DECISION DOCUMENT

ANALYSIS OF THE SECTION 301(h) SECONDARY TREATMENT WAIVER APPLICATION FOR THE CAROLINA REGIONAL WASTEWATER TREATMENT PLANT NPDES PERMIT NO. PR0023752 PUERTO RICO

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION 2
NEW YORK, NEW YORK

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INTRODUCTION

The Puerto Rico Aqueduct and Sewer Authority (hereinafter, the applicant or PRASA) has requested a renewal of its waiver 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), for the Carolina Regional Wastewater Treatment Plant (RWWTP), a publicly owned treatment works (POTW). [National Pollutant Discharge Elimination System (NPDES) Permit No. PR0023752]

The applicant is seeking a section 301(h) waiver to discharge wastewater receiving less-than-secondary treatment to the Atlantic Ocean. Secondary treatment is defined in regulations at 40 CFR part 133 in terms of effluent quality for total suspended solids (TSS), five-day measure of biochemical oxygen demand (BOD_5) and pH. Pursuant to 40 CFR §133.102, secondary treatment requirements for TSS, BOD_5 and pH are listed below:

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

BOD_5: (1) The 30-day average concentration shall not exceed 30 mg/l;
(2) The 7-day average concentration shall not exceed 45 mg/l; and
(3) The 30-day average percent removal shall not be less than 85 percent.

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

The original application for a section 301(h) modification of secondary treatment requirements at the Carolina RWWTP was submitted to U.S. Environmental Protection Agency (EPA) Region 2 in 1979, and was tentatively approved by EPA on September 30, 1988. In 2002, EPA approved PRASA's first application for renewal of its section 301(h) modified permit ("modified permit") for the Carolina RWWTP, and subsequently issued a modified permit that became effective on June 1, 2002, and expired on May 31, 2007. Pursuant to 40 CFR §122.21, the terms and conditions of the 2002 modified permit have been administratively extended until issuance of a new permit. In December 2006, PRASA again submitted a modified permit application requesting a renewal of its modification from the secondary treatment requirements. On March 26, 2008, the applicant submitted supplemental information to EPA supporting its 2006 permit renewal application in response to an EPA request for additional information.

The applicant has requested a section 301(h) modification from secondary treatment requirements for BOD_5 and TSS only. The applicant has not requested a modification for pH. Table 1 provides a comparison of the applicant's existing and proposed effluent limitations for BOD_5 and TSS and recent performance data from June 2002 to September 2009 for the Carolina RWWTP. The applicant is a large applicant and has requested a modification of secondary treatment requirements for the Carolina RWWTP based on a current discharge within the definitions of 40 CFR §§125.58(c) and (h). The applicant has not requested a change in

concentration or mass-based effluent limits for BOD_5 and TSS that are established in the current permit.

This Decision Document presents EPA Region 2's findings, conclusions, and recommendations as to whether the applicant's modified 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, and Puerto Rico Water Quality Standards (PRWQS) Regulations, Resolution Number R-03-05.

DECISION CRITERIA

Under section 30l(b)(l)(B) of the Act, 33 U.S.C. section 1311(b)(l)(B), POTWs in existence on July l, l977, were required to meet effluent limitations based upon secondary treatment as defined by the Administrator of EPA (the Administrator). As previously described, secondary treatment is defined by the Administrator in terms of three parameters: TSS, BOD_5, and pH. Uniform national effluent limitations for these pollutants were promulgated (see 40 CFR part 133) and included in NPDES permits for POTWs issued under section 402 of the Act. POTWs were required to be in compliance with these limitations, in most circumstances, by July l, l977.

Congress subsequently amended the Act, adding section 301(h), which authorized the Administrator, with State[1] concurrence, to issue NPDES permits which modify the secondary treatment requirements of the Act. P.L. 95-217, 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)(l)(B) of this section 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:
>
> (l) 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 the Act];
>
> (2) the discharge of pollutants in accordance with 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 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 such monitoring is limited to include only those scientific investigations which are necessary to study the effects of the proposed discharge;

[1] Section 502(3) of the Act defines "State" to include the Commonwealth of Puerto Rico. 33 U.S.C. 1362(3).

(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 this Act] after initial mixing in the waters surrounding or adjacent to the point at which such effluent is discharged . . .”

For the purpose 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 comply with the requirements of sections 30l(h)(2) and 101(a)(2) of the Act. For the purposes of section 301(h)(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 30 percent of the suspended solids in the treatment works influent, and disinfection, where appropriate. A municipality which applies for a waiver of 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 shall authorize the discharge of sewage sludge into marine waters. In order for a permit to be issued 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 shall authorize the discharge of any pollutant into marine or estuarine waters which at the time of application does 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.

On August 9, 1994, EPA promulgated final regulations implementing these statutory criteria in 40 CFR part l25, subpart G. These regulations provide that a section 30l(h) modified NPDES permit may not be issued in violation of 40 CFR §l25.59(b), which requires, among other things, compliance with provisions of the Coastal Zone Management Act (l6 U.S.C. l45l et seq.), the Endangered Species Act (l6 U.S.C. l53l et seq.), Title III of the Marine Protection, Research and Sanctuaries Act (l6 U.S.C. l43l et seq.), and other applicable provisions of State or Federal laws or Executive Orders such as requirements of Essential Fish Habitat of the Magnuson-Stevens Fishery Conservation and Management Act and the President's Executive Order on Coral Reef Protection dated June 11, 1998. Furthermore, in accordance with 40 CFR §125.59(i), the decision to grant or deny a section 301(h) waiver shall be made by the Administrator and shall be based on the applicant's demonstration that it has met all the requirements of 40 CFR §§125.59 through 125.68, as described in this Decision Document. EPA has reviewed all data submitted by the applicant in the context of applicable statutory and regulatory criteria and has presented its findings and conclusions in this Decision Document.

SUMMARY OF FINDINGS

Based upon review of information provided by the applicant and other supporting documents, EPA makes the following findings regarding the modified discharge's compliance with statutory and regulatory criteria:

1. The modified discharge will not cause violations of PRWQS standards for dissolved oxygen, color, turbidity, or pH. [section 301(h)(1), 40 CFR §125.61]

2. The applicant has demonstrated that it can consistently achieve PRWQS at and beyond the zone of initial dilution. The applicant's modified discharge, alone or in combination with pollutants from other sources, will not impact public water supplies. The modified discharge will not interfere with the protection and propagation of a balanced indigenous population of fish, shellfish, and wildlife, and will not affect recreational activities. [section 301(h)(2), 40 CFR §l25.62]

3. The applicant has proposed an adequate monitoring program to assess the impact of the modified discharge. The terms of this program will become enforceable conditions of the modified permit to be issued to the applicant. [section 30l(h)(3), 40 CFR §l25.63]

4. The applicant's modified discharge will not result in additional treatment requirements on any other point or nonpoint sources. [section 30l(h)(4), 40 CFR §l25.64]

5. The applicant has an industrial pretreatment program and the program continues to be implemented on an island-wide basis. [section 301(h)(5), 40 CFR §§125.66 and 125.68]

6. The applicant has demonstrated that it has met the urban pretreatment requirements. [section 301(h)(6), 40 CFR §125.65]

7. The applicant has proposed a toxics control program to limit the entrance of toxic pollutants from nonindustrial sources into the treatment works. [section 30l(h)(7), 40 CFR §l25.66]

8. There will be no new or substantially increased discharges from point sources of pollutants to which the waiver applies above those specified in the modified permit. [section 30l(h)(8), 40 CFR §l25.67]

9. The applicant has demonstrated the modified discharge will receive at least primary or equivalent treatment and meet the requirements established under section 304(a)(1) of the Act after initial mixing. [section 301(h)(9), 40 CFR §125.60]

CONCLUSION

EPA has concluded that the applicant's modified discharge will not adversely impact the marine environment and beneficial uses of the receiving water, and will comply with the requirements of section 301(h) of the Act and 40 CFR part 125, subpart G.

RECOMMENDATION

It is recommended that the applicant be granted a section 301(h) modified permit in accordance with the above findings, and that a public notice of intent to issue a section 301(h) modified permit be prepared in accordance with all applicable provisions of 40 CFR parts 122 and l24. In accordance with 40 CFR §125.68, the Carolina RWWTP section 301(h) modified permit (NPDES Permit No. PR0023752) shall contain, in addition to all applicable terms and conditions required by 40 CFR part 122, the following special conditions:

1. All requirements determined necessary by the Puerto Rico Environmental Quality Board as part of its Intent to Issue a Water Quality Certificate to ensure that the modified discharge will comply with all applicable provisions of Commonwealth law, including water quality standards. [section 401, 40 CFR §124.54]

2. Effluent limitations and mass loadings presented in Table 1, in accordance with 40 CFR parts 122 and 125;

3. Requirements for the use of chemical addition (e.g., polymer) to increase solids removal to achieve a 60 percent removal rate, on a monthly average basis, for TSS;

4. Monitoring requirements for establishing and implementing the Carolina RWWTP section 301(h) Waiver Demonstration Studies that include, but are not limited to, biological, effluent,

Table 1 - Proposed section 301(h) Modified Effluent Limitations

Parameter	Monthly Average	Average Weekly	Daily Maximum	Percent Removal
Flow, MGD	45	--[1]	90	--
BOD_5, mg/l	130	--	--	30
BOD_5, kg/day	22,166	44,332	--	--
TSS, mg/l	70	--	--	60
TSS, kg/day	11,935	23,870	--	--

[1]No effluent limitation proposed

and water quality monitoring that are consistent with 40 CFR §§125.60, 125.62, 125.63, and 125.68(c);

5. Reporting requirements for the Carolina RWWTP section 301(h) Waiver Demonstration Studies, in accordance with 40 CFR §125.68(d);

6. Requirements to modify, as necessary, and implement a toxics control program upon the effective date of the modified permit to limit the entrance of toxic pollutants from nonindustrial sources into the treatment works; and

7. Requirements for implementing a pretreatment program and nonindustrial control program in accordance with 40 CFR §§125.65, 125.66, and 125.68(b).

DESCRIPTION OF THE TREATMENT FACILITY

The Carolina RWWTP is located on the north coast of the island of Puerto Rico, within the town of Loiza. The facility provides service to the towns of Carolina, Trujillo Alto, Canovanas, Loiza, sections of Rio Piedras (San Juan), and Rio Grande. The Carolina RWWTP first began operations in August 1986 and is designed to provide primary treatment of wastewater through screening, grit removal, polymer-enhanced sedimentation, and chlorination for disinfection. The design life of the facility is estimated to be 40 years and the facility has a daily average design flow of 45 MGD and a daily maximum design flow of 90 MGD. Based on flow monitoring data from June 2002 through September 2009, actual daily average flows ranged between 27.1 and 76.2 MGD, and monthly average flows ranged between 17.8 and 48.5 MGD. The facility is owned and operated by PRASA.

At the Carolina RWWTP, influent travels through the bar screen to the grit collector, Parshall flume and primary settling tank. To enhance solids sedimentation PRASA adds polymer. As a result, effluent from the Carolina RWWTP can be considered as having undergone advanced primary treatment. Primary tank sludge is pumped to the holding tank and primary tank scum is sent to the scum collectors. Sludge from the primary treatment process is dewatered onsite and transported either to the Ponce Municipal Landfill on the southwestern portion of the island or to the Puerto Nuevo Regional Wastewater Treatment Plant. The applicant has requested effluent limits based on a daily maximum design flow of 90 MGD and a monthly average design flow of 45 MGD. Table 2 provides a summary of current effluent limitations for BOD_5, TSS and pH, effluent limitations for these parameters requested by the applicant for the term of the renewed

Table 2 - Summary of current and the applicant's requested effluent limitations and effluent monitoring data for the Carolina RWWTP

Parameter	Current and Requested Effluent Limitations			Effluent Monitoring Data[1]		
	Monthly Average	Average Weekly	Daily Maximum	Monthly Average	Average Weekly	Daily Maximum
Flow, MGD	45	--[2]	90	17.8 to 48.5	--	27.1 to 76.2
BOD_5, mg/l	130	--	--	32 to 104	--	--
BOD_5, kg/day	11,935	23,870	--	2,395 to 12,447	5,516 to 25,027	--
BOD_5, percent removal	30	--	--	26 to 73	--	--
TSS, mg/l	70	--	--	23 to 88	--	--
TSS, kg/day	22,166	44,332	--	1,126 to 11,936	2,932 to 59,688	--
TSS, percent removal	60	--	--	35 to 86	--	--
pH, standard units	6.0 to 9.0			5.8 to 8.38		

[1]Effluent monitoring data are based on Discharge Monitoring Reports dated June 2002 to September 2009. Data provide the range between the minimum and maximum values reported.
[2]Limitations not required or data not available for review.

modified permit; and recent performance data.

The Carolina RWWTP discharges treated effluent directly into the Atlantic Ocean through an ocean outfall system that consists of a high-rate multiport diffuser. The terminus of the outfall is located approximately 6,234 ft (1,900 m) offshore at a depth of 90 ft (27 m). [18 degrees 27.739 minutes north latitude and 65 degrees 53.400 minutes west longitude] Effluent is discharged horizontally in alternate directions through a linear multiport diffuser. The design characteristics of the outfall and diffuser system are described in Table 3. In general, the diffuser consists of 34 ports and has a total length of 666 ft (203 m), with ports spaced approximately 20 ft (6.1 m) apart. The outfall and diffuser system, with all 34 ports open, is designed to transport and discharge a daily average flow of 62.5 MGD (2.74 m^3/s) and a maximum daily flow of 125 MGD (5.48 m^3/s). Currently, 14 of the most seaward ports are open and flowing based on an October 2009 inspection by PRASA.

Initial Dilution. For the purpose of section 301(h) evaluations, dilution is defined as the ratio of the total volume of the sample (ambient water plus effluent) to the volume of effluent in the sample. A dilution of 100 is, therefore, a mixture of 99 parts of ambient water to 1 part of effluent. At the time a section 301(h) modification becomes effective, 40 CFR §125.62 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 Zone of Initial Dilution (ZID), all applicable water quality standards. The ZID is defined as a region of mixing surrounding, or adjacent to, the end of the outfall or diffuser, provided that the ZID is not larger than allowed by mixing zone restrictions in applicable water quality standards (see 40 CFR §125.58(dd)). Article 5 of PRWQS authorizes the use of mixing zones through a mixing zone approval process. Upon approval by the Puerto Rico Environmental Quality Board (PREQB), an interim authorization for a mixing zone is granted

Table 3 - Design configuration of the Carolina RWWTP outfall and diffuser system

Maximum daily design flow, MGD[a] (m^3/s)	125 (5.48)
Total outfall + diffuser length, ft (m)	6,234 (1,900)
Outfall diameter, in (cm)	72 (183)
Outfall depth, ft (m)	90 (27)
Diffuser length, ft (m)	666 (203)
Diffuser diameter, in (cm)	72 (183)
Port number [b]	34
Port spacing, ft (m)	20 (6.1)
Port diameter – port No. 1, in (cm)	15 (38)
Port diameter – port No. 2-14, in (cm)	8.75 (22)
Port diameter – port No. 15-34, in (cm)	7.5 (19)
Port vertical discharge angle, degrees	0
Port horizontal discharge angle, degrees	90
Port depth below the surface, ft (m)	86 to 102 (26.3 to 31.1)

[a]The average daily design flow for the outfall and diffuser system is 62.5 MGD (2.74 m^3/s).
[b]The diffuser currently operates with 14 of the most seaward ports opened (numbers 21 through 34).

based on the petitioner's demonstration that water quality standards are met at the boundary of the proposed mixing zone, after the lowest (i.e., critical) initial dilution for open coastal waters (see Article 5.4.4 of PRWQS).

In December 2006, PRASA submitted a mixing zone application to the PREQB requesting a Water Quality Certificate (WQC) and definition of an interim mixing zone (IMZ) for the Carolina RWWTP (PRASA 2006a). On November 9, 2009, PREQB issued an Intent to Issue a Water Quality Certificate (IWQC) for the Carolina RWWTP that included an authorization of an IMZ. In the IWQC, EQB defined the IMZ as being bound by four monitoring stations, C1/MZ1, MZ2, C2/MZ3, and MZ4, based on information provided by PRASA in its December 2006 mixing zone application. The locations of the facility, outfall, and receiving water and coral community monitoring stations are provided in Figure 1. In general, the IMZ can be described as being the ZID, which is sized to include the bottom area and the water column above it. Consistent with PREQB's 1988 Mixing Zone and Bioassay Guidelines, PRASA determined the size of the IMZ through dilution modeling to be approximately 797 ft (243 m) long and 236 ft (72 m) wide, and that it would provide a Critical Initial Dilution (CID) of 123:1 for the Carolina RWWTP modified discharge based on a maximum daily permitted flow of 90 MGD and 29 of the total 34 ports opened to optimize dilution for the permitted flow (PREQB, 1988).[2] For the purpose of the section 301(h) evaluation, the definition of the IMZ is consistent with determination of a ZID and, therefore, monitoring stations C1/MZ1 and C2/MZ3 are herein referred to as ZID monitoring stations C1 and C2. Ambient monitoring at monitoring stations MZ2 and MZ4 are required by the EQB as part of its IWQC.

[2] EPA's 2002 approval of PRASA's application for renewal of its section 301(h) modified permit was based on a CID of 125:1. The revised CID was based on updated critical density profiles and ambient ocean current speeds from section 301(h) Waiver Demonstration Monitoring Studies conducted since 2002. In addition, since submittal of PRASA's 2006 renewal application, PRASA has calculated a new CID of 145:1 with inclusion of vent holes in the top of the risers that were not accounted for in previous dilution modeling. However, for the purpose of this section 301(h) decision document, EPA has considered a CID of 123:1 as a worst-case scenario since EQB's has based the IMZ on this CID in its IWQC.

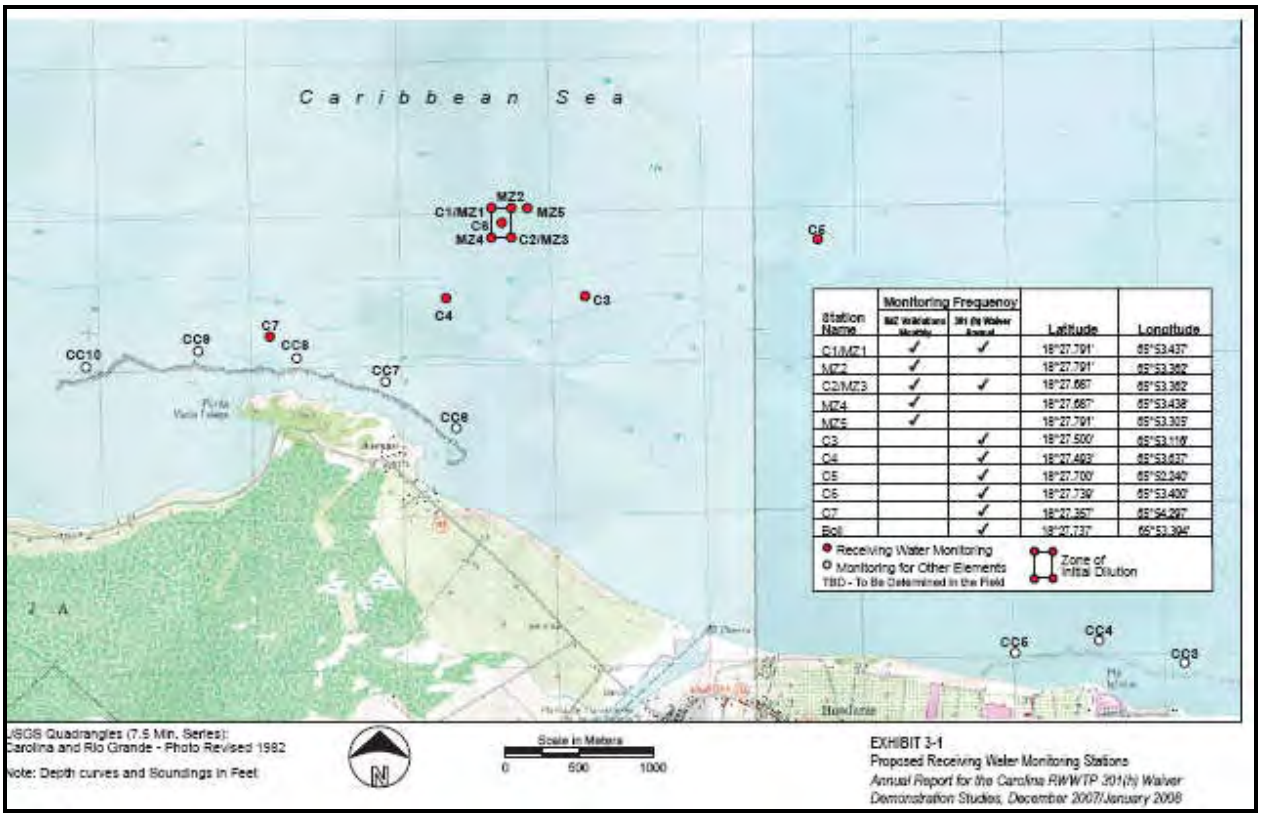

Figure 1. Location of ambient monitoring stations for the Carolina RWWTP. Figure reprinted from the Carolina RWWTP section 301(h) Waiver Demonstration Study, February/March 2008 (PRASA 2008a).

Pursuant to the current modified permit, PRASA is required to maintain the opening of 29 ports. However, only 14 of the most seaward ports currently are open due to seawater intrusion discovered in a 2006 outfall inspection that identified no flow at 13 of the 29 opened ports (PRASA 2010c). At low flow conditions, effluent flow cannot be fully maintained through all diffuser ports. This can lead to the intrusion of seawater into the diffuser, and the diffuser not operating as designed to achieve the necessary initial dilution to meet water quality standards. Nevertheless, with only 14 opened ports, PRASA predicted greater initial dilutions than the CID, with 127:1 and 138:1 determined for the permitted daily maximum flow of 90 MGD and the observed maximum daily flow of 67.9 MGD, respectively. Based on a May 2008 tracer dye study using actual observed ambient data and effluent flows, PRASA also estimated higher initial dilutions with average dilutions that ranged between 385:1 and 538:1 (PRASA 2010b).

Since January 1999, PRASA has been conducting receiving water monitoring within, at, and beyond the ZID. The current modified permit originally required the applicant to conduct quarterly section 301(h) Waiver Demonstration Studies at seven receiving water monitoring stations, which included locations within the ZID (C6), at the boundary of the ZID (C1 and C2), beyond the ZID (i.e., farfield stations C3, C4 and C7), and at a reference site (C5). PRASA is also required to conduct coral community monitoring surveys at eight stations located south of the Caroline RWWTP outfall. Receiving water monitoring under the section 301(h) Waiver

Demonstration Studies consists of sampling at three depths: surface (10 ft), middle (50 ft), and bottom (90 ft). During the current permit term, EPA reduced the section 301(h) monitoring frequency from quarterly to semi-annually in 2003 and then to annually beginning in 2007. Between 1999 and 2009, PRASA conducted 23 section 301(h) Waiver Demonstration Studies with the collection of samples throughout the water column (PRASA 1999b; 1999c; 1999e; 2000; 2001a-d; 2002a-d; 2003a-b; 2004a-b; 2005; 2006b-c; 2007e; 2008a-b; 2010d). The most recent receiving water monitoring event was conducted in October 2009.

DESCRIPTION OF RECEIVING WATERS

The Carolina RWWTP is located on the north coast of the island of Puerto Rico. The north coast consists of a narrow shelf (2.8 to 4.6 km) that forms continuously strong currents and wave action, which can be exacerbated by tropical storm events. Depths at the shelf break are typically around 700 ft (213 m) with the deepest depths ranging between 1,200 ft (366 m) and 2,400 ft (732 m). Because of strong wave action, the north coast has few coral reefs compared to the south coast region of the island, which has a wide shelf that protects the coast and allows for the support of fringing coral reefs. Coral reefs on the north coast are much lower in species diversity than those on the south coast and generally other Caribbean reefs (Glynn 1973). The nearest coral assemblage to the Carolina RWWTP's outfall is at Punta Vacia Talega, which is 0.93 miles (1.5 km) southwest of the outfall, and consists of a rock reef with very sparse hard coral growth.

Currents in the vicinity of the Carolina RWWTP outfall are generally influenced by the Atlantic Ocean current system known as the North Equatorial Current. Local winds do not significantly affect the general hydrological flow patterns near the outfall, although they may influence surface currents. In the renewal application, PRASA provided information on current speed and direction based on receiving water monitoring events conducted between January 1999 and December 2005 (PRASA 2008d). Current data show that surface currents generally flow westerly and range in speeds of 4.9 to 30.2 cm/sec whereas mid-depth and near bottom currents generally flow in the easterly direction and are slightly slower with speeds that ranged between 3.4 and 26.2 cm/sec, and 3.0 and 20.5 cm/sec, respectively. Based on current monitoring data, PRASA determined that the currents in the vicinity of the Carolina RWWTP outfall can be generally characterized as flowing easterly at an average speed of 13.7 cm/sec.

In the renewal application, PRASA indicated that there is little seasonal variation in the water column with respect to temperature and salinity. Density profiles at the Carolina RWWTP outfall taken during wet and dry seasons indicate that thermoclines and haloclines do not form, which allows for constant mixing of the water column throughout the year. Also, annual ambient water temperatures are shown to range between 25 and 29 degrees Celcius, with only minor seasonal and spatial differences. Annual temperature and salinity data indicate that surface-to-bottom differences of these parameters are small, and spatial differences are insignificant.

To protect the designated uses of surface waters of Puerto Rico, the Commonwealth of Puerto Rico has adopted water quality standards for marine waters depending on the level of protection required. Article 2 of PRWQS classifies the coastal waters of Puerto Rico from Punta El Morro

(San Juan Port) to Playa Sardinera (Fajardo) as Class SB and Class SC waters. From the shoreline, Class SB waters are considered the boundary subject to the ebb and flow of tides (mean sea level) to 1,640 ft (500 m) seaward. Coastal waters beyond this area to a maximum distance of 10.3 mi (16.6 km) are considered Class SC waters. Article 3.2 of PRWQS identifies the following protected uses for Class SB and Class SC waters:

> Class SB. Coastal waters and estuarine waters intended for use in primary and secondary contact recreation, and for propagation and preservation of desirable species, including threatened and endangered species; and
>
> Class SC. Coastal waters intended for uses where the human body may come in contact with the water (such as fishing, boating, etc.) and for use in propagation and preservation of desirable species, including threatened or endangered species.

The Carolina RWWTP discharges wastewater approximately 6,234 ft (1,900 m) from the shore into Class SC waters. However, the modified discharge may affect both Class SB and SC waters if onshore currents persist. Consequently, for the purpose of the section 301(h) evaluation, EPA has assessed attainment of water quality standards for both Class SB and SC waters to ensure that the modified discharge from the Carolina RWWTP does not impact beneficial uses in either area. Applicable water quality standards for Class SB and SC waters are summarized in Table 4.

APPLICATION OF STATUTORY AND REGULATORY CRITERIA

1. Attainment of Water Quality Standards related to BOD_5 and TSS [section 301(h)(1), 40 CFR §125.61]

Under 40 CFR §125.61, which implements section 301(h)(1), there must be water quality standards applicable to the pollutants for which the modification is requested, and the applicant must demonstrate that the modified discharge will comply with these standards. The applicant has requested modified secondary treatment requirements for BOD_5, which affects dissolved oxygen (DO), and TSS, which affects the color or turbidity in the receiving water. PRASA has not requested a permit modification from secondary treatment requirements for pH. PRWQS have established water quality criteria for DO, color, turbidity, and pH.

a. DO

The effect of the effluent discharge on DO can occur in the nearshore and farfield as effluent mixes with the receiving water and the oxygen demand of the effluent BOD load is exerted. Pursuant to 40 CFR §§125.61(b)(1) and 125.62(a)(1), the applicant must demonstrate that the modified discharge will comply with water quality criteria for DO and that the outfall and diffuser are located and designed to provide adequate initial dilution, dispersion, and transport of wastewater such that the discharge does not exceed criteria at and beyond the ZID. Article 3.2.2 of PRWQS provides that the DO concentration in Class SB waters "shall not contain less than 5 mg/l, except when natural phenomena cause this value to be depressed." For Class SC waters, the DO concentration shall contain not less than 4 mg/l except when natural conditions cause this value to be depressed (see Article 3.2.3 of PRWQS). In accordance with EPA's Amended

Table 4 - Use Classification and Water Quality Standards for Class SB and SC Waters of Puerto Rico

	Class SB Waters	Class SC Waters
Class Uses and/or Description	Coastal waters and estuarine waters intended for use in primary and secondary contact recreation, and for propagation and preservation of desirable species.	Coastal waters intended for uses where the human body may come in indirect contact with the water (such as fishing, boating, etc.), and for use in propagation and maintenance of desirable species.
DO	Shall contain not less than 5 mg/l, except when natural phenomena cause this value to be depressed.	Shall contain not less than 4 mg/l except when natural conditions cause this value to be depressed.
Bacteria	The fecal coliform geometric mean of a series of representative samples (at least five samples) of the waters taken sequentially shall not exceed 200 colonies/100 ml, and not more than 20 percent of the samples shall exceed 400 colonies/100 ml. In waters intensely used for primary contact recreation, the enterococci density in terms of geometric mean of at least five representative samples taken sequentially shall not exceed 35/100 ml. No single sample should exceed the upper confidence limit of 75 percent using 0.7 as the log standard deviation until sufficient site data exist to establish a site-specific log standard deviation.	The coliform geometric mean of a series of representative samples (at least five samples) of the waters taken sequentially shall not exceed 10,000 colonies/100 ml of total coliform or 2,000 colonies/100 ml of fecal coliform. Not more than 20 percent of the samples shall exceed 4,000 colonies/100 ml of fecal coliforms.
pH	In no case will the pH lie outside the range of 7.3 and 8.5, standard pH units, except when caused by natural phenomena.	
Color	Shall not be altered except by natural causes.	Shall not be altered by other than natural phenomena except when it can be proven that such change in color is harmless to biota and aesthetically acceptable.
Turbidity	Shall not exceed 10 nephelometric turbidity units (NTU), except by natural causes.	Shall not exceed 10 nephelometric turbidity units (NTU).
Taste & Odor Producing Substances	Shall not be present in amounts that will interfere with primary contact recreation or will render any undesirable taste and/or odor to edible aquatic life.	Shall contain none in amounts that will render producing any undesirable taste or odor to edible aquatic life.
Surfactants (as MBAS)	Shall not exceed 500 ug/l.	

section 301(h) Technical Support Document (ATSD), EPA assessed attainment of the water quality criteria for DO based on review of receiving water monitoring data, and predictive modeling to further assess the impact of the modified discharge on DO concentrations in the receiving water under critical conditions (EPA 1994).

Attainment of DO Criteria Based on Ambient Monitoring Data. To determine whether the modified discharge would attain the water quality criteria for DO, EPA reviewed monitoring data provided by PRASA to assess levels of DO in the receiving water. EPA compared concentrations of DO at receiving water monitoring stations for the current discharge to the DO criteria for Class SB and SC waters. Between January 1999 and October 2009, monitoring data show that concentrations of DO at ZID stations C1 and C2 were consistently above the water quality criteria of 4 and 5 mg/l for Class SC and SB waters, respectively, with concentrations ranging between 4.70 and 7.21 mg/l. Furthermore, concentrations of DO meet the criteria within the ZID at station 6, and no depressed levels of DO were observed beyond the ZID.

Attainment of DO Criteria Based on Predictive Modeling. As wastewater is discharged through a diffuser, it forms a buoyant plume that rises during initial dilution. As the discharge plume rises, water from deeper parts of the water column is entrained into the plume and advected to the plume trapping level, which can result in an oxygen depression caused by entrainment if the DO level is lower at the bottom of the water column than at the trapping level or surface. In accordance with EPA's ATSD, EPA assessed the attainment of water quality criteria for DO upon initial dilution and in the farfield for both Class SB and SC waters using predictive modeling.

To assess whether the modified discharge would meet the DO criterion upon completion of initial dilution, EPA evaluated final DO concentrations predicted by the applicant. In the renewal application, PRASA calculated a final DO value in the receiving water upon critical initial dilution based on the following: an effluent DO concentration of 0.0 mg/l; 10^{th} percentile average ambient DO concentration of 5.19 mg/l observed over the depth of the discharge to trapping level under critical conditions; immediate DO demand value of 4.0 mg/l; and CID of 123:1 (PRASA 2008d). PRASA calculated the ambient DO concentration based on DO data (January 1999 through November 2006) below the plume trapping level (7.58 m) from ZID stations C1 and C2, which are the stations closest to the diffuser. Although EPA's ATSD specifies that ambient DO values should represent critical conditions and be calculated based on data that are immediately up-current of the diffuser averaged over the tidal period (12 hours), EPA believes that for the purpose of this section 301(h) evaluation ambient data from ZID stations C1 and C2 provide a conservative measure for assessing the impact of the discharge on DO concentrations in the receiving water. As a result, PRASA predicted a DO depression of 0.075 mg/l from ambient conditions with a final DO concentration of 5.115 mg/l. Since the final DO concentration is predicted to be above the DO criteria of 4 and 5 mg/l for Class SB and SC waters, respectively, the modified discharge is predicted to attain the water quality criteria for DO at the ZID upon CID.

Subsequent to initial dilution, DO in the water column is consumed by BOD in the wastefield. As the discharge plume travels through the water column, the combined oxidation of organic material in the diluted effluent and receiving water can result in oxygen depression beyond the

ZID in the farfield. BOD consists of a carbonaceous component (CBOD) and a nitrogenous component (NBOD), both of which can contribute to oxygen depression in the farfield. To assess DO concentrations after initial dilution, PRASA evaluated receiving water monitoring data and modeled the exertion of BOD in the farfield on DO concentrations under critical conditions. In the renewal application, PRASA predicted the DO demand due to BOD_5 exertion in the farfield using procedures specified in EPA's ATSD (PRASA 2008d). PRASA applied an effluent DO concentration of 0.0 mg/l, ambient DO concentration of 5.19 mg/l, and a final DO concentration of 5.115 mg/l calculated at the end of initial dilution. Calculations were done for 10 days at 6-hour intervals and for one day at 0.5-hour intervals. Using these values, PRASA calculated a minimum farfield DO concentration of 5.105 mg/l for the modified discharge. Because the DO concentration of 5.105 mg/l is greater than DO criteria for Class SB and SC waters, the modified discharge is predicted to meet the water quality criteria for DO beyond the ZID.

In addition to causing DO depression in the water column, the deposition of suspended particles from the wastewater discharge can also impact ambient concentrations of DO near the seafloor. As specified in EPA's ATSD, DO depletion due to steady sediment demand and sediment resuspension depends on many environmental conditions such as sediment composition (e.g., grain size distribution and organic content), sediment accumulation rates, current speeds, and circulation patterns. In the renewal application, PRASA provided an analysis of the impact of the modified discharge on DO concentrations in the receiving water due to sediment oxygen demand (PRASA 2008d). The DO depression due to steady-state sediment oxygen demand was calculated based on the applicant's requested monthly average TSS effluent limitation of 70 mg/l and monthly average wastewater flow of 45 MGD. As a result, PRASA calculated a worst case DO depression of 0.02 mg/l for the 90-day critical period and 0.008 mg/l DO depression for steady-state sediment oxygen demand. For the modified discharge, EPA subtracted these values from the final ambient DO concentration of 5.115 mg/l predicted upon initial dilution and determined a DO concentration of 5.095 mg/l (90-day critical) and 5.107 mg/l (steady-state) due to sediment oxygen demand, which are above the DO criteria of 4 and 5 mg/l for Class SC and SB waters, respectively.

As suspended solids from the discharge are initially deposited on the seafloor, sediments can be resuspended due to disturbances in the water column or on the seafloor which can cause additional DO depression in the water column. In the renewal application, PRASA calculated DO depression due to sudden resuspension of sediments during a 24-hour period in the region of highest accumulation (the area where sediment with a settling velocity of 0.1 cm/sec would accumulate). The worst case DO depression due to sudden resuspension was calculated by PRASA to be 0.108 mg/l for the 90-day critical period and 0.065 mg/l for steady state conditions. To further evaluate DO depression in the receiving water, EPA subtracted these values from the final DO concentration of 5.095 mg/l for 90-day critical period and 5.107 mg/l for steady-state conditions due to sediment oxygen demand and determined DO concentrations of 4.987 mg/l and 5.042 mg/l, respectively. Although the predicted DO concentration for the 90-day critical period is slightly below (or only 0.26 percent less than) the 5 mg/l criterion for Class SB waters, EPA does not anticipate significant depressions of DO in the receiving water since effluent is discharged into Class SC waters, and the predicted DO concentration is above the DO criterion for these waters.

b. Color

Article 3.1.2 of PRWQS provides that "the waters of Puerto Rico shall be free from color . . . attributable to discharges in such a degree as to create a nuisance to the enjoyment of the existing or designated uses of the waterbody." Specifically, for Class SB waters, Article 3.2.2 provides that color shall not be altered except by natural causes. For Class SC waters, Article 3.2.3 provides that color shall not be altered by other than natural phenomena except when it can be proven that such change in color is harmless to biota and aesthetically acceptable. Color in water can reduce light penetration and affect aquatic life by limiting photosynthesis by phytoplankton and aquatic plants (EPA 1986b). To assess the impact of the modified discharge on color in the receiving water, EPA reviewed effluent and ambient monitoring data. Based on effluent monitoring data collected from June 2002 through October 2009, color was observed between 5 and 70 Pt-Co Units. Furthermore, based on section 301(h) Waiver Demonstration Studies, the color at and beyond the ZID was reported between the levels of non-detect and 5 Pt-Co Units. In accordance with PREQB's IWQC, EPA proposes an effluent limitation of 76 Pt-Co for color in the draft permit. Based on review of effluent data, EPA believes that the Carolina RWWTP will be able to meet this limitation.

c. Turbidity

Suspended solids in the effluent can result in a significant loading of particles to the water column and their subsequent deposition onto the seafloor in the vicinity of the discharge. Significant amounts of suspended solids in the water column associated with the discharge can cause turbidity, decrease light penetration, and harm sensitive marine ecosystems by interfering with the light available for photosynthesis. Pursuant to 40 CFR §§125.61 and 125.62, section 301(h) applicants must demonstrate that the modified discharge will comply with water quality standards for suspended solids, which may include criteria for turbidity, light transmission, light scattering, or maintenance of the euphotic zone. In addition, applicants must demonstrate that the outfall and diffuser are 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, these water quality standards. Article 3.1.2 of PRWQS provides that "the waters of Puerto Rico shall be free . . . from turbidity attributable to discharges in such a degree as to create a nuisance to the enjoyment of the existing or designated uses of the waterbody." Specifically, Article 3.2 provides that turbidity in Class SB and SC waters shall not exceed 10 nephelometric turbidity units (NTUs), except by natural causes.

Attainment of Turbidity Criterion Based on Ambient Monitoring Data. In the renewal application, PRASA provided water quality data for turbidity based on receiving water monitoring from January 1999 to December 2005. EPA reviewed these and subsequent receiving water monitoring data from more recent monitoring events conducted between January 2006 and October 2009. Based on review of monitoring data from the 301(h) Waiver Demonstration Studies, levels of turbidity at ZID stations C1 and C2 were consistently below the water quality criterion of 10 NTUs, with turbidity levels ranging between the 0.05 and 4.72 NTUs. Furthermore, turbidity met the criterion at all other stations located within the ZID and in the farfield.

Attainment of Turbidity Criterion Based on Effluent Monitoring Data. Pursuant to EPA's ATSD, EPA also evaluated potential turbidity impacts upon initial dilution using predictive modeling. As previously described, suspended solids in the effluent can result in a loading of solids in the water column that can cause significant turbidity that can adversely impact the marine environment. Although PRWQS do not have criteria specifically for suspended solids, PRWQS do have criterion for turbidity and, as a result, EPA assessed whether the modified discharge would have a substantial effect on the level of turbidity in the receiving water based on predicted suspended solids concentrations. In accordance with EPA's ATSD, PRASA estimated the concentration of suspended solids at the completion of initial dilution for the modified discharge. In the renewal application, PRASA determined that turbidity would be below the water quality criterion of 10 NTU at the boundary of the mixing zone based on the following: the 90th percentile ambient background turbidity value of 0.83 NTUs and CID of 123:1. Using these values, PRASA estimated a turbidity value of 1.5 NTUs at the edge of the ZID, which is below the water quality criterion of 10 NTUs. In accordance with EPA's ATSD, EPA also evaluated turbidity in the effluent and predicted the level of turbidity at the edge of the mixing zone. Based on the maximum effluent turbidity value of 190 NTUs (December 2002**)**, EPA calculated a turbidity value of 2.4 NTUs at the edge of the mixing zone. Since turbidity is predicted to be below the turbidity criteria for Class SB and SC waters under critical conditions, EPA has concluded that the modified discharge is predicted to meet the water quality criterion for turbidity at and beyond the ZID.

In accordance with Article 5 of PRWQS, and as part of its IWQC, EQB has determined that an mixing zone for turbidity is appropriate and that turbidity at the edge of the mixing zone will comply with water quality standards. Therefore, in accordance with EQB's IWQC, EPA proposes an effluent limitation of 168 NTUs for turbidity in the draft permit. Based on review of effluent data, EPA believes that the Carolina RWWTP will be able to meet the proposed effluent limitation for turbidity.

d. pH

Pursuant to 40 CFR part 133, secondary treatment requirements provide that effluent values for pH shall be maintained within the range of 6.0 to 9.0 standard units. In the renewal application, PRASA did not request a waiver from pH requirements (PRASA 2007d). Based on review of effluent monitoring data from June 2002 to October 2009, effluent values for pH ranged between 5.8 and 8.38 standard pH units. During this period, only one effluent monitoring event (January 2007) or 1 percent of effluent samples had a pH concentration below the minimum pH requirement of 6.0 standard units for secondary treatment.

In addition to secondary treatment requirements for pH, Article 3.2 of PRWQS has established water quality criteria for pH for Class SB and SC waters which states that "in no case the pH will lie outside the range of 7.3 to 8.5 standard pH units, except when caused by natural phenomena." In the 2006 Mixing Zone Application, PRASA assessed the dilution needed to meet the pH criteria for SC waters (PRASA 2006a). PRASA determined that a dilution of 25:1 would be necessary to meet the criterion of 7.3 for pH based on a minimum effluent pH value of 6.0. Since the predicted CID of 123:1 is greater than 25:1, PRASA concluded that criteria for pH will be met at the edge of the mixing zone. Although an effluent value below 6.0 standard units has

been observed, with consideration of a CID of 123:1, EPA believes that the modified discharge will meet pH criteria at and beyond the ZID.

Nevertheless, EPA also evaluated receiving water monitoring data for pH at and beyond the edge of the mixing zone to ensure that the modified discharge will not cause or contribute to changes to pH levels in the receiving water. Based on review of monitoring data from the section 301(h) Waiver Demonstration Studies, concentrations of pH at ZID stations C1 and C2 were consistently between the pH criteria, except for data from April 2006 where pH levels were observed below 7.3 at both ZID stations. However, with review of all pH data, EPA has concluded that the applicant has demonstrated that the modified discharge will consistently meet water quality criteria for pH at and beyond the boundary of the ZID.

2. Attainment of Other Water Quality Standards and Impact of Discharge on Public Water Supplies; Shellfish, Fish and Wildlife; and Recreation [section 301(h)(2), 40 CFR §125.62]

Section 301(h)(2) of the Act provides that the Administrator may issue a permit which modifies the requirements of secondary treatment provided that the modified discharge protect human health and the environment. Specifically, section 301(h)(2) requires that the applicant's discharge must not interfere with the attainment and maintenance of water quality which assures protection of public water supplies; assures protection and propagation of a balanced, indigenous population (BIP) of shellfish, fish and wildlife; and allows recreational activities. Pursuant to 40 CFR §125.62(a), the applicant's outfall and diffuser must 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, nor exceed section 304(a) criteria for toxic pollutants for which there are no applicable EPA-approved standards. Attainment of water quality criteria for DO, turbidity and pH was previously discussed. However, in accordance with 40 CFR §125.62(a), the applicant must also demonstrate that the modified discharge will attain other water quality standards, including those for toxic pollutants, bacteria, toxicity, and temperature.

a. Pollutant-specific Analysis [40 CFR §125.62(a)]

Pursuant to the current modified permit, PRASA is required to monitor the concentration of approximately 150 pollutants in the Carolina RWWTP effluent and receiving water in the vicinity of the facility's outfall. Based on review of effluent monitoring data, EPA identified several pollutants of potential concern due to effluent concentrations that were reported above water quality criteria. [3] These include arsenic, copper, cyanide, lead, manganese, mercury, nickel, nitrogen, silver, sulfide, and zinc. As a result, EPA conducted further analysis of these pollutants to assess the potential for each pollutant to cause or contribute to an exceedance of PRWQS or EPA marine water quality criteria at the edge of the mixing zone. In accordance with 40 CFR §125.62(a), EPA has applied a CID of 123:1 to assess attainment of water quality criteria (i.e., toxic pollutants, bacteria, and whole effluent toxicity) at the ZID.

[3] Effluent data was obtained from NPDES Discharge Monitoring Reports and section 301(h) Waiver Demonstration Studies.

Based on the definition of dilution in Article 1 of PRWQS, attainment of applicable water quality criteria is based on the following equation:

$$C = C_a + \frac{(C_e - C_a)}{CID}$$

where,

C = concentration at the boundary of the ZID;
C_a = background receiving water concentration;
C_e = effluent concentration; and
CID = critical initial dilution.

For several pollutants, EPA was unable to adequately assess their impact on water quality since effluent and receiving water concentration values were reported as generally not detected at the Detection Limit, which was often above the respective water quality criterion. Based on review of data collected for the section 301(h) Waiver Demonstration Studies, EPA determined that the Detection Limits for the following pollutants were generally not sensitive enough to evaluate effluent and receiving water quality: acrylonitrile, aldrin, azinphosmethyl, benzidine, chlordane, chlorpyrifos, coumaphos, DDT, demeton, dieldrin, endosulfan, endrin, heptachlor, hexachlorobenzene, malathion, methoxychlor, mirex, naled, pentachlorophenol, toxaphene, and 1,2-diphenylhydrazine. EPA considered several approaches for handling these sample-specific non-detect measurements because if a pollutant is 'not detected', then the pollutant is either not present at all (i.e., the concentration is equal to zero) or has a concentration value somewhere between zero and the detection limit.

For the purpose of the section 301(h) evaluation, EPA took a conservative approach and performed a screening analysis with the comparison of the maximum detection limit reported for each pollutant monitored during the section 301(h) Waiver Demonstration Studies, with consideration of CID, and the water quality criterion as a basis for assessing the attainment of water quality at the edge of the mixing zone. As a result, pollutant concentrations were generally predicted to be below the water quality criteria, except for endosulfan, mirex, toxaphene, chlorpyrifos, and benzidine. Since no known data are available on the use or presence of these pollutants in Puerto Rico, EPA has established monitoring and reporting requirements for these and other toxic pollutants in the draft permit. Furthermore, in accordance with 40 CFR 122.44(d)(1), EPA has specified the use of the Detection Limit (not Reporting Limit) in the draft permit when monitoring for toxic pollutants in the effluent or receiving water to ensure the adequate assessment of reasonable potential to exceed water quality standards during the next permit term.

Arsenic. To protect the beneficial uses of coastal waters, Article 3.1.9(A) of PRWQS provides that the maximum allowable concentration of arsenic shall not exceed 1.4 ug/l. Based on review of effluent monitoring data, arsenic has been detected at concentrations that exceed the water quality criterion. From January 1999 to September 2009, effluent monitoring data show that arsenic concentrations ranged between 0.18 ug/l (January 2007) and 19 ug/l (January 2005). Of the 98 effluent samples analyzed for arsenic, 29 percent (or 26 samples) showed elevated levels of arsenic. With consideration of dilution and a background arsenic concentration of 1.36 ug/l at

reference station C5, the concentration of arsenic is predicted to be above the water quality criterion at the edge of the ZID with a concentration of 1.50 ug/l.

As a result, EPA reviewed arsenic concentrations in the receiving water at and beyond the ZID to further assess the potential impact of arsenic discharged from the Carolina RWWTP on water quality. Based on the 23 monitoring events conducted between January 1999 and October 2009, arsenic concentrations at ZID stations C1 and C2 ranged between 0.3224 (October 1999 at C2) and 1.73 ug/l (January 1999 at C2). Of the 69 samples collected at both ZID stations, only two exceedances were observed at these stations during this period (both in March 2006 at station C2). However, no elevated levels of arsenic were observed at within-ZID station C6. Of farfield stations C3 and C4, and nearshore station C7, concentrations of arsenic ranged between 0.12 and 1.85 ug/l, with the maximum concentration reported at station C3 (January 1999). Of the 69 samples taken at each farfield and nearshore station, eight to 13 percent of the samples indicated levels of arsenic above the water quality criterion. At reference station C5, less than two percent of the samples (or one sample) reported arsenic concentrations above the criterion, with the maximum concentration reported as 1.52 ug/l (November 2002). In summary, although receiving water data demonstrate that concentrations of arsenic were observed above the water quality criterion, arsenic concentrations were generally observed to be below the water quality criterion at and beyond the ZID.

In accordance with Article 5 of PRWQS, and as part of its IWQC, EQB has determined that a mixing zone for arsenic is appropriate and that arsenic will comply with water quality standards at the edge of the mixing zone. Therefore, as specified in EQB's IWQC, EPA has proposed an effluent limitation of 4.0 ug/l for arsenic in the draft permit. Based on review of effluent data, EPA believes that the Carolina RWWTP will be able to meet this limitation.

Copper. To protect the beneficial uses of coastal waters, Article 3.1.9(A) of PRWQS provides that the maximum allowable concentration of copper shall not exceed 3.1 ug/l. Based on review of effluent monitoring data, copper has been detected at concentrations that exceed the water quality criterion. From January 1999 to September 2009, effluent monitoring data show that copper concentrations ranged between the detection limit and 116 ug/l (July 2003). Of the 100 effluent samples analyzed for copper, 98 percent (or 98 samples) showed elevated levels. However, with consideration of dilution and a background copper concentration of 0.194 ug/l observed at reference station C5, the concentration of copper is predicted to be below the water quality criterion at the edge of the ZID with a concentration of 1.14 ug/l.

Nevertheless, EPA also reviewed copper concentrations in the receiving water at and beyond the ZID to further assess the potential impact of copper from the Carolina RWWTP on water quality. Based on the 23 monitoring events conducted between January 1999 and October 2009, copper concentrations at ZID stations C1 and C2 ranged from levels that did not exceed the detection limit to 0.51 ug/l (March/April 2006 at C2). Similarly, copper was observed at levels significantly below the water quality criterion at within-ZID station C6, with a maximum concentration reported as 1.07 ug/l (November 2002). Of farfield stations C3 and C4, and nearshore station C7, the maximum copper concentration of 1.634 ug/l was reported at station C4 (May 2001), which is below the water quality criterion of 3.1 ug/l. The maximum concentration

of copper observed at reference station C5 was also below the criterion and was reported as 0.56 ug/l (November 2001).

In accordance with Article 5 of PRWQS, and as part of its IWQC, EQB has determined that a mixing zone for copper is appropriate and that copper will comply with water quality standards at the edge of the mixing zone. Therefore, as specified in EQB's IWQC, EPA has proposed a copper effluent limitation of 190.4 ug/l in the draft permit. Based on review of effluent data, EPA believes that the Carolina RWWTP will be able to meet this limitation.

Cyanide. To protect the beneficial uses of coastal waters, Article 3.1.9(A) of PRWQS provides that the maximum allowable concentration of cyanide (as free cyanide) shall not exceed 1.0 ug/l. Since December 2005, PRASA has analyzed cyanide using a new methodology that offers better analytical results of the free form. Previous measurements of cyanide in the effluent are in the form of total cyanide and, therefore, cannot be evaluated based on PRWQS. Between December 2005 and December 2008, free cyanide concentrations in the effluent ranged between 0.393 ug/l (November 2006) and 1.71 ug/l (December 2005). Of the five effluent samples analyzed for free cyanide, 80 percent (or four samples) showed elevated levels. However, with consideration of dilution, the concentration of free cyanide is predicted to be below the water quality criterion at the edge of the ZID. Nevertheless, EPA also reviewed free cyanide concentrations in the receiving water at and beyond the ZID to further assess the potential impact of free cyanide from the Carolina RWWTP on water quality. Based on the six monitoring events conducted between December 2005 and October 2009, cyanide concentrations at all monitoring stations were generally not detected above the detection limit.[4]

In accordance with Article 5 of PRWQS, and as part of its IWQC, EQB has determined that a mixing zone for cyanide is appropriate and that cyanide will comply with water quality standards at the edge of the mixing zone. Therefore, in accordance with EQB's IWQC, EPA has proposed an effluent limitation of 2.22 ug/l for cyanide in the draft permit. Based on review of effluent data, EPA believes that the Carolina RWWTP will be able to meet this limitation.

Sulfide (as undissociated H_2S). To protect the beneficial uses of coastal waters, Article 3.1.9(A) of PRWQS provides that the maximum allowable concentration of sulfide (as undissociated H_2S) shall not exceed 2.0 ug/l. Pursuant to the current section 301(h) modified permit, issued in 2002, PRASA is required to monitor for total sulfide in the effluent. In 2003, the water quality criterion for sulfide was modified from total sulfide to sulfide reflected as undissociated H_2S. As part of the section 301(h) Waiver Demonstration Studies, PRASA has been monitoring effluent concentrations of sulfide (as undissociated H_2S) since 2003. Based on review of effluent monitoring data from October 2003 to September 2009, all eight effluent samples showed sulfide concentrations that exceed the water quality criterion. Concentrations of sulfide ranged between 9.5 and 420 ug/l. Even with consideration of dilution, the concentration of sulfide is predicted to be above the water quality criterion at the edge of the ZID. EPA also reviewed sulfide concentrations in the receiving water at and beyond the ZID to further assess the potential impact of sulfide on water quality. Based on receiving water monitoring events, sulfide concentrations

[4] EPA was not able to adequately assess cyanide data collected from stations C1, C3 and C5 during the January 2008 monitoring event, and data from all stations collected during the March 2008 monitoring event since minimum levels were above the water quality criterion.

(as undissociated H_2S) were generally observed below the water quality criterion of 2.0 ug/l at all seven monitoring stations.

In accordance with Article 5 of PRWQS, and as part of its IWQC, EQB has determined that a mixing zone for sulfide (as undissociated H_2S) is appropriate and that sulfide will comply with water quality standards at the edge of the mixing zone. Therefore, in accordance with EQB's IWQC, EPA has proposed an effluent limitation of 188.32 ug/l for sulfide (as undissociated H_2S) in the draft permit. Based on review of effluent data, EPA believes that the Carolina RWWTP will be able to meet this limitation.

Lead. To protect the beneficial uses of coastal waters, Article 3.1.9(A) of PRWQS provides that the maximum allowable concentration of lead shall not exceed 8.1 ug/l. Based on review of effluent monitoring data, lead has been detected at concentrations that exceed the water quality criterion. From January 1999 to September 2009, effluent monitoring data show that lead concentrations ranged between the level of detection and 16 ug/l (November 2004). Of the 99 effluent samples analyzed for lead, only two percent (or two samples) showed elevated levels. With consideration of dilution and a background concentration of 0.026 ug/l observed at reference station C5, EPA has predicted a lead concentration of 0.016 ug/l at the edge of the ZID, which is below the water quality criterion.

Nevertheless, EPA also reviewed lead concentrations in the receiving water at and beyond the ZID to further assess the potential impact of lead on water quality. Based on the 23 monitoring events conducted between January 1999 and October 2009, lead was not observed at concentrations that exceeded the water quality criterion of 8.1 ug/l at any of the ambient monitoring stations. At ZID stations C1 and C2, lead was observed at levels that did not exceed detection limits to a maximum concentration of 0.106 ug/l (April 2006 at station C2). Further, lead was found at levels below the water quality criterion at within-ZID station C6, with a maximum concentration reported as 0.06 mg/l (May 2001). At farfield stations C3 and C4, and nearshore station C7, lead concentrations ranged between the detection limit and 0.061 ug/l (May 2001 at station C3). At reference station C5, the maximum concentration of lead was reported as 0.042 ug/l (April 2006).

In accordance with Article 5 of PRWQS, and as part of its IWQC, EQB has determined that a mixing zone for lead is appropriate and that lead will comply with water quality standards at the edge of the mixing zone. Therefore, in accordance with EQB's IWQC, EPA has proposed an effluent limitation of 8.1 ug/l for lead in the draft permit. Based on review of effluent data, EPA believes that the Carolina RWWTP will be able to meet this limitation.

Mercury. To protect the beneficial uses of coastal waters, Article 3.1.9(A) of PRWQS provides that the maximum allowable concentration of mercury shall not exceed 0.051 ug/l. Based on review of effluent monitoring data, mercury has been detected at concentrations that exceed the water quality criterion. From January 1999 to September 2009, effluent monitoring data show that mercury concentrations ranged between 0.0005 ug/l (July 2005) and 5 ug/l (July 2006). Of the 100 effluent samples analyzed for mercury, 47 percent (or 47 samples) showed elevated levels of mercury. With consideration of dilution and a background concentration of 0.037 ug/l based on the maximum concentration observed at reference station C5, the concentration of

mercury is predicted to be 0.077 ug/l at the edge of the ZID, which is above the water quality criterion of 0.051 ug/l.

Since mercury can bioaccumulate in aquatic life, EPA also reviewed mercury concentrations in the receiving water at and beyond the ZID to further assess the potential impact of mercury from the Carolina RWWTP on water quality. Based on receiving water monitoring data, the maximum concentration of mercury was observed above detection limits at ZID stations C1 and C2. At stations C1 and C2, maximum mercury concentrations were reported as 0.00064 ug/l (November 2000) and 0.0013 ug/l (March 2003), respectively. However, at within-ZID station C6, mercury concentrations were not observed above detection limits. Of all the farfield stations C3 and C4, and nearshore station C7, the maximum mercury concentration of 0.0623 ug/l (January 2008) was reported at station C3, which is above the water quality criterion of 0.051 ug/l. All other monitoring data at the farfield stations reported mercury concentrations not detected above the water quality criterion. Similarly, mercury was not detected above the criterion at reference station C5.

In accordance with Article 5 of PRWQS, and as part of its IWQC, EQB has determined that a mixing zone for mercury is appropriate and that mercury will comply with water quality standards at the edge of the mixing zone. Therefore, in accordance with EQB's IWQC, EPA has proposed an effluent limitation of 0.203 ug/l for mercury in the draft permit. Based on review of effluent data, EPA believes that the Carolina RWWTP will be able to meet this limitation.

Nickel. To protect the beneficial uses of coastal waters, Article 3.1.9(A) of PRWQS provides that the maximum allowable concentration of nickel shall not exceed 8.2 ug/l. Based on review of effluent monitoring data, nickel has been detected at concentrations that exceed the water quality criterion. From January 1999 to September 2009, effluent monitoring data show that nickel concentrations ranged between the Detection Limit and 46.5 ug/l (April 2003). Of the 98 effluent samples analyzed for nickel, only five percent (or five samples) showed elevated levels of nickel. In addition, with consideration of dilution and a background concentration of 0.24 ug/l observed at reference station C5, the concentration of nickel is predicted to be 0.62 ug/l at the edge of the ZID, which is below the water quality criterion.

Nevertheless, EPA also reviewed nickel concentrations in the receiving water at and beyond the ZID to further assess the potential impact of nickel on water quality. Based on the 23 monitoring events conducted between January 1999 and October 2009, nickel was not observed at concentrations that exceeded the water quality criterion of 8.2 ug/l at any of the ambient monitoring stations. Nickel was generally detected at levels that did not exceed the Detection Limit at all seven receiving water stations except for the following when maximum concentrations were reported as: 0.52 ug/l at ZID station C1 on November 2000; and 0.77 and 0.81 ug/l at farfield stations C3 and C4, respectively, on December 2005.

In accordance with Article 5 of PRWQS, and as part of its IWQC, EQB has determined that a mixing zone for nickel is appropriate and that nickel will comply with water quality standards at the edge of the mixing zone. Therefore, in accordance with EQB's IWQC, EPA has proposed an effluent limitation of 17.6 ug/l for nickel in the draft permit. Based on review of effluent data, EPA believes that the Carolina RWWTP will be able to meet this limitation.

Nitrogen. To protect the beneficial uses of coastal waters, Article 3.1.9(A) of PRWQS provides that the maximum allowable concentration of nitrogen (as NO_3+NO_2+NH_3) shall not exceed 5000 ug/l (or 5 mg/l). Based on review of effluent monitoring data, nitrogen has been detected at concentrations that exceed the water quality criterion. From January 1999 to September 2009, effluent monitoring data show that nitrogen concentrations ranged between 0.022 mg/l (June 2002) and 29.36 mg/l (August 2008). Of the 86 effluent samples analyzed for nitrogen, 88 percent (or 76 samples) showed elevated levels of nitrogen. However, with consideration of critical initial dilution and a background nitrogen concentration of 0.177 mg/l based on the maximum concentration observed at reference station C5, the concentration of nitrogen is predicted to be 0.51 mg/l at the edge of the ZID, which is below the water quality criterion.

Nevertheless, EPA also reviewed nitrogen concentrations in the receiving water at and beyond the ZID to further assess the potential water quality impact of nitrogen discharged from the Carolina RWWTP. Based on the 23 monitoring events conducted between January 1999 and October 2009, levels of nitrogen concentrations were consistently below the water quality criterion at ZID stations C1 and C2 with maximum concentrations reported during the March 2006 monitoring event as 1.47 and 1.77 mg/l, respectively. Nitrogen concentrations were also consistently below the criterion at all other monitoring stations, including within-ZID station C6 which indicated a maximum nitrogen concentration of 2.07 mg/l (March 2006).

In accordance with Article 5 of PRWQS, and as part of its IWQC, EQB has determined that a mixing zone for nitrogen is appropriate and that nitrogen will comply with water quality standards at the edge of the mixing zone. Therefore, in accordance with EQB's IWQC, EPA has proposed an effluent limitation of 35.500 mg/l for nitrogen in the draft permit. Based on review of effluent data, EPA believes that the Carolina RWWTP will be able to meet this limitation.

Thallium. Pursuant to 40 CFR §125.62(a), the modified discharge must not exceed, at and beyond the ZID, all applicable water quality standards, nor exceed section 304(a) criteria for toxic pollutants for which there are no applicable EPA-approved standards. PRWQS do not provide water quality criteria for thallium. Where no EPA-approved standards or criteria are available, 40 CFR §131.36 provide section 304(a) criteria priority toxic pollutants for specific pollutants for specific states, such as the Commonwealth of Puerto Rico. To protect the beneficial uses of Class SB and Class SC waters, 40 CFR §131.36(d)(4) provides that the concentration of thallium shall not exceed 6.3 ug/l based on the human health criteria for the consumption of organisms only.

From January 1999 to September 2009, effluent monitoring data show that thallium concentrations ranged between below levels of detection and 100 ug/l (October 2007). Of the 40 effluent samples analyzed for thallium, 47 percent (or 19 samples) showed elevated levels of thallium. However, with consideration of critical initial dilution and a background thallium concentration of 0.5 ug/l based on the maximum concentration observed at reference station C5, the concentration of thallium is predicted to be 1.31 ug/l at the edge of the ZID, which is below the water quality criterion. Nevertheless, EPA also reviewed thallium concentrations in the receiving water at and beyond the ZID to further assess the potential impact of thallium on water quality. Based on the 23 monitoring events conducted between January 1999 and October 2009, thallium was not observed at concentrations that exceeded the water quality criterion of 6.3 ug/l

at any of the ambient monitoring stations. Thallium was generally detected at levels that did not exceed 0.5 ug/l at all seven receiving water stations.

In accordance with Article 5 of PRWQS, and as part of its IWQC, EQB has determined that a mixing zone for thallium is appropriate and that thallium will comply with water quality standards at the edge of the mixing zone. Therefore, in accordance with EQB's IWQC, EPA has proposed an effluent limitation of 12.0 ug/l for thallium in the draft permit. Based on review of effluent data, EPA believes that the Carolina RWWTP will be able to meet this limitation.

Silver. To protect the beneficial uses of coastal waters, Article 3.1.9(A) of PRWQS provides that the maximum allowable concentration of silver shall not exceed 2 ug/l. Based on review of effluent monitoring data, silver has been detected at concentrations that exceed the water quality criterion. From January 1999 to September 2009, effluent monitoring data show that silver concentrations ranged between 0.111 ug/l (December 2007) and 9 ug/l (May 2004). Of the 98 effluent samples analyzed for silver, only six percent (or six samples) showed elevated levels. In addition, with consideration of dilution and a background silver concentration of 0.006 ug/l observed at reference station C5, EPA predicated a silver concentration of 0.08 ug/l at the edge of the ZID, which is below the water quality criterion. Nevertheless, EPA also reviewed silver concentrations in the receiving water at and beyond the ZID to further assess the potential impact of silver on water quality. Based on the 23 monitoring events conducted between January 1999 and October 2009, silver was not detected above detection limits at all seven receiving water stations.

In accordance with Article 5 of PRWQS, and as part of its IWQC, EQB has determined that a mixing zone for silver is appropriate and that silver will comply with water quality standards at the edge of the mixing zone. Therefore, in accordance with EQB's IWQC, EPA has proposed an effluent limitation of 3.1 ug/l for silver in the draft permit. Based on review of effluent data, EPA believes that the Carolina RWWTP will be able to meet this limitation.

Surfactants. To protect the beneficial uses of coastal waters, Article 3.2.3 of PRWQS provides that the surfactants as MBAS shall not exceed 500 ug/l. Based on review of effluent monitoring data, MBAS has been detected at concentrations that exceed the water quality criterion. From January 1999 to September 2009, effluent monitoring data show that MBAS concentrations ranged between the 4 ug/l and 8,160 ug/l (December 2006). Of the 92 effluent samples analyzed for MBAS, a majority of the samples (95 percent) showed elevated levels of MBAS. However, with consideration of dilution and a background concentration of 44 ug/l observed at reference station C5, EPA predicted a MBAS concentration of 48 ug/l at the edge of the ZID, which is below the water quality criterion. Nevertheless, EPA also reviewed MBAS concentrations in the receiving water at and beyond the ZID to further assess the potential impact of MBAS on water quality. Based on the 23 monitoring events conducted between January 1999 and October 2009, MBAS concentrations ranged from not detected above Detection Limits to maximum concentrations of 76 ug/l (November 2002) and 145 ug/l (January 1999) at ZID stations C1 and C2, respectively. Similarly, MBAS was found at levels below the water quality criterion at within-ZID station C6, farfield stations C3 and C4, nearshore station C7, and at reference station C5.

In accordance with Article 5 of PRWQS, and as part of its IWQC, EQB has determined that a mixing zone for MBAS is appropriate and that MBAS will comply with water quality standards at the edge of the mixing zone. Therefore, in accordance with EQB's IWQC, EPA has proposed an effluent limitation of 13,246 ug/l for MBAS in the draft permit. Based on review of effluent data, EPA believes that the Carolina RWWTP will be able to meet this limitation.

Zinc. To protect the beneficial uses of coastal waters, Article 3.1.9(A) of PRWQS provides that the maximum allowable concentration of zinc shall not exceed 81.0 ug/l. Based on review of effluent monitoring data, zinc has been detected at concentrations that exceed the water quality criterion. From January 1999 to September 2009, effluent monitoring data show that zinc concentrations ranged between the level of detection and 353 ug/l (February 2004). Of the 100 effluent samples analyzed for zinc, nine percent (or nine samples) showed elevated levels of zinc. However, with consideration of dilution and a background concentration of 10 ug/l observed at reference station C5, EPA predicted a zinc concentration of 12.8 ug/l at the edge of the ZID, which is below the water quality criterion.

Nevertheless, EPA also reviewed zinc concentrations in the receiving water at and beyond the ZID to further assess the potential impact of zinc on water quality. Based on the 23 monitoring events conducted between January 1999 and October 2009, zinc was generally detected at levels that did not exceed detection limits (e.g., $\leq$ 10 ug/l) at ZID stations C1 and C2. In contrast, zinc was found at levels above the water quality criterion at within-ZID station C6, with a maximum concentration reported as 292 ug/l (November 2002). Of all the farfield stations C3 and C4, and nearshore station C7, the maximum zinc concentration of 13 ug/l was reported at station C4 (January 2008), which is below the water quality criterion of 81.0 ug/l. Similarly, the maximum concentration of zinc at reference station C5 was below the criterion and was reported as 56 ug/l (January 2008).

In accordance with Article 5 of PRWQS, and as part of its IWQC, EQB has determined that a mixing for zinc is appropriate and that zinc will comply with water quality standards at the edge of the mixing zone. Therefore, in accordance with EQB's IWQC, EPA has proposed an effluent limitation of 151.30 ug/l for zinc in the draft permit. Based on review of effluent data, EPA believes that the Carolina RWWTP will be able to meet this limitation.

Whole Effluent Toxicity. Article 3.1.9 of PRWQS provides that all waters of Puerto Rico shall not contain any substance at such concentration which, either alone or as result of synergistic effects with other substances is toxic or produces undesirable physiological responses in human, fish or other fauna or flora. Under section 101(a)(3) of the Act, this is referred to as the general narrative standard of "no toxics in toxic amounts." PRWQS do not provide a numeric standard for toxicity. As part of the NPDES permitting program, whole effluent toxicity (WET) testing is routinely used to evaluate both the toxicity of wastewater discharges and compliance with narrative 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. In 1989, EPA defined WET as "the aggregate toxic effect of an effluent measured directly by a toxicity test" (54 FR 23868, June 2, 1989).

Since effluent toxicity is inversely related to the effect concentration (the lower the effect concentration, the higher the toxicity in the effluent), concentration-based toxicity measurements are typically expressed as toxic units (TUs) to better illustrate the magnitude of potential toxicity. In EPA's Technical Support Document (TSD) for Water Quality-based Toxics Control, EPA recommends that in the absence of a numeric criterion for the parameter toxicity, a criterion maximum concentration (CMC) of 0.3 Toxic $Unit_{acute}$ (TUa) and criterion continuous concentration (CCC) of 1.0 Toxic $Unit_{chronic}$ (TUc) be used to ensure aquatic life protection against acute and chronic toxicity in the receiving water (EPA 1991). Article 1 of PRWQS provides that TUa and TUc be defined by the Lethal Concentration (LC_{50}) of the tested effluent at which 50 percent of the test organisms die, where TUa = 100 ÷ LC_{50}; and the No Observed Effect Concentration (NOEC), where TUc = 100 ÷ NOEC. The NOEC is the highest tested effluent concentration (in percent effluent) that does not cause an adverse effect on the test organism (i.e., the highest effluent concentration at which the values for the observed responses are not statistically different from the control). For the purpose of the section 301(h) evaluation, EPA evaluated receiving water toxicity with consideration of a CID of 123:1. EPA applied the CID to acute and chronic water quality criteria of 0.3 TUa and 1.0 TUc to determine the maximum allowable level of effluent toxicity or wasteload allocation (WLA) that would still ensure attainment of water quality criteria for toxicity at the edge of the mixing zone. EPA calculated acute and chronic WLAs of 36.9 TUa and 123 TUc, respectively, and then compared the WLAs to effluent WET data.

Pursuant to the current modified permit, PRASA is required to conduct acute and chronic WET testing on flow-weighted 24-hour composite effluent samples using the mysid shrimp (*Mysidopsis bahia*), sea urchin (*Arbacia punctulata*); and sheepshead minnow (*Cyprinidon variegatus*).[5] These aquatic tests are laboratory tests and are designed to measure the biological effect (e.g., an acute effect such as mortality and chronic effects such as impairment of growth and reproduction) of the effluent on the aquatic organism. In the 2006 Mixing Zone Application, PRASA provided WET testing data from 1988 and indicated additional WET data will be forthcoming to support the renewal application (PRASA 2006a). EPA has reviewed these and additional WET data since August 2004 to assess effluent toxicity (PRASA 2007a-b; PRASA 2009a-b; PRASA 2010a). Between December 2002 and February 2010, PRASA has conducted 20 acute WET tests using two aquatic species. Between December 2006 and February 2010, PRASA has conducted 20 chronic WET tests using three aquatic species.

A comparison of acute and chronic WET data and WLAs is presented in Appendix A. Based on available WET data, all TUa values were below the acute WLA whereas several chronic WET tests reported TUc values that exceeded the chronic WLA. Of the 20 chronic WET tests conducted, 30 percent (or six tests) resulted in TUc values that exceeded the 123 TUc WLA with nearly all of these tests conducted on the sea urchin in December 2006 and April 2007 (Figure 2). Since chronic toxicity was observed using the NOEC, EPA also reviewed effluent WET data based on the IC_{25} endpoint (inhibition concentration at which a 25 percent effect occurs) since such point estimates can provide additional information on potential effluent toxicity and also be used to determine the need for permit limitations. To facilitate a comparison between the IC_{25}

[5] The current section 301(h) modified permit requires PRASA to conduct WET testing quarterly for one year after the effective date of the permit and then perform annual WET testing thereafter.

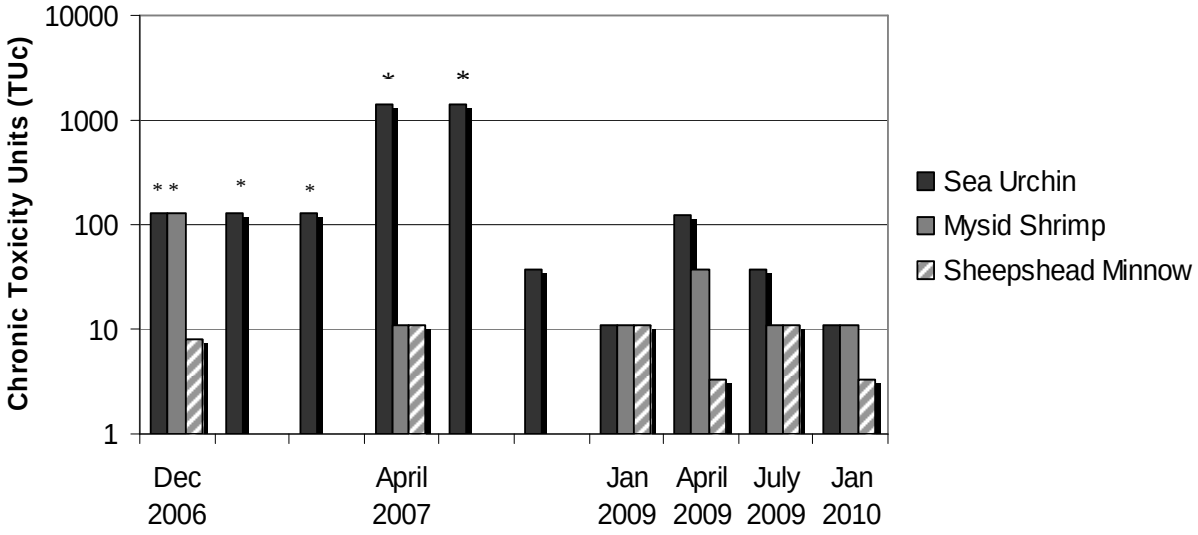

Figure 2. Summary of Chronic Whole Effluent Toxicity Tests for the Carolina RWWTP. Results with (*) indicates a TUc value (in terms of the NOEC) that exceeds the 123 TUc wasteload allocation.

(percent effluent) and the chronic WLA (toxic units), EPA calculated an effluent toxicity value based on the reciprocal of the IC_{25}, where the effluent toxicity value = 100 ÷ IC_{25}. Similar to the chronic toxicity observed based on the NOEC, results indicate that chronic toxicity also can be demonstrated with the IC_{25}, with two effluent toxicity values calculated to be greater than the chronic WLA of 123 TUc. Based on two December 2006 WET tests conducted on the sea urchin, EPA calculated effluent toxicity values of 156.25 and 277.78.

Since chronic toxicity has been observed, EPA has concluded that the applicant has not consistently demonstrated that the modified discharge will meet water quality standards for toxicity in the receiving water as required by 40 CFR §125.62(a). Furthermore, in accordance with 40 CFR §122.44(d)(v), EPA has determined that the modified discharge will cause, has the reasonable potential to cause, or contributes to an excursion above the narrative criterion for chronic toxicity. Therefore, with consideration of dilution, EPA has proposed a maximum daily effluent limitation of 100.47 TUc for chronic toxicity in the draft permit. Based on review of effluent WET data, EPA believes that the Carolina RWWTP will be able to meet this effluent limitation upon permit issuance.

b. Impact of Discharge on Public Water Supplies [40 CFR §125.62(b)]

Pursuant to 40 CFR §125.62(b), which implements section 301(h)(2) of the Act, the applicant's modified discharge must allow for the attainment or maintenance of water quality that assures the protection of public water supplies. The applicant's modified discharge also must not interfere with the use of planned or existing public water supplies. Ocean waters within the vicinity of the modified discharge are not considered a source of public water supply at the present time nor are they expected to become one in the near future. Furthermore, as specified in Article 3.2.3 of PRWQS, drinking water (for human consumption) has not been established as a

designated use for the Class SB or SC waters of Puerto Rico. At this time, drinking water supplies in Puerto Rico are derived from inland surface and groundwater sources. Therefore, EPA has concluded that the modified discharge would not affect public water supplies.

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

Pursuant to 40 CFR §125.62(c), the applicant must demonstrate that its modified discharge will allow for the attainment or maintenance of water quality which assures protection and propagation of a balanced indigenous population (BIP) of shellfish, fish and wildlife, and that a BIP of shellfish, fish and wildlife will exist in all areas beyond the ZID that might be affected by the modified discharge. In 2002, EPA issued a section 301(h) modified permit to the Carolina RWWTP, in part, based on PRASA's demonstration that a BIP exists at and beyond the ZID and that the health and diversity of biological communities located near the existing discharge site did not significantly differ from similar communities at reference sites. Pursuant to the current permit, PRASA is required to implement Carolina RWWTP section 301 Waiver Demonstration Studies that include monitoring of phytoplankton, benthic invertebrate, fish, and coral reef communities. For the purpose of the section 301(h) evaluation, EPA reviewed biological and chemical data based on receiving water monitoring events conducted during issuance of the current modified permit (February 2002 through October 2009).

Phytoplankton

To assess the effect of the modified discharge on phytoplankton, EPA reviewed chlorophyll *a* data provided by PRASA based on Carolina RWWTP section 301(h) Waiver Demonstration Studies. Monitoring chlorophyll *a* concentrations in the receiving water can provide information on localized enhancement (or inhibition) of primary production or phytoplankton biomass. According to Burkholder et. al. (1972), chlorophyll *a* concentrations in shallow Caribbean bays can range from 0.05 to 0.67 mg/m^3 in the absence of blooms, and from 25 to 206 mg/m^3 during bloom conditions. Although the Carolina RWWTP outfall is not located in a shallow bay, these levels can provide a conservative means to assessing chlorophyll *a* concentrations in open coastal waters in the Caribbean area. At this time, EPA is not aware of any phytoplankton blooms that have occurred in the vicinity of the modified discharge. Based on monitoring data, chlorophyll *a* concentrations ranged between 0.01 and 1.30 mg/m^3 at all sampling stations located at and beyond the ZID, with concentrations generally observed lower after issuance of the 2002 modified permit compared to those observed prior to issuance of the modified permit. Maximum chlorophyll *a* concentrations were observed at 0.40 mg/m^3 at within-ZID station C6 and ZID stations C1 and C2. At farfield stations C3 and C4, nearshore station C7, and reference station C5, chlorophyll *a* concentrations at each depth were observed below 0.52 mg/m^3.

Benthic Invertebrates

In aquatic systems, the monitoring of benthic invertebrates adjacent to wastewater discharges can provide useful information on the spatial extent and magnitude of impacts to the surrounding area. Benthic communities are an important component in the analysis of a BIP since they are sedentary or relatively immobile and therefore may be chronically exposed to pollutants. To assess the effect of the modified discharge on benthic infaunal community, EPA reviewed the

Table 5 – Receiving water monitoring stations that reported the highest average benthic metric during the current modified permit monitoring period (February 2002 to October 2009)

Benthic Metric	Receiving Water Monitoring Station						
	C1	C2	C3	C4	C5	C6	C7
Number of Taxa	●					●	
Species Diversity	●			●			
Species Richness	●					●	
Species Evenness		●		●			

number of taxa and several biological indices (e.g., species diversity, evenness, and richness) that escribe the overall condition of the benthic community. For the purpose of the section 301(h) evaluation, EPA reviewed information provided by PRASA that include the following biological indices: Shannon-Wiener Diversity Index (H), Species Evenness (J), and Species Richness (D). A summary of the receiving water monitoring stations that showed the highest average benthic metric is provided in Table 5.

Number of Taxa. Identifying the number of taxa in a particular area can describe the overall variety of the macroinvertebrate assemblage within a community. Based on 14 benthic monitoring events, the average number of taxa was observed to be the highest at ZID station C1 and within-ZID station C6. The lowest number of taxa was found at nearshore station C7 when averaging data from all monitoring events. Specifically, the number of taxa reported at all sampling stations ranged between 12 and 119, with averages ranging between 27 and 47 species over the seven-year post waiver monitoring period. At ZID stations C1 and C2, the number of taxa ranged between 19 and 88, and averaged 50 and 37 species over the eight-year monitoring period, respectively. Within the ZID at station C6, the number of taxa ranged between 24 and 72, with an average of 45 species. At reference station C5, the number of taxa ranged between 24 and 72, and had an average number of 38 species. At farfield stations C3 and C4, and nearshore station C7, the number of taxa ranged between 12 and 119, and averaged between 32 and 44 species. Since 2002, the number of taxa does not appear to significantly differ between ZID stations, and the reference station or farfield stations. Furthermore, number of taxa does not appear to significantly differ between benthic data that were collected before and after issuance of the current modified permit.

Shannon-Wiener Diversity Index. The Shannon-Wiener diversity index (H) provides a measurement of the rarity and commonness of species within a community. It accounts for both the abundance and evenness of the species present within a given period of time. Based on benthic monitoring surveys, the average species diversity was greatest, in descending order, among farfield station C4, ZID station C2, and within-ZID station C6. The lowest species diversity was found at farfield station C3 and reference station C5. Specifically, H values were calculated between 1.27 and 3.94 for all sampling stations, with average H values ranging between 2.08 and 3.09 over the eight-year monitoring period. At ZID stations C1 and C2, H values were generally higher than the reference station and farfield stations with ranges between 1.91 and 3.73 and average H values of 2.90 and 2.87, respectively, based on all monitoring events. At reference station C5, H values ranged between 1.72 and 3.11, with an average of 2.45 which was one of the lowest calculated. At farfield stations C3 and C4, and nearshore station C7, H values ranged between 1.27 and 3.94, with average H values calculated as 2.08, 3.09, and

2.55, respectively. Based on information provided by PRASA, the species diversity does not appear to significantly differ between ZID stations and the reference station or farfield stations. Furthermore, species diversity does not appear to significantly differ between benthic data that were collected before and after issuance of the current modified permit.

Species Evenness. Species Evenness (J) is another measure of species diversity that reflects the relative abundance or proportion of individuals among the species. Based on benthic monitoring surveys, the average species evenness was greatest, in descending order, at farfield station C4, ZID station C2, and within-ZID station C6. The lowest species evenness was observed at farfield station C3 and reference station C5. Specifically, J values were calculated between 0.32 and 0.97, with average J values ranging between 0.68 and 0.84 for all monitoring events combined. At ZID stations C1 and C2, J values ranged between 0.55 and 0.97, respectively. Average J values at ZID stations C1 and C2 were calculated as 0.75 and 0.81, respectively. At reference station C5, J values ranged between 0.52 and 0.81, with a calculated average of 0.68 over the eight-year monitoring period. At farfield stations C3 and C4, and nearshore station C7, J values ranged between 0.32 and 0.96, with average H values calculated as 0.58, 0.84, and 0.75, respectively. Since 2002, the species evenness does not appear to significantly differ between ZID stations and the reference station or farfield stations. Furthermore, species diversity does not appear to significantly differ between post and pre waiver benthic data for all monitoring stations.

Species Richness. Species Richness (D) is a measure of the number of species present in a particular area. Based on benthic monitoring data, the average species richness was greatest at ZID station C1 and within-ZID station C6. The lowest species richness values based on an average of all monitoring events were determined at fairfield station C3 and nearshore station C7. For all monitoring stations, D values were calculated between 2.62 and 16.4, with average D values that range between 5.07 and 8.42 over the eight-year monitoring period. At ZID stations C1 and C2, D values ranged between 3.06 and 11.98, respectively. Average D values at ZID stations C1 and C2 were calculated as 8.42 and 6.59, respectively. At reference station C5, D values ranged between 4.1 and 9.99, with a calculated average of 6.34 over the eight-year monitoring period. At farfield stations C3 and C4, and nearshore station C7, D values ranged between 2.62 and 16.4, with average H values calculated as 6.58, 7.35, and 5.07, respectively. Since issuance of the current modified permit in 2002, the species richness does not appear to significantly differ between ZID stations and the reference station or farfield stations. Furthermore, species diversity does not appear to significantly differ between post and pre waiver benthic data for all monitoring stations.

Presence or Absence of Pollution-Tolerant Benthic Species. Based on benthic monitoring data, pollution-tolerant species and opportunistic colonizers were generally observed at low densities (less than 5 percent) at all monitoring stations over the eight-year monitoring period. Examples of pollution tolerant or indicator species that were evaluated in the surveys include *Capitella capitata*, *Mediomastus ambiseta*, and *Scoloplos rubra*. On one occasion during the May 2002 benthic survey, PRASA indicated a pollution-tolerant polycheate, *Prionospio* sp., dominated the infaunal community by over 50 percent at several stations (within-ZID station 6, farfield station C3, and reference station C5); however, polycheates from this genus showed low densities in subsequent monitoring surveys.

Benthic Invertebrate Summary. Based on benthic monitoring data, benthic invertebrate communities within and at the boundary of the ZID appear moderate to highly diverse relative to communities assessed at monitoring stations beyond the ZID. ZID station C1 and within-ZID station C6 reported the highest number of taxa and species richness, with ZID station C1 also having the greatest species diversity. In addition, benthic species diversity, evenness, and richness appear relatively unchanged between benthic monitoring surveys conducted before and after issuance of the current modified permit at stations located within and at the boundary of the ZID. Furthermore, pollution-tolerant species and opportunistic colonizers were generally observed at low densities. Therefore, EPA has determined that the applicant has demonstrated that the benthic invertebrate community has not been adversely impacted by the modified discharge.

Demersal Fish

In 2002, EPA issued a section 301(h) modified permit to the Carolina RWWTP, in part, based on PRASA's demonstration that there were moderate abundances of fish found in the hard-bottom environments located in the vicinity of the Carolina RRWTP; and that no physical defects or abnormalities were observed in fish samples collected at any of the monitoring stations located at and beyond the ZID. As a result, EPA concluded that fish and epibenthic invertebrate communities did not appear to be adversely impacted. For the purpose of the section 301(h) evaluation, EPA reviewed fish data based on number of fish species, total fish abundance, Shannon-Wiener Fish Species Diversity Index (H'), species evenness and species richness. Since 2002, PRASA has continued to monitor the condition of fish communities at and beyond the ZID. In the renewal application, PRASA indicated that fish collected showed no signs of any physical stress, legions, fin rot, parasitism, or other indicators of potential effluent-dominated stress. As part of the Carolina RWWTP section 301(h) Waiver Demonstration Studies, PRASA collects fish at within-ZID station C6, farfield stations C3 and C4, reference station C5, and nearshore station C7. Pursuant to the current modified permit, PRASA is not required to conduct fish monitoring at ZID stations C1 and C2. A summary of the receiving water monitoring stations that showed the highest average fish metric is provided in Table 6.

Table 6 - Receiving water monitoring stations that reported the highest average fish metric during the current modified permit monitoring period (February 2002 to October 2009)

Fish Metric	Receiving Water Monitoring Station				
	C3	C4	C5	C6	C7
Number of Species		●		●	
Total Abundance		●		●	
Species Diversity		●			●
Species Richness		●		●	
Species Evenness		●			●

Number of Fish Species and Total Fish Abundance. Based on fish monitoring data, the average number of fish species was highest at within-ZID station C6 and farfield station C4. The lowest number of fish species was found at reference station C5 when averaging data from all monitoring events. Specifically, the number of fish species reported at all sampling stations ranged between 0, where no fish were caught, and 12, with averages ranging between 3 and 6

fish species over the eight-year monitoring period. At within-ZID station C6, the number of fish species ranged between 0 and 12, with an average of 6. At farfield stations C3 and C4, the number of fish species ranged between 1 and 12, respectively, with averages of 4 and 6 fish species. At reference station C5, the number of fish species ranged between 1 and 5, with an average of 3 fish species. At nearshore station C7, there were between 2 and 8 fish species identified, with an average of 5. Since 2002, the number of fish species does not appear to significantly differ between the station within the ZID, and the reference station or farfield stations. Furthermore, number of fish species does not appear to significantly differ between fish data collected before and after issuance of the modified permit in 2002.

Based on each monitoring event, the total fish abundance or number of individual fish collected at each station ranged between 0 and 113. The average fish abundance ranged between 12 and 33. Generally, fish abundance was observed to be the highest at within-ZID station C6. The lowest number of fish species was found at reference station C5 when averaging data from all monitoring events. Since 2002, the number of total fish does not appear to significantly differ between the station within the ZID, and the reference station or farfield stations. Furthermore, number of species does not appear to significantly differ between fish surveys conducted before and after issuance of the current modified permit in 2002.

Shannon-Wiener Fish Species Diversity Index. Based on benthic data, the average Shannon-Weiner Fish Species Diversity Index (H') was highest farfield station C4 and nearshore station C7. The lowest average H' value was observed at reference station C5. For all monitoring stations and events, the H' values reported at all sampling stations ranged between 0 and 2.24, with average H' values ranged between 0.77 and 1.42. At within ZID station C6, H' values ranged between 0 and 2.03, with an average of 1.22. At farfield stations C3 and C4, H' values ranged between 0 and 2.24, respectively, with averages of 1.08 and 1.42. At reference station C5, H' values ranged between 0 and 1.41, with an average diversity index of 0.77 calculated over the monitoring period since issuance of the current modified permit. At nearshore station C7, H' values were calculated between 0.6 and 1.81, with an average of 1.30. A comparison of average fish species diversity indices at within- ZID station C6 before and after issuance of the current modified permit indicate that H' values were only slightly decreased whereas H' values at farfield stations C3 and C4, and nearshore station C7 increased after issuance of the modified permit. Species diversity at reference station C5 remained unchanged. Since 2002, fish species diversity does not appear to significantly differ between the station within the ZID, and the reference station or farfield stations. Furthermore, fish species diversity does not appear to significantly differ between fish surveys conducted before and after issuance of the current modified permit.

Fish Species Richness. Based on benthic data, the average fish species richness (d1) was highest farfield station C4 and nearshore station C7. The lowest average d1 value was observed at reference station C5. For all monitoring stations and events, the d1 values reported at all sampling stations ranged between 0 and 3.15, with average fish species richness values ranging between 0.97 and 1.92. At within-ZID station C6, d1 values ranged between 0 and 3.04, with an average of 1.74. At farfield stations C3 and C4, d1 values ranged between 0 and 3.15, respectively, with an average fish species richness index of 1.33 and 1.86 for each corresponding farfield station. At reference station C5, d1 values ranged between 0 and 1.67, with an average

diversity index of 0.97. At nearshore station C7, d1 values were reported between 0.51 and 2.73, with an average of 1.82. Since 2002, fish species richness does not appear to significantly differ between the station within the ZID, and the reference station or farfield stations. Furthermore, fish species richness does not appear to significantly differ between fish surveys conducted before and after issuance of the current modified permit.

Fish Species Evenness. Based on benthic data, fish species evenness (J) has remained nearly unchanged at within ZID station C6 since issuance of the 2002 modified permit. Based on benthic surveys, the average fish species evenness was highest at farfield station C4 and nearshore station C7. The lowest average J value was observed at within-ZID station C6. For all monitoring stations and events, J values reported at all sampling stations ranged between 0 and 1.00, with average fish species evenness values ranging between 0.62 and 0.82. At within-ZID station C6, J values ranged between 0.2 and 0.97, with an average of 0.62. At farfield stations C3 and C4, J values ranged between 0 and 1.00, respectively, with an average fish species evenness index of 0.72 and 0.79 calculated for each corresponding farfield station. At reference station C5, J values ranged between 0.28 and 1.00, with an average evenness index of 0.73. At nearshore station C7, J values were reported between 0.59 and 1.00, with an average of 0.82. Since 2002, fish species evenness does not appear to significantly differ between the station within the ZID, and the reference station or farfield stations. Furthermore, fish species evenness does not appear to significantly differ between fish surveys conducted before and after issuance of the current modified permit.

Demersal Fish Summary. Based on fish monitoring data, fish communities within the ZID appear moderate to highly diverse relative to communities assessed at monitoring stations beyond the ZID. Within-ZID station C6 reported the highest number of species, total abundance, and species richness. In addition, fish species diversity, richness, and evenness appear relatively unchanged between fish monitoring surveys conducted before and after issuance of the current modified permit at stations located within the ZID. Therefore, EPA has determined that the applicant has demonstrated that the fish community has not been adversely impacted by the modified discharge.

Distinctive Habitats of Limited Distribution

According to EPA's ATSD, distinctive habitats of limited distribution are defined as habitats whose protection is of special concern because of their ecological significance, such as coral reefs, or value to humans, such as for subsistence fishing (EPA 1994). Because of their nature, distinctive habitats of limited distribution may be highly susceptible to the potential effects of discharged suspended solids, nutrients, and other pollutants on the unique faunal components of marine communities. Pursuant to the current modified permit, PRASA has conducted coral reef monitoring at eight stations located south of the Caroline RWWTP outfall (see Figure 1). Five stations (CC6 to CC10) are located on inshore reefs south and southwest of the outfall near Punta Vacia Talega. The three remaining stations (CC3 to CC5) are located along the inshore reef areas of the Loiza River. Station CC7 is the nearest coral reef monitoring station to the Carolina RWWTP outfall and is located approximately 0.93 miles (1.5 km) southwest from the oufall.

In 2002, EPA issued a modified permit to the Carolina RWWTP, in part, based on information provided by PRASA that there were no adverse impacts to coral reefs that would be associated with the Carolina RWWTP's modified discharge. Based on 10 coral community monitoring surveys conducted between February 2002 and March 2008, PRASA determined that bare reefrock often dominated the areas monitored and was commonly covered with filamentous algae and/or coralline algae colonies.[6] Percent coral cover for all coral types (stony and soft corals) was generally low at all coral reef monitoring locations, with less than five percent of the total area frequency observed. A comparison of coral data collected prior to issuance of the 2002 modified permit and thereafter showed a modest increase in the average density of corals at stations CC9 (increase of seven percent) and CC10 (increase of six percent) but generally coral density remained nearly unchanged for the other monitoring stations since 2002. Coral species diversity and evenness in living coral communities at all monitoring stations monitored were also shown to be low. Since 2002, coral species diversity showed a slight to moderate increase in average coral species diversity at stations CC3 and CC7 through CC10, and a slight to modest decrease in species diversity at stations CC4, CC5, and CC6. Similar trends were observed in average coral species evenness and average number of fish species in coral reef communities.

The low percent coral coverage and low coral species diversity and evenness frequently observed at all monitoring stations suggests sparse and poorly developed corals throughout the areas surveyed. PRASA attributes this to the dynamic and intense wave action that is characteristic of the north coast waters of Puerto Rico, and the release of freshwater and upstream sediment from the Loiza River onto the coral reef. As a result, based on coral community monitoring, EPA has determined that the applicant has demonstrated that distinctive habitats of limits distribution will not be impacted adversely by the modified discharge from the Carolina RWWTP.

Sediment Quality

The discharge of toxic pollutants and their accumulation in sediments at and beyond the vicinity of the discharge can adversely affect biological communities. With respect to sediment chemistry, sediment samples were collected and analyzed during the annual monitoring surveys (2003 to 2009). The sediments were screened for the presence of constituents regulated by EPA under the 301(h) program including priority pollutant organic compounds, pesticides, metals, and other miscellaneous inorganic constituents. Sediment stations C1, C2, and C6 were within or at the edge of the existing ZID. Stations C3 and C4 represent farfield monitoring sites. Station C7 represents an inshore monitoring site. Station C5 is the "background" reference location. Because of significant differences between surface and subsurface concentrations, only surface sediments were used to evaluate concentrations of section 301(h) constituents, as surface samples represent the greatest exposure to aquatic life, as well as more recent history of chemical deposition.

Results of these analyses indicated that while several organic compounds were periodically detected or estimated from sediments obtained at various sampling stations during the surveys, most were found in concentrations that were much less than the most conservative sediment

[6] PRASA was unable to conduct coral community monitoring for the October 2009 monitoring event due to unfavorable weather conditions underwater. This monitoring event has been rescheduled to occur during the fall of 2010.

toxicity screening criteria. Furthermore, concentrations of detected organic constituents were often greater at reference locations or farfield locations than at the ZID or edge-of-ZID stations and, therefore, outfall-related adverse effects were not indicated from sediment accumulations of organic compounds.

Available ecological benchmark concentrations (where available) are presented for comparison. Of the 20 organic constituents detected in sediment at the ZID station during the annual monitoring periods, with one exception, all estimated concentrations were below applicable NOAA benchmark concentrations. In November 2006, heptachlor was estimated in the sediments at the ZID (station C6; 3.7 µg/kg) as well as at stations C4 (farfield; 5.39 µg/kg), C5 (reference; 3.79 µg/kg), and C7 (onshore; 3.5 µg/kg). These values were above the Apparent Effects Threshold (AET) benchmark of 0.3 µg/kg for heptachlor. However, heptachlor was not detected in sediments at any station since 2006. Because heptachlor was detected in sediments at stations throughout the study area, these elevated concentrations are not attributable to the Carolina RWWTP.

Seventeen metals and inorganic constituents were detected or estimated in sediments collected at the sampling stations during the 2003 to 2009 monitoring surveys. NOAA Effect Range-Low (ER-L), Effects Range-Medium (ER-M), and AET benchmark concentrations for each constituent are included for comparison (where available). Concentrations of inorganic constituents in the sediments were generally equal to or lower at the ZID (station B2) than at the reference and farfield stations.

With respect to sediment benchmark screening values, the concentrations of the inorganic constituents found in the sediments are generally below levels associated with possible adverse effects (benchmark values). In all cases for which NOAA ER-M screening benchmarks are available (antimony, arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc), concentrations in sediments at the edge of ZID did not exceed ER-M values. A total of 3 of the 17 inorganic constituents in sediments collected at the within-ZID station C6 during the past annual monitoring events (2003 to 2009 had concentrations greater than the NOAA ER-L, AET, or other screening benchmark values for marine sediments. These constituents were arsenic, barium, and manganese. However, all three constituents were also found in greater than or comparable concentrations in sediments at the reference and/or farfield stations. Therefore, the concentrations of these constituents are not attributable to the Carolina RWWTP outfall discharge. Analysis of sediment samples collected from the ZID station, as well as from sites located outside of the immediate influence of the effluent from the Carolina RWWTP outfall, indicated that concentrations of inorganic or organic constituents are generally not present at levels that exceed benchmark levels. Further, when exceedances occurred, they were not attributable to discharge from the Carolina RWWTP outfall, as concentrations of constituents quantifiable in the sediments collected from the site nearest the outfall were comparable to those at the reference and farfield stations.

In addition, results of the sediment grain size distribution analysis indicate that the sediment conditions showed typical and natural variation among stations sampled during all monitoring surveys. The physical differences in sediment grain size distribution and texture in the vicinity of the outfall reflect the natural variability in the nearshore bottom types. The data do not suggest

that the outfall is causing accumulations of fine sediments in its vicinity or is creating adverse conditions for populations of infaunal benthic organisms within its vicinity. The TOC, TKN, and TP concentrations, which were monitored throughout the surveys to support interpretation on the community assessment data, did not indicate organic enrichment nor were there indications that nutrient conditions were present that would adversely affect infaunal communities.

Based on this review, EPA has concluded that the chemical characteristics in sediments beyond the ZID are not changed by the modified discharge. There is no indication of long-term accumulation of chemical constituents attributable to Carolina outfall operations, and no apparent cause for concern with respect to the concentrations of organic and inorganic constituents that were identified.

Biological Impact of Deposition of Suspended Solids

Many of the potential impacts of wastewater discharges are associated with the discharge of suspended solids. Suspended solids in the effluent can result in a significant loading of solids to the water column that subsequently deposit onto the seafloor. Suspended solids vary in size and other factors which cause them to settle at different rates. Some solids settle so slowly that they may stay suspended in the water column for long periods of times. According to EPA's ATSD, EPA assumes that 50 percent of suspended solids in wastewater discharges settle quickly enough to potentially accumulate in the vicinity of the outfall. The accumulation of suspended solids from wastewater discharges can lower DO concentrations in near-bottom waters which can adversely impact benthic communities. Article 3.1.5 of PRWQS provides that for all waters that "solids from wastewater sources shall not cause deposition in or be deleterious to the existing or designated uses of the waters."

As specified in EPA's ATSD, the applicant is required to predict the sedimentation of suspended solids that results from the discharge of suspended solids into the receiving water. In accordance with the procedures described in EPA's ATSD, PRASA assessed the accumulation of suspended solids in the vicinity of the modified discharge based on predictive modeling to determine whether the modified discharge would attain water quality criteria for suspended solids deposition. The accumulation of suspended solids in the vicinity of a discharge is influenced by the amount of solids discharged (i.e., mass emission rate), the settling velocity distribution of the particles in the discharge, the plume height-of-rise, and current velocities. In the renewal application, PRASA calculated a monthly average mass emission rate of 11,926 kg/day. This estimate is based on the current permitted monthly average suspended solids concentration of 70 mg/l and the applicant's requested monthly average permitted flow of 45 MGD. For settling velocity distribution, PRASA applied settling velocities based on particle sizes typically observed in primary treated effluent. For the plume height-of-rise, PRASA applied a height-of-rise of 12.03 m for the 90-day critical period and 21.17 m for steady-state conditions based on the initial dilution modeling previously described. For current velocities, PRASA used the following ambient velocities: 11.9 cm/s for upcoast (east); 11.6 cm/s for downcoast (west); 4.1 cm/s for offshore (north); and 5.2 cm/s for onshore (south). As described in the renewal application, PRASA calculated current speeds based on an average of three depth measurements (near surface, mid-depth, and near bottom) for each component direction. This approach is consistent with the procedures described in EPA's ATSD where it specifies that actual current-

speed data are needed to determine the distance from the outfall that the sediments will travel before accumulating to the bottom (EPA 1994). Based on this information, PRASA calculated the accumulation of solids for the critical 90-day period when seabed deposition is likely to be highest and for steady-state conditions where average annual values are used. As a result, PRASA determined a critical 90-day organic mass emission rate of 18.44 $g/m^2/yr$ with an accumulation of solids of 11.99 g/m^2 over the 90-day period. This is predicted to result in the deposition of solids over an area of 2.48 km^2. For steady state conditions, PRASA determined an annual organic mass loading rate of 26.13 $g/m^2/yr$, which is predicted to result in 7.06 g/m^2 of accumulated solids within a 6.97 km^2 area.

According to EPA's ATSD, biological effects are likely to be minimal when steady-state accumulation is estimated to be below 50 g/m^2. Furthermore, EPA believes that organic deposition rates estimated between 36.5 and 365 $g/m^2/yr$ are likely to result in enriched conditions and concentrations greater than 548 $g/m^2/yr$ may result in degraded conditions (Maughan and Oviatt 1993). In the renewal application, PRASA has predicted the critical 90-day and annual accumulation rates of suspended solids to be 11.99 g/m^2 and 26.13 $g/m^2/yr$, respectively. Since these sedimentation loading rates are less than the steady-state accumulation of 50 g/m^2 and organic loading accumulation of 548 $g/m^2/yr$, EPA has concluded that the modified discharge is not likely to cause significant sedimentation of suspended solids in the vicinity of the modified discharge.

Biological Impact of Discharge Conclusion

Based on biological monitoring data, EPA has determined that PRASA has demonstrated that its modified discharge will allow for the attainment or maintenance of water quality which assures protection and propagation of a BIP of shellfish, fish and wildlife, and that a BIP of shellfish, fish and wildlife will exist in all areas beyond the ZID that might be affected by the modified discharge. Therefore, EPA has concluded that the applicant has met the requirements of 40 CFR 125.62(c).

d. Absence of Extreme Adverse Impacts Within the ZID [40 CFR §125.62(c)(3)]

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

As previously described, EPA has concluded that the applicant has demonstrated that the modified discharge would provide for the attainment of water quality criteria for DO, turbidity, toxic pollutants, and toxicity. In addition, EPA is not aware of any phytoplankton blooms, fish kills, or other adverse impacts in the vicinity of the Carolina RWWTP discharge. Therefore, EPA does not anticipate any adverse impacts to rise to the level of being extremely adverse as a result of the modified discharge since the discharge is to open coastal waters and has a predicted CID of 123:1 based on the maximum daily flow of 90 MGD. As a result, EPA has concluded that the modified discharge would not cause conditions within the ZID that would contribute to extreme adverse biological impacts.

e. Impact of Discharge on Recreational Activities [40 CFR §§125.62(a) and (d)]

Under 40 CFR §125.62(a), the applicant's outfall and diffuser must 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. Furthermore, pursuant to 40 CFR §125.62(d), the applicant's discharge must allow for the attainment or maintenance of water quality which allows for recreational activities beyond the ZID, including, without limitation, swimming, diving, boating, fishing, picnicking, and sports activities along shorelines and beaches. Also, there must be no federal, territorial, or local restrictions on recreational activities within the vicinity of the applicant's outfall unless such restrictions are routinely imposed around sewage outfalls or would be lifted or modified if the applicant's Carolina RWWTP were upgraded to secondary treatment (EPA 1994). Because of the potential for pathogenic microorganisms to be transmitted by contaminated water, monitoring of indicator bacteria such as total coliform, fecal coliform and enterococcus can be used to identify the presence of sewage and fecal contamination and ensure the protection of the beneficial uses of the waterbody, such as water contact recreation.

In the renewal application, PRASA indicated that the Carolina RWWTP mixing zone is located 1.7 miles from the nearest recreational beach and, since the discharge point is located more than 6,000 ft offshore at a depth of 90 ft, the modified discharge is unlikely to impact recreational uses (PRASA 2006a; 2007d). Furthermore, due to the generally rough waters of the north coast of Puerto Rico, PRASA also indicated that the area contains no natural attractions such as coral reefs that might attract SCUBA divers, fisherman, or others that might engage in recreational activities in the vicinity of the Carolina RWWTP outfall, nor are there any known restrictions on recreational activities in the area of the modified discharge (PRASA 2007d). Nevertheless, for Class SB and SC waters, PRWQS provide water quality standards to protect water contact recreation and other beneficial uses such as recreational fishing.

Water Contact Recreation

To protect the beneficial uses of Class SB and SC waters for water contact recreation, Articles 3.2.2(B)(2) and 3.2.3(B)(2) of PRWQS provide water quality criteria for bacteria based on the level of indicator bacteria, such as total coliform, fecal coliform, and/or enterococci. In November 2004, pursuant to the Beaches Environmental Assessment and Coastal Health (BEACH) Act of 2000, EPA promulgated enterococci criteria for states and territories, such as Puerto Rico, that do not currently have water quality criteria sufficient to protect recreational uses in coastal waters (69 FR 67217, November 16, 2004). PRWQS for Class SC waters only provide bacteria criteria expressed as coliform indicators. Therefore, in accordance with 40 CFR §131.41(c)(2), EPA also has applied enterococcus criteria to Class SC waters to further assess the potential impact of bacteria on water quality located in the vicinity of the Carolina RWWTP discharge. The following are bacteria criteria that are applicable to the assessment of the impact of the modified discharge:

> Total coliform: The geometric mean of a series of representative samples (at least five samples) of the waters taken sequentially shall not exceed 10,000 colonies/100 ml;

Fecal coliform: The geometric mean of a series of representative samples (at least five) of the waters taken sequentially shall not exceed 200 colonies/100 ml, and not more than 20 percent of the samples shall exceed 400 colonies/100 ml; and

Enterococci: The geometric mean of at least five representative samples taken sequentially shall not exceed 35/100 ml; and no single sample should exceed the upper confidence limit of 75 percent using 0.7 as the log standard deviation until sufficient site data exist to establish a site-specific log standard deviation.

For the purpose of the section 301(h) evaluation, EPA assessed the levels of bacteria in the effluent and receiving water. Although PRWQS provide that bacteria criteria shall apply to the geometric mean of samples that are taken sequentially, it does not specify the duration over which the geometric mean should be calculated, or how the geometric mean criteria, in general, should be applied for infrequently monitored waters. For the receiving water, since the monitoring frequency of the section 301(h) Waiver Demonstration Studies varied from quarterly to annual such that samples could not be collected sequentially to derive a geometric mean for comparison with the bacteria criteria, EPA took a conservative approach and compared the geometric mean and single sample maximum criteria to individual ambient samples taken at each depth during the 23 monitoring events conducted between January 1999 and October 2009. Consequently, EPA believes that the comparison of the geometric mean criterion to both individual single samples and the EPA-calculated geometric mean will provide additional information on the attainment of water quality standards for bacteria. To evaluate the enterococci criteria based on a single sample, EPA has interpreted "no single sample should exceed the upper confidence limit of 75 percent using 0.7 as the log standard deviation until sufficient site data exist to establish a site-specific log standard deviation" to mean a single sample maximum of 104/100 ml as explained in the preamble to the final rule of the BEACH Act and EPA's 1986 Ambient Water Quality Criterion for Bacteria (69 FR 67226, November 14, 2004, EPA 1986a).

In addition, pursuant to the current modified permit, PRASA is required to conduct two distinct and separate effluent monitoring activities for bacteria. For reporting on its Discharge Monitoring Reports (DMRs), PRASA provides data for total coliform and fecal coliform based on the geometric mean of five samples collected within a monthly period. For bacterial monitoring under the section 301(h) Waiver Demonstration Studies, PRASA collects effluent monitoring data for all three bacterial indicators in a single effluent sample. [7] Based on DMR data (June 2002 through September 2009), the maximum geometric mean concentrations of total coliform and fecal coliform reported were 105,098 colonies/100 ml (May 2008) and 16,119 colonies/100 ml (May 2008), respectively. In contrast, review of effluent monitoring data from section 301(h) Waiver Demonstration Studies showed maximum levels of total coliform and fecal coliform in a single sample that were 2,000,000 colonies/100 ml and 200,000 colonies/100

[7] On December 10, 2009, EPA approved PRASA's request to include in its section 301(h) monitoring reports only DMR data for bacterial indicators, including enterococcus. The current modified permit requires enterococcus monitoring in the effluent only under the section 301(h) Waiver Demonstration Studies. Therefore, the most current October 2009 monitoring event did not report enterococcus concentrations in the Carolina RWWTP effluent. Therefore, only eight receiving water monitoring events from May 2003 through February 2008 had effluent concentrations of enterococcus that were available for the section 301(h) evaluation.

ml (December 2007), respectively. The maximum level of enterococci in a single sample was reported as 200,000 colonies/100 ml (February 2008). Based on bacterial data from receiving water monitoring events alone, the levels of total coliform and enterococci at the edge of the mixing zone are predicted to be above the water quality criteria. However, since effluent monitoring for bacteria for the purpose of DMRs is conducted more frequently then under the section 301(h) Waiver Demonstration Studies and is reported as a geometric mean, EPA believes that bacterial data from DMRs better characterizes the modified discharge. There are no enterococci data reported in the DMRs. Therefore, of the 78 effluent results reported in DMRs, 18 percent (or 14 samples) showed elevated levels of fecal coliform based on the geometric mean. For total coliform, only three percent of samples showed elevated concentrations. However, all eight of the single samples collected for enterococci from section 301(h) Waiver Demonstration Studies showed elevated bacterial levels based on criteria for both the geometric mean and single sample maximum.

Since elevated levels of bacteria were observed in the effluent, EPA reviewed bacteria concentrations in the receiving water at and beyond the ZID to further assess the potential impact of bacteria on water quality. Based on review of receiving water monitoring data, levels of bacteria at ZID stations C1 and C2 were consistently below the water quality criteria for all bacteria indictors based on the geometric mean and single sample maximum. Of the 276 samples collected at within-ZID station 6 and ZID stations C1 and C2, over 88 percent of the samples frequently met the water quality criteria for total coliform, fecal coliform, and enterococcus. Similarly, at stations located beyond the ZID, bacteria concentrations were observed frequently below the water quality criterion for bacteria, with 91 to 100 percent of the 69 samples taken at each station meeting water quality criteria.

Based on effluent and receiving water monitoring data, EPA believes that the modified discharge will generally meet water quality criteria for bacteria at the ZID pursuant to 40 CFR §125.62(a). Further, EPA is not aware of any historical or current legal restrictions on any recreational activities in the vicinity of the Carolina RWWTP discharge based on levels of bacteria in the receiving water. Therefore, based on review of available information, EPA has concluded that the applicant has demonstrated that the discharge of pathogens will not interfere, alone or in combination with other sources, with the attainment and maintenance of water quality which allows for recreational activities beyond the ZID such as water contact recreation in accordance with 40 CFR §125.62(d). To ensure continuing protection of Class SB and SC waters for recreational use, in accordance with EQB's IWQC, EPA has proposed effluent limitations for enterococci and fecal coliforms. No effluent limitations for total coliforms are proposed since EPA has established bacterial limits based on the more stringent bacterial criterion specified in Article 3.2.3 of PRWQS.

Bioaccumulation of Toxic Pollutants and Fish Consumption

The bioaccumulation of toxic pollutants in marine organisms can result in adverse impacts to the environment and human health. Specifically, Article 3.1.9 of PRWQS provides that the waters of Puerto Rico shall not contain any substances at such concentrations which produces undesirable physiological responses in human. EPA's issuance of the 2002 modified permit to the Carolina RWWTP was, in part, based on PRASA's demonstration that fish in the vicinity of

the outfall did not bioaccumulate toxic pollutants at levels that would adversely impact human health through the consumption of fish. In 2002, EPA determined that toxic pollutants did not significantly accumulate in fish that were collected from in the vicinity of the Carolina RWWTP outfall. For the purpose of the current section 301(h) evaluation, EPA reviewed fish tissue data collected since 2002 to determine whether fish are bioaccumulating toxic pollutants at levels of concern for the protection of human health.

Between February 2002 and March 2006, PRASA has conducted five fish bioaccumulation studies as part of its section 301(h) Waiver Monitoring Demonstration Studies (PRASA 2007d, PRASA 2007e). During this period, PRASA has collected a total of 164 individual fish from five monitoring stations in the vicinity of the Carolina RWWTP for bioaccumulation analysis. At each station, between 23 and 52 fish of four species (Lane Snapper, White Grunt, Vermillion Snapper, and Coney) were collected and the fish tissue analyzed for 150 parameters. Overall, 41 toxic pollutants were detected in fish tissue from fish collected from all five monitoring stations (Appendix B). To evaluate the potential risk of consumption to recreational fishers, EPA compared fish tissue concentrations to available EPA recommended screening values for specific pollutants (EPA 2000, 2009). Exceedances of recommended screening values may indicate the need for more intensive site-specific monitoring and/or a human health risk evaluation. Of the 41 toxic pollutants detected in fish tissue, only eight had screening values available for assessing fish consumption risk. These include arsenic, cadmium, mercury, selenium, chlordane, total DDT, dieldrin, and heptachlor epoxide.

Based on each monitoring event, average fish concentrations at within-ZID station 6 and at all other stations were below fish consumption screening values for cadmium, mercury, selenium, chlordane, and total DDT. For example, for all monitoring events and all stations combined, average cadmium concentrations in fish tissue samples ranged between 0.088 and 0.042 mg/kg, which is below EPA's screening value of 0.491 mg/kg for non-carcinogenic risk of recreational fishing. For total mercury, average fish tissue concentrations ranged between 0.08 and 0.22 mg/kg, which is below EPA's recommended water quality criterion of 0.3 mg methylmercury/kg fish tissue wet weight (EPA 2009). Selenium concentrations ranged between 0.388 and 1.158 mg/kg, which is below EPA's screening value of 2.457 mg/kg. For heptachlor epoxide, the average tissue concentration at farfield station C7 for the March 2004 monitoring event was above the 4.39 ug/kg recreational fishing tissue screening value; however, heptachlor epoxide concentrations were below the screening value at all other stations for all monitoring events. For dieldrin, average fish tissue concentrations at within-ZID station C6 were observed the screening value of 2.5 during the March 2005 monitoring event but were below the screening values at all other monitoring events.

Based on fish tissue data, EPA believes that the modified discharge will meet the water quality criteria for recreational fishing at the ZID pursuant to 40 CFR §125.62(a). Further, EPA is not aware of any historical or current legal restrictions on any recreational activities in the vicinity of the Carolina RWWTP discharge based on levels of toxic pollutants in fish tissue. Therefore, based on review of available information, EPA has concluded that the applicant has demonstrated that the modified discharge will not interfere, alone or in combination with other sources, with the attainment and maintenance of water quality which allows for recreational activities beyond the ZID such as recreational fishing in accordance with 40 CFR §125.62(d).

f. Stressed Waters [40 CFR §125.62(f)]

Under 40 CFR §125.62(f) the applicant must demonstrate that the modified discharge will not contribute to, increase, or perpetuate stressed conditions, contribute to further degradation if pollution from other sources increases, and will not retard recovery if pollution from other sources decreases. As defined in 40 CFR §125.58(z), stressed waters are those ocean waters for which an applicant can demonstrate that the absence of a balanced indigenous population is caused solely by human perturbations other than the applicant's modified discharge.

In the renewal application, PRASA indicated that Carolina RWWTP does not discharge into stressed waters, as defined in 40 CFR §125.58(z). Based on available data, EPA has determined that a balanced indigenous population exists in the vicinity of the Carolina RWWTP outfall and that the modified discharge will provide for the attainment of water quality standards and criteria at and beyond the ZID. Therefore, EPA has concluded the applicant has met the requirements of 40 CFR §125.62(f).

3. Establishment of a Monitoring Program [section 301(h)(3), 40 CFR §125.63]

Under 40 CFR §125.63, which implements section 301(h)(3) of the Act, 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, and measure toxic substances in the discharge. In addition, the applicant must also demonstrate that it has the resources necessary to implement the monitoring program upon issuance of a section 301(h) modified permit and to carry it out for the life of the permit (40 CFR §125.63(a)(1)(iii)). The frequency and extent of the monitoring program are to be determined by taking into consideration the Carolina RWWTP's rate of discharge, quantities of toxic pollutants discharged, and the potential for significant impacts in the receiving water (40 CFR §125.63(a)(1)(iv)).

Since 1999, PRASA has implemented a section 301(h) monitoring program that consists of biological, water quality, influent, and effluent monitoring. As part of the renewal application, PRASA submitted to EPA a detailed description of its proposed Carolina RWWTP section 301(h) Waiver Demonstration Studies for the next permit term. No significant changes to the monitoring program have been proposed since those initiated in December 2006. Based on information provided in PRASA's Draft 2008 Quality Assurance Project Plan and Sampling and Analysis Protocols for the Carolina RWWTP 301(h) Waiver Demonstration Studies (QAPP/SAP), EPA has reviewed PRASA's monitoring program for the modified discharge to assess compliance with the requirements of 40 CFR 125.63(a) through (d) (PRASA 2008e). A description of the proposed monitoring program for the next permit term is described in Table 7. At this time, the 2008 QAPP/SAP has not been approved by EPA. EPA is currently working with PRASA to ensure that the final QAPP/SAP for the Carolina RWWTP contains the necessary requirements to assure compliance with 40 CFR 125.63, all permit conditions, and EQB's IWQC.

Table 7 - PRASA's proposed monitoring program for the Carolina RWWTP

Monitoring Type	Substrate and/or Parameter	Monitoring Frequency
Biological Monitoring	Benthic Invertebrates	Annual
	Fish Tissue	Once per permit term
	Coral Reef Assemblage	Annual
	Sediment Quality	Annual
Water Quality Monitoring	Conventional pollutants (e.g., DO, bacteria, turbidity)	Annual
	Metals and Pesticides	Annual
	Dioxins, volatile and semi-volatile pollutants	Once per permit term
Effluent Monitoring	Conventional and non-conventional pollutants (e.g., DO, TSS, oil and grease, , turbidity)	Annual
	Metals, Pesticides, and PCBs	Annual

a. Biological Monitoring

Pursuant to 40 CFR §125.63(b), the applicant must have a biological monitoring program that provides adequate data to evaluate the impact of the discharge on the marine biota. Under 40 CFR §125.63(b)(1), the applicant's biological monitoring program must include periodic surveys of control sites and biological communities most likely to be affected by the discharge; periodic bioaccumulation studies and examination of possible adverse effects of effluent-related toxic substances; periodic sampling of sediments for toxic pollutants and pesticides; and periodic assessment of fisheries.

In the 2008 QAPP/SAP, PRASA has proposed a biological monitoring program that consists of the assessment of benthic invertebrate community, fish tissue bioaccumulation, and coral reef community (PRASA 2008e). Annual monitoring of benthic invertebrates will be conducted at monitoring stations located at and beyond the ZID (i.e., stations C1 through C7). PRASA indicated that data will be evaluated for species composition, total invertebrate density, number of species, Shannon-Wiener diversity, among other biological metrics. Data also will be assessed based on a comparison of temporal and spatial variability between monitoring stations. To assess bioaccumulation of toxic pollutants, PRASA has proposed a fish tissue study during the five-year permit term. The 2008 QAPP/SAP indicates that the fish tissue study will focus on the collection of demersal species and species known for their recreational or commercial value (PRASA 2008e). Whole fish tissue will be analyzed for priority pollutant metals that include the following: antimony, arsenic, beryllium, barium, boron, cadmium, chromium, copper, lead, manganese, mercury, nickel, selenium, silver, thallium, and zinc. Sediment quality monitoring will include the sampling and analysis of priority pollutant metals, pesticides, and PCBs on an annual basis at each of the seven ambient monitoring stations. PRASA also proposes to conduct a sediment analysis of dioxin and volatile and semi-volatile organic compounds once during the five-year permit period. Coral reef monitoring will be conducted annually at the current eight coral reef monitoring stations located southeast and southwest of the Carolina RWWTP discharge site. An analysis of fish, substrate type, and major reef biota such as sponges, stony coral, and algae will be used to assess coral reel community structure.

b. Water Quality Monitoring

Pursuant to 40 CFR §125.63(c), the applicant must have a receiving water monitoring program that provides adequate data for evaluating compliance with water quality standards or criteria, and measures the presence of toxic pollutants which have been identified or are expected to be in the Carolina RWWTP effluent discharged to the receiving water.

In the 2008 QAPP/SAP, PRASA has proposed a water quality monitoring program that will include receiving water sampling at monitoring stations located at and beyond the mixing zone. Annual samples will be analyzed for conventional parameters (e.g., DO, chlorophyll *a*, and coliform bacteria) and toxic pollutants (metals and pesticides). PRASA also proposes to conduct a water quality analysis of dioxin and volatile and semi-volatile organic compounds once during the five-year permit period.

c. Effluent Monitoring

Pursuant to 40 CFR §125.63(d), the applicant must have an effluent monitoring program that provides quantitative and qualitative data that measures toxic substances and pesticides in the effluent, and data for evaluating compliance with the percent removal efficiency requirements under 40 CFR §125.60. As described in EPA's ATSD, the major objectives of effluent monitoring are to provide data for determining compliance with permit effluent limitations and section 304(a) water quality criteria, measure the effectiveness of the toxic substances control programs, and relate effluent characteristics to the receiving water biological and water quality conditions (EPA 1994). In addition, influent and effluent monitoring provides data for assessment of treatment plant performance with primary treatment requirements for BOD_5 and TSS.

On October 21, 2009, PRASA proposed an effluent monitoring program that will include annual monitoring of BOD_5, TSS, pH, DO, temperature, oil and grease, coliform bacteria, total residual chlorine, metals, and other parameters identified in the draft permit. PRASA also has proposed to conduct annual effluent monitoring of metals, pesticides, and PCBs.

Since PRASA has proposed a monitoring program for the modified discharge that will consist of biological, water quality and effluent monitoring, EPA has determined that proposed monitoring program is adequately designed to evaluate the impact of the modified discharge on the receiving water. Furthermore, because PRASA has successfully implemented a comprehensive monitoring program pursuant to the current modified permit, EPA has determined that PRASA has demonstrated that it has the resources to implement an adequate monitoring program for the modified discharge in accordance with 40 CFR §125.63(a)(1)(iii). Therefore, EPA has concluded that the applicant has met the requirements of 40 CFR §§125.63(a) through (d).

4. Effect of Discharge on Other Point and Nonpoint Sources [section 301(h)(4), 40 CFR §125.64]

In accordance with section 301(h)(4) of the Act, EPA may not issue a section 301(h) modified permit unless the applicant demonstrates that such modified requirements will not result in any additional requirements on any other point or nonpoint source. In the renewal application,

PRASA indicated that the modified discharge will not cause additional treatment or control requirements for other point or nonpoint sources (PRASA 2007d). On May 23, 2007, PRASA requested a determination from PREQB that the modified discharge from the Carolina RWWTP will comply with all applicable provisions of Commonwealth law, as required by 40 CFR §125.64(b). On November 9, 2009, PREQB issued a draft WQC that the modified discharge will not cause violations to the applicable water quality standards in the receiving water. Until a final WQC is issued by PREQB, EPA has tentatively concluded that the modified discharge from the Carolina RWWTP will not impact other point or nonpoint sources.

5. Urban area pretreatment program [section 301(h)(5) and (6), 40 CFR §125.65]

In accordance with section 301(h)(5) and (6) of the Act, EPA may not issue a section 301(h) modified permit unless the applicant demonstrates that all applicable pretreatment requirements for sources introducing waste into such treatment works will be enforced. As explained in the preamble to the 1994 revision of the section 301(h) regulations (59 FR 40656, August 9, 1994), for urban area pretreatment programs with significant numbers of industrial users, at any given time, it is reasonable to expect that at least one or more of those users might be out of compliance. EPA determines a POTW's continuing eligibility for a section 301(h) modified permit under section 301(h)(6) by measuring industrial user compliance and POTW enforcement activities against existing criteria in the EPA's National Pretreatment Program. A POTW's enforcement program is considered adequate if not more than 15 percent of its industrial users meet the significant noncompliance (SNC) criteria in a single year. Where the POTW is judged to have followed its procedures but the level of significant noncompliance among significant industrial users (SIUs) is 15 percent or greater, the adequacy of the enforcement procedures should be reviewed. Based on PRASA's February 26, 2010 compliance status report covering the period from January 1, 2009 through December 31, 2009, the Carolina RWWTP service area has an SNC rate of 25 percent (two of eight SIUs). Although the SNC rate for the Carolina RWWTP is greater than 15 percent, PRASA has taken enforcement against the two industries, including issuance of penalty orders in March 2010. Based on PRASA's enforcement for the SIUs, EPA concludes that PRASA will enforce its applicable pretreatment requirements in accordance with the section 301(h) requirement at 40 C.F.R. §125.65(b)(2).

40 CFR §125.65(b)(1) requires that the applicant establish control of toxic pollutants that may be introduced by an industrial discharger by demonstrating that it either has in effect an applicable pretreatment requirement in accordance with 40 CFR §125.65(c) or has in effect a program that achieves secondary removal equivalence in accordance with 40 CFR §125.65(d). For toxic pollutants known or suspected of being introduced by industrial sources, the applicant must assess the need for local limits and set local limits based on analysis in accordance with 40 CFR part 403. Local limits are developed for pollutants that may cause interference, pass through, sludge contamination, and/or worker health and safety problems, if discharged in excess of the receiving POTW's capabilities and/or receiving water quality standards. In evaluating the need for local limit development, a POTW must identify industries that might be subject to the pretreatment program and determine the character and volume of pollutants contributed to the POTW by these industries. The POTW then determines which pollutants have a reasonable potential for pass through, interference, or sludge contamination. To calculate the maximum allowable POTW treatment plant influent loading for the pollutants of concern, treatment plant data and estimates of plant pollutant removal rates are used to calculate the total allowable pollutant load that would still meet sludge requirements, permit limits, and water quality

Table 8 - List of parameters and local limits for the Carolina RWWTP

Parameter	Local Limit (mg/l)	Parameter	Local Limit (mg/l)
Arsenic	0.230	Mercury	0.015
Biochemical Oxygen Demand	175	Nickel	0.5
Cadmium	0.1	Oil & Grease	50
Chromium, Total	1.0	Phenols	0.25
Copper	0.5	Selenium	0.2
Cyanide	0.05	Silver	0.05
Fluoride	13.8	Thallium	8.1
Lead	0.1	Total Suspended Solids	250
Manganese	2.0	Zinc	0.5

standards. After accounting for domestic sources, the remaining load is then evenly distributed among industries that contribute to the Carolina RWWTP. PRASA's original 1985 EPA-approved pretreatment program contained general island-wide local limits for all its wastewater treatment facilities. Pursuant to the existing section 301(h) modified permit, on February 28, 2003, PRASA submitted to EPA a technical evaluation of facility-specific local limits for the Carolina RWWTP. A list of current local limits established by PRASA for the Carolina RWWTP is in Table 8.

Based on the February 28, 2003 analysis, the current technically-based local limits may continue to be used by PRASA. In accordance with 40 CFR part 403, PRASA has incorporated EPA-approved local limits into all applicable industrial pretreatment permits.

For several pollutants detected at industrial users, and in facility influent, effluent, or sludge, PRASA determined that local limits were not necessary. For these pollutants, PRASA provided an annual update of the Carolina RWWTP influent and effluent data in its December 2009 Industrial Pretreatment Program Annual Report which covers activities from September 1, 2008 through August 31, 2009. PRASA demonstrated that local limits for barium, boron, chloroform, diethyl phthalate, ethylbenzene, phenol, sulfide, and toluene remain unnecessary. For detergents and total nitrogen, PRASA will be required to develop a local limit upon permit renewal. Since PRASA has established local limits as a means to control toxic pollutants that may be introduced by an industrial discharger, and has demonstrated that it is able to enforce these limits, EPA has concluded that the applicant has demonstrated that it has met requirements of 40 CFR §125.65 for an urban area pretreatment program.

6. Toxics Control Program [section 301(h)(5), 40 CFR §§125.66(a) through (c)]

a. Chemical Analysis

Pursuant to 40 CFR §125.66(a), at the time of application, the applicant must submit a chemical analysis of its current discharge for all toxic pollutants and pesticides defined in 40 CFR §§125.58(p) and (aa). As specified in EPA's ATSD, the applicant must submit results of wet and dry weather analyses of the effluent if known or suspected industrial sources of toxic pollutants or pesticides exist. The analysis shall be performed on a minimum of two 24-hour composite samples (one dry weather and one wet weather). Applicants may supplement or substitute chemical analyses if the composition of the supplemental or substitute samples typifies that which occurs during wet and dry weather conditions.

In the renewal application, the applicant indicated that there are potential industrial sources of toxic pollutants within the Carolina RWWTP basin. PRASA indicated that these pollutants are monitored through the PRASA Pretreatment Program, and that monitoring results are submitted to EPA on an annual basis. Although the applicant did not provide a chemical analysis of its current discharge as part of its renewal application, as required by 40 CFR §125.66(a), EPA has concluded that the most recent two pretreatment annual reports (November 2007 and December 2008) are sufficient to meet the requirements of 40 CFR §125.66(a) (PRASA 2007c, 2008c).

b. 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 shall also categorize the sources according to industrial and nonindustrial types.

In the renewal application, PRASA indicated that the Carolina RWWTP generally provides service to light industry including assembly-type operations and small-scale food processors. At this time, PRASA indicates that thirteen industries are permitted as significant industrial users that discharge to the Carolina RWWTP. Although the applicant did not categorize the sources of toxic pollutant according to industrial and nonindustrial types as part of its renewal application, as required by 40 CFR §125.66(b), EPA has concluded that the most recent two pretreatment annual report (November 2007 and December 2008) is adequate to meet the requirements of 40 CFR §125.66(b).

c. Industrial Pretreatment Program

Under 40 CFR §125.66(c), an application for a section 301(h) waiver that has known or suspected industrial sources of toxic pollutants must have an approved pretreatment program as described in 40 CFR Part 403. In the renewal application, PRASA indicated that the Carolina RWWTP currently has an EPA-approved industrial pretreatment program and has implemented the program throughout the island. EPA originally approved the applicant's industrial pretreatment program on September 28, 1985, and Enforcement Response Plan on May 30, 1995. The Puerto Rico Rules and Regulations for the Supply of Water and Sewer Supply (Rules and Regulations) were approved as part of the original program in 1985 and met the existing pretreatment requirements for legal authority at 40 CFR §403.8. Effective October 3, 2003, PRASA revised its Rules and Regulations in accordance with changes made to the federal pretreatment regulations (e.g., additional federal prohibitions, revised definitions, and notification requirements). Since PRASA has an EPA-approved industrial pretreatment program for the Carolina RWWTP, EPA has concluded that the applicant has demonstrated that it has met the requirements of 40 CFR §125.66(c).

7. Nonindustrial Source Control Program [section 301(h)(7), 40 CFR §125.66(d)]

Pursuant to 40 CFR §125.66(d), which implements section 301(h)(7) of the Act, all applicants must propose a public education program designed to minimize the entrance of nonindustrial toxic pollutants into the wastewater treatment system, which shall be implemented no later than 18 months after issuance of a section 301(h) modified permit.

In the renewal application, the applicant proposed the continuation of its nonindustrial source control public education program referred to as the "Aquamovil" Education Program. Originally implemented in 1993, the island-wide program is designed to control toxic substances from domestic sources through a mobile learning center that travels throughout the island providing literature, illustrations, and models of the wastewater treatment processes (PRASA 2007d). In the renewal application, PRASA indicated that 287 education and public awareness activities were held in 2005 and 2006 at a variety of public and private schools, science and trade fairs, summer camps, and professional conventions. Information was provided on wastewater treatment processes and preventative measures for introducing toxics into the waste stream. In addition, PRASA described its Fat, Oil and Grease (FOG) Program that focuses on educating commercial facilities across the island, such as food establishments that discharge specifically to the Carolina RWWTP, about the impact of FOG on wastewater infrastructure and treatment facilities. In addition, PRASA developed a Best Manufacturing Program Manual in 2006 for the food establishment to better control FOG. Since 2006, PRASA has provided compliance assistance to the public to evaluate FOG management and disposal.

Based on review of PRASA's "Aguamóvil" Education Program, EPA has concluded that the applicant has met the requirements of 40 CFR §125.66(d) for a nonindustrial source control program. EPA has proposed in the modified permit that PRASA to continue to implement its nonindustrial source control program and modify the program, as necessary, within 18 months of the effective date of the renewed permit.

8. Effluent Volume and Mass Loadings [section 301(h)(8), 40 CFR §125.67]

Under 40 CFR §125.67, which implements section 301(h)(8) of the Act, EPA may not issue a section 301(h) modified permit unless the applicant demonstrates there will be no new or substantially increased discharges from the point source of the pollutant to which the modification applies above the volume of discharge specified in the permit. Pursuant to 40 CFR §125.67(b), where pollutant discharges are attributable to combined sewer overflows, the applicant shall minimize existing overflows and prevent increases in the amount of pollutants discharged. Since the Carolina RWWTP is not a combined sewer system, the applicant is exempt from the requirements of 40 CFR §125.67(b). However, 40 CFR §125.67(c) requires that the applicant provide projections of annual average effluent volume in m^3/sec and mass loadings in metric tons/year for any pollutants to which the modification applies in five-year increments for the design life of its facility. The Carolina RWWTP first began operations in the late 1980s and the design life of the facility is considered to be 40 years.

In the renewal application, PRASA has applied for a modified permit with a variance from secondary treatment requirements for BOD_5 and TSS, and has requested an average monthly flow rate of 45 MGD (1.98 m^3/sec) for the new permit term (PRASA 2007a). The applicant has not requested a change in existing permit limits for flow or BOD_5 and TSS based on mass loading. To ensure that mass loadings only reflect those accounted for in the initial design of the treatment system, PRASA indicated that the requested permit flow limitation of 45 MGD considers the impact of inflow and infiltration and reductions from corrective actions in the collection system. PRASA has no plans for expansion of the Carolina RWWTP collection system in the near future that would result in new or substantial increases in loadings of BOD_5 or

TSS beyond those limitations specified in the renewed permit (PRASA 2003c). In the renewal application, the applicant did not provide projections of annual average effluent volume in m^3/sec and mass loadings in metric tons/year for BOD_5 and TSS in five-year increments for the design life of its facility as required by 40 CFR §125.67(c). Instead, PRASA provided historical information on monthly average flow and monthly average discharges of BOD_5 and TSS for the Carolina RWWTP facility.

Consequently, EPA calculated the projected annual average mass loadings for BOD_5 and TSS at the end of the permit term and assumed that these loadings would be constant for the design life of the facility over the next 15 years. Based on PRASA's requested mass-based monthly average effluent limitations of 22,166 kg/day and 11,935 kg/day for BOD_5 and TSS, EPA determined that annual average loadings for BOD_5 and TSS are predicted to be 8,091 and 4,356 metric tons/year, respectively.[8] However, based on DMR data from June 2002 through December 2008, EPA determined that annual monthly average flows ranged between 26 and 33 MGD, which is significantly below the design capacity of the Carolina RWWTP, and that actual annual mass loadings for BOD_5 and TSS were below those predicted during the next permit period.

As a result, EPA has concluded that the applicant has satisfied the requirements of 40 CFR §125.67 based on the following: the applicant has indicated that there will be no new or substantially increased discharges of BOD_5 and TSS above those requested in the permit; and there are no plans for expansion of the Carolina RWWTP collection system in the near future. PRASA has indicated that the existing annual monthly average loadings of BOD_5 and TSS are to remain the same over the design-life of the facility.

9. Minimum level of treatment [section 301(h)(9), 40 CFR §125.60]

Section 301(h) (9) of the Act was amended by section 303(d)(1) and (2) of the WQA. Under section 303(d)(1), the applicant's effluent must be receiving at least primary or equivalent treatment at the time its section 301(h) modified permit becomes effective. Section 303(d)(2) defines primary or equivalent treatment as a means of treatment by screening, sedimentation, and skimming adequate to remove at least 30 percent of the biological oxygen demanding material and of the suspended solids in the POTW's influent, and disinfection, where appropriate. To ensure that the effluent discharge has received primary or equivalent treatment, 40 CFR §125.60 requires that the applicant perform monitoring of influent and effluent and assess BOD_5 and TSS removal rates based on a monthly average.

Based on review of DMR data from June 2002 through September 2009, monthly average removal rates for BOD_5 ranged between 26 percent and 73 percent, with only one month falling below the 30 percent removal requirement. Monthly average concentrations of BOD_5 ranged between 32 mg/l and 104 mg/l. For TSS, removal rates during this same period ranged between 35 and 86 percent, with monthly average TSS concentrations ranging between 23 mg/l and 88 mg/l. As a result, monthly average removal rates for BOD_5 and TSS are generally significantly above the primary treatment requirements. In the renewal application, the applicant proposed an effluent limitation of 30 percent for BOD_5 based on a monthly average removal rate and, since

[8] Mass-based effluent limits are based on the average monthly flow of 45 MGD and the requested concentration-based effluent limitations of 120 mg/l and 70 mg/l for BOD_5 and TSS, respectively.

the Carolina RWWTP can achieve a higher removal rate for TSS due to chemical addition, proposed a 60 percent monthly average removal rate for TSS. In addition, PRASA also proposed concentration-based effluent limitations of 130 mg/l and 70 mg/l for BOD_5 and TSS, respectively. The proposed limitations reflect those established in the current modified permit for the Carolina RWWTP, and are consistent with the requirements of section 301(h) for primary treatment of influent based on a minimum of 30 percent removal of BOD_5 and TSS (40 CFR §125.60).

Based on available data, EPA has concluded that the applicant has demonstrated that the Carolina RWWTP can consistently achieve the 30 percent removal requirement for BOD_5 and TSS based on a monthly average in accordance with 40 CFR §125.60. Moreover, the applicant has demonstrated that the facility is able to achieve greater percent removal for TSS, as required by the existing permit. Therefore, EPA proposes the current effluent limitations of 30 percent removal of BOD_5 and 60 percent removal of TSS from the influent of the Carolina RRWTP in the draft permit, as demonstrated by current facility performance. Furthermore, EPA proposes the following mass and concentrations limits for BOD_5 and TSS:

BOD_5: (1) The 7-day average loading shall not exceed 44,332 kg/day;
(2) The 30-day average loading shall not exceed 22,166 kg/day; and
(3) The 30-day average concentration shall not exceed 130 mg/l.

TSS: (1) The 7-day average loading shall not exceed 11,935 kg/day;
(2) The 30-day average loading shall not exceed 23,870 kg/day; and
(3) The 30-day average concentration shall not exceed 70 mg/l.

COMPLIANCE WITH APPLICABLE PROVISIONS OF COMMONWEALTH, LOCAL, OR OTHER FEDERAL LAW OR EXECUTIVE ORDERS

Under 40 CFR §l25.59(b)(3), a modified permit may not be issued if such issuance would conflict with applicable provisions of Commonwealth, local, or other Federal laws or Executive Orders. As part of the application renewal, the applicant must demonstrate compliance with all applicable Commonwealth and Federal laws and regulations, and Executive Orders which include the Coastal Zone Management Act, Marine Protection Research and Sanctuaries Act, and the Endangered Species Act.

Coastal Zone Management Act

Under 40 CFR §125.59(b)(3), a modified permit must comply with the Coastal Zone Management Act of 1972, as amended, 16 U.S.C. 1451 et seq. In accordance with 16 U.S.C. 1456(c)(3)(A), and its implementing regulations, a section 301(h) modified permit may not be issued unless the proposed discharge is certified by the Commonwealth of Puerto Rico to be consistent with the Commonwealth's Coastal Zone Management Program. In the renewal application, PRASA indicated that the Carolina RWWTP's outfall and diffuser are located in a coastal area managed by the Commonwealth's Coastal Zone Management Program. On May 16, 2007, PRASA requested a consistency certification for the modified discharge from the Puerto

Rico Planning Board (PRPB). To date, EPA has not received a certification from the PRPB and, therefore, has requested that PRASA contact the PRPB to determine issuance status of the certification. A modified permit cannot be renewed until such certification is received by EPA.

Marine Protection, Research and Sanctuaries Act

40 CFR §l25.59(b)(3) provides that issuance of a section 30l(h) modified permit must comply with Title III of the Marine Protection, Research and Sanctuaries Act (MPRSA), l6 U.S.C. l43l et seq. In accordance with 16 U.S.C. 1434(d), a 30l(h) modified permit may not be issued for a discharge located in a marine sanctuary designated pursuant to Title III of the MPRSA if the regulations applicable to the sanctuary prohibit issuance of such a permit. In the renewal application, PRASA indicated that the Carolina WWTP outfall and diffuser are not located in a marine or estuarine sanctuary designated under Title III of the MPRSA. To date, EPA has not received a concurrence from the National Oceanic and Atmospheric Administration (NOAA) that the modified discharge is not located in a marine or estuarine sanctuary designated under Title III of the MPRSA. EPA will not issue a final decision on whether to approve PRASA's application for a modified permit and issue a final modified permit until this concurrence is received by the NOAA.

Endangered Species Act

Under 40 CFR §l25.59(b)(3), a section 30l(h) modified 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 Ac (ESA), 16 U.S.C. 1531 et seq. In the application, PRASA indicated that there are threatened or endangered species that may occur in the vicinity of the Carolina RWWTP outfall. According to the National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS), the threatened or endangered species that may occur in the coastal waters of Puerto Rico are listed in Table 9.

On May 16 and 19, 2007, the applicant requested a certification from USFWS and NMFS, respectively, that the modified discharge will comply with the ESA. To date, EPA has not received a certification from either federal agency. EPA will not issue a final decision on whether to approve PRASA's application for a modified permit and issue a final modified permit until completion of the ESA consultation.

Table 9 - List of Threatened or Endangered Species in the vicinity of the Carolina RWWTP modified discharge

Finback Whale (*Balaenoptera physalus*)	Leatherback Turtle (*Demochelys coriacea*)
Humpback Whale (*Megaptera novaeangliae*)	Loggerhead Turtle (*Caretta caretta*)
Sperm Whale (*Physeter catodon*)	Olive Ridley Turtle (*Lepidochelys olivacea*)
Green Turtle (*Chelonia mydas*)	Brown Pelican (*Pelecanus occidentalis*)
Hawksbill Turtle (*Eretmochelys imbricate*)	

Other Federal, Commonwealth, and Local Laws and Executive Orders

Under 40 CFR §125.59(b)(3), a modified permit must comply with applicable provisions of Federal laws including the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) of 1976, 16 U.S.C. 1801 et seq., which protects against adverse impacts to Essential Fish Habitat (EFH). As required by MSFCMA, EPA must demonstrate that an approval of a section 301(h) waiver for the Carolina RWWTP will not result in adverse impact to any EFH or species included in Caribbean or Federal Fisheries Management Plans. At this time, EPA is working with PRASA and NMFS to complete this analysis. EPA will not issue a final decision on whether to approve PRASA's application for a modified permit and issue a modified permit until completion of the EFH consultation.

On June 11, 1998, the President issued an Executive Order on Coral Reef Protection, directing federal agencies to expand research, preservation and restoration activities for the protection of coral reef ecosystems. As described previously, there is naturally isolated sparse coral growth in the vicinity of the Carolina RWWTP's discharge that EPA has determined is not impacted by the discharge. Therefore, since EPA is issuing this Decision Document to approve the applicant's request for renewal of its modified permit, EPA has determined that modified discharge is consistent the Executive Order on Coral Reef Protection. At this time, EPA is not of aware any additional Commonwealth or local laws that need to be addressed prior to issuance of a final modified permit for the Carolina RWWTP.

COMMONWEALTH CONCURRENCE OF WAIVER

Under 40 CFR §§125.61(b)(2) and 125.64(b), the applicant must provide a determination signed by the state or interstate agency authorized to provide certification under 40 CFR §§124.53 and 124.54 that the modified discharge will comply with applicable provisions of Commonwealth law including water quality standards. The state determination shall include a discussion of the basis for its conclusion. Furthermore, pursuant to 40 CFR §§124.53 and 124.54, the Commonwealth of Puerto Rico must either grant a certification pursuant to section 40l of the Act or waive this certification before EPA may issue a modified permit.

On May 23, 2007, PRASA requested a determination from PREQB that the modified discharge from the Carolina RWWTP will comply with all applicable provisions of Commonwealth law. In response, PREQB issued a draft Water Quality Certification for the Carolina RWWTP on November 9, 2009, that the modified discharge will comply with all applicable provisions of Commonwealth law including applicable water quality standards and will not result in any additional treatment requirements on any point or nonpoint sources. To date, PREQB has not issued a final WQC for the Carolina RWWTP. Therefore, EPA will not issue a final decision on whether to approve PRASA's application for a modified permit and issue a final modified permit until a final WQC has been issued by PREQB.

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Appendices

Appendix A – Summary of Acute and Chronic Whole Effluent Toxicity Data

Appendix B – Summary of 41 Toxic Pollutants Detected in Fish Tissue

Appendix A – Summary of Acute and Chronic Whole Effluent Toxicity Data

Table A1 - Comparison of acute WET results (LC_{50}, TUa) and acute WLA (36.9 TUa)

Test Date	Test Organism	LC_{50} (% Effluent)	Effluent TUa	Is Effluent TUa > 36.9 TUa
December 2002	Mysid Shrimp	<100	>1	No
	Sheepshead Minnow	<100	>1	No
March 2003	Mysid Shrimp	32.99	3.03	No
	Sheepshead Minnow	42.05	2.38	No
June 2003	Mysid Shrimp	35.36	2.83	No
	Sheepshead Minnow	35.36	2.83	No
August 2004	Mysid Shrimp	15.51	6.45	No
	Sheepshead Minnow	48.77	2.05	No
December 2006	Mysid Shrimp	48.3	2.07	No
	Sheepshead Minnow	38.4	2.60	No
April 2007	Mysid Shrimp	54.8	1.82	No
	Mysid Shrimp	46.9	2.13	No
	Sheepshead Minnow	45.7	2.19	No
January 2009	Mysid Shrimp	48.6	2.06	No
	Sheepshead Minnow	22.2	4.51	No
April 2009	Mysid Shrimp	17.5	5.71	No
	Sheepshead Minnow	55.0	1.82	No
July 2009	Mysid Shrimp	52.0	1.92	No
	Sheepshead Minnow	40.5	2.47	No
January 2010	Mysid Shrimp	>100	<1	No
	Sheepshead Minnow	54.8	1.82	No

Table A2 - Comparison of chronic WET results (NOEC, TUc) and chronic WLA (123 TUc)

Test Date	Test Organism	NOEC (% Effluent)	Effluent TUc[1]	Is Effluent TUc > 123 TUc?
December 2006	Mysid Shrimp	<0.79	>127	Yes
	Sea Urchin	<0.78	>128	Yes
	Sea Urchin	<0.78	>128	Yes
	Sea Urchin	0.78	128	Yes
	Sheepshead Minnow	12.5	8	No
April 2007	Mysid Shrimp	9.0	11.1	No
	Sea Urchin	0.07	1429	Yes
	Sea Urchin	<0.07	>1429	Yes
	Sea Urchin	2.7	37	No
	Sheepshead Minnow	9.0	11.1	No
January 2009	Mysid Shrimp	9.0	11.1	No
	Sea Urchin	9.0	11.1	No
	Sheepshead Minnow	9.0	11.1	No
April 2009	Mysid Shrimp	2.71	36.9	No
	Sea Urchin	0.81	123.5	No
	Sheepshead Minnow	30.0	3.33	No
July 2009	Mysid Shrimp	9.0	11.1	No
	Sea Urchin	2.70	37.0	No
	Sheepshead Minnow	9.0	11.1	No
January 2010	Mysid Shrimp	9.0	11.1	No
	Sea Urchin	9.0	11.1	No
	Sheepshead Minnow	30.0	3.33	No

[1]Pursuant to Article 1 of PRWQS, chronic toxic units are calculated based on the NOEC expressed in terms of the percent of the effluent in the dilution water.

Table A3 - Comparison of chronic WET results based on IC_{25} and chronic WLA (123 TUc)

Test Date	Test Organism	IC_{25} (% Effluent)	Effluent Toxicity Value[1]	Is Effluent Toxicity Value > 123 TUc?
	Mysid Shrimp	9.87	10.13	No
	Sea Urchin	0.36	277.78	Yes
December 2006	Sea Urchin	2.25	44.44	No
	Sea Urchin	0.64	156.25	Yes
	Sheepshead Minnow	17.9	5.59	No
	Mysid Shrimp	21.6	4.63	No
	Sea Urchin	1.21	82.64	No
April 2007	Sea Urchin	6.34	15.77	No
	Sea Urchin	3.85	25.97	No
	Sheepshead Minnow	23.2	4.31	No
	Mysid Shrimp	13.8	7.25	No
January 2009	Sea Urchin	14.4	6.94	No
	Sheepshead Minnow	13.1	7.63	No
	Mysid Shrimp	9.95	10.05	No
April 2009	Sea Urchin	3.61	27.70	No
	Sheepshead Minnow	37.5	2.67	No
	Mysid Shrimp	11.3	8.85	No
July 2009	Sea Urchin	4.26	23.47	No
	Sheepshead Minnow	14.7	6.80	No
	Mysid Shrimp	17.0	5.88	No
January 2010	Sea Urchin	3.62	27.62	No
	Sheepshead Minnow	40.2	2.49	No

[1]Effluent toxicity values are calculated based on the reciprocal of the IC_{25} expressed in terms of the percent of the effluent in the dilution water, where the effluent toxicity value = $100 \div IC_{25}$.

Appendix B – Summary of 41 Toxic Pollutants Detected in Fish Tissue

Arsenic	Benzo(g,h,i) perylene
Barium	Benzo(k) fluoranthene
Boron	Chrysene
Cadmium	Diethyl phthalate
Chromium	Di-n-butyl phthalate
Copper	Fluoanthene
Lead	Phenanthrene
Manganese	Pyrene
Mercury	Aldrin
Nickel	Alpha BHC
Selenium	Beta BHC
Zinc	Delta BHC
Cyanide	Gamma BHC
Dioxin	Chlordane – alpha
Ethyl benzene	Chlordane - gamma
Benzene	4,4'-DDT
Methylene Chloride	4,4'-DDE
Toluene	Heptachlor
Anthracene	Heptachlor epoxide
Benzo(a) anthracene	Dieldrin
Benzo(b) fluoranthene	