403(c) Ocean Discharge Criteria Evaluation

Discharges from the Oceanside Water Pollution Control Plant, Wastewater Collection System, and Recycled Water Project

NPDES No. CA0037681

April 2019

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I. BACKGROUND

Section 403(c) of the Clean Water Act (CWA) requires that National Pollutant Discharge Elimination System (NPDES) permits for marine discharges located seaward of the inner boundary of the territorial seas be issued in accordance with regulatory guidelines for determining the potential degradation of the marine environment. These guidelines, referred to as the Ocean Discharge Criteria (CWA section 403(c) and 40 CFR 125.120 et seq., Subpart M), are intended to "prevent unreasonable degradation of the marine environment[1] and to authorize imposition of effluent limitations, including a prohibition of discharge, if necessary, to ensure this goal." 45 Fed. Reg. 65942 (October 3, 1980).

The purpose of this document is to support EPA's determination of no unreasonable degradation of the marine environment for the proposed discharges under the draft 2018 NPDES permit for the Oceanside Water Pollution Control Plant, Recycled Water Project Concentrate, Westside Transport Structure, and Combined Sewer Discharge Points.[2] The draft permit authorizes discharges of stormwater, wastewater, and brine effluent at Discharge Point No. 001 and stormwater and wastewater effluent at Discharge Point CSD 001 through CSD 008. The draft permit contains: (1) dry weather effluent limits and receiving water limits for discharges to federal waters based on the California Ocean Plan, except for chronic toxicity and dioxins[3]; (2) wet weather discharge requirements based on EPA's *Combined Sewer Overflow (CSO) Control Policy*[4]; and (3) discharge prohibitions consistent with the California Ocean Plan and the *CSO Control Policy* to control impacts associated with the discharge.

II. ANALYSIS

Pursuant to 40 CFR 125.122(a)-(b), unreasonable degradation of the marine environment is evaluated based on analyzing a proposed discharge's compliance with ten specific factors or compliance with State water quality standards (the "rebuttable presumption" approach). EPA is using both approaches in in analyzing the discharges from Discharge Point No. 001 and from CSD Discharge Points. Specifically, EPA is applying the State water quality standards, except for chronic toxicity and TCDD equivalents (i.e. dioxins).

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[1] Unreasonable degradation means: (1) Significant adverse changes in ecosystem diversity, productivity and stability of the biological community within the area of discharge and surrounding biological communities; (2) Threat to human health through direct exposure to pollutants or through consumption of exposed aquatic organisms; or (3) Loss of esthetic, recreational, scientific or economic values which is unreasonable in relation to the benefit derived from the discharge. *See* 40 CFR 125.121(e).

[2] This document is updated from the previous analysis EPA conducted for dioxins when reissuing the 2009 NPDES permit. However, this document also includes chronic toxicity since the previous permit implemented the water quality objective in the California Ocean Plan.

[3] Dioxins are a group of hundreds of chemicals that are highly persistent in the environment. The most toxic compound is 2,3,7,8-tetrachlorodibenzo-p-dioxin or TCDD, which is commonly referred to as dioxin. Unless otherwise noted in this document, dioxins refer to this compound, TCDD, as well as furans and other dioxin like compounds.

[4] The California Ocean Plan refers to the EPA's *CSO Control Policy* for wet weather discharges from the City of San Francisco's combined sewer system.

Therefore, EPA is evaluating whether the discharge's toxicity and the concentrations of dioxins present in the discharge would cause unreasonable degradation of the marine environment based on the ten factors listed in 40 CFR 125.122(a). These factors are:

(1) Quantities, composition, and potential for bioaccumulation or persistence of the pollutants discharged;
(2) Potential transport of such pollutants;
(3) Composition and vulnerability of biological communities exposed to such pollutants;
(4) Importance of the receiving water area to the surrounding biological community;
(5) Existence of special aquatic sites;
(6) Potential impacts on human health;
(7) Impacts on recreational and commercial fishing;
(8) Applicable requirements of approved Coastal Zone Management Plans;
(9) Other relevant factors relating to the effects of the discharge; and
(10) Marine water quality criteria developed pursuant to Section 304(a)(1) of the CWA.

The factors analyzed here are (1), (2), (5), (6), (7), (8), (9) and (10). Factors (3) and (4) are discussed in detail in the Biological Evaluation prepared for purposes of the Endangered Species Act, included in the administrative record for the draft permit. *See* Table 4-2 in *CWA Section 403: Procedural and Monitoring Guidance* (EPA 842-B-94-003, March 1994; 403(c) Guidance) (describing the types of monitoring data that may be used to assess the ten factors under section 125.122(a)).

A. Quantities, composition, and potential for bioaccumulation or persistence of toxicity present in the discharge (factor 1)

For this section, EPA evaluated dioxins separately from chronic toxicity. Each pollutant is discussed below.

1. Dioxins

EPA evaluated the quality, composition, and potential for bioaccumulation or persistence of toxicity of dioxins in the discharge using a "toxic equivalency approach" and a "bioaccumulation equivalency approach." These approaches are used by the World Health Organization and by EPA in the Great Lakes Region.

Dioxins are a group of hundreds of chemicals (i.e. dioxin and dioxin like compounds) that share distinct chemical structures and characteristics. Dioxins are highly persistent in the environment, bioaccumulate, and are carcinogenic. Specifically, 2,3,7,8- tetrachlorodibenzo-p-dioxin, or TCDD, is commonly referred to as dioxin. TCDD is the most toxic chemical in the group.

To measure this group of chemicals, a "toxic equivalency approach" is commonly used so that a mixture of dioxins and dioxin like compounds can be expressed as a single number. The single number is the sum of the chemicals multiplied by a toxic equivalent factor (TEF). Specifically, the World Health Organization developed TEFs to convert congener concentrations into equivalent concentrations of 2,3,7,8-TCDD, which when added together are expressed as dioxin-TEQ.[5] Currently, TEFs developed by the World Health Organization range from 1 to 0.0001.

The permittee has monitored dioxins in the discharge for over 10 years. Over the last permit term, the permittee has monitored 17 different congeners annually and has only detected two congeners in the effluent (i.e. octa-chlorinated dibenzodioxin (OCDD) and 2,3,7,8-hepta-chlorinated dibenzodioxin (2,3,7,8-HpCDD)). However, methods are limited with minimum levels (MLs) ranging from 10 to 100 pg/L. Therefore, the discharge may contain some concentration of other congeners below these concentrations. Table 1 shows the detected conger concentrations, which are below the MLs, and the relevant dioxin-TEQ.

Table 1. Concentrations (pg/L) of dioxins from 2011 to 2017 used to assess toxicity. (Nondetect dioxin compounds are not shown).

	2,37,8-HpCDD Conc. (pg/L)		OCDD Conc. (pg/L)		**Total Dioxin-TEQ (pg/L)**
Year	Effluent Conc.	Dioxin-TEQ (TEF = 0.01)	Effluent Conc.	Dioxin-TEQ (TEF = 0.001)	
2011	3.7	0.037	22	0.022	**0.05900**
2012	11	0.11	85	0.085	**0.19500**
2013	2.8	0.028	22	0.022	**0.05000**
2014	ND[1]	ND	18	0.018	**0.01800**
2015	ND	ND	7.7	0.0077	**0.00770**
2016	ND	ND	6.7	0.0067	**0.00670**
2017	2.8	0.028	17	0.017	**0.04500**

[1] ND = concentration was nondetect.

Of the 7 samples, the sample taken in 2012 had the highest dioxin-TEQ concentration at 0.195 pg/L. However, TCDD, the most toxic chemical, was not detected in the effluent and the 2 congeners that were consistently detected are one-hundredth and one-thousandth as toxic as TCDD. With these low concentrations and the large amount of dilution available at the outfall, EPA believes these congeners will not cause unreasonable degradation of the marine environment.

Just as different dioxins exhibit different levels of toxicity, they also exhibit different levels of bioaccumulation potential. To account for the different levels of bioaccumulation potential, each congener may be assigned a bioaccumulation equivalency factor (BEF) relative to the reference chemical 2,3,7,8-TCDD.[6] This

[5] The California Ocean Plan uses the term TCDD equivalents and expressed the water quality standard as 3.9×10^{-9} ug/L as a 30-day average.

[6] This approach of assessing bioaccumulation was adopted by EPA for the Great Lakes System (40 C.F.R. 132, Appendix F). In absence of site-specific BEFs, the U.S. Environmental Protection Agency supports the use of national BEFs, stating, "…EPA believes that national bioaccumulation factors are broadly applicable to sites throughout the United States and can be applied to achieve an acceptable degree of accuracy when estimating bioaccumulation potential at most sites." (EPA-820-B-95-005). EPA is applying these BEFs to this discharge to assess bioaccumulation potential.

"bioaccumulation equivalency approach" is comparable to the "toxicity equivalency approach, described above. Just as TEFs account for relative differences in toxicities, BEFs account for relative differences in biological uptake of the dioxin-congeners. Intrinsic to this approach is the assumption that the congeners bioaccumulate within the food web in an additive manner, which is reasonable given the similar chemical structures dioxins and furans share. The BEFs refine this assumption to better account for variability in the extent to which the congeners bioaccumulate within the food web. Table 2 shows BEFs and the respective dioxin-TEQ for those congeners detected in the discharge.

Table 2. Concentrations (pg/L) of dioxins from 2011 to 2017 used to assess bioaccumulation potential.

	2,37,8-HpCDD Conc. (pg/L)		OCDD Conc. (pg/L)		**Total Dioxin-TEQ w/ BEFs Conc. (pg/L)**
Year	Effluent Conc.	Dioxin-TEQ w/BEF (TEF = 0.01, BEF = 0.05)	Effluent Conc.	Dioxin-TEQ w/BEF (TEF = 0.001, BEF = 0.01)	
2011	3.7	0.00185	22	0.00022	**0.00207**
2012	11	0.0055	85	0.00085	**0.00635**
2013	2.8	0.0014	22	0.00022	**0.00162**
2014	ND[1]	ND	18	0.00018	**0.00018**
2015	ND	ND	7.7	0.000077	**0.00008**
2016	ND	ND	6.7	0.000067	**0.00007**
2017	2.8	0.0014	17	0.00017	**0.00157**

[1] ND = concentration was nondetect.

The two congeners, 2,3,7,8-HpCDD and OCDD, detected in the effluent are among the least bioaccumulative congeners, at one-twentieth and one-hundredth as bioaccumulative as 2,3,7,8 TCDD. With these low BEFs and the large amount of dilution available at the outfall, EPA believes these congeners will not cause unreasonable degradation of the marine environment. Additional discussion regarding bioaccumulation is discussed under *Section D, Potential impacts on human health (factor 6)*.

2. Chronic toxicity

EPA evaluated the occurrence and persistence of chronic toxicity by examining effluent monitoring data and available dilution. The Oceanside Plant outfall is located offshore where the discharge is diluted rapidly and any potential impacts are not likely to occur or persist past the localized area surrounding the discharge point. Table 3 shows effluent toxicity data from 2013 to 2018. For this discharge, acceptable NOEC values protecting aquatic life from chronic toxicity in receiving waters have been acceptably low (≥0.67% effluent). As shown in Table 3 on the next page, all NOEC results achieved this threshold.

Table 3. Oceanside Plant effluent chronic toxicity data (IWC = 0.67% effluent) using the Sea Urchin, *Strongylocentrotus purpuratus* and Sand Dollar, *Dendraster excentricus* Larval Development Test Method (EPA/600/R-95/136, 1995) and NOEC statistical approach. For all toxicity tests, SFPUC laboratory replication (n) = 5, except for Pacific Ecorisk (PER) laboratory where n = 4.

Test Date	Test Species	NOEC	TUc	Test Date	Test Species	NOEC	TUc
2013				2016			
February	*S. purpuratus*	2	50	March	*S. purpuratus*	2	50
May	*S. purpuratus*	2	50	June	*S. purpuratus*	1	100
July (PER)	*S. purpuratus*	2	50	August	*D. excentricus*	2	50
November	*S. purpuratus*	2	50	November	*S. purpuratus*	2	50
2014				2017			
January	*S. purpuratus*	5	20	February	*S. purpuratus*	2	50
April	*S. purpuratus*	5	20	May	*S. purpuratus*	2	50
July	*D. excentricus*	2	50	August	*D. excentricus*	2	50
October	*S. purpuratus*	0.67	149.3	December	*S. purpuratus*	2	50
2015				2018			
February	*S. purpuratus*	2	50	February	*S. purpuratus*	2	50
May	*S. purpuratus*	2	50				
August	*D. excentricus*	2	50				
November	*S. purpuratus*	2	50				

B. Potential for biological, physical, or chemical transport (factor 2)

For this section, EPA evaluated dioxins separately from chronic toxicity. Chronic toxicity is not considered because it is not a non-conservative pollutant and this is expected to be acceptably low after initial dilution of the effluent by receiving waters (Table 2).

1. Dioxins

Since dioxins are hydrophobic, these compounds enter the marine environment absorbed to suspended solids and organic matter. The potential for biological transport occurs where particulate matter is ingested or when sediments settle onto the ocean floor. Specifically, the potential for biological transport includes (1) ingestion of organic matter, (2) absorption across surface membranes, (3) dispersion of potentially contaminated sediments (4) bioaccumulation and biomagnification of pollutants. Zooplankton also play a role in transporting pollutants, like metals or petroleum hydrocarbons from the water column to the sea bottom. However, the receiving water monitoring program indicates that there is no impact of the discharge on the biological transport of dioxins, as there were no significant differences in pollutants in fish or crab tissues taken from samples at the outfall and reference monitoring locations.

The receiving water monitoring program also indicates that there is not an impact associated with the discharge on the physical transport of dioxins. There may be a localized impact of an increase organic pollutants in the sediment near the outfall, but that is likely a characteristic of the fine sediment environment on which the outfall is located. The dominant factors controlling physical transport of dioxins is the southward moving ocean current, the active tectonic plates/fault zones, and the tidal-ebb influence from the San Francisco Bay Delta. These physical factors dominate the physical transport of any suspended solids and organic matter associated with the discharge.

The potential for biological and chemical transport are related due to the chemical properties associated dioxins. Dioxins are generally resistance to abiotic and biotic transformation and considered a persistent organic pollutant (POP). POPs are considered persistent because of their long half-lives due to its hydrophobic and lipophilic nature. Their hydrophobic and lipophilic properties are exactly what cause POPs to accumulate over time in biota as well as in the organics of soils and sediments. Bioaccumulation is further discussed in section A above. However, EPA also considered the physical and chemical characteristics of the sediments in the receiving water to assess chemical transport. As described above, the outfall is in a fine sediment area. Because fine sediments have greater relative surface area, sediments are likely to have higher concentrations of pollutants. The receiving water monitoring program supports this conclusion, in that higher concentrations of organic pollutants have been routinely measured in fine sediment areas when compared to coarse or medium grain sediment areas in the receiving water monitoring program. However, the receiving water monitoring program does not show any trends in physical or chemical sediment characteristic between pre- and post-outfall construction as well as between outfall and reference monitoring locations.

C. Existence of special aquatic sites (factor 5)

Because this factor is evaluating the existence of special aquatic sites, EPA considered the impact of both dioxins and chronic toxicity in combination as opposed to evaluating each separately. The effluent is not discharged into a special aquatic site but is surrounded on three sides by the boundary of the Monterey Bay National Marine Sanctuary (MBNMS). When the MBNMS was designated, the urban waters of San Francisco, Daly City, and Pacifica were deemed incompatible with sanctuary regulations and excluded from MBNMS designation.[7] This unprotected area is referred to as the San Francisco-Pacifica Exclusion Area. The draft permit authorizes discharges into the San Francisco-Pacifica Exclusion Area.

The California Ocean Plan also identifies areas of special biological significance (ASBS) and state marine protected areas (MPAs), which are afforded special protections in the Ocean Plan. ASBS covers much of the length of California’s coastal waters. The effluent is not discharged into an ASBS or a MPA but is located near ASBS #10, which is the Farallon Islands state MPA. *See* Figure VIII-2 of the Ocean Plan.

[7] The reasons for MBNMS exclusion, at the time of designation, included: (1) Pollution problems stemming from the combined sewer overflow component of the City and County of San Francisco's sewage treatment program; (2) High vessel traffic in the area; and (3) Potential pollutants from dredge spoils deposited in the exclusion area. *See* 77 FR 46985. However, in 2012, the National Oceanic and Atmospheric Administration initiated a review of the MBNMS boundaries and proposed to add the exclusion area to the sanctuary. To date, no final action has occurred.

D. Potential impacts on human health (factor 6)

Chronic toxicity is related to the protection of marine aquatic life. Therefore, EPA is evaluating only dioxins under this factor. Health concerns from exposure to dioxins include endocrine, developmental, immune and carcinogenic effects. The route of exposure is primarily through the ingestion of animal and other food products. EPA has a recommended human health criterion of 0.0051 pg/L for consumption of organisms only for 2,3,7,8 TCDD. EPA has not set a recommended concentration for other dioxin or dioxin like compounds. This congener, 2,3,7,8 TCDD has not been detected in the effluent. Since 2,3,7,8 TCDD has not been detected in the effluent and that the bioaccumulation equivalency factors of the detected congeners (2,3,7,8 HpCDD and OCDD) are among the lowest among the congeners, EPA has determined that the proposed discharge of dioxins and the discharge's toxicity will not cause unreasonable degradation of ocean waters.

E. Impacts on recreational and commercial fishing (factor 7)

EPA is evaluating both the discharge's toxicity and the dioxins present in the discharge in relation to impacts on fishing. Recreational and commercial fishing is common in the marine environment offshore of the facility. However, the receiving water monitoring program shows no significant outfall effects in terms of species abundance, diversity, or in pollutant burdens in fish and crab tissue. Therefore, EPA has determined that there will be no unreasonable degradation to existing or potential fishing in the area.

F. Coastal Zone Management Plan (factor 8)

EPA is evaluating both the discharge's toxicity and the dioxins present in the discharge in compliance with an approved Coastal Zone Management Plan. The California Coastal Commission, which conducts oversight of Coastal Zone Management Plan implementation, has waived review of NPDES permits containing effluent limits consistent with secondary treatment standards (i.e. BOD and TSS limits). The draft permit contains BOD and TSS limits consistent with secondary treatment standards for dry weather discharges. Wet weather discharges are controlled by implementation of requirements consistent with EPA's *CSO Control Policy*. Because of these requirements, the discharges are consistent with the Coastal Zone Management Plan. During public notice, EPA will confirm with the California Coastal Commission that a federal consistency determination in not needed for the draft permit.

G. Other factors relating to effects of the discharge (factor 9)

Because the amount and type of pollutants present in the discharge are reflective of the type of waste stream discharged, EPA considered dioxins and chronic toxicity separately under this factor.

1. Dioxins

Dioxins are generally higher in stormwater discharges. Therefore, EPA expects the concentration of dioxins to be higher during wet weather discharges. Wet weather monitoring data from 2000 confirmed this assumption.[8] See table below.

Table 4. TCCD equivalent concentrations in influent at the Oceanside Plant and in effluent discharges at Discharge Point 001.

	TCCD Equivalents Concentration (pg/L)	
	Dry Weather	Wet Weather
Influent	1.3	16
Effluent	0.06	1.7

Despite the higher concentration, EPA does not expect wet weather discharges of dioxins to cause unreasonable degradation of the marine environment. Wet weather discharges are less frequent than dry weather discharges so impact is seasonally limited and more importantly, the receiving water monitoring program does not indicate any adverse impacts associated with the discharge. Specifically, concentration of PCBs[9] at outfall monitoring locations were not significantly different from the reference areas in terms of sediment and fish or crab tissue concentrations. Concentrations appear to be decreasing across all monitoring locations, but definitive conclusions cannot be inferred since concentrations are detected near or below the method detection limits.[10] See table 5 on the next page. Furthermore, the City has monitored for the dioxin like PCBs and has detected only two congeners in samples pre-2001. Specifically, PCB-126[11] and PCB-156 has not been detected since 1999 and 2000, respectively.

Table 5. Mean concentration (ppb, wet weight) of PCBs detected in tissues of Dungeness Crab collected from an outfall and reference monitoring location.

Year	Dungeness Crab Muscle		Dungeness Crab Hepatopancreas	
	Reference Area	Outfall Area	Reference Area	Outfall Area
2000	36	3	127	130
2001	ND[1]	ND	198	159
2002	ND	ND	194	167
2003	2	6[2]	95	87

[8] The most recent wet weather data for dioxins is from 2000. The draft NPDES permit contains a reopener clause allowing for the permit to be modified if EPA determines that the discharge is causing unreasonable degradation or an exceedance of a water quality objective.

[9] PCBs are a group of over 200 organic chemicals. There are 12 known dioxin-like PCBs: PCB-77, 81, 126, 169, 105, 114, 118, 123, 156, 157, 167, and 189. Since 2009, the City's receiving water monitoring program has assessed 52 PCB congeners annually in sediment and tissues samples and includes these 12 dioxin-like PCBs.

[10] See section 7.2 and Table 7-2 of the City's 1997 to 2012 Southwest Ocean Outfall Regional Monitoring Program Sixteen Year Summary Report (2014).

[11] PCB-126 has the potency one-tenth that of TCDD. PCB-126 was detected in hepatopancreas of crabs from both reference and outfall monitoring locations at levels near detection limits from 1999 to 2004, but it has not been detected since 2004.

Year	Dungeness Crab Muscle		Dungeness Crab Hepatopancreas	
	Reference Area	Outfall Area	Reference Area	Outfall Area
2004	2	ND	61	50
2005	4	4	19	20
2006	2	2	32	22
2007	2	ND	101	154
2008	ND	2	71	47
2009	ND	ND	70	65
2010	ND	ND	28	29
2011	ND	ND	41	37
2012	ND	ND	28	43

[1] ND = concentration was nondetect.
[2] Statistically significant from reference location.

2. Chronic toxicity

EPA has not established a CWA section 304(a) criterion for chronic toxicity but recommends a maximum magnitude of 25% reduction for the measured biological endpoints (e.g., development, fertilization, etc.) of WET tests. *See* sections 2.3.3 and 1.3 in *Technical Support Document for Water Quality-Based Toxics Control* (EPA 505/2-90-001; TSD). Biological endpoint measures are usually further interpreted using statistical approaches commonly used under CWA programs, such as NPDES permitting, which can incorporate decisions for both the maximum magnitude of acceptable reduction for the biological endpoint and the statistical confidence of test results. Common statistical approaches in CWA programs are: Effect Concentration (EC) 25, the concentration at which biological effects are observed in 25% of the organisms, and hypothesis testing approaches such as the No Observed Effect Concentration (NOEC) and Test of Significant Toxicity (TST). Hypothesis testing approaches involve comparing the control with a specified concentration of an environmental sample (e.g., NPDES effluent), via a null hypothesis and an alternative hypothesis. *See* TSD and *National Pollutant Discharge Elimination System Test of Significant Toxicity Technical Document* (EPA 833-R-10-004, June 2010; TST Technical Document).

Chronic toxicity in the Oceanside discharge has been characterized using California's Ocean Plan NOEC statistical approach, expressed in NOEC and chronic toxic units (TUc). As with previous permits, the draft permit continues to have a water quality-based effluent limit for chronic toxicity. However, the draft permit specifies chronic toxicity data be evaluated using the TST statistical approach. By using this statistical approach, EPA can improve consistency in assessing effluent toxicity and the impact of the discharge at the discharge-specific in-stream waste concentration ("IWC").

Under CWA section 403(c), the application of statistical considerations that link data, performance, and decision-making is recommended. *See* 403(c) Guidance, pages 37, 38, 209. Examples of such statistical considerations include defining acceptable type

I (α) and type II (β) errors;[12] applying power analysis to evaluate the appropriate number of replicates (n) based on a prior knowledge of variation observed in historical data; etc.). *Id.* Accordingly, statistical rigor (trustworthiness) based on current information for chronic toxicity and this discharge is considered in EPA's analysis under 40 CFR 125.122(a).

Under the draft permit, the TST statistical approach is used for this comparison based on statistical rigor. With any hypothesis testing statistical approach, there are two types of probability-based error rates – type I (α) and type II (β) – that guard the frequency of false results (decisions).[13] Both type I and type II errors (α, β) are not single values. Rather these long-run probabilities are functions of predictable, well-understood population parameters. For a toxicity laboratory's execution of a WET method, the frequency of false results for the NOEC and TST statistical approaches will differ according to the different factors for these parameters such as effect size, population variance, and sample size (n).

These relationships are best understood by studying figures in the TST Technical Document that depict the true toxicity of the sample – expressed as the ratio of the true mean in the sample to the true mean in the control (μ_T/μ_C) – verses the probability of declaring a sample toxic. High variability toxicity tests and low variability toxicity tests are plotted (using the population coefficient of variation) and compared.

Figure 1-1 in the TST Technical Document shows these relationships for the NOEC statistical approach, which incorporates an explicit regulatory management decision in the form of a WET methods error rate ($\alpha = 0.05$ when the true condition is $\mu_T/\mu_C = 1.0$), but does not directly address β. This figure shows how high rejection rates for environmental samples with acceptable toxicity (low PE) and low rejection rates for samples with unacceptable toxicity (high PE) occur under this approach. These rejection rates are made only worse by low variability toxicity tests (i.e., more precise) or high variability toxicity tests (i.e., less precise), respectively. These are undesirable qualities for choosing a hypothesis testing statistical approach to determine if the null hypothesis is rejected in favor of accepting the alternative hypothesis.

Figure 1-2 in the TST Technical Document shows these relationships for the TST statistical approach, which incorporates explicit regulatory management decisions

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[12] Type I error (α) is the error of rejecting the null hypothesis that should have been accepted. Type II (β) error is the error of accepting the null hypothesis that should have been rejected. For toxicity testing, the true population mean (μ) refers to the mean for a theoretical statistical population of results from indefinite repetition of toxicity tests on the same control water and sample (e.g., a 24-hour composite sample of effluent). For an individual toxicity test, there must be a statistical analysis to determine if the null hypothesis is rejected in favor of the alternative hypothesis—in other words, that the difference in the estimated sample means is real and not simply reflective of random variation among the tested organisms. *See* TST Technical Document, pages xxiii and 1-2.

[13] Please note that in relation to type I (α) and type II (β) error rates, the probability rates that provide the frequency of correct results are "1–α" and "1–β". Also, "1–β" is called "test power". Strictly speaking, type I and type II error rates are not equivalent to false positive and negative rates without further qualification about what effect size is important to the investigator; EPA's WET methods' target statistical error rate is 0.05 when the true size of the effect (Percent Effect, PE) is low (0% for NOEC statistical approach, 10% for TST statistical approach).

controlling false results in the form of: (1) a WET method-specific error rate for unacceptable toxicity ($\alpha = 0.05$[14] when the true condition is $b = \mu_T/\mu_C = 0.75$, i.e., a mean effect of 25%); and (2) a WET methods error rate for negligible toxicity ($\beta = 0.05$ when the true condition is $\mu_T/\mu_C = 0.90$, i.e., a mean effect of 10%). This figure shows how low rejection rates for samples with negligible toxicity and high rejection rates for samples with unacceptable toxicity occur under this approach. These rejection rates further improve as toxicity tests become less variable (i.e., more precise).

These are desirable qualities for choosing a hypothesis testing statistical approach to determine if the null hypothesis is rejected in favor of accepting the alternative hypothesis. In contrast to the NOEC statistical approach, the TST's explicit regulatory management decisions result in improved statistical rigor. *See* example in TST Technical Document section 3.4, Chronic *Haliotis rufescens* Larval Development Test, a WET method with a toxicity test experimental design (e.g., number of tested organisms, replicates) and measured biological endpoint similar to that for the Sea Urchin, *Strongylocentrotus purpuratus* and Sand Dollar, *Dendraster excentricus* Larval Development Test Method (EPA/600/R-95/136, 1995) required by this permit.

Both the 2010 TST Technical Document and previous analyses conducted by EPA have found comparable effect sizes for a given statistical power among similar experimental designs and test endpoints (page 9 of TST Technical Document). Therefore, the analyses conducted by Diamond et al. (2013) examining the side-by-side comparison of NOEC and TST results—using California toxicity test data, including data from POTW discharges, for *Haliotis rufescens* used in the red abalone larval development WET method and *Mytilus* species used in the Pacific Oyster, *Crassostrea gigas* and Mussel, *Mytilus* spp. Shell Development Test Method 1005.0—are relevant to this analysis. *See* Diamond D, Denton D, Roberts, J, Zheng L. 2013. Evaluation of the Test of Significant Toxicity for Determining the Toxicity of Effluents and Ambient Water Samples. *Environ Toxicol Chem* 32:1101-1108; and California State Water Resources Control Board. 2011. *Whole Effluent Toxicity Test Drive Analysis of the Test of Significant Toxicity (TST).* Sacramento, CA, USA.

These data indicate that while the TST and NOEC statistical approaches perform similarly most of the time, the TST performs better in identifying toxic (high PE) and nontoxic (low PE) samples, a desirable characteristic for this analysis. This examination also signals that such test methods' false positive rate (β no higher than 0.05 at a mean effect of 10%) and false negative rate (α no higher than 0.05 at a mean effect of 25%) are low.

[14] For example, the red abalone (*Haliotis rufescens*) larval development WET method.

Table 6. Summary of *Haliotis rufescens* larval development tests and *Mytilus* species shell development tests declared toxic and non-toxic regardless of percentage mean effect, those declared toxic with a percentage mean effect at the IWC <25% and ≤10%, and those declared nontoxic with a percentage mean effect at the IWC ≥25%. Numbers in parenthesis represent the percentage.

WET method	N (%) of tests declared nontoxic		N (%) of tests declared toxic		N (%) of tests declared toxic with <25% effect at IWC		N (%) of tests declared toxic with ≤10% effect at IWC		N (%) of tests declared nontoxic with ≥25% effect at IWC	
	TST	NOEC	TST	NOEC	TST	NOEC	TST	NOEC	TST	NOEC
Haliotis rufescens larval development	100 (85.5)	93 (79.5)	17 (14.5)	24 (20.5)	2 (2.0)	10 (9.8)	0 (0.0)	5 (5.2)	0 (0.0)	1 (6.6)
Mytilus species larval development	29 (100)	20 (69)	0 (0.0)	9 (31)	0 (0.0)	9 (31.0)	0 (0.0)	8 (28.6)	0 (0.0)	0 (0.0)

For discharges from the Oceanside Plant, EPA examined the side-by-side comparison of NOEC and TST statistical approaches along with the calculated percent effect at the IWC for years 2013 to 2018. (The chronic toxicity WQBEL in effect for this data is 150 TUc.) These results are presented in Table 7. For the 21 effluent WET tests, the percent effect ranged from -2.35 to 18.16. TUc results based on the NOEC ranged from 1 to 149.3 and a passing permit compliance determination is indicated for all test results. TST results indicate a permit compliance determination of "pass" (nontoxic) for all but one test result (December 2017), where one of five IWC replicates showed 9% development resulting in a "fail" result. These outcomes are similar to those shown by Diamond et al. (2013), where the NOEC and TST statistical approaches agreed most of the time (>92%).

Table 7. Comparison of the Oceanside Plant effluent toxicity test data with the NOEC and TST statistical approaches. Sea Urchin, *Strongylocentrotus purpuratus* and Sand Dollar, *Dendraster excentricus* Larval Development Test Method (EPA/600/R-95/136, 1995).

Test Date	Test Species	NOEC	TUc	TST (0.67% effluent)	% Effect at IWC = 0.67% effluent
February 2013	*S. purpuratus*	2	50	Pass	0.2
May 2013	*S. purpuratus*	2	50	Pass	0.64
July 2013 (PER)	*S. purpuratus*	2	50	Pass	4.6
November 2013	*S. purpuratus*	2	50	Pass	-0.41
January 2014	*S. purpuratus*	5	20	Pass	1.59
April 2014	*S. purpuratus*	5	20	Pass	-2.35
July 2014	*D. excentricus*	2	50	Pass	-7.32
October 2014	*S. purpuratus*	0.67	149.3	Pass	2.27
February 2015	*S. purpuratus*	2	50	Pass	-0.41
May 2015	*S. purpuratus*	2	50	Pass	0.23
August 2015	*D. excentricus*	2	50	Pass	-1.75
November 2015	*S. purpuratus*	2	50	Pass	-0.46
March 2016	*S. purpuratus*	2	50	Pass	2.14
June 2016	*S. purpuratus*	1	100	Pass	8.58

Test Date	Test Species	NOEC	TUc	TST (0.67% effluent)	% Effect at IWC = 0.67% effluent
August 2016	*D. excentricus*	2	50	Pass	4.13
November 2016	*S. purpuratus*	2	50	Pass	0.24
February 2017	*S. purpuratus*	2	50	Pass	0.83
May 2017	*S. purpuratus*	2	50	Pass	0.21
August 2017	*D. excentricus*	2	50	Pass	4.9
December 2017	*S. purpuratus*	2	50	Fail	18.16
February 2018	*S. purpuratus*	2	50	Pass	4.75

Significantly, Section III.F of the Ocean Plan provides for more stringent requirements if necessary to protect the designated beneficial uses of ocean waters. Together, these two comparisons (Tables 6 and 7) highlight that using the TST statistical approach in the draft permit – in conjunction with other Ocean Plan requirements (West Coast WET method/test species for monitoring and limiting chronic toxicity, the IWC representing the critical condition for water quality protection, the initial dilution procedure (Dm), and a single test for compliance) – provides increased assurance that type I (α) and type II (α) errors are more directly addressed and accounted for in decisions regarding chronic toxicity in the discharge. As a result, use of the TST for this discharge is in accordance with Ocean Plan section III.F and CWA section 403(c) and consistent with the Ocean Plan

H. Marine water quality criteria under CWA 304(a)(1) (factor 10)

EPA does not have chronic toxicity marine water quality criteria under CWA 304(a). However, EPA recommends a maximum magnitude to 25% reduction for measured biological endpoints, which was evaluated in *Section G. Other Factors Relating to Effects of the Discharge (Factor 9)*, above. Therefore, under this section, EPA is assessing the discharge of dioxins only.

EPA only has marine water quality criteria for 2,3,7,8 TCDD, which are 5.1E-09 ug/l for consumption of organisms only and 5.0E-09 ug/L for consumption of water and organisms. These recommended criteria are based on a carcinogenicity of 10^{-6} risk. The effluent did not contain any detectable amounts of 2,3,7,8 TCDD.

EPA also considered the California Ocean Plan water quality objective of TCDD equivalents in assessing unreasonable ocean degradation. The water quality criterion in the California Ocean Plan is 0.00039 pg/L for TCDD equivalents as a 30-day average. Following the procedures in the California Ocean Plan, the discharge did not have reasonable potential to cause or contribute to an exceedance of the TCDD equivalent objective.[15]

[15] The Regional Board modified the approach to calculating dioxins (and furans) toxic equivalents in 2010 by incorporating the use of bioaccumulation equivalency factors in additional to toxicity equivalency factors. This modification was a result of a 2008 expert panel that included EPA, Regional Board, SFEI, and Bay Area Clean Water Agencies. This modified approach was adopted by their Board in 2010 and applies to all dischargers within the San Francisco Region.

III. CONCLUSION

EPA has determined that the discharge's toxicity and the discharge of dioxins would comply with 10 criteria listed at 40 C.F.R. 125.122. Moreover, under 40 CFR 125.122(b), the proposed discharges meet the remaining State water quality standards, leading to a "rebuttable presumption" of no unreasonable degradation of the marine environment. Therefore, the discharges authorized by the draft NPDES permit will not cause unreasonable degradation of the marine environment.

EPA recognizes that bioaccumulative pollutants in the discharge, such as dioxins, are of concern and that fishing occurs in receiving water. As a result, the draft permit contains specific receiving water monitoring and effluent monitoring requirements designed to detect environmental impacts related to the discharge. For dioxins and chronic toxicity, the City is required to monitor annually and quarterly, respectively. Based on the conditions, limitations, and requirements contained in the draft NPDES permit, EPA has determined that the discharges authorized by the draft permit will not result in unreasonable degradation of the marine environment.