APPENDIX D
RESPONSE TO COMMENTS

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PART I

STAFF RESPONSE TO WRITTEN COMMENTS ON THE DRAFT STAFF REPORT AND PROPOSED BASIN PLAN AMENDEMENT (July 24, 2015)

We received seven comment letters during the public comment period, which began on July 24 and closed on September 8, 2015. The comments and our responses are presented here in alphabetical order.

Staff responses are shown in italic.

Comment letters received:

1. Bay Area Clean Water Agencies (BACWA, David R. Williams)
2. Central Contra Costa Sanitary District (CCCSD, Roger S. Bailey)
3. Eco Services Operations LLC (Eco Services, Anthony Koo)
4. Partnership for Sound Science in Environmental Policy (PSSEP, Craig S.J. Johns)
5. San Francisco Baykeeper (Baykeeper, Ian Wren)
6. United States Environmental Protection Agency (USEPA, Diane E. Fleck)
7. Western States Petroleum Association (WSPA, Kevin Buchan)

Comment Letter No. 1: Bay Area Clean Water Agencies

Comment 1.1: "BACWA generally supports this implementation plan, but has a concern about the attainability of our agencies' wasteload allocations (WLAs).

Many agencies observe significant year to year variability in their selenium loads. This variability is likely due to both actual variability in the selenium concentrations in their source water and groundwater intrusion to their collection systems, as well as analytical variability, since many of the data points are in the "Detected but Not Quantified" (DNQ) range. The WLAs were calculated by averaging effluent data gathered between 2008 and 2013 without applying an additional safety factor. Therefore, even if conditions remain the same moving forward, as they were in the 2008 to 2013 time period, it is expected that approximately half of the time, selenium loads will be above, and half the time, below, the WLAs. Therefore, it is not reasonable to expect that loads continue to be "equal or less than the wasteload allocations identified in Table 26" for any given timeframe, as stated in the TMDL.

BACWA recommends that the Regional Water Board change the wording so that the requirement reads":

> (Page 111)…the dischargers shall evaluate selenium loads over the previous permit term and verify that ~~they~~ loads are ~~continuing to be equal to or less~~ not significantly greater than the wasteload allocations identified in Table 26

and

> (Page 151) To ensure protection of North Bay water quality, municipal and industrial wastewater Dischargers will be required, once per permit term, to verify that selenium loading continues to be ~~equal to or less than~~ not significantly greater than the wasteload allocations identified in Table 7.2.4-4.

Response: *We understand the concern raised by BACWA with respect to the variability in effluent data and the resulting calculated WLAs. Ultimately our goal is to demonstrate that the loading from municipal wastewater does not increase in the future such that numeric targets are not being met. To provide consistency and clarity on the requirements for the municipal and small industrial dischargers, we have modified the text in the Staff Report and the proposed Basin Plan amendment as follows:*

> Modify the Staff Report (Chapter 8.1: Internal and External Sources, Section: Municipal and Small Industrial Dischargers) … *Specifically, NPDES permits for these dischargers will be structured to require that once per permit term, the dischargers ~~shall~~ will evaluate selenium loads over the previous permit term to demonstrate ~~and verify~~ that ~~they~~ their loads are consistent with ~~continuing to be equal to or less than~~ the wasteload allocations identified in Table 26.*
>
> Modify the Basin Plan amendment Section 7.2.4.5: *To ensure ongoing protection of North Bay water quality, municipal and industrial wastewater dischargers ~~will~~ shall be required to report their average annual load once per permit term to verify that selenium loading is consistent with ~~continues to be equal to or less than~~ the wasteload allocations identified in Table 7.2.4-4.*

Comment 1.2: "BACWA also notes that there are different analytical methods allowed by 40 CFR 136 for measuring selenium in effluent, and that these methods may yield different results. For example, one BACWA member has observed much higher apparent selenium concentrations using USEPA Method 200.8 (reaction cell) compared to atomic absorption gaseous hydride. If an agency switches analytical method and their loads are higher than their WLA, they should be allowed to document the relationship between data generated by the new method, and the method used to calculate the WLA."

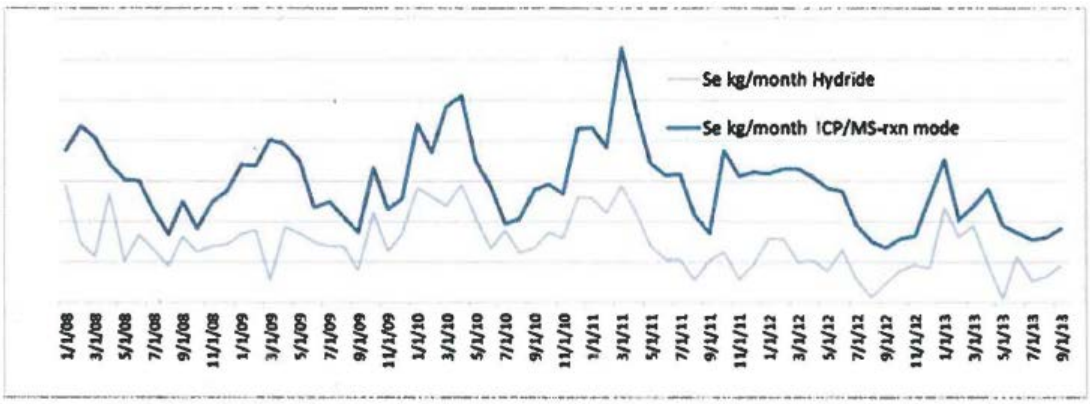
Response: *We acknowledge that the two analytical methods could produce different results; nevertheless, the best available method should be used to monitor selenium concentrations in the effluent and evaluate loads. The dischargers may conduct a specially designed method comparison study or use at least three years of monthly data analyzed with both methods to develop a translator for load estimates between the two approved methods.*

Comment Letter No. 2: Central Contra Costa Sanitary District

Comment 2.1: "The CCCSD generally supports implementation of the TMDL, but has concerns regarding its wasteload allocation of 17.4 kg per year, identified in Table 26 of the TMDL Se NSFB and Table 7.1.4-4 of Appendix A. The waste load allocation was calculated from Selenium measurements made using the M-Hydride Method, which CCCSD used only until September 2013. CCCSD requests that its allocation be re-evaluated to reflect the current method it uses for measuring Selenium, ICP/MS (reaction cell mode), and suggests that a more appropriate wasteload allocation of approximately 34.5 kg per year be given for the reasons outlined below:

1. The M-Hydride Method and the ICP/MS Method, both of which have been used by CCCSD for measurement of Selenium, are approved in Environmental Protection Agency (EPA) Regulation 40 CFR Part 136 and meet the EPA's requirement for "sufficiently sensitive" methodology with respect to Selenium. Prior to September 2013, CCCSD used the M-Hydride Method for Selenium, but moved to ICP/MS as a result of instrument failure. Measurement of low level (<1 .0 ppb) Selenium is subject to variability associated with sample preparation and analytical instrument. In CCCSD's case, this variability creates an apparent increase in Selenium load, as illustrated in Figure 1.

2. Selenium inputs are generally constant. The incoming wastewater is predominantly domestic, and the service area has no selenium source industries. Either method, ICP/MS or M-Hydride, is appropriate for detection of increasing trends, which is the monitoring objective of the TMDL Se NSFB. CCCSD plans to continue measuring Selenium by ICP/MS and has been able to compare Selenium loads calculated from AA-Hydride and ICP/MS measurements for the 2008 through 2013 time period. The comparison illustrates a nearly constant offset between the two methods, with Selenium load by ICP/MS generally twice that of the AA-Hydride Method. A graph comparing monthly load by each method is provided to illustrate the "offset" we observe in this data (Figure 1). The data used for the illustration and the requested allocation will be provided to the Regional Water Quality Control Board."



Response: *We do not agree that the wasteload allocation has to be revised. For the load assessments to be accurate, the best available analytical method should be used to measure selenium concentrations in effluent. As shown by the Commenter, the ICP/MS Method is positively biased and overestimates the loads. The load calculations for the TMDL were conducted with the concentration data measured with the M-Hydride Method, the approved best method. Therefore, the estimated load and the wasteload allocation of 17.4 kg/year (expressed as average annual load) is accurate for this facility.*

However, CCCSD has a 5-year dataset showing results of both analytical methods, which is sufficient to establish a translator between the two analytical methods for this facility. This translator could then be used to demonstrate that CCCSD's loads are consistent with the wasteload allocation of 17.4 kg/year.

Comment 2.2: "CCCSD proposes changes to language in Section 7 of the TMDL Se NSFB and Appendix A, Section 7.2.4.4 Implementation Plan. We propose the verification language be changed from *"verify that selenium loadings continue to be equal to or less than the wasteload allocation identified in Table 7.2.4-4 of Appendix A, and Table 26 of the TMDL Se NSFB" to "verify selenium loadings are not significantly greater than the allocation listed in Table 7.2.4-4 of Appendix A, and Table 26 of the TMDL Se NSFB"*."

Response: *See response to Comment 1.1*

Comment Letter No. 3: Eco Services

Comment 3.1: "The Draft Report should be revised to reflect the change in ownership at the Facility. As of December 1, 2014, ownership of Solvay/Rhodia, Inc. changed to ECO Services."

Response: *We have modified Table 7.2.4-4 of the Basin Plan amendment and Tables 13 and 26 of the Staff Report to reflect the facility name change from Solvay (formerly Rhodia, Inc) to Eco Services (formerly Solvay/Rhodia, Inc).*

Comment 3.2: "Eco Services agrees with the Draft Report's finding that the selenium loads from the Facility are minor and have an insignificant impact on the water quality of the North San Francisco Bay."

Response: *Comment noted.*

Comment 3.3: "The Draft Report quantification of the Facility's daily and annual selenium loads are inaccurate and should be revised. ….Eco Services requests that the estimated daily and annual loadings for the Facility be revised in the Draft Report to 2.49 g/day and 0.9 kg/year, respectively and the Facility's annual wasteload allocation in the Draft Amendment be revised to 0.9 kg/yr."

Response: *With the inclusion of additional monthly data provided by Eco Services, we revised the load calculations based on the consecutive 5-year period of 2010-2014. This is consistent with the number of years used for other dischargers. The estimated selenium load and wasteload allocation in Table 7.2.4-4 of the Basin Plan amendment and Tables 13 and 26 has been changed from 0.5 kg/year to 0.7 kg/year. This is lower than the Commenter's estimate of 0.9 kg/year, which was based on 2005-2015 data. Also a footnote was added under Table 7.2.4-4 saying: Total load differs from column sum due to rounding.*

Comment 3.4: "the understated estimates were derived with a method that is not consistent with the Board's methodology for calculating loads as applied in prior TMDL Reports or with respect to other discharger categories."

Response: *We disagree. There is no single preferred method to calculate TMDL loads, and our methodology reflects the available data and the type of pollutant for which estimates are made. As noted by the Commenter, the draft staff report explains how the loads were calculated. The same method was used to estimate loads for all municipal and small industrial dischargers.*

Comment 3.5: "To account for this variability in the data and to provide a more representative loading calculation, consideration of ten years of data is appropriate to calculate estimated loads."

Response: *We do not agree that the load calculations should include more than five years of data. Up to five years of the most recent data best characterizes the selenium loads and the current ability of the discharger to treat and remove selenium from the effluent. As municipal and small industrial dischargers are required to report their average annual selenium load once per permit term, the use of five years of data provides consistency between the allocations and the reporting requirements.*

Comment Letter No. 4: PSSEP

Comment 4.1: "PSSEP's comments here focus on a single issue related to potential future selenium loads to North San Francisco Bay that are likely to come from the Central Valley Watershed as a result of what is now being called "California Water Fix. …In particular, PSSEP is concerned that the BDCP/WaterFix RDEIR/EIS continues to understate the potential additional selenium loading impacts to the Delta and San Francisco Bay. Those understated future selenium loads are important to the ecological health of San Francisco Bay, which is why we think this issue should be important to the Regional Board." The Commenter attached a copy of their Draft BCDP EIR comment letter dated June 25, 2014.

Response: *We provided similar comments on the draft BDCP EIR's analysis of future selenium loading due to increased flows from the San Joaquin River and worked to ensure that the revised EIR addressed these concerns. As a result, the revised BDCP documents now consider the impacts of selenium load increases on San Francisco Bay. These analyses predict that, despite potential load increases, the long term total selenium concentrations in the North Bay will be almost unchanged, at 0.13 - 0.14 µg/L, which is consistent with our assessment. While there remains uncertainty regarding the actual downstream impacts of the BDCP/WaterFix project, any future changes are speculative and uncertain. We are concerned about future selenium loads and are requiring that monitoring be conducted to inform the need for additional implementation actions to manage the Central Valley load.*

Comment 4.2: "There are three, related provisions in the Regional Board staff report and the proposed Basin Plan Amendment that should be changed to reflect what we believe should be the Regional Board's concern about future increased selenium loads from the Central Valley Watershed, related to the California WaterFix. The underscored/cross-through language that follows highlights those suggested changes":

Draft Staff Report, Section 5, Source Analysis, p. 70.

> The State Water Board has proposed to increase environmental flows in the Lower San Joaquin River to better protect fish and wildlife beneficial uses, which could result in more San Joaquin River flow, with higher ambient selenium concentrations reaching the Delta and the North Bay. In addition, implementation of various construction and restoration alternatives through the BDCP ~~may also~~ are likely to affect selenium balance in the North Bay. According to the BDCP/California WaterFix RDEIR/EIS, if the preferred alternative is constructed, selenium loads from the Central Valley Watershed are expected to increase by 6-11% annually, or between 245-447 kg/year. By altering the flow patterns and mixing of different water sources, the BDCP alternatives ~~have the potential, albeit small, of increasing~~ are also expected to increase selenium water column concentrations in the North Bay. Sacramento River selenium concentrations are much lower (0.09±0.03µg/L dissolved selenium) and more typical of background concentrations in the region.

Response: *We disagree that these changes are necessary. As noted in the BDCP/California WaterFix RDEIR/EIS (Appendix A, Chapter 8, p.8-56):*

> *The model results are not meant to be taken as predictions of future mercury, methylmercury, or selenium concentrations, since known mechanisms such as sorption, settling, and transformation are not quantitatively taken into account, but rather to be used to assess water quality differences between Project Alternatives and make determinations regarding potential effects to beneficial uses relative to assessment baselines.*

Therefore, potential increases in selenium concentrations may not necessarily translate to 245 - 447 kg (these numbers were generated by the Commenter) discharged annually into the North Bay. There remains significant uncertainty in these estimates. See also response to Comment 4.4.

Comment 4.3: "Suggest adding the following document to the list of references included in the Staff Report:

California Dept. of Water Resources and U.S. Bureau of Reclamation, 2015. Bay Delta Conservation Plan/California WaterFix RDEIR/SDEIS."

Response: *It is not appropriate to cite the Draft EIR because we have not relied on this reference to support the scientific basis of the Basin Plan amendment. Moreover, it is not practical to include the whole document, which is thousands of pages long as a reference in the administrative record for this TMDL.*

Comment 4.4: "Suggest changing the Draft Basin Plan Amendment for Selenium, §7.2.4.5 – Implementation Plan, p. 151-152."

> Central Valley Watershed (San Joaquin River)
>
> ... Changes to the State Water or Central Valley Projects' operations, other upstream diversions or flow modifications are likely to cause increases of selenium loading into the North Bay, specifically from increased flows from the San Joaquin River, ~~but these increases are not expected to be significant~~ and these increases may be potentially significant.

Response: *We agree there is uncertainty regarding the actual downstream impacts of the BDCP projects and potential San Joaquin River flow increases.*

We have changed the text in section 7.2.4.5 of the Basin Plan amendment to say:

> *… Changes to the State Water or Central Valley Projects' operations, other upstream diversions, or flow modifications may cause increases of selenium loading into the North Bay, ~~specifically~~ for example, from increased flows from the San Joaquin River but ~~these increases are not expected to be significant.~~ the magnitude and potential impacts of these changes are uncertain at this time. It is the intention of this Water Board to work with the State and the Central Valley Water Boards to ensure the current load allocation for the Central Valley watershed in the TMDL is attained.*

Comment 4.5: "Suggest changing the Draft Basin Plan Amendment for Selenium, §7.2.4.5 – Implementation Plan, p. 151-152."

> Monitoring
>
> ... The Water Board will work with the State Water Board and Central Valley Water Board through their planning, permitting and regulatory processes to ensure that monitoring is conducted to evaluate changes in selenium concentrations and loads from the Central Valley Watershed and San Joaquin River and to ensure that any increases in selenium upstream are addressed through the State Water Board's or Central Valley Water Board's planning, permitting and regulatory processes.

Response: *We did not revise the text as proposed by the Commenter. The language in the TMDL was provided to us by State Board staff and the term "regulatory processes" implicitly includes any potential future permitting actions.*

Comment Letter No. 5: San Francisco Baykeeper

Comment 5.1: The Commenter makes a claim that current conditions are resulting in significant impacts to both white and green sturgeon. " … the Regional Board's decision to maintain the existing selenium load [though] the TMDL process is unwarranted and fails to ensure protection of the Bay's beneficial uses, including Estuarine Habitat (EST) and Preservation of Rare and Endangered Species (RARE).

Given the documented impairment to the federally-listed green sturgeon, we request re-analysis of the TMDL to ensure adequate protection of beneficial uses and to facilitate recovery of this species."

Response: *We disagree. Please see responses to comments 5.2-5.8 below.*

Comment 5.2: "Numeric fish tissue targets insufficient to ensure species protection.

The proposed fish tissue target of 8.1 µg/g whole-body dry weight (dw) and 11.8 µg/g muscle tissue dw is approximately equivalent to, though slightly higher than, U.S. Environmental Protection Agency's (EPA) 2015 *Draft Aquatic Life Ambient Water Quality Criterion for Selenium – Freshwater* (Draft Criteria).

This value *(8.1)*, however, is considerably higher than the EC10 value considered protective of all fish, which is considered to be 5.0 µg/g.

When EPA last requested formal comment on aquatic life criteria for selenium from the U.S. Fish and Wildlife Service (USFWS) in 2005, which are generally consistent with the 2015 Draft Criteria …

USFWS concluded:

> … the proposed tissue value of 7.91 µg/g selenium (parts per million; EPA 2004) is not protective of fish or aquatic-dependent wildlife. In the study cited in the Draft Criteria Document (EPA 2004) as the basis for the 7.91 µg/g proposal (i.e., Lemly 1993), the lowest observed adverse effects (tissue) concentration (LOAEL) was <5.85 µg/g ... "

Response: *We disagree with the Commenter's conclusion that the proposed TMDL targets are not protective of the North Bay fish species. Relying on USEPA's freshwater criteria is appropriate.*

In derivation of the 2015 draft chronic freshwater criteria, USEPA considered sensitive and listed species, all recent scientific information and numerous data sets, and re-evaluated results of relevant toxicity studies in a systematic and comparable manner. The updated criteria now include white sturgeon data, which makes the draft criteria directly applicable to selenium-sensitive fish in the North Bay. In the process, USEPA elected to choose the more stringent threshold (EC10) instead of EC20, which has historically been used in the derivation of USEPA's criteria. The use of the 10 percent effect level makes the criteria more protective that they would otherwise be.

Therefore, the TMDL numeric target is protective of the most sensitive species in the North Bay, the white sturgeon.

The Commenter refers to the USFWS' comments and technical review of the USEPA 2004 draft criteria as the basis for requesting a lower fish tissue target of 5.0 µg/g. The new 2014 USEPA draft

criteria document has already addressed many of the original technical concerns and is based on different toxic endpoints and the new data. USFWS submitted comments on the 2014 USEPA draft criteria in a letter dated July 24 2014[1]. We reviewed the USFWS comments to better understand its position. After that review, we concluded that the USFWS concerns about the proposed draft fish-tissue criteria being too high result from: 1) a need to protect listed freshwater fish for which selenium toxicity data are mostly unavailable, and 2) concerns about risks to aquatic-dependent wildlife.

These concerns do not apply in the North Bay because it does not support freshwater fish. We also considered selenium exposure and risks to threatened and endangered fish and birds following the review by USFWS (2008)[2]. In this review, the estuarine and anadromous fish in a pelagic/planktonic food web (e.g., threatened delta smelt and longfin smelt) were not considered as vulnerable to selenium because of their life histories and absence of selenium-rich food items in their diet. The report showed that only clam-eating bottom feeders were directly exposed to selenium. White sturgeon was considered as a species "most at risk" and green sturgeon, as the most anadromous among sturgeon species and threatened overall, was considered "likely to be a species most at risk." Our evaluation of the exposure pathway for white and green sturgeon concludes that white sturgeon is more directly affected by selenium in the North Bay, and therefore the TMDL targets protective of white sturgeon are also protective of green sturgeon and all fish. See also response to Comment 5.6.

Comment 5.3: "Baykeeper recognizes the TMDL fish tissue targets are roughly consistent with EPA's Draft Criteria of 8.0 µg/g dry weight. However, since this criteria was just released in late-July 2015 and EPA never appeared to respond to USFWS critiques, revisions towards development of a final national criteria are likely.

Further, this criteria does not reflect the presence of sensitive or listed species and bases the measurement endpoint on the EC10 of fish that do not include the most sensitive fish species in the Bay-Delta, such as the green sturgeon.

… This *(EC10)* issue was partially targeted for critique by peer-reviewers of the 2015 Draft Criteria. For instance, when asked to comment on EPA's use of the effects concentration 10th percentile (EC10) as the measurement endpoint for the fish reproductive toxicity studies used to derive the egg-ovary element, Dr. Kevin Brix states":

> It is unclear to me why EPA has selected the EC10 as a measurement endpoint for these studies. … It seems to me that the ECx selected should be based on the level of protection EPA intends to provide and this is independent of variability in exposure… Given the above, I do not believe EPA has **provided a scientific rationale for use of the EC10 in a tissue-based criterion as providing an equivalent level of protection as an EC20 in a water-based criterion.**

[1] http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OW-2004-0019-0355

[2] U.S. Fish and Wildlife Service. 2008. Species at risk from Selenium Exposure in the San Francisco Estuary. USFWS, Sacramento Fish and Wildlife Office. Sacramento, California.

Response: *The draft criteria document was first released for public comment and the external independent scientific peer review in May 2014, not July 2015 as indicated by the Commenter. In July 2015, USEPA released the updated draft, which included only a slight change to the proposed tissue criteria. The revised whole-body concentration was lowered from 8.1 to 8.0 µg/g dw and the muscle tissue concentration was lowered from 11.8 to 11.3 µg/g dw, which makes the proposed criteria even more stringent but does not signify a major shift.*

The updated criteria (8.0 and 11.3 µg/g dw) now include the white sturgeon data, which makes the draft criteria directly applicable to selenium-sensitive fish in the North Bay and are protective of listed species such as green sturgeon. Table 3.1 in the USEPA criteria document identifies 14 acceptable reproductive studies with fish including one study with white sturgeon. The protectiveness of green sturgeon is also evaluated in the USEPA criteria document (See also response to Comment 5.4 and 5.6).

We have no knowledge regarding whether USEPA has responded to USFWS's critiques. However, the North Bay Selenium TMDL was circulated to USFWS along with other resource agencies during our public comment period, and we received no comments from these entities that the proposed numeric targets are not protective of North Bay fish species.

We also disagree with the Commenter's conclusion that the EC10 is somewhat inappropriate for protection of sensitive species based on Dr. Kevin Brix's statement in the scientific peer review. In fact, Dr. Brix was commenting on USEPA's decision to use EC10 to derive selenium criteria as inconsistent with the commonly-used EC20 as the preferred statistical endpoint for water-based toxicity assessments. Dr. Brix did not imply that the EC10 was under-protective and did not consider the USEPA draft criteria as being under-protective for the purposes of setting national criteria (Dr. Brix pers. comm. Sept. 10, 2015). Also, USFWS in their comment letter on the draft 2014 criteria document stated: …"we view EPA's transition to EC10 point estimates of toxic risks (rather than EC20 point estimates) for populating fish toxicity data set as a major improvement compared to EPA's 2004 proposal."

Comment 5.4: " … green sturgeon fed a diet maintaining Se concentrations within the range currently found in the North Bay had a 60% reduction in growth rates after 8 weeks of exposure. In contrast, growth rates in white sturgeon were unaffected, leading researchers to conclude:

> Our results showed that a dietary Se concentration at 19.7 ± 0.6 mg Se/kg, which is in range with the reported Se concentrations of the benthic macro-vertebrate community of the San Francisco Bay, had adverse effects on both sturgeon species … (De Riu et al. 2014).

To provide an appropriate level of protection, the Regional Board should consider either a more conservative level of protection for green sturgeon, the most sensitive species to selenium in the North Bay, or targeted monitoring to support a scientifically-sound fish-tissue target."

Response: *We disagree that more conservative targets are needed to protect green sturgeon in the North Bay. USEPA evaluated the results of the non-reproductive study by De Riu et al. (2014) and found that the whole-body EC10 values for green sturgeon ranged from 16.36 to 28.93 mg/kg and were higher than for white sturgeon. The assessment concluded that the draft whole-body concentration of 8.0 mg/kg dw was protective of green sturgeon. Specifically, USEPA concluded*

that "… the inclusion of the white sturgeon's EC10 in the dataset provides surrogacy for the threatened and endangered species from this group." The protectiveness of the numeric targets, white and green sturgeon exposure to selenium in the North Bay, and their habitat and life histories are explained in Chapter 3, Section 3.7 of the Staff Report.

Moreover, Prof. Moller, in his scientific peer review (see Appendix E) of the numeric targets for the North Bay, acknowledged that the fish tissue targets derived from the 2014 USEPA Draft Fish Tissue Criteria were fully protective of white sturgeon and the derivation of this target was sufficiently conservative to address protection of threatened green sturgeon.

We agree that a dietary selenium concentration of 19.7 ± 0.6 mg Se/kg (=µg/g) is within the range of concentrations found in the invasive clam C. amurensis; however such high selenium concentrations actually occur very rarely. The extensive monitoring of C. amurensis in Suisun Bay over the period of 2000-2010 found selenium concentrations ranging from 2 to 22 µg/g dw, averaging at 9.9 µg/g dw (n=498), with only 6 percent of all samples exceeding 15 µg/g dw. Given the high spatial and seasonal variability in density and abundance of C. amurensis in the North Bay, as well as the change in concentrations with time, the potential of dietary selenium levels in excess of 10 µg/g at any given time is low. For more details on sturgeon monitoring see response to Comment 5.5.

Comment 5.5: "Based on expert advice, white sturgeon monitoring data should not serve as a surrogate for the status of selenium concentrations in green sturgeon.

The on-going monitoring program results in a data set of low statistical power for selenium in white sturgeon and no data for green sturgeon. Given that green sturgeon are known to be more sensitive to selenium at levels currently found in in North Bay food sources, the Regional Board should develop a more robust monitoring program to either include green sturgeon in the monitoring program or enhance the existing white sturgeon monitoring program to ensure adequate statistical representation and ability to monitor the effectiveness of the TMDL."

Response: *Targeted monitoring of green sturgeon is not preferred because of its status as threatened under the federal Endangered Species Act and monitoring would involve a take of a listed species. White sturgeon monitoring is the best and only surrogate for green sturgeon (See also response to Comment 5.6).*

White sturgeon data from 1986 to the present was used in the development of the TMDL, and it is one of the most comprehensive datasets for this long-lived fish. While we continue to rely on the Regional Monitoring Program (RMP) to collect water and tissue samples at regular intervals, we are also actively engaged in conducting additional monitoring and applying innovative techniques to better understand selenium bioaccumulation in sturgeon. Finding a means to obtain a larger number of white sturgeon muscle samples on a more frequent basis without sacrificing the fish is a top priority. In 2009, in addition to standard analyses in sturgeon fillets, tissue plugs were analyzed as a nonlethal surrogate for sampling from a whole fish. This attempt to establish a nonlethal method was repeated in 2014 to obtain a larger sample size for more precise correlation of both types of samples. If plug sampling is found to be suitably accurate, it may form the standard method for future sample collection by the RMP and provide an opportunity to monitor white sturgeon non-lethally, through collaboration with the California Department of Fish and Wildlife (CDFW) and

other agencies. CDFW currently has an annual tagging program that is tracking population trends in sturgeon, and USFWS conducts a study on fish movement patterns, and additional sampling could occur as part of CDFW's tagging studies.

Prof. Janz, in his scientific peer review (see Appendix E), confirmed that ongoing monitoring using muscle plugs in sturgeon would increase the sample size and enhance the validity and accuracy of the modeling approaches used.

In addition, samples of fin rays were also collected in 2015, and we will be evaluating how they can supplement the monitoring effort. Fin rays have a regular growth pattern similar to growth rings of a tree and could be used to analyze selenium concentrations in each annular growth ring to assess life history of chemical exposure. Fin ray analyses could help understand the dynamics of selenium bioaccumulation and evaluate whether or not changes in selenium water chemistry and prey from year to year could be related to changes in tissue concentrations in sturgeon.

Comment 5.6: "Recent research indicates existing Se load is resulting in significant impacts to sensitive species. Based on available literature stating that existing selenium concentrations and, by proxy, ongoing loading rates, are resulting in significant impacts to the federally-listed green sturgeon, maintenance of current loads as the prescribed TMDL is not supported by available science or Basin Plan objectives." The Commenter states that white sturgeon cannot serve as a surrogate for green sturgeon.

Response: *We have evaluated the most recent scientific information and data, and conducted modeling to evaluate the impact of current loads on water quality and beneficial uses in the North Bay (see Staff Report). We found no compelling evidence to suggest that the existing loads adversely affect green sturgeon or that white sturgeon cannot serve as a surrogate for green sturgeon. The Commenter points to one particular study by Kaufman et al. (2008)[1] and provided the Water Board with other references to support their comments.*

We have considered the study by Kaufman et al. (2008) in the Background and Impairment Assessment section of the Staff Report. In this study, the authors tested effects of selenium on green and white sturgeon bioenergetics and concluded that green sturgeon exhibited greater sensitivity to selenium at the dietary dose of 20 µg SeMet/g. We do not dispute the sensitivity of green sturgeon to selenium. However, selenium concentrations and dose spacing (0, 20, 40, 80 µg SeMet/g) used in the experiment were too high to be applicable to the conditions in the North Bay and to accurately determine the toxicologically significant thresholds. Furthermore, the study focused on predator avoidance and reduced swimming performance rather than reproductive end points, which are the key for protection of fish. Experts suggest (Chapman et al. 2009)[2] that reproductive effects have

[1] Kaufman, R.C., Houck, A.G. and J.J. Cech Jr. 2008. Effects of dietary selenium and methylmercury on green and white sturgeon bioenergetics in response to changed environmental conditions. Presentation at the 5th Biennial CALFED Science Conference, October 22-24, 2008, Sacramento, CA.

[2] Chapman P.M., W.J. Adams, M.L. Brooks, C.G. Delos, S.N. Luoma, W.A Maher, H.M. Ohlendorf, T.S. Presser and D.P. Shaw. 2009. Ecological Assessment of Selenium in the Aquatic Environment: Summary of a SETAC Pellston Workshop. Pensacola FL (USA): Society of Environmental Toxicology and Chemistry (SETAC).

been linked to observed reductions in the populations of sensitive fish species in waterbodies having elevated concentrations of selenium, and, therefore, they provide a sound basis for the fish tissue criterion compared to non-reproductive endpoints.

We reviewed the references Baykeeper provided and note that Baykeeper cites a Final Rule and Notice from NOAA/NMFS establishing take prohibitions for the green sturgeon. The Final Rule clearly indicates that the resource agencies use effects observed in white sturgeon to assess risks to green sturgeon:

> *From 75 FR 30721, June 2, 2010*[1]
>
> *The accumulation of industrial chemicals and pesticides … in white sturgeon gonad, liver, and muscle tissues affects growth and reproductive development and results in lower reproductive success … Green sturgeon are believed to experience similar risks from contaminants, although their exposure may be reduced because a greater proportion of their subadult and adult lives are spent in marine waters (70 FR 17386, April 6, 2005). Pesticides may also indirectly affect green sturgeon through effects on their prey species.*
>
> *The discharge or dumping of toxic chemicals or other pollutants into waters and areas where Southern DPS fish occur would be expected to reduce their growth and reproductive success. Pollutants including mercury, selenium, and arsenic have been detected in white sturgeon gonad, liver, and muscle tissues and are believed to affect growth, reproductive development, and reproductive success (Fairey et al., 1997; Davis et al., 2002; Kruse and Scarnecchia, 2002; Greenfield et al., 2005; Webb et al., 2006). Again, the effects on green sturgeon are likely to be similar.*

Comment 5.7: "In the absence of species-specific data for the green sturgeon we encourage the Regional Board to either adopt the more protective 'generic fish (whole body)' fish tissue guideline of 5.0 μg/g, as well as an accompanying downward revision to the TMDL, or conduct species-specific studies to generate a protective fish-tissue target and associated TMDL."

Response: *The TMDL is designed to protect the beneficial uses of the North Bay and is focused specifically on protection of white and green sturgeon. The proposed targets represent the current understanding and knowledge of selenium bioaccumulation. Furthermore, the targets consider site-specific conditions and exposure pathways for fish, include conservative assumptions, and are protective of white and green sturgeon and all other fish species in the North Bay. Arbitrarily setting the target to a "fish tissue guideline of 5 μg/g" is not linked to the prevailing bioaccumulation pathway in the North Bay and is not supported by the USEPA draft criteria or scientific body of knowledge. See also response to Comments 5.2 through 5.6.*

Comment 5.8: "Likely increases in Se concentration associated with the BDCP not adequately analyzed. Given the significant concerns associated with the BDCP with respect to selenium concentrations in North San Francisco Bay, a more robust analysis within the TMDL of the

[1] Federal Register 75 (105): 30714-30730, June 2, 2010: Endangered and Threatened Wildlife and Plants: Final Rulemaking to Establish Take Prohibitions for the Threatened Southern Distinct Population Segment of North American Green Sturgeon.

consequences associated with increased Se concentrations from BDCP implementation and the impacts to listed species is warranted."

Response: *We disagree with the Commenter. We have evaluated the effects of San Joaquin River flow increases on selenium concentrations in the North Bay. The impact of the load increase from San Joaquin River on dissolved and particulate selenium concentrations in water column throughout the North Bay was simulated with the ECoS3 model and the modeling shows that selenium concentrations in the North Bay are likely to remain low and well below the TMDL target (Tetra Tech 2015)[1]. For example, in a conservative scenario of a 50 percent rise in the San Joaquin River inflows, the model simulated that monthly dissolved selenium concentrations in Carquinez Strait may increase by 0.001 to 0.05 µg/L. The predicted selenium concentrations in the North Bay will not exceed 0.2 µg/L, which is currently the maximum detected level in the North Bay. The modeled particulate selenium increases were similarly small, and particulate concentrations even declined below the existing concentrations during winter months, suggesting active removal of this more bioavailable form of selenium. Even factoring in this extreme scenario, the overall water column concentrations would only change slightly and would not exceed the TMDL water column target of 0.5 µg/L. See also response to Comments 4.1.*

[1] Tetra Tech, Inc. 2015. *Updates to ECoS3 to Simulate Selenium Fate and Transport in North San Francisco Bay*. February 2015.

Comment Letter No. 6: US Environmental Protection Agency (Region IX)

Comment 6.1: "We have reviewed the document and find that the technical analyses are rigorous and sound; we commend Regional Board staff on the detailed report to support the TMDL. We encourage the Regional Board's adoption of the package."

Response: *We appreciate U.S. EPA's support of the TMDL.*

Comment 6.2: "We are pleased that EPA's draft national recommended tissue criterion values are used as numeric targets, and believe they are reasonable and appropriate to use for the Bay. Throughout the draft staff report and proposed basin plan amendment, EPA's draft fish tissue values are described as 8.1 mg/kg (or µg/g) dw for whole body and 11.8 mg/kg dw for muscle, and reflect the values that were presented in EPA's May 2014 *External Peer Review Draft of the Aquatic Life Ambient Water Quality Criterion for Selenium – Freshwater*, EPA 822-P-14-001. In July 2015, EPA formally noticed the availability of an updated draft national recommended selenium fish tissue criterion in the Federal Register (80 FR 44350, Monday, July 27, 2015); the draft criterion can be found in EPA's *Draft Aquatic Life Ambient Water Quality Criterion for Selenium – Freshwater*, EPA 822-P-15-001. This EPA document includes a revised whole body fish tissue criterion value of 8.0 mg/kg dw and a muscle fish tissue criterion value of 11.3 mg/kg dw. We understand from discussions with you that the final documents for the selenium TMDL will reflect EPA's revised draft national recommended fish tissue values."

Response: *We acknowledge the USEPA support for incorporating the draft aquatic life criteria as numeric targets for the TMDL. The references to the numeric targets throughout the Staff Report (specifically in Table 5 and Table 7) and in the Basin Plan amendment Table 7.2.4-1 have been revised, and the TMDL targets for the North Bay now reflect the updated whole-body target of 8.0 µg/g dw and the muscle tissue target of 11.3 µg/g dw. The estimates of water column concentrations protective of clam eating fish (Table 8) have been revised to reflect the updated fish tissue target of 8 µg/g dw.*

Comment 6.3: "In Chapter 4, Numeric Targets, both fish tissue (whole body and muscle) and water column values are proposed as TMDL targets; we strongly support this multi-media approach. The (revised) tissue-based targets reflect the dietary bioaccumulation of selenium in the aquatic environment, and are derived from EPA's draft egg/ovary national recommended criterion for the protection of reproductive endpoints through maternal transfer. If the (revised) fish tissue values are translated into water column values using the USGS Ecosystem-Scale model with site-specific data, the water column values should be equally protective of reproductive endpoints for this system. As discussed in Chapter 3, the (revised) targets will likely protect all known sensitive fish species in the North Bay, including clam-eating fish such as white and green sturgeon."

Response: *Comment noted.*

Comment 6.4: "In Chapter 4, Numeric Targets, the USGS Ecosystem-Scale Model is used to determine the water column numeric target; we strongly support the use of this model to determine appropriate water column values … " The USEPA comments that we use a different TTF for Corbula than is used by USGS in the model and asks that we review in more detail the USGS

approach and consider using the same TTF value for Corbula in the calculation of bioaccumulation to upper trophic species.

Response: *In derivation of the site-specific factors for the USGS Ecosystem –Scale Model, we closely followed the recommendations provided in the USGS documents and the USEPA 2015 Draft Criteria document. TTF (Trophic Transfer Function) defines the ability of a species to accumulate selenium from dietary exposure and reflects species-specific physiological coefficients such as: assimilation efficiency, ingestion rate and efflux rate (i.e., selenium excretion or loss). The 2015 Draft Criteria document recommends approaches to derive TTFs. The TTFs can be established based on: 1) experimental studies, 2) physiological coefficients from the literature, and 3) from paired field measurements of selenium concentrations in an organism and the associated particulate material. In order to translate from a fish tissue concentration to an allowable water column concentration, USEPA (2015) calculated TTFs from physiological coefficients, when available.*

We opted to assign the TTF value of 8 for C. amurensis based on available physiological coefficients, which is one of the recommended methods, from studies published in the scientific journals and representing the conditions and species in the North Bay (Schlekat et al, 2002, Lee et al, 2006)[1]. The authors evaluated the influence of geochemical and biological factors on selenium bioaccumulation in C. amurensis and determined physiological bioaccumulation coefficients under salinity, temperature, and phytoplankton species present in San Francisco Bay. The estimates of TTFs based on the above studies range from 3.6 to 8.0 and are listed in Supplemental Table B (Presser and Luoma 2010)[2]. We consider the selected TTF of 8.0 for C. amurensis as the most appropriate value that is also environmentally protective.

Comment 6.5: "In Chapter 5, Source Analysis, Table 9, Sources and Loads of Selenium in the North Bay, includes an estimated load of 520 kg/yr from "Runoff from local tributaries." It is not clear from the analysis whether this estimate includes permitted stormwater discharges that discharge directly into the North Bay. All dischargers to the North San Francisco Bay with a NPDES permit should be addressed in the source analysis and wasteload allocation sections. Please include any stormwater discharges clearly in the analysis and include wasteload allocations for each of them."

Response: *We appreciate the comment so that we can explain our perspective on stormwater discharges. The load of 520 kg/year from runoff from local tributaries includes urban and non-urban runoff delivered to the North Bay. There is no widespread use of selenium, there are no anthropogenic sources of selenium in the North Bay watershed, and the conceptual understanding of selenium generation and transport does not indicate that urban runoff conveyances are contributing*

[1] Schlekat, C.E., Purkerson, D.G. and S.N. Luoma. 2004. "Modeling Se bioaccumulation through arthropod food webs in San Francisco Bay, California, USA". *Environmental Toxicology and Chemistry* 23(12): 3003–3010.
Lee, B.G., Lee, J.S. and S.N. Luoma. 2006. "Comparison of Se bioaccumulation in the clams *Corbicula fluminea* and *Potamocorbula amurensis*: a bioenergetic modeling approach." *Environmental Toxicology and Chemistry*, 25(7): 1933–1940.
[2] Presser, T.S. and S.N. Luoma. 2010a. "A methodology for ecosystem-scale modeling of selenium". *Integrated Environmental Assessment and Management*, Vol. 6, 685–710. Supporting Material.

any additional selenium load. We evaluated the hypothetical loads associated with residential, commercial and industrial land uses (Staff Report: Table 18 and 19) using land use-specific average concentration data derived from BASMAA and SWAMP studies. The overall load is small at 148 kg/year, and we consider it insignificant. Moreover, the concentration data from stormwater conveyance systems are lower than the SWAMP data, which represent watershed concentrations, suggesting that the stormwater conveyances are not sources of selenium.

Comment 6.6: USEPA expressed a concern about the loading estimated for the Central Valley. They comment that the loading in Table 9 of Chapter 5 is calculated using dissolved selenium water column data from 1993 – 2012, and particulate selenium data from 1995 – 2003. They are concerned that these estimates do not reflect recent past and current Central Valley loading which has been decreasing since the late 1990s, as required by the selenium TMDLs for the San Joaquin River, Grassland Marshes and Salt Slough, and that loads since 2010 from the San Joaquin River have been consistently lower than in the late 1990s and 2000s (around 2,000 lbs/yr or less, or approximately 900 kg/yr or less). They recommend reviewing the information and data from more recent years to estimate current loads for the TMDL analyses.

Response: *We have reviewed the information and data from recent years to calculate the load estimates for the Central Valley watershed. The loads in Table 9 were calculated with the USGS dissolved selenium concentration data measured near Vernalis from 2007 through 2013 and the DSM2 Delta outflow model for the 1993-2012 flow period. The longer period (1993-2012) was used to capture inter-annual variability in flow. We will add the information on the period of concentration data used to Table 20, which incorrectly references the data source as Cutter and Cutter 2004.*

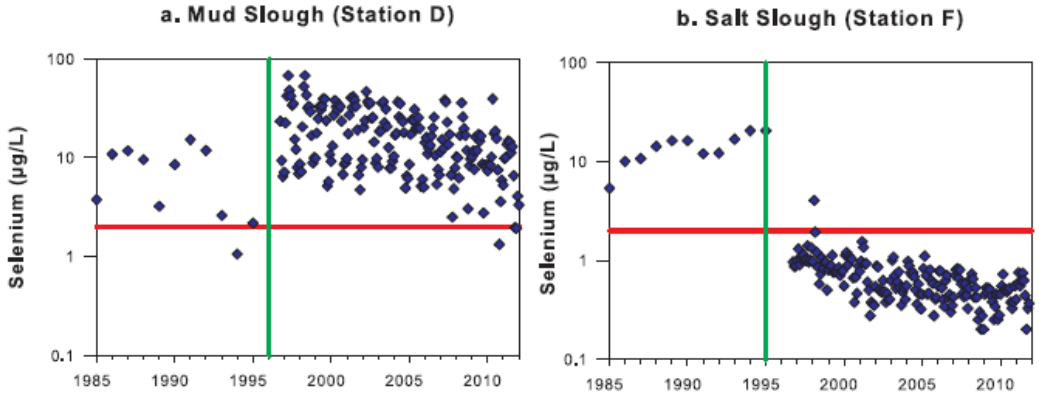
Our estimate of particulate selenium concentration for the Sacramento and San Joaquin Rivers is based on current data. To calculate the particulate selenium load from the Central Valley watershed, we used the only published results available at the time of the assessment (i.e., Doblin et al. 2006, average 0.64 µg/g). However, since then, samples collected during dry and wet seasons from 2010 through 2012 for the Selenium Characterization Study (Tetra Tech 2012)[1] showed that San Joaquin River particulate selenium concentrations ranged from 0.49 to 1.47 µg/g (average 1.0 µg/g), and Sacramento River concentrations were from 0.47 to 0.86 µg/g (average 0.61 µg/g). This latest information not only confirms that the original estimate was within the range of particulate concentrations found in the Sacramento and San Joaquin Rivers, but it also shows that the load represents the lower range of the current conditions. Because particulate selenium concentrations in riverine inputs are difficult to measure and a large variability in concentrations is expected, we think that the current conservative low estimate is appropriate.

We agree that substantial load reductions were achieved through the implementation of the Grassland Bypass Project and other actions in the San Joaquin River watershed. However, our evaluation of the selenium concentration data in the San Joaquin River at Vernalis (downstream from the Grassland watershed) shows that concentrations measured over the 2007-13 period

[1] Tetra Tech, Inc. 2012. *North San Francisco Bay Selenium Characterization Study.* Final Report. October 2012.

already reflect improvements in water quality. The average selenium concentration for this period is 0.57 µg/L and represents background selenium levels in the watershed.

As shown in an example figure below, the change in concentrations at the Grassland sampling locations at Mud and Salt Sloughs is gradual, and despite the large load reductions, concentrations in some drainages still remain in excess of 10 µg/L. It also shows that our range of concentration data (2007-13) is representative of the load reductions already achieved due to implementation of the Grassland Bypass Project.



Green bar (vertical) signifies the implementation of the Grassland Bypass Project
Red line (horizontal)represents the 2 µg/L reference conditions (From Grassland Bypass Project 2010-11, Chapter 12: Summary of Selenium Modeling Results from GBP 1996-2011)

Comment 6.7: "The BPA at Table 7.2.2-1, Numeric Targets for Selenium. …Subsequent discussion states that attainment of either the fish tissue targets or the water column target will be evaluated to assess protection of beneficial uses. This appears inconsistent with the technical analysis in the Draft Staff Report, which states that numeric targets are both the fish tissue values and the water column values, i.e., both tissue and water column targets must be attained. We strongly support a multi-media approach to ensure the Bay continues to support its beneficial uses over the long term, and to prevent any future exceedance of water quality standards. We recommend clarifying that achieving and maintaining both tissue targets and the water column target are necessary; should the water column values start to exceed the target, it is very likely that the fish tissue values will also exceed shortly thereafter."

Response: *We agree and that was the intent. The text of the Basin Plan amendment below Table 7.2.4-1 has been revised as follows:*

> ~~*Attainment of*~~ *Both* ~~*either*~~ *the fish tissue* ~~*or*~~*and the water column targets will be evaluated to assess protection of beneficial uses.*

Comment 6.8: "The BPA in section 7.2.4.5, Implementation Plan, under Petroleum Refineries, states that each refinery shall report its average annual load once per permit term (a 5 year term). Since wasteload allocations are in annual loads, we suggest annual reporting to ensure that loads are held to the assigned annual allocations or below."

Response: *Petroleum refineries are required to have numeric effluent limits and must comply with these limits on monthly basis. Monthly monitoring ensures that they meet their annual wasteload allocations.*

Additionally, the wasteload allocations were estimated over a five-year period and expressed as an annual average; therefore, the reporting requirement to estimate each refinery average annual load over a five-year period is consistent with the wasteload allocations.

Comment 6.9: "The BPA at Table 7.2.4-4, Individual Wasteload Allocations for Municipal and Industrial Dischargers … Each facility is required to verify once per permit term that its selenium loading is equal to or less than the assigned wasteload allocation identified in Table 7.2.4-4. However, it appears that these facilities discharge concentrations of selenium near the water column numeric target of 0.5 ug/L (Table 11, Draft Staff Report), and their combined mass exceeds 100 kg/yr. As a precaution to ensure this group of dischargers does not contribute to future selenium impairment, we recommend including implementation provisions designed to ensure dischargers are held to current levels or below on a more frequent basis than once per permit term, in order to ensure that beneficial uses will be maintained in the long term."

Response: *The wasteload allocations were estimated over a multi-year period to account for natural variability in loads. Therefore, the reporting requirement to estimate each discharger's average annual load over the permit period (usually 5 years) is consistent with the wasteload allocations.*

We determined that these dischargers have an insignificant impact on North Bay water quality and do not require further controls or load reductions. Please see the discussion in Chapter 7.1 Municipal and Small Industrial Dischargers in the Staff Report for detailed explanation. Also see response to Comment 1.1.

Comment Letter No. 7: Western States Petroleum Association

Comment 7.1: "… there are still some pending issues related to the variability in the TTFs as a result of dietary selenium concentration, and in turn, we recommend further evaluation of the appropriate sturgeon number(s) used in the TMDL. This would include consideration to use white sturgeon as well as generic/non-sturgeon-based numeric targets. Further refinement of these model parameters will help to result in a more scientifically defensible back-calculated water column numeric target for the Bay. Our attachment delves into greater detail on this issue."

Response: *Specific responses to this WSPA comment and those expressed in the Review and Evaluation of the Staff Report by GEI Consultants, Inc., & Windward Environmental, LLC, are provided below under Comments 7.4a through 7.4g.*

Comment 7.2: "In Section 5.1 on page 53, there is a gap in the two refinery data plots in Figure 21. WSPA would like to provide the data to fill those gaps, and have it incorporated into the graph."

Response: *The missing data have been incorporated into Figure 21 in the Staff Report.*

Comment 7.3: "WSPA recommends the Board amend the second paragraph on page 152, under the Monitoring section. We have provided the draft language below from the BPA in italic, with our requested amendments in underline/strikeout format."

> Monitoring of loads to demonstrate that there are no load increases inconsistent with ~~above~~ the wasteload allocations shall be conducted by petroleum refineries and municipal and industrial wastewater dischargers.

Response: *We agree with the Commenter. The text in the Basin Plan amendment Monitoring section has been revised as follows:*

> *Monitoring of loads to demonstrate that ~~there are no load increases above~~ they are consistent with the wasteload allocations shall be conducted by petroleum refineries and municipal and industrial wastewater dischargers.*

Technical Comments: GEI Consultants, Inc. and Windward Environmental, LLC

Comment 7.4a: "Overall, we believe that the various selenium EC10 estimates for white sturgeon are uncertain given the absence of complete effects data. However, the EC10s do appear to be conservative and therefore not inappropriate for deriving protective water selenium targets for this TMDL."

Response: We concur with the Commenter that the EC10s are appropriate for deriving protective selenium targets for the North Bay.

Comment 7.4b: "We recommend evaluating multiple food chain models, including a white sturgeon-specific model that relies on white sturgeon toxicity thresholds and exposure assumptions and a generic fish model that relies on whole-body selenium target (such as the EPA's draft criterion) and a food chain model that reflects the dietary habits of non-sturgeon species of interest

(such as an arthopod-dominated diet)." The Commenters then evaluated other food chain scenarios and discussed the potential water column concentrations.

Response: *See Chapter 4.2 and Chapter 6 in the Staff Report for an explanation why the clam-eating fish were considered as the most appropriate food web for derivation of the water column target. See also responses to Comments 7.4e and 7.4g.*

Comment 7.4c: " GEI/Windward made several comments in our 2013 review to the importance of understanding the difference between freshwater and marine systems as well as the dietary differences between "landward" and "seaward" sturgeon (i.e., white vs. green sturgeon) in order to ensure that the selenium partitioning model reflects these differences.

We believe that the Draft Staff Report works to better address these issues and hone in on the differences in species dietary and habitat preferences."

Response: *Comment noted.*

Comment 7.4d: The Commenters evaluated an alternative approach to using a K_d value for the purpose of establishing a water column target and stated that … "neither an alternative approach nor alternative *Kd* values are recommended given the nature of the available data. However, the existing data do suggest that the *Kd* values used in Baginska (2015) are conservative and provide an additional extra margin of safety in the numeric targets for selenium in the water column."

Response: *We acknowledge the Commenters' support.*

Comment 7.4e: "Appropriateness of approaches and assumptions used to develop the numeric targets. …. the water column target proposed for the TMDL may be lower than necessary to protect sensitive species within the Bay. Based on this modified analysis of sturgeon and non-sturgeon selenium EC10s, TTFs, and dietary fractions, the water column target could vary significantly from 0.71 (whole-body) to 3.3 µg/L (egg) and still be considered protective. This leads to a level of uncertainty in what an appropriate water column target should be."

Response: *The Commenters used the fish tissue target (8.1 µg/g-dw) and the USGS modeling approach with a range of parameters discussed in the Staff Report, the 2015 USEPA draft criteria document, and other studies to document possible water column targets protective of white sturgeon and generic fish species. Depending on the food-web and the choice of parameters, the Commenters calculated the allowable selenium concentrations for sturgeon and non-sturgeon fish species in the range of 0.52-3.3 µg/L (white sturgeon) and 0.52-1.6 µg/L (generic fish).*

We recognize that different inputs used in the modeling would result in a range of allowable water column concentrations. However, given the inherent uncertainties and simplifying assumptions in the translation methodology, it is appropriate to set the allowable water column concentrations to conservative values. We consider the TMDL water column target of 0.5 µg/L as protective of all known sensitive fish species including clam-eating fish such as white and green sturgeon and, therefore, sufficiently conservative for the North Bay.

Comment 7.4f: "As these loads are currently attainable, there should not be any difficulties with attaining these loads in the future. Although, we would recommend, if not already underway, that an evaluation is completed as to whether or not the proposed load allocations would make future permit limits for selenium difficult to meet."

Response: *The numeric effluent limits proposed in the TMDL are based on current performance and therefore attainable. The petroleum refineries have demonstrated in the past that they were committed to lowering selenium loads and to maintaining and improving their performance in the future. With the growing use of renewable energy, there is no evidence to suggest that the loads from refineries should increase in the near future.*

Comment 7.4g: "… there are still some pending issues related to the variability in the TTFs as a result of dietary selenium concentration, and in turn, we recommend further evaluation of the appropriate sturgeon number(s) for use in the TMDL, including potential consideration for the use of a white sturgeon- as well as generic/non-sturgeon-based numeric targets. Further refinement of these model parameters will help to result in a more scientifically defensible back-calculated water column numeric target for the Bay."

Response: *We acknowledge that there is inherent variability in the parameters used in the modeling, which is why the TMDLs must include a margin of safety to address uncertainty in the analyses. The selection of the appropriate parameter values is explained in the Staff Report (Chapter 4.2), and the derivation of the water column target reflects the available data and knowledge in the peer-reviewed scientific literature.*

The scientific basis for establishing the numeric targets for the TMDL and the assumptions used in the translation from fish tissue to water column concentrations underwent independent scientific peer review by experts in the field, Professors David Janz and Gregory Moller (Appendix E). The peer reviewers offered strong support for the choice of targets and the application of the translation methodology. Further evaluation or adding numeric targets for white sturgeon or generic/non-sturgeon-based numeric targets, as proposed by the commenter, are not necessary.

PART II

STAFF RESPONSE TO PEER REVIEW COMMENTS ON THE STAFF REPORT AND BASIN PLAN AMENDEMENT DRAFTS (June 16, 2015)

Peer Review Comments from Dr. David Janz, Professor, Department of Veterinary Biomedical Sciences, University of Saskatchewan, Canada, July 10, 2015

Overall assessment:

> There will always be uncertainties in assessing the ecological risks associated with selenium, and perhaps more than any other trace element some form of site-specific assessment is required. This document provides such site-specific assessment in a scientifically defensible and rigorous manner by taking into account specific hydrological, geochemical, ecological and physiological attributes of the North Bay and surrounding watershed. Overall, in my opinion the scientific portion of the proposed rule is based upon sound scientific knowledge, methods, and practices.

Response: *We appreciate the reviewer's comments and his assessment of the draft TMDL report as comprehensive, scientifically defensible and making use of current understanding of selenium sources, distribution, trophodynamics, and toxicity in freshwater and saltwater ecosystems.*

The revisions resulting from the peer review comments (Comment 1 through 6 below) were reflected in the July 24, 2015, draft Staff Report circulated for public comment.

Specific Comments:

Comment 1: Selenomethionine (SeMet) is the major (60-80% of total Se) species of Se in consumer organisms such as benthic invertebrates, fish, and birds, and thus represents an important form of Se in the environment (as the "environment" includes both biotic and abiotic components, including humans). The Fan et al. (2002) paper reported this earlier, and a more recent study could also be considered (Janz *et al*. 2014. *Integrated Environmental Assessment and Management* 10, 543-554). Thus, the "aquatic cycling of selenium" also includes the important biotransformation of inorganic Se to organoselenium by primary producers. In fact, SeMet can be present at significant concentrations in solution, especially in saltwater. Refer to Cutter's work on this topic. If this section is referring specifically to the abiotic/inorganic phases of Se cycling, then this should be stated. Otherwise I suggest incorporating the importance of organoselenium formation and incorporation (e.g., biofilms).

Response: *Information on selenomethionine and specific references mentioned by the reviewer were added to section discussing properties and speciation of selenium in the environment. The*

biotransformation of inorganic selenium by primary producers and aquatic cycling of selenium is discussed in Section 6.1: Importance of Particulate Selenium in Managing Ecological Exposure.

Comment 2: …"the presence of sulfate ions that may prevent the interaction of SeMet with proteins". This is an incorrect statement.

Response: *The statement was corrected.*

Comment 3: Throughout the document Se concentrations are expressed as dry weight, as is the convention, but all of a sudden here they are expressed as wet weight. Is this a typo? If not then using 75% moisture these levels are 4-times greater in dry weight and this might change your conclusions. I suggest being consistent using dry weights and if not available convert to dry weight for comparison. Also in Figure 14, what is meant by "tissue"? Muscle? Be specific. Liver is a tissue, as is ovary. Then on page 37 top, Se concentrations are presented with no ww or dw designation. Be consistent throughout the document when reporting Se concentrations!

Response: *Selenium concentrations in muscle tissue of diving ducks are expressed as wet weight for comparison with the OEHHA Fish Contaminant Goals (FCGs) to evaluate whether consumption of waterfowl poses risk to human health. The OEHHA FCGs are expressed as wet weight and the North Bay was originally listed as impaired because a health advisory was issued against consumption of diving ducks.*

The caption in Figure 14 was revised to clearly state that it shows the muscle tissue concentrations and the appropriate designations added to the text on page 37.

Comment 4: Page 37 last sentence: this is pure speculation and should be removed. The subject of Se tolerance is of great interest but to my knowledge has not been shown.

Response: *A reference was added to provide a source for the statement.*

Comment 5: Ongoing monitoring using muscle plugs in sturgeon, as described in the document, will increase the sample sizes from different areas of the Bay and allow for a more accurate predictive model. It is recommended that this be an ongoing initiative and priority, to enhance the validity and accuracy of the modeling approaches used.

Response: *Comment noted.*

Peer Review Comments from Dr. Gregory Moller, Professor of Environmental Chemistry and Toxicology, University of Idaho, Moscow, ID, July 27, 2015.

Overall assessment:

> In my opinion, the scientific portion of the proposed rule is based upon sound and well accepted peer-reviewed scientific knowledge, methods, and practices in our understanding of the complex ecotoxicology of selenium. By leveraging the 2014 USEPA Draft Aquatic Life Freshwater Criteria approach, the present report harmonizes that effort with the current TMDL task. The references used and cited in the development of the North SF Bay TMDL and the target fish tissue and water column Se levels, and the models used represent our best understanding of selenium dynamics and potential risk in this estuarine system. The overall approach is conservative. It is protective of beneficial uses, ecosystem health, wildlife, and human health.

Response: *We appreciate the comments and the reviewer's acknowledgement of the protectiveness of the proposed TMDL targets, quality of the estimates of selenium loads from different sources, and state-of-the art modeling used to evaluate selenium dynamics and environmental risks in the North Bay.*

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PART III

STAFF-INITIATED CHANGES TO DRAFT STAFF REPORT AND BASIN PLAN AMENDMENT

Water Board staff made insignificant editorial changes to the Staff Report, intended to clarify or correct the July 24, 2015, draft. These include correcting punctuation and other typographic errors, deletion of outdated information and references, and related minor wording changes.

Other staff-initiated changes are described below:

1. We added a wasteload allocation to the Basin Plan amendment Table 7.2.4-4 for one additional industrial discharger: C&H Sugar Company-Crockett WWTP. The estimated allocation is 0.5 kg/year. This increased the total wasteload allocation for municipal and industrial (non-refinery) wastewater dischargers from 116 to 117 kg/year (Table 7.2.4-2 and 7.2.4-4). Sections 5 and 6 in the Staff Report were revised accordingly.
2. Page 30: Outdated text and reference were deleted.

~~In addition, the assumed optimum concentration of 1 µg/g-dw is lower than the natural background concentrations found in fish from areas where selenium is attributed to natural geologic sources (Eisler 1985).~~

3. Page 35-36: Text was deleted that was incorrect and a discussion of liver selenium concentrations in birds was deleted as it is no longer relevant.

The concentrations of selenium in greater scaups in 2002 and 2005, on average, did not exceed 5 µg/g-ww; the levels in San Pablo Bay and Suisun Bay were slightly higher in the most recent samples than in 1986-1987 (average: 2.5 µg/g-ww). ~~Nevertheless, the results show that typically, for both species, selenium concentrations in 2002-2005 were lower in most regions of the Estuary than in the peak concentration years of the late 1980s~~.

~~A similar reduction in selenium concentrations in aquatic birds from Central Valley has been detected in the Grasslands area, which is affected by selenium, from 1986 to 2005. Paveglio and Kilbride (2007) reported that selenium concentrations in the livers of mallards, pintails, coots and stilts from the North Grasslands declined by 38 percent to 68 percent throughout the 20-year period. For birds collected in the North Grasslands in 2005, the average concentrations of selenium in livers varied from 5 to 8.5 µg/g-dw. The 95 percent confidence intervals (7.1 – 11 µg/g-dw) were highest in black-necked stilts. The authors affirmed that all 95 percent confidence intervals for the 2005 data from the North Grasslands were below the potential reproductive impairment range of 20 to 30 µg/g-dw derived from the US FWS data.~~

4. Staff Report Page 88: A statement was added to clarify the potential difference in particulate selenium speciation from riverine versus estuarine sources.

Speciation of particulate selenium from riverine sources may differ from particulate selenium in the Bay.

5. Staff Report Page 117: An informational statement was added to clarify the status of bird egg monitoring.

Bird egg monitoring for selenium is currently conducted by the Regional Monitoring Program and is expected to continue.