Rationale for Adoption of a 1 ppb (µg/l) Selenium
Water Quality Objective for the Bay-Delta Instead of Existing 5 ppb

To comply with Section 303 of the CWA, the California State Water Resources Control Board (SWRCB) adopted water quality plans for Enclosed Bays and Estuaries (EBEP) and Inland Surface Water (ISWP) in the early 1990s. The plans established statewide water quality objectives for many toxic pollutants in California. However, various polluters filed suit against the State and won, resulting in the SWRCB rescinding the two water quality control plans in September of 1994. As a result, USEPA took over by promulgating federal water quality criteria with what is now called the California Toxics Rule. See http://www.c-win.org/selenium-and-california-toxics-rule.html.

Consultation under the federal Endangered Species Act was required for the California Toxics Rule because many listed species were affected. NMFS and USFWS issued a joint Biological Conference Opinion on March 24, 2000.[1] A remaining unresolved issue for California was the establishment of water quality criteria/objectives for selenium that takes into account bioaccumulation. The current State water quality objectives for selenium (2 µg/l monthly mean for lentic (still) waters of the Grasslands marshes; and 5 µg/l 4 day average for lotic/flowing waters of sloughs and rivers) do not consider bioaccumulation and are generally considered inadequate.

The California Toxics Rule Biological Opinion (p 9-10) required that USEPA perform the following actions:

1. EPA will revise its recommended 304(a) acute and chronic aquatic life criteria for selenium by January 2002.

2. EPA will propose revised acute and chronic aquatic life criteria for selenium in California by January of 2003.

Neither of these requirements of the CA Toxics Rule Biological Opinion has yet to be implemented. However, USEPA has released a peer-reviewed report by the US Geological Survey upon which to base revision of San Francisco/Sacramento/San Joaquin Bay-Delta selenium water quality criteria and is now accepting comments on the report.[2]

The new selenium water quality criteria are supposed to be based on consideration of bioaccumulation using the Presser/Luoma (USGS) selenium model. The recently released USGS report shows that the Bay-Delta criteria/objective should be lowered

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[1] http://www.c-win.org/webfm_send/40
[2] http://www.epa.gov/region9/water/ctr/

from 5 µg/l to 1 µg/l or less, depending on residence time of selenium in the Bay-Delta and other factors.

The report, "Ecosystem-Scale Selenium Modeling in Support of Fish and Wildlife Criteria Development for the San Francisco Bay-Delta Estuary, California"[3] difficult contains findings that can be found in Tables 20-23, attached.[4]

Tables 20 through 23 identify predicted (modeled) selenium as dissolved (µg/l) and as particulate (µg/g) in order to meet specified threshold of whole fish or bird selenium body weight. Various scenarios are considered including 3 different selenium body weight thresholds that induce varying percentages of mortality, as well as different estimates of selenium in diet and residency time of selenium in the Bay-Delta. Under all scenarios for sturgeon, diving birds and steelhead, the highest water column dissolved selenium was 1.145 µg/l. The existing water quality objective for selenium is 5 µg/l. In many cases, particularly when the residence time of selenium in the Bay-Delta is long (during drier periods of low inflow), the values are much lower, sometimes less than a 0.1 µg/l.

The issue of residence time is relevant to plans to build a Peripheral Canal or Tunnel. Construction of a Peripheral Tunnel or Canal will exacerbate selenium problems in the Bay-Delta by decreasing the amount of Sacramento River water and concentrating the residency and amount of selenium contaminated-water from the San Joaquin River in the Delta.

Beyond the implications of existing Bay-Delta selenium water quality objectives, the report raises questions about the adequacy of existing selenium water quality objectives in the San Joaquin River and its wetlands and wildlife refuges. The existing selenium water quality objective for the San Joaquin River is 5 µg/l and for wetlands and refuges it is 2µg/l. The is 2µg/l water quality objective at the Mendota Pool on the San Joaquin River was violated in five months of the first six months of 2011.[5]

Additionally, there is no continuous monitoring program for selenium in the San Joaquin River below Crow's Landing or anywhere in the Bay-Delta itself. This toxic contaminant threatens the health of the Bay-Delta and those who rely on its waters.

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[3] By Theresa S. Presser and Samuel N. Luoma U.S. Geological Survey, Menlo Park, California. Administrative Report. December, 2010. http://www.epa.gov/region9/water/ctr/selenium-modeling_admin-report.pdf, accessed 9/3/11.
[4] http://www.epa.gov/region9/water/ctr/selenium-modeling_tables1-22.pdf, accessed 9/3/11.
[5] http://www.c-win.org/webfm_send/187, accessed 9/3/11.

Table 20. Prediction scenarios using Suisun Bay-Carquinez Strait transects for a suspended particulate material>*C. amurensis*>white sturgeon food web.

fish Se target (µg/g wb, dw)	K_d	predicted dissolved Se µg/L	predicted particulate Se µg/g	predicted prey Se µg/g
TTF_{fish} = 1.1; TTF_{clam} = 17				
8	1,180 (June 98, 11 days)	0.363	0.428	7.27
5		0.227	0.267	4.55
1.8		0.082	0.096	1.64
8	2,666 (Apr 99, 16 days)	0.160	0.428	7.27
5		0.100	0.267	4.55
1.8		0.036	0.096	1.64
8	3,435 (Oct 98, 22 days)	0.125	0.428	7.27
5		0.078	0.267	4.55
1.8		0.028	0.096	1.64
8	5,986 (Nov 99, 70 days)	0.071	0.428	7.27
5		0.045	0.267	4.55
1.8		0.016	0.096	1.64
TTF_{fish} = 1.1; $TTF_{clam + amphipod}$ = 8.8[a]				
8	1,180 (June 98, 11 days)	0.700	0.826	7.27
5		0.438	0.517	4.55
1.8		0.158	0.186	1.64
8	2,666 (Apr 99, 16 days)	0.310	0.826	7.27
5		0.194	0.517	4.55
1.8		0.070	0.186	1.64
8	3,435 (Oct 98, 22 days)	0.241	0.826	7.27
5		0.150	0.517	4.55
1.8		0.054	0.186	1.64
8	5,986 (Nov 99, 70 days)	0.138	0.826	7.27
5		0.086	0.517	4.55
1.8		0.031	0.186	1.64
TTF_{fish} = 0.8; TTF_{clam} = 17				
8	1,180 (June 98, 11 days)	0.499	0.588	10
5		0.312	0.368	6.25
1.8		0.112	0.132	2.25
8	2,666 (Apr 99, 16 days)	0.221	0.588	10
5		0.138	0.368	6.25
1.8		0.050	0.132	2.25
8	3,435 (Oct 98, 22 days)	0.171	0.588	10
5		0.107	0.368	6.25
1.8		0.039	0.132	2.25
8	5,986 (Nov 99, 70 days)	0.098	0.588	10
5		0.061	0.368	6.25

fish Se target (µg/g wb, dw)	K_d	predicted dissolved Se µg/L	predicted particulate Se µg/g	predicted prey Se µg/g
1.8		0.022	0.132	2.25
TTF_{fish} = 0.8; $TTF_{clam + amphipod}$ = 8.8 [a]				
8	1,180 (June 98, 11 days)	0.963	1.14	10
5		0.602	0.710	6.25
1.8		0.217	0.256	2.25
8	2,666 (Apr 99, 16 days)	0.426	1.14	10
5		0.266	0.710	6.25
1.8		0.096	0.256	2.25
8	3,435 (Oct 98, 22 days)	0.331	1.14	10
5		0.207	0.710	6.25
1.8		0.074	0.256	2.25
8	5,986 (Nov 99, 70 days)	0.190	1.14	10
5		0.119	0.710	6.25
1.8		0.043	0.256	2.25

[a] TTF = 8.8 is a composite TTF of TTF_{clam} + $TTF_{amphipod}$ where diet is assumed as 50% *C. amurensis* (TTF = 17) and 50% amphipod (TTF = 0.6). Predicted prey concentrations also are a composite that would need to be separated into components to assess the allowable *C.* amurensis Se concentration and the allowable amphipod Se concentration.

Table 21. Prediction scenarios using Suisun Bay-Carquinez Strait transects for a suspended particulate material>*C. amurensis*>clam-eating bird species food web.

bird egg Se target (µg/g wb, dw)	K_d	predicted dissolved Se µg/L	predicted particulate Se µg/g	predicted prey Se µg/g
$TTF_{bird\ egg}$ = 2.6; TTF_{clam} = 17				
12	1,180 (June 98, 11 days)	0.230	0.271	4.62
7.7		0.148	0.174	2.96
5.9		0.113	0.133	2.27
12	2,666 (Apr 99, 16 days)	0.102	0.271	4.62
7.7		0.065	0.174	2.96
5.9		0.050	0.133	2.27
12	3,435 (Oct 98, 22 days)	0.079	0.271	4.62
7.7		0.051	0.174	2.96
5.9		0.039	0.133	2.27
12	5,986 (Nov 99, 70 days)	0.045	0.271	4.62
7.7		0.029	0.174	2.96
5.9		0.022	0.133	2.27
$TTF_{bird\ egg}$ = 2.6; $TTF_{clam + amphipod}$ = 8.8 [a]				
12	1,180 (June 98, 11 days)	0.444	0.524	4.62
7.7		0.285	0.337	2.96
5.9		0.219	0.258	2.27
12	2,666 (Apr 99, 16 days)	0.197	0.524	4.62
7.7		0.126	0.337	2.96
5.9		0.097	0.258	2.27
12	3,435 (Oct 98, 22 days)	0.153	0.524	4.62
7.7		0.098	0.337	2.96
5.9		0.075	0.258	2.27
12	5,986 (Nov 99, 70 days)	0.088	0.524	4.62
7.7		0.056	0.337	2.96
5.9		0.043	0.258	2.27

[a] TTF = 8.8 is a composite TTF of TTF_{clam} + $TTF_{amphipod}$ where diet is assumed as 50% *C. amurensis* (TTF = 17) and 50% amphipod (TTF = 0.6). Predicted prey concentrations also are a composite that would need to be separated into components to assess the allowable *C.* amurensis Se concentration and the allowable amphipod Se concentration.

Table 22. Prediction scenarios using landward-focused transects for suspended particulate material>aquatic insect>juvenile salmon or steelhead.

fish Se target (µg/g wb, dw)	K_d	predicted dissolved Se µg/L	predicted particulate Se µg/g	predicted prey Se µg/g
TTF_{fish} = 1.1; $TTF_{aquatic\ insect}$ = 2.8				
8	2268 (50,847 cfs)	1.145	2.597	7.27
5		0.716	1.623	4.55
1.8		0.258	0.584	1.64
8	2981 (30,924 cfs)	0.871	2.597	7.27
5		0.545	1.623	4.55
1.8		0.196	0.584	1.64
8	2684 (21,218 cfs)	0.968	2.597	7.27
5		0.605	1.623	4.55
1.8		0.218	0.584	1.64
8	5855 (4,350 cfs)	0.444	2.597	7.27
5		0.277	1.623	4.55
1.8		0.100	0.584	1.64

Table 23. Prediction scenarios using landward-focused transects for suspended particulate material>aquatic insect>rail.

fish Se target (µg/g wb, dw)	K_d	predicted dissolved Se µg/L	predicted particulate Se µg/g	predicted prey Se µg/g
$TTF_{bird\ egg}$ = 2.6; $TTF_{aquatic\ insect}$ = 2.8				
12	2268 (50,847 cfs)	0.727	1.648	4.62
7.7		0.466	1.058	2.96
5.9		0.357	0.810	2.27
12	2981 (30,924 cfs)	0.553	1.648	4.62
7.7		0.355	1.058	2.96
5.9		0.272	0.810	2.27
12	2684 (21,218 cfs)	0.614	1.648	4.62
7.7		0.394	1.058	2.96
5.9		0.302	0.810	2.27
12	5855 (4,350 cfs)	0.282	1.648	4.62
7.7		0.181	1.058	2.96
5.9		0.138	0.810	2.27