading	lb/day	**14,797**			
Design Diurnal Peak Mass Loading	lb/day	20,715			
Volatile Suspended Solids (VSS)					
Percent VSS	%	**87%**			
Design Average Concentration	mg/L	130			
Design Average Mass Loading	lb/day	12,879			
Design Diurnal Peak Mass Loading	lb/day	18,030			E
Total Kjeldahl Nitrogen (TKN as N)					
Design Average Concentration	mg/L	23	23		
Design Average Mass Loading	lb/day	**2,284**			
Design Diurnal Peak Mass Loading	lb/day	3,198			
Ammonia-Nitrogen (NH3-N as N)			TKN/ammonia Ratio		
Design Average Concentration	mg/L	14	1.66		
Design Average Mass Loading	lb/day	**1,379**			
Design Diurnal Peak Mass Loading	lb/day	1,931			
Total Phosphorus (as P)					
Design Average Concentration	mg/L	4			
Design Average Mass Loading	lb/day	**397**	Estimated		
Design Diurnal Peak Mass Loading	lb/day	556			
Alkalinity (as CaCO3)					
Design Average Concentration	mg/L	167	167		
Design Average Mass Loading	lb/day	**16,584**			Se
Design Diurnal Peak Mass Loading	lb/day	23,218			Secondary (
Hydrogen Sulfide (H2S)					
Design Average Concentration	mg/L	1			F
Design Average Mass Loading	lb/day	**99**	Estimated		
Design Diurnal Peak Mass Loading	lb/day	139			
Chemical Addition:					
Select the Metal Salt (if used)		3			
Flow Splitter: TrPS					
Splitter Influent Flow	MGD	12.4			
Flow Splits			1985 Plant Flow, mgd		Se
TrPS Splitter Effluent (SplitE) RecyFAB	%	65%	**8.03**		Secondary (
TrPS Splitter Effluent (SplitE) PBNR1975	%	**35%**			
	%	**0%**			
	%	**0%**			
	%	**0%**			
	%	**0%**			
	%	**0%**			
	%	**0%**			
	%	**0%**			
Biological Process - PBNR: 1975					
Total SRT (anaerobic + anoxic + aerobic)	days	**5.0**			
Nitrifier Minimum SRT (SRT_{min})	days	1.2			
DO	mg/L	2.0			
Temperature in the Biological Process	oF	**80.6**			
SVI	mL/g	**120**			
Biosolids Production Rates					
Net Yield (mg TSS/mg BOD_5)	lb/lb	1.15			
Volatile Fraction	%	78.2%			
Active Fraction	%	43.8%			
Nitrifier Fraction	%	1.1%			
Nitrogen Content, N/VSS	%	6.8%			
Phosphorus Content, P/VSS	%	2.8%			
Process Oxygen Requirements					
Carbonaceous AOR/BOD5 - wt/wt	lb/lb	1.0			

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Total AOR/BOD% - wt/wt	lb/lb	1.3		
AOR (wt/day)	lb/day			
Average		6,294		
Diurnal Peak		9,727		
AOR	mg/L-hr			
Average		29		
Diurnal Peak		45		
Bioreactor With Secondary Clarifier				
Total Bioreactor Volume	MG	**1.09**		
HRT	hr	6.0		
% non-aerobic		20%		
% aerobic		80%		
Average MLSS Concentration	mg/L	3,103		
Bioreactor Clarifier				
Total Area	sq.ft.	**8,000**		
Overflow Rate	gpd-sq.ft.			
Average		544		
Diurnal Peak		805		<1000 gpd/sq.ft.; <900 gpd/sq.ft. with chem
Effluent TSS	mg/L			
Average		**10**		
Diurnal Peak		**20**		
Underflow Rate				
Average Flow Ratio		**67%**	0.67	
Average Rate	gpd-sq.ft.	364		
Peak Flow Ratio		**50%**		Default RAS = 100%
Peak Rate	gpd-sq.ft.	403		Adjust underflow rate to vary RAS
Solids Loading Rate	lb/day-sq.ft.			
Average		23		
Diurnal Peak		31		<50 lb/day-sq.ft.; <25 lb/day-sq.ft. with nit.
Limiting Solids Loading Rate	lb/day-sq.ft.	49		
Return sludge rate at which limiting solids rate can be achieved				
RAS Flow Rate	MGD	4.1		
Percent of Influent to Bioreactor	%	95%		
RAS Concentration	mg/L			
Average		7,485		
Diurnal Peak		9,287		
No Membrane Bioreactor Selected				
Effluent TSS	mg/L			
Average		**1**		
Diurnal Peak		**1**		
Chemical Compound Applied before Secondary Clarifier				
Chemical Added? **No**				
Chemical Type		0		
Chemical Dosage (as chemical)	lb/day	**200**		
Chemical Dosage (mg chemical/L treated)	mg/L	N/A		
Molar Ratio Dosage Applied (M+:PO4-P)		N/A		
Effluent PO4-P	lb/day	N/A		
Effluent PO4-P	mg/L	N/A		
Biological Process - PBNR: 1985				
Total SRT (anaerobic + anoxic + aerobic)	days	**11.3**		
Nitrifier Minimum SRT (SRT_{min})	days	1.2		
DO	mg/L	2.0		
Temperature in the Biological Process	oF	**80**		
SVI	mL/g	**120**		
Biosolids Production Rates				
Net Yield (mg TSS/mg BOD_5)	lb/lb	1.15		
Volatile Fraction	%	79.3%		
Active Fraction	%	34.0%		
Nitrifier Fraction	%	1.0%		
Nitrogen Content, N/VSS	%	6.4%		
Phosphorus Content, P/VSS	%	3.0%		
Process Oxygen Requirements				
Carbonaceous AOR/BOD5 - wt/wt	lb/lb	1.2		
Total AOR/BOD% - wt/wt	lb/lb	1.4		
AOR (wt/day)	lb/day			
Average		12,901		
Diurnal Peak		19,545		
AOR	mg/L-hr			
Average		21		
Diurnal Peak		32		
Bioreactor With Secondary Clarifier				
Total Bioreactor Volume	MG	**3.04**	0.05channel+0.8FAB+2.19CAB	
HRT	hr	8.9		
% non-aerobic		26%		
% aerobic		74%		
Average MLSS Concentration	mg/L	4,769		
Bioreactor Clarifier				

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Total Area	sq.ft.	**17,671**	4	Number of 75' diam SCs
Overflow Rate	gpd-sq.ft.			
Average		466		
Diurnal Peak		685		<1000 gpd/sq.ft.; <900 gpd/sq.ft. with chem
Effluent TSS	mg/L			
Average		**3**		
Diurnal Peak		**20**		
Underflow Rate				
Average Flow Ratio		**50%**	0.67	
Average Rate	gpd-sq.ft.	233		
Peak Flow Ratio		**50%**		Default RAS = 100%
Peak Rate	gpd-sq.ft.	342		Adjust underflow rate to vary RAS
Solids Loading Rate	lb/day-sq.ft.			
Average		23		
Diurnal Peak		41		<50 lb/day-sq.ft.; <25 lb/day-sq.ft. with nit.
Limiting Solids Loading Rate	lb/day-sq.ft.	47		
Return sludge rate at which limiting solids rate can be achieved				
RAS Flow Rate	MGD	8.9		
Percent of Influent to Bioreactor	%	107%		
RAS Concentration	mg/L			
Average		11,257		
Diurnal Peak		11,567		
No Membrane Bioreactor Selected				
Effluent TSS	mg/L			
Average		**1**		
Diurnal Peak		**1**		
Chemical Compound Applied before Secondary Clarifier				
Chemical Added? **No**				
Chemical Type		0		
Chemical Dosage (as chemical)	lb/day	**200**		
Chemical Dosage (mg chemical/L treated)	mg/L	N/A		
Molar Ratio Dosage Applied (M+:PO4-P)		N/A		
Effluent PO4-P	lb/day	N/A		
Effluent PO4-P	mg/L	N/A		
Filters: 1995				
Filters? **Yes**				
Total Area	ft2	**2,400**		
Hydraulic Loading Rate	gpm/ft2			
Average		3.44		
Diurnal Peak		5.17		
Solids Loading Rate	lb/day-sq.ft.			
Average		0.05		
Diurnal Peak		0.26		
Filter Run Time	hr	**24**		
Instantaneous Backwash Rate	gpm/ft2	**0.14**		
Duration of Backwash Flow	minutes	**1,440**		
Backwash Operating Time (%cycle)	%	100.00%		
Backwash Flow Rate	MGD	0.48		
Ratio of Backwash Production to Filter Influent	%	3.9%		
TSS Removal Efficiency at Average Conditions		**85%**		
TSS Removal Efficiency at Diurnal Peak Conditions		**75%**		
Chemical Compound Applied to Filter Influent **No**				
Chemical Formula		Al2(SO4)3*14H20		
Chemical Dosage (mg chemical/L treated)	mg/L	**10**		
Chemical Dosage (as chemical)	lb/day	1032.2		
Molar Ratio of Metal to Phosphate		0.0		
Percent of Soluble P that is ortho-P		***100%***		
Effective TSS Removal with Chemical Addition - Average Conditions(%)		85%		
Effective TSS Removal with Chemical Addition - Peak Conditions(%)		75%		
Backwash Concentration	mg/L	124		
WAS Thickening: 1				
WAS Thickener? **Yes**				
Solids Capture	%	**95%**		
Thickened Sludge Concentration	mg/L	**60,000**		
Belt Wash Water Flow Rate	gpm	**0**		
Hours/Day of Operation		**24**		
Days/Week of Operation		**7**		
Dewatering: 1				
Dewatering? **Yes**				
Solids Capture	%	**95%**		
Dewatered Sludge Concentration	%	**15%**		
Belt Wash Water Flow Rate	gpm	**0**		
Hours/Day of Operation		**24**		
Days/Week of Operation		**7**		

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Mass Balance for Average Flow Conditions

Constituent	Raw Wastewater (RW)	InfBox Recycle Influent (RecyI)	InfBox Recycled Stream (Recycle)	InfBox Combined Recycle Effluent (RecyE)	TrPS Splitter Influent (SplitI)	TrPS Splitter Effluent (SplitE) RecyFAB	TrPS Splitter Effluent (SplitE) PBNR1975	FAB Recycle Influent (RecyI)	FAB Recycled Stream (Recycle)	FAB Combined Recycle Effluent (RecyE)	1975 Bioreactor Influent (BI)	1975 Secondary Clarifier Influent (SI)	1975 Secondary Clarifier Effluent (SE)	1985 Bioreactor Influent (BI)	1985 Secondary Clarifier Influent (SI)	1985 Secondary Clarifier Effluent (SE)	Eff Combined Discharge	1995 Granular Media Filter Influent (GMFI)	1995 Granular Media Filter Effluent (GMFE)	Plant Effluent (PLE)	1975 WAS	1985 WAS	WAS Combined Discharge	1 WAS Thickener Influent (TWASI)	1 Thickened WAS (TWAS)
Flow (gallons/day)	11,900,000	11,900,000	479,973	12,379,973	12,379,973	8,030,000	4,349,973	8,030,000	212,862	8,242,783	4,349,973	7,264,454	4,265,298	8,242,783	12,364,058	8,103,380	12,368,679	12,368,679	11,888,706	11,888,706	84,674	139,325	223,999	223,999	29,888
Carbonaceous BOD_5 (lbs/day)	13,903	13,903	86	13,989	13,989	9,073	4,915	9,073	232	9,305	4,915	37,781	81	9,305	49,776	43	124	124	38	38	1,064	1,309	2,373	2,373	2,254
Particulate	7,292	7,292	3	7,295	7,295	4,732	2,563	4,732	6	4,738	2,563	1,222	2	4,738	1,223	1	3	3	0	0	34	32	67	67	63
Heterotrophs	0	0	73	73	73	47	26	47	190	237	26	34,078	65	237	37,750	22	86	86	13	13	960	993	1,953	1,953	1,856
PAOs	0	0	9	9	9	6	3	6	34	40	3	2,462	5	40	10,778	6	11	11	2	2	69	283	353	353	335
PHA	0	0	0	0	0	0	0	0	0	0	0	3	0	0	3	0	0	0	0	0	0	0	0	0	0
Filtrate	6,611	6,611	1	6,612	6,612	4,289	2,323	4,289	0	4,289	2,323	16	10	4,289	22	15	24	24	23	23	0	0	0	0	0
COD (lbs/day)	35,168	35,168	682	35,848	35,848	23,252	12,596	23,252	1,768	25,016	12,596	211,114	1,549	25,016	446,370	2,436	3,985	3,985	3,303	3,303	5,917	11,691	17,608	17,608	16,678
Particulate Bio	12,801	12,801	5	12,807	12,807	8,307	4,500	8,307	13	8,320	4,500	2,470	5	8,320	2,471	1	6	6	1	1	70	65	135	135	128
Particulate Non-Bio	5,486	5,486	320	5,805	5,805	3,766	2,040	3,766	1,041	4,805	2,040	112,783	214	4,805	285,265	163	377	377	57	57	3,178	7,503	10,682	10,682	10,147
Heterotrophs	0	0	165	164	164	106	58	106	428	533	58	76,543	145	533	84,791	48	194	194	29	29	2,157	2,230	4,387	4,387	4,168
Autotrophs	0	0	6	6	6	4	2	4	18	21	2	2,250	4	21	4,431	3	7	7	1	1	63	117	180	180	171
PAOs	0	0	56	56	56	37	20	37	211	247	20	15,091	29	247	66,065	38	66	66	10	10	425	1,738	2,163	2,163	2,055
PHA	0	0	0	0	0	0	0	0	0	0	0	15	0	0	16	0	0	0	0	0	0	0	1	1	1
Soluble Bio	6,963	6,963	2	6,965	6,965	4,518	2,447	4,518	1	4,518	2,447	31	18	4,518	42	27	45	45	44	44	0	0	1	1	0
Colloidal Bio	4,642	4,642	0	4,642	4,642	3,011	1,631	3,011	0	3,011	1,631	0	0	3,011	0	0	0	0	0	0	0	0	0	0	0
Soluble Non-Bio	3,165	3,165	128	3,293	3,293	2,136	1,157	2,136	57	2,192	1,157	1,932	1,134	2,192	3,289	2,155	3,290	3,290	3,162	3,162	23	37	60	60	8
Colloidal Non-Bio	2,110	2,110	0	2,110	2,110	1,369	741	1,369	0	1,369	741	0	0	1,369	0	0	0	0	0	0	0	0	0	0	0
TSS (lbs/day)	14,797	14,797	496	15,291	15,291	9,918	5,373	9,918	1,536	11,450	5,373	187,677	356	11,450	397,857	227	583	583	87	87	5,289	10,465	15,754	15,754	14,966
Biodegradable	10,017	10,017	4	10,021	10,021	6,500	3,521	6,500	10	6,510	3,521	1,932	4	6,510	1,934	1	5	5	1	1	54	51	105	105	100
Non-Biodegradable	4,780	4,780	266	5,046	5,046	3,273	1,773	3,273	865	4,135	1,773	94,231	179	4,135	236,182	135	313	313	47	47	2,656	6,212	8,868	8,868	8,424
Metal Hydroxide	0	0	**0**	**0**	**0**	**0**	**0**	**0**	0	**0**	**0**	0	0	**0**	0	0	0	0	**0**	**0**	0	0	0	0	0
Metal Phosphate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heterotrophs	0	0	148	147	147	95	52	95	384	478	52	68,662	130	478	76,061	43	174	174	26	26	1,935	2,001	3,936	3,936	3,739
Autotrophs	0	0	5	5	5	3	2	3	16	19	2	2,018	4	19	3,975	2	6	6	1	1	57	105	161	161	153
PAOs	0	0	51	51	51	33	18	33	189	222	18	13,537	26	222	59,263	34	59	59	9	9	381	1,559	1,940	1,940	1,843
PHA	0	0	0	0	0	0	0	0	0	0	0	9	0	0	10	0	0	0	0	0	0	0	1	1	0
Poly-P	0	0	22	22	22	14	8	14	72	86	8	7,288	14	86	20,434	12	25	25	4	4	205	537	743	743	706
VSS (lbs/day)	12,879	12,879	409	13,286	13,286	8,618	4,668	8,618	1,257	9,872	4,668	156,523	297	9,872	322,328	184	481	481	72	72	4,411	8,478	12,889	12,889	12,245
Biodegradable	9,015	9,015	4	9,019	9,019	5,850	3,169	5,850	9	5,859	3,169	1,739	3	5,859	1,740	1	4	4	1	1	49	46	95	95	90
Non-Biodegradable	3,864	3,864	222	4,085	4,085	2,650	1,435	2,650	718	3,366	1,435	78,979	150	3,366	195,210	111	261	261	39	39	2,226	5,135	7,360	7,360	6,992
Metal Hydroxide	0	0	**0**	**0**	**0**	**0**	**0**	**0**	0	**0**	**0**	0	0	**0**	0	0	0	0	**0**	**0**	0	0	0	0	0
Heterotrophs	0	0	133	132	132	86	46	86	345	430	46	61,796	117	430	68,455	39	156	156	23	23	1,741	1,801	3,542	3,542	3,365
Autotrophs	0	0	5	5	5	3	2	3	14	17	2	1,816	3	17	3,577	2	5	5	1	1	51	94	145	145	138
PAOs	0	0	46	45	45	29	16	29	170	200	16	12,183	23	200	53,336	30	54	54	8	8	343	1,403	1,746	1,746	1,659
PHA	0	0	0	0	0	0	0	0	0	0	0	9	0	0	10	0	0	0	0	0	0	0	1	1	0
TKN (lbs/day)	2,284	2,284	33	2,317	2,317	1,503	814	1,503	83	1,586	814	10,148	86	1,586	20,481	129	214	214	181	181	284	536	820	820	776
NH_3-N (lbs-N/day)	1,379	1,379	3	1,382	1,382	896	486	896	1	897	486	44	26	897	60	39	65	65	63	63	1	1	1	1	0
Particulate Bio Org N	496	496	0	496	496	322	174	322	0	322	174	65	0	322	65	0	0	0	0	0	2	2	4	4	3
Non-Bio Part Org N	212	212	12	225	225	146	79	146	40	185	79	4,283	8	185	10,832	6	14	14	2	2	121	285	406	406	385
Heterotrophs	0	0	10	10	10	6	3	6	26	32	3	4,636	9	32	5,135	3	12	12	2	2	131	135	266	266	252
Autotrophs	0	0	0	0	0	0	0	0	1	1	0	136	0	1	268	0	0	0	0	0	4	7	11	11	10
PAOs	0	0	3	3	3	2	1	2	13	15	1	914	2	15	4,001	2	4	4	1	1	26	105	131	131	124
Non-Bio Soluble Org. N	114	114	5	119	119	77	42	77	2	79	42	70	41	79	118	78	118	118	114	114	1	1	2	2	0
Non-Bio Colloidal Org. N	76	76	0	76	76	49	27	49	0	49	27	0	0	49	0	0	0	0	0	0	0	0	0	0	0
Soluble Bio Org N	4	4	0	4	4	3	1	3	0	3	1	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Colloidal Bio Org N	3	3	0	3	3	2	1	2	0	2	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0
NO_3-N (lbs-N/day)	0	0	8	8	8	5	3	5	4	9	3	165	97	9	167	110	206	206	198	198	2	2	4	4	1
TP (lbs-P/day)	397	397	14	411	411	266	144	266	41	308	144	4,723	11	308	10,918	21	32	32	19	19	133	287	420	420	399
Bio Particulate	90	90	0	90	90	58	32	58	0	59	32	12	0	59	12	0	0	0	0	0	0	0	1	1	1
Non-Bio Particulate	39	39	2	40	40	26	14	26	5	31	14	574	1	31	1,451	1	2	2	0	0	16	38	54	54	52
Metal Phosphate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heterotrophs	0	0	3	3	3	2	1	2	9	11	1	1,531	3	11	1,696	1	4	4	1	1	43	45	88	88	83
Autotrophs	0	0	0	0	0	0	0	0	0	0	0	45	0	0	89	0	0	0	0	0	1	2	4	4	3
PAOs	0	0	1	1	1	1	0	1	4	5	0	302	1	5	1,321	1	1	1	0	0	9	35	43	43	41
Poly-P	0	0	7	7	7	4	2	4	22	27	2	2,256	4	27	6,326	4	8	8	1	1	64	166	230	230	218
Ortho-PO4	268	268	1	269	269	175	95	175	0	175	95	4	2	175	23	15	17	17	16	16	0	0	0	0	0
Alkalinity (lbs/day as $CaCO_3$)	16,584	16,584	532	17,116	17,116	11,102	6,014	11,102	236	11,338	6,014	7,958	4,672	11,338	13,793	9,040	13,712	13,712	13,180	13,180	93	155	248	248	33
H_2S (lbs/day)	99	99	0	99	99	64	35	64	0	64	35	0	0	64	0	0	0	0	0	0	0	0	0	0	0
BOD_5 (mg/L)	140	140	21	135	135	135	135	135	130	135	135	623	2	135	482	1	1	1	0	0	1,506	1,126	1,270	1,270	9,038
COD (mg/L)	354	354	170	347	347	347	347	347	995	364	347	3,482	44	364	4,326	36	39	39	33	33	8,373	10,054	9,419	9,419	66,863
TSS (mg/L)	149	149	124	148	148	148	148	148	865	166	148	3,096	10	166	3,856	3	6	6	1	1	7,485	9,000	8,427	8,427	60,000
VSS (mg/L)	130	130	102	129	129	129	129	129	707	144	129	2,582	0	144	3,124	0	0	0	1	1	6,242	7,291	6,895	6,895	49,090
TKN (mg-N/L)	23.0	23	8	22	22	22	22	22	47	23	22	167	2	23	198	2	2	2	2	2	402	461	439	439	3,113
NH_3-N (mg-N/L)	13.9	14	1	13	13	13	13	13	1	13	13	1	1	13	1	1	1	1	1	1	1	1	1	1	1
NO_3-N (mg-N/L)	0.0	0	2	0	0	0	0	0	2	0	0	3	3	0	2	2	2	2	2	2	3	2	2	2	2
TP (mg-P/L)	4.0	4	3	4	4	4	4	4	23	4	4	78	0	4	106	0	0	0	0	0	188	247	225	225	1,598
Alkalinity (mg/L as $CaCO_3$)	167	167	133	166	166	166	166	166	133	165	166	131	131	165	134	134	133	133	133	133	131	134	133	133	133
H_2S (mg/L)	1.0	1	0	1	1	1	1	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0

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Mass Balance for Average Flow

Constituent	1 Dewatering Influent (DWI)	1 Dewatered Sludge (DWE)	Biosolids to Dispoal	1995 Filter Backwash (BW)	1 WAS Thickening Recycle (TWASR)	1 Dewatering Recycle (DWR)	BW Combined Discharge	Cent Combined Discharge
Flow (gallons/day)	29,888	11,137	11,137	479,973	194,111	18,751	479,973	212,862
Carbonaceous BOD_5 (lbs/day)	2,254	2,142	2,142	86	119	113	86	232
Particulate	63	60	60	3	3	3	3	6
Heterotrophs	1,856	1,763	1,763	73	98	93	73	190
PAOs	335	318	318	9	18	17	9	34
PHA	0	0	0	0	0	0	0	0
Filtrate	0	0	0	1	0	0	1	0
COD (lbs/day)	16,678	15,839	15,839	682	930	839	682	1,768
Particulate Bio	128	121	121	5	7	6	5	13
Particulate Non-Bio	10,147	9,640	9,640	320	534	507	320	1,041
Heterotrophs	4,168	3,960	3,960	165	219	208	165	428
Autotrophs	171	162	162	6	9	9	6	18
PAOs	2,055	1,952	1,952	56	108	103	56	211
PHA	1	1	1	0	0	0	0	0
Soluble Bio	0	0	0	2	1	0	2	1
Colloidal Bio	0	0	0	0	0	0	0	0
Soluble Non-Bio	8	3	3	128	52	5	128	57
Colloidal Non-Bio	0	0	0	0	0	0	0	0
TSS (lbs/day)	14,966	14,218	14,218	496	788	748	496	1,536
Biodegradable	100	95	95	4	5	5	4	10
Non-Biodegradable	8,424	8,003	8,003	266	443	421	266	865
Metal Hydroxide	0	0	0	**0**	0	0	**0**	0
Metal Phosphate	0	0	0	0	0	0	0	0
Heterotrophs	3,739	3,552	3,552	148	197	187	148	384
Autotrophs	153	146	146	5	8	8	5	16
PAOs	1,843	1,751	1,751	51	97	92	51	189
PHA	0	0	0	0	0	0	0	0
Poly-P	706	670	670	22	37	35	22	72
VSS (lbs/day)	12,245	11,632	11,632	409	644	612	409	1,257
Biodegradable	90	86	86	4	5	5	4	9
Non-Biodegradable	6,992	6,643	6,643	222	368	350	222	718
Metal Hydroxide	0	0	0	**0**	0	0	**0**	0
Heterotrophs	3,365	3,197	3,197	133	177	168	133	345
Autotrophs	138	131	131	5	7	7	5	14
PAOs	1,659	1,576	1,576	46	87	83	46	170
PHA	0	0	0	0	0	0	0	0
TKN (lbs/day)	776	737	737	33	44	39	33	83
NH_3-N (lbs-N/day)	0	0	0	3	1	0	3	1
Particulate Bio Org N	3	3	3	0	0	0	0	0
Non-Bio Part Org N	385	366	366	12	20	19	12	40
Heterotrophs	252	240	240	10	13	13	10	26
Autotrophs	10	10	10	0	1	1	0	1
PAOs	124	118	118	3	7	6	3	13
Non-Bio Soluble Org. N	0	0	0	5	2	0	5	2
Non-Bio Colloidal Org. N	0	0	0	0	0	0	0	0
Soluble Bio Org N	0	0	0	0	0	0	0	0
Colloidal Bio Org N	0	0	0	0	0	0	0	0
NO_3-N (lbs-N/day)	1	0	0	8	3	0	8	4
TP (lbs-P/day)	399	379	379	14	21	20	14	41
Bio Particulate	1	1	1	0	0	0	0	0
Non-Bio Particulate	52	49	49	2	3	3	2	5
Metal Phosphate	0	0	0	0	0	0	0	0
Heterotrophs	83	79	79	3	4	4	3	9
Autotrophs	3	3	3	0	0	0	0	0
PAOs	41	39	39	1	2	2	1	4
Poly-P	218	208	208	7	11	11	7	22
Ortho-PO4	0	0	0	1	0	0	1	0
Alkalinity (lbs/day as $CaCO_3$)	33	12	12	532	215	21	532	236
H_2S (lbs/day)	0	0	0	0	0	0	0	0
BOD_5 (mg/L)	9,038	23,040	23,040	21	73	721	21	130
COD (mg/L)	66,863	170,410	170,410	170	574	5,359	170	995
TSS (mg/L)	60,000	152,963	152,963	124	486	4,782	124	865
VSS (mg/L)	49,090	125,149	125,149	102	398	3,912	102	707
TKN (mg-N/L)	3,113	7,933	7,933	8	27	250	8	47
NH_3-N (mg-N/L)	1	1	1	1	1	1	1	1
NO_3-N (mg-N/L)	2	2	2	2	2	2	2	2
TP (mg-P/L)	1,598	4,074	4,074	3	13	128	3	23
Alkalinity (mg/L as $CaCO_3$)	133	133	133	133	133	133	133	133
H_2S (mg/L)	0	0	0	0	0	0	0	0

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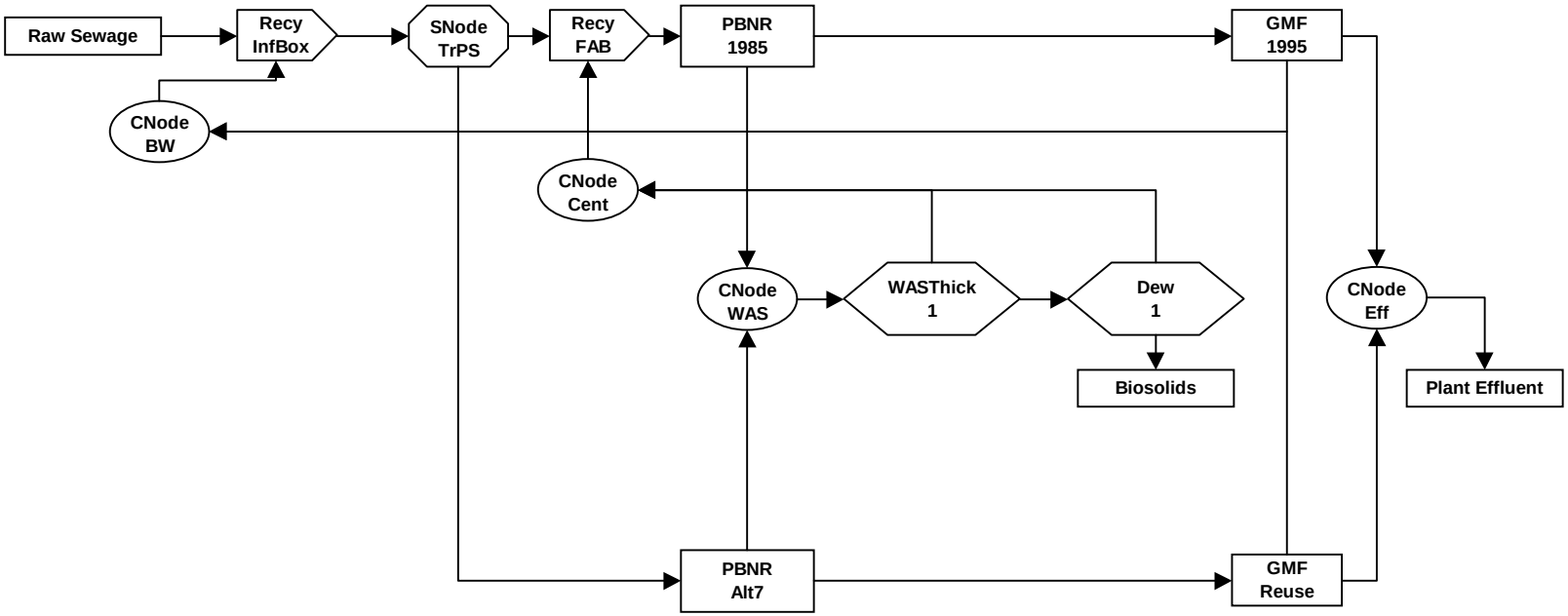

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Model Convergence 0.29%

Facility Operating Parameters			Project	First Assumptions
Item		**Value**	**Notes**	**US**
Influent Wastewater	(US)	(US)		
Flow	MG/day			
Design Average		**13.50**	MM	MM/Peak PF
Design Diurnal Peak		**19.8**		1.5
Design Peaking Factor for WW Diurnal flow		1.466666667		
Design Peaking Factor for WW Diurnal loads		**1.4**		
Carbonaceous Five-Day Biochemical Oxygen Demand (CBOD5)			Maximum Month Conditions	
Design Average Concentration	mg/L	140	140	
Design Average Mass Loading	lb/day	**15,772**		
Design Diurnal Peak Mass Loading	lb/day	22,081		
Total Suspended Solids (TSS)				
Design Average Concentration	mg/L	149	149	
Design Average Mass Loading	lb/day	**16,786**		
Design Diurnal Peak Mass Loading	lb/day	23,500		
Volatile Suspended Solids (VSS)				
Percent VSS	%	**87%**		
Design Average Concentration	mg/L	130		
Design Average Mass Loading	lb/day	14,610		
Design Diurnal Peak Mass Loading	lb/day	20,454		
Total Kjeldahl Nitrogen (TKN as N)				
Design Average Concentration	mg/L	23	23	
Design Average Mass Loading	lb/day	**2,591**		
Design Diurnal Peak Mass Loading	lb/day	3,628		
Ammonia-Nitrogen (NH3-N as N)			TKN/ammonia Ratio	
Design Average Concentration	mg/L	14	1.66	
Design Average Mass Loading	lb/day	**1,565**		
Design Diurnal Peak Mass Loading	lb/day	2,191		
Total Phosphorus (as P)				
Design Average Concentration	mg/L	4		
Design Average Mass Loading	lb/day	**451**	Estimated	
Design Diurnal Peak Mass Loading	lb/day	631		
Alkalinity (as CaCO3)				
Design Average Concentration	mg/L	167	167	
Design Average Mass Loading	lb/day	**18,814**		
Design Diurnal Peak Mass Loading	lb/day	26,339		S
Hydrogen Sulfide (H2S)				
Design Average Concentration	mg/L	1		
Design Average Mass Loading	lb/day	**113**	Estimated	
Design Diurnal Peak Mass Loading	lb/day	158		
Chemical Addition:				
Select the Metal Salt (if used)		3		
Flow Splitter: TrPS				
Splitter Influent Flow	MGD	14.5		
Flow Splits			1985 Plant Flow, mgd	
TrPS Splitter Effluent (SplitE) Recy1	%	57%	**8.25**	S
TrPS Splitter Effluent (SplitE) PBNR1975	%	**43%**		
	%	**0%**		
	%	**0%**		
	%	**0%**		
	%	**0%**		
	%	**0%**		
	%	**0%**		
	%	**0%**		
Biological Process - PBNR: Alt7				
Total SRT (anaerobic + anoxic + aerobic)	days	**10.0**		
Nitrifier Minimum SRT (SRT_{min})	days	1.2		
DO	mg/L	2.0		
Temperature in the Biological Process	oF	**80.6**		
SVI	mL/g	**120**		
Biosolids Production Rates				
Net Yield (mg TSS/mg BOD_5)	lb/lb	1.04		
Volatile Fraction	%	76.1%		
Active Fraction	%	34.6%		
Nitrifier Fraction	%	1.1%		
Nitrogen Content, N/VSS	%	6.7%		
Phosphorus Content, P/VSS	%	3.2%		
Process Oxygen Requirements				
Carbonaceous AOR/BOD5 - wt/wt	lb/lb	1.2		

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Total AOR/BOD% - wt/wt	lb/lb	1.4		
AOR (wt/day)	lb/day			
Average		9,811		
Diurnal Peak		14,702		
AOR	mg/L-hr			
Average		23		
Diurnal Peak		35		
Bioreactor **With Secondary Clarifier**				
Total Bioreactor Volume	MG	**2.10**	SWD	20
HRT	hr	8.1	Length	160
% non-aerobic		20%	Width	88
% aerobic		80%		
Average MLSS Concentration	mg/L	4,044		
Bioreactor Clarifier				
Total Area	sq.ft.	**15,080**	3	# of 80' Diam SCs
Overflow Rate	gpd-sq.ft.		97.97958971	
Average		412		
Diurnal Peak		591		<1000 gpd/sq.ft.; <900 gpd/sq.ft
Effluent TSS	mg/L			
Average		**10**		
Diurnal Peak		**20**		
Underflow Rate				
Average Flow Ratio		**67%**	0.67	
Average Rate	gpd-sq.ft.	276		
Peak Flow Ratio		**50%**		Default RAS = 100%
Peak Rate	gpd-sq.ft.	296		Adjust underflow rate to vary RA
Solids Loading Rate	lb/day-sq.ft.			
Average		23		
Diurnal Peak		30		<50 lb/day-sq.ft.; <25 lb/day-sq.
Limiting Solids Loading Rate	lb/day-sq.ft.	44		
Return sludge rate at which limiting solids rate can be achieved				
RAS Flow Rate	MGD	7.0		
Percent of Influent to Bioreactor	%	113%		
RAS Concentration	mg/L			
Average		9,856		
Diurnal Peak		12,107		
No Membrane Bioreactor Selected				
Effluent TSS	mg/L			
Average		**1**		
Diurnal Peak		**1**		
Chemical Compound Applied before Secondary Clarifier				
Chemical Added? **No**				
Chemical Type		0		
Chemical Dosage (as chemical)	lb/day	**200**		
Chemical Dosage (mg chemical/L treated)	mg/L	N/A		
Molar Ratio Dosage Applied (M+:PO4-P)		N/A		
Effluent PO4-P	lb/day	N/A		
Effluent PO4-P	mg/L	N/A		
Biological Process - PBNR: 1985				
Total SRT (anaerobic + anoxic + aerobic)	days	**11.3**		
Nitrifier Minimum SRT (SRT_{min})	days	1.2		
DO	mg/L	2.0		
Temperature in the Biological Process	oF	**80**		
SVI	mL/g	**120**		
Biosolids Production Rates				
Net Yield (mg TSS/mg BOD_5)	lb/lb	1.17		
Volatile Fraction	%	79.0%		
Active Fraction	%	33.4%		
Nitrifier Fraction	%	1.0%		
Nitrogen Content, N/VSS	%	6.4%		
Phosphorus Content, P/VSS	%	3.0%		
Process Oxygen Requirements				
Carbonaceous AOR/BOD5 - wt/wt	lb/lb	1.2		
Total AOR/BOD% - wt/wt	lb/lb	1.4		
AOR (wt/day)	lb/day			
Average		12,851		
Diurnal Peak		19,490		
AOR	mg/L-hr			
Average		21		
Diurnal Peak		32		
Bioreactor **With Secondary Clarifier**				
Total Bioreactor Volume	MG	**3.04**	0.05channel+0.8FAB+2.19CAB	
HRT	hr	8.6		
% non-aerobic		26%		
% aerobic		74%		
Average MLSS Concentration	mg/L	4,844		
Bioreactor Clarifier				

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Total Area	sq.ft.	**17,671**	4	Number of 75' diam SCs
Overflow Rate	gpd-sq.ft.			
Average		479		
Diurnal Peak		682		<1000 gpd/sq.ft.; <900 gpd/sq.ft
Effluent TSS	mg/L			
Average		**3**		
Diurnal Peak		**20**		
Underflow Rate				
Average Flow Ratio		**50%**	0.67	
Average Rate	gpd-sq.ft.	239		
Peak Flow Ratio		**50%**		Default RAS = 100%
Peak Rate	gpd-sq.ft.	341		Adjust underflow rate to vary RA
Solids Loading Rate	lb/day-sq.ft.			
Average		23		
Diurnal Peak		41		<50 lb/day-sq.ft.; <25 lb/day-sq.
Limiting Solids Loading Rate	lb/day-sq.ft.	46		
Return sludge rate at which limiting solids rate can be achieved				
RAS Flow Rate	MGD	8.7		
Percent of Influent to Bioreactor	%	102%		
RAS Concentration	mg/L			
Average		11,439		
Diurnal Peak		11,746		
No Membrane Bioreactor Selected				
Effluent TSS	mg/L			
Average		**1**		
Diurnal Peak		**1**		
Chemical Compound Applied before Secondary Clarifier				
Chemical Added? **No**				
Chemical Type		0		
Chemical Dosage (as chemical)	lb/day	**200**		
Chemical Dosage (mg chemical/L treated)	mg/L	N/A		
Molar Ratio Dosage Applied (M+:PO4-P)		N/A		
Effluent PO4-P	lb/day	N/A		
Effluent PO4-P	mg/L	N/A		
Filters: Reuse				
Filters? **Yes**				
Total Area	ft2	**2,400**		
Hydraulic Loading Rate	gpm/ft2			
Average		1.63		
Diurnal Peak		2.42		
Solids Loading Rate	lb/day-sq.ft.			
Average		0.04		
Diurnal Peak		0.13		
Filter Run Time	hr	**24**		
Instantaneous Backwash Rate	gpm/ft2	**0.14**		
Duration of Backwash Flow	minutes	**1,440**		
Backwash Operating Time (%cycle)	%	100.00%		
Backwash Flow Rate	MGD	0.48		
Ratio of Backwash Production to Filter Influent	%	7.8%		
TSS Removal Efficiency at Average Conditions		**85%**		
TSS Removal Efficiency at Diurnal Peak Conditions		**75%**		
Chemical Compound Applied to Filter Influent **No**				
Chemical Formula		Al2(SO4)3*14H20		
Chemical Dosage (mg chemical/L treated)	mg/L	**10**		
Chemical Dosage (as chemical)	lb/day	511.6		
Molar Ratio of Metal to Phosphate		0.0		
Percent of Soluble P that is ortho-P		***100%***		
Effective TSS Removal with Chemical Addition - Average Conditions(%)		85%		
Effective TSS Removal with Chemical Addition - Peak Conditions(%)		75%		
Backwash Concentration	mg/L	109		
Filters: 1995				
Filters? **Yes**				
Total Area	ft2	**2,400**		
Hydraulic Loading Rate	gpm/ft2			
Average		2.27		
Diurnal Peak		3.31		
Solids Loading Rate	lb/day-sq.ft.			
Average		0.02		
Diurnal Peak		0.17		
Filter Run Time	hr	**24**		
Instantaneous Backwash Rate	gpm/ft2	**0.14**		
Duration of Backwash Flow	minutes	**1,440**		
Backwash Operating Time (%cycle)	%	100.00%		
Backwash Flow Rate	MGD	0.48		
Ratio of Backwash Production to Filter Influent	%	5.8%		
TSS Removal Efficiency at Average Conditions		**85%**		
TSS Removal Efficiency at Diurnal Peak Conditions		**75%**		

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Chemical Compound Applied to Filter Influent	**No**		
Chemical Formula			Al2(SO4)3*14H20
Chemical Dosage (mg chemical/L treated)		mg/L	**10**
Chemical Dosage (as chemical)		lb/day	694.1
Molar Ratio of Metal to Phosphate			0.0
Percent of Soluble P that is ortho-P			***100%***
Effective TSS Removal with Chemical Addition - Average Conditions(%)			85%
Effective TSS Removal with Chemical Addition - Peak Conditions(%)			75%
Backwash Concentration		mg/L	49
WAS Thickening: 1			
WAS Thickener?	**Yes**		
Solids Capture		%	**95%**
Thickened Sludge Concentration		mg/L	**60,000**
Belt Wash Water Flow Rate		gpm	**0**
Hours/Day of Operation			**24**
Days/Week of Operation			**7**
Dewatering: 1			
Dewatering?	**Yes**		
Solids Capture		%	**95%**
Dewatered Sludge Concentration		%	**15%**
Belt Wash Water Flow Rate		gpm	**0**
Hours/Day of Operation			**24**
Days/Week of Operation			**7**

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Mass Balance for Average Flow Conditions

Constituent	Alt7 Wastewater (RW)	Alt7 Recycle Influent (RecyI)	Alt7 Recycled Stream (Recycle)	Alt7 Combined Recycle Effluent (RecyE)	Alt7 Splitter Influent (SplitI)	Alt7 Splitter Effluent (SplitE) Recy1	Alt7 Splitter Effluent (SplitE) PBNR1975	Alt7 Recycle Influent (RecyI)	Alt7 Recycled Stream (Recycle)	Alt7 Combined Recycle Effluent (RecyE)	Alt7 Bioreactor Influent (BI)	Alt7 Secondary Clarifier Influent (SI)	Alt7 Secondary Clarifier Effluent (SE)	Alt7 Bioreactor Influent (BI)	Alt7 Secondary Clarifier Influent (SI)	Alt7 Secondary Clarifier Effluent (SE)	Alt7 Granular Media Filter Influent (GMFI)	Alt7 Granular Media Filter Effluent (GMFE)	Alt7 Granular Media Filter Influent (GMFI)	Alt7 Granular Media Filter Effluent (GMFE)	Alt7 Combined Discharge	Alt7 Effluent (PLE)	Alt7 WAS	Alt7 WAS	Alt7 Combined Discharge
Flow (gallons/day)	13,500,000	13,500,000	959,945	14,459,945	14,459,945	8,250,000	6,209,945	8,250,000	209,255	8,459,079	6,209,945	10,370,609	6,129,998	8,459,079	12,688,355	8,317,435	6,129,998	5,650,026	8,317,435	7,837,462	13,487,488	13,487,488	79,947	141,469	221,416
Carbonaceous BOD_5 (lbs/day)	15,772	15,772	90	15,863	15,863	9,050	6,812	9,050	222	9,272	6,812	51,345	87	9,272	50,924	44	87	22	44	19	41	41	966	1,305	2,271
Particulate	8,273	8,273	2	8,275	8,275	4,721	3,554	4,721	6	4,727	3,554	1,298	2	4,727	1,265	1	2	0	1	0	0	0	24	32	57
Heterotrophs	0	0	74	74	74	42	32	42	178	220	32	44,303	65	220	38,545	22	65	10	22	3	13	13	834	988	1,822
PAOs	0	0	12	12	12	7	5	7	38	45	5	5,721	8	45	11,087	6	8	1	6	1	2	2	108	284	392
PHA	0	0	0	0	0	0	0	0	0	0	0	2	0	0	3	0	0	0	0	0	0	0	0	0	0
Filtrate	7,500	7,500	2	7,501	7,501	4,280	3,222	4,280	0	4,280	3,222	20	12	4,280	23	15	12	11	15	14	25	25	0	0	0
COD (lbs/day)	39,896	39,896	962	40,859	40,859	23,312	17,547	23,312	1,922	25,234	17,547	390,492	2,220	25,234	465,327	2,500	2,220	1,608	2,500	2,150	3,759	3,759	7,320	11,877	19,197
Particulate Bio	14,523	14,523	4	14,527	14,527	8,288	6,239	8,288	11	8,299	6,239	2,625	4	8,299	2,557	1	4	1	1	0	1	1	49	66	115
Particulate Non-Bio	6,224	6,224	450	6,674	6,674	3,808	2,866	3,808	1,202	5,010	2,866	246,163	361	5,010	300,211	169	361	54	169	25	79	79	4,634	7,694	12,328
Heterotrophs	0	0	165	165	165	94	71	94	399	493	71	99,510	146	493	86,578	49	146	22	49	7	29	29	1,873	2,219	4,092
Autotrophs	0	0	8	8	8	4	3	4	19	24	3	4,317	6	24	4,588	3	6	1	3	0	1	1	81	118	199
PAOs	0	0	76	76	76	43	33	43	234	277	33	35,069	51	277	67,958	38	51	8	38	6	13	13	660	1,742	2,402
PHA	0	0	0	0	0	0	0	0	0	0	0	13	0	0	17	0	0	0	0	0	0	0	0	0	1
Soluble Bio	7,899	7,899	3	7,903	7,903	4,509	3,394	4,509	1	4,510	3,394	38	22	4,510	44	29	22	20	29	27	47	47	0	0	1
Colloidal Bio	5,266	5,266	0	5,266	5,266	3,005	2,262	3,005	0	3,005	2,262	0	0	3,005	0	0	0	0	0	0	0	0	0	0	0
Soluble Non-Bio	3,591	3,591	255	3,846	3,846	2,194	1,652	2,194	56	2,250	1,652	2,758	1,630	2,250	3,375	2,212	1,630	1,503	2,212	2,085	3,587	3,587	21	38	59
Colloidal Non-Bio	2,394	2,394	0	2,394	2,394	1,366	1,028	1,366	0	1,366	1,028	0	0	1,366	0	0	0	0	0	0	0	0	0	0	0
TSS (lbs/day)	16,786	16,786	633	17,420	17,420	9,939	7,481	9,939	1,677	11,616	7,481	349,289	512	11,616	414,588	233	512	77	233	35	112	112	6,576	10,626	17,201
Biodegradable	11,363	11,363	4	11,367	11,367	6,485	4,882	6,485	9	6,494	4,882	2,054	3	6,494	2,001	1	3	0	1	0	1	1	39	51	90
Non-Biodegradable	5,423	5,423	373	5,796	5,796	3,307	2,489	3,307	995	4,302	2,489	204,222	299	4,302	248,159	139	299	45	139	21	66	66	3,845	6,360	10,205
Metal Hydroxide	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0
Metal Phosphate	0	0	**0**	**0**	**0**	**0**	**0**	**0**	0	**0**	**0**	0	0	**0**	0	0	0	0	0	**0**	**0**	**0**	0	0	0
Heterotrophs	0	0	148	148	148	85	64	85	358	443	64	89,264	131	443	77,663	44	131	20	44	7	26	26	1,680	1,990	3,671
Autotrophs	0	0	7	7	7	4	3	4	17	21	3	3,873	6	21	4,115	2	6	1	2	0	1	1	73	105	178
PAOs	0	0	68	68	68	39	29	39	210	249	29	31,458	46	249	60,961	34	46	7	34	5	12	12	592	1,562	2,155
PHA	0	0	0	0	0	0	0	0	0	0	0	8	0	0	10	0	0	0	0	0	0	0	0	0	0
Poly-P	0	0	33	33	33	19	14	19	88	107	14	18,412	27	107	21,679	12	27	4	12	2	6	6	347	556	902
VSS (lbs/day)	14,610	14,610	516	15,127	15,127	8,630	6,496	8,630	1,361	9,991	6,496	286,054	419	9,991	334,536	188	419	63	188	28	91	91	5,385	8,574	13,959
Biodegradable	10,227	10,227	3	10,230	10,230	5,837	4,393	5,837	8	5,845	4,393	1,848	3	5,845	1,801	1	3	0	1	0	1	1	35	46	81
Non-Biodegradable	4,383	4,383	312	4,695	4,695	2,679	2,016	2,679	826	3,505	2,016	172,063	252	3,505	204,260	115	252	38	115	17	55	55	3,239	5,235	8,474
Metal Hydroxide	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0
Heterotrophs	0	0	133	134	134	76	57	76	322	398	57	80,337	118	398	69,897	39	118	18	39	6	24	24	1,512	1,791	3,304
Autotrophs	0	0	6	6	6	3	3	3	16	19	3	3,485	5	19	3,704	2	5	1	2	0	1	1	66	95	161
PAOs	0	0	61	61	61	35	26	35	189	224	26	28,312	41	224	54,865	31	41	6	31	5	11	11	533	1,406	1,939
PHA	0	0	0	0	0	0	0	0	0	0	0	8	0	0	10	0	0	0	0	0	0	0	0	0	0
TKN (lbs/day)	2,591	2,591	45	2,636	2,636	1,504	1,132	1,504	88	1,592	1,132	17,949	97	1,592	21,287	131	97	69	131	114	183	183	337	543	880
NH_3-N (lbs-N/day)	1,565	1,565	3	1,568	1,568	895	673	895	1	895	673	20	12	895	60	39	12	11	39	37	48	48	0	1	1
Particulate Bio Org N	562	562	0	563	563	321	242	321	0	321	242	70	0	321	68	0	0	0	0	0	0	0	1	2	3
Non-Bio Part Org N	241	241	17	258	258	147	111	147	46	193	111	9,348	14	193	11,400	6	14	2	6	1	3	3	176	292	468
Heterotrophs	0	0	10	10	10	6	4	6	24	30	4	6,027	9	30	5,243	3	9	1	3	0	2	2	113	134	248
Autotrophs	0	0	0	0	0	0	0	0	1	1	0	261	0	1	278	0	0	0	0	0	0	0	5	7	12
PAOs	0	0	5	5	5	3	2	3	14	17	2	2,124	3	17	4,116	2	3	0	2	0	1	1	40	105	145
Non-Bio Soluble Org. N	129	129	9	138	138	79	59	79	2	81	59	99	59	81	121	80	59	54	80	75	129	129	1	1	2
Non-Bio Colloidal Org. N	86	86	0	86	86	49	37	49	0	49	37	0	0	49	0	0	0	0	0	0	0	0	0	0	0
Soluble Bio Org N	4	4	0	4	4	3	2	3	0	3	2	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Colloidal Bio Org N	3	3	0	3	3	2	1	2	0	2	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0
NO_3-N (lbs-N/day)	0	0	18	18	18	10	8	10	4	14	8	256	151	14	167	110	151	140	110	103	243	243	2	2	4
TP (lbs-P/day)	451	451	19	470	470	268	202	268	47	315	202	9,753	20	315	11,457	22	20	7	22	15	23	23	183	293	477
Bio Particulate	102	102	0	102	102	58	44	58	0	58	44	13	0	58	12	0	0	0	0	0	0	0	0	0	1
Non-Bio Particulate	44	44	2	46	46	26	20	26	6	32	20	1,252	2	32	1,527	1	2	0	1	0	0	0	24	39	63
Metal Phosphate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heterotrophs	0	0	3	3	3	2	1	2	8	10	1	1,990	3	10	1,732	1	3	0	1	0	1	1	37	44	82
Autotrophs	0	0	0	0	0	0	0	0	0	0	0	86	0	0	92	0	0	0	0	0	0	0	2	2	4
PAOs	0	0	2	2	2	1	1	1	5	6	1	701	1	6	1,359	1	1	0	1	0	0	0	13	35	48
Poly-P	0	0	10	10	10	6	4	6	27	33	4	5,700	8	33	6,712	4	8	1	4	1	2	2	107	172	279
Ortho-PO4	305	305	1	306	306	175	131	175	0	175	131	10	6	175	23	15	6	5	15	15	20	20	0	0	0
Alkalinity (lbs/day as $CaCO_3$)	18,814	18,814	1,046	19,860	19,860	11,331	8,529	11,331	230	11,560	8,529	11,038	6,524	11,560	14,155	9,279	6,524	6,014	9,279	8,743	14,757	14,757	85	158	243
H_2S (lbs/day)	113	113	0	113	113	64	48	64	0	64	48	0	0	64	0	0	0	0	0	0	0	0	0	0	0
BOD_5 (mg/L)	140	140	11	131	131	131	131	131	127	131	131	593	2	131	481	1	2	0	1	0	0	0	1,448	1,105	1,229
COD (mg/L)	354	354	120	339	339	339	339	339	1,101	357	339	4,512	43	357	4,394	36	43	34	36	33	33	33	10,972	10,060	10,389
TSS (mg/L)	149	149	79	144	144	144	144	144	960	165	144	4,036	10	165	3,915	3	10	2	3	1	1	1	9,856	9,000	9,309
VSS (mg/L)	130	130	64	125	125	125	125	125	779	142	125	3,305	0	142	3,159	0	0	1	0	0	1	1	8,071	7,262	7,554
TKN (mg-N/L)	23.0	23	6	22	22	22	22	22	51	23	22	207	2	23	201	2	2	1	2	2	2	2	504	460	476
NH_3-N (mg-N/L)	13.9	14	0	13	13	13	13	13	0	13	13	0	0	13	1	1	0	0	1	1	0	0	0	1	0
NO_3-N (mg-N/L)	0.0	0	2	0	0	0	0	0	2	0	0	3	3	0	2	2	3	3	2	2	2	2	3	2	2
TP (mg-P/L)	4.0	4	2	4	4	4	4	4	27	4	4	113	0	4	108	0	0	0	0	0	0	0	275	248	258
Alkalinity (mg/L as $CaCO_3$)	167	167	131	165	165	165	165	165	131	164	165	128	128	164	134	134	128	128	134	134	131	131	128	134	131
H_2S (mg/L)	1.0	1	0	1	1	1	1	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
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Mass Balance for Average Flow

Constituent	Alt7 WAS Thickener Influent (TWASI)	Alt7 Thickened WAS (TWAS)	Alt7 Dewatering Influent (DWI)	Alt7 Dewatered Sludge (DWE)	Alt7Biosolids to Dispoal	Alt7 Filter Backwash (BW)	Alt7 Filter Backwash (BW)	Alt7 WAS Thickening Recycle (TWASR)	Alt7 Dewatering Recycle (DWR)	Alt7 Combined Discharge	Alt7 Combined Discharge
Flow (gallons/day)	221,416	32,635	32,635	12,161	12,161	479,973	479,973	188,781	20,474	959,945	209,255
Carbonaceous BOD_5 (lbs/day)	2,271	2,157	2,157	2,049	2,049	65	25	114	108	90	222
Particulate	57	54	54	51	51	2	1	3	3	2	6
Heterotrophs	1,822	1,731	1,731	1,644	1,644	55	18	91	87	74	178
PAOs	392	372	372	354	354	7	5	20	19	12	38
PHA	0	0	0	0	0	0	0	0	0	0	0
Filtrate	0	0	0	0	0	1	1	0	0	2	0
COD (lbs/day)	19,197	18,189	18,189	17,275	17,275	612	350	1,008	915	962	1,922
Particulate Bio	115	109	109	104	104	3	1	6	5	4	11
Particulate Non-Bio	12,328	11,712	11,712	11,126	11,126	306	143	616	586	450	1,202
Heterotrophs	4,092	3,888	3,888	3,693	3,693	124	41	205	194	165	399
Autotrophs	199	189	189	179	179	5	2	10	9	8	19
PAOs	2,402	2,282	2,282	2,168	2,168	44	32	120	114	76	234
PHA	1	1	1	1	1	0	0	0	0	0	0
Soluble Bio	1	0	0	0	0	2	2	1	0	3	1
Colloidal Bio	0	0	0	0	0	0	0	0	0	0	0
Soluble Non-Bio	59	9	9	3	3	128	128	50	5	255	56
Colloidal Non-Bio	0	0	0	0	0	0	0	0	0	0	0
TSS (lbs/day)	17,201	16,341	16,341	15,524	15,524	435	198	860	817	633	1,677
Biodegradable	90	85	85	81	81	3	1	4	4	4	9
Non-Biodegradable	10,205	9,695	9,695	9,210	9,210	254	119	510	485	373	995
Metal Hydroxide	0	0	0	0	0	**0**	0	0	0	0	0
Metal Phosphate	0	0	0	0	0	0	**0**	0	0	**0**	0
Heterotrophs	3,671	3,487	3,487	3,313	3,313	111	37	184	174	148	358
Autotrophs	178	169	169	161	161	5	2	9	8	7	17
PAOs	2,155	2,047	2,047	1,945	1,945	39	29	108	102	68	210
PHA	0	0	0	0	0	0	0	0	0	0	0
Poly-P	902	857	857	814	814	23	10	45	43	33	88
VSS (lbs/day)	13,959	13,261	13,261	12,598	12,598	356	160	698	663	516	1,361
Biodegradable	81	77	77	73	73	2	1	4	4	3	8
Non-Biodegradable	8,474	8,051	8,051	7,648	7,648	214	98	424	403	312	826
Metal Hydroxide	0	0	0	0	0	**0**	0	0	0	0	0
Heterotrophs	3,304	3,139	3,139	2,982	2,982	100	33	165	157	133	322
Autotrophs	161	153	153	145	145	4	2	8	8	6	16
PAOs	1,939	1,842	1,842	1,750	1,750	35	26	97	92	61	189
PHA	0	0	0	0	0	0	0	0	0	0	0
TKN (lbs/day)	880	833	833	791	791	28	17	46	42	45	88
NH_3-N (lbs-N/day)	1	0	0	0	0	1	2	1	0	3	1
Particulate Bio Org N	3	3	3	3	3	0	0	0	0	0	0
Non-Bio Part Org N	468	445	445	423	423	12	5	23	22	17	46
Heterotrophs	248	235	235	224	224	8	3	12	12	10	24
Autotrophs	12	11	11	11	11	0	0	1	1	0	1
PAOs	145	138	138	131	131	3	2	7	7	5	14
Non-Bio Soluble Org. N	2	0	0	0	0	5	5	2	0	9	2
Non-Bio Colloidal Org. N	0	0	0	0	0	0	0	0	0	0	0
Soluble Bio Org N	0	0	0	0	0	0	0	0	0	0	0
Colloidal Bio Org N	0	0	0	0	0	0	0	0	0	0	0
NO_3-N (lbs-N/day)	4	1	1	0	0	12	6	3	0	18	4
TP (lbs-P/day)	477	453	453	430	430	13	6	24	23	19	47
Bio Particulate	1	1	1	0	0	0	0	0	0	0	0
Non-Bio Particulate	63	60	60	57	57	2	1	3	3	2	6
Metal Phosphate	0	0	0	0	0	0	0	0	0	0	0
Heterotrophs	82	78	78	74	74	2	1	4	4	3	8
Autotrophs	4	4	4	4	4	0	0	0	0	0	0
PAOs	48	46	46	43	43	1	1	2	2	2	5
Poly-P	279	265	265	252	252	7	3	14	13	10	27
Ortho-PO4	0	0	0	0	0	0	1	0	0	1	0
Alkalinity (lbs/day as $CaCO_3$)	243	36	36	13	13	511	535	207	22	1,046	230
H_2S (lbs/day)	0	0	0	0	0	0	0	0	0	0	0
BOD_5 (mg/L)	1,229	7,921	7,921	20,193	20,193	16	6	72	631	11	127
COD (mg/L)	10,389	66,785	66,785	170,210	170,210	153	87	640	5,352	120	1,101
TSS (mg/L)	9,309	60,000	60,000	152,963	152,963	109	49	546	4,782	79	960
VSS (mg/L)	7,554	48,691	48,691	124,132	124,132	89	40	443	3,881	64	779
TKN (mg-N/L)	476	3,059	3,059	7,796	7,796	7	4	29	245	6	51
NH_3-N (mg-N/L)	0	0	0	0	0	0	1	0	0	0	0
NO_3-N (mg-N/L)	2	2	2	2	2	3	2	2	2	2	2
TP (mg-P/L)	258	1,662	1,662	4,237	4,237	3	2	15	133	2	27
Alkalinity (mg/L as $CaCO_3$)	131	131	131	131	131	128	134	131	131	131	131
H_2S (mg/L)	0	0	0	0	0	0	0	0	0	0	0

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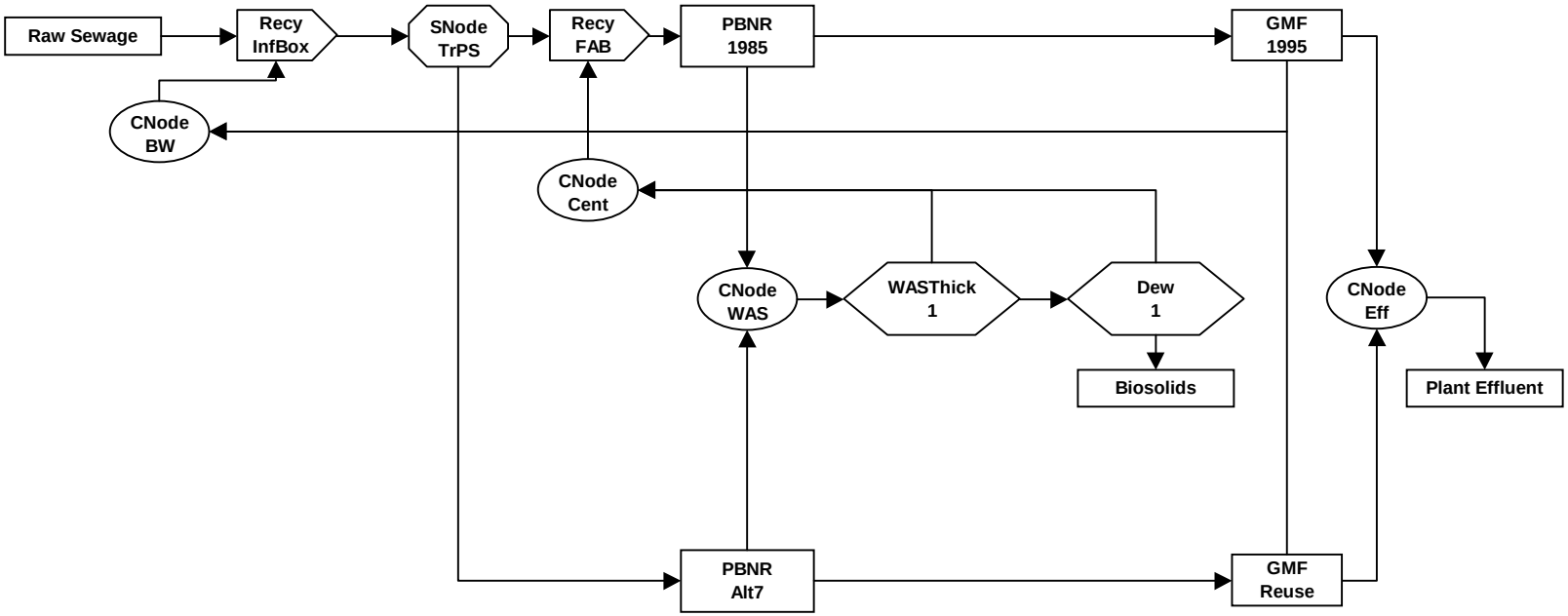

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Model Convergence 0.42%

Facility Operating Parameters			Project	First Assumptions
Item		**Value**	**Notes**	**US**
Influent Wastewater	(US)	(US)		
Flow	MG/day			
Design Average		**18.00**	MM	MM/Peak PF
Design Diurnal Peak		**26.4**		1.5
Design Peaking Factor for WW Diurnal flow		1.466666667		
Design Peaking Factor for WW Diurnal loads		**1.4**		
Carbonaceous Five-Day Biochemical Oxygen Demand (CBOD5)			Maximum Month Conditions	
Design Average Concentration	mg/L	140	140	
Design Average Mass Loading	lb/day	**21,029**		
Design Diurnal Peak Mass Loading	lb/day	29,441		
Total Suspended Solids (TSS)				
Design Average Concentration	mg/L	149	149	
Design Average Mass Loading	lb/day	**22,381**		
Design Diurnal Peak Mass Loading	lb/day	31,334		
Volatile Suspended Solids (VSS)				
Percent VSS	%	**87%**		
Design Average Concentration	mg/L	130		
Design Average Mass Loading	lb/day	19,480		
Design Diurnal Peak Mass Loading	lb/day	27,272		
Total Kjeldahl Nitrogen (TKN as N)				
Design Average Concentration	mg/L	23	23	
Design Average Mass Loading	lb/day	**3,455**		
Design Diurnal Peak Mass Loading	lb/day	4,837		
Ammonia-Nitrogen (NH3-N as N)			TKN/ammonia Ratio	
Design Average Concentration	mg/L	14	1.66	
Design Average Mass Loading	lb/day	**2,086**		
Design Diurnal Peak Mass Loading	lb/day	2,921		
Total Phosphorus (as P)				
Design Average Concentration	mg/L	4		
Design Average Mass Loading	lb/day	**601**	Estimated	
Design Diurnal Peak Mass Loading	lb/day	841		
Alkalinity (as CaCO3)				
Design Average Concentration	mg/L	167	167	
Design Average Mass Loading	lb/day	**25,085**		
Design Diurnal Peak Mass Loading	lb/day	35,119		
Hydrogen Sulfide (H2S)				
Design Average Concentration	mg/L	1		
Design Average Mass Loading	lb/day	**150**	Estimated	
Design Diurnal Peak Mass Loading	lb/day	210		
Chemical Addition:				
Select the Metal Salt (if used)		3		
Flow Splitter: TrPS				
Splitter Influent Flow	MGD	19.0		
Flow Splits			1985 Plant Flow, mgd	
TrPS Splitter Effluent (SplitE) Recy1	%	42%	**7.95**	
TrPS Splitter Effluent (SplitE) PBNR1975	%	**58%**		
	%	**0%**		
	%	**0%**		
	%	**0%**		
	%	**0%**		
	%	**0%**		
	%	**0%**		
	%	**0%**		
Biological Process - PBNR: Alt7				
Total SRT (anaerobic + anoxic + aerobic)	days	**10.0**		
Nitrifier Minimum SRT (SRT_{min})	days	1.2		
DO	mg/L	2.0		
Temperature in the Biological Process	oF	**80.6**		
SVI	mL/g	**120**		
Biosolids Production Rates				
Net Yield (mg TSS/mg BOD_5)	lb/lb	1.05		
Volatile Fraction	%	75.9%		
Active Fraction	%	34.3%		
Nitrifier Fraction	%	1.1%		
Nitrogen Content, N/VSS	%	6.7%		
Phosphorus Content, P/VSS	%	3.2%		
Process Oxygen Requirements				
Carbonaceous AOR/BOD5 - wt/wt	lb/lb	1.2		

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Total AOR/BOD% - wt/wt	lb/lb	1.4		
AOR (wt/day)	lb/day			
Average		17,685		
Diurnal Peak		26,511		
AOR	mg/L-hr			
Average		25		
Diurnal Peak		38		
Bioreactor **With Secondary Clarifier**				
Total Bioreactor Volume	MG	**3.50**	SWD	20
HRT	hr	7.6	Length	200
% non-aerobic		20%	Width	117
% aerobic		80%		
Average MLSS Concentration	mg/L	4,398		
Bioreactor Clarifier				
Total Area	sq.ft.	**25,447**	4	# of 80' Diam SCs
Overflow Rate	gpd-sq.ft.		127.2792206	
Average		433		
Diurnal Peak		624		<1000 gpd/sq.ft.; <900 gpd/sq.ft. with chem
Effluent TSS	mg/L			
Average		**10**		
Diurnal Peak		**20**		
Underflow Rate				
Average Flow Ratio		**67%**	0.67	
Average Rate	gpd-sq.ft.	290		
Peak Flow Ratio		**50%**		Default RAS = 100%
Peak Rate	gpd-sq.ft.	312		Adjust underflow rate to vary RAS
Solids Loading Rate	lb/day-sq.ft.			
Average		26		
Diurnal Peak		34		<50 lb/day-sq.ft.; <25 lb/day-sq.ft. with nit.
Limiting Solids Loading Rate	lb/day-sq.ft.	37		
Return sludge rate at which limiting solids rate can be achieved				
RAS Flow Rate	MGD	10.1		
Percent of Influent to Bioreactor	%	91%		
RAS Concentration	mg/L			
Average		10,732		
Diurnal Peak		13,168		
No Membrane Bioreactor Selected				
Effluent TSS	mg/L			
Average		**1**		
Diurnal Peak		**1**		
Chemical Compound Applied before Secondary Clarifier				
Chemical Added? **No**				
Chemical Type		0		
Chemical Dosage (as chemical)	lb/day	**200**		
Chemical Dosage (mg chemical/L treated)	mg/L	N/A		
Molar Ratio Dosage Applied (M+:PO4-P)		N/A		
Effluent PO4-P	lb/day	N/A		
Effluent PO4-P	mg/L	N/A		
Biological Process - PBNR: 1985				
Total SRT (anaerobic + anoxic + aerobic)	days	**11.3**		
Nitrifier Minimum SRT (SRT_{min})	days	1.2		
DO	mg/L	2.0		
Temperature in the Biological Process	oF	**80**		
SVI	mL/g	**120**		
Biosolids Production Rates				
Net Yield (mg TSS/mg BOD_5)	lb/lb	1.22		
Volatile Fraction	%	78.6%		
Active Fraction	%	32.6%		
Nitrifier Fraction	%	1.0%		
Nitrogen Content, N/VSS	%	6.5%		
Phosphorus Content, P/VSS	%	3.1%		
Process Oxygen Requirements				
Carbonaceous AOR/BOD5 - wt/wt	lb/lb	1.2		
Total AOR/BOD% - wt/wt	lb/lb	1.4		
AOR (wt/day)	lb/day			
Average		12,713		
Diurnal Peak		19,212		
AOR	mg/L-hr			
Average		21		
Diurnal Peak		32		
Bioreactor **With Secondary Clarifier**				
Total Bioreactor Volume	MG	**3.04**	0.05channel+0.8FAB+2.19CAB	
HRT	hr	8.9		
% non-aerobic		26%		
% aerobic		74%		
Average MLSS Concentration	mg/L	4,975		
Bioreactor Clarifier				

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Total Area	sq.ft.	**17,671**	4	Number of 75' diam SCs
Overflow Rate	gpd-sq.ft.			
Average		465		
Diurnal Peak		664		<1000 gpd/sq.ft.; <900 gpd/sq.ft. with chem
Effluent TSS	mg/L			
Average		**3**		
Diurnal Peak		**20**		
Underflow Rate				
Average Flow Ratio		**50%**	0.67	
Average Rate	gpd-sq.ft.	232		
Peak Flow Ratio		**50%**		Default RAS = 100%
Peak Rate	gpd-sq.ft.	332		Adjust underflow rate to vary RAS
Solids Loading Rate	lb/day-sq.ft.			
Average		23		
Diurnal Peak		41		<50 lb/day-sq.ft.; <25 lb/day-sq.ft. with nit.
Limiting Solids Loading Rate	lb/day-sq.ft.	44		
Return sludge rate at which limiting solids rate can be achieved				
RAS Flow Rate	MGD	8.3		
Percent of Influent to Bioreactor	%	101%		
RAS Concentration	mg/L			
Average		11,742		
Diurnal Peak		12,067		
No Membrane Bioreactor Selected				
Effluent TSS	mg/L			
Average		**1**		
Diurnal Peak		**1**		
Chemical Compound Applied before Secondary Clarifier				
Chemical Added? **No**				
Chemical Type		0		
Chemical Dosage (as chemical)	lb/day	**200**		
Chemical Dosage (mg chemical/L treated)	mg/L	N/A		
Molar Ratio Dosage Applied (M+:PO4-P)		N/A		
Effluent PO4-P	lb/day	N/A		
Effluent PO4-P	mg/L	N/A		
Filters: Reuse				
Filters? **Yes**				
Total Area	ft2	**2,400**		
Hydraulic Loading Rate	gpm/ft2			
Average		3.01		
Diurnal Peak		4.42		
Solids Loading Rate	lb/day-sq.ft.			
Average		0.08		
Diurnal Peak		0.23		
Filter Run Time	hr	**24**		
Instantaneous Backwash Rate	gpm/ft2	**0.14**		
Duration of Backwash Flow	minutes	**1,440**		
Backwash Operating Time (%cycle)	%	100.00%		
Backwash Flow Rate	MGD	0.48		
Ratio of Backwash Production to Filter Influent	%	4.4%		
TSS Removal Efficiency at Average Conditions		**85%**		
TSS Removal Efficiency at Diurnal Peak Conditions		**75%**		
Chemical Compound Applied to Filter Influent **No**				
Chemical Formula		Al2(SO4)3*14H20		
Chemical Dosage (mg chemical/L treated)	mg/L	**10**		
Chemical Dosage (as chemical)	lb/day	907.7		
Molar Ratio of Metal to Phosphate		0.0		
Percent of Soluble P that is ortho-P		***100%***		
Effective TSS Removal with Chemical Addition - Average Conditions(%)		85%		
Effective TSS Removal with Chemical Addition - Peak Conditions(%)		75%		
Backwash Concentration	mg/L	193		
Filters: 1995				
Filters? **Yes**				
Total Area	ft2	**2,400**		
Hydraulic Loading Rate	gpm/ft2			
Average		2.20		
Diurnal Peak		3.22		
Solids Loading Rate	lb/day-sq.ft.			
Average		0.02		
Diurnal Peak		0.17		
Filter Run Time	hr	**24**		
Instantaneous Backwash Rate	gpm/ft2	**0.14**		
Duration of Backwash Flow	minutes	**1,440**		
Backwash Operating Time (%cycle)	%	100.00%		
Backwash Flow Rate	MGD	0.48		
Ratio of Backwash Production to Filter Influent	%	5.9%		
TSS Removal Efficiency at Average Conditions		**85%**		
TSS Removal Efficiency at Diurnal Peak Conditions		**75%**		

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Chemical Compound Applied to Filter Influent	**No**				
Chemical Formula			Al2(SO4)3*14H20		
Chemical Dosage (mg chemical/L treated)		mg/L	**10**		
Chemical Dosage (as chemical)		lb/day	673.3		
Molar Ratio of Metal to Phosphate			0.0		
Percent of Soluble P that is ortho-P			***100%***		
Effective TSS Removal with Chemical Addition - Average Conditions(%)			85%		
Effective TSS Removal with Chemical Addition - Peak Conditions(%)			75%		
Backwash Concentration		mg/L	48		
WAS Thickening: 1					
WAS Thickener?	**Yes**				
Solids Capture		%	**95%**		
Thickened Sludge Concentration		mg/L	**60,000**		
Belt Wash Water Flow Rate		gpm	**0**		
Hours/Day of Operation			**24**		
Days/Week of Operation			**7**		
Dewatering: 1					
Dewatering?	**Yes**				
Solids Capture		%	**95%**		
Dewatered Sludge Concentration		%	**15%**		
Belt Wash Water Flow Rate		gpm	**0**		
Hours/Day of Operation			**24**		
Days/Week of Operation			**7**		

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Mass Balance for Average Flow Conditions

Constituent	Alt7 Wastewater (RW)	Alt7 Recycle Influent (RecyI)	Alt7 Recycled Stream (Recycle)	Alt7 Combined Recycle Effluent (RecyE)	Alt7 Splitter Influent (SplitI)	Alt7 Splitter Effluent (SplitE) Recy1	Alt7 Splitter Effluent (SplitE) PBNR1975	Alt7 Recycle Influent (RecyI)	Alt7 Recycled Stream (Recycle)	Alt7 Combined Recycle Effluent (RecyE)	Alt7 Bioreactor Influent (BI)	Alt7 Secondary Clarifier Influent (SI)	Alt7 Secondary Clarifier Effluent (SE)	Alt7 Bioreactor Influent (BI)	Alt7 Secondary Clarifier Influent (SI)	Alt7 Secondary Clarifier Effluent (SE)	Alt7 Granular Media Filter Influent (GMFI)	Alt7 Granular Media Filter Effluent (GMFE)	Alt7 Granular Media Filter Influent (GMFI)	Alt7 Granular Media Filter Effluent (GMFE)	Alt7 Combined Discharge	Alt7 Effluent (PLE)	Alt7 WAS	Alt7 WAS	Alt7 Combined Discharge
Flow (gallons/day)	18,000,000	18,000,000	959,945	18,959,945	18,959,945	7,950,000	11,009,945	7,950,000	262,596	8,213,152	11,009,945	18,386,609	10,876,664	8,213,152	12,320,562	8,068,229	10,876,664	10,396,691	8,068,229	7,588,256	17,984,947	17,984,947	133,282	145,479	278,761
Carbonaceous BOD_5 (lbs/day)	21,030	21,030	138	21,167	21,167	8,876	12,292	8,876	298	9,174	12,292	98,459	154	9,174	49,504	42	154	40	42	18	58	58	1,745	1,308	3,052
Particulate	11,030	11,030	3	11,034	11,034	4,627	6,407	4,627	7	4,634	6,407	2,531	3	4,634	1,201	1	3	1	1	0	1	1	45	32	77
Heterotrophs	0	0	115	115	115	48	67	48	243	292	67	85,086	115	292	37,447	20	115	17	20	3	20	20	1,508	989	2,497
PAOs	0	0	17	17	17	7	10	7	47	54	10	10,801	15	54	10,832	6	15	2	6	1	3	3	191	286	478
PHA	0	0	0	0	0	0	0	0	0	0	0	5	0	0	3	0	0	0	0	0	0	0	0	0	0
Filtrate	10,000	10,000	2	10,001	10,001	4,194	5,808	4,194	0	4,194	5,808	36	21	4,194	22	15	21	21	15	14	34	34	0	0	1
COD (lbs/day)	53,195	53,195	1,327	54,522	54,522	22,861	31,660	22,861	2,547	25,410	31,660	750,371	3,938	25,410	464,406	2,425	3,938	2,954	2,425	2,082	5,036	5,036	13,248	12,221	25,468
Particulate Bio	19,363	19,363	7	19,370	19,370	8,122	11,248	8,122	15	8,137	11,248	5,115	7	8,137	2,427	1	7	1	1	0	1	1	91	64	155
Particulate Non-Bio	8,299	8,299	685	8,983	8,983	3,767	5,216	3,767	1,602	5,370	5,216	474,683	640	5,370	303,565	166	640	96	166	25	121	121	8,413	8,020	16,433
Heterotrophs	0	0	258	258	258	108	150	108	547	655	150	191,114	258	655	84,110	46	258	39	46	7	46	46	3,387	2,222	5,609
Autotrophs	0	0	12	12	12	5	7	5	26	31	7	8,267	11	31	4,573	2	11	2	2	0	2	2	147	121	267
PAOs	0	0	107	107	107	45	62	45	285	331	62	66,207	89	331	66,396	36	89	13	36	5	19	19	1,173	1,754	2,928
PHA	0	0	0	0	0	0	0	0	0	0	0	26	0	0	16	0	0	0	0	0	0	0	0	0	1
Soluble Bio	10,532	10,532	3	10,536	10,536	4,418	6,118	4,418	1	4,419	6,118	68	40	4,419	42	27	40	38	27	26	64	64	0	0	1
Colloidal Bio	7,022	7,022	0	7,022	7,022	2,944	4,077	2,944	0	2,944	4,077	0	0	2,944	0	0	0	0	0	0	0	0	0	0	0
Soluble Non-Bio	4,788	4,788	255	5,043	5,043	2,115	2,928	2,115	70	2,185	2,928	4,890	2,893	2,185	3,277	2,146	2,893	2,765	2,146	2,018	4,784	4,784	35	39	74
Colloidal Non-Bio	3,192	3,192	0	3,192	3,192	1,338	1,853	1,338	0	1,338	1,853	0	0	1,338	0	0	0	0	0	0	0	0	0	0	0
TSS (lbs/day)	22,382	22,382	964	23,344	23,344	9,788	13,556	9,788	2,229	12,019	13,556	673,527	908	12,019	413,596	226	908	136	226	34	170	170	11,938	10,927	22,865
Biodegradable	15,151	15,151	5	15,157	15,157	6,355	8,801	6,355	12	6,367	8,801	4,003	5	6,367	1,899	1	5	1	1	0	1	1	71	50	121
Non-Biodegradable	7,230	7,230	570	7,799	7,799	3,270	4,529	3,270	1,329	4,599	4,529	395,793	533	4,599	250,435	137	533	80	137	21	101	101	7,015	6,616	13,631
Metal Hydroxide	0	0	**0**	**0**	**0**	**0**	**0**	**0**	0	**0**	**0**	0	0	**0**	0	0	0	**0**	0	**0**	**0**	**0**	0	0	0
Metal Phosphate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heterotrophs	0	0	231	231	231	97	134	97	491	588	134	171,436	231	588	75,450	41	231	35	41	6	41	41	3,039	1,993	5,032
Autotrophs	0	0	10	10	10	4	6	4	23	28	6	7,416	10	28	4,103	2	10	1	2	0	2	2	131	108	240
PAOs	0	0	96	96	96	40	56	40	256	297	56	59,390	80	297	59,559	33	80	12	33	5	17	17	1,053	1,574	2,626
PHA	0	0	0	0	0	0	0	0	0	0	0	16	0	0	10	0	0	0	0	0	0	0	0	0	1
Poly-P	0	0	51	51	51	21	30	21	118	140	30	35,473	48	140	22,141	12	48	7	12	2	9	9	629	585	1,214
VSS (lbs/day)	19,480	19,480	784	20,264	20,264	8,497	11,767	8,497	1,804	10,303	11,767	549,507	741	10,303	331,839	181	741	111	181	27	138	138	9,740	8,767	18,506
Biodegradable	13,636	13,636	5	13,641	13,641	5,720	7,921	5,720	11	5,730	7,921	3,602	5	5,730	1,709	1	5	1	1	0	1	1	64	45	109
Non-Biodegradable	5,844	5,844	475	6,319	6,319	2,649	3,669	2,649	1,101	3,751	3,669	331,471	447	3,751	204,920	112	447	67	112	17	84	84	5,875	5,414	11,289
Metal Hydroxide	0	0	**0**	**0**	**0**	**0**	**0**	**0**	0	**0**	**0**	0	0	**0**	0	0	0	**0**	0	**0**	**0**	**0**	0	0	0
Heterotrophs	0	0	208	208	208	87	121	87	442	529	121	154,293	208	529	67,905	37	208	31	37	6	37	37	2,735	1,794	4,529
Autotrophs	0	0	9	9	9	4	5	4	21	25	5	6,674	9	25	3,692	2	9	1	2	0	2	2	118	98	216
PAOs	0	0	86	86	86	36	50	36	230	267	50	53,451	72	267	53,603	29	72	11	29	4	15	15	947	1,416	2,364
PHA	0	0	0	0	0	0	0	0	0	0	0	16	0	0	10	0	0	0	0	0	0	0	0	0	1
TKN (lbs/day)	3,455	3,455	61	3,516	3,516	1,474	2,042	1,474	117	1,591	2,042	34,457	171	1,591	21,154	123	171	127	123	107	233	233	609	556	1,165
NH_3-N (lbs-N/day)	2,086	2,086	3	2,089	2,089	876	1,213	876	1	877	1,213	35	21	877	52	34	21	20	34	32	52	52	0	1	1
Particulate Bio Org N	750	750	0	750	750	315	436	315	0	315	436	136	0	315	64	0	0	0	0	0	0	0	2	2	4
Non-Bio Part Org N	321	321	26	347	347	146	202	146	61	207	202	18,025	24	207	11,527	6	24	4	6	1	5	5	319	305	624
Heterotrophs	0	0	16	16	16	7	9	7	33	40	9	11,575	16	40	5,094	3	16	2	3	0	3	3	205	135	340
Autotrophs	0	0	1	1	1	0	0	0	2	2	0	501	1	2	277	0	1	0	0	0	0	0	9	7	16
PAOs	0	0	6	6	6	3	4	3	17	20	4	4,010	5	20	4,021	2	5	1	2	0	1	1	71	106	177
Non-Bio Soluble Org. N	172	172	9	182	182	76	105	76	3	79	105	176	104	79	118	77	104	100	77	73	172	172	1	1	3
Non-Bio Colloidal Org. N	115	115	0	115	115	48	67	48	0	48	67	0	0	48	0	0	0	0	0	0	0	0	0	0	0
Soluble Bio Org N	6	6	0	6	6	3	3	3	0	3	3	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Colloidal Bio Org N	4	4	0	4	4	2	2	2	0	2	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0
NO_3-N (lbs-N/day)	0	0	18	18	18	8	11	8	5	13	11	461	273	13	161	105	273	261	105	99	360	360	3	2	5
TP (lbs-P/day)	601	601	28	629	629	264	365	264	62	326	365	18,750	35	326	11,537	22	35	13	22	16	29	29	332	304	637
Bio Particulate	136	136	0	136	136	57	79	57	0	57	79	24	0	57	12	0	0	0	0	0	0	0	0	0	1
Non-Bio Particulate	58	58	3	62	62	26	36	26	8	34	36	2,414	3	34	1,544	1	3	0	1	0	1	1	43	41	84
Metal Phosphate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heterotrophs	0	0	5	5	5	2	3	2	11	13	3	3,822	5	13	1,682	1	5	1	1	0	1	1	68	44	112
Autotrophs	0	0	0	0	0	0	0	0	1	1	0	165	0	1	91	0	0	0	0	0	0	0	3	2	5
PAOs	0	0	2	2	2	1	1	1	6	7	1	1,324	2	7	1,328	1	2	0	1	0	0	0	23	35	59
Poly-P	0	0	16	16	16	7	9	7	37	43	9	10,982	15	43	6,855	4	15	2	4	1	3	3	195	181	376
Ortho-PO4	406	406	1	407	407	171	237	171	0	171	237	17	10	171	25	16	10	9	16	15	25	25	0	0	0
Alkalinity (lbs/day as $CaCO_3$)	25,085	25,085	1,045	26,130	26,130	10,956	15,174	10,956	286	11,243	15,174	19,534	11,556	11,243	13,736	8,995	11,556	11,046	8,995	8,460	19,506	19,506	142	162	304
H_2S (lbs/day)	150	150	0	150	150	63	87	63	0	63	87	0	0	63	0	0	0	0	0	0	0	0	0	0	0
BOD_5 (mg/L)	140	140	17	134	134	134	134	134	136	134	134	642	2	134	481	1	2	0	1	0	0	0	1,569	1,077	1,312
COD (mg/L)	354	354	166	345	345	345	345	345	1,162	371	345	4,890	43	371	4,517	36	43	34	36	33	34	34	11,910	10,066	10,948
TSS (mg/L)	149	149	120	148	148	148	148	148	1,017	175	148	4,389	10	175	4,022	3	10	2	3	1	1	1	10,732	9,000	9,828
VSS (mg/L)	130	130	98	128	128	128	128	128	823	150	128	3,581	0	150	3,227	0	0	1	0	0	1	1	8,756	7,221	7,955
TKN (mg-N/L)	23.0	23	8	22	22	22	22	22	53	23	22	225	2	23	206	2	2	1	2	2	2	2	547	458	501
NH_3-N (mg-N/L)	13.9	14	0	13	13	13	13	13	0	13	13	0	0	13	1	1	0	0	1	1	0	0	0	1	0
NO_3-N (mg-N/L)	0.0	0	2	0	0	0	0	0	2	0	0	3	3	0	2	2	3	3	2	2	2	2	3	2	2
TP (mg-P/L)	4.0	4	4	4	4	4	4	4	28	5	4	122	0	5	112	0	0	0	0	0	0	0	299	251	274
Alkalinity (mg/L as $CaCO_3$)	167	167	130	165	165	165	165	165	131	164	165	127	127	164	134	134	127	127	134	134	130	130	127	134	131
H_2S (mg/L)	1.0	1	0	1	1	1	1	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
													5			3						4			

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Mass Balance for Average Flow

Constituent	Alt7 WAS Thickener Influent (TWASI)	Alt7 Thickened WAS (TWAS)	Alt7 Dewatering Influent (DWI)	Alt7 Dewatered Sludge (DWE)	Alt7Biosolids to Dispoal	Alt7 Filter Backwash (BW)	Alt7 Filter Backwash (BW)	Alt7 WAS Thickening Recycle (TWASR)	Alt7 Dewatering Recycle (DWR)	Alt7 Combined Discharge	Alt7 Combined Discharge
Flow (gallons/day)	278,761	43,379	43,379	16,165	16,165	479,973	479,973	235,382	27,214	959,945	262,596
Carbonaceous BOD_5 (lbs/day)	3,052	2,899	2,899	2,754	2,754	114	24	153	145	138	298
Particulate	77	73	73	69	69	3	1	4	4	3	7
Heterotrophs	2,497	2,373	2,373	2,254	2,254	97	17	125	119	115	243
PAOs	478	454	454	431	431	12	5	24	23	17	47
PHA	0	0	0	0	0	0	0	0	0	0	0
Filtrate	1	0	0	0	0	1	1	0	0	2	0
COD (lbs/day)	25,468	24,135	24,135	22,922	22,922	983	343	1,333	1,214	1,327	2,547
Particulate Bio	155	147	147	140	140	6	1	8	7	7	15
Particulate Non-Bio	16,433	15,612	15,612	14,831	14,831	544	141	822	781	685	1,602
Heterotrophs	5,609	5,329	5,329	5,063	5,063	219	39	280	266	258	547
Autotrophs	267	254	254	241	241	9	2	13	13	12	26
PAOs	2,928	2,781	2,781	2,642	2,642	76	31	146	139	107	285
PHA	1	1	1	1	1	0	0	0	0	0	0
Soluble Bio	1	0	0	0	0	2	2	1	0	3	1
Colloidal Bio	0	0	0	0	0	0	0	0	0	0	0
Soluble Non-Bio	74	12	12	4	4	128	128	63	7	255	70
Colloidal Non-Bio	0	0	0	0	0	0	0	0	0	0	0
TSS (lbs/day)	22,865	21,721	21,721	20,635	20,635	772	192	1,143	1,086	964	2,229
Biodegradable	121	115	115	109	109	5	1	6	6	5	12
Non-Biodegradable	13,631	12,950	12,950	12,302	12,302	453	116	682	647	570	1,329
Metal Hydroxide	0	0	0	0	0	**0**	**0**	0	0	**0**	0
Metal Phosphate	0	0	0	0	0	0	0	0	0	0	0
Heterotrophs	5,032	4,780	4,780	4,541	4,541	196	35	252	239	231	491
Autotrophs	240	228	228	216	216	8	2	12	11	10	23
PAOs	2,626	2,495	2,495	2,370	2,370	68	28	131	125	96	256
PHA	1	1	1	0	0	0	0	0	0	0	0
Poly-P	1,214	1,153	1,153	1,095	1,095	41	10	61	58	51	118
VSS (lbs/day)	18,506	17,581	17,581	16,702	16,702	629	154	925	879	784	1,804
Biodegradable	109	104	104	98	98	4	1	5	5	5	11
Non-Biodegradable	11,289	10,724	10,724	10,188	10,188	380	95	564	536	475	1,101
Metal Hydroxide	0	0	0	0	0	**0**	**0**	0	0	**0**	0
Heterotrophs	4,529	4,302	4,302	4,087	4,087	177	32	226	215	208	442
Autotrophs	216	205	205	195	195	8	2	11	10	9	21
PAOs	2,364	2,245	2,245	2,133	2,133	61	25	118	112	86	230
PHA	1	1	1	0	0	0	0	0	0	0	0
TKN (lbs/day)	1,165	1,104	1,104	1,048	1,048	45	16	61	56	61	117
NH_3-N (lbs-N/day)	1	0	0	0	0	1	2	1	0	3	1
Particulate Bio Org N	4	4	4	4	4	0	0	0	0	0	0
Non-Bio Part Org N	624	593	593	563	563	21	5	31	30	26	61
Heterotrophs	340	323	323	307	307	13	2	17	16	16	33
Autotrophs	16	15	15	15	15	1	0	1	1	1	2
PAOs	177	168	168	160	160	5	2	9	8	6	17
Non-Bio Soluble Org. N	3	0	0	0	0	5	5	2	0	9	3
Non-Bio Colloidal Org. N	0	0	0	0	0	0	0	0	0	0	0
Soluble Bio Org N	0	0	0	0	0	0	0	0	0	0	0
Colloidal Bio Org N	0	0	0	0	0	0	0	0	0	0	0
NO_3-N (lbs-N/day)	5	1	1	0	0	12	6	4	1	18	5
TP (lbs-P/day)	637	604	604	574	574	22	6	32	30	28	62
Bio Particulate	1	1	1	1	1	0	0	0	0	0	0
Non-Bio Particulate	84	79	79	75	75	3	1	4	4	3	8
Metal Phosphate	0	0	0	0	0	0	0	0	0	0	0
Heterotrophs	112	107	107	101	101	4	1	6	5	5	11
Autotrophs	5	5	5	5	5	0	0	0	0	0	1
PAOs	59	56	56	53	53	2	1	3	3	2	6
Poly-P	376	357	357	339	339	13	3	19	18	16	37
Ortho-PO4	0	0	0	0	0	0	1	0	0	1	0
Alkalinity (lbs/day as $CaCO_3$)	304	47	47	18	18	510	535	257	30	1,045	286
H_2S (lbs/day)	0	0	0	0	0	0	0	0	0	0	0
BOD_5 (mg/L)	1,312	8,008	8,008	20,416	20,416	28	6	78	638	17	136
COD (mg/L)	10,948	66,668	66,668	169,913	169,913	245	86	679	5,343	166	1,162
TSS (mg/L)	9,828	60,000	60,000	152,963	152,963	193	48	582	4,782	120	1,017
VSS (mg/L)	7,955	48,564	48,564	123,808	123,808	157	38	471	3,870	98	823
TKN (mg-N/L)	501	3,049	3,049	7,771	7,771	11	4	31	244	8	53
NH_3-N (mg-N/L)	0	0	0	0	0	0	1	0	0	0	0
NO_3-N (mg-N/L)	2	2	2	2	2	3	2	2	2	2	2
TP (mg-P/L)	274	1,670	1,670	4,256	4,256	5	2	16	133	4	28
Alkalinity (mg/L as $CaCO_3$)	131	131	131	131	131	127	134	131	131	130	131
H_2S (mg/L)	0	0	0	0	0	0	0	0	0	0	0

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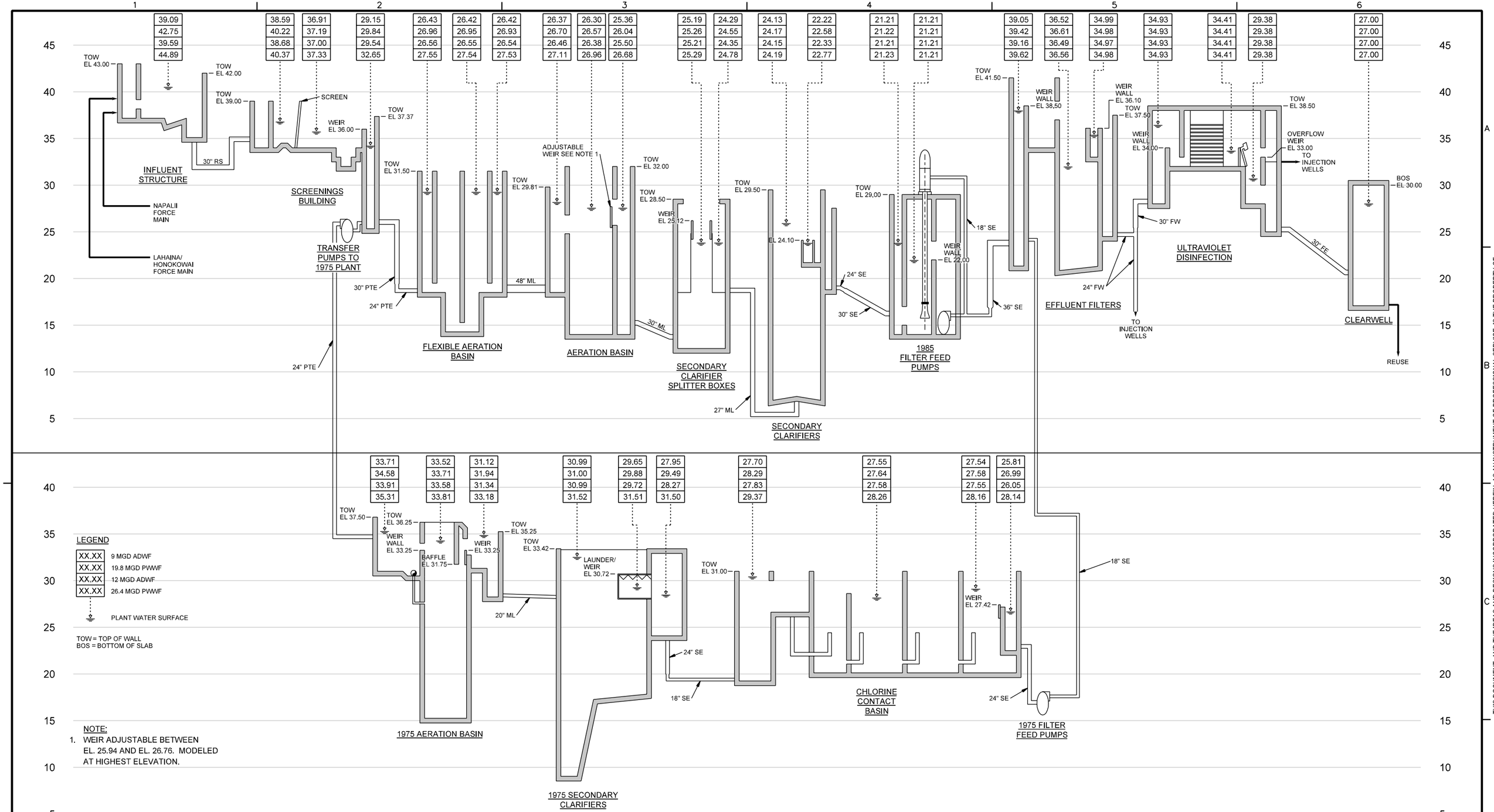
Appendix B – Hydraulic Profiles



FLOW CONDITION	1985 PLANT FLOW	1975 PLANT FLOW	REUSE
9 ADW	5.85	3.15	3.00
12 ADW	7.80	4.20	3.00
19.8 PWW	12.87	6.93	3.00
26.4 PWW	17.16	9.24	3.00

DSGN C. ALLEN					
DR R. LUKE					
CHK					
APVD	NO.	DATE	REVISION	BY	APVD

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

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LAHAINA WWRT
COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS AND WASTE MANAGEMENT
WASTE WATER RECLAMATION DIVISION

FIGURE 1
HYDRAULIC PROFILE
ALTERNATIVE 3
RESTORE 1975 PLANT

SHEET 1 OF 3
DWG PL-1
DATE SEPTEMBER 2003
PROJ 176853

FILENAME: 176853hp01.dlv PLOT DATE: 26-SEP-2003 PLOT TIME: 15:10:10

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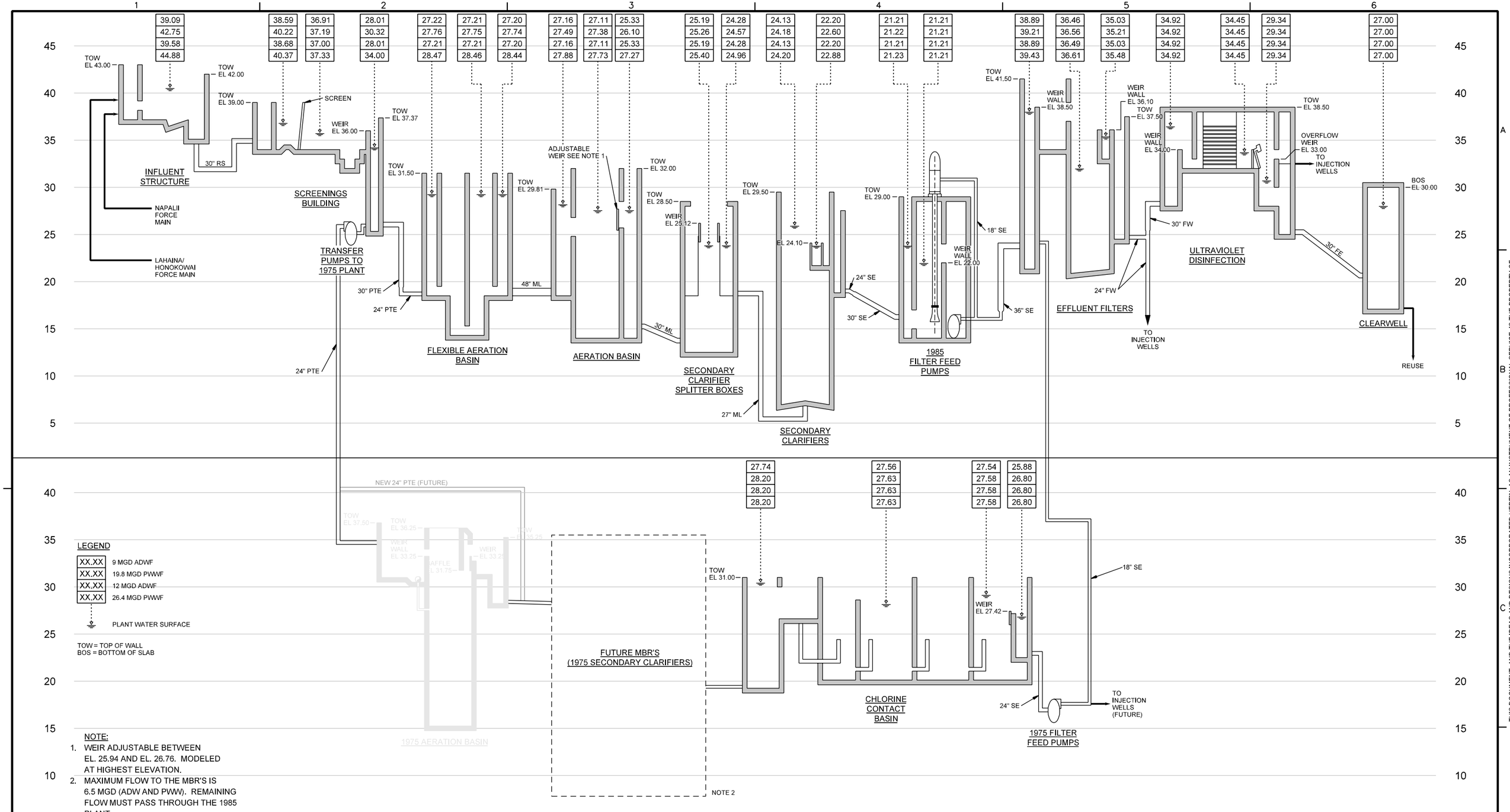

NOTE:
1. WEIR ADJUSTABLE BETWEEN EL. 25.94 AND EL. 26.76. MODELED AT HIGHEST ELEVATION.
2. MAXIMUM FLOW TO THE MBR'S IS 6.5 MGD (ADW AND PWW). REMAINING FLOW MUST PASS THROUGH THE 1985 PLANT.

FLOW CONDITION	1985 PLANT FLOW	1975 PLANT FLOW	REUSE
9 ADW	5.53	3.47	3.00
12 ADW	5.53	6.47	3.00
19.8 PWW	13.33	6.47	3.00
26.4 PWW	19.93	6.47	3.00

DSGN C. ALLEN					
DR R. LUKE					
CHK					
APVD	NO.	DATE	REVISION	BY	APVD

VERIFY SCALE
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DEPARTMENT OF PUBLIC WORKS AND WASTE MANAGEMENT
WASTE WATER RECLAMATION DIVISION

FIGURE 2
HYDRAULIC PROFILE
ALTERNATIVE 4
RETROFIT 1975 PLANT WITH MBR'S

SHEET 2 OF 3
DWG PL-2
DATE SEPTEMBER 2003
PROJ 176853

FILENAME: 176853hp02.dlv PLOT DATE: 26-SEP-2003 PLOT TIME: 14:54:14

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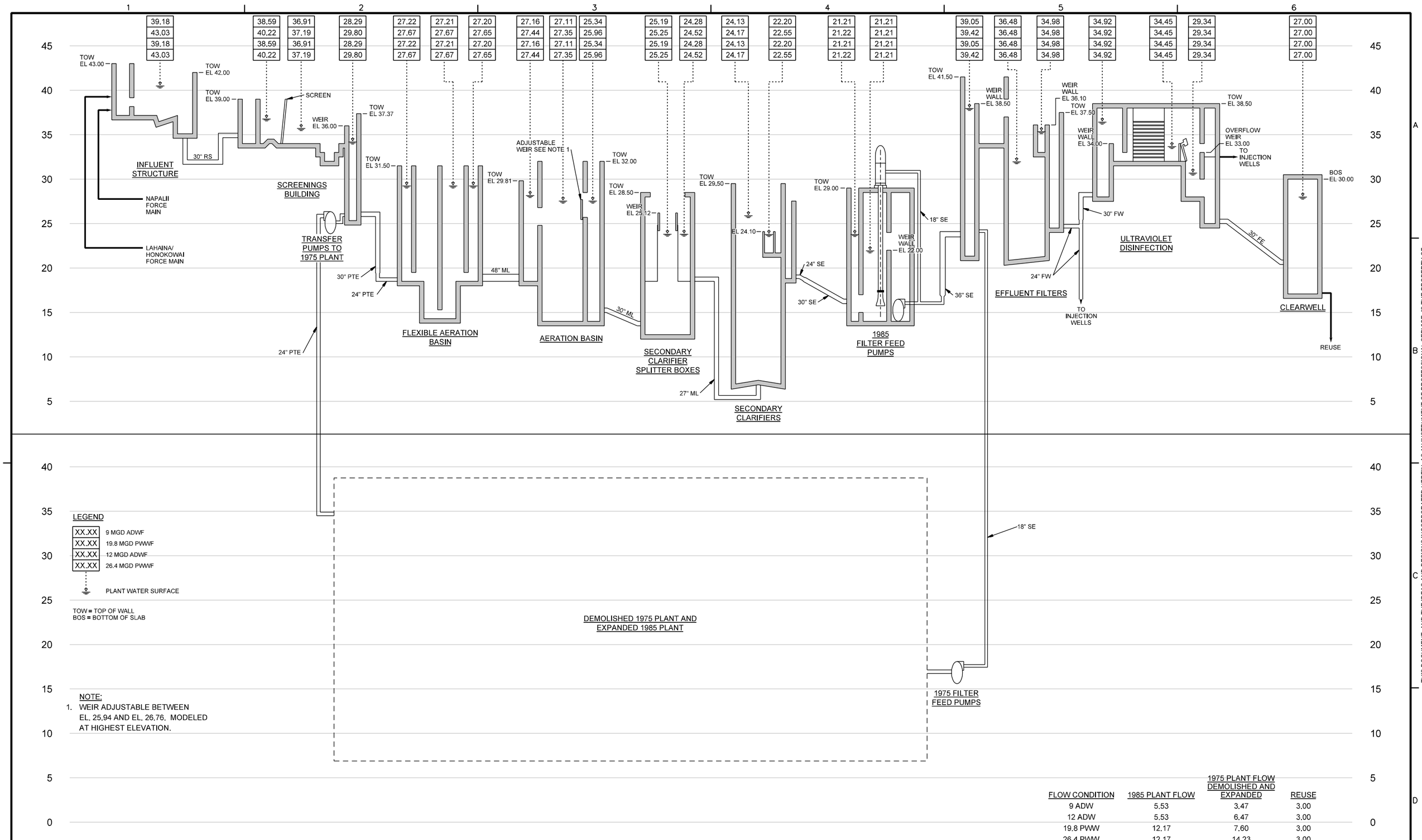

FLOW CONDITION	1985 PLANT FLOW	1975 PLANT FLOW DEMOLISHED AND EXPANDED	REUSE
9 ADW	5.53	3.47	3.00
12 ADW	5.53	6.47	3.00
19.8 PWW	12.17	7.60	3.00
26.4 PWW	12.17	14.23	3.00

DSGN C. ALLEN					
DR R. LUKE					
CHK					
APVD	NO.	DATE	REVISION	BY	APVD

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

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DEPARTMENT OF PUBLIC WORKS AND WASTE MANAGEMENT
WASTE WATER RECLAMATION DIVISION

FIGURE 3
HYDRAULIC PROFILE
ALTERNATIVE 7
DEMOLISH 1975 PLANT AND EXPAND 1985 PLANT

SHEET	3 OF 3
DWG	PL-3
DATE	SEPTEMBER 2003
PROJ	176853

FILENAME: 176853hp03.dlv PLOT DATE: 26-SEP-2003 PLOT TIME: 15:13:07

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Appendix C – Hydraulic Model Output Files (under separate cover)

On separate CD

Appendix D – Cost Estimate Details

C H2M HILL P arametric Cost E stimating S ystem (CPES)

WWTP CONSTRUCTION & LIFE CYCLE COST MODULE

Use PRO2D file | Browse

Click for CPES QA/ QC | Import PRO2D information from this file

Designates User Input Required

Designates Data Automatically Transferred from PRO2D File

Project Name:	Lahaina WWTP
Project Number:	176853
Project Manager:	Ross Kaneko
Estimator:	Bruce R. Johnson
Project Description:	Alternative 3
Project Location (City):	Honolulu
Project Location (State):	HAWAII
Project Location (Country):	USA
Construction Start Date:	Jan-05
Construction Duration (months):	18
Mid-Point of Construction:	Oct-05

To WWTP Flowsheet
To Unit Process Descriptions
To Life Cycle Summary Shee
To Global Life Cycle Data

Roundup to the nearest: $10,000

Item	Is This Facility Included in Project? (Yes or No)	SCOPE OF PROJECT	User Input	Cost
1	No	Preliminary Treatment - Screening Facility		$0
	To Facility Sheet	Number of Channels (EA)	2	
		Screening Channel Width (FT)	3	
		IS A BUILDING INCLUDED?	Yes	
		(Assumption: If there is a building, there is Odor Control)		
		IF "NO" BUILDING, IS THERE ODOR CONTROL?	Yes	
2	No	Preliminary Treatment - Grit System		$0
	To Facility Sheet	Number of Grit Chambers (EA)	2	
		Grit Chamber Diameter (FT)	6	
3	No	Primary Treatment - Primary Clarifier		$0
	To Facility Sheet	Number of Clarifiers (EA)	0	
		Diameter (FT)	0.00	
		SWD (FT)	0.00	
		Depth of Burial (FT)	0.00	
4	No	Secondary Treatment - Aeration Basin		$0
	To Facility Sheet	Aeration Basin		
		Number of Aeration Basins	1	
		Length (Width * 4, FT)	190.85	
		Width (FT)	47.71	
		SWD (FT)	16.00	
		Depth of Burial (FT)	15.00	
		Bioreactor Influent Channel		
		Length (FT)	3.00	
		Mixed Liquor Channel		
		Length (FT)	3.00	
		Is Facility Covered?	No	
5	No	Air Supply - Blower Building		$0
	To Facility Sheet	Number of Blowers (EA)	4	
		SCFM per Blower (SCFM)	1700.00	
6	No	Secondary Clarification - Flow Splitting Structure		$0
	To Facility Sheet	Number of Outlet Basins (EA)	0	
		Depth of Burial (FT)	0.00	
		Inlet Basin		
		Width (FT)	0.00	
		SWD (FT)	0.00	
		Outlet Basin (Dimensions of One)		
		Length (FT)	0.00	
		Width (FT)	0.00	
7	Yes	Secondary Clarification - Secondary Clarifier		$700,000
	To Facility Sheet	Number of Clarifiers (EA)	1	
		Diameter (FT)	75.00	
		SWD (FT)	16	
		Depth of Burial (FT)	12.00	

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	A	B	C	D	E
63	8	Yes	Secondary Sludge Pumping - RAS/WAS Pumping		$240,000
64		To Facility Sheet	Number of RAS Pumps (Each)	4	
65			RAS Pump Capacity (Per Unit, GPH)	42000	
66			Number of WAS Pumps (Each)	2	
67			WAS Pump Capacity (Per Unit, GPH)	9000	
68	9	No	Effluent Disinfection - Hypochlorination - Contact Basin		$0
69		To Facility Sheet	Number of Basins (EA)	0	
70			Overall Contact Basin Length (FT)	0.00	
71			Overall Contact Basin Width (FT)	0.00	
72			SWD (FT)	0.00	
73			Number of Serpentine Walls per Basin (EA)	0	
74			Influent Channel Length (FT)	0.00	
75			Effluent Channel Length (FT)	0.00	
76			Depth of Burial (FT)	0.00	
77	10	No	Effluent Disinfection - Hypochlorination - Chemical Building		$0
78		To Facility Sheet	Plant Capacity (MMADF)	0.00	
79					
80					
81					
82	1	No	Sewage Pump Station (Outside of Plant)		$0
83		To Facility Sheet	Firm Capacity (MGD)		
84					
85	2	No	Sewage Pump Station (In-Plant)		$0
86		To Facility Sheet	Firm Capacity (MGD)	7.50	
87					
88	3	No	Aerated Grit Removal & Flow Metering		$0
89		To Facility Sheet	Basin Volume (CF)		
90			Capacity (MGD) for O&M		
91	4	No	Primary Screening		$0
92		To Facility Sheet	Peak Capacity (MGD)		
93					
94	5	No	Primary Clarifier		$0
95		To Facility Sheet	Number of Clarifiers (EA)		
96			Surface Area (SF per Each)		
97	6	No	Secondary Clarifier		$0
98		To Facility Sheet	Number of Clarifiers (EA)	2	
99			Surface Area (SF per Each)	4,000.00	
100	7	No	Aeration Basin		$0
101		To Facility Sheet	Number of Basins (EA)		
102			Volume (CF per Each)		
103	8	No	Blowers		$0
104		To Facility Sheet	Firm Air Flow Capacity (CFM)	5,000.00	
105			Average Air Flow (SCFM) for O&M		
106	9	No	Air Diffusion		$0
107		To Facility Sheet	Number of Basins (EA)	2	
108			Firm Capacity (CFM per Each Basin)	2,400.00	
109	10	No	Trickling Filter		$0
110		To Facility Sheet	Number of Filters (EA)		
111			Volume of Media (CF per Each)		
112	11	No	Rotating Biological Contactor		$0
113		To Facility Sheet	Area of Media (Million SF)		
114					
115	12	No	Chlorine Contact Basin		$0
116		To Facility Sheet	Volume (CF)		
117					
118	13	No	Effluent Filters		$0
119		To Facility Sheet	Flow (MGD)	4.5000	
120					
121	14	No	Chlorine Feed & Storage		$0
122		To Facility Sheet	Feed Capacity (LB/DAY)		
123			Feed Capacity (Ton/Year) for O&M		
124	15	No	SO2 Storage & Feed Equipment		$0
125		To Facility Sheet	Feed Rate Capacity (LB/DAY)		
126			Feed Capacity (Ton/Year) for O&M		
127	16	No	Polymer Feed System		$0
128		To Facility Sheet	Feed Rate Capacity (LB/DAY)		

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	A	B	C	D	E
129					
130	17	No	Sludge Pumping		$0
131		To Facility Sheet	Firm Capacity (GPM)		
132					
133	18	No	Flotation Sludge Thickener		$0
134		To Facility Sheet	Number of Thickeners (EA)		
135			Diameter (Feet per Each)		
136			Surface Area (SF per Each)	-	
137	19	No	Sludge Holding Tanks		$0
138		To Facility Sheet	Volume (CF)		
139					
140	20	No	Anaerobic Digesters		$0
141		To Facility Sheet	Number of Units (Each)		
142			Digester Volume per Unit (CF)		
143	21	No	Solid Bowl Centrifuge		$0
144		To Facility Sheet	Flow Capacity (GPM)		
145			Average Loading (Total LB/Day) for O&M		
146	22	No	Belt Filter Press		$0
147		To Facility Sheet	Number of Presses (EA)		
148			Width (Meters per Each)		
149			Average Loading per Press (LB/Day) for O&M		
150	23	No	Sludge Drying Beds		$0
151		To Facility Sheet	Area (SF)		
152					
153	24	No	Flow Splitting Structure 2		$0
154		To Facility Sheet			
155					
156	25	No	Yard Piping		$0
157		To Facility Sheet			
158					
159	26	Yes	GBT Installation		$510,000
160		To Facility Sheet			
161					
162	27	No	User Defined Facility 2		$0
163		To Facility Sheet			
164					
165	28	No	User Defined Facility 3		$0
166		To Facility Sheet			
167					
168	SUBTOTAL - PROJECT COST				$1,450,000
169					
170	ADDITIONAL PROJECT COSTS:				
171	Demolition		10%		$145,000
172	Overall Sitework		1%		$14,500
173	Plant Computer System		1%		$14,500
174	Yard Electrical		2%		$29,000
175	Yard Piping		1%		$14,500
176	0		0%		$0
177	0		0%		$0
178	0		0%		$0
179	SUBTOTAL with Additional Project Costs				$1,667,500
180					
181	CONTRACTOR MARKUPS:				
182	Overhead		10%	$1,667,500	$166,750
183	Subtotal				$1,834,250
184	Profit		5%	$1,834,250	$91,713
185	Subtotal				$1,925,963
186	Mob/Bonds/Insurance		5%	$1,925,963	$96,298
187	Subtotal				$2,022,261
188	Contingency		20%	$2,022,261	$404,452
189	SUBTOTAL with Markups				$2,426,713
190					
191	ESCALATION (to Mid-Point of Construction):		5.74%	$2,426,713	$139,199
192	SUBTOTAL with Escalation				$2,565,911

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	A	B	C	D	E
193					
194	***LOCATION ADJUSTMENT FACTOR***		**123.20%**	**$2,565,911**	**$3,161,203**
195	***TOTAL - CONSTRUCTION COST***				**$3,161,203**
196					
197	***RED FLAGS:***				
198	***1***	***Rock Excavation***			
199	***2***	***Pile Foundations***			
200	***3***	***Seismic Foundations***			
201	***4***	***Dewatering Conditions***			
202	***5***	***Wetlands Mitigation***			
203	***6***	***Weather Impacts***			
204	***7***	***Depth of Structures***			
205	***8***	***Local Building Code Restrictions***			
206	***9***	***Coatings or Finishes***			
207	***10***	***Building or Architectural Considerations***			
208	***11***	***Client Material Preferences***			
209	***12***	***Client Equipment Preferences***			
210	***13***	***Piping Galleries, Piping Trenches, Piping Racks***			
211	***14***	***Yard Piping Complexity***			
212	***15***	***Existing Site Utilities (New, Retrofit, and Complexity)***			
213	***16***	***I & C Automation (New or Retrofit)***			
214	***17***	***Electrical Feed (New or Retrofit)***			
215	***18***	***Electrical Distribution***			
216	***19***	***User Defined Red Flag 1***			
217	***20***	***User Defined Red Flag 2***			
218	***21***	***User Defined Red Flag 3***			
219	***22***	***User Defined Red Flag 4***			
220	***23***	***User Defined Red Flag 5***			
221	***24***	***User Defined Red Flag 6***			
222	***25***	***User Defined Red Flag 7***			
223	***TOTAL - RED FLAGS***				**$0**
224					
225	***SUBTOTAL - CONSTRUCTION COST with Red Flags***				**$3,161,203**
226					
227	***Did a CH2M HILL Professional Estimator Review This Cost Estimate?***			**No**	
228	***TOTAL - CONSTRUCTION COST Plus RED FLAGS***				**$4,425,684**
229					
230	***NON-CONSTRUCTION COSTS:***				
231	***Permitting***		**0%**	**$4,425,684**	**$0**
232	***Engineering***		**10%**	**$4,425,684**	**$442,568**
233	***SDC***		**5%**	**$4,425,684**	**$221,284**
234	***Commissioning & Startup***		**5%**	**$4,425,684**	**$221,284**
235	***Land ROW***		**0%**	**$4,425,684**	**$0**
236	***Legal/Admin***		**0%**	**$4,425,684**	**$0**
237	***0***		**0%**	**$4,425,684**	**$0**
238	***SUBTOTAL - Non-Construction Costs***				**$885,137**
239					
240	***TOTAL - CAPITAL COST***				**$5,310,821**

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SECONDARY CLARIFIER

To Summary

Is This Facility Included in My Project? Yes

Assumptions:

Based on Ocala WRF No. 3 (5mgd MMADF)

Number of Clarifiers (EA)	***1***		***PRO2D Input from Summary Sheet***
Diameter (FT)	***75***	***D***	***PRO2D Input from Summary Sheet***
SWD (FT)	***16***	***SWD***	***PRO2D Input from Summary Sheet***
Depth of Burial (FT)	***12***		***User Input from Summary Sheet***

Dimension Calculations:

Logic Test:			
Is "Number of Clarifiers = 0"? ("Yes" = 0, "No" = 1)	1.00		
Slab on Grade Diameter	78.00	D+3	Calculated
Slab on Grade Thickness (inches)	16.00		Fixed
Slab on Grade Thickness (ft)	1.33	TS	Calculated
Freeboard (ft)	3.00	FB	Fixed
Exterior Wall Height (ft)	19.00	H = SWD + FB	Calculated
Exterior Wall Thickness (inches)	16.00		Fixed
Exterior Wall Thickness (ft)	1.33	TW	Calculated
Interior Launder Elevated Slab Width (ft)	5.00	WIS	Constant
Interior Launder Average Diameter (for launder slab area)	70.00	D-WIS	Calculated
Interior Launder Wall Diameter (ft)	72.00	D-(WIS-1*2)	Calculated
Interior Launder Wall Height (ft)	3.00		Fixed
Interior Launder Wall Thickness (inches)	8.00		Fixed
Interior Launder Wall Thickness (ft)	0.67		Calculated
Interior Launder Elevated Slab Thickness (inches)	8.00		Fixed
Interior Launder Elevated Slab Thickness (ft)	0.67		Calculated
Exterior Walkway Slab Width	4.00	WES	Constant
Exterior Walkway Handrail Diameter	85.67	D+(TW*2)+(WES*2	Calculated
Exterior Walkway Slab Thickness	0.67		Constant
Excavation Diameter	82.00	D+7	Calculated
Excavation Depth	14.33		Calculated
Liquid Volume (CF)	***70,650***		Calculated
Liquid Volume (Gal)	***528,499***		Calculated

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
SITEWORK:				
Excavation	3,782	CY	$2.50	$9,454
Structural Backfill	195	CY	$25.00	$4,887
Backfill	1,176	CY	$5.00	$5,878
Haul Excess	3,362	CY	$1.85	$6,221
Allowance for Misc Items	5%		$26,439.69	$1,322
Subtotal				$27,762
CONCRETE:				
Exterior Walls:				
Slab on Grade	236	CY	$250.00	$58,962
Circular Walls	221	CY	$450.00	$99,433

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST	
Interior Launder:					
Circular Walls	17	CY	$500.00	$8,373	
Elevated Slab	27	CY	$450.00	$12,211	
Exterior Walkway:					
Elevated Slab	27	CY	$500.00	$13,284	
Center Sludge/RAS Pit	10	CY	$200.00	$2,000	
Concrete Encasement	20	CY	$180.00	$3,600	
Clarifier Bottom Grout 2"	4,416	SF	$11.00	$48,572	
4" Concrete Pads	0.20	CY	$200.00	$40	
Allowance for Misc Items	5%		$246,435.50	$12,322	
Subtotal				$258,797	
METALS:					
Weir	226	LF	$50.00	$11,304	
Scum Baffle & Supports	226	LF	$100.00	$22,608	
Scum Box	1	EA	$4,000.00	$4,000	
Aluminum Stairs	11	RISERS	$300.00	$3,150	
Aluminum Platform	14	SF	$20.00	$270	
Aluminum Handrail	269	LF	$50.00	$13,450	
Allowance for Misc Items	5%		$54,781.67	$2,739	
Subtotal				$57,521	
EQUIPMENT:					
Clarifier Mechanism	1	EA	$129,375	$129,375	
Submersible Scum Pump	1	EA	$13,500	$13,500	
Allowance for Misc Items	5%		$142,875.00	$7,144	
Subtotal				$150,019	
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**	
Item 1 Description	0		$0.00	$0	
Item 2 Description	0		$0.00	$0	
Item 3 Description	0		$0.00	$0	
Item 4 Description	0		$0.00	$0	
Item 5 Description	0		$0.00	$0	
Item 6 Description	0		$0.00	$0	
Item 7 Description	0		$0.00	$0	
Item 8 Description	0		$0.00	$0	
Item 9 Description	0		$0.00	$0	
Item 10 Description	0		$0.00	$0	
Item 11 Description	0		$0.00	$0	
Item 12 Description	0		$0.00	$0	
Item 13 Description	0		$0.00	$0	
Item 14 Description	0		$0.00	$0	
Item 15 Description	0		$0.00	$0	
Subtotal				$0	
Subtotal				$494,098	
ALLOWANCES:					
Finishes Allowance	2.0%		$695,913	$13,918	
I & C Allowance	4%		$695,913	$27,837	
Mechanical Allowance	20%		$695,913	$139,183	Based on $59,641 / $766,488
Electrical Allowance	3%		$695,913	$20,877	
Facility Cost	**528,499**	**Galllons**	**$1.32**	**$695,913**	
Facility Cost with Additional Project Costs Added	**528,499**	**Galllons**	**$1.51**	**$800,299**	
Facility Cost with Additional Project Costs & Contractor Markups Added	**528,499**	**Galllons**	**$2.20**	**$1,164,676**	
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added	**528,499**	**Galllons**	**$2.33**	**$1,231,483**	
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	**528,499**	**Galllons**	**$2.87**	**$1,517,187**	

RAS AND WAS PUMPING

To Summary

Is This Facility Included in My Project? Yes

Assumptions:

Based on Ocala WRF No. 3 (5mgd MMADF)

RAS and WAS pumps are located outside

Number of RAS Pumps (Each)	***4***		***PRO2D Input from Summary Sheet***
RAS Pump Capacity (Per Unit, GPH)	***42000***		***PRO2D Input from Summary Sheet***
Number of WAS Pumps (Each)	***2***		***PRO2D Input from Summary Sheet***
WAS Pump Capacity (Per Unit, GPH)	***9000***		***PRO2D Input from Summary Sheet***

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
SITEWORK:				
Sitework Allowance	6	LS	$833.33	$5,000
Subtotal				$5,000
CONCRETE:				
8" Slab on Grade	45	CY	$250.00	$11,259
Allowance for Misc Items	5%		$11,259.26	$563
Subtotal				$11,822
EQUIPMENT:				
RAS Pumps (1170 gpm, 870 rpm, TDH =11.5ft, 7.5 hp)	4	EA	$12,796.83	$51,187
WAS Pumps (200 gpm, 1185 rpm TDH = 14 ft, 3hp)	2	EA	$5,114.72	$10,229
Allowance for Misc Items	5%		$61,416.75	$3,071
Subtotal				$64,488
MECHANICAL:				
RAS Piping:				
12" RAS	40	LF	$29.45	$1,178
12" Tee	4	EA	$1,130	$4,520
12" Elbow	4	EA	$700	$2,800
10" x 12" Reducing Elbow	4	EA	$700	$2,800
10" V405	12	EA	$1,750	$21,000
10" V604	4	EA	$2,259	$9,036
8" x 10" Reducing Elbow	4	EA	$532	$2,128
8" x 10" Reducer	4	EA	$532	$2,128
10" x 10 x 2" Tee	4	EA	$943	$3,772
10" Elbow	4	EA	$532	$2,128
10" Tee	12	EA	$943	$11,316
10" Flanged Coupling Adapter	4	EA	$250	$1,000
10" Flow Meter	4	EA	$5,368	$21,472
10" RAS	100	LF	$24.43	$2,443
2" V400	4	EA	$334	$1,336
WAS Piping:				
6" WAS	40	LF	$15.73	$629
6" Elbow	6	EA	$234	$1,404

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
6" V405	2	EA	$802	$1,604
4" x 6" Reducing Elbow	2	EA	$234	$468
4" WAS	100	LF	$14.08	$1,408
4" x 4" x 2" Tee	4	EA	$260	$1,040
2" V400	2	EA	$334	$668
4" V604	2	EA	$565	$1,130
4" Elbow	4	EA	$177	$708
4" Tee	8	EA	$260	$2,080
4" Flow Meter	2	EA	$3,431	$6,862
4" Flanged Coupling Adapter	2	EA	$109	$218
Allowance for Small Pipe & Pipe Supports	6	LS	$1,667	$10,000
Subtotal				$117,276
ELECTRICAL:				
RAS Pumps VFD's (7.5 hp)	4	EA	$4,600	$18,400
Allowance for Misc Items	5%		$18,400.00	$920
Subtotal				$19,320
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**
Delete Concrete and Site Work	1	LS	($16,822.22)	($16,822)
Item 2 Description	0		$0.00	$0
Item 3 Description	0		$0.00	$0
Item 4 Description	0		$0.00	$0
Item 5 Description	0		$0.00	$0
Item 6 Description	0		$0.00	$0
Item 7 Description	0		$0.00	$0
Item 8 Description	0		$0.00	$0
Item 9 Description	0		$0.00	$0
Item 10 Description	0		$0.00	$0
Item 11 Description	0		$0.00	$0
Item 12 Description	0		$0.00	$0
Item 13 Description	0		$0.00	$0
Item 14 Description	0		$0.00	$0
Item 15 Description	0		$0.00	$0
Subtotal				($16,822)
Subtotal				$201,084
ALLOWANCES:				
Finishes Allowance	0.0%		$233,818	$0
I & C Allowance	4%		$233,818	$9,353
Mechanical Allowance	0%		$233,818	$0
Electrical Allowance	10%		$233,818	$23,382
Facility Cost				**$233,818**
Facility Cost with Additional Project Costs Added				**$268,891**
Facility Cost with Additional Project Costs & Contractor Markups Added				**$391,317**
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added				**$413,764**
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added				**$509,757**

GBT Installation

To Summary

Is This Facility Included in My Project? Yes

Parametric Inputs	Value

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST	REFERENCE / COMMENTS
SITEWORK:					
Excavation	0	CY	***$2.50***	$0	***02E***
Structural Backfill	0	CY	***$25.00***	$0	***02SB***
Backfill	0	CY	***$5.00***	$0	***02B***
Haul Excess	0	CY	***$5.00***	$0	***02HE***
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
CONCRETE:					
Slab on Grade	0	CY	***$250.00***	$0	***03S***
Slab on Grade	28	CY	***$250.00***	$6,944	***03S***
Walls	6	CY	***$400.00***	$2,519	***03W***
Walls	0	CY	***$400.00***	$0	***03W***
Walls	0	CY	***$400.00***	$0	***03W***
Walls	0	CY	***$400.00***	$0	***03W***
Beams	0	CY	***$1,000.00***	$0	***03B***
Beams	0	CY	***$1,000.00***	$0	***03B***
Elevated Slab	0	CY	***$450.00***	$0	***03ES***
Elevated Slab	0	CY	***$450.00***	$0	***03ES***
Allowance for Misc Items	5%		$9,463	$473	
Subtotal				$9,936	
MASONRY:					
Type of Building Construction:	**Moderate**				
Building	0	SF	***$100.00***	$0	***04BM***
Subtotal				$0	
METALS:					
Grating	160	SF	***$55.00***	$8,800	***05G***
Handrail	80	LF	***$55.00***	$4,400	***05H***
Stairs	10	Risers	***$300.00***	$3,000	***05S***
Allowance for Misc Items	5%		$16,200.00	$810	
Subtotal				$17,010	
WOOD & PLASTIC:					
Item 1	0	EA	$0.00	$0	
Item 2	0	EA	$0.00	$0	
Item 3	0	EA	$0.00	$0	
Item 4	0	EA	$0.00	$0	
Item 5	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
THERMAL & MOISTURE PROTECTION:					
Item 1	0	EA	$0.00	$0	
Item 2	0	EA	$0.00	$0	
Item 3	0	EA	$0.00	$0	
Item 4	0	EA	$0.00	$0	
Item 5	0	EA	$0.00	$0	
Roof Hatch (4' x 6', double leaf)	0	EA	***$1,800.00***	$0	***07RH1***
Roof Hatch (2' x 2', double leaf)	0	EA	***$300.00***	$0	***07RH2***
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
DOORS & WINDOWS:					
Item 1	0	EA	$0.00	$0	
Item 2	0	EA	$0.00	$0	
Item 3	0	EA	$0.00	$0	
Item 4	0	EA	$0.00	$0	

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Item 5	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
EQUIPMENT:					
Gravity Belt Thickener	2	EA	$110,000.00	$220,000	
Polymer System	1	EA	$50,000.00	$50,000	
Thickened Sludge Pumps	3	EA	$15,000.00	$45,000	
Equipment Item 4	0	EA	$0.00	$0	
Equipment Item 5	0	EA	$0.00	$0	
Equipment Item 6	0	EA	$0.00	$0	
Equipment Item 7	0	EA	$0.00	$0	
Equipment Item 8	0	EA	$0.00	$0	
Equipment Item 9	0	EA	$0.00	$0	
Equipment Item 10	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$315,000.00	$15,750	
Subtotal				$330,750	
I&C:					
Item 1	0	EA	$0.00	$0	
Item 2	0	EA	$0.00	$0	
Item 3	0	EA	$0.00	$0	
Item 4	0	EA	$0.00	$0	
Item 5	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
CONVEYING SYSTEMS:					
Monorail Hoist (3 Ton)	0	EA	***$2,475.00***	$0	***14MH***
Hoist Rail	0	LF	***$25.00***	$0	***14MR***
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
MECHANICAL:					
		EA		$0	
Equipment Item 2	0	EA	$0.00	$0	
Equipment Item 3	0	EA	$0.00	$0	
Equipment Item 4	0	EA	$0.00	$0	
Equipment Item 5	0	EA	$0.00	$0	
Equipment Item 6	0	EA	$0.00	$0	
Equipment Item 7	0	EA	$0.00	$0	
Equipment Item 8	0	EA	$0.00	$0	
Equipment Item 9	0	EA	$0.00	$0	
Equipment Item 10	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**	
Demolition Allowance	1	LS	$50,000.00	$50,000	
Item 2 Description	0		$0.00	$0	
Item 3 Description	0		$0.00	$0	
Item 4 Description	0		$0.00	$0	
Item 5 Description	0		$0.00	$0	
Item 6 Description	0		$0.00	$0	
Item 7 Description	0		$0.00	$0	
Item 8 Description	0		$0.00	$0	
Item 9 Description	0		$0.00	$0	
Item 10 Description	0		$0.00	$0	
Item 11 Description	0		$0.00	$0	
Item 12 Description	0		$0.00	$0	
Item 13 Description	0		$0.00	$0	
Item 14 Description	0		$0.00	$0	
Item 15 Description	0		$0.00	$0	
Subtotal				$50,000	
Subtotal				$407,696	
ALLOWANCES:		**User Over-write**			
Finishes Allowance	2.0%		$509,620	$10,192	
I & C Allowance	4%		$509,620	$20,385	
Mechanical Allowance	10%		$509,620	$50,962	
Electrical Allowance	4%		$509,620	$20,385	
Facility Cost				**$509,620**	
Facility Cost with Additional Project Costs Added	**-**	**0**	**#DIV/0!**	**$586,063**	
Facility Cost with Additional Project Costs & Contractor Markups Added	**-**	**0**	**#DIV/0!**	**$852,898**	
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added	**-**	**0**	**#DIV/0!**	**$901,821**	
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	**-**	**0**	**#DIV/0!**	**$1,111,043**	
Annual O & M					

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Labor	-	HRS	$ 50.00	$0
Energy	-	KWH	$ 0.07	$0
Fuel	-	GAL	$ 1.75	$0
Maintenance Materials & Supplies	1	LS	$0.00	$0
Subtotal				$0

User Defined Annual O&M Items:	Annual Cost
Item 1	$ -
Item 2	$ -
Item 3	$ -
Item 4	$ -
Item 5	$ -
Item 6	$ -
Item 7	$ -
Item 8	$ -
Item 9	$ -
Item 10	$ -
Item 11	$ -
Item 12	$ -
Item 13	$ -
Item 14	$ -
Item 15	$ -
Subtotal Annual O&M Cost	$ -
Contingency 20%	$ -
Total Annual O&M Cost	$ -

Net Present Value (NPV) Calculation:

i =	4%
n =	25

Year	Default Cost	User Over-Ride	Cost Used in NPV Calculation	Adjusted Annual O & M Cost
0	$1,111,043		$1,111,043	
1	$0		$0	
2	$0		$0	
3	$0		$0	
4	$0		$0	
5	$0		$0	
6	$0		$0	
7	$0		$0	
8	$0		$0	
9	$0		$0	
10	$0		$0	
11	$0		$0	
12	$0		$0	
13	$0		$0	
14	$0		$0	
15	$0		$0	
16	$0		$0	
17	$0		$0	
18	$0		$0	
19	$0		$0	
20	$0		$0	
21	$0		$0	
22	$0		$0	
23	$0		$0	
24	$0		$0	
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NPV			**$1,111,043**	**$0**	

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C H2M HILL P arametric Cost E stimating S ystem (CPES)

WWTP CONSTRUCTION & LIFE CYCLE COST MODULE

Use PRO2D file | Browse

Click for CPES QA/ QC | Import PRO2D information from this file

Designates User Input Required

Designates Data Automatically Transferred from PRO2D File

Project Name:	Lahaina WWTP
Project Number:	176853
Project Manager:	Ross Kaneko
Estimator:	Bruce R. Johnson
Project Description:	Alternative 3
Project Location (City):	Honolulu
Project Location (State):	HAWAII
Project Location (Country):	USA
Construction Start Date:	Jan-05
Construction Duration (months):	18
Mid-Point of Construction:	Oct-05

To WWTP Flowsheet
To Unit Process Descriptions
To Life Cycle Summary Shee
To Global Life Cycle Data

Roundup to the nearest: $10,000

Item	Is This Facility Included in Project? (Yes or No)	SCOPE OF PROJECT	User Input	Cost
1	No	Preliminary Treatment - Screening Facility		$0
	To Facility Sheet	Number of Channels (EA)	2	
		Screening Channel Width (FT)	3	
		IS A BUILDING INCLUDED?	Yes	
		(Assumption: If there is a building, there is Odor Control)		
		IF "NO" BUILDING, IS THERE ODOR CONTROL?	Yes	
2	No	Preliminary Treatment - Grit System		$0
	To Facility Sheet	Number of Grit Chambers (EA)	2	
		Grit Chamber Diameter (FT)	6	
3	No	Primary Treatment - Primary Clarifier		$0
	To Facility Sheet	Number of Clarifiers (EA)	0	
		Diameter (FT)	0.00	
		SWD (FT)	0.00	
		Depth of Burial (FT)	0.00	
4	Yes	Secondary Treatment - Aeration Basin		$590,000
	To Facility Sheet	Aeration Basin		
		Number of Aeration Basins	1	
		Length (Width * 4, FT)	190.85	
		Width (FT)	47.71	
		SWD (FT)	16.00	
		Depth of Burial (FT)	15.00	
		Bioreactor Influent Channel		
		Length (FT)	3.00	
		Mixed Liquor Channel		
		Length (FT)	3.00	
		Is Facility Covered?	No	
5	No	Air Supply - Blower Building		$0
	To Facility Sheet	Number of Blowers (EA)	4	
		SCFM per Blower (SCFM)	1700.00	
6	No	Secondary Clarification - Flow Splitting Structure		$0
	To Facility Sheet	Number of Outlet Basins (EA)	0	
		Depth of Burial (FT)	0.00	
		Inlet Basin		
		Width (FT)	0.00	
		SWD (FT)	0.00	
		Outlet Basin (Dimensions of One)		
		Length (FT)	0.00	
		Width (FT)	0.00	
7	Yes	Secondary Clarification - Secondary Clarifier		$700,000
	To Facility Sheet	Number of Clarifiers (EA)	1	
		Diameter (FT)	75.00	
		SWD (FT)	16	
		Depth of Burial (FT)	12.00	

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	A	B	C	D	E
63	8	Yes	Secondary Sludge Pumping - RAS/WAS Pumping		$240,000
64		To Facility Sheet	Number of RAS Pumps (Each)	4	
65			RAS Pump Capacity (Per Unit, GPH)	42000	
66			Number of WAS Pumps (Each)	2	
67			WAS Pump Capacity (Per Unit, GPH)	9000	
68	9	No	Effluent Disinfection - Hypochlorination - Contact Basin		$0
69		To Facility Sheet	Number of Basins (EA)	0	
70			Overall Contact Basin Length (FT)	0.00	
71			Overall Contact Basin Width (FT)	0.00	
72			SWD (FT)	0.00	
73			Number of Serpentine Walls per Basin (EA)	0	
74			Influent Channel Length (FT)	0.00	
75			Effluent Channel Length (FT)	0.00	
76			Depth of Burial (FT)	0.00	
77	10	No	Effluent Disinfection - Hypochlorination - Chemical Building		$0
78		To Facility Sheet	Plant Capacity (MMADF)	0.00	
79					
80					
81					
82	1	No	Sewage Pump Station (Outside of Plant)		$0
83		To Facility Sheet	Firm Capacity (MGD)		
84					
85	2	Yes	Sewage Pump Station (In-Plant)		$330,000
86		To Facility Sheet	Firm Capacity (MGD)	7.50	
87					
88	3	No	Aerated Grit Removal & Flow Metering		$0
89		To Facility Sheet	Basin Volume (CF)		
90			Capacity (MGD) for O&M		
91	4	No	Primary Screening		$0
92		To Facility Sheet	Peak Capacity (MGD)		
93					
94	5	No	Primary Clarifier		$0
95		To Facility Sheet	Number of Clarifiers (EA)		
96			Surface Area (SF per Each)		
97	6	Yes	Secondary Clarifier		$820,000
98		To Facility Sheet	Number of Clarifiers (EA)	2	
99			Surface Area (SF per Each)	4,000.00	
100	7	No	Aeration Basin		$0
101		To Facility Sheet	Number of Basins (EA)		
102			Volume (CF per Each)		
103	8	Yes	Blowers		$540,000
104		To Facility Sheet	Firm Air Flow Capacity (CFM)	5,000.00	
105			Average Air Flow (SCFM) for O&M		
106	9	No	Air Diffusion		$0
107		To Facility Sheet	Number of Basins (EA)	2	
108			Firm Capacity (CFM per Each Basin)	2,400.00	
109	10	No	Trickling Filter		$0
110		To Facility Sheet	Number of Filters (EA)		
111			Volume of Media (CF per Each)		
112	11	No	Rotating Biological Contactor		$0
113		To Facility Sheet	Area of Media (Million SF)		
114					
115	12	No	Chlorine Contact Basin		$0
116		To Facility Sheet	Volume (CF)		
117					
118	13	No	Effluent Filters		$0
119		To Facility Sheet	Flow (MGD)	4.5000	
120					
121	14	No	Chlorine Feed & Storage		$0
122		To Facility Sheet	Feed Capacity (LB/DAY)		
123			Feed Capacity (Ton/Year) for O&M		
124	15	No	SO2 Storage & Feed Equipment		$0
125		To Facility Sheet	Feed Rate Capacity (LB/DAY)		
126			Feed Capacity (Ton/Year) for O&M		
127	16	No	Polymer Feed System		$0
128		To Facility Sheet	Feed Rate Capacity (LB/DAY)		

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	A	B	C	D	E
129					
130	17	No	Sludge Pumping		$0
131		To Facility Sheet	Firm Capacity (GPM)		
132					
133	18	No	Flotation Sludge Thickener		$0
134		To Facility Sheet	Number of Thickeners (EA)		
135			Diameter (Feet per Each)		
136			Surface Area (SF per Each)	-	
137	19	No	Sludge Holding Tanks		$0
138		To Facility Sheet	Volume (CF)		
139					
140	20	No	Anaerobic Digesters		$0
141		To Facility Sheet	Number of Units (Each)		
142			Digester Volume per Unit (CF)		
143	21	No	Solid Bowl Centrifuge		$0
144		To Facility Sheet	Flow Capacity (GPM)		
145			Average Loading (Total LB/Day) for O&M		
146	22	No	Belt Filter Press		$0
147		To Facility Sheet	Number of Presses (EA)		
148			Width (Meters per Each)		
149			Average Loading per Press (LB/Day) for O&M		
150	23	No	Sludge Drying Beds		$0
151		To Facility Sheet	Area (SF)		
152					
153	24	No	Flow Splitting Structure 2		$0
154		To Facility Sheet			
155					
156	25	No	Yard Piping		$0
157		To Facility Sheet			
158					
159	26	Yes	GBT Installation		$510,000
160		To Facility Sheet			
161					
162	27	No	User Defined Facility 2		$0
163		To Facility Sheet			
164					
165	28	No	User Defined Facility 3		$0
166		To Facility Sheet			
167					
168	SUBTOTAL - PROJECT COST				$3,730,000
169					
170	ADDITIONAL PROJECT COSTS:				
171	Demolition		10%		$373,000
172	Overall Sitework		1%		$37,300
173	Plant Computer System		1%		$37,300
174	Yard Electrical		2%		$74,600
175	Yard Piping		1%		$37,300
176	0		0%		$0
177	0		0%		$0
178	0		0%		$0
179	SUBTOTAL with Additional Project Costs				$4,289,500
180					
181	CONTRACTOR MARKUPS:				
182	Overhead		10%	$4,289,500	$428,950
183	Subtotal				$4,718,450
184	Profit		5%	$4,718,450	$235,923
185	Subtotal				$4,954,373
186	Mob/Bonds/Insurance		5%	$4,954,373	$247,719
187	Subtotal				$5,202,091
188	Contingency		20%	$5,202,091	$1,040,418
189	SUBTOTAL with Markups				$6,242,509
190					
191	ESCALATION (to Mid-Point of Construction):		5.74%	$6,242,509	$358,077
192	SUBTOTAL with Escalation				$6,600,586

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	A	B	C	D	E
193					
194	***LOCATION ADJUSTMENT FACTOR***		**123.20%**	**$6,600,586**	**$8,131,922**
195	***TOTAL - CONSTRUCTION COST***				**$8,131,922**
196					
197	***RED FLAGS:***				
198	***1***	***Rock Excavation***			
199	***2***	***Pile Foundations***			
200	***3***	***Seismic Foundations***			
201	***4***	***Dewatering Conditions***			
202	***5***	***Wetlands Mitigation***			
203	***6***	***Weather Impacts***			
204	***7***	***Depth of Structures***			
205	***8***	***Local Building Code Restrictions***			
206	***9***	***Coatings or Finishes***			
207	***10***	***Building or Architectural Considerations***			
208	***11***	***Client Material Preferences***			
209	***12***	***Client Equipment Preferences***			
210	***13***	***Piping Galleries, Piping Trenches, Piping Racks***			
211	***14***	***Yard Piping Complexity***			
212	***15***	***Existing Site Utilities (New, Retrofit, and Complexity)***			
213	***16***	***I & C Automation (New or Retrofit)***			
214	***17***	***Electrical Feed (New or Retrofit)***			
215	***18***	***Electrical Distribution***			
216	***19***	***User Defined Red Flag 1***			
217	***20***	***User Defined Red Flag 2***			
218	***21***	***User Defined Red Flag 3***			
219	***22***	***User Defined Red Flag 4***			
220	***23***	***User Defined Red Flag 5***			
221	***24***	***User Defined Red Flag 6***			
222	***25***	***User Defined Red Flag 7***			
223	***TOTAL - RED FLAGS***				**$0**
224					
225	***SUBTOTAL - CONSTRUCTION COST with Red Flags***				**$8,131,922**
226					
227	***Did a CH2M HILL Professional Estimator Review This Cost Estimate?***			**No**	
228	***TOTAL - CONSTRUCTION COST Plus RED FLAGS***				**$11,384,691**
229					
230	***NON-CONSTRUCTION COSTS:***				
231	***Permitting***		**0%**	**$11,384,691**	**$0**
232	***Engineering***		**10%**	**$11,384,691**	**$1,138,469**
233	***SDC***		**5%**	**$11,384,691**	**$569,235**
234	***Commissioning & Startup***		**5%**	**$11,384,691**	**$569,235**
235	***Land ROW***		**0%**	**$11,384,691**	**$0**
236	***Legal/Admin***		**0%**	**$11,384,691**	**$0**
237	***0***		**0%**	**$11,384,691**	**$0**
238	***SUBTOTAL - Non-Construction Costs***				**$2,276,938**
239					
240	***TOTAL - CAPITAL COST***				**$13,661,629**

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SECONDARY TREATMENT - AERATION BASIN					
		To Summary			
Is This Facility Included in My Project? Yes					
Assumptions:					
Model Based on City of Vancouver, WA Marine Park WRF					
Aeration Basin					
Number of Aeration Basins	**1**		***PRO2D Input from Summary Sheet***		
Length (FT)	**190.85**	**BL**	***User Input from Summary Sheet***		
Width (FT)	**47.71**	**BW**	***User Input from Summary Sheet***		
SWD (FT)	**16.00**	**SWD**	***PRO2D Input from Summary Sheet***		
Depth of Burial (FT)	**15**		***User Input from Summary Sheet***		
Bioreactor Inluent Channel					
Length (FT)	**3**	**BICL**	***User Input from Summary Sheet***		
Mixed Liquor Channel					
Length (FT)	**3**	**MLCL**	***User Input from Summary Sheet***		
Is Facility Covered?	**No**		***User Input from Summary Sheet***		
Dimension Calculations:					
Logic Test:					
Is "Number of Aeration Basins = 0"? ("Yes" = 0, "No" = 1)	1.00				
Facility Length (ft)	203.85	**L**	Calculated		
Facility Width (ft)	51.71	**W**	Calculated		
Slab on Grade Length (ft)	207.85		Calculated		
Slab on Grade Width (ft)	55.71		Calculated		
Slab on Grade Thickness (inches)	24.00		Fixed		
Slab on Grade Thickness (ft)	2.00		Calculated		
Freeboard (ft)	4.00	**FB**	Fixed		
Exterior Wall Height (ft)	20.00	**H**	Fixed		
Exterior Wall Thickness (inches)	24.00		Fixed		
Exterior Wall Thickness (ft)	2.00		Calculated		
Bioreactor Influent Channel Wall Height (ft)	20.00	= H	Calculated		
Bioreactor Influent Channel Wall Thickness (inches)	18.00		Fixed		
Bioreactor Influent Channel Wall Thickness (ft)	1.50		Calculated		
Baffle Wall Height (ft)	16.00	= SWD	Calculated		
Baffle Wall Thickness (inches)	12.00		Fixed		
Baffle Wall Thickness (ft)	1.00		Calculated		
Mixed Liquor Channel Wall Height (ft)	20.00	= H	Calculated		
Mixed Liquor Channel Wall Thickness (inches)	18.00		Fixed		
Mixed Liquor Channel Wall Thickness (ft)	1.50		Calculated		
Basin Divider Wall Height (ft)	20.00	= H	Fixed		

Basin Divider Wall Thickness (inches)	24.00		Fixed		
Basin Divider Wall Thickness (ft)	2.00		Calculated		
Walkway Elevated Slab Width (ft)	4.00		Fixed		
Walkway Elevated Slab Thickness (inches)	8.00		Fixed		
Walkway Elevated Slab Thickness (ft)	0.67		Calculated		
Excavation Length (ft)	211.85		Calculated		
Excavation Width (ft)	59.71		Calculated		
Excavation Depth (ft)	18.00		Calculated		
Liquid Volume (CF)	***145,702***		Calculated		
Liquid Volume (Gal)	***1,089,930***		Calculated		
DESCRIPTION	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**	
SITEWORK:					
Excavation	9,574	CY	$2.50	$23,935	
Structural Backfill	469	CY	$25.00	$11,714	
Backfill	1,368	CY	$5.00	$6,842	
Haul Excess	10,121	CY	$1.85	$18,723	
Allowance for Misc Items	5%		$61,213.28	$3,061	
Subtotal				$64,274	
CONCRETE:					
Slab on Grade	858	CY	$250.00	$214,451	
Exterior Walls	757	CY	$400.00	$302,896	
Bioreactor Influent Channel Wall	57	CY	$400.00	$22,984	
Baffle Wall	31	CY	$400.00	$12,258	
Mixed Liquor Channel Wall	57	CY	$400.00	$22,984	
Basin Divider Wall	0	CY	$400.00	$0	
Walkway Elevated Slab	50	CY	$450.00	$22,717	
Allowance for Misc Items	5%		$598,290.68	$29,915	
Subtotal				$628,205	
MASONRY:					
CMU Building	0	SF	$70.00	$0	
Subtotal				$0	
METALS:					
Handrail	1,022	LF	$40.00	$40,891	
Primary Effluent Channel Grating	-44	SF	$55.00	($2,404)	
Mixed Liquor Channel Grating	-44	SF	$55.00	($2,404)	
Allowance for Misc Items	5%		$36,082.48	$1,804	
Subtotal				$37,887	
EQUIPMENT:					
Diffuser System	10,542	SF	$8.89	$93,690	Unit Cost Based on Santa Rosa
Influent Slide Gates	2	EA	$10,000	$20,000	Rule: 2 per basin
Mixers	1	EA	$12,000	$12,000	Rule: 1 per basin
Mixed Liquor Recycle Pumps	1	EA	$25,000	$25,000	Rule: 1 per basin
Allowance for Misc Items	5%		$150,689.58	$7,534	
Subtotal				$158,224	
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**	
No Sitework	1	LS	($64,273.95)	($64,274)	
Concrete is only repair of existing	1	LS	($424,125.36)	($424,125)	
No building	1	LS	$0.00	$0	
No mixers/recycle pumps	1	LS	($37,000.00)	($37,000)	
Item 5 Description	0		$0.00	$0	
Item 6 Description	0		$0.00	$0	
Item 7 Description	0		$0.00	$0	
Item 8 Description	0		$0.00	$0	
Item 9 Description	0		$0.00	$0	
Item 10 Description	0		$0.00	$0	
Item 11 Description	0		$0.00	$0	
Item 12 Description	0		$0.00	$0	
Item 13 Description	0		$0.00	$0	

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST	
Item 14 Description	0		$0.00	$0	
Item 15 Description	0		$0.00	$0	
Subtotal				($525,399)	
Subtotal				$363,191	
ALLOWANCES:					
Finishes Allowance	2.0%		$585,791	$11,716	
I & C Allowance	4%		$585,791	$23,432	
Mechanical Allowance	22%		$585,791	$128,874	
Electrical Allowance	10%		$585,791	$58,579	
Facility Cost	**1,089,930**	**Gallons**	**$0.54**	**$585,791**	
Facility Cost with Additional Project Costs Added	**1,089,930**	**Gallons**	**$0.62**	**$673,660**	
Facility Cost with Additional Project Costs & Contractor Markups Added	**1,089,930**	**Gallons**	**$0.90**	**$980,377**	
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added	**1,089,930**	**Gallons**	**$0.95**	**$1,036,613**	
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	**1,089,930**	**Gallons**	**$1.17**	**$1,277,107**	

SECONDARY CLARIFIER

To Summary

Is This Facility Included in My Project? Yes

Assumptions:

Based on Ocala WRF No. 3 (5mgd MMADF)

Number of Clarifiers (EA)	***1***		***PRO2D Input from Summary Sheet***
Diameter (FT)	***75***	***D***	***PRO2D Input from Summary Sheet***
SWD (FT)	***16***	***SWD***	***PRO2D Input from Summary Sheet***
Depth of Burial (FT)	***12***		***User Input from Summary Sheet***

Dimension Calculations:

Logic Test:			
Is "Number of Clarifiers = 0"? ("Yes" = 0, "No" = 1)	1.00		
Slab on Grade Diameter	78.00	D+3	Calculated
Slab on Grade Thickness (inches)	16.00		Fixed
Slab on Grade Thickness (ft)	1.33	TS	Calculated
Freeboard (ft)	3.00	FB	Fixed
Exterior Wall Height (ft)	19.00	H = SWD + FB	Calculated
Exterior Wall Thickness (inches)	16.00		Fixed
Exterior Wall Thickness (ft)	1.33	TW	Calculated
Interior Launder Elevated Slab Width (ft)	5.00	WIS	Constant
Interior Launder Average Diameter (for launder slab area)	70.00	D-WIS	Calculated
Interior Launder Wall Diameter (ft)	72.00	D-(WIS-1*2)	Calculated
Interior Launder Wall Height (ft)	3.00		Fixed
Interior Launder Wall Thickness (inches)	8.00		Fixed
Interior Launder Wall Thickness (ft)	0.67		Calculated
Interior Launder Elevated Slab Thickness (inches)	8.00		Fixed
Interior Launder Elevated Slab Thickness (ft)	0.67		Calculated
Exterior Walkway Slab Width	4.00	WES	Constant
Exterior Walkway Handrail Diameter	85.67	D+(TW*2)+(WES*2	Calculated
Exterior Walkway Slab Thickness	0.67		Constant
Excavation Diameter	82.00	D+7	Calculated
Excavation Depth	14.33		Calculated
Liquid Volume (CF)	***70,650***		Calculated
Liquid Volume (Gal)	***528,499***		Calculated

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
SITEWORK:				
Excavation	3,782	CY	$2.50	$9,454
Structural Backfill	195	CY	$25.00	$4,887
Backfill	1,176	CY	$5.00	$5,878
Haul Excess	3,362	CY	$1.85	$6,221
Allowance for Misc Items	5%		$26,439.69	$1,322
Subtotal				$27,762
CONCRETE:				
Exterior Walls:				
Slab on Grade	236	CY	$250.00	$58,962
Circular Walls	221	CY	$450.00	$99,433

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST	
Interior Launder:					
Circular Walls	17	CY	$500.00	$8,373	
Elevated Slab	27	CY	$450.00	$12,211	
Exterior Walkway:					
Elevated Slab	27	CY	$500.00	$13,284	
Center Sludge/RAS Pit	10	CY	$200.00	$2,000	
Concrete Encasement	20	CY	$180.00	$3,600	
Clarifier Bottom Grout 2"	4,416	SF	$11.00	$48,572	
4" Concrete Pads	0.20	CY	$200.00	$40	
Allowance for Misc Items	5%		$246,435.50	$12,322	
Subtotal				$258,797	
METALS:					
Weir	226	LF	$50.00	$11,304	
Scum Baffle & Supports	226	LF	$100.00	$22,608	
Scum Box	1	EA	$4,000.00	$4,000	
Aluminum Stairs	11	RISERS	$300.00	$3,150	
Aluminum Platform	14	SF	$20.00	$270	
Aluminum Handrail	269	LF	$50.00	$13,450	
Allowance for Misc Items	5%		$54,781.67	$2,739	
Subtotal				$57,521	
EQUIPMENT:					
Clarifier Mechanism	1	EA	$129,375	$129,375	
Submersible Scum Pump	1	EA	$13,500	$13,500	
Allowance for Misc Items	5%		$142,875.00	$7,144	
Subtotal				$150,019	
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**	
Item 1 Description	0		$0.00	$0	
Item 2 Description	0		$0.00	$0	
Item 3 Description	0		$0.00	$0	
Item 4 Description	0		$0.00	$0	
Item 5 Description	0		$0.00	$0	
Item 6 Description	0		$0.00	$0	
Item 7 Description	0		$0.00	$0	
Item 8 Description	0		$0.00	$0	
Item 9 Description	0		$0.00	$0	
Item 10 Description	0		$0.00	$0	
Item 11 Description	0		$0.00	$0	
Item 12 Description	0		$0.00	$0	
Item 13 Description	0		$0.00	$0	
Item 14 Description	0		$0.00	$0	
Item 15 Description	0		$0.00	$0	
Subtotal				$0	
Subtotal				$494,098	
ALLOWANCES:					
Finishes Allowance	2.0%		$695,913	$13,918	
I & C Allowance	4%		$695,913	$27,837	
Mechanical Allowance	20%		$695,913	$139,183	Based on $59,641 / $766,488
Electrical Allowance	3%		$695,913	$20,877	
Facility Cost	**528,499**	**Galllons**	**$1.32**	**$695,913**	
Facility Cost with Additional Project Costs Added	**528,499**	**Galllons**	**$1.51**	**$800,299**	
Facility Cost with Additional Project Costs & Contractor Markups Added	**528,499**	**Galllons**	**$2.20**	**$1,164,676**	
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added	**528,499**	**Galllons**	**$2.33**	**$1,231,483**	
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	**528,499**	**Galllons**	**$2.87**	**$1,517,187**	

RAS AND WAS PUMPING

To Summary

Is This Facility Included in My Project? Yes

Assumptions:

Based on Ocala WRF No. 3 (5mgd MMADF)

RAS and WAS pumps are located outside

Number of RAS Pumps (Each)	***4***		***PRO2D Input from Summary Sheet***	
RAS Pump Capacity (Per Unit, GPH)	***42000***		***PRO2D Input from Summary Sheet***	
Number of WAS Pumps (Each)	***2***		***PRO2D Input from Summary Sheet***	
WAS Pump Capacity (Per Unit, GPH)	***9000***		***PRO2D Input from Summary Sheet***	

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
SITEWORK:				
Sitework Allowance	6	LS	$833.33	$5,000
Subtotal				$5,000
CONCRETE:				
8" Slab on Grade	45	CY	$250.00	$11,259
Allowance for Misc Items	5%		$11,259.26	$563
Subtotal				$11,822
EQUIPMENT:				
RAS Pumps (1170 gpm, 870 rpm, TDH =11.5ft, 7.5 hp)	4	EA	$12,796.83	$51,187
WAS Pumps (200 gpm, 1185 rpm TDH = 14 ft, 3hp)	2	EA	$5,114.72	$10,229
Allowance for Misc Items	5%		$61,416.75	$3,071
Subtotal				$64,488
MECHANICAL:				
RAS Piping:				
12" RAS	40	LF	$29.45	$1,178
12" Tee	4	EA	$1,130	$4,520
12" Elbow	4	EA	$700	$2,800
10" x 12" Reducing Elbow	4	EA	$700	$2,800
10" V405	12	EA	$1,750	$21,000
10" V604	4	EA	$2,259	$9,036
8" x 10" Reducing Elbow	4	EA	$532	$2,128
8" x 10" Reducer	4	EA	$532	$2,128
10" x 10 x 2" Tee	4	EA	$943	$3,772
10" Elbow	4	EA	$532	$2,128
10" Tee	12	EA	$943	$11,316
10" Flanged Coupling Adapter	4	EA	$250	$1,000
10" Flow Meter	4	EA	$5,368	$21,472
10" RAS	100	LF	$24.43	$2,443
2" V400	4	EA	$334	$1,336
WAS Piping:				
6" WAS	40	LF	$15.73	$629
6" Elbow	6	EA	$234	$1,404

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
6" V405	2	EA	$802	$1,604
4" x 6" Reducing Elbow	2	EA	$234	$468
4" WAS	100	LF	$14.08	$1,408
4" x 4" x 2" Tee	4	EA	$260	$1,040
2" V400	2	EA	$334	$668
4" V604	2	EA	$565	$1,130
4" Elbow	4	EA	$177	$708
4" Tee	8	EA	$260	$2,080
4" Flow Meter	2	EA	$3,431	$6,862
4" Flanged Coupling Adapter	2	EA	$109	$218
Allowance for Small Pipe & Pipe Supports	6	LS	$1,667	$10,000
Subtotal				$117,276
ELECTRICAL:				
RAS Pumps VFD's (7.5 hp)	4	EA	$4,600	$18,400
Allowance for Misc Items	5%		$18,400.00	$920
Subtotal				$19,320
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**
Delete Concrete and Site Work	1	LS	($16,822.22)	($16,822)
Item 2 Description	0		$0.00	$0
Item 3 Description	0		$0.00	$0
Item 4 Description	0		$0.00	$0
Item 5 Description	0		$0.00	$0
Item 6 Description	0		$0.00	$0
Item 7 Description	0		$0.00	$0
Item 8 Description	0		$0.00	$0
Item 9 Description	0		$0.00	$0
Item 10 Description	0		$0.00	$0
Item 11 Description	0		$0.00	$0
Item 12 Description	0		$0.00	$0
Item 13 Description	0		$0.00	$0
Item 14 Description	0		$0.00	$0
Item 15 Description	0		$0.00	$0
Subtotal				($16,822)
Subtotal				$201,084
ALLOWANCES:				
Finishes Allowance	0.0%		$233,818	$0
I & C Allowance	4%		$233,818	$9,353
Mechanical Allowance	0%		$233,818	$0
Electrical Allowance	10%		$233,818	$23,382
Facility Cost				**$233,818**
Facility Cost with Additional Project Costs Added				**$268,891**
Facility Cost with Additional Project Costs & Contractor Markups Added				**$391,317**
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added				**$413,764**
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added				**$509,757**

Sewage PS - (In-Plant)

To Summary Sheet

Is This Facility Included in My Project? Yes

Assumptions:

Firm Capacity (MGD)	***7.50***	***MGD***	
Cost models are based on this date:	**20 Cities Average**	**Jan-03**	
Cost models are escalated to this date:	**20 Cities Average**	**Jan-03**	**1.00**

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
Sewage PS				
Sewage PS	8	MGD	$87,208.77	$654,066
Subtotal				$654,066
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**
Refurbish Deduction	1	LS	($327,032.90)	($327,033)
Item 2 Description	0		$0.00	$0
Item 3 Description	0		$0.00	$0
Item 4 Description	0		$0.00	$0
Item 5 Description	0		$0.00	$0
Item 6 Description	0		$0.00	$0
Item 7 Description	0		$0.00	$0
Item 8 Description	0		$0.00	$0
Item 9 Description	0		$0.00	$0
Item 10 Description	0		$0.00	$0
Item 11 Description	0		$0.00	$0
Item 12 Description	0		$0.00	$0
Item 13 Description	0		$0.00	$0
Item 14 Description	0		$0.00	$0
Item 15 Description	0		$0.00	$0
Subtotal				($327,033)
Subtotal				$327,033
ALLOWANCES:				
Finishes Allowance	0.0%		$327,033	$0
I & C Allowance	0%		$327,033	$0
Mechanical Allowance	0%		$327,033	$0
Electrical Allowance	0%		$327,033	$0
Facility Cost	**8**	**MGD**	**$43,604.39**	**$327,033**
Facility Cost with Additional Project Costs Added	**8**	**MGD**	**$50,145.04**	**$376,088**
Facility Cost with Additional Project Costs & Contractor Markups Added	**8**	**MGD**	**$72,976.08**	**$547,321**
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added	**8**	**MGD**	**$77,162.06**	**$578,715**
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	**8**	**MGD**	**$95,063.66**	**$712,977**
Annual O & M				

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
	7.50	MGD		
Labor	1,225.29	HRS	$ 50.00	$61,264
Energy	441,929.76	KWH	$ 0.07	$30,935
Maintenance Materials & Supplies	8	MGD	$896.54	$6,724
Subtotal				$98,923
User Defined Annual O&M Items:				**Annual Cost**
Item 1				$ -
Item 2				$ -
Item 3				$ -
Item 4				$ -
Item 5				$ -
Item 6				$ -
Item 7				$ -
Item 8				$ -
Item 9				$ -
Item 10				$ -
Item 11				$ -
Item 12				$ -
Item 13				$ -
Item 14				$ -
Item 15				$ -
Subtotal Annual O&M Cost				**$ 98,923**
Contingency			**20%**	**$ 19,785**
Total Annual O&M Cost				**$ 118,708**
Net Present Value (NPV) Calculation:				
i =	4%			
n =	25			

Year	Default Cost	User Over-Ride	Cost Used in NPV Calculation	Adjusted Annual O & M Cost
0	$712,977		$712,977	
1	$118,708		$118,708	
2	$118,708		$118,708	
3	$118,708		$118,708	
4	$118,708		$118,708	
5	$118,708		$118,708	
6	$118,708		$118,708	
7	$118,708		$118,708	
8	$118,708		$118,708	
9	$118,708		$118,708	
10	$118,708		$118,708	
11	$118,708		$118,708	
12	$118,708		$118,708	
13	$118,708		$118,708	
14	$118,708		$118,708	
15	$118,708		$118,708	
16	$118,708		$118,708	

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
17	$118,708		$118,708	
18	$118,708		$118,708	
19	$118,708		$118,708	
20	$118,708		$118,708	
21	$118,708		$118,708	
22	$118,708		$118,708	
23	$118,708		$118,708	
24	$118,708		$118,708	
25	$118,708		$118,708	
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NPV			$2,567,444	$118,708

Secondary Clarifier

To Summary Sheet

Is This Facility Included in My Project? Yes

Assumptions:

Number of Clarifiers (EA)	***2***	***EA***	
Surface Area (SF per EA)	***4,000.00***	***SF***	
Cost models are based on this date:	**20 Cities Average**	**Jan-03**	
Cost models are escalated to this date:	**20 Cities Average**	**Jan-03**	**1.00**

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
Secondary Clarifier				
Secondary Clarifier	2	EA	$810,288.00	$1,620,576
Subtotal				$1,620,576
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**
Refurbishment Deduction	1	LS	($810,288.00)	($810,288)
Item 2 Description	0		$0.00	$0
Item 3 Description	0		$0.00	$0
Item 4 Description	0		$0.00	$0
Item 5 Description	0		$0.00	$0
Item 6 Description	0		$0.00	$0
Item 7 Description	0		$0.00	$0
Item 8 Description	0		$0.00	$0
Item 9 Description	0		$0.00	$0
Item 10 Description	0		$0.00	$0
Item 11 Description	0		$0.00	$0
Item 12 Description	0		$0.00	$0
Item 13 Description	0		$0.00	$0
Item 14 Description	0		$0.00	$0
Item 15 Description	0		$0.00	$0
Subtotal				($810,288)
Subtotal				$810,288
ALLOWANCES:				
Finishes Allowance	0.0%		$810,288	$0
I & C Allowance	0%		$810,288	$0
Mechanical Allowance	0%		$810,288	$0
Electrical Allowance	0%		$810,288	$0
Facility Cost	**8,000**	**SF**	**$101.29**	**$810,288**
Facility Cost with Additional Project Costs Added	**8,000**	**SF**	**$116.48**	**$931,831**
Facility Cost with Additional Project Costs & Contractor Markups Added	**8,000**	**SF**	**$169.51**	**$1,356,094**
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added	**8,000**	**SF**	**$179.24**	**$1,433,881**
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	**8,000**	**SF**	**$220.82**	**$1,766,541**

Annual O & M	**2**	EA			
	4,000.00	SF			
Labor	2,177.08	HRS	**$ 50.00**	$108,854	$130,625
Energy	26,265.20	KWH	**$ 0.07**	$1,839	$2,206
Maintenance Materials & Supplies	8,000	SF	$0.86	$6,911	$8,293
Subtotal				$117,603	

User Defined Annual O&M Items:	**Annual Cost**
Item 1	**$ -**
Item 2	**$ -**
Item 3	**$ -**
Item 4	**$ -**
Item 5	**$ -**
Item 6	**$ -**
Item 7	**$ -**
Item 8	**$ -**

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DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST			
Item 9				$ -			
Item 10				$ -			
Item 11				$ -			
Item 12				$ -			
Item 13				$ -			
Item 14				$ -			
Item 15				$ -			
Subtotal Annual O&M Cost				$ 117,603			
Contingency			20%	$ 23,521			
Total Annual O&M Cost				$ 141,124		1.2000	<<<< O&M Factor
Net Present Value (NPV) Calculation:							
i =	4%						
n =	25						
Year	**Default Cost**	**User Over-Ride**	**Cost Used in NPV Calculation**	**Adjusted Annual O & M Cost**			
0	**$1,766,541**		**$1,766,541**				
1	**$141,124**		**$141,124**				
2	**$141,124**		**$141,124**				
3	**$141,124**		**$141,124**				
4	**$141,124**		**$141,124**				
5	**$141,124**		**$141,124**				
6	**$141,124**		**$141,124**				
7	**$141,124**		**$141,124**				
8	**$141,124**		**$141,124**				
9	**$141,124**		**$141,124**				
10	**$141,124**		**$141,124**				
11	**$141,124**		**$141,124**				
12	**$141,124**		**$141,124**				
13	**$141,124**		**$141,124**				
14	**$141,124**		**$141,124**				
15	**$141,124**		**$141,124**				
16	**$141,124**		**$141,124**				
17	**$141,124**		**$141,124**				
18	**$141,124**		**$141,124**				
19	**$141,124**		**$141,124**				
20	**$141,124**		**$141,124**				
21	**$141,124**		**$141,124**				
22	**$141,124**		**$141,124**				
23	**$141,124**		**$141,124**				
24	**$141,124**		**$141,124**				
25	**$141,124**		**$141,124**				
26							
27							
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50							
NPV			**$3,971,192**	**$141,124**			

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Blowers

To Summary Sheet

Is This Facility Included in My Project? Yes

Assumptions:

Firm Air Flow Capacity (CFM)	*5,000.00*	*CFM*	
Average Air Flow (SCFM) for O&M	*-*	*SCFM*	
Cost models are based on this date:	**20 Cities Average**	**Jan-03**	
Cost models are escalated to this date:	**20 Cities Average**	**Jan-03**	**1.00**

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
Aeration Basin				
Aeration Basin	5,000	CFM	$106.07	$530,347
Subtotal				$530,347
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**
Item 1 Description	0		$0.00	$0
Item 2 Description	0		$0.00	$0
Item 3 Description	0		$0.00	$0
Item 4 Description	0		$0.00	$0
Item 5 Description	0		$0.00	$0
Item 6 Description	0		$0.00	$0
Item 7 Description	0		$0.00	$0
Item 8 Description	0		$0.00	$0
Item 9 Description	0		$0.00	$0
Item 10 Description	0		$0.00	$0
Item 11 Description	0		$0.00	$0
Item 12 Description	0		$0.00	$0
Item 13 Description	0		$0.00	$0
Item 14 Description	0		$0.00	$0
Item 15 Description	0		$0.00	$0
Subtotal				$0
Subtotal				$530,347
ALLOWANCES:				
Finishes Allowance	0.0%		$530,347	$0
I & C Allowance	0%		$530,347	$0
Mechanical Allowance	0%		$530,347	$0
Electrical Allowance	0%		$530,347	$0
Facility Cost	**5,000**	**CFM**	**$106.07**	**$530,347**
Facility Cost with Additional Project Costs Added	**5,000**	**CFM**	**$121.98**	**$609,899**
Facility Cost with Additional Project Costs & Contractor Markups Added	**5,000**	**CFM**	**$177.52**	**$887,586**
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added	**5,000**	**CFM**	**$187.70**	**$938,499**
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	**5,000**	**CFM**	**$231.25**	**$1,156,231**
Annual O & M				
	0	SCFM		
Labor	-	HRS	**$ 50.00**	$0
Energy	-	KWH	**$ 0.07**	$0
Maintenance Materials & Supplies	0	SCFM	$0.00	$0
Subtotal				$0
User Defined Annual O&M Items:				**Annual Cost**

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
Item 1				$ -
Item 2				$ -
Item 3				$ -
Item 4				$ -
Item 5				$ -
Item 6				$ -
Item 7				$ -
Item 8				$ -
Item 9				$ -
Item 10				$ -
Item 11				$ -
Item 12				$ -
Item 13				$ -
Item 14				$ -
Item 15				$ -
Subtotal Annual O&M Cost				$ -
Contingency			20%	$ -
Total Annual O&M Cost				$ -

Net Present Value (NPV) Calculation:

i =	4%
n =	25

Year	Default Cost	User Over-Ride	Cost Used in NPV Calculation	Adjusted Annual O & M Cost
0	$1,156,231		$1,156,231	
1	$0		$0	
2	$0		$0	
3	$0		$0	
4	$0		$0	
5	$0		$0	
6	$0		$0	
7	$0		$0	
8	$0		$0	
9	$0		$0	
10	$0		$0	
11	$0		$0	
12	$0		$0	
13	$0		$0	
14	$0		$0	
15	$0		$0	
16	$0		$0	
17	$0		$0	
18	$0		$0	
19	$0		$0	
20	$0		$0	
21	$0		$0	
22	$0		$0	
23	$0		$0	
24	$0		$0	
25	$0		$0	
26				
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DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
35				
36				
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42				
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49				
50				
NPV			$1,156,231	$0

GBT Installation

To Summary

Is This Facility Included in My Project? Yes

Parametric Inputs	Value

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST	REFERENCE / COMMENTS
SITEWORK:					
Excavation	0	CY	***$2.50***	$0	***02E***
Structural Backfill	0	CY	***$25.00***	$0	***02SB***
Backfill	0	CY	***$5.00***	$0	***02B***
Haul Excess	0	CY	***$5.00***	$0	***02HE***
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
CONCRETE:					
Slab on Grade	0	CY	***$250.00***	$0	***03S***
Slab on Grade	28	CY	***$250.00***	$6,944	***03S***
Walls	6	CY	***$400.00***	$2,519	***03W***
Walls	0	CY	***$400.00***	$0	***03W***
Walls	0	CY	***$400.00***	$0	***03W***
Walls	0	CY	***$400.00***	$0	***03W***
Beams	0	CY	***$1,000.00***	$0	***03B***
Beams	0	CY	***$1,000.00***	$0	***03B***
Elevated Slab	0	CY	***$450.00***	$0	***03ES***
Elevated Slab	0	CY	***$450.00***	$0	***03ES***
Allowance for Misc Items	5%		$9,463	$473	
Subtotal				$9,936	
MASONRY:					
Type of Building Construction:	**Moderate**				
Building	0	SF	***$100.00***	$0	***04BM***
Subtotal				$0	
METALS:					
Grating	160	SF	***$55.00***	$8,800	***05G***
Handrail	80	LF	***$55.00***	$4,400	***05H***
Stairs	10	Risers	***$300.00***	$3,000	***05S***
Allowance for Misc Items	5%		$16,200.00	$810	
Subtotal				$17,010	
WOOD & PLASTIC:					
Item 1	0	EA	$0.00	$0	
Item 2	0	EA	$0.00	$0	
Item 3	0	EA	$0.00	$0	
Item 4	0	EA	$0.00	$0	
Item 5	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
THERMAL & MOISTURE PROTECTION:					
Item 1	0	EA	$0.00	$0	
Item 2	0	EA	$0.00	$0	
Item 3	0	EA	$0.00	$0	
Item 4	0	EA	$0.00	$0	
Item 5	0	EA	$0.00	$0	
Roof Hatch (4' x 6', double leaf)	0	EA	***$1,800.00***	$0	***07RH1***
Roof Hatch (2' x 2', double leaf)	0	EA	***$300.00***	$0	***07RH2***
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
DOORS & WINDOWS:					
Item 1	0	EA	$0.00	$0	
Item 2	0	EA	$0.00	$0	
Item 3	0	EA	$0.00	$0	
Item 4	0	EA	$0.00	$0	

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Item 5	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
EQUIPMENT:					
Gravity Belt Thickener	2	EA	$110,000.00	$220,000	
Polymer System	1	EA	$50,000.00	$50,000	
Thickened Sludge Pumps	3	EA	$15,000.00	$45,000	
Equipment Item 4	0	EA	$0.00	$0	
Equipment Item 5	0	EA	$0.00	$0	
Equipment Item 6	0	EA	$0.00	$0	
Equipment Item 7	0	EA	$0.00	$0	
Equipment Item 8	0	EA	$0.00	$0	
Equipment Item 9	0	EA	$0.00	$0	
Equipment Item 10	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$315,000.00	$15,750	
Subtotal				$330,750	
I&C:					
Item 1	0	EA	$0.00	$0	
Item 2	0	EA	$0.00	$0	
Item 3	0	EA	$0.00	$0	
Item 4	0	EA	$0.00	$0	
Item 5	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
CONVEYING SYSTEMS:					
Monorail Hoist (3 Ton)	0	EA	***$2,475.00***	$0	***14MH***
Hoist Rail	0	LF	***$25.00***	$0	***14MR***
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
MECHANICAL:					
		EA		$0	
Equipment Item 2	0	EA	$0.00	$0	
Equipment Item 3	0	EA	$0.00	$0	
Equipment Item 4	0	EA	$0.00	$0	
Equipment Item 5	0	EA	$0.00	$0	
Equipment Item 6	0	EA	$0.00	$0	
Equipment Item 7	0	EA	$0.00	$0	
Equipment Item 8	0	EA	$0.00	$0	
Equipment Item 9	0	EA	$0.00	$0	
Equipment Item 10	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**	
Demolition Allowance	1	LS	$50,000.00	$50,000	
Item 2 Description	0		$0.00	$0	
Item 3 Description	0		$0.00	$0	
Item 4 Description	0		$0.00	$0	
Item 5 Description	0		$0.00	$0	
Item 6 Description	0		$0.00	$0	
Item 7 Description	0		$0.00	$0	
Item 8 Description	0		$0.00	$0	
Item 9 Description	0		$0.00	$0	
Item 10 Description	0		$0.00	$0	
Item 11 Description	0		$0.00	$0	
Item 12 Description	0		$0.00	$0	
Item 13 Description	0		$0.00	$0	
Item 14 Description	0		$0.00	$0	
Item 15 Description	0		$0.00	$0	
Subtotal				$50,000	
Subtotal				$407,696	
ALLOWANCES:		**User Over-write**			
Finishes Allowance	2.0%		$509,620	$10,192	
I & C Allowance	4%		$509,620	$20,385	
Mechanical Allowance	10%		$509,620	$50,962	
Electrical Allowance	4%		$509,620	$20,385	
Facility Cost				**$509,620**	
Facility Cost with Additional Project Costs Added	**-**	**0**	**#DIV/0!**	**$586,063**	
Facility Cost with Additional Project Costs & Contractor Markups Added	**-**	**0**	**#DIV/0!**	**$852,898**	
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added	**-**	**0**	**#DIV/0!**	**$901,821**	
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	**-**	**0**	**#DIV/0!**	**$1,111,043**	
Annual O & M					

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Labor	-	HRS	$ 50.00	$0
Energy	-	KWH	$ 0.07	$0
Fuel	-	GAL	$ 1.75	$0
Maintenance Materials & Supplies	1	LS	$0.00	$0
Subtotal				$0

User Defined Annual O&M Items:	Annual Cost
Item 1	$ -
Item 2	$ -
Item 3	$ -
Item 4	$ -
Item 5	$ -
Item 6	$ -
Item 7	$ -
Item 8	$ -
Item 9	$ -
Item 10	$ -
Item 11	$ -
Item 12	$ -
Item 13	$ -
Item 14	$ -
Item 15	$ -
Subtotal Annual O&M Cost	$ -
Contingency 20%	$ -
Total Annual O&M Cost	$ -

Net Present Value (NPV) Calculation:

i =	4%
n =	25

Year	Default Cost	User Over-Ride	Cost Used in NPV Calculation	Adjusted Annual O & M Cost
0	$1,111,043		$1,111,043	
1	$0		$0	
2	$0		$0	
3	$0		$0	
4	$0		$0	
5	$0		$0	
6	$0		$0	
7	$0		$0	
8	$0		$0	
9	$0		$0	
10	$0		$0	
11	$0		$0	
12	$0		$0	
13	$0		$0	
14	$0		$0	
15	$0		$0	
16	$0		$0	
17	$0		$0	
18	$0		$0	
19	$0		$0	
20	$0		$0	
21	$0		$0	
22	$0		$0	
23	$0		$0	
24	$0		$0	
25	$0		$0	
26				
27				
28				
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42					
43					
44					
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47					
48					
49					
50					
NPV			**$1,111,043**	**$0**	

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C H2M HILL P arametric Cost E stimating S ystem (CPES)

WWTP CONSTRUCTION & LIFE CYCLE COST MODULE

Use PRO2D file | Browse

Click for CPES QA/ QC | Import PRO2D information from this file

Designates User Input Required

Designates Data Automatically Transferred from PRO2D File

Project Name:	Lahaina WWTP
Project Number:	176853
Project Manager:	Ross Kaneko
Estimator:	Bruce R. Johnson
Project Description:	Alternative 4 - 9 MGD
Project Location (City):	Honolulu
Project Location (State):	HAWAII
Project Location (Country):	USA
Construction Start Date:	Jan-05
Construction Duration (months):	18
Mid-Point of Construction:	Oct-05

To WWTP Flowsheet
To Unit Process Descriptions
To Life Cycle Summary Shee
To Global Life Cycle Data

Roundup to the nearest: $10,000

Item	Is This Facility Included in Project? (Yes or No)	SCOPE OF PROJECT	User Input	Cost
1	No	Preliminary Treatment - Screening Facility		$0
	To Facility Sheet	Number of Channels (EA)	2	
		Screening Channel Width (FT)	3	
		IS A BUILDING INCLUDED?	Yes	
		(Assumption: If there is a building, there is Odor Control)		
		IF "NO" BUILDING, IS THERE ODOR CONTROL?	Yes	
2	No	Preliminary Treatment - Grit System		$0
	To Facility Sheet	Number of Grit Chambers (EA)	2	
		Grit Chamber Diameter (FT)	6	
3	No	Primary Treatment - Primary Clarifier		$0
	To Facility Sheet	Number of Clarifiers (EA)	0	
		Diameter (FT)	0.00	
		SWD (FT)	0.00	
		Depth of Burial (FT)	0.00	
4	No	Secondary Treatment - Aeration Basin		$0
	To Facility Sheet	Aeration Basin		
		Number of Aeration Basins	0	
		Length (Width * 4, FT)	0.00	
		Width (FT)	0.00	
		SWD (FT)	0.00	
		Depth of Burial (FT)	0.00	
		Bioreactor Influent Channel		
		Length (FT)	0.00	
		Mixed Liquor Channel		
		Length (FT)	0.00	
		Is Facility Covered?	Yes	
5	No	Air Supply - Blower Building		$0
	To Facility Sheet	Number of Blowers (EA)	4	
		SCFM per Blower (SCFM)	1700.00	
6	No	Secondary Clarification - Flow Splitting Structure		$0
	To Facility Sheet	Number of Outlet Basins (EA)	0	
		Depth of Burial (FT)	0.00	
		Inlet Basin		
		Width (FT)	0.00	
		SWD (FT)	0.00	
		Outlet Basin (Dimensions of One)		
		Length (FT)	0.00	
		Width (FT)	0.00	
7	Yes	Secondary Clarification - Secondary Clarifier		$700,000
	To Facility Sheet	Number of Clarifiers (EA)	1	
		Diameter (FT)	75.00	
		SWD (FT)	16	
		Depth of Burial (FT)	12.00	

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	A	B	C	D	E
63	8	Yes	Secondary Sludge Pumping - RAS/WAS Pumping		$670,000
64		To Facility Sheet	Number of RAS Pumps (Each)	4	
65			RAS Pump Capacity (Per Unit, GPH)	333333.3333	
66			Number of WAS Pumps (Each)	2	
67			WAS Pump Capacity (Per Unit, GPH)	9000	
68	9	No	Effluent Disinfection - Hypochlorination - Contact Basin		$0
69		To Facility Sheet	Number of Basins (EA)	0	
70			Overall Contact Basin Length (FT)	0.00	
71			Overall Contact Basin Width (FT)	0.00	
72			SWD (FT)	0.00	
73			Number of Serpentine Walls per Basin (EA)	0	
74			Influent Channel Length (FT)	0.00	
75			Effluent Channel Length (FT)	0.00	
76			Depth of Burial (FT)	0.00	
77	10	No	Effluent Disinfection - Hypochlorination - Chemical Building		$0
78		To Facility Sheet	Plant Capacity (MMADF)	0.00	
79					
80					
81					
82	1	No	Sewage Pump Station (Outside of Plant)		$0
83		To Facility Sheet	Firm Capacity (MGD)		
84					
85	2	No	Sewage Pump Station (In-Plant)		$0
86		To Facility Sheet	Firm Capacity (MGD)	7.00	
87					
88	3	No	Aerated Grit Removal & Flow Metering		$0
89		To Facility Sheet	Basin Volume (CF)		
90			Capacity (MGD) for O&M		
91	4	Yes	Primary Screening		$470,000
92		To Facility Sheet	Peak Capacity (MGD)	7.00	
93					
94	5	No	Primary Clarifier		$0
95		To Facility Sheet	Number of Clarifiers (EA)		
96			Surface Area (SF per Each)		
97	6	No	Secondary Clarifier		$0
98		To Facility Sheet	Number of Clarifiers (EA)	1	
99			Surface Area (SF per Each)	4,417.86	
100	7	No	Aeration Basin		$0
101		To Facility Sheet	Number of Basins (EA)		
102			Volume (CF per Each)		
103	8	Yes	Blowers		$760,000
104		To Facility Sheet	Firm Air Flow Capacity (CFM)	10,800.00	
105			Average Air Flow (SCFM) for O&M		
106	9	Yes	Air Diffusion		$900,000
107		To Facility Sheet	Number of Basins (EA)	2	
108			Firm Capacity (CFM per Each Basin)	5,400.00	
109	10	No	Trickling Filter		$0
110		To Facility Sheet	Number of Filters (EA)		
111			Volume of Media (CF per Each)		
112	11	No	Rotating Biological Contactor		$0
113		To Facility Sheet	Area of Media (Million SF)		
114					
115	12	No	Chlorine Contact Basin		$0
116		To Facility Sheet	Volume (CF)		
117					
118	13	No	Effluent Filters		$0
119		To Facility Sheet	Flow (MGD)		
120					
121	14	No	Chlorine Feed & Storage		$0
122		To Facility Sheet	Feed Capacity (LB/DAY)		
123			Feed Capacity (Ton/Year) for O&M		
124	15	No	SO2 Storage & Feed Equipment		$0
125		To Facility Sheet	Feed Rate Capacity (LB/DAY)		
126			Feed Capacity (Ton/Year) for O&M		
127	16	No	Polymer Feed System		$0
128		To Facility Sheet	Feed Rate Capacity (LB/DAY)		

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	A	B	C	D	E
129					
130	17	No	Sludge Pumping		$0
131		To Facility Sheet	Firm Capacity (GPM)		
132					
133	18	No	Flotation Sludge Thickener		$0
134		To Facility Sheet	Number of Thickeners (EA)		
135			Diameter (Feet per Each)		
136			Surface Area (SF per Each)	-	
137	19	No	Sludge Holding Tanks		$0
138		To Facility Sheet	Volume (CF)		
139					
140	20	No	Anaerobic Digesters		$0
141		To Facility Sheet	Number of Units (Each)		
142			Digester Volume per Unit (CF)		
143	21	No	Solid Bowl Centrifuge		$0
144		To Facility Sheet	Flow Capacity (GPM)		
145			Average Loading (Total LB/Day) for O&M		
146	22	No	Belt Filter Press		$0
147		To Facility Sheet	Number of Presses (EA)		
148			Width (Meters per Each)		
149			Average Loading per Press (LB/Day) for O&M		
150	23	No	Sludge Drying Beds		$0
151		To Facility Sheet	Area (SF)		
152					
153	24	No	Flow Splitting Structure 2		$0
154		To Facility Sheet			
155					
156	25	No	Yard Piping		$0
157		To Facility Sheet			
158					
159	26	Yes	MBR Membrane Package		$10,200,000
160		To Facility Sheet			
161					
162	27	Yes	GBT Installation		$510,000
163		To Facility Sheet			
164					
165	28	No	User Defined Facility 3		$0
166		To Facility Sheet			
167					
168	SUBTOTAL - PROJECT COST				$14,210,000
169					
170	ADDITIONAL PROJECT COSTS:				
171	Demolition		10%		$1,421,000
172	Overall Sitework		2%		$284,200
173	Plant Computer System		3%		$426,300
174	Yard Electrical		3%		$426,300
175	Yard Piping		1%		$142,100
176	0		0%		$0
177	0		0%		$0
178	0		0%		$0
179	SUBTOTAL with Additional Project Costs				$16,909,900
180					
181	CONTRACTOR MARKUPS:				
182	Overhead		10%	$16,909,900	$1,690,990
183	Subtotal				$18,600,890
184	Profit		5%	$18,600,890	$930,045
185	Subtotal				$19,530,935
186	Mob/Bonds/Insurance		5%	$19,530,935	$976,547
187	Subtotal				$20,507,481
188	Contingency		20%	$20,507,481	$4,101,496
189	SUBTOTAL with Markups				$24,608,977
190					
191	ESCALATION (to Mid-Point of Construction):		5.74%	$24,608,977	$1,411,596
192	SUBTOTAL with Escalation				$26,020,573

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	A	B	C	D	E
193					
194	***LOCATION ADJUSTMENT FACTOR***		**123.20%**	**$26,020,573**	**$32,057,346**
195	***TOTAL - CONSTRUCTION COST***				**$32,057,346**
196					
197	***RED FLAGS:***				
198	***1***	***Rock Excavation***			
199	***2***	***Pile Foundations***			
200	***3***	***Seismic Foundations***			
201	***4***	***Dewatering Conditions***			
202	***5***	***Wetlands Mitigation***			
203	***6***	***Weather Impacts***			
204	***7***	***Depth of Structures***			
205	***8***	***Local Building Code Restrictions***			
206	***9***	***Coatings or Finishes***			
207	***10***	***Building or Architectural Considerations***			
208	***11***	***Client Material Preferences***			
209	***12***	***Client Equipment Preferences***			
210	***13***	***Piping Galleries, Piping Trenches, Piping Racks***			
211	***14***	***Yard Piping Complexity***			
212	***15***	***Existing Site Utilities (New, Retrofit, and Complexity)***			
213	***16***	***I & C Automation (New or Retrofit)***			
214	***17***	***Electrical Feed (New or Retrofit)***			
215	***18***	***Electrical Distribution***			
216	***19***	***User Defined Red Flag 1***			
217	***20***	***User Defined Red Flag 2***			
218	***21***	***User Defined Red Flag 3***			
219	***22***	***User Defined Red Flag 4***			
220	***23***	***User Defined Red Flag 5***			
221	***24***	***User Defined Red Flag 6***			
222	***25***	***User Defined Red Flag 7***			
223	***TOTAL - RED FLAGS***				**$0**
224					
225	***SUBTOTAL - CONSTRUCTION COST with Red Flags***				**$32,057,346**
226					
227	***Did a CH2M HILL Professional Estimator Review This Cost Estimate?***			**No**	
228	***TOTAL - CONSTRUCTION COST Plus RED FLAGS***				**$44,880,284**
229					
230	***NON-CONSTRUCTION COSTS:***				
231	***Permitting***		**0%**	**$44,880,284**	**$0**
232	***Engineering***		**10%**	**$44,880,284**	**$4,488,028**
233	***SDC***		**5%**	**$44,880,284**	**$2,244,014**
234	***Commissioning & Startup***		**5%**	**$44,880,284**	**$2,244,014**
235	***Land ROW***		**0%**	**$44,880,284**	**$0**
236	***Legal/Admin***		**0%**	**$44,880,284**	**$0**
237	***0***		**0%**	**$44,880,284**	**$0**
238	***SUBTOTAL - Non-Construction Costs***				**$8,976,057**
239					
240	***TOTAL - CAPITAL COST***				**$53,856,341**

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SECONDARY CLARIFIER

To Summary

Is This Facility Included in My Project? Yes

Assumptions:

Based on Ocala WRF No. 3 (5mgd MMADF)

Number of Clarifiers (EA)	***1***		***PRO2D Input from Summary Sheet***
Diameter (FT)	***75***	***D***	***PRO2D Input from Summary Sheet***
SWD (FT)	***16***	***SWD***	***PRO2D Input from Summary Sheet***
Depth of Burial (FT)	***12***		***User Input from Summary Sheet***

Dimension Calculations:

Logic Test:			
Is "Number of Clarifiers = 0"? ("Yes" = 0, "No" = 1)	1.00		
Slab on Grade Diameter	78.00	D+3	Calculated
Slab on Grade Thickness (inches)	16.00		Fixed
Slab on Grade Thickness (ft)	1.33	TS	Calculated
Freeboard (ft)	3.00	FB	Fixed
Exterior Wall Height (ft)	19.00	H = SWD + FB	Calculated
Exterior Wall Thickness (inches)	16.00		Fixed
Exterior Wall Thickness (ft)	1.33	TW	Calculated
Interior Launder Elevated Slab Width (ft)	5.00	WIS	Constant
Interior Launder Average Diameter (for launder slab area)	70.00	D-WIS	Calculated
Interior Launder Wall Diameter (ft)	72.00	D-(WIS-1*2)	Calculated
Interior Launder Wall Height (ft)	3.00		Fixed
Interior Launder Wall Thickness (inches)	8.00		Fixed
Interior Launder Wall Thickness (ft)	0.67		Calculated
Interior Launder Elevated Slab Thickness (inches)	8.00		Fixed
Interior Launder Elevated Slab Thickness (ft)	0.67		Calculated
Exterior Walkway Slab Width	4.00	WES	Constant
Exterior Walkway Handrail Diameter	85.67	D+(TW*2)+(WES*2	Calculated
Exterior Walkway Slab Thickness	0.67		Constant
Excavation Diameter	82.00	D+7	Calculated
Excavation Depth	14.33		Calculated
Liquid Volume (CF)	***70,650***		Calculated
Liquid Volume (Gal)	***528,499***		Calculated

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
SITEWORK:				
Excavation	3,782	CY	$2.50	$9,454
Structural Backfill	195	CY	$25.00	$4,887
Backfill	1,176	CY	$5.00	$5,878
Haul Excess	3,362	CY	$1.85	$6,221
Allowance for Misc Items	5%		$26,439.69	$1,322
Subtotal				$27,762
CONCRETE:				
Exterior Walls:				
Slab on Grade	236	CY	$250.00	$58,962
Circular Walls	221	CY	$450.00	$99,433

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST	
Interior Launder:					
Circular Walls	17	CY	$500.00	$8,373	
Elevated Slab	27	CY	$450.00	$12,211	
Exterior Walkway:					
Elevated Slab	27	CY	$500.00	$13,284	
Center Sludge/RAS Pit	10	CY	$200.00	$2,000	
Concrete Encasement	20	CY	$180.00	$3,600	
Clarifier Bottom Grout 2"	4,416	SF	$11.00	$48,572	
4" Concrete Pads	0.20	CY	$200.00	$40	
Allowance for Misc Items	5%		$246,435.50	$12,322	
Subtotal				$258,797	
METALS:					
Weir	226	LF	$50.00	$11,304	
Scum Baffle & Supports	226	LF	$100.00	$22,608	
Scum Box	1	EA	$4,000.00	$4,000	
Aluminum Stairs	11	RISERS	$300.00	$3,150	
Aluminum Platform	14	SF	$20.00	$270	
Aluminum Handrail	269	LF	$50.00	$13,450	
Allowance for Misc Items	5%		$54,781.67	$2,739	
Subtotal				$57,521	
EQUIPMENT:					
Clarifier Mechanism	1	EA	$129,375	$129,375	
Submersible Scum Pump	1	EA	$13,500	$13,500	
Allowance for Misc Items	5%		$142,875.00	$7,144	
Subtotal				$150,019	
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**	
Item 1 Description	0		$0.00	$0	
Item 2 Description	0		$0.00	$0	
Item 3 Description	0		$0.00	$0	
Item 4 Description	0		$0.00	$0	
Item 5 Description	0		$0.00	$0	
Item 6 Description	0		$0.00	$0	
Item 7 Description	0		$0.00	$0	
Item 8 Description	0		$0.00	$0	
Item 9 Description	0		$0.00	$0	
Item 10 Description	0		$0.00	$0	
Item 11 Description	0		$0.00	$0	
Item 12 Description	0		$0.00	$0	
Item 13 Description	0		$0.00	$0	
Item 14 Description	0		$0.00	$0	
Item 15 Description	0		$0.00	$0	
Subtotal				$0	
Subtotal				$494,098	
ALLOWANCES:					
Finishes Allowance	2.0%		$695,913	$13,918	
I & C Allowance	4%		$695,913	$27,837	
Mechanical Allowance	20%		$695,913	$139,183	Based on $59,641 / $766,488
Electrical Allowance	3%		$695,913	$20,877	
Facility Cost	**528,499**	**Galllons**	**$1.32**	**$695,913**	
Facility Cost with Additional Project Costs Added	**528,499**	**Galllons**	**$1.57**	**$828,136**	
Facility Cost with Additional Project Costs & Contractor Markups Added	**528,499**	**Galllons**	**$2.28**	**$1,205,186**	
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added	**528,499**	**Galllons**	**$2.41**	**$1,274,317**	
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	**528,499**	**Galllons**	**$2.97**	**$1,569,959**	

RAS AND WAS PUMPING

To Summary

Is This Facility Included in My Project? Yes

Assumptions:

Based on Ocala WRF No. 3 (5mgd MMADF)

RAS and WAS pumps are located outside

Number of RAS Pumps (Each)	***4***		***PRO2D Input from Summary Sheet***	
RAS Pump Capacity (Per Unit, GPH)	***333333.3333***		***PRO2D Input from Summary Sheet***	
Number of WAS Pumps (Each)	***2***		***PRO2D Input from Summary Sheet***	
WAS Pump Capacity (Per Unit, GPH)	***9000***		***PRO2D Input from Summary Sheet***	

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
SITEWORK:				
Sitework Allowance	6	LS	$833.33	$5,000
Subtotal				$5,000
CONCRETE:				
8" Slab on Grade	45	CY	$250.00	$11,259
Allowance for Misc Items	5%		$11,259.26	$563
Subtotal				$11,822
EQUIPMENT:				
RAS Pumps (1170 gpm, 870 rpm, TDH =11.5ft, 7.5 hp)	4	EA	$101,562.11	$406,248
WAS Pumps (200 gpm, 1185 rpm TDH = 14 ft, 3hp)	2	EA	$5,114.72	$10,229
Allowance for Misc Items	5%		$416,477.88	$20,824
Subtotal				$437,302
MECHANICAL:				
RAS Piping:				
12" RAS	40	LF	$29.45	$1,178
12" Tee	4	EA	$1,130	$4,520
12" Elbow	4	EA	$700	$2,800
10" x 12" Reducing Elbow	4	EA	$700	$2,800
10" V405	12	EA	$1,750	$21,000
10" V604	4	EA	$2,259	$9,036
8" x 10" Reducing Elbow	4	EA	$532	$2,128
8" x 10" Reducer	4	EA	$532	$2,128
10" x 10 x 2" Tee	4	EA	$943	$3,772
10" Elbow	4	EA	$532	$2,128
10" Tee	12	EA	$943	$11,316
10" Flanged Coupling Adapter	4	EA	$250	$1,000
10" Flow Meter	4	EA	$5,368	$21,472
10" RAS	100	LF	$24.43	$2,443
2" V400	4	EA	$334	$1,336
WAS Piping:				
6" WAS	40	LF	$15.73	$629
6" Elbow	6	EA	$234	$1,404

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
6" V405	2	EA	$802	$1,604
4" x 6" Reducing Elbow	2	EA	$234	$468
4" WAS	100	LF	$14.08	$1,408
4" x 4" x 2" Tee	4	EA	$260	$1,040
2" V400	2	EA	$334	$668
4" V604	2	EA	$565	$1,130
4" Elbow	4	EA	$177	$708
4" Tee	8	EA	$260	$2,080
4" Flow Meter	2	EA	$3,431	$6,862
4" Flanged Coupling Adapter	2	EA	$109	$218
Allowance for Small Pipe & Pipe Supports	6	LS	$1,667	$10,000
Subtotal				$117,276
ELECTRICAL:				
RAS Pumps VFD's (7.5 hp)	4	EA	$4,600	$18,400
Allowance for Misc Items	5%		$18,400.00	$920
Subtotal				$19,320
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**
Delete Concrete and Site Work	1	LS	($16,822.22)	($16,822)
Item 2 Description	0		$0.00	$0
Item 3 Description	0		$0.00	$0
Item 4 Description	0		$0.00	$0
Item 5 Description	0		$0.00	$0
Item 6 Description	0		$0.00	$0
Item 7 Description	0		$0.00	$0
Item 8 Description	0		$0.00	$0
Item 9 Description	0		$0.00	$0
Item 10 Description	0		$0.00	$0
Item 11 Description	0		$0.00	$0
Item 12 Description	0		$0.00	$0
Item 13 Description	0		$0.00	$0
Item 14 Description	0		$0.00	$0
Item 15 Description	0		$0.00	$0
Subtotal				($16,822)
Subtotal				$573,898
ALLOWANCES:				
Finishes Allowance	0.0%		$667,323	$0
I & C Allowance	4%		$667,323	$26,693
Mechanical Allowance	0%		$667,323	$0
Electrical Allowance	10%		$667,323	$66,732
Facility Cost				**$667,323**
Facility Cost with Additional Project Costs Added				**$794,115**
Facility Cost with Additional Project Costs & Contractor Markups Added				**$1,155,675**
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added				**$1,221,966**
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added				**$1,505,462**

Primary Screening

To Summary Sheet

Is This Facility Included in My Project? Yes

Assumptions:

Peak Capacity (MGD)	***7.00***	***MGD***		
Cost models are based on this date:	**20 Cities Average**	**Jan-03**		
Cost models are escalated to this date:	**20 Cities Average**	**Jan-03**	**1.00**	

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
Primary Screening				
Primary Screening	7	MGD	$65,891.14	$461,238
Subtotal				$461,238
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**
Item 1 Description	0		$0.00	$0
Item 2 Description	0		$0.00	$0
Item 3 Description	0		$0.00	$0
Item 4 Description	0		$0.00	$0
Item 5 Description	0		$0.00	$0
Item 6 Description	0		$0.00	$0
Item 7 Description	0		$0.00	$0
Item 8 Description	0		$0.00	$0
Item 9 Description	0		$0.00	$0
Item 10 Description	0		$0.00	$0
Item 11 Description	0		$0.00	$0
Item 12 Description	0		$0.00	$0
Item 13 Description	0		$0.00	$0
Item 14 Description	0		$0.00	$0
Item 15 Description	0		$0.00	$0
Subtotal				$0
Subtotal				$461,238
ALLOWANCES:				
Finishes Allowance	0.0%		$461,238	$0
I & C Allowance	0%		$461,238	$0
Mechanical Allowance	0%		$461,238	$0
Electrical Allowance	0%		$461,238	$0
Facility Cost	**7**	**MDG**	**$65,891.14**	**$461,238**
Facility Cost with Additional Project Costs Added	**7**	**MDG**	**$78,410.46**	**$548,873**
Facility Cost with Additional Project Costs & Contractor Markups Added	**7**	**MDG**	**$114,110.74**	**$798,775**
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added	**7**	**MDG**	**$120,656.25**	**$844,594**
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	**7**	**MDG**	**$148,648.50**	**$1,040,539**

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Blowers

To Summary Sheet

Is This Facility Included in My Project? Yes

Assumptions:

Firm Air Flow Capacity (CFM)	***10,800.00***	***CFM***		
Average Air Flow (SCFM) for O&M	***-***	***SCFM***		
Cost models are based on this date:	**20 Cities Average**	**Jan-03**		
Cost models are escalated to this date:	**20 Cities Average**	**Jan-03**	**1.00**	

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
Aeration Basin				
Aeration Basin	10,800	CFM	$70.04	$756,414
Subtotal				$756,414
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**
Item 1 Description	0		$0.00	$0
Item 2 Description	0		$0.00	$0
Item 3 Description	0		$0.00	$0
Item 4 Description	0		$0.00	$0
Item 5 Description	0		$0.00	$0
Item 6 Description	0		$0.00	$0
Item 7 Description	0		$0.00	$0
Item 8 Description	0		$0.00	$0
Item 9 Description	0		$0.00	$0
Item 10 Description	0		$0.00	$0
Item 11 Description	0		$0.00	$0
Item 12 Description	0		$0.00	$0
Item 13 Description	0		$0.00	$0
Item 14 Description	0		$0.00	$0
Item 15 Description	0		$0.00	$0
Subtotal				$0
Subtotal				$756,414
ALLOWANCES:				
Finishes Allowance	0.0%		$756,414	$0
I & C Allowance	0%		$756,414	$0
Mechanical Allowance	0%		$756,414	$0
Electrical Allowance	0%		$756,414	$0
Facility Cost	**10,800**	**CFM**	**$70.04**	**$756,414**
Facility Cost with Additional Project Costs Added	**10,800**	**CFM**	**$83.35**	**$900,132**
Facility Cost with Additional Project Costs & Contractor Markups Added	**10,800**	**CFM**	**$121.29**	**$1,309,962**
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added	**10,800**	**CFM**	**$128.25**	**$1,385,103**
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	**10,800**	**CFM**	**$158.00**	**$1,706,447**
Annual O & M				
	0	SCFM		
Labor	-	HRS	**$ 50.00**	$0
Energy	-	KWH	**$ 0.07**	$0
Maintenance Materials & Supplies	0	SCFM	$0.00	$0
Subtotal				$0
User Defined Annual O&M Items:				**Annual Cost**

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
Item 1				$ -
Item 2				$ -
Item 3				$ -
Item 4				$ -
Item 5				$ -
Item 6				$ -
Item 7				$ -
Item 8				$ -
Item 9				$ -
Item 10				$ -
Item 11				$ -
Item 12				$ -
Item 13				$ -
Item 14				$ -
Item 15				$ -
Subtotal Annual O&M Cost				$ -
Contingency			20%	$ -
Total Annual O&M Cost				$ -

Net Present Value (NPV) Calculation:

i =	4%
n =	25

Year	Default Cost	User Over-Ride	Cost Used in NPV Calculation	Adjusted Annual O & M Cost
0	$1,706,447		$1,706,447	
1	$0		$0	
2	$0		$0	
3	$0		$0	
4	$0		$0	
5	$0		$0	
6	$0		$0	
7	$0		$0	
8	$0		$0	
9	$0		$0	
10	$0		$0	
11	$0		$0	
12	$0		$0	
13	$0		$0	
14	$0		$0	
15	$0		$0	
16	$0		$0	
17	$0		$0	
18	$0		$0	
19	$0		$0	
20	$0		$0	
21	$0		$0	
22	$0		$0	
23	$0		$0	
24	$0		$0	
25	$0		$0	
26				
27				
28				
29				
30				
31				
32				
33				
34				

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
35				
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
NPV			$1,706,447	$0

Air Diffusion

To Summary Sheet

Is This Facility Included in My Project? Yes

Assumptions:

Number of Basins (EA)	***2***	***EA***	
Firm Capacity (CFM per Each Basin)	***5,400.00***	***CFM per Basin***	
Cost models are based on this date:	**20 Cities Average**	**Jan-03**	
Cost models are escalated to this date:	**20 Cities Average**	**Jan-03**	**1.00**

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
Air Diffusion				
Air Diffusion	2	EA	$449,013.00	$898,026
Subtotal				$898,026
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**
Item 1 Description	0		$0.00	$0
Item 2 Description	0		$0.00	$0
Item 3 Description	0		$0.00	$0
Item 4 Description	0		$0.00	$0
Item 5 Description	0		$0.00	$0
Item 6 Description	0		$0.00	$0
Item 7 Description	0		$0.00	$0
Item 8 Description	0		$0.00	$0
Item 9 Description	0		$0.00	$0
Item 10 Description	0		$0.00	$0
Item 11 Description	0		$0.00	$0
Item 12 Description	0		$0.00	$0
Item 13 Description	0		$0.00	$0
Item 14 Description	0		$0.00	$0
Item 15 Description	0		$0.00	$0
Subtotal				$0
Subtotal				$898,026
ALLOWANCES:				
Finishes Allowance	0.0%		$898,026	$0
I & C Allowance	0%		$898,026	$0
Mechanical Allowance	0%		$898,026	$0
Electrical Allowance	0%		$898,026	$0
Facility Cost	**10,800**	**CFM**	**$83.15**	**$898,026**
Facility Cost with Additional Project Costs Added	**10,800**	**CFM**	**$98.95**	**$1,068,651**
Facility Cost with Additional Project Costs & Contractor Markups Added	**10,800**	**CFM**	**$144.00**	**$1,555,208**
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added	**10,800**	**CFM**	**$152.26**	**$1,644,416**
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	**10,800**	**CFM**	**$187.59**	**$2,025,920**

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DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
Annual O & M	*2*	*EA*		
	5,400.00	*CFM per Basin*		
Labor	-	HRS	$ 50.00	$0
Energy	-	KWH	$ 0.07	$0
Maintenance Materials & Supplies	10,800	CFM	$0.00	$0
Subtotal				$0
User Defined Annual O&M Items:				**Annual Cost**
Item 1				$ -
Item 2				$ -
Item 3				$ -
Item 4				$ -
Item 5				$ -
Item 6				$ -
Item 7				$ -
Item 8				$ -
Item 9				$ -
Item 10				$ -
Item 11				$ -
Item 12				$ -
Item 13				$ -
Item 14				$ -
Item 15				$ -
Subtotal Annual O&M Cost				$ -
Contingency			20%	$ -
Total Annual O&M Cost				$ -

Net Present Value (NPV) Calculation:

i =	4%
n =	25

Year	Default Cost	User Over-Ride	Cost Used in NPV Calculation	Adjusted Annual O & M Cost
0	$2,025,920		$2,025,920	
1	$0		$0	
2	$0		$0	
3	$0		$0	
4	$0		$0	
5	$0		$0	
6	$0		$0	
7	$0		$0	
8	$0		$0	
9	$0		$0	
10	$0		$0	
11	$0		$0	
12	$0		$0	
13	$0		$0	

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DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
14	$0		$0	
15	$0		$0	
16	$0		$0	
17	$0		$0	
18	$0		$0	
19	$0		$0	
20	$0		$0	
21	$0		$0	
22	$0		$0	
23	$0		$0	
24	$0		$0	
25	$0		$0	
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
NPV			$2,025,920	$0

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MBR Membrane Package

To Summary

Is This Facility Included in My Project? Yes

Parametric Inputs	Value

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST	REFERENCE / COMMENTS
SITEWORK:					
Excavation	0	CY	***$2.50***	$0	***02E***
Structural Backfill	0	CY	***$25.00***	$0	***02SB***
Backfill	0	CY	***$5.00***	$0	***02B***
Haul Excess	0	CY	***$5.00***	$0	***02HE***
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
CONCRETE:					
Slab on Grade	0	CY	***$250.00***	$0	***03S***
Slab on Grade	0	CY	***$250.00***	$0	***03S***
Walls	356	CY	***$400.00***	$142,222	***03W***
Walls	0	CY	***$400.00***	$0	***03W***
Walls	0	CY	***$400.00***	$0	***03W***
Walls	0	CY	***$400.00***	$0	***03W***
Beams	0	CY	***$1,000.00***	$0	***03B***
Beams	0	CY	***$1,000.00***	$0	***03B***
Elevated Slab	111	CY	***$450.00***	$50,000	***03ES***
Elevated Slab	0	CY	***$450.00***	$0	***03ES***
Allowance for Misc Items	5%		$192,222	$9,611	
Subtotal				$201,833	
MASONRY:					
Type of Building Construction:	**Moderate**				
Building	0	SF	***$100.00***	$0	***04BM***
Subtotal				$0	
METALS:					
Grating	0	SF	***$55.00***	$0	***05G***
Handrail	300	LF	***$55.00***	$16,500	***05H***
Stairs	0	Risers	***$300.00***	$0	***05S***
Allowance for Misc Items	5%		$16,500.00	$825	
Subtotal				$17,325	
WOOD & PLASTIC:					
Item 1	0	EA	$0.00	$0	
Item 2	0	EA	$0.00	$0	
Item 3	0	EA	$0.00	$0	
Item 4	0	EA	$0.00	$0	
Item 5	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
THERMAL & MOISTURE PROTECTION:					
Item 1	0	EA	$0.00	$0	
Item 2	0	EA	$0.00	$0	
Item 3	0	EA	$0.00	$0	
Item 4	0	EA	$0.00	$0	
Item 5	0	EA	$0.00	$0	
Roof Hatch (4' x 6', double leaf)	0	EA	***$1,800.00***	$0	***07RH1***
Roof Hatch (2' x 2', double leaf)	0	EA	***$300.00***	$0	***07RH2***
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
DOORS & WINDOWS:					
Item 1	0	EA	$0.00	$0	
Item 2	0	EA	$0.00	$0	
Item 3	0	EA	$0.00	$0	
Item 4	0	EA	$0.00	$0	

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Item 5	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
EQUIPMENT:					
MBR System based on 30 MGD MM Glendale System	7	EA	$939,219.48	$6,574,536	
Equipment Item 2	0	EA	$0.00	$0	
Equipment Item 3	0	EA	$0.00	$0	
Equipment Item 4	0	EA	$0.00	$0	
Equipment Item 5	0	EA	$0.00	$0	
Equipment Item 6	0	EA	$0.00	$0	
Equipment Item 7	0	EA	$0.00	$0	
Equipment Item 8	0	EA	$0.00	$0	
Equipment Item 9	0	EA	$0.00	$0	
Equipment Item 10	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$6,574,536.39	$328,727	
Subtotal				$6,903,263	
I&C:					
Item 1	0	EA	$0.00	$0	
Item 2	0	EA	$0.00	$0	
Item 3	0	EA	$0.00	$0	
Item 4	0	EA	$0.00	$0	
Item 5	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
CONVEYING SYSTEMS:					
Monorail Hoist (3 Ton)	0	EA	***$2,475.00***	$0	***14MH***
Hoist Rail	0	LF	***$25.00***	$0	***14MR***
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
MECHANICAL:					
Equipment Item 1	0	EA	$0.00	$0	
Equipment Item 2	0	EA	$0.00	$0	
Equipment Item 3	0	EA	$0.00	$0	
Equipment Item 4	0	EA	$0.00	$0	
Equipment Item 5	0	EA	$0.00	$0	
Equipment Item 6	0	EA	$0.00	$0	
Equipment Item 7	0	EA	$0.00	$0	
Equipment Item 8	0	EA	$0.00	$0	
Equipment Item 9	0	EA	$0.00	$0	
Equipment Item 10	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**	
				$0	
MBR Building	5,000	sf	$100.00	$500,000	
Item 3 Description	0		$0.00	$0	
Item 4 Description	0		$0.00	$0	
Item 5 Description	0		$0.00	$0	
Item 6 Description	0		$0.00	$0	
Item 7 Description	0		$0.00	$0	
Item 8 Description	0		$0.00	$0	
Item 9 Description	0		$0.00	$0	
Item 10 Description	0		$0.00	$0	
Item 11 Description	0		$0.00	$0	
Item 12 Description	0		$0.00	$0	
Item 13 Description	0		$0.00	$0	
Item 14 Description	0		$0.00	$0	
Item 15 Description	0		$0.00	$0	
Subtotal				$500,000	
Subtotal				$7,622,422	
ALLOWANCES:		**User Over-write**			
Finishes Allowance	2.0%		$9,528,027	$190,561	
I & C Allowance	4%	5%	$9,528,027	$476,401	
Mechanical Allowance	10%	15%	$9,528,027	$1,429,204	
Electrical Allowance	4%	5%	$9,528,027	$476,401	
Facility Cost				**$10,194,989**	
Facility Cost with Additional Project Costs Added	**-**	**0**	**#DIV/0!**	**$12,132,037**	
Facility Cost with Additional Project Costs & Contractor Markups Added	**-**	**0**	**#DIV/0!**	**$17,655,753**	
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added	**-**	**0**	**#DIV/0!**	**$18,668,505**	
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	**-**	**0**	**#DIV/0!**	**$22,999,598**	
Annual O & M					

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Labor	-	HRS	$ 50.00	$0
Energy	-	KWH	$ 0.07	$0
Fuel	-	GAL	$ 1.75	$0
Maintenance Materials & Supplies	1	LS	$0.00	$0
Subtotal				$0

User Defined Annual O&M Items:	Annual Cost
Item 1	$ -
Item 2	$ -
Item 3	$ -
Item 4	$ -
Item 5	$ -
Item 6	$ -
Item 7	$ -
Item 8	$ -
Item 9	$ -
Item 10	$ -
Item 11	$ -
Item 12	$ -
Item 13	$ -
Item 14	$ -
Item 15	$ -
Subtotal Annual O&M Cost	$ -
Contingency 20%	$ -
Total Annual O&M Cost	$ -

Net Present Value (NPV) Calculation:

i =	4%
n =	25

Year	Default Cost	User Over-Ride	Cost Used in NPV Calculation	Adjusted Annual O & M Cost
0	$22,999,598		$22,999,598	
1	$0		$0	
2	$0		$0	
3	$0		$0	
4	$0		$0	
5	$0		$0	
6	$0		$0	
7	$0		$0	
8	$0		$0	
9	$0		$0	
10	$0		$0	
11	$0		$0	
12	$0		$0	
13	$0		$0	
14	$0		$0	
15	$0		$0	
16	$0		$0	
17	$0		$0	
18	$0		$0	
19	$0		$0	
20	$0		$0	
21	$0		$0	
22	$0		$0	
23	$0		$0	
24	$0		$0	
25	$0		$0	
26				
27				
28				
29				
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41				

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42					
43					
44					
45					
46					
47					
48					
49					
50					
NPV			**$22,999,598**	**$0**	

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GBT Installation

To Summary

Is This Facility Included in My Project? Yes

Parametric Inputs	Value

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST	REFERENCE / COMMENTS
SITEWORK:					
Excavation	0	CY	***$2.50***	$0	***02E***
Structural Backfill	0	CY	***$25.00***	$0	***02SB***
Backfill	0	CY	***$5.00***	$0	***02B***
Haul Excess	0	CY	***$5.00***	$0	***02HE***
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
CONCRETE:					
Slab on Grade	0	CY	***$250.00***	$0	***03S***
Slab on Grade	28	CY	***$250.00***	$6,944	***03S***
Walls	6	CY	***$400.00***	$2,519	***03W***
Walls	0	CY	***$400.00***	$0	***03W***
Walls	0	CY	***$400.00***	$0	***03W***
Walls	0	CY	***$400.00***	$0	***03W***
Beams	0	CY	***$1,000.00***	$0	***03B***
Beams	0	CY	***$1,000.00***	$0	***03B***
Elevated Slab	0	CY	***$450.00***	$0	***03ES***
Elevated Slab	0	CY	***$450.00***	$0	***03ES***
Allowance for Misc Items	5%		$9,463	$473	
Subtotal				$9,936	
MASONRY:					
Type of Building Construction:	**Moderate**				
Building	0	SF	***$100.00***	$0	***04BM***
Subtotal				$0	
METALS:					
Grating	160	SF	***$55.00***	$8,800	***05G***
Handrail	80	LF	***$55.00***	$4,400	***05H***
Stairs	10	Risers	***$300.00***	$3,000	***05S***
Allowance for Misc Items	5%		$16,200.00	$810	
Subtotal				$17,010	
WOOD & PLASTIC:					
Item 1	0	EA	$0.00	$0	
Item 2	0	EA	$0.00	$0	
Item 3	0	EA	$0.00	$0	
Item 4	0	EA	$0.00	$0	
Item 5	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
THERMAL & MOISTURE PROTECTION:					
Item 1	0	EA	$0.00	$0	
Item 2	0	EA	$0.00	$0	
Item 3	0	EA	$0.00	$0	
Item 4	0	EA	$0.00	$0	
Item 5	0	EA	$0.00	$0	
Roof Hatch (4' x 6', double leaf)	0	EA	***$1,800.00***	$0	***07RH1***
Roof Hatch (2' x 2', double leaf)	0	EA	***$300.00***	$0	***07RH2***
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
DOORS & WINDOWS:					
Item 1	0	EA	$0.00	$0	
Item 2	0	EA	$0.00	$0	
Item 3	0	EA	$0.00	$0	

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Item 4	0	EA	$0.00	$0	
Item 5	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
EQUIPMENT:					
Gravity Belt Thickener	2	EA	$110,000.00	$220,000	
Polymer System	1	EA	$50,000.00	$50,000	
Thickened Sludge Pumps	3	EA	$15,000.00	$45,000	
Equipment Item 4	0	EA	$0.00	$0	
Equipment Item 5	0	EA	$0.00	$0	
Equipment Item 6	0	EA	$0.00	$0	
Equipment Item 7	0	EA	$0.00	$0	
Equipment Item 8	0	EA	$0.00	$0	
Equipment Item 9	0	EA	$0.00	$0	
Equipment Item 10	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$315,000.00	$15,750	
Subtotal				$330,750	
I&C:					
Item 1	0	EA	$0.00	$0	
Item 2	0	EA	$0.00	$0	
Item 3	0	EA	$0.00	$0	
Item 4	0	EA	$0.00	$0	
Item 5	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
CONVEYING SYSTEMS:					
Monorail Hoist (3 Ton)	0	EA	***$2,475.00***	$0	***14MH***
Hoist Rail	0	LF	***$25.00***	$0	***14MR***
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
MECHANICAL:					
Equipment Item 1	0	EA	$0.00	$0	
Equipment Item 2	0	EA	$0.00	$0	
Equipment Item 3	0	EA	$0.00	$0	
Equipment Item 4	0	EA	$0.00	$0	
Equipment Item 5	0	EA	$0.00	$0	
Equipment Item 6	0	EA	$0.00	$0	
Equipment Item 7	0	EA	$0.00	$0	
Equipment Item 8	0	EA	$0.00	$0	
Equipment Item 9	0	EA	$0.00	$0	
Equipment Item 10	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**	
Demolition Allowance	1	LS	$50,000.00	$50,000	
Item 2 Description	0		$0.00	$0	
Item 3 Description	0		$0.00	$0	
Item 4 Description	0		$0.00	$0	
Item 5 Description	0		$0.00	$0	
Item 6 Description	0		$0.00	$0	
Item 7 Description	0		$0.00	$0	
Item 8 Description	0		$0.00	$0	
Item 9 Description	0		$0.00	$0	
Item 10 Description	0		$0.00	$0	
Item 11 Description	0		$0.00	$0	
Item 12 Description	0		$0.00	$0	
Item 13 Description	0		$0.00	$0	
Item 14 Description	0		$0.00	$0	
Item 15 Description	0		$0.00	$0	
Subtotal				$50,000	
Subtotal				$407,696	
ALLOWANCES:		**User Over-write**			
Finishes Allowance	2.0%		$509,620	$10,192	
I & C Allowance	4%		$509,620	$20,385	
Mechanical Allowance	10%		$509,620	$50,962	
Electrical Allowance	4%		$509,620	$20,385	
Facility Cost				**$509,620**	
Facility Cost with Additional Project Costs Added	**-**	**0**	**#DIV/0!**	**$606,448**	
Facility Cost with Additional Project Costs & Contractor Markups Added	**-**	**0**	**#DIV/0!**	**$882,564**	
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added	**-**	**0**	**#DIV/0!**	**$933,188**	
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	**-**	**0**	**#DIV/0!**	**$1,149,688**	
Annual O & M					

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Labor	-	HRS	$ 50.00	$0
Energy	-	KWH	$ 0.07	$0
Fuel	-	GAL	$ 1.75	$0
Maintenance Materials & Supplies	1	LS	$0.00	$0
Subtotal				$0

User Defined Annual O&M Items:	Annual Cost
Item 1	$ -
Item 2	$ -
Item 3	$ -
Item 4	$ -
Item 5	$ -
Item 6	$ -
Item 7	$ -
Item 8	$ -
Item 9	$ -
Item 10	$ -
Item 11	$ -
Item 12	$ -
Item 13	$ -
Item 14	$ -
Item 15	$ -
Subtotal Annual O&M Cost	$ -
Contingency 20%	$ -
Total Annual O&M Cost	$ -

Net Present Value (NPV) Calculation:

i = 4%
n = 25

Year	Default Cost	User Over-Ride	Cost Used in NPV Calculation	Adjusted Annual O & M Cost
0	$1,149,688		$1,149,688	
1	$0		$0	
2	$0		$0	
3	$0		$0	
4	$0		$0	
5	$0		$0	
6	$0		$0	
7	$0		$0	
8	$0		$0	
9	$0		$0	
10	$0		$0	
11	$0		$0	
12	$0		$0	
13	$0		$0	
14	$0		$0	
15	$0		$0	
16	$0		$0	
17	$0		$0	
18	$0		$0	
19	$0		$0	
20	$0		$0	
21	$0		$0	
22	$0		$0	
23	$0		$0	
24	$0		$0	
25	$0		$0	
26				
27				
28				
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41					
42					
43					
44					
45					
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47					
48					
49					
50					
NPV			**$1,149,688**	**$0**	

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C H2M HILL P arametric Cost E stimating S ystem (CPES)

WWTP CONSTRUCTION & LIFE CYCLE COST MODULE

Use PRO2D file | Browse

Click for CPES QA/ QC | Import PRO2D information from this file

Designates User Input Required

Designates Data Automatically Transferred from PRO2D File

Project Name:	Lahaina WWTP
Project Number:	176853
Project Manager:	Ross Kaneko
Estimator:	Bruce R. Johnson
Project Description:	Alternative 4 - 9 MGD
Project Location (City):	Honolulu
Project Location (State):	HAWAII
Project Location (Country):	USA
Construction Start Date:	Jan-05
Construction Duration (months):	18
Mid-Point of Construction:	Oct-05

To WWTP Flowsheet
To Unit Process Description
To Life Cycle Summary Shee
To Global Life Cycle Data

Roundup to the nearest: $10,000

Item	Is This Facility Included in Project? (Yes or No)	SCOPE OF PROJECT	User Input	Cost
1	No	Preliminary Treatment - Screening Facility		$0
	To Facility Sheet	Number of Channels (EA)	4	
		Screening Channel Width (FT)	3	
		IS A BUILDING INCLUDED?	Yes	
		(Assumption: If there is a building, there is Odor Control)		
		IF "NO" BUILDING, IS THERE ODOR CONTROL?	Yes	
2	No	Preliminary Treatment - Grit System		$0
	To Facility Sheet	Number of Grit Chambers (EA)	3	
		Grit Chamber Diameter (FT)	6	
3	No	Primary Treatment - Primary Clarifier		$0
	To Facility Sheet	Number of Clarifiers (EA)	0	
		Diameter (FT)	0.00	
		SWD (FT)	0.00	
		Depth of Burial (FT)	0.00	
4	No	Secondary Treatment - Aeration Basin		$0
	To Facility Sheet	Aeration Basin		
		Number of Aeration Basins	0	
		Length (Width * 4, FT)	0.00	
		Width (FT)	0.00	
		SWD (FT)	0.00	
		Depth of Burial (FT)	0.00	
		Bioreactor Influent Channel		
		Length (FT)	0.00	
		Mixed Liquor Channel		
		Length (FT)	0.00	
		Is Facility Covered?	Yes	
5	No	Air Supply - Blower Building		$0
	To Facility Sheet	Number of Blowers (EA)	4	
		SCFM per Blower (SCFM)	1700.00	
6	No	Secondary Clarification - Flow Splitting Structure		$0
	To Facility Sheet	Number of Outlet Basins (EA)	0	
		Depth of Burial (FT)	0.00	
		Inlet Basin		
		Width (FT)	0.00	
		SWD (FT)	0.00	
		Outlet Basin (Dimensions of One)		
		Length (FT)	0.00	
		Width (FT)	0.00	
7	Yes	Secondary Clarification - Secondary Clarifier		$700,000
	To Facility Sheet	Number of Clarifiers (EA)	1	
		Diameter (FT)	75.00	
		SWD (FT)	16	
		Depth of Burial (FT)	12.00	

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	A	B	C	D	E
63	8	Yes	Secondary Sludge Pumping - RAS/WAS Pumping		$670,000
64		To Facility Sheet	Number of RAS Pumps (Each)	4	
65			RAS Pump Capacity (Per Unit, GPH)	333333.3333	
66			Number of WAS Pumps (Each)	2	
67			WAS Pump Capacity (Per Unit, GPH)	9000	
68	9	No	Effluent Disinfection - Hypochlorination - Contact Basin		$0
69		To Facility Sheet	Number of Basins (EA)	0	
70			Overall Contact Basin Length (FT)	0.00	
71			Overall Contact Basin Width (FT)	0.00	
72			SWD (FT)	0.00	
73			Number of Serpentine Walls per Basin (EA)	0	
74			Influent Channel Length (FT)	0.00	
75			Effluent Channel Length (FT)	0.00	
76			Depth of Burial (FT)	0.00	
77	10	No	Effluent Disinfection - Hypochlorination - Chemical Building		$0
78		To Facility Sheet	Plant Capacity (MMADF)	0.00	
79					
80					
81					
82	1	No	Sewage Pump Station (Outside of Plant)		$0
83		To Facility Sheet	Firm Capacity (MGD)		
84					
85	2	No	Sewage Pump Station (In-Plant)		$0
86		To Facility Sheet	Firm Capacity (MGD)	24.00	
87					
88	3	No	Aerated Grit Removal & Flow Metering		$0
89		To Facility Sheet	Basin Volume (CF)		
90			Capacity (MGD) for O&M		
91	4	Yes	Primary Screening		$610,000
92		To Facility Sheet	Peak Capacity (MGD)	11.00	
93					
94	5	No	Primary Clarifier		$0
95		To Facility Sheet	Number of Clarifiers (EA)		
96			Surface Area (SF per Each)		
97	6	No	Secondary Clarifier		$0
98		To Facility Sheet	Number of Clarifiers (EA)	1	
99			Surface Area (SF per Each)	4,417.86	
100	7	No	Aeration Basin		$0
101		To Facility Sheet	Number of Basins (EA)		
102			Volume (CF per Each)		
103	8	Yes	Blowers		$1,310,000
104		To Facility Sheet	Firm Air Flow Capacity (CFM)	25,000.00	
105			Average Air Flow (SCFM) for O&M		
106	9	Yes	Air Diffusion		$1,920,000
107		To Facility Sheet	Number of Basins (EA)	2	
108			Firm Capacity (CFM per Each Basin)	13,000.00	
109	10	No	Trickling Filter		$0
110		To Facility Sheet	Number of Filters (EA)		
111			Volume of Media (CF per Each)		
112	11	No	Rotating Biological Contactor		$0
113		To Facility Sheet	Area of Media (Million SF)		
114					
115	12	No	Chlorine Contact Basin		$0
116		To Facility Sheet	Volume (CF)		
117					
118	13	No	Effluent Filters		$0
119		To Facility Sheet	Flow (MGD)		
120					
121	14	No	Chlorine Feed & Storage		$0
122		To Facility Sheet	Feed Capacity (LB/DAY)		
123			Feed Capacity (Ton/Year) for O&M		
124	15	No	SO2 Storage & Feed Equipment		$0
125		To Facility Sheet	Feed Rate Capacity (LB/DAY)		
126			Feed Capacity (Ton/Year) for O&M		
127	16	No	Polymer Feed System		$0
128		To Facility Sheet	Feed Rate Capacity (LB/DAY)		

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	A	B	C	D	E
129					
130	17	No	Sludge Pumping		$0
131		To Facility Sheet	Firm Capacity (GPM)		
132					
133	18	No	Flotation Sludge Thickener		$0
134		To Facility Sheet	Number of Thickeners (EA)		
135			Diameter (Feet per Each)		
136			Surface Area (SF per Each)	-	
137	19	No	Sludge Holding Tanks		$0
138		To Facility Sheet	Volume (CF)		
139					
140	20	No	Anaerobic Digesters		$0
141		To Facility Sheet	Number of Units (Each)		
142			Digester Volume per Unit (CF)		
143	21	No	Solid Bowl Centrifuge		$0
144		To Facility Sheet	Flow Capacity (GPM)		
145			Average Loading (Total LB/Day) for O&M		
146	22	No	Belt Filter Press		$0
147		To Facility Sheet	Number of Presses (EA)		
148			Width (Meters per Each)		
149			Average Loading per Press (LB/Day) for O&M		
150	23	No	Sludge Drying Beds		$0
151		To Facility Sheet	Area (SF)		
152					
153	24	No	Flow Splitting Structure 2		$0
154		To Facility Sheet			
155					
156	25	No	Yard Piping		$0
157		To Facility Sheet			
158					
159	26	Yes	MBR Membrane Package		$14,330,000
160		To Facility Sheet			
161					
162	27	No	User Defined Facility 2		$0
163		To Facility Sheet			
164					
165	28	Yes	GBT Installation		$510,000
166		To Facility Sheet			
167					
168	SUBTOTAL - PROJECT COST				$20,050,000
169					
170	ADDITIONAL PROJECT COSTS:				
171	Demolition		10%		$2,005,000
172	Overall Sitework		2%		$401,000
173	Plant Computer System		3%		$601,500
174	Yard Electrical		3%		$601,500
175	Yard Piping		1%		$200,500
176	0		0%		$0
177	0		0%		$0
178	0		0%		$0
179	SUBTOTAL with Additional Project Costs				$23,859,500
180					
181	CONTRACTOR MARKUPS:				
182	Overhead		10%	$23,859,500	$2,385,950
183	Subtotal				$26,245,450
184	Profit		5%	$26,245,450	$1,312,273
185	Subtotal				$27,557,723
186	Mob/Bonds/Insurance		5%	$27,557,723	$1,377,886
187	Subtotal				$28,935,609
188	Contingency		20%	$28,935,609	$5,787,122
189	SUBTOTAL with Markups				$34,722,730
190					
191	ESCALATION (to Mid-Point of Construction):		5.74%	$34,722,730	$1,991,731
192	SUBTOTAL with Escalation				$36,714,461

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	A	B	C	D	E
193					
194	LOCATION ADJUSTMENT FACTOR		123.20%	$36,714,461	$45,232,216
195	TOTAL - CONSTRUCTION COST				$45,232,216
196					
197	RED FLAGS:				
198	1	Rock Excavation			
199	2	Pile Foundations			
200	3	Seismic Foundations			
201	4	Dewatering Conditions			
202	5	Wetlands Mitigation			
203	6	Weather Impacts			
204	7	Depth of Structures			
205	8	Local Building Code Restrictions			
206	9	Coatings or Finishes			
207	10	Building or Architectural Considerations			
208	11	Client Material Preferences			
209	12	Client Equipment Preferences			
210	13	Piping Galleries, Piping Trenches, Piping Racks			
211	14	Yard Piping Complexity			
212	15	Existing Site Utilities (New, Retrofit, and Complexity)			
213	16	I & C Automation (New or Retrofit)			
214	17	Electrical Feed (New or Retrofit)			
215	18	Electrical Distribution			
216	19	User Defined Red Flag 1			
217	20	User Defined Red Flag 2			
218	21	User Defined Red Flag 3			
219	22	User Defined Red Flag 4			
220	23	User Defined Red Flag 5			
221	24	User Defined Red Flag 6			
222	25	User Defined Red Flag 7			
223	TOTAL - RED FLAGS				$0
224					
225	SUBTOTAL - CONSTRUCTION COST with Red Flags				$45,232,216
226					
227	Did a CH2M HILL Professional Estimator Review This Cost Estimate?			No	
228	TOTAL - CONSTRUCTION COST Plus RED FLAGS				$63,325,102
229					
230	NON-CONSTRUCTION COSTS:				
231	Permitting		0%	$63,325,102	$0
232	Engineering		10%	$63,325,102	$6,332,510
233	SDC		5%	$63,325,102	$3,166,255
234	Commissioning & Startup		5%	$63,325,102	$3,166,255
235	Land ROW		0%	$63,325,102	$0
236	Legal/Admin		0%	$63,325,102	$0
237	0		0%	$63,325,102	$0
238	SUBTOTAL - Non-Construction Costs				$12,665,020
239					
240	TOTAL - CAPITAL COST				$75,990,123

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SECONDARY CLARIFIER

To Summary

Is This Facility Included in My Project? Yes

Assumptions:

Based on Ocala WRF No. 3 (5mgd MMADF)

Number of Clarifiers (EA)	***1***		***PRO2D Input from Summary Sheet***
Diameter (FT)	***75***	***D***	***PRO2D Input from Summary Sheet***
SWD (FT)	***16***	***SWD***	***PRO2D Input from Summary Sheet***
Depth of Burial (FT)	***12***		***User Input from Summary Sheet***

Dimension Calculations:

Logic Test:			
Is "Number of Clarifiers = 0"? ("Yes" = 0, "No" = 1)	1.00		
Slab on Grade Diameter	78.00	D+3	Calculated
Slab on Grade Thickness (inches)	16.00		Fixed
Slab on Grade Thickness (ft)	1.33	TS	Calculated
Freeboard (ft)	3.00	FB	Fixed
Exterior Wall Height (ft)	19.00	H = SWD + FB	Calculated
Exterior Wall Thickness (inches)	16.00		Fixed
Exterior Wall Thickness (ft)	1.33	TW	Calculated
Interior Launder Elevated Slab Width (ft)	5.00	WIS	Constant
Interior Launder Average Diameter (for launder slab area)	70.00	D-WIS	Calculated
Interior Launder Wall Diameter (ft)	72.00	D-(WIS-1*2)	Calculated
Interior Launder Wall Height (ft)	3.00		Fixed
Interior Launder Wall Thickness (inches)	8.00		Fixed
Interior Launder Wall Thickness (ft)	0.67		Calculated
Interior Launder Elevated Slab Thickness (inches)	8.00		Fixed
Interior Launder Elevated Slab Thickness (ft)	0.67		Calculated
Exterior Walkway Slab Width	4.00	WES	Constant
Exterior Walkway Handrail Diameter	85.67	D+(TW*2)+(WES*2	Calculated
Exterior Walkway Slab Thickness	0.67		Constant
Excavation Diameter	82.00	D+7	Calculated
Excavation Depth	14.33		Calculated
Liquid Volume (CF)	***70,650***		Calculated
Liquid Volume (Gal)	***528,499***		Calculated

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
SITEWORK:				
Excavation	3,782	CY	$2.50	$9,454
Structural Backfill	195	CY	$25.00	$4,887
Backfill	1,176	CY	$5.00	$5,878
Haul Excess	3,362	CY	$1.85	$6,221
Allowance for Misc Items	5%		$26,439.69	$1,322
Subtotal				$27,762
CONCRETE:				
Exterior Walls:				
Slab on Grade	236	CY	$250.00	$58,962
Circular Walls	221	CY	$450.00	$99,433

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST	
Interior Launder:					
Circular Walls	17	CY	$500.00	$8,373	
Elevated Slab	27	CY	$450.00	$12,211	
Exterior Walkway:					
Elevated Slab	27	CY	$500.00	$13,284	
Center Sludge/RAS Pit	10	CY	$200.00	$2,000	
Concrete Encasement	20	CY	$180.00	$3,600	
Clarifier Bottom Grout 2"	4,416	SF	$11.00	$48,572	
4" Concrete Pads	0.20	CY	$200.00	$40	
Allowance for Misc Items	5%		$246,435.50	$12,322	
Subtotal				$258,797	
METALS:					
Weir	226	LF	$50.00	$11,304	
Scum Baffle & Supports	226	LF	$100.00	$22,608	
Scum Box	1	EA	$4,000.00	$4,000	
Aluminum Stairs	11	RISERS	$300.00	$3,150	
Aluminum Platform	14	SF	$20.00	$270	
Aluminum Handrail	269	LF	$50.00	$13,450	
Allowance for Misc Items	5%		$54,781.67	$2,739	
Subtotal				$57,521	
EQUIPMENT:					
Clarifier Mechanism	1	EA	$129,375	$129,375	
Submersible Scum Pump	1	EA	$13,500	$13,500	
Allowance for Misc Items	5%		$142,875.00	$7,144	
Subtotal				$150,019	
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**	
Item 1 Description	0		$0.00	$0	
Item 2 Description	0		$0.00	$0	
Item 3 Description	0		$0.00	$0	
Item 4 Description	0		$0.00	$0	
Item 5 Description	0		$0.00	$0	
Item 6 Description	0		$0.00	$0	
Item 7 Description	0		$0.00	$0	
Item 8 Description	0		$0.00	$0	
Item 9 Description	0		$0.00	$0	
Item 10 Description	0		$0.00	$0	
Item 11 Description	0		$0.00	$0	
Item 12 Description	0		$0.00	$0	
Item 13 Description	0		$0.00	$0	
Item 14 Description	0		$0.00	$0	
Item 15 Description	0		$0.00	$0	
Subtotal				$0	
Subtotal				$494,098	
ALLOWANCES:					
Finishes Allowance	2.0%		$695,913	$13,918	
I & C Allowance	4%		$695,913	$27,837	
Mechanical Allowance	20%		$695,913	$139,183	Based on $59,641 / $766,488
Electrical Allowance	3%		$695,913	$20,877	
Facility Cost	**528,499**	**Galllons**	**$1.32**	**$695,913**	
Facility Cost with Additional Project Costs Added	**528,499**	**Galllons**	**$1.57**	**$828,136**	
Facility Cost with Additional Project Costs & Contractor Markups Added	**528,499**	**Galllons**	**$2.28**	**$1,205,186**	
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added	**528,499**	**Galllons**	**$2.41**	**$1,274,317**	
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	**528,499**	**Galllons**	**$2.97**	**$1,569,959**	

RAS AND WAS PUMPING

To Summary

Is This Facility Included in My Project? Yes

Assumptions:

Based on Ocala WRF No. 3 (5mgd MMADF)

RAS and WAS pumps are located outside

Number of RAS Pumps (Each)	***4***		***PRO2D Input from Summary Sheet***	
RAS Pump Capacity (Per Unit, GPH)	***333333.3333***		***PRO2D Input from Summary Sheet***	
Number of WAS Pumps (Each)	***2***		***PRO2D Input from Summary Sheet***	
WAS Pump Capacity (Per Unit, GPH)	***9000***		***PRO2D Input from Summary Sheet***	

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
SITEWORK:				
Sitework Allowance	6	LS	$833.33	$5,000
Subtotal				$5,000
CONCRETE:				
8" Slab on Grade	45	CY	$250.00	$11,259
Allowance for Misc Items	5%		$11,259.26	$563
Subtotal				$11,822
EQUIPMENT:				
RAS Pumps (1170 gpm, 870 rpm, TDH =11.5ft, 7.5 hp)	4	EA	$101,562.11	$406,248
WAS Pumps (200 gpm, 1185 rpm TDH = 14 ft, 3hp)	2	EA	$5,114.72	$10,229
Allowance for Misc Items	5%		$416,477.88	$20,824
Subtotal				$437,302
MECHANICAL:				
RAS Piping:				
12" RAS	40	LF	$29.45	$1,178
12" Tee	4	EA	$1,130	$4,520
12" Elbow	4	EA	$700	$2,800
10" x 12" Reducing Elbow	4	EA	$700	$2,800
10" V405	12	EA	$1,750	$21,000
10" V604	4	EA	$2,259	$9,036
8" x 10" Reducing Elbow	4	EA	$532	$2,128
8" x 10" Reducer	4	EA	$532	$2,128
10" x 10 x 2" Tee	4	EA	$943	$3,772
10" Elbow	4	EA	$532	$2,128
10" Tee	12	EA	$943	$11,316
10" Flanged Coupling Adapter	4	EA	$250	$1,000
10" Flow Meter	4	EA	$5,368	$21,472
10" RAS	100	LF	$24.43	$2,443
2" V400	4	EA	$334	$1,336
WAS Piping:				
6" WAS	40	LF	$15.73	$629
6" Elbow	6	EA	$234	$1,404

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
6" V405	2	EA	$802	$1,604
4" x 6" Reducing Elbow	2	EA	$234	$468
4" WAS	100	LF	$14.08	$1,408
4" x 4" x 2" Tee	4	EA	$260	$1,040
2" V400	2	EA	$334	$668
4" V604	2	EA	$565	$1,130
4" Elbow	4	EA	$177	$708
4" Tee	8	EA	$260	$2,080
4" Flow Meter	2	EA	$3,431	$6,862
4" Flanged Coupling Adapter	2	EA	$109	$218
Allowance for Small Pipe & Pipe Supports	6	LS	$1,667	$10,000
Subtotal				$117,276
ELECTRICAL:				
RAS Pumps VFD's (7.5 hp)	4	EA	$4,600	$18,400
Allowance for Misc Items	5%		$18,400.00	$920
Subtotal				$19,320
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**
Delete Concrete and Site Work	1	LS	($16,822.22)	($16,822)
Item 2 Description	0		$0.00	$0
Item 3 Description	0		$0.00	$0
Item 4 Description	0		$0.00	$0
Item 5 Description	0		$0.00	$0
Item 6 Description	0		$0.00	$0
Item 7 Description	0		$0.00	$0
Item 8 Description	0		$0.00	$0
Item 9 Description	0		$0.00	$0
Item 10 Description	0		$0.00	$0
Item 11 Description	0		$0.00	$0
Item 12 Description	0		$0.00	$0
Item 13 Description	0		$0.00	$0
Item 14 Description	0		$0.00	$0
Item 15 Description	0		$0.00	$0
Subtotal				($16,822)
Subtotal				$573,898
ALLOWANCES:				
Finishes Allowance	0.0%		$667,323	$0
I & C Allowance	4%		$667,323	$26,693
Mechanical Allowance	0%		$667,323	$0
Electrical Allowance	10%		$667,323	$66,732
Facility Cost				**$667,323**
Facility Cost with Additional Project Costs Added				**$794,115**
Facility Cost with Additional Project Costs & Contractor Markups Added				**$1,155,675**
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added				**$1,221,966**
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added				**$1,505,462**

Primary Screening

To Summary Sheet

Is This Facility Included in My Project? Yes

Assumptions:

Peak Capacity (MGD)	***11.00***	***MGD***		
Cost models are based on this date:	**20 Cities Average**	**Jan-03**		
Cost models are escalated to this date:	**20 Cities Average**	**Jan-03**	**1.00**	

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
Primary Screening				
Primary Screening	11	MGD	$54,854.36	$603,398
Subtotal				$603,398
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**
Item 1 Description	0		$0.00	$0
Item 2 Description	0		$0.00	$0
Item 3 Description	0		$0.00	$0
Item 4 Description	0		$0.00	$0
Item 5 Description	0		$0.00	$0
Item 6 Description	0		$0.00	$0
Item 7 Description	0		$0.00	$0
Item 8 Description	0		$0.00	$0
Item 9 Description	0		$0.00	$0
Item 10 Description	0		$0.00	$0
Item 11 Description	0		$0.00	$0
Item 12 Description	0		$0.00	$0
Item 13 Description	0		$0.00	$0
Item 14 Description	0		$0.00	$0
Item 15 Description	0		$0.00	$0
Subtotal				$0
Subtotal				$603,398
ALLOWANCES:				
Finishes Allowance	0.0%		$603,398	$0
I & C Allowance	0%		$603,398	$0
Mechanical Allowance	0%		$603,398	$0
Electrical Allowance	0%		$603,398	$0
Facility Cost	**11**	**MDG**	**$54,854.36**	**$603,398**
Facility Cost with Additional Project Costs Added	**11**	**MDG**	**$65,276.69**	**$718,044**
Facility Cost with Additional Project Costs & Contractor Markups Added	**11**	**MDG**	**$94,997.17**	**$1,044,969**
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added	**11**	**MDG**	**$100,446.30**	**$1,104,909**
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	**11**	**MDG**	**$123,749.85**	**$1,361,248**

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Blowers

To Summary Sheet

Is This Facility Included in My Project? Yes

Assumptions:

Firm Air Flow Capacity (CFM)	***25,000.00***	***CFM***		
Average Air Flow (SCFM) for O&M	***-***	***SCFM***		
Cost models are based on this date:	**20 Cities Average**	**Jan-03**		
Cost models are escalated to this date:	**20 Cities Average**	**Jan-03**	**1.00**	

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
Aeration Basin				
Aeration Basin	25,000	CFM	$52.40	$1,309,887
Subtotal				$1,309,887
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**
Item 1 Description	0		$0.00	$0
Item 2 Description	0		$0.00	$0
Item 3 Description	0		$0.00	$0
Item 4 Description	0		$0.00	$0
Item 5 Description	0		$0.00	$0
Item 6 Description	0		$0.00	$0
Item 7 Description	0		$0.00	$0
Item 8 Description	0		$0.00	$0
Item 9 Description	0		$0.00	$0
Item 10 Description	0		$0.00	$0
Item 11 Description	0		$0.00	$0
Item 12 Description	0		$0.00	$0
Item 13 Description	0		$0.00	$0
Item 14 Description	0		$0.00	$0
Item 15 Description	0		$0.00	$0
Subtotal				$0
Subtotal				$1,309,887
ALLOWANCES:				
Finishes Allowance	0.0%		$1,309,887	$0
I & C Allowance	0%		$1,309,887	$0
Mechanical Allowance	0%		$1,309,887	$0
Electrical Allowance	0%		$1,309,887	$0
Facility Cost	**25,000**	**CFM**	**$52.40**	**$1,309,887**
Facility Cost with Additional Project Costs Added	**25,000**	**CFM**	**$62.35**	**$1,558,766**
Facility Cost with Additional Project Costs & Contractor Markups Added	**25,000**	**CFM**	**$90.74**	**$2,268,471**
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added	**25,000**	**CFM**	**$95.94**	**$2,398,593**
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	**25,000**	**CFM**	**$118.20**	**$2,955,067**
Annual O & M				
	0	SCFM		
Labor	-	HRS	**$ 50.00**	$0
Energy	-	KWH	**$ 0.07**	$0
Maintenance Materials & Supplies	0	SCFM	$0.00	$0
Subtotal				$0
User Defined Annual O&M Items:				**Annual Cost**

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
Item 1				$ -
Item 2				$ -
Item 3				$ -
Item 4				$ -
Item 5				$ -
Item 6				$ -
Item 7				$ -
Item 8				$ -
Item 9				$ -
Item 10				$ -
Item 11				$ -
Item 12				$ -
Item 13				$ -
Item 14				$ -
Item 15				$ -
Subtotal Annual O&M Cost				$ -
Contingency			20%	$ -
Total Annual O&M Cost				$ -

Net Present Value (NPV) Calculation:

i =	4%
n =	25

Year	Default Cost	User Over-Ride	Cost Used in NPV Calculation	Adjusted Annual O & M Cost
0	$2,955,067		$2,955,067	
1	$0		$0	
2	$0		$0	
3	$0		$0	
4	$0		$0	
5	$0		$0	
6	$0		$0	
7	$0		$0	
8	$0		$0	
9	$0		$0	
10	$0		$0	
11	$0		$0	
12	$0		$0	
13	$0		$0	
14	$0		$0	
15	$0		$0	
16	$0		$0	
17	$0		$0	
18	$0		$0	
19	$0		$0	
20	$0		$0	
21	$0		$0	
22	$0		$0	
23	$0		$0	
24	$0		$0	
25	$0		$0	
26				
27				
28				
29				
30				
31				
32				
33				
34				

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
35				
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
NPV			$2,955,067	$0

Air Diffusion

To Summary Sheet

Is This Facility Included in My Project? Yes

Assumptions:

Number of Basins (EA)	***2***	***EA***	
Firm Capacity (CFM per Each Basin)	***13,000.00***	***CFM per Basin***	
Cost models are based on this date:	**20 Cities Average**	**Jan-03**	
Cost models are escalated to this date:	**20 Cities Average**	**Jan-03**	**1.00**

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
Air Diffusion				
Air Diffusion	2	EA	$959,391.00	$1,918,782
Subtotal				$1,918,782
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**
Item 1 Description	0		$0.00	$0
Item 2 Description	0		$0.00	$0
Item 3 Description	0		$0.00	$0
Item 4 Description	0		$0.00	$0
Item 5 Description	0		$0.00	$0
Item 6 Description	0		$0.00	$0
Item 7 Description	0		$0.00	$0
Item 8 Description	0		$0.00	$0
Item 9 Description	0		$0.00	$0
Item 10 Description	0		$0.00	$0
Item 11 Description	0		$0.00	$0
Item 12 Description	0		$0.00	$0
Item 13 Description	0		$0.00	$0
Item 14 Description	0		$0.00	$0
Item 15 Description	0		$0.00	$0
Subtotal				$0
Subtotal				$1,918,782
ALLOWANCES:				
Finishes Allowance	0.0%		$1,918,782	$0
I & C Allowance	0%		$1,918,782	$0
Mechanical Allowance	0%		$1,918,782	$0
Electrical Allowance	0%		$1,918,782	$0
Facility Cost	**26,000**	**CFM**	**$73.80**	**$1,918,782**
Facility Cost with Additional Project Costs Added	**26,000**	**CFM**	**$87.82**	**$2,283,351**
Facility Cost with Additional Project Costs & Contractor Markups Added	**26,000**	**CFM**	**$127.81**	**$3,322,960**
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added	**26,000**	**CFM**	**$135.14**	**$3,513,568**
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	**26,000**	**CFM**	**$166.49**	**$4,328,716**

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DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
Annual O & M	*2*	*EA*		
	13,000.00	*CFM per Basin*		
Labor	-	HRS	$ 50.00	$0
Energy	-	KWH	$ 0.07	$0
Maintenance Materials & Supplies	26,000	CFM	$0.00	$0
Subtotal				$0
User Defined Annual O&M Items:				**Annual Cost**
Item 1				$ -
Item 2				$ -
Item 3				$ -
Item 4				$ -
Item 5				$ -
Item 6				$ -
Item 7				$ -
Item 8				$ -
Item 9				$ -
Item 10				$ -
Item 11				$ -
Item 12				$ -
Item 13				$ -
Item 14				$ -
Item 15				$ -
Subtotal Annual O&M Cost				$ -
Contingency			20%	$ -
Total Annual O&M Cost				$ -

Net Present Value (NPV) Calculation:

i =	4%
n =	25

Year	Default Cost	User Over-Ride	Cost Used in NPV Calculation	Adjusted Annual O & M Cost
0	$4,328,716		$4,328,716	
1	$0		$0	
2	$0		$0	
3	$0		$0	
4	$0		$0	
5	$0		$0	
6	$0		$0	
7	$0		$0	
8	$0		$0	
9	$0		$0	
10	$0		$0	
11	$0		$0	
12	$0		$0	
13	$0		$0	

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DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
14	$0		$0	
15	$0		$0	
16	$0		$0	
17	$0		$0	
18	$0		$0	
19	$0		$0	
20	$0		$0	
21	$0		$0	
22	$0		$0	
23	$0		$0	
24	$0		$0	
25	$0		$0	
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
NPV			$4,328,716	$0

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MBR Membrane Package

To Summary

Is This Facility Included in My Project? Yes

Parametric Inputs	Value

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST	REFERENCE / COMMENTS
SITEWORK:					
Excavation	0	CY	***$2.50***	$0	***02E***
Structural Backfill	0	CY	***$25.00***	$0	***02SB***
Backfill	0	CY	***$5.00***	$0	***02B***
Haul Excess	0	CY	***$5.00***	$0	***02HE***
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
CONCRETE:					
Slab on Grade	0	CY	***$250.00***	$0	***03S***
Slab on Grade	0	CY	***$250.00***	$0	***03S***
Walls	356	CY	***$400.00***	$142,222	***03W***
Walls	0	CY	***$400.00***	$0	***03W***
Walls	0	CY	***$400.00***	$0	***03W***
Walls	0	CY	***$400.00***	$0	***03W***
Beams	0	CY	***$1,000.00***	$0	***03B***
Beams	0	CY	***$1,000.00***	$0	***03B***
Elevated Slab	111	CY	***$450.00***	$50,000	***03ES***
Elevated Slab	0	CY	***$450.00***	$0	***03ES***
Allowance for Misc Items	5%		$192,222	$9,611	
Subtotal				$201,833	
MASONRY:					
Type of Building Construction:	**Moderate**				
Building	0	SF	***$100.00***	$0	***04BM***
Subtotal				$0	
METALS:					
Grating	0	SF	***$55.00***	$0	***05G***
Handrail	300	LF	***$55.00***	$16,500	***05H***
Stairs	0	Risers	***$300.00***	$0	***05S***
Allowance for Misc Items	5%		$16,500.00	$825	
Subtotal				$17,325	
WOOD & PLASTIC:					
Item 1	0	EA	$0.00	$0	
Item 2	0	EA	$0.00	$0	
Item 3	0	EA	$0.00	$0	
Item 4	0	EA	$0.00	$0	
Item 5	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
THERMAL & MOISTURE PROTECTION:					
Item 1	0	EA	$0.00	$0	
Item 2	0	EA	$0.00	$0	
Item 3	0	EA	$0.00	$0	
Item 4	0	EA	$0.00	$0	
Item 5	0	EA	$0.00	$0	
Roof Hatch (4' x 6', double leaf)	0	EA	***$1,800.00***	$0	***07RH1***
Roof Hatch (2' x 2', double leaf)	0	EA	***$300.00***	$0	***07RH2***
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
DOORS & WINDOWS:					
Item 1	0	EA	$0.00	$0	
Item 2	0	EA	$0.00	$0	
Item 3	0	EA	$0.00	$0	
Item 4	0	EA	$0.00	$0	

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Item 5	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
EQUIPMENT:					
MBR System based on 30 MGD MM Glendale System	12	EA	$784,905.53	$9,418,866	
Equipment Item 2	0	EA	$0.00	$0	
Equipment Item 3	0	EA	$0.00	$0	
Equipment Item 4	0	EA	$0.00	$0	
Equipment Item 5	0	EA	$0.00	$0	
Equipment Item 6	0	EA	$0.00	$0	
Equipment Item 7	0	EA	$0.00	$0	
Equipment Item 8	0	EA	$0.00	$0	
Equipment Item 9	0	EA	$0.00	$0	
Equipment Item 10	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$9,418,866.30	$470,943	
Subtotal				$9,889,810	
I&C:					
Item 1	0	EA	$0.00	$0	
Item 2	0	EA	$0.00	$0	
Item 3	0	EA	$0.00	$0	
Item 4	0	EA	$0.00	$0	
Item 5	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
CONVEYING SYSTEMS:					
Monorail Hoist (3 Ton)	0	EA	***$2,475.00***	$0	***14MH***
Hoist Rail	0	LF	***$25.00***	$0	***14MR***
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
MECHANICAL:					
Equipment Item 1	0	EA	$0.00	$0	
Equipment Item 2	0	EA	$0.00	$0	
Equipment Item 3	0	EA	$0.00	$0	
Equipment Item 4	0	EA	$0.00	$0	
Equipment Item 5	0	EA	$0.00	$0	
Equipment Item 6	0	EA	$0.00	$0	
Equipment Item 7	0	EA	$0.00	$0	
Equipment Item 8	0	EA	$0.00	$0	
Equipment Item 9	0	EA	$0.00	$0	
Equipment Item 10	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**	
				$0	
MBR Building	6,000	sf	$100.00	$600,000	
Item 3 Description	0		$0.00	$0	
Item 4 Description	0		$0.00	$0	
Item 5 Description	0		$0.00	$0	
Item 6 Description	0		$0.00	$0	
Item 7 Description	0		$0.00	$0	
Item 8 Description	0		$0.00	$0	
Item 9 Description	0		$0.00	$0	
Item 10 Description	0		$0.00	$0	
Item 11 Description	0		$0.00	$0	
Item 12 Description	0		$0.00	$0	
Item 13 Description	0		$0.00	$0	
Item 14 Description	0		$0.00	$0	
Item 15 Description	0		$0.00	$0	
Subtotal				$600,000	
Subtotal				$10,708,968	
ALLOWANCES:		**User Over-write**			
Finishes Allowance	2.0%		$13,386,210	$267,724	
I & C Allowance	4%	5%	$13,386,210	$669,310	
Mechanical Allowance	10%	15%	$13,386,210	$2,007,931	
Electrical Allowance	4%	5%	$13,386,210	$669,310	
Facility Cost				**$14,323,245**	
Facility Cost with Additional Project Costs Added	**-**	**0**	**#DIV/0!**	**$17,044,661**	
Facility Cost with Additional Project Costs & Contractor Markups Added	**-**	**0**	**#DIV/0!**	**$24,805,095**	
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added	**-**	**0**	**#DIV/0!**	**$26,227,940**	
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	**-**	**0**	**#DIV/0!**	**$32,312,823**	
Annual O & M					

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Labor	-	HRS	$ 50.00	$0
Energy	-	KWH	$ 0.07	$0
Fuel	-	GAL	$ 1.75	$0
Maintenance Materials & Supplies	1	LS	$0.00	$0
Subtotal				$0

User Defined Annual O&M Items:	Annual Cost
Item 1	$ -
Item 2	$ -
Item 3	$ -
Item 4	$ -
Item 5	$ -
Item 6	$ -
Item 7	$ -
Item 8	$ -
Item 9	$ -
Item 10	$ -
Item 11	$ -
Item 12	$ -
Item 13	$ -
Item 14	$ -
Item 15	$ -
Subtotal Annual O&M Cost	$ -
Contingency 20%	$ -
Total Annual O&M Cost	$ -

Net Present Value (NPV) Calculation:

i =	4%
n =	25

Year	Default Cost	User Over-Ride	Cost Used in NPV Calculation	Adjusted Annual O & M Cost
0	$32,312,823		$32,312,823	
1	$0		$0	
2	$0		$0	
3	$0		$0	
4	$0		$0	
5	$0		$0	
6	$0		$0	
7	$0		$0	
8	$0		$0	
9	$0		$0	
10	$0		$0	
11	$0		$0	
12	$0		$0	
13	$0		$0	
14	$0		$0	
15	$0		$0	
16	$0		$0	
17	$0		$0	
18	$0		$0	
19	$0		$0	
20	$0		$0	
21	$0		$0	
22	$0		$0	
23	$0		$0	
24	$0		$0	
25	$0		$0	
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42					
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50					
NPV			**$32,312,823**	**$0**	

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GBT Installation

To Summary

Is This Facility Included in My Project? Yes

Parametric Inputs	Value

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST	REFERENCE / COMMENTS
SITEWORK:					
Excavation	0	CY	***$2.50***	$0	***02E***
Structural Backfill	0	CY	***$25.00***	$0	***02SB***
Backfill	0	CY	***$5.00***	$0	***02B***
Haul Excess	0	CY	***$5.00***	$0	***02HE***
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
CONCRETE:					
Slab on Grade	0	CY	***$250.00***	$0	***03S***
Slab on Grade	28	CY	***$250.00***	$6,944	***03S***
Walls	6	CY	***$400.00***	$2,519	***03W***
Walls	0	CY	***$400.00***	$0	***03W***
Walls	0	CY	***$400.00***	$0	***03W***
Walls	0	CY	***$400.00***	$0	***03W***
Beams	0	CY	***$1,000.00***	$0	***03B***
Beams	0	CY	***$1,000.00***	$0	***03B***
Elevated Slab	0	CY	***$450.00***	$0	***03ES***
Elevated Slab	0	CY	***$450.00***	$0	***03ES***
Allowance for Misc Items	5%		$9,463	$473	
Subtotal				$9,936	
MASONRY:					
Type of Building Construction:	**Moderate**				
Building	0	SF	***$100.00***	$0	***04BM***
Subtotal				$0	
METALS:					
Grating	160	SF	***$55.00***	$8,800	***05G***
Handrail	80	LF	***$55.00***	$4,400	***05H***
Stairs	10	Risers	***$300.00***	$3,000	***05S***
Allowance for Misc Items	5%		$16,200.00	$810	
Subtotal				$17,010	
WOOD & PLASTIC:					
Item 1	0	EA	$0.00	$0	
Item 2	0	EA	$0.00	$0	
Item 3	0	EA	$0.00	$0	
Item 4	0	EA	$0.00	$0	
Item 5	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
THERMAL & MOISTURE PROTECTION:					
Item 1	0	EA	$0.00	$0	
Item 2	0	EA	$0.00	$0	
Item 3	0	EA	$0.00	$0	
Item 4	0	EA	$0.00	$0	
Item 5	0	EA	$0.00	$0	
Roof Hatch (4' x 6', double leaf)	0	EA	***$1,800.00***	$0	***07RH1***
Roof Hatch (2' x 2', double leaf)	0	EA	***$300.00***	$0	***07RH2***
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
DOORS & WINDOWS:					
Item 1	0	EA	$0.00	$0	
Item 2	0	EA	$0.00	$0	
Item 3	0	EA	$0.00	$0	

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Item 4	0	EA	$0.00	$0	
Item 5	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
EQUIPMENT:					
Gravity Belt Thickener	2	EA	$110,000.00	$220,000	
Polymer System	1	EA	$50,000.00	$50,000	
Thickened Sludge Pumps	3	EA	$15,000.00	$45,000	
Equipment Item 4	0	EA	$0.00	$0	
Equipment Item 5	0	EA	$0.00	$0	
Equipment Item 6	0	EA	$0.00	$0	
Equipment Item 7	0	EA	$0.00	$0	
Equipment Item 8	0	EA	$0.00	$0	
Equipment Item 9	0	EA	$0.00	$0	
Equipment Item 10	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$315,000.00	$15,750	
Subtotal				$330,750	
I&C:					
Item 1	0	EA	$0.00	$0	
Item 2	0	EA	$0.00	$0	
Item 3	0	EA	$0.00	$0	
Item 4	0	EA	$0.00	$0	
Item 5	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
CONVEYING SYSTEMS:					
Monorail Hoist (3 Ton)	0	EA	***$2,475.00***	$0	***14MH***
Hoist Rail	0	LF	***$25.00***	$0	***14MR***
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
MECHANICAL:					
Equipment Item 1	0	EA	$0.00	$0	
Equipment Item 2	0	EA	$0.00	$0	
Equipment Item 3	0	EA	$0.00	$0	
Equipment Item 4	0	EA	$0.00	$0	
Equipment Item 5	0	EA	$0.00	$0	
Equipment Item 6	0	EA	$0.00	$0	
Equipment Item 7	0	EA	$0.00	$0	
Equipment Item 8	0	EA	$0.00	$0	
Equipment Item 9	0	EA	$0.00	$0	
Equipment Item 10	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**	
Demolition Allowance	1	LS	$50,000.00	$50,000	
Item 2 Description	0		$0.00	$0	
Item 3 Description	0		$0.00	$0	
Item 4 Description	0		$0.00	$0	
Item 5 Description	0		$0.00	$0	
Item 6 Description	0		$0.00	$0	
Item 7 Description	0		$0.00	$0	
Item 8 Description	0		$0.00	$0	
Item 9 Description	0		$0.00	$0	
Item 10 Description	0		$0.00	$0	
Item 11 Description	0		$0.00	$0	
Item 12 Description	0		$0.00	$0	
Item 13 Description	0		$0.00	$0	
Item 14 Description	0		$0.00	$0	
Item 15 Description	0		$0.00	$0	
Subtotal				$50,000	
Subtotal				$407,696	
ALLOWANCES:		**User Over-write**			
Finishes Allowance	2.0%		$509,620	$10,192	
I & C Allowance	4%		$509,620	$20,385	
Mechanical Allowance	10%		$509,620	$50,962	
Electrical Allowance	4%		$509,620	$20,385	
Facility Cost				**$509,620**	
Facility Cost with Additional Project Costs Added	**-**	**0**	**#DIV/0!**	**$606,448**	
Facility Cost with Additional Project Costs & Contractor Markups Added	**-**	**0**	**#DIV/0!**	**$882,564**	
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added	**-**	**0**	**#DIV/0!**	**$933,188**	
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	**-**	**0**	**#DIV/0!**	**$1,149,688**	
Annual O & M					

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Labor	-	HRS	$ 50.00	$0
Energy	-	KWH	$ 0.07	$0
Fuel	-	GAL	$ 1.75	$0
Maintenance Materials & Supplies	1	LS	$0.00	$0
Subtotal				$0

User Defined Annual O&M Items:	Annual Cost
Item 1	$ -
Item 2	$ -
Item 3	$ -
Item 4	$ -
Item 5	$ -
Item 6	$ -
Item 7	$ -
Item 8	$ -
Item 9	$ -
Item 10	$ -
Item 11	$ -
Item 12	$ -
Item 13	$ -
Item 14	$ -
Item 15	$ -
Subtotal Annual O&M Cost	$ -
Contingency 20%	$ -
Total Annual O&M Cost	$ -

Net Present Value (NPV) Calculation:

i = 4%
n = 25

Year	Default Cost	User Over-Ride	Cost Used in NPV Calculation	Adjusted Annual O & M Cost
0	$1,149,688		$1,149,688	
1	$0		$0	
2	$0		$0	
3	$0		$0	
4	$0		$0	
5	$0		$0	
6	$0		$0	
7	$0		$0	
8	$0		$0	
9	$0		$0	
10	$0		$0	
11	$0		$0	
12	$0		$0	
13	$0		$0	
14	$0		$0	
15	$0		$0	
16	$0		$0	
17	$0		$0	
18	$0		$0	
19	$0		$0	
20	$0		$0	
21	$0		$0	
22	$0		$0	
23	$0		$0	
24	$0		$0	
25	$0		$0	
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NPV			**$1,149,688**	**$0**	

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C H2M HILL P arametric Cost E stimating S ystem (CPES)

WWTP CONSTRUCTION & LIFE CYCLE COST MODULE

Use PRO2D file | Browse

Click for CPES QA/ QC | Import PRO2D information from this file

Designates User Input Required

Designates Data Automatically Transferred from PRO2D File

Project Name:	Lahaina WWTP
Project Number:	176853
Project Manager:	Ross Kaneko
Estimator:	Bruce R. Johnson
Project Description:	Alternative 3
Project Location (City):	Honolulu
Project Location (State):	HAWAII
Project Location (Country):	USA
Construction Start Date:	Jan-05
Construction Duration (months):	18
Mid-Point of Construction:	Oct-05

To WWTP Flowsheet
To Unit Process Descriptions
To Life Cycle Summary Shee
To Global Life Cycle Data

Roundup to the nearest: $10,000

Item	Is This Facility Included in Project? (Yes or No)	SCOPE OF PROJECT	User Input	Cost
1	No	Preliminary Treatment - Screening Facility		$0
	To Facility Sheet	Number of Channels (EA)	2	
		Screening Channel Width (FT)	3	
		IS A BUILDING INCLUDED?	Yes	
		(Assumption: If there is a building, there is Odor Control)		
		IF "NO" BUILDING, IS THERE ODOR CONTROL?	Yes	
2	No	Preliminary Treatment - Grit System		$0
	To Facility Sheet	Number of Grit Chambers (EA)	2	
		Grit Chamber Diameter (FT)	6	
3	No	Primary Treatment - Primary Clarifier		$0
	To Facility Sheet	Number of Clarifiers (EA)	0	
		Diameter (FT)	0.00	
		SWD (FT)	0.00	
		Depth of Burial (FT)	0.00	
4	Yes	Secondary Treatment - Aeration Basin		$740,000
	To Facility Sheet	Aeration Basin		
		Number of Aeration Basins	1	
		Length (Width * 4, FT)	190.85	
		Width (FT)	47.71	
		SWD (FT)	16.00	
		Depth of Burial (FT)	15.00	
		Bioreactor Influent Channel		
		Length (FT)	3.00	
		Mixed Liquor Channel		
		Length (FT)	3.00	
		Is Facility Covered?	No	
5	No	Air Supply - Blower Building		$0
	To Facility Sheet	Number of Blowers (EA)	4	
		SCFM per Blower (SCFM)	1700.00	
6	No	Secondary Clarification - Flow Splitting Structure		$0
	To Facility Sheet	Number of Outlet Basins (EA)	0	
		Depth of Burial (FT)	0.00	
		Inlet Basin		
		Width (FT)	0.00	
		SWD (FT)	0.00	
		Outlet Basin (Dimensions of One)		
		Length (FT)	0.00	
		Width (FT)	0.00	
7	Yes	Secondary Clarification - Secondary Clarifier		$700,000
	To Facility Sheet	Number of Clarifiers (EA)	1	
		Diameter (FT)	75.00	
		SWD (FT)	16	
		Depth of Burial (FT)	12.00	

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	A	B	C	D	E
63	8	Yes	Secondary Sludge Pumping - RAS/WAS Pumping		$240,000
64		To Facility Sheet	Number of RAS Pumps (Each)	4	
65			RAS Pump Capacity (Per Unit, GPH)	42000	
66			Number of WAS Pumps (Each)	2	
67			WAS Pump Capacity (Per Unit, GPH)	9000	
68	9	No	Effluent Disinfection - Hypochlorination - Contact Basin		$0
69		To Facility Sheet	Number of Basins (EA)	0	
70			Overall Contact Basin Length (FT)	0.00	
71			Overall Contact Basin Width (FT)	0.00	
72			SWD (FT)	0.00	
73			Number of Serpentine Walls per Basin (EA)	0	
74			Influent Channel Length (FT)	0.00	
75			Effluent Channel Length (FT)	0.00	
76			Depth of Burial (FT)	0.00	
77	10	No	Effluent Disinfection - Hypochlorination - Chemical Building		$0
78		To Facility Sheet	Plant Capacity (MMADF)	0.00	
79					
80					
81					
82	1	No	Sewage Pump Station (Outside of Plant)		$0
83		To Facility Sheet	Firm Capacity (MGD)		
84					
85	2	Yes	Sewage Pump Station (In-Plant)		$330,000
86		To Facility Sheet	Firm Capacity (MGD)	7.50	
87					
88	3	No	Aerated Grit Removal & Flow Metering		$0
89		To Facility Sheet	Basin Volume (CF)		
90			Capacity (MGD) for O&M		
91	4	No	Primary Screening		$0
92		To Facility Sheet	Peak Capacity (MGD)		
93					
94	5	No	Primary Clarifier		$0
95		To Facility Sheet	Number of Clarifiers (EA)		
96			Surface Area (SF per Each)		
97	6	Yes	Secondary Clarifier		$820,000
98		To Facility Sheet	Number of Clarifiers (EA)	2	
99			Surface Area (SF per Each)	4,000.00	
100	7	No	Aeration Basin		$0
101		To Facility Sheet	Number of Basins (EA)		
102			Volume (CF per Each)		
103	8	Yes	Blowers		$520,000
104		To Facility Sheet	Firm Air Flow Capacity (CFM)	4,700.00	
105			Average Air Flow (SCFM) for O&M		
106	9	No	Air Diffusion		$0
107		To Facility Sheet	Number of Basins (EA)	2	
108			Firm Capacity (CFM per Each Basin)	2,400.00	
109	10	No	Trickling Filter		$0
110		To Facility Sheet	Number of Filters (EA)		
111			Volume of Media (CF per Each)		
112	11	No	Rotating Biological Contactor		$0
113		To Facility Sheet	Area of Media (Million SF)		
114					
115	12	No	Chlorine Contact Basin		$0
116		To Facility Sheet	Volume (CF)		
117					
118	13	No	Effluent Filters		$0
119		To Facility Sheet	Flow (MGD)	4.5000	
120					
121	14	No	Chlorine Feed & Storage		$0
122		To Facility Sheet	Feed Capacity (LB/DAY)		
123			Feed Capacity (Ton/Year) for O&M		
124	15	No	SO2 Storage & Feed Equipment		$0
125		To Facility Sheet	Feed Rate Capacity (LB/DAY)		
126			Feed Capacity (Ton/Year) for O&M		
127	16	No	Polymer Feed System		$0
128		To Facility Sheet	Feed Rate Capacity (LB/DAY)		

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	A	B	C	D	E
129					
130	17	No	Sludge Pumping		$0
131		To Facility Sheet	Firm Capacity (GPM)		
132					
133	18	No	Flotation Sludge Thickener		$0
134		To Facility Sheet	Number of Thickeners (EA)		
135			Diameter (Feet per Each)		
136			Surface Area (SF per Each)	-	
137	19	No	Sludge Holding Tanks		$0
138		To Facility Sheet	Volume (CF)		
139					
140	20	No	Anaerobic Digesters		$0
141		To Facility Sheet	Number of Units (Each)		
142			Digester Volume per Unit (CF)		
143	21	No	Solid Bowl Centrifuge		$0
144		To Facility Sheet	Flow Capacity (GPM)		
145			Average Loading (Total LB/Day) for O&M		
146	22	No	Belt Filter Press		$0
147		To Facility Sheet	Number of Presses (EA)		
148			Width (Meters per Each)		
149			Average Loading per Press (LB/Day) for O&M		
150	23	No	Sludge Drying Beds		$0
151		To Facility Sheet	Area (SF)		
152					
153	24	No	Flow Splitting Structure 2		$0
154		To Facility Sheet			
155					
156	25	No	Yard Piping		$0
157		To Facility Sheet			
158					
159	26	Yes	GBT Installation		$510,000
160		To Facility Sheet			
161					
162	27	No	User Defined Facility 2		$0
163		To Facility Sheet			
164					
165	28	No	User Defined Facility 3		$0
166		To Facility Sheet			
167					
168	SUBTOTAL - PROJECT COST				$3,860,000
169					
170	ADDITIONAL PROJECT COSTS:				
171	Demolition		10%		$386,000
172	Overall Sitework		1%		$38,600
173	Plant Computer System		1%		$38,600
174	Yard Electrical		2%		$77,200
175	Yard Piping		1%		$38,600
176	0		0%		$0
177	0		0%		$0
178	0		0%		$0
179	SUBTOTAL with Additional Project Costs				$4,439,000
180					
181	CONTRACTOR MARKUPS:				
182	Overhead		10%	$4,439,000	$443,900
183	Subtotal				$4,882,900
184	Profit		5%	$4,882,900	$244,145
185	Subtotal				$5,127,045
186	Mob/Bonds/Insurance		5%	$5,127,045	$256,352
187	Subtotal				$5,383,397
188	Contingency		20%	$5,383,397	$1,076,679
189	SUBTOTAL with Markups				$6,460,077
190					
191	ESCALATION (to Mid-Point of Construction):		5.74%	$6,460,077	$370,556
192	SUBTOTAL with Escalation				$6,830,633

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	A	B	C	D	E
193					
194	LOCATION ADJUSTMENT FACTOR		123.20%	$6,830,633	$8,415,340
195	TOTAL - CONSTRUCTION COST				$8,415,340
196					
197	RED FLAGS:				
198	1	Rock Excavation			
199	2	Pile Foundations			
200	3	Seismic Foundations			
201	4	Dewatering Conditions			
202	5	Wetlands Mitigation			
203	6	Weather Impacts			
204	7	Depth of Structures			
205	8	Local Building Code Restrictions			
206	9	Coatings or Finishes			
207	10	Building or Architectural Considerations			
208	11	Client Material Preferences			
209	12	Client Equipment Preferences			
210	13	Piping Galleries, Piping Trenches, Piping Racks			
211	14	Yard Piping Complexity			
212	15	Existing Site Utilities (New, Retrofit, and Complexity)			
213	16	I & C Automation (New or Retrofit)			
214	17	Electrical Feed (New or Retrofit)			
215	18	Electrical Distribution			
216	19	User Defined Red Flag 1			
217	20	User Defined Red Flag 2			
218	21	User Defined Red Flag 3			
219	22	User Defined Red Flag 4			
220	23	User Defined Red Flag 5			
221	24	User Defined Red Flag 6			
222	25	User Defined Red Flag 7			
223	TOTAL - RED FLAGS				$0
224					
225	SUBTOTAL - CONSTRUCTION COST with Red Flags				$8,415,340
226					
227	Did a CH2M HILL Professional Estimator Review This Cost Estimate?			No	
228	TOTAL - CONSTRUCTION COST Plus RED FLAGS				$11,781,476
229					
230	NON-CONSTRUCTION COSTS:				
231	Permitting		0%	$11,781,476	$0
232	Engineering		10%	$11,781,476	$1,178,148
233	SDC		5%	$11,781,476	$589,074
234	Commissioning & Startup		5%	$11,781,476	$589,074
235	Land ROW		0%	$11,781,476	$0
236	Legal/Admin		0%	$11,781,476	$0
237	0		0%	$11,781,476	$0
238	SUBTOTAL - Non-Construction Costs				$2,356,295
239					
240	TOTAL - CAPITAL COST				$14,137,771

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SECONDARY TREATMENT - AERATION BASIN					
		To Summary			
Is This Facility Included in My Project? Yes					
Assumptions:					
Model Based on City of Vancouver, WA Marine Park WRF					
Aeration Basin					
Number of Aeration Basins	**1**		***PRO2D Input from Summary Sheet***		
Length (FT)	**190.85**	**BL**	***User Input from Summary Sheet***		
Width (FT)	**47.71**	**BW**	***User Input from Summary Sheet***		
SWD (FT)	**16.00**	**SWD**	***PRO2D Input from Summary Sheet***		
Depth of Burial (FT)	**15**		***User Input from Summary Sheet***		
Bioreactor Inluent Channel					
Length (FT)	**3**	**BICL**	***User Input from Summary Sheet***		
Mixed Liquor Channel					
Length (FT)	**3**	**MLCL**	***User Input from Summary Sheet***		
Is Facility Covered?	**No**		***User Input from Summary Sheet***		
Dimension Calculations:					
Logic Test:					
Is "Number of Aeration Basins = 0"? ("Yes" = 0, "No" = 1)	1.00				
Facility Length (ft)	203.85	**L**	Calculated		
Facility Width (ft)	51.71	**W**	Calculated		
Slab on Grade Length (ft)	207.85		Calculated		
Slab on Grade Width (ft)	55.71		Calculated		
Slab on Grade Thickness (inches)	24.00		Fixed		
Slab on Grade Thickness (ft)	2.00		Calculated		
Freeboard (ft)	4.00	**FB**	Fixed		
Exterior Wall Height (ft)	20.00	**H**	Fixed		
Exterior Wall Thickness (inches)	24.00		Fixed		
Exterior Wall Thickness (ft)	2.00		Calculated		
Bioreactor Influent Channel Wall Height (ft)	20.00	= H	Calculated		
Bioreactor Influent Channel Wall Thickness (inches)	18.00		Fixed		
Bioreactor Influent Channel Wall Thickness (ft)	1.50		Calculated		
Baffle Wall Height (ft)	16.00	= SWD	Calculated		
Baffle Wall Thickness (inches)	12.00		Fixed		
Baffle Wall Thickness (ft)	1.00		Calculated		
Mixed Liquor Channel Wall Height (ft)	20.00	= H	Calculated		
Mixed Liquor Channel Wall Thickness (inches)	18.00		Fixed		
Mixed Liquor Channel Wall Thickness (ft)	1.50		Calculated		
Basin Divider Wall Height (ft)	20.00	= H	Fixed		

Basin Divider Wall Thickness (inches)	24.00		Fixed		
Basin Divider Wall Thickness (ft)	2.00		Calculated		
Walkway Elevated Slab Width (ft)	4.00		Fixed		
Walkway Elevated Slab Thickness (inches)	8.00		Fixed		
Walkway Elevated Slab Thickness (ft)	0.67		Calculated		
Excavation Length (ft)	211.85		Calculated		
Excavation Width (ft)	59.71		Calculated		
Excavation Depth (ft)	18.00		Calculated		
Liquid Volume (CF)	***145,702***		Calculated		
Liquid Volume (Gal)	***1,089,930***		Calculated		
DESCRIPTION	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**	
SITEWORK:					
Excavation	9,574	CY	$2.50	$23,935	
Structural Backfill	469	CY	$25.00	$11,714	
Backfill	1,368	CY	$5.00	$6,842	
Haul Excess	10,121	CY	$1.85	$18,723	
Allowance for Misc Items	5%		$61,213.28	$3,061	
Subtotal				$64,274	
CONCRETE:					
Slab on Grade	858	CY	$250.00	$214,451	
Exterior Walls	757	CY	$400.00	$302,896	
Bioreactor Influent Channel Wall	57	CY	$400.00	$22,984	
Baffle Wall	31	CY	$400.00	$12,258	
Mixed Liquor Channel Wall	57	CY	$400.00	$22,984	
Basin Divider Wall	0	CY	$400.00	$0	
Walkway Elevated Slab	50	CY	$450.00	$22,717	
Allowance for Misc Items	5%		$598,290.68	$29,915	
Subtotal				$628,205	
MASONRY:					
CMU Building	0	SF	$70.00	$0	
Subtotal				$0	
METALS:					
Handrail	1,022	LF	$40.00	$40,891	
Primary Effluent Channel Grating	-44	SF	$55.00	($2,404)	
Mixed Liquor Channel Grating	-44	SF	$55.00	($2,404)	
Allowance for Misc Items	5%		$36,082.48	$1,804	
Subtotal				$37,887	
EQUIPMENT:					
Diffuser System	10,542	SF	$8.89	$93,690	Unit Cost Based on Santa Rosa
Influent Slide Gates	2	EA	$10,000	$20,000	Rule: 2 per basin
Mixers	1	EA	$12,000	$12,000	Rule: 1 per basin
Mixed Liquor Recycle Pumps	1	EA	$25,000	$25,000	Rule: 1 per basin
Allowance for Misc Items	5%		$150,689.58	$7,534	
Subtotal				$158,224	
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**	
Deduct Earth Work For exisitng basin	1	LS	($64,273.95)	($64,274)	
Deduct Slab and Ext Wall for Exist Basin	1	LS	($365,899.52)	($365,900)	
Item 3 Description	0		$0.00	$0	
Item 4 Description	0		$0.00	$0	
Item 5 Description	0		$0.00	$0	
Item 6 Description	0		$0.00	$0	
Item 7 Description	0		$0.00	$0	
Item 8 Description	0		$0.00	$0	
Item 9 Description	0		$0.00	$0	
Item 10 Description	0		$0.00	$0	
Item 11 Description	0		$0.00	$0	
Item 12 Description	0		$0.00	$0	
Item 13 Description	0		$0.00	$0	

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST	
Item 14 Description	0		$0.00	$0	
Item 15 Description	0		$0.00	$0	
Subtotal				($430,173)	
Subtotal				$458,416	
ALLOWANCES:					
Finishes Allowance	2.0%		$739,381	$14,788	
I & C Allowance	4%		$739,381	$29,575	
Mechanical Allowance	22%		$739,381	$162,664	
Electrical Allowance	10%		$739,381	$73,938	
Facility Cost	**1,089,930**	**Gallons**	**$0.68**	**$739,381**	
Facility Cost with Additional Project Costs Added	**1,089,930**	**Gallons**	**$0.78**	**$850,288**	
Facility Cost with Additional Project Costs & Contractor Markups Added	**1,089,930**	**Gallons**	**$1.14**	**$1,237,425**	
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added	**1,089,930**	**Gallons**	**$1.20**	**$1,308,405**	
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	**1,089,930**	**Gallons**	**$1.48**	**$1,611,955**	

SECONDARY CLARIFIER

To Summary

Is This Facility Included in My Project? Yes

Assumptions:

Based on Ocala WRF No. 3 (5mgd MMADF)

Number of Clarifiers (EA)	***1***		***PRO2D Input from Summary Sheet***
Diameter (FT)	***75***	***D***	***PRO2D Input from Summary Sheet***
SWD (FT)	***16***	***SWD***	***PRO2D Input from Summary Sheet***
Depth of Burial (FT)	***12***		***User Input from Summary Sheet***

Dimension Calculations:

Logic Test:			
Is "Number of Clarifiers = 0"? ("Yes" = 0, "No" = 1)	1.00		
Slab on Grade Diameter	78.00	D+3	Calculated
Slab on Grade Thickness (inches)	16.00		Fixed
Slab on Grade Thickness (ft)	1.33	TS	Calculated
Freeboard (ft)	3.00	FB	Fixed
Exterior Wall Height (ft)	19.00	H = SWD + FB	Calculated
Exterior Wall Thickness (inches)	16.00		Fixed
Exterior Wall Thickness (ft)	1.33	TW	Calculated
Interior Launder Elevated Slab Width (ft)	5.00	WIS	Constant
Interior Launder Average Diameter (for launder slab area)	70.00	D-WIS	Calculated
Interior Launder Wall Diameter (ft)	72.00	D-(WIS-1*2)	Calculated
Interior Launder Wall Height (ft)	3.00		Fixed
Interior Launder Wall Thickness (inches)	8.00		Fixed
Interior Launder Wall Thickness (ft)	0.67		Calculated
Interior Launder Elevated Slab Thickness (inches)	8.00		Fixed
Interior Launder Elevated Slab Thickness (ft)	0.67		Calculated
Exterior Walkway Slab Width	4.00	WES	Constant
Exterior Walkway Handrail Diameter	85.67	D+(TW*2)+(WES*2	Calculated
Exterior Walkway Slab Thickness	0.67		Constant
Excavation Diameter	82.00	D+7	Calculated
Excavation Depth	14.33		Calculated
Liquid Volume (CF)	***70,650***		Calculated
Liquid Volume (Gal)	***528,499***		Calculated

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
SITEWORK:				
Excavation	3,782	CY	$2.50	$9,454
Structural Backfill	195	CY	$25.00	$4,887
Backfill	1,176	CY	$5.00	$5,878
Haul Excess	3,362	CY	$1.85	$6,221
Allowance for Misc Items	5%		$26,439.69	$1,322
Subtotal				$27,762
CONCRETE:				
Exterior Walls:				
Slab on Grade	236	CY	$250.00	$58,962
Circular Walls	221	CY	$450.00	$99,433

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST	
Interior Launder:					
Circular Walls	17	CY	$500.00	$8,373	
Elevated Slab	27	CY	$450.00	$12,211	
Exterior Walkway:					
Elevated Slab	27	CY	$500.00	$13,284	
Center Sludge/RAS Pit	10	CY	$200.00	$2,000	
Concrete Encasement	20	CY	$180.00	$3,600	
Clarifier Bottom Grout 2"	4,416	SF	$11.00	$48,572	
4" Concrete Pads	0.20	CY	$200.00	$40	
Allowance for Misc Items	5%		$246,435.50	$12,322	
Subtotal				$258,797	
METALS:					
Weir	226	LF	$50.00	$11,304	
Scum Baffle & Supports	226	LF	$100.00	$22,608	
Scum Box	1	EA	$4,000.00	$4,000	
Aluminum Stairs	11	RISERS	$300.00	$3,150	
Aluminum Platform	14	SF	$20.00	$270	
Aluminum Handrail	269	LF	$50.00	$13,450	
Allowance for Misc Items	5%		$54,781.67	$2,739	
Subtotal				$57,521	
EQUIPMENT:					
Clarifier Mechanism	1	EA	$129,375	$129,375	
Submersible Scum Pump	1	EA	$13,500	$13,500	
Allowance for Misc Items	5%		$142,875.00	$7,144	
Subtotal				$150,019	
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**	
Item 1 Description	0		$0.00	$0	
Item 2 Description	0		$0.00	$0	
Item 3 Description	0		$0.00	$0	
Item 4 Description	0		$0.00	$0	
Item 5 Description	0		$0.00	$0	
Item 6 Description	0		$0.00	$0	
Item 7 Description	0		$0.00	$0	
Item 8 Description	0		$0.00	$0	
Item 9 Description	0		$0.00	$0	
Item 10 Description	0		$0.00	$0	
Item 11 Description	0		$0.00	$0	
Item 12 Description	0		$0.00	$0	
Item 13 Description	0		$0.00	$0	
Item 14 Description	0		$0.00	$0	
Item 15 Description	0		$0.00	$0	
Subtotal				$0	
Subtotal				$494,098	
ALLOWANCES:					
Finishes Allowance	2.0%		$695,913	$13,918	
I & C Allowance	4%		$695,913	$27,837	
Mechanical Allowance	20%		$695,913	$139,183	Based on $59,641 / $766,488
Electrical Allowance	3%		$695,913	$20,877	
Facility Cost	**528,499**	**Galllons**	**$1.32**	**$695,913**	
Facility Cost with Additional Project Costs Added	**528,499**	**Galllons**	**$1.51**	**$800,299**	
Facility Cost with Additional Project Costs & Contractor Markups Added	**528,499**	**Galllons**	**$2.20**	**$1,164,676**	
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added	**528,499**	**Galllons**	**$2.33**	**$1,231,483**	
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	**528,499**	**Galllons**	**$2.87**	**$1,517,187**	

RAS AND WAS PUMPING

To Summary

Is This Facility Included in My Project? Yes

Assumptions:

Based on Ocala WRF No. 3 (5mgd MMADF)

RAS and WAS pumps are located outside

Number of RAS Pumps (Each)	***4***		***PRO2D Input from Summary Sheet***
RAS Pump Capacity (Per Unit, GPH)	***42000***		***PRO2D Input from Summary Sheet***
Number of WAS Pumps (Each)	***2***		***PRO2D Input from Summary Sheet***
WAS Pump Capacity (Per Unit, GPH)	***9000***		***PRO2D Input from Summary Sheet***

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
SITEWORK:				
Sitework Allowance	6	LS	$833.33	$5,000
Subtotal				$5,000
CONCRETE:				
8" Slab on Grade	45	CY	$250.00	$11,259
Allowance for Misc Items	5%		$11,259.26	$563
Subtotal				$11,822
EQUIPMENT:				
RAS Pumps (1170 gpm, 870 rpm, TDH =11.5ft, 7.5 hp)	4	EA	$12,796.83	$51,187
WAS Pumps (200 gpm, 1185 rpm TDH = 14 ft, 3hp)	2	EA	$5,114.72	$10,229
Allowance for Misc Items	5%		$61,416.75	$3,071
Subtotal				$64,488
MECHANICAL:				
RAS Piping:				
12" RAS	40	LF	$29.45	$1,178
12" Tee	4	EA	$1,130	$4,520
12" Elbow	4	EA	$700	$2,800
10" x 12" Reducing Elbow	4	EA	$700	$2,800
10" V405	12	EA	$1,750	$21,000
10" V604	4	EA	$2,259	$9,036
8" x 10" Reducing Elbow	4	EA	$532	$2,128
8" x 10" Reducer	4	EA	$532	$2,128
10" x 10 x 2" Tee	4	EA	$943	$3,772
10" Elbow	4	EA	$532	$2,128
10" Tee	12	EA	$943	$11,316
10" Flanged Coupling Adapter	4	EA	$250	$1,000
10" Flow Meter	4	EA	$5,368	$21,472
10" RAS	100	LF	$24.43	$2,443
2" V400	4	EA	$334	$1,336
WAS Piping:				
6" WAS	40	LF	$15.73	$629
6" Elbow	6	EA	$234	$1,404

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
6" V405	2	EA	$802	$1,604
4" x 6" Reducing Elbow	2	EA	$234	$468
4" WAS	100	LF	$14.08	$1,408
4" x 4" x 2" Tee	4	EA	$260	$1,040
2" V400	2	EA	$334	$668
4" V604	2	EA	$565	$1,130
4" Elbow	4	EA	$177	$708
4" Tee	8	EA	$260	$2,080
4" Flow Meter	2	EA	$3,431	$6,862
4" Flanged Coupling Adapter	2	EA	$109	$218
Allowance for Small Pipe & Pipe Supports	6	LS	$1,667	$10,000
Subtotal				$117,276
ELECTRICAL:				
RAS Pumps VFD's (7.5 hp)	4	EA	$4,600	$18,400
Allowance for Misc Items	5%		$18,400.00	$920
Subtotal				$19,320
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**
Delete Concrete and Site Work	1	LS	($16,822.22)	($16,822)
Item 2 Description	0		$0.00	$0
Item 3 Description	0		$0.00	$0
Item 4 Description	0		$0.00	$0
Item 5 Description	0		$0.00	$0
Item 6 Description	0		$0.00	$0
Item 7 Description	0		$0.00	$0
Item 8 Description	0		$0.00	$0
Item 9 Description	0		$0.00	$0
Item 10 Description	0		$0.00	$0
Item 11 Description	0		$0.00	$0
Item 12 Description	0		$0.00	$0
Item 13 Description	0		$0.00	$0
Item 14 Description	0		$0.00	$0
Item 15 Description	0		$0.00	$0
Subtotal				($16,822)
Subtotal				$201,084
ALLOWANCES:				
Finishes Allowance	0.0%		$233,818	$0
I & C Allowance	4%		$233,818	$9,353
Mechanical Allowance	0%		$233,818	$0
Electrical Allowance	10%		$233,818	$23,382
Facility Cost				**$233,818**
Facility Cost with Additional Project Costs Added				**$268,891**
Facility Cost with Additional Project Costs & Contractor Markups Added				**$391,317**
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added				**$413,764**
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added				**$509,757**

Sewage PS - (In-Plant)

To Summary Sheet

Is This Facility Included in My Project? Yes

Assumptions:

Firm Capacity (MGD)	***7.50***	***MGD***	
Cost models are based on this date:	**20 Cities Average**	**Jan-03**	
Cost models are escalated to this date:	**20 Cities Average**	**Jan-03**	**1.00**

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
Sewage PS				
Sewage PS	8	MGD	$87,208.77	$654,066
Subtotal				$654,066
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**
Refurbish Deduction	1	LS	($327,032.90)	($327,033)
Item 2 Description	0		$0.00	$0
Item 3 Description	0		$0.00	$0
Item 4 Description	0		$0.00	$0
Item 5 Description	0		$0.00	$0
Item 6 Description	0		$0.00	$0
Item 7 Description	0		$0.00	$0
Item 8 Description	0		$0.00	$0
Item 9 Description	0		$0.00	$0
Item 10 Description	0		$0.00	$0
Item 11 Description	0		$0.00	$0
Item 12 Description	0		$0.00	$0
Item 13 Description	0		$0.00	$0
Item 14 Description	0		$0.00	$0
Item 15 Description	0		$0.00	$0
Subtotal				($327,033)
Subtotal				$327,033
ALLOWANCES:				
Finishes Allowance	0.0%		$327,033	$0
I & C Allowance	0%		$327,033	$0
Mechanical Allowance	0%		$327,033	$0
Electrical Allowance	0%		$327,033	$0
Facility Cost	**8**	**MGD**	**$43,604.39**	**$327,033**
Facility Cost with Additional Project Costs Added	**8**	**MGD**	**$50,145.04**	**$376,088**
Facility Cost with Additional Project Costs & Contractor Markups Added	**8**	**MGD**	**$72,976.08**	**$547,321**
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added	**8**	**MGD**	**$77,162.06**	**$578,715**
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	**8**	**MGD**	**$95,063.66**	**$712,977**
Annual O & M				

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
	7.50	MGD		
Labor	1,225.29	HRS	$ 50.00	$61,264
Energy	441,929.76	KWH	$ 0.07	$30,935
Maintenance Materials & Supplies	8	MGD	$896.54	$6,724
Subtotal				$98,923
User Defined Annual O&M Items:				**Annual Cost**
Item 1				$ -
Item 2				$ -
Item 3				$ -
Item 4				$ -
Item 5				$ -
Item 6				$ -
Item 7				$ -
Item 8				$ -
Item 9				$ -
Item 10				$ -
Item 11				$ -
Item 12				$ -
Item 13				$ -
Item 14				$ -
Item 15				$ -
Subtotal Annual O&M Cost				**$ 98,923**
Contingency			**20%**	**$ 19,785**
Total Annual O&M Cost				**$ 118,708**
Net Present Value (NPV) Calculation:				
i =	4%			
n =	25			

Year	Default Cost	User Over-Ride	Cost Used in NPV Calculation	Adjusted Annual O & M Cost
0	$712,977		$712,977	
1	$118,708		$118,708	
2	$118,708		$118,708	
3	$118,708		$118,708	
4	$118,708		$118,708	
5	$118,708		$118,708	
6	$118,708		$118,708	
7	$118,708		$118,708	
8	$118,708		$118,708	
9	$118,708		$118,708	
10	$118,708		$118,708	
11	$118,708		$118,708	
12	$118,708		$118,708	
13	$118,708		$118,708	
14	$118,708		$118,708	
15	$118,708		$118,708	
16	$118,708		$118,708	

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
17	$118,708		$118,708	
18	$118,708		$118,708	
19	$118,708		$118,708	
20	$118,708		$118,708	
21	$118,708		$118,708	
22	$118,708		$118,708	
23	$118,708		$118,708	
24	$118,708		$118,708	
25	$118,708		$118,708	
26				
27				
28				
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50				
NPV			$2,567,444	$118,708

Secondary Clarifier

To Summary Sheet

Is This Facility Included in My Project? Yes

Assumptions:

Number of Clarifiers (EA)	***2***	***EA***	
Surface Area (SF per EA)	***4,000.00***	***SF***	
Cost models are based on this date:	**20 Cities Average**	**Jan-03**	
Cost models are escalated to this date:	**20 Cities Average**	**Jan-03**	**1.00**

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
Secondary Clarifier				
Secondary Clarifier	2	EA	$810,288.00	$1,620,576
Subtotal				$1,620,576
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**
Refurbishment Deduction	1	LS	($810,288.00)	($810,288)
Item 2 Description	0		$0.00	$0
Item 3 Description	0		$0.00	$0
Item 4 Description	0		$0.00	$0
Item 5 Description	0		$0.00	$0
Item 6 Description	0		$0.00	$0
Item 7 Description	0		$0.00	$0
Item 8 Description	0		$0.00	$0
Item 9 Description	0		$0.00	$0
Item 10 Description	0		$0.00	$0
Item 11 Description	0		$0.00	$0
Item 12 Description	0		$0.00	$0
Item 13 Description	0		$0.00	$0
Item 14 Description	0		$0.00	$0
Item 15 Description	0		$0.00	$0
Subtotal				($810,288)
Subtotal				$810,288
ALLOWANCES:				
Finishes Allowance	0.0%		$810,288	$0
I & C Allowance	0%		$810,288	$0
Mechanical Allowance	0%		$810,288	$0
Electrical Allowance	0%		$810,288	$0
Facility Cost	**8,000**	**SF**	**$101.29**	**$810,288**
Facility Cost with Additional Project Costs Added	**8,000**	**SF**	**$116.48**	**$931,831**
Facility Cost with Additional Project Costs & Contractor Markups Added	**8,000**	**SF**	**$169.51**	**$1,356,094**
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added	**8,000**	**SF**	**$179.24**	**$1,433,881**
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	**8,000**	**SF**	**$220.82**	**$1,766,541**

Annual O & M	**2**	EA			
	4,000.00	SF			
Labor	2,177.08	HRS	**$ 50.00**	$108,854	$130,625
Energy	26,265.20	KWH	**$ 0.07**	$1,839	$2,206
Maintenance Materials & Supplies	8,000	SF	$0.86	$6,911	$8,293
Subtotal				$117,603	

User Defined Annual O&M Items:	**Annual Cost**
Item 1	**$ -**
Item 2	**$ -**
Item 3	**$ -**
Item 4	**$ -**
Item 5	**$ -**
Item 6	**$ -**
Item 7	**$ -**
Item 8	**$ -**

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DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST			
Item 9				$ -			
Item 10				$ -			
Item 11				$ -			
Item 12				$ -			
Item 13				$ -			
Item 14				$ -			
Item 15				$ -			
Subtotal Annual O&M Cost				$ 117,603			
Contingency			20%	$ 23,521			
Total Annual O&M Cost				$ 141,124		1.2000	<<<< O&M Factor
Net Present Value (NPV) Calculation:							
i =	4%						
n =	25						
Year	**Default Cost**	**User Over-Ride**	**Cost Used in NPV Calculation**	**Adjusted Annual O & M Cost**			
0	**$1,766,541**		**$1,766,541**				
1	**$141,124**		**$141,124**				
2	**$141,124**		**$141,124**				
3	**$141,124**		**$141,124**				
4	**$141,124**		**$141,124**				
5	**$141,124**		**$141,124**				
6	**$141,124**		**$141,124**				
7	**$141,124**		**$141,124**				
8	**$141,124**		**$141,124**				
9	**$141,124**		**$141,124**				
10	**$141,124**		**$141,124**				
11	**$141,124**		**$141,124**				
12	**$141,124**		**$141,124**				
13	**$141,124**		**$141,124**				
14	**$141,124**		**$141,124**				
15	**$141,124**		**$141,124**				
16	**$141,124**		**$141,124**				
17	**$141,124**		**$141,124**				
18	**$141,124**		**$141,124**				
19	**$141,124**		**$141,124**				
20	**$141,124**		**$141,124**				
21	**$141,124**		**$141,124**				
22	**$141,124**		**$141,124**				
23	**$141,124**		**$141,124**				
24	**$141,124**		**$141,124**				
25	**$141,124**		**$141,124**				
26							
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48							
49							
50							
NPV			**$3,971,192**	**$141,124**			

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Blowers

To Summary Sheet

Is This Facility Included in My Project? Yes

Assumptions:

Firm Air Flow Capacity (CFM)	*4,700.00*	*CFM*	
Average Air Flow (SCFM) for O&M	*-*	*SCFM*	
Cost models are based on this date:	**20 Cities Average**	**Jan-03**	
Cost models are escalated to this date:	**20 Cities Average**	**Jan-03**	**1.00**

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
Aeration Basin				
Aeration Basin	4,700	CFM	$110.35	$518,654
Subtotal				$518,654
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**
Item 1 Description	0		$0.00	$0
Item 2 Description	0		$0.00	$0
Item 3 Description	0		$0.00	$0
Item 4 Description	0		$0.00	$0
Item 5 Description	0		$0.00	$0
Item 6 Description	0		$0.00	$0
Item 7 Description	0		$0.00	$0
Item 8 Description	0		$0.00	$0
Item 9 Description	0		$0.00	$0
Item 10 Description	0		$0.00	$0
Item 11 Description	0		$0.00	$0
Item 12 Description	0		$0.00	$0
Item 13 Description	0		$0.00	$0
Item 14 Description	0		$0.00	$0
Item 15 Description	0		$0.00	$0
Subtotal				$0
Subtotal				$518,654
ALLOWANCES:				
Finishes Allowance	0.0%		$518,654	$0
I & C Allowance	0%		$518,654	$0
Mechanical Allowance	0%		$518,654	$0
Electrical Allowance	0%		$518,654	$0
Facility Cost	**4,700**	**CFM**	**$110.35**	**$518,654**
Facility Cost with Additional Project Costs Added	**4,700**	**CFM**	**$126.90**	**$596,452**
Facility Cost with Additional Project Costs & Contractor Markups Added	**4,700**	**CFM**	**$184.68**	**$868,017**
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added	**4,700**	**CFM**	**$195.28**	**$917,807**
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	**4,700**	**CFM**	**$240.58**	**$1,130,738**
Annual O & M				
	0	SCFM		
Labor	-	HRS	**$ 50.00**	$0
Energy	-	KWH	**$ 0.07**	$0
Maintenance Materials & Supplies	0	SCFM	$0.00	$0
Subtotal				$0
User Defined Annual O&M Items:				**Annual Cost**

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
Item 1				$ -
Item 2				$ -
Item 3				$ -
Item 4				$ -
Item 5				$ -
Item 6				$ -
Item 7				$ -
Item 8				$ -
Item 9				$ -
Item 10				$ -
Item 11				$ -
Item 12				$ -
Item 13				$ -
Item 14				$ -
Item 15				$ -
Subtotal Annual O&M Cost				$ -
Contingency			20%	$ -
Total Annual O&M Cost				$ -

Net Present Value (NPV) Calculation:

i =	4%
n =	25

Year	Default Cost	User Over-Ride	Cost Used in NPV Calculation	Adjusted Annual O & M Cost
0	$1,130,738		$1,130,738	
1	$0		$0	
2	$0		$0	
3	$0		$0	
4	$0		$0	
5	$0		$0	
6	$0		$0	
7	$0		$0	
8	$0		$0	
9	$0		$0	
10	$0		$0	
11	$0		$0	
12	$0		$0	
13	$0		$0	
14	$0		$0	
15	$0		$0	
16	$0		$0	
17	$0		$0	
18	$0		$0	
19	$0		$0	
20	$0		$0	
21	$0		$0	
22	$0		$0	
23	$0		$0	
24	$0		$0	
25	$0		$0	
26				
27				
28				
29				
30				
31				
32				
33				
34				

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
35				
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
NPV			$1,130,738	$0

GBT Installation

To Summary

Is This Facility Included in My Project? Yes

Parametric Inputs	Value

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST	REFERENCE / COMMENTS
SITEWORK:					
Excavation	0	CY	***$2.50***	$0	***02E***
Structural Backfill	0	CY	***$25.00***	$0	***02SB***
Backfill	0	CY	***$5.00***	$0	***02B***
Haul Excess	0	CY	***$5.00***	$0	***02HE***
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
CONCRETE:					
Slab on Grade	0	CY	***$250.00***	$0	***03S***
Slab on Grade	28	CY	***$250.00***	$6,944	***03S***
Walls	6	CY	***$400.00***	$2,519	***03W***
Walls	0	CY	***$400.00***	$0	***03W***
Walls	0	CY	***$400.00***	$0	***03W***
Walls	0	CY	***$400.00***	$0	***03W***
Beams	0	CY	***$1,000.00***	$0	***03B***
Beams	0	CY	***$1,000.00***	$0	***03B***
Elevated Slab	0	CY	***$450.00***	$0	***03ES***
Elevated Slab	0	CY	***$450.00***	$0	***03ES***
Allowance for Misc Items	5%		$9,463	$473	
Subtotal				$9,936	
MASONRY:					
Type of Building Construction:	**Moderate**				
Building	0	SF	***$100.00***	$0	***04BM***
Subtotal				$0	
METALS:					
Grating	160	SF	***$55.00***	$8,800	***05G***
Handrail	80	LF	***$55.00***	$4,400	***05H***
Stairs	10	Risers	***$300.00***	$3,000	***05S***
Allowance for Misc Items	5%		$16,200.00	$810	
Subtotal				$17,010	
WOOD & PLASTIC:					
Item 1	0	EA	$0.00	$0	
Item 2	0	EA	$0.00	$0	
Item 3	0	EA	$0.00	$0	
Item 4	0	EA	$0.00	$0	
Item 5	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
THERMAL & MOISTURE PROTECTION:					
Item 1	0	EA	$0.00	$0	
Item 2	0	EA	$0.00	$0	
Item 3	0	EA	$0.00	$0	
Item 4	0	EA	$0.00	$0	
Item 5	0	EA	$0.00	$0	
Roof Hatch (4' x 6', double leaf)	0	EA	***$1,800.00***	$0	***07RH1***
Roof Hatch (2' x 2', double leaf)	0	EA	***$300.00***	$0	***07RH2***
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
DOORS & WINDOWS:					
Item 1	0	EA	$0.00	$0	
Item 2	0	EA	$0.00	$0	
Item 3	0	EA	$0.00	$0	
Item 4	0	EA	$0.00	$0	

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Item 5	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
EQUIPMENT:					
Gravity Belt Thickener	2	EA	$110,000.00	$220,000	
Polymer System	1	EA	$50,000.00	$50,000	
Thickened Sludge Pumps	3	EA	$15,000.00	$45,000	
Equipment Item 4	0	EA	$0.00	$0	
Equipment Item 5	0	EA	$0.00	$0	
Equipment Item 6	0	EA	$0.00	$0	
Equipment Item 7	0	EA	$0.00	$0	
Equipment Item 8	0	EA	$0.00	$0	
Equipment Item 9	0	EA	$0.00	$0	
Equipment Item 10	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$315,000.00	$15,750	
Subtotal				$330,750	
I&C:					
Item 1	0	EA	$0.00	$0	
Item 2	0	EA	$0.00	$0	
Item 3	0	EA	$0.00	$0	
Item 4	0	EA	$0.00	$0	
Item 5	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
CONVEYING SYSTEMS:					
Monorail Hoist (3 Ton)	0	EA	***$2,475.00***	$0	***14MH***
Hoist Rail	0	LF	***$25.00***	$0	***14MR***
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
MECHANICAL:					
Equipment Item 1	0	EA	$0.00	$0	
Equipment Item 2	0	EA	$0.00	$0	
Equipment Item 3	0	EA	$0.00	$0	
Equipment Item 4	0	EA	$0.00	$0	
Equipment Item 5	0	EA	$0.00	$0	
Equipment Item 6	0	EA	$0.00	$0	
Equipment Item 7	0	EA	$0.00	$0	
Equipment Item 8	0	EA	$0.00	$0	
Equipment Item 9	0	EA	$0.00	$0	
Equipment Item 10	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**	
Demolition Allowance	1	LS	$50,000.00	$50,000	
Item 2 Description	0		$0.00	$0	
Item 3 Description	0		$0.00	$0	
Item 4 Description	0		$0.00	$0	
Item 5 Description	0		$0.00	$0	
Item 6 Description	0		$0.00	$0	
Item 7 Description	0		$0.00	$0	
Item 8 Description	0		$0.00	$0	
Item 9 Description	0		$0.00	$0	
Item 10 Description	0		$0.00	$0	
Item 11 Description	0		$0.00	$0	
Item 12 Description	0		$0.00	$0	
Item 13 Description	0		$0.00	$0	
Item 14 Description	0		$0.00	$0	
Item 15 Description	0		$0.00	$0	
Subtotal				$50,000	
Subtotal				$407,696	
ALLOWANCES:		**User Over-write**			
Finishes Allowance	2.0%		$509,620	$10,192	
I & C Allowance	4%		$509,620	$20,385	
Mechanical Allowance	10%		$509,620	$50,962	
Electrical Allowance	4%		$509,620	$20,385	
Facility Cost				**$509,620**	
Facility Cost with Additional Project Costs Added	**-**	**0**	**#DIV/0!**	**$586,063**	
Facility Cost with Additional Project Costs & Contractor Markups Added	**-**	**0**	**#DIV/0!**	**$852,898**	
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added	**-**	**0**	**#DIV/0!**	**$901,821**	
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	**-**	**0**	**#DIV/0!**	**$1,111,043**	
Annual O & M					

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Labor	-	HRS	$ 50.00	$0
Energy	-	KWH	$ 0.07	$0
Fuel	-	GAL	$ 1.75	$0
Maintenance Materials & Supplies	1	LS	$0.00	$0
Subtotal				$0

User Defined Annual O&M Items:	Annual Cost
Item 1	$ -
Item 2	$ -
Item 3	$ -
Item 4	$ -
Item 5	$ -
Item 6	$ -
Item 7	$ -
Item 8	$ -
Item 9	$ -
Item 10	$ -
Item 11	$ -
Item 12	$ -
Item 13	$ -
Item 14	$ -
Item 15	$ -
Subtotal Annual O&M Cost	$ -
Contingency 20%	$ -
Total Annual O&M Cost	$ -

Net Present Value (NPV) Calculation:

i =	4%
n =	25

Year	Default Cost	User Over-Ride	Cost Used in NPV Calculation	Adjusted Annual O & M Cost
0	$1,111,043		$1,111,043	
1	$0		$0	
2	$0		$0	
3	$0		$0	
4	$0		$0	
5	$0		$0	
6	$0		$0	
7	$0		$0	
8	$0		$0	
9	$0		$0	
10	$0		$0	
11	$0		$0	
12	$0		$0	
13	$0		$0	
14	$0		$0	
15	$0		$0	
16	$0		$0	
17	$0		$0	
18	$0		$0	
19	$0		$0	
20	$0		$0	
21	$0		$0	
22	$0		$0	
23	$0		$0	
24	$0		$0	
25	$0		$0	
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50					
NPV			**$1,111,043**	**$0**	

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C H2M HILL P arametric Cost E stimating S ystem (CPES)

WWTP CONSTRUCTION & LIFE CYCLE COST MODULE

Use PRO2D file | Browse

Click for CPES QA/ QC | Import PRO2D information from this file

Designates User Input Required

Designates Data Automatically Transferred from PRO2D File

Project Name:	Lahaina WWTP
Project Number:	176853
Project Manager:	Ross Kaneko
Estimator:	Bruce R. Johnson
Project Description:	Alternative 7 - 9 mgd
Project Location (City):	Honolulu
Project Location (State):	HAWAII
Project Location (Country):	USA
Construction Start Date:	Jan-05
Construction Duration (months):	18
Mid-Point of Construction:	Oct-05

To WWTP Flowsheet
To Unit Process Descriptions
To Life Cycle Summary Shee
To Global Life Cycle Data

Roundup to the nearest: $10,000

Item	Is This Facility Included in Project? (Yes or No)	SCOPE OF PROJECT	User Input	Cost
1	No	Preliminary Treatment - Screening Facility		$0
	To Facility Sheet	Number of Channels (EA)	2	
		Screening Channel Width (FT)	3	
		IS A BUILDING INCLUDED?	Yes	
		(Assumption: If there is a building, there is Odor Control)		
		IF "NO" BUILDING, IS THERE ODOR CONTROL?	Yes	
2	No	Preliminary Treatment - Grit System		$0
	To Facility Sheet	Number of Grit Chambers (EA)	2	
		Grit Chamber Diameter (FT)	6	
3	No	Primary Treatment - Primary Clarifier		$0
	To Facility Sheet	Number of Clarifiers (EA)	0	
		Diameter (FT)	0.00	
		SWD (FT)	0.00	
		Depth of Burial (FT)	0.00	
4	Yes	Secondary Treatment - Aeration Basin		$3,600,000
	To Facility Sheet	Aeration Basin		
		Number of Aeration Basins	2	
		Length (Width * 4, FT)	236.94	
		Width (FT)	59.24	
		SWD (FT)	20.00	
		Depth of Burial (FT)	10.00	
		Bioreactor Influent Channel		
		Length (FT)	4.00	
		Mixed Liquor Channel		
		Length (FT)	4.00	
		Is Facility Covered?	No	
5	No	Air Supply - Blower Building		$0
	To Facility Sheet	Number of Blowers (EA)	0	
		SCFM per Blower (SCFM)	0.00	
6	Yes	Secondary Clarification - Flow Splitting Structure		$170,000
	To Facility Sheet	Number of Outlet Basins (EA)	3	
		Depth of Burial (FT)	10.00	
		Inlet Basin		
		Width (FT)	25.00	
		SWD (FT)	20.00	
		Outlet Basin (Dimensions of One)		
		Length (FT)	3.00	
		Width (FT)	3.00	
7	Yes	Secondary Clarification - Secondary Clarifier		$3,010,000
	To Facility Sheet	Number of Clarifiers (EA)	4	
		Diameter (FT)	80.00	
		SWD (FT)	16	
		Depth of Burial (FT)	12.00	

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	A	B	C	D	E
63	8	Yes	Secondary Sludge Pumping - RAS/WAS Pumping		$310,000
64		To Facility Sheet	Number of RAS Pumps (Each)	5	
65			RAS Pump Capacity (Per Unit, GPH)	60000	
66			Number of WAS Pumps (Each)	2	
67			WAS Pump Capacity (Per Unit, GPH)	2940	
68	9	No	Effluent Disinfection - Hypochlorination - Contact Basin		$0
69		To Facility Sheet	Number of Basins (EA)	0	
70			Overall Contact Basin Length (FT)	0.00	
71			Overall Contact Basin Width (FT)	0.00	
72			SWD (FT)	0.00	
73			Number of Serpentine Walls per Basin (EA)	0	
74			Influent Channel Length (FT)	0.00	
75			Effluent Channel Length (FT)	0.00	
76			Depth of Burial (FT)	0.00	
77	10	No	Effluent Disinfection - Hypochlorination - Chemical Building		$0
78		To Facility Sheet	Plant Capacity (MMADF)	0.00	
79					
80					
81					
82	1	No	Sewage Pump Station (Outside of Plant)		$0
83		To Facility Sheet	Firm Capacity (MGD)		
84					
85	2	No	Sewage Pump Station (In-Plant)		$0
86		To Facility Sheet	Firm Capacity (MGD)	7.50	
87					
88	3	No	Aerated Grit Removal & Flow Metering		$0
89		To Facility Sheet	Basin Volume (CF)		
90			Capacity (MGD) for O&M		
91	4	No	Primary Screening		$0
92		To Facility Sheet	Peak Capacity (MGD)		
93					
94	5	No	Primary Clarifier		$0
95		To Facility Sheet	Number of Clarifiers (EA)		
96			Surface Area (SF per Each)		
97	6	No	Secondary Clarifier		$0
98		To Facility Sheet	Number of Clarifiers (EA)	4	
99			Surface Area (SF per Each)	5,026.55	
100	7	No	Aeration Basin		$0
101		To Facility Sheet	Number of Basins (EA)	2	
102			Volume (CF per Each)	141,692.29	
103	8	Yes	Blowers		$610,000
104		To Facility Sheet	Firm Air Flow Capacity (CFM)	7,000.00	
105			Average Air Flow (SCFM) for O&M		
106	9	No	Air Diffusion		$0
107		To Facility Sheet	Number of Basins (EA)	2	
108			Firm Capacity (CFM per Each Basin)	3,500.00	
109	10	No	Trickling Filter		$0
110		To Facility Sheet	Number of Filters (EA)		
111			Volume of Media (CF per Each)		
112	11	No	Rotating Biological Contactor		$0
113		To Facility Sheet	Area of Media (Million SF)		
114					
115	12	No	Chlorine Contact Basin		$0
116		To Facility Sheet	Volume (CF)		
117					
118	13	Yes	Effluent Filters		$2,330,000
119		To Facility Sheet	Flow (MGD)	8.8000	
120					
121	14	No	Chlorine Feed & Storage		$0
122		To Facility Sheet	Feed Capacity (LB/DAY)		
123			Feed Capacity (Ton/Year) for O&M		
124	15	No	SO2 Storage & Feed Equipment		$0
125		To Facility Sheet	Feed Rate Capacity (LB/DAY)		
126			Feed Capacity (Ton/Year) for O&M		
127	16	No	Polymer Feed System		$0
128		To Facility Sheet	Feed Rate Capacity (LB/DAY)		

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	A	B	C	D	E
129					
130	17	No	Sludge Pumping		$0
131		To Facility Sheet	Firm Capacity (GPM)		
132					
133	18	No	Flotation Sludge Thickener		$0
134		To Facility Sheet	Number of Thickeners (EA)		
135			Diameter (Feet per Each)		
136			Surface Area (SF per Each)	-	
137	19	No	Sludge Holding Tanks		$0
138		To Facility Sheet	Volume (CF)		
139					
140	20	No	Anaerobic Digesters		$0
141		To Facility Sheet	Number of Units (Each)		
142			Digester Volume per Unit (CF)		
143	21	No	Solid Bowl Centrifuge		$0
144		To Facility Sheet	Flow Capacity (GPM)		
145			Average Loading (Total LB/Day) for O&M		
146	22	No	Belt Filter Press		$0
147		To Facility Sheet	Number of Presses (EA)		
148			Width (Meters per Each)		
149			Average Loading per Press (LB/Day) for O&M		
150	23	No	Sludge Drying Beds		$0
151		To Facility Sheet	Area (SF)		
152					
153	24	No	Flow Splitting Structure 2		$0
154		To Facility Sheet			
155					
156	25	Yes	Yard Piping		$170,000
157		To Facility Sheet			
158					
159	26	Yes	GBT Installation		$510,000
160		To Facility Sheet			
161					
162	27	No	User Defined Facility 2		$0
163		To Facility Sheet			
164					
165	28	No	User Defined Facility 3		$0
166		To Facility Sheet			
167					
168	SUBTOTAL - PROJECT COST				$10,710,000
169					
170	ADDITIONAL PROJECT COSTS:				
171	Demolition		20%		$2,142,000
172	Overall Sitework		1%		$107,100
173	Plant Computer System		1%		$107,100
174	Yard Electrical		2%		$214,200
175	Yard Piping		1%		$107,100
176	0		0%		$0
177	0		0%		$0
178	0		0%		$0
179	SUBTOTAL with Additional Project Costs				$13,387,500
180					
181	CONTRACTOR MARKUPS:				
182	Overhead		10%	$13,387,500	$1,338,750
183	Subtotal				$14,726,250
184	Profit		5%	$14,726,250	$736,313
185	Subtotal				$15,462,563
186	Mob/Bonds/Insurance		5%	$15,462,563	$773,128
187	Subtotal				$16,235,691
188	Contingency		20%	$16,235,691	$3,247,138
189	SUBTOTAL with Markups				$19,482,829
190					
191	ESCALATION (to Mid-Point of Construction):		5.74%	$19,482,829	$1,117,555
192	SUBTOTAL with Escalation				$20,600,383

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	A	B	C	D	E
193					
194	LOCATION ADJUSTMENT FACTOR		123.20%	$20,600,383	$25,379,672
195	TOTAL - CONSTRUCTION COST				$25,379,672
196					
197	RED FLAGS:				
198	1	Rock Excavation			
199	2	Pile Foundations			
200	3	Seismic Foundations			
201	4	Dewatering Conditions			
202	5	Wetlands Mitigation			
203	6	Weather Impacts			
204	7	Depth of Structures			
205	8	Local Building Code Restrictions			
206	9	Coatings or Finishes			
207	10	Building or Architectural Considerations			
208	11	Client Material Preferences			
209	12	Client Equipment Preferences			
210	13	Piping Galleries, Piping Trenches, Piping Racks			
211	14	Yard Piping Complexity			
212	15	Existing Site Utilities (New, Retrofit, and Complexity)			
213	16	I & C Automation (New or Retrofit)			
214	17	Electrical Feed (New or Retrofit)			
215	18	Electrical Distribution			
216	19	User Defined Red Flag 1			
217	20	User Defined Red Flag 2			
218	21	User Defined Red Flag 3			
219	22	User Defined Red Flag 4			
220	23	User Defined Red Flag 5			
221	24	User Defined Red Flag 6			
222	25	User Defined Red Flag 7			
223	TOTAL - RED FLAGS				$0
224					
225	SUBTOTAL - CONSTRUCTION COST with Red Flags				$25,379,672
226					
227	Did a CH2M HILL Professional Estimator Review This Cost Estimate?			No	
228	TOTAL - CONSTRUCTION COST Plus RED FLAGS				$35,531,541
229					
230	NON-CONSTRUCTION COSTS:				
231	Permitting		0%	$35,531,541	$0
232	Engineering		10%	$35,531,541	$3,553,154
233	SDC		5%	$35,531,541	$1,776,577
234	Commissioning & Startup		5%	$35,531,541	$1,776,577
235	Land ROW		0%	$35,531,541	$0
236	Legal/Admin		0%	$35,531,541	$0
237	0		0%	$35,531,541	$0
238	SUBTOTAL - Non-Construction Costs				$7,106,308
239					
240	TOTAL - CAPITAL COST				$42,637,849

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SECONDARY TREATMENT - AERATION BASIN					
		To Summary			
Is This Facility Included in My Project? Yes					
Assumptions:					
Model Based on City of Vancouver, WA Marine Park WRF					
Aeration Basin					
Number of Aeration Basins	**2**		***PRO2D Input from Summary Sheet***		
Length (FT)	**236.94**	**BL**	***User Input from Summary Sheet***		
Width (FT)	**59.24**	**BW**	***User Input from Summary Sheet***		
SWD (FT)	**20.00**	**SWD**	***PRO2D Input from Summary Sheet***		
Depth of Burial (FT)	**10**		***User Input from Summary Sheet***		
Bioreactor Inluent Channel					
Length (FT)	**4**	**BICL**	***User Input from Summary Sheet***		
Mixed Liquor Channel					
Length (FT)	**4**	**MLCL**	***User Input from Summary Sheet***		
Is Facility Covered?	**No**		***User Input from Summary Sheet***		
Dimension Calculations:					
Logic Test:					
Is "Number of Aeration Basins = 0"? ("Yes" = 0, "No" = 1)	1.00				
Facility Length (ft)	251.94	**L**	Calculated		
Facility Width (ft)	124.47	**W**	Calculated		
Slab on Grade Length (ft)	255.94		Calculated		
Slab on Grade Width (ft)	128.47		Calculated		
Slab on Grade Thickness (inches)	24.00		Fixed		
Slab on Grade Thickness (ft)	2.00		Calculated		
Freeboard (ft)	4.00	**FB**	Fixed		
Exterior Wall Height (ft)	24.00	**H**	Fixed		
Exterior Wall Thickness (inches)	24.00		Fixed		
Exterior Wall Thickness (ft)	2.00		Calculated		
Bioreactor Influent Channel Wall Height (ft)	24.00	= H	Calculated		
Bioreactor Influent Channel Wall Thickness (inches)	18.00		Fixed		
Bioreactor Influent Channel Wall Thickness (ft)	1.50		Calculated		
Baffle Wall Height (ft)	20.00	= SWD	Calculated		
Baffle Wall Thickness (inches)	12.00		Fixed		
Baffle Wall Thickness (ft)	1.00		Calculated		
Mixed Liquor Channel Wall Height (ft)	24.00	= H	Calculated		
Mixed Liquor Channel Wall Thickness (inches)	18.00		Fixed		
Mixed Liquor Channel Wall Thickness (ft)	1.50		Calculated		
Basin Divider Wall Height (ft)	24.00	= H	Fixed		

Basin Divider Wall Thickness (inches)	24.00		Fixed		
Basin Divider Wall Thickness (ft)	2.00		Calculated		
Walkway Elevated Slab Width (ft)	4.00		Fixed		
Walkway Elevated Slab Thickness (inches)	8.00		Fixed		
Walkway Elevated Slab Thickness (ft)	0.67		Calculated		
Excavation Length (ft)	259.94		Calculated		
Excavation Width (ft)	132.47		Calculated		
Excavation Depth (ft)	13.00		Calculated		
Liquid Volume (CF)	***561,422***		Calculated		
Liquid Volume (Gal)	***4,199,730***		Calculated		
DESCRIPTION	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**	
SITEWORK:					
Excavation	17,929	CY	$2.50	$44,822	
Structural Backfill	1,275	CY	$25.00	$31,884	
Backfill	1,619	CY	$5.00	$8,094	
Haul Excess	19,896	CY	$1.85	$36,807	
Allowance for Misc Items	5%		$121,608.57	$6,080	
Subtotal				$127,689	
CONCRETE:					
Slab on Grade	2,436	CY	$250.00	$608,917	
Exterior Walls	1,338	CY	$400.00	$535,346	
Bioreactor Influent Channel Wall	166	CY	$400.00	$66,385	
Baffle Wall	92	CY	$400.00	$36,881	
Mixed Liquor Channel Wall	166	CY	$400.00	$66,385	
Basin Divider Wall	421	CY	$400.00	$168,493	
Walkway Elevated Slab	99	CY	$450.00	$44,657	
Allowance for Misc Items	5%		$1,527,063.22	$76,353	
Subtotal				$1,603,416	
MASONRY:					
CMU Building	0	SF	$70.00	$0	
Subtotal				$0	
METALS:					
Handrail	2,010	LF	$40.00	$80,382	
Primary Effluent Channel Grating	0	SF	$55.00	$0	
Mixed Liquor Channel Grating	0	SF	$55.00	$0	
Allowance for Misc Items	5%		$80,381.92	$4,019	
Subtotal				$84,401	
EQUIPMENT:					
Diffuser System	31,360	SF	$8.89	$278,701	Unit Cost Based on Santa Rosa
Influent Slide Gates	4	EA	$10,000	$40,000	Rule: 2 per basin
Mixers	2	EA	$12,000	$24,000	Rule: 1 per basin
Mixed Liquor Recycle Pumps	2	EA	$25,000	$50,000	Rule: 1 per basin
Allowance for Misc Items	5%		$392,700.74	$19,635	
Subtotal				$412,336	
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**	
				$0	
				$0	
Item 3 Description	0		$0.00	$0	
Item 4 Description	0		$0.00	$0	
Item 5 Description	0		$0.00	$0	
Item 6 Description	0		$0.00	$0	
Item 7 Description	0		$0.00	$0	
Item 8 Description	0		$0.00	$0	
Item 9 Description	0		$0.00	$0	
Item 10 Description	0		$0.00	$0	
Item 11 Description	0		$0.00	$0	
Item 12 Description	0		$0.00	$0	
Item 13 Description	0		$0.00	$0	

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST	
Item 14 Description	0		$0.00	$0	
Item 15 Description	0		$0.00	$0	
Subtotal				$0	
Subtotal				$2,227,842	
ALLOWANCES:					
Finishes Allowance	2.0%		$3,593,294	$71,866	
I & C Allowance	4%		$3,593,294	$143,732	
Mechanical Allowance	22%		$3,593,294	$790,525	
Electrical Allowance	10%		$3,593,294	$359,329	
Facility Cost	**4,199,730**	**Gallons**	**$0.86**	**$3,593,294**	
Facility Cost with Additional Project Costs Added	**4,199,730**	**Gallons**	**$1.07**	**$4,491,617**	
Facility Cost with Additional Project Costs & Contractor Markups Added	**4,199,730**	**Gallons**	**$1.56**	**$6,536,651**	
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added	**4,199,730**	**Gallons**	**$1.65**	**$6,911,599**	
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	**4,199,730**	**Gallons**	**$2.03**	**$8,515,091**	

FLOW SPLITTING STRUCTURE

To Summary

Is This Facility Included in My Project? Yes

Number of Outlet Basins (EA)	***3***		***PRO2D Input from Summary Sheet***		
Depth of Burial (FT)	***10.00***		***User Input from Summary Sheet***		
Inlet Basin					
Width (FT)	***25.00***	**IW**	***User Input from Summary Sheet***		
SWD (FT)	***20.00***	**SWD**	***PRO2D Input from Summary Sheet***		
Outlet Basin (Dimensions of One)					
Length (FT)	***3.00***	**OL**	***User Input from Summary Sheet***		
Width (FT)	***3.00***	**OW**	***User Input from Summary Sheet***		
Dimension Calculations:					
Logic Test:					
Is "Number of Outlet Basins = 0"? ("Yes" = 0, "No" = 1)	1.00				
Overall Length (ft)	13.00	**L**	Calculated		
Overall Width (ft)	31.00	**W**	Calculated		
Slab on Grade Length (ft)	15.00	L + 2	Calculated		
Slab on Grade Width (ft)	33.00	W + 2	Calculated		
Slab on Grade Thickness (inches)	16.00		Fixed		
Slab on Grade Thickness (ft)	1.33		Calculated		
Freeboard (ft)	3.00	**FB**	Fixed		
Wall Height (ft)	23.00	**H**	Calculated		
Wall Thickness (inches)	12.00		Fixed		
Wall Thickness (ft)	1.00		Calculated		
Excavation Length (FT)	19.00	L + 6	Calculated		
Excavation Width (FT)	37.00	W + 6	Calculated		
Excavation Depth (FT)	12.33		Calculated		
DESCRIPTION	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**	**REFERENCE**
SPLITTER BOX MODEL:					
SITEWORK:					
Excavation	637	CY	$2.50	$1,592	
Structural Backfill	26	CY	$25.00	$651	
Backfill	379	CY	$5.00	$1,893	
Haul Excess	385	CY	$1.85	$713	
Allowance for Misc Items	5%		$4,848.29	$242	
SUBTOTAL				$5,091	
CONCRETE:					
Slab on Grade	24	CY	$250.00	$6,111	
Perimeter Walls	75	CY	$400.00	$29,985	
Inlet Basin Interior Wall	11	CY	$400.00	$4,430	
Outlet Basin Interior Walls	5	CY	$400.00	$2,044	
Allowance for Misc Items	5%		$42,570.37	$2,129	
SUBTOTAL				$44,699	
METALS:					
Handrail	88	LF	$40.00	$3,520	
Grating & Supports	352	SF	$55.00	$19,360	

Stairs	20	RISERS	$300.00	$5,850	
Allowance for Misc Items	5%		$28,730.00	$1,437	
SUBTOTAL				$30,167	
EQUIPMENT:					
Motor Operated Gates :					
Inlet Basin	4	EA	$7,500.00	$30,000	=1 + Number of Outlet Basins
Outlet Basins	3	EA	$7,500.00	$22,500	= Number of Outlet Basins
Allowance for Misc Items	5%		$52,500.00	$2,625	
SUBTOTAL				$55,125	
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**	
Item 1 Description	0		$0.00	$0	
Item 2 Description	0		$0.00	$0	
Item 3 Description	0		$0.00	$0	
Item 4 Description	0		$0.00	$0	
Item 5 Description	0		$0.00	$0	
Item 6 Description	0		$0.00	$0	
Item 7 Description	0		$0.00	$0	
Item 8 Description	0		$0.00	$0	
Item 9 Description	0		$0.00	$0	
Item 10 Description	0		$0.00	$0	
Item 11 Description	0		$0.00	$0	
Item 12 Description	0		$0.00	$0	
Item 13 Description	0		$0.00	$0	
Item 14 Description	0		$0.00	$0	
Item 15 Description	0		$0.00	$0	
Subtotal				$0	
Subtotal				$135,081	
ALLOWANCES:					
Finishes Allowance	2.0%		$160,811	$3,216	
I & C Allowance	2%		$160,811	$3,216	
Mechanical Allowance	10%		$160,811	$16,081	
Electrical Allowance	2%		$160,811	$3,216	
Facility Cost				**$160,811**	
Facility Cost with Additional Project Costs Added				**$201,014**	
Facility Cost with Additional Project Costs & Contractor Markups Added				**$292,535**	
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added				**$309,315**	
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added				**$381,076**	

SECONDARY CLARIFIER

To Summary

Is This Facility Included in My Project? Yes

Assumptions:

Based on Ocala WRF No. 3 (5mgd MMADF)

Number of Clarifiers (EA)	***4***		***PRO2D Input from Summary Sheet***
Diameter (FT)	***80***	***D***	***PRO2D Input from Summary Sheet***
SWD (FT)	***16***	***SWD***	***PRO2D Input from Summary Sheet***
Depth of Burial (FT)	***12***		***User Input from Summary Sheet***

Dimension Calculations:

Logic Test:			
Is "Number of Clarifiers = 0"? ("Yes" = 0, "No" = 1)	1.00		
Slab on Grade Diameter	83.00	D+3	Calculated
Slab on Grade Thickness (inches)	16.00		Fixed
Slab on Grade Thickness (ft)	1.33	TS	Calculated
Freeboard (ft)	3.00	FB	Fixed
Exterior Wall Height (ft)	19.00	H = SWD + FB	Calculated
Exterior Wall Thickness (inches)	16.00		Fixed
Exterior Wall Thickness (ft)	1.33	TW	Calculated
Interior Launder Elevated Slab Width (ft)	5.00	WIS	Constant
Interior Launder Average Diameter (for launder slab area)	75.00	D-WIS	Calculated
Interior Launder Wall Diameter (ft)	77.00	D-(WIS-1*2)	Calculated
Interior Launder Wall Height (ft)	3.00		Fixed
Interior Launder Wall Thickness (inches)	8.00		Fixed
Interior Launder Wall Thickness (ft)	0.67		Calculated
Interior Launder Elevated Slab Thickness (inches)	8.00		Fixed
Interior Launder Elevated Slab Thickness (ft)	0.67		Calculated
Exterior Walkway Slab Width	4.00	WES	Constant
Exterior Walkway Handrail Diameter	90.67	D+(TW*2)+(WES*2	Calculated
Exterior Walkway Slab Thickness	0.67		Constant
Excavation Diameter	87.00	D+7	Calculated
Excavation Depth	14.33		Calculated
Liquid Volume (CF)	***321,536***		Calculated
Liquid Volume (Gal)	***2,405,256***		Calculated

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
SITEWORK:				
Excavation	16,774	CY	$2.50	$41,935
Structural Backfill	880	CY	$25.00	$22,006
Backfill	4,989	CY	$5.00	$24,944
Haul Excess	15,140	CY	$1.85	$28,009
Allowance for Misc Items	5%		$116,894.69	$5,845
Subtotal				$122,739
CONCRETE:				
Exterior Walls:				
Slab on Grade	1,068	CY	$250.00	$267,055
Circular Walls	943	CY	$450.00	$424,249

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST	
Interior Launder:					
Circular Walls	72	CY	$500.00	$35,819	
Elevated Slab	116	CY	$450.00	$52,333	
Exterior Walkway:					
Elevated Slab	112	CY	$500.00	$56,236	
Center Sludge/RAS Pit	40	CY	$200.00	$8,000	
Concrete Encasement	80	CY	$180.00	$14,400	
Clarifier Bottom Grout 2"	20,096	SF	$11.00	$221,056	
4" Concrete Pads	0.79	CY	$200.00	$158	
Allowance for Misc Items	5%		$1,079,148.26	$53,957	
Subtotal				$1,133,264	
METALS:					
Weir	967	LF	$50.00	$48,356	
Scum Baffle & Supports	967	LF	$100.00	$96,712	
Scum Box	4	EA	$4,000.00	$16,000	
Aluminum Stairs	42	RISERS	$300.00	$12,600	
Aluminum Platform	54	SF	$20.00	$1,080	
Aluminum Handrail	1,139	LF	$50.00	$56,939	
Allowance for Misc Items	5%		$231,686.67	$11,584	
Subtotal				$243,271	
EQUIPMENT:					
Clarifier Mechanism	4	EA	$138,000	$552,000	
Submersible Scum Pump	4	EA	$13,500	$54,000	
Allowance for Misc Items	5%		$606,000.00	$30,300	
Subtotal				$636,300	
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**	
Item 1 Description	0		$0.00	$0	
Item 2 Description	0		$0.00	$0	
Item 3 Description	0		$0.00	$0	
Item 4 Description	0		$0.00	$0	
Item 5 Description	0		$0.00	$0	
Item 6 Description	0		$0.00	$0	
Item 7 Description	0		$0.00	$0	
Item 8 Description	0		$0.00	$0	
Item 9 Description	0		$0.00	$0	
Item 10 Description	0		$0.00	$0	
Item 11 Description	0		$0.00	$0	
Item 12 Description	0		$0.00	$0	
Item 13 Description	0		$0.00	$0	
Item 14 Description	0		$0.00	$0	
Item 15 Description	0		$0.00	$0	
Subtotal				$0	
Subtotal				$2,135,574	
ALLOWANCES:					
Finishes Allowance	2.0%		$3,007,851	$60,157	
I & C Allowance	4%		$3,007,851	$120,314	
Mechanical Allowance	20%		$3,007,851	$601,570	Based on $59,641 / $766,488
Electrical Allowance	3%		$3,007,851	$90,236	
Facility Cost	**2,405,256**	**Galllons**	**$1.25**	**$3,007,851**	
Facility Cost with Additional Project Costs Added	**2,405,256**	**Galllons**	**$1.56**	**$3,759,814**	
Facility Cost with Additional Project Costs & Contractor Markups Added	**2,405,256**	**Galllons**	**$2.27**	**$5,471,657**	
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added	**2,405,256**	**Galllons**	**$2.41**	**$5,785,516**	
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	**2,405,256**	**Galllons**	**$2.96**	**$7,127,756**	

RAS AND WAS PUMPING

To Summary

Is This Facility Included in My Project? Yes

Assumptions:

Based on Ocala WRF No. 3 (5mgd MMADF)

RAS and WAS pumps are located outside

Number of RAS Pumps (Each)	***5***		***PRO2D Input from Summary Sheet***	
RAS Pump Capacity (Per Unit, GPH)	***60000***		***PRO2D Input from Summary Sheet***	
Number of WAS Pumps (Each)	***2***		***PRO2D Input from Summary Sheet***	
WAS Pump Capacity (Per Unit, GPH)	***2940***		***PRO2D Input from Summary Sheet***	

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
SITEWORK:				
Sitework Allowance	7	LS	$833.33	$5,833
Subtotal				$5,833
CONCRETE:				
8" Slab on Grade	53	CY	$250.00	$13,136
Allowance for Misc Items	5%		$13,135.80	$657
Subtotal				$13,793
EQUIPMENT:				
RAS Pumps (1170 gpm, 870 rpm, TDH =11.5ft, 7.5 hp)	5	EA	$18,281.18	$91,406
WAS Pumps (200 gpm, 1185 rpm TDH = 14 ft, 3hp)	2	EA	$1,670.81	$3,342
Allowance for Misc Items	5%		$94,747.52	$4,737
Subtotal				$99,485
MECHANICAL:				
RAS Piping:				
12" RAS	50	LF	$29.45	$1,473
12" Tee	5	EA	$1,130	$5,650
12" Elbow	5	EA	$700	$3,500
10" x 12" Reducing Elbow	5	EA	$700	$3,500
10" V405	15	EA	$1,750	$26,250
10" V604	5	EA	$2,259	$11,295
8" x 10" Reducing Elbow	5	EA	$532	$2,660
8" x 10" Reducer	5	EA	$532	$2,660
10" x 10 x 2" Tee	5	EA	$943	$4,715
10" Elbow	5	EA	$532	$2,660
10" Tee	15	EA	$943	$14,145
10" Flanged Coupling Adapter	5	EA	$250	$1,250
10" Flow Meter	5	EA	$5,368	$26,840
10" RAS	125	LF	$24.43	$3,054
2" V400	5	EA	$334	$1,670
WAS Piping:				
6" WAS	40	LF	$15.73	$629
6" Elbow	6	EA	$234	$1,404

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
6" V405	2	EA	$802	$1,604
4" x 6" Reducing Elbow	2	EA	$234	$468
4" WAS	100	LF	$14.08	$1,408
4" x 4" x 2" Tee	4	EA	$260	$1,040
2" V400	2	EA	$334	$668
4" V604	2	EA	$565	$1,130
4" Elbow	4	EA	$177	$708
4" Tee	8	EA	$260	$2,080
4" Flow Meter	2	EA	$3,431	$6,862
4" Flanged Coupling Adapter	2	EA	$109	$218
Allowance for Small Pipe & Pipe Supports	7	LS	$1,667	$11,667
Subtotal				$141,207
ELECTRICAL:				
RAS Pumps VFD's (7.5 hp)	5	EA	$4,600	$23,000
Allowance for Misc Items	5%		$23,000.00	$1,150
Subtotal				$24,150
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**
Delete Concrete and Site Work	1	LS	($19,625.93)	($19,626)
Item 2 Description	0		$0.00	$0
Item 3 Description	0		$0.00	$0
Item 4 Description	0		$0.00	$0
Item 5 Description	0		$0.00	$0
Item 6 Description	0		$0.00	$0
Item 7 Description	0		$0.00	$0
Item 8 Description	0		$0.00	$0
Item 9 Description	0		$0.00	$0
Item 10 Description	0		$0.00	$0
Item 11 Description	0		$0.00	$0
Item 12 Description	0		$0.00	$0
Item 13 Description	0		$0.00	$0
Item 14 Description	0		$0.00	$0
Item 15 Description	0		$0.00	$0
Subtotal				($19,626)
Subtotal				$264,842
ALLOWANCES:				
Finishes Allowance	0.0%		$307,956	$0
I & C Allowance	4%		$307,956	$12,318
Mechanical Allowance	0%		$307,956	$0
Electrical Allowance	10%		$307,956	$30,796
Facility Cost				**$307,956**
Facility Cost with Additional Project Costs Added				**$384,945**
Facility Cost with Additional Project Costs & Contractor Markups Added				**$560,210**
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added				**$592,344**
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added				**$729,768**

Blowers

To Summary Sheet

Is This Facility Included in My Project? Yes

Assumptions:

Firm Air Flow Capacity (CFM)	*7,000.00*	*CFM*		
Average Air Flow (SCFM) for O&M	*-*	*SCFM*		
Cost models are based on this date:	**20 Cities Average**	**Jan-03**		
Cost models are escalated to this date:	**20 Cities Average**	**Jan-03**	**1.00**	

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
Aeration Basin				
Aeration Basin	7,000	CFM	$86.90	$608,301
Subtotal				$608,301
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**
Item 1 Description	0		$0.00	$0
Item 2 Description	0		$0.00	$0
Item 3 Description	0		$0.00	$0
Item 4 Description	0		$0.00	$0
Item 5 Description	0		$0.00	$0
Item 6 Description	0		$0.00	$0
Item 7 Description	0		$0.00	$0
Item 8 Description	0		$0.00	$0
Item 9 Description	0		$0.00	$0
Item 10 Description	0		$0.00	$0
Item 11 Description	0		$0.00	$0
Item 12 Description	0		$0.00	$0
Item 13 Description	0		$0.00	$0
Item 14 Description	0		$0.00	$0
Item 15 Description	0		$0.00	$0
Subtotal				$0
Subtotal				$608,301
ALLOWANCES:				
Finishes Allowance	0.0%		$608,301	$0
I & C Allowance	0%		$608,301	$0
Mechanical Allowance	0%		$608,301	$0
Electrical Allowance	0%		$608,301	$0
Facility Cost	**7,000**	**CFM**	**$86.90**	**$608,301**
Facility Cost with Additional Project Costs Added	**7,000**	**CFM**	**$108.63**	**$760,376**
Facility Cost with Additional Project Costs & Contractor Markups Added	**7,000**	**CFM**	**$158.08**	**$1,106,576**
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added	**7,000**	**CFM**	**$167.15**	**$1,170,050**
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	**7,000**	**CFM**	**$205.93**	**$1,441,501**
Annual O & M				
	0	SCFM		
Labor	-	HRS	**$ 50.00**	$0
Energy	-	KWH	**$ 0.07**	$0
Maintenance Materials & Supplies	0	SCFM	$0.00	$0
Subtotal				$0
User Defined Annual O&M Items:				**Annual Cost**

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
Item 1				$ -
Item 2				$ -
Item 3				$ -
Item 4				$ -
Item 5				$ -
Item 6				$ -
Item 7				$ -
Item 8				$ -
Item 9				$ -
Item 10				$ -
Item 11				$ -
Item 12				$ -
Item 13				$ -
Item 14				$ -
Item 15				$ -
Subtotal Annual O&M Cost				$ -
Contingency			20%	$ -
Total Annual O&M Cost				$ -

Net Present Value (NPV) Calculation:

i =	4%
n =	25

Year	Default Cost	User Over-Ride	Cost Used in NPV Calculation	Adjusted Annual O & M Cost
0	$1,441,501		$1,441,501	
1	$0		$0	
2	$0		$0	
3	$0		$0	
4	$0		$0	
5	$0		$0	
6	$0		$0	
7	$0		$0	
8	$0		$0	
9	$0		$0	
10	$0		$0	
11	$0		$0	
12	$0		$0	
13	$0		$0	
14	$0		$0	
15	$0		$0	
16	$0		$0	
17	$0		$0	
18	$0		$0	
19	$0		$0	
20	$0		$0	
21	$0		$0	
22	$0		$0	
23	$0		$0	
24	$0		$0	
25	$0		$0	
26				
27				
28				
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34				

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
35				
36				
37				
38				
39				
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41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
NPV			$1,441,501	$0

Effluent Filters

To Summary Sheet

Is This Facility Included in My Project? Yes

Assumptions:

Flow (MDG)	***8.8000***	***MGD***	
Cost models are based on this date:	**20 Cities Average**	**Jan-03**	
Cost models are escalated to this date:	**20 Cities Average**	**Jan-03**	**1.00**

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
Effluent Filters				
Effluent Filters	9	MGD	$264,549.18	$2,328,033
Subtotal				$2,328,033
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**
Item 1 Description	0		$0.00	$0
Item 2 Description	0		$0.00	$0
Item 3 Description	0		$0.00	$0
Item 4 Description	0		$0.00	$0
Item 5 Description	0		$0.00	$0
Item 6 Description	0		$0.00	$0
Item 7 Description	0		$0.00	$0
Item 8 Description	0		$0.00	$0
Item 9 Description	0		$0.00	$0
Item 10 Description	0		$0.00	$0
Item 11 Description	0		$0.00	$0
Item 12 Description	0		$0.00	$0
Item 13 Description	0		$0.00	$0
Item 14 Description	0		$0.00	$0
Item 15 Description	0		$0.00	$0
Subtotal				$0
Subtotal				$2,328,033
ALLOWANCES:				
Finishes Allowance	0.0%		$2,328,033	$0
I & C Allowance	0%		$2,328,033	$0
Mechanical Allowance	0%		$2,328,033	$0
Electrical Allowance	0%		$2,328,033	$0
Facility Cost	**9**	**MGD**	**$264,549.18**	**$2,328,033**
Facility Cost with Additional Project Costs Added	**9**	**MGD**	**$330,686.47**	**$2,910,041**
Facility Cost with Additional Project Costs & Contractor Markups Added	**9**	**MGD**	**$481,248.03**	**$4,234,983**
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added	**9**	**MGD**	**$508,852.89**	**$4,477,905**
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	**9**	**MGD**	**$626,906.77**	**$5,516,780**
Annual O & M				

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
	9	MGD		
Labor	3,726	HRS	$ 50.00	$186,286
Energy	106,301	KWH	$ 0.07	$7,441
Maintenance Materials & Supplies	9	MGD	$219.17	$1,929
Subtotal				$195,656
User Defined Annual O&M Items:				**Annual Cost**
Item 1				$ -
Item 2				$ -
Item 3				$ -
Item 4				$ -
Item 5				$ -
Item 6				$ -
Item 7				$ -
Item 8				$ -
Item 9				$ -
Item 10				$ -
Item 11				$ -
Item 12				$ -
Item 13				$ -
Item 14				$ -
Item 15				$ -
Subtotal Annual O&M Cost				$ 195,656
Contingency			20%	$ 39,131
Total Annual O&M Cost				$ 234,787

Net Present Value (NPV) Calculation:

i =	4%
n =	25

Year	Default Cost	User Over-Ride	Cost Used in NPV Calculation	Adjusted Annual O & M Cost
0	$5,516,780		$5,516,780	
1	$234,787		$234,787	
2	$234,787		$234,787	
3	$234,787		$234,787	
4	$234,787		$234,787	
5	$234,787		$234,787	
6	$234,787		$234,787	
7	$234,787		$234,787	
8	$234,787		$234,787	
9	$234,787		$234,787	
10	$234,787	$ 10,000,000.00	$10,000,000	
11	$234,787		$234,787	
12	$234,787		$234,787	
13	$234,787		$234,787	
14	$234,787		$234,787	
15	$234,787		$234,787	
16	$234,787		$234,787	

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
17	$234,787		$234,787	
18	$234,787		$234,787	
19	$234,787		$234,787	
20	$234,787		$234,787	
21	$234,787		$234,787	
22	$234,787		$234,787	
23	$234,787		$234,787	
24	$234,787		$234,787	
25	$234,787		$234,787	
26				
27				
28				
29				
30				
31				
32				
33				
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50				
NPV			$15,781,673	$657,076

Yard Piping

PROCESS DESIGN CRITERIA

To Summary

Is This Facility Included in My Project? Yes

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
1.) Input **Average Pipe Burial Depth** (ft)	4			
2.) Input **Yard Pipe Information**				
Yard Pipe Line Description	**Type of Pipe**	**Pipe Diameter (inches)**	**Pipe Length (feet)**	
SC Feed Pipe	DI	16	300.00	
AB Feed Pipe	DI	30	100.00	
SC Effluent Pipe	DI	24	500.00	
RAS Piping	DI	14	500.00	
WAS Piping	DI	6	500.00	
Item 6 Description	Steel			
Item 7 Description	Steel			
Item 8 Description	Steel			
Item 9 Description	Steel			
Item 10 Description	Steel			
Item 11 Description	Steel			
Item 12 Description	Steel			
Item 13 Description	Steel			
Item 14 Description	Steel			
Item 15 Description	Steel			
Item 16 Description	Steel			
Item 17 Description	Steel			
Item 18 Description	Steel			
Item 19 Description	Steel			
Item 20 Description	Steel			

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST	REFERENCE / COMMENTS
SITEWORK:					
Yard Piping Trenching, Bedding, Backfill, Compaction:					
SC Feed Pipe	300	LF	$22.07	$6,622	
AB Feed Pipe	100	LF	$31.72	$3,172	
SC Effluent Pipe	500	LF	$27.30	$13,651	
RAS Piping	500	LF	$20.88	$10,442	
WAS Piping	500	LF	$16.60	$8,300	
Item 6 Description	0	LF	$0.00	$0	
Item 7 Description	0	LF	$0.00	$0	
Item 8 Description	0	LF	$0.00	$0	
Item 9 Description	0	LF	$0.00	$0	
Item 10 Description	0	LF	$0.00	$0	
Item 11 Description	0	LF	$0.00	$0	
Item 12 Description	0	LF	$0.00	$0	
Item 13 Description	0	LF	$0.00	$0	
Item 14 Description	0	LF	$0.00	$0	
Item 15 Description	0	LF	$0.00	$0	
Item 16 Description	0	LF	$0.00	$0	
Item 17 Description	0	LF	$0.00	$0	
Item 18 Description	0	LF	$0.00	$0	
Item 19 Description	0	LF	$0.00	$0	
Item 20 Description	0	LF	$0.00	$0	
Yard Pipiping:					
SC Feed Pipe	300	LF	$53.72	$16,116	
AB Feed Pipe	100	LF	$103.68	$10,368	
SC Effluent Pipe	500	LF	$82.27	$41,133	
RAS Piping	500	LF	$46.58	$23,292	
WAS Piping	500	LF	$18.04	$9,020	
Item 6 Description	0	LF	$0.00	$0	
Item 7 Description	0	LF	$0.00	$0	
Item 8 Description	0	LF	$0.00	$0	
Item 9 Description	0	LF	$0.00	$0	
Item 10 Description	0	LF	$0.00	$0	
Item 11 Description	0	LF	$0.00	$0	
Item 12 Description	0	LF	$0.00	$0	
Item 13 Description	0	LF	$0.00	$0	
Item 14 Description	0	LF	$0.00	$0	
Item 15 Description	0	LF	$0.00	$0	
Item 16 Description	0	LF	$0.00	$0	
Item 17 Description	0	LF	$0.00	$0	
Item 18 Description	0	LF	$0.00	$0	
Item 19 Description	0	LF	$0.00	$0	
Item 20 Description	0	LF	$0.00	$0	
Allowance for Fittings	15%		$99,929.36	$14,989	
Allowance for Misc Items	5%		$157,104.86	$7,855	
Subtotal				$164,960	

USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**
Item 1 Description	0		$0.00	$0
Item 2 Description	0		$0.00	$0
Item 3 Description	0		$0.00	$0
Item 4 Description	0		$0.00	$0
Item 5 Description	0		$0.00	$0
Item 6 Description	0		$0.00	$0
Item 7 Description	0		$0.00	$0

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Item 8 Description	0		$0.00	$0
Item 9 Description	0		$0.00	$0
Item 10 Description	0		$0.00	$0
Item 11 Description	0		$0.00	$0
Item 12 Description	0		$0.00	$0
Item 13 Description	0		$0.00	$0
Item 14 Description	0		$0.00	$0
Item 15 Description	0		$0.00	$0
Subtotal				$0
Subtotal				$164,960
ALLOWANCES:				
Finishes Allowance	0.0%		$164,960	$0
I & C Allowance	0%		$164,960	$0
Mechanical Allowance	0%		$164,960	$0
Electrical Allowance	0%		$164,960	$0
Facility Cost				**$164,960**
Facility Cost with Additional Project Costs Added	**-**	**0**	**#DIV/0!**	**$206,200**
Facility Cost with Additional Project Costs & Contractor Markups Added	**-**	**0**	**#DIV/0!**	**$300,083**
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added	**-**	**0**	**#DIV/0!**	**$317,296**
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	**-**	**0**	**#DIV/0!**	**$390,909**
Annual O & M				
Labor	-	HRS	**$ 50.00**	$0
Energy	-	KWH	**$ 0.07**	$0
Maintenance Materials & Supplies	1	LS	$0.00	$0
Subtotal				$0
User Defined Annual O&M Items:				**Annual Cost**
Item 1				**$ -**
Item 2				**$ -**
Item 3				**$ -**
Item 4				**$ -**
Item 5				**$ -**
Item 6				**$ -**
Item 7				**$ -**
Item 8				**$ -**
Item 9				**$ -**
Item 10				**$ -**
Item 11				**$ -**
Item 12				**$ -**
Item 13				**$ -**
Item 14				**$ -**
Item 15				**$ -**
Subtotal Annual O&M Cost				**$ -**
Contingency			**20%**	**$ -**
Total Annual O&M Cost				**$ -**
Net Present Value (NPV) Calculation:				
i =	4%			
n =	25			
Year	**Default Cost**	**User Over-Ride**	**Cost Used in NPV Calculation**	**Adjusted Annual O & M Cost**
0	**$390,909**		**$390,909**	
1	**$0**		**$0**	
2	**$0**		**$0**	
3	**$0**		**$0**	
4	**$0**		**$0**	
5	**$0**		**$0**	
6	**$0**		**$0**	
7	**$0**		**$0**	
8	**$0**		**$0**	
9	**$0**		**$0**	
10	**$0**		**$0**	
11	**$0**		**$0**	
12	**$0**		**$0**	
13	**$0**		**$0**	
14	**$0**		**$0**	
15	**$0**		**$0**	
16	**$0**		**$0**	
17	**$0**		**$0**	
18	**$0**		**$0**	
19	**$0**		**$0**	
20	**$0**		**$0**	
21	**$0**		**$0**	
22	**$0**		**$0**	
23	**$0**		**$0**	
24	**$0**		**$0**	
25	**$0**		**$0**	
26				
27				
28				
29				
30				
31				

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32					
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50					
NPV			**$390,909**	**$0**	

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GBT Installation

To Summary

Is This Facility Included in My Project? Yes

Parametric Inputs	Value

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST	REFERENCE / COMMENTS
SITEWORK:					
Excavation	0	CY	***$2.50***	$0	***02E***
Structural Backfill	0	CY	***$25.00***	$0	***02SB***
Backfill	0	CY	***$5.00***	$0	***02B***
Haul Excess	0	CY	***$5.00***	$0	***02HE***
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
CONCRETE:					
Slab on Grade	0	CY	***$250.00***	$0	***03S***
Slab on Grade	28	CY	***$250.00***	$6,944	***03S***
Walls	6	CY	***$400.00***	$2,519	***03W***
Walls	0	CY	***$400.00***	$0	***03W***
Walls	0	CY	***$400.00***	$0	***03W***
Walls	0	CY	***$400.00***	$0	***03W***
Beams	0	CY	***$1,000.00***	$0	***03B***
Beams	0	CY	***$1,000.00***	$0	***03B***
Elevated Slab	0	CY	***$450.00***	$0	***03ES***
Elevated Slab	0	CY	***$450.00***	$0	***03ES***
Allowance for Misc Items	5%		$9,463	$473	
Subtotal				$9,936	
MASONRY:					
Type of Building Construction:	**Moderate**				
Building	0	SF	***$100.00***	$0	***04BM***
Subtotal				$0	
METALS:					
Grating	160	SF	***$55.00***	$8,800	***05G***
Handrail	80	LF	***$55.00***	$4,400	***05H***
Stairs	10	Risers	***$300.00***	$3,000	***05S***
Allowance for Misc Items	5%		$16,200.00	$810	
Subtotal				$17,010	
WOOD & PLASTIC:					
Item 1	0	EA	$0.00	$0	
Item 2	0	EA	$0.00	$0	
Item 3	0	EA	$0.00	$0	
Item 4	0	EA	$0.00	$0	
Item 5	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
THERMAL & MOISTURE PROTECTION:					
Item 1	0	EA	$0.00	$0	
Item 2	0	EA	$0.00	$0	
Item 3	0	EA	$0.00	$0	
Item 4	0	EA	$0.00	$0	
Item 5	0	EA	$0.00	$0	
Roof Hatch (4' x 6', double leaf)	0	EA	***$1,800.00***	$0	***07RH1***
Roof Hatch (2' x 2', double leaf)	0	EA	***$300.00***	$0	***07RH2***
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
DOORS & WINDOWS:					
Item 1	0	EA	$0.00	$0	
Item 2	0	EA	$0.00	$0	
Item 3	0	EA	$0.00	$0	
Item 4	0	EA	$0.00	$0	

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Item 5	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
EQUIPMENT:					
Gravity Belt Thickener	2	EA	$110,000.00	$220,000	
Polymer System	1	EA	$50,000.00	$50,000	
Thickened Sludge Pumps	3	EA	$15,000.00	$45,000	
Equipment Item 4	0	EA	$0.00	$0	
Equipment Item 5	0	EA	$0.00	$0	
Equipment Item 6	0	EA	$0.00	$0	
Equipment Item 7	0	EA	$0.00	$0	
Equipment Item 8	0	EA	$0.00	$0	
Equipment Item 9	0	EA	$0.00	$0	
Equipment Item 10	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$315,000.00	$15,750	
Subtotal				$330,750	
I&C:					
Item 1	0	EA	$0.00	$0	
Item 2	0	EA	$0.00	$0	
Item 3	0	EA	$0.00	$0	
Item 4	0	EA	$0.00	$0	
Item 5	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
CONVEYING SYSTEMS:					
Monorail Hoist (3 Ton)	0	EA	***$2,475.00***	$0	***14MH***
Hoist Rail	0	LF	***$25.00***	$0	***14MR***
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
MECHANICAL:					
Equipment Item 1	0	EA	$0.00	$0	
Equipment Item 2	0	EA	$0.00	$0	
Equipment Item 3	0	EA	$0.00	$0	
Equipment Item 4	0	EA	$0.00	$0	
Equipment Item 5	0	EA	$0.00	$0	
Equipment Item 6	0	EA	$0.00	$0	
Equipment Item 7	0	EA	$0.00	$0	
Equipment Item 8	0	EA	$0.00	$0	
Equipment Item 9	0	EA	$0.00	$0	
Equipment Item 10	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**	
Demolition Allowance	1	LS	$50,000.00	$50,000	
Item 2 Description	0		$0.00	$0	
Item 3 Description	0		$0.00	$0	
Item 4 Description	0		$0.00	$0	
Item 5 Description	0		$0.00	$0	
Item 6 Description	0		$0.00	$0	
Item 7 Description	0		$0.00	$0	
Item 8 Description	0		$0.00	$0	
Item 9 Description	0		$0.00	$0	
Item 10 Description	0		$0.00	$0	
Item 11 Description	0		$0.00	$0	
Item 12 Description	0		$0.00	$0	
Item 13 Description	0		$0.00	$0	
Item 14 Description	0		$0.00	$0	
Item 15 Description	0		$0.00	$0	
Subtotal				$50,000	
Subtotal				$407,696	
ALLOWANCES:		**User Over-write**			
Finishes Allowance	2.0%		$509,620	$10,192	
I & C Allowance	4%		$509,620	$20,385	
Mechanical Allowance	10%		$509,620	$50,962	
Electrical Allowance	4%		$509,620	$20,385	
Facility Cost				**$509,620**	
Facility Cost with Additional Project Costs Added	**-**	**0**	**#DIV/0!**	**$637,025**	
Facility Cost with Additional Project Costs & Contractor Markups Added	**-**	**0**	**#DIV/0!**	**$927,063**	
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added	**-**	**0**	**#DIV/0!**	**$980,240**	
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	**-**	**0**	**#DIV/0!**	**$1,207,656**	
Annual O & M					

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Labor	-	HRS	$ 50.00	$0
Energy	-	KWH	$ 0.07	$0
Fuel	-	GAL	$ 1.75	$0
Maintenance Materials & Supplies	1	LS	$0.00	$0
Subtotal				$0

User Defined Annual O&M Items:	Annual Cost
Item 1	$ -
Item 2	$ -
Item 3	$ -
Item 4	$ -
Item 5	$ -
Item 6	$ -
Item 7	$ -
Item 8	$ -
Item 9	$ -
Item 10	$ -
Item 11	$ -
Item 12	$ -
Item 13	$ -
Item 14	$ -
Item 15	$ -
Subtotal Annual O&M Cost	$ -
Contingency 20%	$ -
Total Annual O&M Cost	$ -

Net Present Value (NPV) Calculation:

i =	4%
n =	25

Year	Default Cost	User Over-Ride	Cost Used in NPV Calculation	Adjusted Annual O & M Cost
0	$1,207,656		$1,207,656	
1	$0		$0	
2	$0		$0	
3	$0		$0	
4	$0		$0	
5	$0		$0	
6	$0		$0	
7	$0		$0	
8	$0		$0	
9	$0		$0	
10	$0		$0	
11	$0		$0	
12	$0		$0	
13	$0		$0	
14	$0		$0	
15	$0		$0	
16	$0		$0	
17	$0		$0	
18	$0		$0	
19	$0		$0	
20	$0		$0	
21	$0		$0	
22	$0		$0	
23	$0		$0	
24	$0		$0	
25	$0		$0	
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				
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41				

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42					
43					
44					
45					
46					
47					
48					
49					
50					
NPV			**$1,207,656**	**$0**	

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C H2M HILL P arametric Cost E stimating S ystem (CPES)

WWTP CONSTRUCTION & LIFE CYCLE COST MODULE

Use PRO2D file | Browse

Click for CPES QA/ QC | Import PRO2D information from this file

Designates User Input Required

Designates Data Automatically Transferred from PRO2D File

Project Name:	Lahaina WWTP
Project Number:	176853
Project Manager:	Ross Kaneko
Estimator:	Bruce R. Johnson
Project Description:	Alternative 7 - 12 mgd
Project Location (City):	Honolulu
Project Location (State):	HAWAII
Project Location (Country):	USA
Construction Start Date:	Jan-05
Construction Duration (months):	18
Mid-Point of Construction:	Oct-05

To WWTP Flowsheet
To Unit Process Descriptions
To Life Cycle Summary Shee
To Global Life Cycle Data

Roundup to the nearest: $10,000

Item	Is This Facility Included in Project? (Yes or No)	SCOPE OF PROJECT	User Input	Cost
1	No	Preliminary Treatment - Screening Facility		$0
	To Facility Sheet	Number of Channels (EA)	4	
		Screening Channel Width (FT)	3	
		IS A BUILDING INCLUDED?	Yes	
		(Assumption: If there is a building, there is Odor Control)		
		IF "NO" BUILDING, IS THERE ODOR CONTROL?	Yes	
2	No	Preliminary Treatment - Grit System		$0
	To Facility Sheet	Number of Grit Chambers (EA)	4	
		Grit Chamber Diameter (FT)	6	
3	No	Primary Treatment - Primary Clarifier		$0
	To Facility Sheet	Number of Clarifiers (EA)	0	
		Diameter (FT)	0.00	
		SWD (FT)	0.00	
		Depth of Burial (FT)	0.00	
4	Yes	Secondary Treatment - Aeration Basin		$5,110,000
	To Facility Sheet	Aeration Basin		
		Number of Aeration Basins	2	
		Length (Width * 4, FT)	305.89	
		Width (FT)	76.47	
		SWD (FT)	20.00	
		Depth of Burial (FT)	10.00	
		Bioreactor Influent Channel		
		Length (FT)	4.00	
		Mixed Liquor Channel		
		Length (FT)	4.00	
		Is Facility Covered?	No	
5	No	Air Supply - Blower Building		$0
	To Facility Sheet	Number of Blowers (EA)	4	
		SCFM per Blower (SCFM)	4200.00	
6	Yes	Secondary Clarification - Flow Splitting Structure		$200,000
	To Facility Sheet	Number of Outlet Basins (EA)	4	
		Depth of Burial (FT)	10.00	
		Inlet Basin		
		Width (FT)	25.00	
		SWD (FT)	20.00	
		Outlet Basin (Dimensions of One)		
		Length (FT)	3.00	
		Width (FT)	3.00	
7	Yes	Secondary Clarification - Secondary Clarifier		$3,760,000
	To Facility Sheet	Number of Clarifiers (EA)	5	
		Diameter (FT)	80.00	
		SWD (FT)	16	
		Depth of Burial (FT)	12.00	

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	A	B	C	D	E
63	8	Yes	Secondary Sludge Pumping - RAS/WAS Pumping		$350,000
64		To Facility Sheet	Number of RAS Pumps (Each)	5	
65			RAS Pump Capacity (Per Unit, GPH)	78000	
66			Number of WAS Pumps (Each)	2	
67			WAS Pump Capacity (Per Unit, GPH)	2940	
68	9	No	Effluent Disinfection - Hypochlorination - Contact Basin		$0
69		To Facility Sheet	Number of Basins (EA)	0	
70			Overall Contact Basin Length (FT)	0.00	
71			Overall Contact Basin Width (FT)	0.00	
72			SWD (FT)	0.00	
73			Number of Serpentine Walls per Basin (EA)	0	
74			Influent Channel Length (FT)	0.00	
75			Effluent Channel Length (FT)	0.00	
76			Depth of Burial (FT)	0.00	
77	10	No	Effluent Disinfection - Hypochlorination - Chemical Building		$0
78		To Facility Sheet	Plant Capacity (MMADF)	0.00	
79					
80					
81					
82	1	No	Sewage Pump Station (Outside of Plant)		$0
83		To Facility Sheet	Firm Capacity (MGD)		
84					
85	2	No	Sewage Pump Station (In-Plant)		$0
86		To Facility Sheet	Firm Capacity (MGD)	7.50	
87					
88	3	No	Aerated Grit Removal & Flow Metering		$0
89		To Facility Sheet	Basin Volume (CF)		
90			Capacity (MGD) for O&M		
91	4	No	Primary Screening		$0
92		To Facility Sheet	Peak Capacity (MGD)		
93					
94	5	No	Primary Clarifier		$0
95		To Facility Sheet	Number of Clarifiers (EA)		
96			Surface Area (SF per Each)		
97	6	No	Secondary Clarifier		$0
98		To Facility Sheet	Number of Clarifiers (EA)	4	
99			Surface Area (SF per Each)	5,026.55	
100	7	No	Aeration Basin		$0
101		To Facility Sheet	Number of Basins (EA)	2	
102			Volume (CF per Each)	141,692.29	
103	8	Yes	Blowers		$830,000
104		To Facility Sheet	Firm Air Flow Capacity (CFM)	12,600.00	
105			Average Air Flow (SCFM) for O&M		
106	9	No	Air Diffusion		$0
107		To Facility Sheet	Number of Basins (EA)	2	
108			Firm Capacity (CFM per Each Basin)	3,500.00	
109	10	No	Trickling Filter		$0
110		To Facility Sheet	Number of Filters (EA)		
111			Volume of Media (CF per Each)		
112	11	No	Rotating Biological Contactor		$0
113		To Facility Sheet	Area of Media (Million SF)		
114					
115	12	No	Chlorine Contact Basin		$0
116		To Facility Sheet	Volume (CF)		
117					
118	13	Yes	Effluent Filters		$3,360,000
119		To Facility Sheet	Flow (MGD)	15.8000	
120					
121	14	No	Chlorine Feed & Storage		$0
122		To Facility Sheet	Feed Capacity (LB/DAY)		
123			Feed Capacity (Ton/Year) for O&M		
124	15	No	SO2 Storage & Feed Equipment		$0
125		To Facility Sheet	Feed Rate Capacity (LB/DAY)		
126			Feed Capacity (Ton/Year) for O&M		
127	16	No	Polymer Feed System		$0
128		To Facility Sheet	Feed Rate Capacity (LB/DAY)		

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	A	B	C	D	E
129					
130	17	No	Sludge Pumping		$0
131		To Facility Sheet	Firm Capacity (GPM)		
132					
133	18	No	Flotation Sludge Thickener		$0
134		To Facility Sheet	Number of Thickeners (EA)		
135			Diameter (Feet per Each)		
136			Surface Area (SF per Each)	-	
137	19	No	Sludge Holding Tanks		$0
138		To Facility Sheet	Volume (CF)		
139					
140	20	No	Anaerobic Digesters		$0
141		To Facility Sheet	Number of Units (Each)		
142			Digester Volume per Unit (CF)		
143	21	No	Solid Bowl Centrifuge		$0
144		To Facility Sheet	Flow Capacity (GPM)		
145			Average Loading (Total LB/Day) for O&M		
146	22	No	Belt Filter Press		$0
147		To Facility Sheet	Number of Presses (EA)		
148			Width (Meters per Each)		
149			Average Loading per Press (LB/Day) for O&M		
150	23	No	Sludge Drying Beds		$0
151		To Facility Sheet	Area (SF)		
152					
153	24	No	Flow Splitting Structure 2		$0
154		To Facility Sheet			
155					
156	25	Yes	Yard Piping		$210,000
157		To Facility Sheet			
158					
159	26	Yes	GBT Installation		$510,000
160		To Facility Sheet			
161					
162	27	No	User Defined Facility 2		$0
163		To Facility Sheet			
164					
165	28	No	User Defined Facility 3		$0
166		To Facility Sheet			
167					
168	SUBTOTAL - PROJECT COST				$14,330,000
169					
170	ADDITIONAL PROJECT COSTS:				
171	Demolition		20%		$2,866,000
172	Overall Sitework		1%		$143,300
173	Plant Computer System		1%		$143,300
174	Yard Electrical		2%		$286,600
175	Yard Piping		1%		$143,300
176	0		0%		$0
177	0		0%		$0
178	0		0%		$0
179	SUBTOTAL with Additional Project Costs				$17,912,500
180					
181	CONTRACTOR MARKUPS:				
182	Overhead		10%	$17,912,500	$1,791,250
183	Subtotal				$19,703,750
184	Profit		5%	$19,703,750	$985,188
185	Subtotal				$20,688,938
186	Mob/Bonds/Insurance		5%	$20,688,938	$1,034,447
187	Subtotal				$21,723,384
188	Contingency		20%	$21,723,384	$4,344,677
189	SUBTOTAL with Markups				$26,068,061
190					
191	ESCALATION (to Mid-Point of Construction):		5.74%	$26,068,061	$1,495,290
192	SUBTOTAL with Escalation				$27,563,351

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	A	B	C	D	E
193					
194	LOCATION ADJUSTMENT FACTOR		123.20%	$27,563,351	$33,958,049
195	TOTAL - CONSTRUCTION COST				$33,958,049
196					
197	RED FLAGS:				
198	1	Rock Excavation			
199	2	Pile Foundations			
200	3	Seismic Foundations			
201	4	Dewatering Conditions			
202	5	Wetlands Mitigation			
203	6	Weather Impacts			
204	7	Depth of Structures			
205	8	Local Building Code Restrictions			
206	9	Coatings or Finishes			
207	10	Building or Architectural Considerations			
208	11	Client Material Preferences			
209	12	Client Equipment Preferences			
210	13	Piping Galleries, Piping Trenches, Piping Racks			
211	14	Yard Piping Complexity			
212	15	Existing Site Utilities (New, Retrofit, and Complexity)			
213	16	I & C Automation (New or Retrofit)			
214	17	Electrical Feed (New or Retrofit)			
215	18	Electrical Distribution			
216	19	User Defined Red Flag 1			
217	20	User Defined Red Flag 2			
218	21	User Defined Red Flag 3			
219	22	User Defined Red Flag 4			
220	23	User Defined Red Flag 5			
221	24	User Defined Red Flag 6			
222	25	User Defined Red Flag 7			
223	TOTAL - RED FLAGS				$0
224					
225	SUBTOTAL - CONSTRUCTION COST with Red Flags				$33,958,049
226					
227	Did a CH2M HILL Professional Estimator Review This Cost Estimate?			No	
228	TOTAL - CONSTRUCTION COST Plus RED FLAGS				$47,541,268
229					
230	NON-CONSTRUCTION COSTS:				
231	Permitting		0%	$47,541,268	$0
232	Engineering		10%	$47,541,268	$4,754,127
233	SDC		5%	$47,541,268	$2,377,063
234	Commissioning & Startup		5%	$47,541,268	$2,377,063
235	Land ROW		0%	$47,541,268	$0
236	Legal/Admin		0%	$47,541,268	$0
237	0		0%	$47,541,268	$0
238	SUBTOTAL - Non-Construction Costs				$9,508,254
239					
240	TOTAL - CAPITAL COST				$57,049,522

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SECONDARY TREATMENT - AERATION BASIN					
		To Summary			
Is This Facility Included in My Project? Yes					
Assumptions:					
Model Based on City of Vancouver, WA Marine Park WRF					
Aeration Basin					
Number of Aeration Basins	**2**		***PRO2D Input from Summary Sheet***		
Length (FT)	**305.89**	**BL**	***User Input from Summary Sheet***		
Width (FT)	**76.47**	**BW**	***User Input from Summary Sheet***		
SWD (FT)	**20.00**	**SWD**	***PRO2D Input from Summary Sheet***		
Depth of Burial (FT)	**10**		***User Input from Summary Sheet***		
Bioreactor Inluent Channel					
Length (FT)	**4**	**BICL**	***User Input from Summary Sheet***		
Mixed Liquor Channel					
Length (FT)	**4**	**MLCL**	***User Input from Summary Sheet***		
Is Facility Covered?	**No**		***User Input from Summary Sheet***		
Dimension Calculations:					
Logic Test:					
Is "Number of Aeration Basins = 0"? ("Yes" = 0, "No" = 1)	1.00				
Facility Length (ft)	320.89	**L**	Calculated		
Facility Width (ft)	158.95	**W**	Calculated		
Slab on Grade Length (ft)	324.89		Calculated		
Slab on Grade Width (ft)	162.95		Calculated		
Slab on Grade Thickness (inches)	24.00		Fixed		
Slab on Grade Thickness (ft)	2.00		Calculated		
Freeboard (ft)	4.00	**FB**	Fixed		
Exterior Wall Height (ft)	24.00	**H**	Fixed		
Exterior Wall Thickness (inches)	24.00		Fixed		
Exterior Wall Thickness (ft)	2.00		Calculated		
Bioreactor Influent Channel Wall Height (ft)	24.00	= H	Calculated		
Bioreactor Influent Channel Wall Thickness (inches)	18.00		Fixed		
Bioreactor Influent Channel Wall Thickness (ft)	1.50		Calculated		
Baffle Wall Height (ft)	20.00	= SWD	Calculated		
Baffle Wall Thickness (inches)	12.00		Fixed		
Baffle Wall Thickness (ft)	1.00		Calculated		
Mixed Liquor Channel Wall Height (ft)	24.00	= H	Calculated		
Mixed Liquor Channel Wall Thickness (inches)	18.00		Fixed		
Mixed Liquor Channel Wall Thickness (ft)	1.50		Calculated		
Basin Divider Wall Height (ft)	24.00	= H	Fixed		

Basin Divider Wall Thickness (inches)	24.00		Fixed		
Basin Divider Wall Thickness (ft)	2.00		Calculated		
Walkway Elevated Slab Width (ft)	4.00		Fixed		
Walkway Elevated Slab Thickness (inches)	8.00		Fixed		
Walkway Elevated Slab Thickness (ft)	0.67		Calculated		
Excavation Length (ft)	328.89		Calculated		
Excavation Width (ft)	166.95		Calculated		
Excavation Depth (ft)	13.00		Calculated		
Liquid Volume (CF)	***935,704***		Calculated		
Liquid Volume (Gal)	***6,999,550***		Calculated		
DESCRIPTION	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**	
SITEWORK:					
Excavation	28,140	CY	$2.50	$70,349	
Structural Backfill	2,034	CY	$25.00	$50,840	
Backfill	2,043	CY	$5.00	$10,216	
Haul Excess	31,724	CY	$1.85	$58,690	
Allowance for Misc Items	5%		$190,095.85	$9,505	
Subtotal				$199,601	
CONCRETE:					
Slab on Grade	3,921	CY	$250.00	$980,372	
Exterior Walls	1,706	CY	$400.00	$682,438	
Bioreactor Influent Channel Wall	212	CY	$400.00	$84,771	
Baffle Wall	118	CY	$400.00	$47,095	
Mixed Liquor Channel Wall	212	CY	$400.00	$84,771	
Basin Divider Wall	544	CY	$400.00	$217,524	
Walkway Elevated Slab	126	CY	$450.00	$56,914	
Allowance for Misc Items	5%		$2,153,886.10	$107,694	
Subtotal				$2,261,580	
MASONRY:					
CMU Building	0	SF	$70.00	$0	
Subtotal				$0	
METALS:					
Handrail	2,561	LF	$40.00	$102,446	
Primary Effluent Channel Grating	0	SF	$55.00	$0	
Mixed Liquor Channel Grating	0	SF	$55.00	$0	
Allowance for Misc Items	5%		$102,445.68	$5,122	
Subtotal				$107,568	
EQUIPMENT:					
Diffuser System	51,005	SF	$8.89	$453,288	Unit Cost Based on Santa Rosa
Influent Slide Gates	4	EA	$10,000	$40,000	Rule: 2 per basin
Mixers	2	EA	$12,000	$24,000	Rule: 1 per basin
Mixed Liquor Recycle Pumps	2	EA	$25,000	$50,000	Rule: 1 per basin
Allowance for Misc Items	5%		$567,288.48	$28,364	
Subtotal				$595,653	
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**	
				$0	
				$0	
Item 3 Description	0		$0.00	$0	
Item 4 Description	0		$0.00	$0	
Item 5 Description	0		$0.00	$0	
Item 6 Description	0		$0.00	$0	
Item 7 Description	0		$0.00	$0	
Item 8 Description	0		$0.00	$0	
Item 9 Description	0		$0.00	$0	
Item 10 Description	0		$0.00	$0	
Item 11 Description	0		$0.00	$0	
Item 12 Description	0		$0.00	$0	
Item 13 Description	0		$0.00	$0	

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST	
Item 14 Description	0		$0.00	$0	
Item 15 Description	0		$0.00	$0	
Subtotal				$0	
Subtotal				$3,164,402	
ALLOWANCES:					
Finishes Allowance	2.0%		$5,103,874	$102,077	
I & C Allowance	4%		$5,103,874	$204,155	
Mechanical Allowance	22%		$5,103,874	$1,122,852	
Electrical Allowance	10%		$5,103,874	$510,387	
Facility Cost	**6,999,550**	**Gallons**	**$0.73**	**$5,103,874**	
Facility Cost with Additional Project Costs Added	**6,999,550**	**Gallons**	**$0.91**	**$6,379,843**	
Facility Cost with Additional Project Costs & Contractor Markups Added	**6,999,550**	**Gallons**	**$1.33**	**$9,284,585**	
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added	**6,999,550**	**Gallons**	**$1.40**	**$9,817,158**	
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	**6,999,550**	**Gallons**	**$1.73**	**$12,094,739**	

FLOW SPLITTING STRUCTURE

To Summary

Is This Facility Included in My Project? Yes

Number of Outlet Basins (EA)	***4***		***PRO2D Input from Summary Sheet***		
Depth of Burial (FT)	***10.00***		***User Input from Summary Sheet***		
Inlet Basin					
Width (FT)	***25.00***	**IW**	***User Input from Summary Sheet***		
SWD (FT)	***20.00***	**SWD**	***PRO2D Input from Summary Sheet***		
Outlet Basin (Dimensions of One)					
Length (FT)	***3.00***	**OL**	***User Input from Summary Sheet***		
Width (FT)	***3.00***	**OW**	***User Input from Summary Sheet***		
Dimension Calculations:					
Logic Test:					
Is "Number of Outlet Basins = 0"? ("Yes" = 0, "No" = 1)	1.00				
Overall Length (ft)	17.00	**L**	Calculated		
Overall Width (ft)	31.00	**W**	Calculated		
Slab on Grade Length (ft)	19.00	L + 2	Calculated		
Slab on Grade Width (ft)	33.00	W + 2	Calculated		
Slab on Grade Thickness (inches)	16.00		Fixed		
Slab on Grade Thickness (ft)	1.33		Calculated		
Freeboard (ft)	3.00	**FB**	Fixed		
Wall Height (ft)	23.00	**H**	Calculated		
Wall Thickness (inches)	12.00		Fixed		
Wall Thickness (ft)	1.00		Calculated		
Excavation Length (FT)	23.00	L + 6	Calculated		
Excavation Width (FT)	37.00	W + 6	Calculated		
Excavation Depth (FT)	12.33		Calculated		
DESCRIPTION	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**	**REFERENCE**
SPLITTER BOX MODEL:					
SITEWORK:					
Excavation	727	CY	$2.50	$1,817	
Structural Backfill	32	CY	$25.00	$788	
Backfill	406	CY	$5.00	$2,028	
Haul Excess	466	CY	$1.85	$863	
Allowance for Misc Items	5%		$5,495.97	$275	
SUBTOTAL				$5,771	
CONCRETE:					
Slab on Grade	31	CY	$250.00	$7,741	
Perimeter Walls	82	CY	$400.00	$32,711	
Inlet Basin Interior Wall	14	CY	$400.00	$5,793	
Outlet Basin Interior Walls	8	CY	$400.00	$3,067	
Allowance for Misc Items	5%		$49,311.11	$2,466	
SUBTOTAL				$51,777	
METALS:					
Handrail	96	LF	$40.00	$3,840	
Grating & Supports	461	SF	$55.00	$25,355	

Stairs	20	RISERS	$300.00	$5,850	
Allowance for Misc Items	5%		$35,045.00	$1,752	
SUBTOTAL				$36,797	
EQUIPMENT:					
Motor Operated Gates :					
Inlet Basin	5	EA	$7,500.00	$37,500	=1 + Number of Outlet Basins
Outlet Basins	4	EA	$7,500.00	$30,000	= Number of Outlet Basins
Allowance for Misc Items	5%		$67,500.00	$3,375	
SUBTOTAL				$70,875	
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**	
Item 1 Description	0		$0.00	$0	
Item 2 Description	0		$0.00	$0	
Item 3 Description	0		$0.00	$0	
Item 4 Description	0		$0.00	$0	
Item 5 Description	0		$0.00	$0	
Item 6 Description	0		$0.00	$0	
Item 7 Description	0		$0.00	$0	
Item 8 Description	0		$0.00	$0	
Item 9 Description	0		$0.00	$0	
Item 10 Description	0		$0.00	$0	
Item 11 Description	0		$0.00	$0	
Item 12 Description	0		$0.00	$0	
Item 13 Description	0		$0.00	$0	
Item 14 Description	0		$0.00	$0	
Item 15 Description	0		$0.00	$0	
Subtotal				$0	
Subtotal				$165,220	
ALLOWANCES:					
Finishes Allowance	2.0%		$196,690	$3,934	
I & C Allowance	2%		$196,690	$3,934	
Mechanical Allowance	10%		$196,690	$19,669	
Electrical Allowance	2%		$196,690	$3,934	
Facility Cost				**$196,690**	
Facility Cost with Additional Project Costs Added				**$245,863**	
Facility Cost with Additional Project Costs & Contractor Markups Added				**$357,804**	
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added				**$378,328**	
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added				**$466,100**	

SECONDARY CLARIFIER

To Summary

Is This Facility Included in My Project? Yes

Assumptions:

Based on Ocala WRF No. 3 (5mgd MMADF)

Number of Clarifiers (EA)	***5***		***PRO2D Input from Summary Sheet***
Diameter (FT)	***80***	***D***	***PRO2D Input from Summary Sheet***
SWD (FT)	***16***	***SWD***	***PRO2D Input from Summary Sheet***
Depth of Burial (FT)	***12***		***User Input from Summary Sheet***

Dimension Calculations:

Logic Test:			
Is "Number of Clarifiers = 0"? ("Yes" = 0, "No" = 1)	1.00		
Slab on Grade Diameter	83.00	D+3	Calculated
Slab on Grade Thickness (inches)	16.00		Fixed
Slab on Grade Thickness (ft)	1.33	TS	Calculated
Freeboard (ft)	3.00	FB	Fixed
Exterior Wall Height (ft)	19.00	H = SWD + FB	Calculated
Exterior Wall Thickness (inches)	16.00		Fixed
Exterior Wall Thickness (ft)	1.33	TW	Calculated
Interior Launder Elevated Slab Width (ft)	5.00	WIS	Constant
Interior Launder Average Diameter (for launder slab area)	75.00	D-WIS	Calculated
Interior Launder Wall Diameter (ft)	77.00	D-(WIS-1*2)	Calculated
Interior Launder Wall Height (ft)	3.00		Fixed
Interior Launder Wall Thickness (inches)	8.00		Fixed
Interior Launder Wall Thickness (ft)	0.67		Calculated
Interior Launder Elevated Slab Thickness (inches)	8.00		Fixed
Interior Launder Elevated Slab Thickness (ft)	0.67		Calculated
Exterior Walkway Slab Width	4.00	WES	Constant
Exterior Walkway Handrail Diameter	90.67	D+(TW*2)+(WES*2	Calculated
Exterior Walkway Slab Thickness	0.67		Constant
Excavation Diameter	87.00	D+7	Calculated
Excavation Depth	14.33		Calculated
Liquid Volume (CF)	***401,920***		Calculated
Liquid Volume (Gal)	***3,006,570***		Calculated

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
SITEWORK:				
Excavation	20,968	CY	$2.50	$52,419
Structural Backfill	1,100	CY	$25.00	$27,508
Backfill	6,236	CY	$5.00	$31,180
Haul Excess	18,925	CY	$1.85	$35,012
Allowance for Misc Items	5%		$146,118.36	$7,306
Subtotal				$153,424
CONCRETE:				
Exterior Walls:				
Slab on Grade	1,335	CY	$250.00	$333,819
Circular Walls	1,178	CY	$450.00	$530,311

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST	
Interior Launder:					
Circular Walls	90	CY	$500.00	$44,774	
Elevated Slab	145	CY	$450.00	$65,417	
Exterior Walkway:					
Elevated Slab	141	CY	$500.00	$70,295	
Center Sludge/RAS Pit	50	CY	$200.00	$10,000	
Concrete Encasement	100	CY	$180.00	$18,000	
Clarifier Bottom Grout 2"	25,120	SF	$11.00	$276,320	
4" Concrete Pads	0.99	CY	$200.00	$198	
Allowance for Misc Items	5%		$1,348,935.33	$67,447	
Subtotal				$1,416,580	
METALS:					
Weir	1,209	LF	$50.00	$60,445	
Scum Baffle & Supports	1,209	LF	$100.00	$120,890	
Scum Box	5	EA	$4,000.00	$20,000	
Aluminum Stairs	53	RISERS	$300.00	$15,750	
Aluminum Platform	68	SF	$20.00	$1,350	
Aluminum Handrail	1,423	LF	$50.00	$71,173	
Allowance for Misc Items	5%		$289,608.33	$14,480	
Subtotal				$304,089	
EQUIPMENT:					
Clarifier Mechanism	5	EA	$138,000	$690,000	
Submersible Scum Pump	5	EA	$13,500	$67,500	
Allowance for Misc Items	5%		$757,500.00	$37,875	
Subtotal				$795,375	
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**	
Item 1 Description	0		$0.00	$0	
Item 2 Description	0		$0.00	$0	
Item 3 Description	0		$0.00	$0	
Item 4 Description	0		$0.00	$0	
Item 5 Description	0		$0.00	$0	
Item 6 Description	0		$0.00	$0	
Item 7 Description	0		$0.00	$0	
Item 8 Description	0		$0.00	$0	
Item 9 Description	0		$0.00	$0	
Item 10 Description	0		$0.00	$0	
Item 11 Description	0		$0.00	$0	
Item 12 Description	0		$0.00	$0	
Item 13 Description	0		$0.00	$0	
Item 14 Description	0		$0.00	$0	
Item 15 Description	0		$0.00	$0	
Subtotal				$0	
Subtotal				$2,669,468	
ALLOWANCES:					
Finishes Allowance	2.0%		$3,759,814	$75,196	
I & C Allowance	4%		$3,759,814	$150,393	
Mechanical Allowance	20%		$3,759,814	$751,963	Based on $59,641 / $766,488
Electrical Allowance	3%		$3,759,814	$112,794	
Facility Cost	**3,006,570**	**Galllons**	**$1.25**	**$3,759,814**	
Facility Cost with Additional Project Costs Added	**3,006,570**	**Galllons**	**$1.56**	**$4,699,767**	
Facility Cost with Additional Project Costs & Contractor Markups Added	**3,006,570**	**Galllons**	**$2.27**	**$6,839,571**	
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added	**3,006,570**	**Galllons**	**$2.41**	**$7,231,896**	
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	**3,006,570**	**Galllons**	**$2.96**	**$8,909,695**	

RAS AND WAS PUMPING

To Summary

Is This Facility Included in My Project? Yes

Assumptions:

Based on Ocala WRF No. 3 (5mgd MMADF)

RAS and WAS pumps are located outside

Number of RAS Pumps (Each)	***5***		***PRO2D Input from Summary Sheet***	
RAS Pump Capacity (Per Unit, GPH)	***78000***		***PRO2D Input from Summary Sheet***	
Number of WAS Pumps (Each)	***2***		***PRO2D Input from Summary Sheet***	
WAS Pump Capacity (Per Unit, GPH)	***2940***		***PRO2D Input from Summary Sheet***	

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
SITEWORK:				
Sitework Allowance	7	LS	$833.33	$5,833
Subtotal				$5,833
CONCRETE:				
8" Slab on Grade	53	CY	$250.00	$13,136
Allowance for Misc Items	5%		$13,135.80	$657
Subtotal				$13,793
EQUIPMENT:				
RAS Pumps (1170 gpm, 870 rpm, TDH =11.5ft, 7.5 hp)	5	EA	$23,765.53	$118,828
WAS Pumps (200 gpm, 1185 rpm TDH = 14 ft, 3hp)	2	EA	$1,670.81	$3,342
Allowance for Misc Items	5%		$122,169.29	$6,108
Subtotal				$128,278
MECHANICAL:				
RAS Piping:				
12" RAS	50	LF	$29.45	$1,473
12" Tee	5	EA	$1,130	$5,650
12" Elbow	5	EA	$700	$3,500
10" x 12" Reducing Elbow	5	EA	$700	$3,500
10" V405	15	EA	$1,750	$26,250
10" V604	5	EA	$2,259	$11,295
8" x 10" Reducing Elbow	5	EA	$532	$2,660
8" x 10" Reducer	5	EA	$532	$2,660
10" x 10 x 2" Tee	5	EA	$943	$4,715
10" Elbow	5	EA	$532	$2,660
10" Tee	15	EA	$943	$14,145
10" Flanged Coupling Adapter	5	EA	$250	$1,250
10" Flow Meter	5	EA	$5,368	$26,840
10" RAS	125	LF	$24.43	$3,054
2" V400	5	EA	$334	$1,670
WAS Piping:				
6" WAS	40	LF	$15.73	$629
6" Elbow	6	EA	$234	$1,404

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
6" V405	2	EA	$802	$1,604
4" x 6" Reducing Elbow	2	EA	$234	$468
4" WAS	100	LF	$14.08	$1,408
4" x 4" x 2" Tee	4	EA	$260	$1,040
2" V400	2	EA	$334	$668
4" V604	2	EA	$565	$1,130
4" Elbow	4	EA	$177	$708
4" Tee	8	EA	$260	$2,080
4" Flow Meter	2	EA	$3,431	$6,862
4" Flanged Coupling Adapter	2	EA	$109	$218
Allowance for Small Pipe & Pipe Supports	7	LS	$1,667	$11,667
Subtotal				$141,207
ELECTRICAL:				
RAS Pumps VFD's (7.5 hp)	5	EA	$4,600	$23,000
Allowance for Misc Items	5%		$23,000.00	$1,150
Subtotal				$24,150
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**
Delete Concrete and Site Work	1	LS	($19,625.93)	($19,626)
Item 2 Description	0		$0.00	$0
Item 3 Description	0		$0.00	$0
Item 4 Description	0		$0.00	$0
Item 5 Description	0		$0.00	$0
Item 6 Description	0		$0.00	$0
Item 7 Description	0		$0.00	$0
Item 8 Description	0		$0.00	$0
Item 9 Description	0		$0.00	$0
Item 10 Description	0		$0.00	$0
Item 11 Description	0		$0.00	$0
Item 12 Description	0		$0.00	$0
Item 13 Description	0		$0.00	$0
Item 14 Description	0		$0.00	$0
Item 15 Description	0		$0.00	$0
Subtotal				($19,626)
Subtotal				$293,635
ALLOWANCES:				
Finishes Allowance	0.0%		$341,436	$0
I & C Allowance	4%		$341,436	$13,657
Mechanical Allowance	0%		$341,436	$0
Electrical Allowance	10%		$341,436	$34,144
Facility Cost				**$341,436**
Facility Cost with Additional Project Costs Added				**$426,795**
Facility Cost with Additional Project Costs & Contractor Markups Added				**$621,115**
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added				**$656,742**
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added				**$809,107**

Blowers

To Summary Sheet

Is This Facility Included in My Project? Yes

Assumptions:

Firm Air Flow Capacity (CFM)	*12,600.00*	*CFM*		
Average Air Flow (SCFM) for O&M	*-*	*SCFM*		
Cost models are based on this date:	**20 Cities Average**	**Jan-03**		
Cost models are escalated to this date:	**20 Cities Average**	**Jan-03**	**1.00**	

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
Aeration Basin				
Aeration Basin	12,600	CFM	$65.60	$826,572
Subtotal				$826,572
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**
Item 1 Description	0		$0.00	$0
Item 2 Description	0		$0.00	$0
Item 3 Description	0		$0.00	$0
Item 4 Description	0		$0.00	$0
Item 5 Description	0		$0.00	$0
Item 6 Description	0		$0.00	$0
Item 7 Description	0		$0.00	$0
Item 8 Description	0		$0.00	$0
Item 9 Description	0		$0.00	$0
Item 10 Description	0		$0.00	$0
Item 11 Description	0		$0.00	$0
Item 12 Description	0		$0.00	$0
Item 13 Description	0		$0.00	$0
Item 14 Description	0		$0.00	$0
Item 15 Description	0		$0.00	$0
Subtotal				$0
Subtotal				$826,572
ALLOWANCES:				
Finishes Allowance	0.0%		$826,572	$0
I & C Allowance	0%		$826,572	$0
Mechanical Allowance	0%		$826,572	$0
Electrical Allowance	0%		$826,572	$0
Facility Cost	**12,600**	**CFM**	**$65.60**	**$826,572**
Facility Cost with Additional Project Costs Added	**12,600**	**CFM**	**$82.00**	**$1,033,215**
Facility Cost with Additional Project Costs & Contractor Markups Added	**12,600**	**CFM**	**$119.34**	**$1,503,638**
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added	**12,600**	**CFM**	**$126.18**	**$1,589,888**
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	**12,600**	**CFM**	**$155.46**	**$1,958,742**
Annual O & M				
	0	SCFM		
Labor	-	HRS	**$ 50.00**	$0
Energy	-	KWH	**$ 0.07**	$0
Maintenance Materials & Supplies	0	SCFM	$0.00	$0
Subtotal				$0
User Defined Annual O&M Items:				**Annual Cost**

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
Item 1				$ -
Item 2				$ -
Item 3				$ -
Item 4				$ -
Item 5				$ -
Item 6				$ -
Item 7				$ -
Item 8				$ -
Item 9				$ -
Item 10				$ -
Item 11				$ -
Item 12				$ -
Item 13				$ -
Item 14				$ -
Item 15				$ -
Subtotal Annual O&M Cost				$ -
Contingency			20%	$ -
Total Annual O&M Cost				$ -

Net Present Value (NPV) Calculation:

i =	4%
n =	25

Year	Default Cost	User Over-Ride	Cost Used in NPV Calculation	Adjusted Annual O & M Cost
0	$1,958,742		$1,958,742	
1	$0		$0	
2	$0		$0	
3	$0		$0	
4	$0		$0	
5	$0		$0	
6	$0		$0	
7	$0		$0	
8	$0		$0	
9	$0		$0	
10	$0		$0	
11	$0		$0	
12	$0		$0	
13	$0		$0	
14	$0		$0	
15	$0		$0	
16	$0		$0	
17	$0		$0	
18	$0		$0	
19	$0		$0	
20	$0		$0	
21	$0		$0	
22	$0		$0	
23	$0		$0	
24	$0		$0	
25	$0		$0	
26				
27				
28				
29				
30				
31				
32				
33				
34				

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
35				
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
NPV			$1,958,742	$0

Effluent Filters

To Summary Sheet

Is This Facility Included in My Project? Yes

Assumptions:

Flow (MDG)	***15.8000***	***MGD***	
Cost models are based on this date:	**20 Cities Average**	**Jan-03**	
Cost models are escalated to this date:	**20 Cities Average**	**Jan-03**	**1.00**

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
Effluent Filters				
Effluent Filters	16	MGD	$212,421.20	$3,356,255
Subtotal				$3,356,255
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**
Item 1 Description	0		$0.00	$0
Item 2 Description	0		$0.00	$0
Item 3 Description	0		$0.00	$0
Item 4 Description	0		$0.00	$0
Item 5 Description	0		$0.00	$0
Item 6 Description	0		$0.00	$0
Item 7 Description	0		$0.00	$0
Item 8 Description	0		$0.00	$0
Item 9 Description	0		$0.00	$0
Item 10 Description	0		$0.00	$0
Item 11 Description	0		$0.00	$0
Item 12 Description	0		$0.00	$0
Item 13 Description	0		$0.00	$0
Item 14 Description	0		$0.00	$0
Item 15 Description	0		$0.00	$0
Subtotal				$0
Subtotal				$3,356,255
ALLOWANCES:				
Finishes Allowance	0.0%		$3,356,255	$0
I & C Allowance	0%		$3,356,255	$0
Mechanical Allowance	0%		$3,356,255	$0
Electrical Allowance	0%		$3,356,255	$0
Facility Cost	**16**	**MGD**	**$212,421.20**	**$3,356,255**
Facility Cost with Additional Project Costs Added	**16**	**MGD**	**$265,526.49**	**$4,195,319**
Facility Cost with Additional Project Costs & Contractor Markups Added	**16**	**MGD**	**$386,420.71**	**$6,105,447**
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added	**16**	**MGD**	**$408,586.18**	**$6,455,662**
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	**16**	**MGD**	**$503,378.18**	**$7,953,375**
Annual O & M				

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
	16	MGD		
Labor	4,604	HRS	$ 50.00	$230,207
Energy	175,037	KWH	$ 0.07	$12,253
Maintenance Materials & Supplies	16	MGD	$180.52	$2,852
Subtotal				$245,312
User Defined Annual O&M Items:				**Annual Cost**
Item 1				$ -
Item 2				$ -
Item 3				$ -
Item 4				$ -
Item 5				$ -
Item 6				$ -
Item 7				$ -
Item 8				$ -
Item 9				$ -
Item 10				$ -
Item 11				$ -
Item 12				$ -
Item 13				$ -
Item 14				$ -
Item 15				$ -
Subtotal Annual O&M Cost				**$ 245,312**
Contingency			**20%**	**$ 49,062**
Total Annual O&M Cost				**$ 294,374**

Net Present Value (NPV) Calculation:

i =	4%
n =	25

Year	Default Cost	User Over-Ride	Cost Used in NPV Calculation	Adjusted Annual O & M Cost
0	$7,953,375		$7,953,375	
1	$294,374		$294,374	
2	$294,374		$294,374	
3	$294,374		$294,374	
4	$294,374		$294,374	
5	$294,374		$294,374	
6	$294,374		$294,374	
7	$294,374		$294,374	
8	$294,374		$294,374	
9	$294,374		$294,374	
10	$294,374	$ 10,000,000.00	$10,000,000	
11	$294,374		$294,374	
12	$294,374		$294,374	
13	$294,374		$294,374	
14	$294,374		$294,374	
15	$294,374		$294,374	
16	$294,374		$294,374	

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
17	$294,374		$294,374	
18	$294,374		$294,374	
19	$294,374		$294,374	
20	$294,374		$294,374	
21	$294,374		$294,374	
22	$294,374		$294,374	
23	$294,374		$294,374	
24	$294,374		$294,374	
25	$294,374		$294,374	
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
NPV			$19,108,888	$714,086

Yard Piping

PROCESS DESIGN CRITERIA

To Summary

Is This Facility Included in My Project? Yes

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST
1.) Input **Average Pipe Burial Depth** (ft)	4			
2.) Input **Yard Pipe Information**				
Yard Pipe Line Description	**Type of Pipe**	**Pipe Diameter (inches)**	**Pipe Length (feet)**	
SC Feed Pipe	DI	20	300.00	
AB Feed Pipe	DI	36	100.00	
SC Effluent Pipe	DI	30	500.00	
RAS Piping	DI	16	500.00	
WAS Piping	DI	10	500.00	
Item 6 Description	Steel			
Item 7 Description	Steel			
Item 8 Description	Steel			
Item 9 Description	Steel			
Item 10 Description	Steel			
Item 11 Description	Steel			
Item 12 Description	Steel			
Item 13 Description	Steel			
Item 14 Description	Steel			
Item 15 Description	Steel			
Item 16 Description	Steel			
Item 17 Description	Steel			
Item 18 Description	Steel			
Item 19 Description	Steel			
Item 20 Description	Steel			

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST	REFERENCE / COMMENTS
SITEWORK:					
Yard Piping Trenching, Bedding, Backfill, Compaction:					
SC Feed Pipe	300	LF	$24.59	$7,378	
AB Feed Pipe	100	LF	$36.56	$3,656	
SC Effluent Pipe	500	LF	$31.72	$15,860	
RAS Piping	500	LF	$22.07	$11,037	
WAS Piping	500	LF	$18.65	$9,324	
Item 6 Description	0	LF	$0.00	$0	
Item 7 Description	0	LF	$0.00	$0	
Item 8 Description	0	LF	$0.00	$0	
Item 9 Description	0	LF	$0.00	$0	
Item 10 Description	0	LF	$0.00	$0	
Item 11 Description	0	LF	$0.00	$0	
Item 12 Description	0	LF	$0.00	$0	
Item 13 Description	0	LF	$0.00	$0	
Item 14 Description	0	LF	$0.00	$0	
Item 15 Description	0	LF	$0.00	$0	
Item 16 Description	0	LF	$0.00	$0	
Item 17 Description	0	LF	$0.00	$0	
Item 18 Description	0	LF	$0.00	$0	
Item 19 Description	0	LF	$0.00	$0	
Item 20 Description	0	LF	$0.00	$0	
Yard Pipiping:					
SC Feed Pipe	300	LF	$67.99	$20,398	
AB Feed Pipe	100	LF	$125.09	$12,509	
SC Effluent Pipe	500	LF	$103.68	$51,838	
RAS Piping	500	LF	$53.72	$26,861	
WAS Piping	500	LF	$32.31	$16,156	
Item 6 Description	0	LF	$0.00	$0	
Item 7 Description	0	LF	$0.00	$0	
Item 8 Description	0	LF	$0.00	$0	
Item 9 Description	0	LF	$0.00	$0	
Item 10 Description	0	LF	$0.00	$0	
Item 11 Description	0	LF	$0.00	$0	
Item 12 Description	0	LF	$0.00	$0	
Item 13 Description	0	LF	$0.00	$0	
Item 14 Description	0	LF	$0.00	$0	
Item 15 Description	0	LF	$0.00	$0	
Item 16 Description	0	LF	$0.00	$0	
Item 17 Description	0	LF	$0.00	$0	
Item 18 Description	0	LF	$0.00	$0	
Item 19 Description	0	LF	$0.00	$0	
Item 20 Description	0	LF	$0.00	$0	
Allowance for Fittings	15%		$127,761.32	$19,164	
Allowance for Misc Items	5%		$194,179.02	$9,709	
Subtotal				$203,888	

USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**
Item 1 Description	0		$0.00	$0
Item 2 Description	0		$0.00	$0
Item 3 Description	0		$0.00	$0
Item 4 Description	0		$0.00	$0
Item 5 Description	0		$0.00	$0
Item 6 Description	0		$0.00	$0
Item 7 Description	0		$0.00	$0

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Item 8 Description	0		$0.00	$0
Item 9 Description	0		$0.00	$0
Item 10 Description	0		$0.00	$0
Item 11 Description	0		$0.00	$0
Item 12 Description	0		$0.00	$0
Item 13 Description	0		$0.00	$0
Item 14 Description	0		$0.00	$0
Item 15 Description	0		$0.00	$0
Subtotal				$0
Subtotal				$203,888
ALLOWANCES:				
Finishes Allowance	0.0%		$203,888	$0
I & C Allowance	0%		$203,888	$0
Mechanical Allowance	0%		$203,888	$0
Electrical Allowance	0%		$203,888	$0
Facility Cost				**$203,888**
Facility Cost with Additional Project Costs Added	**-**	**0**	**#DIV/0!**	**$254,860**
Facility Cost with Additional Project Costs & Contractor Markups Added	**-**	**0**	**#DIV/0!**	**$370,898**
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added	**-**	**0**	**#DIV/0!**	**$392,173**
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	**-**	**0**	**#DIV/0!**	**$483,157**
Annual O & M				
Labor	-	HRS	**$ 50.00**	$0
Energy	-	KWH	**$ 0.07**	$0
Maintenance Materials & Supplies	1	LS	$0.00	$0
Subtotal				$0
User Defined Annual O&M Items:				**Annual Cost**
Item 1				**$ -**
Item 2				**$ -**
Item 3				**$ -**
Item 4				**$ -**
Item 5				**$ -**
Item 6				**$ -**
Item 7				**$ -**
Item 8				**$ -**
Item 9				**$ -**
Item 10				**$ -**
Item 11				**$ -**
Item 12				**$ -**
Item 13				**$ -**
Item 14				**$ -**
Item 15				**$ -**
Subtotal Annual O&M Cost				**$ -**
Contingency			**20%**	**$ -**
Total Annual O&M Cost				**$ -**
Net Present Value (NPV) Calculation:				
i =	4%			
n =	25			
Year	**Default Cost**	**User Over-Ride**	**Cost Used in NPV Calculation**	**Adjusted Annual O & M Cost**
0	**$483,157**		**$483,157**	
1	**$0**		**$0**	
2	**$0**		**$0**	
3	**$0**		**$0**	
4	**$0**		**$0**	
5	**$0**		**$0**	
6	**$0**		**$0**	
7	**$0**		**$0**	
8	**$0**		**$0**	
9	**$0**		**$0**	
10	**$0**		**$0**	
11	**$0**		**$0**	
12	**$0**		**$0**	
13	**$0**		**$0**	
14	**$0**		**$0**	
15	**$0**		**$0**	
16	**$0**		**$0**	
17	**$0**		**$0**	
18	**$0**		**$0**	
19	**$0**		**$0**	
20	**$0**		**$0**	
21	**$0**		**$0**	
22	**$0**		**$0**	
23	**$0**		**$0**	
24	**$0**		**$0**	
25	**$0**		**$0**	
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NPV			**$483,157**	**$0**	

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GBT Installation

To Summary

Is This Facility Included in My Project? Yes

Parametric Inputs	Value

DESCRIPTION	QUANT	UNIT	$/UNIT	TOTAL COST	REFERENCE / COMMENTS
SITEWORK:					
Excavation	0	CY	***$2.50***	$0	***02E***
Structural Backfill	0	CY	***$25.00***	$0	***02SB***
Backfill	0	CY	***$5.00***	$0	***02B***
Haul Excess	0	CY	***$5.00***	$0	***02HE***
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
CONCRETE:					
Slab on Grade	0	CY	***$250.00***	$0	***03S***
Slab on Grade	28	CY	***$250.00***	$6,944	***03S***
Walls	6	CY	***$400.00***	$2,519	***03W***
Walls	0	CY	***$400.00***	$0	***03W***
Walls	0	CY	***$400.00***	$0	***03W***
Walls	0	CY	***$400.00***	$0	***03W***
Beams	0	CY	***$1,000.00***	$0	***03B***
Beams	0	CY	***$1,000.00***	$0	***03B***
Elevated Slab	0	CY	***$450.00***	$0	***03ES***
Elevated Slab	0	CY	***$450.00***	$0	***03ES***
Allowance for Misc Items	5%		$9,463	$473	
Subtotal				$9,936	
MASONRY:					
Type of Building Construction:	**Moderate**				
Building	0	SF	***$100.00***	$0	***04BM***
Subtotal				$0	
METALS:					
Grating	160	SF	***$55.00***	$8,800	***05G***
Handrail	80	LF	***$55.00***	$4,400	***05H***
Stairs	10	Risers	***$300.00***	$3,000	***05S***
Allowance for Misc Items	5%		$16,200.00	$810	
Subtotal				$17,010	
WOOD & PLASTIC:					
Item 1	0	EA	$0.00	$0	
Item 2	0	EA	$0.00	$0	
Item 3	0	EA	$0.00	$0	
Item 4	0	EA	$0.00	$0	
Item 5	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
THERMAL & MOISTURE PROTECTION:					
Item 1	0	EA	$0.00	$0	
Item 2	0	EA	$0.00	$0	
Item 3	0	EA	$0.00	$0	
Item 4	0	EA	$0.00	$0	
Item 5	0	EA	$0.00	$0	
Roof Hatch (4' x 6', double leaf)	0	EA	***$1,800.00***	$0	***07RH1***
Roof Hatch (2' x 2', double leaf)	0	EA	***$300.00***	$0	***07RH2***
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
DOORS & WINDOWS:					
Item 1	0	EA	$0.00	$0	
Item 2	0	EA	$0.00	$0	
Item 3	0	EA	$0.00	$0	
Item 4	0	EA	$0.00	$0	

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Item 5	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
EQUIPMENT:					
Gravity Belt Thickener	2	EA	$110,000.00	$220,000	
Polymer System	1	EA	$50,000.00	$50,000	
Thickened Sludge Pumps	3	EA	$15,000.00	$45,000	
Equipment Item 4	0	EA	$0.00	$0	
Equipment Item 5	0	EA	$0.00	$0	
Equipment Item 6	0	EA	$0.00	$0	
Equipment Item 7	0	EA	$0.00	$0	
Equipment Item 8	0	EA	$0.00	$0	
Equipment Item 9	0	EA	$0.00	$0	
Equipment Item 10	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$315,000.00	$15,750	
Subtotal				$330,750	
I&C:					
Item 1	0	EA	$0.00	$0	
Item 2	0	EA	$0.00	$0	
Item 3	0	EA	$0.00	$0	
Item 4	0	EA	$0.00	$0	
Item 5	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
CONVEYING SYSTEMS:					
Monorail Hoist (3 Ton)	0	EA	***$2,475.00***	$0	***14MH***
Hoist Rail	0	LF	***$25.00***	$0	***14MR***
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
MECHANICAL:					
Equipment Item 1	0	EA	$0.00	$0	
Equipment Item 2	0	EA	$0.00	$0	
Equipment Item 3	0	EA	$0.00	$0	
Equipment Item 4	0	EA	$0.00	$0	
Equipment Item 5	0	EA	$0.00	$0	
Equipment Item 6	0	EA	$0.00	$0	
Equipment Item 7	0	EA	$0.00	$0	
Equipment Item 8	0	EA	$0.00	$0	
Equipment Item 9	0	EA	$0.00	$0	
Equipment Item 10	0	EA	$0.00	$0	
Allowance for Misc Items	5%		$0.00	$0	
Subtotal				$0	
USER DEFINED ESTIMATE ITEMS:	**QUANT**	**UNIT**	**$/UNIT**	**TOTAL COST**	
Demolition Allowance	1	LS	$50,000.00	$50,000	
Item 2 Description	0		$0.00	$0	
Item 3 Description	0		$0.00	$0	
Item 4 Description	0		$0.00	$0	
Item 5 Description	0		$0.00	$0	
Item 6 Description	0		$0.00	$0	
Item 7 Description	0		$0.00	$0	
Item 8 Description	0		$0.00	$0	
Item 9 Description	0		$0.00	$0	
Item 10 Description	0		$0.00	$0	
Item 11 Description	0		$0.00	$0	
Item 12 Description	0		$0.00	$0	
Item 13 Description	0		$0.00	$0	
Item 14 Description	0		$0.00	$0	
Item 15 Description	0		$0.00	$0	
Subtotal				$50,000	
Subtotal				$407,696	
ALLOWANCES:		**User Over-write**			
Finishes Allowance	2.0%		$509,620	$10,192	
I & C Allowance	4%		$509,620	$20,385	
Mechanical Allowance	10%		$509,620	$50,962	
Electrical Allowance	4%		$509,620	$20,385	
Facility Cost				**$509,620**	
Facility Cost with Additional Project Costs Added	**-**	**0**	**#DIV/0!**	**$637,025**	
Facility Cost with Additional Project Costs & Contractor Markups Added	**-**	**0**	**#DIV/0!**	**$927,063**	
Facility Cost with Additional Project Costs, Contractor Markups & Escalation Added	**-**	**0**	**#DIV/0!**	**$980,240**	
Facility Cost with Additional Project Costs, Contractor Markups, Escalation Added & Location Adjustment Factor Added	**-**	**0**	**#DIV/0!**	**$1,207,656**	
Annual O & M					

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Labor	-	HRS	$ 50.00	$0
Energy	-	KWH	$ 0.07	$0
Fuel	-	GAL	$ 1.75	$0
Maintenance Materials & Supplies	1	LS	$0.00	$0
Subtotal				$0

User Defined Annual O&M Items:	Annual Cost
Item 1	$ -
Item 2	$ -
Item 3	$ -
Item 4	$ -
Item 5	$ -
Item 6	$ -
Item 7	$ -
Item 8	$ -
Item 9	$ -
Item 10	$ -
Item 11	$ -
Item 12	$ -
Item 13	$ -
Item 14	$ -
Item 15	$ -
Subtotal Annual O&M Cost	$ -
Contingency 20%	$ -
Total Annual O&M Cost	$ -

Net Present Value (NPV) Calculation:

i = 4%

n = 25

Year	Default Cost	User Over-Ride	Cost Used in NPV Calculation	Adjusted Annual O & M Cost
0	$1,207,656		$1,207,656	
1	$0		$0	
2	$0		$0	
3	$0		$0	
4	$0		$0	
5	$0		$0	
6	$0		$0	
7	$0		$0	
8	$0		$0	
9	$0		$0	
10	$0		$0	
11	$0		$0	
12	$0		$0	
13	$0		$0	
14	$0		$0	
15	$0		$0	
16	$0		$0	
17	$0		$0	
18	$0		$0	
19	$0		$0	
20	$0		$0	
21	$0		$0	
22	$0		$0	
23	$0		$0	
24	$0		$0	
25	$0		$0	
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NPV			**$1,207,656**	**$0**	

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Appendix E – Technical Memorandum 2 Operation and Maintenance Cost with NPV

County of Maui
Lahaina WWRF Process Study Report
Operation and Maintenance Cost with NPV

PREPARED FOR:	County of Maui, Department of Public Works & Environmental Management, Wastewater Reclamation Division
PREPARED BY:	Dave Porter/OMI/DEN
SUBMITTED BY:	Ross Kaneko/CH2M HILL/HNL
COPIES:	Project File
DATE:	Sept 24, 2005

This document presents the requested revision of Phase 2 study report for calculation of NPV cost to include the addition of electrical upgrades to each alternative proposed by CH2M HILL for the Lahaina Wastewater Reclamation Facility (Lahaina WWRF). The NPV for the six alternatives generated from Phase 2 were adjusted to include the additional cost associated with upgrade of the power system as recommended by CH2M HILL. The additional cost for each alternative include for power upgrades was:

- Alternative 1 – Status Quo $ 50,000
- Alternative 2 – Operational Improvements Only $ 150,000
- Alternative 3 – Restore the 1975 Plant to Original Design $ 1,250,000
- Alternative 4 – Install MBRs in Portion of 1975 Plant $ 500,000
- Alternative 5 – Use 1975 Plant and Parallel Nitrogen Removal $ 750,000
- Alternative 7 – Demolish 1975 Plant and Expand 1985 Plant $ 2,250,000

This document was developed with the intent to provide additional cost information on each of the proposed alternatives. The cost methodology used to adjust the NPV was the same as for the previous TM, as to construction schedule for the additional costs for power upgrades.

Table 1 summarizes the adjusted NPV and Total Construction cost associated with each alternative. There were no adjustments made to the operations cost.

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TABLE 1

LAHAINA WWTP SECONDARY CLARIFIER CAPACITY ANALYSIS
NPV, TOTAL CONSTRUCTION AND ANNUAL OPERATIONS COSTS

Lahaina WWRF Cost Comparison	20 YEAR NET PRESENT VALUE	CONSTRUCTION AND O&M COSTS	ESTIMATED ANNUAL O&M COSTS
Comparisons of alternatives that will meet requirements			
Alt 2 – 9 mgd 5 day SRT GBTs	$ 60,684,399	**$ 8,338,567**	$2,888,567
Alt 2 – 9 mgd 5 day SRT DAFTs	$ 60,089,960	**$ 8,307,370**	$2,857,370
Alt 3 – 9 mgd 5 day SRT GBTs	$ 70,138,911	**$ 18,119,624**	$2,869,624
Alt 3 – 9 mgd 5 day SRT DAFTs	$ 70,231,127	**$ 18,124,105**	$2,874,105
Alt 4 – 9 mgd 11.3 / 5 day SRT GBTs	$ 120,098,480	**$ 57,935,417**	$3,435,417
Alt 4 – 9 mgd 11.3 / 5 Day SRT DAFTs	$ 120,069,746	**$ 57,933,604**	$3,433,604
Alt 5 – 9 mgd 11.3 / 5 day SRT GBTs	$ 71,122,325	**$ 17,696,739**	$2,946,739
Alt 5 – 9 mgd 11.3 / 5 day SRT DAFT	$ 70,047,098	**$ 17,640,491**	$2,890,491
Alt 7 – 9 mgd 11.3 / 10 day SRT GBTs	$ 99,208,729	**$ 48,078,085**	$2,828,085
Alt 7 – 9 mgd 11.3 / 10 day SRT DAFTs	$ 99,227,237	**$ 48,078,813**	$2,828,813
Alt 3 – 12 mgd 5 day SRT GBTs	$ 81,195,597	**$ 18,700,563**	$3,450,563
Alt 3 – 12 mgd 5 day SRT DAFTs	$ 80,247,398	**$ 18,650,772**	$3,400,772
Alt 4 – 12 mgd 11.3 / 5 day SRT GBTs	$ 151,324,825	**$ 80,426,698**	$3,926,698
Alt 4 – 12 mgd 11.3 / 5 Day SRT DAFTs	$ 151,221,282	**$ 80,420,897**	$3,920,897
Alt 7 – 12 mgd 11.3 / 10 day SRT GBTs	$ 123,694,274	**$ 62,632,125**	$3,382,125
Alt 7 – 12 mgd 11.3 / 10 day SRT DAFTs	$ 123,633,632	**$ 62,628,647**	$3,378,647
*WAS = Waste Activated Sludge			

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Table 4 summarizes the adjusted Total Construction

TABLE 2

LAHAINA WWTP SECONDARY CLARIFIER CAPACITY ANALYSIS
LAHAINA WWRF COST COMPARISON

Alternative	TOTAL OF ESTIMATED CONSTRUCTION AND O&M COSTS	ESTIMATED ANNUAL O&M COSTS
Status Quo "do nothing " alternative Base Cost Estimation (estimation at 5.09 mgd average)	**$ 2,175,942**	$2,125,924
Operational Improvements (New Thickening Facility)		
Alt 2 – 9 mgd 5 day SRT GBTs	**$ 8,307,370**	$2,888,567
Alt 2 – 12 mgd 5 day SRT GBTs (not achievable)	**$ 8,685,219**	$3,254,722
Alt 2 – 9 mgd 10 day SRT GBTs (not achievable)	**$ 8,184,323**	$2,740,431
Alt 2 – 12 mgd 10 day SRT GBTs (not achievable)	**$ 8,629,103**	$3,186,011
Alt 2 9 mgd 5 day SRT DAFTs	$10,356,602	$2,857,370
Alt 2 – 12 mgd 5 day SRT DAFTs (not achievable)	$10,734,451	$3,235,219
Alt 2 – 9 mgd 10 day SRT DAFTs (not achievable)	$10,233,555	$2,734,323
Alt 2 – 12 mgd 10 day SRT DAFTs (not achievable)	$10,678,335	$3,179,103
Restore 1975 plant to original design		
Alt 3 – 9 mgd 5 day SRT GBTs	**$ 18,119,624**	$2,869,624
Alt 3 – 12 mgd 5 day SRT GBTs	**$ 18,700,563**	$3,450,563
Alt 3 – 9 mgd 5 day SRT DAFTs	**$ 18,124,105**	$2,874,105
Alt 3 – 12 mgd 5 day SRT DAFTs	**$ 18,650,772**	$3,400,772
Install Membrane Bioreactors in Portion of 1975 Plant		
Alt 4 – 9 mgd MBR 11.3 / 5 day SRT GBTs	**$ 57,935,417**	$3,435,417
Alt 4 – 12 mgd MBR 11.3 / 5 day SRT GBTs	**$ 80,426,698**	$3,926,698
Alt 4 – 9 mgd MBR 11.3 / 5 day SRT DAFTs	**$ 57,933,604**	$3,433,604
Alt 4 – 12 mgd MBR 11.3 / 5 day SRT DAFTs	**$ 80,420,897**	$3,920,897

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TABLE 2

LAHAINA WWTP SECONDARY CLARIFIER CAPACITY ANALYSIS
LAHAINA WWRF COST COMPARISON

Alternative	TOTAL OF ESTIMATED CONSTRUCTION AND O&M COSTS	ESTIMATED ANNUAL O&M COSTS
Restore the 1975 Plant to Original Design		
Alt 5 – 9 mgd 11.3 / 5 day SRT GBTs	**$ 17,696,739**	$2,946,739
Alt 5 – 9 mgd 11.3 / 5 day SRT DAFTs	**$ 18,640,491**	$2,890,491
Replace 1975 plant with New		
Alt 7 – 9 mgd 11.3 / 10 day SRT GBTs	**$ 48,078,085**	$2,828,085
Alt 7 – 12 mgd 11.3 / 10 day SRT GBTs	**$ 62,632,125**	$3,382,125
Alt 7 – 9 mgd 11.3 / 10 day SRT DAFTs	**$ 48,078,813**	$2,828,813
Alt 7 – 12 mgd 11.3 / 10 day SRT DAFTs	**$ 62,628,647**	$3,378,647

1.0 Twenty-Year Life Cycle / Net Present Value

Based on the annual O&M and construction cost for each alternative, an adjusted 20 year life cycle / NPV was calculated for each alternative. The NPV for each alternative included:

- Adjusted addition to the estimated construction cost spread out equally over the anticipated construction period of 1 or 2 years depending on the alternative evaluated.
    - Alternatives 2,3 and 5 at one (1) year construction period;
    - Alternatives 4 and 7 at two (2) years construction period.
- Annual operations cost for each alternative process evaluated for 20 years were used in the NPV as per the previous verson.
- Projected inflation for the four main cost types (Labor, Power, Chemicals and Maintenance) based on the average inflation of these items over the last 20 years, for the next 20 years as shown in Table 3.
- NPV calculation was then applied to the anticipated 20 year escalated O&M and construction cost and discounted to present day value at 3.5%.

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TABLE 3

LAHAINA WWTP SECONDARY CLARIFIER CAPACITY ANALYSIS
COST ESCALATION FOR O&M MODEL

Years out	Labor	Electrical	Chemicals	Maintenance	Other	Avg CPI
Year 1	3.50%	3.60%	3.57%	3.71%	3.22%	3.52%
Year 2	3.42%	3.52%	3.49%	3.63%	3.15%	3.44%
Year 3	3.34%	3.44%	3.41%	3.54%	3.07%	3.36%
Year 4	3.26%	3.36%	3.33%	3.46%	3.00%	3.28%
Year 5	3.18%	3.28%	3.25%	3.38%	2.93%	3.20%
Year 6	3.11%	3.20%	3.17%	3.29%	2.86%	3.12%
Year 7	3.03%	3.12%	3.09%	3.21%	2.79%	3.05%
Year 8	2.95%	3.04%	3.01%	3.13%	2.71%	2.97%
Year 9	2.87%	2.96%	2.93%	3.04%	2.64%	2.89%
Year 10	2.79%	2.88%	2.85%	2.96%	2.57%	2.81%
Year 11	2.71%	2.80%	2.77%	2.88%	2.50%	2.73%
Year 12	2.64%	2.71%	2.69%	2.79%	2.42%	2.65%
Year 13	2.56%	2.63%	2.61%	2.71%	2.35%	2.57%
Year 14	2.48%	2.55%	2.53%	2.63%	2.28%	2.49%
Year 15	2.40%	2.47%	2.45%	2.54%	2.21%	2.41%
Year 16	2.32%	2.39%	2.37%	2.46%	2.14%	2.34%
Year 17	3.00%	3.09%	3.06%	3.18%	2.76%	3.02%
Year 18	3.16%	3.25%	3.22%	3.35%	2.91%	3.18%
Year 19	2.09%	2.15%	2.13%	2.21%	1.92%	2.10%
Year 20	2.90%	2.99%	2.96%	3.07%	2.67%	2.92%

Based on the adjusted NPV cost evaluation, Alt 2 - 9 mgd 5 day SRT GBTs generated the lowest NPV cost at $60,089,960. Table 4 summarizes the adjusted NPV of each alternative in ascending order.

TABLE 4

LAHAINA WWTP SECONDARY CLARIFIER CAPACITY ANALYSIS
20 YEAR NPV OF ALTERNATIVES IN ASCENDING ORDER

Alternative	NPV @ 3.5%
Status Quo “do nothing “ alternative Base Cost Estimation (estimation at 5.09 mgd average)	$ 41,621,584

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TABLE 4

LAHAINA WWTP SECONDARY CLARIFIER CAPACITY ANALYSIS
20 YEAR NPV OF ALTERNATIVES IN ASCENDING ORDER

Alternative	NPV @ 3.5%
Alt 2 9 mgd 5 day SRT GBTs	$ 60,089,960
Alt 2 9 mgd 5 day SRT DAFTs	$ 60,684,399
Alt 3 9 mgd 5 day SRT GBTs	$ 70,047,098
Alt 5 9 mgd 11.3 / 5 day SRT GBTs	$ 70,138,911
Alt 3 9 mgd 5 day SRT DAFTs	$ 70,231,127
Alt 5 9 mgd 11.3 / 5 day SRT DAFT	$ 71,122,325
Alt 3 12 mgd 5 day SRT GBTs	$ 80,247,398
Alt 3 12 mgd 5 day SRT DAFTs	$ 81,195,597
Alt 7 9 mgd 11.3 / 10 day SRT GBTs	$ 99,208,729
Alt 7 9 mgd 11.3 / 10 day SRT DAFTs	$ 99,227,237
Alt 4 9 mgd MBR 11.3 / 5 day SRT GBTs	$ 120,069,746
Alt 7 12 mgd 11.3 / 10 day SRT GBTs	$ 120,098,480
Alt 4 9 mgd MBR 11.3 / 5 day SRT DAFTs	$ 123,633,632
Alt 7 12 mgd 11.3 / 10 day SRT DAFTs	$ 123,694,274
Alt 4 12 mgd MBR 11.3 / 5 day SRT GBTs	$ 151,221,282
Alt 4 12 mgd MBR 11.3 / 5 day SRT DAFTs	$ 151,324,825

Note: Status Quo is based on 5.09 mgd vs. the 9 and 12 mgd costs for other alternatives and thus does not reflect the NPV to meet the objectives of this evaluation.

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County of Maui
Lahaina WWRF Process Study Report
Operation and Maintenance Cost with NPV

PREPARED FOR: County of Maui, Department of Public Works & Environmental Management, Wastewater Reclamation Division

PREPARED BY: Dave Porter/OMI/DEN

SUBMITTED BY: Ross Kaneko/CH2M HILL/HNL

COPIES: Project File

DATE: July 1, 2005

Overview

This document presents the requested continuation of Phase 2 to include operations and maintenance costs and a net present value (NPV) for alternatives proposed by CH2M HILL for the Lahaina Wastewater Reclamation Facility (Lahaina WWRF). Phase 1 of the study involved a review of the existing facilities, setup and calibration of a steady-state process model, and preliminary screening of various process alternatives. Phase 2 produced a recommended alternative based on process and hydraulic modeling results, and developed capital costs for improvements and modifications associated with the modeled alternatives. This document expands on the Phase 2 analysis to provide a life cycle cost of each of the alternatives, and to provide the County of Maui a better understanding and comparison of the cost associated with each alternative being evaluated. The six alternatives generated from Phase 2 were modeled using OMI's operations and maintenance costing model and included options for using a gravity belt or dissolved air flotation for solids thickening. The six alternatives include:

- Alternative 1 – Status Quo (the "do nothing" alternative)
- Alternative 2 – Operational Improvements Only
- Alternative 3 – Restore the 1975 Plant to Original Design
- Alternative 4 – Install Membrane Bioreactors (MBRs) in Portion of 1975 Plant
- Alternative 5 – Use 1975 Plant with Modifications to Provide Parallel Nitrogen Removal
- Alternative 7 – Demolish 1975 Plant and Expand 1985 Plant

This document was developed with the intent to provide a quantifiable cost value to assist the County of Maui in making a sound determination of the proposed alternatives. The cost methodology used to model each of the six alternatives was based on the desired increase in influent plant flow to an average dry weather (ADW) flow of 9 and 12 mgd.

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Table 1 summarizes the NPV, Total Construction and Annual operations cost associated with each alternative modeled. The remaining document provides the conditions associated with each alternative and details as to how the data was generated.

TABLE 1

NPV, TOTAL CONSTRUCTION AND ANNUAL OPERATIONS COSTS

Lahaina WWRF Cost Comparison	20 YEAR NET PRESENT	CONSTRUCTION AND O&M COSTS	ESTIMATED ANNUAL O&M COSTS
Comparisons of alternatives that will meet requirements			
Alt 2 – 9 mgd 5 day SRT GBTs	$60,534,806	$8,188,567	$2,888,567
Alt 2 – 9 mgd 5 day SRT DAFTs	$59,940,367	$10,206,602	$2,857,370
Alt 3 – 9 mgd 5 day SRT GBTs	$68,892,306	$16,869,624	$2,869,624
Alt 3 – 9 mgd 5 day SRT DAFTs	$68,984,522	$18,923,337	$2,874,105
Alt 4 – 9 mgd 11.3 / 5 day SRT GBTs	$119,600,690	$57,435,417	$3,435,417
Alt 4 – 9 mgd 11.3 / 5 Day SRT DAFTs	$119,571,956	$59,482,836	$3,433,604
Alt 5 – 9 mgd 11.3 / 5 day SRT GBTs	$70,374,362	$16,946,739	$2,946,739
Alt 5 – 9 mgd 11.3 / 5 day SRT DAFT	$69,299,135	$18,939,723	$2,890,491
Alt 7 – 9 mgd 11.3 / 10 day SRT GBTs	$96,968,670	$45,828,085	$2,828,085
Alt 7 – 9 mgd 11.3 / 10 day SRT DAFTs	$96,987,178	$47,878,045	$2,828,813
Alt 3 – 12 mgd 5 day SRT GBTs	$79,948,992	$17,450,563	$3,450,563
Alt 3 – 12 mgd 5 day SRT DAFTs	$79,000,793	$19,450,004	$3,400,772
Alt 4 – 12 mgd 11.3 / 5 day SRT GBTs	$150,827,034	$79,926,698	$3,926,698
Alt 4 – 12 mgd 11.3 / 5 Day SRT DAFTs	$150,723,491	$81,970,129	$3,920,897
Alt 7 – 12 mgd 11.3 / 10 day SRT GBTs	$121,454,215	$60,382,125	$3,382,125
Alt 7 – 12 mgd 11.3 / 10 day SRT DAFTs	$121,393,573	$62,427,879	$3,378,647
*WAS = Waste Activated Sludge			

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1.0 Background

Phase 1 of the study involved a review of the existing facilities, setup and calibration of a steady-state process model, and preliminary screening of various process alternatives. Phase 2 produced a recommended alternative based on process and hydraulic modeling results, and developed capital costs for improvements and modifications associated with the modeled alternatives.

1.1 Objective

In order to provide the County of Maui, Department of Public Works and Waste Management with a comparable budgetary annual and life cycle operations and maintenance (O&M) cost for the alternative processes proposed for the Lahaina WWRF, CH2M HILL has prepared the following evaluation.

2.0 Cost Modeling

CH2M HILL utilized the cost modeling tools of its OMI subsidiary which operates over 180 water and wastewater facilities around the world. The methodology for OMI's costing models includes both actual operations costs from their existing facilities as well as standard costs provided by vendors for the types of equipment proposed, and incorporated local utility costs.

OMI's costing models were first calibrated against CH2M HILL's PRO2D process model at maximum month values generated from the Phase 2 report (Section 2.1.3 – Modeling Results) to obtain flows, loading and solids quantities. In addition, average loading values for each cost model use the parameters in the Phase 2 report (Section 2.1.2) and as shown in Table 2.

TABLE 2

AVERAGE LOADING VALUES

Parameter		9 mgd	12 mgd
CBOD5 mg/l	140	10,508 lbs/day	14,912 lbs/day
TSS, mg/l	149	11,184 lbs/day	14,011 lbs/day
Ammonia, mg N/l	14	1,050 lbs/day	1,401 lbs/day

Finally, proposed pump energy requirements were based on CH2M HILL's hydraulic model in regards to total dynamic head (TDH) requirements calculated.

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In order to generate a comparable annual O&M cost, each process was modeled against the Alternative 1 "Status Quo" at the current flow of 5.09 mgd and annual budgets provided by the County of Maui for the Lahaina WWRF. Costs for each alternative were then generated at the desired flows of 9 and 12 mgd as applicable. Note that Alternatives 1 and 2 are not perceived to meet the desired effluent quality at the flow rates of either 9 or 12 mgd, and Alternative 5 was only modeled at the 9 mgd as proposed.

An additional analysis was run on each proposed alternative in order to compare the cost of thickening alternatives for gravity belt thickeners (GBTs) and dissolved air flotation thickeners (DAFTs).

2.1 Annual O&M costing:

The following assumptions were used in estimating annual O&M costs for each alternative:

- Lahaina WWRF will continue to truck dewatered solids to the landfill for disposal.
- Costing was based on additional vehicles or manpower required for the additional solids that will be generated.
- Labor costs were estimated for additional and solids generated at the 9 and 12 mgd facilities, based on operating the facility 2 shifts per day (16 hours) 5 days per week for thickening and dewatering operations. Total manpower was figured at;
    - Alternatives 3 and 7 added one position for additional solids handling at the 9 mgd flow and 3 positions at the 12 mgd flow for a total of 9 and 11 positions respectively.
    - Alternative 4 and 5 added 2 positions for the 9 mgd flow and 3 for the 12 mgd flow rates for a total of 10 and 11 positions respectively. The additional manpower is due to the increased solids, clean in place requirements for the MBR facility and the more complex operations of the Modified-Ludzack-Ettinger (MLE) process proposed for alternative 5.
- Labor cost were estimated with standard benefits and manpower estimations for the different alternatives proposed.
- Major maintenance will continue to be handled through a centralized maintenance center and only the current 4 person maintenance staff will remain on site for minor maintenance issues.
- Hours of operations for each thickening unit was based on 200 gpm/meter for GBTs and 200 gpm/unit for DAFTs with a minimum of 2 units in operations to maintain operations hours within the 2 shift 5 day per week operations assumption stated above.
- This type of facility is classified as a "J" Medium Power Use Business. Average kWH power cost is $0.1925 with a $8.50 per kW added on during peak demand and a $8.00 per kW added on during off peak demand.
- Maintenance repair costs were based on utilizing some of the existing structures and equipment and based on OMI's average costs for the type of equipment proposed for each alternative.

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- Variable costs were estimated as shown in Table 3.

TABLE 3

VARIABLE COSTS

Cost Basis for Modeling	Quantity	Units
Grit truck	10.00	yd^3/load
Miles to Land fill / disposal site for Grit only	25.00	miles
Vehicles average miles per gallon of truck	9.00	miles/gal
Miles to Land fill / disposal site for sludge only	25.00	miles
Sodium Hypo Chloride	800.00	$/ton
Thickening Polymer	2.35	$/lbs
Dewatering Polymer	3.25	$/lbs
Water (Potable)	1.81	$/100 cubic feet
Fuel Cost (Diesel)	2.09	$/gal
Grit Hauling Fee	79.00	$/trip
Grit Tipping Fee	29.00	$/$yd^3$
Sludge Hauling Fee	26.00	$/ton
Sludge Tipping Fee	29.00	$/ton

Note: Total sludge disposal cost is figured at $55.00/ton. Model used hauling and tipping fee separately.

2.2 Cost exclusions:

The costing models were run based on direct operations and maintenance cost and did not consider the following;

- Administration cost
- Pump stations outside of the plant
- Groundskeeping
- Insurance costs
- General operations supplies, i.e. computers, papers etc.

The following table summarizes the annual operations cost for each alternative. The total estimation of the construction and O&M cost is one (1) year estimated O&M cost plus total construction cost for that alternative as presented in the Phase 2 report Table 13 page 27.

TABLE 4

LAHAINA WWRF COST COMPARISON

Alternative	TOTAL OF ESTIMATED CONSTRUCTION AND O&M COSTS	ESTIMATED ANNUAL O&M COSTS
Status Quo "do nothing " alternative Base Cost Estimation	$2,125,924	$2,125,924

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TABLE 4

LAHAINA WWRF COST COMPARISON

Alternative	TOTAL OF ESTIMATED CONSTRUCTION AND O&M COSTS	ESTIMATED ANNUAL O&M COSTS
(estimation at 5.09 mgd average)		
Operational Improvements (New Thickening Facility)		
Alt 2 – 9 mgd 5 day SRT GBTs	$8,188,567	$2,888,567
Alt 2 – 12 mgd 5 day SRT GBTs (not achievable)	$8,554,722	$3,254,722
Alt 2 – 9 mgd 10 day SRT GBTs (not achievable)	$8,040,431	$2,740,431
Alt 2 – 12 mgd 10 day SRT GBTs (not achievable)	$8,486,011	$3,186,011
Alt 2 9 mgd 5 day SRT DAFTs	$10,206,602	$2,857,370
Alt 2 – 12 mgd 5 day SRT DAFTs (not achievable)	$10,584,451	$3,235,219
Alt 2 – 9 mgd 10 day SRT DAFTs (not achievable)	$10,083,555	$2,734,323
Alt 2 – 12 mgd 10 day SRT DAFTs (not achievable)	$10,528,335	$3,179,103
Restore 1975 plant to original design		
Alt 3 – 9 mgd 5 day SRT GBTs	$16,869,624	$2,869,624
Alt 3 – 12 mgd 5 day SRT GBTs	$17,450,563	$3,450,563
Alt 3 – 9 mgd 5 day SRT DAFTs	$18,923,337	$2,874,105
Alt 3 – 12 mgd 5 day SRT DAFTs	$19,450,004	$3,400,772
Install Membrane Bioreactors in Portion of 1975 Plant		
Alt 4 – 9 mgd MBR 11.3 / 5 day SRT GBTs	$57,435,417	$3,435,417
Alt 4 – 12 mgd MBR 11.3 / 5 day SRT GBTs	$79,926,698	$3,926,698
Alt 4 – 9 mgd MBR 11.3 / 5 day SRT DAFTs	$59,482,836	$3,433,604
Alt 4 – 12 mgd MBR 11.3 / 5 day SRT DAFTs	$81,970,129	$3,920,897
Restore the 1975 Plant to Original Design		
Alt 5 – 9 mgd 11.3 / 5 day SRT GBTs	$16,946,739	$2,946,739
Alt 5 – 9 mgd 11.3 / 5 day SRT DAFTs	$18,939,723	$2,890,491

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TABLE 4

LAHAINA WWRF COST COMPARISON

Alternative	TOTAL OF ESTIMATED CONSTRUCTION AND O&M COSTS	ESTIMATED ANNUAL O&M COSTS
Replace 1975 plant with New		
Alt 7 – 9 mgd 11.3 / 10 day SRT GBTs	$45,828,085	$2,828,085
Alt 7 – 12 mgd 11.3 / 10 day SRT GBTs	$60,382,125	$3,382,125
Alt 7 – 9 mgd 11.3 / 10 day SRT DAFTs	$47,878,045	$2,828,813
Alt 7 – 12 mgd 11.3 / 10 day SRT DAFTs	$62,427,879	$3,378,647

3.0 20 Year Life Cycle / Net Present Value NPV

Based on the annual O&M and construction cost for each alternative, a 20 year life cycle / NPV was calculated for each alternative. NPV for each alternative included:

- Estimated construction cost spread out equally over the anticipated construction period of 1 or 2 years depending on the alternative evaluated.
    - Alternatives 2,3 and 5 at one (1) year construction period;
    - Alternatives 4 and 7 at two (2) years construction period.
- Annual operations cost for each alternative process evaluated for 20 years were used in the NPV.
- Projected inflation for the four main cost types (Labor, Power, Chemicals and Maintenance) based on the average inflation of these items over the last 20 years, for the next 20 years as shown in Table 5.
- NPV calculation was then applied to the anticipated 20 year escalated O&M and construction cost and discounted to present day value at 3.5%.

TABLE 5

COST ESCALATION FOR O&M MODEL

Years out	Labor	Electrical	Chemicals	Maintenance	Other	Avg CPI
Year 1	3.50%	3.60%	3.57%	3.71%	3.22%	3.52%
Year 2	3.42%	3.52%	3.49%	3.63%	3.15%	3.44%
Year 3	3.34%	3.44%	3.41%	3.54%	3.07%	3.36%
Year 4	3.26%	3.36%	3.33%	3.46%	3.00%	3.28%

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TABLE 5

COST ESCALATION FOR O&M MODEL

Years out	Labor	Electrical	Chemicals	Maintenance	Other	Avg CPI
Year 1	3.50%	3.60%	3.57%	3.71%	3.22%	3.52%
Year 2	3.42%	3.52%	3.49%	3.63%	3.15%	3.44%
Year 5	3.18%	3.28%	3.25%	3.38%	2.93%	3.20%
Year 6	3.11%	3.20%	3.17%	3.29%	2.86%	3.12%
Year 7	3.03%	3.12%	3.09%	3.21%	2.79%	3.05%
Year 8	2.95%	3.04%	3.01%	3.13%	2.71%	2.97%
Year 9	2.87%	2.96%	2.93%	3.04%	2.64%	2.89%
Year 10	2.79%	2.88%	2.85%	2.96%	2.57%	2.81%
Year 11	2.71%	2.80%	2.77%	2.88%	2.50%	2.73%
Year 12	2.64%	2.71%	2.69%	2.79%	2.42%	2.65%
Year 13	2.56%	2.63%	2.61%	2.71%	2.35%	2.57%
Year 14	2.48%	2.55%	2.53%	2.63%	2.28%	2.49%
Year 15	2.40%	2.47%	2.45%	2.54%	2.21%	2.41%
Year 16	2.32%	2.39%	2.37%	2.46%	2.14%	2.34%
Year 17	3.00%	3.09%	3.06%	3.18%	2.76%	3.02%
Year 18	3.16%	3.25%	3.22%	3.35%	2.91%	3.18%
Year 19	2.09%	2.15%	2.13%	2.21%	1.92%	2.10%
Year 20	2.90%	2.99%	2.96%	3.07%	2.67%	2.92%

Alternative 2 for the 9 mgd 10 day SRT and both Alternative 2 for the 12 mgd 5 and 10 day facilities, though evaluated, will not meet the required quality based on CH2M HILL's PRO2D modeling.

Based on the NPV cost alternatives Alt 2 - 9 mgd 5 day SRT GBTs generated the lowest NPV cost of $60,534,806. This is due to the lower construction cost associated with this alternative. Table 6 summarizes the NPV of each alternative in ascending order.

TABLE 6

20 YEAR NPV OF ALTERNATIVES IN ASCENDING ORDER

Alternative	NPV @ 3.5%
Status Quo "do nothing " alternative Base Cost Estimation (estimation at 5.09 mgd average)	$40,689,925
Alt 2 9 mgd 5 day SRT GBTs	$60,534,806
Alt 2 9 mgd 5 day SRT DAFTs	$61,989,599
Alt 3 9 mgd 5 day SRT GBTs	$68,892,306

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TABLE 6

20 YEAR NPV OF ALTERNATIVES IN ASCENDING ORDER

Alternative	NPV @ 3.5%
Alt 5 9 mgd 11.3 / 5 day SRT GBTs	$70,374,362
Alt 3 9 mgd 5 day SRT DAFTs	$71,033,754
Alt 5 9 mgd 11.3 / 5 day SRT DAFT	$71,348,367
Alt 3 12 mgd 5 day SRT GBTs	$79,948,992
Alt 3 12 mgd 5 day SRT DAFTs	$81,050,025
Alt 7 9 mgd 11.3 / 10 day SRT GBTs	$96,968,670
Alt 7 9 mgd 11.3 / 10 day SRT DAFTs	$99,036,410
Alt 4 9 mgd MBR 11.3 / 5 day SRT GBTs	$119,600,690
Alt 7 12 mgd 11.3 / 10 day SRT GBTs	$121,454,215
Alt 4 9 mgd MBR 11.3 / 5 day SRT DAFTs	$121,621,188
Alt 7 12 mgd 11.3 / 10 day SRT DAFTs	$123,442,805
Alt 4 12 mgd MBR 11.3 / 5 day SRT GBTs	$150,827,034
Alt 4 12 mgd MBR 11.3 / 5 day SRT DAFTs	$152,772,723

Note: Status Quo is based on 5.09 mgd vs. the 9 and 12 mgd costs for other alternatives and thus does not reflect the NPV to meet the objectives of this evaluation.

4.0 Thickening Options Evaluation

In general the alternatives cost models run with DAFTs generating a lower annual operating cost. The main differences were DAFTs used more power but had less chemical cost, however there is a minor overall difference. The major consideration for determination of the thickening options should be the anticipated increase in polymer costs verses power cost over the years. Historical trends indicate that power costs are rising faster than chemical costs, however based on OMI's experience over the last year chemical costs are current rising faster than power costs. This is mainly due to the ability of power companies to hedge the rising fuel costs better than the chemical companies on a short term basis.

The attached spread sheets contain a more detailed break down of the costs for each alterative.

Appendix A - O&M annual estimated costs

See attached spread sheets.

Appendix B – NPV calculations

See attached spread sheets.

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Appendix A

O&M Annual Estimated Costs

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Appendix A-1

O&M Annual Estimated Costs – 9 mgd

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Lahaina WWRF Operations Cost Comparision Sheet

.

	20 Year Net Present Value with O&M and Costruction	TOTAL CONSTRUCTION AND O&M ESTIMATED COSTS (Adds O&M Cost and Construction line item)	O&M ESTIMATED COSTS (Adds only line items in bold)	LABOR	MAINTENANCE	Rutine Preventitive/Predictive	Corrective	Replacement	VEHICLE EXPENSES	Grit & Screenings	Sludge Hauling	CHEMICALS	Sodium Hypochlorite	Sodium Bisulfite	Clean in Place Chemicals	Ferric Chloride	Primary Thickener - Polymer	Secondary Thickener - Polymer	Dewatering - Polymer	FUEL OIL	Miscellaneous	Generator Operation
All 9 MGD Comparisons (that will meet requirements)																						
Alt 2 Case 1 9 mgd 5 day SRT GBTs	$ 60,534,806	**$ 8,188,567**	**$ 2,888,567**	**$ 685,282**	**$ 741,555**	$ 122,655	$ 210,050	$ 408,850	**$ 93,829**	$ 40,526	$ 53,303	**$ 195,922**	$ 76,711	$ -	$ -	$ -	$ -	$ 32,613	$ 86,597	$ -	$ -	$ -
Alt 2 Case 1 9 mgd 5 day SRT DAFTs	$ 59,940,367	**$ 8,157,370**	**$ 2,857,370**	**$ 685,282**	**$ 733,905**	$ 121,380	$ 207,925	$ 404,600	**$ 93,829**	$ 40,526	$ 53,303	**$ 185,051**	$ 76,711	$ -	$ -	$ -	$ -	$ 21,742	$ 86,597	$ -	$ -	$ -
Alt 3 Case 2 5 day SRT 9 mgd GBTs	$ 68,892,306	**$ 16,869,624**	**$ 2,869,624**	**$ 685,282**	**$ 781,280**	$ 121,875	$ 253,155	$ 406,250	**$ 88,078**	$ 40,526	$ 47,553	**$ 183,061**	$ 76,711	$ -	$ -	$ -	$ -	$ 29,095	$ 77,255	$ -	$ -	$ -
Alt 3 Case 2 5 day SRT 9 mgd DAFTs	$ 68,984,522	**$ 16,874,105**	**$ 2,874,105**	**$ 685,282**	**$ 783,856**	$ 122,280	$ 253,976	$ 407,600	**$ 88,078**	$ 40,526	$ 47,553	**$ 173,363**	$ 76,711	$ -	$ -	$ -	$ -	$ 19,396	$ 77,255	$ -	$ -	$ -
Alt 4 Case 1 9 mgd 11.3 / 5 day SRT GBTs	$ 119,600,690	**$ 57,435,417**	**$ 3,435,417**	**$ 741,293**	**$ 1,089,916**	$ 130,050	$ 237,616	$ 722,250	**$ 88,055**	$ 40,526	$ 47,529	**$ 235,568**	$ 76,711	$ -	$ 52,560	$ -	$ -	$ 29,080	$ 77,217	$ -	$ -	$ -
Alt 4 Case 1 9 mgd 11.3 / 5 Day SRT DAFTs	$ 119,571,956	**$ 57,433,604**	**$ 3,433,604**	**$ 741,293**	**$ 1,087,805**	$ 129,705	$ 237,000	$ 721,100	**$ 88,055**	$ 40,526	$ 47,529	**$ 225,875**	$ 76,711	$ -	$ 52,560	$ -	$ -	$ 19,387	$ 77,217	$ -	$ -	$ -
Alt 5 Case 2 11.3 / 5 day SRT 9 mgd GBTs	$ 70,374,362	**$ 16,946,739**	**$ 2,946,739**	**$ 741,293**	**$ 785,575**	$ 125,625	$ 241,200	$ 418,750	**$ 88,078**	$ 40,526	$ 47,553	**$ 183,061**	$ 76,711	$ -	$ -	$ -	$ -	$ 29,095	$ 77,255	$ -	$ -	$ -
Alt 5 Case 2 11.3 / 5 day SRT 9 mgd DAFT	$ 69,299,135	**$ 16,890,491**	**$ 2,890,491**	**$ 685,282**	**$ 783,433**	$ 125,280	$ 240,553	$ 417,600	**$ 88,078**	$ 40,526	$ 47,553	**$ 173,363**	$ 76,711	$ -	$ -	$ -	$ -	$ 19,396	$ 77,255	$ -	$ -	$ -
Alt 7 Case 2 9 mgd 11.3 / 10 day SRT GBTs	$ 96,968,670	**$ 45,828,085**	**$ 2,828,085**	**$ 685,282**	**$ 771,387**	$ 125,625	$ 227,012	$ 418,750	**$ 83,534**	$ 40,526	$ 43,009	**$ 172,898**	$ 76,711	$ -	$ -	$ -	$ -	$ 26,314	$ 69,873	$ -	$ -	$ -
Alt 7 Case 2 9 mgd 11.3 / 10 day SRT DAFTs	$ 96,987,178	**$ 45,828,813**	**$ 2,828,813**	**$ 685,282**	**$ 769,283**	$ 125,280	$ 226,403	$ 417,600	**$ 83,534**	$ 40,526	$ 43,009	**$ 164,127**	$ 76,711	$ -	$ -	$ -	$ -	$ 17,543	$ 69,873	$ -	$ -	$ -
By Solids Thickening																						
GBTs																						
Alt 2 Case 1 9 mgd 5 day SRT GBTs	$ 60,534,806.2	**$ 8,188,567**	**$ 2,888,567**	**$ 685,282**	**$ 741,555**	$ 122,655	$ 210,050	$ 408,850	**$ 93,829**	$ 40,526	$ 53,303	**$ 195,922**	$ 76,711	$ -	$ -	$ -	$ -	$ 32,613	$ 86,597	$ -	$ -	$ -
Alt 3 Case 2 5 day SRT 9 mgd GBTs	$ 68,892,305.7	**$ 16,869,624**	**$ 2,869,624**	**$ 685,282**	**$ 781,280**	$ 121,875	$ 253,155	$ 406,250	**$ 88,078**	$ 40,526	$ 47,553	**$ 183,061**	$ 76,711	$ -	$ -	$ -	$ -	$ 29,095	$ 77,255	$ -	$ -	$ -
Alt 4 Case 1 9 mgd 11.3 / 5 day SRT GBTs	$ 119,600,689.6	**$ 57,435,417**	**$ 3,435,417**	**$ 741,293**	**$ 1,089,916**	$ 130,050	$ 237,616	$ 722,250	**$ 88,055**	$ 40,526	$ 47,529	**$ 235,568**	$ 76,711	$ -	$ 52,560	$ -	$ -	$ 29,080	$ 77,217	$ -	$ -	$ -
Alt 5 Case 2 11.3 / 5 day SRT 9 mgd GBTs	$ 70,374,362.2	**$ 16,946,739**	**$ 2,946,739**	**$ 741,293**	**$ 785,575**	$ 125,625	$ 241,200	$ 418,750	**$ 88,078**	$ 40,526	$ 47,553	**$ 183,061**	$ 76,711	$ -	$ -	$ -	$ -	$ 29,095	$ 77,255	$ -	$ -	$ -
Alt 7 Case 2 9 mgd 11.3 / 10 day SRT GBTs	$ 96,968,670.1	**$ 45,828,085**	**$ 2,828,085**	**$ 685,282**	**$ 771,387**	$ 125,625	$ 227,012	$ 418,750	**$ 83,534**	$ 40,526	$ 43,009	**$ 172,898**	$ 76,711	$ -	$ -	$ -	$ -	$ 26,314	$ 69,873	$ -	$ -	$ -
DAFTs																						
Alt 2 Case 1 9 mgd 5 day SRT DAFTs	$ 59,940,367	**$ 8,157,370**	**$ 2,857,370**	**$ 685,282**	**$ 733,905**	$ 121,380	$ 207,925	$ 404,600	**$ 93,829**	$ 40,526	$ 53,303	**$ 185,051**	$ 76,711	$ -	$ -	$ -	$ -	$ 21,742	$ 86,597	$ -	$ -	$ -
Alt 3 Case 2 5 day SRT 9 mgd DAFTs	$ 68,984,522	**$ 16,874,105**	**$ 2,874,105**	**$ 685,282**	**$ 783,856**	$ 122,280	$ 253,976	$ 407,600	**$ 88,078**	$ 40,526	$ 47,553	**$ 173,363**	$ 76,711	$ -	$ -	$ -	$ -	$ 19,396	$ 77,255	$ -	$ -	$ -
Alt 4 Case 1 9 mgd 11.3 / 5 Day SRT DAFTs	$ 119,571,956	**$ 57,433,604**	**$ 3,433,604**	**$ 741,293**	**$ 1,087,805**	$ 129,705	$ 237,000	$ 721,100	**$ 88,055**	$ 40,526	$ 47,529	**$ 225,875**	$ 76,711	$ -	$ 52,560	$ -	$ -	$ 19,387	$ 77,217	$ -	$ -	$ -
Alt 5 Case 2 11.3 / 5 day SRT 9 mgd DAFT	$ 69,299,135	**$ 16,890,491**	**$ 2,890,491**	**$ 685,282**	**$ 783,433**	$ 125,280	$ 240,553	$ 417,600	**$ 88,078**	$ 40,526	$ 47,553	**$ 173,363**	$ 76,711	$ -	$ -	$ -	$ -	$ 19,396	$ 77,255	$ -	$ -	$ -
Alt 7 Case 2 9 mgd 11.3 / 10 day SRT DAFTs	$ 96,987,178	$ 45,828,813	$ 2,828,813	$ 685,282	$ 769,283	$ 125,280	$ 226,403	$ 417,600	$ 83,534	$ 40,526	$ 43,009	$ 164,127	$ 76,711	$ -	$ -	$ -	$ -	$ 17,543	$ 69,873	$ -	$ -	$ -

Lahaina WWRF Operations Cost Comparision Sheet

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	Incinerator Fuel Oil	CONTRACT HAULING COSTS	Grit & Screenings	Sludge - Liquid	Sludge - Cake	TIPPING FEE	Grit & Screenings	Sludge - Liquid	Sludge - Cake	NATURAL GAS	Incinerator Operation	Heating	ELECTRICITY	Plant	Transfer pump Station	WATER	OTHER DIRECT OPERATING COST	CONSTRUCTION COST
All 9 MGD Comparisons (that will meet requirements)																		
Alt 2 Case 1 9 mgd 5 day SRT GBTs	$ -	$ -	$ -	$ -	$ -	**$ 405,840**	$ 1,763	$ -	$ 404,077	$ -	$ -	$ -	**$ 759,910**	$ 759,910	$ -	**$ 6,229**	**$ -**	**$ 5,300,000**
Alt 2 Case 1 9 mgd 5 day SRT DAFTs	$ -	$ -	$ -	$ -	$ -	**$ 405,840**	$ 1,763	$ -	$ 404,077	$ -	$ -	$ -	**$ 747,743**	$ 747,743	$ -	**$ 5,720**	**$ -**	**$ 5,300,000**
Alt 3 Case 2 5 day SRT 9 mgd GBTs	$ -	$ -	$ -	$ -	$ -	**$ 362,248**	$ 1,763	$ -	$ 360,485	$ -	$ -	$ -	**$ 763,445**	$ 736,451	$ 26,994	**$ 6,229**	**$ -**	**$ 14,000,000**
Alt 3 Case 2 5 day SRT 9 mgd DAFTs	$ -	$ -	$ -	$ -	$ -	**$ 362,248**	$ 1,763	$ -	$ 360,485	$ -	$ -	$ -	**$ 775,048**	$ 748,054	$ 26,994	**$ 6,229**	**$ -**	**$ 14,000,000**
Alt 4 Case 1 9 mgd 11.3 / 5 day SRT GBTs	$ -	$ -	$ -	$ -	$ -	**$ 362,069**	$ 1,763	$ -	$ 360,306	$ -	$ -	$ -	**$ 912,287**	$ 885,293	$ 26,994	**$ 6,229**	**$ -**	**$ 54,000,000**
Alt 4 Case 1 9 mgd 11.3 / 5 Day SRT DAFTs	$ -	$ -	$ -	$ -	$ -	**$ 362,069**	$ 1,763	$ -	$ 360,306	$ -	$ -	$ -	**$ 924,059**	$ 897,065	$ 26,994	**$ 4,449**	**$ -**	**$ 54,000,000**
Alt 5 Case 2 11.3 / 5 day SRT 9 mgd GBTs	$ -	$ -	$ -	$ -	$ -	**$ 362,248**	$ 1,763	$ -	$ 360,485	$ -	$ -	$ -	**$ 780,255**	$ 753,260	$ 26,994	**$ 6,229**	**$ -**	**$ 14,000,000**
Alt 5 Case 2 11.3 / 5 day SRT 9 mgd DAFT	$ -	$ -	$ -	$ -	$ -	**$ 362,248**	$ 1,763	$ -	$ 360,485	$ -	$ -	$ -	**$ 791,858**	$ 764,864	$ 26,994	**$ 6,229**	**$ -**	**$ 14,000,000**
Alt 7 Case 2 9 mgd 11.3 / 10 day SRT GBTs	$ -	$ -	$ -	$ -	$ -	**$ 327,800**	$ 1,763	$ -	$ 326,037	$ -	$ -	$ -	**$ 781,464**	$ 754,470	$ 26,994	**$ 5,720**	**$ -**	**$ 43,000,000**
Alt 7 Case 2 9 mgd 11.3 / 10 day SRT DAFTs	$ -	$ -	$ -	$ -	$ -	$ 327,800	$ 1,763	$ -	$ 326,037	$ -	$ -	$ -	$ 793,067	$ 766,073	$ 26,994	$ 5,720	$ -	$ 43,000,000
By Solids Thickening																		
GBTs																		
Alt 2 Case 1 9 mgd 5 day SRT GBTs	$ -	$ -	$ -	$ -	$ -	**$ 405,840**	$ 1,763	$ -	$ 404,077	$ -	$ -	$ -	**$ 759,910**	$ 759,910	$ -	**$ 6,229**	**$ -**	**$ 5,300,000**
Alt 3 Case 2 5 day SRT 9 mgd GBTs	$ -	$ -	$ -	$ -	$ -	**$ 362,248**	$ 1,763	$ -	$ 360,485	$ -	$ -	$ -	**$ 763,445**	$ 736,451	$ 26,994	**$ 6,229**	**$ -**	**$ 14,000,000**
Alt 4 Case 1 9 mgd 11.3 / 5 day SRT GBTs	$ -	$ -	$ -	$ -	$ -	**$ 362,069**	$ 1,763	$ -	$ 360,306	$ -	$ -	$ -	**$ 912,287**	$ 885,293	$ 26,994	**$ 6,229**	**$ -**	**$ 54,000,000**
Alt 5 Case 2 11.3 / 5 day SRT 9 mgd GBTs	$ -	$ -	$ -	$ -	$ -	**$ 362,248**	$ 1,763	$ -	$ 360,485	$ -	$ -	$ -	**$ 780,255**	$ 753,260	$ 26,994	**$ 6,229**	**$ -**	**$ 14,000,000**
Alt 7 Case 2 9 mgd 11.3 / 10 day SRT GBTs	$ -	$ -	$ -	$ -	$ -	**$ 327,800**	$ 1,763	$ -	$ 326,037	$ -	$ -	$ -	**$ 781,464**	$ 754,470	$ 26,994	**$ 5,720**	**$ -**	**$ 43,000,000**
DAFTs																		
Alt 2 Case 1 9 mgd 5 day SRT DAFTs	$ -	$ -	$ -	$ -	$ -	**$ 405,840**	$ 1,763	$ -	$ 404,077	$ -	$ -	$ -	**$ 747,743**	$ 747,743	$ -	**$ 5,720**	**$ -**	**$ 5,300,000**
Alt 3 Case 2 5 day SRT 9 mgd DAFTs	$ -	$ -	$ -	$ -	$ -	**$ 362,248**	$ 1,763	$ -	$ 360,485	$ -	$ -	$ -	**$ 775,048**	$ 748,054	$ 26,994	**$ 6,229**	**$ -**	**$ 14,000,000**
Alt 4 Case 1 9 mgd 11.3 / 5 Day SRT DAFTs	$ -	$ -	$ -	$ -	$ -	**$ 362,069**	$ 1,763	$ -	$ 360,306	$ -	$ -	$ -	**$ 924,059**	$ 897,065	$ 26,994	**$ 4,449**	**$ -**	**$ 54,000,000**
Alt 5 Case 2 11.3 / 5 day SRT 9 mgd DAFT	$ -	$ -	$ -	$ -	$ -	**$ 362,248**	$ 1,763	$ -	$ 360,485	$ -	$ -	$ -	**$ 791,858**	$ 764,864	$ 26,994	**$ 6,229**	**$ -**	**$ 14,000,000**
Alt 7 Case 2 9 mgd 11.3 / 10 day SRT DAFTs	$ -	$ -	$ -	$ -	$ -	$ 327,800	$ 1,763	$ -	$ 326,037	$ -	$ -	$ -	$ 793,067	$ 766,073	$ 26,994	$ 5,720	$ -	$ 43,000,000

Appendix A-2

O&M Annual Estimated Costs – 12 mgd

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Lahaina WWRF Operations Cost Comparision Sheet

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	20 Year Net Present Value with O&M and Construction	TOTAL CONSTRUCTION AND O&M ESTIMATED COSTS (Adds O&M Cost and Construction line item)	O&M ESTIMATED COSTS (Adds only line items in bold)	LABOR	MAINTENANCE	Rutine Preventitive/Predictive	Corrective	Replacement	VEHICLE EXPENSES	Grit & Screenings	Sludge Hauling	CHEMICALS	Sodium Hypochlorite	Sodium Bisulfite	Clean in Place Chemicals	Ferric Chloride	Primary Thickener - Polymer	Secondary Thickener - Polymer	Dewatering - Polymer	FUEL OIL	Miscellaneous
All 12 MGD Comparisons (that will meet requirements)																					
Alt 3 Case 3 5 day SRT 12 mgd GBTs	$ 79,948,992	**$ 17,450,563**	**$ 3,450,563**	**$ 797,304**	**$ 865,666**	$ 121,875	$ 337,541	$ 406,250	**$ 116,727**	$ 53,323	$ 63,404	**$ 244,082**	$ 102,282	$ -	$ -	$ -	$ -	$ 38,793	$ 103,007	$ -	$ -
Alt 3 Case 3 5 day SRT 12 mgd DAFTs	$ 79,000,793	**$ 17,400,772**	**$ 3,400,772**	**$ 741,293**	**$ 868,515**	$ 122,280	$ 338,635	$ 407,600	**$ 116,727**	$ 53,323	$ 63,404	**$ 231,151**	$ 102,282	$ -	$ -	$ -	$ -	$ 25,862	$ 103,007	$ -	$ -
Alt 4 Case 2 12 mgd 11.3 / 5 day SRT GBTs	$ 150,827,034	**$ 79,926,698**	**$ 3,926,698**	**$ 797,304**	**$ 1,169,121**	$ 130,050	$ 316,821	$ 722,250	**$ 116,695**	$ 53,323	$ 63,372	**$ 314,091**	$ 102,282	$ -	$ 70,080	$ -	$ -	$ 38,773	$ 102,956	$ -	$ -
Alt 4 Case 2 12 mgd 11.3 / 5 Day SRT DAFTs	$ 150,723,491	**$ 79,920,897**	**$ 3,920,897**	**$ 797,304**	**$ 1,166,805**	$ 129,705	$ 316,000	$ 721,100	**$ 116,695**	$ 53,323	$ 63,372	**$ 301,167**	$ 102,282	$ -	$ 70,080	$ -	$ -	$ 25,849	$ 102,956	$ -	$ -
Alt 7 Case 2 12 mgd 11.3 / 10 day SRT GBTs	$ 121,454,215	**$ 60,382,125**	**$ 3,382,125**	**$ 797,304**	**$ 847,057**	$ 125,625	$ 302,682	$ 418,750	**$ 110,668**	$ 53,323	$ 57,345	**$ 230,531**	$ 102,282	$ -	$ -	$ -	$ -	$ 35,086	$ 93,164	$ -	$ -
Alt 7 Case 2 12 mgd 11.3 / 10 day SRT DAFTs	$ 121,393,573	**$ 60,378,647**	**$ 3,378,647**	**$ 797,304**	**$ 844,751**	$ 125,280	$ 301,871	$ 417,600	**$ 110,668**	$ 53,323	$ 57,345	**$ 218,836**	$ 102,282	$ -	$ -	$ -	$ -	$ 23,390	$ 93,164	$ -	$ -
By Solids Thickening																					
Alt 3 Case 3 5 day SRT 12 mgd GBTs	$ 79,948,992	**$ 17,450,563**	**$ 3,450,563**	**$ 797,304**	**$ 865,666**	$ 121,875	$ 337,541	$ 406,250	**$ 116,727**	$ 53,323	$ 63,404	**$ 244,082**	$ 102,282	$ -	$ -	$ -	$ -	$ 38,793	$ 103,007	$ -	$ -
Alt 4 Case 2 12 mgd 11.3 / 5 day SRT GBTs	$ 150,827,034	**$ 79,926,698**	**$ 3,926,698**	**$ 797,304**	**$ 1,169,121**	$ 130,050	$ 316,821	$ 722,250	**$ 116,695**	$ 53,323	$ 63,372	**$ 314,091**	$ 102,282	$ -	$ 70,080	$ -	$ -	$ 38,773	$ 102,956	$ -	$ -
Alt 7 Case 2 12 mgd 11.3 / 10 day SRT GBTs	$ 121,454,215	**$ 60,382,125**	**$ 3,382,125**	**$ 797,304**	**$ 847,057**	$ 125,625	$ 302,682	$ 418,750	**$ 110,668**	$ 53,323	$ 57,345	**$ 230,531**	$ 102,282	$ -	$ -	$ -	$ -	$ 35,086	$ 93,164	$ -	$ -
Alt 3 Case 3 5 day SRT 12 mgd DAFTs	$ 79,000,793	**$ 17,400,772**	**$ 3,400,772**	**$ 741,293**	**$ 868,515**	$ 122,280	$ 338,635	$ 407,600	**$ 116,727**	$ 53,323	$ 63,404	**$ 231,151**	$ 102,282	$ -	$ -	$ -	$ -	$ 25,862	$ 103,007	$ -	$ -
Alt 4 Case 2 12 mgd 11.3 / 5 Day SRT DAFTs	$ 150,723,491	**$ 79,920,897**	**$ 3,920,897**	**$ 797,304**	**$ 1,166,805**	$ 129,705	$ 316,000	$ 721,100	**$ 116,695**	$ 53,323	$ 63,372	**$ 301,167**	$ 102,282	$ -	$ 70,080	$ -	$ -	$ 25,849	$ 102,956	$ -	$ -
Alt 7 Case 2 12 mgd 11.3 / 10 day SRT DAFTs	$ 121,393,573	**$ 60,378,647**	**$ 3,378,647**	**$ 797,304**	**$ 844,751**	$ 125,280	$ 301,871	$ 417,600	**$ 110,668**	$ 53,323	$ 57,345	**$ 218,836**	$ 102,282	$ -	$ -	$ -	$ -	$ 23,390	$ 93,164	$ -	$ -

Lahaina WWRF Operations Cost Comparision Sheet

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	Generator Operation	Incinerator Fuel Oil	CONTRACT HAULING COSTS	Grit & Screenings	Sludge - Liquid	Sludge - Cake	TIPPING FEE	Grit & Screenings	Sludge - Liquid	Sludge - Cake	NATURAL GAS	Incinerator Operation	Heating	ELECTRICITY	Plant	Transfer pump Station	WATER	OTHER DIRECT OPERATING COST	CONSTRUCTION COST
All 12 MGD Comparisons (that will meet requirements)																			
Alt 3 Case 3 5 day SRT 12 mgd GBTs	$ -	$ -	$ -	$ -	$ -	$ -	**$ 482,998**	$ 2,351	$ -	$ 480,647	$ -	$ -	$ -	**$ 937,559**	$ 910,565	$ 26,994	**$ 6,229**	**$ -**	**$ 14,000,000**
Alt 3 Case 3 5 day SRT 12 mgd DAFTs	$ -	$ -	$ -	$ -	$ -	$ -	**$ 482,998**	$ 2,351	$ -	$ 480,647	$ -	$ -	$ -	**$ 953,861**	$ 926,866	$ 26,994	**$ 6,229**	**$ -**	**$ 14,000,000**
Alt 4 Case 2 12 mgd 11.3 / 5 day SRT GBTs	$ -	$ -	$ -	$ -	$ -	$ -	**$ 482,759**	$ 2,351	$ -	$ 480,408	$ -	$ -	$ -	**$ 1,040,499**	$ 1,013,505	$ 26,994	**$ 6,229**	**$ -**	**$ 76,000,000**
Alt 4 Case 2 12 mgd 11.3 / 5 Day SRT DAFTs	$ -	$ -	$ -	$ -	$ -	$ -	**$ 482,759**	$ 2,351	$ -	$ 480,408	$ -	$ -	$ -	**$ 1,051,719**	$ 1,024,724	$ 26,994	**$ 4,449**	**$ -**	**$ 76,000,000**
Alt 7 Case 2 12 mgd 11.3 / 10 day SRT GBTs	$ -	$ -	$ -	$ -	$ -	$ -	**$ 437,066**	$ 2,351	$ -	$ 434,715	$ -	$ -	$ -	**$ 953,779**	$ 926,784	$ 26,994	**$ 5,720**	**$ -**	**$ 57,000,000**
Alt 7 Case 2 12 mgd 11.3 / 10 day SRT DAFTs	$ -	$ -	$ -	$ -	$ -	$ -	**$ 437,066**	$ 2,351	$ -	$ 434,715	$ -	$ -	$ -	**$ 964,303**	$ 937,309	$ 26,994	**$ 5,720**	**$ -**	**$ 57,000,000**
By Solids Thickening																			
Alt 3 Case 3 5 day SRT 12 mgd GBTs	$ -	$ -	$ -	$ -	$ -	$ -	**$ 482,998**	$ 2,351	$ -	$ 480,647	$ -	$ -	$ -	**$ 937,559**	$ 910,565	$ 26,994	**$ 6,229**	**$ -**	**$ 14,000,000**
Alt 4 Case 2 12 mgd 11.3 / 5 day SRT GBTs	$ -	$ -	$ -	$ -	$ -	$ -	**$ 482,759**	$ 2,351	$ -	$ 480,408	$ -	$ -	$ -	**$ 1,040,499**	$ 1,013,505	$ 26,994	**$ 6,229**	**$ -**	**$ 76,000,000**
Alt 7 Case 2 12 mgd 11.3 / 10 day SRT GBTs	$ -	$ -	$ -	$ -	$ -	$ -	**$ 437,066**	$ 2,351	$ -	$ 434,715	$ -	$ -	$ -	**$ 953,779**	$ 926,784	$ 26,994	**$ 5,720**	**$ -**	**$ 57,000,000**
Alt 3 Case 3 5 day SRT 12 mgd DAFTs	$ -	$ -	$ -	$ -	$ -	$ -	**$ 482,998**	$ 2,351	$ -	$ 480,647	$ -	$ -	$ -	**$ 953,861**	$ 926,866	$ 26,994	**$ 6,229**	**$ -**	**$ 14,000,000**
Alt 4 Case 2 12 mgd 11.3 / 5 Day SRT DAFTs	$ -	$ -	$ -	$ -	$ -	$ -	**$ 482,759**	$ 2,351	$ -	$ 480,408	$ -	$ -	$ -	**$ 1,051,719**	$ 1,024,724	$ 26,994	**$ 4,449**	**$ -**	**$ 76,000,000**
Alt 7 Case 2 12 mgd 11.3 / 10 day SRT DAFTs	$ -	$ -	$ -	$ -	$ -	$ -	**$ 437,066**	$ 2,351	$ -	$ 434,715	$ -	$ -	$ -	**$ 964,303**	$ 937,309	$ 26,994	**$ 5,720**	**$ -**	**$ 57,000,000**

Appendix B

NPV Calculations

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Lahaina WWRF NPV Operations and Construction Cost Comparision Sheet

									TOTAL CONSTRUCTION AND O&M ESTIMATED COSTS	O&M ESTIMATED COSTS Inflated per tabe	LABOR	MAINTENANCE	VEHICLE EXPENSES	CHEMICALS	TIPPING FEE	ELECTRICITY	WATER	OTHER DIRECT OPERATING COST	CONSTRUCTION COST
1	Labor / S	Electrical	Chemicals	Maintenanc	Other	NPV	Status Quo "do nothing " alternative Base Cost Estimation (estimation at 5.09 mgd average)		$ 2,125,942	$ 2,125,942	$ 629,271	$ 369,487	$ 49,866	$ 142,676	$ 198,244	$ 730,678	$ 5,720	$ -	$ -
Year 1	3.50%	3.60%	3.57%	3.71%	3.22%	3.50%			$ 2,200,942	$ 2,200,942	651,728	383,190	51,471	147,269	204,625	756,755	5,904		-
Year 2	3.42%	3.52%	3.49%	3.63%	3.15%				$ 2,276,851	$ 2,276,851	674,465	397,083	53,090	151,903	211,064	783,156	6,090		-
Year 3	3.34%	3.44%	3.41%	3.54%	3.07%		Net Present Value @		$ 2,353,581	$ 2,353,581	697,455	411,149	54,722	156,573	217,553	809,851	6,277		-
Year 4	3.26%	3.36%	3.33%	3.46%	3.00%	1.00		$40,689,925	$ 2,431,039	$ 2,431,039	720,671	425,371	56,365	161,274	224,085	836,807	6,466		-
Year 5	3.18%	3.28%	3.25%	3.38%	2.93%				$ 2,509,126	$ 2,509,126	744,082	439,731	58,017	165,999	230,651	863,991	6,655		-
Year 6	3.11%	3.20%	3.17%	3.29%	2.86%				$ 2,587,741	$ 2,587,741	767,658	454,210	59,675	170,743	237,242	891,367	6,845		-
Year 7	3.03%	3.12%	3.09%	3.21%	2.79%				$ 2,666,775	$ 2,666,775	791,367	468,788	61,337	175,499	243,851	918,896	7,036		-
Year 8	2.95%	3.04%	3.01%	3.13%	2.71%				$ 2,746,116	$ 2,746,116	815,174	483,444	63,002	180,261	250,468	946,540	7,227		-
Year 9	2.87%	2.96%	2.93%	3.04%	2.64%				$ 2,825,647	$ 2,825,647	839,045	498,156	64,666	185,022	257,083	974,257	7,418		-
Year 10	2.79%	2.88%	2.85%	2.96%	2.57%				$ 2,905,250	$ 2,905,250	862,943	512,901	66,327	189,776	263,687	1,002,007	7,608		-
Year 11	2.71%	2.80%	2.77%	2.88%	2.50%				$ 2,984,798	$ 2,984,798	886,831	527,656	67,983	194,514	270,271	1,029,744	7,798		-
Year 12	2.64%	2.71%	2.69%	2.79%	2.42%				$ 3,064,165	$ 3,064,165	910,670	542,397	69,631	199,230	276,824	1,057,425	7,988		-
Year 13	2.56%	2.63%	2.61%	2.71%	2.35%				$ 3,143,220	$ 3,143,220	934,421	557,098	71,269	203,917	283,336	1,085,004	8,175		-
Year 14	2.48%	2.55%	2.53%	2.63%	2.28%				$ 3,221,829	$ 3,221,829	958,044	571,733	72,894	208,566	289,797	1,112,433	8,362		-
Year 15	2.40%	2.47%	2.45%	2.54%	2.21%				$ 3,299,856	$ 3,299,856	981,496	586,278	74,504	213,172	296,195	1,139,665	8,546		-
Year 16	2.32%	2.39%	2.37%	2.46%	2.14%				$ 3,377,163	$ 3,377,163	1,004,737	600,705	76,095	217,724	302,521	1,166,651	8,729		-
Year 17	3.00%	3.09%	3.06%	3.18%	2.76%				$ 3,479,410	$ 3,479,410	1,035,482	619,808	78,195	223,734	310,871	1,202,350	8,970		-
Year 18	3.16%	3.25%	3.22%	3.35%	2.91%				$ 3,590,377	$ 3,590,377	1,068,858	640,569	80,469	230,238	319,909	1,241,105	9,231		-
Year 19	2.09%	2.15%	2.13%	2.21%	1.92%				$ 3,665,970	$ 3,665,970	1,091,600	654,733	82,013	234,656	326,048	1,267,512	9,408		-
Year 20	2.90%	2.99%	2.96%	3.07%	2.67%				$ 3,773,278	$ 3,773,278	1,123,890	674,859	84,201	240,917	334,747	1,305,005	9,659		-
2	Labor / S	Electrical	Chemicals	Maintenanc	Other	NPV	Alt 2 Case 1 9 mgd 5 day SRT GBTs		$ 8,188,567	$ 2,888,567	$ 685,282	$ 741,555	$ 93,829	$ 195,922	$ 405,840	$ 759,910	$ 6,229	$ -	$ 5,300,000
Year 1	3.50%	3.60%	3.57%	3.71%	3.22%	3.50%			$ 8,460,836	$ 2,990,235	709,738	769,057	96,849	202,228	418,904	787,030	6,429		5,470,601
Year 2	3.42%	3.52%	3.49%	3.63%	3.15%				$ 3,093,130	$ 3,093,130	734,499	796,940	99,896	208,592	432,085	814,487	6,631		
Year 3	3.34%	3.44%	3.41%	3.54%	3.07%		Net Present Value @		$ 3,197,132	$ 3,197,132	759,535	825,170	102,968	215,005	445,370	842,250	6,835		
Year 4	3.26%	3.36%	3.33%	3.46%	3.00%	2.00		$60,534,806	$ 3,302,116	$ 3,302,116	784,817	853,713	106,059	221,460	458,741	870,285	7,040		
Year 5	3.18%	3.28%	3.25%	3.38%	2.93%				$ 3,407,947	$ 3,407,947	810,312	882,534	109,167	227,949	472,182	898,557	7,247		
Year 6	3.11%	3.20%	3.17%	3.29%	2.86%				$ 3,514,488	$ 3,514,488	835,987	911,594	112,286	234,463	485,677	927,027	7,454		
Year 7	3.03%	3.12%	3.09%	3.21%	2.79%				$ 3,621,591	$ 3,621,591	861,806	940,852	115,414	240,994	499,206	955,658	7,662		
Year 8	2.95%	3.04%	3.01%	3.13%	2.71%				$ 3,729,105	$ 3,729,105	887,732	970,266	118,546	247,533	512,751	984,407	7,869		
Year 9	2.87%	2.96%	2.93%	3.04%	2.64%				$ 3,836,874	$ 3,836,874	913,727	999,792	121,677	254,071	526,294	1,013,234	8,077		
Year 10	2.79%	2.88%	2.85%	2.96%	2.57%				$ 3,944,733	$ 3,944,733	939,753	1,029,386	124,803	260,598	539,815	1,042,093	8,285		
Year 11	2.71%	2.80%	2.77%	2.88%	2.50%				$ 4,052,515	$ 4,052,515	965,767	1,058,999	127,919	267,105	553,293	1,070,941	8,492		
Year 12	2.64%	2.71%	2.69%	2.79%	2.42%				$ 4,160,047	$ 4,160,047	991,728	1,088,582	131,021	273,581	566,708	1,099,729	8,698		
Year 13	2.56%	2.63%	2.61%	2.71%	2.35%				$ 4,267,152	$ 4,267,152	1,017,593	1,118,087	134,103	280,017	580,039	1,128,411	8,902		
Year 14	2.48%	2.55%	2.53%	2.63%	2.28%				$ 4,373,649	$ 4,373,649	1,043,318	1,147,461	137,160	286,402	593,265	1,156,937	9,105		
Year 15	2.40%	2.47%	2.45%	2.54%	2.21%				$ 4,479,353	$ 4,479,353	1,068,858	1,176,652	140,189	292,726	606,364	1,185,259	9,306		
Year 16	2.32%	2.39%	2.37%	2.46%	2.14%				$ 4,584,079	$ 4,584,079	1,094,168	1,205,606	143,183	298,977	619,315	1,213,325	9,505		
Year 17	3.00%	3.09%	3.06%	3.18%	2.76%				$ 4,722,585	$ 4,722,585	1,127,649	1,243,945	147,135	307,229	636,408	1,250,452	9,767		
Year 18	3.16%	3.25%	3.22%	3.35%	2.91%				$ 4,872,898	$ 4,872,898	1,163,996	1,285,612	151,412	316,161	654,909	1,290,757	10,051		
Year 19	2.09%	2.15%	2.13%	2.21%	1.92%				$ 4,975,291	$ 4,975,291	1,188,762	1,314,039	154,318	322,229	667,478	1,318,221	10,244		
Year 20	2.90%	2.99%	2.96%	3.07%	2.67%				$ 5,120,637	$ 5,120,637	1,223,926	1,354,433	158,435	330,826	685,286	1,357,214	10,517		
3	Labor / S	Electrical	Chemicals	Maintenanc	Other	NPV	Alt 2 Case 1 9 mgd 5 day SRT DAFTs		$ 8,157,370	$ 2,857,370	$ 685,282	$ 733,905	$ 93,829	$ 185,051	$ 405,840	$ 747,743	$ 5,720	$ -	$ 5,300,000
Year 1	3.50%	3.60%	3.57%	3.71%	3.22%	3.50%			$ 8,428,555	$ 2,957,954	709,738	761,123	96,849	191,007	418,904	774,428	5,904		5,470,601
Year 2	3.42%	3.52%	3.49%	3.63%	3.15%				$ 3,059,752	$ 3,059,752	734,499	788,718	99,896	197,018	432,085	801,446	6,090		
Year 3	3.34%	3.44%	3.41%	3.54%	3.07%		Net Present Value @		$ 3,162,646	$ 3,162,646	759,535	816,657	102,968	203,075	445,370	828,764	6,277		
Year 4	3.26%	3.36%	3.33%	3.46%	3.00%	3.00		$59,940,367	$ 3,266,511	$ 3,266,511	784,817	844,906	106,059	209,172	458,741	856,350	6,466		
Year 5	3.18%	3.28%	3.25%	3.38%	2.93%				$ 3,371,216	$ 3,371,216	810,312	873,430	109,167	215,301	472,182	884,169	6,655		
Year 6	3.11%	3.20%	3.17%	3.29%	2.86%				$ 3,476,622	$ 3,476,622	835,987	902,190	112,286	221,454	485,677	912,184	6,845		
Year 7	3.03%	3.12%	3.09%	3.21%	2.79%				$ 3,582,586	$ 3,582,586	861,806	931,146	115,414	227,622	499,206	940,356	7,036		
Year 8	2.95%	3.04%	3.01%	3.13%	2.71%				$ 3,688,957	$ 3,688,957	887,732	960,256	118,546	233,799	512,751	968,645	7,227		
Year 9	2.87%	2.96%	2.93%	3.04%	2.64%				$ 3,795,579	$ 3,795,579	913,727	989,478	121,677	239,974	526,294	997,010	7,418		
Year 10	2.79%	2.88%	2.85%	2.96%	2.57%				$ 3,902,292	$ 3,902,292	939,753	1,018,766	124,803	246,139	539,815	1,025,408	7,608		
Year 11	2.71%	2.80%	2.77%	2.88%	2.50%				$ 4,008,929	$ 4,008,929	965,767	1,048,074	127,919	252,284	553,293	1,053,793	7,798		
Year 12	2.64%	2.71%	2.69%	2.79%	2.42%				$ 4,115,318	$ 4,115,318	991,728	1,077,352	131,021	258,401	566,708	1,082,120	7,988		
Year 13	2.56%	2.63%	2.61%	2.71%	2.35%				$ 4,221,286	$ 4,221,286	1,017,593	1,106,552	134,103	264,480	580,039	1,110,343	8,175		
Year 14	2.48%	2.55%	2.53%	2.63%	2.28%				$ 4,326,652	$ 4,326,652	1,043,318	1,135,623	137,160	270,511	593,265	1,138,413	8,362		
Year 15	2.40%	2.47%	2.45%	2.54%	2.21%				$ 4,431,235	$ 4,431,235	1,068,858	1,164,513	140,189	276,483	606,364	1,166,281	8,546		
Year 16	2.32%	2.39%	2.37%	2.46%	2.14%				$ 4,534,849	$ 4,534,849	1,094,168	1,193,169	143,183	282,388	619,315	1,193,897	8,729		
Year 17	3.00%	3.09%	3.06%	3.18%	2.76%				$ 4,671,886	$ 4,671,886	1,127,649	1,231,112	147,135	290,182	636,408	1,230,430	8,970		
Year 18	3.16%	3.25%	3.22%	3.35%	2.91%				$ 4,820,605	$ 4,820,605	1,163,996	1,272,349	151,412	298,618	654,909	1,270,090	9,231		
Year 19	2.09%	2.15%	2.13%	2.21%	1.92%				$ 4,921,913	$ 4,921,913	1,188,762	1,300,483	154,318	304,349	667,478	1,297,114	9,408		
Year 20	2.90%	2.99%	2.96%	3.07%	2.67%				$ 5,065,718	$ 5,065,718	1,223,926	1,340,460	158,435	312,469	685,286	1,335,482	9,659		
4	Labor / S	Electrical	Chemicals	Maintenanc	Other	NPV	Alt 3 Case 2 5 day SRT 9 mgd GBTs		$ 16,869,624	$ 2,869,624	$ 685,282	$ 781,280	$ 88,078	$ 183,061	$ 362,248	$ 763,445	$ 6,229	$ -	$ 14,000,000
Year 1	3.50%	3.60%	3.57%	3.71%	3.22%	3.50%			$ 17,421,534	$ 2,970,890	709,738	810,256	90,913	188,954	373,909	790,691	6,429		14,450,644
Year 2	3.42%	3.52%	3.49%	3.63%	3.15%				$ 3,073,386	$ 3,073,386	734,499	839,632	93,774	194,899	385,674	818,276	6,631		
Year 3	3.34%	3.44%	3.41%	3.54%	3.07%		Net Present Value @		$ 3,176,993	$ 3,176,993	759,535	869,374	96,657	200,892	397,532	846,168	6,835		
Year 4	3.26%	3.36%	3.33%	3.46%	3.00%	4.00		$68,892,306	$ 3,281,587	$ 3,281,587	784,817	899,447	99,559	206,923	409,467	874,333	7,040		
Year 5	3.18%	3.28%	3.25%	3.38%	2.93%				$ 3,387,034	$ 3,387,034	810,312	929,812	102,476	212,986	421,464	902,736	7,247		
Year 6	3.11%	3.20%	3.17%	3.29%	2.86%				$ 3,493,195	$ 3,493,195	835,987	960,428	105,405	219,073	433,509	931,339	7,454		
Year 7	3.03%	3.12%	3.09%	3.21%	2.79%				$ 3,599,925	$ 3,599,925	861,806	991,253	108,341	225,175	445,585	960,103	7,662		
Year 8	2.95%	3.04%	3.01%	3.13%	2.71%				$ 3,707,073	$ 3,707,073	887,732	1,022,243	111,281	231,285	457,676	988,987	7,869		
Year 9	2.87%	2.96%	2.93%	3.04%	2.64%				$ 3,814,482	$ 3,814,482	913,727	1,053,352	114,220	237,394	469,764	1,017,947	8,077		
Year 10	2.79%	2.88%	2.85%	2.96%	2.57%				$ 3,921,988	$ 3,921,988	939,753	1,084,530	117,154	243,493	481,832	1,046,941	8,285		
Year 11	2.71%	2.80%	2.77%	2.88%	2.50%				$ 4,029,425	$ 4,029,425	965,767	1,115,730	120,079	249,572	493,863	1,075,922	8,492		
Year 12	2.64%	2.71%	2.69%	2.79%	2.42%				$ 4,136,619	$ 4,136,619	991,728	1,146,898	122,991	255,623	505,837	1,104,844	8,698		
Year 13	2.56%	2.63%	2.61%	2.71%	2.35%				$ 4,243,395	$ 4,243,395	1,017,593	1,177,983	125,884	261,636	517,736	1,133,660	8,902		
Year 14	2.48%	2.55%	2.53%	2.63%	2.28%				$ 4,349,571	$ 4,349,571	1,043,318	1,208,931	128,754	267,602	529,541	1,162,319	9,105		

Lahaina WWRF NPV Operations and Construction Cost Comparision Sheet

									TOTAL CONSTRUCTION AND O&M ESTIMATED COSTS	O&M ESTIMATED COSTS Inflated per tabe	LABOR	MAINTENANCE	VEHICLE EXPENSES	CHEMICALS	TIPPING FEE	ELECTRICITY	WATER	OTHER DIRECT OPERATING COST	CONSTRUCTION COST
Year 15	2.40%	2.47%	2.45%	2.54%	2.21%				$ 4,454,963	$ 4,454,963	1,068,858	1,239,685	131,597	273,511	541,234	1,190,772	9,306		
Year 16	2.32%	2.39%	2.37%	2.46%	2.14%				$ 4,559,386	$ 4,559,386	1,094,168	1,270,191	134,408	279,352	552,793	1,218,968	9,505		
Year 17	3.00%	3.09%	3.06%	3.18%	2.76%				$ 4,697,499	$ 4,697,499	1,127,649	1,310,583	138,118	287,062	568,050	1,256,269	9,767		
Year 18	3.16%	3.25%	3.22%	3.35%	2.91%				$ 4,847,396	$ 4,847,396	1,163,996	1,354,483	142,133	295,408	584,564	1,296,761	10,051		
Year 19	2.09%	2.15%	2.13%	2.21%	1.92%				$ 4,949,513	$ 4,949,513	1,188,762	1,384,433	144,861	301,077	595,783	1,324,353	10,244		
Year 20	2.90%	2.99%	2.96%	3.07%	2.67%				$ 5,094,474	$ 5,094,474	1,223,926	1,426,990	148,726	309,110	611,679	1,363,527	10,517		
5	Labor / S	Electrical	Chemicals	Maintenanc	Other	NPV	Alt 3 Case 3	5 day SRT 12 mgd GBTs	$ 17,450,563	$ 3,450,563	$ 797,304	$ 865,666	$ 116,727	$ 244,082	$ 482,998	$ 937,559	$ 6,229	$ -	$ 14,000,000
Year 1	3.50%	3.60%	3.57%	3.71%	3.22%	3.50%			$ 18,022,587	$ 3,571,943	825,758	897,771	120,484	251,938	498,545	971,019	6,429		14,450,644
Year 2	3.42%	3.52%	3.49%	3.63%	3.15%				$ 3,694,785	$ 3,694,785	854,566	930,320	124,275	259,866	514,233	1,004,895	6,631		
Year 3	3.34%	3.44%	3.41%	3.54%	3.07%		Net Present Value @		$ 3,818,947	$ 3,818,947	883,695	963,274	128,096	267,855	530,042	1,039,148	6,835		
Year 4	3.26%	3.36%	3.33%	3.46%	3.00%	5.00		$79,948,992	$ 3,944,277	$ 3,944,277	913,110	996,595	131,942	275,897	545,956	1,073,737	7,040		
Year 5	3.18%	3.28%	3.25%	3.38%	2.93%				$ 4,070,618	$ 4,070,618	942,772	1,030,240	135,808	283,981	561,953	1,108,618	7,247		
Year 6	3.11%	3.20%	3.17%	3.29%	2.86%				$ 4,197,803	$ 4,197,803	972,644	1,064,163	139,689	292,097	578,012	1,143,744	7,454		
Year 7	3.03%	3.12%	3.09%	3.21%	2.79%				$ 4,325,658	$ 4,325,658	1,002,683	1,098,317	143,580	300,234	594,114	1,179,068	7,662		
Year 8	2.95%	3.04%	3.01%	3.13%	2.71%				$ 4,454,001	$ 4,454,001	1,032,848	1,132,655	147,476	308,380	610,234	1,214,539	7,869		
Year 9	2.87%	2.96%	2.93%	3.04%	2.64%				$ 4,582,645	$ 4,582,645	1,063,093	1,167,123	151,371	316,525	626,352	1,250,104	8,077		
Year 10	2.79%	2.88%	2.85%	2.96%	2.57%				$ 4,711,396	$ 4,711,396	1,093,372	1,201,669	155,260	324,657	642,443	1,285,710	8,285		
Year 11	2.71%	2.80%	2.77%	2.88%	2.50%				$ 4,840,053	$ 4,840,053	1,123,639	1,236,238	159,137	332,763	658,484	1,321,301	8,492		
Year 12	2.64%	2.71%	2.69%	2.79%	2.42%				$ 4,968,409	$ 4,968,409	1,153,844	1,270,773	162,995	340,831	674,449	1,356,819	8,698		
Year 13	2.56%	2.63%	2.61%	2.71%	2.35%				$ 5,096,254	$ 5,096,254	1,183,937	1,305,216	166,829	348,849	690,315	1,392,206	8,902		
Year 14	2.48%	2.55%	2.53%	2.63%	2.28%				$ 5,223,371	$ 5,223,371	1,213,867	1,339,506	170,633	356,803	706,055	1,427,402	9,105		
Year 15	2.40%	2.47%	2.45%	2.54%	2.21%				$ 5,349,541	$ 5,349,541	1,243,582	1,373,582	174,401	364,681	721,645	1,462,344	9,306		
Year 16	2.32%	2.39%	2.37%	2.46%	2.14%				$ 5,474,541	$ 5,474,541	1,273,029	1,407,383	178,126	372,470	737,057	1,496,971	9,505		
Year 17	3.00%	3.09%	3.06%	3.18%	2.76%				$ 5,639,859	$ 5,639,859	1,311,984	1,452,138	183,042	382,750	757,400	1,542,778	9,767		
Year 18	3.16%	3.25%	3.22%	3.35%	2.91%				$ 5,819,267	$ 5,819,267	1,354,272	1,500,779	188,363	393,877	779,419	1,592,505	10,051		
Year 19	2.09%	2.15%	2.13%	2.21%	1.92%				$ 5,941,476	$ 5,941,476	1,383,087	1,533,964	191,978	401,436	794,377	1,626,389	10,244		
Year 20	2.90%	2.99%	2.96%	3.07%	2.67%				$ 6,114,950	$ 6,114,950	1,423,999	1,581,118	197,100	412,147	815,571	1,674,498	10,517		
6	Labor / S	Electrical	Chemicals	Maintenanc	Other	NPV	Alt 3 Case 2	5 day SRT 9 mgd DAFTs	$ 16,874,105	$ 2,874,105	$ 685,282	$ 783,856	$ 88,078	$ 173,363	$ 362,248	$ 775,048	$ 6,229	$ -	$ 14,000,000
Year 1	3.50%	3.60%	3.57%	3.71%	3.22%	3.50%			$ 17,426,212	$ 2,975,568	709,738	812,927	90,913	178,943	373,909	802,708	6,429		14,450,644
Year 2	3.42%	3.52%	3.49%	3.63%	3.15%				$ 3,078,265	$ 3,078,265	734,499	842,400	93,774	184,574	385,674	830,712	6,631		
Year 3	3.34%	3.44%	3.41%	3.54%	3.07%		Net Present Value @		$ 3,182,077	$ 3,182,077	759,535	872,241	96,657	190,249	397,532	859,028	6,835		
Year 4	3.26%	3.36%	3.33%	3.46%	3.00%	6.00		$68,984,522	$ 3,286,879	$ 3,286,879	784,817	902,413	99,559	195,961	409,467	887,622	7,040		
Year 5	3.18%	3.28%	3.25%	3.38%	2.93%				$ 3,392,536	$ 3,392,536	810,312	932,878	102,476	201,702	421,464	916,457	7,247		
Year 6	3.11%	3.20%	3.17%	3.29%	2.86%				$ 3,498,910	$ 3,498,910	835,987	963,595	105,405	207,467	433,509	945,494	7,454		
Year 7	3.03%	3.12%	3.09%	3.21%	2.79%				$ 3,605,856	$ 3,605,856	861,806	994,522	108,341	213,246	445,585	974,695	7,662		
Year 8	2.95%	3.04%	3.01%	3.13%	2.71%				$ 3,713,222	$ 3,713,222	887,732	1,025,614	111,281	219,032	457,676	1,004,018	7,869		
Year 9	2.87%	2.96%	2.93%	3.04%	2.64%				$ 3,820,849	$ 3,820,849	913,727	1,056,825	114,220	224,817	469,764	1,033,418	8,077		
Year 10	2.79%	2.88%	2.85%	2.96%	2.57%				$ 3,928,576	$ 3,928,576	939,753	1,088,106	117,154	230,593	481,832	1,062,853	8,285		
Year 11	2.71%	2.80%	2.77%	2.88%	2.50%				$ 4,036,234	$ 4,036,234	965,767	1,119,408	120,079	236,350	493,863	1,092,274	8,492		
Year 12	2.64%	2.71%	2.69%	2.79%	2.42%				$ 4,143,650	$ 4,143,650	991,728	1,150,680	122,991	242,081	505,837	1,121,636	8,698		
Year 13	2.56%	2.63%	2.61%	2.71%	2.35%				$ 4,250,648	$ 4,250,648	1,017,593	1,181,867	125,884	247,776	517,736	1,150,889	8,902		
Year 14	2.48%	2.55%	2.53%	2.63%	2.28%				$ 4,357,045	$ 4,357,045	1,043,318	1,212,917	128,754	253,425	529,541	1,179,984	9,105		
Year 15	2.40%	2.47%	2.45%	2.54%	2.21%				$ 4,462,659	$ 4,462,659	1,068,858	1,243,773	131,597	259,021	541,234	1,208,870	9,306		
Year 16	2.32%	2.39%	2.37%	2.46%	2.14%				$ 4,567,300	$ 4,567,300	1,094,168	1,274,379	134,408	264,553	552,793	1,237,495	9,505		
Year 17	3.00%	3.09%	3.06%	3.18%	2.76%				$ 4,705,705	$ 4,705,705	1,127,649	1,314,904	138,118	271,855	568,050	1,275,362	9,767		
Year 18	3.16%	3.25%	3.22%	3.35%	2.91%				$ 4,855,920	$ 4,855,920	1,163,996	1,358,948	142,133	279,758	584,564	1,316,470	10,051		
Year 19	2.09%	2.15%	2.13%	2.21%	1.92%				$ 4,958,255	$ 4,958,255	1,188,762	1,388,997	144,861	285,127	595,783	1,344,481	10,244		
Year 20	2.90%	2.99%	2.96%	3.07%	2.67%				$ 5,103,527	$ 5,103,527	1,223,926	1,431,695	148,726	292,734	611,679	1,384,250	10,517		
7	Labor / S	Electrical	Chemicals	Maintenanc	Other	NPV	Alt 3 Case 3	5 day SRT 12 mgd DAFTs	$ 17,400,772	$ 3,400,772	$ 741,293	$ 868,515	$ 116,727	$ 231,151	$ 482,998	$ 953,861	$ 6,229	$ -	$ 14,000,000
Year 1	3.50%	3.60%	3.57%	3.71%	3.22%	3.50%			$ 17,971,069	$ 3,520,425	767,748	900,726	120,484	238,591	498,545	987,902	6,429		14,450,644
Year 2	3.42%	3.52%	3.49%	3.63%	3.15%				$ 3,641,519	$ 3,641,519	794,532	933,382	124,275	246,099	514,233	1,022,367	6,631		
Year 3	3.34%	3.44%	3.41%	3.54%	3.07%		Net Present Value @		$ 3,763,915	$ 3,763,915	821,615	966,445	128,096	253,665	530,042	1,057,216	6,835		
Year 4	3.26%	3.36%	3.33%	3.46%	3.00%	7.00		$79,000,793	$ 3,887,464	$ 3,887,464	848,963	999,876	131,942	261,281	545,956	1,092,406	7,040		
Year 5	3.18%	3.28%	3.25%	3.38%	2.93%				$ 4,012,010	$ 4,012,010	876,542	1,033,631	135,808	268,936	561,953	1,127,893	7,247		
Year 6	3.11%	3.20%	3.17%	3.29%	2.86%				$ 4,137,389	$ 4,137,389	904,315	1,067,666	139,689	276,622	578,012	1,163,630	7,454		
Year 7	3.03%	3.12%	3.09%	3.21%	2.79%				$ 4,263,429	$ 4,263,429	932,245	1,101,933	143,580	284,328	594,114	1,199,568	7,662		
Year 8	2.95%	3.04%	3.01%	3.13%	2.71%				$ 4,389,951	$ 4,389,951	960,290	1,136,383	147,476	292,043	610,234	1,235,655	7,869		
Year 9	2.87%	2.96%	2.93%	3.04%	2.64%				$ 4,516,771	$ 4,516,771	988,410	1,170,965	151,371	299,756	626,352	1,271,839	8,077		
Year 10	2.79%	2.88%	2.85%	2.96%	2.57%				$ 4,643,697	$ 4,643,697	1,016,563	1,205,625	155,260	307,457	642,443	1,308,064	8,285		
Year 11	2.71%	2.80%	2.77%	2.88%	2.50%				$ 4,770,530	$ 4,770,530	1,044,703	1,240,308	159,137	315,134	658,484	1,344,274	8,492		
Year 12	2.64%	2.71%	2.69%	2.79%	2.42%				$ 4,897,069	$ 4,897,069	1,072,786	1,274,956	162,995	322,774	674,449	1,380,410	8,698		
Year 13	2.56%	2.63%	2.61%	2.71%	2.35%				$ 5,023,103	$ 5,023,103	1,100,765	1,309,512	166,829	330,367	690,315	1,416,412	8,902		
Year 14	2.48%	2.55%	2.53%	2.63%	2.28%				$ 5,148,422	$ 5,148,422	1,128,593	1,343,915	170,633	337,900	706,055	1,452,220	9,105		
Year 15	2.40%	2.47%	2.45%	2.54%	2.21%				$ 5,272,806	$ 5,272,806	1,156,220	1,378,104	174,401	345,361	721,645	1,487,769	9,306		
Year 16	2.32%	2.39%	2.37%	2.46%	2.14%				$ 5,396,038	$ 5,396,038	1,183,598	1,412,016	178,126	352,737	737,057	1,522,998	9,505		
Year 17	3.00%	3.09%	3.06%	3.18%	2.76%				$ 5,559,019	$ 5,559,019	1,219,817	1,456,918	183,042	362,473	757,400	1,569,602	9,767		
Year 18	3.16%	3.25%	3.22%	3.35%	2.91%				$ 5,735,891	$ 5,735,891	1,259,134	1,505,719	188,363	373,011	779,419	1,620,194	10,051		
Year 19	2.09%	2.15%	2.13%	2.21%	1.92%				$ 5,856,374	$ 5,856,374	1,285,925	1,539,013	191,978	380,169	794,377	1,654,667	10,244		
Year 20	2.90%	2.99%	2.96%	3.07%	2.67%				$ 6,027,398	$ 6,027,398	1,323,962	1,586,322	197,100	390,312	815,571	1,703,612	10,517		
8	Labor / S	Electrical	Chemicals	Maintenanc	Other	NPV	Alt 4 Case 1 SRT GBTs	9 mgd 11.3 / 5 day	$ 57,435,417	$ 3,435,417	$ 741,293	$ 1,089,916	$ 88,055	$ 235,568	$ 362,069	$ 912,287	$ 6,229	$ -	$ 54,000,000
Year 1	3.50%	3.60%	3.57%	3.71%	3.22%	3.50%			$ 31,426,223	$ 3,557,123	767,748	1,130,338	90,889	243,151	373,724	944,845	6,429		27,869,100
Year 2	3.42%	3.52%	3.49%	3.63%	3.15%				$ 32,426,375	$ 3,680,325	794,532	1,171,319	93,749	250,802	385,484	977,808	6,631		28,746,051
Year 3	3.34%	3.44%	3.41%	3.54%	3.07%		Net Present Value @		$ 3,804,878	$ 3,804,878	821,615	1,212,811	96,631	258,513	397,335	1,011,138	6,835		
Year 4	3.26%	3.36%	3.33%	3.46%	3.00%	8.00		$119,600,690	$ 3,930,632	$ 3,930,632	848,963	1,254,763	99,532	266,274	409,264	1,044,794	7,040		
Year 5	3.18%	3.28%	3.25%	3.38%	2.93%				$ 4,057,428	$ 4,057,428	876,542	1,297,123	102,449	274,076	421,256	1,078,735	7,247		
Year 6	3.11%	3.20%	3.17%	3.29%	2.86%				$ 4,185,098	$ 4,185,098	904,315	1,339,834	105,377	281,909	433,295	1,112,914	7,454		
Year 7	3.03%	3.12%	3.09%	3.21%	2.79%				$ 4,313,467	$ 4,313,467	932,245	1,382,836	108,312	289,762	445,365	1,147,286	7,662		
Year 8	2.95%	3.04%	3.01%	3.13%	2.71%				$ 4,442,353	$ 4,442,353	960,290	1,426,069	111,251	297,624	457,449	1,181,800	7,869		
Year 9	2.87%	2.96%	2.93%	3.04%	2.64%				$ 4,571,567	$ 4,571,567	988,410	1,469,466	114,189	305,485	469,532	1,216,407	8,077		
Year 10	2.79%	2.88%	2.85%	2.96%	2.57%				$ 4,700,912	$ 4,700,912	1,016,563	1,512,961	117,123	313,333	481,594	1,251,054	8,285		

Lahaina WWRF NPV Operations and Construction Cost Comparision Sheet

								TOTAL CONSTRUCTION AND O&M ESTIMATED COSTS	O&M ESTIMATED COSTS Inflated per tabe	LABOR	MAINTENANCE	VEHICLE EXPENSES	CHEMICALS	TIPPING FEE	ELECTRICITY	WATER	OTHER DIRECT OPERATING COST	CONSTRUCTION COST
Year 11	2.71%	2.80%	2.77%	2.88%	2.50%			$ 4,830,187	$ 4,830,187	1,044,703	1,556,486	120,047	321,156	493,618	1,285,685	8,492		
Year 12	2.64%	2.71%	2.69%	2.79%	2.42%			$ 4,959,184	$ 4,959,184	1,072,786	1,599,967	122,958	328,943	505,587	1,320,246	8,698		
Year 13	2.56%	2.63%	2.61%	2.71%	2.35%			$ 5,087,689	$ 5,087,689	1,100,765	1,643,332	125,850	336,681	517,480	1,354,679	8,902		
Year 14	2.48%	2.55%	2.53%	2.63%	2.28%			$ 5,215,486	$ 5,215,486	1,128,593	1,686,505	128,720	344,358	529,279	1,388,926	9,105		
Year 15	2.40%	2.47%	2.45%	2.54%	2.21%			$ 5,342,350	$ 5,342,350	1,156,220	1,729,409	131,562	351,961	540,966	1,422,926	9,306		
Year 16	2.32%	2.39%	2.37%	2.46%	2.14%			$ 5,468,058	$ 5,468,058	1,183,598	1,771,965	134,372	359,479	552,519	1,456,620	9,505		
Year 17	3.00%	3.09%	3.06%	3.18%	2.76%			$ 5,634,340	$ 5,634,340	1,219,817	1,828,314	138,081	369,400	567,769	1,501,192	9,767		
Year 18	3.16%	3.25%	3.22%	3.35%	2.91%			$ 5,814,828	$ 5,814,828	1,259,134	1,889,555	142,095	380,139	584,275	1,549,579	10,051		
Year 19	2.09%	2.15%	2.13%	2.21%	1.92%			$ 5,937,800	$ 5,937,800	1,285,925	1,931,337	144,822	387,435	595,488	1,582,550	10,244		
Year 20	2.90%	2.99%	2.96%	3.07%	2.67%			$ 6,112,380	$ 6,112,380	1,323,962	1,990,706	148,686	397,771	611,376	1,629,362	10,517		
							Alt 4 Case 2 12 mgd 11.3 / 5 day											
9	Labor / S	Electrical	Chemicals	Maintenanc	Other	NPV	SRT GBTs		$ 79,926,698	$ 3,926,698	$ 797,304	$ 1,169,121	$ 116,695	$ 314,091	$ 482,759	$ 1,040,499	$ 6,229	$ -	$ 76,000,000
Year 1	3.50%	3.60%	3.57%	3.71%	3.22%	3.50%			$ 43,288,428	$ 4,065,251	825,758	1,212,481	120,451	324,201	498,298	1,077,632	6,429		39,223,177
Year 2	3.42%	3.52%	3.49%	3.63%	3.15%				$ 44,662,892	$ 4,205,487	854,566	1,256,440	124,242	334,403	513,978	1,115,228	6,631		40,457,405
Year 3	3.34%	3.44%	3.41%	3.54%	3.07%		Net Present Value @		$ 4,347,245	$ 4,347,245	883,695	1,300,947	128,061	344,684	529,780	1,153,242	6,835		
Year 4	3.26%	3.36%	3.33%	3.46%	3.00%	9.00		$150,827,034	$ 4,490,351	$ 4,490,351	913,110	1,345,948	131,906	355,032	545,686	1,191,629	7,040		
Year 5	3.18%	3.28%	3.25%	3.38%	2.93%				$ 4,634,626	$ 4,634,626	942,772	1,391,386	135,771	365,435	561,674	1,230,339	7,247		
Year 6	3.11%	3.20%	3.17%	3.29%	2.86%				$ 4,779,877	$ 4,779,877	972,644	1,437,201	139,651	375,878	577,726	1,269,323	7,454		
Year 7	3.03%	3.12%	3.09%	3.21%	2.79%				$ 4,925,908	$ 4,925,908	1,002,683	1,483,329	143,541	386,349	593,820	1,308,525	7,662		
Year 8	2.95%	3.04%	3.01%	3.13%	2.71%				$ 5,072,511	$ 5,072,511	1,032,848	1,529,703	147,436	396,832	609,932	1,347,890	7,869		
Year 9	2.87%	2.96%	2.93%	3.04%	2.64%				$ 5,219,470	$ 5,219,470	1,063,093	1,576,254	151,330	407,314	626,042	1,387,360	8,077		
Year 10	2.79%	2.88%	2.85%	2.96%	2.57%				$ 5,366,563	$ 5,366,563	1,093,372	1,622,910	155,218	417,778	642,125	1,426,876	8,285		
Year 11	2.71%	2.80%	2.77%	2.88%	2.50%				$ 5,513,562	$ 5,513,562	1,123,639	1,669,597	159,094	428,209	658,158	1,466,374	8,492		
Year 12	2.64%	2.71%	2.69%	2.79%	2.42%				$ 5,660,229	$ 5,660,229	1,153,844	1,716,238	162,951	438,591	674,115	1,505,793	8,698		
Year 13	2.56%	2.63%	2.61%	2.71%	2.35%				$ 5,806,324	$ 5,806,324	1,183,937	1,762,754	166,784	448,908	689,973	1,545,065	8,902		
Year 14	2.48%	2.55%	2.53%	2.63%	2.28%				$ 5,951,599	$ 5,951,599	1,213,867	1,809,065	170,587	459,144	705,706	1,584,124	9,105		
Year 15	2.40%	2.47%	2.45%	2.54%	2.21%				$ 6,095,802	$ 6,095,802	1,243,582	1,855,087	174,354	469,282	721,288	1,622,903	9,306		
Year 16	2.32%	2.39%	2.37%	2.46%	2.14%				$ 6,238,677	$ 6,238,677	1,273,029	1,900,736	178,078	479,305	736,693	1,661,332	9,505		
Year 17	3.00%	3.09%	3.06%	3.18%	2.76%				$ 6,427,651	$ 6,427,651	1,311,984	1,961,179	182,992	492,533	757,025	1,712,169	9,767		
Year 18	3.16%	3.25%	3.22%	3.35%	2.91%				$ 6,632,748	$ 6,632,748	1,354,272	2,026,871	188,312	506,852	779,034	1,767,355	10,051		
Year 19	2.09%	2.15%	2.13%	2.21%	1.92%				$ 6,772,470	$ 6,772,470	1,383,087	2,071,689	191,926	516,580	793,984	1,804,960	10,244		
Year 20	2.90%	2.99%	2.96%	3.07%	2.67%				$ 6,970,816	$ 6,970,816	1,423,999	2,135,373	197,047	530,362	815,168	1,858,351	10,517		
							Alt 4 Case 1 9 mgd 11.3 / 5 Day SRT											
10	Labor / S	Electrical	Chemicals	Maintenanc	Other	NPV	DAFTs		$ 57,433,604	$ 3,433,604	$ 741,293	$ 1,087,805	$ 88,055	$ 225,875	$ 362,069	$ 924,059	$ 4,449	$ -	$ 54,000,000
Year 1	3.50%	3.60%	3.57%	3.71%	3.22%	3.50%			$ 31,424,383	$ 3,555,283	767,748	1,128,149	90,889	233,146	373,724	957,037	4,592		27,869,100
Year 2	3.42%	3.52%	3.49%	3.63%	3.15%				$ 32,424,509	$ 3,678,458	794,532	1,169,050	93,749	240,482	385,484	990,425	4,737		28,746,051
Year 3	3.34%	3.44%	3.41%	3.54%	3.07%		Net Present Value @		$ 3,802,986	$ 3,802,986	821,615	1,210,461	96,631	247,875	397,335	1,024,185	4,882		
Year 4	3.26%	3.36%	3.33%	3.46%	3.00%	10.00		$119,571,956	$ 3,928,715	$ 3,928,715	848,963	1,252,333	99,532	255,317	409,264	1,058,276	5,029		
Year 5	3.18%	3.28%	3.25%	3.38%	2.93%				$ 4,055,486	$ 4,055,486	876,542	1,294,611	102,449	262,798	421,256	1,092,654	5,176		
Year 6	3.11%	3.20%	3.17%	3.29%	2.86%				$ 4,183,133	$ 4,183,133	904,315	1,337,239	105,377	270,309	433,295	1,127,275	5,324		
Year 7	3.03%	3.12%	3.09%	3.21%	2.79%				$ 4,311,480	$ 4,311,480	932,245	1,380,158	108,312	277,838	445,365	1,162,090	5,473		
Year 8	2.95%	3.04%	3.01%	3.13%	2.71%				$ 4,440,345	$ 4,440,345	960,290	1,423,306	111,251	285,377	457,449	1,197,050	5,621		
Year 9	2.87%	2.96%	2.93%	3.04%	2.64%				$ 4,569,538	$ 4,569,538	988,410	1,466,620	114,189	292,915	469,532	1,232,103	5,769		
Year 10	2.79%	2.88%	2.85%	2.96%	2.57%				$ 4,698,864	$ 4,698,864	1,016,563	1,510,031	117,123	300,440	481,594	1,267,197	5,918		
Year 11	2.71%	2.80%	2.77%	2.88%	2.50%				$ 4,828,121	$ 4,828,121	1,044,703	1,553,471	120,047	307,941	493,618	1,302,275	6,065		
Year 12	2.64%	2.71%	2.69%	2.79%	2.42%				$ 4,957,100	$ 4,957,100	1,072,786	1,596,868	122,958	315,408	505,587	1,337,282	6,213		
Year 13	2.56%	2.63%	2.61%	2.71%	2.35%				$ 5,085,589	$ 5,085,589	1,100,765	1,640,149	125,850	322,827	517,480	1,372,159	6,359		
Year 14	2.48%	2.55%	2.53%	2.63%	2.28%				$ 5,213,370	$ 5,213,370	1,128,593	1,683,238	128,720	330,188	529,279	1,406,848	6,504		
Year 15	2.40%	2.47%	2.45%	2.54%	2.21%				$ 5,340,220	$ 5,340,220	1,156,220	1,726,059	131,562	337,479	540,966	1,441,287	6,647		
Year 16	2.32%	2.39%	2.37%	2.46%	2.14%				$ 5,465,914	$ 5,465,914	1,183,598	1,768,533	134,372	344,686	552,519	1,475,415	6,789		
Year 17	3.00%	3.09%	3.06%	3.18%	2.76%				$ 5,632,178	$ 5,632,178	1,219,817	1,824,773	138,081	354,200	567,769	1,520,563	6,977		
Year 18	3.16%	3.25%	3.22%	3.35%	2.91%				$ 5,812,649	$ 5,812,649	1,259,134	1,885,895	142,095	364,497	584,275	1,569,574	7,179		
Year 19	2.09%	2.15%	2.13%	2.21%	1.92%				$ 5,935,610	$ 5,935,610	1,285,925	1,927,596	144,822	371,492	595,488	1,602,970	7,317		
Year 20	2.90%	2.99%	2.96%	3.07%	2.67%				$ 6,110,176	$ 6,110,176	1,323,962	1,986,850	148,686	381,404	611,376	1,650,386	7,512		
							Alt 4 Case 2 12 mgd 11.3 / 5 Day SRT											
11	Labor / S	Electrical	Chemicals	Maintenanc	Other	NPV	DAFTs		$ 79,920,897	$ 3,920,897	$ 797,304	$ 1,166,805	$ 116,695	$ 301,167	$ 482,759	$ 1,051,719	$ 4,449	$ -	$ 76,000,000
Year 1	3.50%	3.60%	3.57%	3.71%	3.22%	3.50%			$ 43,282,468	$ 4,059,291	825,758	1,210,079	120,451	310,861	498,298	1,089,252	4,592		39,223,177
Year 2	3.42%	3.52%	3.49%	3.63%	3.15%				$ 44,656,773	$ 4,199,368	854,566	1,253,950	124,242	320,643	513,978	1,127,253	4,737		40,457,405
Year 3	3.34%	3.44%	3.41%	3.54%	3.07%		Net Present Value @		$ 4,340,966	$ 4,340,966	883,695	1,298,369	128,061	330,501	529,780	1,165,677	4,882		
Year 4	3.26%	3.36%	3.33%	3.46%	3.00%	11.00		$150,723,491	$ 4,483,913	$ 4,483,913	913,110	1,343,281	131,906	340,423	545,686	1,204,478	5,029		
Year 5	3.18%	3.28%	3.25%	3.38%	2.93%				$ 4,628,027	$ 4,628,027	942,772	1,388,630	135,771	350,398	561,674	1,243,606	5,176		
Year 6	3.11%	3.20%	3.17%	3.29%	2.86%				$ 4,773,120	$ 4,773,120	972,644	1,434,354	139,651	360,412	577,726	1,283,009	5,324		
Year 7	3.03%	3.12%	3.09%	3.21%	2.79%				$ 4,918,992	$ 4,918,992	1,002,683	1,480,390	143,541	370,451	593,820	1,322,634	5,473		
Year 8	2.95%	3.04%	3.01%	3.13%	2.71%				$ 5,065,436	$ 5,065,436	1,032,848	1,526,672	147,436	380,503	609,932	1,362,424	5,621		
Year 9	2.87%	2.96%	2.93%	3.04%	2.64%				$ 5,212,238	$ 5,212,238	1,063,093	1,573,131	151,330	390,553	626,042	1,402,319	5,769		
Year 10	2.79%	2.88%	2.85%	2.96%	2.57%				$ 5,359,175	$ 5,359,175	1,093,372	1,619,694	155,218	400,586	642,125	1,442,261	5,918		
Year 11	2.71%	2.80%	2.77%	2.88%	2.50%				$ 5,506,019	$ 5,506,019	1,123,639	1,666,289	159,094	410,588	658,158	1,482,186	6,065		
Year 12	2.64%	2.71%	2.69%	2.79%	2.42%				$ 5,652,533	$ 5,652,533	1,153,844	1,712,838	162,951	420,543	674,115	1,522,029	6,213		
Year 13	2.56%	2.63%	2.61%	2.71%	2.35%				$ 5,798,476	$ 5,798,476	1,183,937	1,759,262	166,784	430,436	689,973	1,561,725	6,359		
Year 14	2.48%	2.55%	2.53%	2.63%	2.28%				$ 5,943,601	$ 5,943,601	1,213,867	1,805,480	170,587	440,251	705,706	1,601,205	6,504		
Year 15	2.40%	2.47%	2.45%	2.54%	2.21%				$ 6,087,656	$ 6,087,656	1,243,582	1,851,411	174,354	449,972	721,288	1,640,402	6,647		
Year 16	2.32%	2.39%	2.37%	2.46%	2.14%				$ 6,230,386	$ 6,230,386	1,273,029	1,896,970	178,078	459,582	736,693	1,679,246	6,789		
Year 17	3.00%	3.09%	3.06%	3.18%	2.76%				$ 6,419,169	$ 6,419,169	1,311,984	1,957,294	182,992	472,266	757,025	1,730,630	6,977		
Year 18	3.16%	3.25%	3.22%	3.35%	2.91%				$ 6,624,060	$ 6,624,060	1,354,272	2,022,855	188,312	485,996	779,034	1,786,412	7,179		
Year 19	2.09%	2.15%	2.13%	2.21%	1.92%				$ 6,763,644	$ 6,763,644	1,383,087	2,067,584	191,926	495,323	793,984	1,824,422	7,317		
Year 20	2.90%	2.99%	2.96%	3.07%	2.67%				$ 6,961,794	$ 6,961,794	1,423,999	2,131,142	197,047	508,538	815,168	1,878,389	7,512		

Lahaina WWRF NPV Operations and Construction Cost Comparision Sheet

.

	Labor / S	Electrical	Chemicals	Maintenanc	Other	NPV		TOTAL CONSTRUCTION AND O&M ESTIMATED COSTS	O&M ESTIMATED COSTS Inflated per tabe	LABOR	MAINTENANCE	VEHICLE EXPENSES	CHEMICALS	TIPPING FEE	ELECTRICITY	WATER	OTHER DIRECT OPERATING COST	CONSTRUCTION COST
							Alt 5 Case 2 11.3 / 5 day SRT 9 mgd											
12							GBTs	$ 16,946,739	$ 2,946,739	$ 741,293	$ 785,575	$ 88,078	$ 183,061	$ 362,248	$ 780,255	$ 6,229	$ -	$ 14,000,000
Year 1	3.50%	3.60%	3.57%	3.71%	3.22%	3.50%		$ 17,501,407	$ 3,050,763	767,748	814,710	90,913	188,954	373,909	808,100	6,429		14,450,644
Year 2	3.42%	3.52%	3.49%	3.63%	3.15%			$ 3,156,052	$ 3,156,052	794,532	844,247	93,774	194,899	385,674	836,293	6,631		
Year 3	3.34%	3.44%	3.41%	3.54%	3.07%		Net Present Value @	$ 3,262,483	$ 3,262,483	821,615	874,153	96,657	200,892	397,532	864,799	6,835		
Year 4	3.26%	3.36%	3.33%	3.46%	3.00%	12.00	$70,374,362	$ 3,369,929	$ 3,369,929	848,963	904,391	99,559	206,923	409,467	893,585	7,040		
Year 5	3.18%	3.28%	3.25%	3.38%	2.93%			$ 3,478,251	$ 3,478,251	876,542	934,923	102,476	212,986	421,464	922,613	7,247		
Year 6	3.11%	3.20%	3.17%	3.29%	2.86%			$ 3,587,309	$ 3,587,309	904,315	965,707	105,405	219,073	433,509	951,846	7,454		
Year 7	3.03%	3.12%	3.09%	3.21%	2.79%			$ 3,696,952	$ 3,696,952	932,245	996,702	108,341	225,175	445,585	981,243	7,662		
Year 8	2.95%	3.04%	3.01%	3.13%	2.71%			$ 3,807,026	$ 3,807,026	960,290	1,027,863	111,281	231,285	457,676	1,010,762	7,869		
Year 9	2.87%	2.96%	2.93%	3.04%	2.64%			$ 3,917,368	$ 3,917,368	988,410	1,059,142	114,220	237,394	469,764	1,040,360	8,077		
Year 10	2.79%	2.88%	2.85%	2.96%	2.57%			$ 4,027,811	$ 4,027,811	1,016,563	1,090,492	117,154	243,493	481,832	1,069,992	8,285		
Year 11	2.71%	2.80%	2.77%	2.88%	2.50%			$ 4,138,183	$ 4,138,183	1,044,703	1,121,863	120,079	249,572	493,863	1,099,612	8,492		
Year 12	2.64%	2.71%	2.69%	2.79%	2.42%			$ 4,248,308	$ 4,248,308	1,072,786	1,153,202	122,991	255,623	505,837	1,129,171	8,698		
Year 13	2.56%	2.63%	2.61%	2.71%	2.35%			$ 4,358,003	$ 4,358,003	1,100,765	1,184,458	125,884	261,636	517,736	1,158,621	8,902		
Year 14	2.48%	2.55%	2.53%	2.63%	2.28%			$ 4,467,083	$ 4,467,083	1,128,593	1,215,576	128,754	267,602	529,541	1,187,911	9,105		
Year 15	2.40%	2.47%	2.45%	2.54%	2.21%			$ 4,575,359	$ 4,575,359	1,156,220	1,246,500	131,597	273,511	541,234	1,216,991	9,306		
Year 16	2.32%	2.39%	2.37%	2.46%	2.14%			$ 4,682,638	$ 4,682,638	1,183,598	1,277,173	134,408	279,352	552,793	1,245,808	9,505		
Year 17	3.00%	3.09%	3.06%	3.18%	2.76%			$ 4,824,531	$ 4,824,531	1,219,817	1,317,787	138,118	287,062	568,050	1,283,930	9,767		
Year 18	3.16%	3.25%	3.22%	3.35%	2.91%			$ 4,978,531	$ 4,978,531	1,259,134	1,361,928	142,133	295,408	584,564	1,325,313	10,051		
Year 19	2.09%	2.15%	2.13%	2.21%	1.92%			$ 5,083,445	$ 5,083,445	1,285,925	1,392,043	144,861	301,077	595,783	1,353,512	10,244		
Year 20	2.90%	2.99%	2.96%	3.07%	2.67%			$ 5,232,377	$ 5,232,377	1,323,962	1,434,834	148,726	309,110	611,679	1,393,549	10,517		

	Labor / S	Electrical	Chemicals	Maintenanc	Other	NPV												
							Alt 5 Case 2 11.3 / 5 day SRT 9 mgd											
13							DAFT	$ 16,890,491	$ 2,890,491	$ 685,282	$ 783,433	$ 88,078	$ 173,363	$ 362,248	$ 791,858	$ 6,229	$ -	$ 14,000,000
Year 1	3.50%	3.60%	3.57%	3.71%	3.22%	3.50%		$ 17,443,183	$ 2,992,539	709,738	812,488	90,913	178,943	373,909	820,118	6,429		14,450,644
Year 2	3.42%	3.52%	3.49%	3.63%	3.15%			$ 3,095,827	$ 3,095,827	734,499	841,945	93,774	184,574	385,674	848,729	6,631		
Year 3	3.34%	3.44%	3.41%	3.54%	3.07%		Net Present Value @	$ 3,200,238	$ 3,200,238	759,535	871,770	96,657	190,249	397,532	877,659	6,835		
Year 4	3.26%	3.36%	3.33%	3.46%	3.00%	13.00	$69,299,135	$ 3,305,643	$ 3,305,643	784,817	901,925	99,559	195,961	409,467	906,873	7,040		
Year 5	3.18%	3.28%	3.25%	3.38%	2.93%			$ 3,411,909	$ 3,411,909	810,312	932,374	102,476	201,702	421,464	936,333	7,247		
Year 6	3.11%	3.20%	3.17%	3.29%	2.86%			$ 3,518,897	$ 3,518,897	835,987	963,074	105,405	207,467	433,509	966,001	7,454		
Year 7	3.03%	3.12%	3.09%	3.21%	2.79%			$ 3,626,459	$ 3,626,459	861,806	993,985	108,341	213,246	445,585	995,835	7,662		
Year 8	2.95%	3.04%	3.01%	3.13%	2.71%			$ 3,734,443	$ 3,734,443	887,732	1,025,060	111,281	219,032	457,676	1,025,793	7,869		
Year 9	2.87%	2.96%	2.93%	3.04%	2.64%			$ 3,842,692	$ 3,842,692	913,727	1,056,254	114,220	224,817	469,764	1,055,832	8,077		
Year 10	2.79%	2.88%	2.85%	2.96%	2.57%			$ 3,951,040	$ 3,951,040	939,753	1,087,519	117,154	230,593	481,832	1,085,904	8,285		
Year 11	2.71%	2.80%	2.77%	2.88%	2.50%			$ 4,059,319	$ 4,059,319	965,767	1,118,804	120,079	236,350	493,863	1,115,964	8,492		
Year 12	2.64%	2.71%	2.69%	2.79%	2.42%			$ 4,167,355	$ 4,167,355	991,728	1,150,058	122,991	242,081	505,837	1,145,963	8,698		
Year 13	2.56%	2.63%	2.61%	2.71%	2.35%			$ 4,274,971	$ 4,274,971	1,017,593	1,181,229	125,884	247,776	517,736	1,175,851	8,902		
Year 14	2.48%	2.55%	2.53%	2.63%	2.28%			$ 4,381,982	$ 4,381,982	1,043,318	1,212,262	128,754	253,425	529,541	1,205,576	9,105		
Year 15	2.40%	2.47%	2.45%	2.54%	2.21%			$ 4,488,206	$ 4,488,206	1,068,858	1,243,101	131,597	259,021	541,234	1,235,088	9,306		
Year 16	2.32%	2.39%	2.37%	2.46%	2.14%			$ 4,593,452	$ 4,593,452	1,094,168	1,273,691	134,408	264,553	552,793	1,264,334	9,505		
Year 17	3.00%	3.09%	3.06%	3.18%	2.76%			$ 4,732,656	$ 4,732,656	1,127,649	1,314,194	138,118	271,855	568,050	1,303,023	9,767		
Year 18	3.16%	3.25%	3.22%	3.35%	2.91%			$ 4,883,739	$ 4,883,739	1,163,996	1,358,215	142,133	279,758	584,564	1,345,022	10,051		
Year 19	2.09%	2.15%	2.13%	2.21%	1.92%			$ 4,986,665	$ 4,986,665	1,188,762	1,388,247	144,861	285,127	595,783	1,373,640	10,244		
Year 20	2.90%	2.99%	2.96%	3.07%	2.67%			$ 5,132,776	$ 5,132,776	1,223,926	1,430,922	148,726	292,734	611,679	1,414,273	10,517		

	Labor / S	Electrical	Chemicals	Maintenanc	Other	NPV												
							Alt 7 Case 2 9 mgd 11.3 / 10 day SRT											
14							GBTs	$ 45,828,085	$ 2,828,085	$ 685,282	$ 771,387	$ 83,534	$ 172,898	$ 327,800	$ 781,464	$ 5,720	$ -	$ 43,000,000
Year 1	3.50%	3.60%	3.57%	3.71%	3.22%	3.50%		$ 25,120,089	$ 2,928,028	709,738	799,995	86,223	178,464	338,351	809,353	5,904		22,192,061
Year 2	3.42%	3.52%	3.49%	3.63%	3.15%			$ 25,919,564	$ 3,029,190	734,499	828,999	88,936	184,079	348,998	837,589	6,090		22,890,374
Year 3	3.34%	3.44%	3.41%	3.54%	3.07%		Net Present Value @	$ 3,131,454	$ 3,131,454	759,535	858,365	91,670	189,739	359,728	866,139	6,277		
Year 4	3.26%	3.36%	3.33%	3.46%	3.00%	14.00	$96,968,670	$ 3,234,695	$ 3,234,695	784,817	888,057	94,423	195,435	370,528	894,969	6,466		
Year 5	3.18%	3.28%	3.25%	3.38%	2.93%			$ 3,338,783	$ 3,338,783	810,312	918,037	97,189	201,162	381,385	924,043	6,655		
Year 6	3.11%	3.20%	3.17%	3.29%	2.86%			$ 3,443,580	$ 3,443,580	835,987	948,266	99,967	206,910	392,284	953,321	6,845		
Year 7	3.03%	3.12%	3.09%	3.21%	2.79%			$ 3,548,943	$ 3,548,943	861,806	978,701	102,751	212,674	403,212	982,764	7,036		
Year 8	2.95%	3.04%	3.01%	3.13%	2.71%			$ 3,654,723	$ 3,654,723	887,732	1,009,298	105,540	218,445	414,152	1,012,329	7,227		
Year 9	2.87%	2.96%	2.93%	3.04%	2.64%			$ 3,760,764	$ 3,760,764	913,727	1,040,013	108,327	224,215	425,091	1,041,973	7,418		
Year 10	2.79%	2.88%	2.85%	2.96%	2.57%			$ 3,866,905	$ 3,866,905	939,753	1,070,797	111,110	229,975	436,012	1,071,651	7,608		
Year 11	2.71%	2.80%	2.77%	2.88%	2.50%			$ 3,972,981	$ 3,972,981	965,767	1,101,601	113,884	235,717	446,898	1,101,316	7,798		
Year 12	2.64%	2.71%	2.69%	2.79%	2.42%			$ 4,078,822	$ 4,078,822	991,728	1,132,375	116,645	241,432	457,734	1,130,921	7,988		
Year 13	2.56%	2.63%	2.61%	2.71%	2.35%			$ 4,184,253	$ 4,184,253	1,017,593	1,163,066	119,389	247,111	468,501	1,160,416	8,175		
Year 14	2.48%	2.55%	2.53%	2.63%	2.28%			$ 4,289,095	$ 4,289,095	1,043,318	1,193,622	122,112	252,746	479,184	1,189,752	8,362		
Year 15	2.40%	2.47%	2.45%	2.54%	2.21%			$ 4,393,167	$ 4,393,167	1,068,858	1,223,987	124,808	258,326	489,764	1,218,877	8,546		
Year 16	2.32%	2.39%	2.37%	2.46%	2.14%			$ 4,496,283	$ 4,496,283	1,094,168	1,254,106	127,473	263,844	500,224	1,247,739	8,729		
Year 17	3.00%	3.09%	3.06%	3.18%	2.76%			$ 4,632,673	$ 4,632,673	1,127,649	1,293,987	130,992	271,126	514,030	1,285,919	8,970		
Year 18	3.16%	3.25%	3.22%	3.35%	2.91%			$ 4,780,706	$ 4,780,706	1,163,996	1,337,330	134,800	279,008	528,974	1,327,367	9,231		
Year 19	2.09%	2.15%	2.13%	2.21%	1.92%			$ 4,881,557	$ 4,881,557	1,188,762	1,366,901	137,387	284,362	539,126	1,355,610	9,408		
Year 20	2.90%	2.99%	2.96%	3.07%	2.67%			$ 5,024,725	$ 5,024,725	1,223,926	1,408,920	141,052	291,949	553,510	1,395,709	9,659		

	Labor / S	Electrical	Chemicals	Maintenanc	Other	NPV												
							Alt 7 Case 2 12 mgd 11.3 / 10 day SRT											
15							GBTs	$ 60,382,125	$ 3,382,125	$ 797,304	$ 847,057	$ 110,668	$ 230,531	$ 437,066	$ 953,779	$ 5,720	$ -	$ 57,000,000
Year 1	3.50%	3.60%	3.57%	3.71%	3.22%	3.50%		$ 32,918,651	$ 3,501,268	825,758	878,472	114,230	237,951	451,135	987,817	5,904		29,417,383
Year 2	3.42%	3.52%	3.49%	3.63%	3.15%			$ 33,964,904	$ 3,621,851	854,566	910,322	117,824	245,439	465,331	1,022,279	6,090		30,343,054
Year 3	3.34%	3.44%	3.41%	3.54%	3.07%		Net Present Value @	$ 3,743,735	$ 3,743,735	883,695	942,568	121,447	252,985	479,637	1,057,125	6,277		
Year 4	3.26%	3.36%	3.33%	3.46%	3.00%	15.00	$121,454,215	$ 3,866,771	$ 3,866,771	913,110	975,173	125,093	260,580	494,037	1,092,312	6,466		
Year 5	3.18%	3.28%	3.25%	3.38%	2.93%			$ 3,990,805	$ 3,990,805	942,772	1,008,094	128,758	268,215	508,513	1,127,797	6,655		
Year 6	3.11%	3.20%	3.17%	3.29%	2.86%			$ 4,115,672	$ 4,115,672	972,644	1,041,288	132,438	275,881	523,045	1,163,531	6,845		
Year 7	3.03%	3.12%	3.09%	3.21%	2.79%			$ 4,241,201	$ 4,241,201	1,002,683	1,074,708	136,127	283,566	537,615	1,199,465	7,036		
Year 8	2.95%	3.04%	3.01%	3.13%	2.71%			$ 4,367,216	$ 4,367,216	1,032,848	1,108,307	139,821	291,260	552,203	1,235,550	7,227		
Year 9	2.87%	2.96%	2.93%	3.04%	2.64%			$ 4,493,531	$ 4,493,531	1,063,093	1,142,035	143,514	298,953	566,788	1,271,730	7,418		
Year 10	2.79%	2.88%	2.85%	2.96%	2.57%			$ 4,619,954	$ 4,619,954	1,093,372	1,175,838	147,201	306,633	581,349	1,307,952	7,608		
Year 11	2.71%	2.80%	2.77%	2.88%	2.50%			$ 4,746,290	$ 4,746,290	1,123,639	1,209,664	150,876	314,289	595,864	1,344,159	7,798		
Year 12	2.64%	2.71%	2.69%	2.79%	2.42%			$ 4,872,335	$ 4,872,335	1,153,844	1,243,457	154,534	321,909	610,311	1,380,292	7,988		
Year 13	2.56%	2.63%	2.61%	2.71%	2.35%			$ 4,997,882	$ 4,997,882	1,183,937	1,277,159	158,170	329,482	624,668	1,416,291	8,175		
Year 14	2.48%	2.55%	2.53%	2.63%	2.28%			$ 5,122,719	$ 5,122,719	1,213,867	1,310,712	161,776	336,994	638,912	1,452,095	8,362		
Year 15	2.40%	2.47%	2.45%	2.54%	2.21%			$ 5,246,629	$ 5,246,629	1,243,582	1,344,056	165,348	344,435	653,019	1,487,642	8,546		

Lahaina WWRF NPV Operations and Construction Cost Comparision Sheet

								TOTAL CONSTRUCTION AND O&M ESTIMATED COSTS	O&M ESTIMATED COSTS Inflated per tabe	LABOR	MAINTENANCE	VEHICLE EXPENSES	CHEMICALS	TIPPING FEE	ELECTRICITY	WATER	OTHER DIRECT OPERATING COST	CONSTRUCTION COST
Year 16	2.32%	2.39%	2.37%	2.46%	2.14%			$ 5,369,393	$ 5,369,393	1,273,029	1,377,130	168,880	351,791	666,966	1,522,868	8,729		
Year 17	3.00%	3.09%	3.06%	3.18%	2.76%			$ 5,531,760	$ 5,531,760	1,311,984	1,420,923	173,541	361,501	685,374	1,569,468	8,970		
Year 18	3.16%	3.25%	3.22%	3.35%	2.91%			$ 5,707,971	$ 5,707,971	1,354,272	1,468,518	178,586	372,010	705,299	1,620,055	9,231		
Year 19	2.09%	2.15%	2.13%	2.21%	1.92%			$ 5,828,008	$ 5,828,008	1,383,087	1,500,990	182,013	379,150	718,835	1,654,525	9,408		
Year 20	2.90%	2.99%	2.96%	3.07%	2.67%			$ 5,998,402	$ 5,998,402	1,423,999	1,547,130	186,869	389,266	738,013	1,703,466	9,659		
16	Labor / S	Electrical	Chemicals	Maintenanc	Other	NPV	Alt 7 Case 2 9 mgd 11.3 / 10 day SRT DAFTs	$ 45,828,813	$ 2,828,813	$ 685,282	$ 769,283	$ 83,534	$ 164,127	$ 327,800	$ 793,067	$ 5,720	$ -	$ 43,000,000
Year 1	3.50%	3.60%	3.57%	3.71%	3.22%	3.50%		$ 25,120,871	$ 2,928,810	709,738	797,813	86,223	169,410	338,351	821,370	5,904		22,192,061
Year 2	3.42%	3.52%	3.49%	3.63%	3.15%			$ 25,920,401	$ 3,030,027	734,499	826,738	88,936	174,741	348,998	850,025	6,090		22,890,374
Year 3	3.34%	3.44%	3.41%	3.54%	3.07%		Net Present Value @	$ 3,132,348	$ 3,132,348	759,535	856,024	91,670	180,113	359,728	879,000	6,277		
Year 4	3.26%	3.36%	3.33%	3.46%	3.00%	16.00	$96,987,178	$ 3,235,647	$ 3,235,647	784,817	885,635	94,423	185,520	370,528	908,258	6,466		
Year 5	3.18%	3.28%	3.25%	3.38%	2.93%			$ 3,339,794	$ 3,339,794	810,312	915,534	97,189	190,956	381,385	937,763	6,655		
Year 6	3.11%	3.20%	3.17%	3.29%	2.86%			$ 3,444,652	$ 3,444,652	835,987	945,680	99,967	196,414	392,284	967,476	6,845		
Year 7	3.03%	3.12%	3.09%	3.21%	2.79%			$ 3,550,077	$ 3,550,077	861,806	976,032	102,751	201,885	403,212	997,356	7,036		
Year 8	2.95%	3.04%	3.01%	3.13%	2.71%			$ 3,655,919	$ 3,655,919	887,732	1,006,546	105,540	207,363	414,152	1,027,360	7,227		
Year 9	2.87%	2.96%	2.93%	3.04%	2.64%			$ 3,762,024	$ 3,762,024	913,727	1,037,176	108,327	212,840	425,091	1,057,444	7,418		
Year 10	2.79%	2.88%	2.85%	2.96%	2.57%			$ 3,868,229	$ 3,868,229	939,753	1,067,876	111,110	218,308	436,012	1,087,563	7,608		
Year 11	2.71%	2.80%	2.77%	2.88%	2.50%			$ 3,974,371	$ 3,974,371	965,767	1,098,596	113,884	223,758	446,898	1,117,669	7,798		
Year 12	2.64%	2.71%	2.69%	2.79%	2.42%			$ 4,080,277	$ 4,080,277	991,728	1,129,286	116,645	229,184	457,734	1,147,713	7,988		
Year 13	2.56%	2.63%	2.61%	2.71%	2.35%			$ 4,185,774	$ 4,185,774	1,017,593	1,159,894	119,389	234,575	468,501	1,177,646	8,175		
Year 14	2.48%	2.55%	2.53%	2.63%	2.28%			$ 4,290,683	$ 4,290,683	1,043,318	1,190,366	122,112	239,924	479,184	1,207,417	8,362		
Year 15	2.40%	2.47%	2.45%	2.54%	2.21%			$ 4,394,821	$ 4,394,821	1,068,858	1,220,649	124,808	245,221	489,764	1,236,975	8,546		
Year 16	2.32%	2.39%	2.37%	2.46%	2.14%			$ 4,498,004	$ 4,498,004	1,094,168	1,250,686	127,473	250,458	500,224	1,266,265	8,729		
Year 17	3.00%	3.09%	3.06%	3.18%	2.76%			$ 4,634,483	$ 4,634,483	1,127,649	1,290,458	130,992	257,371	514,030	1,305,013	8,970		
Year 18	3.16%	3.25%	3.22%	3.35%	2.91%			$ 4,782,613	$ 4,782,613	1,163,996	1,333,683	134,800	264,853	528,974	1,347,076	9,231		
Year 19	2.09%	2.15%	2.13%	2.21%	1.92%			$ 4,883,531	$ 4,883,531	1,188,762	1,363,173	137,387	269,936	539,126	1,375,738	9,408		
Year 20	2.90%	2.99%	2.96%	3.07%	2.67%			$ 5,026,795	$ 5,026,795	1,223,926	1,405,077	141,052	277,138	553,510	1,416,432	9,659		
17	Labor / S	Electrical	Chemicals	Maintenanc	Other	NPV	Alt 7 Case 2 12 mgd 11.3 / 10 day SRT DAFTs	$ 60,378,647	$ 3,378,647	$ 797,304	$ 844,751	$ 110,668	$ 218,836	$ 437,066	$ 964,303	$ 5,720	$ -	$ 57,000,000
Year 1	3.50%	3.60%	3.57%	3.71%	3.22%	3.50%		$ 32,915,086	$ 3,497,703	825,758	876,080	114,230	225,880	451,135	998,717	5,904		29,417,383
Year 2	3.42%	3.52%	3.49%	3.63%	3.15%			$ 33,961,254	$ 3,618,200	854,566	907,842	117,824	232,987	465,331	1,033,559	6,090		30,343,054
Year 3	3.34%	3.44%	3.41%	3.54%	3.07%		Net Present Value @	$ 3,739,998	$ 3,739,998	883,695	940,001	121,447	240,151	479,637	1,068,789	6,277		
Year 4	3.26%	3.36%	3.33%	3.46%	3.00%	17.00	$121,393,573	$ 3,862,948	$ 3,862,948	913,110	972,517	125,093	247,361	494,037	1,104,365	6,466		
Year 5	3.18%	3.28%	3.25%	3.38%	2.93%			$ 3,986,896	$ 3,986,896	942,772	1,005,349	128,758	254,608	508,513	1,140,241	6,655		
Year 6	3.11%	3.20%	3.17%	3.29%	2.86%			$ 4,111,678	$ 4,111,678	972,644	1,038,452	132,438	261,885	523,045	1,176,369	6,845		
Year 7	3.03%	3.12%	3.09%	3.21%	2.79%			$ 4,237,124	$ 4,237,124	1,002,683	1,071,782	136,127	269,180	537,615	1,212,700	7,036		
Year 8	2.95%	3.04%	3.01%	3.13%	2.71%			$ 4,363,055	$ 4,363,055	1,032,848	1,105,289	139,821	276,484	552,203	1,249,183	7,227		
Year 9	2.87%	2.96%	2.93%	3.04%	2.64%			$ 4,489,286	$ 4,489,286	1,063,093	1,138,925	143,514	283,786	566,788	1,285,763	7,418		
Year 10	2.79%	2.88%	2.85%	2.96%	2.57%			$ 4,615,628	$ 4,615,628	1,093,372	1,172,636	147,201	291,077	581,349	1,322,384	7,608		
Year 11	2.71%	2.80%	2.77%	2.88%	2.50%			$ 4,741,883	$ 4,741,883	1,123,639	1,206,370	150,876	298,345	595,864	1,358,991	7,798		
Year 12	2.64%	2.71%	2.69%	2.79%	2.42%			$ 4,867,848	$ 4,867,848	1,153,844	1,240,071	154,534	305,578	610,311	1,395,522	7,988		
Year 13	2.56%	2.63%	2.61%	2.71%	2.35%			$ 4,993,316	$ 4,993,316	1,183,937	1,273,681	158,170	312,767	624,668	1,431,918	8,175		
Year 14	2.48%	2.55%	2.53%	2.63%	2.28%			$ 5,118,076	$ 5,118,076	1,213,867	1,307,143	161,776	319,898	638,912	1,468,118	8,362		
Year 15	2.40%	2.47%	2.45%	2.54%	2.21%			$ 5,241,910	$ 5,241,910	1,243,582	1,340,396	165,348	326,961	653,019	1,504,057	8,546		
Year 16	2.32%	2.39%	2.37%	2.46%	2.14%			$ 5,364,599	$ 5,364,599	1,273,029	1,373,380	168,880	333,945	666,966	1,539,671	8,729		
Year 17	3.00%	3.09%	3.06%	3.18%	2.76%			$ 5,526,869	$ 5,526,869	1,311,984	1,417,053	173,541	343,161	685,374	1,586,785	8,970		
Year 18	3.16%	3.25%	3.22%	3.35%	2.91%			$ 5,702,975	$ 5,702,975	1,354,272	1,464,519	178,586	353,138	705,299	1,637,931	9,231		
Year 19	2.09%	2.15%	2.13%	2.21%	1.92%			$ 5,822,941	$ 5,822,941	1,383,087	1,496,902	182,013	359,915	718,835	1,672,781	9,408		
Year 20	2.90%	2.99%	2.96%	3.07%	2.67%			$ 5,993,237	$ 5,993,237	1,423,999	1,542,917	186,869	369,518	738,013	1,722,262	9,659		

Appendix F – Technical Memorandum 3 Secondary Clarifier Stress Testing

County of Maui
Lahaina WWRF Process Study Report: Secondary Clarifier Stress Testing

PREPARED FOR: County of Maui, Department of Public Works & Environmental Management, Wastewater Reclamation Division

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COPIES: Project File

DATE: July 1, 2005

Overview

Stress testing is conducted to measure the actual capacity of a unit process. On June 22 and 23, 2005, stress testing was conducted on the secondary clarifiers at the Lahaina Wastewater Reclamation Facility (Lahaina WWRF). During the stress test, loading on secondary clarifiers was varied and their response was quantified. The results are summarized as a plot of process loading versus performance.

The Lahaina WWRF has three secondary clarifiers (Clarifiers 3, 4, and 5). Clarifiers 3 and 4 are similar in design, and are different from Clarifier 5. Clarifiers 3 and 5 were selected as the test clarifiers. Flows to the test clarifiers were varied by taking clarifiers off line.

Total flows to the plant and return activated sludge (RAS) rates were recorded on a 30-minute basis. Grab samples of the influent, effluent, and RAS were collected; and sludge blanket levels were measured on a 30 minute to 1 hour basis. The results of this test quantified the instantaneous response of the clarifier(s). The clarifiers were loaded beyond their reliable treatment capacity, thereby allowing determination of their capacity limits.

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Testing Logistics

Materials Needed

The following equipment was used to run this test:

- Manual sampler, for collecting samples;
- Sludge judge, for measuring sludge blanket depth;
- Settlemeter, to determine settling characteristics of the mixed liquor; and
- Other in-house lab equipment (used by plant staff), to measure TSS and turbidity. A magnetic stirrer and turkey baster were also used for evaluating dispersed and flocculated suspended solids.

Test Procedure

The secondary treatment system was used for testing. Secondary Clarifiers 3 and 5 were identified as the test units. The flow to the clarifier was adjusted by removing parallel clarifiers from service. The test runs were conducted as shown in Table 1.

TABLE 1

LAHAINA WWTP SECONDARY CLARIFIER CAPACITY ANALYSIS
STRESS TESTING RUNS

Test Run	Day 1 Wednesday, June 22, 2005	Day 2 Thursday, June 23, 2005
1	All 3 clarifiers in service - 5 hours long - parallel test observations on Clarifiers 3 and 5	All 3 clarifiers in service - 4 hours long - parallel test observations on Clarifiers 3 and 5
2	2 clarifiers in service (Clarifier 4 out of service) - 6 hours long - parallel test observations on Clarifiers 3 and 5	2 clarifiers in service (Clarifier 4 out of service) - 5.5 hours long - parallel test observations on Clarifiers 3 and 5
3	1 clarifier in service (Clarifier 5) -5 hours long - observations made on Clarifier 5	1 clarifier in service (Clarifier 3) - 3.5 hours long* - observations made on Clarifier 3

*Was not able to achieve the full 4 to 5 hour duration needed for the analyses as the stress testing was halted by the plant supervisor, due to increasing effluent turbidity levels.

All three clarifiers were operational during the stress testing. As shown in Table 1, for the first test run, all three clarifiers were in service. For all subsequent test runs, the influent gates to each of the non-test clarifiers were closed and their corresponding RAS pump was taken off line, and all of the flow was directed to the remaining test clarifier(s).

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The parameters measured are summarized in Table 2. The plant influent flow rate and RAS flow rate for the test clarifiers were recorded on a 30 minute basis using the facility's SCADA system. Each test run was maintained between 4 to 6 hours, or until excessive effluent turbidity levels were observed.

TABLE 2

LAHAINA WWTP SECONDARY CLARIFIER CAPACITY ANALYSIS
TEST PARAMETERS AND SAMPLING SCHEDULE

Characteristic	Sampling Method	Sampling Frequency	Parameter Analyzed
Influent (combined)	Grab	30-60 minutes Each test run 30-60minutes 30 Minutes	TSS (Maui) SVI (Maui) DSS/FSS Flow rate
Effluent (for each test clarifier)	Grab	30 minutes 30 minutes	TSS Turbidity
RAS	Grab	30 minutes 30 minutes	TSS Flow rate
Sludge blanket (for each test clarifier)	Sludge judge	30-60 minutes	Depth

Grab samples of the combined clarifier influent was collected for each test run to determine the mixed liquor settling characteristics (SVI). These grab samples were collected from the secondary clarifier splitter box, using the manual sampler. On selected runs, influent samples were also collected to measure dispersed suspended solids (DSS) and flocculated suspended solids (FSS) as specified in WERF/CRTC Protocols for Evaluating Secondary Clarifier Performance (WERF Project 00-CTS-1, 2001). To measure DSS, a settlemeter was used instead of a Kemmerer Sampler.

Samples from each test clarifier effluent were collected from the effluent outlet using the manual sampler. The samples were analyzed for turbidity and total suspended solids (TSS). The sludge blanket level in Clarifier 3 was measured every half hour at three locations along the clarifier cross section to determine changes in blanket level during the test period. Due to the large depth of Clarifier 5 and the length of the sludge judge required to measure blanket levels, only one sludge blanket level reading, along its cross section, was taken every half hour. Distances of the sample locations are listed in Table 3.

RAS samples were collected every half hour using built-in sampling ports and were analyzed for total suspended solids (TSS). On selected runs, RAS samples were used in the settlemeter analyses.

Sample locations are detailed in Figure 1.

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TABLE 3

LAHAINA WWTP SECONDARY CLARIFIER CAPACITY ANALYSIS
CLARIFIER SLUDGE BLANKET LOCATION DESCRIPTIONS

Sample Location	Sampling Location Description
Clarifier 3 – 1	12 feet from inside of clarifier wall, along the catwalk
Clarifier 3 – 2	19 feet from inside of clarifier wall, along the catwalk
Clarifier 3 – 3	On the inside of the influent inner well
Clarifier 5	11.5 feet from inside of clarifier wall, along the catwalk

Catastrophic failure of the clarifier was not observed. Clarifier failure is defined as flooding of the clarifier effluent launder (hydraulic throughput failure), rising of the sludge blanket below the clarifier launders, or observed deterioration in the secondary clarifier effluent. During stress testing of Clarifier 3, testing was halted when effluent turbidity levels exceeded the pre-established target level set by the plant supervisor.

Data Analysis

The influent, RAS, effluent and sludge blanket data collected for June 22 and 23, 2005 are summarized in Appendix A.

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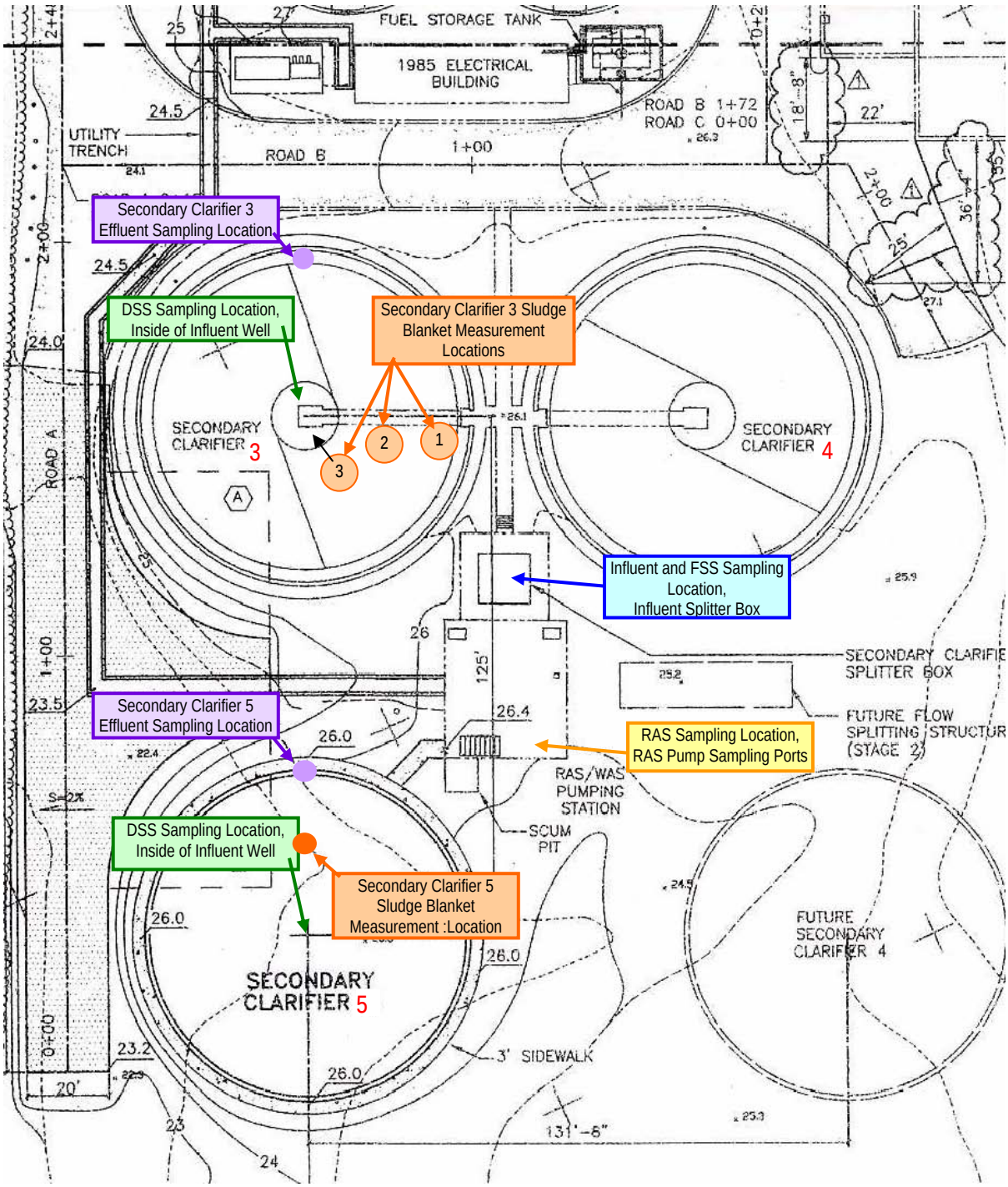
FIGURE 1

LAHAINA WWTP SECONDARY CLARIFIER CAPACITY ANALYSIS
SAMPLE LOCATIONS



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Data Observations and Assumptions

1. The solids loading rate as measured by adding the feed (from the SCADA system) and RAS flow with the MLSS is often higher than the solids loading rate as measured by the RAS flow and RAS concentration.

TABLE 4

LAHAINA WWTP SECONDARY CLARIFIER CAPACITY ANALYSIS
SOLIDS LOADING RATE COMPARISON

	Clarifier 3 Solids Loading Rate (lbs/d/ft^2)		Clarifier 5 Solids Loading Rate (lbs/d/ft^2)	
Date	**Feed Load**	**RAS Load**	**Feed Load**	**RAS Load**
6/22/2005	10.9	10.4	19.3	16.4
6/22/2005	12.5	11.5	21.2	15.9
6/22/2005			34.4	27.0
6/23/2005	13.4	11.7	23.6	19.4
6/23/2005	12.5	13.9	21.0	21.0
6/23/2005	30.7	16.3		

Notes:
Feed Load = (Feed Flow + RAS Flow) * MLSS Concentration
RAS Load = RAS Flow * RAS Concentration

The most likely reason for this discrepancy is that there is a calibration issue with either the feed or RAS flow meter. It is expected that the RAS flow meter is the one with a calibration issue since sludge flows are normally difficult to measure.

Note that the lower RAS loads at the highest flux rates may be a result of the clarifiers being overloaded. This is certainly the case for Clarifier 3, but it is less certain that it is occurring in Clarifier 5.

2. Effluent TSS, DSS, FSS data was not of sufficient accuracy to be useful in the evaluation of clarifier performance. It was done at 10 mg/L intervals which indicate an accuracy of +/- 10 mg/L. As a result the most accurate method of evaluating effluent quality is to base it on the grab sample turbidity data for the effluent quality. It was not possible to recover information on the DSS/FSS testing.

3. Since individual clarifier feed flow data was not available, it was necessary to assume that the feed flow split to the clarifiers is proportional to the clarifier's weir length. Weir length of Clarifier 3 and 4 is 112", and Clarifier 5 is 149.75". With this in mind, with all 3 clarifiers on-line at the same time, Clarifiers 3 and 4 each take 30% of the flow, with Clarifier 5 taking 40%. With only Clarifiers 3 and 5 on-line, Clarifier 3 must now take 43% and Clarifier 5 takes 57%.

4. The reported SVI's on June 22nd are inconsistent with the measured settling rates in the flux curve analysis data. For that day the measured SVI averaged about 250. The flux testing indicates that the value was on the order of 110. On June 23rd the

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measured SVI averaged 127. A large change in SVI like this would not be expected, so it is assumed that the first day's reported SVI is incorrect.

5. The plant influent flow rates during each test were relatively stable. It was only during the first run of the morning (with the lowest flow rates) that the flows varied significantly. All other runs had a standard deviation of the flow of approximately 0.5 mgd or less.

Results

The capacity of a clarifier is determined from two aspects, the hydraulic and the solids handling capacity. One of these will always be controlling. In most wastewater treatment plants the solids handling capacity is the limitation. Data from the testing appears to support this for the Lahaina WWRF, but there was evidence of increased effluent TSS prior to the solids handling limit of Clarifier 5.

Since Clarifier 3 and Clarifier 5 have the same area, they should have similar operating characteristics. However, one important difference is that Clarifier 5 was operated with a RAS rate of approximately 2.4 mgd and Clarifier 3 at a RAS rate of approximately 1.0 mgd. While this will not have a large effect on the hydraulic capacity, it has a major effect on the solids loading rate capacity of the unit. The lower RAS rate will result in a much lower solids handling capacity.

Hydraulic Capacity

As discussed earlier, the effluent TSS data was not able to be used. However, effluent turbidity is normally a very good indicator of the effluent TSS. In most cases, the effluent turbidity is proportional to the effluent TSS. Figure 2 shows a plot of the clarifier overflow rate versus the effluent turbidity for the two clarifiers.

In Figure 2, it can be seen that the effluent quality was relatively stable for both clarifiers at lower overflow rates, but when the flow got up to between 1,300 and 1,400 gpd/ft^2 there was a noticeable decrease in effluent quality. Note that the 1,400 gpd/ft^2 turbidity value for Clarifier 3 is much higher than for Clarifier 5. This is most likely a result of the high sludge blanket that was present in Clarifier 3 during this test (as a result of a solids overload, discussed later).

This data seems to indicate that so long as the units are not solids overloaded, the effluent TSS from the clarifiers over a wide range of hydraulic conditions should be less than about 6 mg/L (at this particular SVI of about 120). Higher SVI's will result in poorer performance.

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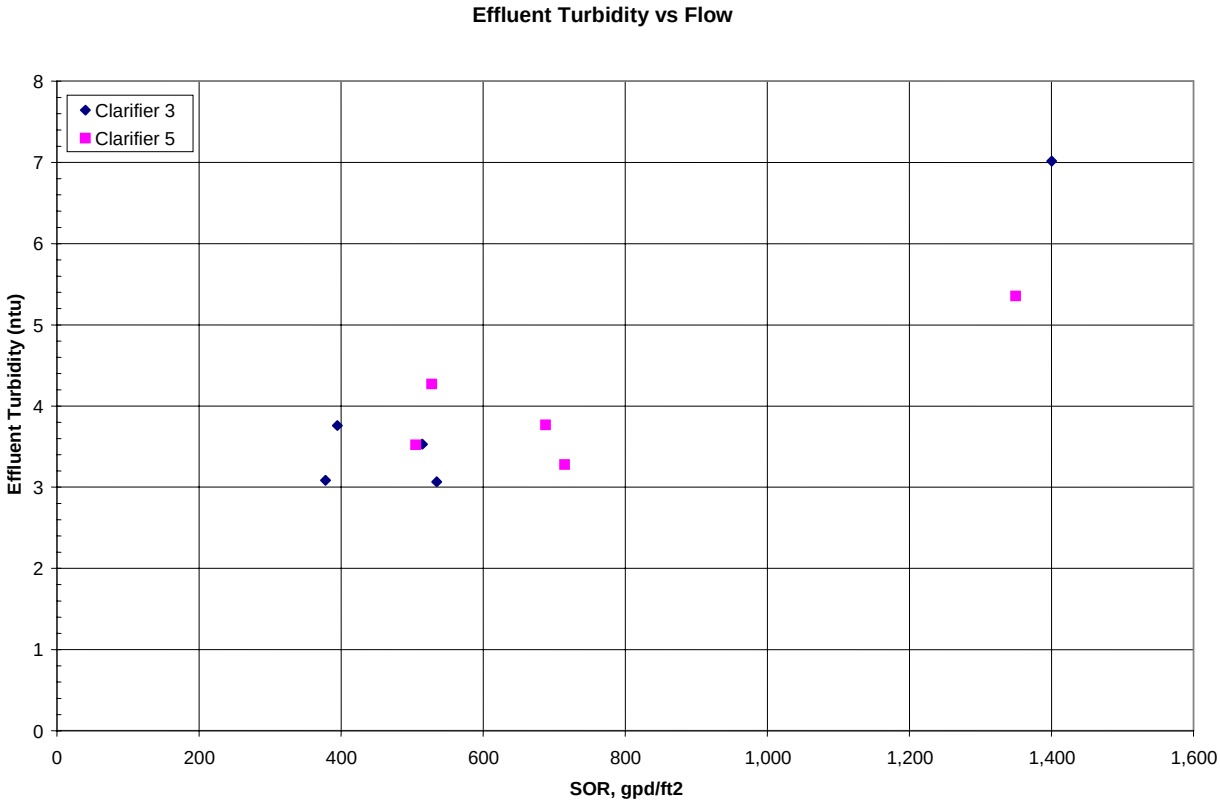
FIGURE 2
LAHAINA WWTP SECONDARY CLARIFIER CAPACITY ANALYSIS
HYDRAULIC CAPACITY PERFORMANCE



Solids Handling Capacity

The solids loading rates (SLRs) on a clarifier normally control its capacity. It needs to be noted that two clarifiers with the same SLR may have different capacities based on the RAS rates in their respective systems. This is the case for these tests since Clarifier 5 was operating at over twice the RAS rate than Clarifier 3. When a clarifier is overloaded, the sludge blanket will rise over the course of the overloaded period. Therefore a decent measure of clarifier overloading is its final blanket depth as compared to non-overloaded conditions.

Figure 3 shows a plot of the final blanket depth of Clarifiers 3 and 5 as a function of the average solids loading rate to that clarifier. Note that these SLRs are an average of the two SLRs shown in Figure 1. The sludge blanket depth plotted for Clarifier 3 is the mid-radius sludge blanket depth. The Clarifier 5 depth is from the fixed sampling point in that clarifier.

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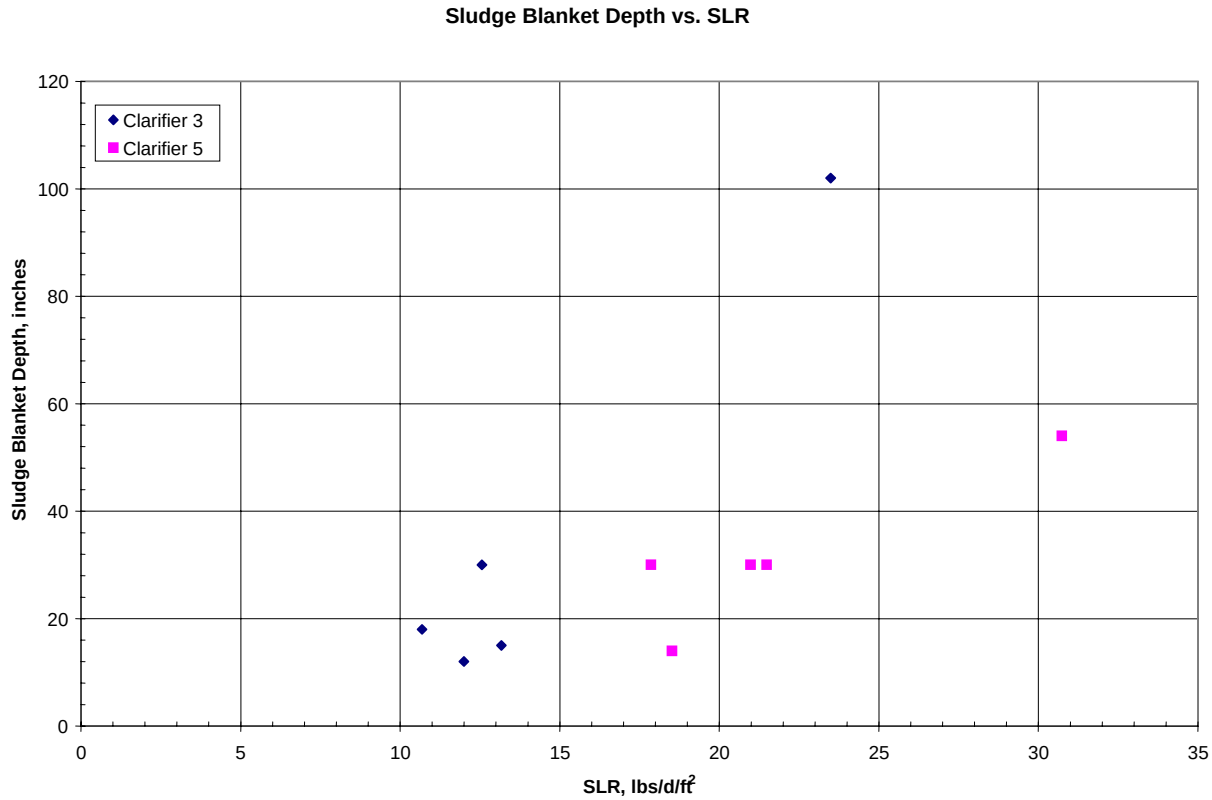
FIGURE 3

LAHAINA WWTP SECONDARY CLARIFIER CAPACITY ANALYSIS
SOLIDS HANDLING CAPACITY



Both units showed relatively low blankets at SLRs up to about 20 lbs/d/ft². However above that load, Clarifier 3 showed a dramatic rise in blanket depth, thus indicating an overloaded condition. Clarifier 5 also showed a blanket depth increase at the higher solids load, but not as dramatic as in Clarifier 3.

Figure 4 shows the time series blanket depth data for these two runs in more detail. From Figure 4, it is apparent that Clarifier 5 was not overloaded during this high load period (average of approximately 30 lbs/d/ft²). The blanket was certainly higher than in previous runs, but it did not show any significant signs of getting deeper as the test progressed beyond the first 30 minutes. However, Clarifier 3 was very obviously overloaded. The blanket depths kept increasing during the test and showed only little indication of leveling off.

This data indicates that the capacity of Clarifier 5 is above about 30 lbs/d/ft² at this RAS rate (which as 2.3 mgd or about 40% of the influent flow rate). The lower RAS rate in Clarifier 3 lowered the capacity of that unit significantly. At a 1 mgd RAS rate (or about 16% of the influent flow rate) the clarifier was overloaded at a solids loading rate of approximately 24 lbs/d/ft².

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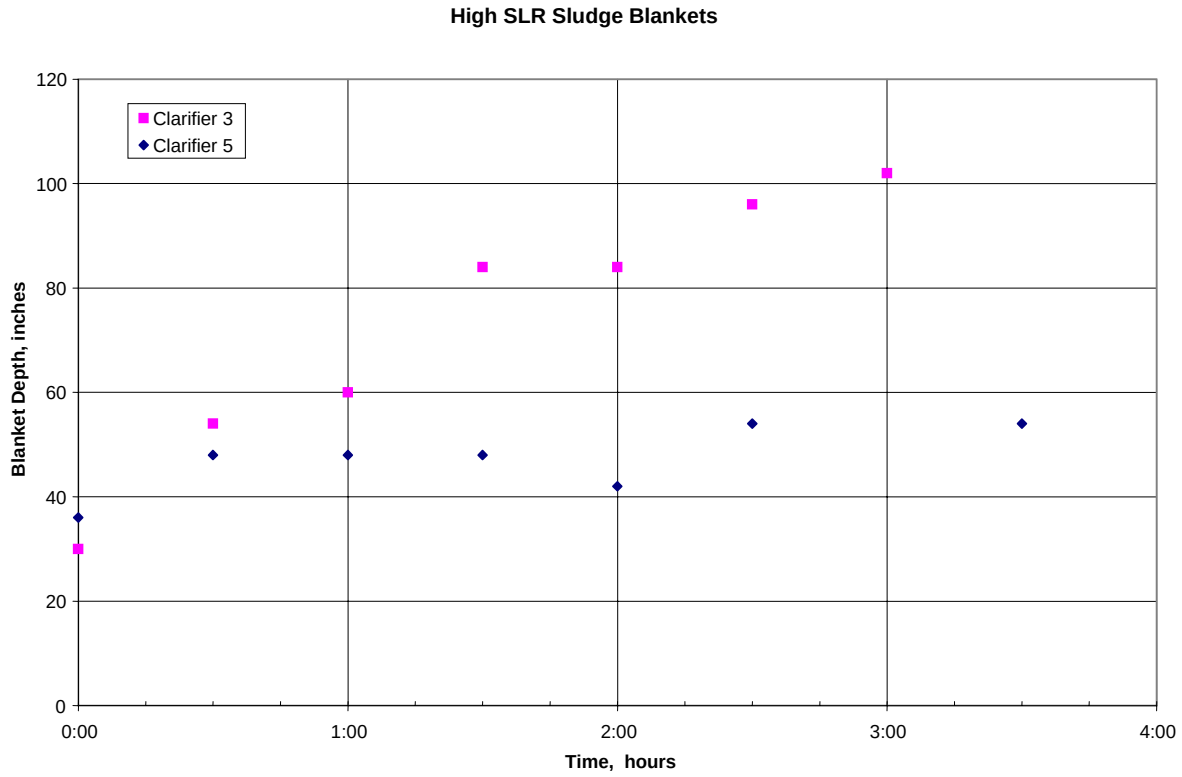
FIGURE 4

LAHAINA WWTP SECONDARY CLARIFIER CAPACITY ANALYSIS
HIGH SOLIDS LOAD TIME SERIES SLUDGE BLANKET DEPTH



A state-point analysis of these two runs was also done, and confirms these results. Using industry standard values for sludge settling characteristics, the state point analysis showed that Clarifier 3 should be overloaded. This analysis is shown graphically in Figure 5.

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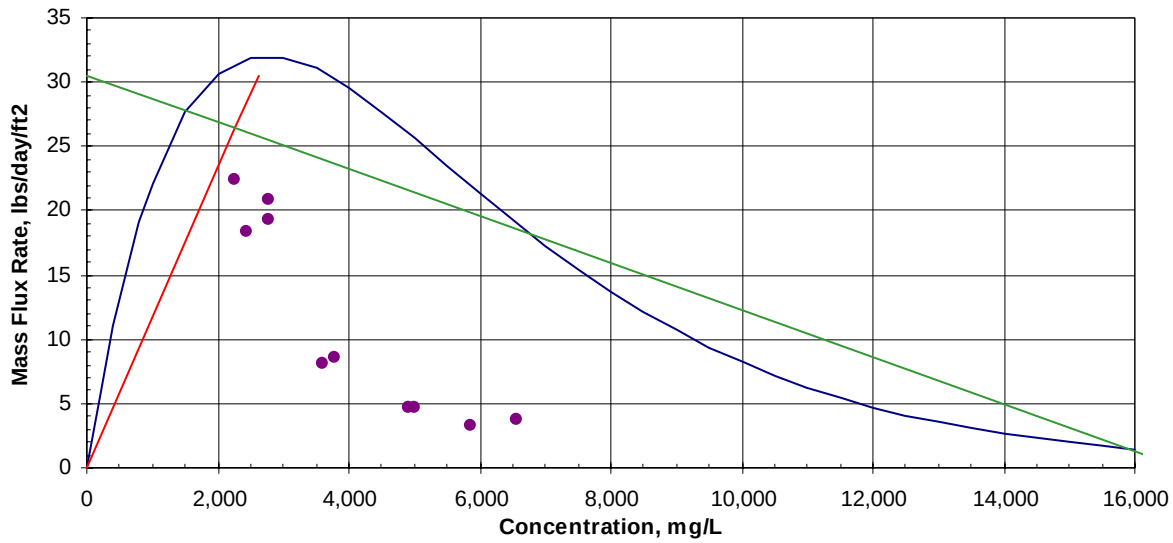
FIGURE 5

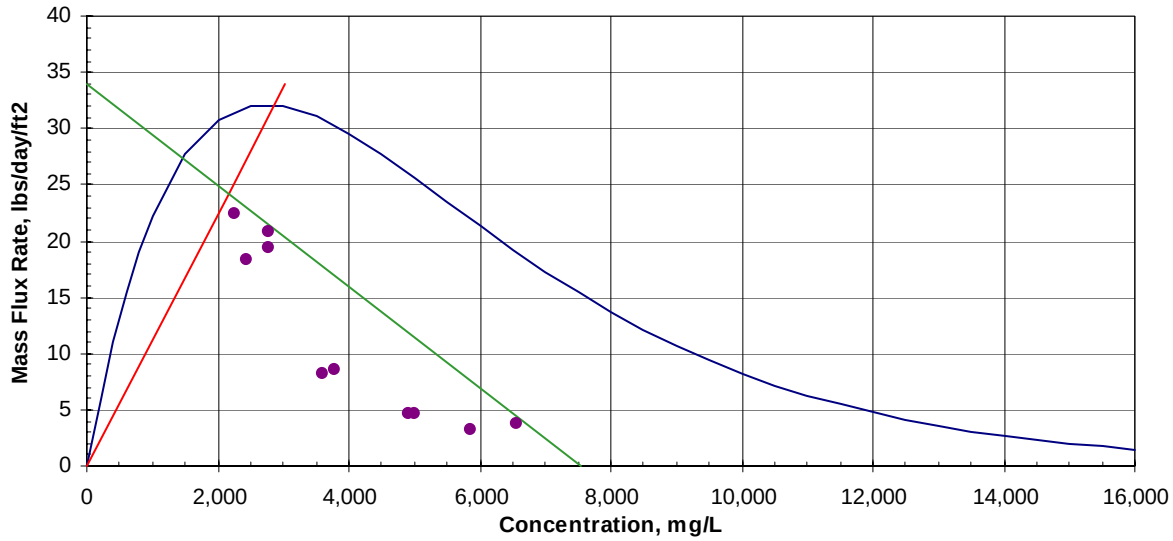
LAHAINA WWTP SECONDARY CLARIFIER CAPACITY ANALYSIS
STATE POINT ANALYSIS OF CLARIFIER 3



Basically, if the underflow line (the straight line dropping from left to right) intersects the curve, the system is overloaded with respect to solids. The state point analysis predicts that the clarifier became overloaded at a SLR of approximately 20 lbs/day/ft^2. In contrast, the same analysis for Clarifier 5 showed that it was not overloaded. The state-point analysis indicates that the unit could handle solids loading rates of up to 35 lbs/d/ft^2 prior to being solids overloaded. Note however, that the effluent quality may be unacceptable at that high of a loading.

FIGURE 6

LAHAINA WWTP SECONDARY CLARIFIER CAPACITY ANALYSIS
STATE POINT ANALYSIS OF CLARIFIER 5



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While this analysis was done with industry standard data for the shape of the flux curve, it was also attempted to develop the flux curve specifically for the Lahaina WWTP. This flux data is shown on both Figure 5 and Figure 6 as data points. It can be seen that this data did not agree well with the industry standard data. Also, if this data is used to determine the status of the clarifier, it indicates that Clarifier 5 should have been overloaded at the highest rate. This result was not supported by the other data obtained in the test. It therefore appears that there is some problem with these data that should eliminate its use.

Conclusions and Recommendations

1. The hydraulic capacity of the clarifiers does not appear to be limiting (up to about 1,400 gpd/ft or approximately 6 mgd per clarifier, but a judgment by plant staff needs to be made relative to what an acceptable effluent quality is from the facilities.

2. The solids loading rate capacity of the clarifiers appears to be approximately 35 lbs/d/ft^2 at an SVI of about 120 and a RAS rate of about 40% of the influent flow or greater. A 6 mgd feed to one clarifier and 40% RAS ratio, results in a maximum MLSS of about 2,200 mg/L.

3. These results are consistent with previous assumptions about clarifier capacities. However, these loading rates need to be used in conjunction with the detailed influent flow profile to determine what the design load should be. Normally the maximum month conditions are used to determine this and then the peak day conditions are used in conjunction with the results from this work to ensure that the system is not overloaded unless it is a peak event. At the Lahaina WWRF it is estimated that a 9 mgd ADW flow equates to a 20 mgd peak flow. Since all three clarifiers together, at the higher RAS rates, can only treat up to about 18 mgd, the plant would be overloaded during that period. In order to treat this level of flow for a longer period, it would be necessary to convert the FAB over to step feed or contact stabilization mode to protect the solids during such a high flow event.

4. The clarifiers appear to be run at a constant RAS flow rate. If possible, improved operation and reduced operating costs (through reduced pumping) could be achieved if the RAS pumps were controlled to supply RAS as a fixed percentage of the influent flow rate.

5. This study was not able to provide data on what benefits might be realized through the implementation of clarifier improvements, such as baffles and improved flocculation wells. However, it is believed that the plant will see improvement in effluent quality as a result of improvements such as these. Note that these improvements will not increase solids handling capacity.

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Appendix A

Lahaina WWRF – Secondary Clarifier Stress Testing Data and Graphs

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Lahaina WWRF

SECONDARY CLARIFIER STRESS TESTING

Clarifier 3 Surface Area: 4,415 ft2

Clarifier 5 Surface Area: 4,415 ft2

Time	Run	Description	No. of Clarifiers Operating	MLSS (Clarifier Influent)						RAS												Small Clarifier (#3)									Big Clarifier (#5)						
										3				4				5				Inf, mgd	Effluent		Sludge Blanket (in)						Inf, mgd	Effluent		Sludge Blanket			
				TSS	SVI	DSS	FSS	Flow Depth (in. to water level)	Flow (SCADA), MGD	TSS	Flow Rate (gpm)	Flow Rate (MGD)	% of Total	TSS	Flow Rate (gpm)	Flow Rate (MGD)	% of Total	TSS	Flow Rate (gpm)	Flow Rate (MGD)	% of Total		TSS	Turbidity	1	2	3	SOR (gpd/ft2)	SLR Feed (lbpd/ft2)	SLR Sludge (lbpd/ft2)		TSS	Turbidity	(inches)	SOR (gpd/ft2)	SLR Feed (lbpd/ft2)	SLR Sludge (lbpd/ft2)
6:00	1	All Clarifiers						6.25	2.43													0.73						165			0.97				221		
6:30			3	2320	280				3.62	4740	600.67	0.86	23.89%	4660	596.90	0.86	23.74%	2460	1,595.25	2.30	63.46%	1.08	20	2.86	3	6	18	246	8.55	7.75	1.45		3.89	24	329	16.43	10.68
7:00			3	2010	240	40	10	6.50	4.57	4950	621.81	0.90	19.59%	4820	627.29	0.90	19.77%	2880	1,624.59	2.34	51.19%	1.37	30	3.38				310	8.60	8.38	1.83	10	3.72		415	15.84	12.73
7:30			3					6.00	5.87	5040	664.01	0.96	16.29%	4960	662.48	0.95	16.25%	3270	1,643.73	2.37	40.32%	1.76	20	3.19	6	8	18	398		9.11	2.35	10	3.60	18	533		14.63
8:00			3	2220	240	40	10	6.00	6.33	5740	653.86	0.94	14.87%	5350	652.33	0.94	14.84%	3580	1,655.40	2.38	37.66%	1.90	50	3.49				430	11.91	10.22	2.54	50	3.75		574	20.64	16.13
8:30			3					5.75	6.37	5850	670.08	0.96	15.15%	5130	668.76	0.96	15.12%	3710	1,665.92	2.40	37.66%	1.91	0	3.11	6	8	24	432		10.67	2.55	0	3.28	24	578		16.82
9:00			3	2250	250	20	40	5.75	6.67	6120	688.99	0.99	14.87%	5510	697.29	1.00	15.05%	3720	1,683.64	2.42	36.35%	2.00	0	2.70				453	12.72	11.48	2.67		3.30		605	21.68	17.05
9:30			3					6.00	6.81	6560	678.51	0.98	14.35%	5950	681.90	0.98	14.42%	4490	1,681.42	2.42	35.55%	2.04	30	2.98	3	12	18	462		12.11	2.73	30	3.25	24	618		20.55
10:00			3	2280	300	40	10	6.00	6.62	6510	684.86	0.99	14.90%	6020	686.55	0.99	14.93%	4390	1,682.97	2.42	36.61%	1.98	40	2.97				449	12.80	12.14	2.65	20	3.38		601	21.87	20.11
10:30			3					5.75	6.40	6600	678.12	0.98	15.26%	6500	674.92	0.97	15.19%	4210	1,671.55	2.41	37.61%	1.92	0		8	18	24	434		12.18	2.56			30	581		19.15
11:00																																				
11:30																																				
12:00																																				
12:30	2	1 Big, 1 Small (and 1 Offline) Clarifier	2	1960	270	20	40	5.50	5.01	7150	667.04	0.96	19.17%					4690	1628.54	2.35	46.81%	2.14	40	3.01				486	11.50	12.98	2.87	20	3.11		649	19.31	20.79
13:00			2					5.75	5.09	7000	645.24	0.93	18.25%					4370	1632.74	2.35	46.19%	2.18	30	3.18	5	8	24	493		12.29	2.91	20	3.22	18	660		19.42
13:30			2	1950	230	0	40	6.00	5.12	6950	645.10	0.93	18.14%					10	1637.59	2.36	46.06%	2.19	20	2.87				496	11.50	12.20	2.93	0	3.15		663	19.49	0.04
14:00			2					6.50	4.85	6850	631.20	0.91	18.74%					3750	1627.32	2.34	48.32%	2.08	30	3.00	8	10	14	470		11.77	2.77	30	3.21	24	628		16.61
14:30			2	1850	220	10	0	6.00	5.48	6160	641.87	0.92	16.87%					3710	1646.12	2.37	43.26%	2.34	0	2.90				531	11.43	10.76	3.14	0	2.86		710	19.25	16.62
15:00			2					6.00	5.74	6190	653.05	0.94	16.38%					3790	1660.10	2.39	41.65%	2.46	0	3.01	4	8	18	556		11.00	3.28	0	3.09	27	744		17.13
15:30			2	2010	220	20	0	5.50	6.18	6210	661.72	0.95	15.42%					3570	1660.13	2.39	38.68%	2.64	0	3.01				599	13.67	11.18	3.54	0	3.47		801	22.51	16.13
16:00			2					5.75	6.18	6330	659.08	0.95	15.36%					3810	1654.63	2.38	38.55%	2.64	10	3.32	12	12	18	599		11.36	3.54	0	3.95	14	801		17.16
16:30			2	2290	260		20	5.75	6.00	6440	548.83	0.79	13.17%					4230	1658.56	2.39	39.81%	2.57	30	3.30				582	14.53	9.62	3.43	20	3.46		778	25.20	19.10
17:00																																				
17:30																																				
18:00																																				
18:30	3	1 Big Only	1	2280	260		0	4.00	6.14									5800	1681.30	2.42	39.43%										6.14	0	4.98	36	1391	36.89	26.54
19:00			1			20		4.25	6.10									5830	1671.80	2.41	39.47%										6.10	0	5.34	48	1382		26.53
19:30			1	2300	270		20	4.75	5.90									6150	1663.15	2.39	40.59%										5.90	30	5.72	48	1336	36.06	27.84
20:00			1			10		4.75	5.02									5990	1650.29	2.38	47.34%										5.02	0	5.40	48	1137		26.91
20:30			1	2180	270		10	5.00	5.44									6210	1659.11	2.39	43.92%										5.44	0	5.68	42	1232	32.26	28.04
21:00			1			40		4.75	5.66									6010	1644.22	2.37	41.83%										5.66	20	5.37	54	1282		26.90
21:30			1	1890	250		0	4.75	6.75									6130	1638.23	2.36	34.95%										6.75	10	5.44	-	1529	32.54	27.33
22:00			1					5.00	6.66									5840	1645.92	2.37	35.59%										6.66	0	4.90	54	1508		26.16

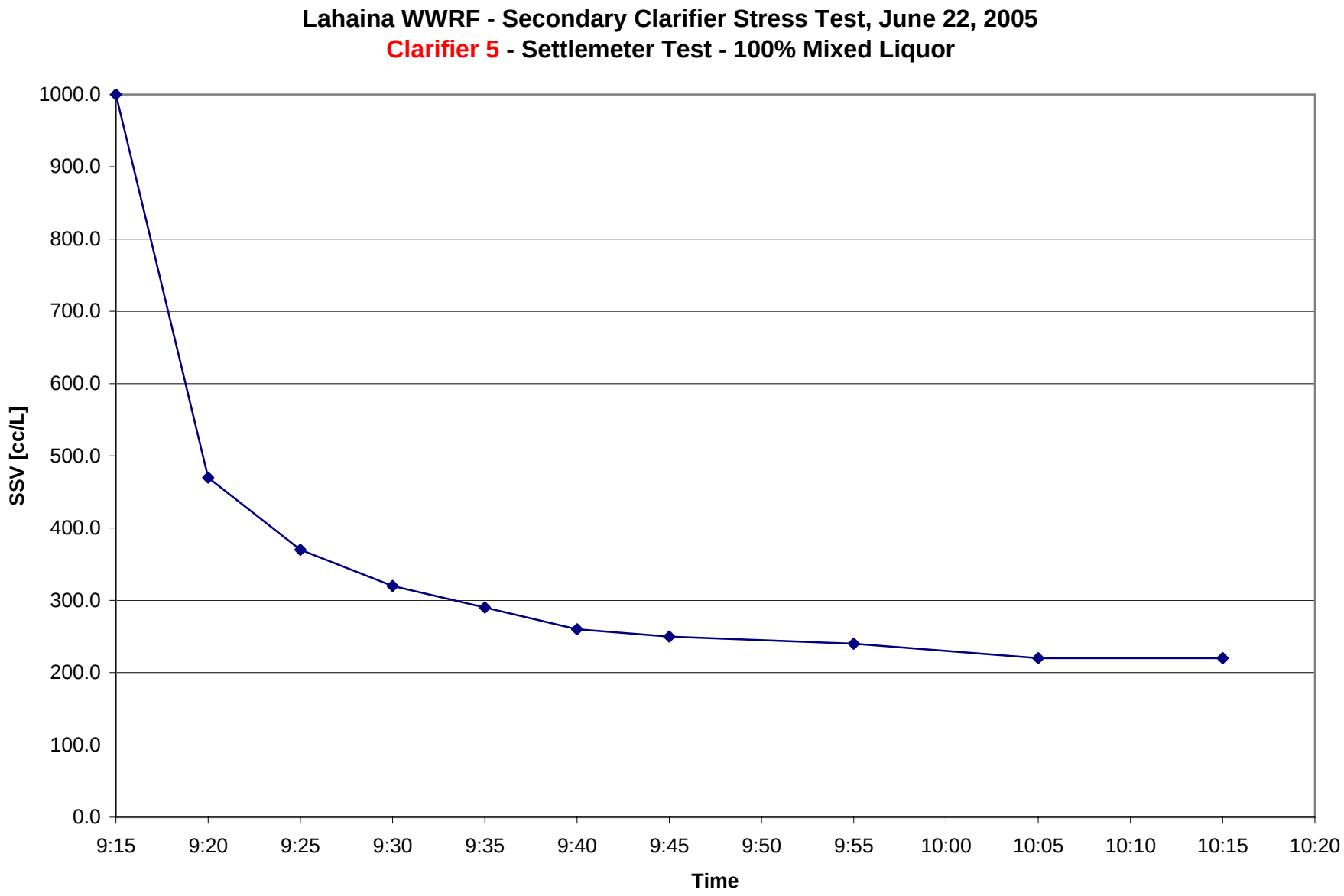
Lahaina WWRF

SECONDARY CLARIFIER STRESS TESTING

Clarifier 3 Surface Area: 4,415 ft2

Clarifier 5 Surface Area: 4,415 ft2

Time	Run	Description	No. of Clarifiers Operating	MLSS (Clarifier Influent)						RAS												Small Clarifier (#3)									Big Clarifier (#5)						
										3				4				5				Inf, mgd	Effluent		Sludge Blanket (in)						Inf, mgd	Effluent		Sludge Blanket			
				TSS	SVI	DSS	FSS	Flow Depth (in. to water level)	Flow (SCADA), MGD	TSS	Flow Rate (gpm)	Flow Rate (MGD)	% of Total	TSS	Flow Rate (gpm)	Flow Rate (MGD)	% of Total	TSS	Flow Rate (gpm)	Flow Rate (MGD)	% of Total	1	TSS	Turbidity	1	2	3	SOR (gpd/ft2)	SLR Feed (lbpd/ft2)	SLR Sludge (lbpd/ft2)		TSS	Turbidity	(inches)	SOR (gpd/ft2)	SLR Feed (lbpd/ft2)	SLR Sludge (lbpd/ft2)
6:30	1	All Clarifiers Operational	3	2440	127.05		40	7.00	3.59	4890	597.63	0.86	23.97%	4680	598.39	0.86	24.00%	2530	1,590.62	2.29	63.80%	1.08	0	3.32	3	5	12	244	8.93	7.95	1.44	20	4.37	18	326	17.20	10.95
7:00			3			0		6.50	4.53	5050	619.01	0.89	19.68%	4770	622.63	0.90	19.79%	3120	1,623.00	2.34	51.59%	1.36	40	3.18				307		8.51	1.82	50	3.79		411		13.78
7:30			3	2780	115.11		20	6.00	5.57	5850	637.12	0.92	16.47%	5140	645.50	0.93	16.69%	3690	1,642.79	2.37	42.47%	1.67	0	3.31	6	10	14	378	13.59	10.14	2.23	10	4.26	18	505	24.16	16.50
8:00			3			10		6.00	5.82	6340	657.75	0.95	16.27%	6000	656.22	0.94	16.24%	4260	1,649.14	2.37	40.80%	1.74	10	3.64				395		11.35	2.33	10	4.11		528		19.12
8:30			3	2880	111.11		20	5.75	6.31	7710	682.21	0.98	15.57%	5850	684.53	0.99	15.62%	4930	1,679.19	2.42	38.32%	1.89	10	4.32	6	15	21	428	15.64	14.32	2.53	20	5.21	30	573	26.93	22.53
9:00			3			0		6.00	6.74	7220	692.16	1.00	14.79%	7450	691.40	1.00	14.77%	5570	1,689.81	2.43	36.10%	2.02	0	4.59				457		13.60	2.70	10	3.97		612		25.62
9:30			3	2560	128.91		0	6.00	7.31	7350	693.65	1.00	13.66%	7850	691.67	1.00	13.63%	5270	1,686.21	2.43	33.22%	2.19	40	3.99	8	18	30	496	15.43	13.88	2.93	20	4.34	30	663	25.92	24.19
10:00			3			20		6.00	6.66	7750	665.61	0.96	14.39%	8040	669.50	0.96	14.48%	4960	1,678.06	2.42	36.28%	2.00	30	3.71				452		14.04	2.67	30	4.12		604		22.65
10:30																																				
11:00	2	1 Big, 1 Small (and 1 Offline) Clarifier	2	2010	124.38		0	5.25	6.26	7720	685.59	0.99	15.77%					5430	1684.79	2.43	38.76%	2.68	0	3.66	12	24	36	607	13.9	14.41	3.58	0	3.80	39	811	22.82	24.90
11:30			2			0		5.50	5.52	8090	640.41	0.92	16.71%					5750	1634.01	2.35	42.63%	2.36	0	3.59				535		14.10	3.16	0	3.79		715		25.57
12:00			2	2090	110.05		20	5.50	5.04	7600	647.15	0.93	18.49%					5080	1645.53	2.37	47.02%	2.16	30	3.49	8	18	24	488	12.2	13.39	2.88	20	3.65	30	653	20.75	22.75
12:30			2			0		5.75	4.90	8350	629.84	0.91	18.51%					4680	1627.32	2.34	47.82%	2.10	0	3.60				475		14.31	2.80	0	3.67		635		20.73
13:00			2	1970	116.75		0	5.75	5.12	8260	620.10	0.89	17.44%					4580	1638.41	2.36	46.08%	2.19	10	3.24	11	18	18	496	11.5	13.94	2.93	20	5.03	30	663	19.69	20.42
13:30			2			30		5.50	4.79	8140	636.44	0.92	19.13%					3750	1638.15	2.36	49.25%	2.05	0	3.02				464		14.10	2.74	0	3.25		621		16.72
14:00			2	1500	153.33		20	5.50	5.00	7890	643.46	0.93	18.53%					4510	1644.95	2.37	47.37%	2.14	0	3.61	6	12	24	485	8.7	13.82	2.86	0	3.27	24	648	14.83	20.19
14:30			2	2120	122.64	40	30	5.50	5.81	7770	646.24	0.93	16.02%					4180	1644.31	2.37	40.75%	2.49	0	3.78				563	13.7	13.67	3.32	0	3.25		753	22.81	18.71
15:00			2	2230	103.14		60	5.50	5.40	7870	643.41	0.93	17.16%					4650	1634.51	2.35	43.59%	2.31	20	3.70	7	15	30	523	13.6	13.78	3.09	0	4.31	30	700	22.94	20.69
15:30			2	2260	123.89	10	20	5.50	5.24	7580	648.37	0.93	17.82%					4300	1649.14	2.37	45.32%	2.24	10	3.60				508	13.6	13.38	3.00	0	3.66		679	22.95	19.30
16:00	3	1 Small Only (Clarifier #3)	1	2220	126.13		0	-	5.87	7590	669.50	0.96	16.42%									5.87	0	4.14	24	30	24	1330	28.7	13.83							
16:30			1	2240	125.00	0	0	3.50	6.43	8390	682.78	0.98	15.29%									6.43	0	5.41	48	54	48	1456	31.4	15.59							
17:00			1	2380	117.65		10	3.50	6.11	8490	669.50	0.96	15.78%									6.11	20	6.16	48	60	48	1384	31.8	15.47							
17:30			1	1820	153.85	10	30	3.00	6.22	8830	665.76	0.96	15.41%									6.22	20	7.65	84	84	156	1409	24.7	16.00							
18:00			1	2340	123.93		20	3.00	5.86	9360	674.99	0.97	16.59%									5.86	30	8.04	84	84	156	1327	30.2	17.20							
18:30			1	2510	119.52	10	30	2.75	6.63	9860	688.33	0.99	14.95%									6.63	10	8.71	96	96	144	1502	36.2	18.47							
19:00			1	2390	125.52		30	3.25	6.16	9630	657.10	0.95	15.36%									6.16	0	9.00	96	102	150	1395	32.1	17.22							


Lahaina WWRF - Secondary Clarifier Stress Test, June 22, 2005
Clarifier 5 - Settlemeter Test - 100% Mixed Liquor
SSV [cc/L]
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
9:15
9:20
9:25
9:30
9:35
9:40
9:45
9:50
9:55
10:00
10:05
10:10
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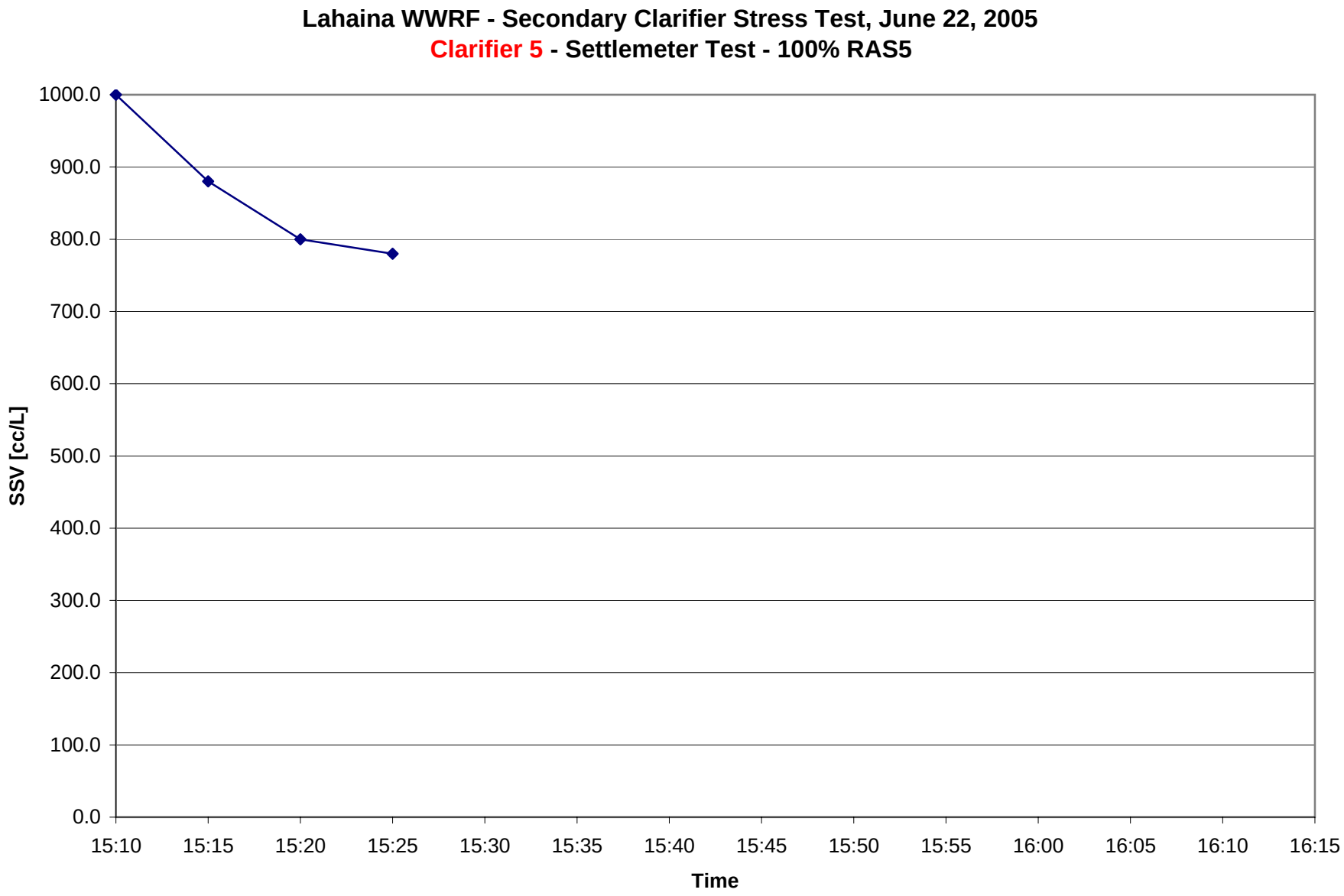
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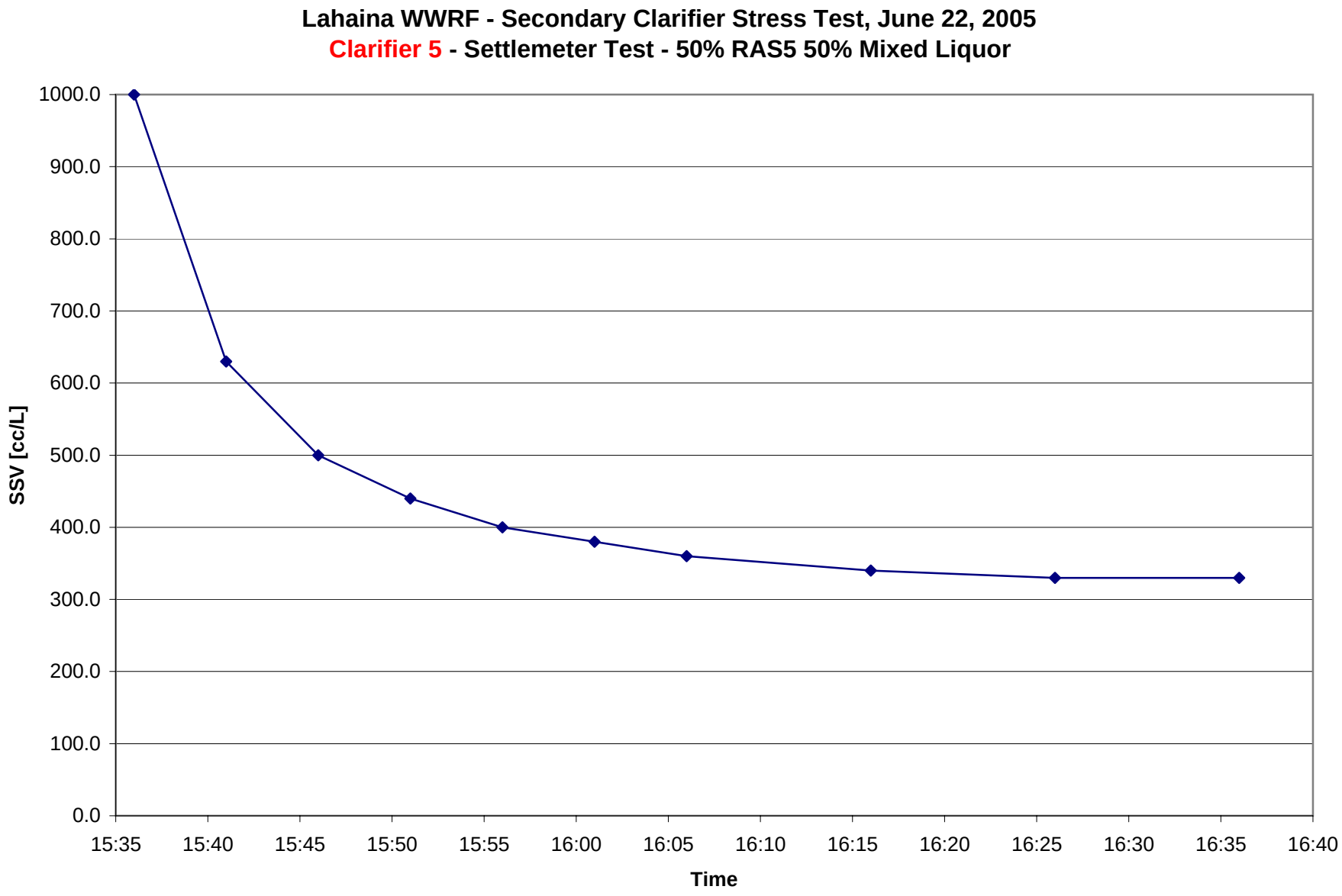
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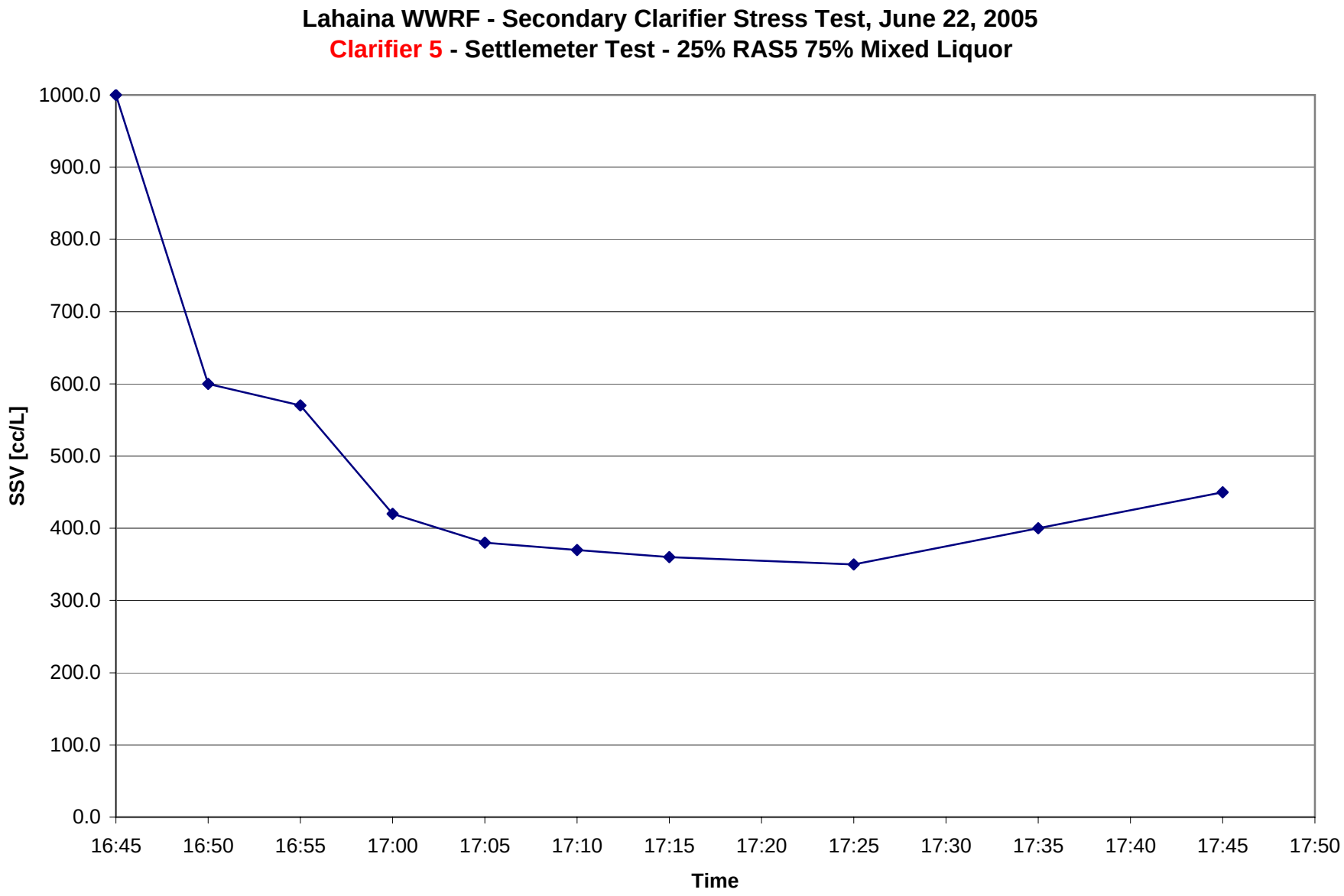
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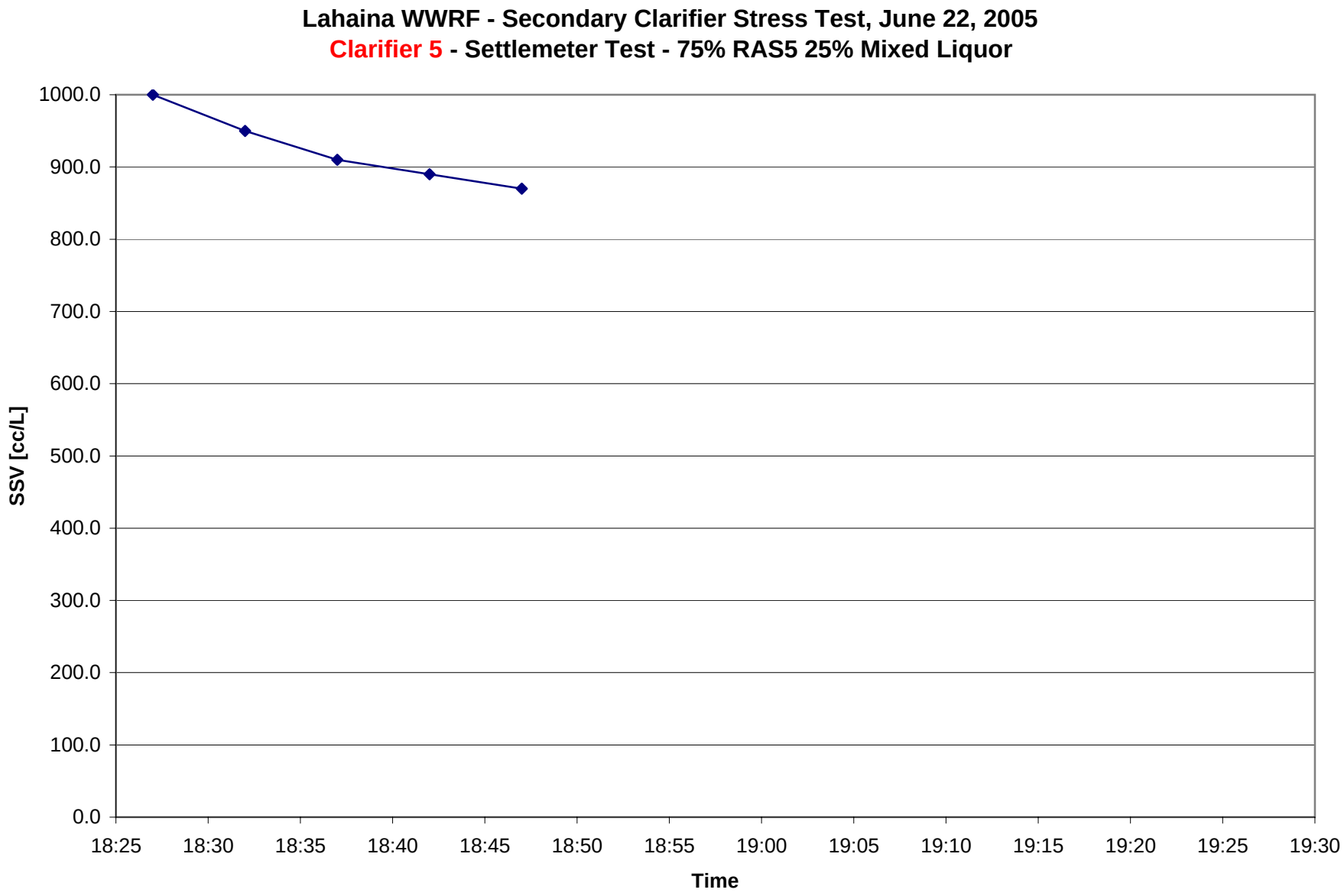
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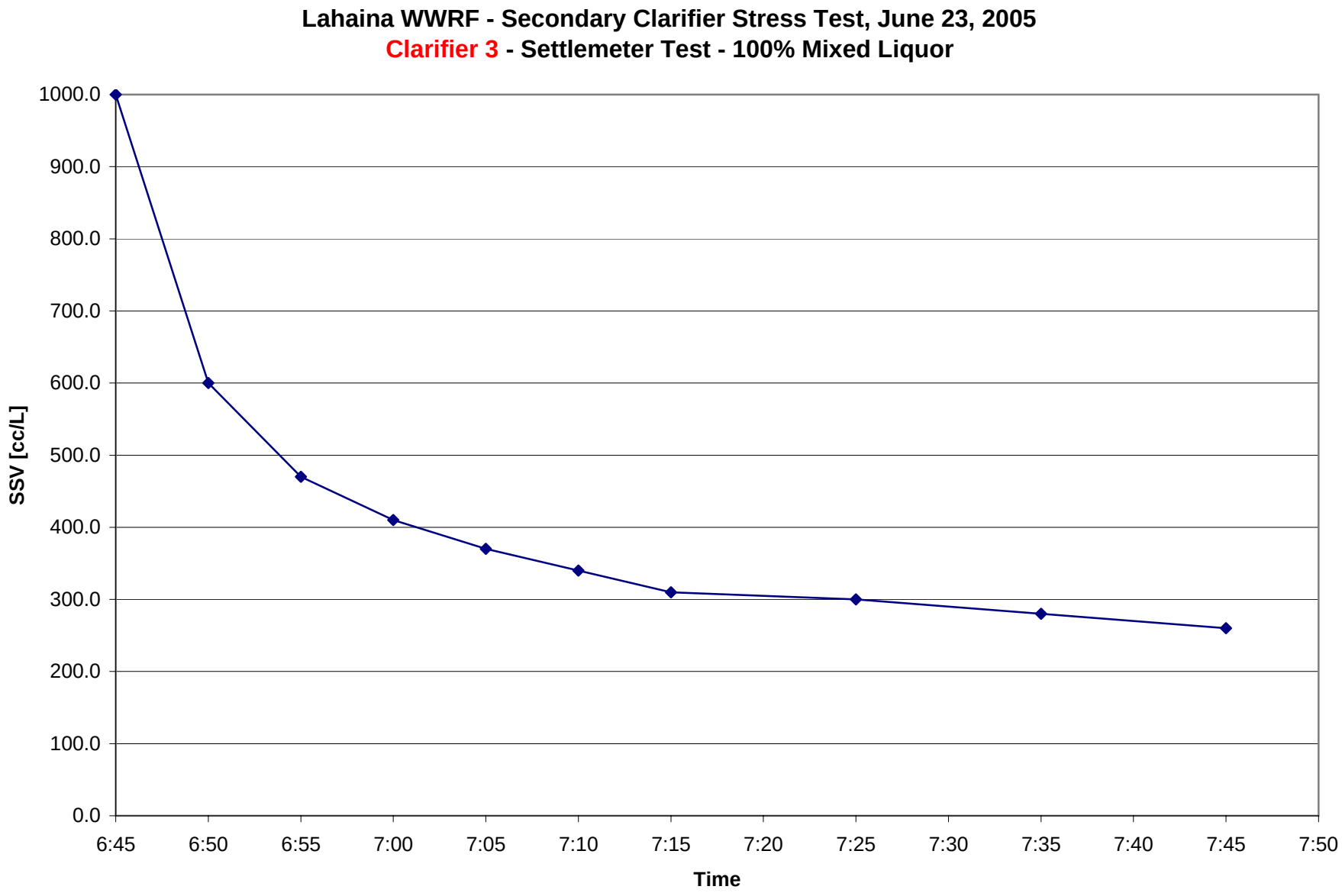
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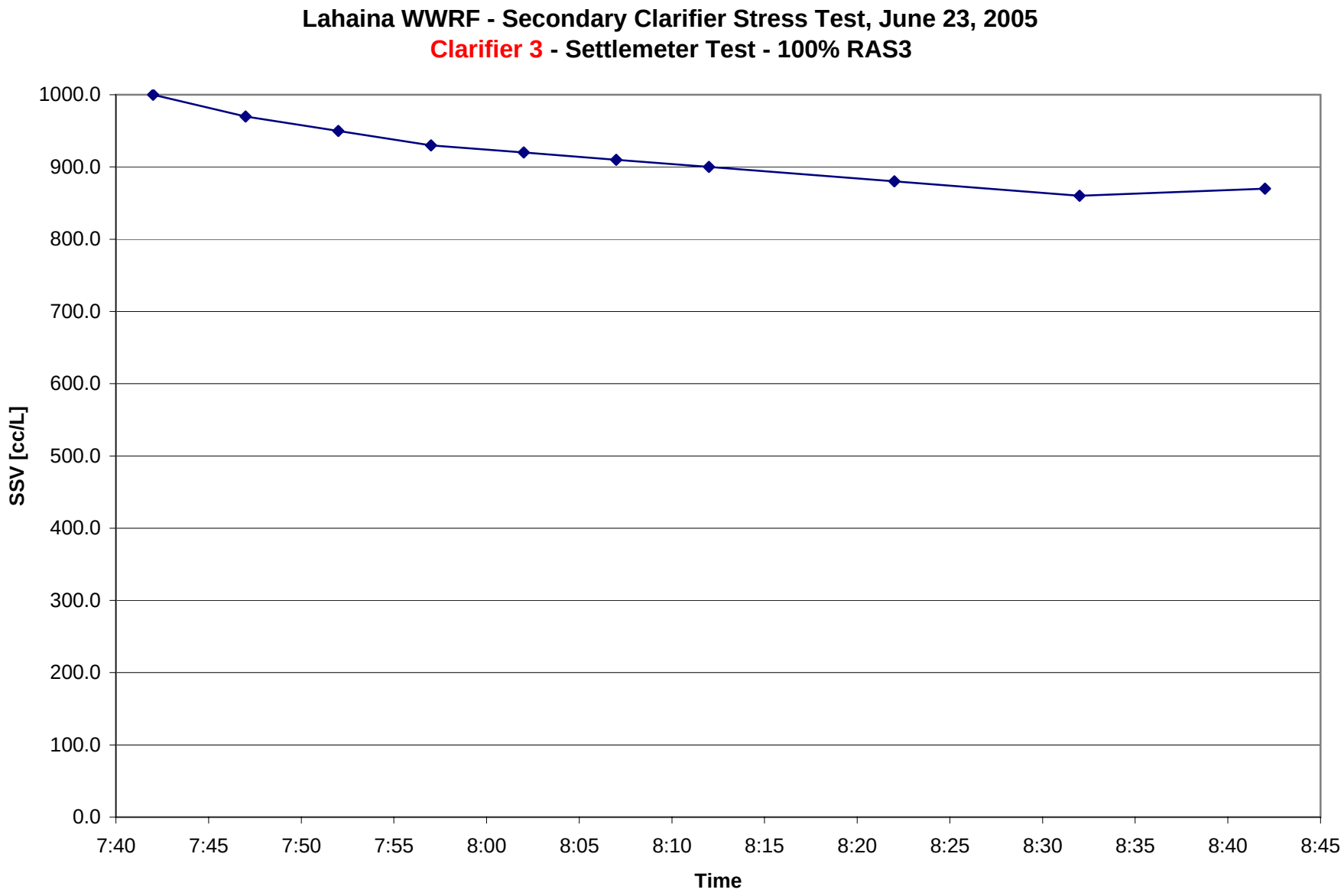
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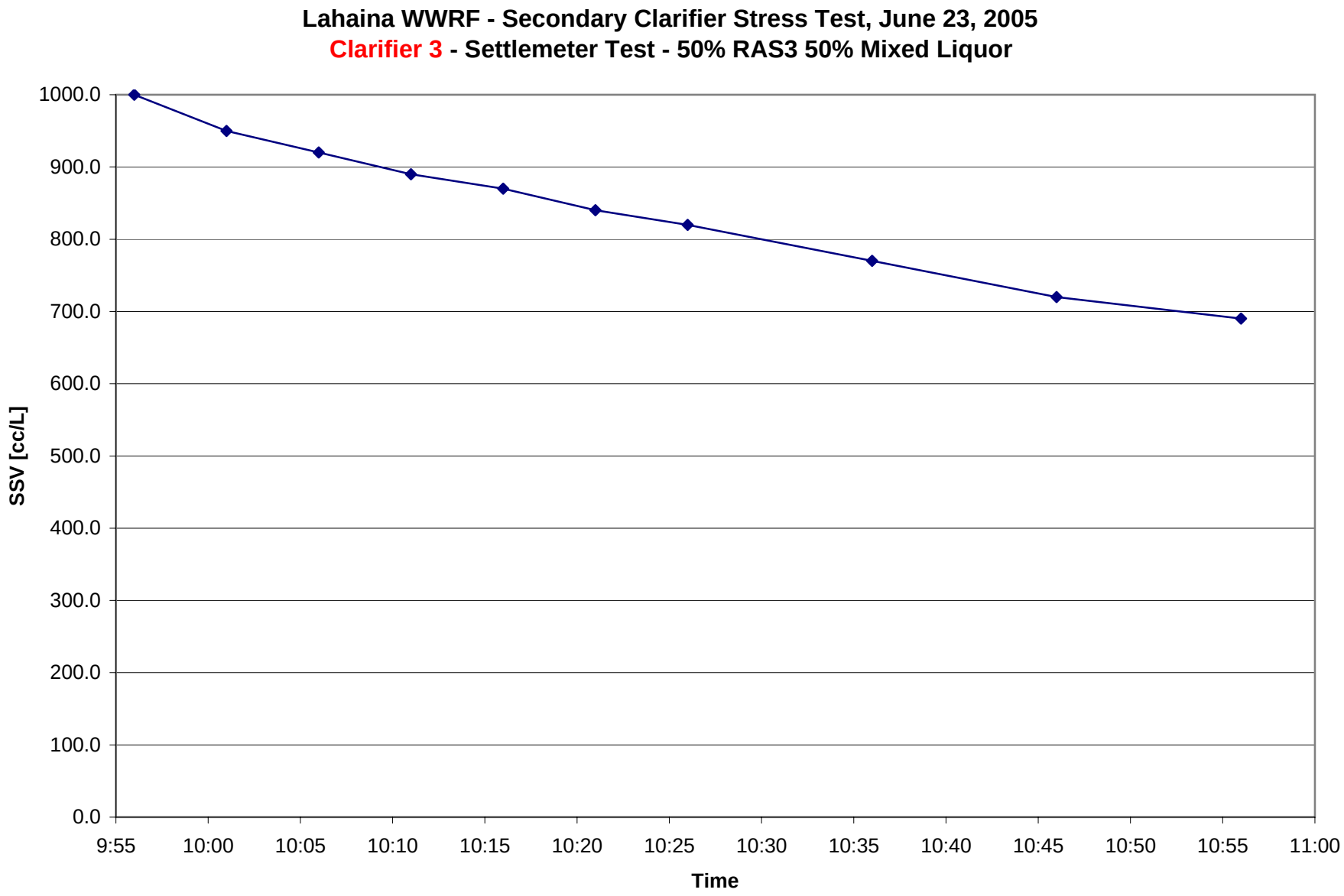
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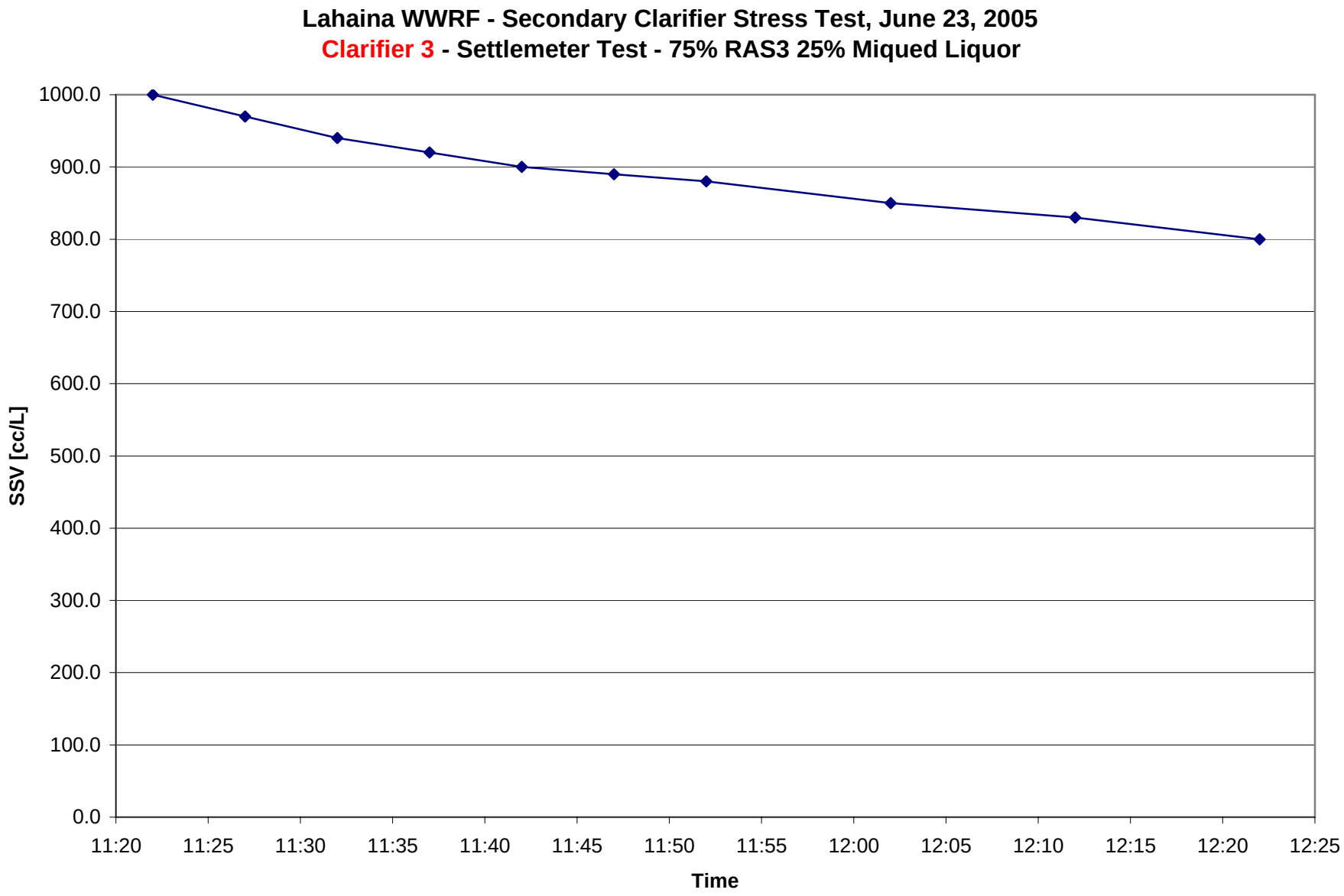
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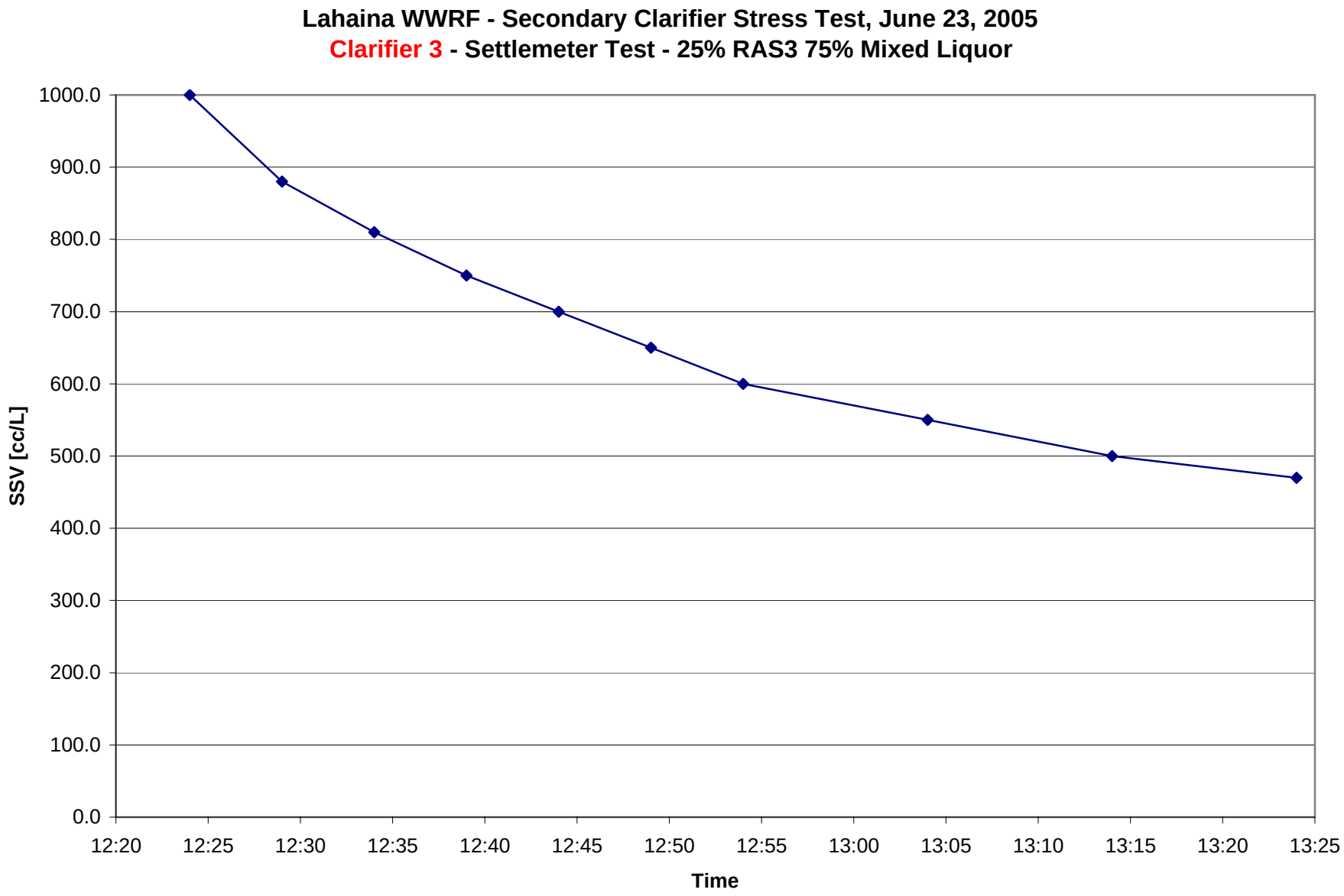
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Appendix G – Electrical Assessment Report

COUNTY OF MAUI
LAHAINA WASTEWATER TREATMENT FACILITY

ELECTRICAL ASSESSMENT

Prepared by:

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PO Box 880280
Pukalani, Maui, Hawaii 96788

August 2005

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Section 1 - Introduction

An electrical assessment of the Lahaina Wastewater Reclamation Facility was conducted during the months of April through July 2005. The objective was to obtain information and data through site observations and application of recording instruments to prepare an assessment and report on any findings with recommendations.

The focus of this assessment was also to assist with the evaluation of the proposed alternatives in the Phase 2 of this project.

The facility evaluation was broken down by electrically identifiably areas.

Section 2 - Methodology

Visual and analytical methods were used as the basis for the condition assessment. For historical reference, digital photographs and electronically recorded data were incorporated for detailed and future analysis. Testing data such as voltage, current, power (KW and KVAR), power factor, insulation resistance, infrared imaging, and vibration were obtained on a majority of the equipment during this assessment

The electrical parameters were recorded using an AEMC Model 3945 Power Quality Analyzer. The data recordings varied from approximately 15 minutes for specific equipment to three days for switchboards and major feeders. This electrical information was downloaded to a computer for further analysis and storage for future comparison. Copies of this data are included in the Appendix section of this report.

The insulation resistance readings were taken, on the non-operational motors, at 30 seconds for smaller motors (<75 HP) and at one minute for motors larger than 75 HP using a Yokogawa Model 2426A Digital Insulation Tester. Vibration readings were taken using a Balmac 211S Vibration Meter. Infrared images were obtained using a Flir Model E4 Thermacam unit.

Where possible, the electrical enclosures were opened to expose the components so additional data could be taken.

This assessment involved the collective compliment of observations, conversations with personnel, review of digital photos and recorded data, electrical single line diagrams, and comparison with the previous assessment.

The assessment covered the various plant equipment from the primary power breakers and transformers to the distribution centers and motor control centers and in many areas covered the driven unit. These were generally broken into two subcategories identified as “Condition” and “Performance”. These were further broken down into sub-factors, with each given an equal weight. A number of 0 to 4 was assigned to each sub-factor to arrive at an average for each subcategory. These were than totaled and averaged, based on the number of reported sub-

factors. If a sub-factor item was not applicable, this was not included in arriving at the averaged value.

The rating system is described in the following table. As a general rule, equipment that is fairly well maintained and operational will have a rating average in the 2.75 to 3.25 category, while equipment that is not operational will generally be in the 1.25 to 1.75 range. In several cases, the equipment was not operational due to its dependence on another part of the system being non-functional, hence a performance test was not possible. A rough number was included as though the equipment had been operational.

The following is a description of the Assessment Rating System used:

Assessment Rating System Scale	
System Rating	Description of Equipment State
0	The equipment was present at one time but is presently missing. The equipment is not operational and not repairable. A New unit is required to be installed.
1	Equipment is present but in Poor or Damaged Condition. Equipment is not operational but may be repairable and will require a high degree of maintenance to keep operational. Replacement is best option.
2	The equipment is present and in Fair Condition. The equipment may be operational but other necessary components prevent the equipment from becoming operational. The equipment requires maintenance and/or repair.
3	The equipment is present and in moderately good condition. The equipment is operational with routine maintenance presently being performed.
4	The equipment is present and is new or like New Condition. The equipment is operational and newly installed.

A summary of the assessment is found in the Observation and Findings section. The detailed assessment worksheets are in the Appendix section of this report.

Section 3 - Existing Electrical System Description

The following is a description of the present electrical distribution system at the facility.

Primary Distribution System

The Lahaina Wastewater Reclamation Facility receives its Maui Electric Company 12.47 KV primary power through the substation at Mahinahina through a single overhead line which enters the south side of the facility. Two Maui Electric Company substations provide power redundancy.

The power is available at the facility through two sets of utility risers. The primary riser, which services the entire facility, consists of a set of parallel cables that provide power to Unit Substation No. 3 (USS-3) at the '85 portion. This main service is through a 1200 Amp 15KV Main Vacuum Circuit Breaker and metering section. This switchgear also is equipped with two secondary breakers for the USS-4 Feeder and the 1000 KVA Transformer along with a spare compartment for a future breaker. The 1000 KVA transformer provides 480 volt secondary power to the Solids Building, the aeration basins, clarifiers, and filter feed pumps. A 500 KW emergency generator provides backup power for the distribution switchgear in this area.

At Substation USS-4, the switchgear consist of three 15 KV Vacuum Breakers. One serves as the feeder from USS-3, the second to the '75 portion of the facility, and the third to the 1500 KVA transformer for the Blowers and Screening Buildings. A 750 KW emergency generator provides back-up power to the blower and screenings building.

In the existing arrangement, the control power for this substation is from the load side of the '75 feeder whereby the breakers would have to be charged, if previously discharged in a power outage, and closed manually. Operating this breaker manually has been a somewhat tenuous situation.

The electrical primary distribution system was originally intended and designed to have the power originate at USS-1 at the '75 Electrical Building and be looped to the '85 Electrical System with the division at the USS-3 side of USS-4. This required two metering points. The meters were not combined and hence, only one set of utility meters are used today.

At the '75 portion of the facility, the primary switchgear is arranged such that power could be received through of two 15 KV Magneblast air circuit breakers and from their respective risers. The third 15 KV breaker connects the '75 portion of the facility to USS-4 and provides the power to the '75 facility.

The power is distributed throughout the '75 portion of the facility through three power distribution transformers. The 750 KVA transformer is backed by the 565 KW emergency generator and provides power to the main facility circuits. The other two transformers at the effluent pumping station transformer (1500 KVA) and the UV channel transformer (TRF-4D, 150 KVA) are not provided with back-up generator power.

Secondary Distribution System

The secondary electrical distribution system utilizes 277/480 volts and 120/208 volts, three phase three and four wire. Most of the 1975 portion of the plant is wired for three phase three wire while portions of the 1985 plant use a four wire system.

Most of the lighting within the buildings is 120/208 volts three phase four wire as is the UV Disinfection system.

Emergency Generators

The critical circuits at the facility are backed up by standby power. At the '75 portion, a 565 KW Cummings diesel powered emergency generator provides power to the Chlorine Building (MCC-E), Control Building (MCC-C), Backwash Basin (MCC-D), Filters (MCC-4C), '75 Recycle Room (MCC-B), and the older aeration basin and filters (MCC-A). This emergency power is distributed through a single automatic transfer switch and distribution board SDP-2.

A 500 KW Caterpillar diesel powered unit is used at the '85 Electrical Room providing power to the Solids Handling Building (MCC-3D), clarifiers and filter feed pumps (MCC-3A and MCC-3C). Emergency power here is distributed through switchboard SDB-3 and a single automatic transfer switch.

A newly installed 750 KW Cummings diesel powered generator provides power to the Blower (MCC-4A and 4B) and Screenings Building (MCC-3B).

The original feeder cables between the 500 KW Generator and the Blower Building are still in place and can be manually connected, in an emergency condition, to provide back-up power in either direction.

A copy of the single line diagram for the plant is in the Appendix Section of this report.

Section 4 - Electrical Observations and Findings

This assessment will cover the primary distribution equipment, the secondary distribution equipment, motor control centers, and the driven equipment, followed by the general areas.

Unit Substation No. 1 – 1975 Main Electrical Room

1. This switchgear consists of two 15 KV 1200 Amp GE Magna-Blast air breakers for each of the utility services (both are not used and are in the "racked out" position).

2. A third 15 KV air breaker section is used to provide power to the 1975 Facility from USS-4. The protective relay for this breaker does not appear to be operational and hence this breaker is used as a switch and depends on the relay settings of the breaker at USS-4.

3. Two 15 KV fused air switches provide power to USS-2 and the 750 KVA Station transformer.

4. The dust contamination within this room need be cleaned periodically. This fine dust is found on and within the electrical equipment. An effort to should be made to seal the entry points.

5. A single 750 KVA transformer is used to step the voltage down to the 480 volt level for the majority of the '75 Plant. This transformer was previously filled with PCB (Polychlorinated Biphenyls) and was retrofilled during the 1980's. During a recent oil test, the level of PCBs had risen to greater than 50 ppm and hence the transformer has been reclassified to be PCB Contaminated (50 to 500 ppm).

   The transformer has a small oil leak as evidenced by the oil on the floor (see photo section). This oil need be contained to prevent further contamination and treated as PCB material as per 40 CFR Part 761 of the Federal Regulations. At a minimum, a catchment pan should be installed to contain any leaking fluid. The contaminated material need be treated as a hazardous waste.

   It is recommended that the source of the leak be located and repaired. Periodic monitoring is also essential.

750 KVA PCB Contaminated Transformer with oil leak at 1975 USS-1 Main Electrical Vault

Photo 1: Transformer Oil Leak

Photo 2: PCB Contaminated Label

6. The measured load on this transformer was approximately 180 KVA or 24% of the transformer rating.

7. The transformer is operating well within its capability as the plant load is reduced. Any expansion of this area need consider this transformer in the loading.

   Consideration for replacement (as the transformer is approximately 30 years old) is a factor.

<u>Unit Substation No. 2 – 1975 Effluent Pumping Station</u>

1. This substation consists of two 15 KV air switches and a transformer. One of the switches serves as the primary disconnect for the 1500 KVA transformer for the Effluent/Re-use Pumping Station and the other for the 150 KVA Transformer, TRD-4, for the UV disinfection system.

2. The Effluent/Re-use Pump Station Motor Control Center (MCC-D2) powers the effluent and re-use pumps and is newly installed. This motor starter for these pumps use electronic soft start means with a mechanical by-pass at full speed.

3. The enclosure for this equipment is affected by the elements and signs of corrosion are evident. This is particularly evident on the top of the transformer case. These items are recommended to be treated and painted.

4. The transformer previously contained PCB fluid and was retrofilled to a level below 50 ppm. This transformer could be handled as a normal transformer. A small leak was also evident (see photo section). Due to difficulty in determining if the leak is recent or from the past, this determination was not made.

   We recommend that the oil stain be cleaned and periodic monitoring be instituted.

5. The measured load on this station consists primarily of the re-use pumps. During the recording period, only the re-use pump was operated with a load of 67 KVA or 5% of the transformer load.

6. This transformer is also operating well below its rating as the operation of the effluent pumping has changed. Consideration for future loading need be considered in any plant expansion.

<u>Unit Substation No. 3 – (USS-3 at 85 Main Electrical Room)</u>

1. This substation receives the Maui Electric Company service for the entire facility, at 12.47 KV, through a single riser and underground feeder. A second, utility, backup underground feeder is energized and installed in parallel with the main service.

   This is a confusing issue with the Maui Electric Company as the load side of the fused disconnect is energized when under most circumstances, it is not. Utility workers must exercise extreme care when working on this system.

   The original 1975 system was designed as a radial distribution system. The 1985 expansion was designed to provide a back-up to the 1975 section as a loop type system. The present system is not operated in this manner as the 1985 system serves the 1975 section as a radial distribution system.

   An improvement in the operation of the primary electrical system could be achieved by operating as a primary loop, as a shutdown to accomplish load switching would be unnecessary. Working with the electrical utility could accomplish this.

2. A vacuum type, 1200 amp, main circuit breaker serves as the main disconnect for the entire Lahaina Wastewater Facility.

3. The power is further distributed through the switchgear through two other vacuum type circuit breakers. One provides power to USS-4 at the Blower Building and the other provides power to the 1000 KVA transformer for the 1985 Main Electrical Building.

4. The enclosure is experiencing corrosion on the windward side. The rusting areas need be prepared, treated, and painted to minimize the damage.

5. The top of the transformer is in the early stage of corrosion. This need be treated and painted to extend the transformer life.

6. The original transformer failed, however the auxiliary equipment was transferred to the replacement. The result is that this transformer has two nameplates that are slightly different. The old nameplate need be removed to minimize any confusion.

7. The measured load at the main distribution board was 167 KVA or 17% of the transformer rating.

8. The electrical load on this transformer is also well below its rating.

<u>Unit Substation No. 4 – (USS-4 at Blower Building)</u>

1. This switchgear has experienced considerable corrosion on the windward side of the equipment and transformer. This 1500 KVA transformer has experienced extensive corrosion at the top cover, radiators and headers, and base. This transformer requires immediate attention and replacement since the procurement process for a replacement is estimated at 8 months or longer. (It is our understanding that this transformer will be replaced at the end of July 2005).

2. During the switching of the 12.47 KV system, it was noted that the control power for this station is derived from the ‘75 Switchgear Load Side Feeder. The system is presently reversed such that power is served through the ‘85 Switchgear. To operate the breakers, the ‘85 Switchgear feeder breakers need be powered first through a manual closing.

3. The temperature and pressure alarms for the transformer are not connected.

4. In the cubicle that provides power to the USS-1, the nameplate describes it as receiving power from USS-1. Also a leak in the roof of the switchgear allows water to enter the equipment as evidenced by the rust trace on the equipment. This is a very serious condition and need be repaired as soon as possible.

Photo 3: Rust in USS-4

USS-4 Switchgear – Water Infiltration into switchgear. Note water mark in photo at left and rust mark in roof panel.

Photo 4: Water Infiltration

5. The primary line enclosures were locked.

6. The electrical load on this transformer was not measured in total; however, the individual blower and the headworks building were. Each blower (200 HP) was measured at 150 KVA and the headworks at 32 KVA for a total of 332 KVA. The loading is 22% of the transformer rating.

<u>SBD-1 – 1975 Main Electrical Room</u>

1. This switchboard is served by a 12.47 KV to 277/480 volt, station type, 750 KVA transformer (this is the transformer described in the USS-1 above).

2. A 1600 amp metal clad circuit breaker for the main is installed.

3. A 1000 amp feeder breaker for the Emergency transfer switch is used to disconnect the power and test the 565 KW generator under load.

4. This room and equipment need be cleaned of dust to maintain functional operating mechanisms and prevent any flashovers.

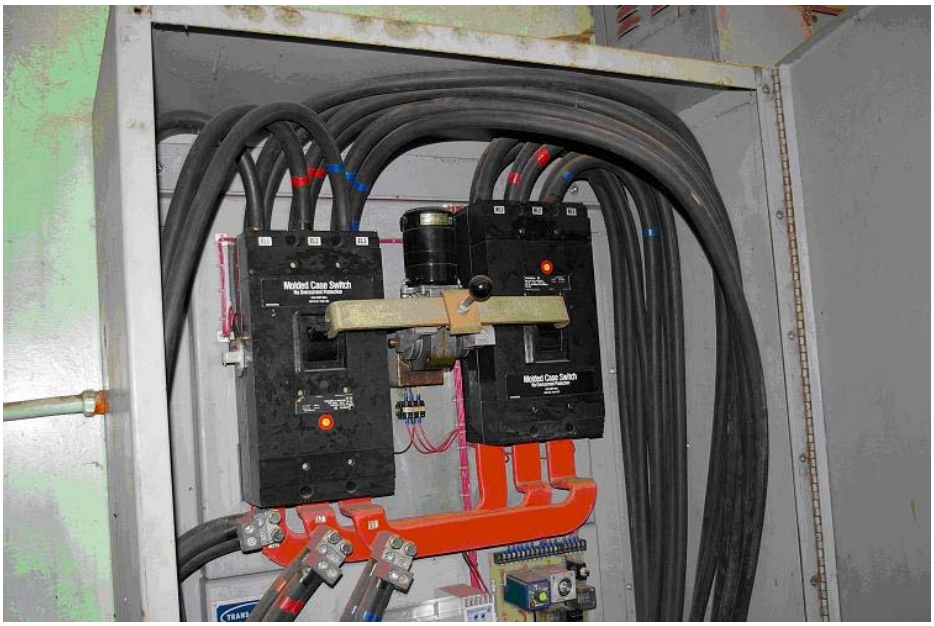
5. The load flow through the transfer switch was measured at 175 KVA. The maintenance building is the only additional load on this feeder and is estimated at 5 KVA for a total of 180 KVA. Based on the breaker size, the feeder load is approximately 24% of the design rating.

SBD-2 – 1975 Generator Room

1. This is the 1975 Emergency Distribution Panelboard and is powered by the 565 KW emergency generator and automatic transfer switch.

2. The measured electrical load at SBD-2 is within the design capability, however need be considered for replacement due to its age and dust contamination.

3. The auto transfer switch is not equipped with an isolation manual by-pass mechanism and is recommended for replacement during any plant improvements.



Auto transfer switch at 75 Generator Room. Power is provided to Main Emergency Board and is not equipped with Isolation or By-pass Means.

Photo 5: Auto Transfer Switch

4. Most of the 1975 Plant is powered through this transfer switch. This switch is also not equipped for isolation by-pass making maintenance a challenge without a total shutdown.

5. The electrical loading on this switch was measured at 175 KVA or approximately 30% of its rating.

MCC-A – 1975 Blower Room

1. This MCC is served through an 800 amp circuit breaker at SDB-2 (Emergency Power) and a 225 amp breaker at SDB-1 (Normal Power).

2. The equipment located at this motor control center previously served the aeration and digester basin with blowers and mechanical aerator equipment.

3. This motor control center is divided into two sections. One section is serviced by normal power and the second through the 565 KW emergency generator and automatic transfer switch.

4. The present primary load on the normal power section is the Maintenance Shop. Relocation and reconnection of this Maintenance Shop feeder at MCC-A to the emergency portion of MCC-A will provide emergency power at the Maintenance Shop during a power outage. This will have no effect on the loading of the '75 emergency generator.

5. The interior of MCC-A is in relatively fairly good condition with exterior corrosion and dust contamination. Many of the springs on the mechanical latch were corroded and require replacement.

6. The motor starter and circuit breaker types are re-useable although of an earlier vintage (1970s).

7. The loading on this MCC was measured at approximately 10 KVA. Since this is not operational, the reading does not reflect the capability of the feeder at 530 KVA.

MCC-B – 1975 Recycle Room

1. This MCC is served through a 225 amp circuit breaker at SBD-2 located at the 1975 Generator room.

2. This MCC is also on emergency power through the 565 KW emergency generator and automatic transfer switch.

3. The equipment located at this motor control center serves the 1975 Facility sludge handling equipment. This equipment was not in service.

4. The interior of this MCC was in fair condition with exterior corrosion on the MCC doors and the latching mechanism. Dirt contamination was evident on the interior of several starters however most were relatively clean.

5. MCC-B1 is powered through MCC-B and powers the Robicon variable speed drives for the two 1975 WAS/Scum Pumps.

6. This MCC is also not currently in use and the measured load was negligible. The feeder capability is approximately 150 KVA.

MCC-C – 1975 Control Building

1. The Control Building is serviced through a 100 amp circuit breaker at SBD-2 and backed by the 565 KW Generator and auto transfer switch.

2. Only one feeder (on emergency power) is provided to the Control Building.

3. The wiring section for the Main SCADA unit was clean with minimal dust contamination.

4. The measured load for this building was measured at 35 KVA with a feeder rating of 70 KVA or approximately 50% of its rating. This is primarily due to the air conditioning load on the building.

MCC-D – 1975 Backwash Room

1. This MCC is served through a 400 amp circuit breaker at SDB-2, which is located at the 1975 Generator Room.

2. This power to this MCC is backed up through the 565 KW emergency generator and automatic transfer switch.

3. Only one set of feeder cables power this MCC.

4. This primary loads on this MCC are MCC D-1 (utility water) and MCC 4C (filter power). Most of the motor starters on this MCC are no longer used.

5. The major motor starters on this MCC consist of the ‘75 Filter Feed Pumps.

6. This MCC show signs of corrosion at the terminal blocks and power transformer located in the lower compartment, from a previous flooding of this area. The MCC is in fair to poor condition with a fair amount of dirt and dust contamination.

Photo 6: Motor Control Center Power Transformer with Corrosion

7. The measured load to this MCC was measured at 157 KVA with a design rating of 265 KVA or approximately 60% of its rating. Any load expansion on this feeder need to consider the present loading and lack of feeder redundancy.

<u>MCC-D1 – 1975 Backwash Room</u>

1. This MCC is served through a 350 amp circuit breaker, located at MCC-D.

2. This MCC is backed up by the 565 KW emergency generator through MCC-D.

3. Only one set of feeder conductors provide power to this motor control center.

4. The primary loads on this MCC are the Backwash Waste Pumps and Utility Water Pumps. Both are operated on variable speed.

5. This MCC is in good condition with minimal dust contamination.

6. The load on this MCC was not measured but could be deduced from total load of MCC-D less MCC-4C. This would compute to approximately 82 KVA or 31% of its rating.

MCC-D2 – 1975 Effluent and Reuse Pumping Station

1. This MCC is served through USS-2 (1500 KVA transformer) to power the 250 HP Effluent pumps and the two 250 HP and two 200 HP Re-use pumps.

2. This MCC is not on emergency generator power.

3. The Re-use pumps operate during the evening (off-peak) demand period to pump to the golf course irrigation reservoir, although this was observed as operating during the day.

4. The motor starters within this MCC are electronic reduced voltage with by-pass type of current technology.

5. This MCC was installed within the past three years and is in relatively new and good condition.

6. The measured load on this MCC was measured at 67 KVA with one of the re-use pumps in operation. This would equate to approximately 5% of the transformer rating.

MCC-E – 1975 Chlorine Building

1. This MCC receives its power from SBD-2 through a 70 amp circuit breaker and is backed by the 565 KW emergency generator and auto transfer switch.

2. Only one set of feeder conductors provides power to this MCC.

3. Many of the components of this MCC are no longer used.

4. The MCC is located within an air conditioned environment.

5. The measured load for this building was 33 KVA or approximately 66% of the feeder design rating. This seemed high for this building.

SB-3 – 1985 Main Electrical Building

1. Switchboard SB-3 is the 1600 amp Main Distribution Board for the 1000 KVA transformer.

2. The main breaker provides normal power to the auto transfer switch with emergency power being provided by the 500 KW generator.

3. The feeder breakers are identified as MCC-3A, MCC-3D-Solids Processing, MCC-3B, and TVSS. ATS and MCC-3B are spare breakers.

4. This switchboard is in relatively good condition with some dust contamination.

5. This is also the main feeder for this building and was measured at 167 KVA or 17% of the transformer 1000 KVA rating.

MCC-3A – 1985 Main Electrical Building

1. This MCC is on the emergency power system.

2. Most of the equipment on this MCC is not used.

3. This MCC also provides power to MCC-3A1 which consists of variable speed drives.

4. This MCC is in relatively good condition with minimal dust contamination. The room is air conditioned.

5. The measured load for this MCC was 50 KVA which is 9.5% of the 530 KVA design rating.

MCC-3A1 – 1985 Main Electrical Room

1. The variable speed drives for the 1985 Filter Feed Pump, WAS Pump, and WAS/Scum Pumps are located at this MCC.

2. This MCC is backed by the 500 KW emergency generator.

3. The MCC is in good condition.

4. Minimal dust contamination was evident.

5. The power measured here was combined with MCC-3A and not measured individually.

MCC-3B – Screenings Building

1. The power for this building is from the Blower Building Distribution Switchboard (MCC-4) and is on emergency power from the 750 KW generator.

2. The effects of sewage gas are very evident on the electrical components of this MCC, despite being housed in an air conditioned room.

3. The Variable speed drives at MCC-3B1 for the two transfer pumps are not used.

4. The measured load for this feeder was 32 KVA which is 21% of the design rating of 91 KVA.

5. MCC-3B1 was not measured and was not in use.

MCC-3C – 1985 Main Electrical Building

1. This MCC also provides power to MCC-3C1 (VFD units for the Filter Feed and Clarifier RAS Pumps).

2. Most of the items on this MCC are no longer used. This MCC is in relatively good condition.

3. This MCC is backed by the 500 KW emergency generator.

4. The measured load for this feeder was 88 KVA or 17% of the design rating of 530 KVA.

MCC-3C1 – 1985 Main Electrical Building

1. This MCC receives it power from MCC-3C and provides power to the VFD drives of the second Filter Feed Pump and the RAS pumps of clarifiers 1 through 3.

2. This MCC is backed up by the 500 KW emergency generator.

3. The load on this MCC was included with MCC-3C and not measured individually.

MCC-3D – Solids Building

1. This MCC receives its power from the 1985 Main Electrical Building (SB-3) and is backed up by the 500 KW emergency generator.

2. The MCC is housed in an air conditioned room and hence is in relatively good condition.

3. Many of the MCC cubicles were not in use.

4. The measured load for this feeder was 91 KVA with two centrifuges in operation. This is approximately 23% of the design rating of 400 KVA.

Blower Building Main Board (MCC-4) – 1985 Blower Building

1. The main distribution switchboard that provides power to MCC-4A and MCC-4B is located at the Blower Building Electrical Room.

2. Power to this MCC is through the building's 1500 KVA transformer at USS-4. Emergency power is through the ATS and new 750 KW Emergency Generator.

3. This room is air conditioned and the equipment is in very good condition.

4. The main distribution board also houses the main breaker and an automatic transfer/by-pass switch unit using circuit breakers.

MCC-4A - 1985 Blower Building

1. This MCC contain the reduced voltage electronic motor starters for Blowers No. 1 and 3.

2. The equipment is in good condition with minimal dust contamination.

3. The power demand for Blower 1 was measured between 125 and 133 KW with an average high power factor of 85%. Power factor correction capacitors were added to this motor ahead of the recording point. This should correct the power factor to greater than 85%. This equates to a load of approximately 150 KVA.

MCC-4B – 1985 Blower Building

1. This MCC contains the reduced voltage electronic motor starters for Blowers No. 2 and 4.

2. The equipment is in good condition.

3. The blower load was also the same at approximately 150 KVA. Only blower 4 was smaller in size, but was not operated.

MCC-4C – Filters (Fiberglass Building)

1. Power for this MCC is fed through a separately enclosed 400 amp circuit breaker located at MCC-D (Emergency Power) at the Backwash Room. The cables are tapped to the MCC-D BUS.

2. The enclosure is air conditioned and the equipment is in good condition and shows minimal dust contamination.

3. The recorded power at this MCC ranged from 42 to 65 KW with an average high power factor of 87%. This is well below the equipment rating. The largest load was due to the air compressors.

4. The measured load is approximately 28% of the feeder design rating.

UV Equipment

1. The UV (ultraviolet) equipment and Panel 011 is powered through its own 12.47 KV-120/208 volt 150 KVA transformer (TFR-4D) located adjacent to the channel.

2. The UV transformer is heavily corroded and has been treated and painted several times. It is recommended that this unit be replaced with a stainless steel transformer case unit and the distribution panel relocated to the UV Channel.

3. The main breaker at the transformer was observed to have a higher than normal temperature at the right line side terminal lug. This need be checked and repaired.

4. The load at the UV transformer was not measured.

1975 Maintenance Building

1. The power for the Maintenance Building is from MCC-A at the 1975 Blower Building and it is not on emergency power.

2. Most of the power used at MCC-A is for the Maintenance Building.

3. The panel is in fair condition with some dust contamination and corrosion.

SCADA

1. The present SCADA comprise the Motorola MOSCAD system with remote terminal units (RTU) located throughout the plant. The communication system is hard wired to each RTU.

2. This system appears to be in good working condition with fairly clean cabinets and enclosures.

3. The uninterruptible power supply (UPS) systems have either been removed or disconnected. Each RTU unit is equipped with battery back-up.

Electrical Loading Table Summary

Station	Board / MCC	Breaker	Design KVA	Actual KVA	Percent Load
USS-1	SBD-1	1200A	800	180	23%
750 KVA	SBD-2	900A	600	175	30%
	MCC-A	800	530	10	2%
	MCC-B	225	150	NIL	
	MCC-C	100	70	35	50%
	MCC-D	400	265	157	60%
	MCC-D1	400	265	Not Measured	
	MCC-4C	400	265	100	38%
	MCC-E	70	50	33	66%
USS-2	MCC-D2	3000A	2000	67	3%
1500 KVA					
USS-3	SBD-3	800A	530	167	32%
1000 KVA	MCC-3A & MCC-3A-1	800A	530	50	9.5%
	MCC-3C & MCC-3C-1	800A	530	88	17%
	MCC-3D	600A	400	91	23%
USS-4	MCC-4A (1 & 3)	800A	530	150	28%
1500 KVA	MCC-4B (2 & 4)	800A	530	150	28%
	MCC-3B & MCC-3B-1	225A	150	32	21%
			Total:	332 KVA	22%

General Observations

1. The basic electrical design of the plant is that of a radial system with all of the motor control centers being fed from one set of feeder cables. In certain areas, this limits the amount of maintenance that can be performed. This is more evident in the 1975 Section of the Plant.

Designing the motor control centers and distribution boards for double ended feed will be an improvement in reliability and meet current guidelines.

2. Corrosion and dust on the interior affect the performance of the electrical system. This is particularly important with the primary 12.47 KV system as extensive damage and outages can occur.

3. Based on the location of this plant, the use of non-corrosive enclosures and raceways is critical for electrical equipment life in exterior and damp locations. At the '75 Plant, rigid metal conduit and enclosures were used. Many of these locations have rusted through and expose the wiring. With a plant expansion, we recommend the replacement of the raceways and enclosures with new.

4. Those feeders at the 1975 plant that are in use were found to be loaded to greater than 50% of their design rating, while those that were in use at the 1985 Plant were loaded to less than 33%. Clearly the 1985 Plant has greater capacity for additional load.

   Those circuits at the 1975 plant that were not in use are capable of handling the existing equipment or its equivalent.

Section 5 - Electrical Assessment Relating to Proposed Alternatives

The electrical system and its impact on the proposed alternatives are covered below:

Alternative 1 – "Status Quo"

In this alternative, no electrical work will be undertaken at the 1975 plant. Those items identified in the assessment relating to operational areas of the treatment facility will be addressed.

The present electrical system at the 1975 plant is approximately 30 years of age. The electrical conductors have an estimated life of 30 to 50 years while the equipment is 50 years or based on availability of replacement parts, whichever is sooner. Most of the motors have not been operated and maintenance will be required to make this area operational.

Alternative 2 – Operational Improvements

In this alternative, only electrical work in conjunction with improvements to process capacity at the 1985 plant will be undertaken. From the Load Summary Spreadsheet, the present power requirements at the 1985 Plant show that it is fully capable of handling the improvements described.

Alternative 3 – Restoration of 1975 Plant

The existing electrical system is capable of handling the power requirements for restoring the 1975 Plant facilities. The electrical wiring and equipment at the 1975 portion of the plant is approximately 30 years old with an estimated remaining life of 20 years. Many of the existing motors require servicing such as replacement of bearings and seals, conductor and motor insulation checks, motor servicing and lubrication, cleaning and painting, replacement of couplings, alignment, cleaning and testing of drive controllers, and verification and checking of the protective devices.

Although most major electrical suppliers stock replacement parts for switchboards and equipment, control and electronic devices become obsolete after a few years. Replacement of 20+ year old parts often requires research for upgrade modifications or procurement of reconditioned parts through an after-market supplier.

Many of the original installations used above ground rigid metallic raceways. These raceways show signs of corrosion at the transition interfaces. It appears that water has entered the raceways and hence internal corrosion would be evident and require re-routing and replacement.

To improve the reliability of the older electrical system, the redesign of the electrical system is planned where an alternative feeder would be installed and the motor control centers divided into two sections with a tie breaker. The consequent motor starters and equipment panels would be divided into two sections such that the loss of one feeder would not seriously affect plant operations.

Although the goal is to maintain the status quo, the addition of the second feeder is necessary to improve reliability due to the age of the original cables. This is costlier than installing new equipment that could be equipped with this design improvement.

Motor control centers MCC-C (Control Building at 50% capacity), MCC-D (Backwash Basin and Filter at 60% capacity), and MCC-E (Chlorine Building at 66% capacity) are near to their design capacity limits and any improvements affecting these areas need further investigation and study.

Alternative 4 – Membrane Bioreactors (MBR) Installation at Portion of 1975 Plant

The addition of Membrane Bioreactor (MBR) units to the 1975 Plant will increase the loading by approximately 70 KVA. The main distribution board is fully capable of handling this additional load.

The power for the MBR units will be incorporated into the design for this alternative.

As covered earlier, the original plant was designed as a radial system providing little redundancy at the motor control centers. A redundant back-up system would be incorporated into the upgrade design.

Alternative 5 – 1975 Plant with Parallel Nitrogen Removal Modifications

In this alternative, both portions of the 1975 and 1985 Plant equipment will be upgraded. This should have little impact on the ability of the electrical system to handle the additional load over the present measurements or affect the design capacity.

Alternative 7 – Demolish 1975 Plant and Expand 1985 Plant

This involves the demolition of the 1975 Plant electrical system with re-design to provide main and redundant power feeds to the motor control centers remaining in operation.

Depending on the routing and scheduling, the present underground 12.47 KV service to the plant may be in jeopardy as it crosses between the clarifiers and chlorine contact chambers. This need be considered in the design phase of the planned improvement.

Section 6 - Conclusions and Recommendations

1. Corrosion and Contamination – The location of the Lahaina Wastewater Reclamation Facility exposes virtually all facility equipment to the elements of dust contamination, ultraviolet sunlight, and salt air. As a result, a high level of maintenance is required to prevent catastrophic failures. Areas most heavily affected by corrosion are all windward exposed equipment, particularly in the vicinity of USS-3 and USS-4.

Building interiors exposed to sewage gases, such as the Screenings Building, also experienced a higher level of oxidation and corrosion. In these cases, the raceways between the corrosive and non-corrosive areas need be sealed with the electrical rooms and cabinets purged with positive pressured outside air. Keeping the area cooled (above the dew point) also helps remove any excessive heat and moisture.

All areas exposed to potentially high levels of corrosion are recommended to be constructed using 316 stainless steel or enclosed within a protective building.

Another maintenance factor is dust which requires frequent and periodic cleaning. The Hawaiian dust is semi conductive with a high level of iron oxide content. These areas need be cleaned using a vacuum system and not compressed air. Those areas that have been sealed and air conditioned experience considerably less dust accumulation and contamination.

The facility equipment was observed to be in fair to good condition but will require periodic cleaning and maintenance to insure asset life.

2. Electrical Power Redundancy – At the time the facility was designed, a standard practice was to provide the motor control centers with two sources of power, either utility (normal) or emergency (generator). This has its limitations for performing electrical inspections and maintenance on the main electrical bus as the entire panelboard or control center is required to be shut down, for safety reasons. The move toward safety in the workplace, particularly dealing with arc fault energy, has prompted system redesigns for electrical isolation and redundancy.

Areas of the facility critical for continued operation are recommended to be redundantly provided with power and allow for the respective circuits to be isolated.

At the 1975 section of the plant, such as the control building, only one feeder provides power to the motor control center (MCC-C) which in turn provides power to the SCADA system for the entire Lahaina Wastewater Treatment System.

It is recommended that the entire electrical system be reviewed for possible redesign such that double redundant circuits are provided to critical areas of the operation.

3. Conductor and Equipment Age – At the 1975 section, the original electrical wiring is over 30 years old and approaching its design life. The electrical equipment, including the generator, is also over 30 years old and replacement parts will become a factor. It is recommended that the critical circuits in this area of the facility be programmed for redundancy and wiring replaced.

Many of the motor control cubicles are no longer used or have been replaced with variable speed drives. These could be used as spare parts for the existing units in operation. Considering the age of the 75 Plant, any new installation work is recommended to use new materials and conductors.

4. Primary Electrical Equipment – The station exterior transformers that are experiencing heavy corrosion are recommended to be replaced with those using a stainless steel tank. Those that are leaking need be treated and repaired. The USS-1 750 KVA PCB Contaminated transformer need be treated and the leak repaired with a containment area immediately placed below the leaking area. Remediation steps need be implemented to prevent further contamination.

Working with the Maui Electric Company to redirect the primary system from a radial to a loop system is advantageous. This negotiation can be in conjunction with the transfer of ownership and operation of the primary equipment. Corrosion maintenance on the existing steel enclosures is essential regardless of whether the utility operates the system or not.

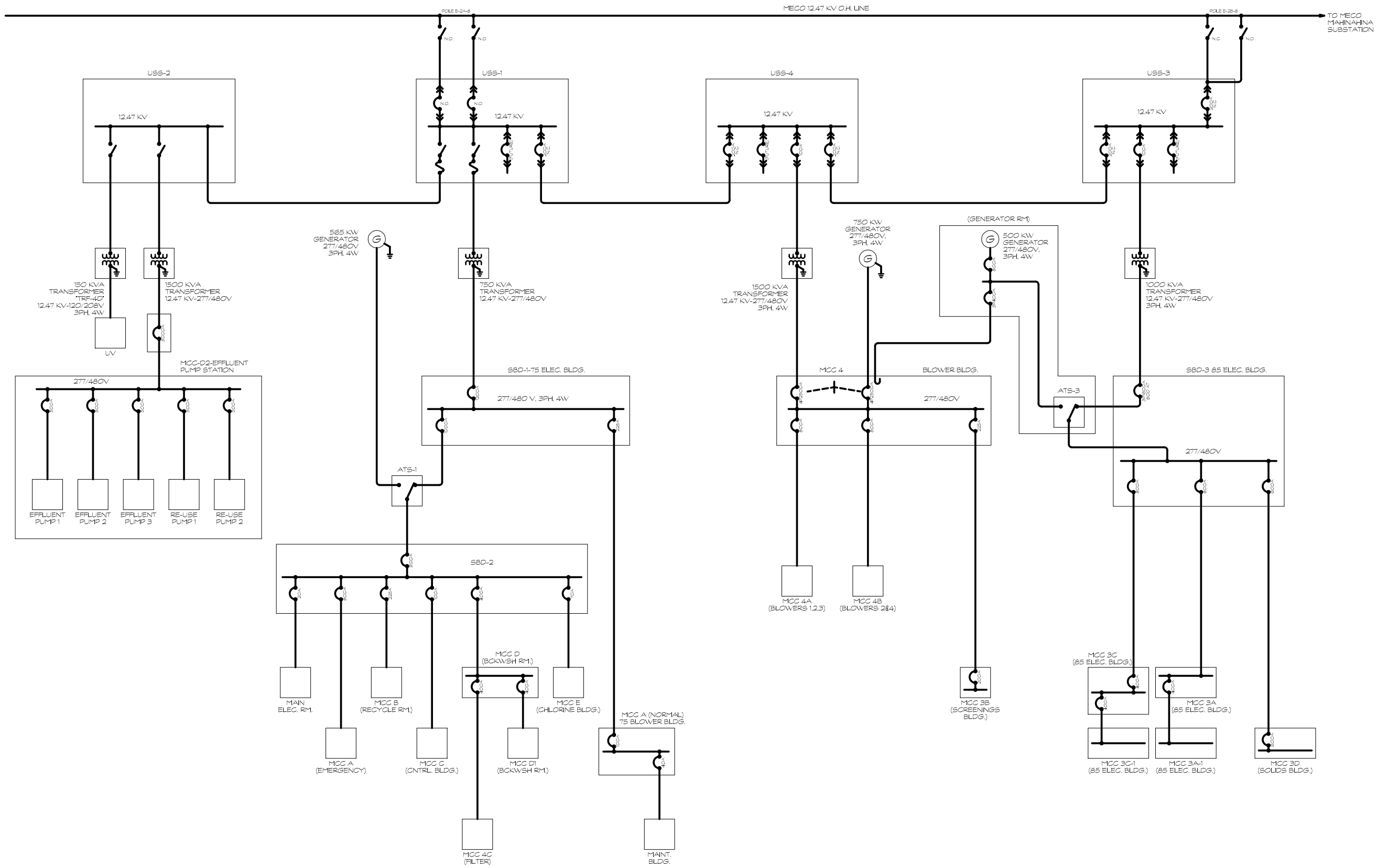
5. Plant Expansion and Design – The elements of the 1975 electrical system are covered in the previous recommendations. Basically, much of the metal raceways have corroded to some extent at the concrete to air interface. These can be repaired by chipping the concrete but the extent of the corrosion is not known. This is a major consideration for reuse of the existing raceways.

It is recommended that new raceways and wiring be installed for the expansion along with the replacement of the motor control centers and distribution boards. Into the expansion would be the redesign for an electrical redundant system with emergency generator power backup.

6. Electrical Power Loading – The existing Treatment Facility electrical system has the capability to meet the electrical requirements for the planned expansion at the 1985 Plant as well as at most areas of the 1975 Plant.

The recorded load for the main transformer for the 1975 Plant (USS-1 750 KVA) was approximately 180 KVA or 24% of its rated load. Planned additions for the expansion can handle an additional 570 KVA, sufficient to handle the various proposed alternatives.

The 1985 Plant USS-3 Transformer (1000 KVA) was recorded at approximately 167 KVA or 17% of its full load rating. This will yield an additional 833 KVA, which is more than sufficient to handle the improvements planned.



SINGLE LINE DIAGRAM

NOT TO SCALE

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EXPIRES: 4/30/06

This work was prepared by me or under my supervision and construction of this project will be under my observation.

JOB NO.	DATE:
05-076	7-11-05

DRAWN BY:	DESIGNED BY:
K.N.	D.S./L.M.

TMK: (2) 4-4-01: 04

LAHAINA WWRF ELECTRICAL SINGLE LINE DIAGRAM

ELECTRICAL PLANS FOR

LAHAINA, MAUI, HAWAII

REVISIONS:

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