BDCP1401.

From: Food & Water Watch <act@fwwatch.org> on behalf of Suzanne Cerny <act@fwwatch.org>
Sent: Saturday, June 21, 2014 10:46 AM
To: BDCP.comments@noaa.gov
Subject: I Oppose the BDCP

Jun 21, 2014

Ryan Wulff
650 Capitol Mall. Suite 5-100
Sacramento, CA 95814

Dear Wulff,

I am concerned and alarmed by the proposal for the new tunnel project to redirect water from the Sacramento River.

I am saving water in plastic containers and glass containers. One for washing and one for drinking. But if there is no more water, none will be saved, and all Californians will be migrating to somewhere there is water.

This project will cost billions of taxpayer dollars at a time when our state cannot afford it. An entire river should not be redirected for the sake of large-scale, unmetered agriculture and the oil industry.

The proposed tunnels have already been rejected by voters in 1982, and similar tunnel projects in places like Santa Barbara County have not been cost effective and have provided little benefit to taxpayers.

Overall, the tunnels are unnecessary and fiscally irresponsible. The existing aquaduct could be reinforced and other local water projects like rainwater collection could be implemented instead, providing a much greater benefit at a lower cost.

Sincerely,

Ms. Suzanne Cerny
1740 Julian Ct
El Cerrito, CA 94530-2010

BDCP1402.

From: Food & Water Watch <act@fwwatch.org> on behalf of Pauline Thom <act@fwwatch.org>
Sent: Saturday, June 21, 2014 10:52 AM
To: BDCP.comments@noaa.gov
Subject: I Oppose the BDCP

Jun 21, 2014

Ryan Wulff
650 Capitol Mall. Suite 5-100
Sacramento, CA 95814

Dear Wulff,

I am concerned and alarmed by the proposal for the new tunnel project to redirect water from the Sacramento River.

WATER FOR DRINKING, NOT FOR CORPORATIONS!

This project will cost billions of taxpayer dollars at a time when our state cannot afford it. An entire river should not be redirected for the sake of large-scale, unmetered agriculture and the oil industry.

The proposed tunnels have already been rejected by voters in 1982, and similar tunnel projects in places like Santa Barbara County have not been cost effective and have provided little benefit to taxpayers.

Overall, the tunnels are unnecessary and fiscally irresponsible. The existing aquaduct could be reinforced and other local water projects like rainwater collection could be implemented instead, providing a much greater benefit at a lower cost.

Sincerely,

Dr. Pauline Thom
2400 Via Mariposa W Unit 2a
Laguna Woods, CA 92637-2029

From: Food & Water Watch <act@fwwatch.org> on behalf of Malcolm Moore <act@fwwatch.org>
Sent: Saturday, June 21, 2014 10:46 AM
To: BDCP.comments@noaa.gov
Subject: I Oppose the BDCP

Jun 21, 2014

Ryan Wulff
650 Capitol Mall. Suite 5-100
Sacramento, CA 95814

Dear Wulff,

I am concerned and alarmed by the proposal for the new tunnel project to redirect water from the Sacramento River.

This project will cost billions of taxpayer dollars at a time when our state cannot afford it. An entire river should not be redirected for the sake of large-scale, unmetered agriculture and the oil industry.

The proposed tunnels have already been rejected by voters in 1982, and similar tunnel projects in places like Santa Barbara County have not been cost effective and have provided little benefit to taxpayers.

BIG AG with their Pesticide- laced food Must Pay for their water.

Overall, the tunnels are unnecessary and fiscally irresponsible. The existing aquaduct could be reinforced and other local water projects like rainwater collection could be implemented instead, providing a much greater benefit at a lower cost.

Sincerely,

Mr. Malcolm Moore
564 E Quincy Ave
Portola, CA 96122-8210

From: Food & Water Watch <act@fwwatch.org> on behalf of LaMar Olk <act@fwwatch.org>
Sent: Saturday, June 21, 2014 10:55 AM
To: BDCP.comments@noaa.gov
Subject: I Oppose the BDCP

Jun 21, 2014

Ryan Wulff
650 Capitol Mall. Suite 5-100
Sacramento, CA 95814

Dear Wulff,

I am concerned and alarmed by the proposal for the new tunnel project to redirect water from the Sacramento River.

This project will cost billions of taxpayer dollars at a time when our state cannot afford it. An entire river should not be redirected for the sake of large-scale, unmetered agriculture and the oil industry.

The proposed tunnels have already been rejected by voters in 1982, and similar tunnel projects in places like Santa Barbara County have not been cost effective and have provided little benefit to taxpayers.

Another sell out to Global Corporations .

Overall, the tunnels are unnecessary and fiscally irresponsible. The existing aquaduct could be reinforced and other local water projects like rainwater collection could be implemented instead, providing a much greater benefit at a lower cost.

Sincerely,

Mr. LaMar Olk
36160 Hilltop Ln
Gualala, CA 95445-9567

From: Food & Water Watch <act@fwwatch.org> on behalf of Gina Monge <act@fwwatch.org>
Sent: Saturday, June 21, 2014 10:58 AM
To: BDCP.comments@noaa.gov
Subject: I Oppose the BDCP

Jun 21, 2014

Ryan Wulff
650 Capitol Mall. Suite 5-100
Sacramento, CA 95814

Dear Wulff,

I am concerned and alarmed by the proposal for the new tunnel project to redirect water from the Sacramento River.

This project will cost billions of taxpayer dollars at a time when our state cannot afford it. An entire river should not be redirected for the sake of large-scale, unmetered agriculture and the oil industry.

The proposed tunnels have already been rejected by voters in 1982, and similar tunnel projects in places like Santa Barbara County have not been cost effective and have provided little benefit to taxpayers.
Let's not forget that there is a drought so this project has the potential to risk one of our most valuable resources. Why not spend this money for making more sustainable energy sources. Our modern times have the technology to produce an eco-friendly energy system. We as a human race have already recognized the threat of climate change but we are slow to making the necessary changes to protect future generations.
This new tunnel project will only aid in the current climate change project. I urge you to be considerate of your fellow earthlings and make a decision that does not harm our air or water.

Overall, the tunnels are unnecessary and fiscally irresponsible. The existing aquaduct could be reinforced and other local water projects like rainwater collection could be implemented instead, providing a much greater benefit at a lower cost.

Sincerely,

Ms. Gina Monge
1691 E Brockton Ave
Redlands, CA 92374-3974

From: Food & Water Watch <act@fwwatch.org> on behalf of Richard Bloom <act@fwwatch.org>
Sent: Saturday, June 21, 2014 11:00 AM
To: BDCP.comments@noaa.gov
Subject: I Oppose the BDCP

Jun 21, 2014

Ryan Wulff
650 Capitol Mall. Suite 5-100
Sacramento, CA 95814

Dear Wulff,

I am concerned and alarmed by the proposal for the new tunnel project to redirect water from the Sacramento River.

This project will cost billions of taxpayer dollars at a time when our state cannot afford it. An entire river should not be redirected for the sake of large-scale, unmetered agriculture and the oil industry.

The proposed tunnels have already been rejected by voters in 1982, and similar tunnel projects in places like Santa Barbara County have not been cost effective and have provided little benefit to taxpayers.

Until all conservation measures are implemented and the price of water reflects its scarcity we should not dump billions of dollars into perpetuating a broken system.

Overall, the tunnels are unnecessary and fiscally irresponsible. The existing aquaduct could be reinforced and other local water projects like rainwater collection could be implemented instead, providing a much greater benefit at a lower cost.

Sincerely,

Mr. Richard Bloom
755 W Sierra Ave
Cotati, CA 94931-4281

BDCP1407.

From: Food & Water Watch <act@fwwatch.org> on behalf of Gregory Lambert <act@fwwatch.org>
Sent: Saturday, June 21, 2014 11:04 AM
To: BDCP.comments@noaa.gov
Subject: I Oppose the BDCP

Jun 21, 2014

Ryan Wulff
650 Capitol Mall. Suite 5-100
Sacramento, CA 95814

Dear Wulff,

I am concerned and alarmed by the proposal for the new tunnel project to redirect water from the Sacramento River.

This project will cost billions of taxpayer dollars at a time when our state cannot afford it. An entire river should not be redirected for the sake of large-scale, unmetered agriculture and the oil industry.

The proposed tunnels have already been rejected by voters in 1982, and similar tunnel projects in places like Santa Barbara County have not been cost effective and have provided little benefit to taxpayers.

I spend time in the Sacramento River, the Central Valley and Los Angeles. I do not support this proposed change that would radically alter the cultural geography of the state. We cannot sacrifice one part of the state to benefit another.

Overall, the tunnels are unnecessary and fiscally irresponsible. The existing aquaduct could be reinforced and other local water projects like rainwater collection could be implemented instead, providing a much greater benefit at a lower cost.

Sincerely,

Mr. Gregory Lambert
10989 Rochester Ave Apt 117
Los Angeles, CA 90024-6228

BDCP1408.

From: Food & Water Watch <act@fwwatch.org> on behalf of Anne Karam <act@fwwatch.org>
Sent: Saturday, June 21, 2014 11:12 AM
To: BDCP.comments@noaa.gov
Subject: I Oppose the BDCP

Jun 21, 2014

Ryan Wulff
650 Capitol Mall. Suite 5-100
Sacramento, CA 95814

Dear Wulff,

I am concerned and alarmed by the proposal for the new tunnel project to redirect water from the Sacramento River.

Perhaps the issue is about how much public input decision makers need from their constituents in order to hold the line against the money interests that threaten not only the environment, but the health and well being of human beings.

This project will cost billions of taxpayer dollars at a time when our state cannot afford it. An entire river should not be redirected for the sake of large-scale, unmetered agriculture and the oil industry.

The proposed tunnels have already been rejected by voters in 1982, and similar tunnel projects in places like Santa Barbara County have not been cost effective and have provided little benefit to taxpayers.

Overall, the tunnels are unnecessary and fiscally irresponsible. The existing aquaduct could be reinforced and other local water projects like rainwater collection could be implemented instead, providing a much greater benefit at a lower cost.

Sincerely,

Mrs. Anne Karam
6175 Paseo Canyon Dr
Malibu, CA 90265-3132

BDCP1409.

From: Food & Water Watch <act@fwwatch.org> on behalf of Daryl G. Williams <act@fwwatch.org>
Sent: Saturday, June 21, 2014 11:15 AM
To: BDCP.comments@noaa.gov
Subject: I Oppose the BDCP

Jun 21, 2014

Ryan Wulff
650 Capitol Mall. Suite 5-100
Sacramento, CA 95814

Dear Wulff,

I am concerned and alarmed by the proposal for the new tunnel project to redirect water from the Sacramento River.

This project will cost billions of taxpayer dollars at a time when our state cannot afford it. An entire river should not be redirected for the sake of large-scale, unmetered agriculture and the oil industry.

The proposed tunnels have already been rejected by voters in 1982, and similar tunnel projects in places like Santa Barbara County have not been cost effective and have provided little benefit to taxpayers.
The water has always been rerouted south. The water left alone will flow west. Let the water flow as it always has. For you to continue to be short sighted and play pay-up quid pro quo, is to hanker after the same anonymous private interests that are always selfishly motivated around a dire game of cat and mouse with the American public's best interests.

Overall, the tunnels are unnecessary and fiscally irresponsible. The existing aquaduct could be reinforced and other local water projects like rainwater collection could be implemented instead, providing a much greater benefit at a lower cost.

Sincerely,

Mr. Daryl G. Williams
2212 Martin Luther King Jr Way
Berkeley, CA 94704-1411

BDCP1410.

From: Food & Water Watch <act@fwwatch.org> on behalf of Vicki Salzman <act@fwwatch.org>
Sent: Monday, June 23, 2014 9:12 AM
To: BDCP.comments@noaa.gov
Subject: I Oppose the BDCP

Jun 23, 2014

Ryan Wulff
650 Capitol Mall. Suite 5-100
Sacramento, CA 95814

Dear Wulff,

I am concerned and alarmed by the proposal for the new tunnel project to redirect water from the Sacramento River.

This project will cost billions of taxpayer dollars at a time when our state cannot afford it. An entire river should not be redirected for the sake of large-scale, unmetered agriculture and the oil industry.

The proposed tunnels have already been rejected by voters in 1982, and similar tunnel projects in places like Santa Barbara County have not been cost effective and have provided little benefit to taxpayers.

This is the Peripheral Canal all over again, only worse. We need to stop tampering with our water supply, for the sake of the salmon, etc.

Overall, the tunnels are unnecessary and fiscally irresponsible. The existing aquaduct could be reinforced and other local water projects like rainwater collection could be implemented instead, providing a much greater benefit at a lower cost.

Sincerely,

Mrs. Vicki Salzman
1437 Josephine St
Berkeley, CA 94703-1115

From: Food & Water Watch <act@fwwatch.org> on behalf of Bambi Merryweather <act@fwwatch.org>
Sent: Monday, June 23, 2014 11:13 AM
To: BDCP.comments@noaa.gov
Subject: I Oppose the BDCP

Jun 23, 2014

Ryan Wulff
650 Capitol Mall. Suite 5-100
Sacramento, CA 95814

Dear Wulff,

I am concerned and alarmed by the proposal for the new tunnel project to redirect water from the Sacramento River.

Dear Governor Brown, I am astonished that you would consider this. I have always felt that you are a Champion for the Well Being of all Californians. After all we collectively put our Faith in you, and elected you to speak for all of us, I realize that California has major financial problems, but accepting the money of huge & wealthy interests, ahead of the NEEDS of the best interests of our communities and Environment is the absolute antithesis of what I have believed of you. Have you spoken to the communities in other States where fracking has literally destroyed the ground water, and of course the wells of it's residents? I have. Do you really think that giving Big Agriculture large scale unmetered water, will in some way help the rest of the people of California? We are in such a drought now, in some parts of the state, that we are watering our plants with gray water. Not flushing the toilets every time we go to the bath room. What about all of the Organic Growers in the State, who are actually contributing much more to our health and welfare and Environment than the big, wealthy, giant agriculture you want us to
subsidize, Please PLEASE JUST SAY NO to this project.
SOMEHOW I FEEL YOU ARE INTUITIVE ENOUGH TO REALIZE THIS IS TRULY NOT THE ANSWER THAT WILL BENEFIT MORE THAN A FEW VERY WEALTH SPECIAL INTERESTS, AT THE EXPENSE OF THE REST OF US.
WE EACH AND EVERY ONE OF US SHOULD BE ABLE TO SHARE OUR WATER. AFTER ALL WE CAN NOT LIVE WITHOUT IT.
WHAT HAPPENS WHEN WE CAN NO LONGER PAY THE PRICE?
Thanking you for your consideration.
Bambi Merryweather

P.S. Does anyone from your office actually read these? If so I would really love a response saying so. Bambi Merryweather sai108@aol.com Thank you!

This project will cost billions of taxpayer dollars at a time when our state cannot afford it. An entire river should not be redirected for the sake of large-scale, unmetered agriculture and the oil industry.

The proposed tunnels have already been rejected by voters in 1982, and similar tunnel projects in places like Santa Barbara County have not been cost effective and have provided little benefit to taxpayers.

Overall, the tunnels are unnecessary and fiscally irresponsible. The existing aquaduct could be reinforced and other local water projects like rainwater collection could be implemented instead, providing a much greater benefit at a lower cost.

Sincerely,

Dr. Bambi Merryweather

BDCP 1411

Westbourne St.
La Jolla, CA 92037

From: Food & Water Watch <act@fwwatch.org> on behalf of Susan Erikson <act@fwwatch.org>
Sent: Monday, June 23, 2014 7:42 AM
To: BDCP.comments@noaa.gov
Subject: I Oppose the BDCP

Jun 23, 2014

Ryan Wulff
650 Capitol Mall. Suite 5-100
Sacramento, CA 95814

Dear Wulff,

I am concerned and alarmed by the proposal for the new tunnel project to redirect water from the Sacramento River.

This project will cost billions of taxpayer dollars at a time when our state cannot afford it. An entire river should not be redirected for the sake of large-scale, unmetered agriculture and the oil industry.

The proposed tunnels have already been rejected by voters in 1982, and similar tunnel projects in places like Santa Barbara County have not been cost effective and have provided little benefit to taxpayers.

In addition, the sal water intrusion caused by the diversions is horrendous with salt water intrusion in Rio Vista and up to the Antioch bridge right now. The tunnels will on exaccerbate this problem.

There is no earthly reason why water-intensivecrops such as almonds and cotton are grown in the Central Valley. And there is no reason for fracking in California - the Monterey Formation, because it is folded and faulted is not amenable to fracking. Just another waste of Delta water.

And do you want to be put in the same category as Schwarzenegger? He oversaw the collapse of the entire salmon fishery! This is a self-sustaining resource - let's protect it, not destroy it.

WE CAN'T EAT COTTON OR OIL! Why can't you and Diane Feinstein understand this!

Overall, the tunnels are unnecessary and fiscally irresponsible. The existing aquaduct could be reinforced and other local water projects like rainwater collection could be implemented instead, providing a much greater benefit at a lower cost.

Sincerely,

Ms. Susan Erikson
8240 Stevenson Ave
Sacramento, CA 95828-5208

From: Food & Water Watch <act@fwwatch.org> on behalf of Charlene Woodcock <act@fwwatch.org>
Sent: Monday, June 23, 2014 7:42 AM
To: BDCP.comments@noaa.gov
Subject: I Oppose the BDCP

Jun 23, 2014

Ryan Wulff
650 Capitol Mall. Suite 5-100
Sacramento, CA 95814

Dear Wulff,

I am concerned and alarmed by the proposal for the new tunnel project to redirect water from the Sacramento River.

As a native Southern Californian, I've been very conscious since childhood that the lower half of our state is desert land that has been made to produce agricultural products artificially, by bringing water from the north. As fewer and fewer industrial growers have taken control of our land and water, we see our precious water used heedlessly, for water-needy crops like cotton, rice, and almonds. And we see those Central Valley growers like billionaire Stuart Resnick making increasing efforts to gain more control over water distribution in California. It was not surprising that Arnold Schwarzenegger would come up with a plan to assist their efforts but it was a shock to see Governor Brown support the outrageous twin tunnels plan to divert vast amounts of water directly to the Central Valley and Southern California while pretending to be a plan to restore the health of our essential delta. And with the gas and oil companies' plans to use hydrofracture to suck up every drop of gas and oil, poisoning more than one million gallons of water for each well, much of our scarce water will be destroyed for further use to increase corporate profits for the oil and gas companies.

This is unacceptable and intolerable.

This falsely-named Bay Delta Conservation project will cost billions of taxpayer dollars at a time when our state cannot afford it, either in money or water lost to special agribusiness and oil company interests.

The proposed tunnels were rejected by voters in 1982, and similar tunnel projects in places like Santa Barbara County have not been cost effective and have provided little benefit to taxpayers.

Overall, the tunnels are unnecessary and fiscally irresponsible. The existing aquaduct could be reinforced and other local water projects like rainwater collection could be implemented instead, providing a much greater benefit at a lower cost.

Sincerely,

Mrs. Charlene Woodcock
2355 Virginia St
Berkeley, CA 94709-1315

From: Food & Water Watch <act@fwwatch.org> on behalf of Gregg Eisman <act@fwwatch.org>
Sent: Monday, June 23, 2014 7:42 AM
To: BDCP.comments@noaa.gov
Subject: I Oppose the BDCP

Jun 23, 2014

Ryan Wulff
650 Capitol Mall. Suite 5-100
Sacramento, CA 95814

Dear Wulff,

I am concerned and alarmed by the proposal for the new tunnel project to redirect water from the Sacramento River.

WE ARE IN A DROUGHT MR. BROWN.

NO BIG-OIL, BIG-AGRICULTURE FREE WATER!

This project will cost billions of taxpayer dollars at a time when our state cannot afford it. An entire river should not be redirected for the sake of large-scale, unmetered agriculture and the oil industry.

The proposed tunnels have already been rejected by voters in 1982, and similar tunnel projects in places like Santa Barbara County have not been cost effective and have provided little benefit to taxpayers.

Overall, the tunnels are unnecessary and fiscally irresponsible. The existing aquaduct could be reinforced and other local water projects like rainwater collection could be implemented instead, providing a much greater benefit at a lower cost.

Sincerely,

Mr. Gregg Eisman
19823 Santee Ln
Valley Center, CA 92082-6919

From: Food & Water Watch <act@fwwatch.org> on behalf of Robin McCollum <act@fwwatch.org>
Sent: Monday, June 23, 2014 6:41 AM
To: BDCP.comments@noaa.gov
Subject: I Oppose the BDCP

Jun 23, 2014

Ryan Wulff
650 Capitol Mall. Suite 5-100
Sacramento, CA 95814

Dear Wulff,

I am concerned and alarmed by the proposal for the new tunnel project to redirect water from the Sacramento River.

This project will cost billions of taxpayer dollars at a time when our state cannot afford it. An entire river should not be redirected for the sake of large-scale, unmetered agriculture and the oil industry.

The proposed tunnels have already been rejected by voters in 1982, and similar tunnel projects in places like Santa Barbara County have not been cost effective and have provided little benefit to taxpayers.

Taking water from one area of scarcity to another is inequitable and destructive to northern agriculture and riparian ecosystems.

Put the same money into WAVE Powered Desalination along the coast and provide abundant water to all.

Overall, the tunnels are unnecessary and fiscally irresponsible. The existing aquaduct could be reinforced and other local water projects like rainwater collection could be implemented instead, providing a much greater benefit at a lower cost.

Sincerely,

Mr. Robin McCollum
1337 Bruce St
Chico, CA 95928-6274

From: Food & Water Watch <act@fwwatch.org> on behalf of mary campbell <act@fwwatch.org>
Sent: Monday, June 23, 2014 6:11 AM
To: BDCP.comments@noaa.gov
Subject: I Oppose the BDCP

Jun 23, 2014

Ryan Wulff
650 Capitol Mall. Suite 5-100
Sacramento, CA 95814

Dear Wulff,

I am concerned and alarmed by the proposal for the new tunnel project to redirect water from the Sacramento River.

This project will cost billions of taxpayer dollars at a time when our state cannot afford it. An entire river should not be redirected for the sake of large-scale, unmetered agriculture and the oil industry.

The proposed tunnels have already been rejected by voters in 1982, and similar tunnel projects in places like Santa Barbara County have not been cost effective and have provided little benefit to taxpayers.

The agricultural community is much like the Pentagon. They use resources (money) when they have more than they need and buy things they don't need to keep the money flowing. If they don't use it they don't get as much the next time around. Big Ag does much the same thing. I have seen many times the wasteful irrigation practices in the heat of summer, in drought conditions, and crying for more. All of the home owners are putting in rock gardens, not flushing toilets, forgoeing bathing, so as to save and see the cost of our water use skyrocket.

The reality is we are using the same water the dinosaurs used and there will never be any more of it. If we pollute and waste we become the dinosaurs. Better spending the money on helping the farmers irrigate wisely and the the oil industry needs to do what it can to put themselves into a more environmentally friendly way of doing business.
They should be investing in solar and wind and tidal power. We know it is always about money. They should figure this out like they figured out how to get the ancient sun out of the ground. Now they need to find how to use current sun.

Overall, the tunnels are unnecessary and fiscally irresponsible. The existing aquaduct could be reinforced and other local water projects like rainwater collection could be implemented instead, providing a much greater benefit at a lower cost.

Sincerely,

Ms. mary campbell
20 Berkeley Ave
San Anselmo, CA 94960-1406

From: Food & Water Watch <act@fwwatch.org> on behalf of Diane McCray <act@fwwatch.org>
Sent: Monday, June 23, 2014 5:11 AM
To: BDCP.comments@noaa.gov
Subject: I Oppose the BDCP

Jun 23, 2014

Ryan Wulff
650 Capitol Mall. Suite 5-100
Sacramento, CA 95814

Dear Wulff,

I am concerned and alarmed by the proposal for the new tunnel project to redirect water from the Sacramento River.

This project will cost billions of taxpayer dollars at a time when our state cannot afford it. An entire river should not be redirected for the sake of large-scale, unmetered agriculture and the oil industry.

The proposed tunnels have already been rejected by voters in 1982, and similar tunnel projects in places like Santa Barbara County have not been cost effective and have provided little benefit to taxpayers.

Water is one of the reason many in Northern CA are considering forming another state. Steal our water and more will join the movement.

Overall, the tunnels are unnecessary and fiscally irresponsible. The existing aquaduct could be reinforced and other local water projects like rainwater collection could be implemented instead, providing a much greater benefit at a lower cost.

Sincerely,

Ms. Diane McCray
5838 Black Olive Dr Spc 12
Paradise, CA 95969-4631

From: Food & Water Watch <act@fwwatch.org> on behalf of Damien Coyle <act@fwwatch.org>
Sent: Monday, June 23, 2014 4:41 AM
To: BDCP.comments@noaa.gov
Subject: I Oppose the BDCP

Jun 23, 2014

Ryan Wulff
650 Capitol Mall. Suite 5-100
Sacramento, CA 95814

Dear Wulff,

I am concerned and alarmed by the proposal for the new tunnel project to redirect water from the Sacramento River.

This project will cost billions of taxpayer dollars at a time when our state cannot afford it. An entire river should not be redirected for the sake of large-scale, unmetered agriculture and the oil industry.

The proposed tunnels have already been rejected by voters in 1982, and similar tunnel projects in places like Santa Barbara County have not been cost effective and have provided little benefit to taxpayers.

Farms and other businesses should pay the same per gallon of water as do citizens. No discounts because you have clout.

Overall, the tunnels are unnecessary and fiscally irresponsible. The existing aquaduct could be reinforced and other local water projects like rainwater collection could be implemented instead, providing a much greater benefit at a lower cost.

Sincerely,

Dr. Damien Coyle
Main Street
Dublin, CA 90210

From: Food & Water Watch <act@fwwatch.org> on behalf of Greg Moore <act@fwwatch.org>
Sent: Monday, June 23, 2014 3:41 AM
To: BDCP.comments@noaa.gov
Subject: I Oppose the BDCP

Jun 23, 2014

Ryan Wulff
650 Capitol Mall. Suite 5-100
Sacramento, CA 95814

Dear Wulff,

I am concerned and alarmed by the proposal for the new tunnel project to redirect water from the Sacramento River.

In particular, I'm concerned that you haven't taken time to review the recent GRACE satellite measurements of what is happening to groundwater in the San Joaquin Valley. 10 cubic kilometers (10 billion tons) of water overdraft each year. Worse still diverted surface water as contemplated under the plan is being pumped underground, polluted with toxic chemicals and then recovered as contaminated production water on the surface (see e.g. Starrh v, Aera Oil). Given the damage to existing geological structure the idea of adding to the problem seems almost insane. You have subsidence over 12 meters in some places! Since "resource theft as usual" approach is no longer working like it used to, you might want to consider measures that would actually help California in the long run such as land retirement in the southern San Joaquin.

Overall, the tunnels are unnecessary and fiscally irresponsible. The existing aquaduct could be reinforced and other local water projects like rainwater collection could be implemented instead, providing a much greater benefit at a lower cost.

Sincerely,

Mr. Greg Moore
1807 Drummond Ave
Ridgecrest, CA 93555-8970

BDCP1420.

From: Food & Water Watch <act@fwwatch.org> on behalf of Thomas Zachary <act@fwwatch.org>
Sent: Monday, June 30, 2014 6:59 AM
To: BDCP.comments@noaa.gov
Subject: I Oppose the BDCP

Jun 30, 2014

Ryan Wulff
650 Capitol Mall. Suite 5-100
Sacramento, CA 95814

Dear Wulff,

I am concerned and alarmed by the proposal for the new tunnel project to redirect water from the Sacramento River.

This project will cost billions of taxpayer dollars at a time when our state cannot afford it. An entire river should not be redirected for the sake of large-scale, unmetered agriculture and the oil industry.

The proposed tunnels have already been rejected by voters in 1982, and similar tunnel projects in places like Santa Barbara County have not been cost effective and have provided little benefit to taxpayers.

Spend the money on preventing saltwater incursion into the Delta and protect the Delta fisheries.

Live within your water and monetary means.

Subject any plan to citizen review by vote!

Overall, the tunnels are unnecessary and fiscally irresponsible. The existing aquaduct could be reinforced and other local water projects like rainwater collection could be implemented instead, providing a much greater benefit at a lower cost.

Sincerely,

Mr. Thomas Zachary
2534 Foothill Blvd
La Crescenta, CA 91214-3506

BDCP1421.

From: Food & Water Watch <act@fwwatch.org> on behalf of Carol reom <act@fwwatch.org>
Sent: Saturday, June 28, 2014 1:56 PM
To: BDCP.comments@noaa.gov
Subject: I Oppose the BDCP

Jun 28, 2014

Ryan Wulff
650 Capitol Mall. Suite 5-100
Sacramento, CA 95814

Dear Wulff,

I am concerned and alarmed by the proposal for the new tunnel project to redirect water from the Sacramento River.

This project will cost billions of taxpayer dollars at a time when our state cannot afford it. An entire river should not be redirected for the sake of large-scale, unmetered agriculture and the oil industry.

The proposed tunnels have already been rejected by voters in 1982, and similar tunnel projects in places like Santa Barbara County have not been cost effective and have provided little benefit to taxpayers.

Why should we support these water tunnel for oil and nut companies porfit?We the people are supposed to have a say and I think the people have spoken out agajnst this and they know best . There has got to be better ways to get water for the southern California than stripping north California of it's water.Building those tunnels would make more problems than it would solve We don't need them! Don't even consider them.What is our delta without water?You would prefer nuts over all the things that are grown on the delta islands?Many people make their living off the delta islands.

Overall, the tunnels are unnecessary and fiscally irresponsible. The existing aquaduct could be reinforced and other local water projects like rainwater collection could be implemented instead, providing a much greater benefit at a lower cost.

Sincerely,

Mrs. Carol reom
300 Olive Ave
Piedmont, CA 94611-4434

BDCP1422.

From: Food & Water Watch <act@fwwatch.org> on behalf of Don Heichel <act@fwwatch.org>
Sent: Saturday, June 28, 2014 8:27 AM
To: BDCP.comments@noaa.gov
Subject: I Oppose the BDCP

Jun 28, 2014

Ryan Wulff
650 Capitol Mall. Suite 5-100
Sacramento, CA 95814

Dear Wulff,

I am concerned and alarmed by the proposal for the new tunnel project to redirect water from the Sacramento River.

This project will cost billions of taxpayer dollars at a time when our state cannot afford it. An entire river should not be redirected for the sake of large-scale, unmetered agriculture and the oil industry.

The proposed tunnels have already been rejected by voters in 1982, and similar tunnel projects in places like Santa Barbara County have not been cost effective and have provided little benefit to taxpayers.

You'll alter the salinity of the Delta too!!!

Overall, the tunnels are unnecessary and fiscally irresponsible. The existing aquaduct could be reinforced and other local water projects like rainwater collection could be implemented instead, providing a much greater benefit at a lower cost.

Sincerely,

Ms. Don Heichel
34 Pasatiempo Dr
Santa Cruz, CA 95060-1807

From: Food & Water Watch <act@fwwatch.org> on behalf of Greg Miller <act@fwwatch.org>
Sent: Saturday, June 28, 2014 1:52 AM
To: BDCP.comments@noaa.gov
Subject: I Oppose the BDCP

Jun 28, 2014

Ryan Wulff
650 Capitol Mall. Suite 5-100
Sacramento, CA 95814

Dear Wulff,

I am concerned and alarmed by the proposal for the new tunnel project to redirect water from the Sacramento River.

This project will cost billions of taxpayer dollars at a time when our state cannot afford it. An entire river should not be redirected for the sake of large-scale, unmetered agriculture and the oil industry.

The proposed tunnels have already been rejected by voters in 1982, and similar tunnel projects in places like Santa Barbara County have not been cost effective and have provided little benefit to taxpayers.

Southern California is already sucking up water from the whole southwestern US. No, don't take the last of northern California's water. You want water, desalinate!

The environment can't take this kind of abuse.

Overall, the tunnels are unnecessary and fiscally irresponsible. The existing aquaduct could be reinforced and other local water projects like rainwater collection could be implemented instead, providing a much greater benefit at a lower cost.

Sincerely,

Mr. Greg Miller
1817 Palm Ave
Chico, CA 95926-2320

From: Food & Water Watch <act@fwwatch.org> on behalf of Natalie Barrett <act@fwwatch.org>
Sent: Saturday, June 28, 2014 12:54 AM
To: BDCP.comments@noaa.gov
Subject: I Oppose the BDCP

Jun 28, 2014

Ryan Wulff
650 Capitol Mall. Suite 5-100
Sacramento, CA 95814

Dear Wulff,

I am concerned and alarmed by the proposal for the new tunnel project to redirect water from the Sacramento River.

This project will cost billions of taxpayer dollars at a time when our state cannot afford it. An entire river should not be redirected for the sake of large-scale, unmetered agriculture and the oil industry.

The proposed tunnels have already been rejected by voters in 1982, and similar tunnel projects in places like Santa Barbara County have not been cost effective and have provided little benefit to taxpayers.

Not only do I NOT want ANY re-direct of a major public water source, but I CERTAINLY do NOT want to pay any more for the water I DO use!!

AND, I would like to see agri-business, big oil and fracking companies charged with the responsibility of cleaning up the toxins that they
release into our environment - AT THEIR COST!! AND pay their share of
the water and resources that they use up!

Overall, the tunnels are unnecessary and fiscally irresponsible. The existing aquaduct could be reinforced and other local water projects like rainwater collection could be implemented instead, providing a much greater benefit at a lower cost.

Sincerely,

Ms. Natalie Barrett
30924 Via Rivera
Rancho Palos Verdes, CA 90275-5345

From: Food & Water Watch <act@fwwatch.org> on behalf of Brooke Ewoldsen <act@fwwatch.org>
Sent: Friday, June 27, 2014 4:28 PM
To: BDCP.comments@noaa.gov
Subject: I Oppose the BDCP

Jun 27, 2014

Ryan Wulff
650 Capitol Mall. Suite 5-100
Sacramento, CA 95814

Dear Wulff,

I am concerned and alarmed by the proposal for the new tunnel project to redirect water from the Sacramento River.

This project will cost billions of taxpayer dollars at a time when our state cannot afford it. An entire river should not be redirected for the sake of large-scale, unmetered agriculture and the oil industry.
Unmetered ag and unmetered use of water for the oil companies must be stopped. We must take care of the only Planet Earth that I live on, and I hope many more generations can live on. Think about it........let's GO GREEN now so California can show other States how to do it.
The proposed tunnels have already been rejected by voters in 1982, and similar tunnel projects in places like Santa Barbara County have not been cost effective and have provided little benefit to taxpayers.

Overall, the tunnels are unnecessary and fiscally irresponsible. The existing aquaduct could be reinforced and other local water projects like rainwater collection could be implemented instead, providing a much greater benefit at a lower cost.

Sincerely,

Ms. Brooke Ewoldsen
6335 Imperial Ct
Aptos, CA 95003-3133

From: Food & Water Watch <act@fwwatch.org> on behalf of Caroline Hickson <act@fwwatch.org>
Sent: Friday, June 27, 2014 2:36 PM
To: BDCP.comments@noaa.gov
Subject: I Oppose the BDCP

Jun 27, 2014

Ryan Wulff
650 Capitol Mall. Suite 5-100
Sacramento, CA 95814

Dear Wulff,

I am concerned and alarmed by the proposal for the new tunnel project to redirect water from the Sacramento River.

This project will cost billions of taxpayer dollars. Water diversion from the Delta should not be redirected for the sake of large-scale, unmetered agriculture and the oil industry.

The proposed tunnels have already been rejected by voters in 1982, and similar tunnel projects in places like Santa Barbara County have not been cost effective and have provided little benefit to taxpayers.

Significant, and I mean new paradigm in faming, needs to occur before anything as radical, destructive, and expensive should be undertaken.
It has been clearly documented and publicized that most farming still wastes huge amounts of water...this is our first priority to make more
water available to families. Water conservation is our responsibility
FIRST. This could also impact our ground water supplies, which are being drained at a very scary rate.

Then we need to consider what crops are grown in this DESERT state....water intensive crops which need irrigation because they are grown where rainfall is always poor need to be curtailed and replaced with crops that match their environment. An example is COTTON. I also question the need for such huge acreage of wine grapes...really...how essential is wine to human health and the economy? Not anywhere close
to clean free water.

The tunnel project is a bad idea for many reasons, and should be a last resort if even considered at all.

Overall, the tunnels are unnecessary and fiscally irresponsible. The existing aquaduct could be reinforced and other local water projects like rainwater collection could be implemented instead, providing a much greater benefit at a lower cost.

Sincerely,

Ms. Caroline Hickson
PO Box 1005
Colfax, CA 95713-1005

BDCP1427.

From: Tina Rosasco <trose@clearwire.net>
Sent: Monday, June 30, 2014 10:11 PM
To: BDCP.comments@noaa.gov
Subject: BDCP

I strongly oppose the proposed new water facilities project within the Bay Delta Conservation Plan. I believe that the huge corporate farms have bought any politicians involved in recommending this plan. No matter what anyone says the only people that win if these tunnels are built are these corporate farms that have planted crops in a desert.

Phyllis Garsino
PO Box 782
Linden, CA 95236

From: Michael <seacap26@yahoo.com>
Sent: Monday, June 30, 2014 12:06 PM
To: bdcp.comments@noaa.gov
Subject: Delta Tunnels and the water grab...

Dear Sirs and Ma'ams,

I formally oppose the Delta tunnels that Gov. Brown believes is the solution to California's water issues.

It truly is simple; stop growing alfalfa, cotton and rice in the desert.

Respectfully,

Michael Caporale
seacap26@yahoo.com

BDCP1429.

From: Bruce MacKimmie <bmackimmie@sbcglobal.net>
Sent: Monday, June 30, 2014 10:47 AM
To: bdcp.comments@noaa.gov
Subject: Tunnel Plan

I am very much opposed to your tunnel plan / water grab. Enough already with the shipping water South.The delta needs that fresh water flow in order to stay half way healthy.
No on Delta Tunnel Plan.
Bruce MacKimmie, CA resident and tax payer.

Sent from my iPad

BDCP1430.

From: Susan Richter <Susan.Richter@yolocounty.org>
Sent: Wednesday, July 02, 2014 8:14 AM
To: 'BDCP.comments@noaa.gov'
Cc: Lana Harman; Rachel Wolf; Crista Cannariato
Subject: Request for DVD of Bay Delta Conservation Plan

Dear Sir/Madame:

Yolo County Library has 5 locations listed as having DVD copies of the above mentioned plan. Unfortunately we have only received two copies. Please send 3 additional DVDs, to my attention, at:

Susan Richter
Yolo Branch Library
P.O. Box 447
Yolo, CA 95697

Thank you for your assistance.

Susan Richter
Branch Supervisor
Knights Landing and Yolo Branch Libraries

From: Lynn Yeatrakas <lyeatrakas@att.net>
Sent: Monday, June 30, 2014 8:30 AM
To: bdcp.comments@noaa.gov
Subject: Opposed to this plan fo building water tunnels diverting Sacramento River

This is a STUPID plan, waste of tax payer dollars and it will have a severe detrimental impact on the Sacramento delta environment. BROWN should get over it, stop dreaming that he needs to do this for the folks in LA. This is just a bad idea that should not survive even the weakest environmental impact study.

Can anyone be dumb enough to think that diverting water from the upper Sacramento River not impact the water flow to the rest of the river?
I urge you to kill this project; do not lend one bit of support to it.
Peter Yeatrakas
105 harbor Seal Ct
San Mateo, Ca 94404

BDCP1432.

From:	Kevin Buchan <kbuchan@wspa.org>
Sent:	Wednesday, July 02, 2014 12:05 PM
To:	BDCP.comments@noaa.gov
Subject:	WSPA cmts on BDCP EIR/EIS, Plan
Attachments:	BDCP EIR-EIS, WSPA cmts pkg 07-02-2014.pdf

Mr. Wulff,

Attached are our comments for the Bay Delta Conservation Plan, and EIR/EIS. We appreciate the opportunity to submit these. Please give me a call if you have any questions. Thank you.

Kevin Buchan
Manager, CA Climate Policy and State Water Issues
Western States Petroleum Association
1415 L Street, Suite 600
Sacramento, CA 95814
(916) 498-7755
Kevin@wspa.org

BDCP1432

Western States Petroleum Association
Credible Solutions • Responsive Service • Since 1907

Kevin Buchan
Manager, CA Climate Policy and State Water Issues

VIA ELECTRONIC MAIL

July 2, 2014

National Marine Fisheries Service
Attention: Ryan Wulff
650 Capitol Mall, Suite 5-100
Sacramento, CA 95814
BDCP.comments@noaa.gov

Subject: WSPA Comments on November 2013 Draft BDCP and Supporting Draft EIR/EIS – Focus on Selenium Impacts

Dear Mr. Wulff:

The Western States Petroleum Association (WSPA) represents companies that account for the majority of exploration and production, refining, marketing and transportation of crude oil and refined petroleum products in California and in five other western states.

WSPA members in the San Francisco Bay region will be directly affected by any actions taken pursuant to the BDCP. Thus, WSPA and its members are "interested parties" for purposes of the California Environmental Quality Act ("CEQA"), the National Environmental Protection Act ("NEPA") and the respective state and federal Endangered Species Acts ("ESAs").

Executive Summary

WSPA and its Bay Area members are specifically concerned about the expect increase in selenium concentrations that will result from the BDCP preferred alternative, and its subsequent impacts to San Francisco Bay. Our comments address both the BDCP and the EIR/EIS. Our primary concerns are summarized here, and are more fully described below in the Detailed Comments section:

1. The EIR/EIS fails to consider the effects of BDCP Conservation Measures on San Francisco Bay.

2. The BDCP and the EIR/EIS significantly underestimate additional selenium loads to the Delta associated with Preferred Alternative 4.

3. The EIR/EIS relies on inappropriate regulatory standards for concluding "No Substantial Effects" associated with selenium load increases.

4. The BDCP fails to provide adequate assurances for mitigation of known or reasonably foreseeable impacts to San Francisco and San Pablo Bays related to increased selenium loads.

Introduction

The BDCP is an elaborate and complex plan which purports to restore and protect the Sacramento-San Joaquin Delta ecosystem as part of an effort to secure future water deliveries from the Delta to state and federal water contractors *via* the Central Valley Project and State Water Project. The overall plan includes three new riverine water intakes located on the Sacramento River, in the northern Delta. A total of nine alternatives (with some sub-alternatives for a total of fifteen action alternatives) and the "no action" alternative were evaluated in the BDCP and the EIR/EIS. "Alternative 4" is the CEQA/NEPA preferred alternative, which would consist of a dual conveyance system of pipeline/tunnel and the new riverine water intakes that collectively provide export capacity of 9,000 cubic feet per second – or more than 6.5 million acre feet per year. Under Alternative 4, water would be conveyed from the north Delta to the south Delta through pipelines/tunnels and through surface channels.[1]

BDCP implementation project(s) would result in a substantial amount of Sacramento River water being removed from the Delta, resulting in a significant increase in flow from the San Joaquin River. As water flows from the San Joaquin River increase, so will a corresponding amount of increased selenium at elevated concentration levels flow into the Delta and thereafter into San Pablo and San Francisco Bays. As a result, due to known selenium behavior both as a required nutrient and as a toxicant at higher levels, there could be significant impacts on fish and other wildlife in San Francisco Bay. This phenomenon was recently explored by scientists studying the sources and fate of selenium loads affecting San Francisco Bay, wherein it was concluded that, "Manipulations to the Delta system, especially those that increase San Joaquin [River] flow into the bay, will also have selenium impacts to the bay that must be evaluated."[2]

Detailed Comments

WSPA takes no position on the desirability of the BDCP and/or the underlying "alternative water conveyance facilities" the BDCP is being developed to support. WSPA's members simply desire to ensure that the final BDCP is both ***technically accurate*** and adequately ensures that known or reasonably foreseeable impacts that are likely to accrue as a result of BDCP will be formally recognized and fully mitigated

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1 *See generally,* BDCP Plan, Executive Summary; *see also*, BDCP EIR/EIS, Ch. 2. (ICF, November 2013.)

2 "*Modeling Fate, Transport, and Biological Uptake of Selenium in North San Francisco Bay*", L. Chen, Meseck, Roy, Grieb, and Baginska; Estuaries & Coasts, November 2012. (Copy provided as Attachment 1.)

under CEQA, NEPA and the Sacramento-San Joaquin Delta Reform Act of 2009 ("Delta Act").

In particular, WSPA is concerned that the BDCP understates the potential additional selenium loading impacts to the Delta, and completely ignores the potential impacts these additional selenium loads will have to San Francisco Bay.

1. The EIR/EIS fails to consider the effects of BDCP Conservation Measures on San Francisco Bay.

Chapter 8 of the EIR/EIS purports to analyze known and reasonably foreseeable environmental impacts associated with the BDCP and each of the Conservation Measures to be taken thereunder, all with a view toward supporting the "preferred" Alternative 4. By its very terms, and as specifically set forth in Chapter 8, the EIR/EIS cannot meet the legal adequacy requirements of CEQA and NEPA because the effects analysis is artificially restricted, and the EIR/EIS fails to provide a "reasonable explanation for the geographic limitation used."[3] Indeed, for purposes of analyzing water quality[4] and water supply[5] impacts of the BDCP, the EIR/EIS preparers chose to include "upstream of the Delta (including the Sacramento and San Joaquin River watersheds)"[6] or – alternatively - the "Sacramento hydrologic region,"[7] yet somehow concluded that the water quality and water supply impacts ***downstream*** of the BDCP project were unimportant.[8]

According to the EIR/EIS, "[f]or the purposes of characterizing the existing water quality conditions and evaluating the consequences of implementing the BDCP alternatives on surface water quality, *the affected environment is defined as anywhere an effect could occur*, which includes but is not necessarily limited to the statutory Delta, Suisun Bay

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[3] *See,* CEQA Guidelines §15130(b)(1)(B)(3), which provides that, "Lead agencies should define the geographic scope of the area affected by the cumulative effect and provide a reasonable explanation for the geographic limitation used." Further, when considering potentially significant impacts on the affected "environment," it is worth noting that CEQA defines "environment" to mean, "the physical conditions that exist within the area which will be affected by a proposed project, including land, air, water, minerals, flora, fauna, noise, or objects of historic or aesthetic significance." (California Public Resources Code § 21060.5.)

[4] BDCP EIR/EIS, Chapter 8.

[5] BDCP EIR/EIS, Chapter 6.

[6] BDCP EIR/EIS, Section 8.1.5 at page 8-3.

[7] BDCP EIR/EIS, Section 6.1 at page 6-1. Under the Delta Reform Act, the Sacramento Hydrologic Region is defined by reference to the Department of Water Resources' "Bulletin 160-05," commonly known as the "California Water Plan." In turn, the California Water Plan describes the Sacramento Hydrologic Region as: "The entire drainage area of the state's largest river and its tributaries, extending from the Oregon border downstream to the Sacramento – San Joaquin Delta. The region covers 27,246 square miles including all or a portion of 20 predominately rural Northern California counties, and extends from the crest of the Sierra Nevada in the east to the summit of the Coast Range in the west." According to the Water Plan, "The population of the Sacramento River Hydrologic Region was 2,593,000 in 2000, which represents about 8 percent of California's total population." (California Water Plan, (Bulletin 160-05), Ch. 6 pages 6.1-6.2.)

[8] For comparison, the surface area of the entire San Francisco Bay is approximately 1,100 square miles, or roughly 4% of the 27,246 square miles that comprise the Sacramento Hydrologic Region. (*See*, Water Quality Control Plan for the San Francisco Bay Basin, Ch. 1 (2013).)

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BDCP1432

and Marsh, and areas to the north and south of the Delta, which are defined in various parts of this chapter as Upstream of the Delta and the State Water Project/Central Valley Project Export Service Areas, as shown in Figure 1-4. When compared to the watershed boundaries, it is noted that the affected environment falls primarily within the Sacramento and San Joaquin River watersheds."[9]

Yet aside from the statement that the EIR/EIS considered water quality impacts "anywhere an effect could occur," it is clear from the EIR/EIS itself that the affected area where water quality impacts were analyzed was artificially constricted.

An extracted copy of the map contained in the referenced Figure 1-4, showing the affected area wherein environmental impacts were analyzed under the EIR/EIS, is included herein as Attachment 2. This map demonstrates that the preparers of the BDCP and supporting EIR/EIS excluded San Francisco and San Pablo Bays from their effects analyses, which violates CEQA and NEPA.[10]

In its critical assessment of the BDCP and the EIR/EIS, the Delta Independent Science Board ("DISB") noted one of its major concerns was that, "The analyses largely neglect the influences of downstream effects on San Francisco Bay..."[11] Further on the topic of the restricted geographic scope of the EIR/EIS analyses, the DISB cautioned that, "the geographic scope of the DEIR/DEIS was defined to exclude San Pablo Bay and San Francisco Bay. The consequences of BDCP actions undertaken within the Plan Area, however, will extend downstream to affect these bays.

Changes in sedimentation in the Delta associated with BDCP actions, for example, will not be confined to the Delta."[12] As noted by the DISB, San Pablo and San Francisco Bays were excluded from consideration in the EIR/EIS simply because they fall outside of the legal boundaries of the Delta.[13] The artificial determination of the BDCP "affected area" is neither legally supportable nor, according to the DISB, "scientifically justified."[14]

2. *The BDCP and the EIR/EIS significantly underestimate additional selenium loads to the Delta associated with Preferred Alternative 4.*

Chapter 8 of the EIR/EIS analyzes various "factors affecting water quality" in the Delta and essentially ignores the well-known and well-documented selenium loading that comes from the San Joaquin and Sacramento Rivers. Concurrently, the authors of the EIR/EIS suggest that the Bay Area refineries are responsible for considerable selenium loading to Suisun Bay and the Delta without any empirical data or evidence to support

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[9] BDCP EIR/EIS, Sec. 8.2.1 at page 8-6. (Emphasis added.)

[10] CEQA requires a state lead agency to provide specific reasons why certain environmental effects "have not been discussed in detail in the environmental impact report." (California Public Resources Code §21100(c).)

[11] Delta Independent Science Board, "Review of the Draft EIR/EIS for the Bay Delta Conservation Plan," May 15, 2014, page 3. (hereafter, "DISM Review").

[12] DISB Review, page 7. (Emphasis added.)

[13] DISB Review, page 8.

[14] DISB Review, page 8.

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this claim.[15] These multiple references to the Bay Area refineries and the quality of their respective effluents to North San Francisco Bay should be removed, unless they are supported in both a factually and contextually accurate manner, the BDCP flow impacts are appropriately modeled, and the BDCP modelling is shown to have no impact on the selenium loading in the San Francisco and San Pablo Bays.

Indeed, the most current understanding of selenium loading to San Francisco Bay has been compiled by the San Francisco Regional Board in developing its North San Francisco Bay TMDL for Selenium. That data shows the _overwhelming_ percentage of selenium load to the Bay comes from the Delta.[16]

The underlying conclusions of the EIR/EIS – that development of the BDCP preferred Alternative 4 conveyance facilities "would result in essentially no change in selenium concentrations throughout the Delta"[17] - - is inaccurate.

According to a recent Tetra Tech analysis (attached) of the EIR/EIS assessment of selenium loading and impacts related to the BDCP project, "[s]elenium concentrations used in the Sacramento River for the BDCP EIR/EIS study are biased high."[18] This analysis determined that the EIR/EIS preparers ***excluded*** recent selenium water concentration data from the Freeport and Vernalis gauge stations maintained by USGS, and used older data based on high "non-detect" values, which artificially inflated the current calculated values of water column selenium by more than a factor of two.[19]

When valid boundary values for the Sacramento and San Joaquin Rivers are input into the *same modeling framework* used by the BDCP preparers, Tetra Tech found the following:

> "The model analysis shows that the BDCP-preferred Alternative 4 will result in higher percent changes in water column concentrations than that calculated in the EIR/EIS. Using the bioaccumulation model in the EIR/EIS, we find a similar projected increase in fish tissue concentrations between Alternative 4 and existing conditions (i.e., no BDCP project). Importantly, the new calculations suggest that there is an effect of the BDCP changes to the water column and white sturgeon selenium concentrations at the Mallard Island station for CEQA Alternative 4, representing conditions in Suisun Bay (8-20% increase, depending on the hydrology). This is higher

[15] *See, e.g.,* BDCP EIR/EIS, Sec. 8.4.3 at pages 8-286, 8-347, 8-401, 8-477, 8-535, 8-587, 8-642, 8-694, 8-747.

[16] *See,* Technical Memorandum 2: North San Francisco Bay Selenium Data Summary and Source Analysis, July 2008, TetraTech, Inc.

[17] BDCP EIR/EIS, Sec. 8.4.3.9 at page 8-474.

[18] "Review of Selenium Bioaccumulation Assessment in the Bay Delta Conservation Program Draft EIR/EIS," TetraTech, May 30, 2014. (Hereafter, "TetraTech Selenium Review.") (Copy provided in Attachment 3.)

[19] TetraTech Selenium Review at page 5-1.

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than currently estimated for Alternative 4 at this station (2-5% increase, calculated by Tetra Tech)..."[20]

The BDCP reviewers underestimated the anticipated increase in selenium loading that will be caused by construction and operation of the preferred Alternative 4 conveyance facilities by an average of approximately 15% for any given hydrology year.

Not only must the BDCP proponents re-evaluate the selenium-related water quality effects based on the results of the Tetra Tech analysis, but adequate resources must be allocated for future water column and fish tissue monitoring throughout the term of the BDCP permits.

In addition, mitigation for these impacts must be provided by the BDCP beneficiaries as part of their CEQA and NEPA obligations,[21] as well as under the Delta Reform Act of 2009. (*See* discussion in Section 4, below.)

3. The EIR/EIS relies on inappropriate regulatory standards for concluding "No Substantial Effects" associated with selenium load increases.

Under the "Effects Determinations" analysis contained in Section 8.4.3, the BDCP preparers concluded that there would be "no substantial effects" related to selenium associated with the BDCP project. In part, this conclusion is based on a water quality criteria established under the California Toxics Rule for San Francisco and Suisun Bays in 2000.[22]

Yet, the EIR/EIS acknowledges that US EPA Region IX is currently developing a new water quality criterion for selenium in San Francisco and San Pablo Bays, and further concedes that the anticipated new selenium criterion is likely to be far lower than current fresh and marine waters criteria.[23] Nevertheless, because the BDCP preparers concluded that only the *existing* selenium water quality criteria applies for purposes of determining substantial effects related to the BDCP project, the anticipated US EPA criteria is ignored.

CEQA requires a lead agency to analyze all reasonably foreseeable, significant effects on the environment.[24] "Significant effect on the environment" is defined under CEQA to

[20] TetraTech Selenium Review, page 1-2.

[21] An adequate EIR must respond to specific suggestions for mitigating a significant environmental impacts unless the suggested mitigation is facially infeasible. *See, San Francisco Ecology Center v. City and County of San Francisco* (1975) 48 Cal.App.3d 584, 596.

[22] BDCP EIR/EIS, Sec. 8.4.2.3, page 8-96 – 8-97. *See,* Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California. 65 Fed.Reg. 31682.

[23] BDCP EIR/EIS, Sec. 8.4.2.3, page 8-99 – 8-100.

[24] California Public Resources Code §21065. A "project" subject to CEQA review means "means an activity which may cause either a direct physical change in the environment, or a reasonably foreseeable indirect physical change in the environment." (*Ibid.*)

mean, "a substantial, or potentially substantial, adverse change in the environment."[25] As discussed above, the BDCP preferred Alternative 4 is reasonably likely to result in increased selenium loads to San Francisco and San Pablo Bays at a range of between 8-20% every year, depending on hydrological conditions.[26] These anticipated increases in selenium load to San Francisco and San Pablo Bays are significant, and the BDCP must both consider these effects on the downstream environment, as well as provide adequate mitigation for them.

Furthermore, the EIR/EIS must analyze these expected selenium load increases in the context of US EPA's anticipated new selenium criteria for San Francisco Bay which, as the EIR/EIS preparers are well aware, is likely to be *substantially lower* than the current criteria used by the preparers.

4. The BDCP fails to provide adequate assurances for mitigation of known or reasonably foreseeable impacts to San Francisco and San Pablo Bays related to increased selenium loads.

The federal and state Endangered Species Acts require that a Habitat Conservation Plan (HCP) contain specific information to ensure adequate funding to carry out all aspects of the HCP.[27] Case law interpreting the Federal Endangered Species Act on the need for ensuring adequate HCP funding has further held that the permit "applicant cannot rely on speculative future actions of others."[28]

Yet, the BDCP specifically refers to and relies upon putative funding derived from a Water Bond that has yet to be placed before the voters, let alone actually passed. This clearly cannot satisfy the requirements of the federal and state Endangered Species Acts, as interpreted by case law applicable to California.

Moreover, the Delta Reform Act of 2009 specifically provides that proponents of a new Delta water conveyance facility must pay to mitigate all impacts associated with the construction, operation, and maintenance of such facility.[29]

There is nothing in the BDCP which accounts for mitigation related to increased selenium loads that will occur with the construction and operation of the preferred Alternative 4 water conveyance facilities. We believe this is due to the EIR/EIS preparers specifically excluding an analysis of selenium loading to San Francisco and San Pablo Bays.

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[25] California Public Resources Code §21068. *See also*, CEQA Guidelines §15382.

[26] *See*, Section 2 above, at pages 4-5.

[27] *See*, 16 U.S.C. §§1539(a)(2)(A)(ii) and 1539(a)(2)(B)(iii); California Fish & Game Code §2820(a)(10). *See also*, *Nat'l Wildlife Federation v. Babbit*, 128 F.Supp.2d 1274 (E.D. Cal., 2000); *Southwest Center for Biological Diversity v. Bartel*, 470 F.Supp.2d 1118 (S.D. Cal., 2006).

[28] *Southwest Center for Biological Diversity v. Bartel*, *supra*, 470 F.Supp.2d 1118, 1155, citing, *Nat'l Wildlife Federation v. Babbit*, *supra*, 128 F.Supp. 2d 1274, 1294-95.

[29] California Water Code §85089(a).

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According to Section 8.3, the BDCP will rely on three, primary, sources of funding for all aspects of the Plan: (1) federal government funding; (2) state government funding (including putative funding provided by future water bonds to be placed before the California voters); and (3) the State and Federal Water Contractors (including, for purposes of municipal water supply districts, individual ratepayers).

Yet, the BDCP contains no financing plan and no legal assurances that any of the "expected" funds will actually materialize. An analysis of the sources of funds from reveals that it cannot meet the "speculative future actions" test of ensuring HCP funding.

According to Table 8-37 in Chapter 8,[30] the BDCP expects to receive $3.5 billion from the federal government, derived from various appropriations. However, the BDCP acknowledges that "additional federal legislation will be required to authorize the continued use of certain federal funds and to extend or broaden fund availability."[31] In terms of securing funding for BDCP implementation, it is difficult to imagine anything more speculative than relying on future acts of Congress to make-up what is expected to be approximately 14% of the entire BDCP budget.

Regarding the sources of state government funds for BDCP implementation, Table 8-37 indicates that BDCP proponents expect approximately $4.1 billion to come from the State of California, which accounts for approximately 17% of the entire BDCP budget. Section 8.3.5 of the BDCP provides that, "Funds derived from the issuance of [the 2009 Water Bond] would be used, in part, to satisfy the State's financial commitments to the BDCP."[32]

According to the capital cost estimates for the entire BDCP project, the Authorized Entities are relying on the not-yet passed Water Bond for approximately 10% of the entire BDCP budget.[33] Furthermore, Table 8-37 indicates that BDCP proponents assume the passage of a "Second Water Bond" at some unstated time in the future that will provide an additional $2.2 billion dollars to fund BDCP actions.[34] All totaled, the BDCP proponents expect the voters of California to pass future water bonds in the amount of $3.75 billion to fund BDCP actions – an amount approximately equal to 25% of the entire BDCP budget.

The remaining BDCP budget ($17 billion) is expected to be funded by the State and Federal Water Contractors, according to Table 8-37. Yet a review of Section 8.3.4.4 reveals that even this source of funds is speculative. According to that section, "[t]he most credible assurances of funding from the participating state and federal water contractors result from an economic benefits analysis..." and two primary conclusions

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[30] BDCP, Ch. 8, page 8-65 – 8-66.

[31] BDCP, Sec. 8.3.1, page 8-64, lines 16-18.

[32] BDCP, Sec. 8.3.5.1, page 8-84, lines 9-11.

[33] *See*, Table 8-35 (Ch. 8, page 8-63) and Table 8-46 (Ch. 8, page 8-85).

[34] BDCP proponents expect this "Second Water Bond" to be passed by the voters of California approximately 15 years into the permit term. (BDCP, Sec. 8.3.5.1, page 8-85, lines 3-6.)

derived from the economic analysis that: (1) the costs are affordable by the ratepayers, and (2) the benefits to be gained from the BDCP exceed the total cost.[35]

What is missing from these "assurances" is any discussion of whether the State and Federal Water Contractors and their ratepayers would be willing to pay additional billions of dollars in the event that state water bond funding and/or federal appropriations do not materialize. Moreover, the analysis fails to assess the potential impacts of one (or more) State or Federal Water Contractors, or their member agencies, withdraw or refuse to continue to participate in the Plan.

Lastly, the BDCP analysis fails to account for the possibility of reduced Delta water exports as a result of the State Water Board's future Delta flow standards, and mistakenly assumes benefits based on expected water deliveries from the newly-constructed conveyance facilities will not be impacted by these flow standards. This major regulatory action that will not likely be taken until after the BDCP is approved under the current time-schedule.[36]

Conclusion

WSPA believes the BDCP and the supporting EIR/EIS are seriously flawed with respect to potential long-term impacts related to selenium loading to San Francisco and San Pablo Bays.

Our members respectfully request that these flaws be corrected, and that adequate financial commitments are made by the BDCP proponents to carry out adequate long-term monitoring of future selenium loading to San Francisco and San Pablo Bays that are directly or indirectly attributable to BDCP actions.

Further, we request that the BDCP proponents provide adequate financial assurances that future "adaptive management" actions will be taken to address the impacts of expected selenium loading of San Francisco and San Pablo Bays which, we believe, a robust Bay-Delta selenium monitoring program will confirm.

Thank you for the opportunity to provide these comments on the November, 2013 BDCP and Supporting Draft EIR/EIS.

Sincerely,

Kevin Buchan

Attachments:

1. "Modeling Fate, Transport, and Biological Uptake of Selenium in North San Francisco Bay", L. Chen, Meseck, Roy, Grieb, and Baginska; Estuaries & Coasts, November 2012.
2. BDCP EIR/EIS, Ch. 1, Figure 1-4. (ICF, November 2013)

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[35] BDCP, Sec. 8.3.4.4, page 8-81, lines 5-22.

[36] See, "*The High Price of Water Supply Reliability: California's Bay Delta Conservation Plan Would Require Significant Investment*," S&P Capital IQ, McGraw-Hill Financial, February 13, 2014.

3. "Review of Selenium Bioaccumulation Assessment in the Bay Delta Conservation Program Draft EIR/EIS," TetraTech, May 30, 2014.

Copies (with Attachments) to:

Bruce Wolf, San Francisco Regional Water Quality Control Board
Thomas Howard, State Water Resources Control Board
Diane Fleck, US EPA
Ren Lohoefener Regional Director, US Fish & Wildlife Service
Charlton H. Bonham, Director, California Dept. of Fish & Wildlife
Jessica Pearson, Executive Director, Delta Stewardship Council

(ATTACHMENTS Begin on Next Page)

Estuaries and Coasts
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BDCP 1432

Modeling Fate, Transport, and Biological Uptake of Selenium in North San Francisco Bay

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Abstract Selenium behavior in North San Francisco Bay, the largest estuary on the US Pacific coast, is simulated using a numerical model. This work builds upon a previously published application for simulating selenium in the bay and considers point and non-point sources, transport and mixing of selenium, transformations between different species of selenium, and biological uptake by phytoplankton, bivalves, and higher organisms. An evaluation of the calibrated model suggests that it is able to represent salinity, suspended material, and chlorophyll *a* under different flow conditions beyond the calibration period, through comparison against long-term data, and the distribution of different species of dissolved and particulate selenium. Model-calculated selenium concentrations in bivalves compared well to a long-term dataset, capturing the annual and seasonal variations over a 15-year period. In particular, the observed lower bivalve concentrations in the wet flow periods, corresponding to lower average particulate selenium concentrations in the bay, are well represented by the model, demonstrating the role of loading and hydrology in affecting clam concentrations. Simulated selenium concentrations in higher organisms including white sturgeon and greater scaup also compared well to the observed data in the bay. Finally, a simulation of changing riverine inflows into the bay that might occur as a consequence of proposed hydrologic modifications indicated significant increases in dissolved and particulate selenium concentrations in the bay. The modeling framework allows an examination of the relationship between selenium loads, variations in inflow, in-bay concentrations, and biota concentrations to support management for limiting wildlife impacts.

Keywords Bioaccumulation · Selenium speciation · TMDL · Estuarine modeling · ECoS

Electronic supplementary material The online version of this article (doi:10.1007/s12237-012-9530-y) contains supplementary material, which is available to authorized users.

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Introduction

Selenium is a limiting nutrient to aquatic organisms at low concentrations; however, it becomes toxic when concentrations are elevated (Harrison et al. 1988; Lauchli 1993; Lemly 1996). The element is toxic to fish and birds due to its adverse impacts on the reproductive system (Lemly 1985; Presser and Luoma 2006). Selenium can substitute for sulfur in the structure of proteins and therefore causes deformities in embryos or inhibition of the hatchability of eggs (Skorupa 1998). Under the Clean Water Act of the USA, North San Francisco Bay (NSFB) is listed as being impaired for selenium, due to high concentrations observed in fish tissues (particularly in white sturgeon, *Acipenser transmontanus*, up to 50 μg/g dry weight) and diving ducks (such as greater scaup, *Aythya marila* up to 35 μg/g dry weight in muscle tissues) (White et al. 1988, 1989; Urquhart et al. 1991; SFEI 2006). NSFB is an important water body for the study of selenium biogeochemistry and ecotoxicology, because it is the largest estuary on the Pacific coast of

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the USA and receives significant selenium loadings from sources that are directly related to human activity: it is downstream of irrigated selenium-bearing soils of the semi-arid San Joaquin Valley (representing 7 % of total US agricultural production and four of the top five agriculturally productive counties in the US), and it receives selenium discharged from five major oil refineries (which together constitute 5.6 % of the total refining capacity of the USA; based on data from the US Census of Agriculture 2007; California Energy Commission 2012). Selenium has been a contaminant of interest in this region since the discovery of deformed waterfowl in the Kesterson Wildlife Refuge in San Joaquin Valley, which received most of its water from agricultural drainage (Ohlendorf et al. 1988).

Selenium is present in the aquatic environment in several different forms (Cutter 1992). Dissolved forms of selenium include inorganic selenite (SeO_3^{2-}+$HSeO_3^-$), selenate (SeO_4^{2-}), and organic selenides. The particulate forms include elemental selenium, organic selenides, and selenite and selenate adsorbed on particles. Selenium in biogenic particles is principally composed of organic selenide (Cutter and Bruland 1984) with each species being subject to different transformations and biological uptake (Suzuki et al. 1979; Measures et al. 1980; Cutter and Bruland 1984). Particulate organic selenides can decompose and release dissolved organic selenides at relatively fast rates (>0.2/day, Cutter 1982). Organic selenides can be oxidized to selenite and further to selenate and this has been described using pseudo-first-order reactions (Cutter and Bruland 1984). The oxidation of organic selenides to selenite can occur on the order of days, while oxidation from selenite to selenate can take years (Cutter 1992; Meseck and Cutter 2006).

Dissolved forms of selenium can be taken up by phytoplankton and bacterioplankton communities. The uptake of dissolved selenium by these organisms is a key step in selenium entering the food web (Luoma et al. 1992; Wang et al. 1996). The bioavailability of dissolved selenium differs by chemical form, with selenite and organic selenides being taken up more rapidly than selenate (Riedel et al. 1996). Despite low selenium concentrations in the water column, certain species of phytoplankton can concentrate selenium to relatively high concentrations (Baines and Fisher 2001; Doblin et al. 2006). Organic selenides in cells can be released into the environment through excretion, cell lysis, or grazing (Cutter 1982).

The uptake of selenium by invertebrates is mainly through the ingestion of particulates (Luoma et al. 1992; Sanders and Gilmour 1994; Wang and Fisher 1996), especially particulate organic selenides which are more easily assimilated by invertebrates. Measured assimilation efficiencies for elemental selenium range from 2 to 28 % (Schlekat et al. 2000), while assimilation efficiencies for organic selenium range from 53 to 89 % (Schlekat et al. 2002). As with phytoplankton, the accumulation of particulate selenium in invertebrates and zooplankton differs by species. Certain species of invertebrates (e.g., the clam *Corbula amurensis* that is abundant in NSFB) are able to accumulate selenium to relatively high concentrations due to high food ingestion rates and slow excretion (Stewart et al. 2004), resulting in relatively high selenium concentrations in the benthic food web.

Sources of selenium to the NSFB include riverine inputs from the Sacramento and San Joaquin Rivers, tributaries surrounding the NSFB, discharge from refineries, and municipal and industrial wastewater treatment plant discharges. The NSFB water column is characterized by low selenium concentrations (~0.2 μg/L); however, bioaccumulation by *C. amurensis*, may be a pathway leading to high selenium in certain benthic-feeding fish and birds.

The San Francisco Bay Regional Water Quality Control Board is in the process of developing a selenium total maximum daily load (TMDL) for NSFB to address this impairment. Under the Clean Water Act, a TMDL is required when a water body is listed as impaired due to one or more contaminants and sets in motion a process to manage and control the impairment. To effectively address impairment, TMDLs need tools, often in the form of numerical models, to represent the linkage between sources of contamination and biological endpoints, including concentrations in the tissues of target organisms. The objective of the present study is to develop a model representing the transport, fate, and uptake of selenium in the benthic food web of NSFB, focusing on phytoplankton, clams, and fish and bird species that consume these clams. The model is calibrated using the best available data on hydrology, selenium loading from the major rivers, petroleum refineries, municipal wastewater treatment plants, and other industrial sources and selenium speciation in different compartments as reported in monitoring programs and the scientific literature over the last two decades.

The modeling framework builds on a previous study of selenium biogeochemistry in NSFB (Meseck and Cutter 2006), developed using an estuary modeling framework (ECoS3) (Harris and Gorley 1998). The previous study was modified for the TMDL by: (1) using more recent selenium loads from five major refineries and principal riverine sources, Sacramento and San Joaquin Rivers, (2) adding selenium loads from smaller, local tributaries, and all municipal and industrial dischargers with discharge permits; (3) modification of the model to consider particulate selenium, total suspended material (TSM), and phytoplankton inputs from the San Joaquin River; (4) changing the riverine boundary conditions of TSM, chlorophyll *a* and different species of particulate selenium to time-varying inputs; and (5) expanding the model to simulate selenium concentrations in biota (clams, fish, and diving ducks). The final change is especially important because the impairment in NSFB is driven by concentrations in biota. The above changes necessitated a recalibration and extension of the Meseck and Cutter (2006) model, as detailed in the following section while retaining the basic setup of the original work. The updated model was recalibrated for the 1999–2000 water years, and then used to simulate long-term selenium dynamics in NSFB for the period of 1999–2008. Through this development and integration process, the key research questions to be answered are: can we describe the speciation of selenium in the waters of NSFB under different flow and loading conditions, the changing seasonal and long-term concentrations of selenium in the clam *C. amurensis*, monitored at a regular frequency as a sentinel species in the bay over 1995–2010, and concentration patterns in other predator species that consume *C. amurensis*? A reasonable representation of these observations lends credibility to the use of this modeling framework for management of selenium in NSFB over the coming years during which many changes are possible, including changes in land use, upstream water diversions, sea level rise, and modified freshwater outflows. More generally, the framework for integration of data and mechanistic processes presented here may be applicable to the management of selenium in estuaries receiving inflows from urbanized and developed watersheds, although affected species and food webs may differ.

Methods

ECoS Modeling Framework

ECoS3 is a modeling framework developed by the Center for Coastal and Marine Sciences (Plymouth Marine Laboratory, UK) that can be used to simulate transport and dynamics of dissolved and particulate constituents in a one-dimensional (1-D) or 2-D form for an estuary (Harris and Gorley 1998, 2003). By using a single box or a multiple box approach, the model will simulate salinity, nutrients, TSM, and biological productivity once the shape, geometry, and tidal movement in the estuary are established (Harris and Gorley 1998). ECoS3 considers transport due to advection and dispersion, transformations between species through exchange or reactions, and changes through point or non-point inputs and outputs. ECoS3 has been widely applied to simulate different constituents (e.g., salinity, suspended particles, carbon, nitrogen, nutrients, Zn, and Ni) in estuaries including the Humber Estuary in UK (Harris 2003; Tappin et al. 2003), Tweed Estuary (Punt et al. 2003; Uncles et al. 2003), and Tamar Estuary (Liu et al. 1998). Meseck and Cutter (2006) used ECoS3 to focus on simulating transport and biogeochemistry of selenium in 1-D form in the NSFB.

Model Domain and Components

As in Meseck and Cutter (2006), the model was applied starting from the Sacramento River at Rio Vista, extending through NSFB to the Golden Gate Bridge (Fig. 1), with Rio Vista constituting the freshwater boundary, and the Golden Gate Bridge the ocean boundary. The model consists of 33 linked cells, each 3 km wide, representing this domain, with external flows and selenium load inputs at various intermediate locations (Fig. 2). The Sacramento-San Joaquin Delta is not explicitly modeled in this work: Sacramento River flows at Rio Vista are the main freshwater input, with inflows from San Joaquin River added at the confluence 19 km from Rio Vista. Flows at Rio Vista are measured, with the contribution from San Joaquin River estimated as the difference between the Delta outflow and the Rio Vista flow. Tributary flows from 10 local watersheds surrounding NSFB, 5 major refineries, and 23 additional municipal wastewater and industrial point sources were added to the model corresponding to their distance from the head of the estuary at Rio Vista. These sources are identified and their distances from Rio Vista listed in Table 1 in the Electronic supplementary material (ESM).

Meseck and Cutter (2006) used the model to simulated salinity, TSM, phytoplankton, and different species of dissolved and particulate selenium (dissolved selenate, selenite, organic selenide, particulate elemental selenium, particulate organic selenides, and adsorbed selenite and selenate). The modified and recalibrated model presented here simulates these constituents and selenium concentrations in bivalves and higher trophic level organisms (white sturgeon and greater scaup).

As a first step, salinity in the bay is simulated because it represents the advection and dispersion of all dissolved water column constituents in the estuary (Harris and Gorley 1998). Accurate simulation of salinity is an indicator that the advection and dispersion of dissolved species is represented adequately. The simulation of TSM indicates how well the fate and transport of all other constituents associated with particulates in the estuary is simulated. TSM concentrations also affect reactions of selenium with particulates and the distribution of particulate selenium in the estuary. Simulation of phytoplankton greatly affects the fate of selenium, because selenium uptake by phytoplankton is an important first step in subsequent foodweb uptake (Luoma et al. 1992). Loads, transport, and transformations of different species of selenium are important modeling components as bioavailability differs among the different species of selenium. The bioaccumulation of selenium through the foodweb is an important component of this model as it links selenium

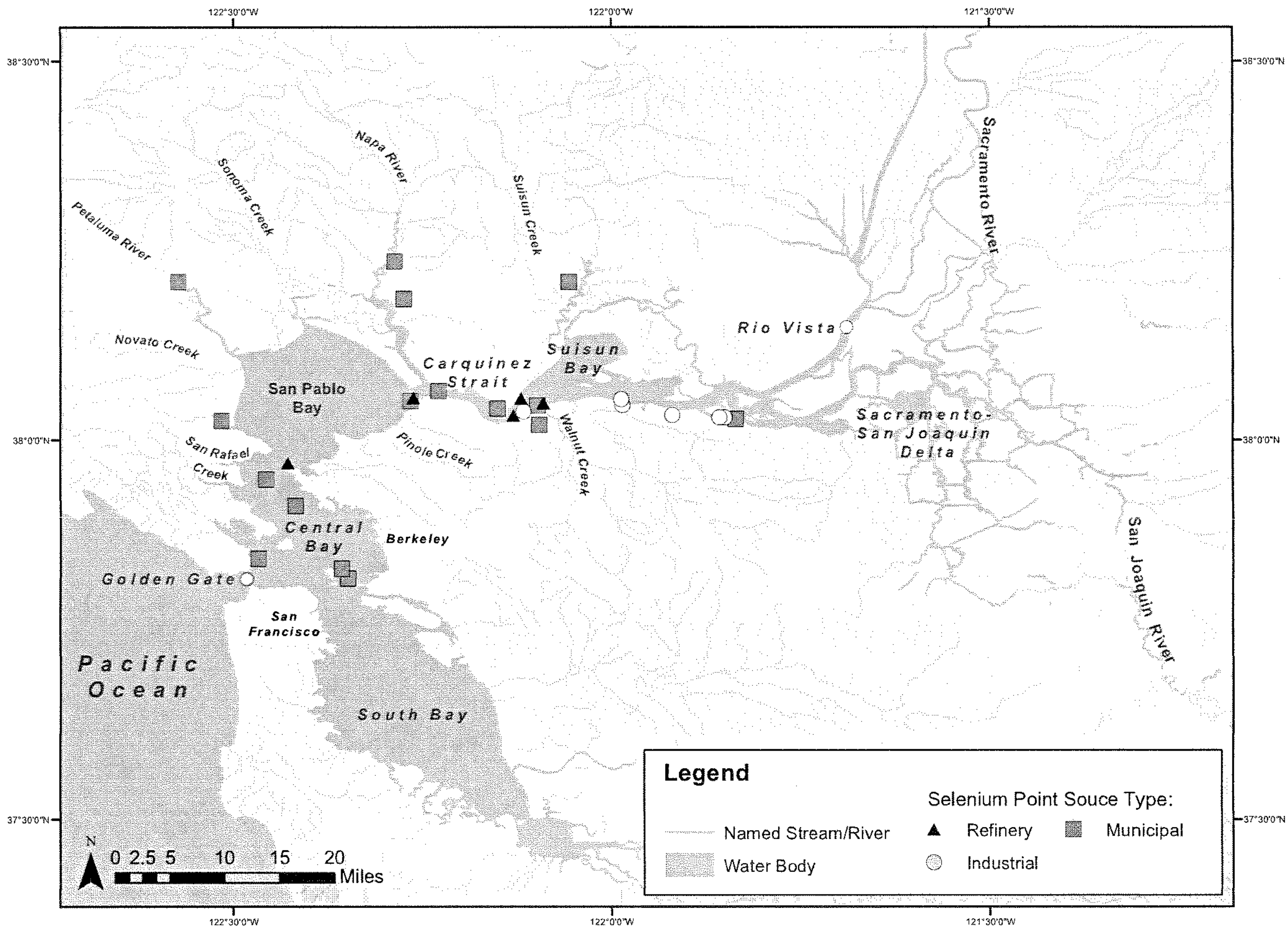

Fig. 1 San Francisco Bay region and surroundings. The model uses Rio Vista on Sacramento River as the starting point of the simulations and spans the region to Golden Gate, following Meseck and Cutter (2006). San Joaquin River inflows are added as a tributary 19 km downstream of Rio Vista. Other tributaries and point sources are also shown and listed in Table 1 in the ESM. The Delta is not explicitly modeled in this application

concentrations in the water column to biota of ecological concern.

To adapt the Meseck and Cutter (2006) model for the present application required some modifications to the loads and model formulation, as outlined here. Refinery loads were updated using daily selenium inputs from five refineries in the NSFB, estimated based on daily flow and weekly concentrations for the period of 1999–2007. These loads were added to model cells based on their discharge locations. In addition, selenium loads from local tributaries to NSFB (i.e., in addition to the major riverine flows through the Delta) were added to the model based on their discharge locations. These loads were not identified in the prior application and may be significant during wet months. Loads from publicly owned treatment works and other point source dischargers in the NSFB were added to the model based on their discharge locations. All sources of selenium are identified in Fig. 1. Besides selenium inputs from the San Joaquin River, TSM loads (with TSM concentrations modeled as a function of flow) and phytoplankton loads (with observed phytoplankton concentrations) from the San Joaquin River were also added to the model. In simulating the TSM, phytoplankton, and particulate selenium, the current model uses observed concentrations as much as possible in defining the riverine boundary conditions.

The transfer of dissolved selenium to particulate selenium through phytoplankton uptake is an important process in its bioaccumulation. Therefore, particulate selenium associated with phytoplankton uptake within the estuary was tracked as a separate constituent and was added to the total particulate selenium. At the boundaries, the input of phytoplankton and all other forms of particulate selenium were estimated separately through calibration. Simulated Se/C ratio in phytoplankton was also tracked by the model and was compared with data observed for species found in the bay. Finally, a dynamic multi-pathway bioaccumulation model

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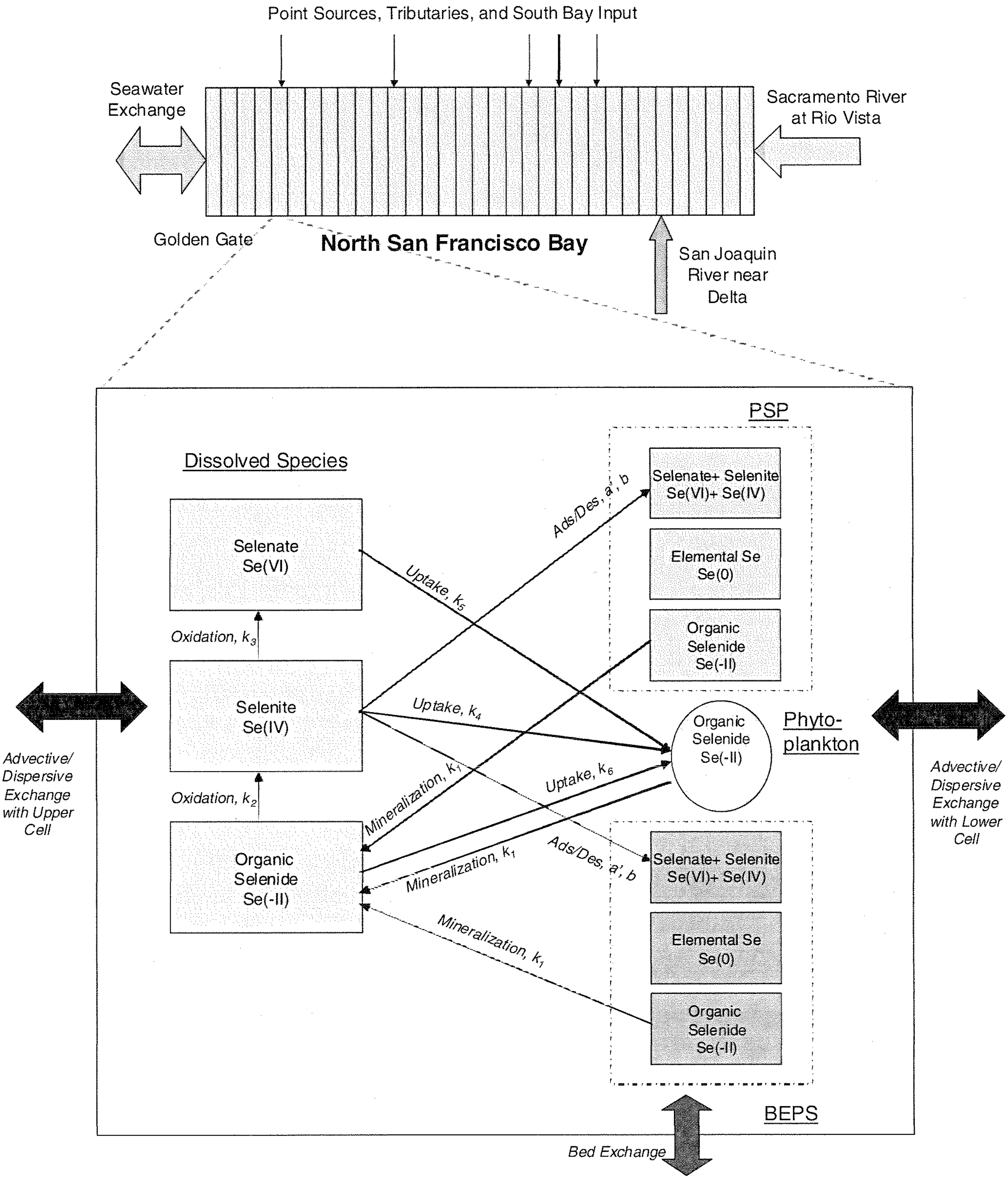

Fig. 2 Schematic of model representation of the NSFB, showing model cells or nodes (*vertical boxes*), boundary conditions, and external loads. Each cell is 3 km wide. The locations of the external loads are illustrative and are added in the model location at the approximate location they enter the estuary

(DYMBAM; Presser and Luoma 2006) was added to predict tissue selenium concentrations in bivalves; previously developed relationships between prey and predator concentrations by Presser and Luoma (2006)

Table 1 DYMBAM model parameters for *Corbula amurensis*

K_u (L g^{-1} day^{-1})	IR (g g^{-1} day^{-1})	AE (%)	K_e (day^{-1})	Growth rate (per day)	Tissue Se concentration (mg/kg)	References
0.003	0.25	45–80	0.025		2.1–12.0	Stewart et al. (2004)
0.009	0.1–1.0	36 (sediment) 54 (algae)	0.023	0.005	3.9–20.0	Lee et al. (2006)

DYMBAM dynamic multi-pathway bioaccumulation model, *AE* assimilation efficiencies

were used to predict bioaccumulation of selenium to the higher trophic levels (bivalves, benthic-feeding fish, and diving ducks).

The above changes entailed a recalibration of the model and evaluation against the most recently available data in NSFB including salinity, TSM, chlorophyll *a*, dissolved and particulate selenium, and selenium concentrations in clams for the period beyond 1999 (US Geological Survey (USGS) monthly cruises in the bay; SFEI 2006; Doblin et al. 2006; Kleckner et al. 2010). The complete modeling framework development, calibration, and application to NSFB are detailed in a report prepared for the TMDL effort (Tetra Tech 2010; available on the Internet at: http://www.swrcb.ca.gov/rwqcb2//water_issues/programs/TMDLs/seleniumtmdl.shtml).

Selenium Transformations Simulated

While in the water column, different species of selenium can undergo biological and chemical transformations, and these transformations were simulated by the model (Cutter 1982; Cutter 1992). Transformations of dissolved selenite simulated by the model include oxidation to selenate, uptake by phytoplankton, and adsorption and desorption from minerals. Transformations of dissolved organic selenide include oxidation to selenite and uptake by phytoplankton. Particulate organic selenides can undergo mineralization to form dissolved organic selenide (Cutter 1982). The exchange of selenium between different compartments simulated by the model is shown schematically in Fig. 2, identifying the different dissolved and particulate species, and the exchanges between them. In this formulation, particulates are tracked as three phases, permanently suspended particulates (PSP), composed of fine material that remains in suspension, bed exchangeable particles (BEPS), composed of larger particles that originate from sediment resuspension, and phytoplankton. The transformations among different species of dissolved and particulate selenium are modeled as a set of first-order reactions, labeled with rate constants from k_1 to k_6, an approach similar to that by Meseck and Cutter (2006). Under oxic conditions, such as those occurring in the waters of the NSFB, the key transformations include oxidation of organic selenide to selenite, and further oxidation of selenite to selenate, as well as uptake of all dissolved species by particulate phases (PSP, BEPS, and phytoplankton). Values of the rate constants were estimated from the literature and are listed in Table 2 in the ESM. These ranges were used as a starting point for the modeling, and where the range was broad, the parameters were adjusted to obtain a best fit to the data from the NSFB. In the work, the rate constants k_1 and k_2 were estimated through calibration, whereas k_3 through k_6 were based on literature estimates. In general, these rate constants indicate that the oxidation of organic selenide is relatively rapid, although oxidation of selenite to selenate is a very slow process. Also, uptake of selenide and selenite onto particulate phases was more rapid than for selenate.

Selenium Bioaccumulation Through the Foodweb

Selenium Uptake by Bacteria and Phytoplankton

Dissolved selenium in the water column can be directly taken up by phytoplankton and bacteria. After uptake, selenium exists in reduced organic forms within algal or bacterial cells or is exuded as dissolved organic selenium to the water column. Organic selenium in algal cells is highly bioavailable to organisms that consume them, such as zooplankton and bivalves (Luoma et al. 1992; Schlekat et al. 2000). Therefore, the uptake of selenium by bacterial and planktonic organisms is important in evaluating selenium bioaccumulation in the foodweb. The uptake of selenium by bacteria and phytoplankton is modeled using first-order reactions.

Selenium Bioaccumulation Through Bivalves

Bioaccumulation of particulate selenium to lower trophic level organisms (e.g., bivalves) is simulated using a DYMBAM (Luoma et al. 1992; Stewart et al. 2004; Presser and Luoma 2006). The model predicts metal concentrations in bivalve tissues using concentrations in food, food ingestion rate, metal assimilation efficiency, and elimination rate.

The dynamic form of the DYMBAM model is as follows:

$$\frac{dC_{mss}}{dt} = k_u \times C_w + AE \times IR \times C_f - k_e \times C_{mss} \quad (1)$$

where C_{mss} is selenium concentration in tissue (in micrograms per gram), k_u is the dissolved metal uptake rate

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constant (in liters per gram per day), C_w is the dissolved metal concentrations in water (in micrograms per liter), AE is the assimilation efficiency (in percent), IR is the ingestion rate (in grams per gram per day), C_f is the metal concentration in food (e.g., phytoplankton, suspended particulate matter, and sediment; in micrograms per gram), and k_e is the efflux rate (in day^{-1}). Uptake through the waterborne pathway was found to be negligible (Luoma et al. 1992) and not considered. Parameter values in Eq (1) for uptake of selenium by *C. amurensis* are derived from Stewart et al. (2004) and shown in Table 1. Parameters for different metals and different species of organisms have been quantified in previous studies (summarized in Luoma and Rainbow 2005). The filter-feeding organism *C. amurensis* was found to have a higher assimilation efficiency and lower elimination rate, and thus accumulating selenium to higher concentrations than other bivalve species common in the bay, such as *Corbicula fluminea* (Lee et al. 2006; Linville et al. 2002). Bioaccumulation into bivalves considers different efficiencies of absorption for different selenium species (Table 2). Assimilation efficiencies (AE) measured by Schlekat et al. (2002) for organic selenide are in a relatively narrow range for different species of algae and are generally high (53–89 %). AE for elemental selenium are generally low (2–28 %), with biogenic particulate elemental selenium showing higher AE. In developing model predictions in this work, an AE of 0.2 or 20 % was used for particulate elemental selenium, an AE of 45 % was used for particulate adsorbed selenite+selenate, and an AE of 80 % was used for particulate organic selenium (Fig. 3).

A range of ingestion rates has also been estimated for *C. amurensis* by Lee et al. (2006) and covers a wide range from 0.1 to 1.0 $g g^{-1}$ day^{-1} (Table 1). The ranges in assimilation efficiency and ingestion rates were used to forecast the range of selenium concentrations in bivalves. The predicted selenium concentrations in bivalves were compared with observed data by Stewart et al. (2004). In forecasting the long-term selenium concentrations in bivalves, an ingestion rate of 0.65 $g g^{-1}$ day^{-1} (roughly the midpoint value) was used in model predictions.

Selenium Bioaccumulation to Higher Trophic Levels (Fish and Diving Ducks)

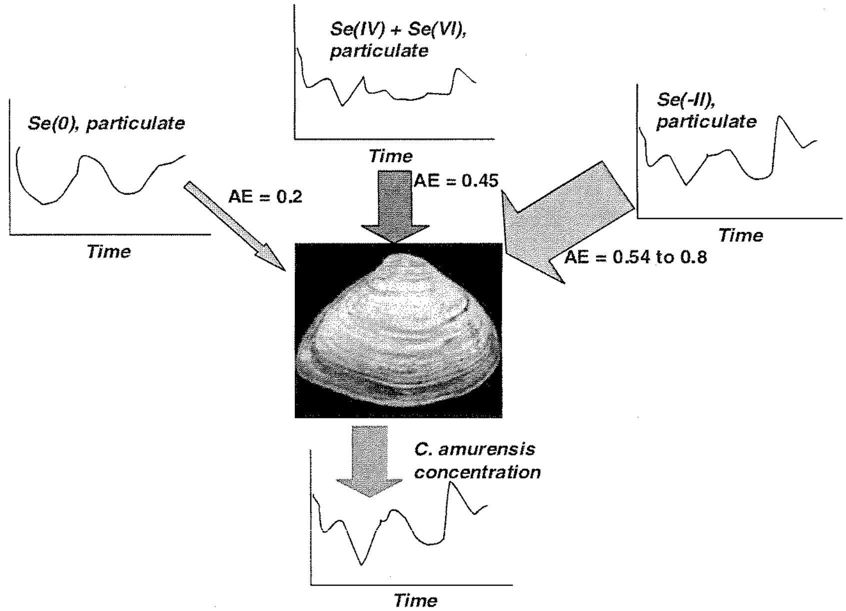
A ratio between selenium concentrations in the tissues and diet of organisms, the trophic transfer factor (TTF) can be used in estimating bioaccumulation of selenium through the food web, once dietary concentrations are known (Presser and Luoma 2010). The ratio can be derived based on kinetic uptake rates or observed concentrations of diet and tissue. For example, the TTF for invertebrates can be derived as: $TTF=(AE)(IR)/k_e$, where AE is the assimilation efficiency; IR is the ingestion rate, and k_e is the elimination rate. The TTFs are a relatively simple and effective way to incorporate the complex processes of biological uptake from bivalves (e.g., clams) to predator species (e.g., sturgeon and scaup) in this model. The significance of clams in the diet of these species has been reported previously (Stewart et al. 2004). TTFs for fish have been found to vary over a relatively narrow range across species and habitats, based on an examination of data from 29 field studies (Presser and Luoma 2010). For several fish species studied the TTFs for selenium range from 0.52 to 1.6 (Presser and Luoma 2010), and a value of 1.3 was reported for white sturgeon. A TTF of 1.8 has been reported for bird egg concentrations in mallards (Presser and Luoma 2010).

Table 2 Literature values of assimilation efficiencies (AE) for different selenium species for *Corbula amurensis*

Species	AE	Origin	References
Se(0)[a]	2 %	AA—reduction of SeO_3^{2-} to Se(0) through ascorbic acid (AA)	Schlekat et al. (2000)
Se(0)	7±1 %	SES— reduction of SeO_3^{2-} to Se(0) through pure bacteria culture (SES)	Schlekat et al. (2000)
Se(0)	28± 15 %	SED—reduction of SeO_3^{2-} to Se(0) through sediment microbial consortium (SED), biogenic origin	Schlekat et al. (2000)
Selenoanions	11 %	Reoxidized sediment slurries	Schlekat et al. (2000)
Organoselenium	53 %	Ph. Tricornutum	Schlekat et al. (2000)
Cryptomonas sp.	88.9 %	Algae cells	Schlekat et al. (2002)
Gymnodinium sanguinem	82.6 %	Algae cells	Schlekat et al. (2002)
Phaeodactylum tricornutum	80 %	Algae cells	Schlekat et al. (2002)
Synechococcus sp.	78.3 %	Algae cells	Schlekat et al. (2002)
Thalassiosira pseudonana	87.3 %	Algae cells	Schlekat et al. (2002)
Sediment	36 %	Fresh water stream, San Jose, CA	Lee et al. (2006)
Algae (mixed with sediment)	54 %	Diatan, *P. tricornutum*	Lee et al. (2006)

[a] This form of elemental selenium does not occur in nature and was synthesized in the laboratory

Fig. 3 Bioaccumulation of particulate selenium in bivalves



Model Boundary Conditions and External Loads

Riverine Inputs of TSM and Chlorophyll a

Riverine inputs of flow from the Sacramento River at Rio Vista are daily records from the Interagency Ecological Program (IEP 2010) for the period of 1999–2008. The San Joaquin River is modeled as a tributary to the Sacramento River, with flow derived as the difference between Net Delta Outflow Index and flow from the Sacramento River at Rio Vista.

Riverine inputs (Sacramento and San Joaquin Rivers) of TSM and chlorophyll *a* were estimated as flow at the Sacramento River at Rio Vista and San Joaquin River multiplied by concentrations.

The riverine concentrations of TSM were modeled as a function of flow:

$$TSM_{river} = a + b * Q_{river}^{c} \quad (2)$$

where a is the minimum concentration in the river water, b and c are calibration coefficients, and Q_{river} is the riverine flow rate.

Riverine chlorophyll *a* concentrations were observed data obtained from the USGS and Bay Delta and Tributary Project (BDAT) for the Sacramento River at Rio Vista for the period of 1999–2008. For the San Joaquin River, BDAT data for San Joaquin River at Twitchell Island were used.

Selenium Loads from Refineries and Municipal and Industrial Wastewater

Selenium loads to the NSFB include point sources from refineries, municipal and industrial dischargers and tributaries. Point and nonpoint sources of selenium were added to the model cells at their corresponding discharge locations (Table 1 in the ESM).

Daily refinery loads over 1999–2007 from five refineries in the NSFB estimated in Tetra Tech (2008) were used in the model calibration. For the refinery effluent data, only total selenium was reported, and for the purpose of the modeling, the speciation was held constant at values reported by Cutter and Cutter (2004): selenite (13 %), organic selenide (30 %), and selenate (57 %). The daily load varied from day to day depending on the effluent data reported and was 558.8 kg/year for 1999 for all five refineries combined.

Daily selenium loads from local tributaries estimated in a previous assessment (Tetra Tech 2008) were added to the model using the annual load for each hydrological area multiplied by a time series scaling factor, derived from daily flow record at Napa River (USGS station 11458000). No selenium speciation data exist for local tributaries. The speciation from local tributaries is assumed to be the same as from the Sacramento River reported by Cutter and Cutter (2004): selenite (9 %), organic selenide (35 %), and selenate (56 %). The total selenium load from tributaries estimated in the model varies depending on the volume of runoff each year and was 819.7 kg/year for 1999.

Selenium loads from other point sources including municipal and industrial wastewater discharges were also added to the model. Speciation for municipal wastewater discharges used is organic selenide (15 %), selenite (25 %), and selenate (60 %). For 1999, the total loads from these sources were 175.8 kg/year.

Riverine Dissolved Selenium Loads

Dissolved selenium loads for selenate, selenite, and organic selenide were specified from the rivers as a product of flow and selenium concentrations by species. Different species of selenium concentrations were derived using fitted functions

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based on observed data by Cutter and Cutter (2004) at the Sacramento and San Joaquin River stations, similar to the approach used in Meseck and Cutter (2006). A Delta removal constant was used in converting observed selenium concentrations in the San Joaquin River at Vernalis to concentrations at the confluence with Sacramento River. This constant represents exports of San Joaquin River through the aqueducts in the Delta and also the biogeochemical processes of selenium removal within the Delta.

Particulate Selenium Loads

Riverine particulates are assumed to exist in two forms: PSP and BEPS, the latter representing sediment bed-load transport. Riverine particulate selenium inputs are estimated as selenium concentrations associated with PSP and BEPS (both in micrograms per gram), multiplied by riverine inputs of PSP and BEPS (in milligrams per liter). Also added to the particulate loads are the riverine phytoplankton Se loads using a Se/C ratio and chlorophyll *a* concentrations.

Particulate selenium concentrations associated with PSP were measured by Doblin et al. (2006) and showed a range of values. Particulate elemental selenium ranged from 0.08 to 0.40 μg/g (mean, 0.149±0.108 μg/g), particulate selenite and selenate range from nondetectable to 0.25 μg/g (mean, 0.270±0.137 μg/g), and organic selenide concentrations ranged from 0.015 to 0.74 μg/g (mean, 0.134±0.238 μg/g) at Sacramento River at Rio Vista (Doblin et al. 2006). Particulate selenium concentrations associated with BEPS are data from Meseck and Cutter (2012). The total particulate selenium at Rio Vista is 0.46 μg/g (the sum of particulate organic, inorganic, and elemental selenium). Higher selenium content on particulates may be expected during low flows (e.g., 0.75 μg/g in November 1999). Therefore, the model was also run using a higher riverine particulate selenium concentration of 0.75 μg/g for a low flow period (river flow, $<1.5\times10^{10}$ l/day) (Table 3). Particulate selenium concentrations at the seawater end of the model domain observed by Doblin et al. (2006) ranged between 0.84 and 1.18 μg/g at Golden Gate Bridge. A seawater end member concentration for each species of particulate selenium was specified corresponding to measured values at Golden Gate.

Model Calibration and Evaluation

Model Calibration

Before the model is used to predict selenium concentrations on particulates and bivalves, it was calibrated for physical parameters (salinity and TSM), phytoplankton, and dissolved and particulate selenium species, using observed general water quality data (from cruises conducted by the USGS, http://sfbay.wr.usgs.gov/access/wqdata/) and selenium speciation data sampled by Cutter and Cutter (2004) for 1999. Calibration for the general water quality parameters was conducted based on data from 19 USGS monitoring stations located in the NSFB and was roughly on monthly intervals from January 1999 to December 1999. The use of the USGS dataset supplements data used in the previous study by Meseck and Cutter (2006), which was mainly based on Cutter and Cutter (2004) data. Selenium speciation data collected during two time periods in 1999 (April and November) by Cutter and Cutter (2004) were used in model calibration for selenium. Water year 1999 was selected for calibration because detailed refinery discharge data and selenium speciation data are available for this year, and selenium loads from refineries decreased by about two thirds in mid-1998 and have stayed at approximately those levels since that time. The 1999 estuary data thus represent conditions following refinery load reductions. Key model calibration parameters are those that affect advection and dispersion of PSP and BEPS, phytoplankton growth rate and grazing rate, selenium transformation rates, and Delta removal constants for selenium inputs from the San Joaquin River.

Model Evaluation Criteria (Goodness of Fit)

The model goodness of fit was evaluated using two measures: the correlation coefficient (r) between predicted and observed values, a goodness of fit defined in Perrin et al. (2001).

$$\mathrm{GOF}(\%) = 100^*\left(1-\left|\sqrt{\frac{\sum X_{\mathrm{cal}}}{\sum X_{\mathrm{obs}}}}-\sqrt{\frac{\sum X_{\mathrm{obs}}}{\sum X_{\mathrm{cal}}}}\right|\right) \quad (4)$$

where X_{cal} is the model simulated concentration and X_{obs} is the

Table 3 Lower and higher boundary of riverine and seawater endmember concentrations (Doblin et al. 2006; Meseck 2002; Baines et al. 2004)

	Riverine boundary				Seawater boundary
	PSP PSe (μg/g)	BEPS PSe (μg/g)	Se/C in phytoplankton (μg/g)	PSP PSe (μg/g)	Se/C in phytoplankton (μg/g)
Lower boundary	0.46	0.25	15.9	0.84	21.0
Higher boundary (applied when Net Delta Outflow Index, $<1.5\times10^{10}$ l/day)	0.75	0.50	15.9	1.18	21.0

observed concentration. A 100 % goodness of fit indicates a perfect fit between simulated and observed values.

Model Evaluation

The model evaluation was conducted using long-term data available for years after 1999, which include several low and high flow years, for the period of 1999–2008. The calibrated model was evaluated against estuarine profile data collected by USGS for salinity, TSM, and phytoplankton for two specific water years 2001 and 2005, and long-term total selenium data collected by the San Francisco Bay Regional Monitoring Program (RMP) for water year 2001 through water year 2007 (RMP 2010). The RMP dataset reports dissolved and total selenium and does not include characterization of selenium speciation and the separation of dissolved and particulate selenium. The difference between total and dissolved selenium, although in principle an approximation of particulate selenium, is not an accurate representation of particulate selenium, and sometimes negative values may result. Water year 2001 was selected because it was a dry year, with flows much lower than 1999 and water year 2005 was selected because it was a relatively wet year based on the commonly used classification by the California Department of Water Resources (DWR 2010). The evaluation was for both simulations along the length of the estuary and at fixed locations over long-term time periods, for both physical and biological parameters and selenium species concentrations.

Model Hindcast

Model hindcasting is another form of evaluation and provides insight on model's capability to simulate conditions that are different from the calibration period in terms of hydrology and internal selenium loading. The calibrated model was run to hindcast selenium concentrations during two time periods prior to refinery load reductions in 1986 and 1998. To simulate selenium concentrations in 1986 and 1998, river discharges from the Sacramento River at Rio Vista and the San Joaquin River at Jersey Point for 1986 and 1998 were used (obtained from IEP 2010). Selenium loads of different species from the refineries for 1986 and 1998 were based on data from Meseck (2002).

Results

Model Evaluation for the Post-1999 Period

The calibrated model was evaluated against estuarine profile data on salinity, TSM, and phytoplankton for water years 2001 and 2005 collected by USGS, and long-term total selenium data collected by RMP for water year 2001 through water year 2005 (RMP 2010). The water year 2001 represents a dry year, with flows much lower than 1999 and water year 2005 represents a relatively wet year, as noted above.

Evaluation of salinity, TSM, and chlorophyll *a* for the low flow year 2001 suggested good agreement of simulated salinity versus observed values for different months across the year (Figs. 1, 2, and 3 in the ESM). Overall values for goodness of fit for these months are between 71.5 and 97.9 % for salinity, 36.4 and 99.4 % for TSM, and 53.7 and 95.7 % for chlorophyll *a*. The location of the estuarine turbidity maximum (ETM) was simulated well for most months in 2001, particularly for June and July 2001. For about 2 months, chlorophyll *a* concentrations were under-predicted near the Central Bay, similar to the pattern in the calibration. For the evaluation period, the simulated correlation coefficient (r) is 0.92–1.00 for salinity in 2001, 0.68–0.97 for TSM in 2001, and 0.02–0.79 for chlorophyll *a* in 2001.

A similar evaluation of salinity, TSM, and chlorophyll *a* was performed for an above-normal flow year (2005) (Figs. 4, 5, and 6 in the ESM). Salinity predictions showed very good agreement with the observed data (GOF=50.4–99.7 %). The evaluation of TSM for 2005 shows good agreement for the first several months, particularly for January, March, and June 2005. For April and May 2005, the ETM was under-predicted (GOF=48.2–97.7 %). This is similar to the results in the calibration phase where the ETM was under-predicted on some occasions. Chlorophyll *a* predictions were able to represent the average values through the estuary but did not capture the peaks (GOF=25.2–98.5 %).

Simulated TSM and chlorophyll *a* concentrations were also evaluated for longer time periods at fixed locations, using data from the USGS long-term monitoring stations (Figs. 7 and 8 in the ESM). The model-simulated chlorophyll *a* and TSM concentrations were compared with long-term data at four stations, stations 3 (Suisun Bay), 6 (Suisun Bay), 14 (San Pablo Bay), and 18 (Central Bay), respectively. The results suggest that the model is able to capture the seasonal variations in chlorophyll *a* and TSM relatively well.

Although the calibration process for the general water quality parameters was extensive, and generally described key constituents of interest across a range of years, seasons, and loading conditions using a relatively small number of adjustable parameters, several features could not be fully captured by the model. This includes peaks in concentrations for constituents such as TSM and phytoplankton, represented by chlorophyll *a* concentrations. This is likely attributable to the limitations of the 1-D model in capturing the complexities of processes in the NSFB, and also to seasonal changes that were not fully parameterized during calibration.

Comparison of simulated selenium concentrations against the RMP transect sampling data for the period of 2000–2005 suggested that the model simulates profiles of

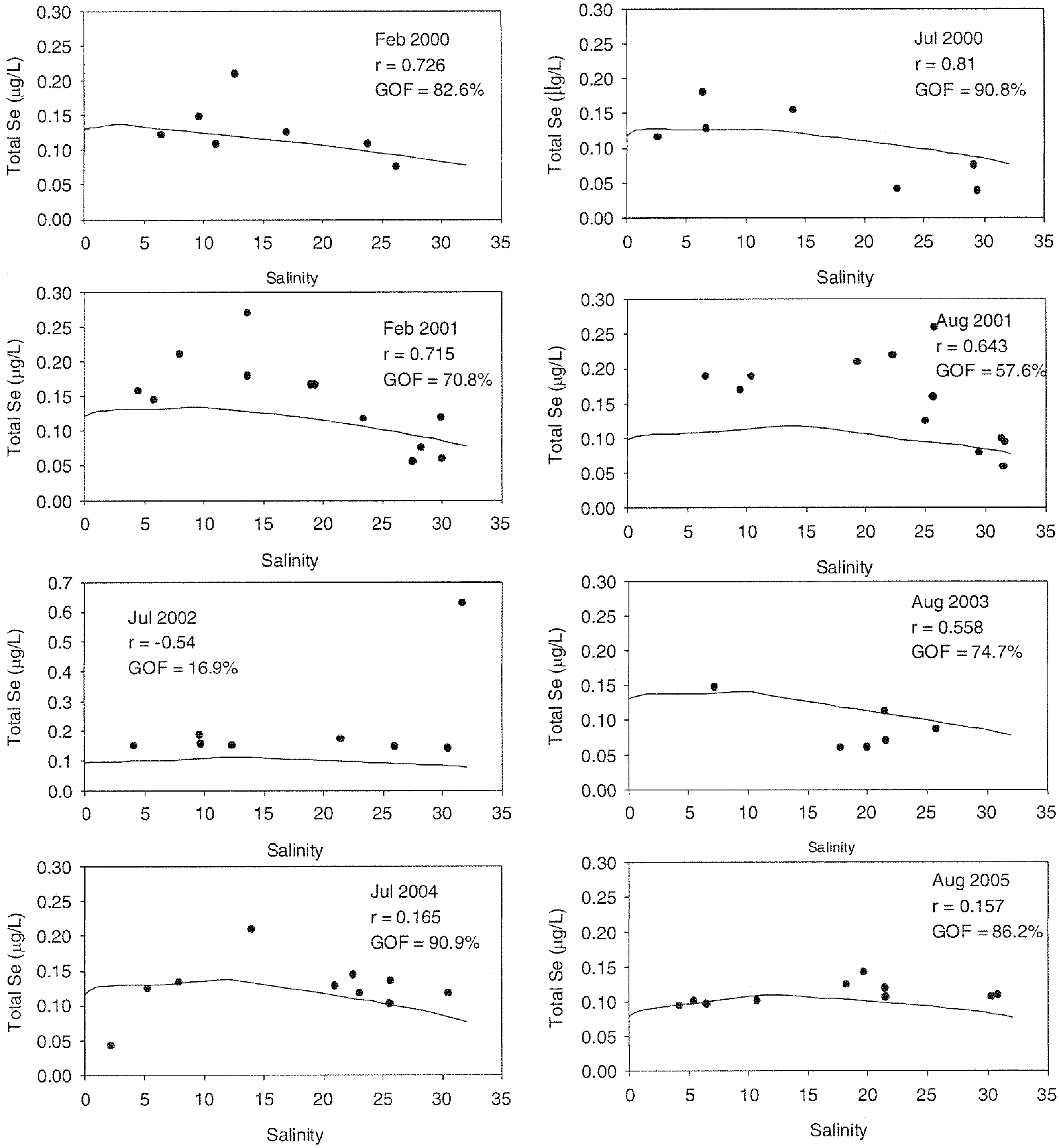

Fig. 4 Model simulated total selenium concentrations (dissolved+particulate) compared with selenium data collected by the San Francisco Bay RMP. Note that the RMP dataset does not report selenium species information, and no selenium speciation data are available for this period in NSFB. RMP data on the Internet at: http://www.sfei.org/rmp/data

selenium concentrations along the estuarine longitude well for a range of hydrological and load input conditions during 2000–2005, including both dry and wet years, and dry and wet season conditions (Fig. 4), and the long-term variations in selenium concentrations at fixed locations (Fig. 5).

Model Hindcast

The model hindcast (prior to refinery selenium load reductions) suggests that the model-simulated salinity, TSM and chlorophyll *a* compared well with the observed values for both high and low

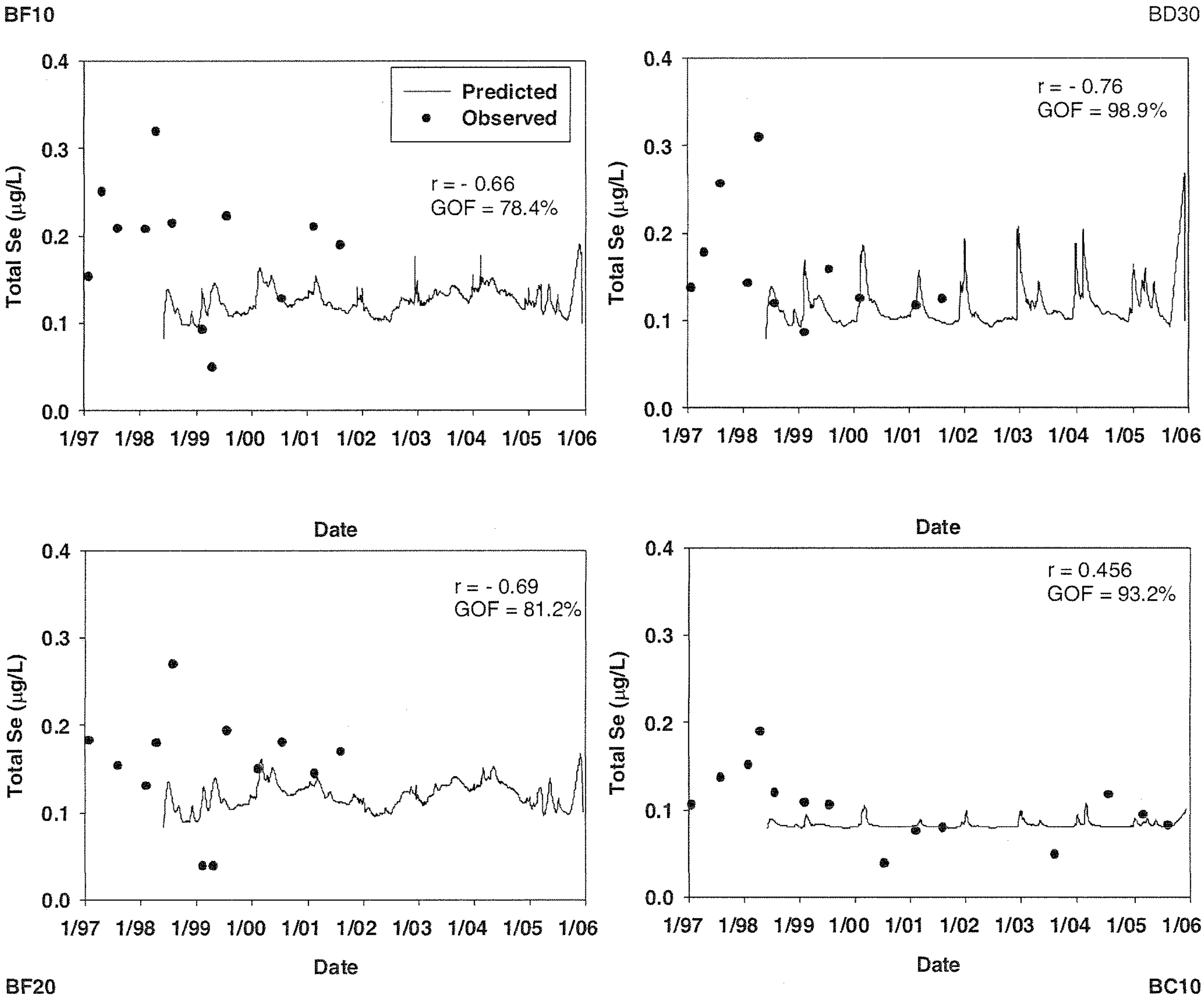

Fig. 5 Model simulated total selenium concentrations at BF10 (Suisun Bay), BF20 (Suisun Bay), BD30 (San Pablo Bay), and at BC10 (Central Bay) compared with observed total selenium by RMP. RMP data on the Internet at: http://www.sfei.org/rmp/data

flow. The model is able to simulate the ETM that occurred during October 1998. The hindcast of dissolved selenium suggests that the model is able to simulate the relatively conservative mixing behavior of selenium during high flow periods and the mid-estuarine peaks during low flow, a result similar to that previously reported in Meseck and Cutter (2006). Simulated selenium concentrations on particulates for the hindcast period compared well with the observed particulate selenium values, and suggested that the model can represent the behavior of selenium on particulates in different periods (Fig. 6).

Simulated Selenium Concentrations on Particulates and Biota

Simulated selenium concentrations on particulate matter (in micrograms per gram) for 11 November 1999 were compared with the observed data from Doblin et al. (2006; Fig. 7). The predicted mean particulate selenium concentrations for NSFB for 11 November 1999 is 0.77±0.35 µg/g, compared with the observed value of 0.735±0.25 µg/g (r=0.45).

Predicted selenium concentrations in *C. amurensis* near Carquinez Strait as a function of time were compared with data from Stewart et al. (2004) and are shown in Fig. 8 for a range of ingestion rates and different assimilation efficiencies of organic selenium used.

Clam selenium concentrations are also available for a longer time period of 1995–2010 from USGS (Kleckner et al. 2010). Simulated clam selenium concentrations at Carquinez Strait for the time period prior to refinery load reductions (1995–1998) and following refinery load reductions (1999–2010) using an ingestion rate of 0.65 gg^{-1} day^{-1} and a seawater particulate selenium boundary of 1.05 µg/g were compared with these data (Fig. 9). The model is generally able to capture the seasonal and long-term patterns in clam selenium concentrations over a period with variability in hydrology and loading. Lower

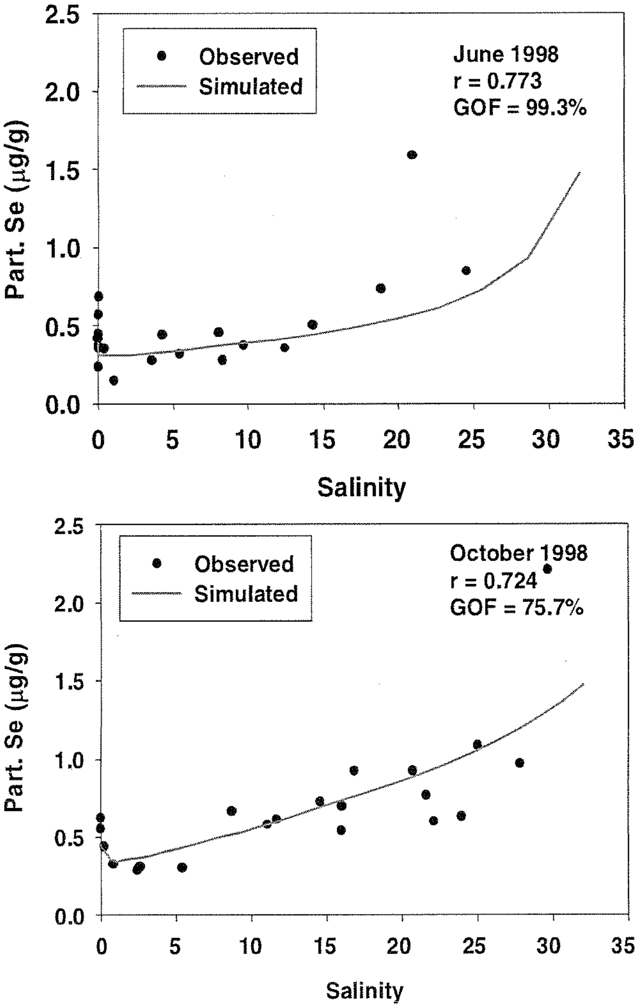

Fig. 6 Model simulated hindcast values of particulate selenium for June and October 1998

selenium concentrations in bivalves are coincident with high flow periods (e.g., April) and wet years (e.g., 2005 and 2006).

Simulated selenium concentrations in muscle and liver tissues of white sturgeon and greater scaup using TTF and regression equations from Presser and Luoma (2006) were compared with observed values in the NSFB (Figs. 10 and 11). White sturgeon sampled from San Francisco Bay-Delta between 1986 and 1990 contained selenium at concentrations ranging from 9 to 30 µg/g dw (mean, 26.55 µg/g) in liver and 7 to 15 µg/g in muscle tissue (mean, 12.57 µg/g; Urquhart and Regalado 1991; White et al. 1988). Lower selenium concentrations in livers of white sturgeon were reported by another study (mean: 9.75 µg/g) between 2002 and 2004 (Linares et al. 2004, cited in Linville 2006). Predicted selenium concentrations in muscle tissue of white sturgeon are 10.7 µg/g using a TTF of 1.3.

Evaluation of Future Management Scenarios

To test the changes in particulate selenium as a result of load changes from the rivers, particularly from the San Joaquin River, the model was run assuming that all the San Joaquin River flow at Vernalis will reach the Bay. This is in contrast with current conditions, where a significant part of the San Joaquin flow is withdrawn from the Delta into aqueducts. Under the elevated flow condition, it was assumed that the residence time of San Joaquin River water in the Delta significantly decreases, and, as a worst-case from the standpoint of selenium loading to NSFB, the Delta removal effect of selenium on San Joaquin River water was considered to be zero. Therefore, the scenario assumes higher inputs of selenium as a result of both increase in flow from the San Joaquin River and the loss of the Delta removal effects on selenium.

Model simulations using San Joaquin River flow at Vernalis were compared with simulation results using normal San Joaquin River flow (base case). Under the base case, flow from the San Joaquin River was estimated as the difference between Delta outflow and flow from the Sacramento River at Rio Vista. Simulated dissolved and particulate selenium concentrations were higher under the scenario of increased San Joaquin River flow than the base case, for both high- and low-flow periods (Fig. 12).

Predicted model-simulated selenium concentrations on particulates (in micrograms per gram) are significantly higher under the scenario of increased San Joaquin River flow, particularly for the upper estuary. Setting the flow of the San Joaquin River to the measured flow at Vernalis, particulate selenium concentrations are nearly doubled with increases greater than 0.4 µg/g predicted in the upper estuary (Fig. 12). These increases may lead to corresponding increases in clam concentrations. The application of this modeling framework to a wider range of loading and flow scenarios is presented in a technical memorandum developed as part of the selenium TMDL process (Tetra Tech 2010).

Discussion

Model Uncertainties

Model calibration involved the selection of the principal transformation rates that pertain to flow, salinity, sediment transport, phytoplankton growth, and selenium chemistry. Many of these were based on values reported in the scientific literature, although about half the parameters were estimated by adjusting values to fit observed data. The model was calibrated to data primarily from 1999, for which detailed selenium speciation data in the estuary were available.

For the simulation period, the model is able to capture key aspects of physical and biological constituents that affect selenium concentrations. The model simulates salinity

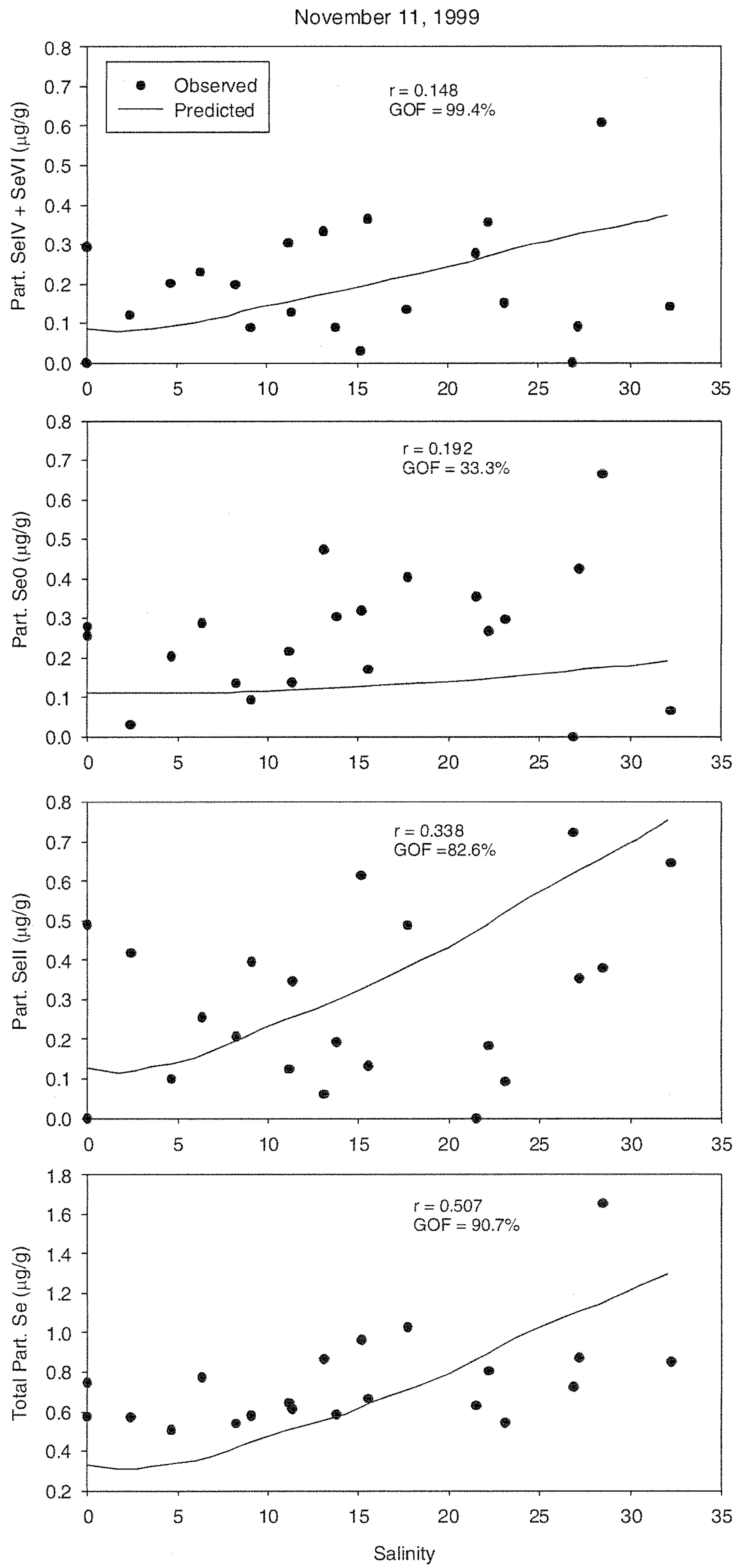

Fig. 7 Simulated particulate selenium compared with the observed data from Doblin et al. (2006) for November 1999

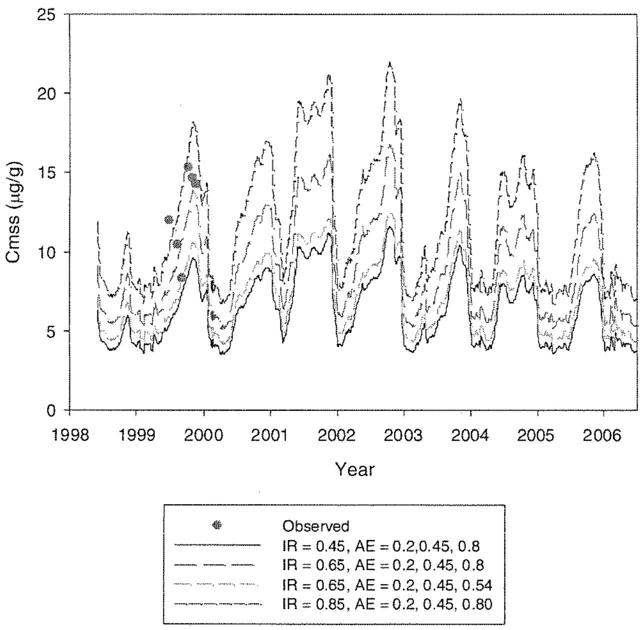

Fig. 8 Simulated selenium concentrations in bivalve *C. amurensis* near the Carquinez Strait compared with observed values from Stewart et al. (2004; station 8.1)

along the estuary well for different hydrological conditions. The evaluation results for phytoplankton and TSM over short-time periods (during specific sampling events for selected years) and long-term periods for multiple years indicated that the model is able to simulate the general temporal and spatial pattern in TSM and phytoplankton, although specific-day peaks may not match very well. For phytoplankton, a few spring blooms are not captured by the model as the model uses a single light limitation function to simulate growth, which limits phytoplankton growth in spring months. Overall, for ancillary parameters, especially TSM and phytoplankton, the model does better at fitting average concentrations than peak concentrations. To some extent this is a consequence of the 1-D formulation of the model, although local variability in driving parameters cannot be ruled out. However, given the hydrodynamic complexities of San Francisco Bay, the inter-annual and seasonal variability in hydrology, this 1-D model produces reasonable results of the ancillary variables for use in computing selenium fate and transport.

The simulated selenium species include dissolved forms such as selenite, selenate and organic selenide and particulate species such as adsorbed selenite and selenate, particulate organic selenide and particulate elemental selenium. The transfer of dissolved selenium to particulate selenium is simulated through kinetic adsorption and phytoplankton uptake and not through equilibrium partitioning. Uptake of selenium by phytoplankton included kinetic uptake of selenite, organic selenide, and selenate, in decreasing order of importance. The uptake rates used in the model simulations are similar to rates used in Meseck and Cutter (2006). During calibration, the model was able to fit the patterns in concentrations of dissolved selenate and selenite well, although it performed less well for dissolved organic selenide. This may be due to the method used for determining dissolved organic selenide (estimated as the difference of total dissolved selenium minus the dissolved selenite+selenate). Therefore the errors and uncertainty in the dissolved organic selenide may be larger. This also may be due to local variations in phytoplankton abundance and species, which may affect uptake of selenium and releases of dissolved organic selenium.

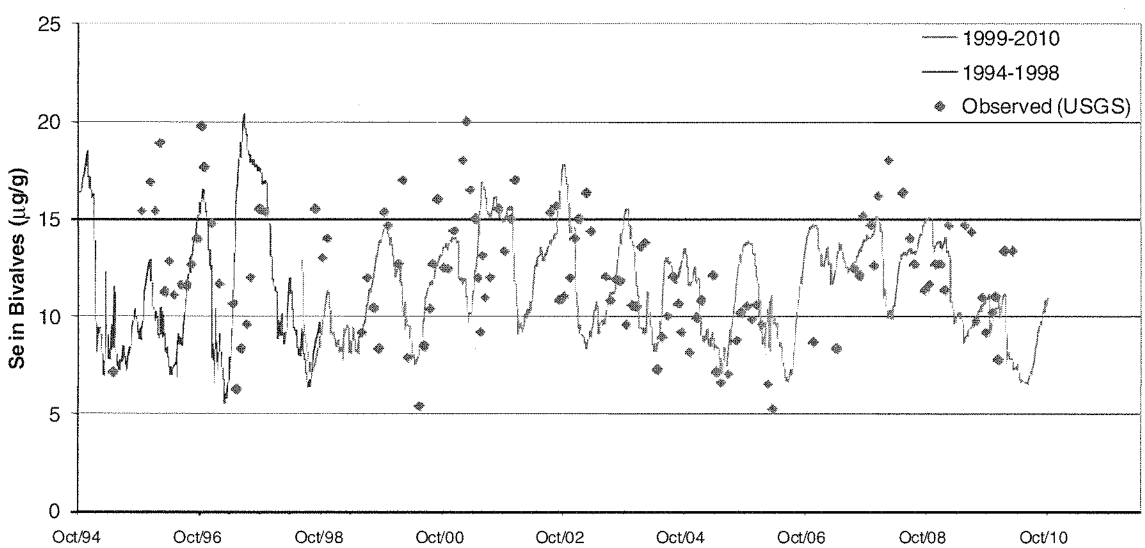

Fig. 9 Simulated selenium concentrations in bivalve *C. amurensis* compared with long-term data from USGS at the Carquinez Strait for the period of 1995–2010 (Kleckner et al. 2010). Flow data used—DAYFLOW records from the California Department of Water Resources; refinery data used—daily data for 1999–2007, constant loads after 2007; San Joaquin River Selenium—observed data at Vernalis, multiplied by Delta removal constants with fixed speciation—selenite (SeIV), 0.028; Se(VI), 0.658; and OrgSe, 0.314

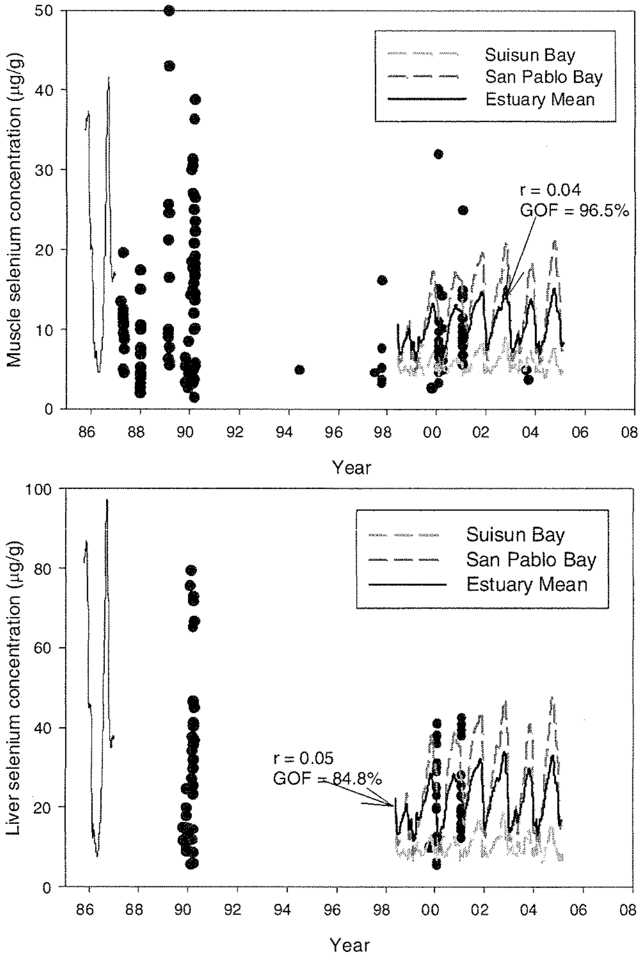

Fig. 10 Simulated selenium concentrations in muscle tissue and liver of white sturgeon at Suisun Bay and San Pablo Bay compared with observed values (White et al. 1988, 1989; Urquhart et al. 1991, USGS and SFEI), using TTF=1.3 for muscle tissue(Presser and Luoma 2010) and regression equation from Presser and Luoma (2006; for liver concentrations)

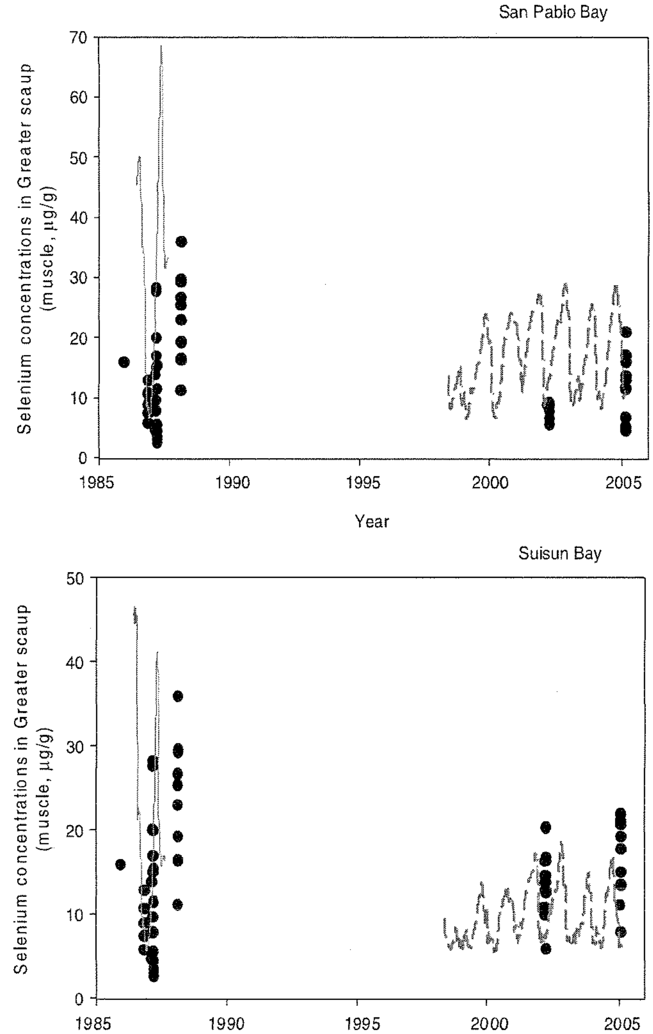

Fig. 11 Simulated selenium concentrations muscle tissue of diving ducks (dry weight; Greater Scaup) compared with observed data in San Pablo Bay and Suisun Bay, respectively (White et al. 1988, 1989; Urquhart et al. 1991; SFEI), using TTF=1.8

Similarly, the model was able to fit the particulate selenate plus selenite better than the particulate organic selenide. In general, the model was better able to represent the broad trends in concentration better than the localized spatial variation. The reasons underlying this behavior are not fully understood and may relate to local variability or to small scale processes that are not captured in the 1-D model with 33 cells representing a 100-km long modeling domain.

Future model development may seek to address some of the shortcomings of the modeling presented here, such as the occasional inability to represent the estuarine turbidity maximum and the chlorophyll *a* peaks, the uncertainties in riverine and ocean boundary conditions and their effect on the conclusions, and the difficulty in capturing large local-scale variability in organic selenium concentrations, which may be partly due to the complexity and limited understanding of phytoplankton growth dynamics and species distribution.

A sensitivity analysis of the various model parameters was performed. The analysis indicated that the model is relatively sensitive to parameters that affect the location and magnitude of the TSM. Dissolved and particulate selenium concentrations are most sensitive to the riverine input parameters (Table 3 in the ESM). Particulate selenium concentrations are sensitive to selenium content on particulates at the riverine boundary. Dissolved and particulate selenium are less sensitive to selenium transformation coefficients such as phytoplankton uptake and selenite adsorption rates. Particulate organic selenide and particulate selenium are also sensitive to increases in phytoplankton growth rates. The relatively high sensitivity of particulate organic selenium, particulate selenium, and dissolved selenite to increases in phytoplankton growth rate (also as an indicator of phytoplankton concentrations) underscores how certain species of selenium are closely tied to phytoplankton concentrations. In addition, particulate organic selenide is also sensitive

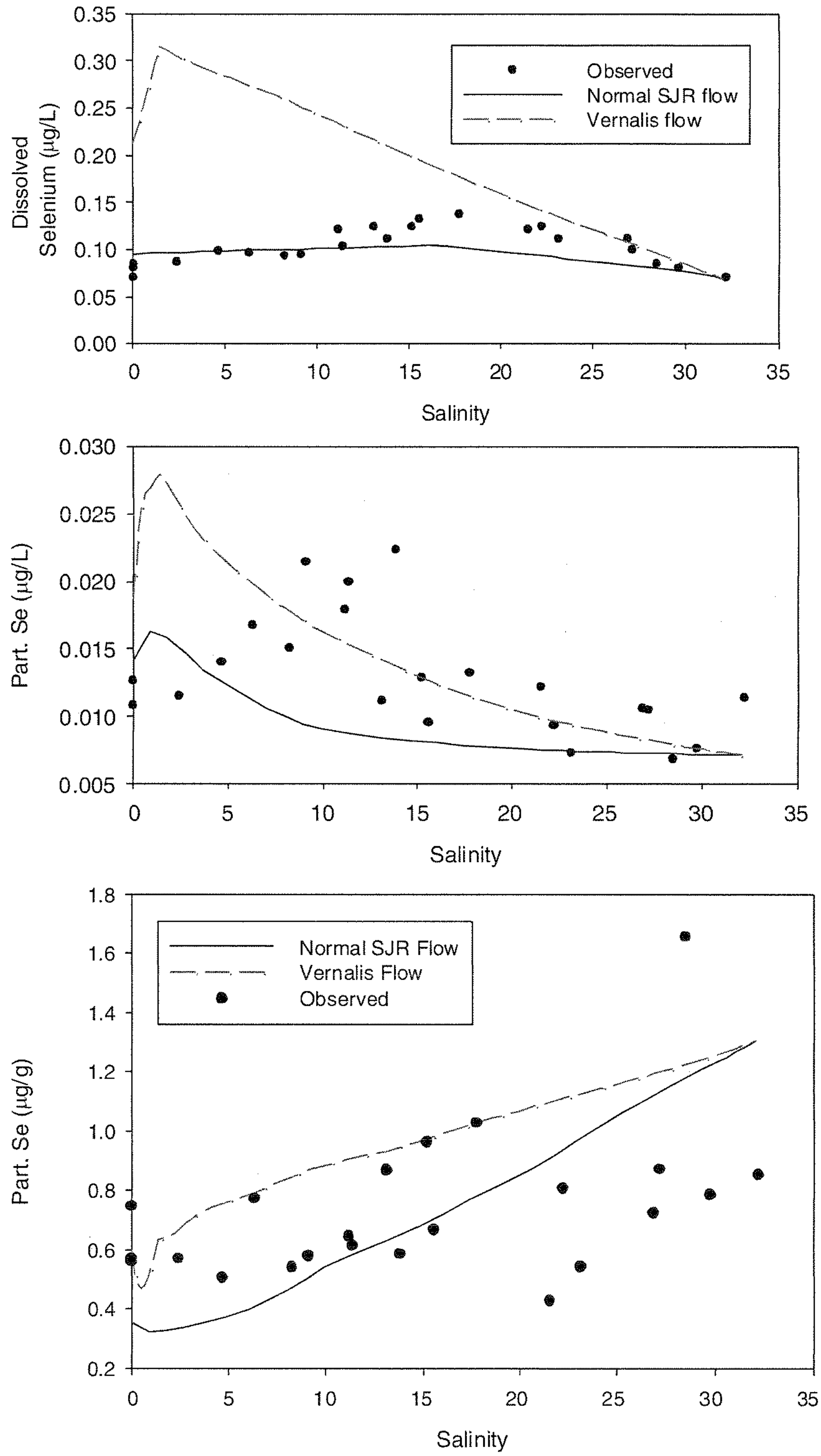

Fig. 12 Predicted dissolved and particulate selenium for different San Joaquin River discharge rates during a low flow period (11 November 1999)

to its mineralization rate. Through adjustment of several of these parameters, the ECoS framework was able to capture the essential behavior of selenium and ancillary parameters in NSFB. Future work in the bay focusing on these components of selenium behavior, including characterization of the riverine boundary and phytoplankton growth and uptake, may enhance the robustness of the modeling.

Temporal Variations in Selenium Concentrations in Clams

The recently reported *C. amurensis* concentration data from San Francisco Bay (Kleckner et al. 2010) illustrate internannual and inter-seasonal patterns in clam concentrations from 1995 to 2010, a period over which there have been variations in freshwater inflows as well as changes in the selenium loading, particularly changes in refinery wastewater loading in 1998, and a general reduction in San Joaquin River loads through selenium source control actions in the San Joaquin River watershed. Over this period of record, two features stand out in the observed clam data: there has not been a large reduction in clam concentrations despite the load changes, and there is a significant amount of inter-seasonal and inter-annual variability, with the lowest concentrations in each year occurring during the high flow months, and the highest concentrations occurring in the low-flow months. Seasonal high concentrations are almost a factor of two as high as the low concentrations.

The seasonal pattern is a feature of the clam data and cannot be explained by the dissolved selenium concentration data alone, as the dissolved data do not show a similar seasonal pattern. However, the modeling framework presented in this study does provide a plausible hypothesis, as outlined below. Particulates in the bay, especially phytoplankton, can have higher selenium concentrations (on a microgram-per-gram basis), than particulates originating in the riverine source in Rio Vista (with a greater mineral fraction). High flow periods are associated with high particulate loads from Rio Vista, largely made up of Sacramento River flows, resulting in lower average selenium concentrations in the bay than during low-flow periods. Thus, changes in selenium concentrations in clams from one year to the next appear to be influenced significantly by hydrology, with wet years (such as 2005 and 2006) resulting in lower clam concentrations. This hypothesis does not consider changes in the rate of selenium uptake as a function of the clam's life cycle, although such a process may also be a factor in the overall variation. There are, however, insufficient data to independently evaluate the significance of the growth effect at this time. An evaluation of the Kleckner et al. (2010) data showed no consistent relationships between clam size (as represented by mean shell length) and selenium concentrations. The hypothesis developed here through the integration of best-available data and modeling provides insight into the future management of selenium concerns in NSFB, although it must be re-evaluated as new data and process-level information become available.

The long-term trends in selenium concentrations in clams (1995–2010) suggest the importance of in-estuary transformations in affecting particulate and biota selenium concentrations in addition to the external loads. Given the decreases in external loads over the study period (both from the refineries and the San Joaquin River), dissolved selenium concentrations in the bay have shown a more direct response to these changes. However, the corresponding changes in particulate selenium are generally minimal, as reported previously in Doblin et al. (2006). As shown through the modeling framework presented here, this could be due to the fact that phytoplankton in the estuary are still able to concentrate relatively high selenium concentrations, which contribute to relatively high particulate selenium concentrations that enter the food web, and result in continued high concentrations in the clams. In effect, this framework indicates that particulate selenium concentrations, and therefore the concentrations in filter feeders, such as clams, are not a simple linear function of dissolved concentrations. Accurate predictions of concentrations in the food web require accurate characterization of particulate concentrations, through observations where possible, or through adequate characterization of uptake by the particulate phases. The model developed here is a tool for supporting such predictions.

Summary and Conclusions

The ECoS model framework was applied to the NSFB for computing salinity, TSM, and chlorophyll *a*, and for selenium concentrations. The model was calibrated to data from 1999, because this is the most recent year for which speciated selenium data in the water column of the NSFB are available. The three ancillary constituents, salinity, TSM, and chlorophyll *a*, were calibrated using monthly water quality cruise data reported by the USGS. Although the ancillary water quality data in the bay are relatively abundant for the calibration of a 1-D model, the calibration period was limited by the availability of selenium data. Following calibration, where model parameters, especially the first-order rate constants that represent selenium transformation and uptake were estimated, the model was applied to different years for evaluating its performance. The calibrated model performed well under different hydrological and load conditions, and was able to simulate salinity, TSM, and chlorophyll *a* profiles for both dry years (e.g., 2001) and wet years (2005), and long-term TSM and chlorophyll *a* concentrations variations. The calibrated model was also run in a hindcast mode using hydrological and refinery loads for 1998. Selenium species and loads in this period were different from current loads, and the hindcast was another test of the credibility of the model. The simulated dissolved selenium concentrations compared well with the observed data. The model was able to simulate the mid-estuarine peaks in selenite for low flow of 1998. This indicates the location and magnitude of the selenium input from point sources and the transport and transformation of selenium are represented well in the model. Simulated particulate selenium concentrations also compared well with the observed values.

The model was able to simulate different selenium speciation and the bioavailability of each species, therefore is able to simulate selenium concentrations on particulates relatively well for different time periods (e.g., 1999 and 1998). The model could also represent the long-term variations (inter-annual and seasonal) in clam selenium concentrations for both prior-to refinery clean up (1994–1998) and post-refinery clean up time periods (1998–2010), including years with high and low clam selenium concentrations. The accumulation of selenium to higher trophic organisms is simulated using a TTF approach, which is able to represent selenium concentrations in white sturgeon and greater scaup in the bay.

A scenario of increasing flow and selenium loads from the San Joaquin River was also examined using the calibrated model. The results suggest that when flow from the San Joaquin River is a greater contributor to outflow from the Delta, significant increases in dissolved and particulate selenium, and selenium on particulates, are predicted in the bay. This would be expected to increase clam concentrations. This is of interest for long term planning for selenium management in NSFB, because there are plans being evaluated by the state of California to make changes in the way water is exported from the Delta through intakes further upstream in the Sacramento River, and by use of an isolated conveyance facility (CALFED 2008). Manipulations to the Delta system, especially those that increase San Joaquin flow into the bay, will also have selenium impacts to the bay that must be evaluated.

Although simplified through a 1-D representation, the modeling approach presented here is able to capture key features of selenium behavior at a level of complexity that is consistent with data that can be measured in the bay in future years. A benefit of the model is its ability to link sources to biota concentrations under a range of hydrologic conditions, and with mechanistic representations of transport, transformation and uptake processes. The mechanistic representation allows consideration of selenium uptake under future conditions, with changes in background water quality, hydrology, and the food web structure, which may be related to human interventions or natural causes. The modeling framework as developed, or with changes to reflect underlying processes and Delta modifications, can be used to explore selenium management options in San Francisco Bay in the context of the TMDL.

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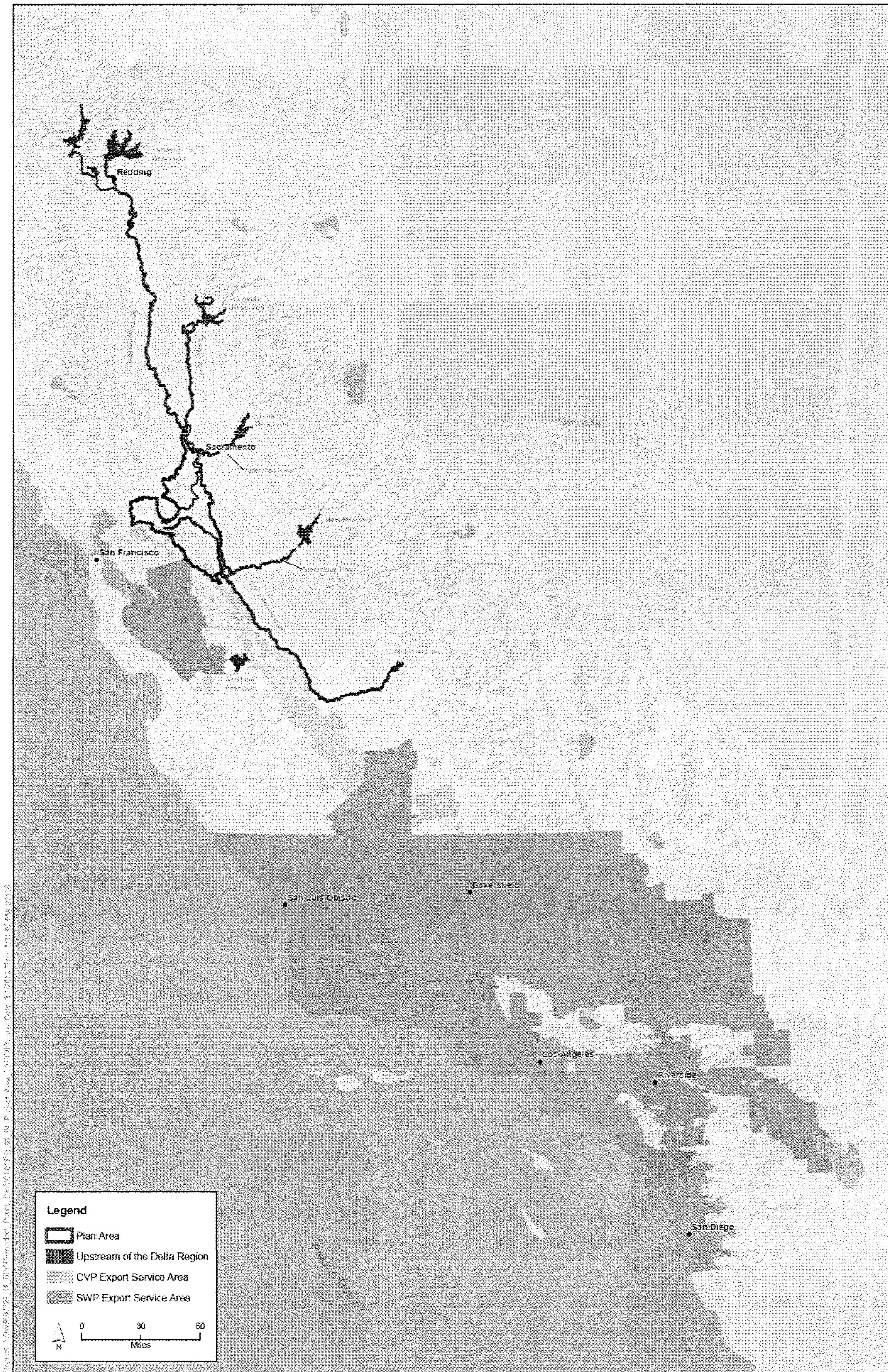

Sources: Plan Area, ICF 2012; SWP/CVP Canals/Aqueducts, HDR 2011; CVP Division Entities, USBR 2010; SWP Service Areas, ESA 2007;

Figure 1-4
Project Area

BDCP1432

Review of Selenium Bioaccumulation Assessment in the Bay Delta Conservation Program Draft EIR/EIS

Revised Final Report

Prepared for:
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ACRONYMS

BDCP	Bay Delta Conservation Plan
CEQA	California Environmental Quality Act
DSM2	Delta Simulation Model 2
DWR	Department of Water Resources
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
ESO	Evaluated Starting Operations
HOS	high outflow scenario
LOS	low outflow scenario
ND	Non-detect
RL	Reporting Limit
TTF	Trophic transfer factor
USGS	United States Geological Survey
WSPA	Western States Petroleum Association

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EXECUTIVE SUMMARY

The Bay Delta Conservation Plan (BDCP) proposes a comprehensive water conservation strategy to restore and protect the ecosystem health and protect the water supply and water quality of the Delta (ICF, 2013). The plan includes new intakes in the northern Delta through a tunnel system to improve reliability and water quality. A total of 9 alternatives (with some sub-alternatives for a total of 15 action alternatives) and the no Action alternative were evaluated in the plan EIR/EIS. Alternative 4 is the CEQA preferred alternative. Alternative 4 is the dual conveyance with pipeline/tunnel and intakes with an export capacity of 9,000 cfs. Under Alternative 4, water would be conveyed from the north Delta to the south Delta through pipelines/tunnels and through surface channels.

Selenium in the San Francisco Bay/Sacramento-San Joaquin River Delta is of concern due to its adverse ecological impacts at high concentrations, primarily through bioaccumulation in the food web. The Bay Delta Conservation Plan (BDCP) Environmental Impact Report/Environmental Impact Statement (EIR/EIS) presents an analysis of selenium impacts that is the subject of this review. The implementation of various construction and restoration alternatives through the BDCP do not, by themselves, introduce new selenium into the system. However, by altering the flow patterns, and the relative mixing of different water sources entering the Bay and Delta, the different alternatives have the potential of altering the selenium water column concentrations in the Bay.

Selenium concentrations used in the Sacramento River for the BDCP EIR/EIS study are biased high, likely due to the inclusion of older analytical values reported at detection limits of 1 μg/L. Detection limits for dissolved selenium using the selective hydride generation/atomic absorption method are normally at 0.0016 μg/L and have been used for studies in San Francisco Bay (Cutter and Cutter, 2004; Tetra Tech, 2012). Long-term detection limits for using ICP-MS[1] method are 0.05 μg/L (USGS, 2014). The

[1] Inductively coupled plasma mass spectrometry

Sacramento River selenium values are critical to the calculation because this is the dominant flow into the Bay. In the current version of the public review documents, the calculated values of water column selenium in San Francisco Bay (0.21 – 0.31 µg/L at Mallard Island) are much higher than the observed (from 0.08 to 0.12 µg/L across multiple sampling events in Suisun Bay). Using the calculated water column concentration in the EIR/EIS, the calculated values of white sturgeon tissue selenium (9.9 µg/g mean and 15 µg/g drought year value) are higher than observed in the last decade across multiple samples.

Using valid boundary values for the Sacramento and San Joaquin Rivers (Freeport: 0.095 µg/l and Vernalis: 0.57 µg/l, both based on observed data from the US Geological Survey), we have updated the San Francisco Bay water column and white sturgeon calculations. Using the same modeling framework as in the original BDCP analysis, but with the corrected boundary values, we are able to get a reasonable match with the observed data for current conditions. The model analysis shows that the BDCP-preferred Alternative 4 will result in higher percent changes in water column concentrations than that calculated in the EIR/EIS. Using the bioaccumulation model in the EIR/EIS, we find a similar projected increase in fish tissue concentrations between Alternative 4 and existing conditions (i.e., no BDCP project). Importantly, the new calculations suggest that there is an effect of the BDCP changes to the water column and white sturgeon selenium concentrations at the Mallard Island station for CEQA Alternative 4, representing conditions in Suisun Bay (8-20% increase, depending on the hydrology). This is higher than currently estimated for Alternative 4 at this station (2-5% increase, calculated by Tetra Tech), and may be evaluated in the context of the CEQA conclusion: "Relative to Existing Conditions, modeling estimates indicate that all scenarios under Alternative 4 would result in essentially no change in selenium concentrations throughout the Delta." (page 8-476, Draft EIR/EIS).

From the standpoint of water column selenium concentrations, the worst case conditions are not the drought years of 1987-1991, but years where the San Joaquin flow contributions to the bay are greater. Periods with high San Joaquin River flow to the Bay occur in the wet months of wet years, and should also be considered for the selenium effects. Should alternatives besides the CEQA preferred Alternative 4 be considered in future phases, selenium impacts could be more significant. The change in selenium concentration (existing conditions versus the alternatives) needs to be addressed through the EIR/EIS.

Besides correction of the boundary values in the EIR/EIS, other considerations follow. The calculated white sturgeon concentrations with the new boundary conditions are lower under existing conditions than that calculated in EIR/EIS, below the 8.1 µg/g whole-body values now proposed by the US Environmental Protection Agency as a fish tissue target (USEPA, 2014). The North San Francisco Bay is considered impaired due to a Se (303d) listing and a total maximum daily load analysis (TMDL) is being prepared. The potential of impairment under existing conditions and current loads from various point- and non-point sources will be addressed by the San Francisco Bay Regional Water Quality Control Board through this TMDL, but it is important to note that this modeling suggests that future BDCP changes may well increase water column and fish concentrations by a greater percentage than what is calculated in the current EIR/EIS. Given this finding, there is a need to monitor the changes in water and fish over the coming years and to consider if any and what mitigation might be needed if the BDCP plan is implemented.

Table ES-1. Summary of EIR and Tetra Tech calculated selenium concentrations in water and in fish.

	EIR Boundary Condition	Actual Boundary Conditions	Calculated EIR Se Water Conc.	Calculated Revised Se Water Conc	Actual Water Conc.	EIR Calc Fish Tissue	Calculated Revised Fish Tissue	Actual Fish Tissue	Alt 4 Se Water Conc	TT Alt 4 Calc Water Conc	Alt 4 Calc Fish Tissue	TT Alt 4 Calc Fish Tissue
Entire 16-year period	Sac: 0.32 µg/L; SJR: 0.84 µg/L	Sac: 0.095 µg/L; SJR: 0.57 µg/L	0.257µg/L	0.120 µg/L	0.08-0.12 µg/L	10.2 µg/g	4.8 µg/g	3-10 µg/g	0.268 µg/L	0.139 µg/L	10.6 µg/g	5.5µg/g

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1 INTRODUCTION

The Bay Delta Conservation Plan (BDCP) proposes a comprehensive water conservation strategy to restore and protect the ecosystem health and also protect the water supply and water quality of the Delta (ICF, 2013). The plan includes new intakes in the northern Delta through a tunnel system to improve reliability and water quality. A total of 9 alternatives (with some sub-alternatives for a total of 15 action alternatives) and the no Action alternative were evaluated in the plan EIR/EIS. Alternative 4 is the CEQA preferred alternative. Alternative 4 is a dual conveyance with pipeline/tunnel and intakes with an export capacity of 9,000 cfs. Under Alternative 4, water would be conveyed from the north Delta to the south Delta through pipelines/tunnels, and through surface channels.

The Bay Delta Conservation Plan (BDCP) environmental assessment, notably the Environmental Impact Report/Environmental Impact Statement (EIR/EIS), presents in some detail the impacts of the plan on various water quality constituents in the San Francisco Bay and Delta region under the no-action alternative as well as various project alternatives (Chapter 8 of the Draft EIR/EIS, November 2013). Of the constituents addressed, selenium in the San Francisco Bay/Sacramento-San Joaquin River Delta is of concern due to its adverse ecological impacts at high concentrations, primarily through bioaccumulation in the food web. This review is focused on the analysis of selenium impacts that are presented in the BDCP EIR/EIS.

Selenium concentrations in the water column originate from a variety of point sources and non-point sources in the watershed of San Francisco Bay and the Delta. Upstream of the Delta, high selenium concentrations in the San Joaquin River watershed have been a long-standing concern. The San Joaquin River watershed is naturally enriched in selenium and agricultural practices in the watershed have mobilized selenium from the soils to groundwater and surface water that drains into the Delta. The watershed and specifically a sub-area, the Grasslands area, has been identified as an important source of selenium to the Bay Delta (Central Valley Regional Water Board, 2001). In contrast, selenium concentrations in the other major riverine flow into the Delta, the Sacramento River, are relatively low. Because the combined flows of the Sacramento and San Joaquin Rivers are the primary freshwater inflows into the Bay, the proportional mix of these inflows has a strong influence on selenium concentrations in the western Delta and the Bay.

The implementation of various construction and restoration alternatives through the BDCP do not, by themselves, introduce new selenium into the system. However, by altering the flow patterns, and the relative mixing of different water sources entering the Bay and Delta, the different alternatives have the potential of altering the selenium water column concentrations in the Bay. In the EIR/EIS, changes in the water column selenium concentrations for the different alternatives considered were developed using the Delta Simulation Model (DSM2), a tool that is widely used for evaluating water quality changes in the Delta under current and future conditions.

In the bioaccumulation model used in the BDCP EIR/EIS, the water column concentrations are related to various biological endpoints, such as concentrations in largemouth bass and in white sturgeon. In the BDCP EIR/EIS, the analysis is performed using a trophic transfer model that relates water column concentrations to tissue concentrations (fish tissue or bird egg), and is presented in Appendices 8M and an Addendum M.A). Appendix 8M performed the analysis for largemouth bass, and Addendum M.A performed the analysis for white sturgeon. This was done because of the potentially greater bioaccumulation of selenium in sturgeon because of their preference for clams that bioaccumulate selenium to a greater extent (Chapter 8, page 8-138).

In this review, we use the same tools and assumptions as used in the November 2013 EIR/EIS, but modify the boundary selenium concentrations in the Sacramento and San Joaquin Rivers to be more representative of observed values. We then compare the modeled water column and sturgeon concentrations for key locations in the system across different alternatives. Observed data on the boundary selenium concentrations and in white sturgeon are also presented to substantiate the modeling changes that are proposed in this review.

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2 BDCP EIR/EIS Modeling Approach

The Bay Delta Conservation Plan (BDCP) proposes a comprehensive water conservation strategy to restore and protect the ecosystem health and also protect the water supply and water quality of the Delta (ICF, 2013). The plan includes new intakes in the northern Delta through a tunnel system to improve reliability and water quality. A total of 9 alternatives (with some sub-alternatives for a total of 15 action alternatives) and the no Action alternative were evaluated in the plan EIR/EIS. Alternative 4 is the CEQA preferred alternative.

Because the San Joaquin River was historically identified as a major source of selenium to the Delta, there are concerns with respect to increased inputs of selenium from the San Joaquin River relative to the Sacramento River as a result of the proposed water operations (Evaluated Starting Operations, ESO).

The impacts of ESO water operations on selenium in water of the Bay Delta and in fish species were evaluated through a modeling study using the Delta Simulation Model II (DSM2) in the EIR/EIS. DSM2 is a one-dimensional mathematical model for simulation of one-dimensional hydrodynamics and water quality in the channels of the Delta and the eastern part of San Francisco Bay. The western boundary of the model is located in Martinez along the western portion of Suisun Bay. The DSM2 model was run to estimate changes in water flows under the proposed action alternatives. The outputs from the DSM2 model, along with the available measured waterborne selenium concentrations in the boundary sources, were used to calculate concentrations of selenium at locations throughout the Delta. Modeled selenium concentrations in the water column were used to calculate selenium concentrations in whole-body fish and bird eggs using ecosystem-scale models developed by Presser and Luoma (2013).

The DSM2 model was run to estimate the volumetric contribution from six major inputs to the Delta: the Sacramento River, San Joaquin River, Martinez (representing the San Francisco Bay boundary), east side tributaries, agricultural return flows, and Yolo Bypass (Figure 2-1). Observed selenium concentrations in the six major sources were used to predict the resultant selenium concentrations at given locations in the Delta (Table 2-1). Predicted selenium concentrations in water column are listed in Table 2-2.

The DSM2 model was run for a scenario without BDCP (EBC2_LLT) and under three BDCP scenarios: 1) evaluated starting operations late long term (ESO_LLT), 2) a low-outflow scenario (LOS_LLT), and 3) a high-outflow scenario (HOS_LLT). The hydrologic conditions considered include: 1) all water years (1975- 1991) representing the 16-year period modeled using DSM2 (termed "All" in the scenarios below); and 2) a drought period of five consecutive years (water years 1987-1991) consisting of dry and critical water-year types (termed "Drought").

The predicted selenium concentrations in the water column were translated to concentrations in fish using the ecosystem – scale model developed by Presser and Luoma (2013). The ecosystem models were developed using data from laboratory and field studies. Selenium concentrations in water column were translated to concentrations in particulate matter using fixed ratios (termed Kd). Further bioaccumulation from particles to lower trophic level prey items and then to fish was accomplished through Trophic Transfer Factors (TTF). TTF values are based on ecosystem-wide measurements, and were based on data from San Francisco Bay. Presser and Luoma (2013) determined Kd values for the San Francisco Bay (including Carquinez Strait – Suisun Bay) during "low flow" conditions (5,986 l/mg) and "average" conditions (3,317 l/mg). These values were used to model selenium concentrations in particulates for "Drought" and "All" conditions at locations in the western Delta. TTF values for particulates to clams/amphipods were determined to be 9.2 (dimensionless). TTF values for prey to fish (white sturgeon) was determined to be 1.3 (dimensionless).

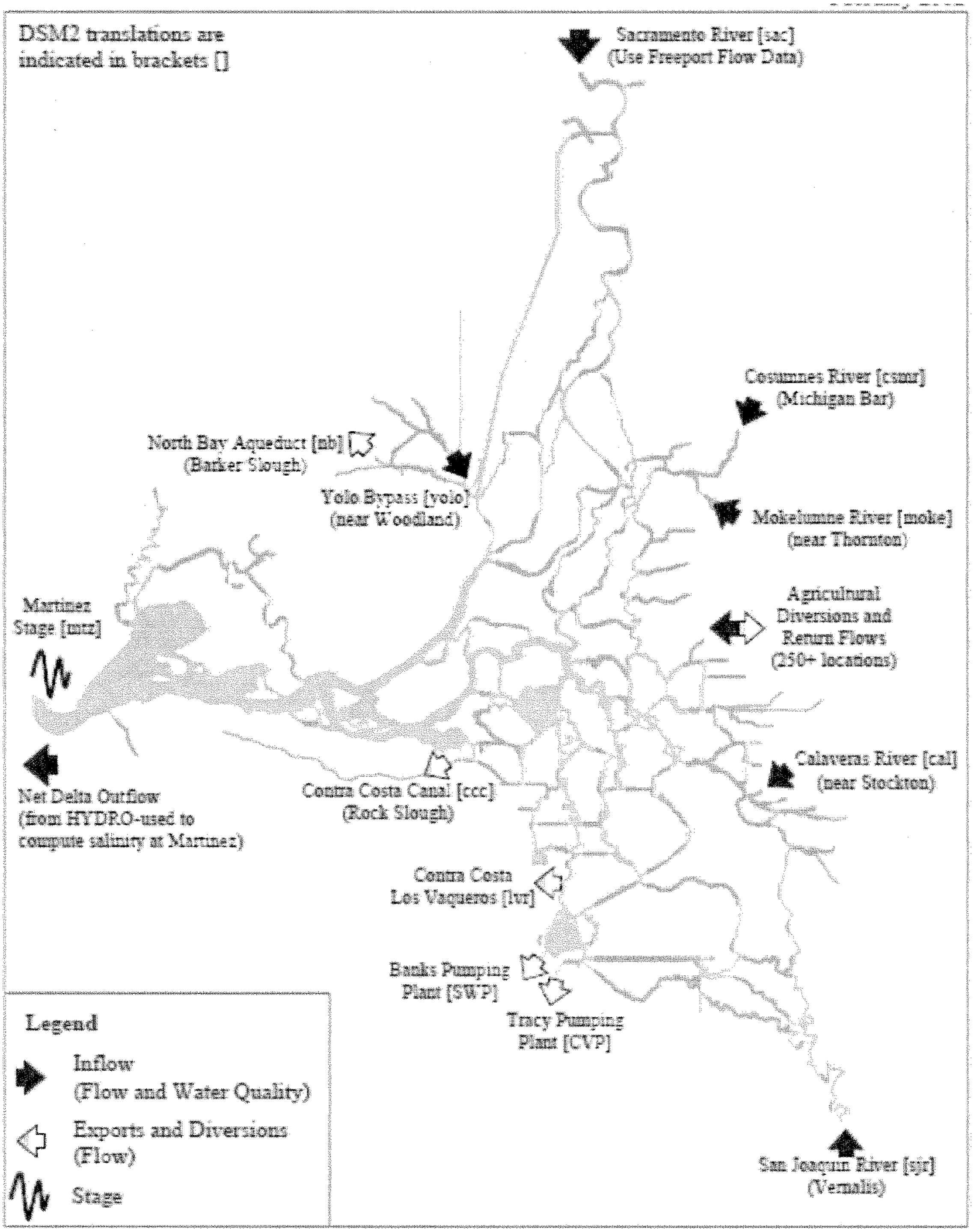

Figure 2-1. Map of typical DSM2 boundary conditions

Table 2-1
Historical selenium concentrations in the six Delta source waters for the period 1996 – 2010 (Source: Table 8-56, Draft EIR/EIS, November 2013)

Source water	Sacramento River[a]	San Joaquin River[b]	San Francisco Bay[a]	East side tributaries[c]	Agriculture in the Delta[a]	Yolo Bypass[d]
Mean (μg/L)[e]	0.32	0.84	0.09	0.1	0.11	0.45
Minimum (μg/L)	0.04	0.40	0.03	0.1	0.11	0.19
Maximum (μg/L)	1.00	2.80	0.45	0.1	0.11	1.05
75th percentile (μg/L)	1.00	1.20	0.11	0.1	0.11	0.65
99th percentile (μg/L)	1.00	2.60	0.41	0.1	0.11	1.04
Data source	USGS 2010	SWAMP 2009	SFEI 2010	None	Lucas and Stewart 2007	DWR 2009b
Stations	Sacramento River at Freeport	San Joaquin River at Vernalis (Airport Way)	Central-west; San Joaquin River near Mallard Is. (BG30)	None	Mildred Island, center	Sacramento River at Knights Landing
Date Range	1996-2001, 2007 -2010	1999-2007	2000-2008	None	2000, 2003-2004	2003, 2004, 2007, 2008
ND replaced with RL	Yes	Yes	Yes	Not applicable	No	Yes
Data omitted	None	Pending data	None	Not applicable	No	None
No. of data points	62	453	11	None	1	13

[a] Dissolved selenium concentrations
[b] Not specified total or dissolved
[c] Dissolved concentrations are assumed to be 0.1 μg/L due to lack of data
[d] Total selenium concentrations. Ideally, dissolved concentrations should be used for comparison, and constitutes the dominant form of selenium in the system. Not all stations report selenium in the same form. The combined use of total and dissolved selenium across different stations is a source of potential uncertainty.
[e] Means are geometric means

Table 2-2
Modeled selenium concentrations in water column for late long-term scenario (values reproduced from Table 8M1 in Appendix 8M of the EIR/EIS)

Location	Period	Period Average concentrations (μg/L)		
		Existing Conditions	No Action Alternative LLT	Alternative 4H1
San Joaquin River at Antioch Ship Channel	ALL	0.31	0.31	0.33
	Drought	0.27	0.27	0.28
Sacramento River at Mallard Island	All	0.25	0.25	0.26
	Drought	0.21	0.21	0.21

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Under the low flow condition (after modifying Kd units) (based on the EIR/EIR, Appendix 8M),

Sturgeon Se = Cw*6.0*9.2*1.3 mg/g or

= Cw*71.8 mg/g,
where Cw is the water column concentration in µg/L (typically the dissolved water column concentration)

Under the average flow condition,

Sturgeon Se = Cw*3.3*9.2*1.3 mg/g or

= Cw*39.5 mg/g,
where Cw is the water column concentration in µg/L (typically the dissolved water column concentration)

In the EIR/EIS, fish Se values are compared to a low benchmark of 5 µg/g and a high benchmark of 8 µg/g (µg/g = mg/kg). At this time, fish targets are being developed by the US Environmental Protection Agency, and these fish tissue benchmarks are a reasonable representation of the range.

Selenium concentrations associated with source waters particularly in the Sacramento River (0.32 µg/L) that are used in the BDCP EIR/EIS modeling were notably higher than concentrations reported for this river (0.07 µg/L) by Cutter and Cutter (2004). A possible reason for these high concentrations was the high detection limit (1 µg/L) that was in the early period of the data record. For the concentration level of concern in the Bay-Delta region (0.1-0.2 µg/L), a high detection limit of 1 µg/L will significantly bias the results of selenium concentrations in the water. Modeled selenium concentrations at Mallard Island and Antioch were also significantly higher than values observed in the Bay water.

In this study, we conducted an independent evaluation of selenium concentrations associated with the rivers to be considered as inputs to the Delta, using the same data source used in the BDCP EIR/EIS study.

Copies of the DSM2 model inputs and outputs for the scenarios were made available by the California Department of Water Resources (DWR) to Tetra Tech, and were employed for the subsequent analysis (Brian Heiland, personal communication, June 2013). We confirmed that the runs were identical to those used in the November 2013 draft of the EIR/EIS (Brian Heiland, personal communication, January, 2014).

We then conducted DSM2 runs to replicate results from the BDCP EIR/EIS study. Selenium concentrations from our independent evaluation were then used in calculating concentrations in the Delta. We recomputed fish selenium concentrations (white sturgeon) based on selenium concentrations in the water.

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3 Independent Review of Selenium Data from USGS on Rivers

In our evaluation, we downloaded data from US Geological Survey National Water Information System (NWIS) database for the Freeport Station on Sacramento River (station code 11447650) and Vernalis on the San Joaquin River (station code 11303500), given the importance of these stations in the inflows to the Delta and then to the Bay.

For Freeport, a total of 411 values from 1973 to present were found for dissolved or total selenium. From the beginning of record to 9/15/98, values are classified as "historical" and reported using a hydride analytical method. For these dates, values were reported as < 1 µg/L and noted to be less than the method detection limit (MDL) of 1 µg/L. No data were found from 9/15/1998 to 11/26/2007. From 11/27/2007 to present, there are 75 values, all reported as using the ICP-MS method, with an MDL of 0.03 to 0.04 µg/L. From 11/2007, dissolved selenium concentrations range from 0.04 to 0.23 µg/L, with a median concentration of 0.09 µg/L, and a mean concentration of 0.095 µg/L.

Similar to the Sacramento River, an independent review of the selenium data from USGS for the San Joaquin River at Vernalis was conducted. From 11/28/2007 to present, there are 78 values, all reported using an ICP-MS method, with an MDL of 0.03 to 0.06 µg/L. From 11/2007, dissolved selenium values range from 0.12 to 1.5 µg/L, with a median of 0.47 µg/L, and a mean of 0.57 µg/L.

As shown in Figure 3-1 and Figure 3-2, dissolved selenium concentrations in the Sacramento River were generally below 0.2 µg/L and were approximately 0.5 µg/L for the San Joaquin River.

Another independent study of selenium concentrations in the rivers by the Western States Petroleum Association (WSPA) is available for comparison for the period 2010 – 2012 (Table 3-1) (Tetra Tech, 2012). Average selenium concentrations sampled by WSPA for

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this time period are 0.07 µg/L for the Sacramento River at Freeport and 0.34 µg/L for the San Joaquin River.

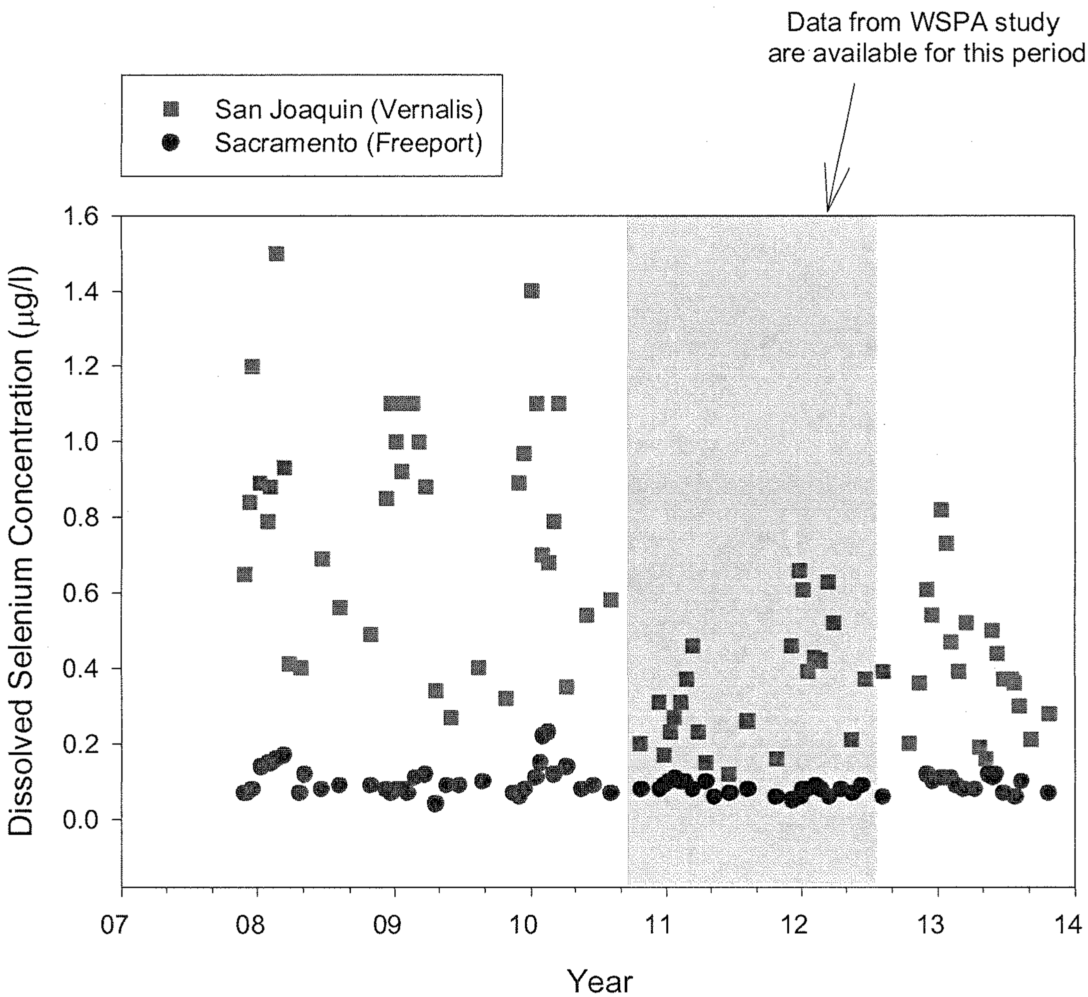

Figure 3-1 Dissolved selenium concentrations in Sacramento and San Joaquin River from 2007 - present (USGS NWIS data)

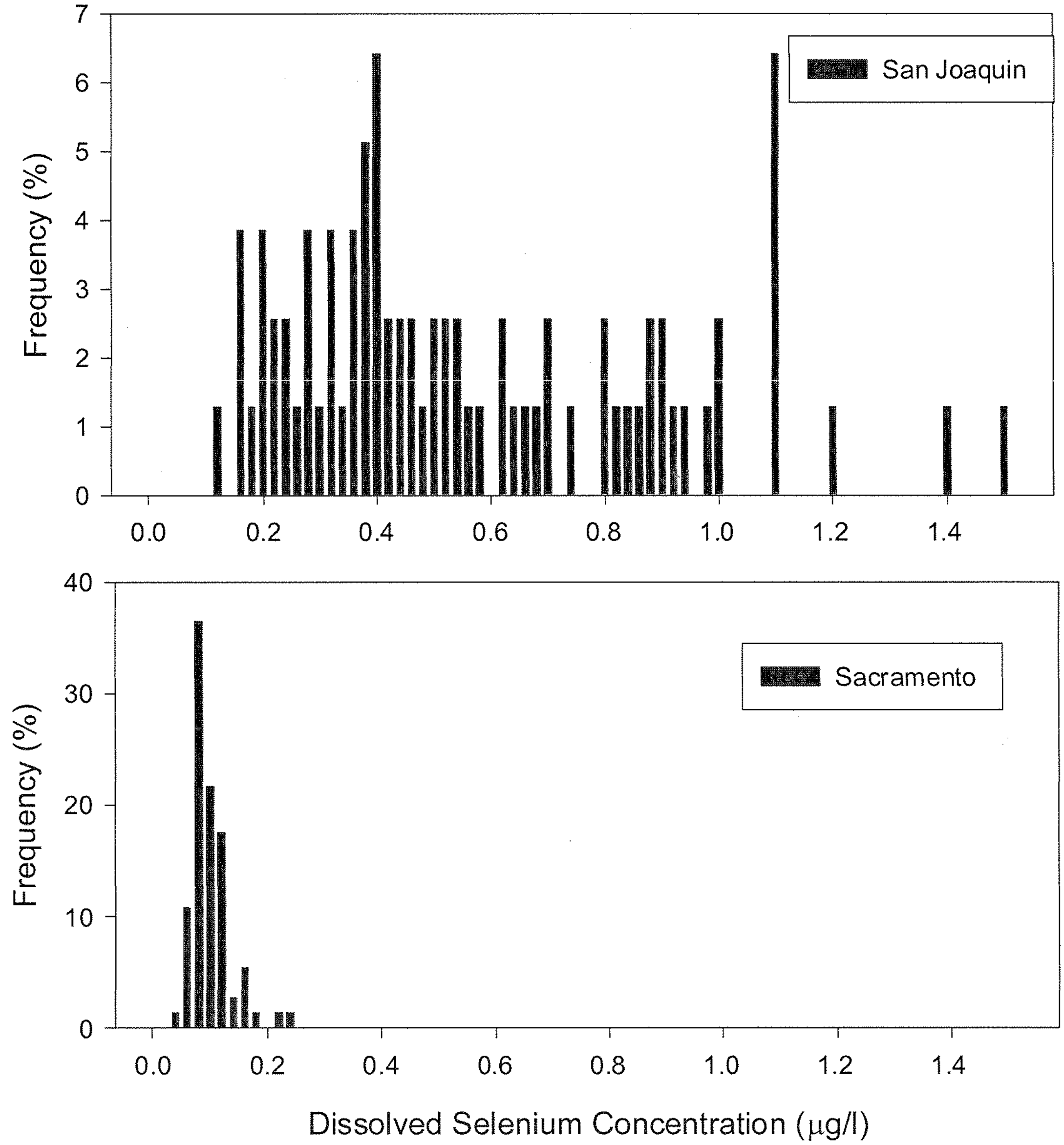

Figure 3-2 *Frequency of distribution for dissolved selenium concentrations in the Sacramento and San Joaquin Rivers (USGS NWIS data)*

The Suisun Bay location, as the boundary of the DSM2 model domain and the Carquinez Strait, was also evaluated for selenium concentrations (Table 3-2 and Table 3-3). Average selenium concentrations in Suisun Bay from several sources suggested relatively low concentrations of around 0.10 μg/L, as opposed to higher concentrations in the Bay predicted by BDCP EIR/EIS in Table 2-2.

Selenium concentrations from six sources that are used in our calculation of concentrations in the Bay are shown in Table 3-4. For the Freeport and Vernalis stations only, these were updated from the original data ranges reported in Table 2-1. The largest changes occurred at the Freeport station from 0.32 µg/l in the EIR/EIS to the corrected value of 0.095 µg/l in the update. This change is critical to the analysis because the Freeport flows are the dominant freshwater flows in the Delta system.

For context, the observed white sturgeon concentrations from San Francisco Bay are also shown in Figure 3-3. These data were obtained from the CEDEN database, and are based on data reported by the Regional Monitoring Program. Sturgeon are sampled every 3-5 years, and the current data available in CEDEN for North San Francisco Bay covers Suisun Bay and San Pablo Bay. The dry weight of selenium in fish tissue range from 1.75 to 10.8 µg/g, with a single value in San Pablo Bay at 18.5 µg/g. Suisun Bay values range from 3.1 to 10.8 µg/g.

Table 3-1
Riverine selenium concentrations sampled by WSPA for the period of 2010 – 2012 (Tetra Tech, 2012)

Station	Sample data	Total dissolved Se (µg/L)	Mean (µg/L)
Freeport	10-Sep-10	0.068	0.07
Freeport	18-Mar-11	0.062	
Freeport	7-Oct-11	0.064	
Freeport	16-Apr-12	0.09	
Vernalis	10-Sep- 10	0.353	0.34
Vernalis	18-Mar-11	0.317	
Vernalis	7-Oct-11	0.207	
Vernalis	16-Apr - 12	0.47	

Table 3-2
Selenium concentrations in Suisun Bay for 1999 Cutter and Cutter (2004) and for 2010-2012 by Tetra Tech (2012)

Sample data	Average dissolved Se(µg/L)	Number of stations during sampling event
Apr -99	0.12	4
Nov – 99	0.10	10
8-Sep-10	0.09	9
15-Mar-11	0.10	4
4-Oct-11	0.08	7
11-Apr-12	0.10	5

Table 3-3
Selenium concentrations in Carquinez Strait for 1999 Cutter and Cutter (2004) and for 2010-2012 by Tetra Tech (2012)

Sample data	Average dissolved (µg/L)	Number of stations in this region during sampling event
Apr -99	0.100	4
Nov – 99	0.129	4
8-Sep-10	0.103	4
15-Mar-11	0.101	2
4-Oct-11	0.10	4
11-Apr-12	0.123	3

Table 3-4
Updated selenium concentrations in the six Delta source waters

Source water	Sacramento River[a]	San Joaquin River[a]	San Francisco Bay[a]	East side tributaries[b]	Agriculture in the Delta[a]	Yolo Bypass[c]
Mean (µg/L)[d]	0.095	0.568	0.09	0.1	0.11	0.45
Minimum (µg/L)	0.04	0.12	0.03	0.1	0.11	0.19
Maximum (µg/L)	0.23	1.50	0.45	0.1	0.11	1.05
75th percentile (µg/L)	0.11	0.80	0.11	0.1	0.11	0.65
99th percentile (µg/L)	0.22	1.42	0.41	0.1	0.11	1.04
Data source	USGS	USGS	SFEI 2010	None	Lucas and Stewart 2007	DWR 2009b
Stations	Sacramento River at Freeport	San Joaquin River at Vernalis (Airport Way)	Central-west; San Joaquin River near Mallard Is. (BG30)	None	Mildred Island, center	Sacramento River at Knights Landing
Date Range	2007-2014	2007-2014	2000-2008	None	2000, 2003-2004	2003, 2004, 2007, 2008
ND replaced with RL	Yes	Yes	Yes	Not applicable	No	Yes
Data omitted	None	None	None	Not applicable	No	None
No. of data points	82	84	11	None	1	13

[a] Dissolved selenium concentrations
[b] Dissolved concentrations are assumed to be 0.1 µg/L due to lack of data
[c] Total selenium concentrations
[d] Means are geometric means

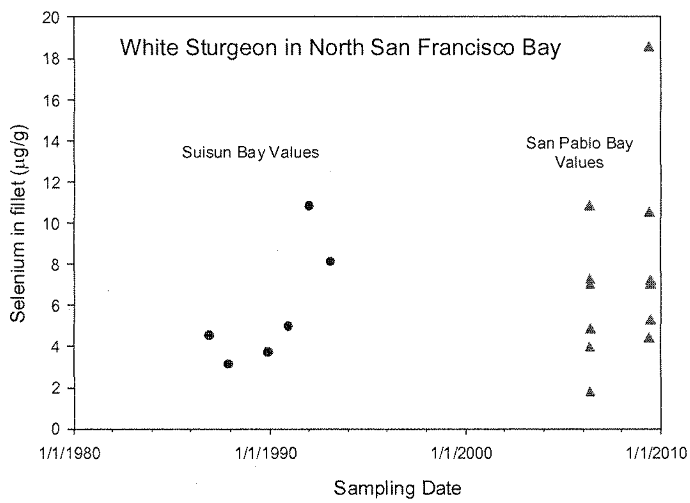

Figure 3-3 White sturgeon selenium concentrations in Suisun Bay and San Pablo Bay (Regional Monitoring Program data obtained from CEDEN database)

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4 RESULTS

The presentation below first considers replication of the EIR/EIS calculations, followed by an updated set of calculations where we modified the boundary conditions to more accurately represent observed values.

4.1 BDCP CALCULATIONS REPLICATED BY TETRA TECH

The DSM2 model scenarios obtained from DWR were first run for existing conditions, using the same boundary concentrations as used in the November 2013 EIR/EIS.

The model was used to predict the volumetric contribution from six source boundaries to volumes at Mallard Island. The predicted volumetric contribution from the San Joaquin River showed elevated contributions during the wet years (Figure 4-1). Predicted volumetric contributions in conjunction with selenium concentrations in the six source waters listed in Table 2-1 (average concentrations) were used to predict selenium concentrations at Mallard Island. Modeled selenium concentrations for the drought period were lower due to lower contributions from the San Joaquin River. For the wet years of 1981- 1985, predicted selenium concentrations at Mallard Island were higher due to higher contributions from the San Joaquin River during this period (Table 4-1).

The model was also run for the Alternative 4 scenario. Alternative 4 is the CEQA preferred scenario identified in the EIR/EIS report and includes a tunnel for a portion of the diversions from the Sacramento River. The model was used to predict the volumetric contribution from six source boundaries to Mallard Island, under the altered hydrological conditions of Alternative 4. The volumetric contributions from San Joaquin River showed elevated contributions during the wet years (Figure 4-2). As in the existing conditions analysis, the volumetric contributions and selenium concentrations in the six source waters listed in Table 2-1 were used to predict selenium concentrations at Mallard Island. Modeled selenium concentrations for the drought period were lower due to decreased contributions from the San Joaquin River. For the wet years of 1981- 1985, predicted selenium concentrations at Mallard Island were higher due to higher contributions from the San Joaquin River during that period (Table 4-2).

The results show small changes in selenium concentrations from existing conditions to the preferred alternative (Alternative 4; Table 4-3). For the entire period, the change in total selenium from existing condition is 4.3%. The change in total selenium from the existing condition for the high San Joaquin contribution years (1981-1985) is slightly higher at 5.3%.

The predicted selenium concentrations in water column were used to predict selenium concentrations in whole-body of white sturgeon, using the reported Kd and TTF values from Luoma and Presser (2013). The Kd values for transferring dissolved selenium to particulate selenium are 3,317 l/g for all conditions and 5,986 l/g for the drought period. The TTF for transferring selenium in particulates to invertebrate is 9.2. The TTF for invertebrate to whole-body white sturgeon is 1.3. Calculated results of selenium concentrations in whole body white sturgeon are shown in Table 4-4 and Table 4-5. Mean concentrations for the 16-year simulation period increase from 10.21 μg/g under existing conditions to 10.65 μg/g under Alternative 4.

Because only the mean concentrations from source boundaries were used to predict concentrations at Mallard, as opposed to time series data used in the original study, very slight differences may be seen from the results compared to the original study. Despite these differences, the replicated selenium concentrations in the water column and in white sturgeon for the existing conditions and Alternative 4 are similar to the BDCP EIR/EIS report (Table 8M1 and 8M2 of the Draft EIR/EIS, November 2013).

Comparison of BDCP and Tetra Tech replicated concentrations in the water column and white sturgeon for the existing conditions and other alternatives is shown in Table 4-6 and Table 4-7. The table shows that we are able to independently reproduce with minimal differences the values for water column and sturgeon across a wide range of alternatives.

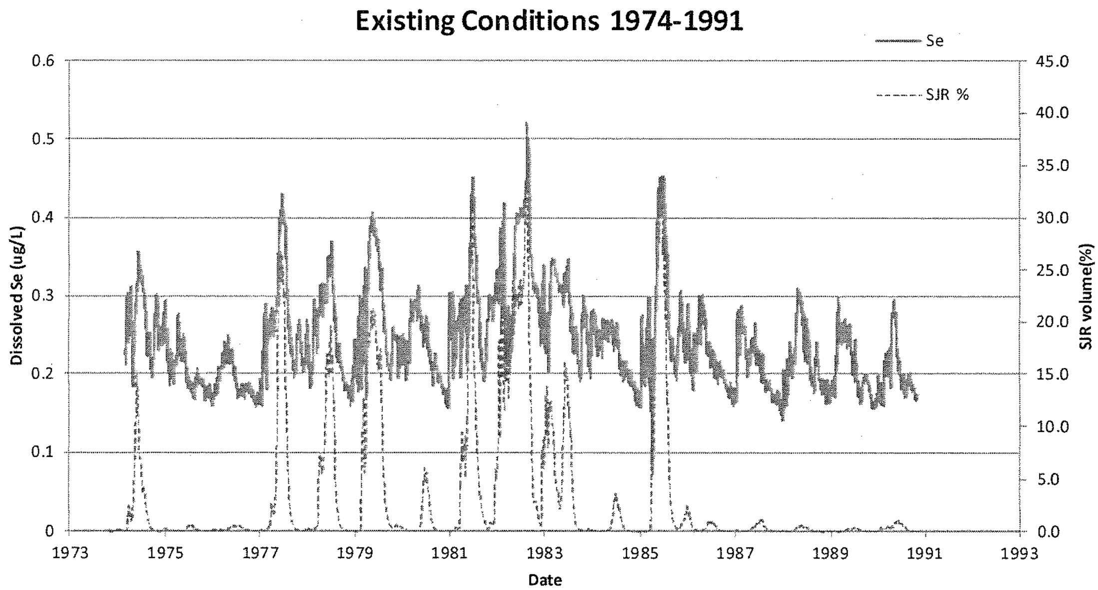

Figure 4-1 *BDCP calculations replicated by Tetra Tech for existing conditions at Mallard Island using source concentrations: of 0.09 µg/L at Martinez, 0.32 µg/L at Sacramento River, 0.84 µg/L at San Joaquin River, 0.11 µg/L in the agricultural return flows, and 0.1 µg/L in east side tributaries.*

Table 4-1
Mallard Island: BDCP calculations replicated by Tetra Tech for existing conditions

Selenium at Mallard Island	Entire 16-year period (1974-1991)	1987-1991 drought	High San Joaquin contribution (1981-1985)
Min (µg/l)	0.135	0.135	0.152
Max (µg/l)	0.508	0.327	0.508
Mean (µg/l)	0.257	0.213	0.298

Using concentrations in source water: Martinez = 0.09 µg/L, Sacramento River = 0.32 µg/L, San Joaquin River = 0.84 µg/L, agricultural return flow = 0.11 µg/L, and east side = 0.1 µg/L.

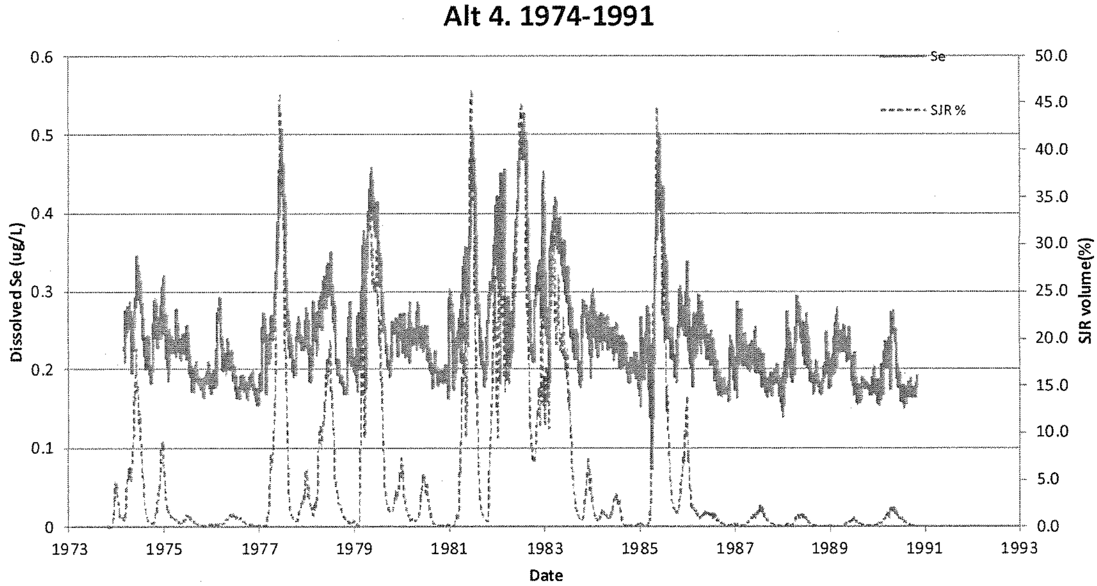

Figure 4-2 *BDCP calculations replicated by Tetra Tech for alternative 4 at Mallard Island using source concentrations: of 0.09 µg/L at Martinez, 0.32 µg/L at Sacramento River, and 0.84 µg/L at San Joaquin River, 0.11 µg/L in the agricultural return flows, and 0.1 µg/L in east side tributaries.*

Table 4-2
Alternative 4 at Mallard Island: BDCP calculations replicated by Tetra Tech

Selenium at Mallard Island	Entire 16-year period (1974-1991)	1987-1991 drought	High San Joaquin contribution (1981-1985)
Min (µg/l)	0.137	0.137	0.161
Max (µg/l)	0.542	0.348	0.537
Mean (µg/l)	0.268	0.218	0.314

Using concentrations in source water: Martinez = 0.09 µg/L, Sacramento River = 0.32 µg/L, San Joaquin River = 0.84 µg/L, agricultural return flow = 0.11 µg/L, and east side = 0.1 µg/L.

Table 4-3
Mallard Island: Predicted water column change from existing conditions: BDCP inputs

	Existing conditions, total Se (µg/L)	Preferred alternative (Number 4), total Se (µg/L)	Change (%) from existing
Entire 16-year period (1974-1991)	0.257	0.268	4.3
1987- 1991 drought	0.213	0.218	2.0
High San Joaquin contribution (1981-1985)	0.298	0.314	5.3

Table 4-4
Mallard Island: BDCP calculations for concentrations in whole-body sturgeon replicated by Tetra Tech for existing conditions

Selenium in whole-body white sturgeon at Mallard Island	Entire 16-year period (1974-1991)	1987-1991 drought	High San Joaquin contribution (1981-1985)
Mean (µg/g)	10.21	15.27	11.82

Using concentrations in source water: Martinez = 0.09 µg/L, Sacramento River = 0.32 µg/L, San Joaquin River = 0.84 µg/L, agricultural return flow = 0.11 µg/L, and east side tributaries = 0.1 µg/L.

Table 4-5
Alternative 4 at Mallard Island: BDCP calculations for concentrations in whole-body sturgeon (µg/g) replicated by Tetra Tech

Selenium in whole-body sturgeon at Mallard Island	Entire 16-year period (1974-1991)	1987-1991 drought	High San Joaquin contribution (1981-1985)
Mean (µg/g)	10.65	15.57	12.45

Using concentrations in source water: Martinez = 0.09 µg/L, Sacramento River = 0.32 µg/L, San Joaquin River = 0.84 µg/L, agricultural return flow = 0.11 µg/L, and east side = 0.1 µg/L.

Table 4-6
Mallard Island: Comparison of modeled selenium concentrations in water (µg/l) for existing conditions, no action alternative, and Alternative 1-9 by BDCP and Tetra Tech.

Location	Period	Existing conditions	No Action	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6	Alt. 7	Alt. 8	Alt. 9
EIR/EIS Calculations	All	0.25	0.25	0.26	0.27	0.25	0.27	0.26	0.3	0.29	0.29	0.28
	Drought	0.21	0.21	0.21	0.22	0.21	0.22	0.21	0.24	0.24	0.24	0.23
Replicated by Tetra Tech	All	0.26	0.26	0.26	0.27	0.25	0.27	0.26	0.30	0.29	0.29	0.28
	Drought	0.21	0.21	0.21	0.22	0.21	0.22	0.22	0.24	0.24	0.24	0.23

Table 4-7
Mallard Island: Comparison of modeled selenium concentrations in white sturgeon (µg/g) for existing conditions, no action alternative, and Alternative 1-9 by BDCP and Tetra Tech.

Location	Period	Existing conditions	No Action	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6	Alt. 7	Alt. 8	Alt. 9
EIR/EIS Calculations	All	9.92	9.92	10.3	10.7	9.92	10.7	10.3	11.9	11.5	11.5	11.1
	Drought	15	15	15	15.8	15	15.8	15	17.2	17.2	17.2	16.5
Replicated by Tetra Tech	All	10.2	10.2	10.2	10.7	10.0	10.7	10.2	11.8	11.4	11.4	11.1
	Drought	15.3	15.3	15.1	15.6	15.2	15.6	15.4	17.1	16.9	17.1	16.6

4.2 Updated Calculations Replicated by Tetra Tech

The DSM2 models obtained from DWR were run with modified boundary conditions, especially the selenium concentrations at Freeport on the Sacramento River (0.095 µg/l) and Vernalis on the San Joaquin River (0.57 µg/l), and used to compute concentrations at Mallard Island (Figure 4-3). Model simulated selenium concentrations at Mallard Island for the three periods: 1) entire 16-year period, 2) 1987-1991 drought period; and 3) a period with high San Joaquin contribution (1981-1985) are listed in Table 4-8. Simulated selenium concentrations at Mallard Island were higher during the high San Joaquin contribution period (1981-1985). Simulated mean selenium concentrations at Mallard Island over the entire 16-year simulation period were 0.12 µg/L and were notably lower than the BDCP study (Table 4-1, 0.257 µg/L).

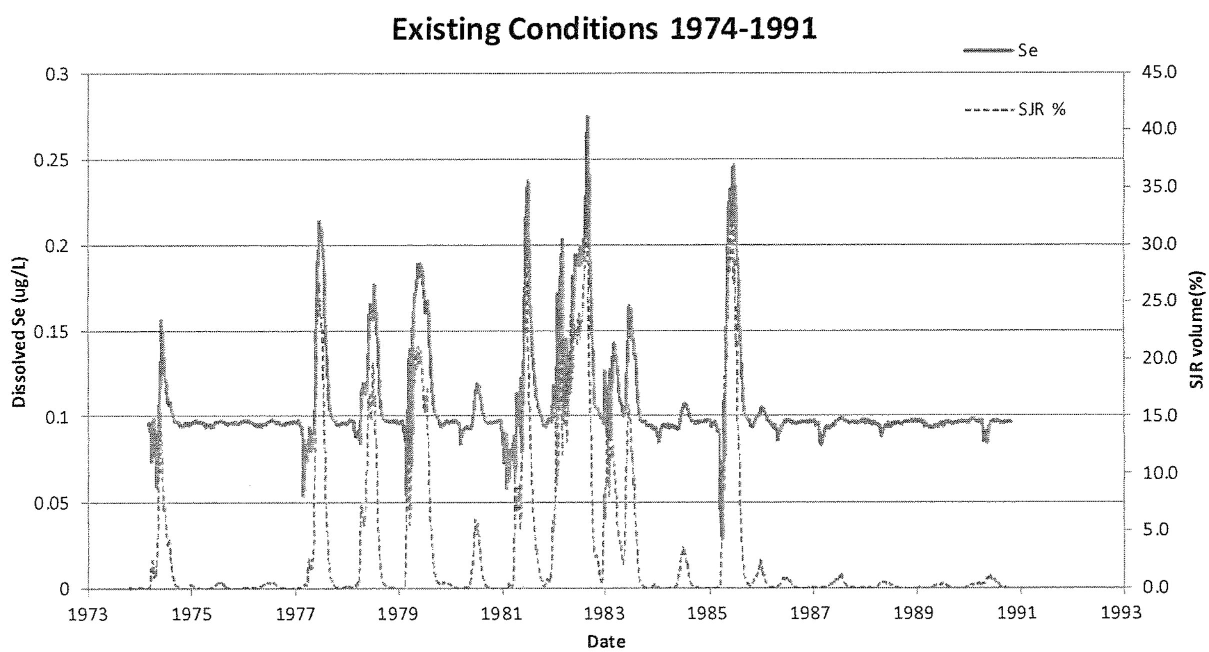

Figure 4-3 *Updated calculations by Tetra Tech for existing conditions at Mallard Island using source concentrations: of 0.09 µg/L at Martinez, 0.095 µg/L at Sacramento River, 0.57 µg/L at San Joaquin River, 0.11 µg/L in the Agriculture return flow, and 0.1 µg/L in east side tributaries.*

Table 4-8
Mallard Island: Updated calculation by Tetra Tech for existing conditions

Selenium at Mallard Island	Entire 16-year period (1974-1991)	1987-1991 drought	High San Joaquin contribution (1981-1985)
Min µg/L	0.092	0.092	0.092
Max µg/L	0.343	0.134	0.343
Mean µg/L	0.120	0.097	0.139

Using concentrations in source water: Martinez = 0.09 µg/L, Sacramento River = 0.095 µg/L, San Joaquin River = 0.57 µg/L, agricultural return flow = 0.11 µg/L, east side = 0.1 µg/L.

The model was also run for the Alternative 4 scenario (CEQA preferred alternative). The model was used to predict volumetric contributions from six source boundaries to Mallard Island, under the altered hydrological conditions in Alternative 4. Mean concentrations were higher than in the existing conditions case: 0.139 µg/L (Table 4-9). For the wet years of 1981-1985, predicted selenium concentrations at Mallard Island were higher (0.168 µg/L) due to higher contributions from the San Joaquin River during that period. The results show greater change in selenium concentrations from existing conditions to preferred alternative (Alternative 4; Table 4-10). For the entire period, the change in total selenium from existing conditions is 15.3%. The change in total selenium from the existing condition for the high San Joaquin contribution years (1981-1985) is also higher at 20.9%. Simulation results for other alternatives considered in the CEQA analysis are included in Appendix A.

Table 4-9
Alternative 4 at Mallard Island: Updated calculations by Tetra Tech

Selenium at Mallard Island	Entire 16-year period (1974-1991)	1987-1991 drought	High San Joaquin contribution (1981-1985)
Min µg/L	0.093	0.093	0.093
Max µg/L	0.367	0.171	0.367
Mean µg/L	0.139	0.105	0.168

Using concentrations in source water: Martinez = 0.09 µg/L, Sacramento River = 0.095 µg/L, San Joaquin River = 0.57 µg/L, agricultural return flow = 0.11 µg/L, east side = 0.1 µg/L

Table 4-10
Mallard Island: Predicted water column change from existing conditions

	Existing conditions, total Se (µg/L)	Preferred alternative (Number 4), total Se (µg/L)	Change (%) from existing
Entire 16-year period (1974-1991)	0.120	0.139	15.3
1987- 1991 drought	0.097	0.105	8.8
High San Joaquin contribution (1981-1985)	0.139	0.168	20.9

Model-simulated selenium concentrations in the water column at Mallard Island were used to predict selenium concentrations in white sturgeon under the existing conditions and Alternative 4. The predicted white sturgeon selenium concentrations and the changes are listed in Table 4-11, Table 4-12 and Table 4-13. Because the function relating water column and white sturgeon concentrations is linear, there is a similar predicted increase in the white sturgeon concentrations from existing conditions to Alternative 4. Importantly, however, the sturgeon values in this calculation are considerably lower than in the original BDCP analysis: mean value of 4.78 mg/g for the entire 16-year simulation, with higher values during drought periods (6.93 µg/g) and periods with high San Joaquin River contribution (5.52 µg/g). For comparison, the 1990 sampling of white sturgeon in Suisun Bay (a dry year) reported a mean value of 5.86 µg/g. Also, the 2006 sampling of sturgeon in San Pablo Bay reported a mean of 7.34 µg/g. If one high value of 18.1 µg/g was excluded, the 2006 average was 6.3 µg/g. Although the fish data are limited, and the concept of using fixed TTFs and Kds for bioaccumulation a great simplification, it appears that for these boundary values, the existing condition fish values are in the range of observations, whereas the EIR/EIS values are clearly higher (16-year mean of 10.21 µg/g, and drought value of 15.27 µg/g; Table 4-4).

Table 4-11
Mallard Island: Updated calculation for concentrations in whole-body white sturgeon by Tetra Tech for existing conditions (updated boundary values)

Selenium in whole-body white sturgeon at Mallard Island	Entire 16-year period (1974-1991)	1987-1991 drought	High San Joaquin contribution (1981-1985)
Mean, µg/g	4.78	6.93	5.52

Using concentrations in source water: Martinez = 0.09 µg/L, Sacramento River = 0.095 µg/L, San Joaquin River = 0.57 µg/L, agricultural return flow = 0.11 µg/L, east side = 0.1 µg/L.

Table 4-12
Alternative 4 at Mallard Island: Updated calculations for concentrations in whole-body white sturgeon by Tetra Tech for (updated boundary values)

Selenium in whole-body white sturgeon at Mallard Island	Entire 16-year period (1974-1991)	1987-1991 drought	High San Joaquin contribution (1981-1985)
Mean, µg/g	5.51	7.54	6.65

Using concentrations in source water: Martinez = 0.09 µg/L, Sacramento River = 0.095 µg/L, San Joaquin River = 0.57 µg/L, agricultural return flow = 0.11 µg/L, east side = 0.1 µg/L

Table 4-13
Tetra Tech updated white sturgeon selenium concentrations change from existing conditions

	Existing conditions, total Se (µg/g)	Preferred alternative (Number 4), total Se (µg/g)	Change (%) from existing
Entire 16-year period (1974-1991)	4.8	5.5	15.3
1987- 1991 drought	6.9	7.5	8.8
High San Joaquin contribution (1981-1985)	5.5	6.7	20.9

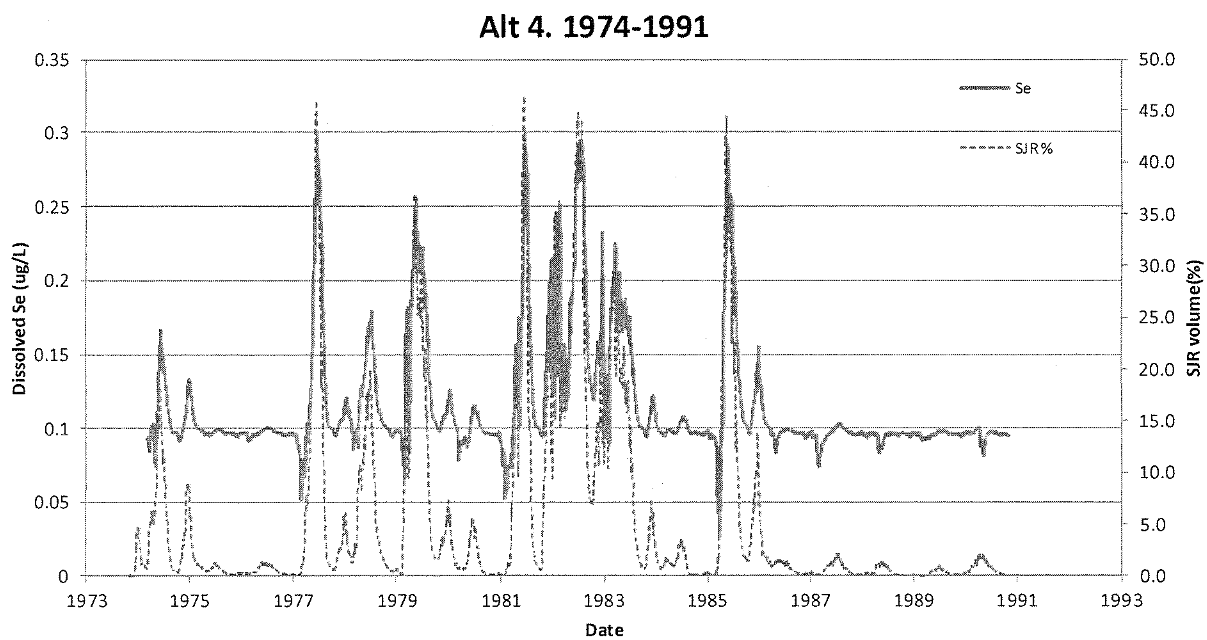

Figure 4-4 *Updated calculations by Tetra Tech for alternative 4 at Mallard Island using source concentrations: of 0.09 µg/L at Martinez, 0.095 µg/L at Sacramento River, 0.57 µg/L at San Joaquin River, 0.11 µg/L in the Agriculture return flow, and 0.1 µg/L in east side tributaries.*

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5 SUMMARY AND RECOMMENDATIONS

5.1 SUMMARY

Selenium concentrations used in the Sacramento River for the BDCP EIR/EIS study (November 2013 public review draft) are biased high, likely due to the inclusion of older analytical values at 1 µg/L. The Sacramento River selenium values are critical to the calculation because this is the dominant flow into the Bay. In the current version of the public review documents, the calculated values of water column selenium in San Francisco Bay (0.21 – 0.31 µg/L at Mallard Island) are more than a factor of two higher than the observed values (from 0.08 to 0.12 µg/L across multiple sampling events in Suisun Bay). Using this water column concentration, the calculated mean values of white sturgeon tissue selenium (9.9 µg/g mean and 15 µg/g drought year value) are higher than observed in the last decade across multiple samples. Although the data are limited, the range of individual observations in composite whole-body fish samples from Suisun Bay is 3.1-10.8 µg/g.

Using valid boundary values for the Sacramento and San Joaquin Rivers (Freeport: 0.095 µg/l and Vernalis: 0.57 µg/l, both based on USGS data), we have updated the water column and white sturgeon calculations. Using the same modeling framework as used in the EIR/EIS, but with the corrected boundary values, we are able to get a reasonable match with the observed data for existing conditions. The model analysis shows that the BDCP preferred Alternative 4 will result in higher water column concentrations than that estimated in the EIR/EIS. Using the bioaccumulation model in the EIR/EIS, we find a similar projected increase in fish tissue concentrations from existing conditions. Some alternatives (besides the CEQA preferred alternative) result in much higher water column selenium concentrations in the Bay.

5.2 RECOMMENDATIONS

The corrections we made to the riverine boundary selenium concentrations are important to consider in any revision to the EIR. Because the Sacramento River is the dominant flow to the Bay-Delta, correct representation of selenium concentrations in this river is important in determining concentrations in the Bay water. The changes to the selenium concentrations in the Sacramento River proposed here improve the match between predicted and observed data for concentrations in the water and in fish species under existing conditions. Predicted selenium concentrations in white sturgeon with updated boundary concentrations were lower in the range of 4.8-6.9 µg/g, which is more in line with recent observations.

Importantly, the new calculations suggest that there is an effect of the BDCP changes to the water column and white sturgeon selenium concentrations at the Mallard Island station for CEQA Alternative 4, representing conditions in Suisun Bay (8-20% increase, depending on the hydrology). This is higher than currently estimated for Alternative 4 at this station (2-5% increase, calculated by Tetra Tech), and may be evaluated in the context of the CEQA conclusion "Relative to Existing Conditions, modeling estimates indicate that all scenarios under Alternative 4 would result in essentially no change in selenium concentrations throughout the Delta." (page 8-476, Draft EIR/EIS). Note that in the bioaccumulation model used in the BDCP analysis the water column and fish tissue concentrations are proportionally related; thus, a change of a given percent in water column concentrations corresponds to the same percent change in fish tissue concentrations. The worst case conditions are not the drought years of 1987-1991, but years where the San Joaquin flow contributions to the Bay are larger, and should also be considered for selenium effects. Should alternatives besides the CEQA preferred Alternative 4 be considered in future phases, Se impacts could be more significant. This potential change needs to be addressed though the EIR/EIS.

Besides correction of the boundary values in the EIR/EIS, other considerations follow. The calculated white sturgeon concentrations with the new boundary conditions are lower under existing conditions, and in the range of the 8.1 µg/g target now proposed by the USEPA as a whole-body fish tissue target (USEPA, 2014). The potential of impairment under existing conditions and current loads from various point- and non-point sources will be addressed by the Regional Board through the total maximum daily load analysis (TMDL) under way, but it is important to note that this modeling suggests that future BDCP changes may well increase water column and fish concentrations greater than what is calculated in the current EIR/EIS. Given this finding, there is a need to monitor the changes in water and fish over the coming years and to consider if any mitigation might be needed.

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APPENDIX A. ACTION ALTERNATIVES EVALUATED IN THE BDCP EIR/EIS

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Table A-1 Alternatives Identified

EIR/EIS alternative number	Conveyance	Conveyance alignment	Intakes selected for analysis	North delta diversion capacity (cfs)	Operations	Conservation components	Measures to reduce other stressors
1A	Dual	Pipeline/tunnel	1,2,3,4,5	15,000	Scenario A	Per BDCP steering committee proposed project	Per BDCP steering committee proposed project
1B	Dual	East	1,2,3,4,5	15,000	Scenario A	Per BDCP steering committee proposed project	Per BDCP steering committee proposed project
1C	Dual	West	West side intakes 1,2,3, 4,5	15,000	Scenario A	Per BDCP steering committee proposed project	Per BDCP steering committee proposed project
2A	Dual	Pipeline/tunnel	1,2,3,4,5	15,000	Scenario B	Per BDCP steering committee proposed project	Per BDCP steering committee proposed project
2B	Dual	East	1,2,3,4,5	15,000	Scenario B	Per BDCP steering committee proposed project	Per BDCP steering committee proposed project
2C	Dual	West	West side intakes 1,2,3,4,5	15,000	Scenario B	Per BDCP steering committee proposed project	Per BDCP steering committee proposed project

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EIR/EIS alternative number	Conveyance	Conveyance alignment	Intakes selected for analysis	North delta diversion capacity (cfs)	Operations	Conservation components	Measures to reduce other stressors
3	Dual	Pipeline/tunnel	1,2	6,000	Scenario A	Per BDCP steering committee proposed project	Per BDCP steering committee proposed project
4 (CEQA preferred alternative)	Dual	Pipeline/tunnel	2,3,5	9,000	Scenario H	Per BDCP steering committee proposed project	Per BDCP steering committee proposed project
5	Isolated	Pipeline/tunnel	1,2,3,4,5	3,000	Scenario C	Per BDCP steering committee proposed project	Per BDCP steering committee proposed project
6A	Isolated	Pipeline/Tunnel	1,2,3,4,5	15,000	Scenario D	Per BDCP steering committee proposed project	Per BDCP steering committee proposed project
6B	Isolated	East	West side intakes 1,2,3, 4,5	15,000	Scenario D	Per BDCP steering committee proposed project	Per BDCP steering committee proposed project
6C	Isolated	West	1,2,3,4,5	15,000	Scenario D	Per BDCP steering committee proposed project	Per BDCP steering committee proposed project
7	Dual	Pipeline/Tunnel	2,3,5	9,000	Scenario E	Per BDCP steering committee proposed project	Per BDCP steering committee proposed project

EIR/EIS alternative number	Conveyance	Conveyance alignment	Intakes selected for analysis	North delta diversion capacity (cfs)	Operations	Conservation components	Measures to reduce other stressors
8	Dual	Pipeline/Tunnel	2,3,5	9,000	Scenario F	Per BDCP steering committee proposed project	Per BDCP steering committee proposed project
9	Through – Delta	Through Delta/Separate corridors	Screened intakes at Delta cross channel and Georgiana Slough	15,000	Scenario G	Per BDCP steering committee proposed project	Per BDCP steering committee proposed project

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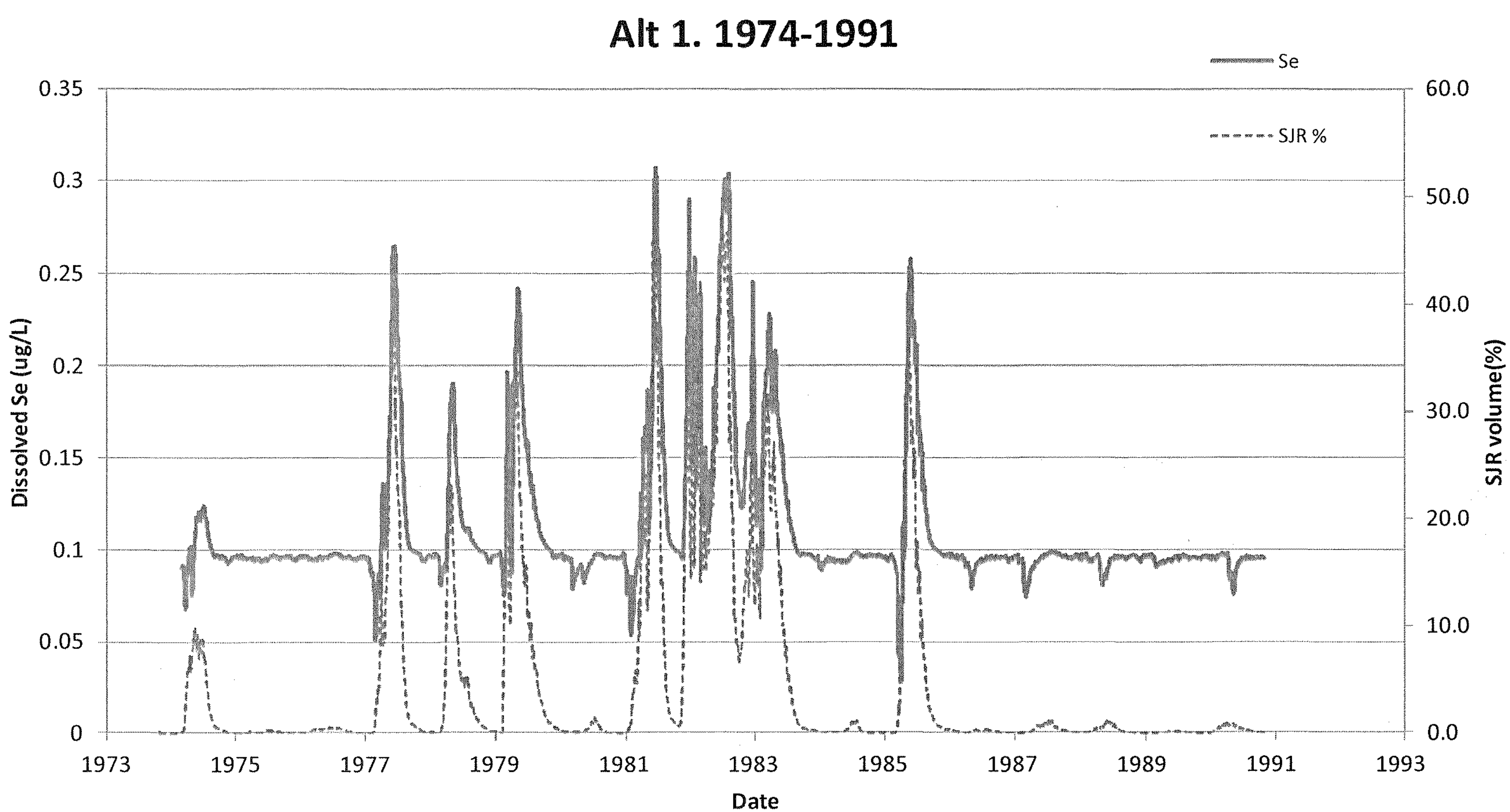

Figure A-1 *Updated calculations by Tetra Tech for alternative 1 at Mallard Island using source concentrations: of 0.09 µg/L at Martinez, 0.095 µg/L at Sacramento River, and 0.57 µg/L at San Joaquin River*

BDCP1432

Table A-2
Updated calculations by Tetra Tech for alternative 1 at Mallard Island

Selenium at Mallard Island	Entire 16-year period (1974-1991)	1987-1991 drought	High San Joaquin contribution (1981-1985)
Min	0.092	0.093	0.093
Max	0.364	0.170	0.364
Mean	0.134	0.102	0.165

Using concentrations in source water: Martinez = 0.09 µg/L, Sacramento River = 0.095 µg/L, San Joaquin River = 0.57 µg/L.

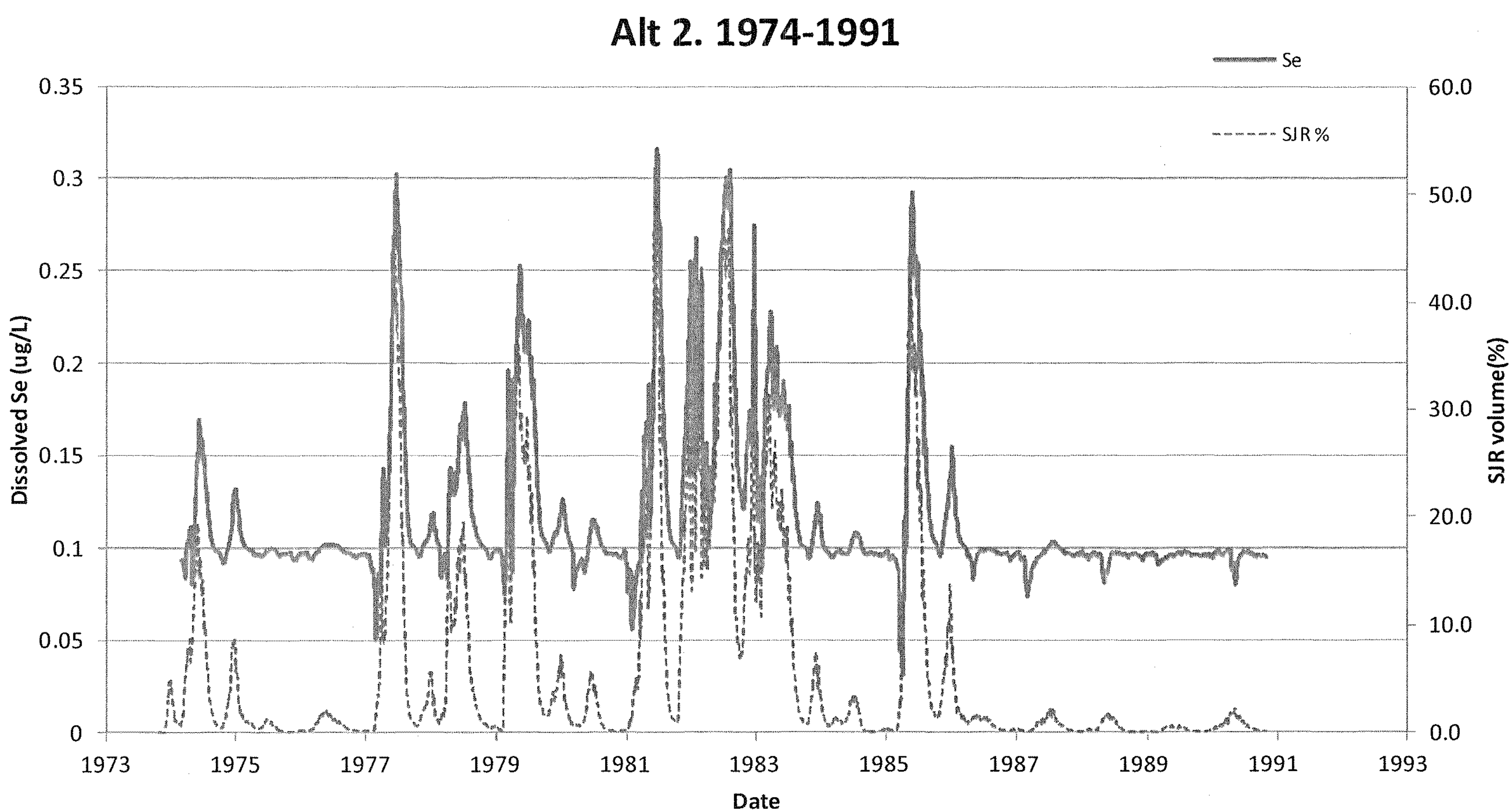

Figure A-2 Updated calculations by Tetra Tech for alternative 2 at Mallard Island using source concentrations: of 0.09 µg/L at Martinez, 0.095 µg/L at Sacramento River, and 0.57 µg/L at San Joaquin River

BDCP1432

Table A-3
Updated calculations by Tetra Tech for alternative 2 at Mallard Island

Selenium at Mallard Island	Entire 16-year period (1974-1991)	1987-1991 drought	High San Joaquin contribution (1981-1985)
Min	0.093	0.093	0.093
Max	0.366	0.175	0.366
Mean	0.141	0.105	0.171

Using concentrations in source water: Martinez = 0.09 µg/L, Sacramento River = 0.095 µg/L, San Joaquin River = 0.57 µg/L.

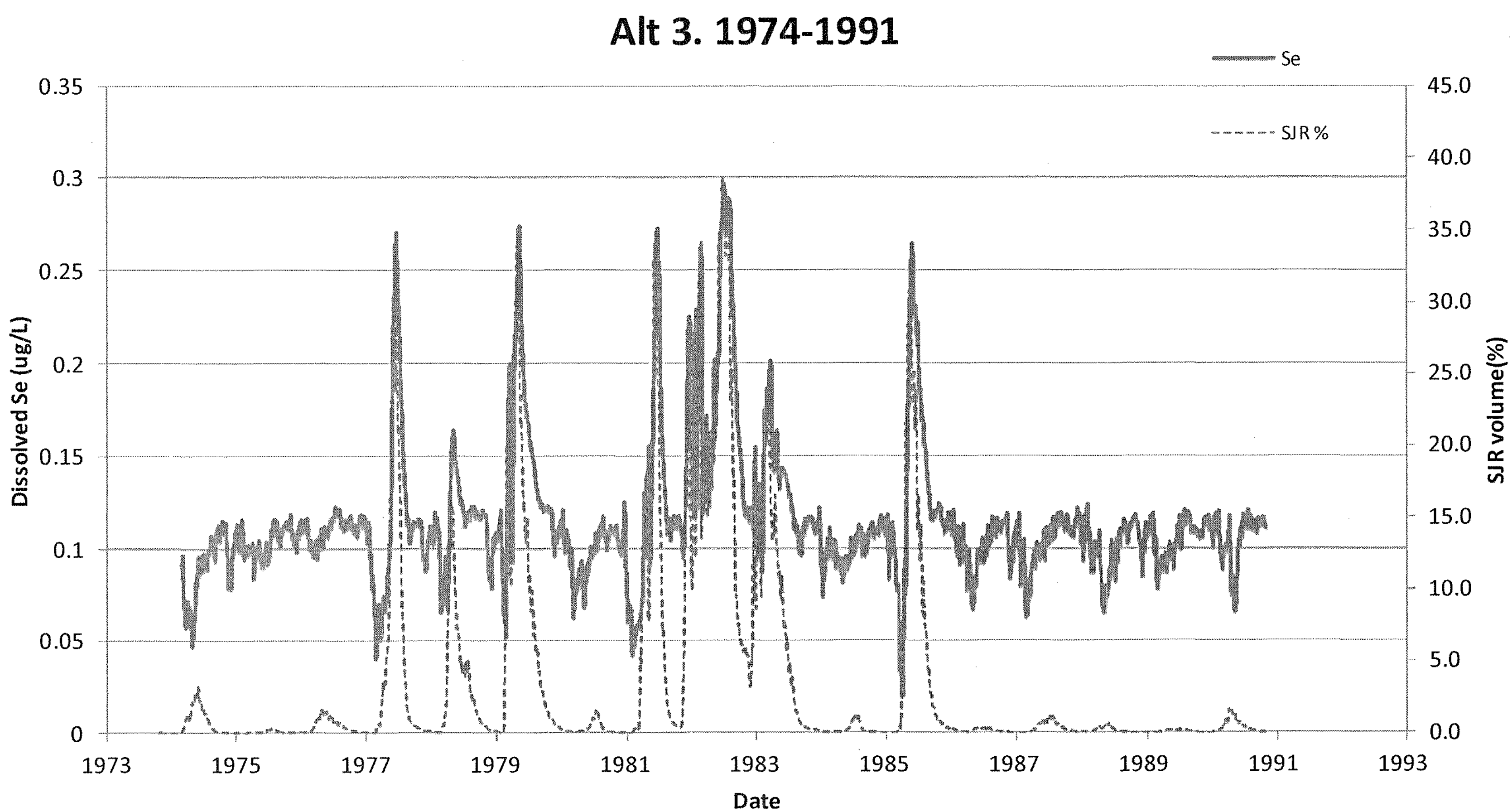

Figure A-3 Updated calculations by Tetra Tech for alternative 3 at Mallard Island using source concentrations: of 0.09 μg/L at Martinez, 0.095 μg/L at Sacramento River, and 0.57 μg/L at San Joaquin River

BDCP1432

Table A-4
Updated calculations by Tetra Tech for alternative 3 at Mallard Island

Selenium at Mallard Island	Entire 16-year period (1974-1991)	1987-1991 drought	High San Joaquin contribution (1981-1985)
Min	0.092	0.093	0.093
Max	0.364	0.168	0.364
Mean	0.129	0.102	0.154

Using concentrations in source water: Martinez = 0.09 µg/L, Sacramento River = 0.095 µg/L, San Joaquin River = 0.57 µg/L.

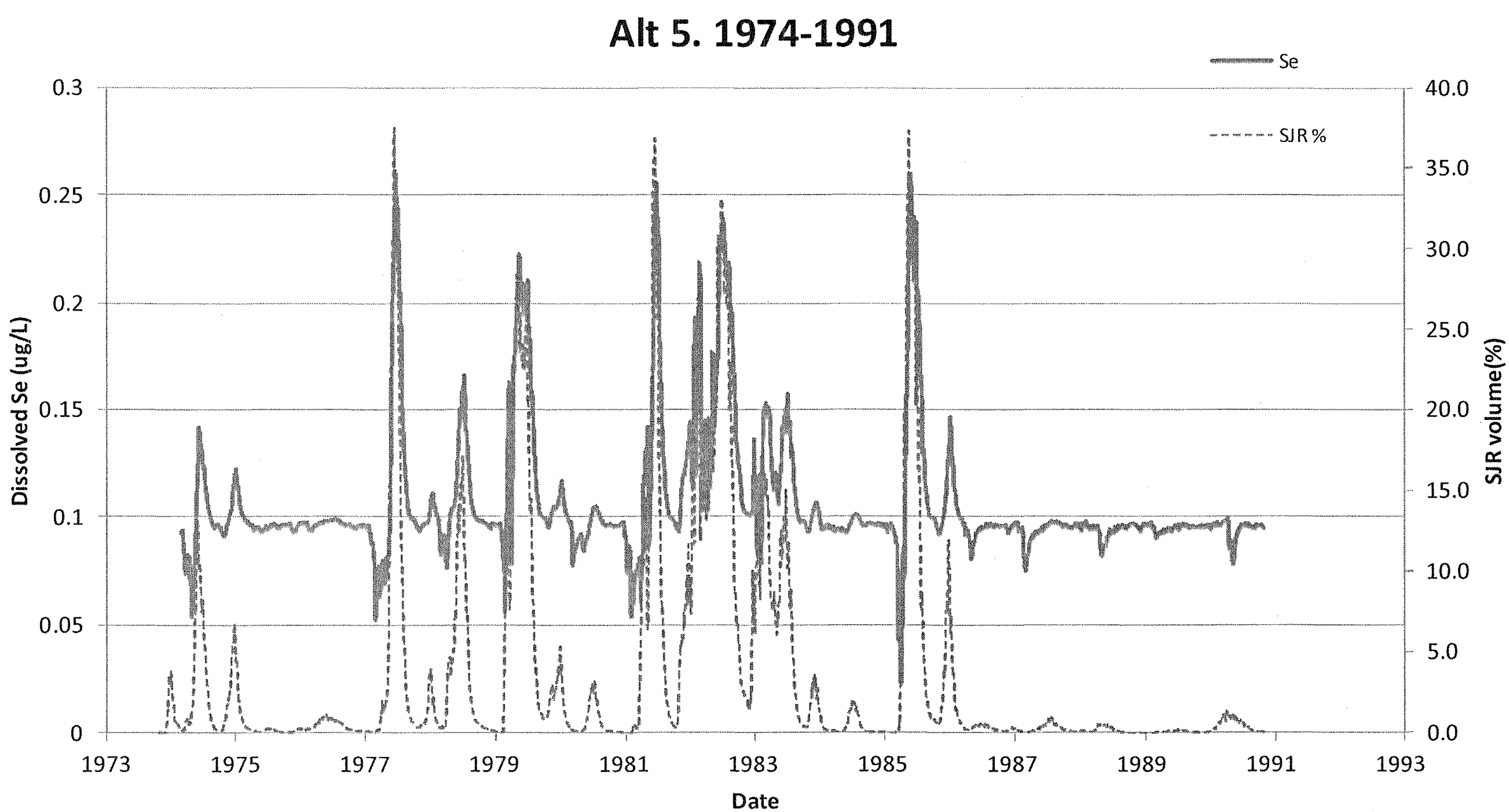

Figure A-4 *Updated calculations by Tetra Tech for alternative 5 at Mallard Island using source concentrations: of 0.09 µg/L at Martinez, 0.095 µg/L at Sacramento River, and 0.57 µg/L at San Joaquin River*

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Table A-5
Updated calculations by Tetra Tech for alternative 5 at Mallard Island

Selenium at Mallard Island	Entire 16-year period (1974-1991)	1987-1991 drought	High San Joaquin contribution (1981-1985)
Min	0.022	0.074	0.053
Max	0.260	0.145	0.255
Mean	0.104	0.091	0.113

Using concentrations in source water: Martinez = 0.09 µg/L, Sacramento River = 0.095 µg/L, San Joaquin River = 0.57 µg/L.

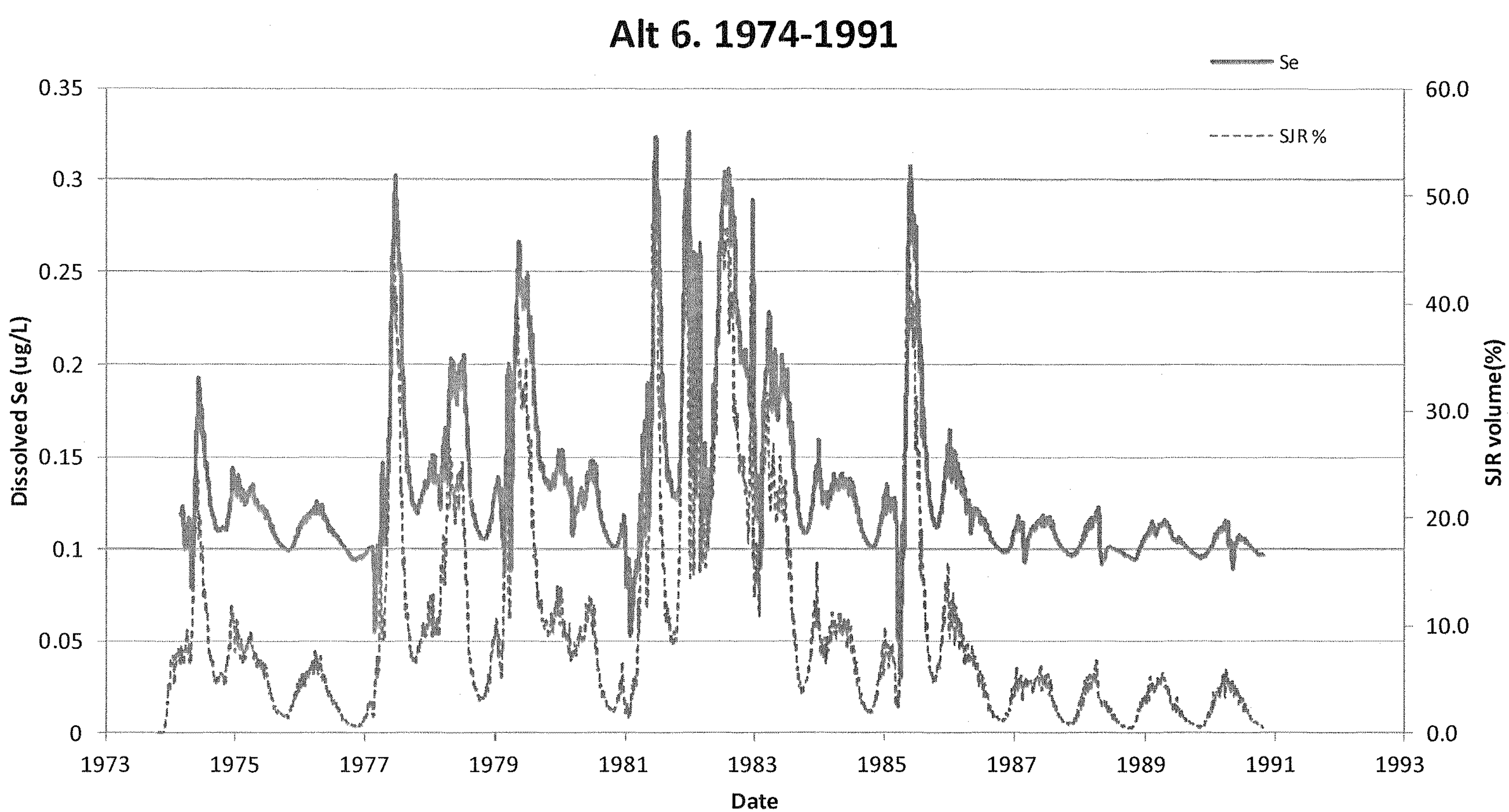

Figure A-5 Updated calculations by Tetra Tech for alternative 6 at Mallard Island using source concentrations: of 0.09 µg/L at Martinez, 0.095 µg/L at Sacramento River, and 0.57 µg/L at San Joaquin River

Table A-6
Updated calculations by Tetra Tech for alternative 6 at Mallard Island

Selenium at Mallard Island	Entire 16-year period (1974-1991)	1987-1991 drought	High San Joaquin contribution (1981-1985)
Min	0.097	0.097	0.104
Max	0.367	0.187	0.367
Mean	0.160	0.118	0.195

Using concentrations in source water: Martinez = 0.09 µg/L, Sacramento River = 0.095 µg/L, San Joaquin River = 0.57 µg/L.

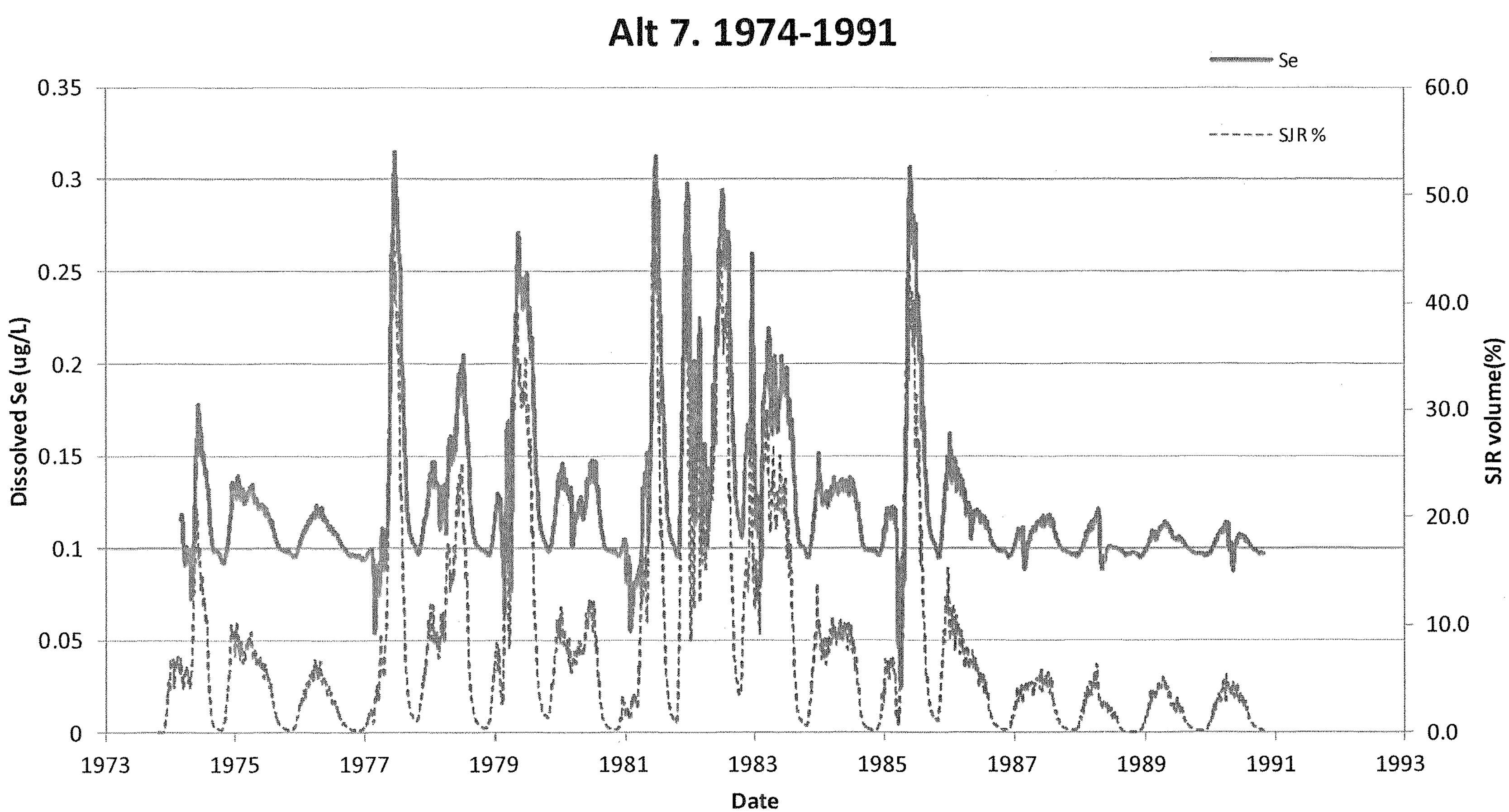

Figure A-6 *Updated calculations by Tetra Tech for alternative 7 at Mallard Island using source concentrations: of 0.09 µg/L at Martinez, 0.095 µg/L at Sacramento River, and 0.57 µg/L at San Joaquin River*

BDCP1432

Table A-7
Updated calculations by Tetra Tech for alternative 7 at Mallard Island

Selenium at Mallard Island	Entire 16-year period (1974-1991)	1987-1991 drought	High San Joaquin contribution (1981-1985)
Min	0.093	0.093	0.094
Max	0.367	0.190	0.367
Mean	0.149	0.114	0.179

Using concentrations in source water: Martinez = 0.09 µg/L, Sacramento River = 0.095 µg/L, San Joaquin River = 0.57 µg/L.

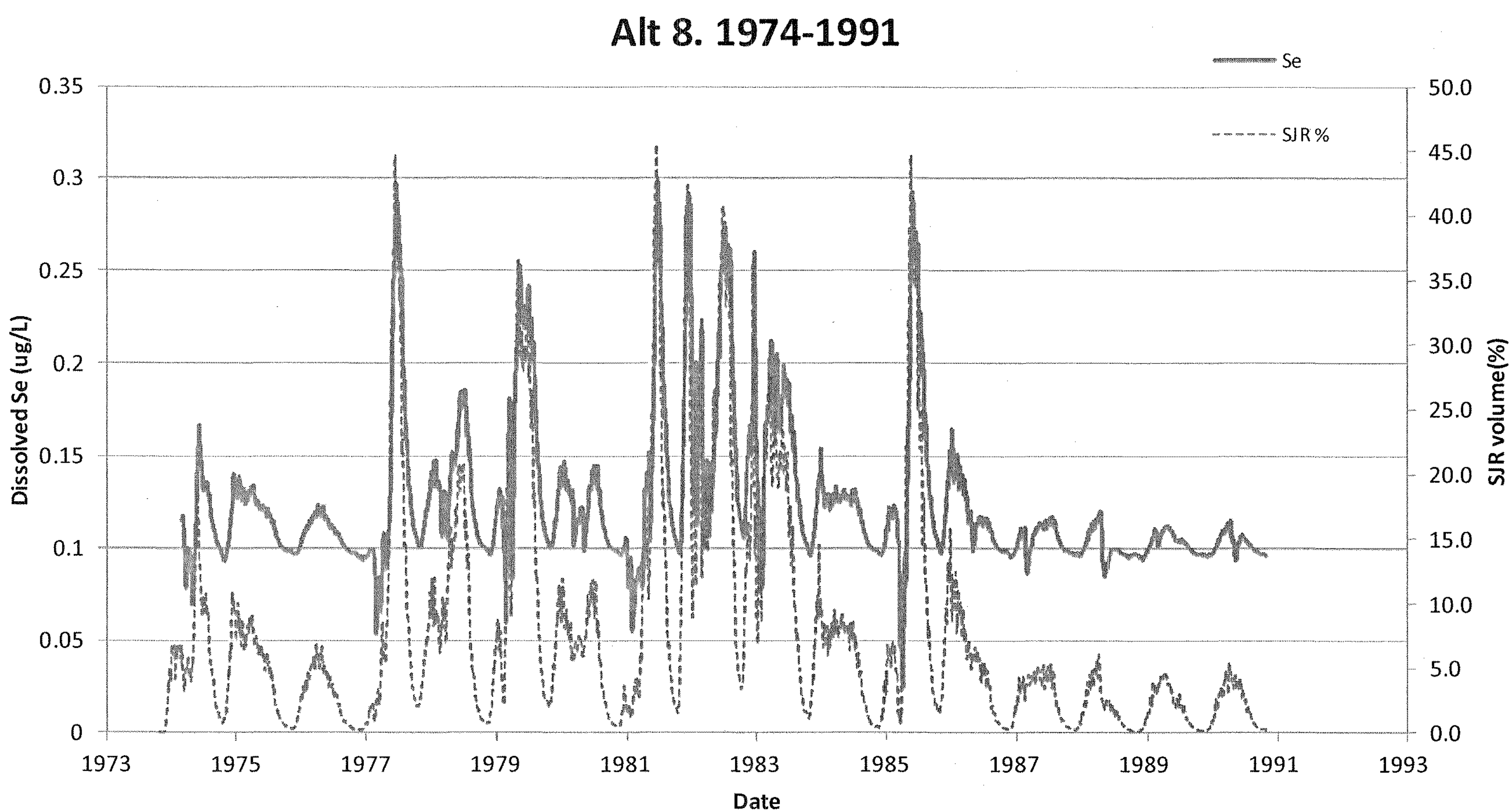

Figure A-7 Updated calculations by Tetra Tech for alternative 8 at Mallard Island using source concentrations: of 0.09 µg/L at Martinez, 0.095 µg/L at Sacramento River, and 0.57 µg/L at San Joaquin River

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Table A-8
Updated calculations by Tetra Tech for alternative 8 at Mallard Island

Selenium at Mallard Island	Entire 16-year period (1974-1991)	1987-1991 drought	High San Joaquin contribution (1981-1985)
Min	0.094	0.094	0.095
Max	0.367	0.198	0.367
Mean	0.150	0.115	0.179

Using concentrations in source water: Martinez = 0.09 µg/L, Sacramento River = 0.095 µg/L, San Joaquin River = 0.57 µg/L.

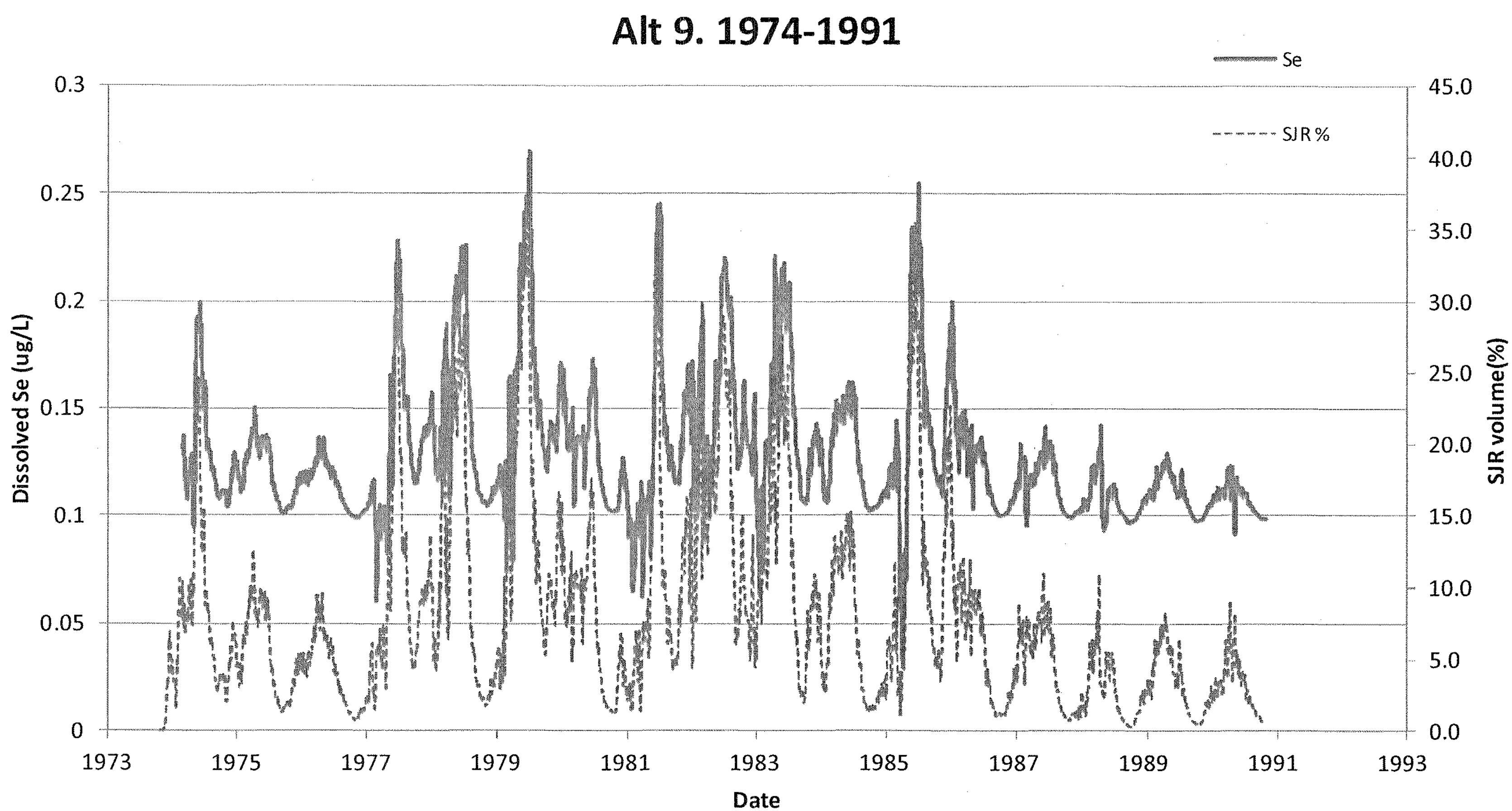

Figure A-8 *Updated calculations by Tetra Tech for alternative 9 at Mallard Island using source concentrations: of 0.09 µg/L at Martinez, 0.095 µg/L at Sacramento River, and 0.57 µg/L at San Joaquin River*

BDCP1432

Table A-9
Updated calculations by Tetra Tech for alternative 9 at Mallard Island

Selenium at Mallard Island	Entire 16-year period (1974-1991)	1987-1991 drought	High San Joaquin contribution (1981-1985)
Min	0.095	0.095	0.100
Max	0.355	0.208	0.355
Mean	0.149	0.121	0.169

Using concentrations in source water: Martinez = 0.09 µg/L, Sacramento River = 0.095 µg/L, San Joaquin River = 0.57 µg/L.

From: Craig Johns <cjohns@calrestrats.com>
Sent: Wednesday, July 02, 2014 2:35 PM
To: BDCP.comments@noaa.gov
Subject: BDCP and EIR/EIS Comments
Attachments: BDCP-PSSEP-CommentLtr&Atts3-062514.pdf

Dear Mr. Wulff:

Attached are the comments from Partnership for Sound Science in Environmental Policy on the November 2013 Draft BDCP and supporting EIR/EIS. I would appreciate confirmation of your receipt hereof.

Thank you,

Craig Johns
Program Manager,
Partnership for Sound Science in Environmental Policy
1115 – 11th Street, Suite 100
Sacramento, CA 95814
(office) 916.498-3326
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BDCP1433

PSSEP
Partnership for
Sound Science
in Environmental
Policy

June 25, 2014

National Marine Fisheries Service
Attention: Ryan Wulff
650 Capitol Mall, Suite 5-100
Sacramento, CA 95814

Submitted via email: BDCP.comments@noaa.gov

Subject: Comments on [November 2013] Draft BDCP and Supporting Draft EIR/EIS – Focus on Selenium Impacts

Dear Mr. Wulff:

These comments are submitted on behalf of the Partnership for Sound Science in Environmental Policy ("PSSEP") on the November 2013 Draft Bay Delta Conservation Plan ("BDCP") and the supporting Environmental Impact Report/Statement ("EIR/EIS") required under state and federal law. PSSEP is an association of municipal, industrial, and trade association entities in California whose members are regulated by the State and Regional Water Boards under their joint, Federal Clean Water Act and Porter-Cologne Water Quality Control Act authorities. Some of PSSEP's members and/or affiliates are located in the San Francisco Bay Area and will be directly affected by any actions taken pursuant to the BDCP. As such, PSSEP and its members are "interested parties" for purposes of the California Environmental Quality Act ("CEQA"), the National Environmental Protection Act ("NEPA") and the respective state and federal Endangered Species Acts ("ESAs").

We note at the outset that PSSEP takes no position on the desirability of the BDCP and/or the underlying "alternative water conveyance facilities" the BDCP is being developed to support. PSSEP's members simply desire to ensure that the final BDCP is both technically accurate and adequately ensures that known or reasonably foreseeable impacts that are likely to accrue as a result of BDCP will be formally recognized and fully mitigated under CEQA, NEPA and the Sacramento-San Joaquin Delta Reform Act of 2009 ("Delta Act"). In particular, PSSEP is concerned that the BDCP understates the potential additional selenium loading impacts to the Delta, and completely ignores the potential impacts these additional selenium loads will have to San Francisco Bay.

The BDCP is an elaborate and complex plan which purports to restore and protect the Sacramento-San Joaquin Delta ecosystem as part of an effort to secure future water deliveries from the Delta to state and federal water contractors *via* the Central Valley Project and State Water Project. The overall plan includes three new riverine water intakes located on the Sacramento River, in the northern Delta. A total of nine alternatives (with some sub-alternatives for a total of fifteen action alternatives) and the "no action" alternative were evaluated in the BDCP and the EIR/EIS. "Alternative 4" is the CEQA/NEPA preferred alternative, which would consist of a dual conveyance system of pipeline/tunnel and the new riverine water intakes that collectively provide export capacity of 9,000 cubic feet per second – or more than 6.5 million acre feet per year. Under Alternative 4, water would be conveyed from the north Delta to the south Delta through pipelines/tunnels and through surface channels.[1]

BDCP implementation project(s) would result in a massive amount of Sacramento River water being removed from the Delta, resulting in a substantial increase in flow from the San Joaquin River. As water flows from the San Joaquin River increase, so will a corresponding amount of increased selenium at elevated concentration levels flow into the Delta and thereafter into San Pablo and San Francisco Bays. As a result, due to known selenium behavior both as a required nutrient and as a toxicant at higher levels, there could be significant impacts on fish and other wildlife in San Pablo and San Francisco Bays. This phenomenon was recently explored by scientists studying the sources and fate of selenium loads affecting San Francisco Bay, wherein it was concluded that, "Manipulations to the Delta system, especially those that increase San Joaquin [River] flow into the bay, will also have selenium impacts to the bay that must be evaluated."[2]

PSSEP's comments will address both the BDCP and the EIR/EIS, as specifically indicated. A summary of our primary concerns, which are more fully described below, include:

- The EIR/EIS fails to consider the effects of BDCP Conservation Measures on San Francisco Bay.
- The BDCP and the EIR/EIS significantly underestimate additional selenium loads to the Delta associated with Preferred Alternative 4.
- The EIR/EIS relies on inappropriate regulatory standards for concluding "No Substantial Effects" associated with selenium load increases.
- The BDCP fails to provide adequate assurances for mitigation of known or reasonably foreseeable impacts to San Francisco and San Pablo Bays related to increased selenium loads.
- The BDCP implementation structure and process is inadequate and inappropriately devolves excessive authority to the Water Contractors in making decisions that will impact San Francisco Bay.
- The BDCP must include the State Water Resources Control Board and the Delta Watermaster within the governing and implementing agency hierarchy.
- The BDCP fails to comply with Delta Reform Act.

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1 *See generally,* BDCP Plan, Executive Summary; *see also*, BDCP EIR/EIS, Ch. 2. (ICF, November 2013.)

2 "*Modeling Fate, Transport, and Biological Uptake of Selenium in North San Francisco Bay*", L. Chen, Meseck, Roy, Grieb, and Baginska; Estuaries & Coasts, November 2012. (Copy provided as Attachment 1.)

1. The EIR/EIS fails to consider the effects of BDCP Conservation Measures on San Francisco Bay.

Chapter 8 of the EIR/EIS purports to analyze known and reasonably foreseeable environmental impacts associated with the BDCP and each of the Conservation Measures to be taken thereunder, all with a view toward supporting the "preferred" Alternative 4. According to the EIR/EIS, "[f]or the purposes of characterizing the existing water quality conditions and evaluating the consequences of implementing the BDCP alternatives on surface water quality, ***the affected environment is defined as anywhere an effect could occur***, which includes but is not necessarily limited to the statutory Delta, Suisun Bay and Marsh, and areas to the north and south of the Delta, which are defined in various parts of this chapter as Upstream of the Delta and the State Water Project/Central Valley Project Export Service Areas, as shown in Figure 1-4. When compared to the watershed boundaries, it is noted that the affected environment falls primarily within the Sacramento and San Joaquin River watersheds."[3] Yet aside from the statement that the EIR/EIS considered water quality impacts "anywhere an effect could occur," it is clear from the EIR/EIS itself that the affected area where water quality impacts were analyzed was artificially constricted.

An extracted copy of the map contained in the referenced Figure 1-4, showing the affected area wherein environmental impacts were analyzed under the EIR/EIS, is included herein as Attachment 2. This map very clearly demonstrates that the preparers of the BDCP and supporting EIR/EIS ***excluded*** San Francisco and San Pablo Bays from their effects analyses, which clearly violates CEQA and NEPA.[4]

In its highly critical assessment of the BDCP and the EIR/EIS, the Delta Independent Science Board ("DISB") noted one of its "major concerns" was that, "The analyses largely neglect the influences of downstream effects on San Francisco Bay..."[5] Further on the topic of the artificially restricted geographic scope of the EIR/EIS analyses, the DISB cautioned that, "the geographic scope of the DEIR/DEIS was defined to exclude San Pablo Bay and San Francisco Bay. The consequences of BDCP actions undertaken within the Plan Area, however, ***will extend downstream to affect these bays.*** Changes in sedimentation in the Delta associated with BDCP actions, for example, will not be confined to the Delta."[6] As noted by the DISB, San Pablo and San Francisco Bays were excluded from consideration in the EIR/EIS simply because they fall outside of the legal boundaries of

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[3] BDCP EIR/EIS, Sec. 8.2.1 at page 8-6. (Emphasis added.)

[4] CEQA requires a state lead agency to provide specific reasons why certain environmental effects "have not been discussed in detail in the environmental impact report." (California Public Resources Code §21100(c).)

[5] Delta Independent Science Board, "Review of the Draft EIR/EIS for the Bay Delta Conservation Plan," May 15, 2014, page 3. (hereafter, "DISM Review").

[6] DISB Review, page 7. (Emphasis added.)

the Delta.[7] The artificial determination of the BDCP "affected area" is neither legally supportable nor, according to the DISB, "scientifically justified."[8]

By its very terms, and as specifically set forth in Chapter 8, the EIR/EIS cannot meet the legal adequacy requirements of CEQA and NEPA because the effects analysis is artificially restricted, and the EIR/EIS fails to provide a "reasonable explanation for the geographic limitation used."[9] Indeed, the EIR/EIS preparers chose to include "upstream of the Delta (including the Sacramento and San Joaquin River watersheds)" [10] or – alternatively - the "Sacramento hydrologic region,"[11] yet somehow concluded that the water quality and water supply impacts downstream of the BDCP project were unimportant.[12]

2. *The BDCP and the EIR/EIS significantly underestimate additional selenium loads to the Delta associated with Preferred Alternative 4.*

Chapter 8 of the EIR/EIS analyzes various "factors affecting water quality" in the Delta and essentially *brushes aside* the well-known and well-documented selenium loading that comes from the San Joaquin and Sacramento Rivers. Concurrently, the authors of the EIR/EIS suggest that the Bay Area refineries are responsible for considerable selenium loading to Suisun Bay and the Delta - - without any empirical data or evidence to support this claim.[13] These multiple references to the Bay Area refineries and the quality of their respective effluents to North San Francisco Bay should be completely eliminated, unless

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[7] DISB Review, page 8.

[8] DISB Review, page 8.

[9] *See,* CEQA Guidelines §15130(b)(1)(B)(3), which provides that: "Lead Agencies should define the geographic scope of the area affected by the cumulative effects and provide a reasonable explanation for the geographic limitation used." Further, when considering potentially significant impacts on the affected "environment," it is worth noting that CEQA defines "environment" to mean, "the physical conditions that exist within the area which will be affected by a proposed project, including land, air, water, minerals, flora, fauna, noise or objects of historic or aesthetic significance." (California Public Resources Code §21060.5.)

[10] BDCP EIR/EIS, Section 8.1.5 at page 8-3.

[11] BDCP EIR/EIS, Section 6.1 at page 6-1. Under the Delta Reform Act, the Sacramento Hydrologic Region is defined by reference to the Department of Water Resources' "Bulletin 160-05," commonly known as the "California Water Plan." In turn, the California Water Plan describes the Sacramento Hydrologic Region as: "The entire drainage area of the state's largest river and its tributaries, extending from the Oregon border downstream to the Sacramento – San Joaquin Delta. The region covers 27,246 square miles including all or a portion of 20 predominately rural Northern California counties, and extends from the crest of the Sierra Nevada in the east to the summit of the Coast Range in the west." According to the Water Plan, "The population of the Sacramento River Hydrologic Region was 2,593,000 in 2000, which represents about 8 percent of California's total population." (California Water Plan, (Bulletin 160-05), Ch. 6 pages 6.1-6.2.)

[12] For comparison, the surface area of the entire San Francisco Bay is approximately 1,100 square miles, or roughly 4% of the 27,246 square miles that comprise the Sacramento Hydrologic Region. (*See*, Water Quality Control Plan for the San Francisco Bay Basin, Ch. 1 (2013).)

[13] *See, e.g.,* BDCP EIR/EIS, Sec. 8.4.3 at pages 8-286, 8-347, 8-401, 8-477, 8-535, 8-587, 8-642, 8-694, 8-747.

they are re-cast to be both factually and contextually accurate and the BDCP flow impacts are appropriately modeled. Indeed, the most current understanding of selenium loading to San Francisco Bay has been compiled by the San Francisco Regional Board in developing its North San Francisco Bay TMDL for Selenium. That data shows the ***overwhelming*** percentage of selenium load to the Bay comes from the Delta.[14]

The underlying conclusions of the EIR/EIS – that development of the BDCP preferred Alternative 4 conveyance facilities "would result in essentially no change in selenium concentrations throughout the Delta"[15] - - is false. According to a recent TetraTech analysis of the EIR/EIS assessment of selenium loading and impacts related to the BDCP project, "[s]elenium concentrations used in the Sacramento River for the BDCP EIR/EIS study are biased high."[16] This analysis determined that the EIR/EIS preparers ***excluded*** recent selenium water concentration data from the Freeport and Vernalis gauge stations maintained by USGS, and used older data based on high "non-detect" values, which artificially inflated the current calculated values of water column selenium by more than a factor of two.[17] When valid boundary values for the Sacramento and San Joaquin Rivers are input into the *same modeling framework* used by the BDCP preparers, TetraTech found the following:

> "The model analysis shows that the BDCP-preferred Alternative 4 will result in higher percent changes in water column concentrations than that calculated in the EIR/EIS. Using the bioaccumulation model in the EIR/EIS, we find a similar projected increase in fish tissue concentrations between Alternative 4 and existing conditions (i.e., no BDCP project). Importantly, ***the new calculations suggest that there is an effect of the BDCP changes to the water column and white sturgeon selenium concentrations at the Mallard Island station for CEQA Alternative 4***, representing conditions in Suisun Bay (8-20% increase, depending on the hydrology). This is higher than currently estimated for Alternative 4 at this station (2-5% increase, calculated by Tetra Tech)…"[18]

In essence, the BDCP reviewers ***underestimated*** the anticipated increase in selenium loading that will be caused by construction and operation of the preferred Alternative 4 conveyance facilities by an average of approximately 15% for any given hydrology year. Not only must the BDCP Lead Agencies re-evaluate the selenium-related water quality effects based on the results of the TetraTech Selenium Review, but adequate

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[14] *See,* Technical Memorandum 2: North San Francisco Bay Selenium Data Summary and Source Analysis, July 2008, TetraTech, Inc.

[15] BDCP EIR/EIS, Sec. 8.4.3.9 at page 8-474.

[16] "Review of Selenium Bioaccumulation Assessment in the Bay Delta Conservation Program Draft EIR/EIS," TetraTech, May 30, 2014. (Hereafter, "TetraTech Selenium Review.") (Copy provided in Attachment 3.)

[17] TetraTech Selenium Review, page 5-1.

[18] TetraTech Selenium Review, page 1-2. (Emphasis added.)

resources must be allocated for future water column and fish tissue monitoring throughout the term of the BDCP permits. In addition, mitigation for these impacts must be provided by the BDCP beneficiaries as part of their CEQA and NEPA obligations,[19] as well as under the Delta Reform Act of 2009. (*See* discussion in Section 4, below.)

3. The EIR/EIS relies on inappropriate regulatory standards for concluding "No Substantial Effects" associated with selenium load increases.

Under the "Effects Determinations" analysis contained in Section 8.4.3, the BDCP preparers concluded that there would be "no substantial effects" related to selenium associated with the BDCP project. In part, this conclusion is based on a water quality criteria established under the California Toxics Rule for San Francisco and Suisun Bays in 2000.[20] Yet, the EIR/EIS acknowledges that US EPA Region IX is currently developing a new water quality criterion for selenium in San Francisco and San Pablo Bays, and further concedes that the anticipated new selenium criterion is likely to be far lower than current fresh and marine waters criteria.[21] Nevertheless, because the BDCP preparers concluded that only the *existing* selenium water quality criteria applies for purposes of determining substantial effects related to the BDCP project, the anticipated US EPA criteria is ignored.

CEQA requires a lead agency to analyze all reasonably foreseeable, significant effects on the environment.[22] "Significant effect on the environment" is defined under CEQA to mean, "a substantial, or potentially substantial, adverse change in the environment."[23] As discussed above, the BDCP preferred Alternative 4 is reasonably likely to result in ***increased selenium loads*** to San Francisco and San Pablo Bays at a range of between 8-20% every year, depending on hydrological conditions.[24] These anticipated increases in selenium load to San Francisco and San Pablo Bays are clearly significant, and the BDCP must both consider these effects on the downstream environment, as well as provide adequate mitigation for them. Furthermore, the EIR/EIS must analyze these expected selenium load increases in the context of US EPA's anticipated new selenium criteria for San Francisco Bay which, as the EIR/EIS preparers are well aware, is likely to be *substantially lower* than the current criteria used by the preparers.

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[19] An adequate EIR must respond to specific suggestions for mitigating significant environmental impacts unless the suggested mitigation is facially infeasible. *See, San Francisco Ecology Center v. City and County of San Francisco* (1975) 48 Cal.App.3d 584, 596.

[20] BDCP EIR/EIS, Sec. 8.4.2.3, page 8-96 – 8-97. *See,* Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California. 65 Fed.Reg. 31682.

[21] BDCP EIR/EIS, Sec. 8.4.2.3, page 8-99 – 8-100.

[22] California Public Resources Code §21065. A "project" subject to CEQA review means "means an activity which may cause either a direct physical change in the environment, or a reasonably foreseeable indirect physical change in the environment." (*Ibid.*)

[23] California Public Resources Code §21068. *See also*, CEQA Guidelines §15382.

[24] *See*, Section 2 above, at pages 4-5.

4. The BDCP fails to provide adequate assurances for mitigation of known or reasonably foreseeable impacts to San Francisco and San Pablo Bays related to increased selenium loads.

The federal and state Endangered Species Acts require that a Habitat Conservation Plan (HCP) contain specific information to ensure adequate funding to carry out all aspects of the HCP.[25] Case law interpreting the Federal Endangered Species Act on the need for ensuring adequate HCP funding has further held that the permit "applicant cannot rely on speculative future actions of others."[26] Yet, the BDCP specifically refers to and relies upon putative funding derived from a Water Bond that has yet to be placed before the voters, let alone actually passed. This clearly cannot satisfy the requirements of the federal and state Endangered Species Acts, as interpreted by case law applicable to California.

Moreover, the Delta Reform Act of 2009 specifically provides that proponents of a new Delta water conveyance facility must pay to mitigate all impacts associated with the construction, operation, and maintenance of such facility.[27] There is nothing in the BDCP which accounts for mitigation related to increased selenium loads that will occur with the construction and operation of the preferred Alternative 4 water conveyance facilities. This is because, as discussed above, the EIR/EIS preparers specifically excluded analysis of selenium loading to San Francisco and San Pablo Bays.[28]

According to Section 8.3, the BDCP will rely on three, primary, sources of funding for all aspects of the Plan: (1) federal government funding; (2) state government funding (including putative funding provided by future water bonds to be placed before the California voters); and (3) the State and Federal Water Contractors (including, for purposes of municipal water supply districts, individual ratepayers). Yet, the BDCP contains no financing plan and no legal assurances that any of the funds "expected" will actually materialize. An analysis of the sources of funds from reveals that it cannot meet the "speculative future actions" test of ensuring HCP funding.

According to Table 8-37 in Chapter 8,[29] the BDCP expects to receive $3.5 billion from the federal government, derived from various appropriations. However, the BDCP

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[25] *See*, 16 U.S.C. §§1539(a)(2)(A)(ii) and 1539(a)(2)(B)(iii); California Fish & Game Code §2820(a)(10). *See also*, *Nat'l Wildlife Federation v. Babbit*, 128 F.Supp.2d 1274 (E.D. Cal., 2000); *Southwest Center for Biological Diversity v. Bartel*, 470 F.Supp.2d 1118 (S.D. Cal., 2006).

[26] *Southwest Center for Biological Diversity v. Bartel*, *supra*, 470 F.Supp.2d 1118, 1155, citing, *Nat'l Wildlife Federation v. Babbit*, *supra*, 128 F.Supp. 2d 1274, 1294-95.

[27] California Water Code §85089(a).

[28] It bears noting that the mitigation obligations of the BDCP proponents under Water Code §85089(a) is not limited to those identified and included under CEQA, but are in fact ***in addition*** to any CEQA mitigation obligations. Under that section, the State and Federal Water Contractors must pay for "[t]he costs of the environmental review, planning, design, construction, and mitigation, ***including mitigation required pursuant to [CEQA]***, required for the construction, operation, and maintenance of any new Delta water conveyance facility." (Emphasis added.)

[29] BDCP, Ch. 8, page 8-65 – 8-66.

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acknowledges that "additional federal legislation will be required to authorize the continued use of certain federal funds and to extend or broaden fund availability."[30] In terms of securing funding for BDCP implementation, it is hard to imagine anything more speculative than relying on future acts of Congress to make-up what is expected to be approximately 14% of the entire BDCP budget.

Regarding the sources of state government funds for BDCP implementation, Table 8-37 indicates that BDCP proponents expect approximately $4.1 billion to come from the State of California, which accounts for approximately 17% of the entire BDCP budget. Section 8.3.5 of the BDCP provides that, "Funds derived from the issuance of [the 2009 Water Bond] would be used, in part, to satisfy the State's financial commitments to the BDCP."[31]

According to the capital cost estimates for the entire BDCP project, the Authorized Entities are relying on the not-yet passed Water Bond for approximately 10% of the entire BDCP budget.[32] Furthermore, Table 8-37 indicates that BDCP proponents assume the passage of a "Second Water Bond" at some unstated time in the future that will provide an additional $2.2 billion dollars to fund BDCP actions.[33] All totaled, the BDCP proponents expect the voters of California to pass future water bonds in the amount of $3.75 billion to fund BDCP actions – an amount approximately equal to 25% of the entire BDCP budget.

The remaining BDCP budget ($17 billion) is expected to be funded by the State and Federal Water Contractors, according to Table 8-37. Yet a review of Section 8.3.4.4 reveals that even this source of funds is speculative. According to that section, "[t]he most credible assurances of funding from the participating state and federal water contractors result from an economic benefits analysis…" and two primary conclusions derived from the economic analysis that: (1) the costs are affordable by the ratepayers, and (2) the benefits to be gained from the BDCP exceed the total cost.[34] What is missing from these "assurances" is any discussion of whether the State and Federal Water Contractors and their ratepayers would be willing to pay ***additional*** billions of dollars in the event that state water bond funding and/or federal appropriations do not materialize. Moreover, the analysis fails to assess the potential impacts of one (or more) State or Federal Water Contractors, or their member agencies, withdraw or refuse to continue to participate in the Plan. Finally, the BDCP analysis mistakenly assumes benefits based on expected water deliveries from the newly-constructed conveyance facilities that fails to account for the possibility of reduced Delta water exports as a result of the State Water Board's future Delta flow

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[30] BDCP, Sec. 8.3.1, page 8-64, lines 16-18.

[31] BDCP, Sec. 8.3.5.1, page 8-84, lines 9-11.

[32] *See*, Table 8-35 (Ch. 8, page 8-63) and Table 8-46 (Ch. 8, page 8-85).

[33] BDCP proponents expect this "Second Water Bond" to be passed by the voters of California approximately 15 years into the permit term. (BDCP, Sec. 8.3.5.1, page 8-85, lines 3-6.)

[34] BDCP, Sec. 8.3.4.4, page 8-81, lines 5-22.

standards; a major regulatory action that will likely not be taken until after the BDCP is approved under the current time-schedule.[35]

All of these issues, whether taken together or individually, raise serious questions about the long-term financial assurances required under federal and state law for an approvable HCP/NCCP.

5. The BDCP implementation structure and process is inadequate and inappropriately devolves excessive authority to the Water Contractors in making decisions that will impact San Francisco Bay.

The very nature of the permits to be granted under the BDCP underscores the importance of long-term, substantive input of "downstream" stakeholders into the future implementation of the BDCP itself. Indeed, the permits to be issued by the federal and state agencies to those in the Authorized Entity Group will last for 50 years. Further, under the "No Surprises Rule," the permittees cannot be held responsible for continued species decline. According to the No Surprises Rule:

> "Once an HCP permit has been issued and its terms and conditions are being fully complied with, the permittee may remain secure regarding the agreed upon cost of conservation and mitigation. If the status of a species addressed under an HCP unexpectedly worsens because of unforeseen circumstances, the primary obligation for implementing additional conservation measures would be the responsibility of the Federal government, other government agencies, and other non-Federal landowners who have not yet developed an HCP."[36]

As a result, the process of "who" and "how" changed circumstances are identified, as well as what future "adaptive management" actions should be taken to address them, is vitally important to interests located, living, or working in or downstream of the Delta region. Further, what is deemed to be "unforeseen circumstances" is equally important to downstream stakeholders because, under the "No Surprises Rule," responsibility for addressing future Delta decline due to "unforeseen circumstances" will likely fall on those Delta or downstream stakeholders, or on the People of the State of California.

PSSEP requests the Lead Agencies to address the following examples of the BDCP's inadequate implementation structure:

- *Section 6.4.2.1: Process to Identify Changed Circumstances*. Under the BDCP, the Implementation Office or the Permit Oversight Group "may identify the onset of a

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[35] *See*, "*The High Price of Water Supply Reliability: California's Bay Delta Conservation Plan Would Require Significant Investment*," S&P Capital IQ, McGraw-Hill Financial, February 13, 2014.

[36] *See,* 50 C.F.R. Part 222; *see also*, 63 Federal Register 8867 (February 23, 1998).

changed circumstance, using information obtained from system-wide or effectiveness monitoring, scientific study, or information provided by other sources."[37] Glaringly absent from this process of identifying "changed circumstances" (which, in turn, requires the Authorized Entities Group to make changes to applicable Conservation Measures identified in the BDCP) is any substantive role for the State Water Resources Control Board and the Delta Watermaster. Each of these independent state agency/offices have very important and discreet roles with regard to policies, regulations, permits, and other actions affecting the Delta, and they should both be given more substantive roles during the 50-year, "No Surprises" permit that the Authorized Entity Group will receive.

- *Section 6.4.2.2: Changed Circumstances Related to the BDCP*. This section summarizes nine identified categories of "changed circumstances related to the BDCP," including: levee failures, flooding, new species listing, drought, wildfire, toxic or hazardous spills, nonnative invasive species or disease, climate change, and vandalism.[38] Specifically absent from these nine "anticipated" changed circumstances are non-ESA and CESA regulatory changes, changes to the "Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary" (Bay-Delta Plan), and even water availability decline, except as superficially treated in the "Drought" section.

It is unfathomable to think that changes to the Bay-Delta Plan by the State Water Board are not "reasonably anticipated" by the Authorized Entity Group and the Permit Oversight Group. Indeed, the State Water Board has been working on planned amendments to the Bay-Delta Plan for at least the past eight years to address various issues and known stressors to the Delta ecosystem. According to the State Water Board website:

> "The State Water Board is in the process of developing and implementing updates to the Bay-Delta Water Quality Control Plan (Bay-Delta Plan) and flow objectives for priority tributaries to the Delta to protect beneficial uses in the Bay-Delta watershed. Phase 1 of this work involves updating San Joaquin River flow and southern Delta water quality requirements included in the Bay-Delta Plan. Phase 2 involves other comprehensive changes to the Bay-Delta Plan to protect beneficial uses not addressed in Phase 1. Phase 3 involves changes to water rights and other measures to implement changes to the Bay-Delta Plan from Phases 1 and 2. Phase 4 involves developing and implementing flow objectives for priority Delta tributaries outside of the Bay-Delta Plan updates."[39]

Many dozens of entities that are members of the State Water Contractors or the Federal Water Contractors (and thus part of the Authorized Entities under BDCP) have participated in or been represented at public workshops, hearings, and State Water Board meetings regarding various elements of the Bay-Delta Plan revisions. They, more than

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[37] BDCP, Ch. 6, page 6-31, lines 24-25.

[38] BDCP, Sec. 6.4.2.2, pages 6-32 through 6-45.

[39] http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/

most, are intimately aware of the work that the State Water Board is doing on the Bay-Delta Plan revisions, and they should be able to "reasonably anticipate" changes that will likely affect salinity limits, flow standards, and potential water rights changes.

- *Section 6.4.3. Unforeseen Circumstances:* "Unforeseen circumstances" are defined in the BDCP as "those changes in circumstances that affect a species or geographic area covered by an HCP that could not reasonably have been anticipated by the plan participants during the development of the conservation plan, and that result in a substantial and adverse change in the status of a covered species."[40] The significance of whether changed circumstances affecting Delta species or the geographic area covered by the BDCP are deemed to be "unforeseen" is that the Permit Oversight Group "may not require the commitment of additional land or financial compensation, or additional restrictions on the use of land, water, or other natural resources other than those agreed to in the plan, unless the Authorized Entities consent."[41] Stated alternatively, if any "unforeseen circumstances" arise and require additional commitments of land or water to enhance species survival, none of the Authorized Entities would be required to pay for it. As such, individuals and entities located, living or working in, or downstream of the Delta will likely be left holding the bag.

- *Section 6.4.4. BDCP Relationship to Significant Future Projects or Government Regulations:* Section 6.4.4 acknowledges that the State Water Board is developing new Delta flow standards which will likely affect the Delta, but then oddly concludes that such action "may affect the conservation strategy [of the BDCP] in ways that cannot be predicted."[42] Given all of the various models run on expected salinity levels, mercury loading, temperature variation, selenium loading and expected climate change impacts to BDCP Conservation Measures, it seems dubious – at best – to conclude that impacts associated with anticipated Delta flow standards "cannot be predicted." Indeed, the Authorized Entities are certainly aware of the State Water Board's August 3, 2010 report, "Development of Flow Criteria for the Sacramento-San Joaquin Delta Ecosystem," wherein various potential reductions in allowable water exports from the Delta were analyzed and recommended. Certainly, the BDCP could easily (and thus, should) include various modeling scenarios to account for reduced water exports equal to 20, 30, 40 or 50 percent, and develop appropriate Conservation Measures to account for these potentialities.

- *Section 6.5. Changes to the Plan or Permits*: Section 6.5 describes the processes that are to be followed to change the BDCP or permits issued thereunder. These changes are referred to as "administrative changes," "minor modifications or revisions," and "formal amendments" to the BDCP. "Minor modifications or revisions" are further defined to include, without limitation, "Adaptive management changes to conservation measures or biological objectives, including actions to avoid, minimize, and mitigate impacts, or modifications to habitat management strategies developed through and consistent with the adaptive management and monitoring program described in Chapter 3, Conservation

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[40] BDCP, Sec. 6.4.3, page 6-45, lines 15-22.

[41] BDCP, Ch. 6.4.3, page 6-45, lines 20-22.

[42] BDCP, Sec. 6.4.4, page 6-46, lines 21-25.

Strategy."[43] Read in conjunction with Section 3.6, relative to changing Conservation Measures or biological objectives under the adaptive management process, it is clear that the Authorized Entities have no intention of re-submitting substantive BDCP changes to the Delta Stewardship Council for Delta Plan concurrence.

Under the Sacramento-San Joaquin Delta Reform Act of 2009, the Legislature created the Delta Stewardship Council, an independent agency of the state charged with developing an over-arching "Delta Plan" to implement the "co-equal goals" of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. There is little question that the 2009 Delta Legislation envisioned a significant role for the Delta Stewardship Council as the BDCP was being developed and during its implementation. In fact, the 2009 Delta Legislation provides that the BDCP can be "considered" for inclusion within the Delta Plan, but specifically prohibits inclusion of the BDCP into the Delta Plan unless the Council finds that the BDCP meets nine, legislatively-established conditions. Some of these conditions relate to obligations under the Natural Community Conservation Planning Act, which in turn, include the development and implementation of Conservation Measures intended to restore the imperiled Delta ecosystem. However, there is no provision within BDCP that requires any substantive changes to the Plan to be re-submitted to the Delta Stewardship Council for confirmation that it is consistent with the Delta Plan, and thereafter re-incorporated within the Delta Plan.

6. *The BDCP should include the State Water Resources Control Board and the Delta Watermaster within the governing and implementing agency hierarchy.*

As currently contemplated, the BDCP provides no formal role for either the State Water Board or the Delta Watermaster in any substantive governance or oversight entity. Yet, as previously noted, the State Water Board will be setting new Delta flow standards in the coming few years, and will be responsible for ongoing regulatory actions (*e.g.,* revised flow standards in the future, water quality plan for the Delta, water rights permitting and enforcement) which are likely to affect BDCP actions over the course of the 50-year permit expected to be issued for the Project. Similarly, the Delta Watermaster – created by the Delta Reform Act – has important authority to enforce the State Water Board's regulatory decisions affecting the Delta, and should also be part of any BDCP oversight entity.

In essence, the governance structure of BDCP is being created by water exporter interests, gives decision making authority to water exporter interests, and grants dispute resolution authority to water exporter interests. There must be a more balanced approach to governance that does not exclude local authorities. Furthermore, for governance actions that could affect interests of stakeholders in San Francisco and San Pablo Bays, there

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[43] BDCP, Sec. 6.5.2, page 6-49, lines 8-11.

needs to be a mechanism to allow these stakeholders' interests to be more substantively represented in the BDCP decision-making process.[44]

7. The BDCP fails to comply with the Delta Reform Act of 2009.

The Delta Reform Act provides that the BDCP will not be incorporated into the Delta Stewardship Council's "Delta Plan" if it does not meet specific minimum requirements.[45] The EIR/EIS fails to adequately address specific requirements of the Delta Reform Act in the following major areas:

- The EIR/EIS is to provide a comprehensive analysis of a reasonable range of flow criteria, rates of diversion, and other operational criteria. This range is to include flows necessary for recovering the Delta and restoring fisheries under a reasonable range of hydrologic conditions. This range is to include the flow criteria developed by the SWRCB in August 2010 which identified flow conditions and operational requirements to provide fishery protection under the existing Delta configuration.

- Using the above information, the EIR/EIS is to identify the remaining water available for export and other beneficial uses.

- As discussed above, the Delta Reform Act prohibits construction of a new Delta conveyance facility until arrangements have been made to pay for the cost of mitigation required for construction, operation and maintenance of any new Delta conveyance facility.[46] Accordingly, the mitigation measures need to be clearly specified and linkages to impacts of the proposed project should be plainly identified so that the financial obligations are apparent.

The EIR/EIS either fails to include or fails to clearly address these major requirements of the Delta Reform Act. Therefore, the BDCP cannot be incorporated into the Delta Plan unless these flaws are remedied.

Additionally, the Delta Plan requires that actions be taken to reduce reliance on the Delta as a water supply. CEQA requires that the EIR/EIS give proper consideration to measures that would reduce reliance on the Delta, including improved water use efficiency, increased storage, and local water supply projects (e.g. desalination). These measures

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[44] Indeed, a review of the various NCCPs adopted and in the planning stages throughout California reveal that the vast majority of these plans are either lead by or include affected county and local governments or special districts within their governance structure. (*See*, https://www.dfg.ca.gov/habcon/nccp/status/index.html.) If adopted, the BDCP would be unusual in California in that it would enable parties not located within the affected geographical area of the NCCP to literally control most (if not all) of the day-to-day operations and decision-making relative to the NCCP.

[45] California Water Code Section 85320(b).

[46] California Water Code §85089(a).

should be addressed either as an alternative to the proposed plan or as proposed mitigation measures to address significant impacts of the proposed project. The EIR/EIS fails to consider or properly address these measures as alternatives to the proposed project.

In sum, PSSEP maintains the BDCP and the supporting EIR/EIS are seriously flawed with respect to potential long-term impacts related to selenium loading to San Francisco and San Pablo Bays. Our members respectfully request that these flaws be corrected, and that adequate financial commitments are made by the BDCP proponents to carry out adequate long-term monitoring of future selenium loading to San Francisco and San Pablo Bays that are directly or indirectly attributable to BDCP actions. Further, we request that the BDCP proponents provide adequate financial assurances that future "adaptive management" actions will be taken to address the impacts of expected selenium loading of San Francisco and San Pablo Bays which, we believe, a robust Bay-Delta selenium monitoring program will confirm.

Sincerely,

Craig S.J. Johns
Program Manager

Attachments Included:

1. "Modeling Fate, Transport, and Biological Uptake of Selenium in North San Francisco Bay", L. Chen, Meseck, Roy, Grieb, and Baginska; Estuaries & Coasts, November 2012.
2. BDCP EIR/EIS, Ch. 1, Figure 1-4. (ICF, November 2013)
3. "Review of Selenium Bioaccumulation Assessment in the Bay Delta Conservation Program Draft EIR/EIS," TetraTech, May 30, 2014.

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Modeling Fate, Transport, and Biological Uptake of Selenium in North San Francisco Bay

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Abstract Selenium behavior in North San Francisco Bay, the largest estuary on the US Pacific coast, is simulated using a numerical model. This work builds upon a previously published application for simulating selenium in the bay and considers point and non-point sources, transport and mixing of selenium, transformations between different species of selenium, and biological uptake by phytoplankton, bivalves, and higher organisms. An evaluation of the calibrated model suggests that it is able to represent salinity, suspended material, and chlorophyll *a* under different flow conditions beyond the calibration period, through comparison against long-term data, and the distribution of different species of dissolved and particulate selenium. Model-calculated selenium concentrations in bivalves compared well to a long-term dataset, capturing the annual and seasonal variations over a 15-year period. In particular, the observed lower bivalve concentrations in the wet flow periods, corresponding to lower average particulate selenium concentrations in the bay, are well represented by the model, demonstrating the role of loading and hydrology in affecting clam concentrations. Simulated selenium concentrations in higher organisms including white sturgeon and greater scaup also compared well to the observed data in the bay. Finally, a simulation of changing riverine inflows into the bay that might occur as a consequence of proposed hydrologic modifications indicated significant increases in dissolved and particulate selenium concentrations in the bay. The modeling framework allows an examination of the relationship between selenium loads, variations in inflow, in-bay concentrations, and biota concentrations to support management for limiting wildlife impacts.

Keywords Bioaccumulation · Selenium speciation · TMDL · Estuarine modeling · ECoS

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Introduction

Selenium is a limiting nutrient to aquatic organisms at low concentrations; however, it becomes toxic when concentrations are elevated (Harrison et al. 1988; Lauchli 1993; Lemly 1996). The element is toxic to fish and birds due to its adverse impacts on the reproductive system (Lemly 1985; Presser and Luoma 2006). Selenium can substitute for sulfur in the structure of proteins and therefore causes deformities in embryos or inhibition of the hatchability of eggs (Skorupa 1998). Under the Clean Water Act of the USA, North San Francisco Bay (NSFB) is listed as being impaired for selenium, due to high concentrations observed in fish tissues (particularly in white sturgeon, *Acipenser transmontanus*, up to 50 μg/g dry weight) and diving ducks (such as greater scaup, *Aythya marila* up to 35 μg/g dry weight in muscle tissues) (White et al. 1988, 1989; Urquhart et al. 1991; SFEI 2006). NSFB is an important water body for the study of selenium biogeochemistry and ecotoxicology, because it is the largest estuary on the Pacific coast of

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the USA and receives significant selenium loadings from sources that are directly related to human activity: it is downstream of irrigated selenium-bearing soils of the semi-arid San Joaquin Valley (representing 7 % of total US agricultural production and four of the top five agriculturally productive counties in the US), and it receives selenium discharged from five major oil refineries (which together constitute 5.6 % of the total refining capacity of the USA; based on data from the US Census of Agriculture 2007; California Energy Commission 2012). Selenium has been a contaminant of interest in this region since the discovery of deformed waterfowl in the Kesterson Wildlife Refuge in San Joaquin Valley, which received most of its water from agricultural drainage (Ohlendorf et al. 1988).

Selenium is present in the aquatic environment in several different forms (Cutter 1992). Dissolved forms of selenium include inorganic selenite ($SeO_3^{2-}+HSeO_3^{-}$), selenate (SeO_4^{2-}), and organic selenides. The particulate forms include elemental selenium, organic selenides, and selenite and selenate adsorbed on particles. Selenium in biogenic particles is principally composed of organic selenide (Cutter and Bruland 1984) with each species being subject to different transformations and biological uptake (Suzuki et al. 1979; Measures et al. 1980; Cutter and Bruland 1984). Particulate organic selenides can decompose and release dissolved organic selenides at relatively fast rates (>0.2/day, Cutter 1982). Organic selenides can be oxidized to selenite and further to selenate and this has been described using pseudo-first-order reactions (Cutter and Bruland 1984). The oxidation of organic selenides to selenite can occur on the order of days, while oxidation from selenite to selenate can take years (Cutter 1992; Meseck and Cutter 2006).

Dissolved forms of selenium can be taken up by phytoplankton and bacterioplankton communities. The uptake of dissolved selenium by these organisms is a key step in selenium entering the food web (Luoma et al. 1992; Wang et al. 1996). The bioavailability of dissolved selenium differs by chemical form, with selenite and organic selenides being taken up more rapidly than selenate (Riedel et al. 1996). Despite low selenium concentrations in the water column, certain species of phytoplankton can concentrate selenium to relatively high concentrations (Baines and Fisher 2001; Doblin et al. 2006). Organic selenides in cells can be released into the environment through excretion, cell lysis, or grazing (Cutter 1982).

The uptake of selenium by invertebrates is mainly through the ingestion of particulates (Luoma et al. 1992; Sanders and Gilmour 1994; Wang and Fisher 1996), especially particulate organic selenides which are more easily assimilated by invertebrates. Measured assimilation efficiencies for elemental selenium range from 2 to 28 % (Schlekat et al. 2000), while assimilation efficiencies for organic selenium range from 53 to 89 % (Schlekat et al. 2002). As with phytoplankton, the accumulation of particulate selenium in invertebrates and zooplankton differs by species. Certain species of invertebrates (e.g., the clam *Corbula amurensis* that is abundant in NSFB) are able to accumulate selenium to relatively high concentrations due to high food ingestion rates and slow excretion (Stewart et al. 2004), resulting in relatively high selenium concentrations in the benthic food web.

Sources of selenium to the NSFB include riverine inputs from the Sacramento and San Joaquin Rivers, tributaries surrounding the NSFB, discharge from refineries, and municipal and industrial wastewater treatment plant discharges. The NSFB water column is characterized by low selenium concentrations (~0.2 μg/L); however, bioaccumulation by *C. amurensis*, may be a pathway leading to high selenium in certain benthic-feeding fish and birds.

The San Francisco Bay Regional Water Quality Control Board is in the process of developing a selenium total maximum daily load (TMDL) for NSFB to address this impairment. Under the Clean Water Act, a TMDL is required when a water body is listed as impaired due to one or more contaminants and sets in motion a process to manage and control the impairment. To effectively address impairment, TMDLs need tools, often in the form of numerical models, to represent the linkage between sources of contamination and biological endpoints, including concentrations in the tissues of target organisms. The objective of the present study is to develop a model representing the transport, fate, and uptake of selenium in the benthic food web of NSFB, focusing on phytoplankton, clams, and fish and bird species that consume these clams. The model is calibrated using the best available data on hydrology, selenium loading from the major rivers, petroleum refineries, municipal wastewater treatment plants, and other industrial sources and selenium speciation in different compartments as reported in monitoring programs and the scientific literature over the last two decades.

The modeling framework builds on a previous study of selenium biogeochemistry in NSFB (Meseck and Cutter 2006), developed using an estuary modeling framework (ECoS3) (Harris and Gorley 1998). The previous study was modified for the TMDL by: (1) using more recent selenium loads from five major refineries and principal riverine sources, Sacramento and San Joaquin Rivers, (2) adding selenium loads from smaller, local tributaries, and all municipal and industrial dischargers with discharge permits; (3) modification of the model to consider particulate selenium, total suspended material (TSM), and phytoplankton inputs from the San Joaquin River; (4) changing the riverine boundary conditions of TSM, chlorophyll *a* and different species of particulate selenium to time-varying inputs; and (5) expanding the model to simulate selenium concentrations in biota (clams, fish, and diving ducks). The final change is especially important because the impairment in NSFB is driven by concentrations in biota. The above changes necessitated a recalibration and extension of the Meseck and Cutter (2006) model, as detailed in the following section while retaining the basic setup of the original work. The updated model was recalibrated for the 1999–2000 water years, and then used to simulate long-term selenium dynamics in NSFB for the period of 1999–2008. Through this development and integration process, the key research questions to be answered are: can we describe the speciation of selenium in the waters of NSFB under different flow and loading conditions, the changing seasonal and long-term concentrations of selenium in the clam *C. amurensis*, monitored at a regular frequency as a sentinel species in the bay over 1995–2010, and concentration patterns in other predator species that consume *C. amurensis*? A reasonable representation of these observations lends credibility to the use of this modeling framework for management of selenium in NSFB over the coming years during which many changes are possible, including changes in land use, upstream water diversions, sea level rise, and modified freshwater outflows. More generally, the framework for integration of data and mechanistic processes presented here may be applicable to the management of selenium in estuaries receiving inflows from urbanized and developed watersheds, although affected species and food webs may differ.

Methods

ECoS Modeling Framework

ECoS3 is a modeling framework developed by the Center for Coastal and Marine Sciences (Plymouth Marine Laboratory, UK) that can be used to simulate transport and dynamics of dissolved and particulate constituents in a one-dimensional (1-D) or 2-D form for an estuary (Harris and Gorley 1998, 2003). By using a single box or a multiple box approach, the model will simulate salinity, nutrients, TSM, and biological productivity once the shape, geometry, and tidal movement in the estuary are established (Harris and Gorley 1998). ECoS3 considers transport due to advection and dispersion, transformations between species through exchange or reactions, and changes through point or non-point inputs and outputs. ECoS3 has been widely applied to simulate different constituents (e.g., salinity, suspended particles, carbon, nitrogen, nutrients, Zn, and Ni) in estuaries including the Humber Estuary in UK (Harris 2003; Tappin et al. 2003), Tweed Estuary (Punt et al. 2003; Uncles et al. 2003), and Tamar Estuary (Liu et al. 1998). Meseck and Cutter (2006) used ECoS3 to focus on simulating transport and biogeochemistry of selenium in 1-D form in the NSFB.

Model Domain and Components

As in Meseck and Cutter (2006), the model was applied starting from the Sacramento River at Rio Vista, extending through NSFB to the Golden Gate Bridge (Fig. 1), with Rio Vista constituting the freshwater boundary, and the Golden Gate Bridge the ocean boundary. The model consists of 33 linked cells, each 3 km wide, representing this domain, with external flows and selenium load inputs at various intermediate locations (Fig. 2). The Sacramento-San Joaquin Delta is not explicitly modeled in this work: Sacramento River flows at Rio Vista are the main freshwater input, with inflows from San Joaquin River added at the confluence 19 km from Rio Vista. Flows at Rio Vista are measured, with the contribution from San Joaquin River estimated as the difference between the Delta outflow and the Rio Vista flow. Tributary flows from 10 local watersheds surrounding NSFB, 5 major refineries, and 23 additional municipal wastewater and industrial point sources were added to the model corresponding to their distance from the head of the estuary at Rio Vista. These sources are identified and their distances from Rio Vista listed in Table 1 in the Electronic supplementary material (ESM).

Meseck and Cutter (2006) used the model to simulated salinity, TSM, phytoplankton, and different species of dissolved and particulate selenium (dissolved selenate, selenite, organic selenide, particulate elemental selenium, particulate organic selenides, and adsorbed selenite and selenate). The modified and recalibrated model presented here simulates these constituents and selenium concentrations in bivalves and higher trophic level organisms (white sturgeon and greater scaup).

As a first step, salinity in the bay is simulated because it represents the advection and dispersion of all dissolved water column constituents in the estuary (Harris and Gorley 1998). Accurate simulation of salinity is an indicator that the advection and dispersion of dissolved species is represented adequately. The simulation of TSM indicates how well the fate and transport of all other constituents associated with particulates in the estuary is simulated. TSM concentrations also affect reactions of selenium with particulates and the distribution of particulate selenium in the estuary. Simulation of phytoplankton greatly affects the fate of selenium, because selenium uptake by phytoplankton is an important first step in subsequent foodweb uptake (Luoma et al. 1992). Loads, transport, and transformations of different species of selenium are important modeling components as bioavailability differs among the different species of selenium. The bioaccumulation of selenium through the foodweb is an important component of this model as it links selenium

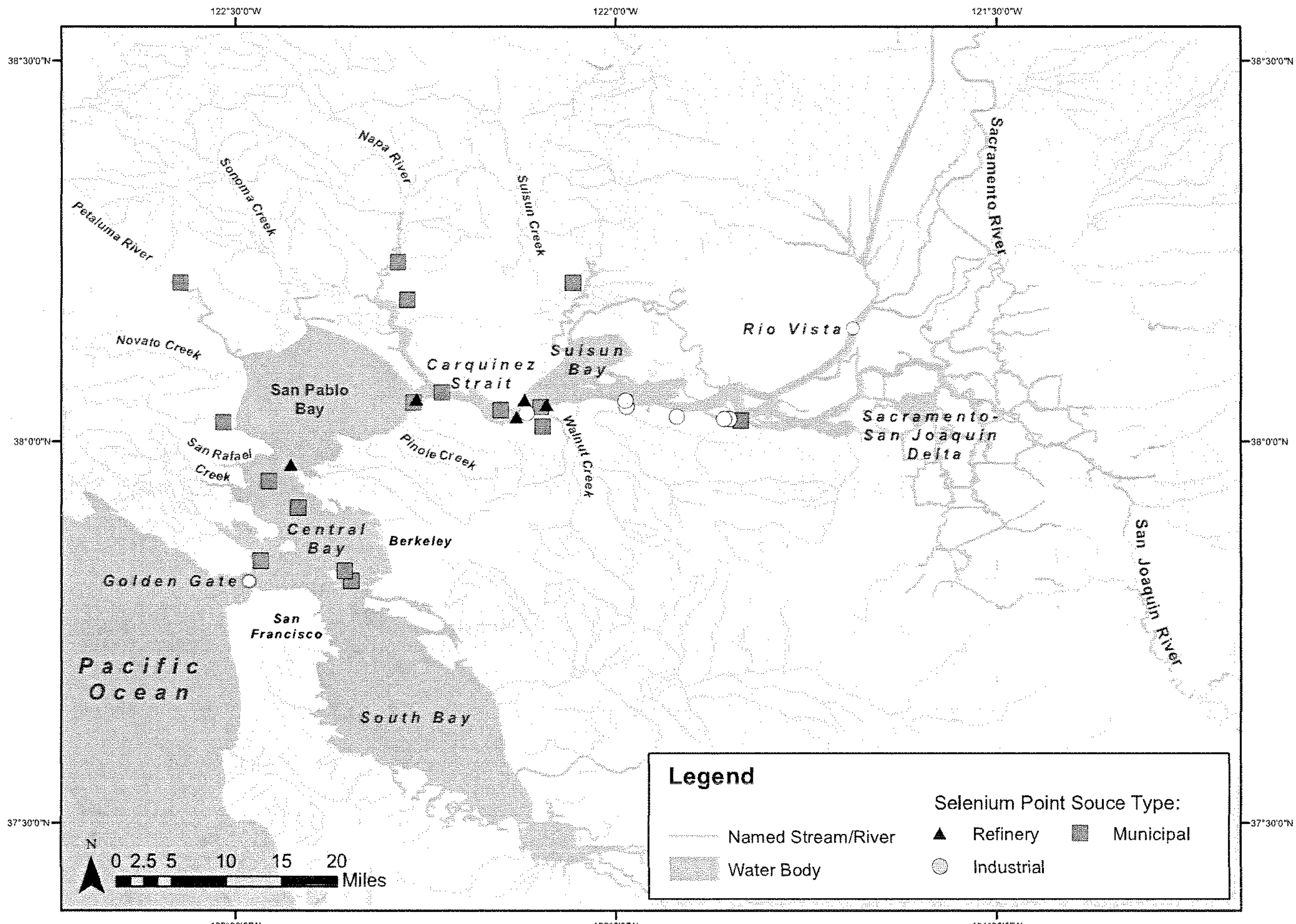

Fig. 1 San Francisco Bay region and surroundings. The model uses Rio Vista on Sacramento River as the starting point of the simulations and spans the region to Golden Gate, following Meseck and Cutter (2006). San Joaquin River inflows are added as a tributary 19 km downstream of Rio Vista. Other tributaries and point sources are also shown and listed in Table 1 in the ESM. The Delta is not explicitly modeled in this application

concentrations in the water column to biota of ecological concern.

To adapt the Meseck and Cutter (2006) model for the present application required some modifications to the loads and model formulation, as outlined here. Refinery loads were updated using daily selenium inputs from five refineries in the NSFB, estimated based on daily flow and weekly concentrations for the period of 1999–2007. These loads were added to model cells based on their discharge locations. In addition, selenium loads from local tributaries to NSFB (i.e., in addition to the major riverine flows through the Delta) were added to the model based on their discharge locations. These loads were not identified in the prior application and may be significant during wet months. Loads from publicly owned treatment works and other point source dischargers in the NSFB were added to the model based on their discharge locations. All sources of selenium are identified in Fig. 1. Besides selenium inputs from the San Joaquin River, TSM loads (with TSM concentrations modeled as a function of flow) and phytoplankton loads (with observed phytoplankton concentrations) from the San Joaquin River were also added to the model. In simulating the TSM, phytoplankton, and particulate selenium, the current model uses observed concentrations as much as possible in defining the riverine boundary conditions.

The transfer of dissolved selenium to particulate selenium through phytoplankton uptake is an important process in its bioaccumulation. Therefore, particulate selenium associated with phytoplankton uptake within the estuary was tracked as a separate constituent and was added to the total particulate selenium. At the boundaries, the input of phytoplankton and all other forms of particulate selenium were estimated separately through calibration. Simulated Se/C ratio in phytoplankton was also tracked by the model and was compared with data observed for species found in the bay. Finally, a dynamic multi-pathway bioaccumulation model

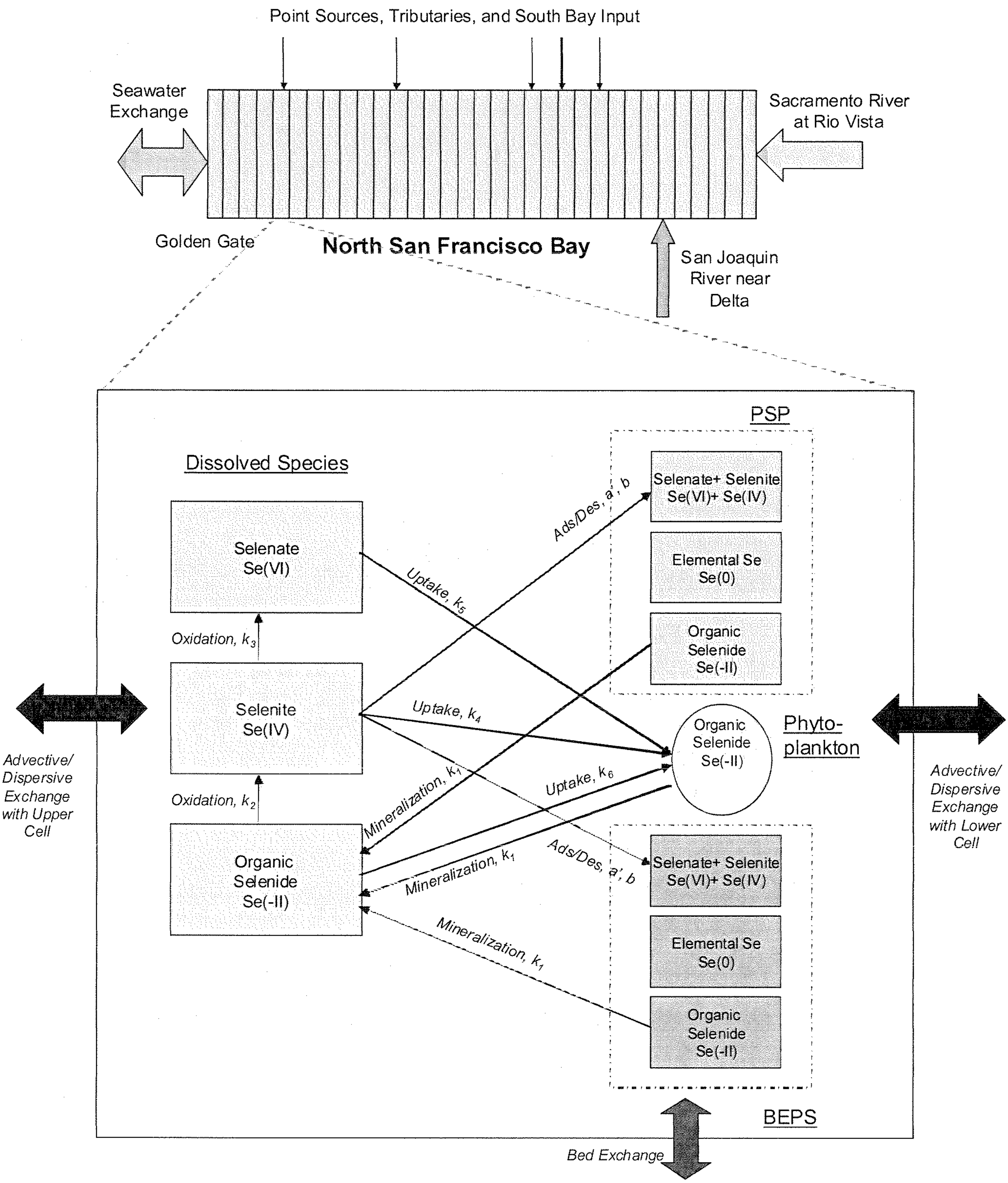

Fig. 2 Schematic of model representation of the NSFB, showing model cells or nodes (*vertical boxes*), boundary conditions, and external loads. Each cell is 3 km wide. The locations of the external loads are illustrative and are added in the model location at the approximate location they enter the estuary

(DYMBAM; Presser and Luoma 2006) was added to predict tissue selenium concentrations in bivalves; previously developed relationships between prey and predator concentrations by Presser and Luoma (2006)

Table 1 DYMBAM model parameters for *Corbula amurensis*

K_u (L g^{-1} day^{-1})	IR (g g^{-1} day^{-1})	AE (%)	K_e (day^{-1})	Growth rate (per day)	Tissue Se concentration (mg/kg)	References
0.003	0.25	45–80	0.025		2.1–12.0	Stewart et al. (2004)
0.009	0.1–1.0	36 (sediment) 54 (algae)	0.023	0.005	3.9–20.0	Lee et al. (2006)

DYMBAM dynamic multi-pathway bioaccumulation model, *AE* assimilation efficiencies

were used to predict bioaccumulation of selenium to the higher trophic levels (bivalves, benthic-feeding fish, and diving ducks).

The above changes entailed a recalibration of the model and evaluation against the most recently available data in NSFB including salinity, TSM, chlorophyll *a*, dissolved and particulate selenium, and selenium concentrations in clams for the period beyond 1999 (US Geological Survey (USGS) monthly cruises in the bay; SFEI 2006; Doblin et al. 2006; Kleckner et al. 2010). The complete modeling framework development, calibration, and application to NSFB are detailed in a report prepared for the TMDL effort (Tetra Tech 2010; available on the Internet at: http://www.swrcb.ca.gov/rwqcb2//water_issues/programs/TMDLs/seleniumtmdl.shtml).

Selenium Transformations Simulated

While in the water column, different species of selenium can undergo biological and chemical transformations, and these transformations were simulated by the model (Cutter 1982; Cutter 1992). Transformations of dissolved selenite simulated by the model include oxidation to selenate, uptake by phytoplankton, and adsorption and desorption from minerals. Transformations of dissolved organic selenide include oxidation to selenite and uptake by phytoplankton. Particulate organic selenides can undergo mineralization to form dissolved organic selenide (Cutter 1982). The exchange of selenium between different compartments simulated by the model is shown schematically in Fig. 2, identifying the different dissolved and particulate species, and the exchanges between them. In this formulation, particulates are tracked as three phases, permanently suspended particulates (PSP), composed of fine material that remains in suspension, bed exchangeable particles (BEPS), composed of larger particles that originate from sediment resuspension, and phytoplankton. The transformations among different species of dissolved and particulate selenium are modeled as a set of first-order reactions, labeled with rate constants from k_1 to k_6, an approach similar to that by Meseck and Cutter (2006). Under oxic conditions, such as those occurring in the waters of the NSFB, the key transformations include oxidation of organic selenide to selenite, and further oxidation of selenite to selenate, as well as uptake of all dissolved species by particulate phases (PSP, BEPS, and phytoplankton). Values of the rate constants were estimated from the literature and are listed in Table 2 in the ESM. These ranges were used as a starting point for the modeling, and where the range was broad, the parameters were adjusted to obtain a best fit to the data from the NSFB. In the work, the rate constants k_1 and k_2 were estimated through calibration, whereas k_3 through k_6 were based on literature estimates. In general, these rate constants indicate that the oxidation of organic selenide is relatively rapid, although oxidation of selenite to selenate is a very slow process. Also, uptake of selenide and selenite onto particulate phases was more rapid than for selenate.

Selenium Bioaccumulation Through the Foodweb

Selenium Uptake by Bacteria and Phytoplankton

Dissolved selenium in the water column can be directly taken up by phytoplankton and bacteria. After uptake, selenium exists in reduced organic forms within algal or bacterial cells or is exuded as dissolved organic selenium to the water column. Organic selenium in algal cells is highly bioavailable to organisms that consume them, such as zooplankton and bivalves (Luoma et al. 1992; Schlekat et al. 2000). Therefore, the uptake of selenium by bacterial and planktonic organisms is important in evaluating selenium bioaccumulation in the foodweb. The uptake of selenium by bacteria and phytoplankton is modeled using first-order reactions.

Selenium Bioaccumulation Through Bivalves

Bioaccumulation of particulate selenium to lower trophic level organisms (e.g., bivalves) is simulated using a DYMBAM (Luoma et al. 1992; Stewart et al. 2004; Presser and Luoma 2006). The model predicts metal concentrations in bivalve tissues using concentrations in food, food ingestion rate, metal assimilation efficiency, and elimination rate.

The dynamic form of the DYMBAM model is as follows:

$$\frac{dC_{mss}}{dt} = k_u \times C_w + AE \times IR \times C_f - k_e \times C_{mss} \quad (1)$$

where C_{mss} is selenium concentration in tissue (in micrograms per gram), k_u is the dissolved metal uptake rate constant (in liters per gram per day), C_w is the dissolved metal concentrations in water (in micrograms per liter), AE is the assimilation efficiency (in percent), IR is the ingestion rate (in grams per gram per day), C_f is the metal concentration in food (e.g., phytoplankton, suspended particulate matter, and sediment; in micrograms per gram), and k_e is the efflux rate (in day^{-1}). Uptake through the waterborne pathway was found to be negligible (Luoma et al. 1992) and not considered. Parameter values in Eq (1) for uptake of selenium by *C. amurensis* are derived from Stewart et al. (2004) and shown in Table 1. Parameters for different metals and different species of organisms have been quantified in previous studies (summarized in Luoma and Rainbow 2005). The filter-feeding organism *C. amurensis* was found to have a higher assimilation efficiency and lower elimination rate, and thus accumulating selenium to higher concentrations than other bivalve species common in the bay, such as *Corbicula fluminea* (Lee et al. 2006; Linville et al. 2002). Bioaccumulation into bivalves considers different efficiencies of absorption for different selenium species (Table 2). Assimilation efficiencies (AE) measured by Schlekat et al. (2002) for organic selenide are in a relatively narrow range for different species of algae and are generally high (53–89 %). AE for elemental selenium are generally low (2–28 %), with biogenic particulate elemental selenium showing higher AE. In developing model predictions in this work, an AE of 0.2 or 20 % was used for particulate elemental selenium, an AE of 45 % was used for particulate adsorbed selenite+selenate, and an AE of 80 % was used for particulate organic selenium (Fig. 3).

A range of ingestion rates has also been estimated for *C. amurensis* by Lee et al. (2006) and covers a wide range from 0.1 to 1.0 gg^{-1} day^{-1} (Table 1). The ranges in assimilation efficiency and ingestion rates were used to forecast the range of selenium concentrations in bivalves. The predicted selenium concentrations in bivalves were compared with observed data by Stewart et al. (2004). In forecasting the long-term selenium concentrations in bivalves, an ingestion rate of 0.65 gg^{-1} day^{-1} (roughly the midpoint value) was used in model predictions.

Selenium Bioaccumulation to Higher Trophic Levels (Fish and Diving Ducks)

A ratio between selenium concentrations in the tissues and diet of organisms, the trophic transfer factor (TTF) can be used in estimating bioaccumulation of selenium through the food web, once dietary concentrations are known (Presser and Luoma 2010). The ratio can be derived based on kinetic uptake rates or observed concentrations of diet and tissue. For example, the TTF for invertebrates can be derived as: TTF=(AE)(IR)/k_e, where AE is the assimilation efficiency; IR is the ingestion rate, and k_e is the elimination rate. The TTFs are a relatively simple and effective way to incorporate the complex processes of biological uptake from bivalves (e.g., clams) to predator species (e.g., sturgeon and scaup) in this model. The significance of clams in the diet of these species has been reported previously (Stewart et al. 2004). TTFs for fish have been found to vary over a relatively narrow range across species and habitats, based on an examination of data from 29 field studies (Presser and Luoma 2010). For several fish species studied the TTFs for selenium range from 0.52 to 1.6 (Presser and Luoma 2010), and a value of 1.3 was reported for white sturgeon. A TTF of 1.8 has been reported for bird egg concentrations in mallards (Presser and Luoma 2010).

Table 2 Literature values of assimilation efficiencies (AE) for different selenium species for *Corbula amurensis*

Species	AE	Origin	References
Se(0)[a]	2 %	AA—reduction of SeO_3^{2-} to Se(0) through ascorbic acid (AA)	Schlekat et al. (2000)
Se(0)	7±1 %	SES— reduction of SeO_3^{2-} to Se(0) through pure bacteria culture (SES)	Schlekat et al. (2000)
Se(0)	28± 15 %	SED—reduction of SeO_3^{2-} to Se(0) through sediment microbial consortium (SED), biogenic origin	Schlekat et al. (2000)
Selenoanions	11 %	Reoxidized sediment slurries	Schlekat et al. (2000)
Organoselenium	53 %	Ph. Tricornutum	Schlekat et al. (2000)
Cryptomonas sp.	88.9 %	Algae cells	Schlekat et al. (2002)
Gymnodinium sanguinem	82.6 %	Algae cells	Schlekat et al. (2002)
Phaeodactylum tricornutum	80 %	Algae cells	Schlekat et al. (2002)
Synechococcus sp.	78.3 %	Algae cells	Schlekat et al. (2002)
Thalassiosira pseudonana	87.3 %	Algae cells	Schlekat et al. (2002)
Sediment	36 %	Fresh water stream, San Jose, CA	Lee et al. (2006)
Algae (mixed with sediment)	54 %	Diatan, *P. tricornutum*	Lee et al. (2006)

[a]This form of elemental selenium does not occur in nature and was synthesized in the laboratory

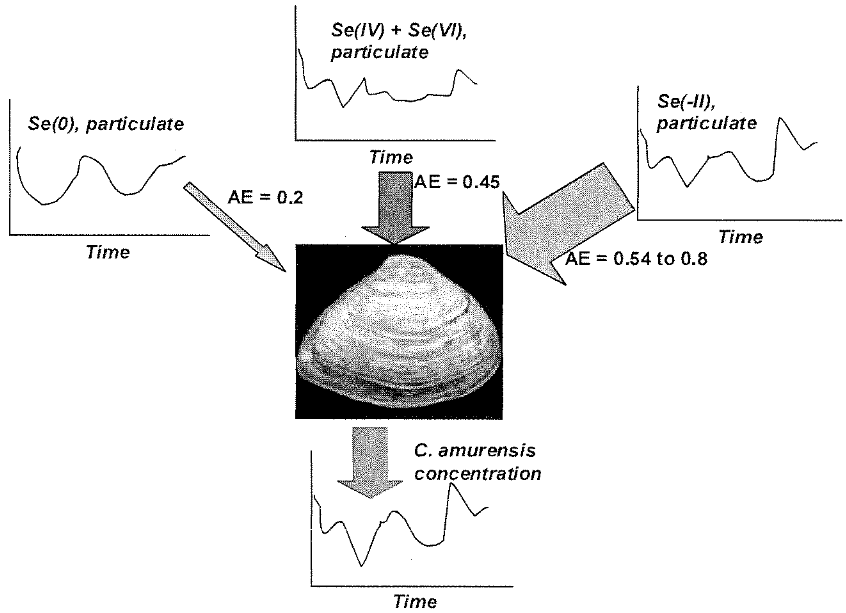

Fig. 3 Bioaccumulation of particulate selenium in bivalves

Model Boundary Conditions and External Loads

Riverine Inputs of TSM and Chlorophyll a

Riverine inputs of flow from the Sacramento River at Rio Vista are daily records from the Interagency Ecological Program (IEP 2010) for the period of 1999–2008. The San Joaquin River is modeled as a tributary to the Sacramento River, with flow derived as the difference between Net Delta Outflow Index and flow from the Sacramento River at Rio Vista.

Riverine inputs (Sacramento and San Joaquin Rivers) of TSM and chlorophyll *a* were estimated as flow at the Sacramento River at Rio Vista and San Joaquin River multiplied by concentrations.

The riverine concentrations of TSM were modeled as a function of flow:

$$\mathrm{TSM}_{\mathrm{river}} = a + b * Q_{\mathrm{river}}{}^{c} \quad (2)$$

where a is the minimum concentration in the river water, b and c are calibration coefficients, and Q_{river} is the riverine flow rate.

Riverine chlorophyll *a* concentrations were observed data obtained from the USGS and Bay Delta and Tributary Project (BDAT) for the Sacramento River at Rio Vista for the period of 1999–2008. For the San Joaquin River, BDAT data for San Joaquin River at Twitchell Island were used.

Selenium Loads from Refineries and Municipal and Industrial Wastewater

Selenium loads to the NSFB include point sources from refineries, municipal and industrial dischargers and tributaries. Point and nonpoint sources of selenium were added to the model cells at their corresponding discharge locations (Table 1 in the ESM).

Daily refinery loads over 1999–2007 from five refineries in the NSFB estimated in Tetra Tech (2008) were used in the model calibration. For the refinery effluent data, only total selenium was reported, and for the purpose of the modeling, the speciation was held constant at values reported by Cutter and Cutter (2004): selenite (13 %), organic selenide (30 %), and selenate (57 %). The daily load varied from day to day depending on the effluent data reported and was 558.8 kg/year for 1999 for all five refineries combined.

Daily selenium loads from local tributaries estimated in a previous assessment (Tetra Tech 2008) were added to the model using the annual load for each hydrological area multiplied by a time series scaling factor, derived from daily flow record at Napa River (USGS station 11458000). No selenium speciation data exist for local tributaries. The speciation from local tributaries is assumed to be the same as from the Sacramento River reported by Cutter and Cutter (2004): selenite (9 %), organic selenide (35 %), and selenate (56 %). The total selenium load from tributaries estimated in the model varies depending on the volume of runoff each year and was 819.7 kg/year for 1999.

Selenium loads from other point sources including municipal and industrial wastewater discharges were also added to the model. Speciation for municipal wastewater discharges used is organic selenide (15 %), selenite (25 %), and selenate (60 %). For 1999, the total loads from these sources were 175.8 kg/year.

Riverine Dissolved Selenium Loads

Dissolved selenium loads for selenate, selenite, and organic selenide were specified from the rivers as a product of flow and selenium concentrations by species. Different species of selenium concentrations were derived using fitted functions based on observed data by Cutter and Cutter (2004) at the Sacramento and San Joaquin River stations, similar to the approach used in Meseck and Cutter (2006). A Delta removal constant was used in converting observed selenium concentrations in the San Joaquin River at Vernalis to concentrations at the confluence with Sacramento River. This constant represents exports of San Joaquin River through the aqueducts in the Delta and also the biogeochemical processes of selenium removal within the Delta.

Particulate Selenium Loads

Riverine particulates are assumed to exist in two forms: PSP and BEPS, the latter representing sediment bed-load transport. Riverine particulate selenium inputs are estimated as selenium concentrations associated with PSP and BEPS (both in micrograms per gram), multiplied by riverine inputs of PSP and BEPS (in milligrams per liter). Also added to the particulate loads are the riverine phytoplankton Se loads using a Se/C ratio and chlorophyll *a* concentrations.

Particulate selenium concentrations associated with PSP were measured by Doblin et al. (2006) and showed a range of values. Particulate elemental selenium ranged from 0.08 to 0.40 μg/g (mean, 0.149±0.108 μg/g), particulate selenite and selenate range from nondetectable to 0.25 μg/g (mean, 0.270±0.137 μg/g), and organic selenide concentrations ranged from 0.015 to 0.74 μg/g (mean, 0.134±0.238 μg/g) at Sacramento River at Rio Vista (Doblin et al. 2006). Particulate selenium concentrations associated with BEPS are data from Meseck and Cutter (2012). The total particulate selenium at Rio Vista is 0.46 μg/g (the sum of particulate organic, inorganic, and elemental selenium). Higher selenium content on particulates may be expected during low flows (e.g., 0.75 μg/g in November 1999). Therefore, the model was also run using a higher riverine particulate selenium concentration of 0.75 μg/g for a low flow period (river flow, $<1.5\times10^{10}$ l/day) (Table 3). Particulate selenium concentrations at the seawater end of the model domain observed by Doblin et al. (2006) ranged between 0.84 and 1.18 μg/g at Golden Gate Bridge. A seawater end member concentration for each species of particulate selenium was specified corresponding to measured values at Golden Gate.

Model Calibration and Evaluation

Model Calibration

Before the model is used to predict selenium concentrations on particulates and bivalves, it was calibrated for physical parameters (salinity and TSM), phytoplankton, and dissolved and particulate selenium species, using observed general water quality data (from cruises conducted by the USGS, http://sfbay.wr.usgs.gov/access/wqdata/) and selenium speciation data sampled by Cutter and Cutter (2004) for 1999. Calibration for the general water quality parameters was conducted based on data from 19 USGS monitoring stations located in the NSFB and was roughly on monthly intervals from January 1999 to December 1999. The use of the USGS dataset supplements data used in the previous study by Meseck and Cutter (2006), which was mainly based on Cutter and Cutter (2004) data. Selenium speciation data collected during two time periods in 1999 (April and November) by Cutter and Cutter (2004) were used in model calibration for selenium. Water year 1999 was selected for calibration because detailed refinery discharge data and selenium speciation data are available for this year, and selenium loads from refineries decreased by about two thirds in mid-1998 and have stayed at approximately those levels since that time. The 1999 estuary data thus represent conditions following refinery load reductions. Key model calibration parameters are those that affect advection and dispersion of PSP and BEPS, phytoplankton growth rate and grazing rate, selenium transformation rates, and Delta removal constants for selenium inputs from the San Joaquin River.

Model Evaluation Criteria (Goodness of Fit)

The model goodness of fit was evaluated using two measures: the correlation coefficient (r) between predicted and observed values, a goodness of fit defined in Perrin et al. (2001).

$$\mathrm{GOF}(\%) = 100^*\left(1 - \left|\sqrt{\frac{\sum X_{\mathrm{cal}}}{\sum X_{\mathrm{obs}}}} - \sqrt{\frac{\sum X_{\mathrm{obs}}}{\sum X_{\mathrm{cal}}}}\right|\right) \quad (4)$$

where X_{cal} is the model simulated concentration and X_{obs} is the

Table 3 Lower and higher boundary of riverine and seawater endmember concentrations (Doblin et al. 2006; Meseck 2002; Baines et al. 2004)

	Riverine boundary				Seawater boundary
	PSP PSe (μg/g)	BEPS PSe (μg/g)	Se/C in phytoplankton (μg/g)	PSP PSe (μg/g)	Se/C in phytoplankton (μg/g)
Lower boundary	0.46	0.25	15.9	0.84	21.0
Higher boundary (applied when Net Delta Outflow Index, $<1.5\times10^{10}$ l/day)	0.75	0.50	15.9	1.18	21.0

observed concentration. A 100 % goodness of fit indicates a perfect fit between simulated and observed values.

Model Evaluation

The model evaluation was conducted using long-term data available for years after 1999, which include several low and high flow years, for the period of 1999–2008. The calibrated model was evaluated against estuarine profile data collected by USGS for salinity, TSM, and phytoplankton for two specific water years 2001 and 2005, and long-term total selenium data collected by the San Francisco Bay Regional Monitoring Program (RMP) for water year 2001 through water year 2007 (RMP 2010). The RMP dataset reports dissolved and total selenium and does not include characterization of selenium speciation and the separation of dissolved and particulate selenium. The difference between total and dissolved selenium, although in principle an approximation of particulate selenium, is not an accurate representation of particulate selenium, and sometimes negative values may result. Water year 2001 was selected because it was a dry year, with flows much lower than 1999 and water year 2005 was selected because it was a relatively wet year based on the commonly used classification by the California Department of Water Resources (DWR 2010). The evaluation was for both simulations along the length of the estuary and at fixed locations over long-term time periods, for both physical and biological parameters and selenium species concentrations.

Model Hindcast

Model hindcasting is another form of evaluation and provides insight on model's capability to simulate conditions that are different from the calibration period in terms of hydrology and internal selenium loading. The calibrated model was run to hindcast selenium concentrations during two time periods prior to refinery load reductions in 1986 and 1998. To simulate selenium concentrations in 1986 and 1998, river discharges from the Sacramento River at Rio Vista and the San Joaquin River at Jersey Point for 1986 and 1998 were used (obtained from IEP 2010). Selenium loads of different species from the refineries for 1986 and 1998 were based on data from Meseck (2002).

Results

Model Evaluation for the Post-1999 Period

The calibrated model was evaluated against estuarine profile data on salinity, TSM, and phytoplankton for water years 2001 and 2005 collected by USGS, and long-term total selenium data collected by RMP for water year 2001 through water year 2005 (RMP 2010). The water year 2001 represents a dry year, with flows much lower than 1999 and water year 2005 represents a relatively wet year, as noted above.

Evaluation of salinity, TSM, and chlorophyll *a* for the low flow year 2001 suggested good agreement of simulated salinity versus observed values for different months across the year (Figs. 1, 2, and 3 in the ESM). Overall values for goodness of fit for these months are between 71.5 and 97.9 % for salinity, 36.4 and 99.4 % for TSM, and 53.7 and 95.7 % for chlorophyll *a*. The location of the estuarine turbidity maximum (ETM) was simulated well for most months in 2001, particularly for June and July 2001. For about 2 months, chlorophyll *a* concentrations were under-predicted near the Central Bay, similar to the pattern in the calibration. For the evaluation period, the simulated correlation coefficient (r) is 0.92–1.00 for salinity in 2001, 0.68–0.97 for TSM in 2001, and 0.02–0.79 for chlorophyll *a* in 2001.

A similar evaluation of salinity, TSM, and chlorophyll *a* was performed for an above-normal flow year (2005) (Figs. 4, 5, and 6 in the ESM). Salinity predictions showed very good agreement with the observed data (GOF=50.4–99.7 %). The evaluation of TSM for 2005 shows good agreement for the first several months, particularly for January, March, and June 2005. For April and May 2005, the ETM was under-predicted (GOF=48.2–97.7 %). This is similar to the results in the calibration phase where the ETM was under-predicted on some occasions. Chlorophyll *a* predictions were able to represent the average values through the estuary but did not capture the peaks (GOF=25.2–98.5 %).

Simulated TSM and chlorophyll *a* concentrations were also evaluated for longer time periods at fixed locations, using data from the USGS long-term monitoring stations (Figs. 7 and 8 in the ESM). The model-simulated chlorophyll *a* and TSM concentrations were compared with long-term data at four stations, stations 3 (Suisun Bay), 6 (Suisun Bay), 14 (San Pablo Bay), and 18 (Central Bay), respectively. The results suggest that the model is able to capture the seasonal variations in chlorophyll *a* and TSM relatively well.

Although the calibration process for the general water quality parameters was extensive, and generally described key constituents of interest across a range of years, seasons, and loading conditions using a relatively small number of adjustable parameters, several features could not be fully captured by the model. This includes peaks in concentrations for constituents such as TSM and phytoplankton, represented by chlorophyll *a* concentrations. This is likely attributable to the limitations of the 1-D model in capturing the complexities of processes in the NSFB, and also to seasonal changes that were not fully parameterized during calibration.

Comparison of simulated selenium concentrations against the RMP transect sampling data for the period of 2000–2005 suggested that the model simulates profiles of

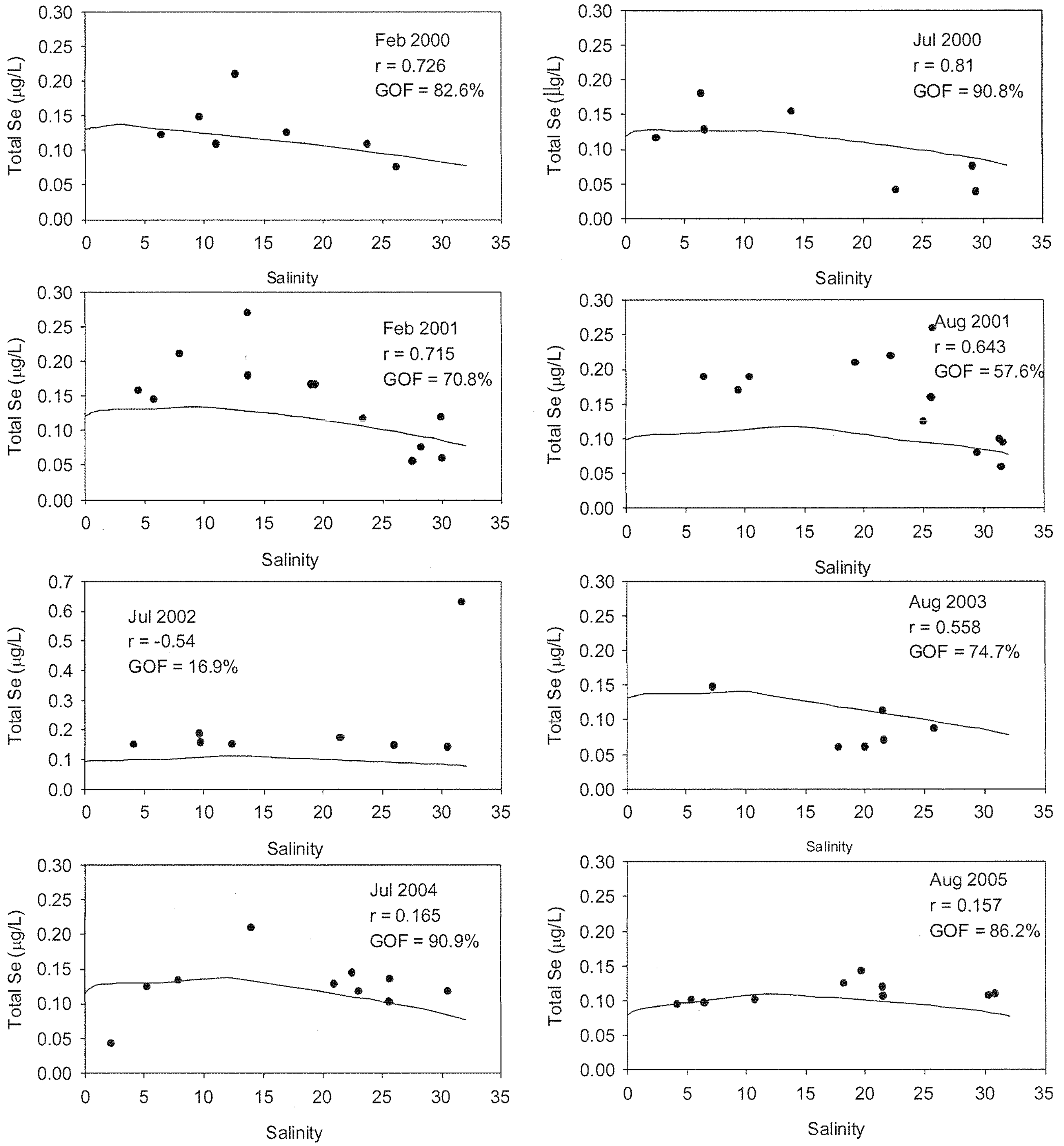

Fig. 4 Model simulated total selenium concentrations (dissolved+particulate) compared with selenium data collected by the San Francisco Bay RMP. Note that the RMP dataset does not report selenium species information, and no selenium speciation data are available for this period in NSFB. RMP data on the Internet at: http://www.sfei.org/rmp/data

selenium concentrations along the estuarine longitude well for a range of hydrological and load input conditions during 2000–2005, including both dry and wet years, and dry and wet season conditions (Fig. 4), and the long-term variations in selenium concentrations at fixed locations (Fig. 5).

Model Hindcast

The model hindcast (prior to refinery selenium load reductions) suggests that the model-simulated salinity, TSM and chlorophyll *a* compared well with the observed values for both high and low

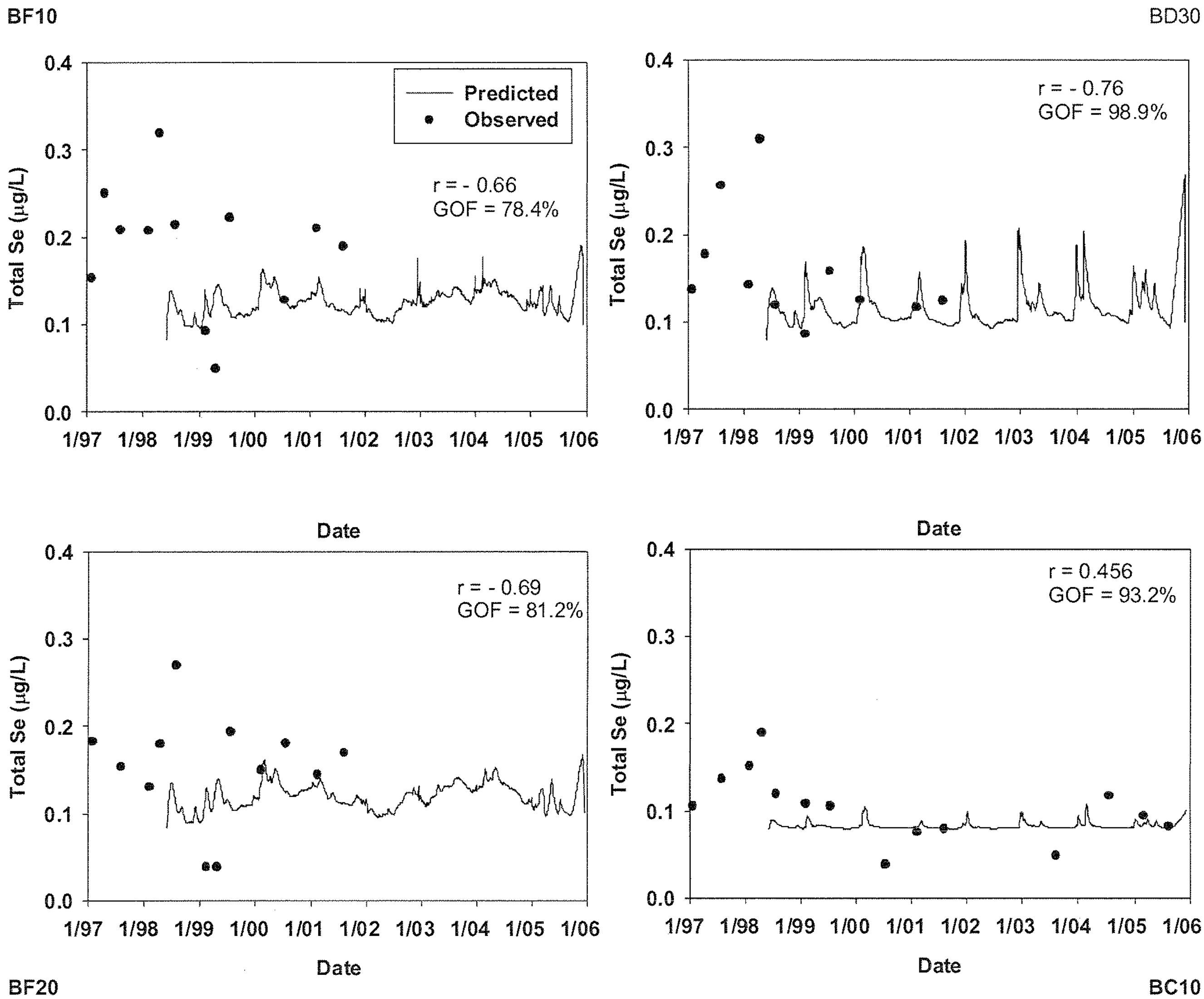

Fig. 5 Model simulated total selenium concentrations at BF10 (Suisun Bay), BF20 (Suisun Bay), BD30 (San Pablo Bay), and at BC10 (Central Bay) compared with observed total selenium by RMP. RMP data on the Internet at: http://www.sfei.org/rmp/data

flow. The model is able to simulate the ETM that occurred during October 1998. The hindcast of dissolved selenium suggests that the model is able to simulate the relatively conservative mixing behavior of selenium during high flow periods and the mid-estuarine peaks during low flow, a result similar to that previously reported in Meseck and Cutter (2006). Simulated selenium concentrations on particulates for the hindcast period compared well with the observed particulate selenium values, and suggested that the model can represent the behavior of selenium on particulates in different periods (Fig. 6).

Simulated Selenium Concentrations on Particulates and Biota

Simulated selenium concentrations on particulate matter (in micrograms per gram) for 11 November 1999 were compared with the observed data from Doblin et al. (2006; Fig. 7). The predicted mean particulate selenium concentrations for NSFB for 11 November 1999 is 0.77±0.35 μg/g, compared with the observed value of 0.735±0.25 μg/g (r=0.45).

Predicted selenium concentrations in *C. amurensis* near Carquinez Strait as a function of time were compared with data from Stewart et al. (2004) and are shown in Fig. 8 for a range of ingestion rates and different assimilation efficiencies of organic selenium used.

Clam selenium concentrations are also available for a longer time period of 1995–2010 from USGS (Kleckner et al. 2010). Simulated clam selenium concentrations at Carquinez Strait for the time period prior to refinery load reductions (1995–1998) and following refinery load reductions (1999–2010) using an ingestion rate of 0.65 gg^{-1} day^{-1} and a seawater particulate selenium boundary of 1.05 μg/g were compared with these data (Fig. 9). The model is generally able to capture the seasonal and long-term patterns in clam selenium concentrations over a period with variability in hydrology and loading. Lower

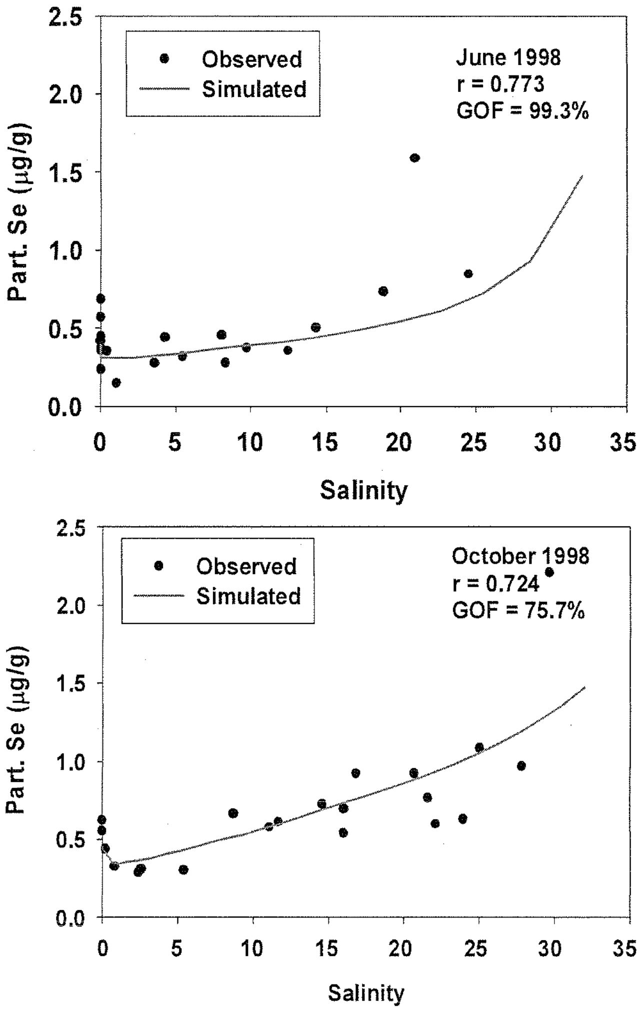

Fig. 6 Model simulated hindcast values of particulate selenium for June and October 1998

selenium concentrations in bivalves are coincident with high flow periods (e.g., April) and wet years (e.g., 2005 and 2006).

Simulated selenium concentrations in muscle and liver tissues of white sturgeon and greater scaup using TTF and regression equations from Presser and Luoma (2006) were compared with observed values in the NSFB (Figs. 10 and 11). White sturgeon sampled from San Francisco Bay-Delta between 1986 and 1990 contained selenium at concentrations ranging from 9 to 30 µg/g dw (mean, 26.55 µg/g) in liver and 7 to 15 µg/g in muscle tissue (mean, 12.57 µg/g; Urquhart and Regalado 1991; White et al. 1988). Lower selenium concentrations in livers of white sturgeon were reported by another study (mean: 9.75 µg/g) between 2002 and 2004 (Linares et al. 2004, cited in Linville 2006). Predicted selenium concentrations in muscle tissue of white sturgeon are 10.7 µg/g using a TTF of 1.3.

Evaluation of Future Management Scenarios

To test the changes in particulate selenium as a result of load changes from the rivers, particularly from the San Joaquin River, the model was run assuming that all the San Joaquin River flow at Vernalis will reach the Bay. This is in contrast with current conditions, where a significant part of the San Joaquin flow is withdrawn from the Delta into aqueducts. Under the elevated flow condition, it was assumed that the residence time of San Joaquin River water in the Delta significantly decreases, and, as a worst-case from the standpoint of selenium loading to NSFB, the Delta removal effect of selenium on San Joaquin River water was considered to be zero. Therefore, the scenario assumes higher inputs of selenium as a result of both increase in flow from the San Joaquin River and the loss of the Delta removal effects on selenium.

Model simulations using San Joaquin River flow at Vernalis were compared with simulation results using normal San Joaquin River flow (base case). Under the base case, flow from the San Joaquin River was estimated as the difference between Delta outflow and flow from the Sacramento River at Rio Vista. Simulated dissolved and particulate selenium concentrations were higher under the scenario of increased San Joaquin River flow than the base case, for both high- and low-flow periods (Fig. 12).

Predicted model-simulated selenium concentrations on particulates (in micrograms per gram) are significantly higher under the scenario of increased San Joaquin River flow, particularly for the upper estuary. Setting the flow of the San Joaquin River to the measured flow at Vernalis, particulate selenium concentrations are nearly doubled with increases greater than 0.4 µg/g predicted in the upper estuary (Fig. 12). These increases may lead to corresponding increases in clam concentrations. The application of this modeling framework to a wider range of loading and flow scenarios is presented in a technical memorandum developed as part of the selenium TMDL process (Tetra Tech 2010).

Discussion

Model Uncertainties

Model calibration involved the selection of the principal transformation rates that pertain to flow, salinity, sediment transport, phytoplankton growth, and selenium chemistry. Many of these were based on values reported in the scientific literature, although about half the parameters were estimated by adjusting values to fit observed data. The model was calibrated to data primarily from 1999, for which detailed selenium speciation data in the estuary were available.

For the simulation period, the model is able to capture key aspects of physical and biological constituents that affect selenium concentrations. The model simulates salinity

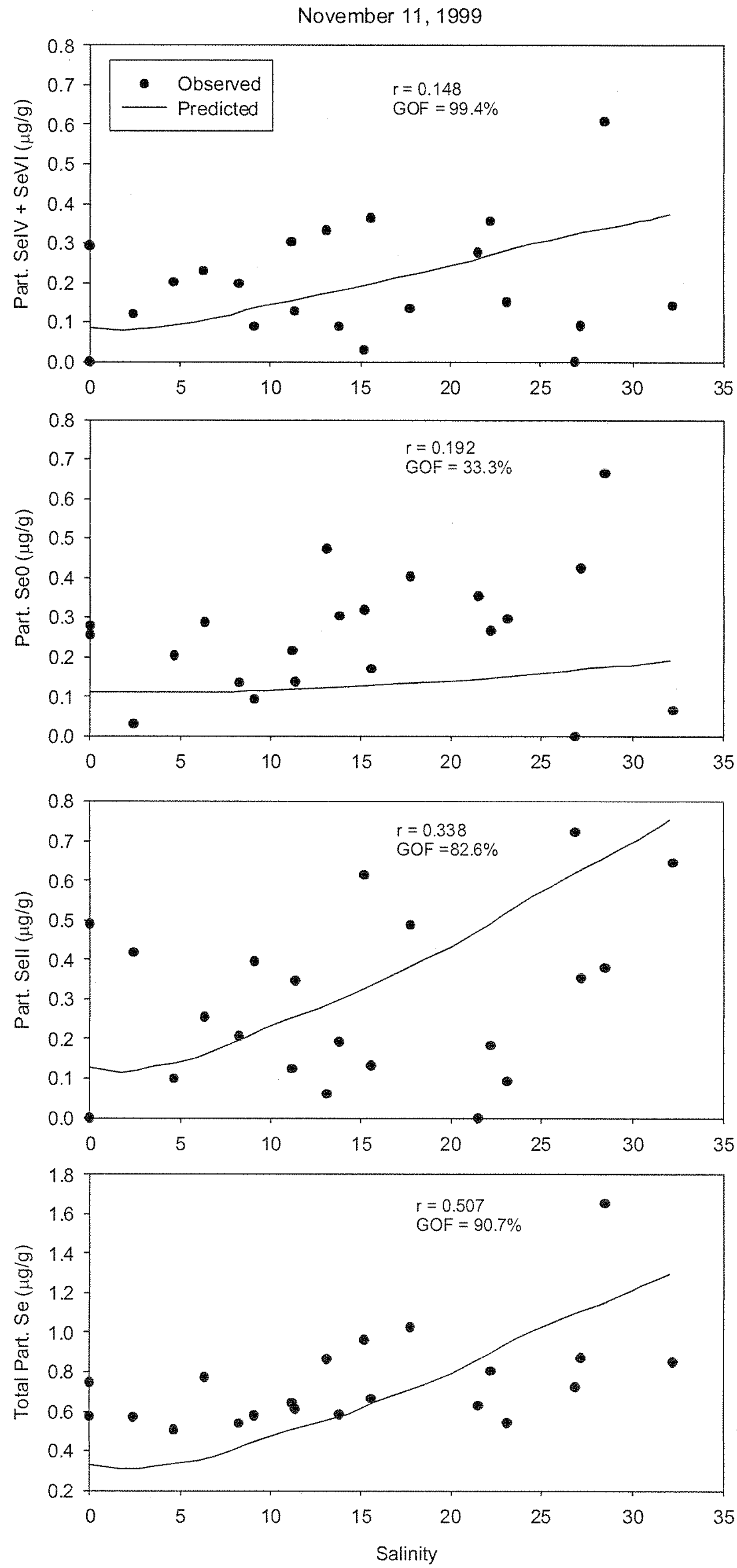

Fig. 7 Simulated particulate selenium compared with the observed data from Doblin et al. (2006) for November 1999

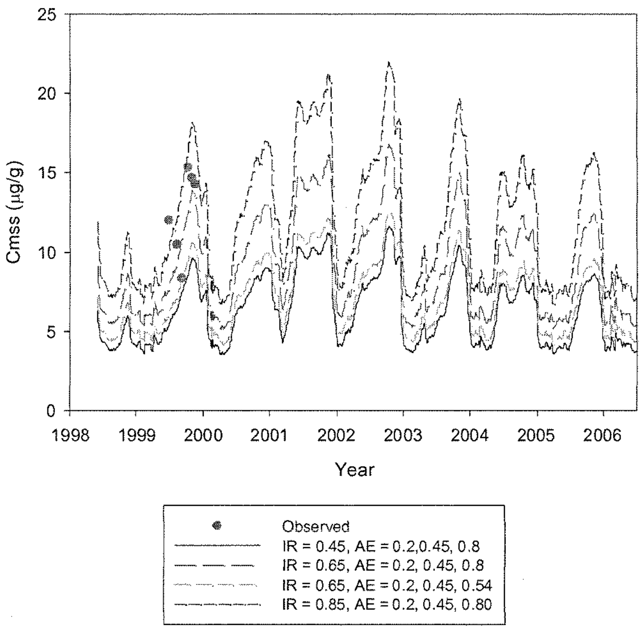

Fig. 8 Simulated selenium concentrations in bivalve *C. amurensis* near the Carquinez Strait compared with observed values from Stewart et al. (2004; station 8.1)

along the estuary well for different hydrological conditions. The evaluation results for phytoplankton and TSM over short-time periods (during specific sampling events for selected years) and long-term periods for multiple years indicated that the model is able to simulate the general temporal and spatial pattern in TSM and phytoplankton, although specific-day peaks may not match very well. For phytoplankton, a few spring blooms are not captured by the model as the model uses a single light limitation function to simulate growth, which limits phytoplankton growth in spring months. Overall, for ancillary parameters, especially TSM and phytoplankton, the model does better at fitting average concentrations than peak concentrations. To some extent this is a consequence of the 1-D formulation of the model, although local variability in driving parameters cannot be ruled out. However, given the hydrodynamic complexities of San Francisco Bay, the inter-annual and seasonal variability in hydrology, this 1-D model produces reasonable results of the ancillary variables for use in computing selenium fate and transport.

The simulated selenium species include dissolved forms such as selenite, selenate and organic selenide and particulate species such as adsorbed selenite and selenate, particulate organic selenide and particulate elemental selenium. The transfer of dissolved selenium to particulate selenium is simulated through kinetic adsorption and phytoplankton uptake and not through equilibrium partitioning. Uptake of selenium by phytoplankton included kinetic uptake of selenite, organic selenide, and selenate, in decreasing order of importance. The uptake rates used in the model simulations are similar to rates used in Meseck and Cutter (2006). During calibration, the model was able to fit the patterns in concentrations of dissolved selenate and selenite well, although it performed less well for dissolved organic selenide. This may be due to the method used for determining dissolved organic selenide (estimated as the difference of total dissolved selenium minus the dissolved selenite+selenate). Therefore the errors and uncertainty in the dissolved organic selenide may be larger. This also may be due to local variations in phytoplankton abundance and species, which may affect uptake of selenium and releases of dissolved organic selenium.

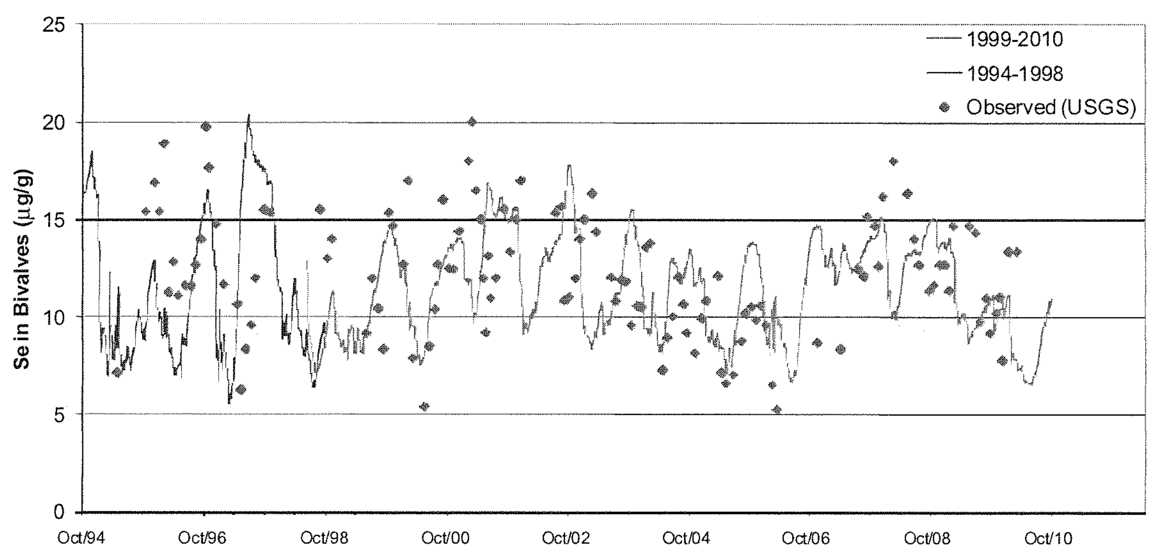

Fig. 9 Simulated selenium concentrations in bivalve *C. amurensis* compared with long-term data from USGS at the Carquinez Strait for the period of 1995–2010 (Kleckner et al. 2010). Flow data used—DAYFLOW records from the California Department of Water Resources; refinery data used—daily data for 1999–2007, constant loads after 2007; San Joaquin River Selenium—observed data at Vernalis, multiplied by Delta removal constants with fixed speciation—selenite (SeIV), 0.028; Se(VI), 0.658; and OrgSe, 0.314

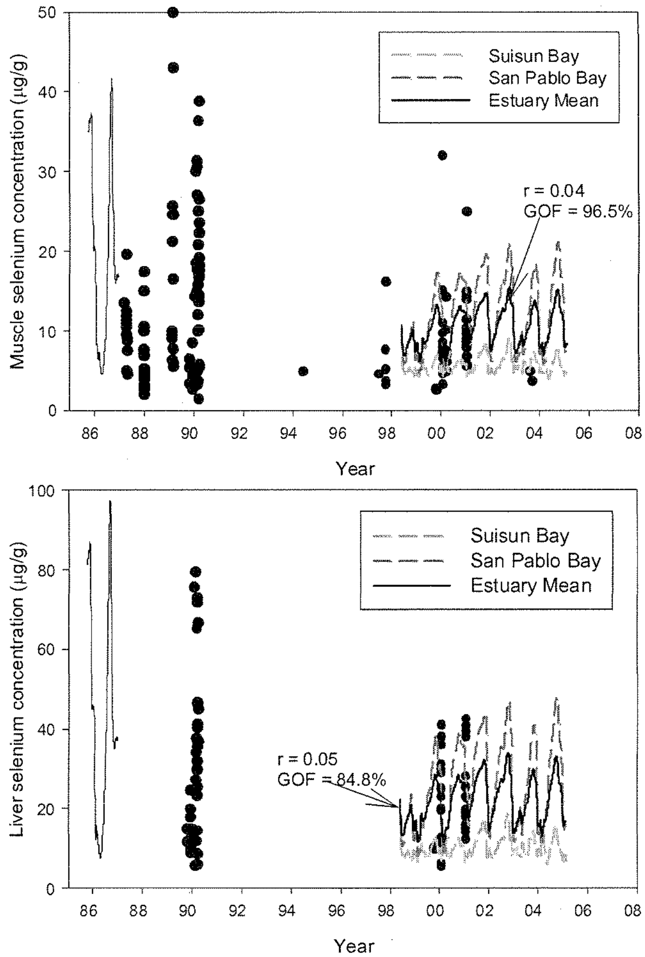

Fig. 10 Simulated selenium concentrations in muscle tissue and liver of white sturgeon at Suisun Bay and San Pablo Bay compared with observed values (White et al. 1988, 1989; Urquhart et al. 1991, USGS and SFEI), using TTF=1.3 for muscle tissue(Presser and Luoma 2010) and regression equation from Presser and Luoma (2006; for liver concentrations)

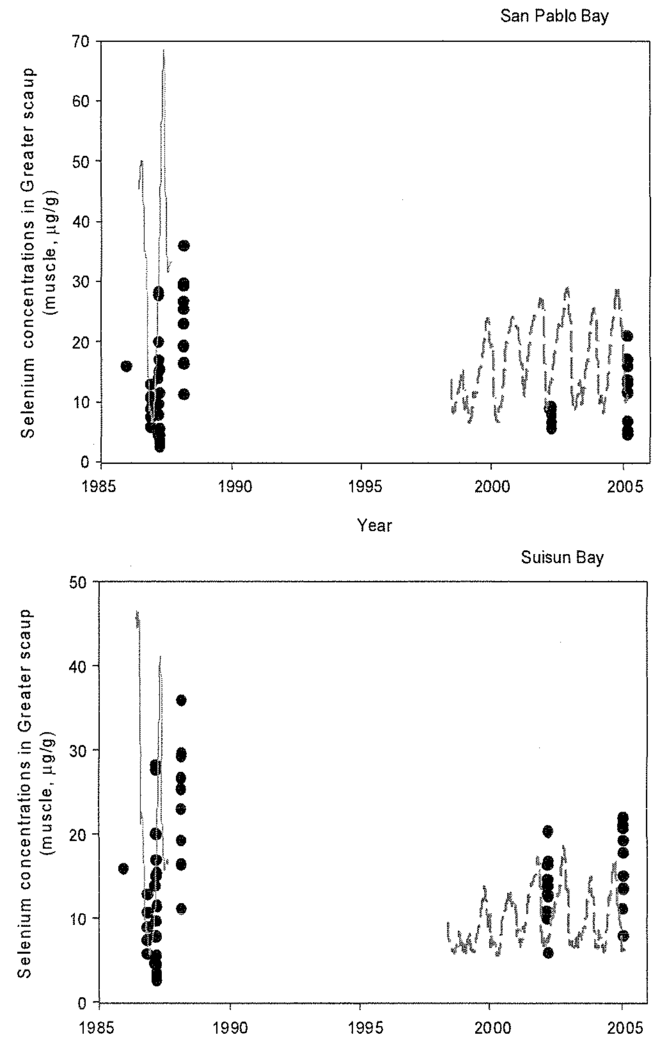

Fig. 11 Simulated selenium concentrations muscle tissue of diving ducks (dry weight; Greater Scaup) compared with observed data in San Pablo Bay and Suisun Bay, respectively (White et al. 1988, 1989; Urquhart et al. 1991; SFEI), using TTF=1.8

Similarly, the model was able to fit the particulate selenate plus selenite better than the particulate organic selenide. In general, the model was better able to represent the broad trends in concentration better than the localized spatial variation. The reasons underlying this behavior are not fully understood and may relate to local variability or to small scale processes that are not captured in the 1-D model with 33 cells representing a 100-km long modeling domain.

Future model development may seek to address some of the shortcomings of the modeling presented here, such as the occasional inability to represent the estuarine turbidity maximum and the chlorophyll *a* peaks, the uncertainties in riverine and ocean boundary conditions and their effect on the conclusions, and the difficulty in capturing large local-scale variability in organic selenium concentrations, which may be partly due to the complexity and limited understanding of phytoplankton growth dynamics and species distribution.

A sensitivity analysis of the various model parameters was performed. The analysis indicated that the model is relatively sensitive to parameters that affect the location and magnitude of the TSM. Dissolved and particulate selenium concentrations are most sensitive to the riverine input parameters (Table 3 in the ESM). Particulate selenium concentrations are sensitive to selenium content on particulates at the riverine boundary. Dissolved and particulate selenium are less sensitive to selenium transformation coefficients such as phytoplankton uptake and selenite adsorption rates. Particulate organic selenide and particulate selenium are also sensitive to increases in phytoplankton growth rates. The relatively high sensitivity of particulate organic selenium, particulate selenium, and dissolved selenite to increases in phytoplankton growth rate (also as an indicator of phytoplankton concentrations) underscores how certain species of selenium are closely tied to phytoplankton concentrations. In addition, particulate organic selenide is also sensitive

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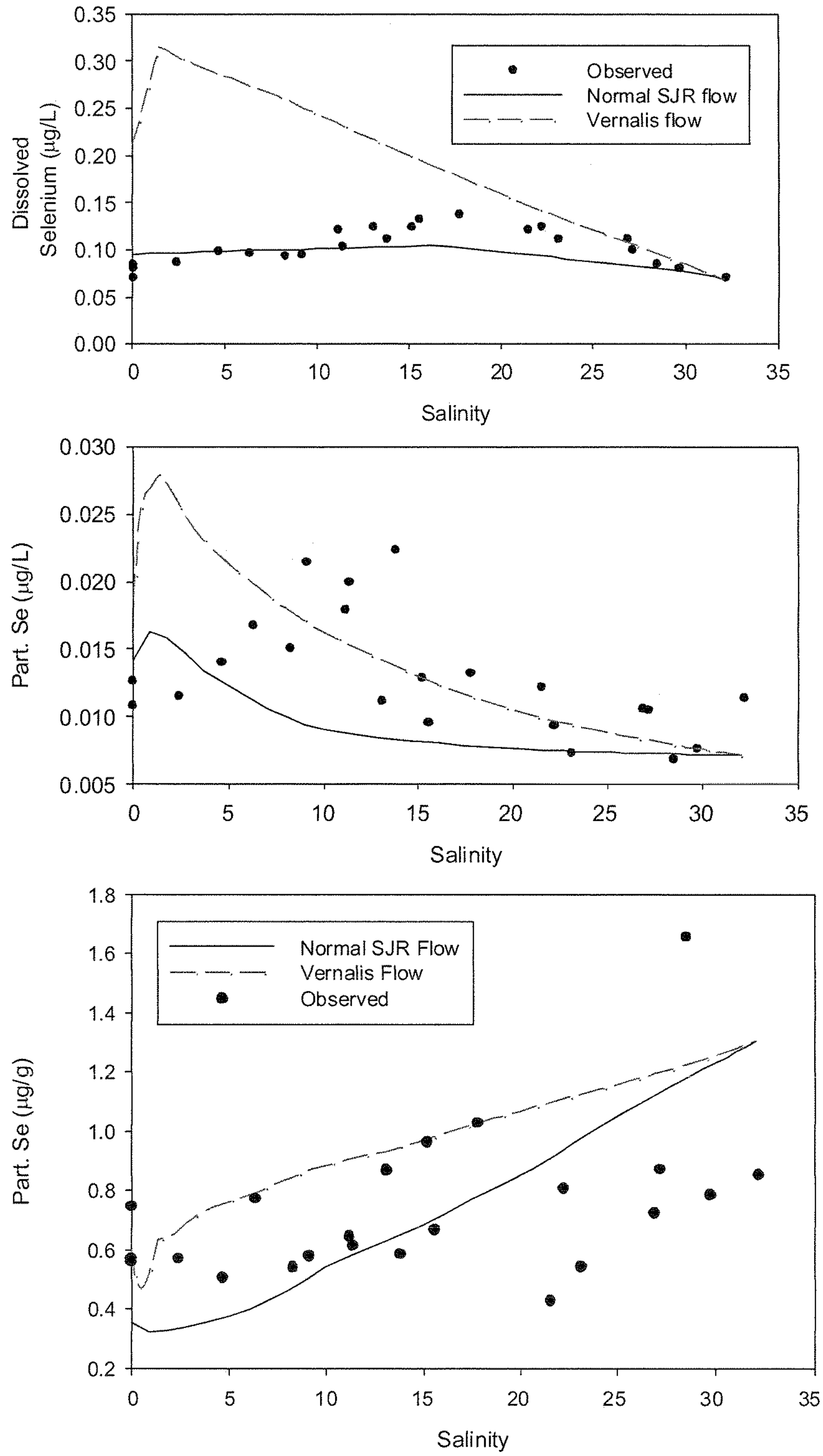
Fig. 12 Predicted dissolved and particulate selenium for different San Joaquin River discharge rates during a low flow period (11 November 1999)



to its mineralization rate. Through adjustment of several of these parameters, the ECoS framework was able to capture the essential behavior of selenium and ancillary parameters in NSFB. Future work in the bay focusing on these components of selenium behavior, including characterization of the riverine boundary and phytoplankton growth and uptake, may enhance the robustness of the modeling.

Temporal Variations in Selenium Concentrations in Clams

The recently reported *C. amurensis* concentration data from San Francisco Bay (Kleckner et al. 2010) illustrate internannual and inter-seasonal patterns in clam concentrations from 1995 to 2010, a period over which there have been variations in freshwater inflows as well as changes in the selenium loading, particularly changes in refinery wastewater loading in 1998, and a general reduction in San Joaquin River loads through selenium source control actions in the San Joaquin River watershed. Over this period of record, two features stand out in the observed clam data: there has not been a large reduction in clam concentrations despite the load changes, and there is a significant amount of inter-seasonal and inter-annual variability, with the lowest concentrations in each year occurring during the high flow months, and the highest concentrations occurring in the low-flow months. Seasonal high concentrations are almost a factor of two as high as the low concentrations.

The seasonal pattern is a feature of the clam data and cannot be explained by the dissolved selenium concentration data alone, as the dissolved data do not show a similar seasonal pattern. However, the modeling framework presented in this study does provide a plausible hypothesis, as outlined below. Particulates in the bay, especially phytoplankton, can have higher selenium concentrations (on a microgram-per-gram basis), than particulates originating in the riverine source in Rio Vista (with a greater mineral fraction). High flow periods are associated with high particulate loads from Rio Vista, largely made up of Sacramento River flows, resulting in lower average selenium concentrations in the bay than during low-flow periods. Thus, changes in selenium concentrations in clams from one year to the next appear to be influenced significantly by hydrology, with wet years (such as 2005 and 2006) resulting in lower clam concentrations. This hypothesis does not consider changes in the rate of selenium uptake as a function of the clam's life cycle, although such a process may also be a factor in the overall variation. There are, however, insufficient data to independently evaluate the significance of the growth effect at this time. An evaluation of the Kleckner et al. (2010) data showed no consistent relationships between clam size (as represented by mean shell length) and selenium concentrations. The hypothesis developed here through the integration of best-available data and modeling provides insight into the future management of selenium concerns in NSFB, although it must be re-evaluated as new data and process-level information become available.

The long-term trends in selenium concentrations in clams (1995–2010) suggest the importance of in-estuary transformations in affecting particulate and biota selenium concentrations in addition to the external loads. Given the decreases in external loads over the study period (both from the refineries and the San Joaquin River), dissolved selenium concentrations in the bay have shown a more direct response to these changes. However, the corresponding changes in particulate selenium are generally minimal, as reported previously in Doblin et al. (2006). As shown through the modeling framework presented here, this could be due to the fact that phytoplankton in the estuary are still able to concentrate relatively high selenium concentrations, which contribute to relatively high particulate selenium concentrations that enter the food web, and result in continued high concentrations in the clams. In effect, this framework indicates that particulate selenium concentrations, and therefore the concentrations in filter feeders, such as clams, are not a simple linear function of dissolved concentrations. Accurate predictions of concentrations in the food web require accurate characterization of particulate concentrations, through observations where possible, or through adequate characterization of uptake by the particulate phases. The model developed here is a tool for supporting such predictions.

Summary and Conclusions

The ECoS model framework was applied to the NSFB for computing salinity, TSM, and chlorophyll *a*, and for selenium concentrations. The model was calibrated to data from 1999, because this is the most recent year for which speciated selenium data in the water column of the NSFB are available. The three ancillary constituents, salinity, TSM, and chlorophyll *a*, were calibrated using monthly water quality cruise data reported by the USGS. Although the ancillary water quality data in the bay are relatively abundant for the calibration of a 1-D model, the calibration period was limited by the availability of selenium data. Following calibration, where model parameters, especially the first-order rate constants that represent selenium transformation and uptake were estimated, the model was applied to different years for evaluating its performance. The calibrated model performed well under different hydrological and load conditions, and was able to simulate salinity, TSM, and chlorophyll *a* profiles for both dry years (e.g., 2001) and wet years (2005), and long-term TSM and chlorophyll *a* concentrations variations. The calibrated model was also run in a hindcast mode using hydrological and refinery loads for 1998. Selenium species and loads in this period were different from current loads, and the hindcast was another test of the credibility of the model. The simulated dissolved selenium concentrations compared well with the observed data. The model was able to simulate the mid-estuarine peaks in selenite for low flow of 1998. This indicates the location and magnitude of the selenium input from point sources and the transport and transformation of selenium are represented well in the model. Simulated particulate selenium concentrations also compared well with the observed values.

The model was able to simulate different selenium speciation and the bioavailability of each species, therefore is able to simulate selenium concentrations on particulates relatively well for different time periods (e.g., 1999 and 1998). The model could also represent the long-term variations (inter-annual and seasonal) in clam selenium concentrations for both prior-to refinery clean up (1994–1998) and post-refinery clean up time periods (1998–2010), including years with high and low clam selenium concentrations. The accumulation of selenium to higher trophic organisms is simulated using a TTF approach, which is able to represent selenium concentrations in white sturgeon and greater scaup in the bay.

A scenario of increasing flow and selenium loads from the San Joaquin River was also examined using the calibrated model. The results suggest that when flow from the San Joaquin River is a greater contributor to outflow from the Delta, significant increases in dissolved and particulate selenium, and selenium on particulates, are predicted in the bay. This would be expected to increase clam concentrations. This is of interest for long term planning for selenium management in NSFB, because there are plans being evaluated by the state of California to make changes in the way water is exported from the Delta through intakes further upstream in the Sacramento River, and by use of an isolated conveyance facility (CALFED 2008). Manipulations to the Delta system, especially those that increase San Joaquin flow into the bay, will also have selenium impacts to the bay that must be evaluated.

Although simplified through a 1-D representation, the modeling approach presented here is able to capture key features of selenium behavior at a level of complexity that is consistent with data that can be measured in the bay in future years. A benefit of the model is its ability to link sources to biota concentrations under a range of hydrologic conditions, and with mechanistic representations of transport, transformation and uptake processes. The mechanistic representation allows consideration of selenium uptake under future conditions, with changes in background water quality, hydrology, and the food web structure, which may be related to human interventions or natural causes. The modeling framework as developed, or with changes to reflect underlying processes and Delta modifications, can be used to explore selenium management options in San Francisco Bay in the context of the TMDL.

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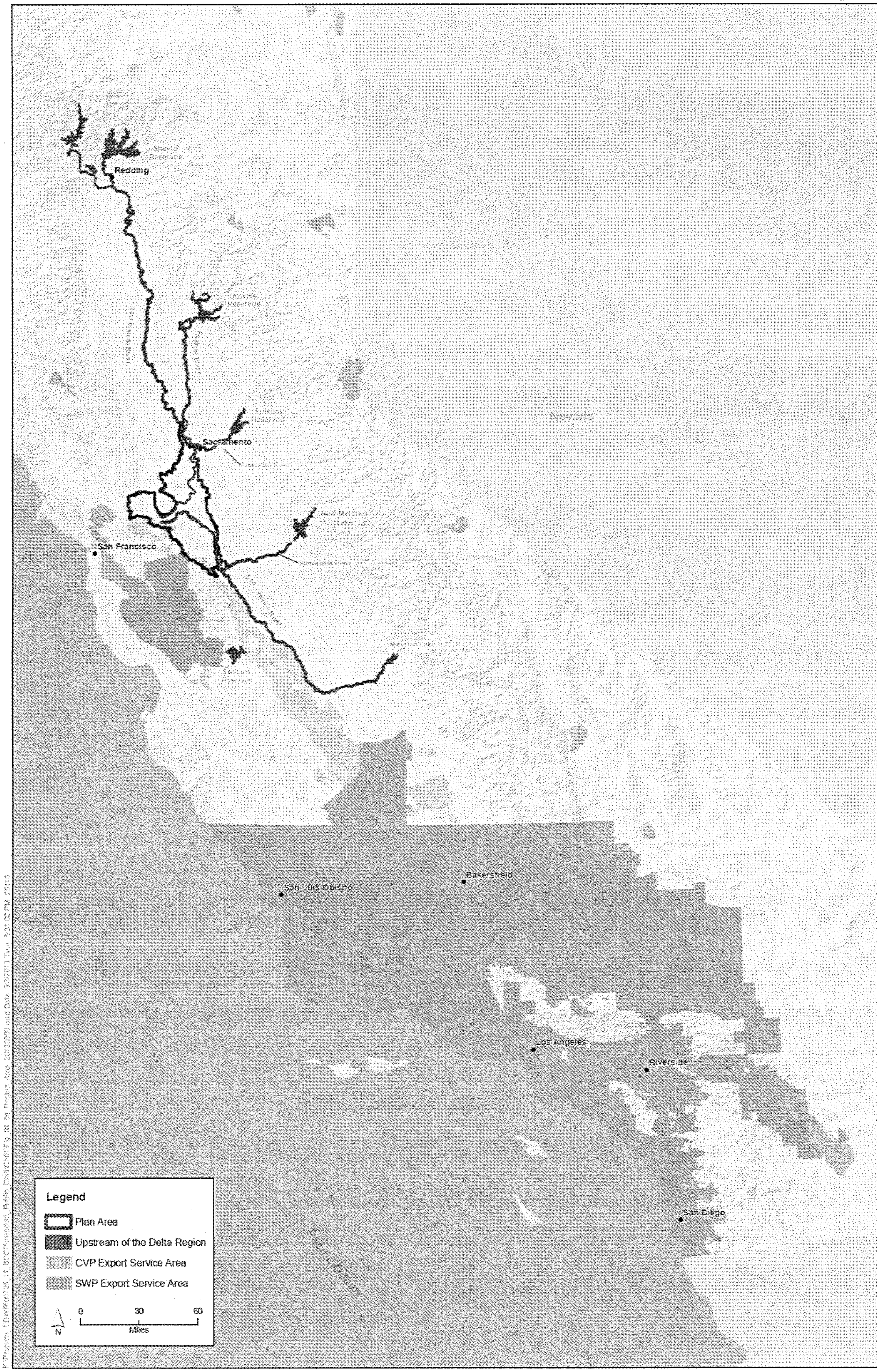
BDCP1433



Sources: Plan Area, ICF 2012; SWP/CVP Canals/Aqueducts, HDR 2011; CVP Division Entities, USBR 2010; SWP Service Areas, ESA 2007;

Figure 1-4
Project Area

BDCP1433

Review of Selenium Bioaccumulation Assessment in the Bay Delta Conservation Program Draft EIR/EIS

Revised Final Report

Prepared for:
Western States Petroleum Association

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May 30, 2014

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ACRONYMS

BDCP	Bay Delta Conservation Plan
CEQA	California Environmental Quality Act
DSM2	Delta Simulation Model 2
DWR	Department of Water Resources
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
ESO	Evaluated Starting Operations
HOS	high outflow scenario
LOS	low outflow scenario
ND	Non-detect
RL	Reporting Limit
TTF	Trophic transfer factor
USGS	United States Geological Survey
WSPA	Western States Petroleum Association

BDCP1433

EXECUTIVE SUMMARY

The Bay Delta Conservation Plan (BDCP) proposes a comprehensive water conservation strategy to restore and protect the ecosystem health and protect the water supply and water quality of the Delta (ICF, 2013). The plan includes new intakes in the northern Delta through a tunnel system to improve reliability and water quality. A total of 9 alternatives (with some sub-alternatives for a total of 15 action alternatives) and the no Action alternative were evaluated in the plan EIR/EIS. Alternative 4 is the CEQA preferred alternative. Alternative 4 is the dual conveyance with pipeline/tunnel and intakes with an export capacity of 9,000 cfs. Under Alternative 4, water would be conveyed from the north Delta to the south Delta through pipelines/tunnels and through surface channels.

Selenium in the San Francisco Bay/Sacramento-San Joaquin River Delta is of concern due to its adverse ecological impacts at high concentrations, primarily through bioaccumulation in the food web. The Bay Delta Conservation Plan (BDCP) Environmental Impact Report/Environmental Impact Statement (EIR/EIS) presents an analysis of selenium impacts that is the subject of this review. The implementation of various construction and restoration alternatives through the BDCP do not, by themselves, introduce new selenium into the system. However, by altering the flow patterns, and the relative mixing of different water sources entering the Bay and Delta, the different alternatives have the potential of altering the selenium water column concentrations in the Bay.

Selenium concentrations used in the Sacramento River for the BDCP EIR/EIS study are biased high, likely due to the inclusion of older analytical values reported at detection limits of 1 µg/L. Detection limits for dissolved selenium using the selective hydride generation/atomic absorption method are normally at 0.0016 µg/L and have been used for studies in San Francisco Bay (Cutter and Cutter, 2004; Tetra Tech, 2012). Long-term detection limits for using ICP-MS [1] method are 0.05 µg/L (USGS, 2014). The

[1] Inductively coupled plasma mass spectrometry

Sacramento River selenium values are critical to the calculation because this is the dominant flow into the Bay. In the current version of the public review documents, the calculated values of water column selenium in San Francisco Bay (0.21 – 0.31 µg/L at Mallard Island) are much higher than the observed (from 0.08 to 0.12 µg/L across multiple sampling events in Suisun Bay). Using the calculated water column concentration in the EIR/EIS, the calculated values of white sturgeon tissue selenium (9.9 µg/g mean and 15 µg/g drought year value) are higher than observed in the last decade across multiple samples.

Using valid boundary values for the Sacramento and San Joaquin Rivers (Freeport: 0.095 µg/l and Vernalis: 0.57 µg/l, both based on observed data from the US Geological Survey), we have updated the San Francisco Bay water column and white sturgeon calculations. Using the same modeling framework as in the original BDCP analysis, but with the corrected boundary values, we are able to get a reasonable match with the observed data for current conditions. The model analysis shows that the BDCP-preferred Alternative 4 will result in higher percent changes in water column concentrations than that calculated in the EIR/EIS. Using the bioaccumulation model in the EIR/EIS, we find a similar projected increase in fish tissue concentrations between Alternative 4 and existing conditions (i.e., no BDCP project). Importantly, the new calculations suggest that there is an effect of the BDCP changes to the water column and white sturgeon selenium concentrations at the Mallard Island station for CEQA Alternative 4, representing conditions in Suisun Bay (8-20% increase, depending on the hydrology). This is higher than currently estimated for Alternative 4 at this station (2-5% increase, calculated by Tetra Tech), and may be evaluated in the context of the CEQA conclusion: "Relative to Existing Conditions, modeling estimates indicate that all scenarios under Alternative 4 would result in essentially no change in selenium concentrations throughout the Delta." (page 8-476, Draft EIR/EIS).

From the standpoint of water column selenium concentrations, the worst case conditions are not the drought years of 1987-1991, but years where the San Joaquin flow contributions to the bay are greater. Periods with high San Joaquin River flow to the Bay occur in the wet months of wet years, and should also be considered for the selenium effects. Should alternatives besides the CEQA preferred Alternative 4 be considered in future phases, selenium impacts could be more significant. The change in selenium concentration (existing conditions versus the alternatives) needs to be addressed through the EIR/EIS.

Besides correction of the boundary values in the EIR/EIS, other considerations follow. The calculated white sturgeon concentrations with the new boundary conditions are lower under existing conditions than that calculated in EIR/EIS, below the 8.1 µg/g whole-body values now proposed by the US Environmental Protection Agency as a fish tissue target (USEPA, 2014). The North San Francisco Bay is considered impaired due to a Se (303d) listing and a total maximum daily load analysis (TMDL) is being prepared. The potential of impairment under existing conditions and current loads from various point- and non-point sources will be addressed by the San Francisco Bay Regional Water Quality Control Board through this TMDL, but it is important to note that this modeling suggests that future BDCP changes may well increase water column and fish concentrations by a greater percentage than what is calculated in the current EIR/EIS. Given this finding, there is a need to monitor the changes in water and fish over the coming years and to consider if any and what mitigation might be needed if the BDCP plan is implemented.

Table ES-1. Summary of EIR and Tetra Tech calculated selenium concentrations in water and in fish.

	EIR Boundary Condition	Actual Boundary Conditions	Calculated EIR Se Water Conc.	Calculated Revised Se Water Conc	Actual Water Conc.	EIR Calc Fish Tissue	Calculated Revised Fish Tissue	Actual Fish Tissue	Alt 4 Se Water Conc	TT Alt 4 Calc Water Conc	Alt 4 Calc Fish Tissue	TT Alt 4 Calc Fish Tissue
Entire 16-year period	Sac: 0.32 µg/L; SJR: 0.84 µg/L	Sac: 0.095 µg/L; SJR: 0.57 µg/L	0.257µg/L	0.120 µg/L	0.08-0.12 µg/L	10.2 µg/g	4.8 µg/g	3-10 µg/g	0.268 µg/L	0.139 µg/L	10.6 µg/g	5.5µg/g

1 INTRODUCTION

The Bay Delta Conservation Plan (BDCP) proposes a comprehensive water conservation strategy to restore and protect the ecosystem health and also protect the water supply and water quality of the Delta (ICF, 2013). The plan includes new intakes in the northern Delta through a tunnel system to improve reliability and water quality. A total of 9 alternatives (with some sub-alternatives for a total of 15 action alternatives) and the no Action alternative were evaluated in the plan EIR/EIS. Alternative 4 is the CEQA preferred alternative. Alternative 4 is a dual conveyance with pipeline/tunnel and intakes with an export capacity of 9,000 cfs. Under Alternative 4, water would be conveyed from the north Delta to the south Delta through pipelines/tunnels, and through surface channels.

The Bay Delta Conservation Plan (BDCP) environmental assessment, notably the Environmental Impact Report/Environmental Impact Statement (EIR/EIS), presents in some detail the impacts of the plan on various water quality constituents in the San Francisco Bay and Delta region under the no-action alternative as well as various project alternatives (Chapter 8 of the Draft EIR/EIS, November 2013). Of the constituents addressed, selenium in the San Francisco Bay/Sacramento-San Joaquin River Delta is of concern due to its adverse ecological impacts at high concentrations, primarily through bioaccumulation in the food web. This review is focused on the analysis of selenium impacts that are presented in the BDCP EIR/EIS.

Selenium concentrations in the water column originate from a variety of point sources and non-point sources in the watershed of San Francisco Bay and the Delta. Upstream of the Delta, high selenium concentrations in the San Joaquin River watershed have been a long-standing concern. The San Joaquin River watershed is naturally enriched in selenium and agricultural practices in the watershed have mobilized selenium from the soils to groundwater and surface water that drains into the Delta. The watershed and specifically a sub-area, the Grasslands area, has been identified as an important source of selenium to the Bay Delta (Central Valley Regional Water Board, 2001). In contrast, selenium concentrations in the other major riverine flow into the Delta, the Sacramento River, are relatively low. Because the combined flows of the Sacramento and San Joaquin Rivers are the primary freshwater inflows into the Bay, the proportional mix of these inflows has a strong influence on selenium concentrations in the western Delta and the Bay.

The implementation of various construction and restoration alternatives through the BDCP do not, by themselves, introduce new selenium into the system. However, by altering the flow patterns, and the relative mixing of different water sources entering the Bay and Delta, the different alternatives have the potential of altering the selenium water column concentrations in the Bay. In the EIR/EIS, changes in the water column selenium concentrations for the different alternatives considered were developed using the Delta Simulation Model (DSM2), a tool that is widely used for evaluating water quality changes in the Delta under current and future conditions.

In the bioaccumulation model used in the BDCP EIR/EIS, the water column concentrations are related to various biological endpoints, such as concentrations in largemouth bass and in white sturgeon. In the BDCP EIR/EIS, the analysis is performed using a trophic transfer model that relates water column concentrations to tissue concentrations (fish tissue or bird egg), and is presented in Appendices 8M and an Addendum M.A). Appendix 8M performed the analysis for largemouth bass, and Addendum M.A performed the analysis for white sturgeon. This was done because of the potentially greater bioaccumulation of selenium in sturgeon because of their preference for clams that bioaccumulate selenium to a greater extent (Chapter 8, page 8-138).

In this review, we use the same tools and assumptions as used in the November 2013 EIR/EIS, but modify the boundary selenium concentrations in the Sacramento and San Joaquin Rivers to be more representative of observed values. We then compare the modeled water column and sturgeon concentrations for key locations in the system across different alternatives. Observed data on the boundary selenium concentrations and in white sturgeon are also presented to substantiate the modeling changes that are proposed in this review.

2 BDCP EIR/EIS MODELING APPROACH

The Bay Delta Conservation Plan (BDCP) proposes a comprehensive water conservation strategy to restore and protect the ecosystem health and also protect the water supply and water quality of the Delta (ICF, 2013). The plan includes new intakes in the northern Delta through a tunnel system to improve reliability and water quality. A total of 9 alternatives (with some sub-alternatives for a total of 15 action alternatives) and the no Action alternative were evaluated in the plan EIR/EIS. Alternative 4 is the CEQA preferred alternative.

Because the San Joaquin River was historically identified as a major source of selenium to the Delta, there are concerns with respect to increased inputs of selenium from the San Joaquin River relative to the Sacramento River as a result of the proposed water operations (Evaluated Starting Operations, ESO).

The impacts of ESO water operations on selenium in water of the Bay Delta and in fish species were evaluated through a modeling study using the Delta Simulation Model II (DSM2) in the EIR/EIS. DSM2 is a one-dimensional mathematical model for simulation of one-dimensional hydrodynamics and water quality in the channels of the Delta and the eastern part of San Francisco Bay. The western boundary of the model is located in Martinez along the western portion of Suisun Bay. The DSM2 model was run to estimate changes in water flows under the proposed action alternatives. The outputs from the DSM2 model, along with the available measured waterborne selenium concentrations in the boundary sources, were used to calculate concentrations of selenium at locations throughout the Delta. Modeled selenium concentrations in the water column were used to calculate selenium concentrations in whole-body fish and bird eggs using ecosystem-scale models developed by Presser and Luoma (2013).

The DSM2 model was run to estimate the volumetric contribution from six major inputs to the Delta: the Sacramento River, San Joaquin River, Martinez (representing the San Francisco Bay boundary), east side tributaries, agricultural return flows, and Yolo Bypass (Figure 2-1). Observed selenium concentrations in the six major sources were used to predict the resultant selenium concentrations at given locations in the Delta (Table 2-1). Predicted selenium concentrations in water column are listed in Table 2-2.

The DSM2 model was run for a scenario without BDCP (EBC2_LLT) and under three BDCP scenarios: 1) evaluated starting operations late long term (ESO_LLT), 2) a low-outflow scenario (LOS_LLT), and 3) a high-outflow scenario (HOS_LLT). The hydrologic conditions considered include: 1) all water years (1975- 1991) representing the 16-year period modeled using DSM2 (termed "All" in the scenarios below); and 2) a drought period of five consecutive years (water years 1987-1991) consisting of dry and critical water-year types (termed "Drought").

The predicted selenium concentrations in the water column were translated to concentrations in fish using the ecosystem – scale model developed by Presser and Luoma (2013). The ecosystem models were developed using data from laboratory and field studies. Selenium concentrations in water column were translated to concentrations in particulate matter using fixed ratios (termed Kd). Further bioaccumulation from particles to lower trophic level prey items and then to fish was accomplished through Trophic Transfer Factors (TTF). TTF values are based on ecosystem-wide measurements, and were based on data from San Francisco Bay. Presser and Luoma (2013) determined Kd values for the San Francisco Bay (including Carquinez Strait – Suisun Bay) during "low flow" conditions (5,986 l/mg) and "average" conditions (3,317 l/mg). These values were used to model selenium concentrations in particulates for "Drought" and "All" conditions at locations in the western Delta. TTF values for particulates to clams/amphipods were determined to be 9.2 (dimensionless). TTF values for prey to fish (white sturgeon) was determined to be 1.3 (dimensionless).

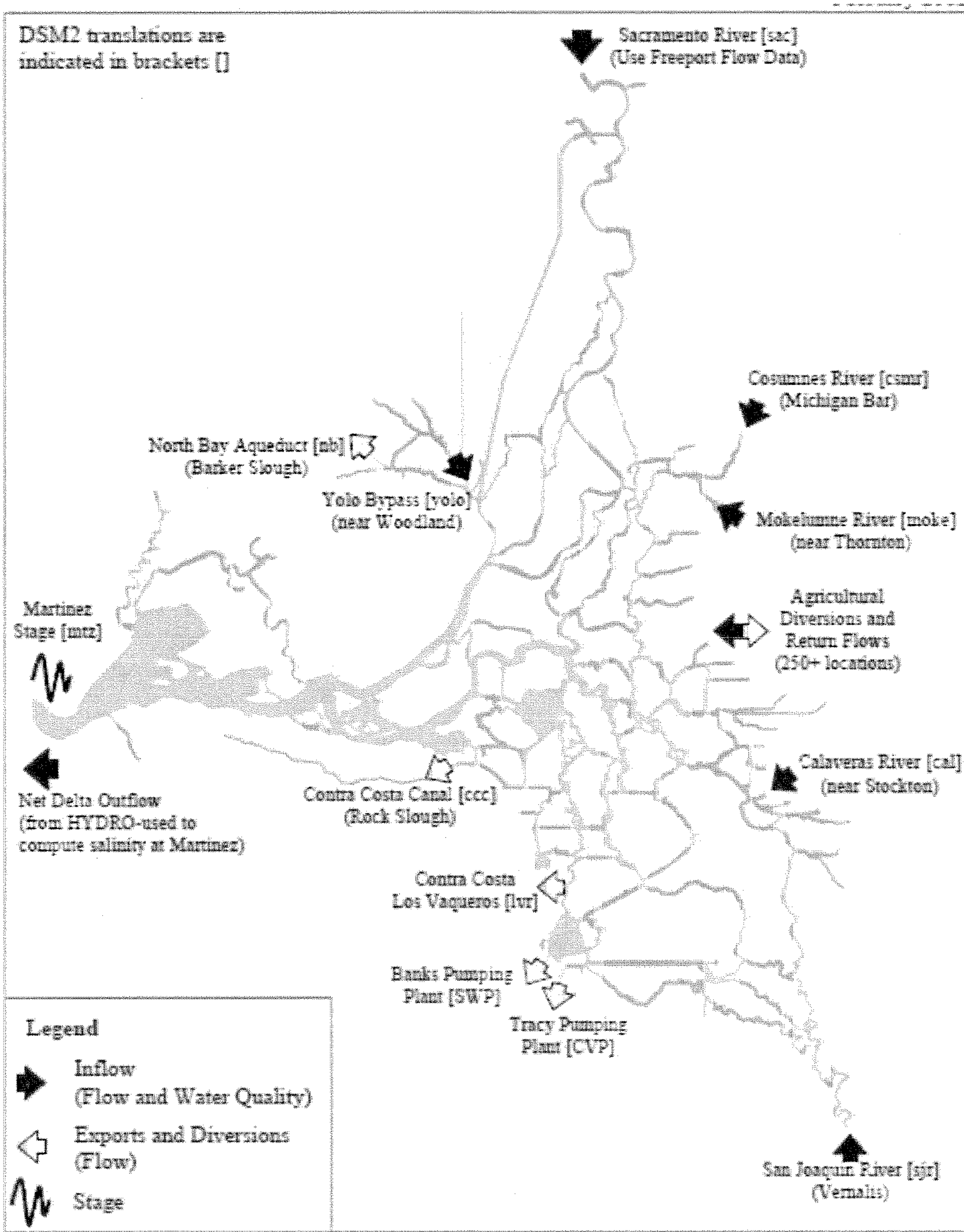

Figure 2-1. Map of typical DSM2 boundary conditions

Table 2-1
Historical selenium concentrations in the six Delta source waters for the period 1996 – 2010 (Source: Table 8-56, Draft EIR/EIS, November 2013)

Source water	Sacramento River[a]	San Joaquin River[b]	San Francisco Bay[a]	East side tributaries[c]	Agriculture in the Delta[a]	Yolo Bypass[d]
Mean (µg/L)[e]	0.32	0.84	0.09	0.1	0.11	0.45
Minimum (µg/L)	0.04	0.40	0.03	0.1	0.11	0.19
Maximum (µg/L)	1.00	2.80	0.45	0.1	0.11	1.05
75th percentile (µg/L)	1.00	1.20	0.11	0.1	0.11	0.65
99th percentile (µg/L)	1.00	2.60	0.41	0.1	0.11	1.04
Data source	USGS 2010	SWAMP 2009	SFEI 2010	None	Lucas and Stewart 2007	DWR 2009b
Stations	Sacramento River at Freeport	San Joaquin River at Vernalis (Airport Way)	Central-west; San Joaquin River near Mallard Is. (BG30)	None	Mildred Island, center	Sacramento River at Knights Landing
Date Range	1996-2001, 2007 -2010	1999-2007	2000-2008	None	2000, 2003-2004	2003, 2004, 2007, 2008
ND replaced with RL	Yes	Yes	Yes	Not applicable	No	Yes
Data omitted	None	Pending data	None	Not applicable	No	None
No. of data points	62	453	11	None	1	13

[a] Dissolved selenium concentrations
[b] Not specified total or dissolved
[c] Dissolved concentrations are assumed to be 0.1 µg/L due to lack of data
[d] Total selenium concentrations. Ideally, dissolved concentrations should be used for comparison, and constitutes the dominant form of selenium in the system. Not all stations report selenium in the same form. The combined use of total and dissolved selenium across different stations is a source of potential uncertainty.
[e] Means are geometric means

Table 2-2
Modeled selenium concentrations in water column for late long-term scenario (values reproduced from Table 8M1 in Appendix 8M of the EIR/EIS)

Location	Period	Period Average concentrations (µg/L)		
		Existing Conditions	No Action Alternative LLT	Alternative 4H1
San Joaquin River at Antioch Ship Channel	ALL	0.31	0.31	0.33
	Drought	0.27	0.27	0.28
Sacramento River at Mallard Island	All	0.25	0.25	0.26
	Drought	0.21	0.21	0.21

Under the low flow condition (after modifying Kd units) (based on the EIR/EIR, Appendix 8M),

Sturgeon Se = Cw*6.0*9.2*1.3 mg/g or

= Cw*71.8 mg/g,
where Cw is the water column concentration in µg/L (typically the dissolved water column concentration)

Under the average flow condition,

Sturgeon Se = Cw*3.3*9.2*1.3 mg/g or

= Cw*39.5 mg/g,
where Cw is the water column concentration in µg/L (typically the dissolved water column concentration)

In the EIR/EIS, fish Se values are compared to a low benchmark of 5 µg/g and a high benchmark of 8 µg/g (µg/g = mg/kg). At this time, fish targets are being developed by the US Environmental Protection Agency, and these fish tissue benchmarks are a reasonable representation of the range.

Selenium concentrations associated with source waters particularly in the Sacramento River (0.32 µg/L) that are used in the BDCP EIR/EIS modeling were notably higher than concentrations reported for this river (0.07 µg/L) by Cutter and Cutter (2004). A possible reason for these high concentrations was the high detection limit (1 µg/L) that was in the early period of the data record. For the concentration level of concern in the Bay-Delta region (0.1-0.2 µg/L), a high detection limit of 1 µg/L will significantly bias the results of selenium concentrations in the water. Modeled selenium concentrations at Mallard Island and Antioch were also significantly higher than values observed in the Bay water.

In this study, we conducted an independent evaluation of selenium concentrations associated with the rivers to be considered as inputs to the Delta, using the same data source used in the BDCP EIR/EIS study.

Copies of the DSM2 model inputs and outputs for the scenarios were made available by the California Department of Water Resources (DWR) to Tetra Tech, and were employed for the subsequent analysis (Brian Heiland, personal communication, June 2013). We confirmed that the runs were identical to those used in the November 2013 draft of the EIR/EIS (Brian Heiland, personal communication, January, 2014).

We then conducted DSM2 runs to replicate results from the BDCP EIR/EIS study. Selenium concentrations from our independent evaluation were then used in calculating concentrations in the Delta. We recomputed fish selenium concentrations (white sturgeon) based on selenium concentrations in the water.

3 INDEPENDENT REVIEW OF SELENIUM DATA FROM USGS ON RIVERS

In our evaluation, we downloaded data from US Geological Survey National Water Information System (NWIS) database for the Freeport Station on Sacramento River (station code 11447650) and Vernalis on the San Joaquin River (station code 11303500), given the importance of these stations in the inflows to the Delta and then to the Bay.

For Freeport, a total of 411 values from 1973 to present were found for dissolved or total selenium. From the beginning of record to 9/15/98, values are classified as "historical" and reported using a hydride analytical method. For these dates, values were reported as < 1 µg/L and noted to be less than the method detection limit (MDL) of 1 µg/L. No data were found from 9/15/1998 to 11/26/2007. From 11/27/2007 to present, there are 75 values, all reported as using the ICP-MS method, with an MDL of 0.03 to 0.04 µg/L. From 11/2007, dissolved selenium concentrations range from 0.04 to 0.23 µg/L, with a median concentration of 0.09 µg/L, and a mean concentration of 0.095 µg/L.

Similar to the Sacramento River, an independent review of the selenium data from USGS for the San Joaquin River at Vernalis was conducted. From 11/28/2007 to present, there are 78 values, all reported using an ICP-MS method, with an MDL of 0.03 to 0.06 µg/L. From 11/2007, dissolved selenium values range from 0.12 to 1.5 µg/L, with a median of 0.47 µg/L, and a mean of 0.57 µg/L.

As shown in Figure 3-1 and Figure 3-2, dissolved selenium concentrations in the Sacramento River were generally below 0.2 µg/L and were approximately 0.5 µg/L for the San Joaquin River.

Another independent study of selenium concentrations in the rivers by the Western States Petroleum Association (WSPA) is available for comparison for the period 2010 – 2012 (Table 3-1) (Tetra Tech, 2012). Average selenium concentrations sampled by WSPA for this time period are 0.07 μg/L for the Sacramento River at Freeport and 0.34 μg/L for the San Joaquin River.

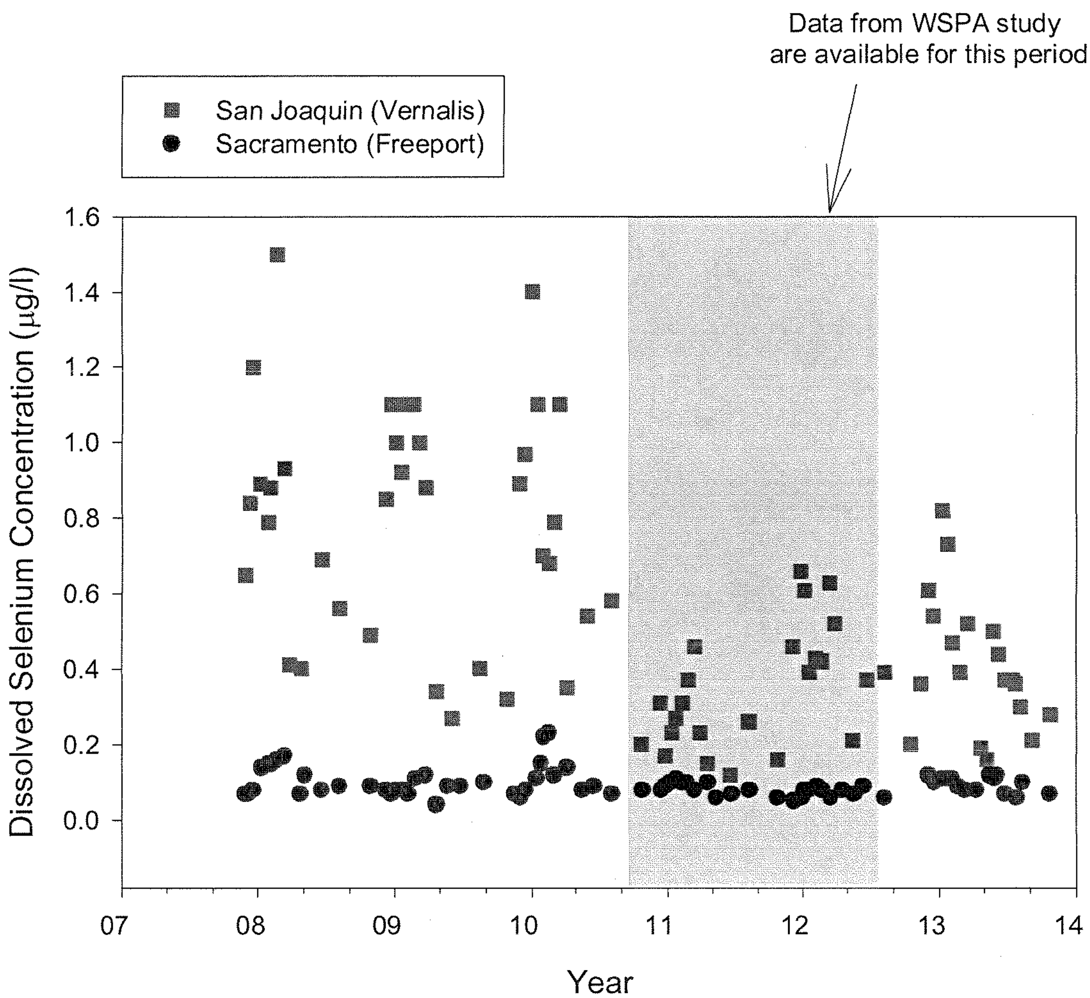

Figure 3-1 *Dissolved selenium concentrations in Sacramento and San Joaquin River from 2007 - present (USGS NWIS data)*

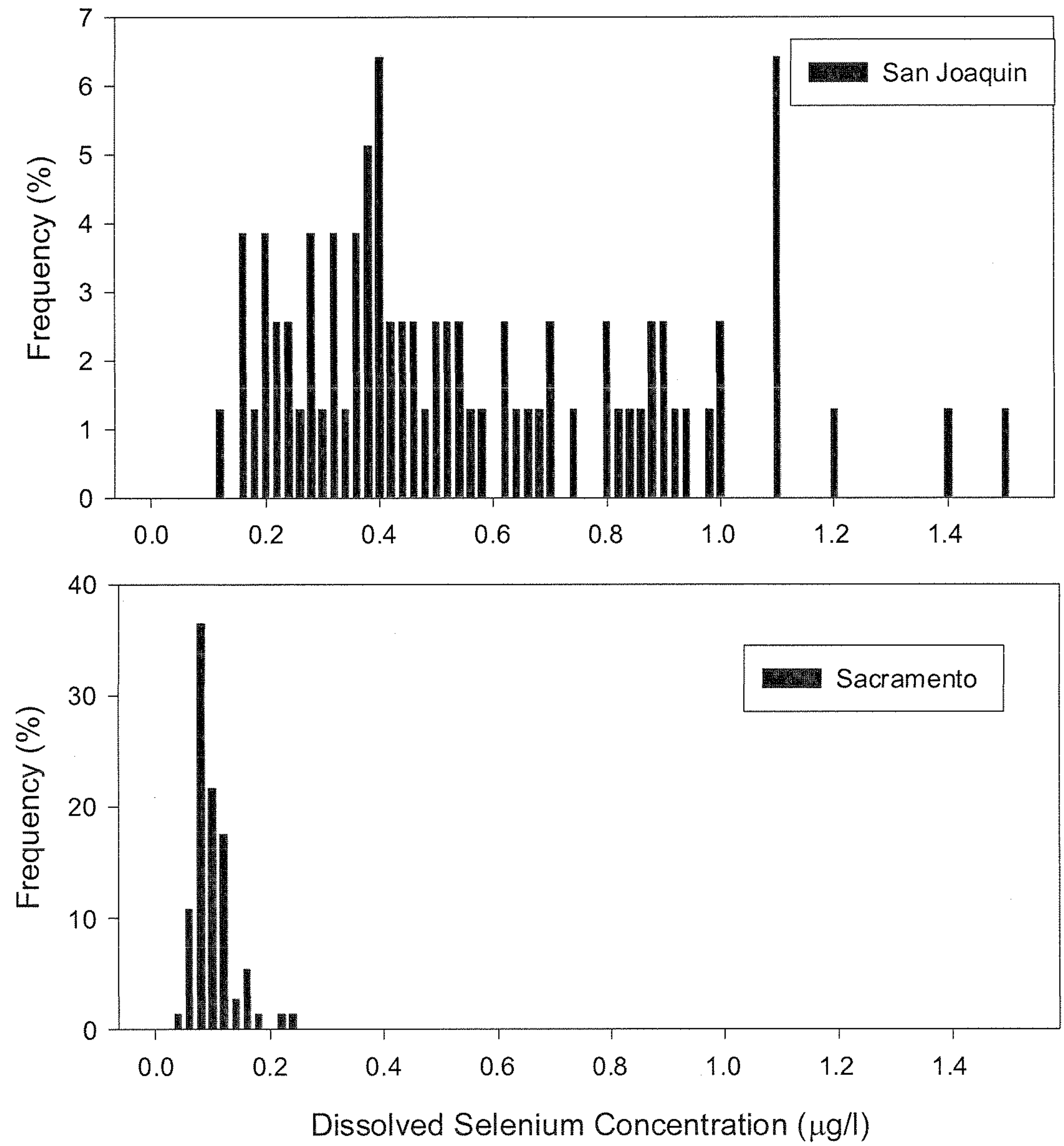

Figure 3-2 *Frequency of distribution for dissolved selenium concentrations in the Sacramento and San Joaquin Rivers (USGS NWIS data)*

The Suisun Bay location, as the boundary of the DSM2 model domain and the Carquinez Strait, was also evaluated for selenium concentrations (Table 3-2 and Table 3-3). Average selenium concentrations in Suisun Bay from several sources suggested relatively low concentrations of around 0.10 µg/L, as opposed to higher concentrations in the Bay predicted by BDCP EIR/EIS in Table 2-2.

Selenium concentrations from six sources that are used in our calculation of concentrations in the Bay are shown in Table 3-4. For the Freeport and Vernalis stations only, these were updated from the original data ranges reported in Table 2-1. The largest changes occurred at the Freeport station from 0.32 µg/l in the EIR/EIS to the corrected value of 0.095 µg/l in the update. This change is critical to the analysis because the Freeport flows are the dominant freshwater flows in the Delta system.

For context, the observed white sturgeon concentrations from San Francisco Bay are also shown in Figure 3-3. These data were obtained from the CEDEN database, and are based on data reported by the Regional Monitoring Program. Sturgeon are sampled every 3-5 years, and the current data available in CEDEN for North San Francisco Bay covers Suisun Bay and San Pablo Bay. The dry weight of selenium in fish tissue range from 1.75 to 10.8 µg/g, with a single value in San Pablo Bay at 18.5 µg/g. Suisun Bay values range from 3.1 to 10.8 µg/g.

Table 3-1
Riverine selenium concentrations sampled by WSPA for the period of 2010 – 2012 (Tetra Tech, 2012)

Station	Sample data	Total dissolved Se (µg/L)	Mean (µg/L)
Freeport	10-Sep-10	0.068	0.07
Freeport	18-Mar-11	0.062	
Freeport	7-Oct-11	0.064	
Freeport	16-Apr-12	0.09	
Vernalis	10-Sep- 10	0.353	0.34
Vernalis	18-Mar-11	0.317	
Vernalis	7-Oct-11	0.207	
Vernalis	16-Apr - 12	0.47	

Table 3-2
Selenium concentrations in Suisun Bay for 1999 Cutter and Cutter (2004) and for 2010-2012 by Tetra Tech (2012)

Sample data	Average dissolved Se(µg/L)	Number of stations during sampling event
Apr -99	0.12	4
Nov – 99	0.10	10
8-Sep-10	0.09	9
15-Mar-11	0.10	4
4-Oct-11	0.08	7
11-Apr-12	0.10	5

Table 3-3
Selenium concentrations in Carquinez Strait for 1999 Cutter and Cutter (2004) and for 2010-2012 by Tetra Tech (2012)

Sample data	Average dissolved (µg/L)	Number of stations in this region during sampling event
Apr -99	0.100	4
Nov – 99	0.129	4
8-Sep-10	0.103	4
15-Mar-11	0.101	2
4-Oct-11	0.10	4
11-Apr-12	0.123	3

Table 3-4
Updated selenium concentrations in the six Delta source waters

Source water	Sacramento River[a]	San Joaquin River[a]	San Francisco Bay[a]	East side tributaries[b]	Agriculture in the Delta[a]	Yolo Bypass[c]
Mean (µg/L)[d]	0.095	0.568	0.09	0.1	0.11	0.45
Minimum (µg/L)	0.04	0.12	0.03	0.1	0.11	0.19
Maximum (µg/L)	0.23	1.50	0.45	0.1	0.11	1.05
75th percentile (µg/L)	0.11	0.80	0.11	0.1	0.11	0.65
99th percentile (µg/L)	0.22	1.42	0.41	0.1	0.11	1.04
Data source	USGS	USGS	SFEI 2010	None	Lucas and Stewart 2007	DWR 2009b
Stations	Sacramento River at Freeport	San Joaquin River at Vernalis (Airport Way)	Central-west; San Joaquin River near Mallard Is. (BG30)	None	Mildred Island, center	Sacramento River at Knights Landing
Date Range	2007-2014	2007-2014	2000-2008	None	2000, 2003-2004	2003, 2004, 2007, 2008
ND replaced with RL	Yes	Yes	Yes	Not applicable	No	Yes
Data omitted	None	None	None	Not applicable	No	None
No. of data points	82	84	11	None	1	13

[a] Dissolved selenium concentrations
[b] Dissolved concentrations are assumed to be 0.1 µg/L due to lack of data
[c] Total selenium concentrations
[d] Means are geometric means

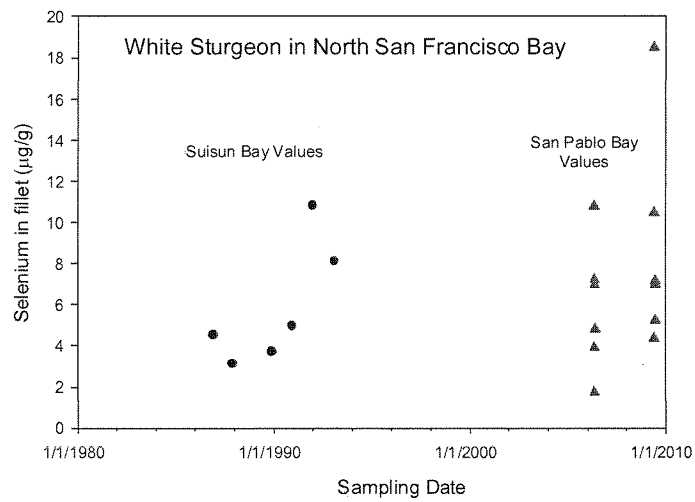

Figure 3-3 White sturgeon selenium concentrations in Suisun Bay and San Pablo Bay (Regional Monitoring Program data obtained from CEDEN database)

4 RESULTS

The presentation below first considers replication of the EIR/EIS calculations, followed by an updated set of calculations where we modified the boundary conditions to more accurately represent observed values.

4.1 BDCP CALCULATIONS REPLICATED BY TETRA TECH

The DSM2 model scenarios obtained from DWR were first run for existing conditions, using the same boundary concentrations as used in the November 2013 EIR/EIS.

The model was used to predict the volumetric contribution from six source boundaries to volumes at Mallard Island. The predicted volumetric contribution from the San Joaquin River showed elevated contributions during the wet years (Figure 4-1). Predicted volumetric contributions in conjunction with selenium concentrations in the six source waters listed in Table 2-1 (average concentrations) were used to predict selenium concentrations at Mallard Island. Modeled selenium concentrations for the drought period were lower due to lower contributions from the San Joaquin River. For the wet years of 1981- 1985, predicted selenium concentrations at Mallard Island were higher due to higher contributions from the San Joaquin River during this period (Table 4-1).

The model was also run for the Alternative 4 scenario. Alternative 4 is the CEQA preferred scenario identified in the EIR/EIS report and includes a tunnel for a portion of the diversions from the Sacramento River. The model was used to predict the volumetric contribution from six source boundaries to Mallard Island, under the altered hydrological conditions of Alternative 4. The volumetric contributions from San Joaquin River showed elevated contributions during the wet years (Figure 4-2). As in the existing conditions analysis, the volumetric contributions and selenium concentrations in the six source waters listed in Table 2-1 were used to predict selenium concentrations at Mallard Island. Modeled selenium concentrations for the drought period were lower due to decreased contributions from the San Joaquin River. For the wet years of 1981- 1985, predicted selenium concentrations at Mallard Island were higher due to higher contributions from the San Joaquin River during that period (Table 4-2).

The results show small changes in selenium concentrations from existing conditions to the preferred alternative (Alternative 4; Table 4-3). For the entire period, the change in total selenium from existing condition is 4.3%. The change in total selenium from the existing condition for the high San Joaquin contribution years (1981-1985) is slightly higher at 5.3%.

The predicted selenium concentrations in water column were used to predict selenium concentrations in whole-body of white sturgeon, using the reported Kd and TTF values from Luoma and Presser (2013). The Kd values for transferring dissolved selenium to particulate selenium are 3,317 l/g for all conditions and 5,986 l/g for the drought period. The TTF for transferring selenium in particulates to invertebrate is 9.2. The TTF for invertebrate to whole-body white sturgeon is 1.3. Calculated results of selenium concentrations in whole body white sturgeon are shown in Table 4-4 and Table 4-5. Mean concentrations for the 16-year simulation period increase from 10.21 μg/g under existing conditions to 10.65 μg/g under Alternative 4.

Because only the mean concentrations from source boundaries were used to predict concentrations at Mallard, as opposed to time series data used in the original study, very slight differences may be seen from the results compared to the original study. Despite these differences, the replicated selenium concentrations in the water column and in white sturgeon for the existing conditions and Alternative 4 are similar to the BDCP EIR/EIS report (Table 8M1 and 8M2 of the Draft EIR/EIS, November 2013).

Comparison of BDCP and Tetra Tech replicated concentrations in the water column and white sturgeon for the existing conditions and other alternatives is shown in Table 4-6 and Table 4-7. The table shows that we are able to independently reproduce with minimal differences the values for water column and sturgeon across a wide range of alternatives.

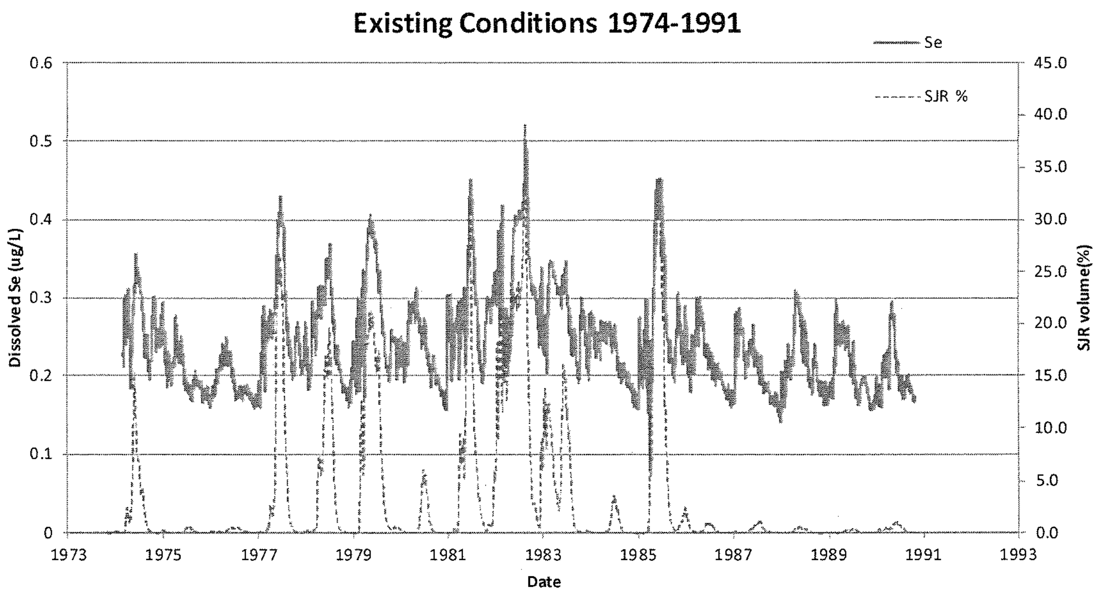

Figure 4-1 BDCP calculations replicated by Tetra Tech for existing conditions at Mallard Island using source concentrations: of 0.09 µg/L at Martinez, 0.32 µg/L at Sacramento River, 0.84 µg/L at San Joaquin River, 0.11 µg/L in the agricultural return flows, and 0.1 µg/L in east side tributaries.

Table 4-1
Mallard Island: BDCP calculations replicated by Tetra Tech for existing conditions

Selenium at Mallard Island	Entire 16-year period (1974-1991)	1987-1991 drought	High San Joaquin contribution (1981-1985)
Min (µg/l)	0.135	0.135	0.152
Max (µg/l)	0.508	0.327	0.508
Mean (µg/l)	0.257	0.213	0.298

Using concentrations in source water: Martinez = 0.09 µg/L, Sacramento River = 0.32 µg/L, San Joaquin River = 0.84 µg/L, agricultural return flow = 0.11 µg/L, and east side = 0.1 µg/L.

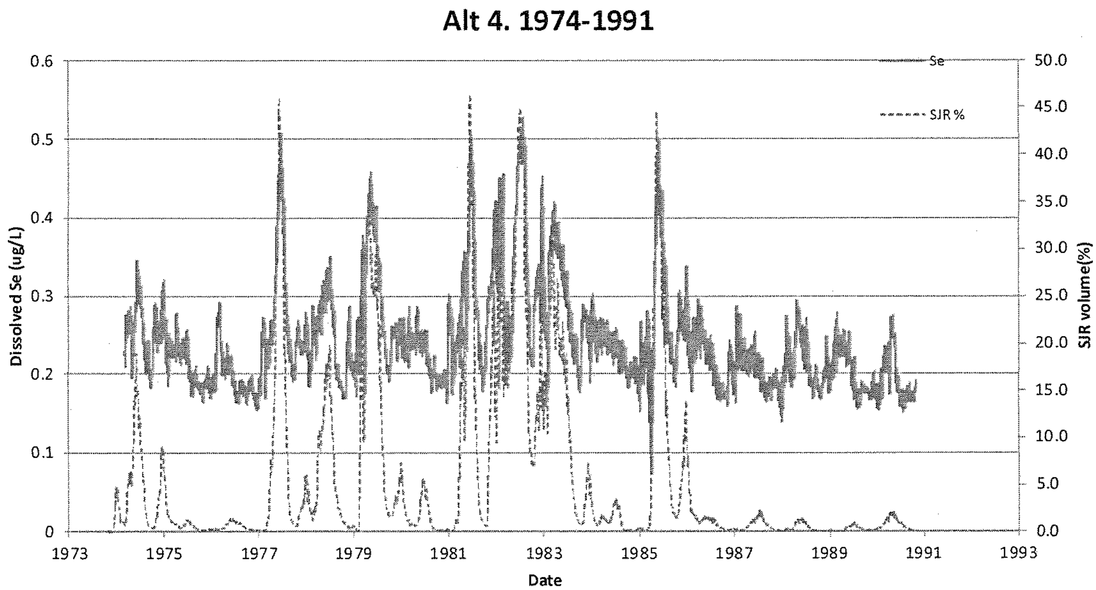

Figure 4-2 *BDCP calculations replicated by Tetra Tech for alternative 4 at Mallard Island using source concentrations: of 0.09 µg/L at Martinez, 0.32 µg/L at Sacramento River, and 0.84 µg/L at San Joaquin River, 0.11 µg/L in the agricultural return flows, and 0.1 µg/L in east side tributaries.*

Table 4-2
Alternative 4 at Mallard Island: BDCP calculations replicated by Tetra Tech

Selenium at Mallard Island	Entire 16-year period (1974-1991)	1987-1991 drought	High San Joaquin contribution (1981-1985)
Min (µg/l)	0.137	0.137	0.161
Max (µg/l)	0.542	0.348	0.537
Mean (µg/l)	0.268	0.218	0.314

Using concentrations in source water: Martinez = 0.09 µg/L, Sacramento River = 0.32 µg/L, San Joaquin River = 0.84 µg/L, agricultural return flow = 0.11 µg/L, and east side = 0.1 µg/L.

Table 4-3
Mallard Island: Predicted water column change from existing conditions: BDCP inputs

	Existing conditions, total Se (µg/L)	Preferred alternative (Number 4), total Se (µg/L)	Change (%) from existing
Entire 16-year period (1974-1991)	0.257	0.268	4.3
1987- 1991 drought	0.213	0.218	2.0
High San Joaquin contribution (1981-1985)	0.298	0.314	5.3

Table 4-4
Mallard Island: BDCP calculations for concentrations in whole-body sturgeon replicated by Tetra Tech for existing conditions

Selenium in whole-body white sturgeon at Mallard Island	Entire 16-year period (1974-1991)	1987-1991 drought	High San Joaquin contribution (1981-1985)
Mean (μg/g)	10.21	15.27	11.82

Using concentrations in source water: Martinez = 0.09 μg/L, Sacramento River = 0.32 μg/L, San Joaquin River = 0.84 μg/L, agricultural return flow = 0.11 μg/L, and east side tributaries = 0.1 μg/L.

Table 4-5
Alternative 4 at Mallard Island: BDCP calculations for concentrations in whole-body sturgeon (μg/g) replicated by Tetra Tech

Selenium in whole-body sturgeon at Mallard Island	Entire 16-year period (1974-1991)	1987-1991 drought	High San Joaquin contribution (1981-1985)
Mean (μg/g)	10.65	15.57	12.45

Using concentrations in source water: Martinez = 0.09 μg/L, Sacramento River = 0.32 μg/L, San Joaquin River = 0.84 μg/L, agricultural return flow = 0.11 μg/L, and east side = 0.1 μg/L.

Table 4-6
Mallard Island: Comparison of modeled selenium concentrations in water (μg/l) for existing conditions, no action alternative, and Alternative 1-9 by BDCP and Tetra Tech.

Location	Period	Existing conditions	No Action	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6	Alt. 7	Alt. 8	Alt. 9
EIR/EIS Calculations	All	0.25	0.25	0.26	0.27	0.25	0.27	0.26	0.3	0.29	0.29	0.28
	Drought	0.21	0.21	0.21	0.22	0.21	0.22	0.21	0.24	0.24	0.24	0.23
Replicated by Tetra Tech	All	0.26	0.26	0.26	0.27	0.25	0.27	0.26	0.30	0.29	0.29	0.28
	Drought	0.21	0.21	0.21	0.22	0.21	0.22	0.22	0.24	0.24	0.24	0.23

Table 4-7
Mallard Island: Comparison of modeled selenium concentrations in white sturgeon (μg/g) for existing conditions, no action alternative, and Alternative 1-9 by BDCP and Tetra Tech.

Location	Period	Existing conditions	No Action	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6	Alt. 7	Alt. 8	Alt. 9
EIR/EIS Calculations	All	9.92	9.92	10.3	10.7	9.92	10.7	10.3	11.9	11.5	11.5	11.1
	Drought	15	15	15	15.8	15	15.8	15	17.2	17.2	17.2	16.5
Replicated by Tetra Tech	All	10.2	10.2	10.2	10.7	10.0	10.7	10.2	11.8	11.4	11.4	11.1
	Drought	15.3	15.3	15.1	15.6	15.2	15.6	15.4	17.1	16.9	17.1	16.6

4.2 UPDATED CALCULATIONS REPLICATED BY TETRA TECH

The DSM2 models obtained from DWR were run with modified boundary conditions, especially the selenium concentrations at Freeport on the Sacramento River (0.095 µg/l) and Vernalis on the San Joaquin River (0.57 µg/l), and used to compute concentrations at Mallard Island (Figure 4-3). Model simulated selenium concentrations at Mallard Island for the three periods: 1) entire 16-year period, 2) 1987-1991 drought period; and 3) a period with high San Joaquin contribution (1981-1985) are listed in Table 4-8. Simulated selenium concentrations at Mallard Island were higher during the high San Joaquin contribution period (1981-1985). Simulated mean selenium concentrations at Mallard Island over the entire 16-year simulation period were 0.12 µg/L and were notably lower than the BDCP study (Table 4-1, 0.257 µg/L).

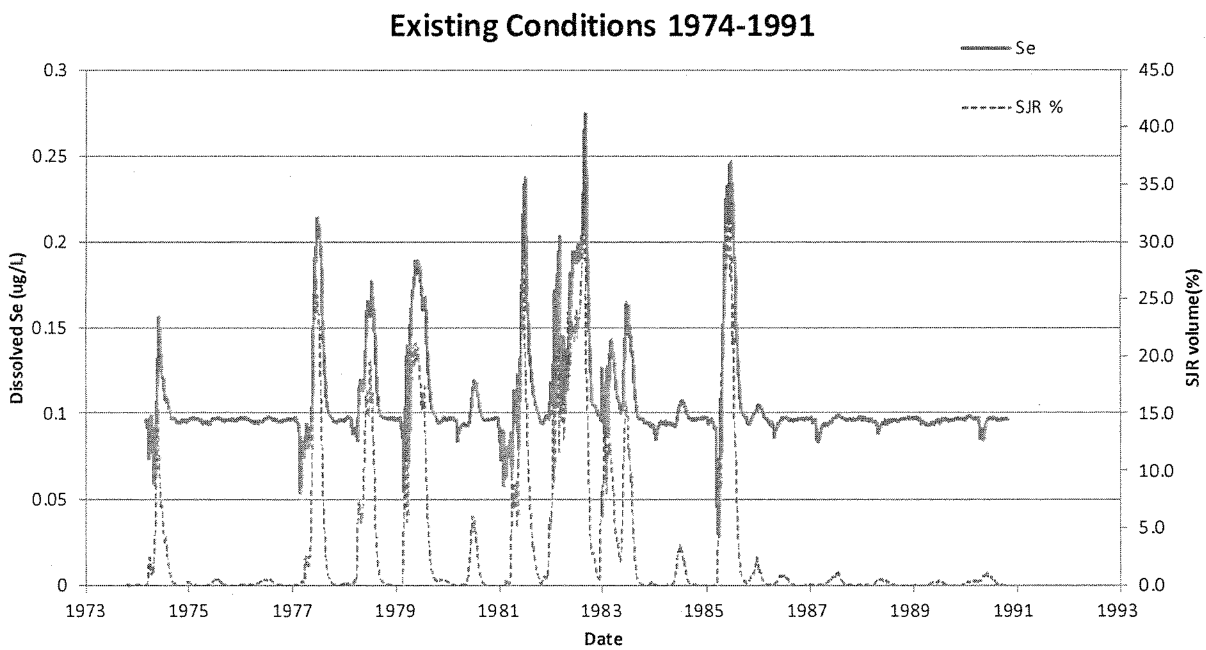

Figure 4-3 *Updated calculations by Tetra Tech for existing conditions at Mallard Island using source concentrations: of 0.09 µg/L at Martinez, 0.095 µg/L at Sacramento River, 0.57 µg/L at San Joaquin River, 0.11 µg/L in the Agriculture return flow, and 0.1 µg/L in east side tributaries.*

Table 4-8
Mallard Island: Updated calculation by Tetra Tech for existing conditions

Selenium at Mallard Island	Entire 16-year period (1974-1991)	1987-1991 drought	High San Joaquin contribution (1981-1985)
Min µg/L	0.092	0.092	0.092
Max µg/L	0.343	0.134	0.343
Mean µg/L	0.120	0.097	0.139

Using concentrations in source water: Martinez = 0.09 µg/L, Sacramento River = 0.095 µg/L, San Joaquin River = 0.57 µg/L, agricultural return flow = 0.11 µg/L, east side = 0.1 µg/L.

The model was also run for the Alternative 4 scenario (CEQA preferred alternative). The model was used to predict volumetric contributions from six source boundaries to Mallard Island, under the altered hydrological conditions in Alternative 4. Mean concentrations were higher than in the existing conditions case: 0.139 µg/L (Table 4-9). For the wet years of 1981-1985, predicted selenium concentrations at Mallard Island were higher (0.168 µg/L) due to higher contributions from the San Joaquin River during that period. The results show greater change in selenium concentrations from existing conditions to preferred alternative (Alternative 4; Table 4-10). For the entire period, the change in total selenium from existing conditions is 15.3%. The change in total selenium from the existing condition for the high San Joaquin contribution years (1981-1985) is also higher at 20.9%. Simulation results for other alternatives considered in the CEQA analysis are included in Appendix A.

Table 4-9
Alternative 4 at Mallard Island: Updated calculations by Tetra Tech

Selenium at Mallard Island	Entire 16-year period (1974-1991)	1987-1991 drought	High San Joaquin contribution (1981-1985)
Min µg/L	0.093	0.093	0.093
Max µg/L	0.367	0.171	0.367
Mean µg/L	0.139	0.105	0.168

Using concentrations in source water: Martinez = 0.09 µg/L, Sacramento River = 0.095 µg/L, San Joaquin River = 0.57 µg/L, agricultural return flow = 0.11 µg/L, east side = 0.1 µg/L

Table 4-10
Mallard Island: Predicted water column change from existing conditions

	Existing conditions, total Se (µg/L)	Preferred alternative (Number 4), total Se (µg/L)	Change (%) from existing
Entire 16-year period (1974-1991)	0.120	0.139	15.3
1987- 1991 drought	0.097	0.105	8.8
High San Joaquin contribution (1981-1985)	0.139	0.168	20.9

Model-simulated selenium concentrations in the water column at Mallard Island were used to predict selenium concentrations in white sturgeon under the existing conditions and Alternative 4. The predicted white sturgeon selenium concentrations and the changes are listed in Table 4-11, Table 4-12 and Table 4-13. Because the function relating water column and white sturgeon concentrations is linear, there is a similar predicted increase in the white sturgeon concentrations from existing conditions to Alternative 4. Importantly, however, the sturgeon values in this calculation are considerably lower than in the original BDCP analysis: mean value of 4.78 mg/g for the entire 16-year simulation, with higher values during drought periods (6.93 µg/g) and periods with high San Joaquin River contribution (5.52 µg/g). For comparison, the 1990 sampling of white sturgeon in Suisun Bay (a dry year) reported a mean value of 5.86 µg/g. Also, the 2006 sampling of sturgeon in San Pablo Bay reported a mean of 7.34 µg/g. If one high value of 18.1 µg/g was excluded, the 2006 average was 6.3 µg/g. Although the fish data are limited, and the concept of using fixed TTFs and Kds for bioaccumulation a great simplification, it appears that for these boundary values, the existing condition fish values are in the range of observations, whereas the EIR/EIS values are clearly higher (16-year mean of 10.21 µg/g, and drought value of 15.27 µg/g; Table 4-4).

Table 4-11
Mallard Island: Updated calculation for concentrations in whole-body white sturgeon by Tetra Tech for existing conditions (updated boundary values)

Selenium in whole-body white sturgeon at Mallard Island	Entire 16-year period (1974-1991)	1987-1991 drought	High San Joaquin contribution (1981-1985)
Mean, µg/g	4.78	6.93	5.52

Using concentrations in source water: Martinez = 0.09 µg/L, Sacramento River = 0.095 µg/L, San Joaquin River = 0.57 µg/L, agricultural return flow = 0.11 µg/L, east side = 0.1 µg/L.

Table 4-12
Alternative 4 at Mallard Island: Updated calculations for concentrations in whole-body white sturgeon by Tetra Tech for (updated boundary values)

Selenium in whole-body white sturgeon at Mallard Island	Entire 16-year period (1974-1991)	1987-1991 drought	High San Joaquin contribution (1981-1985)
Mean, µg/g	5.51	7.54	6.65

Using concentrations in source water: Martinez = 0.09 µg/L, Sacramento River = 0.095 µg/L, San Joaquin River = 0.57 µg/L, agricultural return flow = 0.11 µg/L, east side = 0.1 µg/L

Table 4-13
Tetra Tech updated white sturgeon selenium concentrations change from existing conditions

	Existing conditions, total Se (µg/g)	Preferred alternative (Number 4), total Se (µg/g)	Change (%) from existing
Entire 16-year period (1974-1991)	4.8	5.5	15.3
1987- 1991 drought	6.9	7.5	8.8
High San Joaquin contribution (1981-1985)	5.5	6.7	20.9

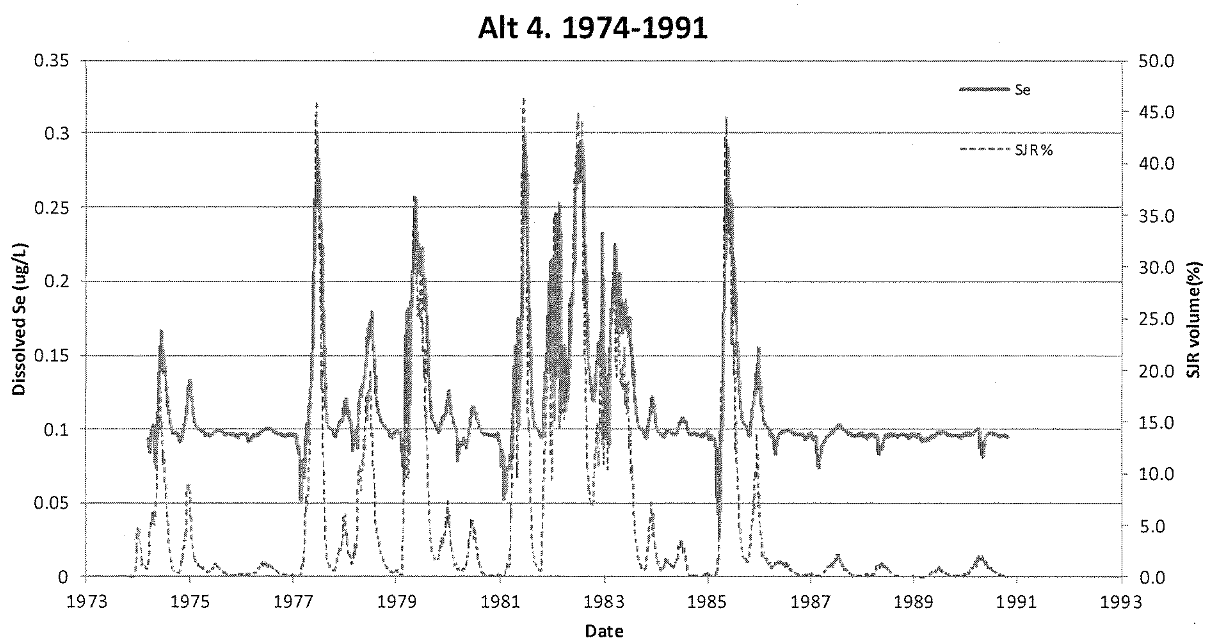

Figure 4-4 *Updated calculations by Tetra Tech for alternative 4 at Mallard Island using source concentrations: of 0.09 µg/L at Martinez, 0.095 µg/L at Sacramento River, 0.57 µg/L at San Joaquin River, 0.11 µg/L in the Agriculture return flow, and 0.1 µg/L in east side tributaries.*

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5 SUMMARY AND RECOMMENDATIONS

5.1 SUMMARY

Selenium concentrations used in the Sacramento River for the BDCP EIR/EIS study (November 2013 public review draft) are biased high, likely due to the inclusion of older analytical values at 1 µg/L. The Sacramento River selenium values are critical to the calculation because this is the dominant flow into the Bay. In the current version of the public review documents, the calculated values of water column selenium in San Francisco Bay (0.21 – 0.31 µg/L at Mallard Island) are more than a factor of two higher than the observed values (from 0.08 to 0.12 µg/L across multiple sampling events in Suisun Bay). Using this water column concentration, the calculated mean values of white sturgeon tissue selenium (9.9 µg/g mean and 15 µg/g drought year value) are higher than observed in the last decade across multiple samples. Although the data are limited, the range of individual observations in composite whole-body fish samples from Suisun Bay is 3.1-10.8 µg/g.

Using valid boundary values for the Sacramento and San Joaquin Rivers (Freeport: 0.095 µg/l and Vernalis: 0.57 µg/l, both based on USGS data), we have updated the water column and white sturgeon calculations. Using the same modeling framework as used in the EIR/EIS, but with the corrected boundary values, we are able to get a reasonable match with the observed data for existing conditions. The model analysis shows that the BDCP preferred Alternative 4 will result in higher water column concentrations than that estimated in the EIR/EIS. Using the bioaccumulation model in the EIR/EIS, we find a similar projected increase in fish tissue concentrations from existing conditions. Some alternatives (besides the CEQA preferred alternative) result in much higher water column selenium concentrations in the Bay.

5.2 RECOMMENDATIONS

The corrections we made to the riverine boundary selenium concentrations are important to consider in any revision to the EIR. Because the Sacramento River is the dominant flow to the Bay-Delta, correct representation of selenium concentrations in this river is important in determining concentrations in the Bay water. The changes to the selenium concentrations in the Sacramento River proposed here improve the match between predicted and observed data for concentrations in the water and in fish species under existing conditions. Predicted selenium concentrations in white sturgeon with updated boundary concentrations were lower in the range of 4.8-6.9 µg/g, which is more in line with recent observations.

Importantly, the new calculations suggest that there is an effect of the BDCP changes to the water column and white sturgeon selenium concentrations at the Mallard Island station for CEQA Alternative 4, representing conditions in Suisun Bay (8-20% increase, depending on the hydrology). This is higher than currently estimated for Alternative 4 at this station (2-5% increase, calculated by Tetra Tech), and may be evaluated in the context of the CEQA conclusion "Relative to Existing Conditions, modeling estimates indicate that all scenarios under Alternative 4 would result in essentially no change in selenium concentrations throughout the Delta." (page 8-476, Draft EIR/EIS). Note that in the bioaccumulation model used in the BDCP analysis the water column and fish tissue concentrations are proportionally related; thus, a change of a given percent in water column concentrations corresponds to the same percent change in fish tissue concentrations. The worst case conditions are not the drought years of 1987-1991, but years where the San Joaquin flow contributions to the Bay are larger, and should also be considered for selenium effects. Should alternatives besides the CEQA preferred Alternative 4 be considered in future phases, Se impacts could be more significant. This potential change needs to be addressed though the EIR/EIS.

Besides correction of the boundary values in the EIR/EIS, other considerations follow. The calculated white sturgeon concentrations with the new boundary conditions are lower under existing conditions, and in the range of the 8.1 µg/g target now proposed by the USEPA as a whole-body fish tissue target (USEPA, 2014). The potential of impairment under existing conditions and current loads from various point- and non-point sources will be addressed by the Regional Board through the total maximum daily load analysis (TMDL) under way, but it is important to note that this modeling suggests that future BDCP changes may well increase water column and fish concentrations greater than what is calculated in the current EIR/EIS. Given this finding, there is a need to monitor the changes in water and fish over the coming years and to consider if any mitigation might be needed.

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APPENDIX A. ACTION ALTERNATIVES EVALUATED IN THE BDCP EIR/EIS

BDCP1433

Table A-1 Alternatives Identified

EIR/EIS alternative number	Conveyance	Conveyance alignment	Intakes selected for analysis	North delta diversion capacity (cfs)	Operations	Conservation components	Measures to reduce other stressors
1A	Dual	Pipeline/tunnel	1,2,3,4,5	15,000	Scenario A	Per BDCP steering committee proposed project	Per BDCP steering committee proposed project
1B	Dual	East	1,2,3,4,5	15,000	Scenario A	Per BDCP steering committee proposed project	Per BDCP steering committee proposed project
1C	Dual	West	West side intakes 1,2,3, 4,5	15,000	Scenario A	Per BDCP steering committee proposed project	Per BDCP steering committee proposed project
2A	Dual	Pipeline/tunnel	1,2,3,4,5	15,000	Scenario B	Per BDCP steering committee proposed project	Per BDCP steering committee proposed project
2B	Dual	East	1,2,3,4,5	15,000	Scenario B	Per BDCP steering committee proposed project	Per BDCP steering committee proposed project
2C	Dual	West	West side intakes 1,2,3,4,5	15,000	Scenario B	Per BDCP steering committee proposed project	Per BDCP steering committee proposed project

EIR/EIS alternative number	Conveyance	Conveyance alignment	Intakes selected for analysis	North delta diversion capacity (cfs)	Operations	Conservation components	Measures to reduce other stressors
3	Dual	Pipeline/tunnel	1,2	6,000	Scenario A	Per BDCP steering committee proposed project	Per BDCP steering committee proposed project
4 (CEQA preferred alternative)	Dual	Pipeline/tunnel	2,3,5	9,000	Scenario H	Per BDCP steering committee proposed project	Per BDCP steering committee proposed project
5	Isolated	Pipeline/tunnel	1,2,3,4,5	3,000	Scenario C	Per BDCP steering committee proposed project	Per BDCP steering committee proposed project
6A	Isolated	Pipeline/Tunnel	1,2,3,4,5	15,000	Scenario D	Per BDCP steering committee proposed project	Per BDCP steering committee proposed project
6B	Isolated	East	West side intakes 1,2,3, 4,5	15,000	Scenario D	Per BDCP steering committee proposed project	Per BDCP steering committee proposed project
6C	Isolated	West	1,2,3,4,5	15,000	Scenario D	Per BDCP steering committee proposed project	Per BDCP steering committee proposed project
7	Dual	Pipeline/Tunnel	2,3,5	9,000	Scenario E	Per BDCP steering committee proposed project	Per BDCP steering committee proposed project

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EIR/EIS alternative number	Conveyance	Conveyance alignment	Intakes selected for analysis	North delta diversion capacity (cfs)	Operations	Conservation components	Measures to reduce other stressors
8	Dual	Pipeline/Tunnel	2,3,5	9,000	Scenario F	Per BDCP steering committee proposed project	Per BDCP steering committee proposed project
9	Through – Delta	Through Delta/Separate corridors	Screened intakes at Delta cross channel and Georgiana Slough	15,000	Scenario G	Per BDCP steering committee proposed project	Per BDCP steering committee proposed project

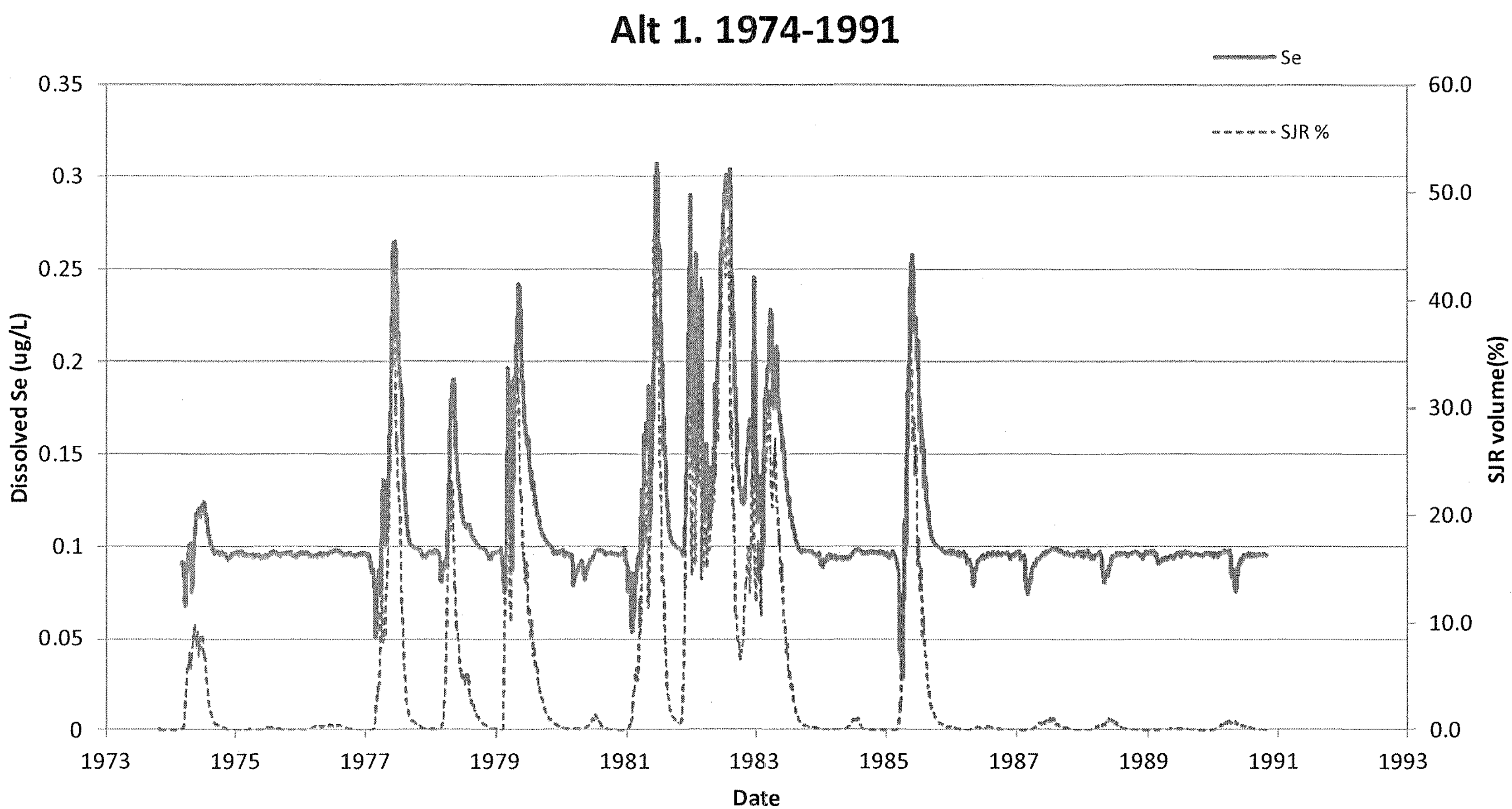

Figure A-1 *Updated calculations by Tetra Tech for alternative 1 at Mallard Island using source concentrations: of 0.09 µg/L at Martinez, 0.095 µg/L at Sacramento River, and 0.57 µg/L at San Joaquin River*

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Table A-2
Updated calculations by Tetra Tech for alternative 1 at Mallard Island

Selenium at Mallard Island	Entire 16-year period (1974-1991)	1987-1991 drought	High San Joaquin contribution (1981-1985)
Min	0.092	0.093	0.093
Max	0.364	0.170	0.364
Mean	0.134	0.102	0.165

Using concentrations in source water: Martinez = 0.09 µg/L, Sacramento River = 0.095 µg/L, San Joaquin River = 0.57 µg/L.

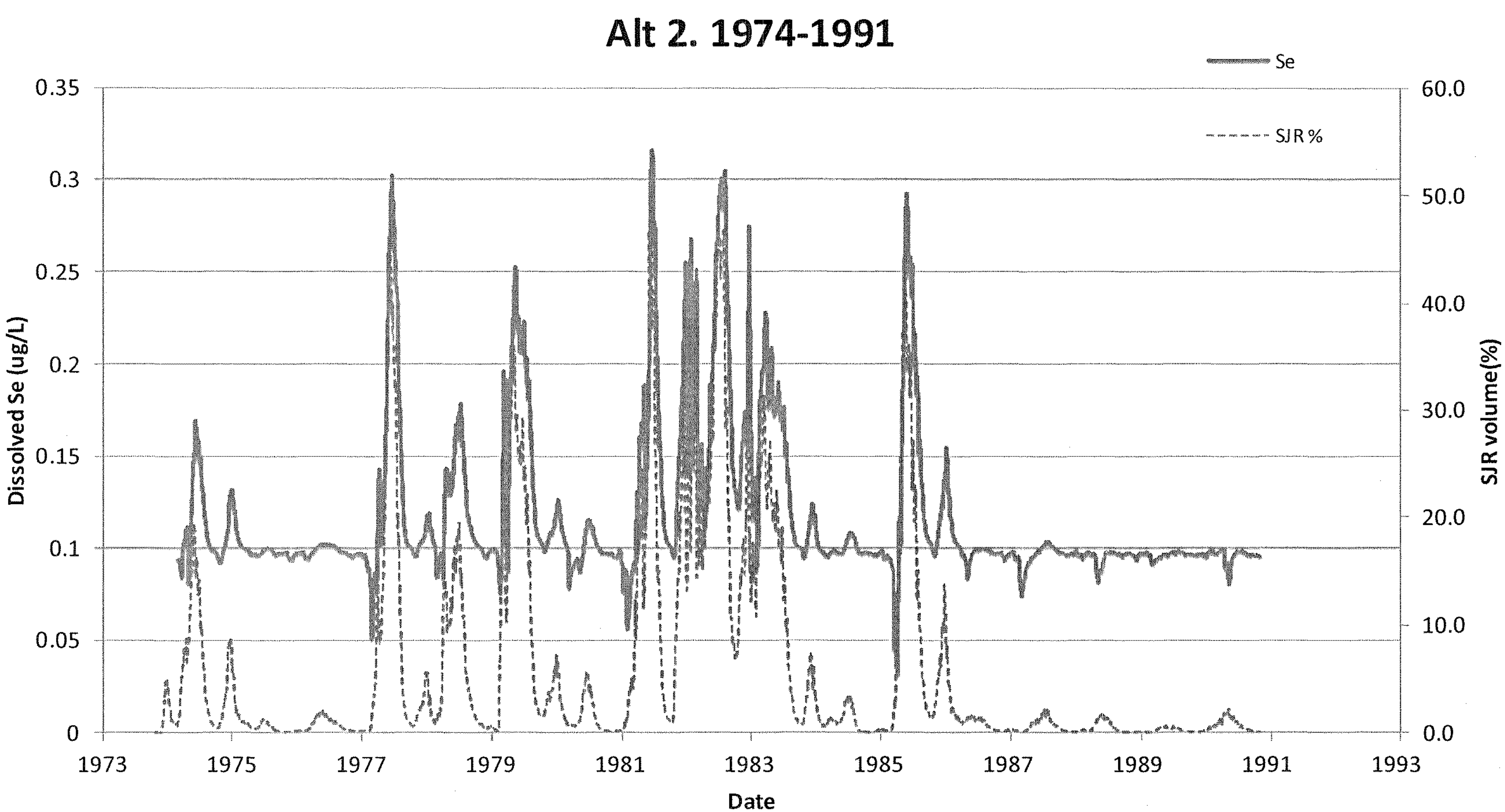

Figure A-2 *Updated calculations by Tetra Tech for alternative 2 at Mallard Island using source concentrations: of 0.09 µg/L at Martinez, 0.095 µg/L at Sacramento River, and 0.57 µg/L at San Joaquin River*

BDCP1433

Table A-3
Updated calculations by Tetra Tech for alternative 2 at Mallard Island

Selenium at Mallard Island	Entire 16-year period (1974-1991)	1987-1991 drought	High San Joaquin contribution (1981-1985)
Min	0.093	0.093	0.093
Max	0.366	0.175	0.366
Mean	0.141	0.105	0.171

Using concentrations in source water: Martinez = 0.09 µg/L, Sacramento River = 0.095 µg/L, San Joaquin River = 0.57 µg/L.

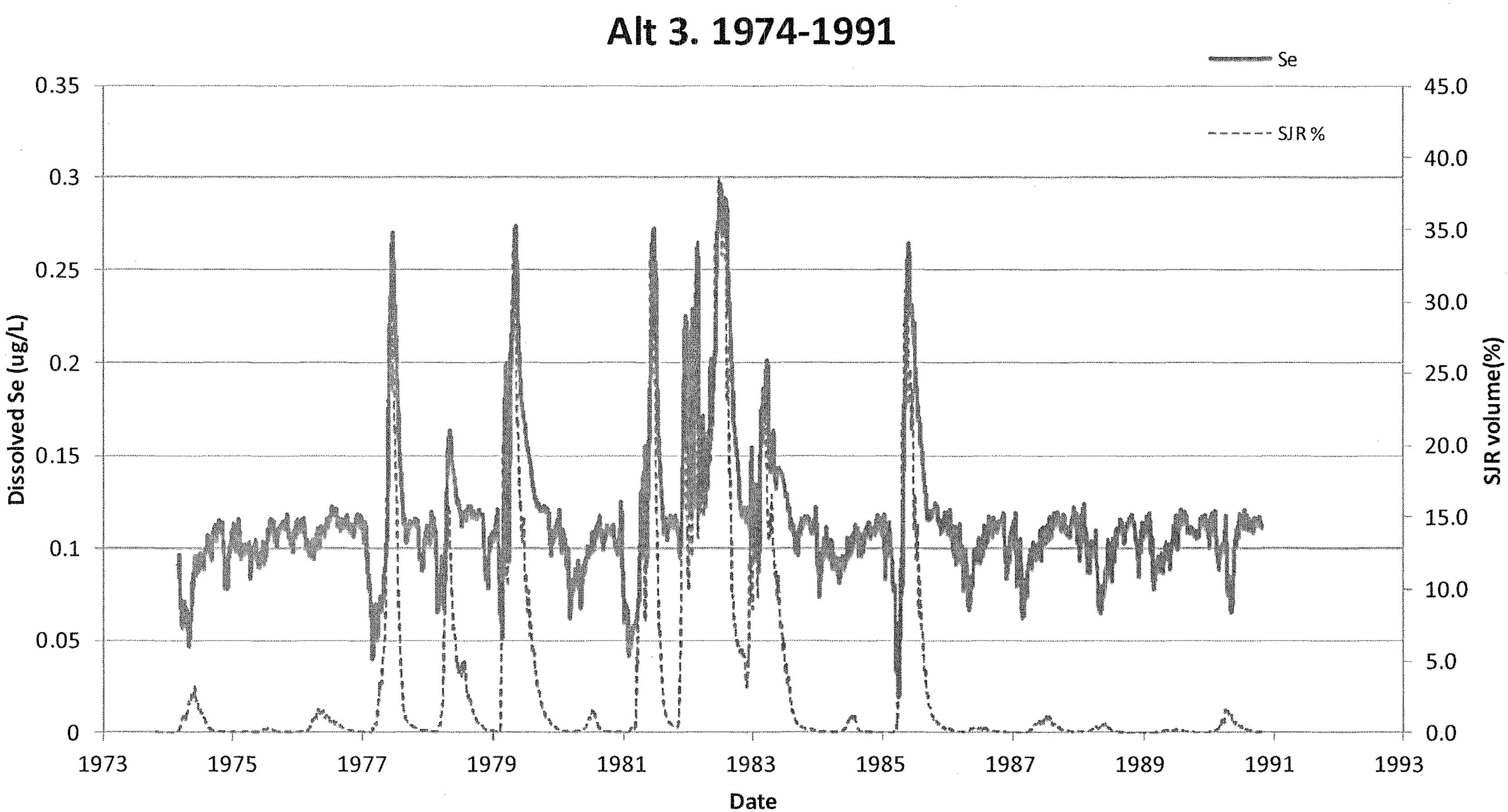

Figure A-3 *Updated calculations by Tetra Tech for alternative 3 at Mallard Island using source concentrations: of 0.09 µg/L at Martinez, 0.095 µg/L at Sacramento River, and 0.57 µg/L at San Joaquin River*

BDCP1433

Table A-4
Updated calculations by Tetra Tech for alternative 3 at Mallard Island

Selenium at Mallard Island	Entire 16-year period (1974-1991)	1987-1991 drought	High San Joaquin contribution (1981-1985)
Min	0.092	0.093	0.093
Max	0.364	0.168	0.364
Mean	0.129	0.102	0.154

Using concentrations in source water: Martinez = 0.09 µg/L, Sacramento River = 0.095 µg/L, San Joaquin River = 0.57 µg/L.

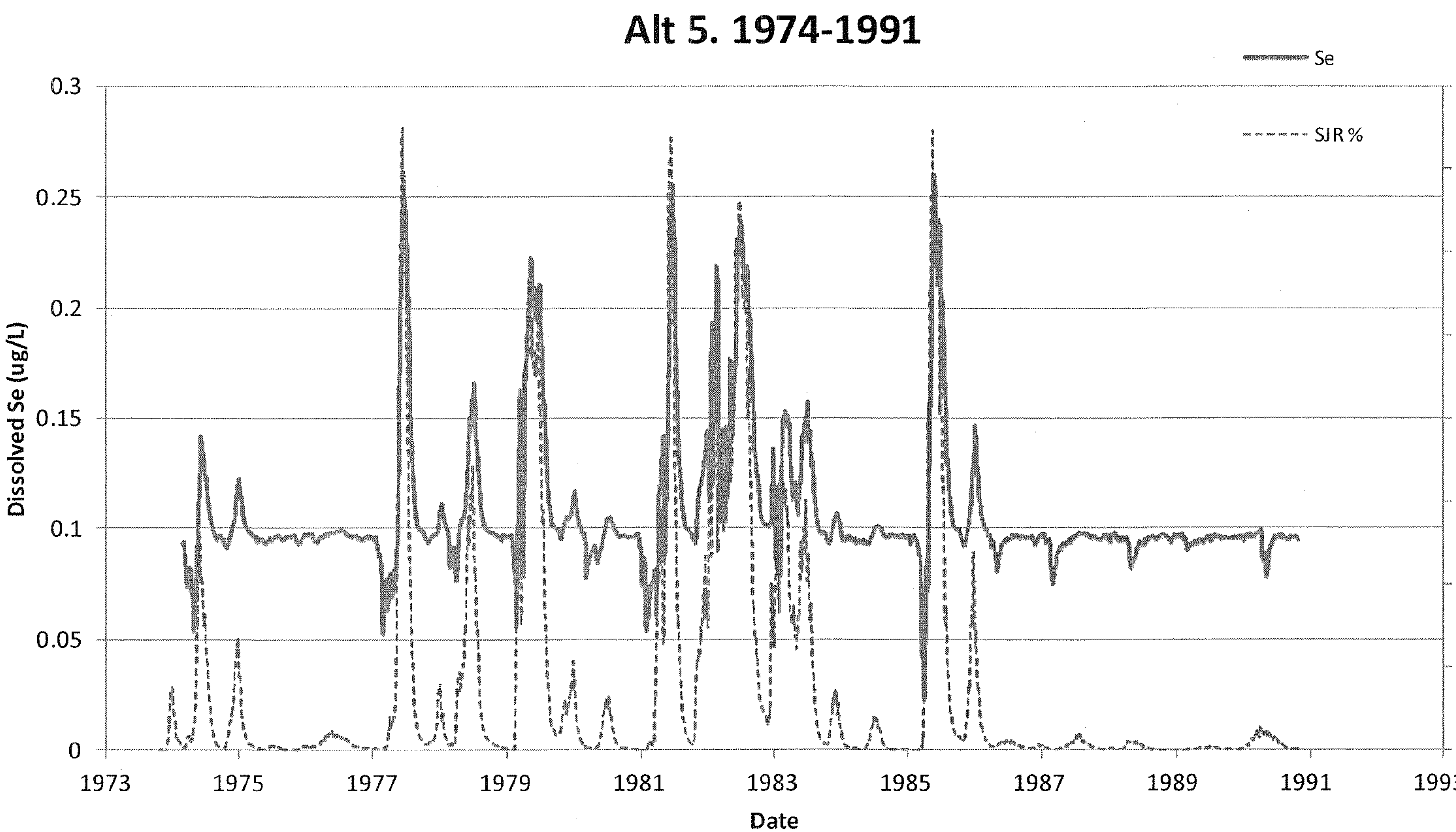

Figure A-4 *Updated calculations by Tetra Tech for alternative 5 at Mallard Island using source concentrations: of 0.09 µg/L at Martinez, 0.095 µg/L at Sacramento River, and 0.57 µg/L at San Joaquin River*

BDCP1433

Table A-5
Updated calculations by Tetra Tech for alternative 5 at Mallard Island

Selenium at Mallard Island	Entire 16-year period (1974-1991)	1987-1991 drought	High San Joaquin contribution (1981-1985)
Min	0.022	0.074	0.053
Max	0.260	0.145	0.255
Mean	0.104	0.091	0.113

Using concentrations in source water: Martinez = 0.09 µg/L, Sacramento River = 0.095 µg/L, San Joaquin River = 0.57 µg/L.

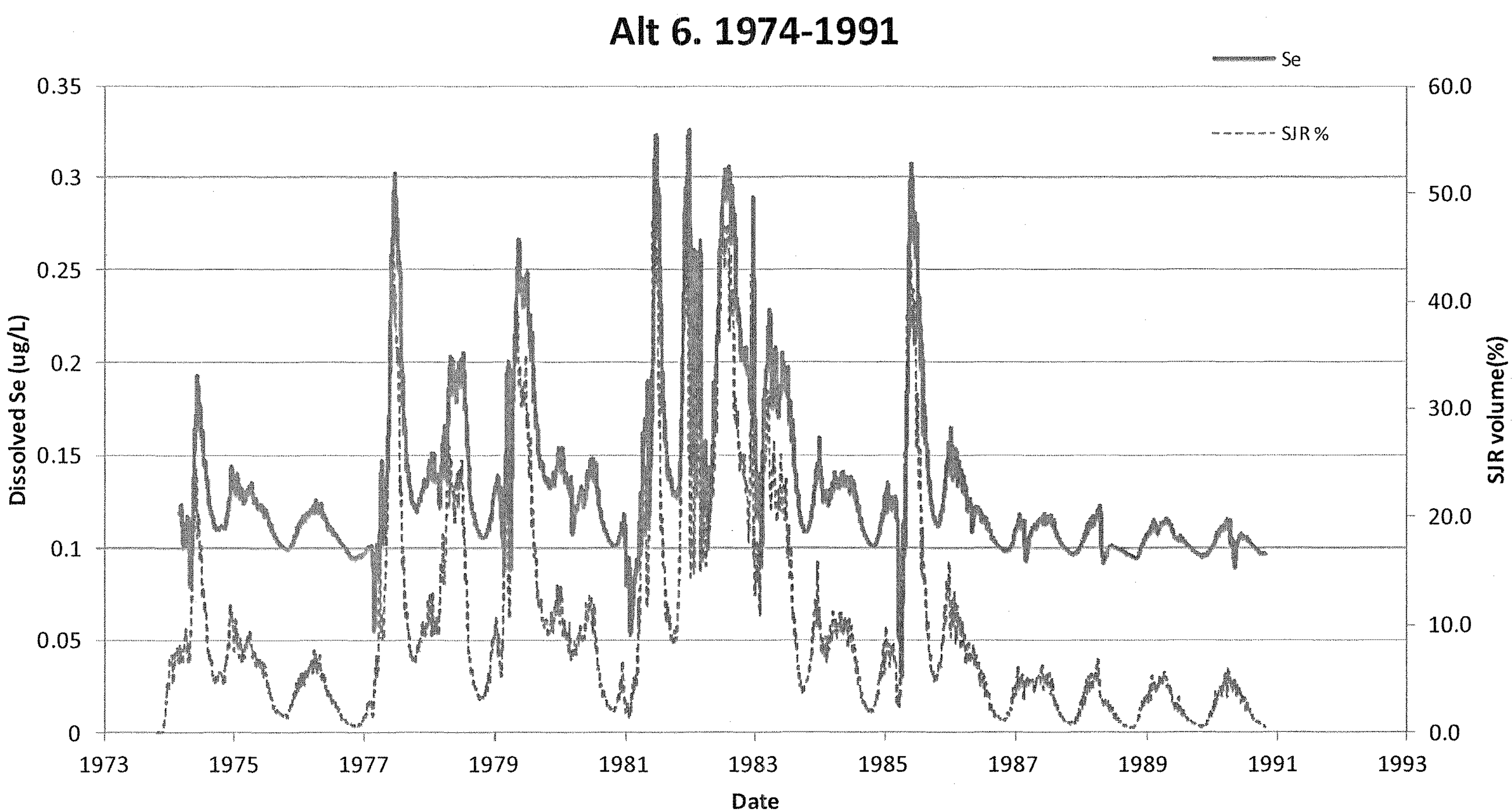

Figure A-5 Updated calculations by Tetra Tech for alternative 6 at Mallard Island using source concentrations: of 0.09 µg/L at Martinez, 0.095 µg/L at Sacramento River, and 0.57 µg/L at San Joaquin River

BDCP1433

Table A-6
Updated calculations by Tetra Tech for alternative 6 at Mallard Island

Selenium at Mallard Island	Entire 16-year period (1974-1991)	1987-1991 drought	High San Joaquin contribution (1981-1985)
Min	0.097	0.097	0.104
Max	0.367	0.187	0.367
Mean	0.160	0.118	0.195

Using concentrations in source water: Martinez = 0.09 µg/L, Sacramento River = 0.095 µg/L, San Joaquin River = 0.57 µg/L.

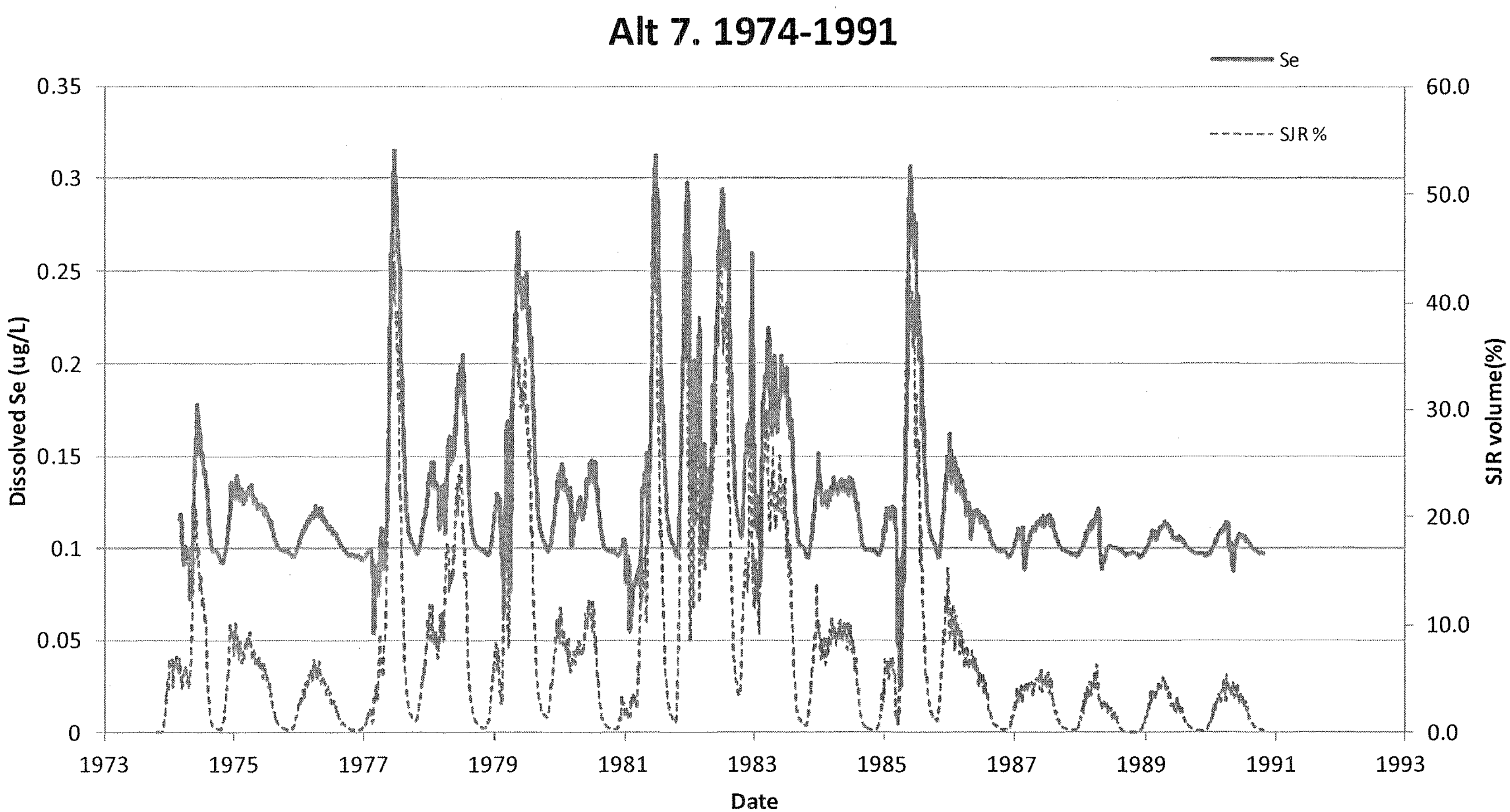

Figure A-6 Updated calculations by Tetra Tech for alternative 7 at Mallard Island using source concentrations: of 0.09 µg/L at Martinez, 0.095 µg/L at Sacramento River, and 0.57 µg/L at San Joaquin River

BDCP1433

Table A-7
Updated calculations by Tetra Tech for alternative 7 at Mallard Island

Selenium at Mallard Island	Entire 16-year period (1974-1991)	1987-1991 drought	High San Joaquin contribution (1981-1985)
Min	0.093	0.093	0.094
Max	0.367	0.190	0.367
Mean	0.149	0.114	0.179

Using concentrations in source water: Martinez = 0.09 µg/L, Sacramento River = 0.095 µg/L, San Joaquin River = 0.57 µg/L.

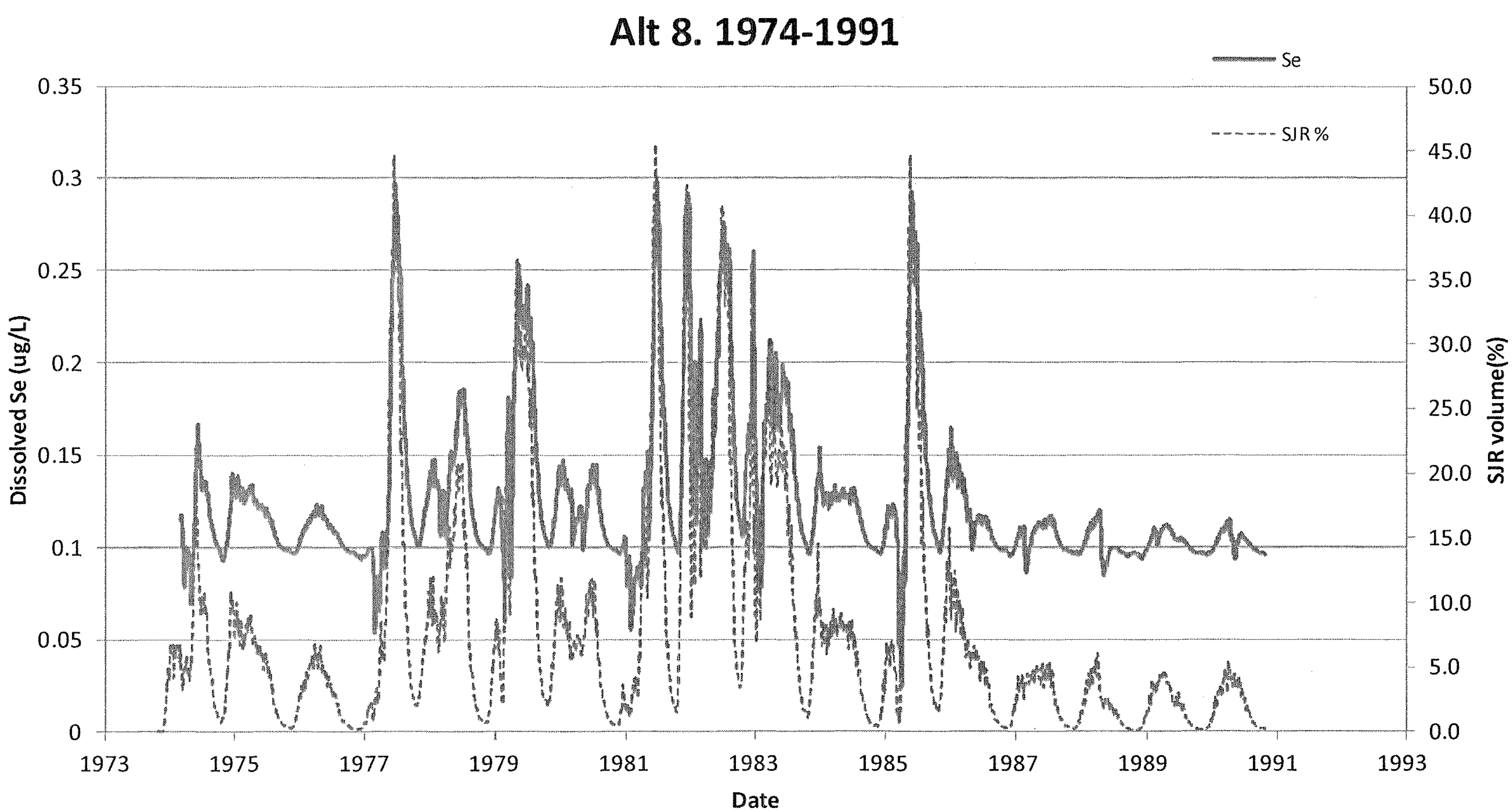

Figure A-7 *Updated calculations by Tetra Tech for alternative 8 at Mallard Island using source concentrations: of 0.09 µg/L at Martinez, 0.095 µg/L at Sacramento River, and 0.57 µg/L at San Joaquin River*

BDCP1433

Table A-8
Updated calculations by Tetra Tech for alternative 8 at Mallard Island

Selenium at Mallard Island	Entire 16-year period (1974-1991)	1987-1991 drought	High San Joaquin contribution (1981-1985)
Min	0.094	0.094	0.095
Max	0.367	0.198	0.367
Mean	0.150	0.115	0.179

Using concentrations in source water: Martinez = 0.09 µg/L, Sacramento River = 0.095 µg/L, San Joaquin River = 0.57 µg/L.

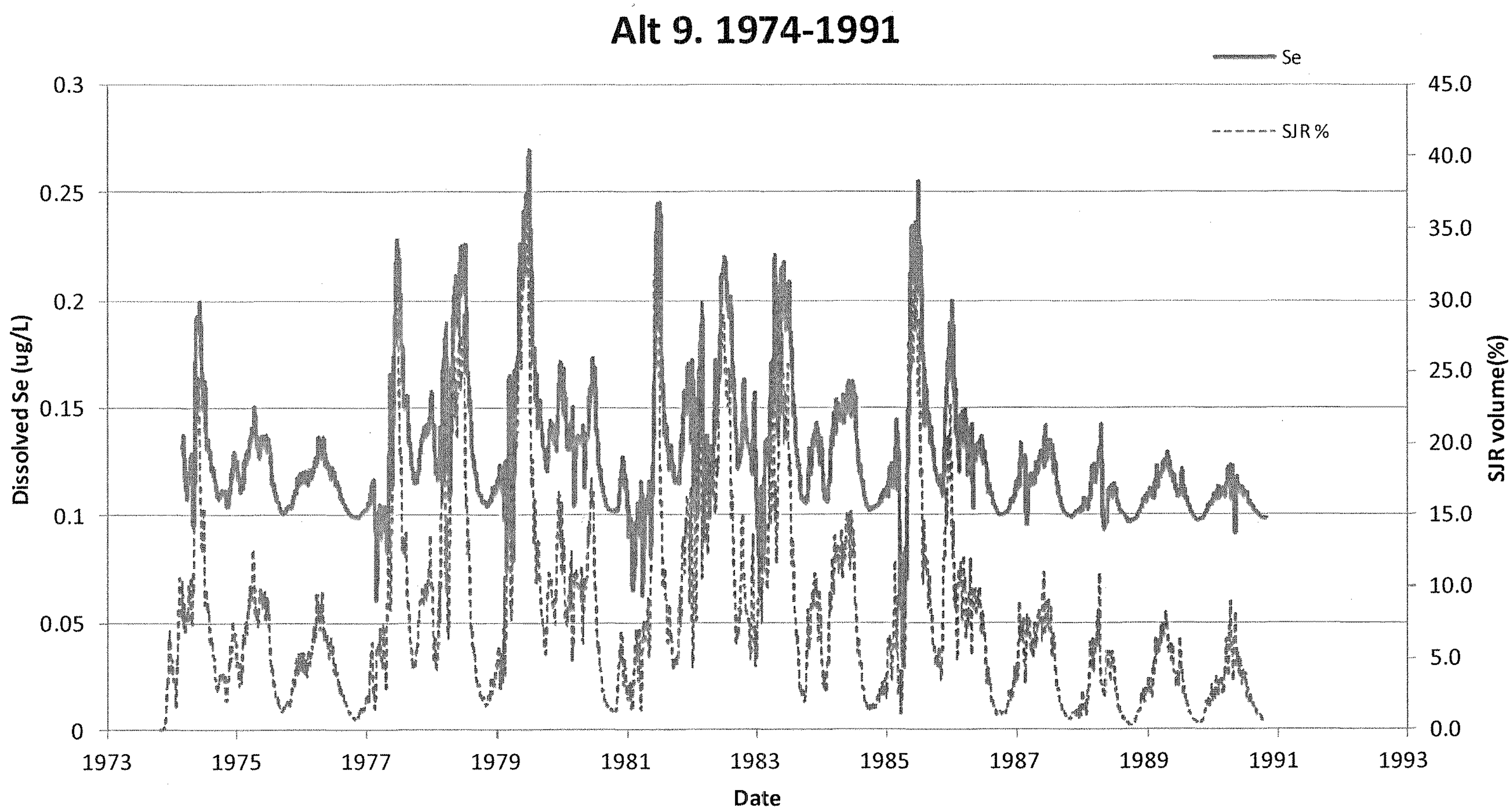

Figure A-8 *Updated calculations by Tetra Tech for alternative 9 at Mallard Island using source concentrations: of 0.09 µg/L at Martinez, 0.095 µg/L at Sacramento River, and 0.57 µg/L at San Joaquin River*

BDCP1433

Table A-9
Updated calculations by Tetra Tech for alternative 9 at Mallard Island

Selenium at Mallard Island	Entire 16-year period (1974-1991)	1987-1991 drought	High San Joaquin contribution (1981-1985)
Min	0.095	0.095	0.100
Max	0.355	0.208	0.355
Mean	0.149	0.121	0.169

Using concentrations in source water: Martinez = 0.09 µg/L, Sacramento River = 0.095 µg/L, San Joaquin River = 0.57 µg/L.

From: CHARLENE McGHEE <CMcGHEE@airquality.org>
Sent: Wednesday, July 02, 2014 9:50 AM
To: BDCP.comments@noaa.gov
Cc: LARRY ROBINSON; CHARLENE McGHEE
Subject: BDCP Draft EIR/EIS Comments from Sacramento Metropolitan Air Quality Management District
Attachments: Comments_ DEIR_EIS_LG signed_7-2-14.pdf

Mr. Wulff

Attached please find the comments from the Sacramento Metropolitan Air Quality Management District on the BDCP Draft EIR/EIS. We appreciate the opportunity to review the project and your consideration of the attached.

Regards,

Charlene McGhee
Associate Air Quality Analyst
Sacramento Metropolitan AQMD| 777 12th Street, 3rd Floor| Sacramento, CA 95814
desk: 916.874.4883 | reception: 916.874.4800

SACRAMENTO METROPOLITAN
AIR QUALITY
MANAGEMENT DISTRICT

BDCP1434

Larry Greene
AIR POLLUTION CONTROL OFFICER

July 2, 2014

Mr. Ryan Wulff
National Marine Fisheries Services
650 Capitol Mall, Suite 5-100
Sacramento, CA 95814

RE: Bay Delta Conservation Plan Draft Environmental Impact Report and Environmental Impact Statement (EIR/EIS)
SMAQMD#: SAC201201424

Dear Mr. Wulff:

Sacramento Metropolitan Air Quality Management District (SMAQMD) appreciates the opportunity to review and comment on the Draft EIR/EIS for the Bay Delta Conservation Plan.

Attached please find an annotated list of our comments for your consideration. We look forward the implementation of these recommendations in the final EIR/EIS document for this project.

Any questions regarding these comments can be directed to Larry Robinson at lrobinson@airquality.org or 916.874.4816 or Charlene McGhee at cmcghee@airquality.org or 916.874.4883.

Regards,

Larry Greene
Executive Director/Air Pollution Control Officer
Sacramento Metropolitan AQMD

Attachment

c: Larry Robinson; Land Use and Transportation Program Coordinator, SMAQMD
Charlene McGhee; Land Use and Transportation Associate Air Quality Analyst, SMAQMD

BDCP1434

Bay Delta Conservation Plan (BDCP)
DRAFT EIR/EIS Comment Form

Document: **BDCP Draft EIR/EIS** (released December 13, 2013)

Comment Source: Sacramento Metropolitan Air Quality Management District (SMAQMD)
Submittal Date: July 2, 2014

No.	Page	Line #	Comment
1	General		Though this is a program level document, we recommend that there be a more detailed estimate of impacts made in the Cumulative Effects sections in each chapter. It is inadequate to simply state an impact could be significant, if the EIR does not also give information regarding the size or scope of the impact. Without that information, decision-makers cannot make informed decisions as to whether the impact is acceptable.
2	General		Given the scope of this project in terms of length of time and cost to construct, to ensure the many air quality mitigation commitments being made (for all pollutants) are met, we recommend that plans be outlined for development of contingency mitigation should any currently proposed mitigation prove infeasible.
3	22-30	Footnote 3	As stated in July 2013 comments; section 22.2.3.2 Greenhouse Gases - Footnote 3 says that "once fully constructed, the project will not be a land use development or stationary source project, and would therefore likely not be subject to land use development and stationary source guidance recommended by the SMAQMD." Any future SMAQMD Rules will apply and compliance is required. Please revise by adding the following (or similar) statement: "If the air district amends its rules in the future, project proponents will need to reevaluate the rule and guidance applicability."
4	22-35	Line 16	SMAQMD does not use mass emission threshold for PM10, but rather a concentration based threshold, which was correctly used for calculations in other sections of the document. The concentration-based threshold should also be used here, or the analysis should explain why the mass emission threshold is being used instead. Without the explanation, we cannot determine whether the DEIR approach is supportable. SMAQMD threshold details are available here http://www.airquality.org/ceqa/cequguideupdate/Ch2TableThresholds.pdf and are recommended for use in all appropriate sections of the document.
5	22-37	Section 22.3.1.4	This section does not satisfactorily explain or justify why dispersion modeling was performed only on Alternative 4. Please include an adequate explanation, or provide dispersion modeling results for all alternatives.
6	22-41	Section 22.3.2.2	NOx is a precursor to both ozone and PM, and while the EIR acknowledges the ozone relationship, it is silent on the role of NOx as a precursor to PM. The CEQA significance threshold for NOx is relevant to both ozone and PM pollution problems. Because the 85 pound threshold is triggered, the analysis should be revised to indicate NOx is a precursor to both summertime ozone and late fall and wintertime PM problems, and that there is a significant impact in both areas. The mitigation obligation would remain the same, because reducing NOx emissions year-round through cleaner equipment addresses both fall/winter ozone and summer PM levels. Because NOx is a precursor to both pollutants, any mitigation fees collected to help meet emission reduction commitments will be used to fund emission

BDCP1434

			reducing strategies designed to address PM or ozone problems by reducing one or more of the following pollutants; PM, NOx and VOC emissions. These strategies include replacement of older construction equipment with newer models, replacement of older on-road-heavy-duty trucks with newer trucks, replacement of wood-burning fireplaces, stoves and inserts with cleaner burning devices, and enforcement of wood-burning prohibitions.
7	22-51 to 22-54	Impact 2 MM AQ-2a	The language of this measure accurately reflects discussions between BDCP consultants and SMAQMD staff at the administrative draft stage of this document. It is worth noting that any decisions regarding general conformity de minimis thresholds being satisfactorily met are up to EPA not the local air district.
8	22-233	MM AQ-2c	Refer to comment #4. Though this mitigation appears accurate given current analysis, if additional analysis is performed on other alternatives, this analysis should change accordingly.
9	22c-17	16	Refer to comment #3. Use the link to locate the SMAQMD threshold for PM2.5 which was overlooked in the PM analysis for this jurisdiction.
10	3B-23	14-20	The mitigation plan takes a progressive approach to requiring use of low- and no-emission technology. Although we support this approach, there is a risk that not all of the measures will be achieved. In light of that, the EIR should include a requirement for contingency plans or measures where particular projects are unable to achieve full compliance with the mitigation plan. Otherwise, there is a risk that the plan will not achieve the reductions needed to mitigate impacts.

BDCP1435.

From: Ohara, Kimberly <Kimberly.Ohara@ladwp.com>
Sent: Wednesday, July 02, 2014 10:29 AM
To: BDCP.Comments@noaa.gov
Cc: Kwan, Delon; Pettijohn, David; Falcon, Penny; Yancy, Winifred
Subject: BDCP Comment Letter From LADWP
Attachments: Final LADWP Comment Letter - JBM Signature.pdf

Good morning,

Attached is a comment letter from the Los Angeles Department of Water and Power on the draft BDCP documents. A hard copy of the letter has also been sent via regular mail.

Best regards,

Kim Ohara
Water System Legislation and Grants
Los Angeles Department of Water and Power
111 N. Hope Street, Room 1463
Los Angeles, CA 90012
(213) 367-5290
(213) 367-5285 (fax)

BDCP1435

Los Angeles Department of Water & Power

ERIC GARCETTI
Mayor

Commission
MEL LEVINE, *President*
WILLIAM W. FUNDERBURK JR., *Vice President*
JILL BANKS BARAD
MICHAEL F. FLEMING
CHRISTINA E. NOONAN
BARBARA E. MOSCHOS, *Secretary*

MARCIE L. EDWARDS
General Manager

July 1, 2014

BDCP Comments
Ryan Wulff, National Marine Fisheries Service
650 Capitol Mall, Suite 5-100
Sacramento, CA 95814

Subject: Comments on the Draft Bay Delta Conservation Plan, Associated Draft Environmental Documents, and Draft Implementing Agreement

Dear Mr. Wulff:

On behalf of the Los Angeles Department of Water and Power (LADWP), thank you for the opportunity to comment on the draft Bay Delta Conservation Plan (BDCP), associated draft Environmental Impact Report/Environmental Impact Statement (EIR/EIS), and draft BDCP Implementing Agreement.

The City of Los Angeles (City) is working diligently to reduce its reliance on water from the Sacramento-San Joaquin Delta (Delta) by implementing a host of local water supply projects and programs outlined in LADWP's 2010 Urban Water Management Plan (UWMP) and the City's 2006 Water Integrated Resources Plan. Those plans identify significant investments in water conservation, water recycling, stormwater capture, and groundwater remediation aimed at reducing by half the City's dependency on imported water purchased from the Metropolitan Water District of Southern California (MWD).

These efforts are consistent with priorities of the California Water Action Plan, issued by the Brown Administration in January 2014, and the 2009 Delta Reform Act, which states:

> *"The policy of the State of California is to reduce reliance on the Delta in meeting California's future water supply needs through a statewide strategy of investing in improved regional supplies, conservation, and water use efficiency."*

Increased local water resource development, conservation, and groundwater cleanup, along with State efforts to ensure reliable deliveries from the Delta, are necessary to secure the City's water future. Local supplies alone will not be sufficient to meet the City's water needs into the foreseeable future, and after fully implementing the local resource development and groundwater remediation programs outlined in the 2010

UWMP, imported supplemental water from the Delta will still be required as part of Los Angeles' water portfolio. That diverse portfolio is particularly important in dry years, when the City will rely on purchased imported water from MWD for up to 50 percent of its supply, with the majority of that purchased water coming from the Delta.

LADWP is the largest municipally owned water and power utility in the nation, serving a 464 square-mile area and delivering water and electricity to nearly four million residents and businesses in the City. The City receives most of its water from the Eastern Sierra Nevada through the Los Angeles Aqueduct, by purchases from MWD, and from locally pumped groundwater. A mix of these sources, along with a strong water conservation ethos and some water recycling, provide the water supply needed to serve the City.

In an average hydrological year, the City now purchases approximately 52 percent of its water supply from MWD, with about 44 percent coming from the Delta and about 8 percent coming from the Colorado River. In dry years, purchased water makes up a much larger percentage of the City's water supply. For example, purchased water will make up about 79 percent of the City's supply during the current year, with about 71 percent coming from the Delta.

The LADWP's experience is that Delta water supplies have already been reduced by about 30 percent in recent years due to concerns about impacts to the Delta fishery system, and we anticipate that maintaining the status quo will result in the continuing decline of the Delta ecosystem and a likely increase in pumping restrictions. The Delta's levee system is at risk from a variety of factors including climate change, sea level rise, land subsidence, earthquake, and storm surge events. In the case of major levee failures in the Delta, water deliveries to Southern California could be disrupted for up to three years. The Los Angeles Economic Development Corporation estimates that a three-year disruption of water deliveries from the Delta could result in a total revenue loss to Los Angeles County of $240 billion.[1]

The City was supportive of the passage of the 2009 Delta Reform Act and continues to monitor the current BDCP process. Consistent with the City's support of the 2009 Delta Reform Act, LADWP supports a solution that provides the following:

- Equitable cost distribution according to a "beneficiary pays" approach.
- Enhanced Delta ecosystem fishery habitat throughout the Delta.
- Increased water supply reliability to the Southern California region.

---

[1] "Total Regional Economic Losses from Water Supply Disruptions to the Los Angeles County Economy," July 23, 2013. Report prepared by A. Rose, I.S. Wing, D. Wei, and M. Avetisyan of the Price School of Public Policy and Center for Risk and Economic Analysis of Terrorism Events, University of Southern California for the Los Angeles County Economic Development Corporation. 54 pages.

- Flexible Delta pumping operations to help reduce the inherent conflict between fisheries and water conveyance.
- Improved export water quality to meet stricter urban drinking water standards while also allowing habitat features that promote a healthy food web for fish.
- Reduced climate change risks to export water supplies, including reduced risk from salinity intrusion and levee failure associated with rising sea levels and storm surge events.
- Reduced risks to export water supplies from seismic-induced levee failure, land subsidence, and subsequent flooding.

Proposals identified in the draft BDCP EIR/EIS could meet the principles for a Delta solution that the City supported in 2009. A viable solution will better protect threatened and endangered fish species, and also address the impacts of climate change on the Delta system, which may result in changes in the water volume and runoff pattern of the Sacramento River and Delta watershed, and a decreased proportion of precipitation that is naturally stored as snowpack.

Because implementation of BDCP will not occur in the Los Angeles area, the primary impact to LADWP ratepayers is cost. The draft BDCP documents, including the Implementing Agreement, do not yet address final cost sharing percentages for the state and federal water contractors. While the draft BDCP documents do include a 36 percent construction contingency, Los Angeles ratepayers and other beneficiaries will be at risk from cost overruns and issues with project delivery that exceed the contingency. In past positions on the Delta and BDCP, the City has established a principle of paying a fair share for the construction of conveyance facilities and associated mitigation. LADWP will continue to monitor negotiations, review future drafts of the implementing agreement, and work to ensure that City ratepayers are not required to bear additional or unjustified costs. It is of paramount importance to LADWP that costs associated with a Delta solution do not impact the ability to invest adequately in local resource projects.

Based on the information available, LADWP staff estimates a typical single-family residential household in Los Angeles would expect to see a $2-3 per month increase in their water bill to pay for the construction of the proposed conveyance facility, also called Conservation Measure 1. This estimate is based on several assumptions and variables, including the following:

- Total cost for the conveyance facility is $14.5 billion, with annual debt service costs of $1.1 billion.
- Costs are shared equitably among water exporters based on water deliveries, with MWD's expected share of the state contractor's cost at about 50 percent.

- LADWP continues to purchase water from MWD at current volumes, which is about 15 percent of MWD's total sales.
- LADWP collects revenue to cover this cost through retail water sales.
- A typical single-family residential household in Los Angeles uses about 12 hundred cubic feet per month.

Chapter 8 also recommends that most of the costs associated with Conservation Measures 2 through 22 (Delta habitat enhancement and restoration and other stressors) and other tasks (monitoring, research, plan administration) should be paid for by State and federal funding sources. LADWP staff agrees with this recommendation, given the statewide and regional benefits provided by these measures and tasks.

LADWP firmly believes that ensuring the reliability of Delta supplies is only one component of the City's water supply equation. Preliminary estimates indicate that meeting the local resource development and groundwater remediation goals outlined in the City's 2010 UWMP will require about $2.5 billion in local projects (capital costs) to reach a total of about 258,800 acre feet per year (AFY) of local water supply, including existing groundwater entitlements. State and federal funding, such as that potentially provided by a 2014 Water Bond, would help to minimize the rate impacts to Los Angeles ratepayers. LADWP urges the state and federal governments to provide additional funding to make local resource development (i.e., water conservation, water recycling, and stormwater capture) and groundwater remediation projects locally cost effective for ratepayers. This funding is critical to reducing future dependence on the Delta.

Local resource development, groundwater remediation, and an improved and reliable Delta water delivery system are complementary efforts and critical to the overall future reliability of the City of Los Angeles' water supply and to the continuing success of its economy. These local efforts are also critical to achieve the environmental benefits that are fundamental to the BDCP by lessening future demands on the Delta. The City's local resource projects go hand-in-hand with a Delta solution and serve to further the Governor's water policy by reducing the City's future reliance on the Delta.

LADWP acknowledges that BDCP is a comprehensive effort to address the chronic water challenges facing both the State Water Project and the Central Valley Project in a manner that also protects the Delta environment. The Delta is currently facing many risks (i.e., earthquakes, levee failure, land subsidence, ecosystem decline, sea level rise, storm surge, climate change, and fish restrictions), which if ignored, will have serious impacts to the City's water supply reliability and economy. There is an opportunity now to implement a long-term solution in the Delta through the implementation of BDCP. However, the State must remember that support for local water resource projects is a necessary and complementary component of the broader statewide water solution, and that proper cost control and allocation of a Delta solution will be necessary to ensure those local resource projects can be constructed.

We appreciate the extended public comment period for the draft BDCP and associated documents to allow for the input of stakeholders, including export interests, and the thoughtful consideration of public input that has characterized the BDCP development process to date.

If you have any questions regarding these comments, please contact Mr. David R. Pettijohn, Director of Water Resources, at (213) 367-0899.

Sincerely,

James B. McDaniel
Senior Assistant General Manager – Water System

KO:vf
c: David R. Pettijohn

From: Sean Karafin <Sean@sdcta.org>
Sent: Wednesday, July 02, 2014 3:13 PM
To: BDCP.comments@noaa.gov
Subject: BDCP Comment Letter
Attachments: image003.emz; SDCTA BDCP Comment Letter 6-1-14 SK.pdf

San Diego County Taxpayers Association

Taxpayers watchdog since 1945

707 Broadway, Suite 905, San Diego, CA 92101 • P: (619) 234-6423 • F: (619) 234-7403 • www.sdcta.org

July 1, 2014

BDCP Comments
Ryan Wulff, National Marine Fisheries Service
650 Capitol Mall, Suite 5-100 Sacramento, CA 95814

Re: Comment on Bay Delta Conservation Plan

Dear Mr. Wulff:

The San Diego County Taxpayers Association (SDCTA) is a non-profit, non-partisan organization, dedicated to promoting accountable, cost-effective and efficient government and opposing unnecessary taxes and fees. Recognizing the economic importance of water, SDCTA is proud to be a regional leader in water research and advocacy. As Co-Chair of the Water Reliability Coalition and as San Diego's chief ratepayer advocate, SDCTA provides leadership in advocating for reliability and ratepayer protections.

On behalf of SDCTA, I would like to invite the California Natural Resources Agency to respond to the specific questions outlined for further SDCTA analysis regarding the Bay Delta Conservation Plan (BDCP).

A. Please identify the methodology used for determining the preferred conveyance size:
    a. Please include where and how the increased conservation anticipated as a result of rate increases is reflected in the methodology.
    b. Please include where and how the increased local supply development incentivized by lessening the cost differential between imported water and local supply development is reflected in the methodology.
    c. Please include where and how the tolerance of ratepayers to invest in local supply development given the higher rates is reflected in the methodology.

B. How does the conveyance sizing account for local projects that are planned across the state? Specifically, if all planned local projects are successfully constructed, how would demand for imported water compare to the state's capacity to import it?

BDCP1436

C. While it is understood by SDCTA that the existing analysis is an environmental process, the feasibility and success of the project will in part be determined by financing mechanisms available. What assurances are offered that planned financing mechanisms will reflect dynamic projections as described in item 'A'?

D. While it is understood by SDCTA that the existing analysis is an environmental process, the feasibility and success of the project will in part be determined by financing mechanisms available. What assurances are offered that rate increases and allocation will be fair, appropriate and competitive with local potable water sources and conservation?

E. For each of the conveyance sizes studied, to what degree is water reliability out of the Bay Delta increased through managing habitat?

F. For each of the conveyance sizes studied, to what degree is the drinking water system protected from seawater contamination that could result from a major earthquake.

If you have any questions, please feel free to contact me at (619) 234-6423 or sean@sdcta.org.

Sincerely,

Sean Karafin
Economic Policy Analyst

Sean Karafin | Economic Policy Analyst | San Diego County Taxpayers Association
707 Broadway, Suite 905 | San Diego, CA 92101
T: (619) 234-6423 x12 | F: (619) 234-7403 | C: (858) 531-2244
E: sean@sdcta.org Twitter: twitter.com/SeanKarafin

BDCP1436

San Diego County Taxpayers Association

Taxpayers watchdog since 1945

707 Broadway, Suite 905, San Diego, CA 92101 • P: (619) 234-6423 • F: (619) 234-7403 • www.sdcta.org

July 1, 2014

BDCP Comments
Ryan Wulff, National Marine Fisheries Service
650 Capitol Mall, Suite 5-100 Sacramento, CA 95814

Re: Comment on Bay Delta Conservation Plan

Dear Mr. Wulff:

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    a. Please include where and how the increased conservation anticipated as a result of rate increases is reflected in the methodology.
    b. Please include where and how the increased local supply development incentivized by lessening the cost differential between imported water and local supply development is reflected in the methodology.
    c. Please include where and how the tolerance of ratepayers to invest in local supply development given the higher rates is reflected in the methodology.

B. How does the conveyance sizing account for local projects that are planned across the state? Specifically, if all planned local projects are successfully constructed, how would demand for imported water compare to the state's capacity to import it?

C. While it is understood by SDCTA that the existing analysis is an environmental process, the feasibility and success of the project will in part be determined by financing mechanisms available. What assurances are offered that planned financing mechanisms will reflect dynamic projections as described in item 'A'?

BDCP1436

D. While it is understood by SDCTA that the existing analysis is an environmental process, the feasibility and success of the project will in part be determined by financing mechanisms available. What assurances are offered that rate increases and allocation will be fair, appropriate and competitive with local potable water sources and conservation?

E. For each of the conveyance sizes studied, to what degree is water reliability out of the Bay Delta increased through managing habitat?

F. For each of the conveyance sizes studied, to what degree is the drinking water system protected from seawater contamination that could result from a major earthquake.

If you have any questions, please feel free to contact me at (619) 234-6423 or sean@sdcta.org.

Sincerely,

Sean Karafin
Economic Policy Analyst

From: Knight, Russell <RKnight@WAPA.GOV>
Sent: Wednesday, July 02, 2014 9:39 AM
To: BDCP.comments@noaa.gov
Cc: Yarbrough, John@DWR (John.Yarbrough@water.ca.gov)
Subject: Additional WAPA Comments on BDCP Draft EIR/EIS

Western Area Power Administration, Sierra Nevada Region (Western)
Additional Comments on the Bay Delta Conservation Plan (BDCP)
Draft Environmental Impact Report/Environmental Impact Statement (EIR/EIS)

In addition to the comments provided by Western under cover letter dated May 19, 2014, Western submits the following comments on the BDCP Draft EIR/EIS as they relate to the evaluation of impacts to the Western transmission system as set forth in Chapters 20 and 21.

1. The proposed expansion of the Clifton Court Forebay will directly impact Western's existing Hurley-Tracy No. 1 and 2 double circuit 230-kilovolt (kV) transmission line (HUR-TRY 1&2), Tracy-Contra Costa/Tracy-Los Vaqueros 69-kV transmission lines (TRY-CC/LV Lines) and the Transmission Agency of Northern California's (TANC) Olinda-Tracy 500-kV transmission line (TANC Line) as part of the California-Oregon Transmission Project. Western operates, maintains, and holds the land easement rights for this impacted segment of the TANC Line. When developing new transmission corridors, Western selects alignments that avoid crossing over or through open bodies of water unless required in order to span over rivers and/or canals. Reasonable access to maintain these transmission lines is critical to the operational reliability of Western's electric network and the TANC Line. An alignment of a Western transmission line over/through the proposed Clifton Court Forebay expansion is unacceptable to Western.

   If the proposed expansion of the Clifton Court Forebay is necessary as part of the BDCP, then the HUR-TRY 1&2, TRY-CC/LV Lines and TANC Line will need to be relocated/rerouted as required by Western and TANC. As these lines are part of the bulk electric system and critical to the reliability of the network, it should be noted that acquiring the necessary outages to relocate these lines may be limited or restricted under certain system operating conditions. The BDCP will enter into an agreement with Western which will include terms and conditions for advance funding and payment of all of Western's costs to relocate/reroute Western transmission lines.

2. For the proposed temporary and permanent transmission lines necessary to serve the BDCP temporary construction activities and ongoing BDCP pumping loads when the tunnels are placed in-service, Western recommends an increase to the width of the proposed transmission line corridors from 150 feet to not less than 300 feet. Evaluating a wider corridor will allow for engineering flexibility during design and final alignment of the temporary construction and permanent easements that are expected to range between 100 and 150 feet for the 230-kV transmission line segments.

BDCP1437

3. Western expects the lead federal agency for the EIS will be the lead federal agency for Section 106 National Historic Preservation Act compliance and all other consultation requirements required by the National Historic Preservation Act and all other laws, orders, and legislation regarding Native American consultation, including appropriate Government-to-Government consultation with federally recognized tribes. The lead agency for Section 106 requirements would be responsible for all appropriate consultation with California State Historic Preservation Office (SHPO), Advisory Council on Historic Preservation, and any other agency requirements. Western recommends that it be a signatory on any Programmatic Agreement and/or other appropriate agreements regarding Section 106 compliance for the BDCP. Western would review all cultural resource documents to ensure adequacy for Western's requirements as appropriate.

4. Western recommends that the transmission line portion of the BDCP be included in the project Endangered Species Act (ESA) and Section 106 (NHPA) consultation and mitigation. If the transmission portion of the project is not sufficiently covered under the project ESA or NHPA consultation and mitigation, then it could cause delays and Western will need to complete additional ESA and NHPA consultation. If Western needs to relocate/reroute existing transmission lines to support the BDCP project, it is likely that Western would need to arrange for a separate ESA and NHPA consultation.

5. One of the BDCP proposed soil spoils area is located in the vicinity of Western's TRY-CC/LV Lines, towers 4/1 through 5/2, west of Clifton Court Forebay. Typically, the Western easement agreement restricts the landowner from piling or placing materials within the easement area. This restriction is needed to insure ground to conductor clearance of not less than 35 feet for the 69-kV circuits. In addition, 30 feet of unobstructed maintenance access is required around the towers.

6. In general, plans for all tunnel crossings, spoil areas and any other use of Western's rights-of-way or easements shall be reviewed and approved by Western during the design phase and prior to construction.

7. Western requires an entity working in or around Western electrical power lines to abide and comply with the National Electric Safety Code and Occupational Safety and Health Administration (OSHA) standards. Equipment within a Western easement area shall not exceed (14) feet in height when the transmission line is energized.

8. During construction activities, BDCP must prevent or minimize the proliferation of dust from contaminating and building up on insulators of nearby Western transmission lines.

9. Abide by Western's General Guidelines for the Use of Electric Transmission Line Rights-of-Way (copy attached).

Western recommends it participate in the BDCP environmental review as a federal Cooperating Agency. As a Cooperating Agency under an appropriate agreement, Western will likely not need to supplement the BDCP NEPA documents, provided the BDCP EIR/EIS addresses Western's requirements. If Western does not become a Cooperating Agency, Western could adopt the BDCP EIR/EIS and then, at a minimum, submit comments on the Draft EIR/EIS and recirculate the document, or prepare its own NEPA document.

BDCP 1437

Whether Western is a federal Cooperating Agency or not, coordination with Western throughout the NEPA process is appropriate and necessary to ensure that any action taken by Western to construct, remove, replace, install, acquire land, acquire easements, perform environmental reviews, etc. associated with the Western transmission system in support of the BDCP project is covered under the BDCP NEPA documentation (including required mitigation).

Western Area Power Administration Contact:

Gerald Robbins
Natural Resources Manager
(916) 353-4032
GRobbins@wapa.gov

Western Area Power Administration
Sierra Nevada Region
114 Parkshore Drive
Folsom, CA 95630

BDCP1437

From: Knight, Russell <RKnight@WAPA.GOV>
Sent: Friday, July 11, 2014 2:55 PM
To: Vang, Maifiny@DWR; BDCP.comments@noaa.gov
Cc: Yarbrough, John@DWR (John.Yarbrough@water.ca.gov)
Subject: RE: Additional WAPA Comments on BDCP Draft EIR/EIS
Attachments: GUIDES Bay Delta Conservation Plan hrm.docx

Maifiny –

Attachment Follows

Attached is the document inadvertently not included with Western's July 2, 2014 email submission of comments under item 9 entitled "Western's General Guidelines for the Use of Electric Transmission Line Rights-of-Way for the Bay Delta Conservation Plan.

Russell Knight
Power Operations Advisor
Western Area Power Administration
Sierra Nevada Region
(916) 353-4523

From: Vang, Maifiny@DWR [mailto:Maifiny.Vang@water.ca.gov]
Sent: Friday, July 11, 2014 1:47 PM
To: Knight, Russell
Subject: RE: Additional WAPA Comments on BDCP Draft EIR/EIS

Hi Russell,

Thanks for the comments. There was supposed to be an attachment for comment #9 that referenced Western's General Guidelines for the Use of Electric Transmission Line Rights-of-Way, however, it appears to have been left out when sent to John. Could you send it?

Maifiny Vang
916-574-0671

From: Knight, Russell [mailto:RKnight@WAPA.GOV]
Sent: Wednesday, July 02, 2014 9:39 AM
To: BDCP.comments@noaa.gov
Cc: Yarbrough, John@DWR
Subject: Additional WAPA Comments on BDCP Draft EIR/EIS

Western Area Power Administration, Sierra Nevada Region (Western)
Additional Comments on the Bay Delta Conservation Plan (BDCP)
Draft Environmental Impact Report/Environmental Impact Statement (EIR/EIS)

In addition to the comments provided by Western under cover letter dated May 19, 2014, Western submits the following comments on the BDCP Draft EIR/EIS as they relate to the evaluation of impacts to the Western transmission system as set forth in Chapters 20 and 21.

June 2014

WESTERN AREA POWER ADMINISTRATION GENERAL GUIDELINES CONCERNING THE USE OF ELECTRIC TRANSMISSION LINE RIGHTS-OF-WAY FOR THE BAY DELTA CONSERVATION PLAN

Western Area Power Administration (Western) owns and maintains the Olinda-Tracy 500-kilovolt (kV) 200 foot wide transmission line right-of-way (ROW), the Tracy-Los Vaqueros and Tracy-Contra Costa 69-kV 175-foot wide transmission line ROW, and the Hurley-Tracy 230-kV double circuit 125 foot wide transmission line ROW. Western's rights within the easement include the right to construct, reconstruct, operate, maintain, and patrol the transmission line.

Rights usually reserved to the landowner include the right to cultivate, occupy, and use the land for any purpose that does not conflict with Western's use of its easement. To avoid potential conflicts, it is Western's policy to review all proposed uses within the transmission line easement. Western considers: (1) Safety of the public, (2) Safety of our Employees, (3) Restrictions covered in the easement, (4) Western's maintenance requirements, and (5) Protection of the transmission line structures and (6) Road or street crossings.

The outline below lists the considerations covered in the review. Please note that some items may overlap. This outline has been prepared only as a guide; each right-of-way encroachment is evaluated on an individual or case-by-case basis.

1. Safety of The Public

   A. Approval depends, to a large extent, on the type and purpose of the development. Western takes our obligation to public safety very seriously. To insure our obligation, any use of the easement that will endanger the public will not be allowed or strongly discouraged (e.g., kite flying is prohibited).

   B. Metal fences must be grounded in accordance with applicable safety codes.

   C. Lighting standards shall not exceed a maximum height of 15 feet and not placed directly under the conductors (wires). All lighting standards must be grounded.

   D. Structures are not allowed on the easement. Structures include, but are not limited to, buildings, sheds, swimming pools, basketball courts, tennis courts, gazebos, etc.

   E. No ground elevation changes are allowed which would reduce the ground to conductor clearance below 35 feet.

2. Safety of Our Employees

Vegetation and encroachments into our right-of-way requires our crews to take action, which places them at risk. Therefore, any vegetation or encroachments that present a risk to our employees will not be allowed.

3. Restrictions Covered In the Easement

The easement prohibits the following: (1) any use that will interfere with or damage the equipment of the United States, (2) digging or drilling of a well, (3) erecting buildings or structures, (4) placing or piling up material within the easement boundaries. The easement gives Western the right to remove trees, brush or other objects interfering with the safe operation and maintenance of the line.

4. Maintenance Requirements

A. Berms shall not be placed next to the base of the transmission line tower.

B. Any proposed improvements to the easement (including grading, parking lot, lighting, landscaping, fences, etc.), must be reviewed by Western to assure that they will not interfere with the safe operation and maintenance of the transmission line.

C. A 14-foot gate is required in any fences that cut off access along our easement.

D. Thirty (30) feet of unobstructed access is to be maintained to and around the towers.

5. Protection of the Transmission Line Structure (Towers, Guy Wires, etc.)

A. If the proposed use increases the possibility of a motor vehicle hitting the transmission line structure, an appropriate guardrail shall be installed to protect the structure (e.g., parking lots or roads).

B. Trench digging within 200 feet of the structures, which would weaken or damage the structures, is prohibited. Also the locations of the tunnels shall not cross at midspan of the structures.

C. No ground elevation changes are allowed within 30 feet of the structures, and in no case shall the conductor to ground clearance be reduced below 35 feet.

D. Abide and comply with the National Electric Safety Code and Occupational Safety and Health Administration (OSHA) standards. These standards shall be applied for equipment, electrical, and non-electrical workers operating around electrical power lines.

E. Utilize water trucks while earth moving equipment is in use to prevent dust contamination on the transmission line insulators.

F. Equipment within the easement area shall not exceed (14) feet in height including tunnel burrowing machines, excavators, backhoes, front-end loaders, cranes or other equipment.

6. Roads or Street Crossings

Western's policy is to have roads or streets cross the easement at right angles, or as nearly at right angles as possible, so that a minimum area of the road or street lies within the transmission line easement.

Plans for the BDCP should be submitted to: Western Area Power Administration, Sierra Nevada Regional Office, Attn: Realty Specialist, 114 Parkshore Drive, Folsom, CA 95630.

BDCP1438.

1947 Galileo Ct., Suite 103 • Davis, California 95618

YOLO-SOLANO AIR QUALITY MANAGEMENT DISTRICT

(530) 757-3650 • (800) 287-3650 • Fax (530) 757-3670

July 1, 2014

BDCP Comments
Ryan Wulff, NMFS
650 Capital Mall, Suite 5-100
Sacramento, CA 95814

Re: **Bay Delta Conservation Plan Draft EIR**

Dear Mr. Wulff:

The Yolo-Solano Air Quality Management District (YSAQMD) has received the above referenced document (DEIR). The DEIR describes various alternatives for the operation of the existing State Water Project Delta facilities and for the construction and operation of conveyance facilities for the movement of water entering the Delta from the Sacramento Valley watershed to the existing State Water Project and federal Central Valley Project pumping plants in the southern Delta.

The YSAQMD would like to make the following comments regarding the proposed project and the DEIR:

1. The DEIR analyzes impacts to air quality for each project alternative described in the DEIR. Not all of these alternatives would produce impacts in the YSAQMD. For alternatives that would generate criteria air pollutants in excess of YSAQMD thresholds, the DEIR proposes implementation of Mitigation Measure AQ-2a to offset the emissions. Mitigation Measure AQ-2a would offset emissions through the payment of offsite mitigation fees that would be used to fund clean air projects, such as the replacement of older vehicles with newer, less emissive vehicles. The projects funded by the offset payments could occur anywhere in the Sacramento Federal Nonattainment Area.

   One of the components of Mitigation Measure AQ-2a is the following:

   - "Develop a compliance program to calculate emissions and collect fees from the construction contractors for payment to SMAQMD. The program will require, as a standard or specification of their construction contracts with DWR, that construction contractors identify construction emissions and their share of required offsite fees, if applicable. Base on the emissions estimates, DWR will collect fees from the individual construction contractors (as applicable) for payment to

SMAQMD. Construction contractors will have the discretion to reduce their construction emissions to the lowest possible level through additional onsite mitigation, as the greater the emissions reductions that can be achieved by onsite mitigation, the lower the required offsite fee. Acceptable options for reducing emissions may include use of late-model engines, low-emission diesel products, additional electrification or alternative fuels, engine-retrofit technology, and/or after-treatment products. All control strategies must be verified by SMAQMD."

Regarding the implementation of this mitigation measure, the YSAQMD would like to emphasize that when a threshold of significance for criteria pollutants is exceeded, on-site emission reductions are always preferable to offsite mitigation. Reducing emissions on-site ensures that reductions occur at the same time and at the same location that the emissions are generated. This is especially true for particulate emissions, the impacts of which are far more localized than the impacts resulting from emissions of ozone precursors. While offsite mitigation of criteria pollutants is a legitimate measure for reducing emissions, and will definitely be necessary if it is determined that emissions should be reduced to "net zero", priority should always be given to limiting emissions from the actual emission source(s). The YSAQMD recommends that emissions from the project be reduced to the greatest extent practicable on-site, and that any remaining emissions be mitigated through Measure AQ-2a.

2. Table 22-9 on page 22-42 of the DEIR shows thresholds of significance that have been adopted by the various air districts in which impacts from the project would occur. The table identifies an increased cancer risk of ten in one million for the YSAQMD as a threshold for long-term exposure to toxic air contaminants (TACs), such as diesel particulate matter. The YSAQMD would like to emphasize that this ten-in-one-million threshold does not apply to impacts from mobile sources, including construction-related vehicles. The YSAQMD's Handbook for Assessing and Mitigating Air Quality Impacts, which provides guidance for analyzing air quality impacts in the District, states that the TAC thresholds are based on the District's Risk Management Policy (page 7). The Handbook further states: "While the District's Risk Management Policy provides a basis for a threshold for TACs from stationary sources, this policy does not cover TACs from mobile sources. The District has no permitting or other regulatory authority over mobile sources. While the District continues to evaluate a threshold of significance for mobile source TAC, no specific mobile source TAC threshold is proposed at this time."

Since the YSAQMD has no official mobile source threshold of significance for TACs, lead agencies can choose a threshold that they believe is appropriate for their analysis. Many analyses for projects that have occurred in the YSAQMD in the past have determined that the ten-in-one-million excess cancer risk stationary source threshold is also appropriate for mobile or construction-related TAC impacts.

In conclusion, the District appreciates receiving the draft EIR for review. If you require additional information or would like to discuss the comments contained in this letter, please feel free to contact me at (530) 757-3668.

Sincerely,

Matthew R Jones

Matthew R. Jones
Planning Manager

From: Ryan Wulff - NOAA Federal <ryan.wulff@noaa.gov>
Sent: Thursday, July 03, 2014 12:42 PM
To: bdcp comments - NOAA Service Account
Subject: Fwd: BCDP COMMENTS
Attachments: 20140625 - Dennis Leary - Walnut Grove.pdf; 20140702 - Rio Linda - Elverta Community Water District.pdf; 20140702 - Yolo Solano Air Quality Management District.pdf; 20140703 - Irvine Ranch Water District.pdf

Sent from my iPhone

Begin forwarded message:

From: Anita Deguzman - NOAA Affiliate <anita.deguzman@noaa.gov>
To: Ryan Wulff - NOAA Federal <ryan.wulff@noaa.gov>
Subject: BCDP COMMENTS

I have attached the following comments for your files.

Copies have been made and are in your mailbox - original letters are up front at the reception desk.

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Anita deGuzman

Administrative Assistant

*NOAA Fisheries * West Coast Region*

*U.S. Department of Commerce *

650 Capitol Mall, Suite 5-100

Sacramento, CA 95814

916-930-3600 <916-930-3600> - main

916-930-3629 - fax

Anita.deGuzman@noaa.gov <Anita.deGuzman@noaa.gov>

<Anita.deGuzman@noaa.gov>

BDCP1438

* <Anita.deGuzman@noaa.gov>*

L # 1439

- ☐ Unused
- ✓ Duplicate of 706
- ☐ Out of Scope
- ☐ Other: ____________________

(replace original)

BDCP1440.

RIO LINDA/ELVERTA COMMUNITY
WATER DISTRICT
P.O. BOX 400 • 730 L STREET
RIO LINDA, CALIFORNIA 95673
Phone: (916) 991-1000 • Fax: (916) 991-6616
www.rlecwd.com

The Honorable Edmund G. Brown Jr.
Governor, the State of California
State Capitol Building, Suite 1173
Sacramento, CA 95814

Mr. Ryan Wulff
National Marine Fisheries Services
650 Capitol Mall, Suite 5-100
Sacramento, CA 95814

RE: Concerns over proposed Delta plans

Dear Governor Brown and Mr. Wulff,

I'm writing you today, as a concerned citizen, to ask that any Delta solution developed by the state does not come at the expense of those who live and work in the Sacramento region. The proposed solutions in the Bay Delta Conservation Plan focus on solving the Delta's environmental problems and Central and Southern California's water supply needs. However, it continues to ignore the needs of Northern California upstream of the Delta. This poses serious risks to our economy, environment and quality of life.

In early 2014, I was shocked and saddened by the drought's impacts upon Folsom Lake and the lower American River. The lake and river are key to the Sacramento region's economy, lifestyle and environment and are crucial in providing water for California's water system and the Sacramento-San Joaquin Delta.

The current draft of the BDCP's Environmental Impact Statement/Environmental Impact report states that as the BDCP is implemented, Folsom Reservoir could go to "dead pool" approximately once every ten years Folsom Lake is crucial not only to our water supplies, but for the entire state. The BDCP acknowledges the possibility of Folsom Lake going dry, but the state is not proactively working toward solving this critical issue.

In this "dead pool" scenario, significant urban populations in Sacramento, Placer and El Dorado counties – including Granite Bay and the cities of Folsom and Roseville – would be essentially cut off from critical surface water supplies for several months. This would devastate the region's economy, devalue property and likely lead to depopulation of cities. It would also ultimately devastate the same environment that

BDCP 1440

the BDCP is looking to restore -- the San Francisco- San Joaquin Bay Delta. These economic and environmental impacts would not only harm the Sacramento Region, but also harm the entire state.

The Sacramento region's water agencies, cities and counties have worked together on a comprehensive review of the current draft of the BDCP and its related documents and have identified fatal flaws. As a concerned citizen of California, I feel it is critical to reiterate the fatal flaws in the current draft of the BDCP.

The current draft of the BDCP is fundamentally inconsistent with existing water rights and contracts held by diverters from Folsom Reservoir (cities of Roseville and Folsom and San Juan Water District). The current plan does not meet the basic federal and state criteria to be considered complete. The BDCP lacks an operational plan for the proposed twin tunnels, and the overall governance of the twin tunnels is unclear. Without clarity in the BDCP about the operation of the twin tunnels, the impacts to Folsom Reservoir remain unclear and our region continues to face the potential of "dead pool" with no clear solutions.

With too many unanswered questions, errors and questionable assumptions, I strongly feel that the current draft of the BDCP should be considered incomplete. I ask that you direct the Department of Water Resources to do a better and more complete job and provide the public with a document that clearly defines a solution to the Delta and also supports a good, comprehensive water plan for all of California.

Sincerely,

Mary Henrici
General Manager
Rio Linda/Elverta Community Water District
mhenrici@rlecwd.com

cc:
Congressmen John Garamendi
State Assemblymen Roger Dickinson
State Senator Darrel Steinberg
U.S. Senator, Barbara Boxer
U.S. Senator Diane Feinstein

BDCP1440

From: Ryan Wulff - NOAA Federal <ryan.wulff@noaa.gov>
Sent: Thursday, July 03, 2014 12:42 PM
To: bdcp comments - NOAA Service Account
Subject: Fwd: BCDP COMMENTS
Attachments: 20140625 - Dennis Leary - Walnut Grove.pdf; 20140702 - Rio Linda - Elverta Community Water District.pdf; 20140702 - Yolo Solano Air Quality Management District.pdf; 20140703 - Irvine Ranch Water District.pdf

Sent from my iPhone

Begin forwarded message:

> **From:** Anita Deguzman - NOAA Affiliate <anita.deguzman@noaa.gov>
> **To:** Ryan Wulff - NOAA Federal <ryan.wulff@noaa.gov>
> **Subject: BCDP COMMENTS**
>
> I have attached the following comments for your files.
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> Copies have been made and are in your mailbox - original letters are up front at the reception desk.
>
> --
>
> *~~~~~~~~~~~~~~~~~~~~~~~~~~*
>
> Anita deGuzman
>
> *Administrative Assistant*
>
> *NOAA Fisheries * West Coast Region*
>
> *U.S. Department of Commerce *
>
> *650 Capitol Mall, Suite 5-100*
>
> *Sacramento, CA 95814*
>
> *916-930-3600 <916-930-3600> - main*
>
> 916-930-3629 - fax
>
> *Anita.deGuzman@noaa.gov <Anita.deGuzman@noaa.gov>*
>
> <Anita.deGuzman@noaa.gov>

* <Anita.deGuzman@noaa.gov>*

BDCP1441.

DENNIS LEARY
13990 State Highway 160
PO Box 186
Walnut Grove, CA 95690

Telephone 916-776-1466

BDCP Comments
Ryan Wulff, National Marine Fisheries Service
650 Capitol Mall, Suite 5-100
Sacramento CA 95814

June 24, 2014

Dear Mr. Wulff:

My really worry concerning the proposed TUNNEL PROJECT [BDCP] is the long term affect on farming in a area that has provided food for the country for almost 160 years. It's location, soil and WATER are the three main reasons that brought the farmers here and the reason we are still here.

The tunnels, as proposed, are of such size that when later the originally proposed pumps, and the additional two intakes are added, the 15000 cu'/sec would doom all of us that are down river from the intakes.

We might live through the construction period, but only with complete destruction of the area.

Several things that bother me are:

1] Is it under or right next to my home as was the first proposed alignment. Why don't we now know where the tunnels would go?

2] The questions that were asked at "public" meetings with DWR officers were never answered. Why were the meetings held?

3] DEWATTERING ! That chapter leaves you with more questions then answers. If wells have to be drilled between 50' and 75' apart ahead of the tunneling machine a path through the orchard would have to be made to make room for the drilling rigs, the removal of the water and muck. Removing water for tunnel construction removes water from the orchard itself, and certainly from any domestic water well in it's path.

By chance I have been following the tunneling project near Seattle where the costs will have far exceeded the estimates, and the period of down time-Dec '13 to March '15 is the present estimate before drilling will be restored. I hope all of you are following this projet.

Most sincerely,

Dennis Leary

Dennis Leary

BDCP 1441

From: Ryan Wulff - NOAA Federal <ryan.wulff@noaa.gov>
Sent: Thursday, July 03, 2014 12:42 PM
To: bdcp comments - NOAA Service Account
Subject: Fwd: BCDP COMMENTS
Attachments: 20140625 - Dennis Leary - Walnut Grove.pdf; 20140702 - Rio Linda - Elverta Community Water District.pdf; 20140702 - Yolo Solano Air Quality Management District.pdf; 20140703 - Irvine Ranch Water District.pdf

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>
> 916-930-3629 - fax
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> *Anita.deGuzman@noaa.gov <Anita.deGuzman@noaa.gov>*
>
> <Anita.deGuzman@noaa.gov>

BDCP 1441

* <Anita.deGuzman@noaa.gov>*

From: Elizabeth Creely <elizabethcreely@yahoo.com>
Sent: Monday, June 30, 2014 10:42 AM
To: BDCP.Comments@noaa.gov
Subject: Abandon the Bay Delta Conservation Plan

Dear Mr. Wulff,
Absolutely not. I do not support exporting more water to encourage urban sprawl. Leave it where it is, and encourage an end to urban development instead.
The Draft Environmental Impact Report/Statement (DEIR/S) for the Bay Delta Conservation Plan (BDCP) uses models based on over-allocated water rights to analyze the plan's impacts, which would result in severe environmental consequences. Building more irrigation infrastructure, as the BDCP proposes, is not going to fix drought problems in California, instead these projects will exacerbate drought conditions. The proposed plan would result in impacts to endangered fish by reducing flows to impaired watersheds, draining estuaries that are essential to healthy river ecosystems, and allowing the continued operation of pumps that will kill fish that are protected under the Endangered Species Act. As proposed, the "conservation plan" is flawed and should be abandoned or revised to reduce exports that take water out of rivers, it should instead prioritize delta recovery, and improve water conservation, recycling and stormwater capture measures.
The 40,000 page BDCP document fails to disclose cumulative effects to our rivers and salmonids. The BDCP contains major flaws resulting in irreversible environmental impacts, and for the many reasons outlined below, the plan must be rejected.

1. Policy must be written into the BDCP to prevent environmental rollbacks from occurring during drought emergencies.
2. In order to mitigate impacts to protected species, delta exports must be reduced, not increased.
3. The BDCP is not consistent with its own biological objectives and the requirements of the federal and state endangered species acts because operation of the tunnels would contribute to the decline of numerous fisheries, which have already decreased by 90% or more since the inception of the State Water Project.
4. Habitat restoration project funding and success must be assured prior to construction of the twin tunnels, because of the uncertainties expressed by the scientific community. No commitment can be made to invest in tunnel costs or construction until restoration actions have demonstrated a benefit to the delta, as called for in the 2009 Delta Reform Act.
5. The BDCP fails Endangered Species Act requirements for ecological benefits to the proposed seasonal floodplain inundation of the Yolo Bypass and impacts to salmonids.
6. In order to avoid take of listed species, the BDCP must be amended to require improvements to fish screens and salvage operations to mitigate reverse flow impacts on fisheries at the existing South Delta export facilities at Jones and Banks that would continue to pump during dry years.
7. In order to comply with the Clean Water Act Section 401 and 303, the BDCP must establish science based flow criteria that restore the Delta through in-stream water rights that provide legal protection for the flow needs of sensitive waterways and the species they support.
8. The Plan's "Conservation Measures" are inadequate and must be amended to include adaptations to climate change that are supported by quantitative data. Policies must be amended to include cost effective climate change responses such as water efficiency, water conservation and demand reduction.
9. DEIR/S Chapter 11 Page 11-55 says that the flow impacts on key fish species migration cannot be determined. This is unacceptable, as the public and scientific community cannot properly assess the validity of a document addressing impacts on endangered fish species the plan is supposed to recover if the impacts to protected species are undetermined.

BDCP 1442

10. BDCP water operations modeling erroneously assumes that the High Outflow Scenario (HOS) water would all come from Oroville, which does not comply with the Coordinated Operations Agreement between DWR and Reclamation. It is likely that Shasta, Trinity and Folsom would see their cold water pools depleted by the HOS.

11. BDCP modeling assumptions that there will be no changes or impacts to the Trinity River are unsubstantiated because there are no specified limits to the amount of water that can be exported from the Trinity River Basin. To avoid significant environmental impacts, the plan must include specific limits of water that can be exported from the Trinity River Basin.

12. The information provided in Chapter 8 does not provide assurances that adequate funding will be provided to implement conservation actions to minimize effects to threatened or endangered species to satisfy the federal Endangered Species Act (USC 1539(a)(2)(A)) or the Natural Community Conservation Planning Act ([Fish & Game Code 2820(a)(10)).

13. BDCP documents must be amended to include specified limits to the amount of water that can be exported from the Trinity River Basin in order to avoid cold water pool depletion.

14. Total consumptive water rights claims for the Sacramento and Trinity River basins exceed annual average unimpaired flows by a factor of 5.6 acre-feet of claims per acre-foot of flow. The Central Valley Project and the State Water Project have failed for decades to have enough water to fulfill the contract-based demands of their numerous contractors in the Central Valley and southern California. The proposed project uses modeling based on water rights that allocate more water than exists. If the project is carried out based on this data, it will result in significant environmental impacts to rivers and fish that have not been disclosed in the DEIR/S.

15. The absence of clearly analyzed and legally reliable water availability for aquatic resources means that the state and federal fishery agencies risk incidental take of protected species for the benefit of the Applicants.

16. The BDCP must outline how new Trinity River management approaches address over allocated water rights and water management for the benefit of fish and the Trinity River watershed communities.

17. The BDCP DEIR/S must be amended to assure that the Trinity River and its beneficial uses will be protected for existing or future CVP and SWP operations to keep viable fish populations below Trinity and Lewiston Dams.

18. Page 5-60 of the BDCP must be amended to prevent catastrophic loss of cold water storage and basic flows to keep fish in good condition below Trinity and Lewiston Dams.

19. In order to protect fish listed under the Endangered Species Act, the proposed project must be amended to include pumping constraints in the Delta that will minimize the risk of losing cold water from the Trinity and Lower Klamath rivers stored in Trinity Lake to out of basin export.

20. BDCP models must be amended to acknowledge the 50,000 acre-feet Humboldt County area of origin reservation of water.

21. Comprehensive Trinity River Basin Plan temperature objectives must be fully described, analyzed and incorporated in the BDCP environmental documentation and policy, as well as the Bureau of Reclamation's state water permits.

22. The BDCP must be amended to include policy that incorporates the NMFS 2000 Biological Opinion for the Trinity River, which includes a minimum carryover storage on September 30 of at least 600,000 AF and requires reconsultation if storage falls below that level.

23. Fracking should not be considered a reasonable use of water under the BDCP. As proposed, the BDCP considers fracking a reasonable use of water. Since the BDCP facilitates fracking, it must also disclose the environmental impacts of fracking. One hydraulic fracking well uses 3 to 8 million gallons per day. California's water is already over allocated and fracking puts water supplies at risk, especially when developers drill through aquifers en route to gas reserves in shale. Waste water from Fracking is so contaminated it cannot be recovered, and the chemicals are left in the ground.

24. The BDCP must address and mitigate impacts to listed species in the Sacramento River including winter and spring run Chinook due to habitat loss and incidental takes such as mortalities caused by pumping facilities, low water quality, and loss of habitat.

In order for the Trinity River to be protected, BDCP and its EIR/EIS must at a minimum include a recommendation that the SWRCB convene a Trinity-specific water right hearing as directed in SWRCB Water Quality Order 89-18. The water right hearing shall license Reclamation's eight Trinity River water permits as follows:

- Conformance with the in-stream fishery flows contained in the Trinity River Record of Decision.
- Provision for release of Humboldt County's 50,000 AF in addition to fishery flows per the 1955 Trinity River Act.

BDCP1442

- Inclusion of permit terms and conditions to require Reclamation to comply with the Trinity River temperature objectives contained in the Water Quality Control Plan for the North Coast Region (NCRWQCB) for all relevant time periods and for all uses of Trinity water diverted to the Sacramento River.

- A requirement to maintain an adequate supply of cold water in Trinity Reservoir adequate to preserve and propagate all runs of salmon and steelhead in the Trinity River below Lewiston Dam during multi-year drought similar to 1928-1934.

- Eliminate paper water in Reclamation's Trinity River water rights.

- Require Reclamation to solve the temperature issue in Lewiston Reservoir through a feasibility study and environmental document to follow up on the 2012 preliminary technical memorandum by Reclamation.

In summary, the Bay Delta Conservation Plan is inadequate for many reasons and if implemented, it would result in major environmental impacts to rivers and estuaries that are already impaired and several fish species that are protected under the Endangered Species Act. Building two giant tunnels to transport water from the San Joaquin Delta is not going to carry out either of the plan's two main goals: to reliably transport more water to San Joaquin farms and Southern California cities, or to restore the fisheries and ecology of the delta. The risks of the proposed project are too great. Please abandon the Bay Delta Conservation Plan before irreparable damage is done.
Respectfully,

Elizabeth Creely
2784 22nd st
san francisco, CA 94110

From: Deborah Dinzes <deborah.dinzes@comcast.net>
Sent: Monday, June 30, 2014 1:32 PM
To: BDCP.Comments@noaa.gov
Subject: Abandon the Bay Delta Conservation Plan

Dear Mr. Wulff,

I'm sure you've read the big long letters coming in detailing all the problems with this proposal. I just want to ask you to please drop this heinous plan. It's clearly a disaster.

I just drove through Northern California yesterday. The drought conditions are killing off hundreds year old oak trees. Northern California simply can't afford to water Southern California. To take away the water from the people and farmers and businesses of the north is a total crime. A crime.

I was in the south, too, last week. They're overcrowded and they have to figure out another alternative to their water problems. When I lived through the drought in Santa Barbara, the city built a desal plant -- and the city's landscaping now looks fine. Back then, it was all dying -- but the desal plant appears to be doing it's job. LA needs to learn to conserve, the farmers down south need to implement better watering schemes. It can be done. It's important for communities to find solutions -- stealing the water from other people isn't a solution.

The risks of the proposed project are too great. Please abandon the Bay Delta Conservation Plan before irreparable damage is done.
Respectfully,

Deborah Dinzes
pob 1092
Summerland, CA 93067

BDCP1444.

From: Barbara LaFargue <siralex9146@att.net>
Sent: Wednesday, July 02, 2014 1:44 PM
To: BDCP.comments@noaa.gov
Subject: Our delta

Please don't ruin our delta so many boaters, site seers need A place just to enjoy and as you know when the government messes with our lives it turns out terribly bad. We are fighting the water weeds that are so bad they are going to over take our sloughs so why don't you work on that problem and it is a big problem you havent addressed in many years it is on its way to killing the boating adventures here so here's hoping you will address the real problem in the delta not make more.

Thanks

Barbara LaFargue

Sent from my iPad

BDCP1445.

From: Food & Water Watch <act@fwwatch.org> on behalf of J. Hester <act@fwwatch.org>
Sent: Monday, June 30, 2014 10:30 AM
To: BDCP.comments@noaa.gov
Subject: I Oppose the BDCP

Jun 30, 2014

Ryan Wulff
650 Capitol Mall. Suite 5-100
Sacramento, CA 95814

Dear Wulff,

I am concerned and alarmed by the proposal for the new tunnel project to redirect water from the Sacramento River.

This project will cost billions of taxpayer dollars at a time when our state cannot afford it. An entire river should not be redirected for the sake of large-scale, unmetered agriculture and the oil industry.

The proposed tunnels have already been rejected by voters in 1982, and similar tunnel projects in places like Santa Barbara County have not been cost effective and have provided little benefit to taxpayers.

We don't want this pork-barrel, impracticable boondoggle or the bill for it. We want our wetlands restored to health, not have their water shipped to Corporate farms. We don't want to subsidise desert farming, especially while our good, fertile bottomlands are being built over with housing and shopping malls.
What we want is for our Governor to live up to his self-projected image as a champion of the People, not a Corporate flunkie. Please, Jerry...Save the wetlands and the S.F. Bay from this corporate rip-off.

Overall, the tunnels are unnecessary and fiscally irresponsible. The existing aquaduct could be reinforced and other local water projects like rainwater collection could be implemented instead, providing a much greater benefit at a lower cost.

Sincerely,

Dr. J. Hester
a
Morgan Hill, CA 95037-9520

BDCP1446.

From: Food & Water Watch <act@fwwatch.org> on behalf of Mary Johnson <act@fwwatch.org>
Sent: Monday, June 30, 2014 12:00 PM
To: BDCP.comments@noaa.gov
Subject: I Oppose the BDCP

Jun 30, 2014

Ryan Wulff
650 Capitol Mall. Suite 5-100
Sacramento, CA 95814

Dear Wulff,

I am concerned and alarmed by the proposal for the new tunnel project to redirect water from the Sacramento River.

This project will cost billions of taxpayer dollars at a time when our state cannot afford it. An entire river should not be redirected for the sake of large-scale, unmetered agriculture and the oil industry.

The proposed tunnels have already been rejected by voters in 1982, and similar tunnel projects in places like Santa Barbara County have not been cost effective and have provided little benefit to taxpayers. I strongly oppose their construction! Put the money into desalinization plants!

Overall, the tunnels are unnecessary and fiscally irresponsible. The existing aquaduct could be reinforced and other local water projects like rainwater collection could be implemented instead, providing a much greater benefit at a lower cost.

Sincerely,

Mrs. Mary Johnson
1134 Strawberry Ct
Sunnyvale, CA 94087-2433

From: Food & Water Watch <act@fwwatch.org> on behalf of Katherine Miller <act@fwwatch.org>
Sent: Tuesday, July 01, 2014 1:31 AM
To: BDCP.comments@noaa.gov
Subject: I Oppose the BDCP

Jul 1, 2014

Ryan Wulff
650 Capitol Mall. Suite 5-100
Sacramento, CA 95814

Dear Wulff,

I am concerned and alarmed by the proposal for the new tunnel project to redirect water from the Sacramento River.

This project will cost BILLIONS of taxpayer dollars at a time when our state cannot afford it.

THE PLAN is SIMPLY NOT REASONABLE!

An ENTIRE river should not be redirected for the sake of LARGE-SCALE, UNMETERED agriculture and the oil industry FRACKING!!

The proposed tunnels were rejected by voters in 1982. Why reconsider them?

Similar tunnel projects in places like Santa Barbara County have NOT been cost effective and have provided little benefit to taxpayers.

Please consider more cost-effective and productive alternatives.

Overall, the tunnels are unnecessary and fiscally irresponsible. The existing aquaduct could be reinforced and other local water projects like rainwater collection could be implemented instead, providing a much greater benefit at a lower cost.

Sincerely,

Ms. Katherine Miller
4349 Mount Jeffers Ave
San Diego, CA 92117-4740