Appendix D

Responses to Comments

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SITE-SPECIFIC WATER QUALITY OBJECTIVES FOR CYANIDE in SAN FRANCISCO BAY

Responses to Comments

California Regional Water Quality Control Board
San Francisco Bay Region

December 4, 2006

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I. RESPONSES TO WRITTEN COMMENTS ON AUGUST 18, 2006 STAFF REPORT AND DRAFT BASIN PLAN AMENDMENT

On August 18, 2006, the San Francisco Bay Water Board released, for public review and comment, the Staff Report on proposed site-specific objectives for cyanide for San Francisco Bay. We received eleven comment letters during the public review period that closed on October 2, 2006.

Comment Letters Received:

1. US Environmental Protection Agency, Region IX
2. Bay Area Clean Water Agencies (BACWA)
3. Central Contra Costa Sanitary District (CCCSD)
4. California Association of Sanitation Agencies (CASA) and Tri-TAC - joint letter
5. City of Palo Alto Public Works Department
6. Delta Diablo Sanitation District (DDSD)
7. City of Sunnyvale
8. Vallejo Sanitation and Flood Control District
9. San Francisco Public Utilities Commission (SFPUC)
10. South Bayside System Authority (SBSA)
11. City of San Jose Environmental Services Department

1. Comment Letter No. 1 received from US Environmental Protection Agency, Region IX, Douglas E. Eberhardt, September 29, 2006

<u>Comment No. 1.1:</u> "It is our understanding that the marine site-specific objectives that were developed for Puget Sound and incorporated into the draft Basin Plan amendment for San Francisco Bay were developed consistent with EPA methods, and we believe they are protective of the beneficial uses in the Basin Plan for San Francisco Bay."

Comment noted.

<u>Comment No. 1.2:</u> "We are still concerned that this proposal could jeopardize beneficial uses within the mixing zones. The calculated mixing zone surface areas are quite extensive for most of the shallow water dischargers, and range from a median of 4.2 acres to the largest mixing zones for San Jose and Hayward Marsh of 41 acres. …. we are concerned that given the extent of the mixing zones, aquatic organisms including swimming fish as well as drifting and sessile organisms are likely to live out their lives within the mixing zones. The chronic objectives were developed to protect organisms from chronic effects on a frequency of an average of four days once every three years. This proposal, however, would allow exceedences of the chronic objectives at all times within the mixing zones."

In response to this comment, Board Staff reevaluated the mixing zones associated with each shallow water discharger. The mixing zones for American Canyon, Fairfield Suisun Sewer

District, Hayward Marsh, Napa SD, City of Petaluma, City of San Jose/Santa Clara and Sonoma County Water Agency have been revised in accordance with the Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays and Estuaries of California (SIP) to make them as small as practicable. The resulting mixing zones vary in size from 0.1 acre to 19.8 acres and have a median size of 0.8 acre. The revisions are based on a reevaluation of existing data, new information provided by the dischargers, and high resolution satellite imagery data making it possible to more accurately estimate surface areas of the proposed mixing zones. Changes in the Staff Report that reflect the revised mixing zones have been made to Table 21, Appendix D *Spatial Descriptions of Effluent Attenuation* and include the addition of a new Table in Staff Report Appendix J *Basin Plan and SIP Requirements for Approval of Dilution Credit for Shallow Water Dischargers*.

The new Appendix J Table 1 is provided below:

Table 1: Description of mixing zone studies and dimensions to establish dilution credits for shallow water dischargers in San Francisco Bay.

Discharger	Immediate Receiving Water Body [a]	Study Type	Mixing Zone Area	Receiving Water Area	Description
			(acres)		
American Canyon	North Slough	Monitoring	0.3	32	Dead-end slough to Napa River (estuarine)
Fairfield Suisun Sewer District	Boynton Slough	Monitoring/ Modeling	3.5	35	Dead-end slough to Suisun Slough/ Marsh
Hayward Marsh[b]	Hayward Marsh	Modeling	6.2	40	Wetlands (man-made dead-end system) to Lower San Francisco Bay
Las Gallinas	Miller Creek	Monitoring	1.0	8	Minor tributary to San Pablo Bay
Mt. View SD	McNabney Marsh/ Peyton Slough	Monitoring	0.1	135	Dead-end slough to Carquinez Strait
Napa SD[c]	Napa River (estuarine)	Monitoring/ Modeling	0.4	Less than half river width	Major tributary to San Pablo Bay
Novato SD	San Pablo Bay	Modeling	0.1	57600	950 feet off shore
City of Palo Alto	Man-made channel	Modeling	4.2	5.2	Dead-end channel to South San Francisco Bay
City of Petaluma	Petaluma River (estuarine)	Modeling	0.8	Less than half river width	Minor tributary to San Pablo Bay
City of San Jose/ Santa Clara	Artesian Slough	Monitoring	19.8	60	Dead-end slough to Coyote Creek (major tributary), South San Francisco Bay
Sonoma County Water Agency	Schell Slough	Monitoring/ Modeling	0.2	6.4	Dead-end slough San Pablo Bay
City of Sunnyvale	Moffett Channel	Monitoring	5.8	8.3	Highly modified channel to Guadalupe Slough (Minor tributary), South San Francisco Bay
USS Posco	New York Slough	Modeling	0.2	265	Dredged slough channel to Suisun Bay

[a] The estimated mixing zone does not extend beyond the water body where the effluent outfall is located. For example for Fairfield Suisun SD the mixing zone is 3.5 acres and Boynton Slough channel is 35 acres.

[b] This area represents the approximate total surface area of mixing channels that drain the marsh before discharging the excess treated effluent to Lower San Francisco Bay.

[c] The extent of the mixing zone is estimated based on a Mixing Zone Study Report (2006) submitted to the Water Board in August 2006.

The reevaluation of the mixing zones causes a reduction in the proposed dilution credit for the City of San Jose/Santa Clara. Table 4-7 in the proposed Basin Plan amendment has been modified to reflect a dilution credit of 3:1 for the City of San Jose/Santa Clara rather than 3.25:1.

In addition, exceedences of the chronic objective are expected to occur rarely, if at all, within the mixing zones and beneficial uses are not expected to be adversely impacted. An analysis of the receiving water data collected near the outfalls of shallow water dischargers indicates that about 95 percent of samples are below the chronic objective of 2.9 µg/L (Figure 1).

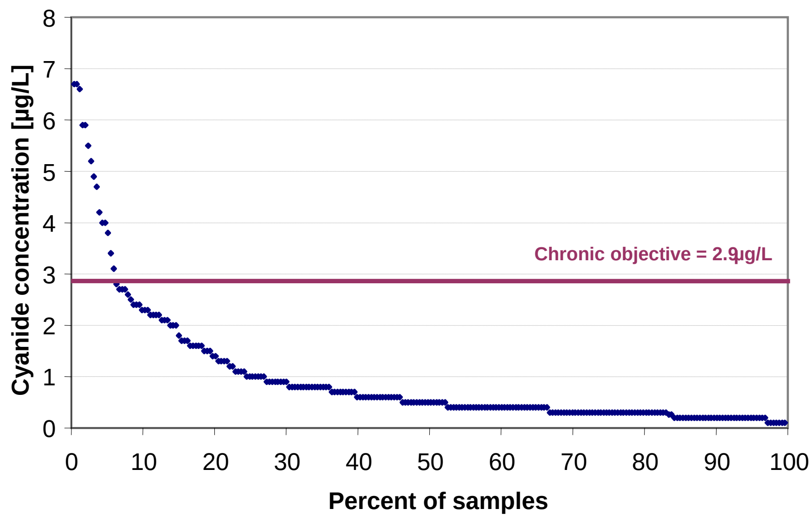


Figure 1: Frequency Distribution of Cyanide in Receiving Waters near Shallow Water Discharges [*May 2004 data point excluded*]

The receiving water samples above the chronic objective are based on one-time grab samples and are not expected to be sustained for a four day period of time, the applicable duration of the chronic objective. In other words, the magnitude and duration of the exceedances are expected to be limited. This is supported by observations that higher effluent concentrations, ranging from 13 to 31 µg/L, diminish rapidly and are reduced to levels below the analytical detection limit within 2 to 3 days. Similarly, periodic spikes of cyanide in the effluent resulting from illegal releases into the discharger collection system are generally not sustained over a 96 hour time period. Data collected during the City of San Jose Study in May 2004 identified a high effluent concentration of 62 µg/L of total cyanide that was later tracked to an illegal discharge to the wastewater system. The effluent concentration decreased to 7.4 µg/L on the following day and was below the chronic objective of 2.9 µg/L within 3 days from the date it was first detected. Total cyanide measured in the receiving water at station SB13 at the confluence of Artesian Slough with Coyote Creek on the first day this incident took place, was 7.2 µg/L. Similar higher magnitude cyanide losses depending on the initial concentration of cyanide were reported by WERF researchers in their constructed wetland experiment (WERF 2003).

Additional discussion about protection of beneficial uses within the mixing zones was added to the Staff Report Appendix J *Basin Plan and SIP Requirements for Approval of Dilution Credit for Shallow Water Dischargers*. The revised Appendix J is presented at the end of this document.

Comment No. 1.3: "the staff report does not demonstrate the extent of the degradation of cyanide in Bay waters to "harmless by-products." In fact, the staff report's discussion of uncertainties surrounding industrial inputs of thiocyanate (page 5-34) underscores the need for a better understanding of the various cyanide-containing compounds that may not be accounted for in a total cyanide analysis. …. many of the by-products may not be harmless, and cyanide may potentially be adhering to sediment that is settling in the benthic zone.

Staff's understanding (Ghosh et al., 2006a, Dzombak et al., 2006a) is that cyanide in wastewater and surface waters is usually found in free and complexed forms. Free cyanide, mainly hydrogen cyanide HCN, is the most reactive and primary toxic form in the aquatic environment (Gensemer et al., 2006). Free cyanide in the environment is oxidized rapidly by bacteria. Under most environmental conditions, free cyanide degrades to CO_2 and ammonia. Most complexed forms are metal-cyanide complexes and due to the high affinity of the cyanide ion for iron, most are iron complexes. It is possible for these forms of cyanide to dissociate upon exposure to light; the resulting free cyanide biodegrades or is volatilized rapidly. Thiocyanate is a relatively nontoxic form of cyanide and is not as common a cyanide contaminant as the free cyanide species and metal-cyanide complexes. Bacteria are capable of degrading cyanide in all three of these forms, as free cyanide, metal-cyanide complexes and thiocyanate. Bacteria degrade these compounds to detoxify cyanide and ultimately convert it to carbon and nitrogen in a form that can be used by the bacteria (Ebbs, 2006). Additional information regarding the cycling of cyanide in the environment is provided in the response to Board Member Margaret Bruce's question in section 2 below.

Ghosh et al. (2006b) identifies species of cyanide, other than thiocyanate, that are not captured in the conventional total cyanide test; they include cyanate, CNO^-, and cyanogen halides such as cyanogen chloride. However, these forms of cyanide are rarely formed under environmental conditions.

Staff is not aware of concerns regarding cyanide sorbing to sediment and accumulating in bedded sediments. According to Ghosh et al. (2006c), free cyanide adsorbs weakly onto soils and sediments.

Comment No. 1.4: "It is unclear whether the SIP requirements (page 15) for mixing zones have been met for all the mixing zones proposed. The SIP requires that each discharger complete an "independent mixing zone study" and that the mixing zone shall not "adversely impact biologically sensitive or critical habitats, including, but not limited to, habitat of species listed under federal or State endangered species laws." Additionally the SIP requires that the mixing zone not dominate the receiving water body. In the case of many of these discharges, the receiving water body is a slough tributary to the Bay, not the entire Bay.

In response to this comment, staff is providing additional analyses in Appendix J *Basin Plan and SIP Requirements for Approval of Dilution Credit for Shallow Water Dischargers*. The revised

Appendix J is presented at the end of this document. Some minor editorial changes that staff has made during the revision of Appendix J are also shown in strikethrough/underline throughout the text.

Comment No. 1.5: "To evaluate the overall acceptability of mixing zones, EPA's *Technical Support Document for Water Quality-based Toxics Control* suggests the use of a multi-step procedure, described in an EPA document entitled *Allocated Impact Zones for Areas of Non-Compliance.* (EPA 823-R-95-003) To determine whether the proposed mixing zones are appropriate, ecosystem information and other considerations as discussed in the EPA's *Allocated Impact Zones for Areas of Non-Compliance* (EPA 823-R-95-003) should be analyzed and discussed in the staff report.

Board Staff has reviewed the documents referenced in the comment. Staff is of the opinion that compliance with the SIP is sufficient to address the recommendations in these US EPA documents.

Comment No. 1.6: … "EPA believes that mixing zones proposed in this document contain critical habitat areas for the threatened Central California Coastal steelhead and the endangered delta smelt. The staff report does not provide information regarding the behavior of these federally-listed species within the mixing zones, and whether exceedances of the chronic cyanide SSO will impact these species. At a minimum, the staff report should provide information for each discharge that explains with the SIP requirement under 1.4.2.2.A, that a mixing zone shall <u>not</u> (3) restrict the passage of aquatic life, and (4) adversely impact biologically sensitive or critical habitats, including but not limited to, habitat of species listed under federal or State endangered species laws. This analysis is required by the SIP, but will also be critical to EPA's Endangered Species Act (ESA) consultation obligations."

Additional information is now included in Appendix J, *Basin Plan and SIP Requirements for Approval of Dilution Credit for Shallow Water Dischargers (see pages 29-32),* to respond to this comment. The revised Appendix J is presented at the end of this document.

In addition a new Section 6.1.6 has been added to the Staff Report to provide more detail about those shallow water dischargers that discharge to critical habitat areas for threatened steelhead and Delta smelt, the behavior of these federally-listed species, and possible implications of the proposed mixing zones in these designated habitats. U.S. EPA provided staff with references to critical habitat maps for Delta smelt and steelhead. These maps have been modified by Board Staff and are included as Figure 2 below.

6.1.6 <u>Consideration of Critical Habitat for Listed Species</u>

<u>The SIP requires that mixing zones shall not adversely impact biologically sensitive or critical habitats. Analysis of the outfall location (Figure 2) for each</u>

shallow water discharger indicates that six out of thirteen dischargers currently discharge effluent to waters that have been listed as critical habitat areas for Delta smelt (*Hypomesus transpacificus*) or steelhead (*Oncorhynchus mykiss*). These dischargers include five municipal wastewater dischargers: Fairfield Suisun Sewer District (FSSD), Napa Sanitation District (Napa SD), Petaluma, Las Gallinas and Sonoma Valley SD, and one industrial discharger: USS Posco.

Delta Smelt

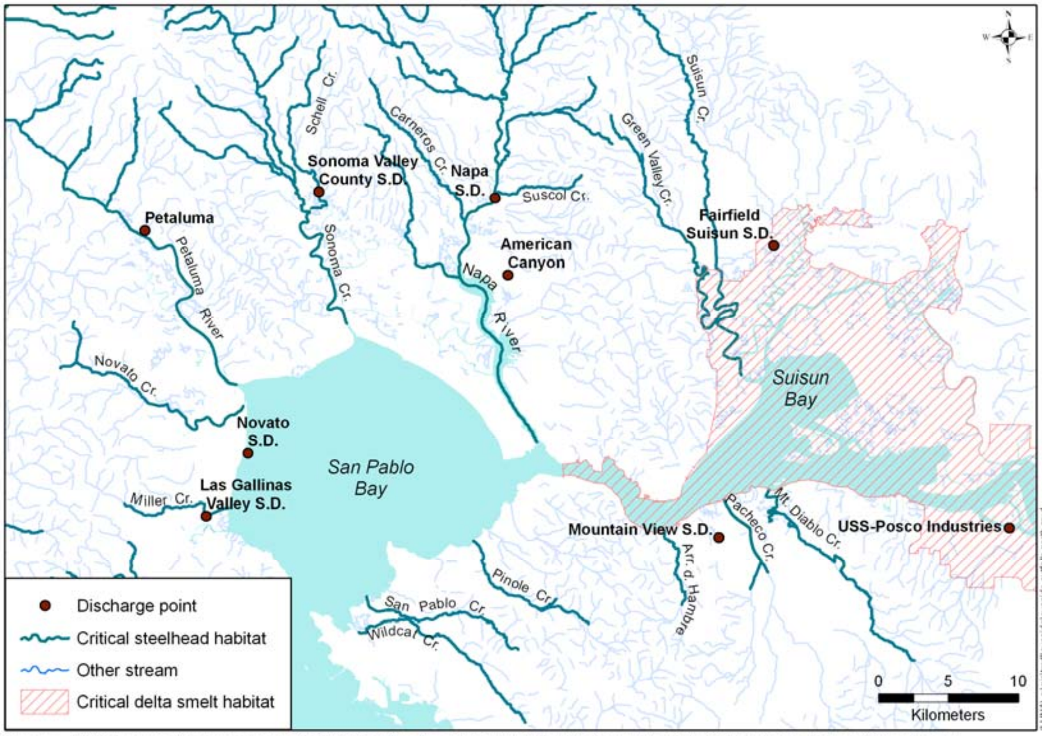
FSSD and USS Posco have their outfalls located at the northern and southern edges of the area designated as critical habitat for Delta smelt (Figure2).

The Delta smelt (*Hypomesus transpacificus*) is a small native fish restricted to a narrow margin of low salinity habitat and spends much of its one year long life near the confluence of the Sacramento and San Joaquin rivers. In 1993, the US Fish and Wildlife Service and the California Fish and Game Commission listed the Delta smelt as threatened pursuant to the federal and state endangered species acts. Since then, the amount of new information on Delta smelt biology and ecology has increased significantly and all the recent scientific knowledge was critically reviewed and synthesized by Bennett in Critical Assessment of the Delta Smelt Population (2005). No information exists on the Delta smelt's sensitivity to cyanide.

Delta smelt spawning areas are restricted to the Delta and the freshwater reaches of the San Francisco Estuary (FWS, 2004). The extent to which Delta smelt distribution varies from year to year is not well understood. Little is known about the spawning microhabitat for Delta smelt or the actual spawning locations. The latter are usually inferred from the catches of very young larvae and fish. Fertilization and hatching success are extremely variable and most markedly constrained by water temperature. It has been observed that abundance of Delta smelt is elevated only in years when the low salinity zone is located within Suisun Bay, when a delicate balance between freshwater flows due to rainfall and water diversion is maintained. Although Delta smelt could be widely dispersed throughout Suisun Bay, it appears that northern Suisun Bay and adjoining shallows provide more favorable habitat for smelt than the deeper Ship channel to the south (Bennett, 2005).

The northernmost edges of Suisun Marsh and New York Slough, in the vicinity of FSSD and USS Posco, have not been identified as hatching habitat. The mixing zones for cyanide established for these two wastewater treatment facilities are not expected to adversely impact the Delta smelt.

<u>**Figure 2: Wastewater Outfalls Near Designated Critical Habitat Areas**</u>



Sources: NPDES permits (discharge points); NOAA/CalFish (steelhead habitat); US FWS (delta smelt habitat); Nat'l. Hydrologic Dataset (Other streams)
Date: October 22, 2006 Editor: J. Kapellas, SF Bay Regional Water Quality Control Board

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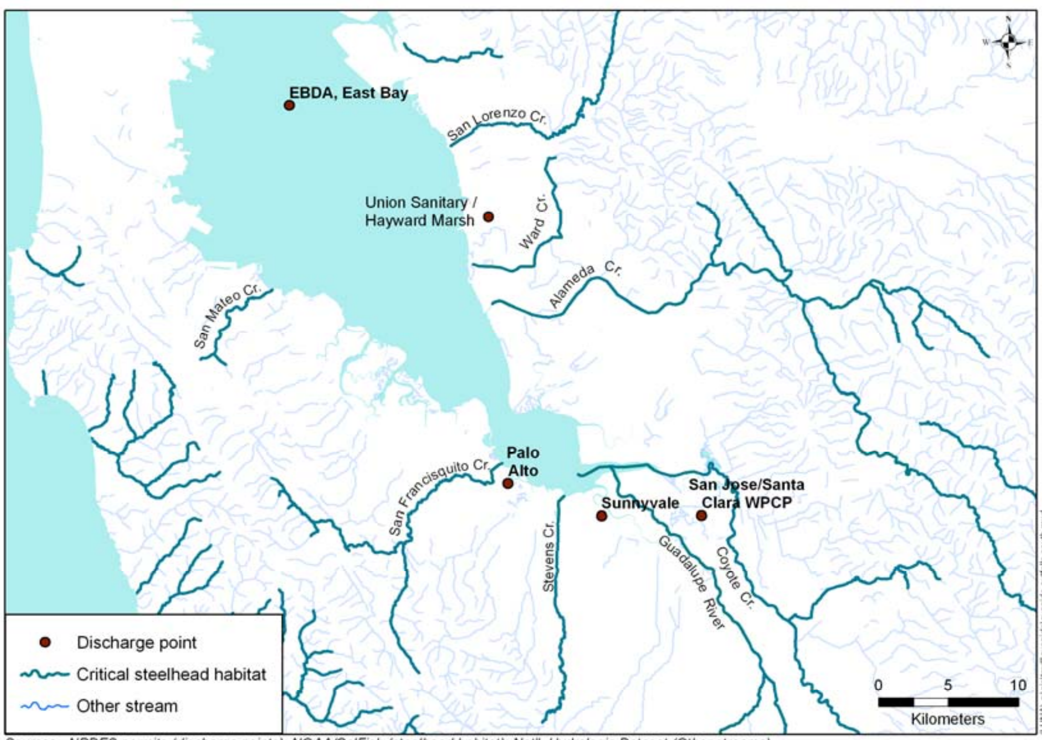

Sources: NPDES permits (discharge points); NOAA/CalFish (steelhead habitat); Nat'l. Hydrologic Dataset (Other streams)
Date: November 2, 2006 Editor: J. Kapellas, SF Bay Regional Water Quality Control Board

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Steelhead Rainbow Trout

Napa River, Miller Creek, Petaluma River and Schell Creek/Schell Slough are designated as a critical habitat for steelhead (*Oncorhynchus mykiss*), listed as threatened under the Endangered Species Act. The Napa, Las Gallinas, Sonoma and Petaluma Sanitation Districts discharge treated effluent to these designated rivers and creeks (Figure 2).

Steelhead is the anadromous form of rainbow trout found in coastal drainages south and north of San Francisco. Their ecological requirements are similar to those of Pacific Salmon; however, they exhibit larger variability in terms of migration and spawning habits. Generally steelhead spend most of their lives in the ocean and return to freshwater as mature fish (CDFG, 2001). The San Francisco Estuary and its tributaries are known for so called "winter steelhead" that typically begin their spawning migration in the fall and winter and spawn within a period of weeks to months from the time they enter freshwater. The spawning requires cool, well-oxygenated waters and mostly occurs from December through April (Goals Project, 2000) in the upper reaches of small tributaries where these conditions are sustained year-round. It has been shown (CDFG, 2001) that water temperature is a critical factor for steelhead as egg mortality begins to occur at 13 ^{o}C and thermal stress is evident at temperatures approaching 18 ^{o}C. At the same time studies of population structure demonstrate that steelhead exhibit extreme adaptive capacity allowing populations to persist in varying climatic, hydrologic and limnological conditions.

Leidy, et al. (2005), investigated historical distribution and current status of steelhead in the San Francisco Estuary. They found that steelhead runs, of undetermined size, were known to exist in Miller Creek and in the upstream part of Napa River and its tributary streams with the exception of the headwaters of the river above Kimball Canyon Dam that forms a complete barrier to upstream fish migration. While Petaluma River was noted as a historical migration route and "lightly used" steelhead habitat in 1962, no steelhead or other salmonids were observed there during subsequent surveys. Schell Creek was also cited as a migratory corridor only and no steelhead were found there during more recent surveys. An extensive monitoring program of the restored and created habitat in the vicinity of Napa City (Stillwater Sciences, 2006) indicated insignificant capture rates (7 in 3 years) for steelhead in the project area. Steelhead inhabited Miller Creek historically, and were found consistently during surveys in 1981, 1993 and 1997. All these surveys were conducted upstream from Hwy. 101, above the Las Gallinas outfall, which is located approximately 1 mile west from San Pablo Bay.

All shallow water discharger outfalls are located at considerable distance from the suitable spawning and rearing areas for steelhead. Their locations are tidally influenced within the lower reaches of the water bodies, where the subsequent river systems have been highly modified due to flood management, urbanization and agricultural development. To limit any possible adverse impacts on the environment and sensitive biological species, effluent discharge is only allowed during the wet weather season, from November through May, when watershed runoff and upstream inflows provide substantial volumes of freshwater. The monitoring of receiving water quality near each of the outfalls and along the discharge gradient confirms that cyanide concentrations at these critical areas are consistently low. The concentrations measured at the outfall for all four dischargers vary from 1.5 to 2. 9 μg/L and never exceeded the proposed chronic objective for cyanide of 2.9 μg/L. This together with relatively small effluent volumes and the timing restrictions suggests that the proposed mixing zones would not cause any adverse impact on steelhead or any other sensitive biological habitats.

Comment 1.6: "We do not understand the discrepancy between some outfall levels in Appendix D and the mean and maximum concentrations in Table 2 of Appendix C (i.e. for Fairfield-Suisun Sewer District)."

The timeframes for the data represented in the two Appendices are different, and therefore, there is no discrepancy. Table 2 in Appendix C reports the descriptive statistics for effluent cyanide concentrations for 2000-2004; there were 101 effluent samples collected for Fairfield-Suisun Sewer District during this timeframe. Appendix D represents limited effluent cyanide samples analyzed as part of the shallow-water dischargers' studies. Appendix D has been revised (see response to US EPA Comment No. 1.2) to include a revised Table for the Fairfield-Suisun Sewer District. Effluent concentrations used by the Fairfield-Suisun Sewer District to compute cyanide attenuation downstream from their outfall have been revised using actual measured concentrations from the more recent time period of 2003 to 2006, representing 71 samples.

Comment Letter No. 2, Bay Area Clean Water Agencies (BACWA), Michele M. Pla, Executive Director, October 2, 2006

Comment 2.1: "It is our expectation that improvement in analytical methodology will result in the speciation of chemical substances so that the actual composition of cyanide species in wastewater effluent can be determined in the future. It is fair to say that not all the cyanide that is discharged by the clean water agencies is free cyanide. Free cyanide is the most toxic form. The lack of analytical tools that allow for speciation of cyanide has led the Water Board to the conservative assumption that all in wastewater effluent is free cyanide."

Staff concurs with the comment and will continue to work with the State Board and BACWA to review and evaluate improved analytical methods for cyanide.

Comment 2.2 (echoed in Comment Letter Nos. 6 Delta Diablo Sanitation District, 7 City of Sunnyvale, 9 San Francisco Public Utilities Commission, 10 South Bayside System Authority, and 11 City of San Jose Environmental Services Department): The mandatory effluent limits proposed in the Basin Plan may lead to program inefficiencies in the future as the clean water agencies will utilize resources to meet regulatory program requirements regardless of their overall impact toward pollution prevention and water quality restoration. BACWA encourages the Water Board to include a program evaluation component into their Basin Plan language which will require an adaptive management review and evaluation of this standard and the implementation after 10 years. The purpose is to evaluate the effectiveness of these requirements and to determine if there is new scientific or water quality information which could support revisions to this site specific objective."

We acknowledge the clean water agencies' continued efforts toward pollution prevention and restoration of water quality in San Francisco Bay. However, permit effluent limits are an effective tool for maintaining the water quality of San Francisco Bay. Therefore, the inclusion in the proposed Basin Plan amendment of a provision to review and evaluate effluent management requirements after 10 years is not supported by staff. The triennial review conducted by the Water Board provides an opportunity to identify and address any issues related to the implementation programs in the Basin Plan.

Comment Letter Nos. 3 through 11: These letters were favorable to the proposed site-specific objectives for cyanide, the Basin Plan amendment and the use of dilution credits in the calculation of effluent limits.

Comment Noted.

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II. RESPONSES TO ISSUES RAISED AT THE OCTOBER 11, 2006 PUBLIC HEARING

Michele Pla, representing BACWA, presented oral comments at the October 11, 2006 Water Board testimony hearing. The comments raised by Ms. Pla are addressed in the previous section. Below we summarize and respond to questions raised by Board members.

Board Member Mr. Eliahu asked "How do you calculate the dilution credit? and How do you know how much water is going to go in there in that water(sic) body?"

The dilution credits have been established in accordance with the SIP. The SIP defines a dilution credit as "the amount of dilution granted to a discharge in the calculation of water quality-based effluent limitations, based on the allowance of a specified mixing zone. It is calculated from the dilution ratio, or determined through conducting a mixing zone study or modeling of the discharge and receiving water." For incompletely – mixed discharges, such as the shallow water discharges defined in our Staff Report, the SIP also specifies the type of studies that could be used to determine dilution credits and mixing zones (e.g. tracer studies, dye studies, modeling studies and monitoring upstream and downstream of the discharge). These studies sometimes do not explicitly estimate the volume of inflow water available to dilute the effluent that is discharged into receiving waters. This is particularly true in the estuarine environment where dilution occurs as a result of tidal mixing and turbulent diffusion.

Each shallow water discharger performed either a monitoring study that measured concentrations of cyanide in receiving waters, upstream and downstream of the effluent discharge point and along the discharge gradient, or a mathematical modeling study. Rapidly diminishing concentrations of cyanide observed along the discharge gradients provide a means of estimating dilution from empirical data. An example of the details of this monitoring approach conducted by the City of San Jose is discussed in Appendix K of the Staff Report.

Dilution analysis using mathematical modeling is usually performed in two steps. Step one involves development of a hydrodynamic model for the portion of the Bay affected by the specific discharger. This model computes spatial and temporal fluid velocities and water depths that are a necessary input to the water quality model developed as step two of a mixing zone study. Dilution of effluent discharge could also be simulated, using for example a conservative tracer, and then expressed as percent of wastewater versus Bay waters. Appendix E in the Staff Report summarizes three modeling approaches undertaken by dischargers that are representative of different hydrodynamic and environmental conditions within the Bay.

These monitoring and modeling studies helped determine the degree to which cyanide attenuates in the receiving waters near shallow water discharges due to dilution, tidal mixing and natural degradation. A multi-step analysis was then conducted to assign each discharger with a dilution credit that is protective of beneficial uses and conforms to the Basin Plan and the SIP.

In response to this question from Board Member Eliahu, a footnote has also been added to Table 4-7 of the Basin Plan amendment, page A-6, to express more clearly the meaning of the dilution credit assigned for each shallow water discharger. That footnote reads as follows: "The dilution credit is expressed as the ratio of total parts mixed (effluent and receiving waters) to one part of effluent."

Board Member Ms. Bruce asked "As monitoring technologies and the analytical science has evolved, have we determined whether or not cyanide compounds are actually created in the aquatic environment like methylmercury …"

There is no available evidence to suggest that cyanide compounds are created in the aquatic environment. There is evidence that cyanide is produced naturally in the environment in very small quantities (at levels of nano-moles) by various bacteria, algae and fungi, but no information is available specifically about the marine environment.

Numerous species of plants including beans, fruits, nuts and grains produce cyanide compounds as a chemical defense mechanism against herbivores (Wong-Chong et al., 2006). Among all natural sources of cyanide, incomplete combustion during forest fires is considered a major environmental source of cyanide in the atmosphere. Biomass burning from natural and manmade activities is estimated to contribute approximately 2.9×10^{12} g of HCN (expressed as N) per year to ocean waters (Dzombak et al., 2006b). Yet, despite this release of cyanide which translates into an open ocean concentration of 8 μg/L, there is no evidence of cyanide accumulation; in fact, measured concentrations are considerably below 1 μg/L. The fact that there is no accumulation of cyanide is because plants and microbes use cyanide as a source of nitrogen or incorporate cyanide into their metabolic system and subsequently even anthropogenic cyanide associated with wastewater discharges becomes part of the natural cycle, where cyanide is recycled through the combination of physical, chemical and biological processes.

III. RESPONSES TO PEER REVIEW COMMENTS ON MAY 5, 2005 AND NOVEMBER 10, 2005 STAFF REPORTS AND BASIN PLAN AMENDMENTS

Professor David Sedlak from University of California, Berkeley provided independent scientific review of the technical basis for updated cyanide objectives for San Francisco Bay described in May 09, 2006 Staff Report. The revised Staff Report that was released for public review and comment on August 18, 2006 included changes resulting from the comments made by Prof. Sedlak, as well as additional amendments to the text that improved and clarified the content of the Report. Professor John Dracup from University of California, Berkeley provided additional independent scientific review of the revised Staff Report dated November 10, 2005.

1. Scientific Peer Review Comment No. 1 Professor David Sedlak, dated June 16, 2005

Peer Review Comment 1.1: Prof. Sedlak provided positive feedback on the methods used to develop marine site-specific objectives for cyanide on the basis that "the approach used to recalculate the criteria has undergone peer review by one of the top scientific journals in the field of ecotoxicology (i.e., Environmental Toxicology and Chemistry) and has been adopted by the State of Washington for Puget Sound."

Comment Noted.

Peer Review Comment 1.2: The approach employs data on cyanide concentrations measured near the discharge points of wastewater treatment plants to account for the effects of dilution and transformation on cyanide concentrations. While I believe that the approach of using attenuation factors may have merit in this situation, I found the documentation of the attenuation factors included in the report to be inadequate. The explanation of the data and methods used for arriving at the specific values to be employed was unclear and the documentation needed to assess the quality of the science used to arrive at the values was not included in the report or the appendix.

We have made significant changes in the August 18, 2006 Staff Report to better explain the scientific basis of the attenuation analysis. An appendix to the report was added, Appendix K *Cyanide Attenuation and Dilution Studies*, that provides the rationale used to derive the information in Appendix D, *Spatial Descriptions of Effluent Attenuation* together with a comparison of results from the attenuation analysis and a dilution dye experiment. Appendices B *Ambient Cyanide Data* and D have been updated to include the raw data (n=322 for San Jose and other shallow water dischargers) used to arrive at the attenuation values. Information about analytical method is included as Appendix L *City of San Jose Modified Analytical Methods for Total Cyanide* for the methodology developed by the City of San Jose.

Peer Comment No. 1.3: There is no explanation of why the concentrations increased between the [City of San Jose's] outfall and the first two observation points.

Appendix K contains the following explanation as to why higher concentrations of cyanide were observed in the receiving waters than in the effluent on the same day. The final effluent sample is taken at the head of the effluent discharge channel; SB15 is located 790 meters downstream at the overflow weir from the discharge channel. In most instances, these samples were taken on the same day in the same 40 minute time period. Therefore, differences in concentration between these two effluent samples (which are essentially field duplicates) are attributable to analytical variability and short-term minor variability in effluent quality. In instances where samples were taken one day apart, apparent increases in cyanide concentration at downstream locations were likely the result of day-to-day variations in effluent cyanide concentrations in addition to analytical and short-term variability. For the period November 2003 to June 2004, when samples were collected at all three locations, the median cyanide concentrations were 2.9 μg/L in final effluent, 3.0 μg/L at SB15 and 2.5 μg/L at SB14. In the calculation of attenuation factor values, final effluent concentrations (rather than the slightly higher SB15 concentrations) were used.

Peer Review Comment 1.4: The main scientific justification for using attenuation factors in lieu of dilution is that cyanide degrades in surface waters. The information provided in Appendix D cannot be used to assess the validity of this supposition because there has not been an attempt to discriminate between dilution and attenuation. Without some data to indicate that the concentrations decrease through some factor other than dilution, the attenuation factors seem like an alternative way of estimating dilution from empirical data. I doubt that the SFRWQCB would use this approach for a compound that is known not to degrade in surface waters. Therefore, it seems like the report needs to address the issue of degradation more directly.

The Staff Report has been revised to define attenuation of cyanide as a combination of dilution, tidal mixing and natural degradation. It is effectively equivalent to dilution since, in both cases, the cyanide concentration in the receiving water diminishes with distance from the discharge location. Observations made during the City of San Jose study suggest that attenuation may be dependent upon the magnitude of the discharged cyanide. WERF (2003) found that cyanide removal rates in a constructed wetland had "some first-order character. That is, influent with a high concentration of cyanide experienced a relatively rapid cyanide loss whereas low influent cyanide concentrations exhibited a lower loss rate." This observed effect of the fate of cyanide in receiving waters is significantly greater than dilution alone. The factors involved in "attenuation" (e.g. microbial degradation, volatilization) add to our understanding of the fate of cyanide in receiving waters. Thus, while attenuation is a better conceptual model for the fate of cyanide than is dilution alone, an attenuation model does not preclude the ultimate simplification and use of the model as dilution to quantitatively apply an appropriate factor for development of effluent limits, as was done in the Staff Report.

Peer Review Comment 1.5: I presume that somewhere there is a report that provides more detail on the data included in Appendix D. I believe that this report would be strengthened considerably if such information were included in the appendix or in the main body of the report. In particular, I would like to see more information on the data used to generate attenuation factors in appendix D, the sampling program design and results (e.g., methods, sample types, actual data and not medians), the expected dilution at each sampling site based on hydrologic modeling and tracer studies, interpretation of uncertainty in data and estimated attenuation factors.

As noted in our response to Peer Review Comment 1.2, the additional details are provided in Appendix B, K and L, describing the approach, analytical method and data used by each shallow water discharger to determine the degree of cyanide attenuation. Each discharger performed either a monitoring study or a mathematical modeling of flow and water quality to assess levels of cyanide attenuation in the vicinity of effluent outfall. Mathematical modeling methodology demonstrating dilution characteristics for three different types of shallow water dischargers is presented in Appendix E.

Peer Review Comment No. 1.6: Page 1-5, second sentence: "…are typically undetected at concentrations far below levels…" This sentence is confusing. I think the authors mean that cyanide is not detected even using methods with detection limits below levels that cause toxicity to marine organisms. Can the sentence be reworded?

The confusing sentence was removed from the Staff Report.

Peer Review Comment No. 1.7: Page 3-12: second sentence. At pH 8.5 HCN accounts for about 90% of the free cyanide. This sentence implies all of the free cyanide is protonated rather than most of the free cyanide.

The sentence was corrected to read "In natural waters in the pH range from 6.5 to 8.5, free cyanide is typically present in the hydrogen cyanide form (HCN)."

Peer Review Comment No. 1.8: Page 1-5, last paragraph: Thiocyanate has a negative charge (SCN^-)

Comment Noted.

Peer Review Comment No. 1.9: Page 3-14: Table 2: AMEL and MDEL are never defined. Also, it would be easier if there were a page break and the whole table was placed on one page.

Definitions of the AMEL and MDEL were added.

Peer Review Comment No. 1.10: Page 3-22: What is "organically complexed cyanide"? How does an anion form a complex with an organic compound?

This incorrect statement was removed from the Staff Report.

Peer Review Comment No. 1.11: Page 4-37; fourth full paragraph: "disinfectants" is missing an s.

Correction made.

Peer Review Comment No. 1.12: Discussion on impacts of chlorination and UV disinfection starting on page 4-38: The discussion on these pages appears to have implications for wastewater disinfection that are not addressed in the report. For example, the authors state that increasing the chlorine dose would have a benefit of destroying cyanide. What are the implications for a utility that decreased their chlorine dose (e.g., if the treatment plant used a small dose of chlorine to prevent fouling of filters but used UV for final disinfection)? Also, the report indicates that UV light can form significant amounts of cyanide. I think that it is important to mention that the UV conditions used in the referenced study were not necessarily intended to mimic those employed for wastewater disinfection and that the potential for cyanide formation during effluent disinfection is unknown.

We agree that the author of the UV reference (Zheng et al. 2004a) does not explicitly state whether the conditions used in the study were, or were not modeled from wastewater treatment processes. We have edited the report to more accurately portray the potential contribution of UV to cyanide formation, and have conducted an economic analysis in Section 7 regarding the switching of chlorination processes to UV processes for the region's POTWs, concluding that the costs and uncertainty of treatability outweigh the benefits of converting to UV radiation at this time.

Peer Review Comment No. 1.13: Also, the report cites the WERF report to justify some of the conclusions. WERF reports are often not readily accessible to the public. I suggest that you also include the relevant citations to the peer-reviewed literature (as you have already done in many places).

As suggested, references to the WERF report that point to information derived from a previous study have been changed to reference those specific studies.

Peer Review Comment No. 1.14: Page 4-40: There is a statement about ozone forming cyanide from thiocyanate. Either include a reference or delete the statement.

Statement deleted.

Peer Review Comment No. 1.15: Page 5-42: In the third full paragraph there is a statement about the absence of cyanide in urban runoff. Please include a citation.

In the Water Board's urban runoff monitoring studies, cyanide has not been detected in any sample in streets or in creeks. No specific citation was added to the Staff Report, as it is based on the collective experience of Board Staff's review of numerous technical reports.

Peer Review Comment No. 1.16: Page 5-44: The report states, "The 3.5 attenuation factor would establish more protective limits than the 4.5 attenuation factor while still providing POTWs with attainable effluent limits… For these reasons, 3.5 is the recommended attenuation factor…" This sounds as if the RWQCB is setting the attenuation factor to assure that the treatment plants don't have to do anything to comply with the site-specific standard. I was under the impression that the attenuation factor was supposed to be set to protect the environment and not to assure compliance of the regulated discharges.

This was not the intent of staff, and the statement has been removed from the report. This section of the report now describes the projected compliance of each shallow water discharger with final cyanide effluent limits assuming different attenuation values. Discharger specific attenuation factors ranging from 2.0 to 3.0 have been incorporated into the proposed dilution credits for shallow water dischargers that are protective of beneficial uses and the environment.

The requirement for mandatory effluent limits, a Cyanide Action Plan and model permit provisions ensure that dischargers will have to undertake actions to maintain a high level of performance and address sources of cyanide in their effluent. Compliance of the regulated discharges is not assured unless these implementation requirements are met.

Peer Review Comment No. 1.17: Table 15 seems to have some interesting information in it. It could use more explanation.

Table 15, includes the calculation of the proposed site-specific objective in detail, according to U.S. EPA methodology; it is now appropriately referenced in the text.

2. Scientific Peer Review Comment No. 2 Professor John Dracup, January 31, 2006

Peer Review Comment 2.1. This proposed change of 840% for acute cyanide objectives and 190% change for chronic cyanide objectives for marine and estuarine waters seems to be based on a single journal article published in August 2000 and referenced above. The four authors of this article appear to be employees of two consulting companies and an oil company. The companies are EcoTox, a North Bend, Washington consulting firm; Parametrix, a Kirkland, Washington consulting firm; and Shell Oil Co. of Houston, Texas. There are no further studies or reports that collaborate the findings of this journal article. Furthermore, a

search in the Scientific Citation Index indicates that this article has not been cited by a single author since its publication in 2000, indicating a lack of scientific import or credibility.

Staff disagrees with the conclusion drawn by the reviewer that the scientific basis for the reevaluation of the cyanide objectives is not sound based solely by looking into the citation history of the August 2000 journal article and the authors' connection to industry. See also response to Comment 2.5.

Peer Review Comment 2.2: On page 3-16 of this CA WQCB report, the previous cyanide objectives for San Francisco Bay are described as 1.0 μg/L (4-day average), which was adopted by the "U.S. EPA under National Toxics rule in 1992…" These 1992 objectives "superseded the 1986 Basin Plan objective of 5.0 μg/L because it was more stringent…"

It seems to me that these cyanide objectives constitute a political football that goes into play when politicians feel that an end game might be successful. The U.S. EPA in 1985, under the Republican administration of Reagan, chose the 5.0 μg/L values; the Democrats under Clinton reduced the value to 1.0 μg/L; and now the Republicans again, under Bush, want to raise it to an even higher level of 9.4 μg/L.

Staff disagrees with the implication that the development of cyanide site-specific objectives for the San Francisco Bay is politically motivated. The proposed site specific objectives are based on published federal and state procedures and policies. The 1992 objectives superseded the 1986 objective as a matter of regulatory policy. The Bush administration did not propose developing cyanide site specific objectives for the San Francisco Bay.

Peer Review Comment 2.3: On the last line of page 3-18 of this CA WQCB report it states that ""…none of the twelve shallow water dischargers examined can achieve the projected NTR-based cyanide effluent limits." However, it is not stated why the POTWs cannot remove the cyanide from their discharge. A cursory review of the literature indicates that cyanide can be removed using Ion Exchange methods and Reverse Osmosis.

Sections 7.1 and 7.2 of the Staff Report summarize an evaluation of 13 treatment methods to reduce cyanide in discharges and their associated cost. The conclusion is that none of the available treatment methods are reasonable compliance options, due to high cost and the lack of demonstrable benefits to aquatic life.

Peer Review Comment 2.4: Two minor suggestions are to add a listing of all acronyms and a glossary of terms.

Staff considered this comment but prefers the current approach in which acronyms and unfamiliar terms are defined when they first appear in the Staff Report.

Peer Review Comment 2.5: In conclusion, based on the rationale provided above, I cannot support the recommendations of this report to raise the proposed cyanide objectives for marine and estuarine waters to the levels indicated on Table 1, page 3-16. In fact, in

reviewing the report and supporting literature, I came to the conclusion that the recommendation to alter the proposed cyanide level was not based on sound science.

Prof. Dracup's review expresses his opinion on the site-specific objectives but does not provide compelling scientific evidence to support his stated conclusion that the proposed site-specific objectives are not based on sound science. He did not provide a substantive foundation for his opinion. Therefore, staff respectfully disagree with Prof. Dracup's conclusion and assert that the technical work supporting the proposed objectives and implementation plan is scientifically sound.

IV. STAFF-INITIATED CHANGES

Changes to the proposed Basin Plan Amendment

Changes to Table 4-7 were initiated by staff to correct spelling errors, incorrect names and to clearly identify the immediate discharge location for each discharger. Those changes are provided below.

Table 4-7: Dilution Credits for Calculation of Cyanide Water Quality-Based Effluent Limits for Shallow Water Dischargers

Discharger	**Discharge Location**	**Dilution Credit [a]**
American Canyon	North Slough	3.25:1
Fairfield-Suisun	Boynton Slough~~/Suisun Slough~~	4.0:1
Hayward Marsh	Hayward Shoreline Regional Park Marsh Basin	3.25:1
Las Gallinas	Miller Creek	3.25:1
Mt. View SD	Peyton~~acheco~~ Slough	3.25:1
Napa SD	Napa River	3.25:1
Novato SD	San Pablo Bay	3.25:1
City of Palo Alto	Manmade~~Unnamed~~ channel~~/South Bay~~	3.25:1
City of Petaluma	Petaluma River	3.25:1
City of San Jose	Artesian Slough~~/Coyote Creek~~	3.~~25~~0:1
Sonoma County Water Agency	Schell Slough	3.25:1
City of Sunnyvale	Guadalupe Slough	4.0:1
USS Posco	New York Slough	3.25:1

[a] The dilution credit is expressed as the ratio of total parts mixed (effluent and receiving waters) to one part of effluent

V. APPENDIX J

Basin Plan and SIP Requirements for Approval of Dilution Credit for Shallow Water Dischargers

There are provisions imposed by the San Francisco Bay Water Quality Control Plan (Basin Plan) and the *Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays and Estuaries of California* (SIP) that must be addressed as a condition of the award of a dilution credit to shallow water discharges. These provisions are discussed below.

Basin Plan:

The Basin Plan allows that a dilution credit may be granted for shallow water dischargers on a discharger-by-discharger and pollutant-by-pollutant basis.

For the proposed Basin Plan amendment and dilution credit consideration, each shallow water discharger has been specifically evaluated. Additionally, the dilution credit in the proposed Basin Plan applies only to cyanide, satisfying the pollutant-by-pollutant requirement.

The Basin Plan also stipulates that the Water Board may "grant a dilution credit…if the discharger demonstrates that a pretreatment and source control program is in place, including the following:

- *Completion of a source identification study,*
- *Development and implementation of a source reduction plan, and*
- *Commitment of resources to fully implement the source control and reduction plan."*

As stated previously in this Staff Report, the cyanide measured in effluent is often a product of wastewater disinfection and is therefore not amenable to source control by municipal agencies. This is evident through inspection of influent and effluent cyanide data for Bay ~~area~~ region treatment facilities (see Section 3.5) and is well supported in the literature (Zheng et al, 2004b; WERF 2003).

A number of the shallow water dischargers (Palo Alto, San Jose, Novato Sanitary District, Sonoma County Water Agency) have performed source identification studies. Industrial sources of cyanide (metal finishers and electroplaters) were identified in the Palo Alto and San Jose service areas and ~~were~~are being controlled through the industrial pretreatment programs at these respective municipalities. No significant cyanide sources were identified in the studies performed by Novato and Sonoma County Water Agency.

It has been demonstrated that in many treatment plants, disinfection ~~process and~~ , particularly the use of chlorination ~~in particular, form~~, creates a ~~significant cyanide~~ source of cyanide which obviates the need for individual cyanide source identification studies at each facility. ~~In lieu of such advance studies, the~~ The proposed Basin Plan amendment requires that each shallow water discharger ~~perform~~performs an assessment of potential cyanide sources within its service area as an initial NPDES permit requirement. This will ensure that potentially significant cyanide sources are identified and will allow agencies to initiate illicit discharge prevention procedures for these sources. The NPDES permit will require the commitment of resources to fully implement source control and ~~illicit discharge~~pollutant minimization plans~~ in those agencies.~~.

In addition to source identification and control, the Basin Plan requires that a demonstration be made that water quality objectives will be achieved, by ensuring the following:

A demonstration that the proposed effluent limitations will result in compliance with water quality objectives, including the narrative chronic toxicity objective, in the receiving water

~~The water quality-based~~Effluent limitations will be established on a permit-by-permit basis. Based on the monitoring and modeling studies conducted, the projected effluent ~~limits are~~ limitations derived ~~to ensure that~~ using the proposed dilution credits will result in compliance with ~~both acute and chronic chemical-specific~~ water quality objectives~~ will occur at the edge of the mixing zone for each shallow water discharger. Therefore, both numeric and ~~, including the narrative ~~objectives will be attained~~chronic toxicity objective, in the receiving waters~~ of the Bay outside of these zones. As described in Section 9.4.1, the expectation is that the concentration of cyanide in effluents is not expected to increase above existing levels. Ambient ~~. The available receiving water data (253~~2~~ samples collected between 2003 to 2005 near shallow water discharges) indicate that existing concentrations of cyanide in the discharge gradients from shallow water dischargers range from less than 1 µg/L to ~~6.~~7.2 µg/L, and are therefore, in all cases, below the proposed acute cyanide saltwater objective of 9.4 µg/~~l and are typically below~~ L. About ninety- five percent of the ~~proposed chronic objective of~~ data collected from receiving waters indicate values below 2.9 µg/~~l~~L, the proposed chronic objective. The receiving water samples above the chronic objective are based on one-time grab samples and are not expected to be sustained for a four-day period of time, the applicable duration of the chronic objective. In addition, the proposed Cyanide Action Plan ~~that~~ will include cyanide as a pollutant of concern for all dischargers in their Pollutant Minimization Plans and will reinforce the identification and control of potentially significant illicit discharges in service areas where such sources exist, adding to the existing capability to control such discharges.

An evaluation of worst-case conditions (in terms of tidal cycle, currents, or in-stream flows, as appropriate) through monitoring and/or modeling to demonstrate that water quality objectives will continue to be met, taking into account the averaging period associated with each objective…

The monitoring and modeling performed for shallow water dischargers provides empirical evidence (n=~~225~~253~~2~~) and/or predicted values to address steady state conditions along the discharge gradients. The modeling ~~allows consideration of~~considered worst case conditions and ~~consideration of~~ appropriate averaging periods to ensure that water quality conditions will be met. Appendix E in the Staff Report provides details of how critical design flow conditions over an extreme low tide cycle and dry season inflows were used to demonstrate mixing and effluent dilution characteristics that are representative of worst-case conditions~~ for distinct shallow water discharges~~.

An evaluation of the effects of mass loading resulting from allowing higher concentrations of pollutants in the discharge, in particular, the potential for accumulation of pollutants in aquatic life or sediments to levels that would impair aquatic life or threaten human health.

Cyanide degrades in the receiving water and does not accumulate in sediment or biota. Levels of cyanide in shallow water discharger effluent do not approach levels of concern to human health (e.g., the OEHHA drinking water public health goal of 150 μg/L).

The Basin Plan also requires that the effluent limits resulting from a dilution credit must be consistent with anti-backsliding provisions of the Clean Water Act (CWA).

Anti-backsliding provisions apply in cases where final effluent limits have been adopted in permits. For wastewater dischargers of cyanide to the San Francisco Bay, no final cyanide limits exist in their current NPDES permits. Therefore, the anti-backsliding provisions of the CWA do not apply in the case of cyanide. ~~Additionally, none of the plants in question could comply with final limits derived from the proposed saltwater site-specific objectives for cyanide without consideration of attenuation. Therefore, anti-backsliding is not a constraint to the adoption of the proposed dilution credits for shallow water dischargers~~.

State Implementation Policy (SIP):

The "RWQCB shall consider the presence of pollutants in the discharge that are carcinogenic, teratogenic, persistent, bioaccumulative, or attractive to aquatic organisms."

As stated in Section 3.3, cyanide is ~~neither~~not carcinogenic, teratogenic, persistent, ~~n~~or bioaccumulative.

The "RWQCB also shall consider…the level of flushing in water bodies such as…enclosed bays, estuaries…where pollutants may not be readily flushed through the system."

The monitoring and modeling studies used in the consideration of dilution credits and mixing zones along the discharge gradients reflect consideration of the hydrodynamics ~~and tidal flushing~~ that occur near shallow water discharges~~.~~ and provide evidence of tidal mixing, dilution or degradation. Because cyanide degrades rapidly, does not accumulate in the Bay, and ~~does not pose an~~is present at low ambient ~~concentration problem~~concentrations in the Bay, ~~concern regarding flushing of cyanide from~~it appears to readily flush through the ~~Bay~~ system ~~is not warranted.~~.

Mixing zone study and mixing zone conditions

An independent ~~attenuation study~~monitoring or ~~a combination of attenuation and~~ modeling study was performed by each shallow water discharger to evaluate dilution and degradation of cyanide in the receiving waters following the procedures set in the SIP for incompletely mixed discharges (Table 1). The methodology employed to determine dilution credits from ~~attenuation~~these studies is summarized in Section 6 and is detailed in Appendix K. ~~Compliance with cyanide water quality objectives occurs at the edge of the cyanide mixing zone. In this Project the extent of the mixing zone is defined as the location in the receiving water where the ratio of effluent concentrations to receiving water concentrations of cyanide equals the attenuation value. The extent of the mixing zone for each discharger is defined in Appendix D.~~

"A mixing zone shall be as small as practicable."

The ~~proposed dilution credits were selected to ensure that the~~ extent of the mixing zone ~~associated with~~for each ~~effluent outfall~~discharger is ~~minimized~~defined in Appendix D and ~~that the computed compliance thresholds such as Maximum Daily Effluent Limit and Average Monthly Effluent Limit are protective of most sensitive aquatic life~~is summarized in Table 1. The proposed mixing zones were selected to be as small as practicable.

Table 1: Description of mixing zone studies and dimensions to establish dilution credits for shallow water dischargers in San Francisco Bay.

Discharger	Immediate Receiving Water Body [a]	Study Type	Mixing Zone Area (acres)	Receiving Water Area (acres)	Description
American Canyon	North Slough	Monitoring	0.3	32	Dead-end slough to Napa River (estuarine)
Fairfield Suisun Sewer District	Boynton Slough	Monitoring/ Modeling	3.5	35	Dead-end slough to Suisun Slough/ Marsh
Hayward Marsh	Hayward Marsh	Modeling	6.2 [b]	40	Wetlands (man-made dead-end system) to Lower San Francisco Bay
Las Gallinas	Miller Creek	Monitoring	1.0	8	Minor tributary to San Pablo Bay
Mt. View SD	McNabney Marsh/ Peyton Slough	Monitoring	0.1	135	Dead-end slough to Carquinez Strait
Napa SD	Napa River (estuarine)	Monitoring/ Modeling[c]	0.4	Less than half river width	Major tributary to San Pablo Bay
Novato SD	San Pablo Bay	Modeling	0.1	57600	950 feet off shore
City of Palo Alto	Man-made channel	Modeling	4.2	5.2	Dead-end channel to South San Francisco Bay
City of Petaluma	Petaluma River (estuarine)	Modeling	0.8	Less than half river width	Minor tributary to San Pablo Bay
City of San Jose/ Santa Clara	Artesian Slough	Monitoring	19.8	60	Dead-end slough to Coyote Creek (major tributary), South San Francisco Bay
Sonoma County Water Agency	Schell Slough	Monitoring/ Modeling	0.2	6.4	Dead-end slough San Pablo Bay
City of Sunnyvale	Moffett Channel	Monitoring	5.8	8.3	Highly modified channel to Guadalupe Slough (Minor tributary), South San Francisco Bay
USS Posco	New York Slough	Modeling	0.2	265	Dredged slough channel to Suisun Bay

[a] The estimated mixing zone does not extend beyond the water body where the effluent outfall is located. For example for Fairfield Suisun SD the mixing zone is 3.5 acres and Boynton Slough channel is 35 acres.

[b] This area represents the approximate total surface area of mixing channels that drain the marsh before discharging the excess treated effluent to Lower San Francisco Bay.

[c] Napa SD submitted a new Mixing Zone Study Report (Limno-Tech, 2006) to the Water Board as part of their permitting process. This study provides additional information on mixing and dilution under critical design flow conditions and includes tidal effects.

Also, "…a mixing zone shall not:

(1) Compromise the integrity of the entire water body…

Cyanide is not currently compromising the integrity of the Bay or its uses.the receiving waters adjacent to the proposed mixing zones. Ambient monitoring indicates that cyanide levels throughout the Bay proper are below 0.4 µg/L, which is less than the detection limit of 1 µg/L, 0.4 µg/l, which is and significantly less lower than the proposed cyanide site-specific chronic objective of 2.9 µg/l.L. Ambient levels of cyanide in the vicinity of the proposed mixing zones of the shallow water discharges are also below 1 µg/L. These ambient levels integrate the existing shallow water discharges of cyanide. As detailed in Section 9.4.1, the proposed consideration of dilution credits in setting effluent limits for shallow water dischargers will not cause or contribute to increased cyanide concentrations in the Bay.

(2) cause acutely toxic conditions to aquatic life passing through the mixing zone…

The copepod *Acartia clausi*, the most acutely sensitive saltwater species, has an acute LC50 value of 30 µg/lL in exposures to free cyanide; Rainbow trout, the most acutely sensitive freshwater species, has an acute LC50 value of 44 µg/lL free cyanide. U.S. EPA presumes that the "no acute effect" level for acute toxicity is typically one half of the LC50 value. Therefore, the approximate "no acute effect" levels for acute toxicity for *Acartia* and Rainbow trout are 15 µg/Ll and 22 µg/l L free cyanide, respectively. Measured levels of total cyanide along the discharge gradients of shallow water dischargers are less than 7 µg/L, typically less than 3 µg/L, and do not currently approach these concentration thresholds for acute toxicity or the proposed acute objective for cyanide. Total cyanide levels along the discharge gradients are not anticipated to increase under the proposed effluent limits. Therefore, it is concluded that proposed effluent limits will not result in acutely toxic conditions in shallow water discharger mixingattenuation zones.

(3) restrict the passage of aquatic life…

Cyanide concentrations in the vicinity of shallow water dischargers willis not known to interfere with the movement of aquatic species and does not restrict the passage of aquatic life. The discharge locations are either dead-end sloughs or otherwise sited to avoid creation of migration barriers for fish.

(4) adversely impact biologically sensitive or critical habitats…

American Canyon: the mixing zone is not within a designated critical habitat. North Slough is a dead end slough channel and the mixing zone represents about 1 percent of the water body. Discharge to North Slough occurs only during the wet season. Discharge during the dry season occurs to a constructed wetland. Aquatic life in the channel is composed primarily of estuarine species. It is assumed that biologically sensitive species may occur within the slough channel and constructed wetland. Effluent data (15 samples) from American Canyon indicate that all data are below 3 µg/L. It is expected that the proposed chronic objective will be met in the receiving water and sensitive species will be protected.

Fairfield Suisun Sewer District: The mixing zone is at the edge of designated critical habitat (Suisun Marsh) for the Delta smelt. The mixing zone represents 10 percent of Boynton Slough, a slough channel within the larger Suisun Marsh and Suisun Bay. Delta smelt spawning areas are restricted to the Delta and the freshwater reaches of the San Francisco Estuary (FWS, 2004). The extent to which Delta smelt distribution varies from year to year is not well understood. Delta smelt is not known to spawn within Suisun Marsh; however, little is known about specific spawning microhabitats. Delta smelt larvae survival is linked primarily to salinity levels and temperature, which are not suitable in the uppermost northern area of the Suisun Marsh. Delta smelt that may find their way into Boyton Slough are not expected to remain within the slough channel for extended periods of time. The mixing zone is not expected to adversely impact Delta smelt or other biologically sensitive habitats.

Hayward Marsh Union Sanitary District: The mixing zone occurs in 6.2 acres of channels within a 60 acre brackish marsh. Discharge from the treatment plant is routed to freshwater treatment basins that discharge to channels within the brackish marsh. During low flow conditions, assumed in the modeling study, the mixing zone would be expected to remain within the channels. The marsh is not within a designated critical habitat. It is assumed that biologically sensitive species may occur within the marsh. Effluent data from the freshwater basins indicate average cyanide concentrations (33 samples) of 2.9 µg/L. Dilution modeling based on salinity measurements indicates a 3:25 to 1 dilution occurs within the mixing zone, thus the proposed chronic objective would be met in the receiving water and sensitive species would be protected.

Las GallinasValley Sanitary District: The mixing zone is within a designated critical habitat for steelhead trout. Surveys of Miller Creek (1981, 1993 and 1997) indicated the presence of steelhead upstream of highway 101. The outfall discharges one mile upstream from San Pablo Bay, to Miller Creek, a tidally influenced perennial creek at considerable distance from suitable spawning and rearing areas for steelhead. Discharge to Miller Creek occurs only during the wet season from November to May when freshwater flows are high. Effluent data from Las Gallinas indicate average cyanide concentrations (26 samples) of 2.6 µg/L. The mixing zone represents an area of 1 acre, which is 12 percent of this segment of Miller Creek. It is assumed that biologically sensitive species may occur within Miller Creek; however, they are likely to be fish species that are sensitive to cyanide at levels greater than the proposed acute water quality objective and would therefore be protected. Sensitive species are only expected to remain within the mixing zone for short periods of time, less than a chronic period averaging time. The available receiving water data indicate cyanide levels below the chronic objective.

Mt. View: The mixing zone is not within a designated critical habitat. The outfall discharges to a constructed marsh and then to sensitive habitat, McNabney Marsh. No detectable levels of cyanide using low detection level analytical methods have been measured in McNabney Marsh. Biologically sensitive species will not be adversely impacted by allowing a mixing zone.

Napa Sanitation District: The receiving water is the Napa River, which is designated critical habitat for steelhead trout. Discharge to the Napa River will occur only during the wet season, from November to May through a diffuser, when water levels in the River are high and predominantly fresh. Average cyanide concentrations in effluent are below the chronic objective. Modeling of the mixing zone indicates that only a portion of the width of the Napa River will be impacted by effluent discharged from the Napa Sanitation District; therefore passage of fish can occur outside of the mixing zone (Limno-Tech, 2006). Sensitive species are only expected to remain within the mixing zones for short periods of time, less than a chronic period averaging time, and will therefore not be adversely impacted.

Novato Sanitary District: The mixing zone is not within a designated critical habitat. The outfall discharges directly to San Pablo Bay in shallow water, 950 feet offshore during the wet season from November to May, via a multi-port diffuser. The mixing zone represents 0.14 acres of San Pablo Bay which is 57, 600 acres in size. Average effluent concentrations during 2000 to 2004 are below the chronic objective of 2.9 µg/L. Aquatic life is composed primarily of estuarine species. It is assumed that biologically sensitive species may occur within San Pablo Bay and are likely to move with the tides and not remain within the mixing zone for periods longer than the duration of the tidal cycle of 6 hours. Impacts to sensitive species within the mixing zone are not likely to occur.

City of Palo Alto: The receiving water is a 5.2 acre man-made channel that is not designated critical habitat. The mixing zone occurs within 4.2 acres of the man-made channel. Sampling of the effluent at the outfall indicates an average concentration of 3.3 µg/L and a maximum concentration of 5 µg/L (50 samples). Palo Alto conducted an evaluation of the biological community within its discharge channel and found that the channel supported a diverse assemblage of aquatic fauna. The study results, which included sampling at a reference site, are included in the Staff Report as Appendix M. Northern Anchovy were found to be present in the discharge channel, an indirect indicator that their food source, the copepod, was also present. Copepods (*Acartia clausi*) are the most sensitive marine species that could be present in estuarine/marine waters of the Bay. The estimated concentration of cyanide for no acute effects to the copepod is 15µg/L. Based on the biological survey, there is no indication of impacts to beneficial uses or adverse impacts to sensitive species within the mixing zone.

Petaluma: The receiving water is the Petaluma River, which is designated critical habitat for steelhead trout. However, surveys conducted within the Petaluma River to date have not found evidence of salmonids. Discharge to the Petaluma River will occur only during the wet season, from November to May when water levels in the River are high and predominantly fresh. Dilution modeling indicates that the discharge plume is distributed immediately downstream of the outfall. Therefore it is assumed that only a portion of the width of the Petaluma River will be impacted by the discharge allowing for passage of fish to occur outside of the mixing zone. Sensitive species are only expected to remain within the mixing zone for short periods of time, less than a chronic period averaging time. In addition, effluent data indicate that average cyanide concentrations are at the chronic objective. The mixing zone will not adversely impact sensitive species.

City of San Jose/Santa Clara: The mixing zone occurs within Artesian Slough which is not designated critical habitat. The size of the assigned mixing zone is 19.8 acres; however, ambient cyanide concentrations exceeding the chronic objective of 2.9µg/L were only detected sporadically within a portion of this mixing zone (6.2 acre) in close proximity to the discharge. The overall mixing zone represents less than 30 percent of Artesian Slough which is a dead-end channel. Artesian Slough discharges to Coyote Creek, which is designated critical habitat for steelhead trout. Receiving water data indicate that average concentrations within the mixing zone are generally below the chronic objective of 2.9µg/L. All concentrations of cyanide within Coyote Creek were measured at levels lower than the chronic objective. Fish migrating through Coyote Creek are expected to remain within the mixing zone in Artesian Slough for short periods of time, less than a chronic period averaging time. Biologically sensitive species are assumed to be present within Artesian Slough. It is expected that the proposed chronic objective will be met in the receiving water and concentrations of cyanide within the mixing zone will not adversely impact sensitive species.

Sonoma County Water Agency: The mixing zone within Schell Slough accounts for 0.2 acres of a 6.4 acre slough. The mixing zone is linked to a critical habitat for steelhead in Schell Creek. Schell Creek is considered to be a migratory corridor only and no steelhead were found there during more recent surveys. Discharge to Schell Slough occurs only during the wet season. Average concentrations within the receiving water indicate levels of cyanide below the chronic objective. Aquatic life in the channel is composed primarily of estuarine species. It is assumed that biologically sensitive species may occur within the slough channel. It is expected that the proposed chronic objective will be met in the mixing zone. Sensitive species are only expected to remain within Schell Slough for periods less than a four-day average chronic time period. Cyanide levels within the mixing zone are not expected to adversely impact sensitive species.

City of Sunnyvale: The mixing zone is not within a critical habitat. The mixing zone occurs within 5.8 acres of the 8.3 acre Moffett Channel. Moffett Channel discharges to Guadalupe Slough. It is assumed that biologically sensitive species exist within Moffett Channel and Guadalupe Slough. The average concentration of effluent data from 2000 to 2004 was 4.4µg/L. However, more than 50 percent of the 80 samples collected were non-detect levels at a detection level of 5 µg/L. Sensitive species are only expected to remain within the channel for periods less than a chronic period averaging time, and cyanide levels within the channel are likely to be at levels less than the chronic objective. Cyanide levels within the mixing zone are not expected to adversely impact sensitive species.

USS Posco: The mixing zone is at the southern edge of designated critical habitat (Suisun Bay) for the Delta smelt. In the recently adopted NPDES permit (Water Board, 2006), the Water Board granted the discharger a dilution credit of 5:1 based on a mixing zone modeling study and determined that USS Posco met the requirements specified in the Basin Plan and the SIP for an exception to discharge prohibition. The results of the modeling study indicated that the mixing zone area for a dilution of 3.25:1, as proposed for cyanide, extends approximately 50 feet from the outfall, which accounts for 0.2 acres. Therefore the mixing zone is small compared to the receiving water body, New York Slough, that exceeds 265 acres in size. New York Slough has not been identified as a hatching habitat for Delta smelt and is largely unsuitable for larvae survival. The small size of the mixing zone and flow conditions near the outfall ensure that the Delta smelt and sensitive species would be protected.

(5) produce undesirable or nuisance aquatic life
(6) result in floating debris, oil or scum;
(7) produce objectionable color, odor, taste, or turbidity;
(8) cause objectionable bottom deposits;

(9) cause nuisance;

At the concentrations in question, cyanide is not known to produce undesirable or nuisance aquatic life, floating debris, oil, scum, objectionable color, odor, taste turbidity, objectionable bottom deposits or nuisance conditions.

(10) dominate the receiving water body or overlap a mixing zone from different outfalls;

The mixing zones ~~described~~are summarized in ~~Appendix D do not overlap~~Table 1 above. The proposed mixing zones represent only a portion of the immediate receiving water bodies,~~y~~ which are generally dead end slough channels, and an even smaller percentage of the larger water body, e.g. Napa, Petaluma Rivers, Suisun Marsh or specific San Francisco Bay segments associated with the outfall locations.

(11) be allowed at or near any drinking water intake…"

No drinking water intakes are located in San Francisco Bay in the vicinity of the proposed Shallow Water Discharger attenuation zones.

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