Comment Summary and Responses

Comment Deadline: February 12, 2016

Amendment to the Water Quality Control Plan for the San Francisco Bay Basin to Establish a Total Maximum Daily Load (TMDL)and Implementation Plan for Selenium in North San Francisco Bay.

List of Commenters:

Comment Reference	Organization	Representative(s)
1	California Water Impact Network (CWIN) and California Sportfishing Protection Alliance (CSPA)	Carolee Krieger and Bill Jennings
2	General Public	Robert C. Kaufman and Ann G. Houck
3	Partnership for Sound Science in Environmental Policy (PSSEP)	Craig S.J. Johns
4	San Francisco Baykeeper (SF Baykeeper)	Ian Wren and Erica A. Maharg
5	US Environmental Protection Agency (U.S. EPA)	Janet Hashimoto
6	Western States Petroleum Association (WSPA)	Kevin Buchan

No:	Author	Comment	Response
1	**CWIN & CSPA**	We are concerned that the final version of the Selenium TMDL North San Francisco Bay Basin Plan Amendment contains a selenium fish tissue and water column objective that is not adequately protective of the most at-risk endangered species- federally-listed green sturgeon. We urge you to reject the Basin Plan Amendment and direct the Regional Board to return with selenium objectives that will protect the beneficial uses of Rare and Endangered Species (RARE) and Estuarine Habitat (EST) objective to a level that is protective of green sturgeon and other species. We incorporate by reference the September 8, 2015 and the February 12, 2016 comments on this issue by San Francisco Baykeeper to the San Francisco Regional Water Quality Control Board and the State Water Resources Control Board, respectively. In summary: • The Status quo approach proposed in the Proposed TMDL is insufficient to ensure species protection • The TMDL fails to consider best available science regarding selenium exposure and risk • The TMDL Fails to consider literature regarding margins of safety necessary to achieve TMDL objectives	We disagree that the fish tissue and water column TMDL targets are not protective of the green sturgeon. Green sturgeon are less at risk than white sturgeon because they only spend a fraction of their long lives in the Bay and, when in the Bay, they do not feed on prey that are high in selenium. As a point of clarification, the TMDL does not propose selenium water quality objectives, instead we developed TMDL targets; TMDLs require a quantitative numeric target to implement existing water quality standards. U.S. EPA is working on developing selenium water quality criteria for San Francisco Bay that will update the California Toxics Rule.[1] These criteria are expected to be completed and available for public review in June 2016. It will take time for the criteria to be finalized. We plan on re-evaluating the TMDL, in light of the final criteria promulgated by U.S. EPA, to make sure that the TMDL numeric targets are protective of the new standards. The TMDL was developed based on the best available science, considered the relevant scientific literature, includes a margin of safety and calls for monitoring to ensure protection of sensitive species. The TMDL fish tissue target was based on U.S. EPA draft criteria which were develop through a 10-year scientifically robust process. The water column target was derived using a USGS model developed for U.S. EPA which is protective of all fish including sturgeon. U.S. EPA strongly supports our scientific approach and the TMDL regulatory components. We have previously responded to SF Baykeeper's comments dated September 8, 2015, in Response to Comments November 18, 2015, pages 10 through 16,

[1] http://www3.epa.gov/region9/water/ctr/

		• Monitoring is insufficient to determine protection of sensitive species	http://www.waterboards.ca.gov/sanfranciscobay/board_info/agendas/2015/November/6_appendix_d.pdf . We address SF Baykeeper's February 12, 2016, letter in Comments 4.1 to 4.22 below. Comments submitted by CWIN and CSPA were also raised by SF Baykeeper (Comments 4.1 to 4.22) and Dr. Kaufman and Ms. Houck (Comments 2.1-2.3). Please also see responses to those comments below.
2	**Robert Kaufman and Ann Houck**	**Comment**	**Response**
2.1		We agree with the conclusion that white sturgeon are relatively insensitive to selenium exposure compared to other fish species. The inclusion of white sturgeon tissue data does add applicability to the proposed standards but may not be protective of the most sensitive species in the North Bay given that white sturgeon are less sensitive than other species of fish, including green sturgeon, to SeMet. The data generated in the CALFED study not only corroborated that white sturgeon are relatively insensitive to selenium, but demonstrated that green sturgeon show a marked difference, and sensitivity, in their response to selenium exposure.	Regional Water Board staff acknowledges the comment. However, white sturgeon has been determined to be one of the most sensitive species among the fish included in derivation of the U.S. EPA draft criteria, which makes the draft criteria directly applicable to selenium-sensitive fish in North Bay. In the process, U.S. EPA elected to choose the more stringent threshold (EC10) instead of the EC20, which has historically been used in the derivation of U.S. EPA's criteria. The use of the 10 percent effect level makes the criteria more protective than they would otherwise be. Based on the available data and assessment of exposure pathways the proposed numeric targets are protective of white and green sturgeon and all fish in North San Francisco Bay (North Bay). For a detailed explanation demonstrating the species that are both sensitive to selenium and for which there is an exposure pathway in the North Bay, see the TMDL Staff Report, Chapter 3 Background and Impairment Assessment. In addition, see responses to comments 2.2 and 2.3 below.

2.2		After an 8-week exposure to dietary levels of 80 and 40 mg/kg SeMet green sturgeon mortality was 8% and 22% respectively with no mortality in the white sturgeon juveniles fed identical diets. These data document marked differences between these two sturgeon species and brings into question the suitability for using white sturgeon as a surrogate for green sturgeon response to SeMet exposure….The lowest dose of SeMet used in this study is at a concentration that has been found in the North Bay and the data suggest that NOEC and LOEC levels are much lower than 20 mg/kg SeMet. These data suggest that white sturgeon would not be suitable as a surrogate species.	Regional Water Board staff acknowledges the value of the unpublished study (Kaufman et al. 2008)[2] as it was one of the first efforts to compare white and green sturgeon responses to selenium. As noted in Dr. Kaufman's letter and stated previously by the Regional Water Board staff, we do not dispute the sensitivity of green sturgeon to selenium. However, we maintain that the selenium concentrations and dose spacing (0, 20, 40, 80 mg SeMet/kg) used in the experiment were too high to be environmentally applicable to the conditions in North Bay, and to accurately determine the toxicologically significant thresholds in this water body. Concentrations in *C. amurensis*, although high and showing strong spatial and seasonal variation, never exceeded 22 mg/kg during the last 15 years of monitoring. Three monitoring stations in Suisun Bay: 8.1 (West), 4.1 (East) and 415.1 (North) show annual averages ranging from 7.1-14.2 mg/kg 2000-09), 6.2-14.0 mg/kg (2001-09) and 9-10.6 mg/kg (2001-03), respectively, with averages for all years of 11.8, 7.9 and 9.6 mg/kg. Only 3 out of more than 500 samples were ≥ 20 mg/kg, the lowest dose in this study, and none of the measured concentrations ever approached 40 or 80 mg/kg. The study (Kaufman et al. 2008) did not test reproductive impacts that are considered to be most representative and linked to impacts observed in most sensitive fish populations.
2.3		Adoption of reproductive indices to protect species inhabiting selenium contaminated waters is prudent for species that spend all, or a majority of their lifespan in these waters. While applicable to white sturgeon there is little to no overlap between the two sturgeon species given green sturgeon's subadult and adult oceanic life history. Pre-spawn green	Staff concurs with the information provided in the comment letter describing the reduced selenium exposure pathway for green sturgeon, as a result of habitat and life history characteristics. Our conclusion regarding protection of green sturgeon under the proposed TMDL targets is based on assessment of the risk of exposure combined with sensitivity. All of Dr. Kaufman's information from this letter was considered in our assessment. In summary, factors leading to

[2] Kaufman, R.C., Houck, A.G. and J.J. Cech Jr. 2008. (unpublished) 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.

		sturgeon adults enter the system in late winter and rapidly migrate through the system to the available upper reaches of the Sacramento River. Larvae and juveniles migrate down river to the estuary where they rear and grow for 1-4 yrs. until they reach a saltwater tolerant size. At this point out migration to the ocean occurs. Green sturgeon spend a majority of their life in the ocean environment with some movement into estuaries along the west coast, USA. Once sexually mature, sDPS green sturgeon adults migrate into the Sacramento River system every 3-5 yrs to spawn. Post spawn adults often spend several months within the Sacramento River near their spawning sites. Increased river flows in the fall trigger an ocean-bound migration. Generally, white sturgeon, are primarily an estuarine species spending the majority of their life in the estuary with little to no ocean forays. This raises the question of the proposed criteria having any applicability at all to protect the listed sDPS green sturgeon population. Tracking and monitoring studies have demonstrated that returning green sturgeon adults spend little time within the North Bay thus limiting their exposure and tissue burdens of SeMet for maternal transport to eggs. SeMet exposure as juveniles, 1-4 yrs or more, within the contaminated estuary is the greater	lowering the risk of selenium exposure in green sturgeon are as follows: • Green sturgeon is the most anadromous among sturgeon species and spends prolonged periods of time in the ocean; • Pre-spawn green sturgeon adults enter the estuary in late winter and rapidly migrate through the system to the available upper reaches of the Sacramento River; • Tagging and acoustic data confirm that mature green sturgeon do not feed or rear in the Bay and therefore do not consume selenium-rich *C. amurensis* as they return to fresher waters to spawn; • Maternal transfer and reproductive effects are considered the main reason for any potential decreases observed in sensitive fish populations. Consequently, the potential for maternal transfer of selenium into developing eggs prior to green sturgeon spawning is low, and much lower than for white sturgeon because of the reduced exposure routes described above; • Juvenile green sturgeon exhibit a diversity of movement patterns, spending time in various parts of the Delta, all Bay segments and the coastal waters[3]. As compared with white sturgeon, which primarily consume *C. amurensis*, green sturgeon have diverse diets, comprised of shrimp, mollusks, amphipods, small fish and clams; • Green sturgeon is sensitive to selenium, but the level of sensitivity amongst sturgeons is not well documented. For example, U.S. EPA evaluated the results of the non-reproductive study by De Riu et al. (2014)[4] and found that the whole-body EC10 values for green sturgeon ranged from 16.36 to 28.93 mg/kg, which are far above the TMDL target of 8.0 mg/kg; • Scientific peer reviews supported the Regional Water Board 's assessment of green sturgeon protection by the proposed TMDL: *The challenge of providing a level of protection for the threatened Green Sturgeon is well addressed using White*

[3] Kimley et al. 2015. Sturgeon in the Sacramento–San Joaquin Watershed: New Insights to Support Conservation and Management. San Francisco Estuary and Watershed Science, 13 (4).

[4] Riu, ND., Lee, JW., Huang, SSY., Moniello, G. and SSO. Hung. 2014. Effect of dietary selenomethionine on growth performance, tissue burden, and histopathology in green and white sturgeon. Aquatic Toxicology. 148: 65-73.

		concern. While the available data on SeMet exposure and response in white and green sturgeon are limited they do exist and should be included in the development of protection criteria. All data collected to date support a single conclusion that green sturgeon are much more sensitive, to SeMet, than the more resistant white sturgeon.	*Sturgeon data and the numerous conservative approaches and assumptions used in developing the numeric TMDL from available data, key scientific studies and state-of-the art modeling*. (Prof. Gregory Moller, University of Idaho) and *Appropriate levels of conservatism have been employed at several steps to adequately assess potential risks to "beneficial uses". In my opinion the document has demonstrated, based on the current hydrological/geochemical/ecological/physiological knowledge of the North Bay and of the behavior of selenium in freshwater and estuarine systems, that the TMDL is scientifically sound.* (Prof. David Janz, University of Saskatchewan) • Selenium does not associate with proteins and there is no evidence of progressive accumulation of selenium with size and age of fish, which may explain the relatively low concentrations in white sturgeon compared to concentrations in *C. amurensis*; • Green sturgeon during the first 1-4 yrs that they spend in the Bay are at lesser risk than white sturgeon due to less exposure to selenium in their diets. More information on the issue of why we consider white sturgeon a surrogate for green sturgeon in the context of this TMDL is provided in the response to comment 4.20.

3	PSSP	Comment	Response
3.1		PSSEP strongly supports the State Board's approval of the Selenium TMDL Basin Plan Amendment, and we wish to acknowledge the extraordinary effort of the San Francisco Regional Water Quality Control Board staff in developing the TMDL and implementation plan. The hard work and dedication of Ms. Barbara Baginska to develop the Selenium TMDL, work with all of the interested parties, and address the comments and concerns of U.S. EPA Region IX were particularly noteworthy and appreciated.	Comment noted.
3.2		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.	Staff acknowledges and agrees that there is uncertainty about future selenium loading from the San Joaquin River watershed.
3.3		The provisions of the Selenium TMDL require ongoing, future monitoring of selenium impacts by all NPDES permittees in the region, and PSSEP certainly supports these obligations. It is important to note that fully 77% of all selenium that loads to North San Francisco Bay derives from upstream, out-of-region sources, and are thus not subject to the regulatory reach of the San Francisco Regional Water Board. To address this fact, the Selenium TMDL Basin Plan Amendment provides:	Comment noted.

		"The Water Board will work with the State Water Board and Central Valley Water Board through their planning 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 regulatory processes." (Selenium TMDL Basin Plan Amendment at p. 7.) PSSEP supports the inclusion of this language and strongly urges the State Water Board to set in motion all appropriate steps to incorporate the *spirit* if not the *letter* of the provision above, to ensure that any parties whose actions may increase selenium loading to the Delta (and therefor, ultimately, to North San Francisco Bay) are not only required to ***monitor*** for such discharges, but to ***abate*** and thereafter ***remediate*** any such increased loads. Without doing so, these reasonably anticipated increased selenium loads may have a profound and negative effect on the North San Francisco Bay ecosystem.	
4	**SF Baykeeper**	**Comment**	**Response**
4.1		Baykeeper recognizes the difficulties of addressing selenium (Se) enrichment from diverse sources, as well as the confounding effects of biomagnification in the benthic macro-vertebrate community.	Comment noted.

4.2		Recent research indicates current conditions are resulting in significant impacts to resident white sturgeon (*Acipenser trasnmontanus*), as well as the more Se-sensitive and federal-listed green sturgeon (*Acipenser medirostris*).	We disagree. See responses to comments 2.1, 2.2 and 2.3.
4.3		The Regional Board's decision to maintain the existing selenium load through the Proposed TMDL process ignores volumes of peer reviewed literature and government reports, 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).	We strongly disagree. We reviewed all the existing available information and peer-reviewed literature in developing the TMDL including the articles and experts SF Baykeeper cites in its letter. After a thorough review of these sources, we concluded the TMDL is protective of all beneficial uses, including estuarine habitat and preservation of rare and endangered species.
4.4		Given the documented impairment to the federally-listed green sturgeon, and numerous other species, due in part to existing Se contamination, we request re-analysis of the Proposed TMDL to ensure adequate protection of beneficial uses and to facilitate recovery of this species.	The TMDL is adequately protective and does not require re-analysis. SF Baykeeper has not provided any information that has not been considered in the technical analysis supporting the TMDL. See responses to comments 2.1, 2.2, 2.3. See also the TMDL Staff Report Chapters 3 and 6.
4.5		Baykeeper is also concerned that stakeholder engagement on this Proposed TMDL over the past 10+ years has largely been limited to discussions between the Regional Board and oil refinery representatives.	This statement is incorrect. As pointed out by SF Baykeeper, the proposed TMDL was developed over a long period of time, and involved extensive stakeholder outreach. In 2007, SF Baykeeper was invited to be a member of the Advisory Committee for the TMDL, and SF Baykeeper's staff participated in the original interview conducted by the Center for Collaborative Policy (CCP) to inform the TMDL process. SF Baykeeper chose not to get engaged formally in the subsequent TMDL development. Though an intern representing SF Baykeeper (Rosalind Becker) did attend at least one technical meeting. The Center for

			Collaborative Policy was brought in to facilitate development of the TMDL and ensure stakeholders were adequately informed and had a voice in the TMDL process. The Center interviewed representatives from environmental and conservation groups, technical specialists, regulatory agencies and affected dischargers to obtain their views on the selenium TMDL. The Stakeholder Assessment Report prepared by CCP, meeting summaries, and Advisory Committee documents and technical reports are posted at the Selenium TMDL project web page (http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/TMDLs/seleniumtmdl.shtml) A series of stakeholders meetings open to the public and advertised through the Regional Water Board's email subscription list was conducted when key technical milestones were reached. Most recently, on March 3, 2015, the Regional Water Board staff held a public workshop to discuss the proposed TMDL and a CEQA scoping meeting. SF Baykeeper was notified of this meeting but did not attend.
4.6		We can find no evidence to suggest Regional Board staff sought the input of readily available international experts on selenium contamination, located in local USGS offices, UC Davis and elsewhere, to support this Proposed TMDL. Nor were the recommendations of these experts, as found in peer-reviewed literature and available technical reports, taken into consideration in the monitoring and modeling components on this Proposed TMDL.	This statement is unfounded. Throughout technical analyses and preparation of the technical reports, we sought input from the experts in the field to help resolve complex scientific questions and prepare the most durable and sustainable TMDL. We convened a Technical Review Committee (TRC) including Dr. Sam Luoma (USGS), Prof. Nicholas Fisher (Stony Brook University), John Oram (formerly San Francisco Estuary Institute), and Dr. Regina Linville (OEHHA). The TRC reviewed the key technical reports: Conceptual Model, Recommendations for Numerical Model Development and Application of ECoS3 Model, and provided advice to the Advisory Committee. Evidence of the TRC members and selection process was posted on the TMDL website and readily available to interested parties. We followed recommendations from TRC members and our TMDL incorporated data from the peer-reviewed literature and available technical reports as can be seen in the robust literature cited. Also see response to comment 4.7 below.
4.7		It appears all technical reports in support of	This statement is unfounded. Technical analyses and the key reports

		this Proposed TMDL were prepared by consultants of Western States Petroleum Association, with no apparent third party review of these particular documents, despite the availability of leading experts within the region, such as Dr. Samuel Luoma and Dr. Theresa Presser.	prepared in support of the proposed TMDL were written by Tetra Tech, Inc., and underwent an extensive review by TMDL stakeholders and experts in the field. Our TRC experts included: • Dr. Sam Luoma (USGS), • Prof. Nicholas Fisher (Stony Brook University), • John Oram (formerly San Francisco Estuary Institute), and • Dr. Regina Linville (OEHHA). Dr. Bill Beckon from USFWS also participated in the TRC meetings and helped with the interpretation of the sturgeon-specific toxicity data. Regional Water Board staff followed the development of the EcoSystem-Scale selenium model and discussed with Dr. Presser issues related to implementation of the model. At the conclusion of the review of the report on application of the ECoS3 model prepared by Tetra Tech with support from Dr. Shannon Meseck (NMFS) and Dr. Gregory Cutter (Old Dominion University), Dr. Luoma stated: I very much respect the serious and thorough effort to address the quite knotty problems raised by comments. By participating in the building of this model we all have learned a great deal about Se in the Bay that can be constructively applied to the TMDL. The ECoS3 modeling results were subsequently published in Estuaries and Coasts (Journal of the Coastal and Estuarine Research Federation). [5]
4.8		Peer review of the Proposed TMDL itself was limited to scientists located out of state and it is not clear whether they were asked to review supporting technical reports or supporting data.	Peer reviews are conducted according to Health and Safety Code section 57004. The peer reviewer's responsibility is to determine whether the scientific findings, conclusions, and assumptions are based upon sound scientific knowledge, methods, and practices. Peer reviewers are asked to review the Basin Plan amendment and TMDL Staff Report. However, all reports are made available to the peer reviewers.

[5] Chen, L., Meseck, S.L., Roy, S.B., Grieb, T.M. and B. Baginska. 2012. "Modeling fate, transport, and biological uptake of selenium in North San Francisco Bay". *Estuaries and Coasts,* v. 35 (6): 1551-1570

			The Regional Board staff has no influence over who is selected as peer reviewers. It is precisely because of the previous involvement of Dr. Sam Luoma in the development of technical documents for the TMDL, that he could not have been engaged as a peer reviewer of the proposed basin plan amendment. The State Water Board peer review process identified national or internal experts on selenium that have the experience and knowledge to make an informed and unbiased assessment of the TMDL.
4.9		Status quo approach proposed in the Proposed TMDL is insufficient to ensure species protection. The Proposed TMDL assumes a 'hold the line approach', partly due to comparison of a small dataset of Se fish tissue concentrations, which the Regional Board felt did not significantly violate the [U.S. EPA's] 2015 *Draft Aquatic Life Ambient Water Quality Criterion for Selenium – Freshwater* 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 the [U.S. EPA] Draft Criteria.	The cited values for the proposed fish tissue targets are incorrect. The proposed targets are: 8.0 µg/g dw and 11.3 µg/g dw. (see Table 5 in the TMDL Staff Report dated November 18, 2015). They are identical to the 2015 U.S. EPA Draft Criteria. SF Baykeeper refers to implementation of the TMDL as representing a status quo approach. The purpose of the TMDL is to create a cap on selenium loads to North San Francisco Bay to ensure that loads do not increase in the future, and to prevent increases of selenium concentrations in fish and water column. This is appropriate to ensure ongoing protection of beneficial uses and attainment of the TMDL targets.
4.10		This value [TMDL target of 8.1ug/g], however, is noticeably higher than the EC10 value considered protective of all fish, including green and white sturgeon under low flow conditions, which is considered to be 5.0 µg/g. Further, the [USEPA] Draft Criteria falls short of considering site-specific data and literature indicating reproductive impairment of white	This issue was previously raised before the Regional Water Board. See Response to Comments November 18, 2015, Comment 5.2. The value of 5 µg/g is not an approved water quality standard but rather a generic fish (whole-body) guideline used by USFWS. In the Ecosystem-Scale modeling in support of U.S. EPA criteria development for the San Francisco Bay-Delta Estuary, Presser and Luoma (2010, Table 5) list EC05 and EC10 levels in white sturgeon derived by USFWS for protection of species at risk in the Estuary [6]. Green sturgeon is not listed in Table 5.

[6] Presser, T.S. and S.N. Luoma. 2010. *Ecosystem-Scale Selenium Modeling in Support of Fish and Wildlife Criteria Development for the San Francisco Bay-Delta Estuary, California.* Administrative Report to USEPA, December 2010.

		sturgeon (and by proxy, green sturgeon) is already occurring.	For sturgeon, two tissue targets were evaluated by USGS, 5 and 8 µg/g. The current thinking by U.S. EPA is that 8.0 µg/g is the appropriate threshold and that was the basis for the TMDL target. USGS is supporting U.S. EPA in their development of a San Francisco Bay selenium standard. SF Baykeeper is arguing for the Regional Water Board to arbitrarily choose a threshold. USFWS staff was notified of the availability of the TMDL and Basin Plan amendment for public comment. However, we received no comment from the USFWS that the 8.0 µg/g TMDL target was under-protective for green sturgeon. The knowledge base around selenium in sturgeon and the Bay has increased dramatically over the last decade and our current TMDL fish tissue target is based on the most recent science that takes into consideration the earlier studies SF Baykeeper cites. The proposed TMDL establishes numeric targets rather than water quality objectives and the TMDL can be re-opened at any time if lower selenium standards are promulgated by the U.S. EPA. We anticipate that the U.S. EPA will issue its site-specific criteria for selenium in San Francisco Bay for public comment in June, 2016, but promulgation of the final criteria could take some time. The U.S. EPA is required to formally consult with the USFWS and NOAA/NMFS and, to our knowledge, the U.S. EPA has been working with these agencies. Regional Water Board staff is not required to formally consult with these resource agencies.
4.11		Impacts from selenium in North San Francisco Bay have been well documented over the last 30 years – with expert findings indicating significant risk to wildlife… *Historic and more recent data show that*	SF Baykeeper includes a citation from Presser and Luoma (2013, page 3-4) [7] summarizing available information on selenium impacts. This paper is cited as a background reference throughout the TMDL Staff Report; staff also considered, evaluated and cited multiple studies referenced within the citation provided by SF Baykeeper. We also provided

[7] Presser, T.S. and S.N. Luoma. 2013. "Ecosystem-scale selenium model for the San Francisco Bay-Delta Regional Ecosystem Restoration Implementation Plan". San Francisco Estuary and Watershed Science, 11(1).

		certain predator species are considered most at risk from Se in the Bay-Delta (e.g., white and green sturgeon, scoter, scaup) because of high exposures obtained when they consume the estuary's dominant bivalve, Corbula amurensis, an efficient bioaccumulator of this metalloid … *Endangered Species Act requirements led to a number of species being determined as jeopardized by Se in the Bay-Delta under a proposed chronic aquatic life Se criterion of* ***5 µg L-1***[emphasis added] *(USFWS and NOAA Fisheries 2000), including green sturgeon (Acipenser medirostris) and its surrogate white sturgeon (Acipenser transmontanus)….* *Recent analysis by the USFWS (2008a) of 45 species assume the species most at risk depended on benthic food webs: ... green sturgeon; and white sturgeon.* In light of findings expressed in readily available literature and data, maintenance of current Se loads is not protective of existing beneficial uses.	detailed explanation highlighting the species that are both sensitive to selenium and for which the exposure pathway exists in North San Francisco Bay (see TMDL Staff Report, Chapter 3 Background and Impairment Assessment). We agree that the existing water quality objective of 5 µg/L in San Francisco Bay may not be fully protective of beneficial uses. That is why the proposed TMDL establishes a water column target for selenium, which is an order of magnitude lower than the currently applicable objective - **0.5 µg/L**. Neither NOAA/NMFS nor USFWS expressed concerns regarding the protectiveness of the fish tissue or water column targets. We acknowledge that green sturgeon is sensitive to selenium, however green sturgeon are less at risk than white sturgeon because they only spend a fraction of their long lives in the Bay and, when in the Bay, they do not feed on prey that are high in selenium. In the 2008 review by USFWS [8] [referred in the comment as USFWS (2008a)] white sturgeon was considered as a species "most at risk" and green sturgeon, whereas the most anadromous among sturgeon species and threatened overall, was considered only "likely to be a species most at risk." Hence, we consider white sturgeon to be directly exposed and susceptible to selenium in North Bay and to be a good surrogate for green sturgeon.
4.12		The [U.S. EPA] Draft Criteria, which Regional Board staff has used to support the rationale for the fish-tissue target in the Proposed TMDL, has not undergone public or interagency review,(*emphasis added*) is clearly	We are at a loss as how to interpret the statement (underlined) by the Commenter that the U.S. EPA Draft Criteria has not undergone public or interagency review. Even the reference material attached to SF Baykeeper's comment letter includes External Peer Review of the Draft Aquatic Life Ambient Water Quality Criterion for Selenium-Freshwater

[8] 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.

		marked with the disclaimer "Do not distribute, quote or cite", and appears to have not fully characterized the results of recent studies regarding green sturgeon impacts. In addition, the [USEPA] Draft Criteria does not consider the basic question of whether the selection of an EC10 value is actually protective of sensitive and listed species.	2014. The availability of the draft criteria document for public review was also announced in Federal Register, first on May 14, 2014, (79 FR 27601) and the revision on July 27, 2015 (80 FR 44350). In the revised 2015 criteria document, the 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 made the proposed criteria even more stringent. As previously stated (see Responses to Comments November 18, 2015 by the Regional Water Board, Comment 5.2), in derivation of the 2015 draft chronic freshwater criteria, U.S. EPA considered sensitive and listed species, all recent scientific information and numerous data sets, and re-evaluated the 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, U.S. EPA elected to choose the more stringent threshold (EC10) instead of EC20, which has historically been used in the derivation of U.S. EPA's criteria. The use of the 10 percent effect level makes the criteria more protective.
4.13		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 [U.S. EPA] Draft Criteria comments included: *… 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 ...* The quote challenged the protectiveness of	This issue was previously raised before the Regional Water Board. See Response to Comments November 18, 2015, Comments 5.2 and 5.3. Despite the similarity between the value of the fish tissue criterion proposed by the U.S. EPA in 2004 (7.91 µg/g) and in 2015 (8 µg/g dw in whole-body) the new draft criterion was developed using different data, scientific rationale and approach, and these two criteria cannot be directly compared. In addition, SF Baykeeper refers to the USFWS' comments and technical review of the U.S. EPA 2004 draft criteria as the basis for requesting a lower fish tissue target of 5.0 µg/g in this current TMDL. The U.S. EPA 2004 draft criteria document was superseded by the 2014 draft criteria and is now, superseded by the new 2015 draft criteria, which has addressed many of the original technical concerns. It is based on different toxic endpoints and on new data.

		7.91 µg/g and proposed a tissue concentration less than 5.8 µg/g to provide an appropriate level of protection for aquatic organisms and wildlife.	
4.14		And just prior to the release of these comments, USFWS presented a technical review of U.S. EPA's Draft Tissue-Based Selenium Criterion, including a critique of California's draft tissue-based criterion - strongly suggestive that regulators were influenced by Central Valley water contractors to rely on EPA's draft document and the associated fish-tissue criteria: *In California, water users within the federal Central Valley Project are citing the draft 7.9 µg/g tissue-based criterion as scientific support for seeking relaxed environmental terms and conditions on long-term water contract renewals that, once negotiated, would not be renewed again for at least 25 years (56-57). Decisions that may be irreversible for decades to come are being proposed based on the presumed scientific soundness of EPA's draft tissue-based chronic criterion for selenium.*	We have no knowledge about the statement referred to here regarding the federal Central Valley Project citing the draft 7.9 µg/g criterion as a reason for relaxing environmental terms and conditions in water contract renewals. The 2015 U.S. EPA draft criteria document is based on the most current understanding of the science and data related to selenium. Also, see response to Comment 4.13 above.
4.15		Although a copy of the Proposed TMDL was circulated to USFWS and USGS, no formal consultation or personal request to comment was solicited to ensure the TMDL reflects site-specific conditions or appropriate species protections. As a result, no comments on the Proposed TMDL were received from any	Prior to release of the draft TMDL Staff Report for scientific peer review, the Regional Water Board staff met with U.S. EPA, USGS, USFWS and NMFS to discuss the Regional Water Board's approach to setting the fish tissue numeric targets for the TMDL, and the translation of the targets to protective water column concentrations. Those agency staff did not express concerns about the protectiveness of the fish tissue target proposed for the TMDL. In addition, USGS has been supporting U.S. EPA

		agency other than EPA.	in the development of criteria for selenium for San Francisco Bay. As pointed out in SF Baykeeper's comment, the TMDL Basin Plan amendment and supporting staff report were circulated for public review twice, once in July 2015 and again in January 2016. These opportunities for public participation did not generate any comments from USFWS or USGS.
4.16		Further, the Draft 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.*	This issue was previously raised before the Regional Water Board. See Response to Comments November 18, 2015, Comment 5.3. In conclusion, external peer reviewers of the draft criterion document did provide a rationale for using the EC10 value so the U.S. EPA was supported in using this metric. As acknowledged by SF Baykeeper, Dr. Brix's statement did not imply that the EC10 was under-protective and he did not consider the U.S. EPA draft criteria as being under-protective for the purposes of setting national criteria. Similarly, Prof. Fisher's comment about the use of EC10 did not imply that this effect level was inappropriate (*personal communication, February 17, 2016*). Dr. Brix and Prof. Fisher were among seven external expert peer review panelists providing comments on the May 2014 "External Peer Review" version of the draft criterion document. All other panelists clearly stated that the use of EC10 endpoints was scientifically defensible, appropriate and consistent, with one of the panelists stating: I agree with this logic for using the EC10 as the measurement endpoint for tissue-based toxicity values, where this effects statistic can be derived. I also agree with the use of an EC10 rather than a no-observed effect concentration (NOEC), lowest-observed-effect concentration (LOEC), or geometric mean of the two, for the reasons discussed in the draft AWQC document. [9] In response to comments received from the peer review panel, U.S. EPA provided a detailed explanation on why the EC10-based criterion is protective of fish and the need for more stringent endpoint, EC10 rather

[9] External Peer Review of the Draft Aquatic Life Ambient Water Quality Criterion for Selenium – Freshwater 2014. Contract No. EP-C-12-021, Work Assignment 1-43. September 25, 2014 This document is included in the reference material provided by SF Baykeeper.

		In the Regional Board's response to comments on the Proposed TMDL, personal communications with Dr. Brix confirmed this statement did not imply that the EC10 was under-protective and that he did not consider the USEPA draft criteria as being under-protective for the purposes of setting national criteria. Dr. Brix was not asked, however, to weigh in on whether the standard was appropriate for site-specific conditions -where listed species maintain critical habitat and where selenium-related impacts have been documented. EPA still has not provided rationale as to the use of the EC10 value and the Regional Board did not evaluate whether managing North San Francisco Bay in a manner that places approximately 10% of listed sturgeon species at significant risk is appropriate. When asked the same question regarding the use of the EC10 standard, Dr. Nicholas S. Fisher (Distinguished Professor & Director, Consortium for Inter-Disciplinary Environmental Research, Stony Brook University) simply replied: "Strikes me as rather arbitrary".	than EC20, for selenium. Just part of the U.S. EPA explanation is given below: When considering the use of the EC10 versus the EC20, an EC10 was determined to be a more appropriate endpoint for tissue based criteria given the nature of exposure and effects for this bioaccumulative chemical. EC20s have historically been used in the derivation of EPA criteria applicable to the water medium. While water concentrations may vary rapidly over time, tissue concentrations of bioaccumulative chemicals are expected to vary gradually. Thus, where concentrations of selenium in fish tissue are used as an effect threshold, there is potential for sustained impacts on aquatic systems, relative to chemicals that are not as bioaccumulative. This calls for use of a lower level of effect to attain sufficient protection. [10] The Regional Water Board agrees with draft U.S. EPA guidance that the EC10 was an appropriate threshold metric, and that a 10% effect for white sturgeon are acceptable. We disagree that the use of the EC10 means that 10% of listed species will be at significant risk. See also responses to comments 1, 2.3 and 4.12.
4.17		While EPA did consider some of the recent research on green sturgeon, the conclusions derived in the Draft Criteria do not seem consistent with those made by the authors of	This issue was previously raised before the Regional Water Board. See Response to Comments November 18, 2015, Comment 5.4. See responses to comments 1 and 2.3 for an explanation of how we

[10] EPA Response to External Peer Review Comments, September 25, 2015 (http://www.epa.gov/sites/production/files/2015-10/documents/epa-response-external-peer-review-comments-selenium.pdf)

		the cited study. For instance, EPA's Draft Criteria claims: *The De Riu et al. (2014) study suggests that green sturgeon may be more sensitive to selenium than white sturgeon and also that the draft EPA whole body concentration of 8.0 mg/kg dw will be protective, based on the survival and growth data and the observation that the control whole body tissue concentrations are similar to the proposed criterion.* It is true that the whole body concentrations in the control group were similar to the proposed criterion. After 8 weeks of dietary exposure at levels present in North San Francisco Bay selenium concentrations in sturgeon was 7.1 µg/g and those in white sturgeon were 5.6 µg/g versus draft criteria of 8 µg/g. However, 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-*	evaluated the risk of green and white sturgeon exposure. In the study by De Riu et al. (2014)[11] juvenile green sturgeon (mean weight of 30±2 g) were exposed to constant dietary concentrations, which significantly exceeded the levels of selenium occurring naturally in the green sturgeon diet and were well above the concentrations found year-round in *C. amurensis*. For a discussion of concentrations in *C. amurensis* see response to comment 4.18 below. Additionally, green sturgeon acclimate before they are able to migrate into the seawater portions of natal estuaries, which can take one to one and a half years. Juveniles rear in Sacramento River and in the Delta before they can move to the estuary. During acclimation they are exposed to and feed on a variety of items. We are not aware of any evidence that selenium concentrations in the diet of green sturgeon in Sacramento River or the Delta are comparable to those used in the experiment. In Suisun Bay, the average concentrations in *C. amurensis* are from approximately 6 to 14 µg/g. The reason selenium concentrations in green sturgeon were higher than white sturgeon in this study is because the background selenium concentrations in the juvenile green sturgeon were elevated. At the initiation of the test, the green sturgeon selenium concentration was 7.2 µg/g. However, after 4 and 8 weeks of exposure to a control diet of 2.2 µg/g of Se, the concentrations in green sturgeon decreased, and were at 6.5 and 7.1 µg/g, respectively. At the same time, selenium in white sturgeon at test initiation was 4.8 µg/g and increased to 7.3 µg/g after 4 weeks, and was still higher at 5.6 µg/g after 8 weeks. Green sturgeon larvae for the experiment were obtained from artificially spawned captive fish. In the past, researchers excluded from statistical interpretation the selenium tissue burden samples from white sturgeon

[11] Riu, ND., Lee, JW., Huang, SSY., Moniello, G. and SSO. Hung. 2014. Effect of dietary selenomethionine on growth performance, tissue burden, and histopathology in green and white sturgeon. Aquatic Toxicology. 148: 65-73.

		vertebrate community of the San Francisco Bay, had adverse effects on both sturgeon species. However, the exposure had a more severe pathological effect on green sturgeon, suggesting that when implementing conservation measures, this federally listed threatened species should be monitored and managed independently from white sturgeon when developing conservation measures to protect this threatened SFBD population segment from Se exposure.	held in captivity for a prolonged time, that is 1 to 11 months (e.g. Linares et al. 2004).[12]
4.18		In the Regional Board's response to this comment *(4.12)*, this finding was dismissed by staff on the grounds that since "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'. USGS monitoring, however, indicates dietary selenium concentrations are nearly <u>always in excess of 10 µg/g</u> (*emphasis added*) at some monitoring stations. And at the Carquinez Strait (station 8.1), downstream of several major oil refineries, Se concentrations in *C. amurensis* approximates the 19.7 ± 0.6 mg Se/kg concentrations of concern for several consecutive months, particularly during low	In 2012, USGS[13] published the results of an approximately 15-year study which measured selenium concentrations in *C. amurensis* on approximately a monthly basis. Our conclusion matches the authors' statement in the report: "These monitoring data indicate that clam selenium concentrations ranged from a low of 2 to a high of 22 µg/g dry weight with strong spatial and seasonal variation over the period of study". The *C amurensis* data (see response to comment 2.2 for details) do not support the Commenter's claim that dietary selenium concentrations are nearly always in excess of 10 µg/g. At station 8.1, 11.2% of 257 samples exceeded 15 µg/g, which suggests that selenium concentrations in *C. amurensis* are usually much lower than 19 µg/g. In addition, selenium concentration in only one diet species does not correlate to impairment in sturgeon. Given the fact that white sturgeon

[12] Linares, J., Linville, R., Van Eenennaam, J. and S. Doroshov. 2004. *Selenium Effects on Health and Reproduction of White Sturgeon in the Sacramento-San Joaquin Estuary.* Final Report for Project No. ERP-02-P35 (contract No. 4600002881).

[13] Kleckner, A.E., Stewart, A.R., Elrick, K., and S.N.Luoma. 2010. *Selenium concentrations and stable isotopic compositions of carbon and nitrogen in the benthic clam Corbula amurensis from Northern San Francisco Bay, California: May 1995–February 2010*: U.S. Geological Survey Open-File Report 2010-1252, 34 p.

		flow conditions. Such observations are in conflict with statements made in the Proposed TMDL, including "Because selenium bioaccumulation is a long-term process, there is no evidence that selenium bioaccumulation is notably higher at any particular time of year, despite the strong seasonal variability in loads reaching the North Bay."	have a large home range, and many of the sturgeon remain year-round in San Pablo Bay (Beckon and Maurer 2008, p.30 [14]) and other parts of the estuary, it is appropriate to consider that their feeding grounds include more than one location. In addition, Presser and Luoma (2013) [15] in their modeling of selenium concentrations in a clam-based food web assumed a conservative diet of 50% clams and 50% benthic crustaceans for sturgeon. With selenium concentrations in crustaceans being generally below 3 µg/g (Stewart et al. 2004)[16] the conditions in which sturgeon will be constantly exposed to selenium in their diet exceeding 10 µg/g is therefore highly unlikely. Moreover, the assumptions of impairment based on concentrations in fish dietary items rather than the fish directly are highly uncertain. This is because neither does it takes into account biological transformations or ability of fish to regulate selenium concentrations in their bodies, nor does it prove the amount of selenium actually consumed, digested and assimilated. In 2004, a Science Panel helping to develop water quality standards for selenium in Great Salt Lake considered dietary thresholds that would prevent impairment of aquatic wildlife. The initially proposed dietary thresholds were subsequently abandoned in recognition of the fact that availability of food sources rich in selenium and selenium ingestion rates may be extremely variable; hence, measuring concentrations in dietary items may not provide the most sensitive indicator of birds' reproductive success. These concerns are also applicable to sturgeon feeding in North Bay.
4.19		The De Riu et al. (2014) study did not evaluate	The TMDL target was derived based upon substantial evidence and the

[14] Beckon WN and TC Maurer. 2008. *Unpublished Report: Potential Effects Of Selenium Contamination On Federally-Listed Species Resulting From Delivery of Federal Water to The San Luis Unit*. U.S. Fish and Wildlife Service, Sacramento Fish and Wildlife Office. Included in Reference Material provided by SF Baykeeper. wwwrcamnl.wr.usgs.gov/Selenium/Library_articles/Beckon_and_Maurer_Effects_of_Se_on_Listed_Species_SLD_2008.pdf

[15] Presser, T.S. and S.N. Luoma. 2013. "Ecosystem-scale selenium model for the San Francisco Bay-Delta Regional Ecosystem Restoration Implementation Plan". San Francisco Estuary and Watershed Science, 11(1).

[16] Stewart, A.R., Luoma, S.N., Schlekat, C.E., Doblin, M.A. and K.A. Hieb. 2004. "Food web pathway determines how selenium affects aquatic ecosystems: A San Francisco Bay case study". *Environmental Science and Technology* 38: 4519–4526.

		whether the proposed Draft Criteria was appropriate but did find that current conditions are insufficient to ensure protection for the green sturgeon. Accordingly, the Proposed TMDL is arbitrary and capricious on the basis it relies primarily on [USEPA] Draft Criteria, rather than site-specific data and expertise and it fails to incorporate a margin of safety necessary for protection of beneficial uses. To provide an appropriate level of protection for sensitive species and/or utilizing Se concentrations in bivalves as an indicator species, as well as a robust monitoring program, as articulated by USGS experts, to assess selenium exposure and risks in San Francisco Bay. …The Regional Board cannot show that it established the proposed TMDL based on the best available science and cannot claim the introduction of an adequate margin of safety because it failed to consider a wealth of data and literature regarding selenium exposure and risk in San Francisco Estuary, including data which indicates white sturgeon populations already exceed fish tissue criteria on a seasonal or inter-annual basis. Reports from the USFWS, for example, states "white sturgeon in the San Francisco Bay estuary are producing eggs with as much as 35-tmes normal selenium content" and "it is highly probable that these fish are reproductively impaired due to selenium exposure."	best available science. Regional Water Board staff considered all available research and data, and engaged local and out-of-State experts, including Dr. Sam Luoma (USGS), Prof. Nicholas Fisher (Stony Brook University), to help understand the conditions leading to selenium bioaccumulation, and help review models to forecast selenium cycling and transformations in North Bay. Baykeeper even acknowledges in the comment letter, "Baykeeper recognizes the difficulties of addressing selenium (Se) enrichment from diverse sources, as well as the confounding effects of biomagnification in the benthic macro-vertebrate community." To ensure a sound, conservative and protective approach, the TMDL was submitted for external technical peer review as required by California law (Health and Safety Code section 57004). Peer review includes a review of the consideration of available data and the soundness of scientific methods and practices that underlie the proposed Basin Plan amendment. The peer reviews concluded: …this document represents one of the most comprehensive, if not the most comprehensive, site-specific selenium assessments at a large-landscape level conducted worldwide. The scientists involved should be proud of the result. The list of participants involved reads like a "who's who" of selenium expertise. Notably, many are on the "conservation" side of the ecological risk assessment spectrum, which should provide stakeholders with confidence in the findings and conclusions of the document…(Prof. David Janz, University of Saskatchewan). The document includes an adequate margin of safety as required in a TMDL (Chapter 7 in the TMDL staff report). In addition, the TMDL represents average loads, rather than maximum measured loads, entering the North Bay, which contributes to the margin of safety. Also, desirable conservatism has already been incorporated into the proposed numeric targets that are based on EC10 endpoints, which represent the lower end of the precedent range of effect concentrations used nationally, and are based on maternal transfer and reproductive effects in fish that were linked to observed decreases in the sensitive fish

			populations. White sturgeon toxicity data was used to determine the EC10, recognizing that sturgeon is sensitive to selenium, and a closely related taxonomic surrogate for other endangered sturgeon. Monitoring of selenium concentrations in bivalves is useful but it is not a direct indicator of concentrations in fish. It is more spatially and temporally variable than fish concentrations, and, therefore, it is less desirable as the TMDL target to evaluate protection of fish. The 15+ year-long monitoring record has already determined concentrations in *C. amurensis* to be in the range of 5 and 20 µg/g for an extended period of loading and hydrologic conditions, and including extremely dry and wet years. For additional information about issues with relying on indicator prey species to infer condition of fish, see response to comment 4.18. In regards to our consideration of the best available science, the TMDL Staff Report alone contains 159 references, the majority of which are research articles published in peer-reviewed journals. The commenter did not identify a single a peer-reviewed article to justify this claim and articles cited by SF Baykeeper were already included in our TMDL Staff Report.
4.20		While Se impacts to white sturgeon have been documented on an on-going basis for some time in North San Francisco Bay, recent research has found the green sturgeon to be even more sensitive to Se exposure. The Proposed TMDL relies on the assumption that white sturgeon can serve as a surrogate for green sturgeon with respect to selenium exposure. This conclusion is taken out of context from an unpublished 2008 report from USFWS staff, who made a coarse generality regarding the absence of selenium data for green sturgeon at the time. Since that time, several studies have been carried out in the Bay-Delta, leading to presentation of research	This issue was previously raised before the Regional Water Board (See Response to Comments November 18, 2015, Comment 5.4, 5.5). As stated previously we do not dispute the sensitivity of green sturgeon to selenium but we disagree that the fish tissue and water column TMDL targets are not protective of the green sturgeon. Green sturgeon are less at risk than white sturgeon because they only spend a fraction of their long lives in the Bay and, when in the Bay, they do not feed on prey that are high in selenium. The TMDL was developed based on the best available science. It includes a margin of safety and calls for monitoring to ensure protection of sensitive species. The TMDL fish tissue target was based on U.S. EPA draft criteria which were developed through a 10-year scientifically robust process. The water column target was derived using a USGS model developed for U.S. EPA which is protective of all fish, including

		by one of the same biologists who made the 2008 statement calling for a revisionist stance on selenium and sturgeon. …National Marine Fisheries Service (NMFS) also recognizes "Recent studies have shown that green sturgeon are more sensitive to selenium than white sturgeon". …Other UC Davis researchers believe that the green sturgeon should be monitored and managed independently from white sturgeon and have announced that green sturgeon are more sensitive to selenium and concluded that white sturgeon are not an appropriate surrogate for green sturgeon in determining the effects of selenium.	sturgeon. U.S. EPA strongly supports our scientific approach and the TMDL regulatory components. In the 2008 review by USFWS [17] white sturgeon was considered as a species "most at risk" and green sturgeon, whereas the most anadromous among sturgeon species and threatened overall, was considered only "likely to be a species most at risk", due to differences in the life cycle. Typically, green sturgeon use the San Francisco Bay during their infrequent (every 3 to 4 years) spawning migrations up to 240 miles upstream the Sacramento River. The tagging and acoustic data confirm that mature green sturgeon do not feed or rear in the Bay but simply continue into natal rivers to spawn and therefore are less exposed to selenium toxicity. Consequently, the potential for maternal transfer of selenium into developing eggs prior to spawning is low. Regional Water Board staff followed the recommendations from the resource agencies in their determination that white sturgeon can serve as a surrogate for green sturgeon. The NOAA/NMFS Final Rule for establishing take prohibitions for the green sturgeon 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[18] 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.

[17] 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.

[18] 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.

			The discharge or dumping of toxic chemicals or other pollutants into waters and areas where Southern Distinct Population Segment (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. In addition, USFWS[19] in the review of potential effects of selenium on federally listed species suggests: : "Little is known of the risk of selenium to green sturgeon, but white sturgeon (*Acipenser transmontanus*), a representative surrogate species [emphasis added] for the green sturgeon, have been the subject of detailed studies within the San Francisco Bay estuary." And provides this explanation: …Considering the high bioaccumulation efficiency of Asian clams and their importance in the diet of white sturgeon any selenium reaching the estuary from upstream sources likely contributes to the exposure risk of white sturgeon. As selenium loads to the San Joaquin River and hence to the estuary are reduced over time due to implementation of selenium total maximum daily load limits [Central Valley TMDLs] and the Grassland Bypass Project, potential impacts to sturgeon due to delivery of water to the San Luis Unit should diminish. This suggests that in the absence of green sturgeon data, white sturgeon is an appropriate surrogate. It also attests that the existing load from the San Joaquin River, which signifies the largest single load to the North Bay (more than 50% of the Central Valley allocation of 4070 kg/year) does not exceed the assimilative capacity of North Bay.

[19] Beckon W.N. and T.C. Maurer. 2008. Potential Effects of Selenium Contamination on Federally-Listed Species Resulting From Delivery of Federal Water to the San Luis Unit. Prepared for the US Bureau of Reclamation (Agreement # 05AA210003). Included in Reference Material provided by SF Baykeeper.

4.21		In light of the fact that recent research indicates the federally-listed green sturgeon is likely experiencing significant impacts associated with selenium at concentrations found in their existing diet, we respectfully request the State Board to reject the status quo approach, in which the proposed TMDL is equivalent to the existing load to the Bay. Through failure to reflect best available science in this Proposed TMDL, as the Regional Board has done here, the decision approving the Proposed TMDL was arbitrary and capricious, an abuse of discretion, and/or otherwise not in accordance with law. *See, e.g., Northwest Environmental Advocates v. U.S. E.P.A*., 855 F. Supp. 2d 1199, 1217-18 (D. Or. 2012) (finding EPA approval of TMDL to be arbitrary and capricious where it failed to "use the best scientific data available" and ignored "historical changes to salmonid populations and river conditions").	The Regional Water Board incorporated the best available science in the TMDL, followed the U.S. EPA methodology to develop our TMDL fish tissue targets, and applied the USGS translation methodology to establish protective water column concentrations. The body of scientific information that forms the basis of this TMDL includes 159 references, input from local, world-renowned selenium experts, and independent scientific peer review. SF Baykeeper has not supplied new information that has not been considered in the development of the TMDL. The purpose of the proposed TMDL is to create a cap on selenium loads to North San Francisco Bay to ensure that loads do not increase in the future, and to maintain ongoing protection of beneficial uses. Upon receiving SF Baykeeper's September 8, 2015 comment letter on the proposed TMDL, Regional Water Board staff met with SF Baykeeper on November 4, 2015 to understand their issues, and explain in detail the scientific basis for the TMDL. Our responses to their comments are provided in the Response to Comments dated November 18, 2015, pages 10 through 16. The Regional Water Board's consideration of all available research regarding selenium impacts on green and white sturgeon – the best scientific evidence available - is quite the opposite of an "arbitrary and capricious decision" or "abuse of discretion." Also see response to comment 4.22 below.
4.22		Here, the Regional Board has not built into the Proposed TMDL a "margin of safety" because it has not taken into account the fact drought conditions in California are the "new normal", resulting in increased selenium concentrations in the water column, thus facilitating greater rates of bioaccumulation. Additionally, as discussed above, the Regional Board did not introduce an adequate margin of safety to account for heightened Se sensitivity in green	The margin of safety has been incorporated into the TMDL (see Staff Report Chapter 7.3). The TMDL targets expressed as fish-tissue and water column concentrations are conservative and protective of beneficial uses in North Bay. These targets are more ecologically relevant and protective than the existing chronic National Toxics Rule objective (5 µg/L), which represents predominantly direct exposure to selenium in water. The draft U.S. EPA criterion is more stringent than the effect levels observed in sturgeon, the fish of main concern in the North Bay. Additionally, in developing the draft chronic criterion, U.S. EPA used effect

		sturgeon, compared to white sturgeon.	concentration levels of EC10 rather than the traditional EC20, which lowered the estimated egg-ovary criterion from which the whole-body and muscle tissue concentrations were derived. Consequently, our TMDL target is conservative, is protective of sturgeon and all other fish species, and already incorporates an additional margin of safety by using the lower effect level of EC10. No data available to Regional Water Board indicate an increase in selenium concentrations as a result of the ongoing drought, and SF Baykeeper did not submit any data in support of this claim. Additionally, the response to comment 4.19 shows that desirable conservatism has already been incorporated into the proposed numeric targets to protect white and green sturgeon. The selenium TMDL was developed using the best available information and scientific understanding of hydrology, and chemical and biological processes leading to bioaccumulation of selenium in fish and wildlife. However, uncertainty remains with respect to the complexity of a natural system as large as the San Francisco Bay Estuary relative to the most sophisticated conceptual and numeric simulation models. Adaptive management allows for implementation of this TMDL based on our current understanding, and we will continue to improve our knowledge of long-term responses to current and future loadings of selenium to the North Bay. Federal regulations and guidance from U.S. EPA do not recommend or contemplate an unwarranted search for full scientific certainty, and a resolution of all uncertainties, before TMDLs can be adopted.
4.23		Implementation of the California Water Fix, or 'twin tunnels' project would exacerbate this issue further. Researchers have estimated that increased diversion of the Sacramento River (low Se concentrations) accompanied by	We disagree with the statement that particulate selenium will double. We have evaluated the effects of San Joaquin River flow increases on selenium concentrations in North Bay (Tetra Tech 2015)[20]. The impact of the load increase from San Joaquin River on dissolved and particulate selenium throughout North Bay was simulated with the ECoS3 model

[20] Tetra Tech, Inc. 2015. *Updates to ECoS3 to Simulate Selenium Fate and Transport in North San Francisco Bay.* February 2015 (http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/TMDLs/seleniumtmdl.shtml)

		greater inflows from the San Joaquin River (high Se concentration) to the Delta and the Bay could result in a doubling of particulate Se concentrations in the Bay. To account for observed shifts in Se exposure under variable flow conditions, researchers have recommended that protective Se concentrations in bivalves and fish should be based upon the most sensitive species (green and white sturgeon) at the most sensitive times (low flow dry years). Such analysis was conducted by leading experts, indicating the level of protection for sturgeon would equate to a fish tissue concentration of 5 µg/g Se, dw fish whole-body [Presser and Luoma 2013].	and the modeling shows that selenium concentrations in North Bay are likely to remain low and well below the TMDL target. For example, for a a 50% rise in the San Joaquin River inflows the model simulated that monthly dissolved selenium concentrations in Carquinez Strait only increase by 0.001 to 0.05 µg/L. These modeled selenium concentrations in North Bay do not exceed 0.2 µg/L, which is also below the current measured concentrations. In the 50% increase scenario, 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. The value of 5 µg/g is not an approved water quality standard but rather a generic fish (whole-body) guideline used by USFWS. In the Ecosystem-Scale modeling in support of U.S. EPA criteria development for the San Francisco Bay-Delta Estuary, Presser and Luoma (2010, Table 5) list EC05 and EC10 levels in white sturgeon derived by USFWS for protection of species at risk in the Estuary [21]. Green sturgeon is not listed in Table 5. Presser and Luoma (2013) [22] acknowledged at that time that the regulatory community was still debating appropriate critical tissue values that relate bioaccumulated selenium concentrations and toxicity in predators. As Baykeeper acknowledges, San Francisco Bay is a complex environment, and bioaccumulation in fish is a long-term process. Different elements of the sturgeon food web are experiencing shifts at any given time. For example, recent monitoring of changes in composition, abundance and distribution of benthic biota in upper San Francisco estuary detected that the critically dry year of 2014 was dramatically different from wet years in the past decade, such as 2006 and 2011. In 2014 a number of brackish-water species seen in wet years,

[21] Presser, T.S. and S.N. Luoma. 2010. *Ecosystem-Scale Selenium Modeling in Support of Fish and Wildlife Criteria Development for the San Francisco Bay-Delta Estuary, California.* Administrative Report to USEPA, December 2010.

[22] Presser, T.S. and S.N. Luoma. 2013. "Ecosystem-scale selenium model for the San Francisco Bay-Delta Regional Ecosystem Restoration Implementation Plan". San Francisco Estuary and Watershed Science, 11(1).

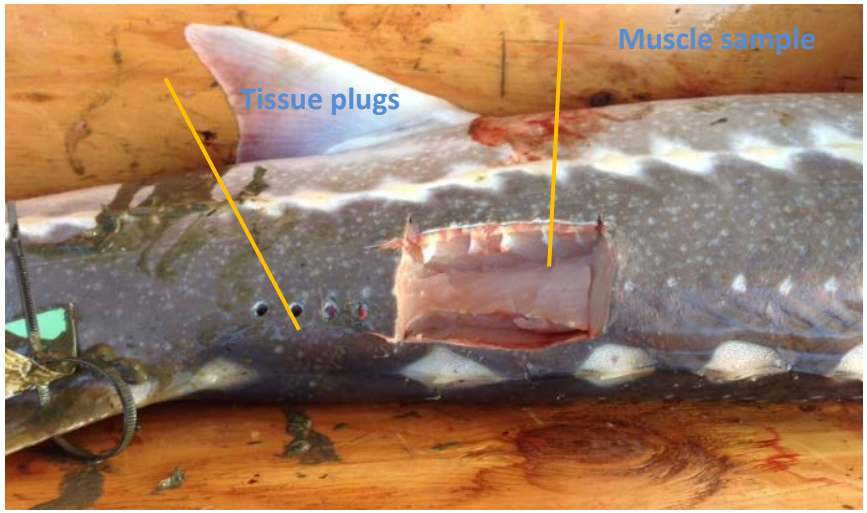
			such as *Potamocorbula amurensis [=C. amurensis*] and Synidotea laevidorsalis, were replaced in 2014 with more marine species (Wells 2015). [23] Moreover, the volumetric proportion of clams found in white sturgeon guts during the 2012-13-period was almost 50% lower than in sturgeon caught in 2001-03 (Zeug et al. 2014).[24] 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.
4.24		Moreover, in approving the Proposed TMDL, the Regional Board ignored policies that require adequate reasonable assurances that nonpoint sources of pollution will be reduced in impaired waters polluted by both point sources and nonpoint sources of pollution. …Based on the Proposed TMDL, it is not clear whether Se TMDLs in the Central Valley are on track for attainment of 2019 load allocations. Nor is it articulated in the Proposed TMDL how Region 2 will accomplish the stated intention to "work with the State and the Central Valley Water Boards to ensure the current load allocation for the Central Valley watershed in	The load allocations for nonpoint sources, including Central Valley watershed, local tributaries and atmospheric deposition, are calculated based on past performance and data collected over the past 20 years. As the proposed TMDL equals to the existing loads, the allocations are being already met. The implementation plan requires monitoring of selenium concentrations and loads in the San Joaquin River to evaluate whether the load allocations for the Central Valley watershed are being attained.

[23] Wells, B. 2015. *Benthic Monitoring, 2014*. IEP Newsletter 28(2).

[24] Zeug, S.C., Brodsky, A., Kogut, N., Stewart, A.R. and J.E. Merz. 2014. "Ancient fish and recent invaders: white sturgeon *Acipenser transmontanus* diet response to invasive species-mediated changes in a benthic prey assemblage". *Marine Ecology Progress Series*, 514: 163–174.

		the TMDL is attained."	
4.25		Because the Regional Board ignored CWA requirements to establish an adequate margin of safety in the Proposed TMDL and to have adequate assurances that nonpoint sources will meet load reductions, the decision approving the Proposed TMDL was arbitrary and capricious, an abuse of discretion, and/or otherwise not in accordance with law.	See response to comment 4.22 regarding the inclusion of a margin of safety in the TMDL. The Regional Water Board's decision approving the TMDL was based upon the best available scientific evidence, including every article and expert Baykeeper has cited. See also, response to comment 4.19, 4.20 and 4.21.
4.26		The Proposed TMDL fails to specify any monitoring requirements for fish tissue and receiving water analysis. The only requirement is for continuation of "discharger-funded RMP monitoring of selenium in fish and water at a spatial scale and frequency to determine whether concentrations in fish, specifically sturgeon, remain low and water column and fish tissue targets are met". Fish tissue monitoring for Se in sturgeon has been carried out at the sole discretion of the Regional Monitoring Program's ("RMP") Steering Committee. To date, green sturgeon have not been sampled and monitored for Se, though white sturgeon have been routinely sampled (in 1997, 2000, 2003, 2006, 2009, and 2014) as part of the RMP Status and Trends sport fish monitoring program. However, the number of fish collected in each round of sampling has been small (~12 fish per round) and out of cost considerations, the sampling frequency has recently been reduced to a once in five year cycle going forward. No statistical analysis has	This issue was previously raised before the Regional Water Board (See Response to Comments November 18, 2015, Comment 5.5) 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 at this time. The proposed TMDL requires monitoring of fish, water column and bird eggs. Relevant monitoring and special studies to collect more fish data and use innovative techniques to better understand selenium bioaccumulation in sturgeon is discussed in the TMDL Staff Report (see Chapter 8.2). We disagree with the characterization of the Regional Monitoring Program (RMP). The Steering Committee ultimately has the authority to make decisions about how funds are expended by the RMP for all receiving water monitoring conducted by the RMP. However, the Steering Committee takes recommendations from the Technical Review Committee, which includes the SF Baykeeper, and recommendations from the Selenium Workgroup. The workgroup is a group of experts, RMP members and the public that are engaged with reviewing and making recommendations about special studies and monitoring for selenium in the Bay. The RMP has a successful record of conducting monitoring and special studies to inform the collective understanding of

		been performed to determine the appropriateness of the current monitoring program, though it is unlikely the current program satisfies TMDL requirements to determine the effectiveness of the implementation actions.	whether the Bay's beneficial uses are protected. In addition, the Regional Water Board maintains its authority to supersede an RMP monitoring design or to ask for additional monitoring beyond what is required in the TMDL if such monitoring is determined to be necessary. 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. 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. In February 2016 a successful data collection was carried out during the annual Sturgeon Derby with 19 fish sampled. Samples of blood plasma, liver, ovary, muscle plug, muscle fillet, fin ray, and otolith were collected from 9 female sturgeon, and blood plasma, fin rays and otoliths were collected from 10 male sturgeon caught by fishermen during the derby. The side by side muscle tissue plugs and fillet samples, which are used traditionally to determine selenium concentrations in fish, were also collected from all 9 female sturgeon. The figure below shows the

			difference between the two sampling techniques, one lethal, the other non-lethal. 
4.27		Proposed TMDL fails to consider recommendations from experts on monitoring programs suitable to determine compliance with TMDLs or fish tissue guidelines. For example, Luoma and Presser (2013) recognize Se concentrations in fish or bird tissues appear to be good indicators of ecological risks from Se. They state that key invertebrates, such as *C. amurensis*, may, however, be a more pragmatic indictor for frequent biological monitoring.	The proposed TMDL requires monitoring of fish, water column and bird eggs. Relevant monitoring and special studies to collect more fish data and to use innovative techniques to better understand selenium bioaccumulation in sturgeon is discussed in the TMDL Staff Report (see Chapter 8.2). See response to comment 4.26 above for details on the current data collection and efforts to collect various fish tissue samples going beyond and above the TMDL compliance. As previously stated, monitoring of selenium concentrations in bivalves is useful but it is not a direct indicator of concentrations in fish. The purpose of monitoring is to establish whether the TMDL numeric targets are being achieved in the North Bay. Bivalves are more spatially and temporally variable than fish concentrations, and, therefore, less desirable to use to establish attainment of standards. The 15+ year-long monitoring record has already determined concentrations in *C. amurensis* to be in the range between 5 and 20 µg/g for an extended period of loading and hydrologic conditions, including extremely dry and wet years.

			Additionally, concentrations in dietary items such as *C. amurensis* do not account for biological transformations or ability of fish to regulate selenium concentrations in their bodies, and do not signify the amount of selenium actually consumed, digested and assimilated by fish. Nonetheless, if it is determined that additional bivalve data are important, the Water Board can require these data be collected.
4.28		[Presser and Luoma 2013] estimate that under existing low flow conditions, 23 to 66% of dissolved selenium measurements in the Bay exceeded the value predicted necessary to meet a fish tissue Se concentrations roughly equivalent to the [USEPA] Draft Criteria. And under guidelines they felt were appropriate to protect endangered species, 100% exceedance occurs at low flow conditions. This finding is startling and deserves to be confirmed through robust monitoring, the standards for which must be established in this TMDL.	Presser and Luoma (2013) [25] used older data in their modeling and evaluation of percent exceedances in the example scenarios (Table 2 in the paper). For low flow conditions, and assuming a tissue guideline of 8 µg/g, Presser and Luoma estimated the allowable level of selenium in water column of no more than 0.112 µg/L. Based on 1998-2000 data, this value was exceeded in 66% of water samples. However, more recent data show consistently lower concentrations. The transect data collected over two dry periods in September 2010 and October 2011 show concentrations of 0.058-0.122 µg/L (average 0.09 µg/L) and 0.064-0.109 µg/L (average 0.08 µg/L). All but one sample are below the target concentration of 0.112 µg/L estimated by Presser and Luoma with a set of very conservative assumptions.
4.29		The Proposed TMDL fails to provide any level of monitoring specificity and fails to recognize the fact monitoring frequencies, program designs and partner agencies are placed at the discretion of RMP management. Because the Regional Board ignored CWA requirements to establish a monitoring program, the decision approving the Proposed TMDL was arbitrary and capricious, an abuse of discretion and/or otherwise not in accordance with law.	See response to comment 4.26 and 4.27 above. The SF Baykeeper was asked during a meeting on November 4, 2015, prior to the Regional Board hearing, to put forward their specific recommendations for monitoring and they failed to do so. We disagree that we have ignored the CWA requirement to establish a monitoring program. The approach taken in this TMDL is similar to the approach taken for other TMDLs adopted for the San Francisco Bay. The RMP has an excellent record as a monitoring program for the Bay.

[25] Presser, T.S. and S.N. Luoma. 2013. "Ecosystem-scale selenium model for the San Francisco Bay-Delta Regional Ecosystem Restoration Implementation Plan". *San Francisco Estuary and Watershed Science,* 11(1).

5	**U.S. EPA**	**Comment**	**Response**
5.1		We have reviewed the Regional Board's Basin Plan Amendment and supporting Staff Report. The technical analyses are rigorous and sound, and we commend the Regional Board on the resulting documents. We encourage the State Water Resources Control Board to approve the Regional Board's Basin Plan Amendment to establish the TMDL and Implementation Plan.	Comment noted.
6	**WSPA**	**Comment**	**Response**
6.1		WSPA supports State Water Board adoption of the proposed amendment to the water quality control plan for the San Francisco Bay Basin to establish a total maximum daily load (TMDL) and implementation plan for selenium in North San Francisco Bay (Bay).	Comment noted.
6.2		The TMDL with the associated basin plan amendment is a culmination of work beginning in 2007 to address selenium and water quality protection in the Bay. The TMDL development effort involved multiple stakeholders, including Bay Area Non-Governmental Organizations, USGS, EPA IX, and industry in collaboration with the San Francisco Regional Board staff.	Comment noted.
6.3		The TMDL was peer reviewed and adopted at the San Francisco Regional Water Quality Control Board with the support of EPA IX. Monitoring efforts for selenium have been developed and are being incorporated into the Bay's Regional Monitoring Plan; all with the support of the Bay area's discharger community.	Comment noted.