III. TECHNICAL EVALUATION

A. Physical Characteristics of Discharge [40 CFR 125.62(a)]

1. What is the critical initial dilution for your current and modified discharge(s) during (1) the period(s) of maximum stratification? and (2) any other critical period(s) of discharge volume/composition, water quality, biological seasons, or oceanographic conditions?

RESPONSE:
Because there has not been significant changes from the existing disposal system or characteristics, the information submit previously is provided here, with updates as applicable.

Overview

The critical initial dilution coefficient during periods of maximum stratification is estimated at approximately 150. The response to this question first describes and discusses the variables used in this determination, and then discusses the results, including sensitivity analyses. The above initial dilution coefficient (150), or more recent coefficients seen as appropriate for applicable situation, is used in the response to subsequent questions concerning water quality impacts.

In summary, the lowest value may not necessarily provide a reliable estimate of compliance with water quality criteria and may be misleading concerning the effect on ambient quality. Since guidance or initial dilution" distributions" are not provided in the technical support document, it is recommended that the minimum results of the" seasonal" initial dilutions be considered for subsequent water quality demonstrations. (The "critical" value of approximately 150 is obtained from the RSB model for summer (maximum stratification) and a value of 340 is obtained for the winter. These values for compliance determinations are for the year 2000 flow conditions. For comparison purposes, it is noted the 1983 reapplication used an initial dilution value of approximately 120 for water quality determinations.). Annual Assessment Report (1998 to 2002) show, for the maximum stratified environment to range from 106.3 to 523 based on PLUMES, an EPA initial dilution software.

Description of Variables

The 1983 reapplication chose to identify the critical period(s) as the "fall" and "winter" seasons. The "fall" was (in the 1983 reapplication) considered the period when maximum stratification occurs. After reviewing the design analysis for the outfall, other previous oceanographic investigations, and the density profile data obtained during the 1991-1993 period, the decision was made that identifying the critical season as the" summer" would be the most consistent with these sources. Likewise, the second critical period when plume surfacing is more likely to occur was labeled the "winter" season. This is likewise consistent with previous reports, but the conditions that lead to vertical mixing are also possible in spring, fall, and even the summer, though less likely. As seen in Section II.B.6a, the maximum stratified water column occurred, most of the time, during the summer months. The section also shows, however, that the most stratified water column could occur during the winter period.

What is significant is not the name of the season, but the set of oceanographic conditions assigned (assembled) into data sets to demonstrate the range of initial dilution results. The names of the season are, therefore, only convenient labels for the reader to follow the discussion without having to read a label describing all the possible input choices associated with a particular initial dilution calculation.

The estimation of initial dilution depends upon numerous variables. This section describes the data set that is used to calculate initial dilution, and other considerations concerning the use of the two dilution models CUM and RSB). The models are contained in the interface program called PLUMES.

Among the input data used, there are several that can be considered variables for which some discussion is warranted. The major variables include:

1) density profiles;
2) flow rate in diffuser;
3) port diameter, depth, flow rate, spacing and number;
4) deep ocean current speed and direction;
5) near surface farfield current velocity; and
6) pollutant concentration and decay rate.

The values adopted for these major variables are discussed next. Other variables such as effluent temperature and salinity are shown in the output that is in the Appendix for Part III.A.I of the 1994 permit application.

Density. Section II.B.6 discussed "critical" ambient water quality conditions including those periods other than maximum stratification.

The classification of the season in which maximum stratification occurs varies between "summer" and "fall" depending upon which previous investigation is considered. For purposes here, the term "summer" is selected because that is the season in which the 1991-1993 monitoring data indicate maximum stratification generally occurs, and for consistency with the 1983 reapplication which also used the "summer" density profiles. Note that the primary variable influencing critical initial dilution is density, but it is not the only variable. Other variables include current speed and effluent discharge rate that are also discussed in this part.

The review of density profile data (those submitted with the DMRs and Section II.B.6a) indicates that there are periods in the fall (and winter) when the pycnocline depth exceeds the diffuser depth (approximately 70 meters) which implies there is no stratification within the zone of the diffuser. Under these conditions, the hydrodynamic dilution considerations actually resemble those in winter and spring, i.e. nearly vertical (linear) density gradients within the range of depth considered in the dilution calculations. However, there are subtle differences, denoted by the density gradient "shift". In other words, the profile during the winter and spring (relative to fall) indicates an increase in overall density that accompanies colder ocean temperatures in the surface (less than 100 meter depth) layer. By examining the increase in density that accompanies winter and spring can be seen by the "shift" of the profiles to the high end of the density scale.

The season in which "maximum" stratification occurs within the depth range that affects the dilution dynamics along the diffuser is defined in this application (and the original design – M&C Pacific, 1983) as "summer". Inspection of density profile data (see Section II.B.4 or the previous application or Section II.B.6a) indicates the pycnocline can exist at mid to bottom depths in this season, e.g. 35 to 60 meter depth.

Under this type of pycnocline condition, initial dilution conditions are "critical" in that the trapping effect on the sewage plume confines the volume into which mixing and dilution occurs.

The conclusion is that the determination of "critical" seasons really depends upon the impact being considered. Actually, rapid changes in the pycnocline can occur in any season. Daily density variations can be more significant than annual variations as noted in Section II.B.3. Identification of a single "critical" season may be misleading. Therefore after reviewing representative density profiles for each season for initial dilution calculations, two sets were selected as "critical". For purposes of reviewing the choices considered, the values for each season are shown in Table II.A.1-1 of the previous permit application. The winter and summer season density profiles were selected as "critical" to initial dilution calculations. Values used for current velocity in the calculations are discussed in a subsequent part.

The density profiles for spring, fall, and winter in Table III.A.1-1 of the previous permit are based upon the 1991-1993 continuous profile measurements at three stations at the boundary of the zone of initial dilution (ZID), namely stations B3, B4, B5, and z. The 1990 density data were not used because the data contains values at only three depths. These stations are appropriate because they are representative of the conditions the diffuser is exposed to but not close to be directly influenced. Comparison of density profiles taken at the same time between ZID, ZOM, and reference stations confirm this conclusion. The representative density profile in each of these three seasons (noted above) is determined by averaging density values (measured in sigma-T units) at equivalent depths over the three ZID stations. The results are density profiles that are nearly constant i.e. show little density variation, but the relative density changes as the overall density increases in the winter and decreases in summer.

There were other considerations than just selecting the average summer density profiles at the monitoring stations. Several years' data did not indicate the presence of a pycnocline. To determine the summer density profile (Table III.A.1-1 of the previous permit), to use for initial dilution calculations, the measured (continuous depth) density profile data were compared to previous density profiles adopted by various investigators, e.g. references M&C Pacific, 1983 and Block 1983). The summer profiles evidence a lot more variability than the other seasons. This may be because the diurnal fluctuations in this season, noted previously, are more significant on any given day when the profile is measured. There are occurrences of the pycnocline in some data sets, but not in others. The "summer" density profile from the original design analysis (Block 1983) is comparable to those density profiles during 1990-1993 that shows maximum stratification. However, if an average of the summer density profiles obtained from the monitoring (1990 - 1993) data were used, it would not represent a "critical" stratification period. Therefore the " summer" density profile from the design analysis was considered the best choice to demonstrate the maximum stratification condition and is shown in the density profile for the summer in Table III.A.1-1 of the previous application. The "summer maximum" in the design analysis portrays a very steep gradient that may occur in deep ocean waters, but has not been evidenced in the four years (1990-1993) density data reviewed for this application. Note that 1990 density data were obtained before the applicant purchased the continuous depth profiling equipment; the 1990 profile is based on only three measurements at the surface, mid, and bottom depths. Therefore it was included on figures in Part II.B.4 of the previous permit application, but not considered for continuous density profile estimates because of potential interpolation errors.

From the initial dilution modeling standpoint, the density profiles selected for modeling have to be inherently stable; at least for the RSB model which does not consider unstable conditions (less dense ambient water underlying a denser layer) .The density profiles shown in Table III.A.1-1of the previous permit application, therefore, were checked to insure stability.

Flow Rate. The TSD (Amended Section 301(h) Technical Support Document) recommends the initial dilution calculation be based upon the predicted two to three-hour peak flow for the new end-of-permit year. Projected and current (1993) three-hour peak flows are shown in Table III.A.1-2 of the previous permit application. The total flow rate is projected to increase approximately four percent by the new end-of-permit year (2000).

In addition, the flow rate for the subsequent 20-year period (1995-2015) is provided for sensitivity analyses. These peak three-hour average effluent flow rates are based upon the East Mamala Bay Wastewater Facilities Plan. Note that the flow rates in Table III.A.1-2 of the previous permit application are projected and there are limitations at the present in terms of the collection system. The East Mamala Bay Wastewater Facilities Plan (pages 5-64 and 5-65) discusses these limitations.

Diffuser Port Information. There are five different port diameters in the Sand Island WWTP diffuser. Diameters were obtained from the diffuser schedule shown on Sheet 7, Plan and Profile (1972 construction drawings). The majority of the port diameters range in size between 3.0 to 3.53 inches (0.076 to 0.090 meters). There are two 7.0 inch (0.178 meters) diameter ports in the end structure flap gate. These ports are approximately 3.4 feet (1.036 meters) apart, at the outer surface of the flap gate. The main diffuser ports are spaced 7.315 meters apart.

For the purposes of the initial dilution modeling, half this distance (3.658 meters) is used for port spacing due to configuration assumptions inherent to the models as shown in the PLUMES user manual tutorial based on the Sand Island diffuser. The UM model assumes ports on one side of the diffuser, and the RSB model interfaced with PLUMES has been adapted for this consideration even though the original RSB model and experiments considered cross flow configurations.

Additional information concerning the diffuser used to develop the initial dilution estimates can be found in Section II.A.8.

There are three diffuser pipe diameters which decrease in size from the beginning of the diffuser to the end structure flap gate. As the flow rate decreases (due to the expulsion of effluent) along the diffuser, a smaller diameter is required to maintain scouring velocities in the pipe. However, the pipe size selected for initial dilution modeling has little effect upon the dilution results. The size used in the PLUMES program manual for the Sand Island tutorial example is the middle diffuser pipe section, namely 1.68 meters (66 inches), and is adopted here as representative. The port elevation variable used in the PLUMES models is one-half this pipe diameter, i.e. 0.84 meters. Note that there are two ports on opposite sides of the diffuser at equal elevations.

There are five different port segments, including the two ports at the end flap gate. The dilution modeling in the next two paragraphs shows the sensitivity of the results to the minimum and maximum port sizes as well as consideration of the end ports.

Two methods are used to compute port flows; their results are compared in Table III.A.I-4 of the previous permit application. Flow rates at each port are ~~estimated using a spreadsheet. The method was checked using the computer~~ program PLUMEHYD, contained in the PLUMES interface program package, and the design port flow rates (Block 1983). The spreadsheet results (XLS) are more closely correlated with the design values than the program (HYD) results.

Based upon the spreadsheet program, the flow distribution among 3.0 to 3.53 inch (0.076 to 0.090 meter) diameter ports varies approximately 30 percent from the smallest to the largest size. This variation is about the same whether one considers the 1993 flow or 2000 flow rate. The increase between 1993 to 2000 port flow rate is proportional to the total flow rate increase, namely about four percent.

Note that the large 0.178-meter (7.0-inch) port flow is approximately three to four times the range in flow rates for the smaller 0.090-meter ports. However, the smaller 0.076-meter ports are estimated to have approximately the same magnitude of flow.

2. What are the dimensions of the zone of initial dilution for your modified discharge(s)?

<u>RESPONSE</u>:

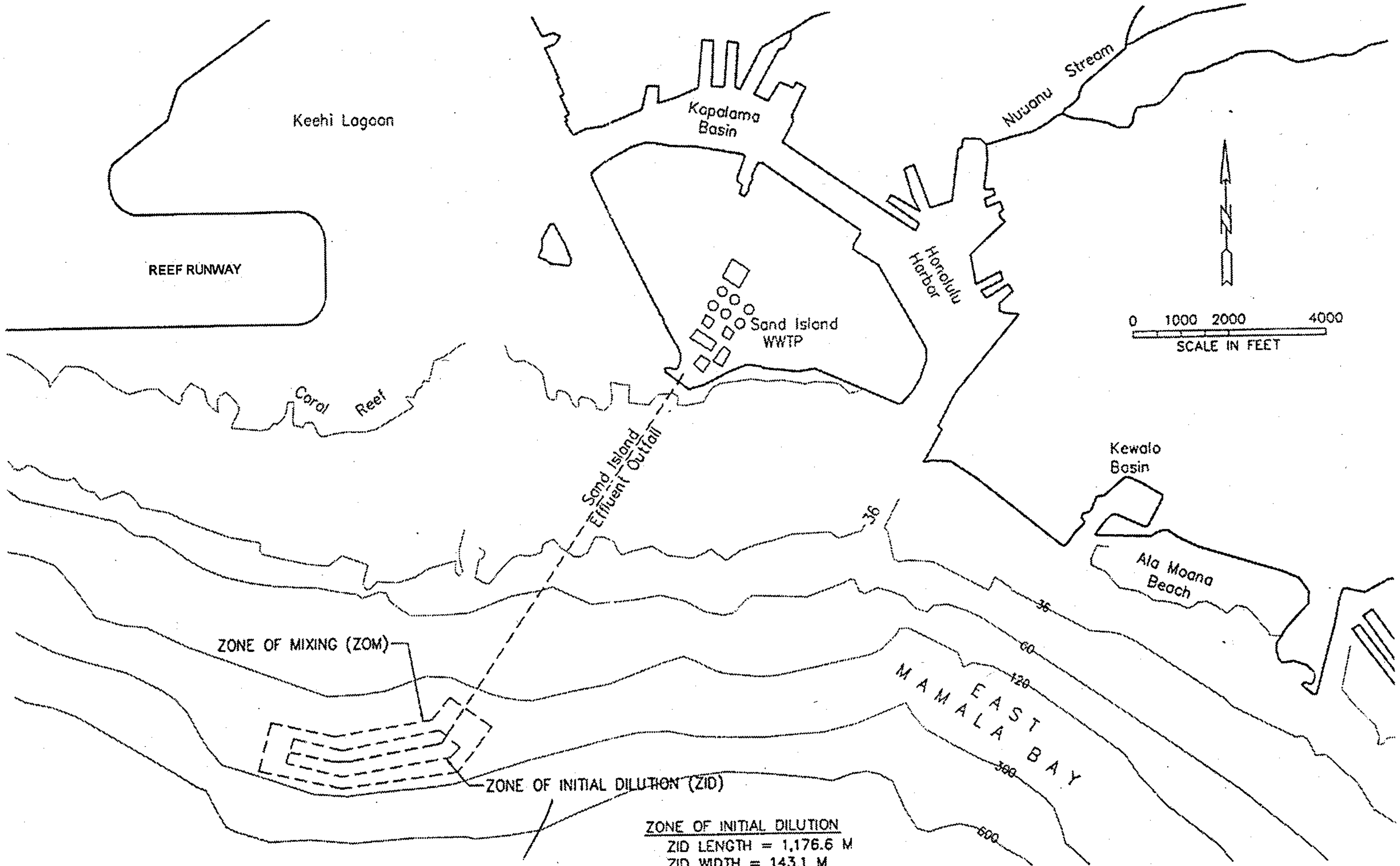
40 CFR 125.58(dd) defines the zone of initial dilution (ZID) as the region of initial mixing surrounding or adjacent to the end of the outfall pipe or diffuser ports, provided that the ZID may not be larger than allowed by mixing zone restrictions in applicable water quality standards.

In the existing permit, a zone of initial dilution (ZID) or a zone of mixing (ZOM) was not defined. Despite this, we submit the following information.

The dimensions of the zone of initial dilution (ZID) are based on the water depth of the diffuser. Relative to mean lower low water, this depth is estimated to be 69.8 meters to the port. The ZID dimensions are equal to an area that circumscribes a horizontal distance on each side of the diffuser approximately equal to this depth. The horizontal distance is seventy-one (71) meters, which is approximately equal to the depth (70 meters), plus the diffuser diameter (1.22 meters at the end).

The ZID dimensions are 143.1 m (469.5 ft) wide and 1,176.6 m (3,860.2 ft) along the centerline of the diffuser.

The Zone of Mixing (ZOM) for the Sand Island Wastewater Treatment Plant was granted by the Department of Health, State of Hawaii (hereinafter HI DOH) with the concurrence of EPA Region 9 in the permit prior to 1994. The ZOM area was 427 m (1,400 ft) wide and 1,463 m (4,800 ft) along the centerline of the diffuser, and extends vertically downward to the ocean floor. The center of the ZOM, as well as the ZID, is at Latitude 21°16'58" N, Longitude 157°54'21" W, with the major axis located on an azimuth of 80°01'40" from the south." See Figure III.A.2-1



NOTE: BATHYMETRIC CONTOURS IN FEET

SOURCE: REFERENCE III.A(1)

ZONE OF INITIAL DILUTION
ZID LENGTH = 1,176.6 M
ZID WIDTH = 143.1 M

ZONE OF MIXING
ZOM LENGTH = 1,463 M
ZOM WIDTH = 427 M

DIFFUSER
LENGTH = 1,034 M

FIGURE III.A.2-1
SAND ISLAND OUTFALL
ZONE OF INITIAL DILUTION
AND ZONE OF MIXING

3. What are the effects of ambient currents and stratification on dispersion and transport of the discharge plume/wastefield?

RESPONSE:
A detailed discussion of ocean currents and stratification was presented in Section II.B.4. We do not believe the existing currents and stratification of the water column has a deleterious effect. Although the currents, because of its cyclic tendency, may transport the plume to offshore regions of recreational waters, we do not believe the transport poses a public health risk; see Appendix E. As mentioned in the Mamala Bay Study, as well as previous submittals, a stratified water column, keeps the plume away from recreational waters. For those events when the plume surfaces, the dilution is great, roughly in the range of thousands.

4. Will there be significant sedimentation of suspended solids in the vicinity of the modified discharge?

RESPONSE:
Previous modeling done in 1983 and 1994 looked at conservative estimates of deposition of solids and found that solids deposition was negligible.

In 1998, EPA recalculated the sediment accumulation predictions using current meter data from the first 31 days of 1991 at the outfall diffuser monitoring station. The average upcoast, downcoast, onshore and offshore current speeds input into the model were determined to be 15.0 cm/sec, 14.1 cm/sec, 4.9 cm/sec, and 4.3 cm/sec, respectively.

The effluent TSS accumulations on the seafloor were predicted using the method provided in the ATSD and an average bottom slope of 0.072 m/m (0.24 ft/ft) in the vicinity of the diffuser.

The annual average accumulations used a predicted annual average plume height of rise of 34.3 m (112.5 ft) and the predicted year-2000 annual average effluent TSS mass emission rate of 18,249 kg/day. The critical 90-day period, characterized as the period having the lowest average plume height of rise, was determined to be May (assumed to be the average of April and June) through July. This critical 90-day average plume height of rise was predicted to be 21.2 m (69.6 ft). The critical 90-day average effluent TSS mass emissions rate is assumed to be the annual average rate.

For the steady state case, the maximum annual average total deposition rate was calculated to be 165 g/m2/yr, with a maximum annual average organic deposition rate of less than 132 g/m2/yr, over an area of 0.68 km2. Using these deposition rates, the maximum annual average steady state organic accumulation was calculated to be 36 g/m2/yr over the same area.

For the critical 90-day case, the critical 90-day total deposition rate that was recalculated from the above inputs was 433 $g/m^2/yr$, with a maximum organic deposition rate of 346 g/m2/yr, over an area of 0.26 km^2. Using these deposition rates, the maximum critical 90-day organic accumulation was calculated to be 56 g/m^2 over the same area.

The TSS concentration rates, calculated above, are for the settleable solids fraction of the effluent. Solids transported out of the outfall vicinity were assumed to be colloidal and expected to remain suspended in the water column indefinitely or, as the applicant suggested, until oxidized by microorganisms. Also, solids deposited within the areas may have been resuspended and transported out of the area. In any case, the accumulation of settled solids decreased gradually to zero outside the above calculated areas.

Organic Accumulation in Sediments

Sediment monitoring studies have been conducted annually, consistent with the terms of the 301(h) permit since 1990. These studies have consistently found that there were no elevated sediment concentrations of silt-clay content, total organic carbon (TOC), total Kjeldahl nitrogen (TKN), or reduced oxygen-reduction potential (redox). Thus, there is no evidence of accumulation of organics in sediments and no sign that deposition is occurring.

5. Sedimentation of suspended solids

a. What fraction of the modified discharge's suspended solids will accumulate within the vicinity of the modified discharge?

b. What are the calculated area(s) and rate(s) of sediment accumulation within the vicinity of the modified discharge(s) (g/m2/yr)?

c. What is the fate of settleable solids transported beyond the calculated sediment accumulation area?

RESPONSE:

See Section III.A.5 that indicates no appreciable accumulation has been measured since the 1990s.

B. Compliance with Applicable Water Quality Standards and CWA §304(a)(1) water quality criteria [125.61(b) and 125.62(a)]

1. What is the concentration of dissolved oxygen immediately following initial dilution for the period(s) of maximum stratification and any other critical period(s) of discharge volume/composition, water quality, biological seasons, or oceanographic conditions?

RESPONSE:

The dissolved oxygen concentration (Amended section 301(h) technical support document) following initial dilution can be predicted using the following equation:

$$DO_f = DO_a + \frac{DO_e - IDOD - DO_a}{S_a}$$

where:

DO_f = final dissolved oxygen concentration of receiving water at plume trapping level (mg/L)
DO_a = ambient dissolved oxygen concentration (5.57 mg/L), assumed at the trapping depth
DO_e = dissolved oxygen of effluent (0.0 mg/1)
IDOD = immediate dissolved oxygen demand (1.1 mg/1)
Sa = predicted initial dilution (150:1)

The predicted initial dilution values are presented in Section III.A.1. Table HI. A. 1-16 compares the results of current dilution modeling with prior model results. Based on this data, the recommended minimum (or critical) initial dilution is 150:1 under maximum stratification conditions.

After sorting the DO database from 1998 to 2002 for reference stations (B1, B6 for 1998, and D1, D4, E1, and E4 for 1999 through 2002), the lowest DO concentration found is 5.57 mg/L from Station E2 sampled on August 3, 1999 at the 54 meter depth.

The immediate dissolved oxygen demand (IDOD) was taken from the prior 1983 Waiver Application, since no additional testing was conducted.

The effluent dissolved oxygen concentration was assumed to be zero, since this represents the worst-case situation. Effluent sample analysis of dissolved oxygen concentration in July 1994 justifies use of zero oxygen concentration. Two samples had mean DO concentrations of 0.22 mg/1 at 26.0°C temperature and 0.05 mg/1 at 26.9°C temperature. Therefore, some instances near zero DO concentration have been measured.

Given these values the calculated final dissolved oxygen concentration of receiving water at plume trapping level is 5.53 mg/L DO concentration. This calculated final DO concentration represents the worst case situation based on the minimum ambient dissolved oxygen level recorded over a five year period.

State DOH dissolved oxygen water quality criteria requires the concentration be not less than 75 percent of saturation. Dissolved oxygen saturation concentration for ocean water depends on temperature and salinity of the water. Average winter (at maximum stratification) water temperature at offshore locations is approximately 24.5° C. and average winter salinity is approximately 35 parts per thousand (35,000 ppm). The saturated concentration of oxygen under these conditions is 6.81 mg/1; seventy-five percent (75%) of the saturated concentration is 5.11 mg/1.

The calculated DO concentration is in compliance with State Water Quality Criteria, i.e., 5.53 mg/L exceeds the 5.11 mg/L minimum standard.

2. What is the farfield dissolved oxygen depression and resulting concentration due to BOD exertion of the wastefield during the period(s) of maximum stratification and any other critical period(s)?

RESPONSE:

The model used to predict farfield dissolved oxygen depletion is given in the guidance document (Amended section 301(h) technical support document) as:

$$DO(t) = DO_a + \frac{DO_f - DO_a}{D_s} - \frac{L_{fc}}{D_s}(1 - \exp(-k_c t)) - \frac{L_{fn}}{D_s}(1 - \exp(k_n t))$$

Where

DO(t) = dissolved oxygen concentration in a submerged wastefield as a function of travel time, t, mg/L

DO_a = ambient dissolved oxygen concentration, mg/L

DO_f = dissolved oxygen concentration at the completion of initial dilution, mg/L

k_c = CBOD decay rate constant k_n = NBOD decay rate constant

L_{fc} = ultimate CBOD concentration above ambient at completion of initial dilution, mg/L

L_{fn} = NBOD concentration above ambient at completion of initial dilution, mg/L

D_s = dilution attained subsequent to initial dilution as a function of travel time

The equation represents the following:

Dissolved Oxygen at Any Time	=	Ambient Dissolved Oxygen	-	Initial DO Deficit	-	DO Depletion Due To Carbonaceous BOD Demand	-	DO Depletion Due To Nitrogenous Demand

The values for each component are discussed below:

Dissolved Oxygen Deficit

The values of minimum ambient dissolved oxygen (DO_a = 5.57 mg/L), and final dissolved oxygen (DO_f = 5.53 mg/L), are discussed in the previous Section III.B.1. The initial dissolved oxygen deficit is relatively small because the initial dissolved oxygen demand (IDOD) is only 1.1 mg/1.

Dissolved Oxygen Depletion

Dissolved oxygen depletion, with time, is the result of both carbonaceous (CBOD) and nitrogenous (NBOD) components. Carbonaceous Biochemical Oxygen Demand has the greatest impact on DO because the reactions are relatively rapid and carbonaceous bacteria are plentiful. CBOD is often reported as BOD_5, or the 5-day BOD.

Since the outfall is located in open coastal water, the oxygen demand due to nitrifying bacteria should be negligible, since there are few nitrifying bacteria available. Therefore, for this analysis, the NBOD components (e.g., L_{fn}) will be assumed to be zero.

Final BOD_5 concentration in the receiving water, following initial dilution can be calculated by the equation:

$$BOD_f = BOD_a + (BOD_C - BOD_a)/S_a$$

Where:

BOD_f = final BOD_5 concentration (mg/L) = L_{fc}

BOD_a =ambient BOD_5 concentration (mg/L)

BOD_e =effluent BOD_5 concentration (mg/L)

S_a = initial dilution (flux-averaged)

The monthly effluent values are summarized in TableS II.A.3a1, II.A.3a2, II.A.3a3, II.A.3a4, and II.A.3a5. In order to account for the worst-case condition, the highest monthly value of effluent BOD_C = 118 mg/L (May 1998) will be utilized. It is noted that this current effluent BOD value is substantially less than the value used in the 1983 Reapplication, which was 432 mg/L. This is attributed to the substantial reduction in both influent and effluent BOD caused by the shutdowns that have occurred in the pineapple canning industry.

As discussed in Section III.A.I, the "critical" case initial dilution (S_a) is projected to be 150:1. The ambient BOD_5 concentration (BOD_a) is generally very low in ocean waters, thus was assumed as 0 mg/l for these calculations. Final BOD_5 concentration, following initial dilution, BOD_f, is projected to be 0.79 mg/L.

This five day value can be converted to the ultimate BOD by multiplying by a factor of 1.46 (Amended section 301(h) technical support document). Thus, L_{fc} = 1.46 x 0.79 = 1.15 mg/L.

The decay rate (K_c for CBOD recommended by the Revised Section 301(h) Technical Support Document is 0.23/day (base e) at 20° C. Corrections for the Sand Island receiving winter ambient water temperature of 24.5° C require that K_c, be adjusted to equal 0.28/day.

Dilution as a Function of Travel Time

Dilution (D_s attained subsequent to initial dilution is a function of the plume travel time (t) and the lateral diffusion. For open coastal areas, dilution can be predicted using the 4/3 Law, which states that the lateral diffusion coefficient increases as the 4/3 power of the wastefield width. This is the coefficient used in the 1983 Reapplication.

The guidance document (Revised Section 301(h) Technical Support Document) states that the 4/3 lateral diffusion coefficient may not be appropriate if the entrainment rate of dilution water is restricted by the proximity of the shore or ocean bottom. While this is not likely to be the case at the Sand Island outfall, a lateral diffusion coefficient of n = 1.0 has been used in subsequent calculations, in order to be conservative.

The farfield dilution (D_s) was obtained from Figure B-5 of the guidance document). The initial field width (b) utilized was 5,000 feet.

Farfield Dissolved Oxygen Depletion

The farfield DO depletion calculations are shown on Table III.B-2.
As indicated in the previous reapplication, the maximum DO depletion and deficit is 0.106 mg/1, which occurs 60 hours following initial dilution. The minimum DO concentration is 5.42 mg/L.

The farfield dissolved oxygen concentration complies with State Water Quality Standards, which require a minimum winter DO of 5.11 mg/L, as discussed in Section III.B.1.

Table III.B.2
FARFIELD DISSOLVED OXYGEN DEPRESSION

Time, t			Farfield Dilution		Initial DO Deficit	Dissolved Oxygen Depletion		Tot DO Depletion and Deficit	Tot Projected DO(t)
HRS	Day	Sec	$12e_0t/b^2$ (t=sec)	D_s (n=1)	$\frac{DO_f-Do_a}{D_s}$	$1-e^{(-.28t)}$ (t = days)	x L_{fc}/D_s	DO_d	Do_a-DO_d
0	0	0	0	1.0	0.040	0.000	0.000	0.040	5.53
1	0.042	3,600	0.145	1.0	0.040	0.012	0.014	0.054	5.48
2	0.083	7,200	0.296	1.2	0.033	0.023	0.022	0.055	5.48
4	0.167	14,400	0.591	1.4	0.029	0.046	0.039	0.067	5.46
8	0.333	28,800	1.182	1.6	0.025	0.089	0.064	0.089	5.44
12	0.500	43,200	1.773	1.9	0.021	0.131	0.079	0.100	5.43
16	0.667	57,600	2.364	2.3	0.017	0.170	0.085	0.102	5.43
24	1.00	86,400	3.546	3.2	0.013	0.244	0.089	0.101	5.43
32	1.33	115,200	4.723	4.0	0.010	0.311	0.089	0.099	5.43
48	2.00	172,800	7.092	5.8	0.007	0.429	0.085	0.092	5.44
60	2.50	216,000	8.865	7.0	0.006	0.503	0.100	**0.106**	**5.42**

3. What are the dissolved oxygen depressions and resulting concentrations near the bottom due to steady sediment demand and resuspension of sediments?

RESPONSE:
We do not anticipate much has changed from the earlier permit application. Given this, we present the same information provided in the previous reapplication.

In Situ Oxygen Demand Measurements

Estimates of benthic oxygen demand based on in-situ measurements by Dollar (Dollar 1986). Average dissolved oxygen flux in 1984 was estimated to range between 2.0 to 20 mmol $m^{-2}day^{-1}$, and the average measurement within the zone of initial dilution was 2.4 mmol $m^{-2}day^{-1}$. This is equivalent to 76.8 mg-O_2 $m^{-2}day^{-1}$. Assuming the oxygen flux occurs within approximately one-half meter above the sediment-water interface, then the sediment oxygen demand is on the order of 0.077 mg/1 per day (76.8 mg $m^{-2}day^{-1}$ ÷ 1/2 meter of water x 1 m^3/1000 liters 0.154 mg/l/day). The selection of water depth of one meter for oxygen transfer is based on the one meter diameter of the hemispheric dome used to monitor oxygen flux in situ.

In comparison, the formula shown below is provided by the Technical Support Document (TSD) to calculate dissolved oxygen depression where measurements are unavailable:

Calculation Formula:

$$\Delta DO = \frac{\delta S K_d X_m}{86{,}400 UHD} \quad \text{III.B.3(1)}$$

Where ?DO = oxygen demand, mg/L-day
δ = stoichiometric ratio 0_2/mg sediment (1.07mg/O_2/mg sediment)
S = average concentration of organic sediments, g/m^2
K_d = sediment decay rate (0.01 day^{-1})
X_m, = length of deposition area alongshore
U = minimum sustained current over deposition area, m/sec
H = depth of water column influenced by sediment demand, m
D = dilution caused by horizontal entrainment of ambient water, dimensionless

Two solutions to this equation are obtained in the previous reapplication. One condition assumed is the steady state accumulation rate and longshore distance. For the steady-state sediment accumulation rate, the estimated oxygen demand (flux) is 0.088 mg-O_2/l (per day).

This is close to the value estimated by Dollar (Dollar 1979) at the zone of initial dilution (see above discussion). The formula provided by the TSD to estimate the depth of water column influenced by sediment O_2 demand is:

$$H = 0.08\left(\frac{eta_z X_m}{U}\right)^{0.5} \quad \text{III.B.3(2)}$$

Where eta_z = vertical diffusion coefficient, assumed 1 cm^2/sec.

This results in an H estimated at 0.67 meters. There is no reference to the depth of water over which oxygen diffusion is influenced by sediment demand in Dollar, 1986. At the sediment-water interface, Dollar estimated the diffusion gradient existed only over a relatively shallow depth (about one centimeter) below the sediment surface. Other experiments have used similar apparatus. For example, Dollar 1986 used a two meter jar to measure in-situ oxygen transfer and concluded there was an exponential trend of decreasing oxygen concentration with depth below the top of the jar.

In summary, Dollar's measurements are in close agreement with the steady-state sediment dissolved oxygen demand calculations, but the assumption concerning the water depth over which oxygen diffusion occurs is significant to establishing the order of magnitude for this comparison.

If one considers the use of equation III.B.3(1) to estimate the critical 90-day oxygen demand the result obtained is 0.27 mg-O_2/l. This value is higher than obtained in any in situ measurements.

There are two values used in equation III.A.3(1) that are not readily verifiable. These are sediment deposition rate and oxygen diffusion coefficient. These values may be sources of differences between the measured (in-situ) oxygen fluxes and calculated values.

Resuspension of Sediments

The procedure recommended in Appendix B-IV of the technical support document guidance was used to estimate oxygen demand due to resuspension of sediments as a function of time. The critical 90-day accumulation rate is used. The calculation is extended until two successive three-hour intervals have equivalent oxygen demands when rounded to the nearest thousands mg/L. This is the limit of the precision of the calculation considering there are only two significant figures in the result, and the precision of the input variables is limited to two significant figures.

The conclusion of the calculation is that the oxygen demand due to resuspension of sediments reaches a maximum value of approximately 0.05 mg-O_2/L between 36 to 40 hours.

4. What is the increase in receiving water suspended solids concentration immediately following initial dilution of the modified discharge(s)?

<u>RESPONSE</u>:
Suspended solids measurements are not taken; however, reference previous annual assessment reports, we have not violated the light extinction or turbidity requirement.

The Computation for suspended solids following initial diluation is as follows:

$$SS_f = SS_a + (SS_e - SS_a)/S_a$$

Where:

SS_f = suspended solids concentration at completion of initial dilution (mg/L);
SS_a = ambient suspended solids concentration (2.0 mg/L);

SS_e = effluent suspended solids concentration (108 mg/L, max for year 2002);
S_a = predicted initial dilution (150:1)

The peak daily effluent suspended solids for 2002 was 108 mg/L. Because suspended solids is not monitored in the receiving waters, the highest ambient suspended solids value reported in the 1983 reapplication was 2.0 mg/L and used herein. Therefore the calculated suspended solids concentration is:

$$SS_f = 2.0 + (108 - 2{,}0)/150$$
$$= 2.71$$

The calculated suspended solids concentration is 0.71 mg/L higher than ambient conditions under the worst-case situation (highest effluent suspended solids concentration). For the most stratified condition, a predicted initial dilution of 106.3:1 was determined (see Section II.B.6). Using this value the calculated suspended solids is 1.0 mg/L higher than ambient. As mentioned previously, however, we do not see any impact from previous and ongoing benthic studies.

5. What is the change in receiving water pH immediately following initial dilution of the modified discharge(s)?

<u>RESPONSE</u>:
All the CTD data, (surface to depth) as prescribed current permit monitoring program, for stations D2, D3, E2, and E3, from 1999 to 2002 were used to determine general pH statistics; see Table III.B.5.

The pH relative to the discharge can be seen from Tables III.B.5 and III.B.6, to be, on average, roughly 8.2. Table III.B.5 also shows that pH of the effluent is below the receiving water pH in the area around the outfall.

TABLE III.B.5
GENERAL STATISTICS OF THE WATER COLUMN
Stations D2, D3, E2, and E3

Statistic	pH [SU]	Effluent pH [SU]
Average Value	8.2	7.0
Sample Standard Deviation	0.06	0.1
# of data points	4,870	1,760
Maximum value	8.3	7.8
Mininum value	8	6.7

6. Does (will) the modified discharge comply with applicable water quality standards for:
--Dissolved oxygen?
--Suspended solids or surrogate standards?
--pH?

RESPONSE:

The Annual Assessment Reports submitted from 1998 to 2002 does not show an exceedance to the State Water Quality Standards for DO, LEC, Turbidity (at the ZID/ZOM), or pH. Some general statistics are given below.

All the CTD data, surface to depth, per the prescribed permitted monitoring program, from 1999 to 2002 were used to determine general statistics; see Table III.B.6.

The table shows that pH is relatively constant throughout the monitoring area. The other parameters also show that the water column is relatively similar, except for temperature, which we attribute to the movement of the thermocline.

TABLE III.B.6
GENERAL STATISTICS OF THE WATER COLUMN

Statistic	pH [SU]	Salinity [ppt]	Sigma-T [°C]	DO [mg/L]
Average	8.2	35.078	23.5	6.3
Sample Standard Deviation	0.06	0.15	0.4	0.2
# of data points	15,419	15,419	15,419	15,419
max	8.3	35.5	24.8	7.0
min	8	34.6	22.7	5.4

7. Provide data to demonstrate that all applicable State water quality standards, and all applicable water quality criteria established under Section 304(a)(l) of the Clean Water Act for which there are no directly corresponding numerical applicable water quality standards approved by EPA, are met at and beyond the boundary of the ZID under critical environmental and treatment plant conditions in the waters surrounding or adjacent to the point at which your effluent is discharged. [40 CFR 125.62(a)(l)]

RESPONSE:

In accordance with 40 CFR 125.69(b)(2), a letter has been sent to the Hawaii Department of Health, requesting that they provide certification that the proposed improved discharge will comply with all applicable Hawaii water quality standards. A copy of the letter is presented in Appendix L.

8. Provide the determination required by 40 CFR 125.61(b)(2) for compliance with all applicable provisions of State law, including water quality standards or, if the

determination has not yet been received, a copy of a letter to the appropriate agency(s) requesting the required determination.

RESPONSE:

Refer to Section III.B and Appendix L.

C. Impact on Public Water Supply [40 CFR 125.62(b)]

1. Is there a planned or existing public water supply (desalinization facility) intake in the vicinity of the current or modified discharge?

2. If yes:

a. What is the location of the intake(s) (latitude and longitude)?

b. Will the modified discharge(s) prevent the use of intake(s) for public water supply?

c. Will the modified discharge(s) cause increased treatment requirements for public water supply(s) to meet local, State, and EPA drinking water standards?

RESPONSE:

To our knowledge, there is no planned or existing public water supply (desalinization facility) intake in the vicinity of the current discharge.

D. Biological Impact of Discharge [40 CFR 125.62(c)]

1. Does (will) a balanced indigenous population of shellfish, fish, and wildlife exist:

--Immediately beyond the ZID of the current and modified discharge(s)?

--In all other areas beyond the ZID where marine life is actually or potentially affected by the current and modified discharge(s)?

RESPONSE:

Introduction

Available data from the City and County of Honolulu's marine monitoring program clearly indicate the existence of a balanced indigenous population (BIP) of shellfish, fish and wildlife immediately beyond the ZID of the existing Sand Island outfall discharge. Proposed modifications to provide ultraviolet light (UV) disinfection as needed to meet water quality standards and protect beneficial uses is not predicted to have any significant impact on marine water quality or the BIP. The City presently plans on maintaining the current level of treatment (primary) and improve existing effluent quality by expanding the wet weather treatment capacity, improving primary clarifier performance and maintaining the control of toxic pollutants through source control. As needed, targeted effort to control identified toxic pollutants, which contribute to water quality violations. This will include efforts to reduce the trace amounts of chlordane and dieldrin (a teaspoonful a day in 65 million gallons) that is entering the collection system by ~~some means and causing effluent violations of standards for the pesticides.~~ It is suspected that these historically used pesticides are entering the system from infiltration of groundwater contaminated by prior widespread use of these chemicals for termite control and general use around homes. There is no evidence that there are any environmental effects from the trace amounts being discharged. The pesticides are not found in sediments or fish muscle tissue and other data support a lack of impacts (amphipod abundance, species diversity, etc.). Efforts will continue to evaluate long-term trends, but it is evident from the widespread nature of the chemicals in local watersheds (as documented by studies by the U. S. Geological Survey) that controlling such trace amounts by any means will be impossible or beyond any financial means. From and environmental and public health perspective they do not pose an unacceptable risk given their ubiquitous nature.

The City has been conducting water quality and benthic surveys in a consistent manner since 1986 in a program designed to conform to guidelines established for the 301(h) Marine Monitoring Program. The only thing that has changed is the station location, which was modified in 1998 to look at a wider region and varying depths. The same sampling methods, taxonomic experts and reporting has been in consistent use. Chemical laboratories used to support the program have changed over time, and this contributes to some variability in the long-term annual sediment quality data. Recently, the data collected has been much more consistent with dramatically lower PQL's (detection limits) for the priority pollutants. From all the evidence at hand it is clear that biological conditions have not "changed" as a result of the Sand Island effluent discharge over the life of the 301(h) permits received in 1990 and 1998. Based on the state of knowledge gained by the work of the contract scientists of the University of Hawaii and the City's own ocean monitoring team, the changes which are measured appear to those associated with either natural forces (including Hurricane Iniki in 1992) or analytical methods for some sediment parameters (better able to detect very low levels of trace constituents).

All biological studies have demonstrated that there are no adverse impacts from the discharge, there should be no question on a favorable decision on the current re-application based on impacts to biological resources.

The evidence for the lack of demonstrated changes in the biological community rests on the consistent database of wastewater and sediment quality, fish and invertebrate samples collected since the early 1990's through 1998. With the new permit issuance in 1998, the coral reef and nearshore assessments and outfall fish observations using a remotely operated video camera were discontinued. Since that time, the infaunal replicate sampling has been reduced and the number of stations near the outfall has been reduced, making the nature of any localized changes more difficult to detect if they should occur.

This application uses this data to explore the relationships(s) between waste ~~discharge and environmental effects, and to provide appropriately responsive~~ answers to this questionnaire - we found that even a program specifically tailored to a 301(h) waiver permit could not answer them all. Many outstanding questions raised about past wastewater discharge practices and the current primary treatment systems were addressed in the $10 million comprehensive study of Mamala Bay that was directed by the independent Mamala Bay Commission. Funds for this study (completed in 1996) were provided by the City through a settlement agreement on two court cases regarding wastewater discharge violations from the Sand Island and Honouliuli treatment plants which occurred in the early 1990's. While technical violations still occur for some permit conditions receiving water ammonium and effluent limits for chlordane and dieldrin), these have not posed a threat to water quality or the biological community based on biological parameters (i.e. plankton growth as measured by chlorophyll a or bioaccumulation of the two pesticides).

One of the more important concepts of 301(h) is that potentially effected waters shall not differ substantially from control localities which are (ostensibly) unaffected by the discharge in question. This can be a difficult task both conceptually and logistically (routine monitoring at reference sites can be costly and finding suitable sites is difficult). The recent permit included changes with regard to fish bioaccumulation studies with the selection of reference sites in Maunalua Bay.

Some important points in this evaluation of existing data are:

1) There is a great deal of natural variability compared to the mean value for the entire set;
2) There were few differences between old ZOM, ZOM-boundary, and control;
3) Biological differences noted at the new monitoring stations designated in the 1998 permit appear to be depth related; and
4) There are even greater differences between years that appear to be unrelated to wastewater discharge.

More recently the variability differences were further complicated by the changes in depth between the monitoring stations. All of the analyses indicate the need for a better understanding of natural variability and directed change, both long- and short-term. Efforts are being made to better understand the changes that occur on a more regional scale through the use of the regional monitoring element incorporated into the 1998 permit monitoring program, which will be initiated for a second time in August of 2003.

Monitoring of the sand bottom animal communities near the Sand Island ocean outfall and at reference stations at greater distances from the outfall have been carried out in 1986, 1990 through 1998 and from 1999 through 2002 under a new program which includes core and regional monitoring at different stations than historically used. The benthic monitoring program was designed to evaluate whether any changes in the benthic community may be occurring as a result of their proximity to the outfall diffuser. Physical-chemical measurements of the sediments together with consistent use of measures to quantitatively description the benthic organisms have been carried annually since 1986 to evaluate outfall impacts. The results are reported in annual benthic sampling reports prepared by Nelson and others at the University of Hawaii (Nelson, et. al. 1987, 1991, 1992,1993,1994,1995, 1996, 1997, 1998 and Swartz et. al., 2000, 2001, and 2003).

Sediment Analyses

Physical characteristics relating to sediments in the vicinity of the Sand Island outfall have been described in Appendix G and detailed in Attachment G-1 of Appendix G and in the annual benthic reports (Swartz, et. al. 2003).

Physical-chemical measurements include sediment grain size, oxidation-reduction potential of the sediments (an indicator or oxygen availability), total organic carbon, and acid volatile sulfides (AVS). There has been no indication of noteworthy changes in any of these parameters over the study period. There has been no indication of an accumulation of organic matter resulting from wastewater effluent at the stations near the diffuser.

Monitoring program measurements of physical parameters made annually over the period 1998- 2002 showed no evidence of a buildup of organic matter in the vicinity of the Sand Island ocean outfall diffuser. This conclusion is confirmed by each of the physical and chemical parameters measured. These are discussed in detail in Appendix G and in Section IIC.

Grain Size

Grain size data is not as useful a parameter in the interpretation of biological data in Mamala Bay as it is in embayments or in depositional environments such as occurs on the mainland. This is based on the fact that the sediments are primarily sand with coral debris and are moving about due to the currents found near the sea floor. There has been no observed increase in the percentage of fine sediments over the years and much variability in the data, particularly now that regional sampling has been implemented. The difficulties in sampling the sediments in Mamala Bay which are not thickly deposited has been noted in the new monitoring program where station locations had to be modified to meet sampling needs and obtain a sufficient amount of material to be processed (CCH, 1999 and CCH 2000).

There was no evidence of an influence of the outfall on the percentage of fine sediments and associated deposition of organic material derived from wastewater particulates in the effluent.

Oxidation-Reduction Potential in Sediments

Mean sediment oxidation-reduction potential (ORP) values over the sampling period 1998-2002 showed no statistically significant difference among sample dates or among stations that is indicative of wastewater impact. In general, there is no evidence to suggest the present outfall is exerting an effect in the immediate vicinity of the discharge.

Total Organic Carbon Levels in Sediments

Total organic carbon values over the period 1998-2002 were all very low. There is clearly no difference in the mean between stations when looking at the long-term trends. There is no evidence to suggest the present outfall is exerting a measurable effect in the vicinity of the discharge.

Trace Metals

There has been no consistent pattern in trace metals concentrations, which can be considered to be related to the outfall discharge (See Attachment G-1 of Appendix G). Concentrations have varied over time by as much as an order of magnitude for some metals and there is no consistency in the patterns found. Generally, the levels are all consistent within any single sampling period with the order of magnitude difference being between sampling years. Overall, given the low concentrations of trace metals found in the effluent, it does not appear that the outfall is contributing to sediment accumulation of metals. Concentrations have not increased over time and none of the ZOM or core stations has exceeded sediment quality guidelines used in the U.S. for screening for possible biological effects on sensitive epibenthic invertebrates (amphipods)(see Table G-1-13)(SQL developed by Long and Morgan, 1995)

Benthic Infauna

The benthic infauna is discussed at length in Appendix G and supporting attachments. Provided here is a summary of some general features of the long-term database. The annual monitoring reports are also useful sources of statistical information and multivariate analysis. The results and discussion sections from these reports are presented in Attachment G-1. Note that with the issuance of the 1998 permit, the stations changed from those along a relatively constant depth (60-70 meters) to stations covering a much wider depth range (20-100 meters).

The spatial patterns of infaunal abundance and species richness in relation to the outfall have varied depending on the taxonomic grouping. No pattern of reduction of either abundance or species richness at stations near the diffuser was observed for total non-mollusks, crustaceans, or mollusks in over time.

The original 1986 outfall study (Nelson et al., 1987) and its conclusions formed the basis for the BIP determination for the granting of the original 301(h) modified

NPDES permit. Independent review by EPA's contractor (Tetra Tech, 1987) confirmed that the evidence for a lack of effect on the benthic community by the diffuser effluent was compelling. Nelson, et al (for each annual survey) conducts cluster analyses of non-mollusk data which indicates that for most years surveyed, all of the seven stations sampled stations are relatively similar to one another in terms of species composition and relative abundance (Nelson et al., 1987, 1990 through 1998).

There has been a large amount of data collected over a number of years, which support the finding that a BIP exists near the Sand Island outfall and within and beyond the zone of initial dilution. Rather than present these in the text of this questionnaire, they have been summarized in Appendix G and in the Annual Assessment Reports and the U. S. Environmental Protection Agency's ODES database.

Species Diversity and Evenness

Species diversity (H') and evenness (J) were relatively similar among all stations for both total non-mollusks and for mollusks. The Pearson and Rosenberg model (1978) of benthic organic enrichment states that in the transition zone on an organic enrichment gradient, a few species will increase and be extremely dominant, while overall diversity and evenness are low. For example, Swartz et al. (1986) showed that the polychaete Capitella spp. made up 85% of abundance of the benthic community at a station within 1 km of sewage outfalls off Los Angeles, 56.2% of the community at 3 km from the outfalls, and only 0.6% of abundance at 5 km distance. Over the years, the range of values for capitellid polychaetes has ranged from 0.6-2.2% (data summarized from Swartz, et. al. 2001) of total abundance for the stations in the vicinity of the Sand Island outfall). There is no indication of a strong increase in capitellid dominance at stations near the outfall.

The Tetra Tech technical review reports of 1987 and 1995 both concluded that there was no evidence of an increase in the proportional representation of these species at stations near the ZID (ZOM). The Annual Benthic Monitoring Reports evaluate the presence of pollution tolerant species each year, and there continues to be no evidence of an increase in pollution tolerant species at stations near the Sand Island ZID (ZOM).

Benthic communities adjacent to the Sand Island ocean outfall have been studied with similar methodologies since 1986 by the same taxonomists and statisticians. Conclusions from these benthic studies at the Sand Island ocean outfall show no strong response patterns of benthic infauna.

~~Neither the response patterns of neither the benthos nor the physical sediment~~ data would support the hypothesis that organic enrichment is occurring in the vicinity of the Sand Island ocean outfall. Composition of the benthic community within the ZID (ZOM), on the boundary of the ZID (ZOM) and at reference stations from 3.7 to 3.8 km from the diffuser, while displaying year to year variation, have remained generally similar to one another throughout the seven year period studied prior to the 1998 change in sampling stations.

According to Nelson, 1993 “Analysis of benthic communities has shown that the abundance, the number of species, the diversity of species, the evenness of individuals distributed among species in the community, and the species composition of the benthic community have no pattern of change which could be attributed to an influence of effluent from the diffuser.” Studies done since that time have confirmed the trends noted through 1995.

The monitoring data over the period 1986-2002 indicate that a "balanced, indigenous population" of benthic organisms has been maintained even at stations immediately adjacent to the Sand Island ocean outfall diffuser (Swartz, et. al. 2003).

One can concluded from all the data collected that on characterizing the benthic community and physical-chemical characteristics of the sediments support the fact that a "balanced, indigenous population" (BIP) of sand bottom dwelling organisms is being maintained near the Sand Island ocean outfall

Fish and Macroinvertebrate Populations

Available qualitative data on populations of fish and macroinvertebrates in the vicinity of the existing CCH's' Sand Island outfall indicate the presence of a balanced indigenous population (BIP). There is some indication that abundance of certain species differ in the immediate vicinity of the outfall (which serves as an artificial reef and enhanced area of potential prey species) (see Appendix G) but this is not felt to represent a major community imbalance. Patchy distributions, low abundances, and transitory nature of most of the fish species present can result in variable observations and it is thus difficult to attribute differences among stations to outfall-related impacts. In general, the species composition and abundances in the vicinity of the outfall are characteristic of animal assemblages found in similar bottom or coral reef environments of Mamala Bay. Fish observed or caught and examined microscopically (histopathology studies) have been found to have no signs of disease that is associated with polluted conditions (i.e. tumors, fin erosion, etc.).

Based on the lack of evidence of any adverse impacts on the fish and macroinvertebrate populations in the vicinity of the Sand Island outfall, it is expected that a balanced indigenous population of these organisms will exist immediately beyond the ZID and in all other potentially impacted areas beyond the ZID in the future if wastewater quality remains similar to present quality.

Status of Fisheries

There are two basic fisheries, the nearshore coral reef fisheries, and the pelagic or offshore fisheries. The offshore fishery is dependent upon use of long lines and range far offshore (up to 1500 miles) and is focused on the valuable pelagic species such as tuna. The nearshore fishery (excluding the Northwest Hawaiian Islands lobster fishery) was worth just 4 percent of the pelagic catch (Dollar, 1993). Catch records are maintained by the State for all licensed commercial fishermen who much report their catches monthly.

Marine recreational fishermen are not licensed and catch records are not available. The commercial catch record near the Sand Island outfall are recorded as one of a fishing block (No 400) which is one of many such statistical areas around Oahu

Brock (1993) did an analysis of commercial fisheries for the periods 1971-72, 1981-82 and 1991-92 for statistical square 400 representing the pre-outfall, newly initiated outfall discharge, and the latest operating conditions. This analysis was updated to include a comparison with 2001-02. This analysis showed that:

1) The catches made in this square are trivial relative to those statewide accounting for from 0.3 to 0.8 percent of the totals for the state.

2) The annual catch was very low in terms of productivity with an annual catch of 0.7g/m2
were similar in 1971 and 1991 and has declined somewhat since that time indicating that this area was not significant state fishing waters.

3) Changes noted in the fishery are not significant and the variation and is probably related to the effort expended and reported and restriction on fishing by fisheries management agencies rather than from changes in abundance in species.

4) There are no significant shellfish resources harvested in the area since they are not present.

The commercial fisheries data suggest that the inshore fisheries in the vicinity of the Sand Island discharge have not been significantly changed over time other than a general decline observed Island wide that is unrelated to wastewater discharge practices. Historical studies of the nearshore areas off Sand Island completed as part of the past outfall monitoring program are presented in Appendix G, Attachment G-4.and described in the following section.

Coral Reef Monitoring Results

The City has in the past contracted with the University of Hawaii to conduct a shallow-water survey of the community structure of fish and macrobenthos at three study sites in water depths ranging from 37 to 5 feet deep inshore of the outfall terminus at distances ranging from 1.6 kilometers to 2.9 kilometers from the terminus of the outfall. More details on the locations and methods involved are contained in Appendix G and in the 1998 final Project Report (Brock, 1998).

The three study sites were sited to capitalize on presumed gradients of impact from wastewater effluent moving toward the shore and the coral reef communities. Data from the surveys has shown that scour and wave impacts are some of the largest influences on the benthic communities. A comparison of the data from the surveys indicated that no statistically significant change was detected at the permanent survey stations, despite the imposition of a major hurricane on the marine communities in September 1992. Also, the data was not sufficient to determine if the operation of the Sand Island deep ocean outfall was having a quantifiable impact on the coral reef resources inshore of the discharge (Brock 1998). These studies were discontinued because of the lack of quantifiable differences and lack of evidence to justify continued time and effort to study these areas.

Plankton

Evaluation of the existence of a balanced indigenous population of plankton in the vicinity of the CCH's existing discharge is limited by insufficient data. However, there is no evidence to suggest adverse impacts to either phytoplankton or zooplankton populations resulting from the effluent based on field observations. Chlorophyll a concentrations in the vicinity of the outfall have been measured and the data from these and the accompanying nutrient analyses reviewed by Dr. Stephen Laws (Laws, 1993) who concluded that there was no outfall influent on phytoplankton growth that was significant. Some nutrient enrichment is noted, but the input is small compared to other sources in the region such as outflow from Pearl Harbor. Zooplankton data were collected in Mamala Bay and in a remote area many years ago (AECOS, 1981) and these studies were inconclusive with regard the influence of wastewater discharges on plankton populations.

The overwhelming influence of large-scale climatic and other physical and biological factors on plankton populations makes the possibility of significant adverse effects from wastewater discharge unlikely. Initial dilution of the effluent and flushing characteristics of the area result in relatively minor changes in water quality conditions (mainly nutrient inputs) that may affect plankton populations. The effects of seasonal changes, nutrient availability, light levels and water column stability as well as plankton life cycle characteristics and biological interactions are of such magnitude that localized nutrient or low-level toxic inputs are insignificant to plankton populations. High variability in populations of both phytoplankton and zooplankton in response to natural phenomena indicate localized impacts resulting from wastewater discharge through the CCH's Sand Island outfall would be unlikely to effect significant changes on plankton populations.

A new open water aquaculture operation located off Ewa Beach may be a source of local nutrient enrichment that could foster plankton growth (Cȧtus International, Inc., 2000). Water quality monitoring is being conducted by the leasee to determine if water quality standards are being met.

Bioaccumulation of Toxic Materials

Toxic pollutants contained in the present and expected levels in the improved Sand Island effluent discharge do not and should not adversely impact the balanced indigenous population through either acute or chronically toxic effects or be bioaccumulated to levels which might adversely affect food webs or human health. The Annual Assessment Reports for the Sand Island WWTP contain assessments of the risk from consumption of fish caught at the outfall and reference areas remote from any potential man-induced contamination of the marine environment. Results show that there are naturally high arsenic levels in fish, but they are not at levels that pose any undue health risks to humans consuming normal quantities of fish in their diet.

Effluent Toxicity

Effluent toxicity is measured using various techniques to assess chronic toxicity. Both *Ceriodaphnia dubia* and Hawaiian marine species (various urchins) are used to assess toxicity. The results of these whole effluent toxicity tests show that the sea urchin tests are difficult to conduct for a variety of reasons including inability to collect, unacceptable control performance and insufficient gametes to perform the test.

There are no high levels of toxicants or measured toxicity from a regulatory perspective. The sea urchin testing showed elevated toxicity for 11 or the past 12 months, but this sensitive test organism is not used for determining permit compliance

This renewal application presents the results of both dry and wet weather priority pollutant analyses of effluent as required, but it must be recognized that there can be a seasonal difference in flow (but not toxicants) to the Sand Island WWTP. Peak flows have generally occurred in the months of January through March. These priority pollutant analyses have consistently shown that there are very few toxic pollutants present in the effluent with the notable exception of some pesticides suspected of entering the collection system from infiltration/inflow. To date, analyses have shown the presence of several toxic organic compounds, trace metals, and pesticides all at very low concentrations except for chlordane and dieldrin. All the toxicants detectable showed that levels were well below those levels needed to be in compliance with State of Hawaii water quality standards with the exception of the two pesticides. Detailed explanation of the potential sources and actions being taken to bring about compliance are presented the sections on toxic pollutant control and treatment strategy.

Chronically Toxic Effects

To assess whether the discharge of potentially toxic compounds will impact the balanced indigenous population immediately beyond the ZID, an evaluation of expected water quality conditions was performed using the maximum effluent concentration of toxic materials measured in the CCH's' final effluent. Based on such a dilution, it is expected that the discharge will comply with all water quality standards except for chlordane and dieldrin.

Ambient water quality standards for ammonia nitrogen are at times exceeded in Mamala Bay, even at stations remote from the Sand Island discharge. Ammonia is not measured in the effluent, so the contribution from Sand Island is not known. Existing treatment plant improvements will not reduce Ammonia concentrations in the future with the continuation of primary treatment. Even secondary treatment does not remove ammonia unless the expensive use of nitrification is employed. For marine discharges ammonia constitutes a source of nutrients and at the concentrations likely to be found in the effluent (probably 30 mg/L or less) is not toxic after initial dilution. The ammonia levels in the receiving waters are higher than state water quality standards, not just at the near diffuser sites, but at reference areas as well. For this reason, CCH is petitioning the State Department of Health to re-examine the standard to be realistic based on what is now known after years of monitoring island-wide waters. Efforts will be made to evaluate the data and determine the factors and/or sources contributing to the elevated receiving water levels.

Total chlorine residual has not been a problem since any disinfection applied to the Sand Island effluent will utilize ultraviolet light that has no chlorine residual.

The City and County of Honolulu in their 2002 Annual Assessment Report in Chapter 6 presented an analysis of compliance. It describes the methodology used to determine compliance with State Water Quality Standards and presents the findings (Figure 6-4 of the 2002 Annual Report). Based on a concentration of <0.25 ug/L in the effluent, toxaphene had the potential to exceed the chronic effluent limit of 0.04 ug/L. The analysis indicates that the only limitations that are potentially violations of State Standards for Fish Consumption (based on highest effluent concentration measured) are chlordane, aldrin, and dieldrin. Possible exceedences (based on estimated concentrations below detection limits) were noted for benzidine, hexachlorobenzene, and 4,4' DDT The three permit effluent exceedences in 2002 were for annual averages for chlordane and dieldrin and the exceedence of the daily limit for dieldrin in May of 2002. Following initial dilution, the theoretical or actual concentration of these compounds is less than a part per trillion in most instances. These same compounds are not detected in sediments or fish and are too low to be measured in any other environmental samples such as the water column. Again, the concentrations found in the effluent, except for dieldrin and chlordane are below permit limits. These two constituents are discussed in detail in Appendix D along with the investigations that have been done to determine the source/s of chlordane and dieldrin and what cost-effective ways there to control the trace amounts which enter the sewer collection system that might bring about compliance.

Another analysis of toxic pollutants is included in the analysis of sediments (Appendix G and Attachment G-1 to it) as well as Appendix H on Bioaccumulation. At present, levels of the compounds in benthic fish muscle are all below available NAS Guideline levels for whole fish and well below FDA action levels for the edible portion (Appendix H) and there is nothing to indicate that this situation will change in the future.

Overall, the results of all the toxic pollutant evaluations do not indicate any environmental levels of toxics, which might pose a threat to the maintenance of a balanced indigenous population (BIP). Environmental concentrations are so low that they are not measured in sediments or fish at levels that cause any concerns or threats to public health. Theoretical values should not be used for determining environmental health, but only as guidelines for determining the need for actual measurements. Without real data, true risks cannot be adequately assessed, and the merits or success of any potential control measures that could be undertaken be evaluated to determine their true effectiveness. There is no evidence to support any additional actions or treatment at this time in order to maintain and protect the BIP.

Summary of the Potential for Toxics Bioaccumulation

The potential for toxic effects from pollutants present in the treated wastewater effluent will continue to be low given the lack of toxic pollutant-generating industries within the Sand Island service area. Ongoing source control efforts will be continued to maintain toxics at low levels. Continued and enhanced efforts will be made to provide for pretreatment compliance and implementation of educational programs to control the entrance of toxics into the sewer collection system. Of particular concern are pesticides. Present pesticide levels that exceed water quality standards appear to be from infiltrating groundwater carrying historically applied pesticides (chlordane and dieldrin) present in soils. Pesticides form land-based sources are an ongoing concern in some of the Water Quality Limited Segments such as the Ala Wai Canal which is a known source of chlordane and dieldrin according to studies by the U.S. Geological Survey.

2. Have distinctive habitats of limited distribution been impacted adversely by the current discharge and will such habitats be impacted adversely by the modified discharge?

<u>RESPONSE:</u>

No distinctive habitats have been identified in areas potentially impacted by the existing or proposed improved discharge.

3. Have commercial or recreational fisheries been impacted adversely by the current discharge (e.g., warnings, restrictions, closures, or mass mortalities) or will they be impacted adversely by the modified discharge?

RESPONSE:

Recent commercial fisheries catch records indicate no adverse effects on fisheries resources in the vicinity of the Sand Island outfall. Evaluation of earlier data presented in the 1979 and 1994 applications yielded similar conclusions. The area around the existing outfall is utilized by various fisherman, but existing catch records show that the percentage of the Oahu catch that are derived from this area are very low.

4. Does the current or modified discharge cause the following within or beyond the ZID: [40 CFR 125.62(c)(3)]

a. Mass mortality of fishes or invertebrates due to oxygen depletion, high concentrations of toxics, or other conditions?

b. An increased incidence of disease in marine organisms?

c. An abnormal body burden of any toxic material in marine organisms?

d. Any other extreme, adverse biological impacts?

RESPONSE:

a. Mass mortality of fishes or invertebrates due to oxygen depletion, high concentrations of toxics, or other conditions?
   Mass mortalities of fish or invertebrates have not been reported in the area of the outfall. A review of the literature, searches on the internet, and inquiries to the head of the City's Oceanographic Team (Alvin Muranaka) who is at sea all the time have indicated that no known mass mortalities had occurred.

b. An increased incidence of disease in marine organisms?
   Fish caught for bioaccumulation analyses are visually examined for gross morphological evidence of diseases and ectoparasites. No unusual ectoparasites have been observed (Brock, J. A. 1999 and 2000 and Work, T. M, 2001).

   No cases of possible fin erosion have been observed to date in any of the various fish surveys.

   No other external lesions or tumors have been noted. Only one reported literature case of a tumor (chromocytoma, skin tumor) has been reported in Hawaiian fish and that was for a butterflyfish from the Island of Maui

(Work, T. M., personal communication, February 26, 2003 as published in Vet. Path., Vol 25. pp 422-431).

In recent years, fish have also been collected for detailed laboratory examination and liver histopathology. Results show no apparent contaminant-induced disease (Brock, J. A. 1999 and 2000 and Work, T. M, 2001).

c. An abnormal body burden of any toxic material in marine organisms?
The present and improved discharge does not cause any abnormal body burden of toxic pollutants, which is known to have adverse effects on the organism or consumers. Tissue burden levels of trace metals and pesticides and priority pollutants are probably related to regional influences from multiple sources. Sediments near the ZID do not contain toxicants, other than trace metals, at levels significantly different than the reference station. Infiltration of groundwater to the sewer collection system contributes to effluent pesticide levels.

Also, nonpoint sources of pesticides in the tributaries to Mamala Bay may be significant contributors to local toxicant body burdens of chlorinated compounds not present in the CCH's' discharge. Pearl Harbor and local flood control and urban drainage channels may also contribute to local water quality impairment. Numerous studies have pointed out that the nearshore and shoreline areas experience water quality impacts from nonpoint sources. This was clearly shown in the studies completed by the Mamala Bay Study Commission and other on-going studies. These efforts have led to the identification of water quality limited segments and the development of Total Maximum Daily Loads (TMDLs) by the Hawaii Department of Health. Some areas of Oahu have been found to have very high levels of pesticides in local fresh water streams. Chlordane has been characterized by the U. S. Geological Survey as being among the highest levels in the United States in the Manoa Stream watershed (U. S. Geological Survey, 2000).

Recent bioaccumulation studies near the existing Sand Island outfall and at two reference stations (see Appendix H and the Annual Assessment Reports) revealed that chlorinated hydrocarbon levels were below detection limits in a majority of the samples collected.

Based on existing water quality criteria and measured effluent levels of pesticides, no adverse biological effects or ecological impacts are expected from chlorinated hydrocarbons which are present in the CCH's' effluent.

d. Any other extreme, adverse biological impacts?
No other extreme, adverse, biological impact is known to have occurred or

is expected to occur. The existing monitoring program will be continued to detect any such impact should one occur.

5. For discharges into saline estuarine waters: [40 CFR 125.62 (c)(4)]

a. Does or will the current or modified discharge cause substantial differences in the benthic population within the ZID and beyond the ZOM?

b. Does or will the current or modified discharge interfere with migratory pathways within the ZID?

c. Does or will the current or modified discharge result in bioaccumulation of toxic pollutants or pesticides at levels which exert adverse effects on the biota within the ZID?

No section (h) modified permit shall be issued where the discharge enters into stressed saline estuarine waters as stated in 40 CFR 125.59(b)(4).

RESPONSE:

a. Does or will the current or modified discharge cause substantial differences in the benthic population within the ZID and beyond the ZOM?

This question does not apply since the discharge is not into saline estuarine waters.

b. Does or will the current or modified discharge interfere with migratory pathways within the ZID?

The CCH discharges into open ocean waters of Mamala Bay. Question 5b does not apply.

c. Does or will the current or modified discharge result in bioaccumulation of toxic pollutants or pesticides at levels which exert adverse effects on the biota within the ZID?

The CCH discharges into open ocean waters of Mamala Bay. Question 5c does not apply.

6. For improved discharges, will the proposed improved discharge(s) comply with the requirements of 40 CFR 125.62(a) through 125.62 (d)? [40 CFR 125.62 (e)]

RESPONSE:

Available data do not indicate adverse ecological impacts due to the current discharge. Studies of the benthic infauna, observations and diving surveys of fish and macroinvertebrates suggest balanced indigenous populations of these organisms exist within and beyond the zone of initial dilution (Zone of Mixing or ZOM is applicable in Hawaii under state statutes).

7. For altered discharge(s), will the altered discharge(s) comply with the requirements of 40 CFR 125.62(a) through 125.62(d)? [40 CFR 125.62(e)]

RESPONSE:

This question in not applicable since the application is based on an improve discharge.

8. If your current discharge is to stressed ocean waters, does or will your current or modified discharge: [40 CFR 125.62(f)]

--Contribute to, increase, or perpetuate such stressed condition?

--Contribute to further degradation of the biota or water quality if the level of human perturbation from other sources increases?

--Retard the recovery of the biota or water quality if human perturbation from other sources decreases?

RESPONSE:
The current Sand Island discharge is not into stressed waters. Mamala Bay supports a health marine community with the presence of a balanced indigenous population of fish, shellfish and marine animals of all types. There are no signs or evidence of any of the following indicators of a stressed marine environment:

1) disease (that is attributable to wastewater-related factors, either directly or indirectly) in marine organisms, particularly fish,
2) elevated levels of toxicants in sediments or fish tissues,
3) fish kills,
4) plankton blooms that cause nuisance conditions or adverse impacts,
5) any impairments to the environmental quality affecting threatened or endangered species or protected marine species,
6) any beach closures attributable to wastewater discharged from the Sand Island treatment plant,
7) any signs of nutrient enrichment that creates impaired water quality conditions,
8) any restrictions on fishing or shellfishing that could be associated with wastewater discharge from the Sand Island treatment plant.
9) reductions in species diversity, pollution-indicator species, an abundance of pollution-tolerant marine invertebrate species or other changes in the benthic community that is normally associated with organic enrichment or the presence of toxic substances in the marine environment.

- Contribute to, increase, or perpetuate such stressed conditions?

The proposed improvements being made at the Sand Island treatment plant will provide for maintenance of a BIP and will provide the ability to disinfect the effluent when it is needed to protect public health and achieve water quality standards.

- Contribute to further degradation of the biota or water quality if the level of human perturbation from other sources increases?

There are human pertubations in the watersheds of Hawaii that have led to the identification of Water Quality Limited Segments. These include the following:

State of Hawaii 303(d) List of Water Quality Limited Waters Island of Oahu -- 1998

Waterbody Segment	Pollutant(s)	Probable Source(s)
Ala Wai Canal (1)	Nutrients Pathogens Metals Turbidity Suspended solids	Urban runoff Natural sources
Honolulu Harbor	Nutrients Pathogens Metals Turbidity Suspended solids	Urban runoff
Pearl Harbor	Nutrients Suspended solids Turbidity	Agriculture Urban runoff
Keehi Lagoon	Nutrients Suspended solids Turbidity	Urban runoff
Kewalo Basin	Nutrients Suspended solids Turbidity	Urban runoff
Kaneohe Bay	Nutrients Suspended solids Turbidity	Urban runoff Agriculture
Waialua-Kaiaka Bays	Nutrients Suspended solids Turbidity	Agriculture Urban runoff
Kapaa Stream (2)	Nutrients Suspended solids Turbidity Metals	Landfill leachate Industrial runoff
Kawa Stream (2)	Nutrients Suspended solids Turbidity	Urban runoff Agriculture
Waimanalo Stream (2)	Nutrients Suspended solids Turbidity	Urban runoff Agriculture

(1) TMDL for this waterbody approved December 1996.
(2) New addition to 303(d) List.

As can be seen, there are a number of pollutants contributed by urban runoff, agriculture and some industrial activities which have impaired local streams and nearshore harbor areas. Efforts are underway to abate these impairments. A major focus are projects to improve water quality in the Ala Wai Canal which has been identified as a major contributor of pathogens and other pollutants including pesticides to the nearshore waters of Mamala Bay. The CCH is participating in this collaborative effort.

The City has undertaken the regional monitoring program element of its NPDES permit to collect data which can be used to identify changes in water quality and hopefully, track improvements in nearshore water quality as the control of nonpoint sources contributing to water quality impairment is implemented.

The City strongly supports the efforts to prioritize and abate those sources and conditions which contribute to water quality degradation and pose threats to biota or public health. The CCH is working with other local, state, and federal agencies to pool resources and collaborate in implementing the various watershed improvement programs being developed.

- **Retard recovery of the biota or water quality if human perturbation from other sources decreases?**

There discharge of treated wastewater at the present level of treatment will not retard recovery of biota or water quality if the abatement of nonpoint sources occurs. The deep offshore waters of Mamala Bay have good water quality and support a BIP.

E. Impacts of Discharge on Recreational Activities [40 CFR 125.62(d)]

1. Describe the existing or potential recreational activities likely to be affected by the modified discharge(s) beyond the zone of initial dilution.

RESPONSE:
The beaches and ocean are central to the life-style and economy of the Hawaiian Islands. An estimated 17.8 million people visit the public beaches of under the watchful eye of lifeguards of the City and County of Honolulu in 2002. Waikiki Beach is one of the most intensively utilized ocean recreation areas in the nation. Based on attendance estimates, some 8.36 million people visited Waikiki Beach during 2002. Following in attendance were Ala Moana Beach Park (1.76 million) and Hanauma Bay (1.75 million). Between Waikiki and Ala Moana over 10 million people are known to enjoy the waterfront of Mamala Bay each year. It is not known how many of those attending the beach or park areas participated in

water contact recreational activities, but it is safe to say that half may have gone into the water.

Recreational activities include surfing, swimming, paddle boarding, windsurfing and kitesurfing, kayaking, outrigger canoeing, personal water craft (PWC) (jet skiing), parasailing, snorkeling, free diving and SCUBA diving, fishing from boards and kayaks, board sailing, catamaran sailing, water skiing and wakeboarding.

Over 99 percent of all water-contact activity in the Waikiki recreation area consists of surfing and swimming. The estimated level of participation in 2002 for surfing and for swimming is not known. Both activities take place in nearshore waters.

Other activities such as paddle boarding, windsurfing and kitesurfing also involve water-contact activities venturing into offshore surface waters. Kayaking, outrigger canoeing, PWC (jet skiing) and parasailing are common activities.

Diving is less frequent than elsewhere in Oahu, such as Haunauma Bay due to the absence of natural reefs. The number of snorkelers and SCUBA divers usign the Bay during 2002 has not been estimated, but is a common activity.

Water-contact recreation is concentrated in the nearshore zone since the predominate sports - surfing and swimming - take place where the surf breaks. Most diving is also near shore. Although PWC (jet skiers), water skiers and wake boarders, windsurfers and kitesurfers, catamaran sailors, outrigger canoes, kayaks, and, paddle boarders can range into offshore waters, most remain close to shore.

Limited water-contact recreation of any type occurs beyond 900 meters (1,000 yards) from shore. Most ocean recreation involves contact with surface waters. Only SCUBA divers have extended contact with subsurface waters.

2. What are the existing and potential impacts of the modified discharge(s) on recreational activities? Your answer should include, but not be limited to, a discussion of fecal coliform bacteria.

<u>RESPONSE</u>:

The consumption of fish and shellfish and participation in water contact sports are the primary recreational activities with the potential for exposure to hazardous contaminants. The Water Quality Assessment of Bacterial Indicator Organisms (Appendix E) and Assessment of Bioaccumulation Data (Appendix H) provides the data to support this assessment of impacts of the Sand Island wastewater discharge and other sources (non-point sources) on recreational activities and considers their associated health risks.

The U. S. Food and Drug Administration (USFDA) regulate the allowable level of contaminants in seafood from commercial fisheries. The USFDA has established limits for the concentration of mercury and DDT in seafood sold for human consumption. Muscle tissue levels in fish from Mamala Bay and its environs are consistently below these limits.

In Hawaii, the Hawaii Department of Health (HDOH) has the responsibility for assessing the risks of chemical contamination in sport fish and issuing advisories. Sport fish consumption advisories provide consumption guidance to the public for reducing exposure and potential adverse health effects. These advisories could be used in making decisions for the protection of human health and the environment.

There are currently no specific advisories in effect in the Mamala Bay or greater Oahu area based on local water quality or fisheries data or concerns. There was a general national advisory put out by the U. S. Food and Drug Administration (FDA) in May of 2001 regarding fish consumption by pregnant women. The advisory indicated that pregnant women should limit their consumption of certain fish species know to have elevated levels of mercury in their tissues. These included tilefish, swordfish, King mackerel, and shark (US FDA, 2001). Ciquatera is the only fish consumption concern that is actively promoted by the HDOH (See Appendix G for more details). There have been no warnings, harvest closures, or, restrictions on seafood taken from the Mamala Bay area (personal communication with the staff of the Hawaii Department of Health, Wilbert Kubuta, Food and Drug Branch). Mr. Kubuta also noted that shellfish harvesting is prohibited from nearshore and harbor areas because of bacterial and toxic pollutant concerns. Many of the areas where traditional shellfish harvesting occurred are now designated as water quality limited segments by the Hawaii Department of Health. No limitation has been put in place as a result of effluent discharge from Sand Island's outfall.

For water contact sports, the State Hawaii has established bacteriological standards for protection of human health, which are the most restrictive of their kind in the nation. These standards use the indicator organism Enterococcus and have established numerical limits five times more restrictive than the national guidelines recommended by the U. S. Environmental Protection Agency's recommended national criterion of 35 enterococcus bacteria per 100 milliliters. Hawaii has adopted a recreational standard for marine waters of 7 enterococcus per 100 milliliters as a geometric mean based on a minimum of 5 samples in a thirty-day period.

The zone in which recreational areas could be potentially impacted has in the past focussed on the offshore and nearshore area extending some 8 km from the entrance to Pearl Harbor on the west to Waikiki Beach on the east and all areas within 0.6 km of the shoreline Activities in these areas include swimming, snorkeling, scuba diving, fishing and surfing. Present Hawaii water quality standards specific to marine recreational waters within 300 m (1000 ft) of the shoreline require an Enterococci content not to exceed a geometric mean of 7.0 colony forming units (CFU) per 100 ml, collected in five equally spaced samples over a 30-day period. If a single sample exceeds the standard by a factor of 10 or more (i.e., 70 CFU/100 ml), then sampling of the type required for the geometric mean limitation should be repeated until the cause of the high counts is determined.

Surface sampling is conducted a 5 shoreline stations and surface and bottom grabs collected at all nearshore and offshore stations (See Appendix E for details). The shoreline and nearshore stations were monitored five days per month; offshore stations were monitored monthly for the current permit, and quarterly in the previous permit.

The existing and potential impacts of the Sand Island effluent discharge is addressed by an analysis of existing data collected over the life of the existing permit. In the past, EPA made a decision to grant the 301(h)-modified permit based on statistical analyses of enteroccoci and fecal coliform densities at nearshore monitoring stations, computer predictions of bacteria transport, dispersion and decay in effluent wastefields, and a bacteriological survey program (EPA, 1998).

The CCH has calculated the long-term geometric means of Enterococci densities at offshore, nearshore, recreational (R Stations) and shoreline stations for four years (1999-2002) and compared the calculations to the State limits (See graphical presentations in Appendix E). This is intended to provide a "big picture" perspective on water quality within the Bay. The responsibility for evaluating the monthly sampling events and regulation of water quality and posting of recreational beaches is the responsibility of the Department of Health. CCH provides them with their monitoring data to assist them with their own independent sampling efforts and data analysis.

The dynamic surf conditions close to shore precludes sampling at areas within the designated limits of recreational waters [. i.e., 300 m (1000 ft) from shore] and thus the permit-designated nearshore stations were located 500 m to 1000 m from shore and thus, do not come within the designated recreational area for determining compliance. Thus an assessment of compliance with recreational standards/permit limits cannot be fairly assessed at the nearshore stations, but only at the shoreline locations. The nearshore and offshore stations are included in the analysis to provide an indication of the possible sources of the bacteria.

It has been shown that Enterococci densities are greater during the wet season at both the shoreline and nearshore stations. Both nearshore bottom and nearshore surface densities were frequently greater than the State standards. Also, the Ala Wai Canal and other shoreline freshwater tributaries have high bacterial levels, which cause the shoreline levels to exceed State standards.

Enterococcus mean densities have been shown to be higher during the wet season (October to February), at both shoreline and nearshore stations. If the Sand Island effluent was the major source of bacteria to recreational areas, then nearshore bacterial densities could be expected to be higher than the shoreline densities during the dry season, and some similarities in temporal patterns would emerge. One would expect to observe a gradient of decreasing concentrations from the outfall to the shoreline. Since this was not the case, and highest densities occurred during the wet months and at the S and R Stations, the likeliest source of higher bacterial densities was non-point sources (e.g., Ala Wai Canal).

Geometric mean of Enterococci densities for stations S1, S2, S5, S7 and S8 were all less than the State standard of 7 CFU/100 ml (See Appendix E for data and graphs) which shows that over the long term (308 samples) compliance with standards if met at the shoreline and recreational uses are being protected. However, individual sampling events have ranged from 630-2000 CFU/'1000. These individual events have occurred during wet weather, further supporting non-point sources as a significant impact. Field sampling conducted during storm events at Ala Wai Canal and beaches east of Sand Island demonstrated that the canal contributed high loading of bacteria to the Bay. This agrees with model simulations that link non-point sources (discharging through the Canal) with the high bacterial concentrations at Ala Moana Beach (MBSC 1996). Therefore, the noncompliance events at the shoreline stations are likely not related to bacterial concentrations in the effluent. Although the data discussed above did not address terrestrial sources, EPA in the past found that weight of the evidence showed it improbable that the Sand Island discharge was the source of significant bacterial contamination along the eastern shoreline of Mamala Bay. The high standard deviations for the shoreline stations also supports the contention that non-point sources are periodically exerting a strong influence on local water quality at the beaches along Mamala Bay. The analysis presented in Appendix E suggests that the source of high enterococci in the shoreline and recreational areas are associated with Keehi Lagoon/Honolulu Harbor and Ala Wai Canal. This analysis confirms previous modeling and sampling efforts that indicated the influence from shoreline sources.

Outside the recreation zone, there are two stations where the calculated geometric mean was found to be higher than 7 CFU/100 ml. (Stations C2A and C3A). These higher values were for samples taken from the bottom at a depth of 13 m., below the depth of offshore recreational activities with the exception of SCUBA diving or good snorkelers who freedive to the bottom. These indicate that the wastewater plume may be reaching these areas at depth. Surface ~~geometric means were all less than 7 CFU/100 ml with occasional high values~~ noted at some surface stations (C6 and C2A). Overall, despite the very restrictive standard, water quality conditions in Mamala Bay are good and compliance with standards is not impaired by the present discharge from the Sand Island WWTP. In the future, the CCH will be completing its disinfection facilities to provide for effluent disinfection when needed (when onshore currents prevail or Kona winds occur).

After reviewing the monitoring data collected to date, CCH has concluded that a connection between the Sand Island plume and beach contamination events or water quality bacterial indicator exceedences is not apparent.

In order to preclude the possibility that treated wastewater released to the ocean is adversely affecting receiving water quality, the CCH is implementing disinfection at the Sand Island WWTP (See Appendix B for details). This should assure protection of public health if municipal wastewater has the potential to enter recreational areas. Disinfection is being implemented as a cautionary, preventive measure, not based on known violations of water quality standards.

Summary

The periodic posting and closing of beaches can significantly impact recreational use of nearshore ocean waters. The Ala Wai Canal, Keehi Lagoon and Honolulu Harbor appear to be the most likely contributors to elevated levels of indicator bacteria at the local beaches. Wastewater discharged from the Sand Island outfall is occasionally transported into shallow water (13 m) but remains at depth (See Appendix E for detailed discussion).

From the analysis of water quality monitoring data (Appendix E), it is unlikely that the discharge of treated wastewater from the Sand Island ocean outfall contributes to elevated bacterial levels along the Mamala Bay shoreline and nearshore recreational waters. However, research and monitoring continue to address this issue. Disinfection is being implemented to assure protection of public health at times when treated wastewater has the potential to enter recreational areas. Thus, the proposed modified discharge is not expected to affect recreational activities in Honolulu's nearshore and shoreline recreational areas.

3. Are there any Federal, State, or local restrictions on recreational activities in the vicinity of the modified discharge(s)? If yes, describe the restrictions and provide citations to available references.

RESPONSE:

There are no Federal, State, or local restrictions on recreational activities in the vicinity of the current discharge or proposed modified discharge.

There have been no periodic postings or closures of beaches inshore from the Sand Island outfall (See the response to question III.E.2). Finding's [University of

Hawaii, Fujioka studies) and Mamala Bay Study Commission] indicate that it is unlikely that the discharge of treated wastewater from the Sand Island ocean outfall contributes to elevated bacterial levels along the shoreline of Mamala Bay. Disinfection using ultraviolet light is being implemented to be used as needed to assure protection of public health from municipal wastewater that has the potential to enter recreational areas.

There are, however, restrictions for water uses as specified in the Coast Guard's Notice to Mariners as follows:

HAWAIIAN ISLANDS - ISLANDS OF HAWAII, MAUI, OAHU AND KAUAI - SECURITY ZONES
The Coast Guard has extended the effective period of security zones in designated waters adjacent to the islands of Oahu, Maui, Hawaii, and Kauai, HI until April 19, 2003. These security zones and a related amendment to regulations for anchorage grounds in Mamala Bay are necessary to protect personnel, vessels, and facilities from acts of sabotage or other subversive acts, accidents, or other causes of a similar nature during operations and will extend from the surface of the water to the ocean floor. Broadcast Notice to Mariners will announce the existence or status of the temporary security zones periodically. Entry into these zones is prohibited unless authorized by the U. S. Coast Guard Captain of the Port Honolulu, HI or U.S. Coast Guard personnel on scene. Persons desiring to transit the areas of the security zones may contact the Captain of the Port at command center telephone number (808) 541-2477 or on VHF channel 16 (156.8 Mhz) to seek permission to transit the area. If permission is granted, all persons and vessels shall comply with the instructions of the Captain of the Port or his designated representatives.

The areas covered by these security zones are: All waters of Honolulu Harbor and entrance channel, Keehi Lagoon, and General Anchorages A, B, C, and D; the waters extending around the Tesoro single point mooring and the Chevron Conventional Buoy Mooring bounded by the following coordinates: 21-15.5N 158-05.55W thence East to 21-16.47N 158-03.5W thence South to 21-17.35N 158-03.91W thence West to 21-16.4N 158-05.01W thence North to the beginning point; Honolulu International Airport's reef runway and adjacent waters; the waters within a 100-yard radius centered on each cruise ship vessel in Hilo Harbor, Hawaii, HI and Entrance Channel shoreward of the COLREG DEMARCATION (See 33 CFR 80.1480). This is a moving security zone when the vessel is in transit and becomes a fixed zone when the vessel is anchored or moored; the waters extending out 500 yards in all directions from cruise ship vessels anchored within 3 miles of Lahaina Small Boat Harbor, Maui, and Kailua-Kona Small Boat Harbor; all waters contained within Nawiliwili Harbor, Kauai, consisting of all waters enclosed by a line drawn between the breakwater light and Kukii Point; all waters consisting of Port Allen harbor and entrance channel; Hilo Harbor and entrance channel, and all waters contained in Barbers Point Harbor, Oahu, enclosed by a line drawn between Harbor Entrance Channel Light 6 and the jetty point daybeacon. FOR FURTHER INFORMATION CONTACT: LTJG E. G. Cantwell, Coast Guard Marine Safety Office Honolulu, Hawaii at (808) 522-8260.

DEPARTMENT OF HOMELAND SECURITY-REPORTS OF SUSPICIOUS ACTIVITIES
The Department of Homeland Security (DHS) encourages the maritime public to report information concerning suspicious activity to their local Federal Bureau of Investigation (FBI) Joint Terrorism Task Force (JTTF) office, http://www.fbi.gov/contact/fo/fo.htm, or to other appropriate authorities. Individuals can contact the DHS watch and warning unit at (202) 323-3205, toll free at 1-888-585-9078, or by e-mail to nipc.watch@fbi.gov. The U.S. Coast Guard reminds the maritime industry that they may also report information concerning suspicious activity to the National Response Center (NRC) at 1-800-424-8802..

4. If recreational restrictions exist, would such restrictions be lifted or modified if you were discharging a secondary treatment effluent?

RESPONSE:
The restrictions imposed are for purposes of security; therefore, it is not anticipated that converting to a higher level of treatment will remove the applied restrictions.

F. Establishment of a Monitoring Program [40 CFR 125.63]

1. Describe the biological, water quality, and effluent monitoring programs which you propose to meet the criteria of 40 CFR 125.63. Only those scientific investigations that are necessary to study the effects of the proposed discharge should be included in the scope of the 301(h) monitoring program [40 CFR 125.63(a)(1)(i)(B)].

RESPONSE:
The existing monitoring CORE program is contained in the current NPDES permit; see Appendix J. This program will be continued until the new permit is issued or upon modification by the EPA. As progress is made in processing this permit application, the City request to work closely with EPA to strengthen the existing monitoring efforts. The City and County of Honolulu (City) is not requesting any specific modifications to the present monitoring program pending resolution of ongoing discussions regarding toxicity testing requirements.

Details of the present monitoring program are described in the exiting permit and in the Annual Assessment reports. The City has effected and supported effluent and receiving water monitoring for two permit cycles. The City also effects and supports another 301(h) waiver permit effluent and receiving water monitoring and two secondary treatment plant effluent and receiving water monitoring program. Lastly, the City also effects and supports three UIC plants. Furthermore, in several instances, the City also has sponsored efforts extending beyond permit requirements. A recent example is the drogue testing effort now being initiated.

The City, as shown under previous permits its ability to carry out biological, chemical, water quality, and effluent monitoring. Since 1997 to present, the City spends roughly $1.5 million in support of wastewater activities.

In areas where the City does not have the requisite capability, consultant contracts are readily available. Separate consultants do several toxic parameters and all of the benthic analyses. The benthic monitoring program, which addresses four marine outfalls has traditionally spend $450,000 per fiscal year, with no plans to discontinue this effort.

2. Describe the sampling techniques, schedules, and locations, analytical techniques, quality control and verification procedures to be used.

RESPONSE:
Our Water Quality Laboratory follows all sampling techniques and analytical techniques specified by permit. Schedules are done through manual....

Sampling locations are specified via GPS and/or land based line ups/markings. Our laboratory also has a quality assurance/quality control capability.

3. Describe the personnel and financial resources available to implement the monitoring programs upon issuance of a modified permit and to carry it out for the life of the modified permit.

RESPONSE:

We currently have 33 laboratory personnel to effect compliance sampling, in part, and analyses. The laboratory is organized into several units: Biology, Microbiology, Chemistry, and Toxics. Quality Control/Quality Assessment is a separate group, reporting to the Laboratory director. What additional resources in the form of professional service contracts are also available and have been used in the past. In addition to the laboratory personnel, we have 8 Water Quality Technicians that comprise our Oceanographic Team. This team is responsible, in part, for all marine sampling. The equipment currently available consist of three vessels, ranging from 22', 25', and 37' boat length, GPS capability, Remotely Operated Vehicle (ROV), CTD Profiler, underwater cameras, various diving equipment.

Financial resources are derived from the sewer fee, which has supported this program for over twenty years.

G. Effect of Discharge on Other Point and Nonpoint Sources [40 CFR 125.64]

1. Does (will) your modified discharge(s) cause additional treatment or control requirements for any other point or nonpoint pollution source(s)?

2. Provide the determination required by 40 CFR 125.64(b) or, if the determination has not yet been received, a copy of a letter to the appropriate agency(s) requesting the required determination.

RESPONSE:

The letter requesting the required determination is provided in Appendix L

H. Toxics Control Program and Urban Area Pretreatment Program [40 CFR 125.65 and 125.66]

1. **a. Do you have any known or suspected industrial sources of toxic pollutants or pesticides?**

RESPONSE:

Yes; see Appendix M for additional information.

b. If no, provide the certification required by 40 CFR 125.66(a)(2) for small dischargers, and required by 40 CFR 125.66(c)(2) for large dischargers.

Not applicable.

c. Provide the results of wet and dry weather effluent analyses for toxic pollutants and pesticides as required by 40 CFR 125.66(a)(l). (* to the extent practicable)

RESPONSE:

See Section II.A.4.b.

d. Provide an analysis of known or suspected industrial sources of toxic pollutants and pesticides identified in (1)(c) above as required by 40 CFR 125.66(b). (* to the extent practicable)

RESPONSE:

As identified and described in Section 2.3.5 – Classification of Pollutants of Concern on page 2-20 & 2-21 of our Urban Area Pretreatment Program Report, Industrial Laundries, Commercial Printing/Lithograph, Newspapers, Photo finishing & Electroplating businesses operating and discharging into the Sand Island WWTP collection system are potential sources of primary pollutants of concern. These pollutants are: Benzene, Tetrachloroethene, Toluene & Heptachlor.

2. a. Are there any known or suspected water quality, sediment accumulation, or biological problems related to toxic pollutants or pesticides from your modified discharge(s)?

b. If no, provide the certification required by 40 CFR 125.66(d)(2) together with available supporting data.

c. If yes, provide a schedule for development and implementation of nonindustrial toxics control programs to meet the requirements of 40 CFR 126.66(d)(3).

d. Provide a schedule for development and implementation of a nonindustrial toxics control program to meet the requirements of 40 CFR 125.66(d)(3).

RESPONSE:

There is a suspected water quality problem related to pesticides, specifically chlordane and dieldrin. The City believes the source of the chlordane and dieldrin are related to previously heavy use of these pollutants to control termites in and around Asian community. Efforts are underway to locate the sources and control entry into the collection system through I/I control; see Appendix D.

There is no suspecion of a sediment or biological problem associated with pesticides; see Section III.D.

The City currently has a nonindustrial toxic control program and is evaluating means of increasing its capability; see Appendix M.

3. Describe the public education program you propose to minimize the entrance of nonindustrial toxic pollutants and pesticides into your treatment system. [40 CFR 125.66(d)(1)]

RESPONSE:

The Department of Environmental Services participates in numerous public events every year in which we distribute information/brochures and other materials promoting the protection of the environment by implementing best management practices and encouraging behavior change. Numerous photos depicting environmental problems and cleanup efforts augment handout material. The Department also conducts a Household Hazardous Waste collection/disposal program on a quarterly basis. This program has resulted in the consistent collection of pesticides, herbicides and other toxic chemicals and cleaners from residents that may have otherwise been improperly discarded. Information about this program is available at www.opala .org.

4. Do you have an approved industrial pretreatment program?

a. If yes, provide the date of EPA approval.

b. If no, and if required by 40 CFR Part 403 to have an industrial pretreatment program, provide a proposed schedule for development and implementation of your industrial pretreatment program to meet the requirements of 40 CFR part 403.

RESPONSE:

The City and County of Honolulu has an approved industrial pretreatment program. Approval, by EPA, was made on July 29, 1982.

5. Urban area pretreatment requirement [40 CFR 125.65] Dischargers serving a population of 50,000 or more must respond.

a. Provide data on all toxic pollutants introduced into the treatment works from industrial sources (categorical and noncategorical).

RESPONSE:

Our Urban Area Pretreatment Study identified the following potential pollutants in the discharge from both non-categorical and categorical industrial users (i.e. significant industrial users):

METALS AND INORGANIC COMPOUNDS: Aluminum, Antimony, Arsenic, Cadmium, Chromium, Copper, Cyanide, Lead, Mercury, Nickel, Selenium, Silver, Thallium, Zinc.

PURGEABLES/VOLATILE ORGANICS: Benzene, Bromodichloromethane, Bromoform, Bromomethane, 2-Chloroethylvinyl ether, Carbon tetrachloride, Chlorobenzene, Chloroethane, Chloroform, Chloromethane, Cis-1,3-

dichloropropene, Dibromochloromethane, 1,1-Dicloroethane, 1,1-Dichloroethene, 1,2-Dichloroethane, 1,2-Dichloropropane, Trans-1,3-dichloropropene, Ethylbenzene, Methylene chloride, Methyl ethyl ketone, 1,1,2,2-Tetrachloroethane, Tetrachloroethene, 1,1,1,2-Tetrachloroethane, 1,1,1-Trichloroethane, 1,1,2-Trichloroethane, Trichloroethene, Trichlorofluoromethane, Toluene, Trans-1,2-dichloroethene, Vinyl chloride

BASE/NEUTRALS: Anthracene, Di-n-butyl phthalate, 1,2-Dichlorobenzene, 1,3-Dichlorobenzene, 1,4-Dichlorobenzene, Naphthalene, Phenanthrene, 1,2,4-Trichlorobenzene

ACIDS: Nitrophenols, Pentachloroethane, Phenol, 2,4,5-Trichlorophenol

b. Note whether applicable pretreatment requirements are in effect for each toxic pollutant. Are the industrial sources introducing such toxic pollutants in compliance with all of their pretreatment requirements? Are these pretreatment requirements being enforced? [40 CFR 125.65(b)(2)]

RESPONSE:

Pretreatment requirements in effect for toxic pollutants are in effect in the form of City Ordinances that "prohibits the discharge of any wastewater containing toxic pollutants such as herbicides and insecticides, in sufficient quantities, either singly or by interaction with other pollutants, to injure or interfere with any wastewater treatment process, constitute a hazard to humans or animals, or create a toxic effect in the receiving waters of the POTW. A toxic pollutant shall include, but is not limited to, any pollutant identified pursuant to Section 307(a) of the Federal Water Pollution Control Act, as amended."

A compliance summary of our significant industrial users is provided annually in our Pretreatment Program Annual Assessment Report.
Appropriate escalating enforcement action is initiated against all industrial users in accordance with our EPA approved Pretreatment Program's Enforcement Response Plan.

c. If applicable pretreatment requirements do not exist for each toxic pollutant in the POTW effluent introduced by industrial sources,

a. provide a description and a schedule for your development and implementation of applicable pretreatment requirements [40 CFR 125.65(c)], or

b. describe how you propose to demonstrate secondary removal equivalency for each of those toxic pollutants, including a schedule for compliance, by using a secondary treatment pilot plant. [40 CFR 125.65(d)]

RESPONSE:

Not applicable because we have an approved pretreatment program.