

US EPA ARCHIVE DOCUMENT

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 9
75 Hawthorne Street
San Francisco, CA 94105

CITY AND COUNTY OF HONOLULU'S
SAND ISLAND WASTEWATER
TREATMENT PLANT APPLICATION
FOR A MODIFIED NPDES PERMIT
UNDER SECTION 301(h) OF THE
CLEAN WATER ACT

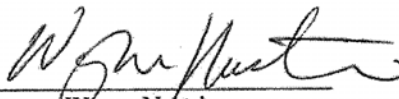
TENTATIVE
DECISION OF THE
REGIONAL ADMINISTRATOR
PURSUANT TO 40 CFR PART 125,
SUBPART G

I have reviewed the attached evaluation analyzing the merits of the application of the City and County of Honolulu's request for the Sand Island Wastewater Treatment Plant and ocean outfall variance from secondary treatment requirements of the Clean Water Act (the Act) pursuant to section 301(h). It is my tentative decision that the Sand Island Wastewater Treatment Plant and ocean outfall be denied a variance in accordance with the terms, conditions and limitations of the attached evaluation, based on section 301(h) of the Act.

My decision is based on available evidence specific to this particular discharge. It is not intended to assess the need for secondary treatment in general, nor does it reflect on the necessity for secondary treatment by other publicly owned treatment works discharging to the marine environment.

Under the procedures of the Permit Regulations, 40 CFR Part 124, public notice and comment regarding this tentative decision will be made available to interested persons. Following the public comment period on this tentative decision, a final decision will be issued under the procedures in 40 CFR Part 124.

Dated: 07 DEC 2007


Wayne NASTRI
Regional Administrator

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INTRODUCTION

The City and County of Honolulu (CCH), Hawaii (the applicant) has requested a renewal of its variance¹ under section 301(h) of the Clean Water Act (the Act), 33 U.S.C. section 1311(h), from the secondary treatment requirements contained in section 301(b)(1)(B) of the Act, 33 U.S.C. section 1311(b)(1)(B).

The variance is being sought for the Sand Island Wastewater Treatment Plant (SIWWTP), a publicly owned treatment works (POTW). The applicant is seeking a 301(h) variance to discharge wastewater receiving less-than-secondary treatment to the Pacific Ocean. Secondary treatment is defined in regulations (40 CFR Part 133) in terms of effluent quality for total suspended solids (TSS), biochemical oxygen demand (BOD) and pH. Pursuant to 40 CFR 133.102, the secondary treatment requirements for TSS, BOD, and pH are listed below:

TSS: (1) The 30-day average shall not exceed 30 mg/l.
(2) The 7-day average shall not exceed 45 mg/l.
(3) The 30-day average percent removal shall not be less than 85%.

BOD: (1) The 30-day average shall not exceed 30 mg/l.
(2) The 7-day average shall not exceed 45 mg/l.
(3) The 30-day average percent removal shall not be less than 85%.

pH: The pH of the effluent shall be maintained within the limits of 6.0 to 9.0 pH units.

This document presents the EPA Region 9's findings, conclusions, and recommendations as to whether the applicant's proposed discharge will comply with the criteria set forth in section 301(h) of the Act, as implemented by regulations contained in 40 CFR Part 125, Subpart G.

DECISION CRITERIA

Under section 301(b)(1)(B) of the Act, 33 U.S.C. section 1311(b)(1)(B), POTWs in existence on July 1, 1977, were required to meet effluent limitations based upon secondary treatment as defined by the Administrator of EPA (the Administrator). Secondary treatment has been defined by the Administrator in terms of three parameters: TSS, BOD, and pH. Uniform national effluent limitations for these pollutants were promulgated and included in National Pollutant Discharge Elimination System (NPDES) permits for POTWs issued under section 402 of the Act. POTWs were required to comply with these limitations by July 1, 1977.

Congress subsequently amended the Act, adding section 301(h) which authorizes the Administrator, with State concurrence, to issue NPDES permits which modify the secondary treatment requirements of the Act with respect to certain discharges [P.L. 95-

¹ A 301(h) variance from secondary treatment is sometimes referred to as a "waiver."

217, 91 Stat. 1566, as amended by, P.L. 97-117, 95 Stat. 1623; and section 303 of the Water Quality Act (WQA) of 1987]. Section 301(h) provides that:

The Administrator, with the concurrence of the State, may issue a permit under section 402 [of the Act] which modifies the requirements of subsection (b)(1)(B) of this section [the secondary treatment requirements] with respect to the discharge of any pollutant from a publicly owned treatment works into marine waters, if the applicant demonstrates to the satisfaction of the Administrator that:

- (1) there is an applicable water quality standard specific to the pollutant for which the modification is requested, which has been identified under section 304(a)(6) of this Act;
- (2) such modified requirements will not interfere, alone or in combination with pollutants from other sources, with the attainment or maintenance of that water quality which assures protection of public water supplies and the protection and propagation of a balanced, indigenous population (BIP) of shellfish, fish, and wildlife, and allows recreational activities, in and on the water;
- (3) the applicant has established a system for monitoring the impact of such discharge on a representative sample of aquatic biota, to the extent practicable, and the scope of the monitoring is limited to include only those scientific investigations which are necessary to study the effects of the proposed discharge;
- (4) such modified requirements will not result in any additional requirements on any other point or nonpoint source;
- (5) all applicable pretreatment requirements for sources introducing waste into such treatment works will be enforced;
- (6) in the case of any treatment works serving a population of 50,000 or more, with respect to any toxic pollutant introduced into such works by an industrial discharger for which pollutant there is no applicable pretreatment requirement in effect, sources introducing waste into such works are in compliance with all applicable pretreatment requirements, the applicant will enforce such requirements, and the applicant has in effect a pretreatment program which, in combination with the treatment of discharges from such works, removes the same amount of such pollutant as would be removed if such works were to apply secondary treatment to discharges and if such works had no pretreatment program with respect to such pollutant;
- (7) to the extent practicable, the applicant has established a schedule of activities designed to eliminate the entrance of toxic pollutants from nonindustrial sources into such treatment works;

(8) there will be no new or substantially increased discharges from the point source of the pollutant to which the modification applies above that volume of discharge specified in the permit;

(9) the applicant at the time such modification becomes effective will be discharging effluent which has received at least primary or equivalent treatment and which meets the criteria established under section 304(a)(1) of the Clean Water Act after initial mixing in the waters surrounding or adjacent to the point at which such effluent is discharged.

For the purposes of this subsection the phrase "the discharge of any pollutant into marine waters" refers to a discharge into deep waters of the territorial sea or the waters of the contiguous zone, or into saline estuarine waters where there is strong tidal movement and other hydrological and geological characteristics which the Administrator determines necessary to allow compliance with paragraph (2) of this subsection, and section 101(a)(2) of this Act. For the purposes of paragraph (9), "primary or equivalent treatment" means treatment by screening, sedimentation and skimming adequate to remove at least 30 percent of the biochemical oxygen demanding material and of the suspended solids in the treatment works influent, and disinfection, where appropriate. A municipality which applies secondary treatment shall be eligible to receive a permit pursuant to this subsection which modifies the requirements of subsection (b)(1)(B) of this section with respect to the discharge of any pollutant from any treatment works owned by such municipality into marine waters. No permit issued under this subsection shall authorize the discharge of sewage sludge into marine waters. In order for a permit to be issued under this subsection for the discharge of a pollutant into marine waters, such marine waters must exhibit characteristics assuring that water providing dilution does not contain significant amounts of previously discharged effluent from such treatment works. No permit issued under this subsection shall authorize the discharge of any pollutant into marine estuarine waters which at the time of application do not support a balanced, indigenous population of shellfish, fish and wildlife, or allow recreation in and on the waters or which exhibit ambient water quality below applicable water quality standards adopted for the protection of public water supplies, shellfish and wildlife, or recreational activities or such other standards necessary to assure support and protection of such uses. The prohibition contained in the preceding sentence shall apply without regard to the presence or absence of a causal relationship between such characteristics and the applicant's current or proposed discharge. Notwithstanding any of the other provisions of this subsection, no permit may be issued under this subsection for discharge of a pollutant into the New York Bight Apex consisting of the ocean waters of the Atlantic Ocean westward of 73 degrees 30 minutes west longitude and westward of 40 degrees 10 minutes north latitude.

EPA regulations implementing section 301(h) provide that a 301(h)-modified NPDES permit may not be issued in violation of 40 CFR 125.59 (b), which requires among other

things, compliance with the provisions of the Coastal Zone Management Act (16 U.S.C. 1451 *et seq.*), the Endangered Species Act (16 U.S.C. 1531 *et seq.*), the Marine Protection Research and Sanctuaries Act (16 U.S.C. 1431 *et seq.*), and any other applicable provision of State or Federal law or Executive Order. In the following discussion, data submitted by the applicant are analyzed in the context of the statutory and regulatory criteria.

SUMMARY OF FINDINGS

Based upon review of data, references, and empirical evidence furnished in the application and other relevant sources, EPA Region 9 makes the following findings with regard to compliance with the statutory and regulatory criteria:

1. The applicant's proposed discharge will comply with primary treatment requirements. [Section 301(h)(9); 40 CFR 125.60]
2. The applicant's proposed discharge will comply with the State of Hawaii's water quality standards for dissolved oxygen, suspended solids, and pH. [Section 301(h)(1); 40 CFR 125.61]
3. The applicant has not shown that it can consistently achieve state water quality standards or water quality criteria beyond the zone of initial dilution. The specific water quality standards the applicant cannot consistently achieve are for whole effluent toxicity, chlordane, dieldrin, and ammonia. [Section 301(h)(9); 40 CFR 125.62(a)(1)(i), 122.4(d)]
4. The applicant's proposed discharge, alone or in combination with pollutants from other sources, will not adversely impact public water supplies. However, the applicant's proposed discharge will interfere with the protection and propagation of a balanced, indigenous population (BIP) of fish, shellfish, and wildlife and may adversely affect recreational activities. The proposed discharge will not adversely affect water contact recreation, provided the new disinfection system is properly operated and maintained, but it may adversely affect fishing due to toxic pollutants in the effluent. [Section 301(h)(2); 40 CFR 125.62(b), (c), (d)]
5. The applicant did not propose a new monitoring program. EPA will work with the applicant to develop an improved monitoring program. [Section 301(h)(3); 40 CFR 125.63]
6. It does not appear that the applicant's proposed discharge would result in any additional treatment requirements on any other point or nonpoint source. [Section 301(h)(4); 40 CFR 125.64]
7. The applicant's existing pretreatment program was approved by EPA on July 29, 1982, and remains in effect. The applicant has demonstrated that its users are in

- compliance with pretreatment requirements and that it will enforce them. The applicant is carrying out a non-industrial source control program that is basically an educational effort to inform the public about nonpoint and wastewater issues and household toxic control measures. [Section 301(h)(5), (6), (7); 40 CFR 125.65, 125.66, 125.67.]
8. The applicant proposes no new or substantially increased discharges from the point source of the pollutants to which the 301(h) variance will apply above those specified in the current permit. [Section 301(h)(8); 40 CFR 125.67]
 9. The applicant has not yet provided determinations or concurrences from the Hawaii Office of Planning of the Department of Business, Economic Development and Tourism that the applicant's discharge is consistent with the State's Coastal Zone Program; from the National Oceanic and Atmospheric Administration that the applicant's discharge is in accordance with Title III of the Marine Protection, Research and Sanctuaries Act, 16 USC 1431 *et seq.*; or from the U.S. Fish and Wildlife Service and NOAA's National Marine Fisheries Service that the discharge is not likely to adversely affect listed threatened or endangered species or habitat. However, these determinations or concurrences are not necessary at this time because the tentative decision is that a modified NPDES permit not be issued. [40 CFR 125.59(b)(3)]
 10. While the State of Hawaii would have to concur in issuance of a final 301(h) modified NPDES permit and make specific determinations regarding compliance with water quality standards and whether the discharge would result in additional requirements on other sources, no State concurrence or determination is necessary at this time because the tentative decision is that a modified NPDES permit not be issued. [40 CFR 125.59(b)(3), 125.61(b)(2), 125.64(b)]

CONCLUSION

It is concluded that the applicant's proposed discharge will not comply with the requirements of section 301(h) and CFR 125, Subpart G, and the water quality conditions of the Hawaii Administrative Rules, Title 11, Chapter 54.

RECOMMENDATION

It is recommended that the applicant be denied its request for a section 301(h) variance in accordance with the above findings pursuant to the applicable provisions of 40 CFR Parts 122-125. The basis for this recommendation is discussed below.

DESCRIPTION OF TREATMENT SYSTEM

Background

The original 301(h) application for a variance from secondary treatment at the Sand Island Wastewater Treatment Plant (SIWWTP) was submitted on September 7, 1979. The applicant submitted a revised application on October 31, 1983, as allowed by EPA. After a technical evaluation of the revised application, EPA issued a tentative decision in June 1985. A draft National Pollutant Discharge Elimination System (NPDES) permit was issued in September 1987 and a public hearing was held on the draft permit in April 1988. The final permit was issued in January 1990. A reapplication for the next 301(h) variance was submitted by CCH on August 18, 1994. Based on the 1994 reapplication, a Tentative Decision Document (TDD) was issued in July 1998. In accordance with the 1998 TDD approving CCH's variance application, the current 301(h)-modified NPDES permit was issued on September 30, 1998, became effective on November 2, 1998, and expired on November 3, 2003. This permit has been administratively extended since the expiration date. On May 5, 2003, CCH again reapplied for a 301(h) variance for the SIWWTP.

Treatment System

The Sand Island facility, located on the southern coast of Oahu, treats wastewater from the city of Honolulu, including Waikiki, and the Fort Shafter military base. The SIWWTP service area encompasses about 79 square miles and serves a population of approximately 412,000 residents and tourists. Wastewater entering the SIWWTP collection system is mainly of residential origin, and there are no combined sewers in the system. Treated effluent is discharged into Mamala Bay through the existing Sand Island outfall at a depth of approximately 70.1 m (230 ft). The outfall is located at latitude 21° 17' 01" N and longitude 157° 54' 24" W. The outfall extends 2,743 m (9,000 ft) offshore and the final 1,036 m (3398 ft) consist of a multi-port diffuser. The characteristics of the outfall and diffuser are summarized in Table 1. The ocean outfall was designed for an estimated 2025 peak flow of 202 MGD.

The 2003 application indicates that the SIWWTP plant was designed to treat an average daily flow of 82 million gallons per day (MGD), based on a population of 451,000, and a peak wet weather flow of 173 MGD. The present daily flow is about 65.6 MGD, or 80% of the plant design capacity. Primary treatment consists of influent bar screens, primary clarifiers, and effluent screens. Although the clarifiers were designed and equipped to be operated as dissolved air flotation (DAF) units, they are instead operated as conventional primary clarifiers at the present time. Solids treatment at the facility includes gravity thickening, digestion, and centrifugation. Prior to the addition of a digester and biosolids heat drier to the SIWWTP in early 2007, centrifuged sludge was either incinerated or hauled to the Waimanalo Gulch landfill. When the biosolids pelletizer is fully operational in the near future, the applicant intends to market the pelletized biosolids. Until that time, the resulting residue is placed in a land fill or stored for future use.

The plant is undergoing construction to increase the dry weather design flow capacity from 82 MGD to 90 MGD and peak wet weather flow of 214 MGD. In 2003, when the application was prepared, construction to expand the plant was nearing completion. The application indicates the expansion includes improved grit removal, installation of a chemical injection system, improved hydraulic control, incorporation of new technology for primary treatment, installation of a standby UV effluent disinfection system, and increased effluent pumping capacity. An inspection of the SIWWTP facility in August 2007, conducted by HDOH and its contractor, indicated that construction on most of these projects has been completed (Tetra Tech, 2007). This reported indicated that the headworks were completed in August 2005, clarifiers were put in service in July 2006, the treatment plant expansion was completed in November 2006, and initial start-up operation of the disinfection facility began in November 2006.

Improved Discharge

An improved discharge is defined in 40 CFR section 125.58(i) as meaning the volume, composition, and location of an applicant's discharge following: (1) construction of planned outfall improvements, including, without limitation, outfall relocation, outfall repair, or diffuser modification; or (2) construction of planned treatment system improvements to treatment levels or discharge characteristics; or (3) implementation of a planned program to improve operation and maintenance of an existing treatment system or to eliminate or control the introduction of pollutants into the applicant's treatment works. CCH is applying for an improved discharge.

The applicant is seeking a variance from the secondary treatment requirements for BOD and TSS, but the applicant is not seeking a variance for pH. The applicant's current effluent limits for BOD and TSS, along with the range of current performance, are listed in Table 2. The applicant is not requesting a change in effluent limits contained in the existing permit. CCH does not believe the wastewater character will change in the near future, and an increase in flow to the plant during the next permit cycle is not anticipated. Therefore, CCH is applying for an improved discharge based only on increased capacity and other facility upgrades.

Projected annual average effluent flow rates, based on anticipated population increases within the service area, are given in Table II.A.5.a1 in the application and summarized in Table 3 of this document.

The applicant is not seeking a variance for pH. The secondary treatment requirement for pH is that effluent values shall be maintained within limits of 6.0 to 9.0 [(40 CFR 133.102(c)]. EPA reviewed discharge monitoring report (DMR) entries for effluent pH values from December 1998 through May 2007. All pH values recorded on DMRs ranged between 6.36 and 8.2. Therefore, pH values in the effluent met permit limits and secondary treatment standards.

For pH, the applicant anticipates the minimum projected value to be 6.0 and the maximum projected value to be 9.0. These estimates are drawn from and in accordance

with NPDES permit limits for pH. They are also consistent with the federal secondary treatment standards for pH.

DESCRIPTION OF RECEIVING WATERS

The SIWWTP discharges into the Pacific Ocean in a broad indentation of the southern coastline of Oahu, which is known as Mamala Bay. The applicant describes the coastal receiving waters in Mamala Bay as ocean waters, as defined in 40 CFR 125.58(n), and the discharge is not to stressed waters as defined in 40 CFR 125.58(z). Mamala Bay extends from Diamond Head in the east to Barbers Point in the west, covering an estimated shoreline distance of about 22 miles. Principal shoreline features in Mamala Bay include the Ala Wai Canal, Kewalo Basin, Keehi Lagoon, Honolulu Harbor, and Pearl Harbor.

The nearshore bathymetry, beyond the fringing reefs of Mamala Bay, is known as the Kahipa-Mamala shelf. The Kahipa-Mamala shelf, which is composed of drowned coral reefs and marine sediments resting on volcanic and sedimentary rocks, extends to a depth of approximately 350 feet (107 meters), at an estimated 1.5 miles (2.4 km) offshore from Diamond Head to the Pearl Harbor channel from where it varies up to 3.6 miles (5.8 km) offshore just southwest of Barbers Point.

As part of the Mamala Bay Study (MBSC 1996), direct field observations of oceanographic and meteorological variables were made to describe the three dimensional current structure in Mamala Bay by characterizing fluctuations in temperature and density profiles, tides, water levels, and surface winds. Sensors and current meters were placed along the shoreline to understand the physical oceanographic conditions of Mamala Bay. This monitoring period occurred between January 1994 and July 1995.

Semi-diurnal tides move to a southwesterly direction in the Pacific. The tides divided near the north shore of Oahu, flowed to the east and the west of the island, then merged within Mamala Bay before continuing to flow in a southwesterly direction. As a result, strong tidal velocities occurred at Barbers Point and Diamond Head. Currents were parallel to the depth contours toward the middle of the bay. Weak currents resulted where flows merged from opposite directions. Converging flows at flood tide caused a downwelling at the center of the bay, which reversed with the tidal cycle at ebb tide. Consequently, large changes in stratification occurred over the tidal cycles, with the water column often becoming homogeneous at different sites. This phenomenon became a critical factor in predicting the transport and fate behavior of the effluent plume.

Diurnal tides were relatively uniform in amplitude throughout the bay and propagated principally from west to east. Consequently, the combination of semi-diurnal and diurnal tides varied significantly at different sites in the bay. Semi-diurnal tides dominated at Barbers Point and Diamond Head, while diurnal tides dominated in the center of the bay. Both tidal components were directed parallel to the depth contours. In both seasons,

onshore flow branched just east of Sand Island, resulting in an eastward mean flow along the shore toward Diamond Head.

Mamala Bay Studies reveal relatively weak local correlation of winds with sea level and current at sampling sites in the center of the bay. Analyses also revealed a general weakening of the westward flows on the shelf with weakening of the trade winds from the northwest. There was little or no evidence of wind forcing effects in shallow nearshore areas, which has implications for plume transport and fate. Instead, analysis of temperature fluctuations revealed a strong dependence of circulation within the bay on the large-scale oceanographic processes in the ocean surrounding the island.

Precipitation falling over the urbanized drainage basins leads to elevated nutrient and sediment levels in Mamala Bay, which are discharged into the bay through drainage courses like Pearl Harbor. According to the applicant, over half of the entire Mamala Bay runoff, which covers approximately 572 km² (221 mi²), drains into the Pearl Harbor lochs. The freshwater discharge through the mouth of Pearl Harbor also contains 7.5 MGD of secondary treated sewage from Fort Kamehameha WWTP.

Recreational Uses

Recreational activities reported by the applicant in the area potentially affected by the Sand Island discharge (8 km west of the entrance to Pearl Harbor to Waikiki Beach) include surfing, swimming, fishing, paddle boarding, windsurfing and kitesurfing, kayaking, outrigger canoeing, jet skiing, parasailing, snorkeling, free and scuba diving, fishing from boards and kayaks, board sailing, catamaran sailing, water skiing, and wakeboarding.

Based on attendance estimates, the application indicates that 8.36 million people visited Waikiki Beach and 1.76 million visited Ala Moana Beach Park during 2002. The application states that “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 park areas participated in water contact recreational activities, but it is safe to say that half have gone into the water.”

Section III.E.1 of the application states that water-contact recreation is concentrated in the nearshore zone since the predominant sports, surfing and swimming, take place where the surf breaks. The applicant also notes that most diving is nearshore, and further states that although jet skiers, water skiers and wake boarders, windsurfers and kitesurfers, catamaran sailors, outrigger canoes, kayaks, and paddle boarders can range into offshores, most remain close to shore. The application indicates that “limited water-contact recreation of any type occurs beyond 900 meters (1000 yards) from shore” and “most ocean recreation involves contact with surface waters.”

In 2003, the applicant employed a research firm to conduct a survey measuring usage of the Oahu south shore by island residents and to determine how the recreational area is used (Ward Research, 2003). The survey results confirmed that residents participated in

recreational activities in ocean waters out to two miles from shore and beyond. Residents identified recreational activities including swimming, snorkeling, sailing, boating, fishing, diving, surfing/bodyboarding/windsurfing, paddling/canoeing/kayaking, and waterskiing. Thirty-four percent of the 375 respondents reported frequent recreational use (defined in the study as use at least once every other week) of the south shore. While the majority recreational activity reported in this survey took place within 91 m (300 feet) of shore, recreational use beyond two miles from shore was reported by at least five percent of the respondents.

Coral Reefs

Coral reefs are common in Hawaiian waters at depths of less than 36.6 m (120 ft). The island of Oahu is surrounded by a fringing reef ecosystem. The Sand Island outfall diffuser is situated seaward of the fringing reef. Available information suggests that there are no extensive coral reefs within about 700-1,000 m (2,300–3,300 ft) of the discharge site. Small patches of coral (primarily *Montipora*) may occur in deep water of Mamala Bay, and species of black coral also live at these depths.

Fisheries

Recreational and commercial fishing within Mamala Bay extends from Pearl Harbor to Diamond Head. Commercially important species include striped mullet (*Mugil cephalus*), also known as *ama'ama*; mackerel scad (*Decapterus macarellus*), also known as *opelu*; bigeye scad (*Trachiurops crumenophthalmus*), also known as *akule*; a number of jacks (family Carangidae) also known as *ulua*; as well as the baitfish (*Stolephorus purpureus*), also known as *nehu*. The application indicated that Pearl Harbor is the primary source of this baitfish.

PHYSICAL CHARACTERISTICS OF THE DISCHARGE

Outfall/Diffuser and Initial Dilution

40 CFR 125.62(a) requires that the proposed outfall and diffuser must be located and designed to provide adequate initial dilution, dispersion, and transport of wastewater to meet all applicable State water quality standards and EPA water quality criteria at and beyond the boundary of the zone of initial dilution (ZID). This evaluation is based on conditions during periods of maximum stratification and during other periods when discharge characteristics, water quality, biological seasons, or oceanographic conditions indicate more critical situations may exist. The physical characteristics of the Sand Island outfall and diffuser are summarized in Table 1.

Figure 1 provides a graphical description of a wastefield generated by a simple ocean outfall. EPA's Amended Section 301(h) Technical Support Document (1994) provides the following description of initial dilution and dispersion:

As the plume rises and entrains ambient saline water, its density increases and its momentum and buoyancy decrease accordingly. If a sufficient ambient vertical density gradient or zone of stratification (like a pycnocline or a thermocline) is present, the plume will spread horizontally at the level of neutral buoyancy (i.e., where the plume density equals ambient water density). If a sufficient density gradient is not present, the diluted effluent will reach the water surface and flow horizontally. The vertical distance from the discharge points to the centerline of the plume when it reaches the level of neutral buoyancy or the water surface is called the “height-of-rise” (sometimes referred to as the height to “trapping” or “equilibrium” level). The dilution achieved at the completion of this process is called the “initial dilution.” Dilution is the ratio of the total volume of a sample (ambient water plus effluent) to the volume of effluent in the sample. A dilution of 100 is a mixture composed of 99 parts of ambient water and 1 part of effluent.

Initial dilution is a critical parameter relative to compliance with State and Federal water quality standards and criteria. The lowest (i.e. critical) initial dilution must be computed for each of the critical environmental periods. The predicted peak 2- to 3-hour effluent flow for the new end-of-permit year, a temperature and salinity depth profile of the receiving water, and current speed no higher than the lowest 10 percentile are applied in a mathematical model to compute the critical initial dilution.

The application indicates that CCH estimated the critical initial dilution during periods of maximum stratification conditions using the EPA-approved mathematical model DOS PLUMES and the RSB model contained within PLUMES (Baumgartner et al., 1994). Using the RSB model, the applicant estimated a critical initial dilution of 150 for the year 2000 flow, and predicted summer and winter to be the critical seasons. To calculate this critical initial dilution, the applicant assessed receiving water temperature and salinity profiles taken from 1991 to 1993 at three stations located on the boundary of the ZID. In the application, CCH indicated that “these stations are appropriate because they are representative of the conditions the diffuser is exposed to but not so close to be directly influenced.”

The application does not clearly present all the data used in making this estimate of 150 for the critical initial dilution value. The current application, dated May 2003, does not contain printouts of the modeling results or an overall summary of the critical initial dilution modeling results. The 2003 application makes numerous references to older data contained in the 1994 application, but the data applied in the model are not clearly indicated or presented. Therefore, it is not possible to cross reference the two applications in order to derive all the data applied by the applicant in the initial dilution model. However, the current application references initial dilution calculations found in the Sand Island Annual Assessment Reports (AARs) from 1998 through 2002. The current application indicates that these initial dilutions range from 106.3 to 523, yet there is little explanation of why 106.3 is not applied as the critical initial dilution. In section III.A.1 of the 2003 application, CCH simply states that the lowest dilution value “may not necessarily provide a reliable estimate of compliance with water quality criteria and may be misleading concerning the effect on ambient quality.”

EPA recalculated the initial dilution for the Sand Island discharge using the EPA-approved model Visual Plumes (Frick et al., 2003), which supersedes EPA's DOS PLUMES modeling system. EPA assessed a total of 33 receiving water temperature and salinity depth profiles in order to determine the critical initial dilution for the Sand Island discharge from a comprehensive and representative collection of receiving water conditions. These 33 receiving water temperature and salinity depth profiles were recorded by the applicant at station E2 and reported to EPA in DMRs between February 1999 and April 2007. Station E2, which is located on the boundary of the zone of mixing, was chosen because it is representative of the receiving water conditions near the diffuser but not so close that temperature and salinity readings are strongly influenced by the effluent plume. This same station was also chosen by the applicant for use in dilution modeling presented in many of their AARs. The current application did not provide estimated peak hourly flows on a monthly or seasonal basis. Instead, the applicant referenced flow data contained in the 1994 Sand Island 301(h) variance application, which included an estimated peak 2- to 3- hour flow for the year 2015. This estimated peak 2- to 3- hour flow of 118.9 MGD for the year 2015 and a current speed of 0.001 cm/sec were applied in the Visual Plumes modeling conducted by EPA. This is the same current speed applied by the applicant in initial dilution modeling presented in the AARs. Prior to use in the Visual Plumes model, some of the temperature and salinity depth profiles were edited so the resulting density profiles contained no instabilities. This practice was also applied to the dilution modeling in the last variance review for CCH's Sand Island wastewater treatment plant.

In this review, the temperature and salinity depth profile producing the lowest (i.e. critical) initial dilution is from July 2, 2002. Using this profile, combined with the estimated end-of-permit flow of 118.9 MGD (5.23 m³/sec) for the year 2015, and a current speed of 0.001 cm/sec, EPA calculated the most critical environmental situation. The Visual Plumes model computed the critical initial dilution of **103** at a trapping depth of 59 meters below the surface. EPA uses the computed dilution ratio of 103:1 throughout this 301(h) review as the critical short-term initial dilution for the Sand Island discharge. The previous EPA tentative decision from 1998 applied an initial dilution factor of 94:1. In the present TDD, modeling based on more recent profiles and an updated version of EPA's dilution model resulted in a critical initial dilution of 103:1.

Application of Initial Dilution to Water Quality Standards

Numeric water quality standards for toxic pollutants listed in Hawaii Administrative Rules (HAR) 11-54-4(b)(3) provide acute and chronic criteria to protect aquatic life and fish consumption criteria to protect human health. This list also identifies toxic pollutants that are carcinogens. In accordance with HAR 11-54-4(b)(3) and the HDOH *State Toxics Control Program: Derivation of Water Quality-Based Discharge Toxicity Limits for Biomonitoring and Specific Pollutants* (1989), minimum dilution is used when comparing toxic pollutant concentrations in effluent discharges through a submerged outfall to numeric aquatic life chronic standards and numeric human health fish consumption standards for non-carcinogens. The average dilution value is used when comparing toxic

pollutant concentrations in effluent discharges through a submerged outfall to numeric human health fish consumption standards for carcinogens.

In Section III.A of the application, CCH presents an initial (i.e. minimum) dilution value of 150. The application does not contain an average dilution value. Instead, the applicant refers to the dilution values presented in the Sand Island AARs from 1998 through 2002. In these AARs, the applicant estimated minimum and average dilution values using EPA's DOS PLUMES model. For the minimum dilution value in each AAR, the applicant applied the maximum average monthly flow, a current speed of 0.001 cm/sec, and a profile from the year assessed. In the 2005 AAR, for example, the applicant applied the maximum average monthly flow of 76.1567 MGD, the current speed of 0.001 cm/sec, and the receiving water temperature and salinity profile collected on August 2, 2005. Minimum dilution values in the AARs from 1999 through 2005 range from 128.5 to 523.6. For the average dilution value in each AAR, the applicant applied the design flow of 82 MGD, a current speed of 0.001 cm/sec, and the same receiving water profile applied in the minimum dilution value estimation. Average dilution values in the AARs from 1999 through 2005 range from 126.7 to 495.3. In each AAR, the applicant applies either the minimum or average dilution value determined for each individual year to the laboratory results of priority toxic pollutant and pesticide monitoring from that same year.

As discussed earlier, EPA calculated the critical (i.e. minimum) initial dilution to be 103:1. Additionally, in accordance with HAR 11-54-4(b)(4) and the HDOH State Toxics Control Program, EPA calculated an average dilution for the Sand Island discharge using the Visual Plumes model. In this model, EPA applied the average current speed of 0.001 cm/sec and the SIWWTP design flow of 3.96 m³/sec (90 MGD) for the end-of-permit year 2015 to each of the 33 temperature and salinity depth profiles previously described. The geometric mean of all these 33 initial dilution values was calculated to be 294:1 and is used by EPA as the average dilution value.

Therefore, in this review by EPA, the minimum (i.e., critical) initial dilution of **103:1** will be applied to chronic and fish consumption criteria for non-carcinogens, and the average dilution of **294:1** will be applied to fish consumption criteria for carcinogens, such as chlordane and dieldrin. The critical initial dilution of 103:1 will also be applied in the sections of this review discussing turbidity, DO, and whole effluent toxicity.

Zone of Initial Dilution

The ZID, as defined in 40 CFR 125.58(dd), refers to 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. EPA's Amended Section 301(h) Technical Support Document (ATSD) operationally delimits this volume of water in relation to the depth of the outfall (i.e., subtending the depth of the outfall on each side of the diffuser and above it). The ZID dimensions are calculated by the applicant to be 143.1 m (469.5 ft) wide and 1,176.6

m (3,860.2 ft) along the centerline of the diffuser (Figure 2). This calculation is consistent with EPA's guidance.

40 CFR 125.62(a) requires that the applicant's outfall and diffuser be located and designed to provide adequate initial dilution, dispersion, and transport of wastewater such that the discharge does not exceed, at and beyond the ZID, all applicable State water quality standards and, for pollutants for which there are no EPA-approved standards, section 304(a) criteria. HAR Chapter 11-54-9 allows a zone of mixing (ZOM), which is a limited area around outfalls to allow for initial dilution of waste discharges. The SIWWTP permit contains a ZOM situated around the ZID. Dimensions of the ZOM are 427 m (1,400 ft) wide and 1,463 m (4,800 ft) along the centerline of the diffuser. The ZOM extends vertically downward to the ocean floor. Although Hawaii's water quality standards allow narrative and numeric criteria to be met at the ZOM for secondary treated effluent, 301(h) regulations require facilities with variances from secondary treatment to meet water quality standards and criteria at the ZID. Thus, this TDD evaluates whether the proposed discharge would comply with water quality standards at the edge of the ZID. However, data from the ZID are not available for all water quality standards. This review notes whether data were assessed at the ZID or, if necessary, at the ZOM due to the lack of ZID data.

The existing permit allocates monitoring effort to address physical, chemical, and biological processes not well addressed by earlier monitoring efforts. The monitoring program designated by the existing permit attempted to provide a framework for interpreting discharge-related effects relative to the effects of other sources of contaminants in Mamala Bay. As part of this effort, four stations were designated as nominal ZID stations (D2, D3, E2, and E3) although these stations are located on the ZOM boundary.

Dilution Water Recirculation

Under section 303(e) of the WQA, before a 301(h) permit may be issued for discharge of a pollutant into marine water, such marine waters must exhibit characteristics assuring that the water providing dilution does not contain significant amounts of previously discharged effluent from the treatment works.

The applicant does not address this topic in the application. However the probability of re-entrainment at the Sand Island outfall is low, and the affect on effluent dilution is very small given the presence of a current to the southwest. In order for a portion of a previously created wastefield to be entrained into a rising effluent plume, a significant portion of the wastefield must be below the lower boundary created by the rising plume.

In general, for constant environmental conditions, the plume height of rise decreases with increasing current speed (Muellenhoff et al. 1985). Because of this fact, it is necessary that the previously created wastefield enter the receiving water during a period of relatively high current flow, travel away from the diffuser, and travel back to the diffuser as the current reverses, and then be entrained into the rising plume during a period of low

current speed. In such a case, the net effect of the reduction of initial dilution at low current speeds is of the order of a few percent. This is because of the high dilution achieved during the initial phase by faster currents, and the subsequent farfield dilution due to horizontal and vertical diffusion before the wastefield is entrained into the rising plume. Therefore, in Sand Island's case, it is estimated that the receiving waters do not contain significant concentrations of previously discharged effluent.

APPLICATION OF STATUTORY AND REGULATORY CRITERIA

A. Compliance with Primary Treatment Requirements

CWA Section 301(h)(9) was amended by Section 303(d)(1) and (2) of the Water Quality Act (WQA) of 1987. Under section 303(d)(1) of the WQA, the applicant's wastewater effluent must be receiving at least primary treatment at the time its 301(h) permit becomes effective. Section 303(d)(2) of the WQA states that, "Primary or equivalent treatment means treatment by screening, sedimentation, and skimming adequate to remove at least 30% of the biological oxygen demanding material and other suspended solids in the treatment works influent, and disinfection, where appropriate." 40 CFR 125.60 requires the applicant to perform monitoring to ensure, based on the monthly average results of the monitoring, that the effluent it discharges has received primary or equivalent treatment. Although the NPDES permit contains both weekly and monthly discharge limits and monitoring requirements, 301(h) regulations require evaluation on a monthly basis for TSS and BOD. Therefore, this review focuses on monthly removal rates.

EPA reviewed DMR data for the period from January 1999 through May 2007. These data indicate the primary treatment requirement of 30% removal was met for TSS. The primary treatment requirement of 30% removal of BOD was met, except for four months (two months in 1999, one month in 2003, and one month in 2004). Tables 4 and 5 contain a summary of monthly TSS and BOD removal rates entered on DMRs from January 1999 through May 2007.

EPA concludes that the applicant has satisfied the requirement of 301(h)(9) because the discharge has consistently met 30% removal for TSS and there have only been four occasions since 1999 when the discharge did not meet the 30% removal requirement for BOD. The discharge has consistently met the 30% removal requirement for BOD since February 2004, and recent data indicate removal of BOD and TSS well above 30%.

B. Attainment of Water Quality Standards related to BOD and TSS

Under 40 CFR 125.61(a), which implements section 301(h)(1), there must be a water quality standard applicable to the pollutants for which the modification is requested and, under 125.61(b)(1), the applicant must demonstrate that the proposed modified discharge will comply with these standards.

The applicant has requested modified requirements for BOD, which affects DO, and suspended solids, which affects the turbidity or light attenuation in the receiving waters and can affect the benthos by eventually settling onto the seabed. The State of Hawaii has established water quality standards for DO and turbidity in HAR Chapter 54, Title 11, Water Quality Standards, Department of Health, 2004.

The waters of Mamala Bay are classified by the State of Hawaii as Class A open coastal waters. The protected designated uses in this class are recreational, aesthetic enjoyment and the support and propagation of fish, shellfish, and wildlife. For Class A open coastal waters, the State has two sets of water quality standards: a “wet” set applies when the open coastal waters receive more than three million gallons per day of fresh water discharge per shoreline mile; and, a “dry” set applies to open coastal waters which receive less than three million gallons per day of fresh water per shoreline mile per day. The State of Hawaii applies the “wet” set of criteria to the Sand Island discharge. The “wet” designation affects turbidity criteria, which are discussed in this section, and nutrient criteria, discussed in section C.1.d. of this document.

1. Dissolved Oxygen

In order to qualify for a variance from secondary treatment standards for BOD, 40 CFR 125.61(b)(1) requires the applicant to demonstrate that the modified discharge will comply with State water quality standards for BOD or DO. The Hawaii water quality standards at HAR 11-54-6(b)(3) require that DO in Class A open coastal waters shall not be less than 75% of saturation, determined as a function of ambient water temperature and salinity. Hawaii does not have a water quality standard for BOD.

The existing permit requires quarterly monitoring (continuous depth profiles) for DO at 15 monitoring stations: five nearshore stations (C1, C2, C3, C4, and C5) and ten offshore stations (D1, D2, D3, D4, D5, E1, E2, E3, E4, and E5). The applicant also conducted quarterly monitoring at eight additional stations (C1A, C2A, C3A, C5A, C6, D3A, E5, and E6) starting in 1999. Attainment of State water quality standards for DO is required at the edge of the ZID, in accordance with 40 CFR 125.62(a). However, ZID monitoring stations were not identified in the permit, and the applicant did not monitor the water column at the ZID.

In analyzing whether the applicant’s discharges will comply with Hawaii’s water quality standards for DO, EPA analyzed both data from the existing discharges and modeling provided by the applicant as to the predicted discharge. While the existing data did not reflect conditions at the ZID, the predictive modeling provided by the applicant did model projected impacts at the ZID.

a. Analysis of Attainment based on Monitoring Data

The application presents graphs of dissolved oxygen profiles, collected as part of concentration-temperature-density (CTD) profiles but does not assess the profiles in relation to ambient conditions.

CTD depth profiles contain basic water column information collected from the surface to the bottom of the water column at each meter of depth and include data for conductivity, pH, temperature, salinity, and DO. The capacity of water to contain DO is dependent on the temperature and salinity of the water. Warmer water can hold less oxygen than cooler water, and water with a higher salinity can hold less oxygen than water with a lower salinity. The highest DO concentration that water can hold (i.e., the DO saturation concentration) can be calculated from temperature and salinity values. The ATSD provides Table B-4 (Dissolved Oxygen Saturation Values) to aid this calculation.

To adhere to Hawaii's water quality standards, which determine DO as a function of ambient temperature and salinity, it is necessary to calculate the DO saturation concentration from ambient temperature and salinity values. The SIWWTP AARs from 1999 through 2005 contain summaries of DO concentrations taken at the designated monitoring stations in the receiving waters. To determine the ambient DO concentration for the receiving water, the applicant averaged temperature and salinity measurements from two reference stations, E1 and E6, at each depth. From this average, the applicant calculated the DO concentration at saturation for each depth and at the 75% saturation value for each depth. The AARs measured DO at each monitoring station was compared to the calculated 75% saturation concentration for each depth. If no measured DO value fell below the 75% saturation value for that depth, then the station was in compliance. The AARs from 1999 through 2005 indicate that all stations were in compliance with the Hawaii water quality standard for DO.

There were 33 monitoring events from February 1999 through April 2007. EPA reviewed the applicant's electronic database of CTD data for receiving water monitoring events conducted from 1999 through April 2007. Although CTD data are available for 1999, the applicant's CTD database does not include profiles for upcurrent reference station E6 in three of the four quarters monitored. According to the ATSD, the upcurrent reference station is used when comparing DO concentrations. Consequently, EPA reviewed CTD data from November 1999 through April 2007.

ZOM and Offshore

To determine the DO saturation concentration at the upcurrent reference station, E6, EPA averaged ambient temperature and salinity for each of three groups of depths at E6, for each individual monitoring event. The surface group included water column data collected from 1 to 23 meter depths, the middle group included depths from 24 to 47 meters, and the bottom group included depths from 48 to 71 meters. Based on averages of measured temperature and salinity readings from each depth (surface, middle, and bottom), EPA calculated the DO saturation concentrations for each depth at reference station E6 and the corresponding 75% saturation concentration for each individual monitoring event. For the monitoring events conducted from November 1999 to April 2007, DO saturation concentration values for all three depths ranged from 6.9 to 7.25 mg/l at E6, and the corresponding 75% values ranged from 5.18 to 5.44 mg/l. All measured DO concentrations for each monitoring station at the ZOM (ZID data are not

available) were then compared to the 75% DO concentration at the corresponding depth of reference station E6. With one exception, described more fully below, measured DO concentrations ranged from 5.18 to 6.99 mg/l. When compared by event, all reported DO concentrations were at or above the 75% saturation concentration at the corresponding depth of reference station E6 for each event.

The exception to this summary resulted from monitoring conducted on March 30, 2006. DO concentrations recorded at offshore monitoring stations during this monitoring event ranged between 0.82 and 8.58 mg/l. The 75% saturation concentration for reference station E6 was 5.32 or 5.36, depending on depth, in the March sample. Stations where low DO concentrations were recorded include stations E1, E2, E3, E4, E5, E6 (at a depth of 24 m), D1, D5, and D3A. Of all 3,816 DO samples taken at all depths at offshore stations during this March sampling event, 324 were below the lowest 75% saturation concentration (5.32 mg/l) of the reference station.

When the applicant submitted the 2006 CTD profiles to EPA as part of the SIWWTP DMRs, there was no discussion of the low recorded DO values attached to the submittal. As of November 2007, when EPA's analysis was completed, the applicant had not yet submitted the Annual Assessment Report for 2006. This report may contain a discussion about the low DO concentrations recorded on March 30, 2006.

EPA evaluated whether these low DO concentrations could be related to the major sewage spill of March 2006. On March 24, 2006, the main sewer line of the wastewater collection system in Waikiki failed. As a result, 48 million gallons of raw sewage were discharged into the Ala Wai canal in Waikiki. Monitoring revealed that the plume of raw wastewater flowed in the direction of Diamond Head, in the opposite direction of the SIWWTP outfall which is located approximately two miles east of the Ala Wai canal. Therefore, it is not possible to conclude that the 48 million gallon discharge influenced DO readings at monitoring stations located on the boundary of the ZOM.

Nearshore

No nearshore sampling exceeded 20 meters depth. Therefore, DO concentrations recorded at nearshore stations were compared to the 75% saturation concentration developed based on the reference station (E6) temperature and salinity averages for the depth of the surface group. For the surface depths, 75% saturation concentrations ranged from 5.25 to 5.36 mg/l. With two exceptions, all DO concentrations recorded at nearshore stations met the Hawaii water quality standard for DO. Without these two exceptions, nearshore measured DO concentrations ranged from 5.27 to 6.86 mg/l. When compared by event, all reported DO concentrations were at or above the 75% saturation concentration at the surface depth of reference station E6 for each event.

The two exceptions occurred on November 1, 2000 and July 2, 2002. On November 2, 2000, DO concentrations ranged from 5.17 to 6.86 mg/l at all nearshore stations. The reference DO concentration for this date is 7.0 mg/l and the corresponding 75% concentration is 5.25 mg/l. Six DO readings were below the 75% saturation value of 5.25

mg/l on this date. All six of the lowest DO concentrations were recorded at the bottom 6 meters of station C1A. Similarly, on July 2, 2002, DO concentrations ranged from 5.13 to 6.72 mg/l at all nearshore stations. The reference DO concentration for this date is 7.0 mg/l and the corresponding 75% concentration value is 5.25 mg/l. Six DO readings were below the 75% saturation value of 5.25 mg/l on this date. All six of the lowest DO concentrations were recorded at the bottom 6 meters of station C5. It should be noted that the critical profile identified by modeling of initial dilution occurred on July 2, 2002. On both occasions, the trapping level of the plume was estimated to be 59 to 60 m.

b. Analysis of Attainment based on Predictive Modeling

The applicant used predictive equations and models from the ATSD to evaluate the potential effect of the discharge on ambient DO concentrations compared to Hawaii water quality standards. In order to evaluate compliance of the proposed discharge with the Hawaii water quality standard for DO, projected receiving water DO levels were calculated in four environmentally critical situations:

- at the boundary of the zone of initial dilution (ZID),
- farfield (beyond the ZID),
- near the bottom due to steady sediment demand, and
- near the bottom due to abrupt sediment resuspension.

Results of these analyses are compared to the Hawaii water quality standard requiring DO concentrations to be above 75 percent of saturation, determined as a function of ambient water temperature and salinity.

Dissolved Oxygen Concentration Upon Initial Dilution

The dissolved oxygen concentration immediately following critical initial dilution, at the boundary of the ZID, is calculated using ATSD Equation B-5:

$$DO_f = DO_a + [(DO_e - IDOD - DO_a) / S_a]$$

where:

- DO_f = Final dissolved oxygen concentration of the receiving water at the plume trapping depth, in mg/L
- S_a = Initial dilution
- IDOD = Immediate dissolved oxygen demand, in mg/l
- DO_e = Dissolved oxygen concentration of the effluent, in mg/l

DO_a = Ambient dissolved oxygen concentration, immediately upcurrent of the diffuser, averaged from the diffuser port depth to the plume trapping depth, in mg/l

The applicant and EPA relied on this equation to predict the final DO concentration of the receiving water at the plume trapping depth, following critical dilution at the boundary of the ZID (DO_f).

A discussion of critical initial dilution and how this value is determined can be found in previous sections of this document. For initial dilution (S_a), the applicant used a critical initial dilution value of 150. In this evaluation, EPA used the recalculated critical initial dilution value of 103, as previously described in this document. Because the initial dilution process occurs rapidly (on the order of minutes), BOD exertion, a relatively slow process, is negligible during this period. However, immediate dissolved oxygen demand (IDOD), representing the oxygen demand of reduced substances in the effluent that are rapidly oxidized (e.g., sulfide to sulfate), may not be negligible. The ATSD states that IDOD values for sewage treatment plant effluents typically vary from 0 to 10 mg/L. Using ATSD Table B-3, the applicant applied an IDOD value of 1.1 mg/L for the SIWWTP effluent. The application indicates that this IDOD was taken from CCH's 1983 application. Therefore, EPA applied this value also.

According to the ATSD, effluent dissolved oxygen (DO_e) at the point of discharge from sewage treatments plants is often 0.0 mg/L. Consequently, the applicant and EPA have assumed a worst-case DO_e value of 0.0 mg/L.

For ambient dissolved oxygen (DO_a), the applicant applied a value of 5.57 mg/l, which the application indicates is the DO concentration from the August 3, 1999 sample at the 54 meter depth at station E2. For this evaluation, EPA calculated a DO_a value of 6.27 mg/l, by averaging the 13 ambient DO readings sampled at upcurrent reference station E6—at 1 meter intervals from the depth of the diffuser (71 meters) to the trapping depth (59 meters)—in July 2002.

Returning to ATSD Equation B-5, using the described input values, the applicant projected a final dissolved oxygen concentration in the receiving water at the plume trapping depth, DO_f , of 5.53 mg/l. In this evaluation, EPA used Equation B-5 and the described input values to project a final dissolved oxygen concentration, DO_f , of 6.20 mg/l.

Dissolved oxygen saturation in ocean waters is dependent on the water's temperature and salinity. If temperature and salinity are known, then the theoretical value (in mg/l) for DO at 100 percent saturation can be determined. For example, if the water temperature is 20° C and salinity is 36 parts per thousand, then the theoretical value for DO at 100 percent saturation is 7.4 mg/l. In contrast, if the water temperature is 25° C and salinity is 36 parts per thousand, then the theoretical value for DO at 100 percent saturation is 7.0 mg/l. ATSD Table B-4 gives theoretical values (in mg/l) for DO at 100 percent saturation, based on ambient temperature and salinity. The Hawaii water quality standard

for DO specifies that concentrations should not be not less than 75 percent saturation, based on ambient temperature and salinity. So, for example, to comply with the Hawaii water quality standard for DO, if ambient temperature and salinity are 25° C and 36 parts per thousand, respectively, then a projected DO_f value (in mg/l) must fall within the range of the DO concentration at 75 percent saturation or 5.25 mg/L, and the DO concentration at 100 percent saturation or 7.0 mg/L.

In their evaluation, the applicant projected a final dissolved oxygen concentration immediately following initial dilution (DO_f) of 5.53 mg/l. Although not using ATSD Table B-4 (Dissolved Oxygen Saturation Values), the applicant used a different source and determined that the theoretical DO concentration at 100 percent saturation was 6.81 mg/l, at an ambient temperature of 24.5° C and a salinity of 35 parts per thousand. (In contrast, EPA notes that ATSD Table B-4 would have yielded a theoretical DO concentration at 100 percent saturation of 7.05 mg/L.) For a DO concentration of 6.81 mg/l, the applicant indicated the corresponding DO concentration at 75 percent saturation is 5.11 mg/l. The applicant concluded that compliance with the Hawaii water quality standard for DO was achieved because the projected final dissolved oxygen concentration (DO_f) of 5.53 mg/l—at 81 percent of saturation—falls within the range of 75 and 100 percent saturation based on ambient temperature and salinity.

In this evaluation, EPA projected a final dissolved oxygen concentration immediately following initial dilution (DO_f) of 6.20 mg/l. Using ATSD Table B-4, at an ambient temperature of 24.5° C and a salinity of 35 parts per thousand, the theoretical DO concentration at 100 percent saturation is 7.05 mg/l and the corresponding DO concentration at 75 percent saturation is 5.29 mg/l. Compliance with the Hawaii water quality standard for DO is achieved because the projected final dissolved oxygen concentration (DO_f) of 6.20 mg/l—at 88 percent saturation—falls within the range of 75 and 100 percent saturation based on ambient temperature and salinity.

Farfield Dissolved Oxygen Depression Due to BOD Exertion

Subsequent to initial dilution, DO in the water column is consumed by biochemical oxygen demand (BOD) in the drifting wastefield. BOD consists of two components, a carbonaceous component (CBOD) and a nitrogenous component (NBOD). CBOD measures the oxidation of carbonaceous compounds and NBOD measures the oxidation of nitrogenous compounds. Both of these components can contribute to oxygen depletion in the farfield. This section evaluates whether farfield BOD exertion in the wastefield causes a violation of the Hawaii water quality standard for DO.

Both the applicant and EPA have relied on the following simplified mathematical model developed by Brooks (1960) to predict farfield dissolved oxygen as a function of travel time, $DO(t)$, in the Sand Island wastefield as it drifts in the coastal waters of Mamala Bay (ATSD, Equation B-16):

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

where:

- DO(t) = Dissolved oxygen concentration in a submerged wastefield as a function of travel time, t, in mg/l
- DO_a = Affected ambient dissolved oxygen concentration immediately updrift of the diffuser, in mg/l
- DO_f = Dissolved oxygen concentration at the completion of initial dilution, in mg/l, calculated using ATDS Equation B-5
- L_{fc} = Ultimate CBOD concentration above ambient at the completion of initial dilution, in mg/l
- k_c = CBOD decay rate coefficient
- L_{fn} = Ultimate NBOD concentration above ambient at the completion of initial dilution, in mg/l
- k_n = NBOD decay rate coefficient
- D_s = Dilution attained subsequent to initial dilution as a function of travel time

In ATSD Equation B-16, above, both ambient dissolved oxygen (DO_a) and dissolved oxygen at the completion of initial dilution (DO_f) are taken from ATSD, Equation B-5, described in the previous TDD section discussing the DO concentration upon completion of initial dilution. The applicant used a DO_a value of 5.57 mg/l and a DO_f value of 5.53 mg/l (assuming an IDOD of 1.1 mg/l). In this evaluation, EPA used a DO_a value of 6.27 mg/l and a DO_f value of 6.20 mg/l (assuming an IDOD of 1.1 mg/l).

According to the ATSD, nitrogenous BOD (NBOD) might not always contribute to oxygen depletion if the discharge is to open coastal waters where there are no other major discharges in the vicinity and the background population of nitrifying bacteria is negligible. Consequently, in this evaluation, the applicant and EPA have assumed that all oxygen depletion occurs in the first phase of the BOD reaction due to carbonaceous BOD (CBOD) and that the effect of NBOD on farfield oxygen depletion is negligible. Based on this assumption, the long-term (ultimate) CBOD (L_{fc}) can be estimated. Using ATSD, Equations B-10 and B-11, long-term (ultimate) BOD (BOD_{fu}) is first calculated and then set equal to L_{fc}, as shown in the following two equations:

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

where:

- BOD_f = Final BOD₅ concentration, in mg/l
- BOD_a = Affected ambient BOD₅ concentration immediately updrift of the

diffuser, from the diffuser port depth to the trapping depth, in mg/l

BOD_e = Effluent BOD_5 concentration, in mg/l

S_a = Initial dilution (flux-averaged)

and:

$$L_{fc} = BOD_{fu} = BOD_f \times 1.46$$

where:

BOD_{fu} = Ultimate BOD at the completion of initial dilution, in mg/l

The applicant indicated that ambient BOD (BOD_a) is generally very low in ocean waters and assumed 0 mg/l for this value. Based on the worst-case monthly maximum effluent BOD (BOD_e) value of 118 mg/l (from May 1998) and a critical initial dilution (S_a) of 150, the applicant calculated final BOD (BOD_f) at the completion of initial dilution as 0.79 mg/l. The applicant then converted BOD_f to the ultimate BOD (BOD_{fu}) value of 1.15 mg/l, by multiplying 0.79 mg/l and the constant 1.46. Because the applicant assumed that all oxygen depletion occurs in the first phase of the BOD reaction due to CBOD only, the ultimate COD (L_{fc}) value is set equal to the BOD_{fu} value of 1.15 mg/l.

In this analysis, EPA also assumed a value of 0 mg/L for BOD_a . Based on the current and proposed limit for effluent BOD (BOD_e) of 116 mg/l and a critical initial dilution (S_a) of 103, EPA calculated BOD_f at the completion of initial dilution as 1.13 mg/l. EPA then converted BOD_f to the ultimate BOD_{fu} value of 1.65 mg/l, by multiplying 1.13 mg/l and the constant 1.46. Because EPA assumed that all oxygen depletion occurs in the first phase of the BOD reaction due to CBOD only, the ultimate COD (L_{fc}) value is set equal to the BOD_{fu} value of 1.65 mg/l.

Returning to ATSD Equation B-16, because the carbonaceous BOD decay rate coefficient (k_c) is temperature dependent, the applicant recalculated a k_c value of 0.28/day at 24.5° C using ATSD Equation B-13:

$$k_c = 0.23 \times 1.047^{(T-20^\circ C)}$$

where:

T = Ambient receiving water temperature (°C)

In this analysis, EPA obtained the same result by using Equation B-13 to calculate a k_c value of 0.28/day at 24.5° C, where 24.5° C is the receiving water temperature at the trapping depth of 59 m, at upcurrent reference station E6 on July 2, 2002.

The value(s) for farfield dilution subsequent to initial dilution as a function of travel time (D_s) must now be calculated using ATSD Equations B-21 and B-18:

$$D_s = \text{erf} [1 / [1.5 / (1 + 12 e_0 t / b^2)^2 - 1]^{1/2}]$$

and:

$$e_0 = 0.001 \times b^{4/3} \text{ ft}^2/\text{sec}$$

where:

- e_0 = Diffusion coefficient when the width of the sewage wastefield at any distance from the ZID is equal to the initial width (approximately the longest dimension of the ZID) of the wastefield, in feet
- t = Travel time, in seconds
- b = Initial width of the sewage wastefield (approximately as the longest dimension of the ZID), in feet
- erf = Error function

For this calculation, the applicant specified that the initial width of the sewage wastefield (b) was 5,000 feet. In this analysis, EPA followed the ATSD and used the longest dimension of the ZID (b), 3,860 feet, to calculate the diffusion coefficient (e_0) of 60.55 ft^2/sec .

Now D_s , can be calculated for time intervals corresponding to the fall velocities of the particles in the wastestream. As shown in part below, the applicant ran a time series for 1 to 60 hours post initial dilution to calculate the corresponding values for D_s :

- $t_1 = 1$ hour, $D_s = 1.0$
 $t_2 = 2$ hours, $D_s = 1.2$
 $t_4 = 4$ hours, $D_s = 1.4$
 $t_8 = 8$ hours, $D_s = 1.6$
 $t_{12} = 12$ hours, $D_s = 1.9$
 $t_{16} = 16$ hours, $D_s = 2.3$
 $t_{24} = 24$ hours, $D_s = 3.2$
 $t_{32} = 32$ hours, $D_s = 4.0$
 $t_{48} = 48$ hours, $D_s = 5.8$
 $t_{60} = 60$ hours, $D_s = 7.0$

In this evaluation, EPA calculated the corresponding values for D_s post initial dilution, at the same time intervals:

- $t_1 = 1$ hour, $D_s = 0.96$
 $t_2 = 2$ hours, $D_s = 1.10$

$t_4 =$	4 hours,	$D_s =$	1.39
$t_8 =$	8 hours,	$D_s =$	1.96
$t_{12} =$	12 hours,	$D_s =$	2.53
$t_{16} =$	16 hours,	$D_s =$	3.11
$t_{24} =$	24 hours,	$D_s =$	4.26
$t_{32} =$	32 hours,	$D_s =$	5.40
$t_{48} =$	48 hours,	$D_s =$	7.70
$t_{60} =$	60 hours,	$D_s =$	9.42

The values described and/or calculated in the previous paragraphs are now used, by the applicant and EPA, in ATSD Equation B-16 to predict farfield dissolved oxygen as a function of travel time, $DO(t)$, where all oxygen depletion occurs in the first phase of the BOD reaction due to carbonaceous BOD:

$$DO(t) = [DO_a + ((DO_f - DO_a) / D_s)] - [(L_{fc} / D_s)(1 - \exp(-k_c t))]$$

The applicant reported the following time series and, based on this, concluded that the projected minimum dissolved oxygen concentration, $DO(t)$, is 5.42 mg/l which occurs 60 hours following initial dilution. The applicant stated that this corresponds to a projected maximum DO depletion and deficit of 0.106 mg/l.

$t_1 =$	1 hour,	$D_s =$	1.0,	where	$DO(t) =$	5.48 mg/l
$t_2 =$	2 hours,	$D_s =$	1.2,	where	$DO(t) =$	5.48 mg/l
$t_4 =$	4 hours,	$D_s =$	1.4,	where	$DO(t) =$	5.46 mg/l
$t_8 =$	8 hours,	$D_s =$	1.6,	where	$DO(t) =$	5.44 mg/l
$t_{12} =$	12 hours,	$D_s =$	1.9,	where	$DO(t) =$	5.43 mg/l
$t_{16} =$	16 hours,	$D_s =$	2.3,	where	$DO(t) =$	5.43 mg/l
$t_{24} =$	24 hours,	$D_s =$	3.2,	where	$DO(t) =$	5.43 mg/l
$t_{32} =$	32 hours,	$D_s =$	4.0,	where	$DO(t) =$	5.43 mg/l
$t_{48} =$	48 hours,	$D_s =$	5.8,	where	$DO(t) =$	5.44 mg/l
$t_{60} =$	60 hours,	$D_s =$	7.0,	where	$DO(t) =$	5.42 mg/l

Although not using ATSD Table B-4 (Dissolved Oxygen Saturation Values), as described earlier, the applicant used a different source and determined that the theoretical DO concentration at 100 percent saturation was 6.81 mg/l, at an ambient temperature of 24.5° C and a salinity of 35 parts per thousand. (In contrast, EPA notes that ATSD Table B-4 would have yielded a theoretical DO concentration at 100 percent saturation of 7.05 mg/l.) The corresponding DO concentration at 75 percent saturation is 5.11 mg/l. The applicant concluded that compliance with the Hawaii water quality standard for DO was achieved because the projected minimum dissolved oxygen concentration, $DO(t)$, of 5.42 mg/l— at 80 percent saturation—falls within the range of 75 and 100 percent saturation based on ambient temperature and salinity.

In this evaluation, EPA calculated the following time series and, based on this, concluded that the projected minimum dissolved oxygen concentration, $DO(t)$, is 6.17 mg/l which occurs one hour following initial dilution. This corresponds to a projected maximum DO

depletion and deficit of 0.1 mg/l, based on a minimum ambient dissolved oxygen (DO_a) value of 6.27 mg/l.

- t₁ = 1 hour, D_s = 0.96, where DO(t) = 6.17 mg/l
- t₂ = 2 hours, D_s = 1.10, where DO(t) = 6.17 mg/l
- t₄ = 4 hours, D_s = 1.39, where DO(t) = 6.16 mg/l
- t₈ = 8 hours, D_s = 1.96, where DO(t) = 6.16 mg/l
- t₁₂ = 12 hours, D_s = 2.53, where DO(t) = 6.16 mg/l
- t₁₆ = 16 hours, D_s = 3.11, where DO(t) = 6.16 mg/l
- t₂₄ = 24 hours, D_s = 4.26, where DO(t) = 6.16 mg/l
- t₃₂ = 32 hours, D_s = 5.40, where DO(t) = 6.16 mg/l
- t₄₈ = 48 hours, D_s = 7.70, where DO(t) = 6.17 mg/l
- t₆₀ = 60 hours, D_s = 9.42, where DO(t) = 6.17 mg/l

Using ATSD Table 6-4, at an ambient temperature of 24.5° C and a salinity of 35 parts per thousand, the theoretical DO concentration at 100 percent saturation is 7.05 mg/l and the corresponding DO concentration at 75 percent saturation is 5.29 mg/l. Compliance with the Hawaii water quality standard for DO is achieved because the projected minimum dissolved oxygen concentration, DO(t), of 6.17 mg/l—at 88 percent saturation—falls within the range of 75 and 100 percent saturation based on ambient temperature and salinity.

DO Depression Due to Steady-State Oxygen Demand

This calculation predicts the effect of sewage solids, which have accumulated on the ocean bottom, on DO concentration in the seawater. For this calculation, the ATSD presents the following equation (B-24):

$$\Delta DO = \bar{S}_b X_m / 86,400 \text{ UHD} = a \bar{S} k_d X_m / 86,400 \text{ UHD}$$

where:

- ΔDO = Oxygen depletion, mg/L
- X_m = Length of deposition area, m
- H = Average depth of water column influenced by sediment oxygen demand, measured above bottom, m
- U = Minimum sustained current over deposition area, m/sec
- k_d = Sediment decay rate constant
- a = Oxygen:sediment stoichiometric ratio

\bar{S} = Average concentration of deposited organic sediments over the deposition area, g/m²

D = Dilution caused by horizontal entrainment of ambient water as it passes over the deposition area

The applicant did not provide the detailed information needed to calculate equation B-24. Instead, the applicant provided estimates of steady-state oxygen demand using other methods.

Using estimates of average DO flux from studies conducted in 1984, the application indicates that sediment oxygen demand is “on the order of 0.077 mg/l” one-half meter above the sediment-water interface at the ZID. When 0.077 mg/l is subtracted from the DO_f of 5.53 mg/l, this calculation yields a DO concentration of 5.45 mg/l resulting from steady-state oxygen demand. This result is 80% of saturation at 6.81 mg/l, which satisfies the State water quality standard for a DO concentration not less than 75% of saturation.

The applicant’s estimated DO depression due to steady-state demand, 0.077 mg/l, subtracted from EPA’s ambient DO concentration following initial dilution, 6.20 mg/l, yields a DO concentration of 6.12 mg/l. This DO concentration is 87% of saturation at 7.05 mg/l, which satisfies the State water quality standard for a DO concentration not less than 75% of saturation.

The applicant also provided an alternate calculation of oxygen demand. Using an adaptation of the model described in Equation B-24 of the ATSD, the applicant calculated that the DO depression due to steady sediment oxygen demand was 0.088 mg/l. When 0.088 mg/l is subtracted from the DO_f of 5.53 mg/l, this calculation yields a DO concentration of 5.44 mg/l resulting from steady-state oxygen demand. This result is 80% of saturation at 6.81 mg/l., which satisfies the State water quality standard for a DO concentration not less than 75% of saturation.

The applicant’s estimated DO depression due to steady-state demand, 0.088 mg/l, subtracted from EPA’s ambient DO concentration following initial dilution, 6.20 mg/l, yields a DO concentration of 6.11 mg/l. This DO concentration is 87% of saturation at 7.05 mg/l, which satisfies the State water quality standard for a DO concentration not less than 75% of saturation.

Dissolved Oxygen Depression Due to Abrupt Sediment Resuspension

The applicant indicated that DO depression due to abrupt sediment resuspension was calculated using the following equation, B-29, found in the ATSD:

$$\Delta DO = \bar{S}_r / DH [1 - \exp(-k_r t / 24)]$$

where:

ΔDO	=	Oxygen depletion, mg/L
\bar{S}_r	=	Average concentration (in g/m^2) of resuspended organic sediment (based on 90-day accumulation), g/m^2
H	=	Depth of water volume containing resuspended materials, m
k_r	=	Decay rate of resuspended sediments,
t	=	Elapsed time following resuspension, h
D	=	Dilution caused by horizontal entrainment of ambient water as it passes over the deposition area,

However, the application does not contain the information needed to calculate this equation. Instead, the application only contains the result. Without showing data, the applicant concluded that oxygen due to resuspension of sediments reaches a maximum of approximately 0.05 mg/l of dissolved oxygen.

The applicant's calculated DO depression due to abrupt resuspension of bottom sediments, 0.05 mg/l, subtracted from the applicant's ambient DO concentration after initial dilution, 5.53 mg/l, yields a DO concentration of 5.48 mg/l. Thus, the applicant's DO concentration resulting from sediment resuspension, 5.48 mg/l, is 81% of saturation at 6.81 mg/l. This concentration satisfies the State water quality standard for a DO concentration not less than 75% of saturation.

The applicant's calculated DO depression due to abrupt resuspension of bottom sediments, 0.05 mg/l, subtracted from EPA's ambient DO concentration following initial dilution, 6.20 mg/l, yields a DO concentration of 6.15 mg/l. This DO concentration is 87% of saturation at 7.05 mg/L, which satisfies the State water quality standard for a DO concentration not less than 75% of saturation.

2. Turbidity, Light Extinction Coefficient, and Suspended Solids

In order to qualify for a variance from the secondary treatment standards for total suspended solids (TSS), 40 CFR 125.61(a) requires an applicant to demonstrate that the modified discharge will comply with State water quality standards for suspended solids, turbidity, light transmission, light scattering, or maintenance of the euphotic zone. There is no Hawaii water quality standard for TSS. Instead, Hawaii's water quality standards contain limits for turbidity and light extinction coefficient (LEC). In accordance with 40 CFR 125.62(a), these standards apply at the ZID boundary. In addition to assessing attainment of water quality standards for turbidity and LEC, EPA used a predictive model to assess whether the amount of suspended solids in the proposed discharge would likely cause a significant effect on water clarity in the vicinity of the discharge.

In Hawaii's water quality standards, turbidity is stated in terms of nephelometric turbidity units (NTU) and light extinction is defined as light extinction coefficient units (k). For Class A "wet" open coastal waters:

- Turbidity values shall not exceed a geometric mean of 0.50 NTU, 10% of values shall not exceed 1.25 NTU, and 2% of values shall not exceed 2.00 NTU; and
- Light extinction coefficient (LEC) values shall not exceed a geometric mean of 0.20 k, 10% of values shall not exceed 0.50 k, and 2% of values shall not exceed 0.85 k.

The existing 301(h)-modified permit requires quarterly monitoring for turbidity and LEC at five nearshore stations (C1, C2, C3, C4, and C5) and ten offshore stations (D1, D2, D3, D4, D5, E1, E2, E3, E4, and E5). At all nearshore and offshore stations, grab samples for turbidity are required at the surface, mid-depth, and bottom. The permit also requires the applicant to record the LEC value at each nearshore and offshore station.

The application refers to summaries included in AARs, but does not provide the specific data needed to assess turbidity and LEC levels for the present discharge. EPA reviewed the annual summaries for turbidity and LEC contained in the AARs from 1999 through 2005. The 2006 AAR was not submitted as of November 2007. As no data were submitted for the ZID boundary, EPA assessed attainment of water quality standards using data collected at the ZOM stations.

a. Turbidity

In the annual assessment summaries, the applicant analyzed turbidity data on an annual (calendar year) basis from offshore stations D2, D3, E2, and E3. Additionally, the applicant analyzed data from these same stations on a five-year basis in order to identify long-term impacts at the ZOM boundary. The AARs indicate that all turbidity values for the four stations around the ZOM were below the Hawaii water quality standard of 0.5 NTU for turbidity. However, data from these four stations appear to have been consolidated, resulting in one overall assessment of the ZOM rather than an assessment at each individual ZOM station. Without the raw data for each station, it is not possible for EPA to fully assess whether the discharge is meeting the Hawaii water quality standard for turbidity. Our overall analysis, however, suggests that the discharge should meet Hawaii water quality standard for turbidity.

b. Light Extinction Coefficient

A Secchi disk measures the transparency of the water. When lowered into the water column, the Secchi depth marks the point where the disk is no longer visible. The applicant recorded Secchi depths at each monitoring station and used this reading to calculate the LEC value for each nearshore and offshore monitoring station. LEC values were calculated from Secchi disk depths using a proportionality constant (k_2) of 1.7.

In accordance with Equation B-54 of the ATSD, LEC is calculated as:

$$\text{LEC} = k_2/\text{Secchi depth (in meters)}$$

where the proportionality constant, k_2 , is 1.7.

The application refers to annual report summaries from the AARs. EPA reviewed summaries of LEC data contained in AARs from 1999 through 2005. In these summaries, annual geometric means were calculated from LEC values reported from quarterly monitoring events. The applicant reported one calculated geometric mean, which appears to represent the four ZOM stations (E2, E3, D2, and D3). These geometric mean values ranged from 0.023 to 0.065 k units. All values were below the Hawaii water quality standard for LEC.

EPA reviewed LEC monitoring results for the years where the applicant submitted LEC and Secchi disk data. The applicant submitted LEC and Secchi disk data from nearshore waters for the years 2002, 2003, 2004, and 2006 and data from offshore waters in the years 2003, 2004, and 2006. EPA reviewed data from the stations identified in the permit, as well as the following additional stations created and monitored by the applicant: C1A, C2A, C3A, C5A, C6, D3A, D6, and E6.

For the years reviewed, LEC values ranged from 0.08 to 0.21 k in nearshore waters and from 0.047 to 0.109 k in offshore waters. In nearshore waters, annual geometric mean values exceeded the State water quality standard for turbidity at two stations, C5 and C3A. In 2004, the annual geometric mean at station C5 was 0.21 k. At station C5, the LEC reading was 0.49 on January 15th. The other two readings taken that year at station C5 were below the LEC criterion. In 2006, the annual geometric mean was 0.21 k at station C3A. At station C3A, two of the four individual readings were above the LEC criterion in 2006. The reading from March 30th was 0.21 k and the reading from May 17th was 0.9 k.

Based on these data, LEC values at most stations in most years were below the Hawaii water quality standard.

c. Suspended Solids

Although there is no water quality standard for suspended solids, EPA used the ATSD to assess the likelihood that the discharge will cause a substantial effect in the water column. The concentration of suspended solids at the completion of initial dilution is calculated using Equation B-31 from the ATSD:

$$\text{SS}_f = \text{SS}_a + (\text{SS}_e - \text{SS}_a)/S_a$$

where:

SS _f	=	Suspended solids concentration at completion of initial dilution, mg/l
SS _a	=	Affected ambient suspended solids concentration immediately upcurrent of the diffuser averaged from the diffuser port to the trapping level, mg/l
SS _e	=	Effluent suspended solids concentration, mg/l
S _a	=	Initial dilution

The applicant obtained a worst-case increase in suspended solids of 0.71 mg/l by using an ambient measurement of 2.0 mg/l, the peak daily effluent suspended solids concentration of 108 mg/l for 2002, and a minimum initial dilution of 150. The applicant calculated SS_f to be 2.71 mg/l.

On page III-17 of the application, the applicant presents the calculated amount of suspended solids under the most stratified condition. The applicant indicated that a predicted initial dilution of 106.3:1 was determined for the most stratified condition. Using 106.3 as S_a, rather than using 150 as S_a, the applicant calculated that the suspended solids at completion of initial dilution would be 1.0 mg/l higher than the ambient concentration of 2.0 mg/l. Consequently, under the most stratified conditions, the applicant calculated SS_f to be 3.0 mg/l.

EPA recalculated the worst-case increase using the revised initial dilution of 103 with an SS_a of 2.0 mg/l and an SS_e of 69 mg/l, which is the average monthly permit limit. EPA obtained a worst-case increase in suspended solids of 0.65 mg/l and, consequently, calculated SS_f to be 2.65 mg/l. This is a 32.5% increase due to the discharge.

The ATSD indicates that an increase in suspended solids at the completion of initial dilution of less than 10 percent is not likely to present a substantial effect in the water column. Both the applicant and EPA calculated worst-case increases in suspended solids greater than 10 percent because a very low ambient concentration was applied in Equation B-31.

The ATSD notes that seabed deposition could still be substantial, depending on the mass emission rate of suspended solids and ambient currents at the discharge site, and should be evaluated. EPA reviewed seabed deposition data provided by the applicant and found no accumulation of solids (see section 3.d. in this document).

3. DO, Turbidity, and LEC Conclusions

Overall, the applicant has demonstrated the ability to meet the Hawaii water quality standards for DO, turbidity, and LEC at and beyond the ZID. Our review of the receiving water monitoring data indicates that the outfall does not have a significant effect on the receiving waters for these parameters.

EPA assessed whether the proposed discharge would meet the Hawaii water quality standard for DO by reviewing past ambient monitoring data and by calculating DO values using predictive modeling. EPA's review of past monitoring data indicated that DO levels near the outfall have met the water quality standard except on a few occasions. With the exception of the March 2006 monitoring event, EPA's review indicated that all ZOM stations and offshore stations beyond the ZOM met the DO standard (no data are available at the ZID boundary). Likewise, with two exceptions (November 2000 and July 2002), EPA's review indicated that nearshore stations met the DO standard. Furthermore, EPA's assessment of the impact on DO levels based on predictive modeling indicates that the proposed discharge would result in attainment of the DO standard following initial dilution, in the farfield, due to the steady-state sediment oxygen demand, and due to abrupt resuspension of sediment. Therefore, EPA concludes that that proposed discharge would consistently attain the Hawaii water quality standard for DO.

EPA concludes that the proposed discharge will consistently attain the Hawaii water quality standards for turbidity and LEC. Water quality exceeded the LEC standard in nearshore waters on a few occasions, but there were no exceedances in offshore waters, where effects of the discharge would be most likely. Although the analysis of suspended solids predicted a 32.5% increase in the concentration of suspended solids in ambient waters due to the discharge, this prediction is only a 0.65 mg/l increase in magnitude. Overall, therefore, EPA concludes that the proposed discharge will not cause exceedances of the Hawaii water quality standards related to suspended solids.

C. Attainment of Other Water Quality Standards and Impact of Discharge on Public Water Supplies; Shellfish, Fish and Wildlife; and Recreation

Section 301(h) generally contemplates that, in order to qualify for a variance, a discharge must protect human health and the environment. Specifically, section 301(h)(2) requires that the applicant's discharge must maintain water quality which assures protection of public water supplies; assures protection and propagation of a balanced indigenous population of shellfish, fish and wildlife; and allows recreational activities. In addition, section 301(h)(9) requires that the applicant must be discharging effluent which meets the criteria established under section 304(a)(1) after initial dilution. This portion of the TDD addresses these requirements as specified in EPA regulations, most specifically in 40 CFR 125.62.

1. Attainment of Other Water Quality Standards and Criteria

40 CFR 125.62(a) requires that the applicant's outfall and diffuser be located and designed to provide adequate initial dilution, dispersion, and transport of wastewater such that the discharge does not exceed, at and beyond the ZID, all applicable water quality standards and, for pollutants for which there are no EPA-approved standards, section 304(a) criteria. Additionally, 40 CFR 125.59(b)(1) prohibits issuance of a modified permit that would not assure compliance with all applicable requirements of Part 122, one of which is that a permit must ensure compliance with all water quality standards [40

CFR 122.4(d) and 122.44(d)]. For purposes of this review, the applicable water quality standards are analyzed in five categories: bacteria, toxics, whole effluent toxicity, nutrients, and pH. The ability of the proposed discharge to attain water quality standards associated with BOD and TSS were assessed in section B of this TDD.

a. Bacteria

Water quality criteria for bacterial indicators protect human health by limiting pathogens in waters designated for recreational uses, thereby reducing the risk of illness resulting from exposure to pathogenic organisms in recreational waters. Enterococcus is the bacterial indicator applied to marine waters.

Present water quality standards applicable to Hawaii's marine waters are the following:

- 1) Hawaii Administrative Rules (HAR) – as amended October 2004:
Within 300 meters (1000 feet) of the shoreline, HAR Chapter 11-54-8 applies specific criteria for marine recreational waters:
 - Enterococci bacteria content shall not exceed a geometric mean of seven colony-forming units (cfu) per 100 milliliters (ml) in not less than five samples spaced to cover a period between 25 and 30 days.
 - No single sample shall exceed the single sample maximum of 100 cfu per 100 ml.
 - At locations where sampling is less frequent than five samples per 25 to 30 days, no single sample shall exceed the single sample maximum nor shall the geometric mean of these samples taken during the 30-day period exceed seven cfu per 100 ml.
- 2) In response to the Beaches Environmental Assessment and Coastal Health (BEACH) Act of 2000, EPA promulgated bacteria criteria for coastal recreational waters on November 16, 2004, based on EPA's *Ambient Water Quality Criteria for Bacteria* (1986). These criteria became effective on December 16, 2004 and applied to Hawaii's marine waters not previously protected by State criteria. Therefore, 40 CFR Section 131.41(c)(2) applies the following criteria to Hawaii's marine waters between 300 meters (1000 feet) from shore and three miles from shore:
 - Enterococci bacteria content shall not exceed a geometric mean of 35 cfu per 100 ml
 - No single sample shall exceed the single sample maximum of 501 cfu per 100 ml. [In 40 CFR Section 131.41(c)(2)(C), EPA promulgated a range of four single sample maximum values between 104 and 501 cfu per 100ml. EPA's rule expects States to apply the appropriate single sample maximum value

based on use of coastal recreation waters. HDOH informed EPA that the single sample value of 501 cfu per 100 ml is appropriate for waters beyond 300 m (1,000 ft) from shore due to infrequent recreational use in these waters (Lau, 6 September 2005 letter). However, HDOH has not yet amended HAR Chapter 11-54 to formally adopt a single sample value applicable to these waters. Additionally, HDOH issued an NPDES permit for the Kailua Regional Wastewater Treatment Plant (Permit No. HI0021296) on August 3, 2006 and applied a single sample maximum value of 104 cfu per 100 ml as a permit limitation in waters beyond 300 m (1,000 ft) from shore. Consequently, this review assesses both single sample maximum values.]

- 3) In the Federal Register (Vol. 69, No. 220) notice accompanying the final rule for water quality criteria for bacteria in coastal waters, EPA responded to a comment on the proposed rule suggesting that criteria should only apply at depths less than 150 feet (46 m). EPA did not find the comment persuasive in light of the clear language of Clean Water Act sections 303(i) and 502(21), which required adoption of criteria for all of the coastal or Great Lake waters designated by the State for use for swimming, bathing, surfing, or similar water contact activities even if the waters designated for swimming are not frequently or typically used for swimming. The SIWWTP discharges to Class A open coastal waters. HAR Chapter 11-54-3 (Classification of water uses) states:

It is the objective of class A waters that their use for recreational and aesthetic enjoyment be protected. Any other use shall be permitted as long as it is comparable with the protection and propagation of fish, shellfish, wildlife, and with recreation in and on these waters. These waters shall not act as receiving waters for any discharge which has not received the best degree of treatment or control compatible with the criteria established for this class.

The existing SIWWTP permit requires the applicant to conduct the following water quality monitoring:

Shoreline – Sample enterococci densities at five shoreline stations (S1, S2, S5, S7, and S8) seven days each month at the surface.

Recreational Waters² – Sample enterococci densities at three recreational waters stations (R1, R2, and R3) seven days each month at one meter below the surface, mid-depth, and 2 m above the bottom.

Nearshore – Sample enterococci densities at five nearshore stations (C1, C2, C3, C4, and C5) seven days each month at one meter below the surface, mid-depth,

² Although these specific locations are labeled “recreational waters” in the existing permit, all the locations are considered to be recreational waters under the BEACH Act rule and Hawaii’s water quality standards, as discussed above.

and 2 m above the bottom. The applicant started monitoring six additional nearshore stations (C1A, C2A, C3A, C4A, C5A, and C6) in late 1999. Due to dynamic surf conditions close to shore, the applicant indicates nearshore stations were located approximately 500 to 1000 meters (1640 to 3280 feet) from shore, at depths up to 20 meters.

Offshore – Sample enterococci densities at ten offshore stations (D1, D2, D3, D4, D5, E1, E2, E3, E4, and E5) once a month at one meter below the surface, mid-depth, and 2 m above the bottom. The applicant started monitoring three additional offshore stations (D3A, D6, and E6) in 1999. The applicant describes these three stations as alternate stations and, additionally, designates D6 and E6 as reference stations. Stations are located approximately 1500 to 2800 meters (5000 to 9000 feet) from shore.

In EPA's review, attainment of HAR Chapter 11-54-8 recreational standards was assessed at the five shoreline and three recreational waters stations. Attainment of EPA's promulgated criteria was assessed at the eleven nearshore stations and the thirteen offshore stations (Figure 3).

Data Analyses

In Appendix E of the application, CCH summarized geometric means for enterococcus densities at five shoreline stations, three recreational, ten nearshore, and eleven offshore stations for an undisclosed period of time. The application contains statistical assessments of data collected from the monitoring stations. In Appendix E, the applicant also presented assessments of geometric means along transects starting at the shoreline and extending out to the offshore monitoring stations and also along transects perpendicular to the shoreline. For example, one transect analyzed by the applicant compared geometric mean densities at the following stations: R1, R2, C2, C2A, D2, and E2 while another compared all shoreline stations.

In addition to the summaries in the application, the applicant also provided EPA with a database of shoreline, recreational waters, nearshore, and offshore monitoring results for the period from January 1998 through August 2007. EPA reviewed these data in addition to the applicant's AARs for the years from 1999 through 2005. In EPA's review, monitoring data are compared to the appropriate geometric mean and single sample maximum value. Both parts of the criteria are applicable to Hawaii's marine waters and must be used to determine whether Hawaii's water quality criteria are met and uses protected.

The single sample maximum value allows a single data point to be evaluated. It is a tool for making beach notification and closure decisions and is an appropriate tool for determining whether water quality on a particular day is protective of the designated use.

A geometric mean represents the central tendency of a series of data points. The best way to interpret a series of bacterial measurements taken over a period of time is in

comparison to the geometric mean. HAR Chapter 11-54-8 states that the geometric mean applies to samples taken in a twenty-five to thirty day period but does not dictate a monthly period versus a rolling or running period. EPA did not specify in the final promulgated rule for bacteria criteria how the averaging period for the geometric mean must be applied. The preamble to the rule (Federal Register Vol. 69, No. 220) recommends that the averaging period be applied as a rolling or running average. EPA expected most States would apply the averaging period as a rolling average; however, EPA also recognized that it would be technically appropriate to apply the averaging period on a set basis such as monthly. For ease in this review, geometric means were developed based on a monthly period. For shoreline, recreational waters, nearshore, and offshore stations, monthly geometric mean averages were generally based on seven or eight samples.

Shoreline

More than 3,700 samples were collected at the five shoreline monitoring sites between January 1999 and August 2007. Throughout this 104 month period, there were a total of 114 exceedances of the geometric mean criterion (7 cfu/100 ml) at the five shoreline stations. Of these 114 exceedances, the greatest number occurred at station S8 and the fewest occurred at station S2. There were 21 exceedances of the monthly geometric mean at station S1, two at station S2, 34 at station S5, 12 at station S7, and 45 at station S8.

In August 2004, the Hawaii Department of Health amended HAR Chapter 11-54-8 to adopt a single sample maximum value of 100 cfu/100 ml for enterococcus concentrations in marine waters within 300 meters (1000 feet) from shore. The new State criterion became effective in October 2004. Consequently, this review compares the single sample criterion against samples collected after January 2005.

During 2005, 19 shoreline samples exceeded the single sample criterion of 100 cfu/100 ml. Enterococcus densities ranged up to 1,900 cfu/100 ml. Of these exceedances of the single sample criterion, seven were at station S1, three at station S5, two at station S7, and seven at station S8. There were no exceedances at station S2.

During 2006, 14 shoreline samples exceeded 100 cfu/ 100 ml. Enterococcus densities ranged up to 880 cfu/100 ml. Of these single sample exceedances, eight were at station S1, one was at station S5, two were at station S7, and three were at station S8. There were no exceedances at station S2.

During the first eight months of 2007, two shoreline samples exceeded the single sample criterion. At station S7, the enterococcus concentration detected in the February 13th sample was 290 cfu/100 ml, and the concentration in the March 25th sample was 510 cfu/100 ml.

In Appendix E, the applicant asserts that exceedances in the surface samples are from non-point source runoff. Although shoreline samples were only taken at the surface,

EPA's review of monitoring results from the recreational waters stations at surface, middle, and bottom depths, as presented in the next paragraphs, supports this claim. Because the likely source of shoreline exceedances is non-point source runoff, EPA concludes that shoreline stations do not appear to be exceeding water quality standards due to influence from the discharge.

Recreational Waters

Between January 2000 and August 2007, more than 5,600 samples were collected at the three stations designated in the Sand Island NPDES permit as recreational waters stations (R1, R2, and R3). At each station, samples were collected at the surface, mid-depth (5-7 meters [16-23 ft]), and bottom depth (9-14 meters [30-46 ft]). In the 2005 AAR, the applicant applied the Hawaii state water quality criteria for enterococci (geometric mean of 7 cfu/100 ml and single sample maximum value of 100 cfu/100 ml) to sampling results from the three recreational waters stations. Prior to December 2004, Hawaii's waters quality standards did not contain a single sample criterion.

Throughout this period of more than seven years, there were a total of 22 exceedances of the geometric mean criterion (7 cfu/100 ml) at all depths of the three recreational waters stations. Of these 22 exceedances, the greatest number occurred at the surface depth. Over this entire period, there were fifteen exceedances in surface samples, three in mid-depth samples, and four in bottom samples. A review of exceedances by station indicated that 12 of the 22 exceedances occurred at station R3, which is located in the boat channel at the mouth of Keehi Lagoon. When reviewed by month, all 22 exceedances occurred in the wet half of the year when non-point source runoff from rain increases.

EPA assessed single sample results from recreational waters samples for the period between January 2005 and August 2007, after the State single sample criterion became effective. During this period, 44 of the 1,962 recreational waters samples exceeded the single sample criterion of 100 cfu/100 ml. Enterococcus densities ranged up to 2000 cfu/100 ml. Of these exceedances of the single sample criterion, 12 were at station R1, 13 were at station R2, and 19 were at station R3. When reviewed by depth, 38 of the 44 exceedances were in surface samples, one in the mid-depth samples, and five in the bottom samples. When reviewed by year, 19 of the 44 exceedances occurred in 2005, 24 in 2006, and one in 2007. All exceedances of the single sample maximum criterion occurred in the months between mid-October and early April, which is considered the rainy season in Hawaii. In 2007, when rainfall was low in the traditionally wet portions of the year, the number of single sample exceedances was far fewer compared to the same months of 2005 and 2006. In fact, NOAA rain gauges at the Honolulu International Airport indicated that rainfall for the entire year-to-date as of September 2007 was 30% of normal (NOAA, 2007).

Overall, exceedances at the three recreational waters stations occurred mainly in the rainy months and generally in the surface samples. EPA cannot rule out the contribution from non-point sources of bacterial contamination.

Nearshore

Prior to EPA's promulgation of bacteria criteria, the State of Hawaii had not applied bacteria criteria to waters beyond 300 meters (1000 feet) from shore. Hawaii's water quality standards only contained a trigger to resample when enterococcus counts exceeded 70 cfu/100 ml. As of December 2004, EPA's promulgated criteria, both the geometric mean and a single sample maximum value, apply to these nearshore waters.

Between January 2005 and August 2007, after EPA's promulgated criteria became effective, the applicant collected approximately 3,615 samples from the five nearshore monitoring sites designated in the permit (C1, C2, C3, C4, and C5). In addition to the monitoring stations required by the permit, the applicant also monitored nearshore waters at stations C1A, C2A, C3A, C5A and C6, which are described by the applicant as alternate stations. These stations are located between nearshore and offshore waters. In all, approximately 7,230 samples from ten stations in nearshore waters were collected, analyzed, and assessed since January 2005. All nearshore stations were monitored at the surface, mid-depth (6 to 10 m [20 to 33 ft]), and bottom of the water column (10 to 20 m [33 to 66 ft]).

In 2005, there was one exceedance of the monthly geometric mean in the surface samples, four exceedances in the mid-depth samples, and seven exceedances in the bottom samples. The exceedance at the surface was from the sample taken in December at station C3A. The four mid-depth exceedances were from samples taken in January, February, and December at stations C3A, C4, or C5A. The seven exceedances in the bottom were from samples taken at stations C1A, C2A, C3, and C3A in the months of January, November, or December. All exceedances were in the rainy season.

In 2005, the single sample value of 501 cfu/100 ml was exceeded a total of 26 times. There were five exceedances of the single sample criterion at the surface, six at mid-depth, and 15 at the bottom of the water column. Six of the 15 exceedances in the bottom samples were at station C3A.

If the single sample maximum limit is set at 104 cfu/100 ml, there were a total of 222 exceedances in 2005. Of these 222 exceedances, 56 were at the surface, 72 were at mid-depth, and 94 were in bottom samples.

In 2006, there were no exceedances of the monthly geometric mean criterion in the surface or mid-depth samples, but there were four exceedances in samples collected at the bottom depth. These four exceedances were from the bottom depth of stations C1A, C2A, and C3A. Three of the four exceedances occurred in the month of March. The fourth exceedance of the year occurred in April at station C3A, which is located above the outfall pipe but not above the diffuser.

In 2006, the single sample value of 501 cfu/100 ml was exceeded in 22 samples. Of these 22 exceedances, there were six at the surface, four at mid-depth, and 12 at the bottom of the water column.

If the single sample maximum limit is set at 104 cfu/100 ml, there were a total of 122 exceedances in 2006. Of these 122 exceedances, 31 were at the surface, 32 at mid-depth, and 59 at the bottom of the water column.

In November 2006, CCH installed and began operating an ultraviolet disinfection unit to disinfect SIWWTP effluent. Between November 2006 and September 2007, the disinfection unit was operated in start-up mode. The existing permit requires the unit to be operated on a one-year trial period. This one-year period began in September 2007.

In the first eight months of 2007, there were no exceedances of the monthly geometric mean in samples from nearshore waters. Likewise, there were no exceedances of either single sample maximum value.

Thus, without the use of UV disinfection, data from 2005 and 2006 show that there were many exceedances of the promulgated water quality criteria for bacteria in 2005 and 2006 at the ZOM, and there is no clear alternative explanation. However, there have been no exceedances of the bacteria criteria since the applicant began operating the UV disinfection unit. Therefore, without disinfection, discharge likely causes exceedances of the water quality standard for bacteria in nearshore water, but this apparently can be prevented with the use of UV disinfection.

Offshore

The applicant submitted monitoring data from 13 offshore monitoring stations. None of these stations are located within or at the edge of the ZID. Five stations (D2, D3, D3A, E2, and E3) are located at the edge of the ZOM. Stations D1 and E1 are located on the Pearl Harbor side of the ZOM, and stations D4, D5, D6, E4, E5, and E6 are located on the Diamond Head side of the ZOM. All E stations are seaward of the D stations.

Prior to EPA's promulgation of bacteria criteria, the State of Hawaii had not applied bacteria criteria to waters beyond 300 meters (1000 feet) from shore. Hawaii's water quality standards only contained a trigger to resample when enterococcus counts exceeded 70 cfu/100 ml. As of December 2004, EPA's promulgated criteria, both the geometric mean and a single sample maximum value, apply to these offshore waters. Therefore, this review focuses on data collected after the beginning of 2005. Between January 2005 and August 2007, after EPA's promulgated criteria became effective, the applicant collected approximately 9,282 samples from the 13 offshore monitoring sites. Samples were collected approximately seven to eight times a month. All offshore stations were monitored at the surface, mid-depth (25 to 50 m [82 to 164 ft]), and bottom of the water column (50 to 100 m [164 to 328 ft]).

In 2005, the total number of samples collected and assessed from all offshore stations was 3,471, including samples from the four stations located on the ZOM and nine stations located beyond the ZOM, some of which are viewed by the applicant as reference stations. There were a total of 128 exceedances of the monthly geometric mean

criterion in all offshore stations at all depths. Of these 128 exceedances, there were six in the surface samples, 44 in the mid-depth samples, and 78 in the samples collected from the bottom of the water column. In the six surface samples exceeding the criterion, monthly geometric mean values ranged between 39 and 123 cfu/100 ml. Exceedances occurred at stations D3, D3A, D5, E3, E4, and E5 in the months of January, February, and October. In the 44 mid-depth samples exceeding the criterion, monthly geometric mean values ranged between 37 and 346 cfu/100 ml. Exceedances occurred at all mid-depth stations except E6 and in every month of the year. The greatest number of exceedances occurred at stations E1, E2, and E3 in the mid-depth samples. In the 78 bottom samples exceeding the criterion, monthly geometric mean values ranged between 36 and 755 cfu/100 ml. Exceedances occurred at all bottom stations except E5 and E6 and in every month of the year. In the bottom samples, the greatest number of exceedances occurred at stations D1, D2, D3, D3A, E2, and E3. There were exceedances at these stations in at least ten of the twelve months of the year. Furthermore, the geometric means for stations D2 and D3A exceeded the criterion in every month of the year.

In 2005, the single sample maximum value of 501 cfu/100 ml was exceeded in 313 samples. Of these 313 exceedances, there were 29 at the surface, 111 at mid-depth, and 173 at the bottom of the water column. Single sample values exceeding the criterion ranged up to 1600 cfu/100 ml in the surface samples; 4,900 cfu/100 ml in the mid-depth samples; and 5,400 cfu/100 ml in the bottom samples.

If the single sample maximum limit is set at 104 cfu/100 ml, there were a total of 651 exceedances in 2005. Of these 651 exceedances, 128 were at the surface, 166 at mid-depth, and 357 at the bottom of the water column.

In 2006, there were a total of 82 exceedances of the monthly geometric mean criterion in all offshore stations, at all depths. The total number of samples collected and assessed from all offshore stations in 2006 was 3,549, including samples from the four stations located on the ZOM and nine stations located beyond the ZOM, some of which are viewed by the applicant as reference stations. There were seven exceedances in the surface samples, 24 in the mid-depth samples, and 51 in the samples collected from the bottom of the water column. In the seven surface samples exceeding the criterion, monthly geometric mean values ranged between 38 and 75 cfu/100 ml. Exceedances occurred at stations D2, D3, D3A, D5, and E2 in the months of January, February, and March. In the 24 mid-depth samples exceeding the criterion, monthly geometric mean values ranged between 37 and 184 cfu/100 ml. Exceedances occurred at stations D2, D3, D3A, D4, E1, E2, E3, E4, and E5. Exceedances occurred in every month except March, November, and December. The greatest number of exceedances occurred at stations D2, D3, D3A, E2, and E3. In the bottom samples exceeding the criterion, monthly geometric mean values ranged between 37 and 580 cfu/100 ml. Exceedances occurred at D1, D2, D3, D3A, D4, E1, E2, and E3. There were exceedances at these stations in at least eleven of the twelve months of the year. The greatest number of exceedances occurred at stations D2, D3, D3A, E2, and E3, which are the stations located on the ZOM.

In 2006, the single sample value of 501 cfu/100 ml was exceeded in 242 samples. Of these 242 exceedances, there were 24 at the surface, 79 at mid-depth, and 139 at the bottom of the water column. Single sample values exceeding the criterion ranged up to 1,700 cfu/100 ml in the surface samples; 4,900 cfu/100 ml in the mid-depth samples; and 8,100 cfu/100 ml in the bottom samples.

If the single sample maximum limit is set at 104 cfu/100 ml, there were a total of 611 exceedances in 2006. Of these 611 exceedances, 112 were at the surface, 212 at mid-depth, and 287 at the bottom of the water column.

In 2005 and 2006, bacteria concentrations frequently exceeded applicable criteria, but this was not the case for 2007. In 2,262 samples collected in the first eight months of 2007, there were no exceedances of the monthly geometric mean in samples from offshore waters. Likewise, there were no exceedances of either single sample maximum value. Thus, the new ultraviolet (UV) disinfection unit installed at the SIWWTP in the end of 2006 appears to be effectively reducing the enterococcus concentration in the offshore receiving waters.

Conclusion

EPA concludes that bacterial concentrations associated with the discharge of wastewater from the Sand Island outfall do not meet current water quality standards without disinfection. This conclusion is based on EPA's review of receiving water monitoring data relative to HAR Chapter 11-54 and EPA's promulgated criteria for bacteria in coastal waters.

The applicant, however, is now operating a UV system to disinfect the effluent. The applicant has indicated that this disinfection process is a standby unit to be used when needed (when onshore currents prevail or Kona winds occur). The application also states that disinfection will be used as needed to assure protection of public health from municipal wastewater that has the potential to enter recreational waters.

The efficacy of continuous UV disinfection with primary effluent is not well understood. Consequently, the 1998 permit required continuous operation for one year to determine the ability of this treatment system to achieve water quality standards for bacteria. The permit contained a compliance schedule which required construction of the disinfection facility by July 20, 2002 and continuous operation of the SIWWTP disinfection facility for one year starting on July 21, 2002.

Given the delays with construction of the UV system and other upgrades to the SIWWTP, in September 2002, EPA ordered (Docket Number CWA-402-9-02-61) the applicant to submit a plan to ensure schedules for completion of all Sand Island WWTP upgrade projects required by 1998 permit. Despite this order, the applicant only began the pilot testing period in September 2007, although preliminary use of the UV system began in November 2006.

The preliminary data indicate that the UV system can adequately disinfect the SIWWTP effluent. Therefore, notwithstanding the limitations of the data available at this time, EPA concludes that the proposed discharge can meet water quality standards for bacteria, provided CCH adequately operates and maintains the UV disinfection system.

b. Toxics

In accordance with 40 CFR 125.66, which implements CWA section 301(h)(7), the applicant is required to provide a chemical analysis of its effluent under both wet and dry weather conditions for the priority toxic pollutants and pesticides defined in 40 CFR 125.58(p) and (aa). The present discharge permit requires the applicant to conduct a priority toxic pollutant and pesticide scan once every six months on 24-hour composite samples of the wastewater treatment plant's influent and effluent. In addition, the permit requires the applicant to monitor the pesticides chlordane and dieldrin in the wastewater treatment plant's influent and effluent once each month.

Although the applicant computed a critical initial dilution of 150:1 in section III.A.1 of the application, this dilution value was not used in the applicant's effluent analyses for priority pollutants and pesticides in the application. The application does not present a proper effluent assessment of all priority toxic pollutants and pesticides after using appropriate initial dilution values (i.e. applying the minimum [or critical] dilution value to non-carcinogens and the average dilution value for carcinogens). The applicant discusses the pesticides chlordane and dieldrin in Appendix D of the application. In Appendix D, the applicant discusses sources of these pesticides and also describes work conducted by CCH to locate routes of entry into the SIWWTP. Priority toxic pollutants and pesticides are discussed in Appendix H of the application, but the focus is on concentrations in fish tissue and sediment. However, the AARs, which are required by the NPDES permit, do contain assessments of priority toxic pollutant and pesticide concentrations detected in the effluent. Each AAR contains a "Summary of Detected Priority Pollutants, 301(h) Pesticides and Additional Water Quality Analytes" which addresses samples collected from the influent, primary, and final effluent. Final effluent results are also reported on the applicant's monthly DMRs, as required by the NPDES permit.

In each AAR, the applicant determined a minimum and an average initial dilution value at the plume trapping depth based on receiving water temperature and salinity profiles collected for the year reviewed. CCH usually collects receiving water temperature and salinity profiles approximately four times each year. For each year, CCH used either the UM or RSB models contained in EPA's PLUMES dilution model to estimate a minimum (or critical) dilution value based on the maximum average flow rate for the year and profiles collected for the year. The profile producing the lowest minimum average dilution value for the year determined the critical (or minimum) dilution values for the year. The applicant evaluated compliance with all State water quality standards and Federal water quality criteria using the minimum dilution value calculated for each year. For the years from 1999 through 2005, these minimum dilution values ranged from 128.5 to 523. As of November 2007, was not submitted for EPA's review. Therefore, the most

recent dilution value calculated by the applicant could not be considered in this tentative decision.

In a similar manner, the applicant determined average dilution values based on a design flow and presented these values in the AARs. In the AARs for 1999 through 2002, the applicant applied a design flow of 90.9 MGD, while the design flow of 82 MGD was applied in AARs from 2003 through 2005. There was no explanation for the use of different design flows. Average dilution values reported by the applicant in AARs ranged from 126.7 to 495.3. However, these average dilution values were not used by the applicant to evaluate compliance with State water quality standards and Federal water quality criteria.

State numeric water quality standards for toxic pollutants listed in HAR 11-54-4(b)(3) provide acute and chronic criteria to protect aquatic life and criteria to protect human health from exposure to pollutants through fish consumption. This list also identifies toxic pollutants as carcinogens. In accordance with HAR 11-54-4(b)(3) and the HDOH *State Toxics Control Program: Derivation of Water Quality-Based Discharge Toxicity Limits for Biomonitoring and Specific Pollutants* (1989), the minimum (critical) initial dilution value is used by EPA when comparing toxic pollutant and pesticide concentrations to State and Federal chronic criteria for aquatic life and non-carcinogen fish consumption criteria for human health. The average initial dilution value is used by EPA when comparing toxic pollutant and pesticide concentrations to State and Federal human health fish consumption criteria for carcinogens.

As explained earlier under “Initial Dilution” in this review, EPA’s recalculated critical (or minimum) initial dilution value is 103:1 and the average initial dilution value is 294:1. These are the values applied by EPA to State water quality standards and Federal water quality criteria for the discharges from this facility.

After the minimum (or critical) initial dilution value of 103:1 computed by EPA is applied to detected effluent concentrations, all the resulting priority toxic pollutant and pesticide values from the 17 samples collected from February 1999 through February 2007, and reported on DMRs, were below the applicable State and Federal chronic criteria and non-carcinogen fish consumption criteria for human health, with one exception. The sample taken in February 1999 contained a chlordane concentration of 2.96 µg/l. When the critical initial dilution value of 103:1 is applied to this concentration, the chlordane concentration in the receiving water at the ZID is calculated to be 0.029 µg/l. This value exceeds the State and Federal chronic criterion of 0.004 µg/l, which protects aquatic life.

After the average initial dilution value of 294:1 computed by EPA is applied to detected effluent concentrations, the resulting concentrations of two pesticides (chlordane and dieldrin) exceeded the State carcinogen fish consumption criteria for human health on a regular basis. HAR 11-54-4(b)(2)(C) requires State fish consumption standards for pollutants identified as carcinogens to be assessed as an average during any 12 month period.

EPA reviewed the applicant's DMRs, as recorded in EPA's Integrated Compliance Information System (ICIS) database, for the 105 month period from December 1998 through August 2007. In its DMRs, the applicant reported chlordane and dieldrin concentrations as a running annual average. Reported annual average chlordane concentrations ranged from 0.19 to 0.79 $\mu\text{g/l}$. After applying the average initial dilution value of 294:1 to the reported annual average chlordane values, the State water quality criterion of 0.000016 $\mu\text{g/l}$ for chlordane, which protects human consumption of fish, was exceeded in all 105 months. The range of estimated chlordane concentrations at the ZID was 0.000066 to 0.0027 $\mu\text{g/l}$.

HDOH (Lau, October 15, 2007) recently stated that the State water quality standard for fish consumption for chlordane (0.000016 mg/l) is a typographical error in the HAR 11-54-4(b)(3). This statement asserts that the correct standard should be 0.00016 mg/l and that HDOH intends to rectify this error. EPA notes that under CWA section 303(c) and 40 CFR 131.20, a change or correction such as this to the Hawaii water quality standards requires a formal amendment to the standards, which includes a public process and formal action by EPA. Until such an amendment is formally adopted by the State and approved by EPA, the value currently contained in the HAR 11-54 applies.³

Nevertheless, EPA evaluated where the State water quality standard for fish consumption for chlordane would be exceeded if it were set at 0.00016 mg/l , rather than at the existing value of 0.000016 $\mu\text{g/l}$. EPA's evaluation found that this less protective limit would have still been exceeded in 87 of 105 months.

In DMRs, reported annual average dieldrin concentrations range from 0.013 to 0.047 $\mu\text{g/l}$ for the same 105 month period from December 1998 through August 2007. After applying the average initial dilution value of 294:1, estimated dieldrin concentrations ranged from 0.000044 to 0.00016 $\mu\text{g/l}$ at the ZID. The State water quality criterion of 0.000025 $\mu\text{g/l}$ for dieldrin, which protects human consumption of fish, was exceeded in all 105 months.

Two other carcinogens, aldrin and heptachlor, exceeded the fish consumption criterion once. In the 17 semi-annual effluent samples collected between February 1999 and February 2007, one sample contained a concentration of aldrin which exceeded the fish consumption criterion for this carcinogen. The effluent sample from May 2002 contained an aldrin concentration of 4.66 $\mu\text{g/l}$. After applying the average dilution value of 294:1, the concentration with dilution was 0.0158 $\mu\text{g/l}$. This concentration exceeds the water quality criterion for aldrin, protective of human consumption of fish, which is 0.000026 $\mu\text{g/l}$.

In the 17 semi-annual samples collected between February 1999 and February 2007, one sample contained a concentration of heptachlor which exceeded the fish consumption

³ EPA's identification of 0.00016 $\mu\text{g/l}$ as the Hawaii water quality standard on page 56 of the March 27, 2007 Tentative Decision for the Honouliuli WWTP was a typographical error. The Honouliuli WWTP Tentative Decision correctly identified the existing water quality standard in Table 18.

criterion for this carcinogen. The sample from February 1999 contained a heptachlor concentration of 0.117 µg/l. After applying the average dilution value of 294:1, the concentration after dilution was 0.0004 µg/l. This concentration exceeds the water quality criterion for heptachlor, protective of human consumption of fish, which is 0.00009 µg/l.

Conclusion

The Sand Island discharge contains concentrations of two pesticides, chlordane and dieldrin, that exceed water quality standards on a regular, monthly basis and two other pesticides, aldrin and heptachlor, that have on occasion exceeded water quality standards. These standards were established to protect human health from ingestion of carcinogens through fish consumption. Based on 24-hour composite samples, the discharge meets all other water quality standards for toxic pollutants and pesticides. Therefore, EPA concludes that the proposed discharge will not comply with water quality standards for two pesticides (chlordane and dieldrin). It is possible that the other two pesticides (aldrin and heptachlor) may not meet State water quality standards in the future, but the data do not suggest the same ongoing exceedances presented by chlordane and dieldrin.

c. Whole Effluent Toxicity

In 1989, EPA defined whole effluent toxicity (WET) as "the aggregate toxic effect of an effluent measured directly by a toxicity test" (54 FR 23868 at 23895, June 2, 1989). Aquatic toxicity tests are laboratory tests that measure the biological effect (e.g., acute effect such as mortality and chronic effects such as reduced growth and reproduction) of effluents or receiving waters on aquatic organisms. In aquatic toxicity tests, organisms of a particular species are held in test chambers and exposed to different concentrations of an aqueous sample (e.g., effluent, effluent combined with dilution water, or receiving water). Observations are then made and recorded at predetermined exposure periods and at the end of the test. The measured responses of the test organisms are used to evaluate the effects of the aqueous test sample. In the NPDES program, WET test results are used to evaluate both the toxicity of wastewater discharges and compliance with State water quality standards that prohibit the discharge of toxic pollutants in toxic amounts, or otherwise provide for the maintenance and propagation of a balanced population of aquatic life. Promulgated in 1989, NPDES regulations at 40 CFR 122.44(d)(1) establish specific procedures for determining when water quality-based effluent limits (WQBELs) for WET are required in permits and specify that the level of water quality achieved by such WQBELs must derive from and comply with State water quality standards.

Background

Basic water quality criteria listed in HAR 11-54-4(a)(4) require all waters to be free of toxic substances at levels or in combinations sufficient to be toxic or harmful to human, animal, plant, or aquatic life, or in amounts sufficient to interfere with any beneficial use of the water. Receiving waters for the Sand Island WWTP discharge are designated Class A open coastal waters in HAR 11-54-6(b)(2)(B). Designated uses for Class A waters

allow for any use as long as the use is compatible with the protection and propagation of fish, shellfish, and wildlife. Class A objectives also state: These waters shall not act as receiving waters for any discharge which has not received the best degree of treatment or control compatible with criteria established for this class.

The applicant's existing 301(h) permit requires monthly effluent monitoring for chronic toxicity by exposing two test organisms, *Ceriodaphnia dubia* (a freshwater water flea) and *Tripneustes gratilla* (a Hawaiian sea urchin), to a composite sample of diluted final effluent. For *C. dubia*, the Sand Island permit requires the applicant to conduct WET tests according to the methods described in *Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms* (EPA/600/4-91/002, 1994). For the sea urchin test, the permit requires the applicant to determine the presence of chronic toxicity using the Hawaiian Collector Urchin Fertilization Test Method.⁴ Data collected under the existing permit are used to evaluate compliance with the 301(h) criteria, including water quality standards.

The toxicity of an effluent can be expressed using either Toxic Unit Chronic (TU_c) or the No Observed Effect Concentration (NOEC).⁵ Permit limits are generally written in terms of TU_c. Hawaii's water quality standards use NOEC, but Hawaii routinely writes permit limits in terms of TU_c. This analysis will discuss toxicity using both measures.

In addition to the narrative water quality standard described above, Hawaii water quality standards include a specific requirement for submerged outfalls, such as the Sand Island outfall. For continuous discharges through submerged outfalls, HAR 11-54-4(b)(4)(A) requires the NOEC, expressed as a percent of effluent concentration, to not be less than 100 divided by the minimum dilution. EPA has calculated that the minimum dilution for the proposed Sand Island discharge is 103:1. Consequently, the measured NOEC must be at or greater than the 0.97 percent effluent concentration to meet the current water quality standards at HAR 11-54-4(b)(4)(A). In equivalent terms, the chronic toxicity of the effluent must be less than or equal to 103 TU_c.

Application and Data Review

The application, which summarizes WET test results for the period from January 1998 through April 2003, indicates the WET test results for *C. dubia* met the water quality

⁴ Adapted by Amy Wagner, U.S. EPA, Region 9 Laboratory, Richmond, CA from a method developed by George Morrison, U.S. EPA, ORD Narragansett, RI and Diane Nacci, Science Applications International Corporation, ORD Narragansett, RI.

⁵ The NOEC is the highest tested effluent concentration that does not cause an adverse effect on the test organisms (i.e., the highest effluent concentration at which the values for the observed responses are not statistically different from the control). The TU_c is the reciprocal of the effluent concentration that causes no observable effect on the test organisms by the end of the chronic exposure period (i.e., 100/NOEC). Thus, the higher an effluent's TU_c rating, the more toxic the effluent. This is discussed in more detail in EPA's TSD for Water Quality-based Toxics Control (1991).

standard for chronic toxicity. The application also indicates that test results for *T. gratilla* often exceeded the water quality standard for chronic toxicity.

EPA's review of DMR data determined that all *C. dubia* tests from December 1998 through May 2007 met the water quality standard, applied to the Sand Island outfall, of 103 TU_c [HAR 11-54-4(b)(4)(A)].

EPA also reviewed WET data reported in DMRs from tests conducted with *T. gratilla*. The TU_c and NOEC values resulting from toxicity tests conducted from January 1999 through May 2007 are listed in Table 6. Seventy-two of the 101 daily maximum results exceed the current water quality standard of 103 TU_c.

Conclusion

The differing toxicity results between the two test organisms, *C. dubia* and *T. gratilla*, clearly identify the need to assess more than one test species in order to protect all aquatic life in the receiving water. EPA recommends periodic testing for toxicity using an alga, invertebrate, and vertebrate species and then using the most sensitive species for monitoring the toxicity of effluents in WET tests (USEPA, 1991). At the prescribed NOEC of 0.97 percent effluent, the WET tests conducted with Sand Island treatment plant effluent using *C. dubia* do not detect the toxicity that is observed in WET tests conducted using *T. gratilla*. Results from WET tests using *T. gratilla* clearly indicate that the Sand Island effluent routinely exerts a toxic effect under predicted critical conditions that exceed water quality standards at the boundary of the zone of initial dilution. Thus, EPA concludes that the proposed discharge will not attain water quality standards for WET and that the proposed discharge will contain substances at levels, or in combinations, sufficient to be toxic to aquatic life, in exceedance of HAR 11-54-4(a)(4). Therefore, the proposed discharge is not protective of uses for Class A waters.

d. Nutrients

The waters of Mamala Bay are classified by the State of Hawaii as Class A wet, open coastal waters. The protected beneficial uses in this class are recreational, aesthetic enjoyment and the support and propagation of fish, shellfish, and wildlife. Nutrient standards are designed to protect aquatic life by preventing eutrophication. In a eutrophic situation, an increased concentration of nutrients promotes algal blooms. When the algae die off, the oxygen concentration in the waterbody can be depleted so severely that other aquatic life cannot be maintained.

Hawaii Administrative Rules (HAR 11-54) contain numeric water quality standards for open coastal waters for the following nutrient parameters: total nitrogen, ammonia nitrogen, nitrate + nitrite nitrogen, total phosphorus, and chlorophyll *a* (phytoplankton indicator) as shown below.

Hawaii "Wet" Nutrient Standards for Open Coastal Waters			
PARAMETER (in µg/l)	Geometric Mean not to exceed given value	Value not to exceed more than 10% of time	Value not to exceed more than 2% of time
Total Nitrogen	150.00	250.00	350.00
Ammonia Nitrogen	3.50	8.50	15.00
NO ₃ + NO ₂ -N	5.00	14.00	25.00
Total Phosphorus	20.00	40.00	60.00
Chlorophyll <i>a</i>	0.30	0.90	1.75

The existing Sand Island NPDES permit requires quarterly receiving water monitoring for all nutrients at ZOM stations (D2, D3, E2, and E3), and other offshore stations beyond the ZOM (D1, D4, D5, E1, E4, and E5). The applicant started monitoring three additional offshore stations (D3A, D6, and E6) in November 2004. The permit requires samples to be collected at 1 m below the surface, mid-depth, and 2 m above the bottom of the water column.

The application does not contain assessments of nutrient monitoring. However, CCH provided EPA with a database of results for all nutrient monitoring conducted in the receiving water from 1998 through 2006. Additionally, EPA reviewed nutrient information presented in the Sand Island AARs from 1999 through 2005. The 2006 AAR was not submitted to EPA as of November 2007.

Although 301(h) regulations at 40 CFR 125.62(a) require State water quality standards to be met at the ZID boundary. Nutrient data were not collected at the ZID. Therefore, there are no available data to directly assess compliance with water quality standards at the ZID boundary. Consequently, data collected from the ZOM stations are used in this review to make the determination on attainment of State water quality standards for nutrients.

In the AARs, the applicant assessed nutrient concentrations on a one-year and also a five-year basis to determine compliance with Hawaii's water quality standards and long-term impacts from nutrients. These assessments were conducted for ZOM stations D2, D3, E2, and E3 using data from the top 30 meters of the water column. It appears that data from all four ZOM stations were combined to produce one result. Data from stations E1, E6, and D6, which the applicant assigned as reference stations, were assessed separately.

In the AARs reviewed by EPA, the applicant identified high ammonia nitrogen concentrations in 1999 and 2001. In the 1999 AAR, the applicant indicated that the criteria for ammonia nitrogen (geometric mean, 10%, and 2%) were exceeded in samples assessed from the four ZOM stations, but not at the reference stations. In the 2001 AAR, the applicant indicated that the 10% and 2% criteria for ammonia nitrogen were exceeded in the ZOM stations, but these criteria were not exceeded at the reference stations. In the five-year assessment contained in the 2001 AAR, the applicant explained that high

concentrations detected in 1999 continued to influence the geometric mean developed in 2001 and led to an exceedance of the geometric mean criterion for ammonia nitrogen in 2001. As mentioned in the previous paragraph, the 1999 ammonia nitrogen data were applied by the applicant in the calculation for the 2001 assessment in order to have the desired number of data points.

In the 1999 AAR, the applicant identified concentrations of total nitrogen in the control stations that exceeded the 10% and 2% limits in the Hawaii water quality standards. There were also exceedances of the geometric mean and 10% criteria for ammonia nitrogen in the control stations.

EPA also analyzed quarterly monitoring data provided by the applicant in the nutrient monitoring database. Initially, EPA assessed the annual geometric mean for each nutrient parameter at each monitoring station (all depths combined). This initial and more general assessment indicated that each station met the Hawaii water quality standard for total nitrogen, nitrate + nitrite nitrogen, total phosphorus, and chlorophyll *a* on an annual basis at the ZOM. Annual geometric means for individual ZOM stations ranged from 69.5 to 98.5 $\mu\text{g/l}$ for total nitrogen; 1.0 to 2.0 $\mu\text{g/l}$ for nitrate + nitrite nitrogen; 4.7 to 8.2 $\mu\text{g/l}$ for total phosphorus; and 0.1 to 0.2 $\mu\text{g/l}$ for chlorophyll *a*. Furthermore, EPA assessed all individual sample results at each station and each depth and concluded that all three criteria levels (i.e., geometric mean, 10%, and 2% limits) of the State water quality standards for these four parameters were met. Where individual values exceeded the geometric mean criterion for a particular parameter, a geometric mean for each depth was developed to ensure that the criterion was met at each depth. The geometric mean criteria for all four parameters were met at all depths. Additionally, the 10% and 2% limits were also met.

However, Hawaii's water quality standard for ammonia nitrogen was not always met. Overall, the annual geometric mean for ammonia nitrogen in the entire water column, with all depths combined at each individual ZOM station, ranged from 1.2 to 8.1 $\mu\text{g/l}$ (Table 7). All but two of the exceedances of the geometric mean criterion were detected in samples from 1999, when the annual geometric means at the four individual ZOM stations ranged from 6.0 to 8.1 $\mu\text{g/l}$. In the years from 2000 to 2006, ammonia nitrogen concentrations at the four individual ZOM stations ranged from 1.2 to 4.7 $\mu\text{g/l}$. The criterion was exceeded in 2001, when the annual geometric mean for ammonia nitrogen at station D3 was 4.7 $\mu\text{g/l}$, and again in 2004, when the annual geometric mean for ammonia nitrogen at station D2 was 4.1 $\mu\text{g/l}$.

When a geometric mean for ammonia nitrogen at each ZOM station is developed based on data collected at each individual depth, there were exceedances of the geometric mean criterion in all three depths (Tables 8, 9, and 10). In 1999, every ZOM station exceeded the geometric mean limit of 3.5 $\mu\text{g/l}$. There were exceedances of the geometric mean limit in all depths of the ZOM stations detected throughout the years from 2000 through 2006, but these were not nearly as numerous or as consistent as the exceedances detected in 1999. In the geometric mean developed from data collected in the surface samples, stations D3 and E3 exceeded the geometric mean criterion in 2001, and station D2

exceeded the criterion in 2004. At the middle depth, the geometric mean criterion was exceeded at station E3 in 2001 and station E2 in 2003. At the bottom depth of the ZOM stations, there were nine exceedances among stations D2, D3, and E3 in the years following 1999. However, there were no exceedances at station E2 in any year following 1999, and there were no exceedances in the years 2003 or 2006 in the bottom depths of the ZOM stations.

Concentrations at the six offshore stations (D1, D4, D5, E1, E4, and E5) beyond the ZOM, with all depths combined at each station, ranged from 4.1 to 5.0 in 1999 (Table 7). In 1999, all ZOM stations exceeded the ammonia nitrogen criterion. In contrast, there were no exceedances of the ammonia nitrogen criterion at the stations beyond the ZOM in the years from 2000 to 2006. Concentrations at these six stations, with all depths combined at each station, ranged from 1.0 to 2.5 $\mu\text{g/l}$ in the years from 2000 to 2006.

When stations beyond the ZOM were assessed by depth, all stations exceeded the ammonia nitrogen criterion in 1999, but there were far fewer exceedances in the years from 2000 through 2006. While there were no exceedances of the geometric mean criterion for ammonia nitrogen at the surface, there were two exceedances in the mid-depth waters and two exceedances in the bottom depths in stations beyond the ZOM (Tables 9 and 10). At mid-depth, the annual geometric mean criterion was exceeded at station E1 in 2001 and 2002. At the bottom depth, the annual geometric mean criterion was exceeded at station D1 in 2004 and, in 2006, the criterion was exceeded at station E1 and again at station D1.

Conclusion

Overall, EPA concludes that the receiving water of the Sand Island outfall has not exceeded the Hawaii water quality criteria for total nitrogen, nitrate + nitrite, total phosphorus and chlorophyll *a*. The Hawaii water quality criteria for ammonia were exceeded at all depths in 1999, and the data show that the exceedances of ammonia criteria have persisted, to a lesser extent, in all three depths of the water column. It is likely that the number of exceedances at the ZID, where 301(h) regulations require attainment of water quality standards, would be greater. Therefore, the applicant has not demonstrated that it can consistently attain State water quality standards for ammonia nitrogen, but State water quality standards for other nutrients (total nitrogen, nitrate + nitrite, total phosphorus, and chlorophyll *a*) can be met.

e. pH

The applicant has not requested a variance for pH. Nevertheless, 40 CFR 125.62(a) requires State water quality standards for pH must be met at the ZID boundary. Hawaii water quality standards for Class A open coastal waters state that pH shall not deviate more than 0.5 units from a value of 8.1 (i.e., within a range of 7.6 to 8.6).

The existing permit requires the applicant to conduct quarterly pH monitoring of receiving water at recreational, nearshore, and offshore stations. Section III.B.5. of the application states that the average pH of stations D2, D3, E2, and E3 is 8.2. Section II.B

of the application presents pH data from water column profiles collected at monitoring stations D2, D3, E2, and E3. The applicant also presents data from water column profiles collected at reference stations E1 and E6. Values for pH at all stations ranged between 8.0 and 8.3. Although the applicant indicates these data represent stations near the ZID, they are actually located at the ZOM or beyond. No monitoring data from the ZID are available.

EPA reviewed CTD data collected at ZOM stations on a quarterly basis from January 1999 through April 2007. The CTD monitoring instrument records a continuous depth profile from samples taken at each meter between the surface and bottom of the water column. Monitored pH values ranged between 7.8 and 8.5 for all stations and all depths for this time period.

Conclusion

Receiving water at and beyond the ZOM met the State water quality standard for pH for the years reviewed. There are no data available to support a conclusion at the ZID directly, but based on the ZOM data, EPA concludes that it is likely the proposed discharge could comply with the applicable pH standard at the ZID boundary.

2. Impact of Discharge on Public Water Supplies

40 CFR 125.62(b), which implements CWA Section 301(h)(2), requires that the discharge must allow for the attainment or maintenance of water quality which assures protection of public water supplies. The application states that there are no planned or existing public water supply (desalinization facility) intakes in the vicinity of the current discharge. Therefore, EPA has concluded that this criterion is satisfied.

3. Impact of Discharge on Shellfish, Fish and Wildlife

40 CFR 125.62(c)(2) requires that a balanced indigenous population (BIP) of shellfish, fish, and wildlife must exist immediately beyond the ZID and in all other areas where marine life is actually or potentially affected by the proposed discharge. A BIP is defined in the section 301(h) regulations [40 CFR 125.58(f)] as an ecological community which exhibits characteristics similar to those of nearby, healthy communities existing under comparable but unpolluted conditions. The terms shellfish, fish and wildlife should be interpreted to include any and all biological communities that might be affected by the discharge.

There are three types of information available to EPA related to the impacts of the proposed discharge on marine life: biological data (marine organisms collected in the vicinity of the outfall), whole effluent toxicity data, and chemical-specific water and sediment quality data. EPA has established guidance that addresses this situation. EPA's Technical Support Document for Water Quality-based Toxics Control (1991) says:

It is EPA's position that the concept of "independent application" be applied to water quality-based situations. Since each method (chemical specific, whole effluent, and bioassessment) has unique as well as overlapping attributes, sensitivities, and program applications, no single approach for detecting impact should be considered uniformly superior to any other approach. For example, the inability to detect receiving water impacts using a biosurvey alone is insufficient evidence to waive or relax a permit limit established using either of the other methods.

In this section, we review and integrate the available data on the effects of the proposed discharge to marine life.

a. Review of Biological Data

i. Plankton

The existing 301(h)-modified permit does not require any definitive plankton studies. Instead, water quality parameters, such as chlorophyll *a*, are measured as a surrogate for phytoplankton abundance. Water column measurements related to water clarity, such as light transmittance, are also conducted. As described earlier, Hawaii water quality standards for these parameters are met by the Sand Island discharge.

ii. Benthic Infauna

The applicant, with assistance from a contractor, began monitoring benthic infauna community structure near the Sand Island ocean outfall in 1986 at a limited number of stations. In 1999, after the existing permit was reissued, the applicant established 15 benthic monitoring stations along three transects (labeled C, D, and E) in the vicinity of the outfall. Subsequent surveys in 2000, 2002, 2004, and 2005 followed the design initiated in 1999. The 2006 summary had not been submitted to EPA as of November 2007.

The three transects were located along three depth contours. Two of the transects were more shallow than the diffuser and one was deeper than the outfall. The 15 monitoring stations were evenly divided between the three transects, with five stations located along each transect. For each transect, one station was located to the west of the diffuser, and two stations were located to the east of the diffuser. On Transects D and E, two stations were located on the boundary of the ZOM. On Transect C, two stations were located inshore of the boundary of the ZOM.

The benthic survey assessed taxa abundance and richness and station diversity and evenness in nonmollusks and mollusks. The nonmollusk fraction included benthic fauna such as polychaetes, nematodes, and crustaceans.

A summary of the most recent survey (Swartz, et al. 2005) reported the following findings:

- Biological data showed few, if any, negative effects of the Sand Island outfall in the macroinvertebrate community.
- Most differences in nonmollusk abundance and taxa richness were among the three transects, but these differences reflect the influence of depth-related factors.
- The abundance and number of taxa of polychaetes, crustaceans, and all nonmollusks were usually significantly greater at several Transect D stations than at many stations on Transects C and E. When stations were pooled by proximity, there were no significant differences between the near-diffuser station group and the beyond-diffuser station groups in the abundance or taxa richness of polychaetes, crustaceans, and all nonmollusks.
- Taxa composition, diversity, and evenness of nonmollusks were also more closely associated with water depth than proximity to the outfall.
- Cluster analysis of nonmollusk taxa composition and abundance resulted in station groups that were associated primarily with the three transects.
- There were no significant differences in mollusk abundance or taxa richness among transects or in abundance between the near-diffuser station group and the beyond-diffuser station group.
- Mollusk taxa richness was significantly greater at near-diffuser stations than at beyond-diffuser stations.
- Depth-related differences in mollusk taxa composition resulted in station clusters generally associated with transects. Four Transect D stations were grouped in a well-defined individual cluster. A second cluster included four stations on Transect C, one station on Transect D, and three stations on Transect E. There was no between-transect grouping of stations that might reflect a common influence of the outfall on either mollusks or nonmollusks.
- There were no significant pairwise contrasts in the abundance and taxa richness of mollusks at Transect C, D, or E in 1999, 2000, 2002, 2004, or 2005.
- The abundance and taxa richness of nonmollusks and crustaceans were often significantly greater at Transect D on 1999, 2000, 2002, 2004, and 2005 than at Transect C and E in most survey years.
- The temporal differences in nonmollusks among Transects C, D, and E are probably associated with water depth.
- There is no indication of a negative temporal trend over the sixteen years of the diffuser effluent on the macrobenthos (conducted between 1986 and 2005).
- Overall 2005 showed little or no indication of a significant influence by the diffuser effluent.

The summary of this report states that the response patterns of benthic fauna near the Sand Island ocean outfall in 2005 showed little or no indication of a significant influence by the discharged effluent. The applicant's assessment of the monitoring data concluded that the benthic environment near the Sand Island outfall has remained stable over the years. The application concludes that there are few, if any, signals of significant responses of the benthic community that can be associated with the effluent discharged from the SIWWTP. EPA agrees with this conclusion.

iii. Fish

The existing 301(h)-modified permit requires the applicant to assess the impact of the Sand Island outfall on fish in several ways. As a general overview, the permit requires the applicant to review fish catch statistics from the State of Hawaii to detect changes in fish abundance and distribution in the vicinity of the Sand Island ocean outfall. At a more detailed level, the permit requires identification of disease symptoms in fish to determine whether the outfall discharge is affecting fish health. Chemical analysis of fish muscle tissue for priority pollutants and pesticides, which is also required by the permit, is discussed in section C.4.a. of this document.

Fish catch statistics are reviewed annually by the applicant, and presented in each AAR, to assess changes in fish abundance and distribution in the vicinity of the outfall. The Hawaii Department of Land and Natural Resource's Division of Aquatic Resources maintains statistics on the amount of commercial fish caught. These statistics are based on catchment areas (CA).

The 2005 AAR contains the applicant's most recent assessment of fish catch statistics in addition to a figure which presents the location of each catchment area. The SIWWTP outfall is located in CA-400, which is adjacent to the most heavily populated area in Hawaii and has the greatest fishing pressure. Since there is no outfall in catchment area CA-402, it is used by the applicant as a control area to compare fish catches. CA-409 is used as an additional control area despite the presence of a small (3.9 MGD) WWTP outfall near its northern boundary. The area of CA-409 within Maunalua Bay also serves as the control station where specimens are collected for pollutant analysis in fish tissue.

In the 2005 AAR, the applicant explains that peaks and valleys in the fish catch data resulted from periods of overfishing and subsequent recovery after commercial fishing moved to other more productive locations along the coast. The fish catch data presented in this AAR show that the take from CA-400 dropped to less than half the total in 2004. The 2005 levels are between those seen in 2002 and 2003. The applicant stated that it seemed clear that fishing pressure, and not the distance to an outfall, is the main predictor of long term fish yields. The applicant asserts that ongoing fishing pressures keep the average size of the fish fairly small, which leads to underreporting to the Division of Aquatic Resources. The applicant also claims that the nutrients discharged from the SIWWTP outfall appear to be an important food source for fish growth in this part of Mamala Bay.

Sampling Data

In addition to assessments of fish catch, the applicant assessed fish specimens for exposure to pollution by having an annual fish health assessment conducted. In this study, the external and internal conditions of fish caught near the diffuser were assessed as an indicator of the health of the fish community impacted by the discharge. The assessment of external conditions included visual examinations to document abnormal growths, atypical color patterns, parasites, fin lesions, skeletal anomalies, and tumors.

Liver tissues were evaluated for parasites and pathological conditions. The most recent report submitted to EPA was for the 2005 assessment (Work, 2005). The 2006 assessment was not submitted by the applicant to EPA for review as of November 2007.

In the 2005 study, gross necropsy and fish liver histopathology were conducted on specimens collected at the Sand Island outfall and at reference stations in Maunalua Bay. Samples were collected from the Sand Island outfall in September and from the reference stations in October and November. Ten specimens of *Lutjanus kasmira* and *Selar crumenophthalmus* were collected from each sampling station for a total of 60 specimens. The applicant's 2005 AAR indicated that the study showed the incidents of spores, parasites and hyperplasia were low in the fish analyzed, and there was no gross or microscopic evidence of tumors found in the livers of the fish evaluated.

Other Surveys

The application contains the findings of a 1998 study using a remotely controlled video camera system to document fish near the diffuser. Five transects surveyed along the length of the diffuser revealed 30 fish species. The same survey was conducted annually in the years from 1991 to 1997. The number of fish species identified in these years ranged from 22 in 1993 to 31 in 1992. The 1998 survey noted one fish species that had not been identified previously. Researchers who conducted this study noted difficulties with poor camera resolution and other sources of variation inherent in the use of the remotely operated video system. This type of survey has not been conducted and reported to EPA since 1998.

Overall, there are very few data available to assess the impact of the outfall on fish health and community structure. From this limited amount of data, EPA concludes that the information from fish catchment areas and the remotely controlled video camera do not indicate that the proposed discharge would adversely affect fish health or community structure.

b. Review of Whole Effluent Toxicity Data

The available data on whole effluent toxicity were reviewed in section C.1.c above to assess whether or not the proposed discharge would exceed water quality standards. EPA found that the proposed discharge would likely frequently exceed the HDOH water quality standard for whole effluent toxicity.

c. Review of Chemical-specific Water Quality Data

The available data on chemical-specific water quality data were reviewed in section C.1. above to assess whether or not the proposed discharge would exceed water quality standards. EPA found that, of the standards established to protect aquatic life, the proposed discharge would exceed the standard for ammonia adopted to protect the biological community from eutrophication.

d. Review of Sediment Quality Data

Suspended solids in the wastewater discharge can result in changes in receiving water quality by lowering the dissolved oxygen concentration in near-bottom waters and reducing water clarity and light transmittance in the water column. Both lower DO concentrations and reduced light transmittance can result in changes to biological communities in the vicinity of the discharge. The potential for these types of changes in the vicinity of the Sand Island outfall is reviewed elsewhere in this document.

Accumulation of suspended (settleable) solids in and beyond the vicinity of the discharge can have adverse effects on water usage and biological communities. For example, suspended solids can cause reduced light transmittance along the water column and thus affect autotrophic production of dissolved oxygen and biological productivity. Hawaii water quality standards prohibit the discharge of materials that will settle to form objectionable sludge or bottom deposits.

The existing Sand Island 301(h)-modified NPDES permit required the applicant to conduct regional monitoring of Mamala Bay in the third and fifth year of the permit. In response, bay-wide monitoring was conducted in 2001 and 2003. This regional monitoring program assessed 160 stations throughout Mamala Bay, in five station types. Thirty recreational waters, forty benthic, thirty zone of mixing, thirty urban estuarine water quality, and thirty shoreline monitoring stations compose the Regional Monitoring Program. Stations 1-30, 31-70, 71-100, 101-130, and 131-160 are numerically identified as recreational, benthic, urban estuarine, and shoreline monitoring stations, respectively. Detailed information and maps of station locations are available in the 2001 and 2003 AARs. The core (general) monitoring program, which was conducted in all other years, assessed 30 stations located at the shoreline and in recreational, nearshore and offshore waters around the Sand Island outfall.

The applicant reported results from two monitoring programs in support of their application. The General Monitoring Program covers 1999, 2000, 2002, 2004, and 2005. The Regional Monitoring Program covers 2001 and 2003. Sediment chemistry results from the General Monitoring Program are summarized in Tables 11, 12, and 13.

Solids and Organic Deposition

The 1998 Sand Island TDD contains predictions of sediment accumulation. The 2003 application provides no updated calculations or worst-case scenario modeling.

As recommended in the ATSD, estimates of organic deposition and accumulation can be derived from sediment deposition models by assuming that the deposits are 80% organic matter and a decay rate of 0.01/day, respectively. Organic accumulation can be calculated through the inclusion of an organic component in mass emission rates in the steady-state and 90-day solids deposition models. Conservative assumptions such as default settling velocities in sediment from primary effluent or raw sewage, and nullifying losses associated with resuspension of sediments are applied. The ATSD

states that steady-state organic accumulations less than 50 g/m² have minimal effects on benthic communities. No organic deposition values were calculated by the applicant in order to make such assessments.

The application provides data on total organic carbon and acid volatile sulfide, total Kjeldahl nitrogen, oil and grease, oxidization-reduction potential and sediment grain size as indicators associated with organic accumulation.

Total Organic Carbon

Total organic carbon data from 1999 and 2000 AARs and Regional Monitoring data from 2001 and 2003 were reported in units of mass (mg/kg); data in the 2002, 2004, and 2005 AARs were reported in percent dry weight.

All reported total organic carbon percentages were less than 1%. Between the Regional Monitoring and the General Sand Island Monitoring programs across all monitoring stations, reported total organic carbon values in mass that were no greater than 2.08 mg/kg and 0.59% dry weight. All reported values were low for both monitoring programs and no discernable patterns were seen spatially or temporally.

Acid Volatile Sulfide

Sixty-eight percent of reported data in the 1999, 2000, 2002, 2004, and 2005 AARs (General Monitoring Program) consisted of non-detect values for acid volatile sulfide. Eighty percent of the samples in 2001 and 2003 (Regional Monitoring Program) were non-detect for acid volatile sulfide. No discernable patterns were seen spatially or temporally.

Total Kjeldahl Nitrogen

Although the concentrations of total Kjeldahl nitrogen were highly variable, no spatial or temporal patterns were seen across both monitoring programs. The applicant reported no statistically significant differences in sediment total Kjeldahl nitrogen among the 25 General Monitoring stations. It is difficult to assess the Regional Monitoring data since only two data points per station were collected (in 2001 and 2003). The maximum value observed in Regional Monitoring datasets was 929 mg/kg dry weight compared to the General Monitoring program's maximum at 607 gm/kg.

Oxidation-Reduction Potential

Oxidation-reduction potential values less than zero are considered indicative of highly reducing conditions caused by the decomposition of deposited organic matter and depletion of oxygen in the sediments. Under these conditions, sulfate can be reduced to form toxic sulfide. Values for oxidation-reduction potential showed no evidence of reducing conditions at the surface of sediments at any station. The lowest oxidation-reduction potential values observed in the General and Regional Monitoring programs

from 1999-2005 are 16 mV and 15 mV, respectively. These results indicate well-oxygenated sediments in the area of the Sand Island outfall.

Sediment Grain Size

Sediment grain size varied considerably from station to station and from year to year, but fine sediment levels were generally low. For example all of the 15 monitoring stations had less than 17% silt and clay in 1999. There were no discernable trends that would indicate the discharge was affecting grain size in the sediments in the vicinity of the outfall.

Priority Pollutants and 301(h) Pesticides in Sediments

There are currently no numeric water quality standards for priority pollutants in sediments. However, there are marine reference levels found in NOAA Screening Quick Reference Tables (SQuiRT) which serve as guidelines for determining the potential for adverse effects on benthic organisms (NOAA, 2006). Approaches and numeric screening derivations are described in the NOAA SQuiRT website. Screening values applied are threshold effects level (TEL), effects range-low (ERL), effects range-median (ERM), probable effect level (PEL), and apparent effect thresholds (AET). These values represent concentrations that are: below levels at which adverse affects can occur rarely (TEL); at lower levels of observable toxic effects that can be seen in sensitive species (ERL); above the median concentration of compiled toxic samples (ERM); or at the level which adverse effects are frequently expected (AET). Table 14 lists all screening values and their respective constituent.

Trace Metals

Tables 11, 12, and 13 provide trace metal sediment chemistry summary statistics for the General Monitoring Program. Cadmium, chromium, copper, lead, mercury, and zinc sediment concentrations did not surpass TEL values. Two-thirds of mercury data from samples consisted of non-detects. In 2000, cadmium was reported as non-detect for all C and D stations despite detected values occurring in other years. Virtually all station concentrations exhibited a slight increase in 2005 compared to 2004. Aluminum, beryllium, and selenium were not included in the analysis due to expected low concentrations and the lack of screening concentrations included in SQuiRT for those elements.

Over 15% of sampled arsenic sediment chemistry data exceeded the arsenic TEL value of 7.24 mg/g. Most exceedances occurred at stations D1 and D5. There were no exceedances at any C station. Nickel exceeded TEL levels nine times, often at station D5. Five of these nine values were high enough for an ERL exceedance. One ERL exceedance was observed at station D6 in 2005.

For 2001 and 2003 regional monitoring data, cadmium and chromium did not exceed TEL values across stations 31 to 100. Arsenic exceeded TEL levels twice and ERL

levels five times at stations 57, 58, 84, 87, 93, 96, and 97. Copper exceeded the ERL level once at station 58. Lead exceeded the TEL once at station 58 and the ERL once at station 94. Nickel exceeded the TEL twice, the ERL times, and PEL three times at stations 51, 56, 57, 58, 67 (and its duplicate sample), 68, 84, 93, 94, 96, and 98. Station 58 had five constituents that exceeded SQuiRT guidelines.

Organic Contaminants

No SQuiRT values for organics were exceeded in the general monitoring program; however, detections of PAHs are described in Figures 4, 5, and 6. Figures 4, 5, and 6 illustrate the percentage of PAH detects across stations on Transects C, D, and E, respectively. Percentages were used in lieu of number of detects because duplicate samples were analyzed for C and D stations, but only single samples were analyzed for E stations. C Stations exhibited regular detection of pyrene and fluoranthrene, with the exception of station C6, where no PAHs were detected. At the D station transect, all analytes were detected at Station D1 and half of the constituents were detected more than 50% of the time. Benzo(a)anthracene, pyrene, and fluoranthrene were detected at Station E6 each time during the sampling period. Prominent detectable PAHs for all three stations are pyrene, fluoranthrene, and benzo(a)anthracene.

The SIWWTP Urban Area Pretreatment Study notes that anthracene and phenanthrene, among many other pollutants, are identified by categorical and non-categorical industrial users as potential pollutants of concern. Section III .F.2-5 and Appendix M of the application describes SIWWTP's toxic control program and pretreatment.

Samples from the general monitoring program were also analyzed for chlordane and dieldrin, but these pesticides were not detected in any samples.

With regard to the regional monitoring program, it is difficult to interpret if sampling was completed because the tables contained many blank fields, with no explanation. Stations 33, 34, 36D, 39, 47, 49, 50, 57, 58, 94, and 95 were the only stations where organic contaminants were reported. Stations 36D and 39 surpassed the PEL value for lindane. At Station 94, nine of seventeen detected organics surpassed sediment SQuiRT values. Phenanthrene exceeded its TEL; fluoranthene, pyrene, benzo(a)anthracene, chrysene, acenaphthylene, and anthracene exceeded their ERLs; and acenaphthalene and benzo(a)pyrene exceeded their PELs .

Conclusion

EPA examined the available data on total organic carbon, acid volatile sulfide, total Kjeldahl nitrogen, oxidation-reduction potential, and sediment grain size to evaluate the extent to which the SIWWTP discharge has resulted in accumulation of sediment on the seafloor in the vicinity of the discharge. Although benchmark values for some of these measures have not been established, none of the available data indicate that sediment is accumulating to levels that would cause concern and some of the data indicated a low

level of impact. Therefore, EPA concludes that the proposed discharge is unlikely to cause adverse effects due to the physical accumulation of sediment around the outfall.

EPA also examined the available data for priority pollutants and 301(h) pesticides in the sediment. Although there were frequent exceedances of SQUIRT reference values for nickel and arsenic and sporadic exceedances for other trace metals, there was no evidence that the outfall was the source of the metals. 301(h) pesticides were not detected in the years evaluated at any of the stations. Therefore, EPA concludes that sediment chemistry data do not show that the proposed discharge is likely to cause adverse effects due to contamination of sediment around the outfall.

e. Analysis of Impacts on Shellfish, Fish, and Wildlife

Wastewater discharges can have a variety of impacts on marine life. For purposes of this review, EPA is dividing the types of impacts into two categories: toxic effects and nutrient-related effects. The discharge of nutrients into aquatic environments can cause excessive growth of aquatic plants. In the case of the SIWWTP, the most likely adverse effect of nutrient discharge would be phytoplankton blooms.

This section is a summary of EPA's analysis and integration of the biological, whole effluent, and chemical-specific data related to impacts to marine life.

i. Toxic Impacts beyond the Zone of Initial Dilution

The information as to whether the proposed discharge would have a toxic impact on marine life is mixed. Past biological and sediment quality data do not show a detectable toxic impact of the discharge, whereas the discharge often exceeds the water quality standard for whole effluent toxicity.

There are limitations with the biological data. First, the data are not extensive, as monitoring is required only infrequently. Second, the scope of the biological monitoring is limited; only portions of the marine community are sampled. Third, the samples that were collected may not have been collected during critical conditions, for example when initial dilution was at critical levels.

The whole effluent toxicity data indicate that the effluent is often highly toxic. Not only is it usually toxic when accounting for critical initial dilution, the effluent is often so toxic it could produce toxic effects in the ocean even when dilution is much higher. Moreover, the applicant has not identified the pollutants in the effluent that are causing toxicity in the whole effluent toxicity tests. Not all pollutants accumulate in sediments. It may be that the pollutant (or pollutants) causing toxicity in the effluent is not the type that accumulates readily in sediment.

Integrating the available information, EPA concludes that the proposed discharge likely would have toxic impacts beyond the ZID.

ii. Nutrient-related Impacts beyond the Zone of Initial Dilution

The information as to whether the proposed discharge would have biostimulatory impacts beyond the ZID as a result of the discharge of nutrients is mixed. Past biological data do not indicate the presence of phytoplankton blooms or other sign of excessive marine plant growth. On the other hand, ambient water quality data for ammonia, a nutrient, indicates that ammonia is sometimes discharged at levels which exceed water quality standards.

There are limitations with the biological data. First, data on plankton populations are scarce. Second, the samples may not have been collected during critical conditions. Therefore, EPA concludes that the discharge may stimulate algae blooms and that the proposed discharge may have nutrient-related effects beyond the ZID.

iii. Impacts within the Zone of Initial Dilution

40 CFR 125.62(c)(3) requires that conditions within the ZID not contribute to extreme adverse biological impacts, including, but not limited to, the destruction of distinctive habitats of limited distribution, the presence of disease epicenter, or the stimulation of phytoplankton blooms which have adverse effects beyond the ZID.

The applicant indicated there are no adverse biological impacts within the ZID caused by the Sand Island discharge. Video recordings from 1998 of fish near the length of the diffuser revealed a diverse community. Internal and external assessments of fish caught near the outfall did not indicate signs of disease. There is no indication of any marked alteration of the benthic community composition related to the outfall. There were no reports of algae blooms in the ZID.

As described in the preceding section, EPA's analysis is that the discharge may have stimulated algae blooms beyond the ZID and that the proposed discharge could contribute to algae blooms. If these blooms were to occur it is likely that the area within the ZID would be affected as well. EPA does not, however, consider it likely that the proposed discharge would cause algae blooms so severe that they should be characterized as extreme adverse biological impacts.

iv. Conclusion

Although the results of EPA's analysis are mixed, EPA concludes that the applicant has failed to demonstrate that a modified discharge would not interfere with the attainment or maintenance of that water quality which assures protection of a balanced, indigenous population of shellfish, fish, and wildlife.

4. Impact of the Discharge on Recreational Activities

The following section describes the potential for impacts on recreational activities from the effluent discharge. Under section 40 CFR 125.62(d), the applicant's proposed modified discharge must allow for the attainment or maintenance of water quality which allows for recreational activities at and beyond the zone of initial dilution, including,

without limitation, swimming, diving, boating, fishing, picnicking, and sports activities along shorelines and beaches.

Recreational areas are present within an 8-km (5-mi) radius of the outfall diffuser. These areas include beaches and waters offshore of beaches where activities such as swimming, snorkeling, scuba diving, boating, fishing, and surfing take place. In 2003, the applicant employed a research firm to conduct a survey measuring usage of the Oahu south shore by island residents to determine recreational uses in the area. The survey results confirmed that residents participated in recreational activities in ocean waters out to two miles from shore and beyond (Ward Research, 2003). Residents identified recreational activities including swimming, surfing/bodyboarding/windsurfing, snorkeling, paddling/canoeing/kayaking, fishing, diving, sailing, boating, and waterskiing. Thirty-four percent of the 375 respondents reported frequent recreational use (defined in the study as use at least once every other week) of the south shore. While the majority of recreational activity reported in this survey took place within 300 feet of shore, recreational use beyond two miles from shore was reported by at least five percent of the respondents.

Thus, there are a variety of recreational activities that could occur in the vicinity of the discharge. For purposes of this review, EPA has grouped these into two categories of recreation: fishing (with associated fish consumption) and water contact recreation.

a. Fish Consumption

There are three types of data relevant to the assessment of impacts from the consumption of fish caught as a result of recreational fishing: data on bioaccumulation of toxic pollutants in fish tissue, data on toxic pollutants in the effluent, and data on toxic pollutants in the sediments surrounding the outfall.

i. Review of Data on Bioaccumulation

As discussed in the ATSD, the discharge of sewage effluents containing toxic substances can result in bioaccumulation in the tissues of aquatic organisms. The degree to which pollutants bioaccumulate in aquatic organisms depends on the type of food chain, the availability and persistence of the pollutant, and the physical-chemical properties of the pollutant. Heavy metals and persistent synthetic organic compounds generally have the highest potential for bioaccumulation in marine organisms.

Most toxic pollutants with a high bioaccumulation potential are generally associated with organic particles in an effluent discharge. Consequently, substantial bioaccumulation is possible when there is localized accumulation of contaminated sediments in the area around an outfall. Alternatively, as explained in the ATSD, bioaccumulation may not be as serious a problem when there is adequate initial dilution of the discharged effluent in conjunction with sufficient circulation to prevent localized accumulation of solids, or trapping of the effluent plume in the nearfield and farfield. The ATSD also notes that the potential for bioaccumulation will be less if fishes with only transitory plume exposure

are present (e.g., pelagic or migratory species), than if demersal species living on or near the seabed dominate in an area of sediment deposition around an outfall.

The existing 301(h)-modified permit requires the applicant to monitor pollutant body burdens for priority pollutants and 301(h) pesticides in fish species consumed by humans and which are representative of species caught by local recreational and commercial fishermen. Once each year, in summer months, the applicant is required to collect fish within the ZID by hook and line, or by setting baited lines and traps. At least two species of common epibenthic fish must be collected. For each species, ten fish or more are to be selected at random and muscle tissue composited. The cumulative total number of composite samples should be at least three.

Samples were collected at three locations; one station near the outfall and two reference stations. In the figures below, the station near the outfall is identified as “Sand Island” and the reference stations are identified as “FR#1” and “FR#2.”

In Appendix H of the application, the applicant described the methodology for annually collecting fish species commonly caught and eaten by local recreational and commercial fishermen. Fish species caught and assessed were akule (*Trachiurops crumenophthalmus*), commonly known as big-eyed scad, and ta’ape (*Lutjanus kasmira*), commonly known as blue-lined snapper.

According to the Hawaii Coral Reef Network, akule is a common reef fish living near the bottom and found in shallow to very deep water. They aggregate during the day, but are primarily nocturnal carnivores, feeding on crabs, shrimps and small fishes. Ta’ape fish are nocturnal carnivores and range widely when foraging for food. Both species are transitory and do not necessarily spend their time in a single location.

In 1999-2005, muscle fish tissue was collected and analyzed to determine the extent of bioaccumulation. The results were described in the AARs for 1999-2005. The AARs conclude that elevated concentrations of pollutants in fish tissue cannot be linked to the effluent.

The AARs provide the results for mercury found in fish muscle. A summary of the data is presented in Figure 7 for akule and Figure 8 for ta’ape. The USFDA has established an action level of 1 mg/kg for methyl mercury. All values reported in the AARs are well under 1.0 mg/kg. Additionally, a chronic non-carcinogen screening value for methyl mercury of 0.13 mg/kg was derived by the applicant utilizing methyl mercury’s reference dose. Mercury concentrations vary across time and space, as is evident in Figures 7 and 8, but all of the results exceeded the screening value. There was no discernable trend between the reference stations and the station near the outfall, however, so EPA concludes that the levels of mercury in fish tissue are likely not due to the outfall.

Arsenic can have both carcinogenic and non-carcinogenic effects, thus both carcinogen and non-carcinogen screening values were derived. The carcinogen screening value (for 10^{-6} risk level) is 0.00024 mg/kg and the chronic non-carcinogen screening value is 0.13

mg/kg. The results of the fish tissue analyses are presented in Figures 9 and 10. All samples exceeded both screening values. However, there was no discernable trend between the reference stations and the station near the outfall, so EPA concludes that the levels of arsenic in fish tissue are likely not due to the outfall.

Reporting of fish tissue data for other trace metals was collected from 1999 through 2006. Only selenium exceeded screening values, but as there was no discernable trend between the reference stations and the station near the outfall, EPA concludes that the levels of selenium in fish tissue are likely not due to the outfall.

Subcategories of organics such as polychlorinated biphenyls (PCBs) and polyaromatic hydrocarbons (PAHs) were sampled. All values were below screening values.

The AARs do not contain data on levels of dieldrin and chlordane in fish tissue, but Appendix D of the application contains data for these pesticides. Results for samples collected near the outfall are reported, but no samples were collected at the reference stations. In Appendix D of the application, akule and ta'ape were analyzed annually from 1991-2002; the moray eel and menapachi were also sampled, but only intermittently. No data are available in Appendix D after 2002. Unspecified fish tissue was used and reported, except for 1995 when liver tissue was sampled. EPA assumes that muscle tissue was sampled in the other years. Dieldrin was not detected in any sample. Chlordane was detected three times: at a level of 2.1 µg/kg in akule in 1993, at a level of 7.7 µg/kg ta'ape in 1993, and at a level of 0.55 µg/kg in moray eel in 1994. The applicant did not provide screening values for chlordane, so EPA calculated screening values based on the Integrated Risk Information System, which is a database developed by EPA to provide information on the risks to public health and the environment from contaminants in air and water. Using the same assumptions for factors such as body weight and fish consumption rate as used by the applicant for other bioaccumulative pollutants, the appropriate screening values for chlordane are 212 µg/kg for chronic noncarcinogenic effects and 1.21 µg/kg for carcinogenic effects (for 10⁻⁶ risk level). Thus, none of the samples analyzed exceeded the screening value for chronic noncarcinogenic effects, but two of the samples exceeded the screening value for carcinogenic effects.

In summary, EPA finds that fish in the vicinity of the discharge have accumulated a variety of toxic pollutants. Mercury, arsenic and selenium were present in at least some samples at levels that exceed screening values, but the levels in samples collected near the outfall were not generally higher than the levels in samples collected at reference stations, so EPA concludes that the source of these pollutants was likely not the outfall. Chlordane, however, was only measured in samples collected near the outfall, and two samples exceeded the screening value for carcinogenic effects. Given that no data are available from reference sites and the elevated levels of chlordane found in the effluent, EPA concludes that the bioaccumulation of chlordane may be a result of the discharge.

ii. Review of Data on Effluent Quality

As described in section C.1.b. above, EPA found that the effluent often contained levels of chlordane and dieldrin that exceeded water quality standards. These standards were established at levels designed to prevent fish from accumulating carcinogenic compounds in their tissues that would pose a significant health risk to persons who caught and consumed them. Also, as describe in section C.1.c. above, EPA found that the effluent was routinely toxic.

iii. Review of Data on Sediment Quality

As described in section C.3.d. above, EPA found that several priority pollutants, including arsenic and nickel, were detected at levels exceeding reference values in sediments in the vicinity of the outfall, but there was no indication that the source of these pollutants was the outfall.

iv. Analysis of Impacts

The information as to whether the proposed modified discharge would cause bioaccumulation of toxic pollutants in fish that would pose a threat to human health is mixed. Chlordane and dieldrin are regularly found in the effluent in concentrations that exceed state water quality standards after allowing for initial dilution. Chlordane was found at elevated levels in fish tissue in 1993, but not since. Chlordane was detected in 2005 but not at elevated levels. Dieldrin has not been detected in fish tissue. Neither chlordane nor dieldrin was detected in sediments. Also, the effluent routinely exhibited toxicity in whole effluent toxicity tests.

EPA's analysis is complicated by the fact that data on bioaccumulation in fish and effluent is very limited. Nevertheless, given the clear exceedance of water quality standards for chlordane and dieldrin in recent effluent samples, the history of whole effluent toxicity exceedances, and the transitory behavior of the fish that were sampled for bioaccumulation analysis, EPA finds that toxic pollutants in the proposed discharge may result in adverse impacts to fishing in the area.

b. Water Contact Recreation

As discussed above in Section C.1.a, EPA has concluded that the Sand Island discharge can consistently achieve water quality standards for bacteria when the UV disinfection system is operating. Water quality criteria for bacterial indicators protect human health by limiting pathogens in waters designated for recreational uses, thereby reducing the risk of illness resulting from exposure to pathogenic organisms in recreational waters. When water quality standards for bacteria are not being met in waters where there is water-contact recreation, the recreational uses are adversely affected.

In the 2003 survey, residents identified water-contact recreational activities such as swimming, surfing, bodyboarding, windsurfing, snorkeling, diving and waterskiing in

waters off the Oahu south shore, including in some cases in waters beyond two miles from shore. As discussed in section C.1.a, the Sand Island Honouliuli treatment plant discharges to waters categorized in Hawaii's water quality standards as Class A open coastal waters, which are to be protected for recreation "in and on" the waters. EPA's analysis of the bacteria data, as discussed above in Section C.1.a., indicates that water quality criteria are met in nearshore and offshore waters when the UV disinfection system is operating.

c. Conclusion

For the reasons discussed above, EPA concludes that fishing (fish consumption) may be adversely affected by the proposed SIWWTP discharge, but water contact recreation would not be, provided the UV disinfection system is properly operated and maintained. Given the possible impacts to fishing, EPA finds that the applicant has not demonstrated that its proposed discharge will not interfere with the attainment or maintenance of water quality which allows for recreational activities in and on the water at and beyond the ZID.

5. Additional Requirements for Improved Discharge

The regulation at 40 CFR 125.62(e) states that where the proposed modified discharge is based on an improved or altered discharge, the applicant must demonstrate that the proposed improvements or alterations to the existing discharge have been thoroughly planned and studied and can be completed or implemented expeditiously, and that the improved or altered discharge will comply with the requirements of 40 CFR 125.62(a)-(d). As discussed above, 40 CFR 125.62(a)-(d) require the attainment or maintenance of water quality that meets water quality standards, assures protection of public water supplies, assures protection of a balanced indigenous population of shellfish, fish, and wildlife and allows for recreational activities.

Improvements to the SIWWTP are discussed in Appendix B of the application. The basis for the improved discharge is the result of a planned increase in the current 82 MGD design flow of the primary treatment plant. When construction is complete, the design flow will be 90 MGD, which is the projected flow in 2025. As a result of these improvements the plant will include new headworks, two additional clarifiers, effluent disinfection capability, and a digester. The applicant is not requesting an increase in the monthly average BOD₅ or TSS limits. The application indicates that the planned improvements to the SIWWTP will result in more reliable compliance with the permit limits for 30% removal of BOD₅, 65% removal of TSS and compliance with the enterococcus limits contained in the permit.

Construction of the improvements was delayed for various reasons. The current permit, which became effective in November 1998, required completion of the following improvements:

- Ala Moana Wastewater Pump Station Modification – to accommodate higher collection system flows and higher head of the new SIWWTP headworks;

- Hart Street Wastewater Pump Station – required to accommodate higher collection system flows and higher head of the new SIWWTP headworks;
- Hart Street Wastewater Pump Station Force Main Replacement – install a new force main;
- Sand Island Parkway Wastewater Pump Station Modification – to accommodate higher head of the new SIWWTP headworks;
- SIWWTP Unit 1, Phase 2A – replace and expand headworks and associated facilities;
- SIWWTP Primary Treatment Expansion – to expand treatment facilities from 82 to 90 MGD, and improve plant hydraulic capacity and increase solids handling capacity; and
- SIWWTP Disinfection Facility – investigate and determine appropriate disinfection technology, and design, construct, and operate continuously for one year an effluent disinfection facility which achieves effective effluent disinfection.

The status of these plant upgrades was described in reports submitted to EPA by the applicant on January 29, 2007 and March 1, 2007. In August 2007, a contractor for EPA and HDOH inspected the SIWWTP and noted the status of the treatment plant improvements. The draft report of the inspection indicated that the headworks were completed in August 2005, two new clarifiers were put in service in July 2006 as part of the primary treatment expansion and the overall treatment plant expansion that was completed in November 2006, and initial start-up operation of the disinfection facility began in November 2006 (Tetra Tech, 2007). Therefore, most of the planned improvements have now been implemented.

EPA is concerned with the delays in implementation of the improvements required by the current permit. Nevertheless, based on EPA's review of the application, EPA has concluded that the applicant has satisfied the requirement of 40 CFR 125.62(e) by demonstrating that the improvements or alterations have been thoroughly planned and can be implemented at this time. However, EPA concludes that even with the improvements, the applicant will not be able to comply with the requirements of 40 CFR 125.62(a), (c), and (d). The application does not indicate that any of the improvements will result in better control of toxicity, pesticides, and ammonia.

6. Conclusions

Based on a review of the available data, EPA concludes that that proposed discharge will not ensure compliance with the State's water quality standards and will not result in attainment or maintenance of water quality which assures the protection and propagation of a balanced indigenous population of shellfish, fish, and wildlife; and allows recreational activities. This conclusion is based on findings that the proposed discharge:

- Would exceed water quality standards for chlordane, dieldrin, and whole effluent toxicity;
- Could exceed water quality standards for ammonia;

- Could have toxic impacts to marine life beyond the ZID;
- Could have nutrient-related impacts beyond the ZID; and
- Could cause bioaccumulation at level that would pose a significant threat to persons who consumed fish near the outfall.

D. Establishment of a Monitoring Program

Under 40 CFR 125.63, which implements section 301(h)(3), the applicant must have a monitoring program designed to evaluate the impact of the modified discharge on the marine biota, demonstrate compliance with applicable water quality standards, measure toxic substances in the discharge, and have the capability to implement these programs upon issuance of a 301(h)-modified NPDES permit. The frequency and extent of the program are to be determined by taking into consideration the applicant's rate of discharge, quantities of toxic pollutants discharged, and potentially significant impacts on receiving water, marine biota, and designated water uses.

CCH included the current monitoring program from the existing permit in the application. The applicant noted that a revised monitoring program was not proposed in the application. Instead, the applicant indicated intent to work with EPA to strengthen the existing monitoring program.

Details of sampling techniques, monitoring schedules, and locations of monitoring sites contained in AARs demonstrate the applicant's adherence to the established monitoring plan. Section III.F. of the application contains a discussion about the resources directed toward monitoring activities over the past permit cycle. The application indicates that CCH employees 33 laboratory personnel to conduct compliance sampling and chemical and biological analyses. Where the applicant does not have the specialized ability needed to conduct specific monitoring activities, contractual consultants are employed. For example, the applicant has established contracts for the analyses of benthic organisms in the SIWWTP receiving water and also the detection of toxic parameters in its effluent. The application also discusses the types of specialized monitoring equipment available to CCH's staff for oceanographic monitoring. All of these facts demonstrate that CCH has the resources to implement and carry out the monitoring program.

EPA's review has determined that the current monitoring program is not sufficient. For example, the current monitoring program does not assess ZID stations. As noted above, the applicant indicated its intent to work with EPA to strengthen the existing monitoring program. In this tentative decision, EPA is not identifying specific changes for the monitoring program; rather, EPA intends to work with the applicant in the development of an improved monitoring program. If EPA issues a final decision to deny the variance, HDOH would become the permitting authority for a secondary permit. In that case, EPA would offer to work with HDOH on the development of an appropriate monitoring program. If EPA's final decision is to grant the variance and issue a renewed modified permit, then EPA will work with the applicant to develop an appropriate monitoring program, and will include revised requirements in the draft permit issued for public comment.

E. Impact of Modified Discharge on Other Point and Non-point Sources

Under 40 CFR 125.64, which implements section 301(h)(4), the applicant's proposed modified discharge must not result in the imposition of additional pollution control requirements on any other point or nonpoint source.

Two other wastewater treatment facilities discharge into Mamala Bay. The Honouliuli WWTP outfall is located about 12 km to the west, and the Fort Kamehameha outfall is located about 5 km to the northeast of the Honouliuli diffuser. Cates International, an offshore fish farm, was operating in the vicinity of the outfall, but is no longer in operation and did not reapply for a new NPDES permit when the previous permit expired in June 2006. EPA is not aware of any additional requirements that have been imposed on these or other sources as a result of the applicant's discharge.

Appendix L of the application contains a letter written on April 24, 2003 by the applicant to the HDOH requesting certification from that the discharge of primary effluent will not increase pollution control requirements for other point or non-point sources. However, Appendix L does not contain a response from HDOH to this letter. The tentative decision is that a modified permit not be issued. Therefore, no State determination is necessary at this time.

F. Toxics Control

In accordance with 40 CFR 125.66, the applicant must design a toxics control program to identify and ensure control of toxic pollutants and pesticides discharged in the effluent. This program must address both industrial and nonindustrial source control. The control of industrial sources is also addressed by the pretreatment program regulations [40 CFR 403.8(d)] and by 40 CFR 125.65, which are discussed in Section G of this document. The SIWWTP Toxics Control Program is discussed in Appendix M of the application.

1. Chemical Analysis

Under 40 CFR 125.66(a), the applicant must submit at the time of application, a chemical analysis of its current discharge for all toxic pollutants and pesticides as defined in 125.58(p) and (aa). The analysis must be performed on two 24-hour composite samples (one in dry weather and one in wet weather).

In the NPDES application, which is contained within the Sand Island 301(h) variance application, CCH provided a list of toxic pollutants and pesticides detected in the SIWWTP final effluent. The applicant also submitted, separate from the application, priority toxic pollutant and pesticide data from influent and effluent sampling conducted in the dry season in 2006 and wet season in 2007, as required by the existing permit. Detected priority pollutants and pesticides, from sampling conducted in 2007 (wet season) and 2006 (dry season), are listed below:

Antimony	Chloroform
Arsenic	Toluene
Beryllium	Benzene
Cadmium	Acrolein
Chromium	Diethyl phthalate
Copper	Methylene chloride
Lead	1,2-Dichlorobenzene
Mercury	Phenol
Nickel	Bis(2-ethylhexyl) phthalate
Selenium	Chlordane
Silver	Dieldrin
Zinc	Heptachlor epoxide
	Heptachlor

Based on this information, EPA has concluded that the applicant has met the requirement of 40 CFR 125.66(a).

2. Toxic Pollutant Source Identification

Under 40 CFR 125.66(b), the applicant must submit at the time of application an analysis of the known or suspected sources of toxic pollutants or pesticides identified in response to 40 CFR 125.66(a). To the extent practicable, the applicant must categorize the sources according to industrial and non-industrial types.

In section III.H.1.d. of the application, the applicant stated that the following four pollutants are a concern in the collection system: benzene, tetrachloroethene, toluene, and heptachlor. The applicant indicates that potential sources of these pollutants include industrial laundries, commercial printing/lithograph, newspapers, photo finishing, and electroplating businesses. The application indicates that sources of these pollutants are discussed in CCH's Urban Area Pretreatment Program Report. Additionally, categories of potential pollutants in the discharge are listed in section III.H.5.a of the application. The applicant also discussed sources of the pesticides chlordane and dieldrin in Appendix D of the application. Therefore, EPA has concluded that the applicant has met the requirements of 40 CFR 125.66(b).

3. Industrial Pretreatment Requirements

Under 40 CFR 125.66(c), an applicant for a 301(h) variance that has known or suspected industrial sources of toxic pollutants must have an approved pretreatment program as described in 40 CFR 403. This requirement applies to CCH for its Sand Island application given the presence of industrial sources of toxic pollutants. The applicant's industrial pretreatment program was approved by EPA on July 29, 1982. This approved program remains in effect. General details of the CCH Pretreatment program, such as staffing inspection, monitoring and enforcement, are outlined in Appendix M of the application and addressed in CCH's most recent Annual Assessment Report, dated March 30, 2007.

On October 29, 2001, CCH submitted the Urban Area Pretreatment Program Local Limits Development – Final Report (Report), for approval by EPA and the HDOH. The Report updated the applicant's industrial pretreatment program in consideration of the influent load from Industrial Users (IUs). The Report discusses industrial sources of toxic pollutants which are served by the Sand Island facility, thus confirming that the requirements of 40 CFR 125.66(c) apply. On May 16, 2005, EPA provided the results of its review of the Report (Kemmerer, 16 May 2005 letter). EPA concurred with the Report's conclusions regarding changes to limits for specified constituents, including heavy metals. However, EPA's May 16, 2005 letter also stated that the Report needed to be revised, specifically related to CCH's control of fats, oils, and grease (FOG) in the CCH collection system. EPA's conclusion was that improved management of FOG is necessary to reduce the number of collection system spills due to blockages caused by FOG. On November 9, 2005, HDOH concurred with EPA's May 16, 2005 letter. CCH responded in a letter dated August 16, 2007 (Takamura, 16 August 2007 letter) outlining revisions to its program regarding FOG. Although EPA has concerns regarding the need for improved management of FOG to avoid future sewage spills from the collection system, EPA has concluded that because an approved pretreatment program is in effect, CCH is complying with the Industrial Pretreatment Requirements of 40 CFR 125.66(c).

4. Nonindustrial Source Control Program

Under 40 CFR 125.66(d), the applicant must submit a proposed public education program designed to minimize the entrance of nonindustrial toxic pollutants and pesticides into the treatment facility.

The application indicates that CCH participates in educational efforts such as environmental displays at public events. At these events, the applicant distributes brochures and other materials containing information about CCH's environmental programs.

CCH also educates the public on the reduction of non-industrial pollutants by use of videos, handouts, newspaper articles, television stories, radio coverage, bus posters, and public service announcements. For example, CCH developed a video to educate the public on the proper disposal of fats, oils, and grease. On a quarterly basis, CCH advertises and conducts a Household Hazardous Waste Collection Program to accept and process chemical pesticides, herbicides, cleaning products and other potentially hazardous products for proper disposal.

In light of CCH's ongoing public education efforts, EPA concludes that the applicant meets the requirements of 40 CFR 122.66(d).

G. Urban Area Pretreatment Program

Under 40 CFR 125.65, large applicants for 301(h) variances that receive one or more toxic pollutants from an industrial source are required to comply with the urban area

pretreatment requirements. Large applicants are defined in 40 CFR 125.65 as those which serve a population of 50,000 or more. These requirements therefore apply to CCH's application for the Sand Island WWTP. A POTW subject to these requirements must demonstrate toxic pollutant control. CCH has chosen to demonstrate this control by developing and implementing the Applicable Pretreatment Requirement, as discussed in 40 CFR 125.65(c).

As discussed with regard to 40 CFR 125.66(c), the applicant's industrial pretreatment program was approved by EPA on July 29, 1982, and EPA considers the applicant has met the requirement to have an approved pretreatment program under CWA 403. Thus, CCH meets the requirements of 40 CFR 125.65(b)(1). In addition, 40 CFR 125.65(b)(2) requires that the applicant demonstrate that industrial sources are in compliance with all applicable pretreatment requirements, and that the applicant will enforce those requirements.

As explained in the preamble to the revised 301(h) regulations (FR 40656, August 9, 1994), "EPA intends to determine a POTW's continuing eligibility for a 301(h) waiver under section 301(h)(6) by measuring industrial user compliance and POTW enforcement activities against existing criteria in the Agency's National Pretreatment Program. In 1989, EPA established criteria for determining POTW compliance with pretreatment implementation obligations. One element of these criteria is the level of significant noncompliance of the POTW's industrial users. The General Pretreatment Regulations (part 403) identify the circumstances when industrial noncompliance is significant. The industrial user significant noncompliance (SNC) criteria are set out in 40 CFR 403.8(f)(2)(vii) and address both effluent and reporting violations. For pretreatment purposes, a POTW's enforcement program is considered adequate if no more than 15 % of its industrial users meet the SNC criteria in a single year. In addition, a POTW is considered in SNC if it fails to take formal, appropriate and timely enforcement action against any industrial user, the wastewater from which passes through the POTW or interferes with the POTW operation."

Considering this preamble explanation, EPA has concluded that CCH has met the requirements under 40 CFR 125.65(b)(2). CCH's 2006 Pretreatment Annual Assessment Report, dated March 30, 2007, indicates that no significant industrial users are in SNC. In addition, the report indicates that there were no instances of pass-through or interference.

H. Increase in Effluent Volume or Amount of Pollutants Discharged

The regulations at 40 CFR 125.67 specify that no modified discharge may result in any new or substantially increased discharges of the pollutant to which the modification applies above the discharge specified in the 301(h)-modified permit.

Table 15 presents the applicant's projections for annual average flow and mass loadings of BOD5 and TSS in five-year increments (2010 to 2025). Effluent loads are based on a BOD5 concentration of 116 mg/l and a suspended solids concentration of 69 mg/l.

The application indicates that flow is not expected to increase over the course of the next permit. The applicant has satisfied section 40 CFR 125.67(c) by providing projections of effluent volume and mass loadings for BOD5 and TSS for the facility. The applicant's facility is not a combined sewer system, so section 40 CFR 125.67(b) does not apply.

I. Compliance with Other Applicable Laws

1. State Coastal Zone Management Program

Under 40 CFR 125.59(b)(3), a 301(h)-modified NPDES permit must comply with the Coastal Zone Management Act, 16 USC 1451 *et seq.* In accordance with 16 USC 1456(c)(3)(A), a 301(h)-modified permit may not be issued unless the proposed discharge is certified by the State to comply with applicable State coastal zone management program(s) approved under the Coastal Zone Management Act, or the State waives such certification.

The application contains a letter written by the applicant on April 21, 2003 to the State of Hawaii's Office of State Planning. In this letter, the applicant requested certification from the Office of State Planning that the discharge of primary effluent will not increase pollution control requirements for other point or non-point sources. This letter does not mention provisions of the Hawaii Coastal Zone Management Program. A response letter from the Office of State Planning is not included in the application. The applicant supplied no indication of why the letter was not submitted. The EPA is not aware that the Office of State Planning has reviewed the current application. However, because this tentative decision is that a modified NPDES permit not be issued, certification is not necessary at this time.

2. Marine Sanctuaries

40 CFR 125.59(b)(3) provides that issuance of a 301(h)-modified NPDES permit must comply with Title III of the Marine Protection, Research and Sanctuaries Act, 16 USC 1431 *et seq.* In accordance with 16 USC 1432(f)(2), a 301(h)-modified NPDES permit may not be issued for a discharge located in a marine sanctuary designated pursuant to Title III if the regulations applicable to the sanctuary prohibit issuance of such a permit.

The application does not address this requirement. Although the application indicates that correspondences sent to various agencies are included in Appendix L, none of the letters contained in Appendix L address the marine sanctuary.

It would seem possible that the discharge would not be restricted by regulations protecting the Hawaiian Islands Humpback Whale National Marine Sanctuary designation, which has specified boundaries around Maui but does not include the island of Oahu, but the applicant has not provided appropriate correspondence to clarify this point.

3. Endangered or Threatened Species

40 CFR 125.59(b)(3) provides that issuance of a 301(h)-modified NPDES permit must comply with the Endangered Species Act (ESA), 16 USC 1531 *et seq.* In accordance with 16 USC 1536(a)(2), a 301(h)-modified NPDES permit may not be issued if the proposed discharge will adversely impact threatened or endangered species or critical habitat listed pursuant to the Endangered Species Act.

The applicant filed letters with NOAA's National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) to determine conformance with the Endangered Species Act. Copies of these letters are included in Appendix L of the application. The application does not include replies to these letters.

If EPA's tentative decision was to approve the 301(h) variance, consultation with the Services would be necessary prior to issuance of a 301(h)-modified permit. Here, as the tentative decision determines that a modified permit would not be appropriate, no modified permit has been prepared, and no NMFS or USFWS concurrence or determination is necessary at this time.

J. State Determinations and Concurrence

The applicant did not provide an indication that the Hawaii Department of Health was contacted to determine whether the discharge would comply with the State of Hawaii's water quality standards or other State requirements, as required by 40 CFR 125.59(b)(3), 125.61(b)(2), or 125.64(b). On page III-19 of the application, where the applicant is requested to provide a determination with all provisions of State law, CCH refers to a response that should be found in section III.B of the application and also in Appendix L. However, there is no applicable response in either section.

If EPA's tentative decision was to approve the 301(h) variance, State concurrence would be necessary prior to issuance of a 301(h)-modified permit. Here, as the tentative decision determines that a modified permit would not be appropriate, no modified permit has been prepared, and no State concurrence or determination is necessary at this time.

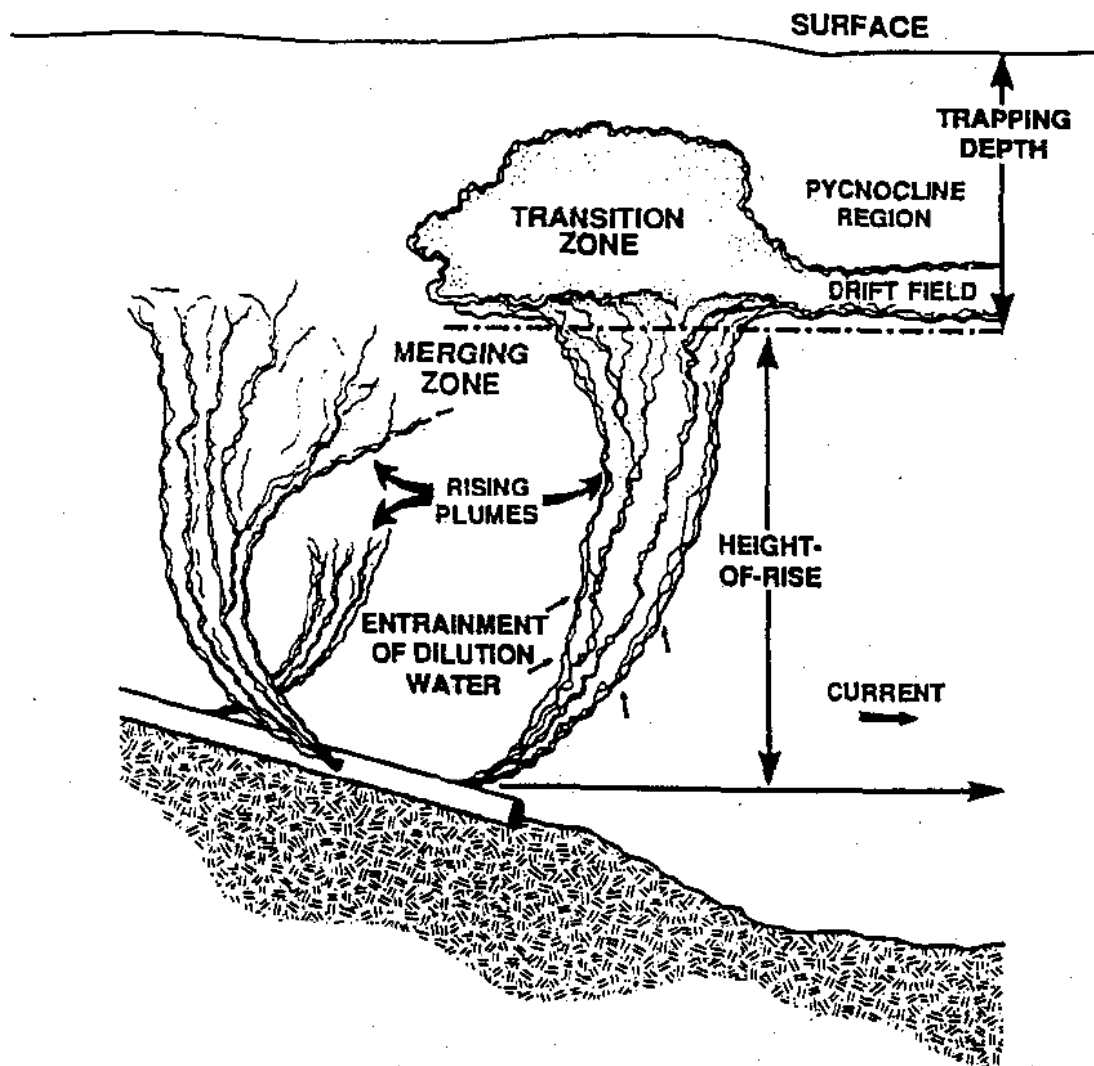


Figure 1. Wastefield generated by a simple ocean outfall (ATSD 1994).

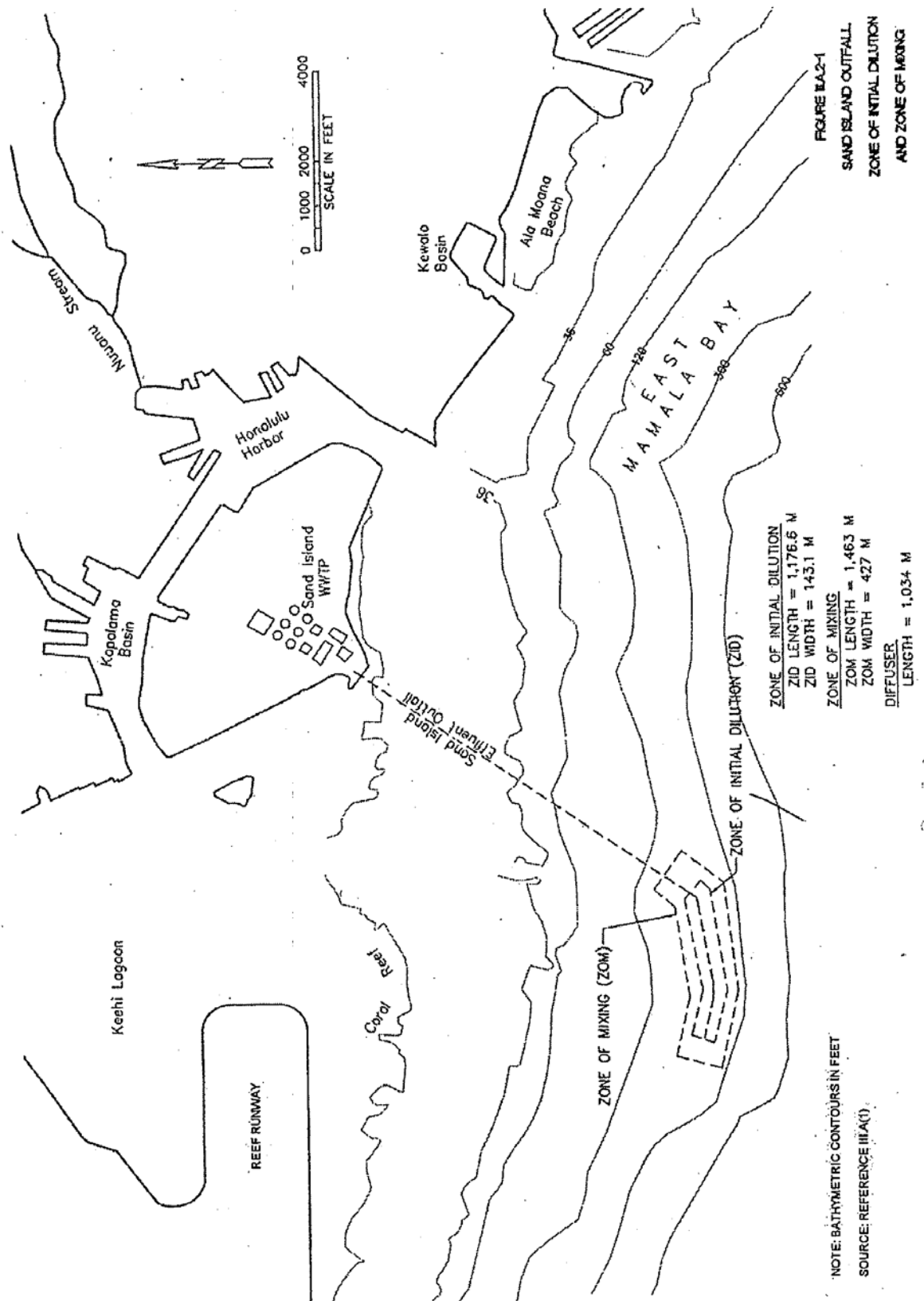


Figure 2. ZID and ZOM in SIWWTP receiving water.

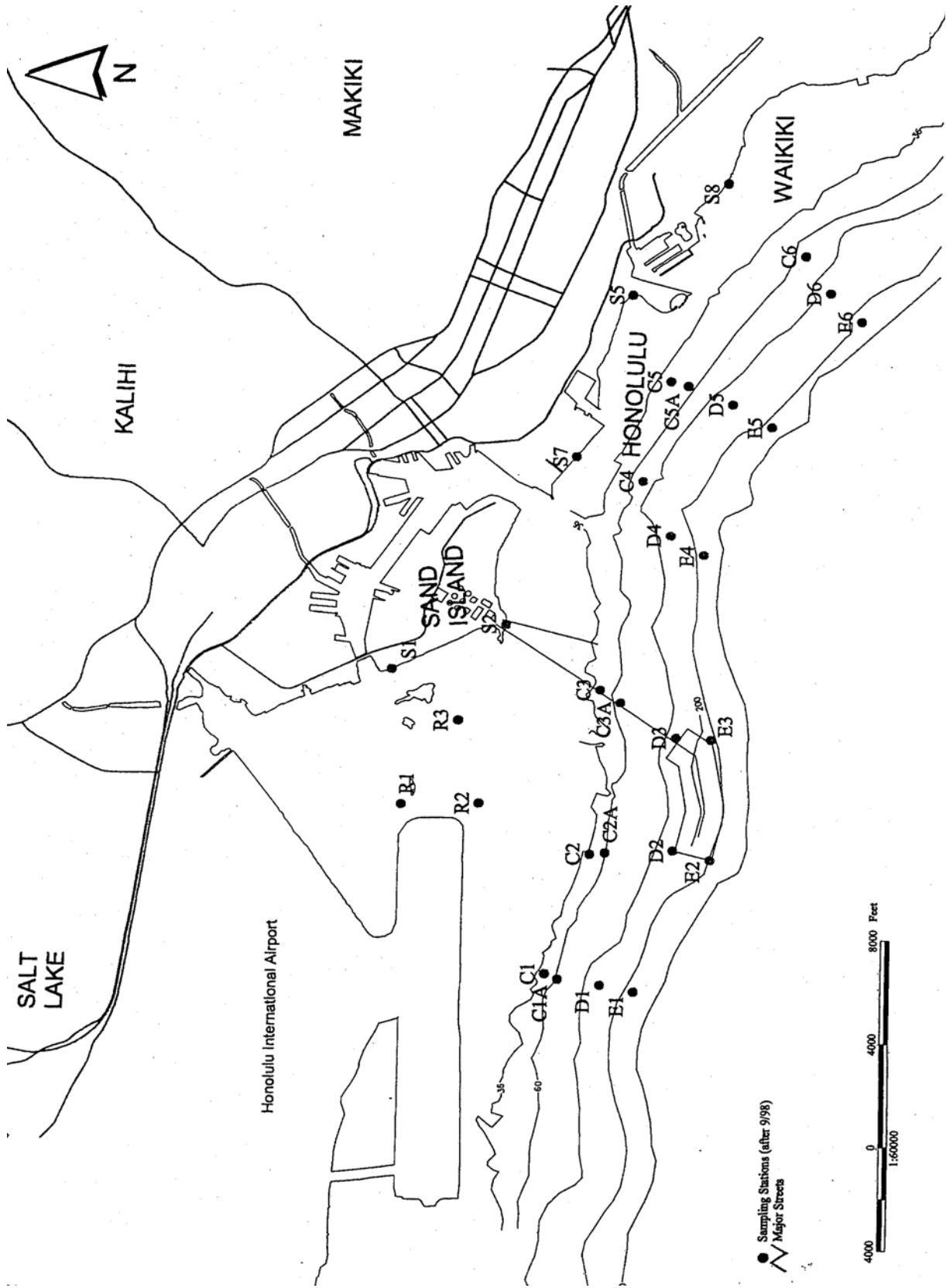


Figure 3. Sand Island WWTP receiving water monitoring stations.

Aggregated Detection Frequencies by Organic Constituents and C Stations

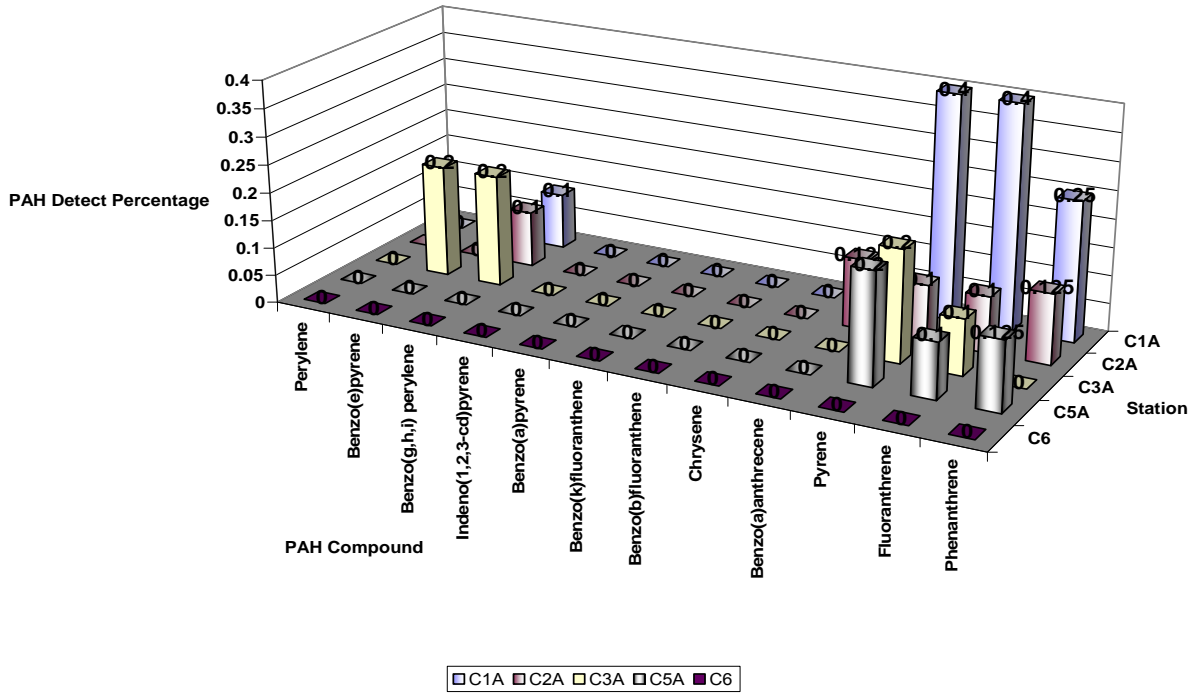


Figure 4. Detection percentages for polyaromatic hydrocarbons at C Stations.

Aggregated Detection Frequencies by Organic Constituents and D Stations

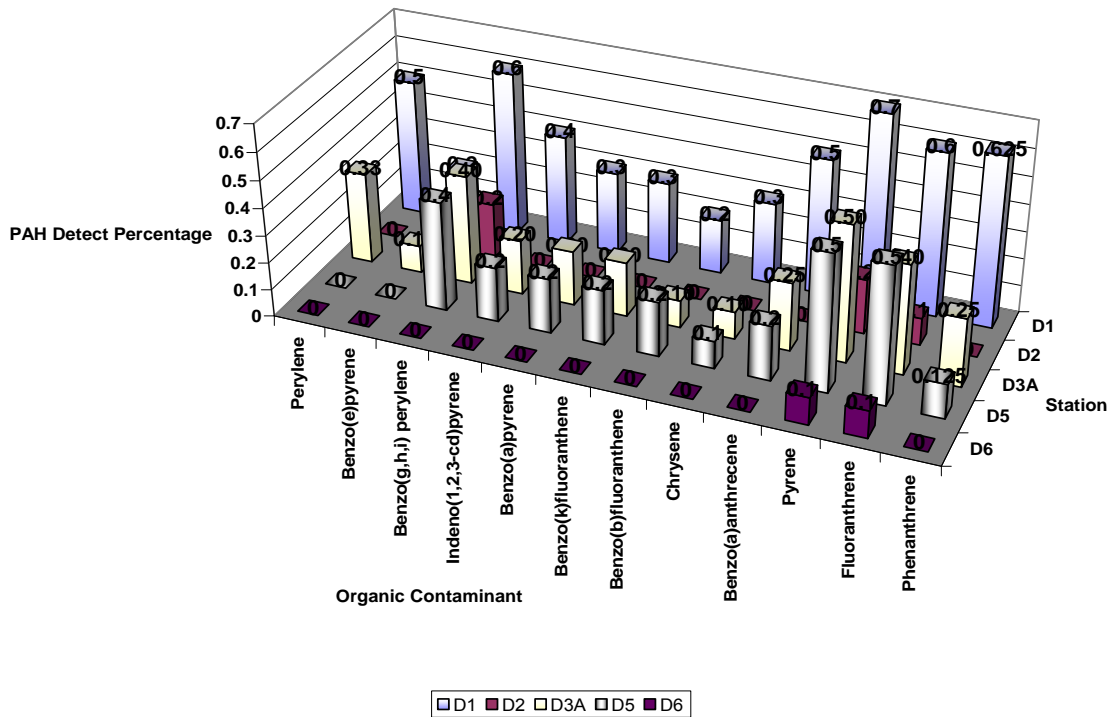


Figure 5. Detection percentages for polyaromatic hydrocarbons at D Stations.

Aggregated Detection Frequencies by Organic Constituents and E Stations

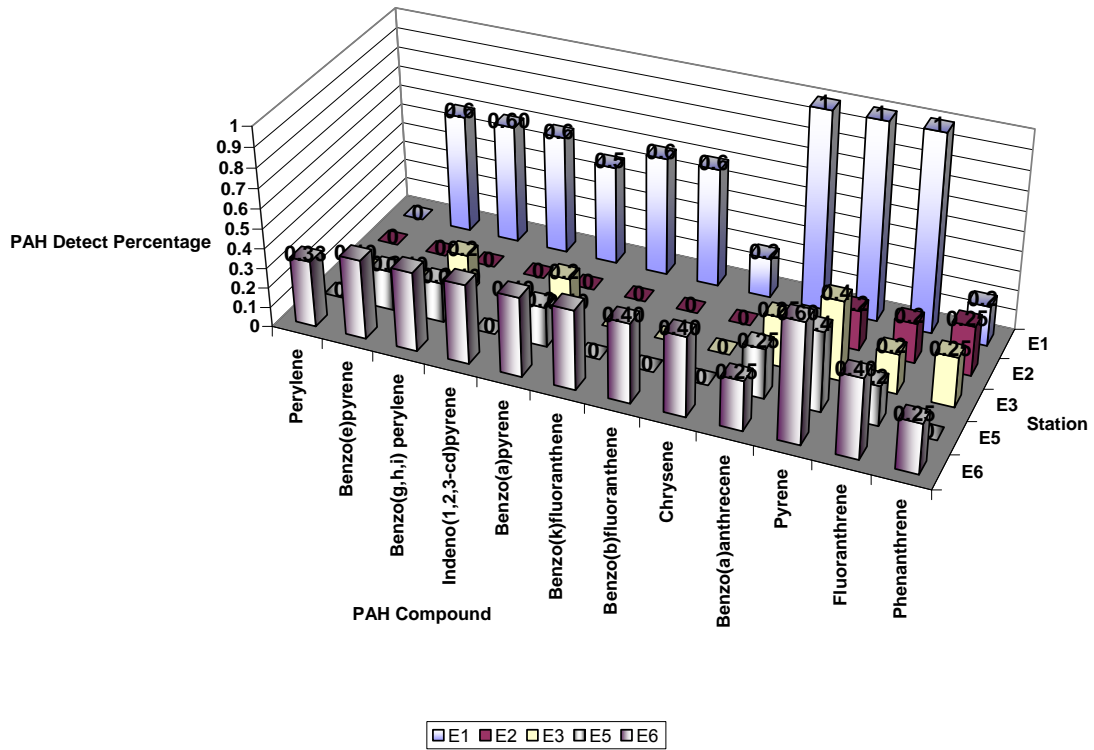


Figure 6. Detection percentages for polyaromatic hydrocarbons at E Stations.

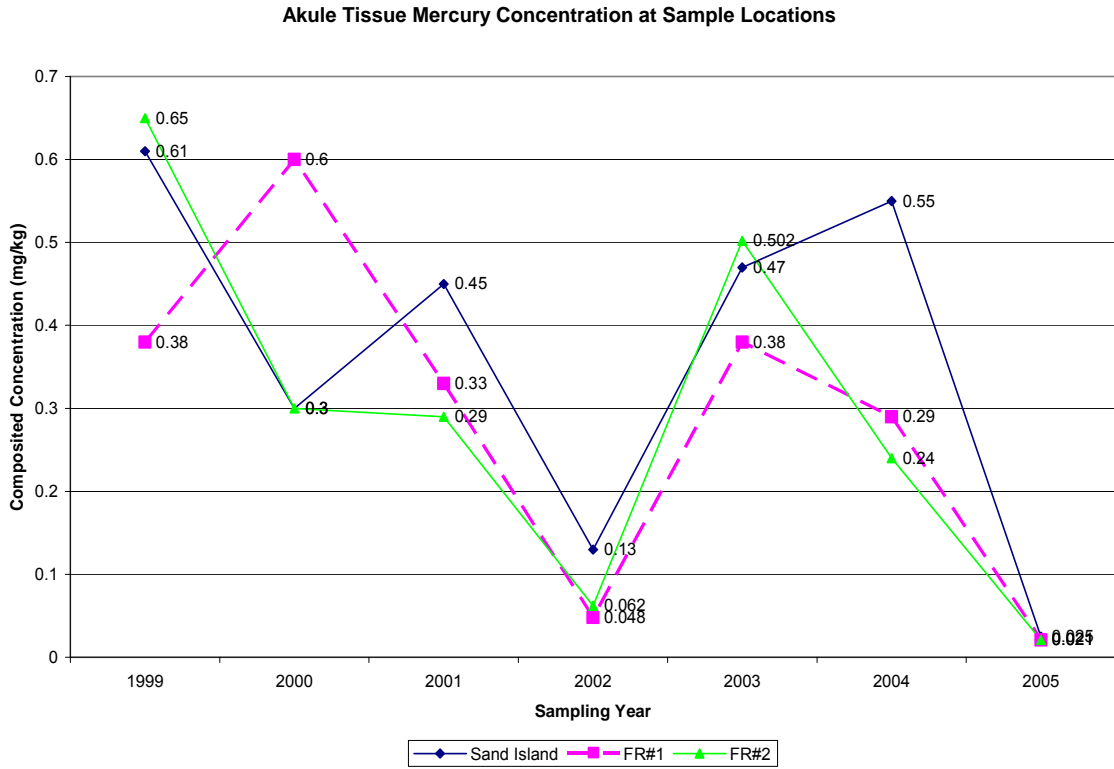


Figure 7. Mercury concentrations of akule from 1999-2005.

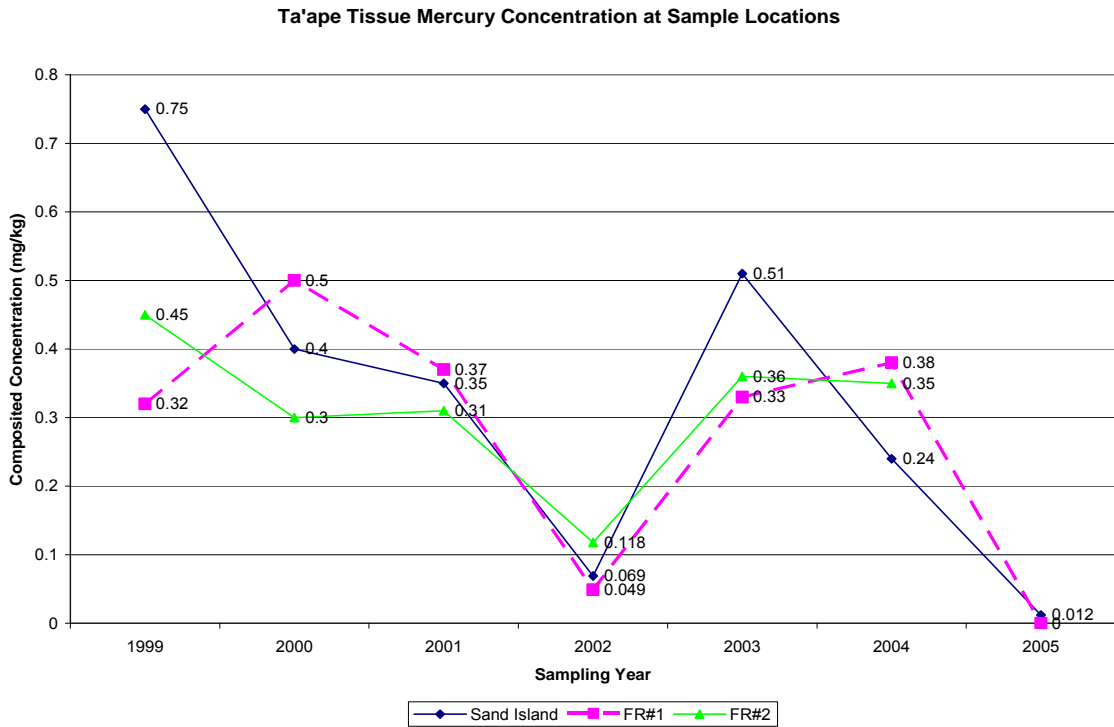


Figure 8. Mercury concentrations of ta'ape from 1999-2005

Akule Tissue Arsenic Concentration at Sample Locations

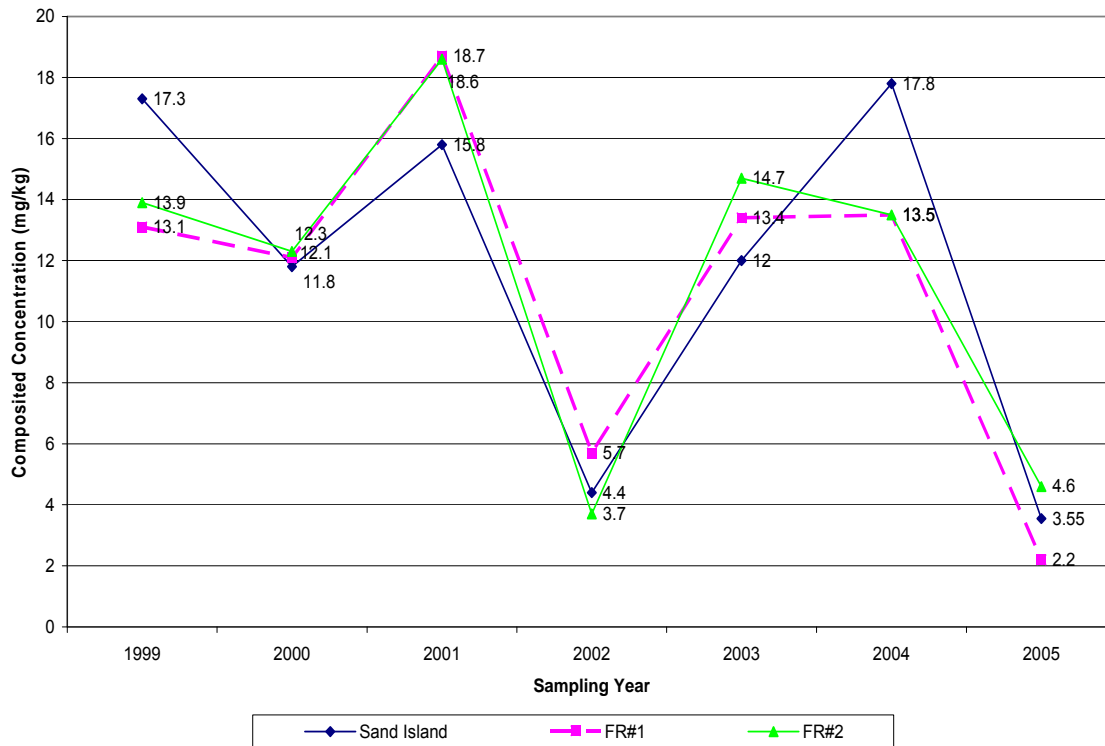


Figure 9. Arsenic concentrations of akule from 1999-2005.

Ta'ape Tissue Arsenic Concentration at Sample Locations

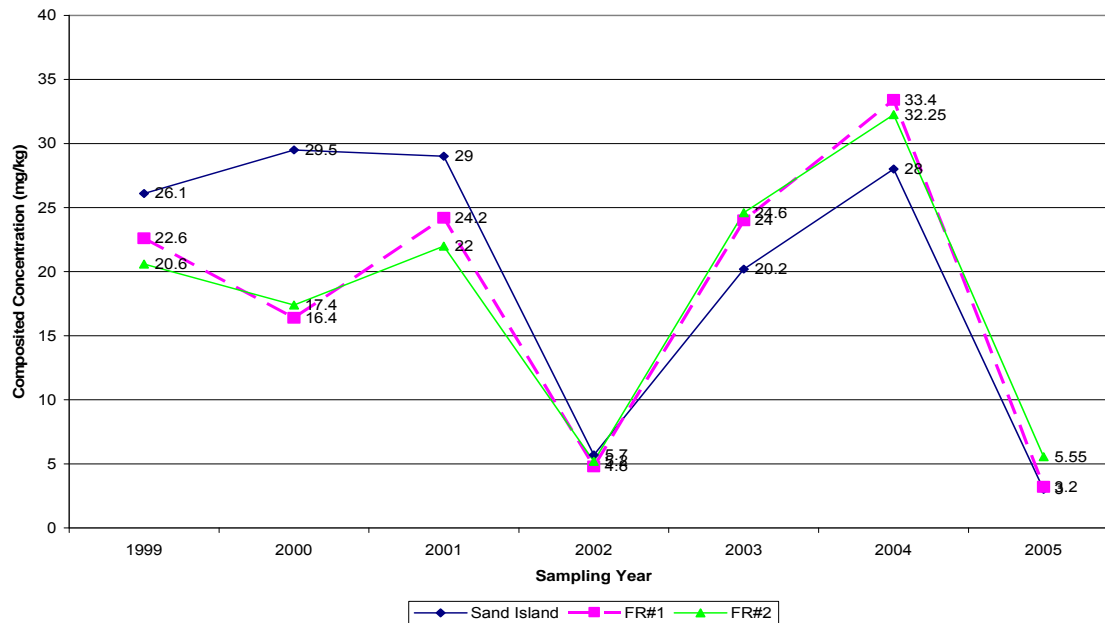


Figure 10. Arsenic concentrations of ta'ape from 1999-2005.

Table 1. Physical characteristics of the Sand Island outfall and diffuser.

Description	Value
Outfall length	2,743 m (9,000 ft)
Diffuser length	1,036 m (3,398 ft)
Number of ports	284
Angle of port orientation from horizontal, degrees	0°
Diffuser diameter: Section 1	2.13 m (84 in)
Section 2	1.68 m (66 in)
Section 3	1.22 m (48 in)
Port diameter: 46 ports	0.076 m (0.25 ft)
85 ports	0.081 m (0.27 ft)
76 ports	0.085 m (0.28 ft)
75 ports	0.090 m (0.30 ft)
2 ports	0.158 m (0.53 ft)
Port discharge depth (average)	70.1 m (230 ft)
Port spacing	7.32 m (24.0 ft)

Table 2. Current effluent limits for BOD and TSS.

Parameter	Current Limits		Current Performance* (range of monthly averages)
	7-day average	30-day average	
BOD	160 mg/l	116 mg/l	88 - 128 mg/l
TSS	104 mg/l	69 mg/l	39 - 56 mg/l

* Based on discharge monitoring reports submitted by the applicant from January 1998 through May 2007.

Table 3. Projected annual average daily effluent flows.

Year	Flow (MGD)
2010	81.27
2015	85.28
2020	88.09
2025	90.51

Table 4. Summary of monthly TSS removal rates.

	1999	2000	2001	2002	2003	2004	2005	2006	2007
January	62	66	62	65	67	63	64	69	84
February	63	66	61	65	69	63	64	68	89
March	63	67	64	65	67	64	64	67	82
April	64	67	64	64	68	63	63	68	88
May	66	66	65	65	68	64	64	81	83
June	66	68	65	66	64	65	64	85	
July	62	68	63	67	62	64	67	84	
August	64	67	62	68	59	65	74	82	
September	66	64	63	68	61	63	66	85	
October	67	64	68	67	59	63	67	85	
November	65	67	64	67	61	61	71	82	
December	66	63	67	68	65	62	67	88	
Annual Average	65	66	64	66	64	63	66	79	84

Table 5. Summary of monthly BOD removal rates.

	1999	2000	2001	2002	2003	2004	2005	2006	2007
January	30	37	32	35	33	28	32	37	47
February	30	37	32	33	35	34	33	38	56
March	32	38	36	36	32	32	33	40	48
April	30	34	32	32	31	31	34	39	56
May	32	36	34	33	35	31	34	52	47
June	34	35	32	35	35	37	30	56	
July	23	35	31	34	33	35	35	53	
August	29	33	33	36	34	35	40	41	
September	30	36	37	37	34	36	42	47	
October	31	34	33	32	30	35	39	46	
November	33	30	35	35	29	34	38	42	
December	38	31	36	32	31	35	36	53	
Annual Average	31	35	34	34	33	34	36	45	51

Table 6. Summary of Sand Island WET test data (from DMR data in ICIS for January 1999 through May 2007). In accordance with HAR 11-54-4(b)(4)(A), the chronic toxicity of the effluent must be less than or equal to 103 TU_c. Exceedances of the water quality standard (103 TU_c) are highlighted.

Tripneustes WET test results (TU _c)	1999	2000	2001	2002	2003	2004	2005	2006	2007
January	182	182	181.8	90.9	181.8	181.8	45.5	181.8	357.1
February	45.5	182	182	357.1	181.8	45.5	45.5	90.9	357.1
March	45.4	45.5	181.8	181.8	181.8	22.7	181.8	45.5	357.1
April	90.9	45.5	181	181.8	181.8	22.7	90.9	22.7	357.1
May	>357	182	357.1	>357.1	357.1	45.5	181.8	45.5	357.1
June	>357	182	357.1	357.1	>357.1	22.7	357.1	181.8	
July	357	357	181.1	>357.1	357.1	90.9	357.1	90.9	
August	357	357	357.1	181.8	357.1	90.9	181.8	357	
September	182	>357	181.8	>357	>357.1	45.5	>357.1	357.1	
October	182	357	>357	357	357.1	45.5	90.9	357.1	
November	357	357	181.8	181.8	181.8	90.9	45.5	357.1	
December	182	181.8	90.9	357.1	90.9	90.9	181.8	357.1	

Table 7. Annual geometric mean of ammonia nitrogen concentrations (µg/l) from quarterly samples taken at offshore monitoring stations (all three depths combined). Annual geometric mean values exceeding the State criterion (3.5 µg/l ammonia nitrogen) are highlighted.

		1999	2000	2001	2002	2003	2004	2005	2006
ZOM stations	D2	6.0	2.4	2.1	2.2	1.3	4.1	2.0	3.0
	D3	6.2	1.9	4.7	2.4	2.0	2.3	1.9	1.9
	E2	6.7	1.3	2.2	2.2	1.7	1.3	1.2	2.9
	E3	8.1	1.9	3.2	3.5	2.0	2.3	1.7	1.3
Beyond ZOM	D1	4.4	1.7	1.7	2.1	1.0	2.5	1.4	1.8
	D4	5.0	1.3	2.3	2.0	1.0	1.3	1.7	1.4
	D5	4.1	1.3	2.1	1.8	1.0	1.3	1.5	1.3
	E1	5.0	1.8	2.5	2.4	1.0	1.7	1.5	2.1
	E4	5.0	1.3	2.4	2.2	1.0	1.3	1.3	1.3
	E5	5.0	1.3	2.3	1.5	1.0	1.7	1.3	1.4

Table 8. Annual geometric mean of ammonia nitrogen concentrations ($\mu\text{g/l}$) from quarterly samples taken at surface offshore monitoring stations. Annual geometric mean values exceeding the State criterion ($3.5 \mu\text{g/l}$ ammonia nitrogen) are highlighted.

		1999	2000	2001	2002	2003	2004	2005	2006
ZOM stations	D2	7.7	1.4	2.0	1.3	1.4	5.8	2.5	2.5
	D3	4.0	1.3	4.2	1.4	2.6	2.0	1.2	1.3
	E2	4.7	1.0	2.0	1.8	1.0	1.0	1.2	2.4
	E3	7.7	1.9	3.6	1.6	2.6	1.9	1.2	1.2
Beyond ZOM	D1	4.1	1.2	1.6	1.2	1.0	2.2	1.2	1.1
	D4	5.0	1.5	2.3	1.6	1.0	1.4	1.3	1.3
	D5	4.3	1.9	2.0	1.7	1.0	1.2	1.2	1.3
	E1	5.0	1.2	2.2	1.6	1.0	1.2	1.2	1.4
	E4	5.1	1.2	2.0	1.6	1.0	1.2	1.0	1.2
	E5	5.1	1.2	2.3	1.5	1.0	1.2	1.2	1.3

Table 9. Annual geometric mean of ammonia nitrogen concentrations ($\mu\text{g/l}$) from quarterly samples taken at mid-depth offshore monitoring stations. Annual geometric mean values exceeding the State criterion ($3.5 \mu\text{g/l}$ ammonia nitrogen) are highlighted.

		1999	2000	2001	2002	2003	2004	2005	2006
ZOM stations	D2	3.8	1.6	2.2	1.3	1.0	2.9	1.4	3.2
	D3	6.1	1.2	2.7	2.4	3.0	1.9	1.2	2.5
	E2	8.0	1.2	2.5	3.4	3.7	1.3	1.0	3.4
	E3	7.2	1.3	3.6	3.2	1.0	1.5	2.6	1.3
Beyond ZOM	D1	4.9	1.6	1.6	2.2	1.0	1.6	1.2	1.2
	D4	4.4	1.3	2.3	1.8	1.0	1.4	1.7	1.3
	D5	4.0	1.2	2.0	1.4	1.0	1.0	2.1	1.3
	E1	4.7	3.5	3.9	4.3	1.0	2.4	2.3	1.5
	E4	6.2	1.4	3.3	2.9	1.0	1.5	1.6	1.3
	E5	5.4	1.4	2.6	1.4	1.0	2.2	1.6	1.8

Table 10. Annual geometric mean of ammonia nitrogen concentrations ($\mu\text{g/l}$) from quarterly samples taken at bottom offshore monitoring stations. Annual geometric mean values exceeding the State criterion ($3.5 \mu\text{g/l}$ ammonia nitrogen) are highlighted.

		1999	2000	2001	2002	2003	2004	2005	2006
ZOM stations	D2	7.4	6.5	2.2	6.0	1.4	4.0	2.3	3.5
	D3	9.7	4.4	9.1	4.3	1.0	3.0	4.8	2.1
	E2	8.0	1.7	2.2	1.6	1.4	1.6	1.4	2.9
	E3	9.8	2.5	2.5	8.0	3.2	4.3	1.6	1.3
Beyond ZOM	D1	4.1	2.5	1.8	3.2	1.0	4.4	1.9	4.1
	D4	5.7	1.2	2.5	2.8	1.0	1.2	2.3	1.6
	D5	3.9	1.0	2.2	2.2	1.0	1.9	1.4	1.4
	E1	5.3	1.4	1.8	2.0	1.0	1.6	1.3	4.4
	E4	4.0	1.4	2.2	2.4	1.0	1.2	1.3	1.3
	E5	4.6	1.3	2.2	1.5	1.0	2.0	1.3	1.3

Table 11. Summary of sediment chemistry results (mg/kg) for nearshore stations (C) during 1999-2000, 2002, and 2004-5.

		C1A	C2A	C3A	C5A	C6
%TOC	MAX	0.44	0.31	0.59	0.56	0.4
	MIN	0.26	0.2	0.21	0.19	0.18
	AVG	0.33	0.24	0.34	0.33	0.29
TOC	MAX	0.45	0.46	1.21	0.82	0.63
	MIN	0.31	0.26	0.3	0.28	0.34
	AVG	0.38	0.3775	0.65	0.505	0.475
%Solids	MAX	70.4	85.8	74.8	76.7	70.83
	MIN	60.5	64.3	64	63.2	63.4
	AVG	65.66	73.88	67.07	68.19	67.06
ORP	MAX	175	195	200	195	195
	MIN	35	50	20	45	20
	AVG	114.09	141.36	131.59	134.55	132.50
AVS	MAX	ND	11.5	6	ND	0.52
	MIN	ND	ND	ND	ND	ND
	AVG	ND	5.88	6	ND	0.27
NO2+NO3	MAX	0.76	1.34	0.9	0.83	0.4
	MIN	0.13	0.14	0.08	0.21	0.03
	AVG	0.40	0.62	0.35	0.49	0.17
TKN	MAX	381	583	338	282	280
	MIN	119	75	155	68	116
	AVG	232.6	273	257	167.6	192.5
Arsenic	MAX	6.4	4.7	3.4	3.8	3.9
	MIN	4.6	3.3	2.8	3	2.8
	AVG	5.515	3.85	3.14	3.49	3.37
Cadmium	MAX	0.17	0.17	0.14	0.16	0.13
	MIN	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023
	AVG	0.124	0.124	0.104	0.116	0.109
Chromium	MAX	15.3	15.5	13.6	12.2	13.4
	MIN	11	8.3	8.6	7.8	8.7
	AVG	12.67	12.27	10.606	9.479	11.298
Copper	MAX	4.4	4.1	4.6	5.3	4.9
	MIN	0.7	0.6	0.58	0.4	0.5
	AVG	1.852	1.763	1.884	1.898	1.831
Lead	MAX	4.6	2.76	2.72	1.5	11.32
	MIN	3.17	1.63	2.05	0.94	1.13
	AVG	3.6	2.039	2.368	1.282	2.366
Mercury	MAX	<0.017	<0.017	0.03	<0.017	0.04
	MIN	<0.017	<0.017	<0.017	<0.017	<0.017
	AVG	<0.017	<0.017	0.0183	<0.017	0.0193
Nickel	MAX	7.1	7	8.9	9	10
	MIN	<0.001	<0.001	<0.001	<0.001	<0.001
	AVG	2.720	2.860	3.150	3.070	5.290
Zinc	MAX	6.9	4.8	5.6	3	3.4
	MIN	2.7	2.3	2.8	1.4	1.5
	AVG	4.79	3.4	3.62	2.1	2.25

Table 12. Summary of sediment chemistry results (mg/kg) for offshore stations (D) during 1999-2000, 2002, and 2004-5.

		D1	D2	D3A	D5	D6
%TOC	MAX	0.49	0.38	0.36	0.42	0.41
	MIN	0.2	0.15	0.21	0.17	0.2
	AVG	0.34	0.27	0.28	0.26	0.31
TOC	MAX	1.51	1.03	1.13	2.08	1.1
	MIN	0.32	0.18	0.28	0.25	0.31
	AVG	0.70	0.46	0.68	1.00	0.74
%Solids	MAX	69.58	75.7	79.6	75.1	69.6
	MIN	63.3	66.3	35.2	65.9	62.5
	AVG	66.268	69.65	64.25	68.95	66.55
ORP	MAX	195	205	350	200	175
	MIN	35	45	25	45	25
	AVG	96.69	108.91	132.62	114.87	106.22
AVS	MAX	31	22.9	9	8.6	28
	MIN	ND	ND	ND	ND	ND
	AVG	18.33	5.33	5.64	4.00	12.42
NO2+NO3	MAX	0.37	0.52	0.59	0.3	0.48
	MIN	0.08	0.22	0.16	0.1	0.08
	AVG	0.217	0.384	0.343	0.178	0.19
TKN	MAX	332	244	607	263	284
	MIN	43	45	133	31	112
	AVG	243.8	186.5	259.3	168.7	195.3
Arsenic	MAX	7.8	5	12.4	14.8	7
	MIN	4.2	3	2.7	6.19	3.5
	AVG	6.82	4.20	4.20	11.62	5.93
Cadmium	MAX	0.15	0.13	0.15	0.14	0.16
	MIN	<0.0023	<0.0023	<0.0023	<0.0023	<0.0023
	AVG	0.10	0.09	0.09	0.10	0.09
Chromium	MAX	49.4	13.1	18.1	99.5	14.7
	MIN	14.1	9.9	8.2	15.3	9.2
	AVG	19.48	11.47	10.448	26.41	12.74
Copper	MAX	5.4	4.3	6.3	5.2	5.9
	MIN	2.1	1.4	1	1.31	1.2
	AVG	3.353	2.465	2.33	2.82	2.617
Lead	MAX	506	2.01	2.86	3.31	2.9
	MIN	3.62	1.27	1.86	2.24	1.26
	AVG	54.27	1.66	2.24	2.53	1.78
Mercury	MAX	0.05	0.02	0.03	0.1	<0.017
	MIN	0.032	<0.017	<0.017	<0.017	<0.017
	AVG	0.0429	0.0182	0.0205	0.0285	<0.017
Nickel	MAX	12.4	8.4	7	26.8	21.4
	MIN	0.04	<0.001	0.02	<0.001	<0.001
	AVG	7.82	4.05	3.14	17.13	11.12
Zinc	MAX	16.3	11	13.3	14.8	10.9
	MIN	5.57	2.8	3.1	5.1	2.7
	AVG	8.352	5.4	5.72	7.47	5.28

Table 13. Summary of sediment chemistry results (mg/kg) for offshore stations (E) during 1999-2000, 2002, and 2004-5.

		E1	E2	E3	E5	E6
%TOC	MAX	0.42	0.32	0.36	0.38	0.37
	MIN	0.26	0.14	0.18	0.19	0.34
	AVG	0.34	0.23	0.29	0.28	0.36
TOC	MAX	0.62	0.24	0.65	0.31	0.33
	MIN	0.24	0.24	0.28	0.28	0.32
	AVG	0.50	0.22	0.52	0.30	0.33
%Solids	MAX	69.8	75.6	65	70.6	64.1
	MIN	59.2	69.1	59.8	61.1	58.1
	AVG	64.22	71.86	62.46	65.86	60.5
ORP	MAX	130	205	165	210	140
	MIN	25	55	25	25	30
	AVG	67.86	124.98	95.59	88.36	82.62
AVS	MAX	0.17	0.11	ND	ND	0.19
	MIN	0.17	0.11	ND	ND	0.19
	AVG	0.17	0.11	ND	ND	0.19
NO2+NO3	MAX	0.48	0.4	0.6	0.95	0.65
	MIN	0.06	0.06	0.28	0.14	0.24
	AVG	0.272	0.234	0.442	0.436	0.388
TKN	MAX	322	141	241	303	336
	MIN	133	48	176	150	162
	AVG	259.4	109	217.4	242.4	288.4
Arsenic	MAX	7.7	7.1	6.5	8.1	4.1
	MIN	5.8	5.3	3.7	5.2	2.9
	AVG	7	6.28	5.24	7.04	3.6
Cadmium	MAX	0.15	0.14	0.13	0.18	0.16
	MIN	<0.0023	<0.0023	0.06	<0.0023	<0.0023
	AVG	0.09	0.09	0.09	0.09	0.06
Chromium	MAX	19.7	13.75	12.1	16.2	12.7
	MIN	12.1	10.8	8.96	14.7	10.1
	AVG	16.32	12.89	10.732	15.32	11.86
Copper	MAX	8	6.2	5.9	7.1	6.7
	MIN	2.33	1.16	1.48	1.87	1.9
	AVG	4.45	2.704	3.132	3.472	3.35
Lead	MAX	5.5	3.1	4.2	4.1	3.7
	MIN	3.38	1.45	2.5	3.13	2.5
	AVG	4.56	1.83	3.10	3.60	3.09
Mercury	MAX	0.08	0.02	0.09	0.03	0.02
	MIN	0.04	<0.017	<0.017	<0.017	<0.017
	AVG	0.054	<0.0176	0.0454	0.0202	<0.0176
Nickel	MAX	11.5	10.7	15.1	13.6	13.4
	MIN	0.08	<0.001	0.03	<0.001	<0.001
	AVG	8.316	7.7362	10.786	9.6202	9.2002
Zinc	MAX	12.1	8.3	10.7	7.9	6.9
	MIN	7.9	3.5	5.3	5.8	5
	AVG	9.32	4.87	7.48	6.86	5.86

Table 14. NOAA Screening Quick Reference Table screening concentration.

Pollutant (mg/kg)	TEL	ERL	PEL	ERM	AET
Arsenic	7.24	8.2	41.6	70	35
Cadmium	0.67	1.2	4.2	9.6	3
Chromium	52.3	81	160	370	260
Copper	18.7	34	108	270	390
Lead	30.2	46.7	112	218	400
Mercury	0.13	0.15	0.7	0.71	0.41
Nickel	15.9	20.9	42.8	51.6	110
Silver	0.73	1	1.77	3.7	3.1
Zinc	124	150	271	410	410
Chlordane	2.26	0.5	6	4.79	2.8
Dieldrin	0.72	0.02	8	4.3	1.9

Table 15. Projected SIWWTP annual average effluent flows and BOD₅ and TSS loading

	2010	2015	2020	2025
Flow - m ³ /sec	3.56	3.74	3.86	3.97
- MGD	81.27	85.28	88.09	90.51
BOD ₅ loading (mt/day)	13,015	13,657	14,107	14,495
TSS loading (mt/day)	7,742	8,124	3,391	8,622

Metric ton (mt) = 2,205 lbs

REFERENCES

Baumgartner, D.J., W.E. Frick, and P.J.W. Roberts. 1994. Dilution models for effluent discharges. EPA/600/R-94/086. Pacific Ecosystems Branch, U.S. Environmental Protection Agency, ERL-N, Newport, OR. 189 pp.

Brooks, N.H. 1960. Diffusion of sewage effluent in an ocean current. pp. 246-267. In: Proceedings of the 1st International Conference on Waste Disposal in the Marine Environment, University of California, Berkeley, CA. July 1959. Pergamon Press, Elmsford, NY.

Frick, W.E., P.J.W. Roberts, L.R. Davis, J. Keyes, D.J. Baumgartner, and K.P. George. 2003. Dilution models for effluent discharges, 4th edition (Visual Plumes). EPA/600/R-03/025 March 2003, U.S. Environmental Protection Agency, Environmental Research Division, Athens, Georgia.

Hawaii Department of Health. 1989. State Toxics Control Program: Derivation of Water Quality-Based Discharge Toxicity Limits for Biomonitoring and Specific Pollutants. Department of Health, Environmental Protection and Health Services Division, Environmental Planning Office, Honolulu, Hawaii.

Hawaii Department of Health. 2004 Revision. Hawaii Administrative Rules. Title 11, Chapter 54. Water quality standards.

Honolulu, City and County of. 2003. Application for Section 301(h) NPDES Permit for the Sand Island Wastewater Treatment Plant, Honolulu, HI.

Kemmerer, J. 16 May 2005. Letter to E. Takamura, Director, Department of Environmental Services, City and County of Honolulu, HI. U.S. EPA Region 9, San Francisco, CA.

Lau, L. 6 September 2005. Letter to A. Strauss, Director, Water Division, U.S. EPA Region 9. Deputy Director for Environmental Health, Hawaii Dept. of Health, Honolulu, HI.

Lau, L. 15 October 2007. Declaration of Laurence Lau, Deputy Director for Environmental Health, Hawaii Dept. of Health, Honolulu, HI.

Mamala Bay Study Commission. 1996. The Mamala Bay Study-Final Report. Honolulu, HI.

Muellerhoff, W.P., A.M. Soldate Jr., D.J. Baumgartner, M.D. Schuldt, L. Davis et al. 1985. Initial mixing characteristics of municipal ocean discharges. Vol. 1. Procedure and applications. Pacific Ecosystems Division, U.S. Environmental Protection Agency ERL-N, Newport, OR. EPA-600/3-85-073a.

Nacci, D and G.E. Morrison. 1993. Standard operating procedure for conducting a sperm toxicity test using the Hawaiian sea urchin, *Tripneustes gratilla*. Environmental Research Laboratory – Narragansett Contribution 1516. U.S. Environmental Protection Agency, Narragansett, R.I.

NOAA. 2006. Screening Quick Reference Tables. Hazmat Report 99-1, updated November 2006. National Oceanic and Atmospheric Administration. Seattle, WA.

NOAA. 2007. September 2007 Precipitation Summary. 3 October 2007. (http://www.prh.noaa.gov/hnl/hydro/pages/data_tbl_09.html).

Swartz, R.C., J.H. Bailey-Brock, W.J. Cooke, and E.A. Kay. 2006. Benthic faunal sampling adjacent to the Sand Island Ocean Outfall, Oahu, Hawaii, August 2005. Water Resources Research Center, University of Hawaii at Manoa, Honolulu, Hawaii. Report prepared for the City and County of Honolulu, March 2006.

Takamura, E.S. 16 August 2007. Letter to John Kemmerer, Associate Director, Water Division, U.S. EPA Region 9. Director, Department of Environmental Services, City and County of Honolulu, HI.

Tetra Tech. 2007. Draft Compliance Evaluation Inspection Checklist. Prepared by Tetra Tech Inc., Lakewood, CO for US Environmental Protection Agency, Region 9, San Francisco, CA and Hawaii Department of Health, Honolulu, HI.

U.S. EPA. 1986. Ambient water quality criteria for bacteria - 1986. EPA-44015-84-002, Office of Water Regulations and Standards, U.S. Environmental Protection Agency, Washington, DC.

U.S. EPA. 1989. Short-term methods for estimating the chronic toxicity of effluents and receiving waters to freshwater organisms. EPA/600/4-89/001.

U.S. EPA. 1991. Technical support document for water quality-based toxics control. EPA/505/2-90-001. USEPA, Office of Water, Washington, D.C.

U.S. EPA. 1994. Amended section 301(h) technical support document. EPA/842/B-94/007. USEPA, Office of Water, Washington, D.C.

U.S. EPA. 2004. Water Quality Standards for Coastal and Great Lakes Recreation Waters; Final Rule. U.S. Environmental Protection Agency, Washington, DC. Federal Register Vol.69, No.220. pp. 67218-67243.

U.S. EPA. 2007. Integrated Risk Information System (IRIS) website: www.epa.gov/iris.

Wagner, Amy. 1998. Hawaiian Collector Urchin, *Tripneustes gratilla* (Hawa'e) Fertilization Test Method. Adapted from a method developed by George Morrison, EPA,

ORD Narragansett, RI and Diane Nacci, Science Applications International Corporation, ORD Narragansett, RI.

Ward Research. 2003. Environmental Issues on Oahu. Prepared by Ward Research, Inc. for City and County of Honolulu Dept. of Environmental Services, Honolulu, HI.

Work, T.M. 2006. Necropsy and liver histopathology for fish sampled in the vicinity of the Sand Island Ocean Outfall and at Reference Stations in Maunalua Bay, Oahu, Hawaii, 2005. Water Resources Research Center, University of Hawaii at Manoa, Honolulu, Hawaii. Report prepared for the City and County of Honolulu, January 2006.