

# Revised Testimony of G. Fred Lee, PhD, BCEES, F.ASCE

Hearing DWR/USBR Request for Change in Point of Diversion  
for CA WaterFix  
2016

# DWR/USBR Assessment of Water Quality/Beneficial Use Impacts of Proposed WaterFix

- DWR/USBR Asserted: Proposed Diversion 9,000 cfs Sacramento River Water at Proposed North Delta Intakes
  - Will Not Cause Adverse Impacts on Delta Water Quality
- P. Nader-Tehrani (p.3 l.11-12 dwr\_66WQ):  
*“The focus of my testimony is on possible changes to water quality and water levels.”*
- Consideration of “Water Quality Impacts”
  - Narrowly Defined – Minimum D-1641
    - Salinity (EC) for Only Part of Delta
    - Cl<sup>-</sup> for Limited Area of Delta
- Not Considered:
  - Wide Range of Existing & Potential Pollutants Impairing Water Quality/Beneficial Uses of Central Delta

# Porter Cologne Act Definitions

CHAPTER 2. DEFINITIONS [13050. - 13051.] (Chapter 2 added by Stats. 1969, Ch. 482.)

§ 13050. [Definitions]

- (f) *“Beneficial uses” of the waters of the state that may be protected against quality degradation include, but are not limited to, domestic, municipal, agricultural and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves.*
- (g) *“Quality of the water” refers to chemical, physical, biological, bacteriological, radiological, and other properties and characteristics of water which affect its use.*

# CA WaterFix – Water Right Change Petition & Water Quality Certification Process Fact Sheet (updated July 21, 2016)

## Fact Sheet (Exhibit CSPA-57):

- *“In order for the State Water Board to approve a change petition, the petitioner must: 1) demonstrate that the change will not initiate a new water right or injure any legal users of water; and 2) provide information on how fish and wildlife would be affected by the change and identify proposed measures to protect them from any unreasonable impacts of the change.”*
- “Water Quality Impact” Evaluation Made by DWR/USBR Does Not Meet Those Conditions

# Bay Delta Conservation Plan Draft EIR/EIS

- Cross-Examination of DWR/USBR Regarding Impacts Other Than EC & CI
  - Responders Stated Those Issues Covered by Draft EIR/EIS
- My Overall Assessment in Comments on BDCP Draft – Exhibit CSPA-58:

Lee, G. F., and Jones-Lee, A., “Comments on Bay Delta Conservation Plan (BDCP) Draft EIR/EIS Chapter 8 – Water Quality, Chapter 25 – Public Health, July 25, 2014,” Comments submitted as part of comments provided by California Sportfishing Protection Alliance, Stockton, CA to Ryan Wulff, NOAA National Marine Fisheries Service, Sacramento, CA, 2 July 28 (2014). [http://www.gfredlee.com/SJR-Delta/Comments\\_BDCP\\_draftEIR\\_EIS\\_July2014.pdf](http://www.gfredlee.com/SJR-Delta/Comments_BDCP_draftEIR_EIS_July2014.pdf)

*“Overall, the draft BDCP EIR/EIS and approaches used in its development are inadequate in scope and reliability for evaluating the potential impacts of diverting substantial amounts of Sacramento River water around or through the Delta on chemical constituents and water quality in Delta channels. The draft EIR/EIS basically used model output of expected changes in the concentrations of a few water quality parameters that have not been found to exceed a water quality objective at a few selected locations in the Delta as was done for this draft EIR/EIS. The approach used does not adequately or reliably consider the range of water quality impacts caused by the wide variety of potential pollutants present in the various Delta channels, that can be expected to result from the removal of large amounts of high-quality Sacramento River water from the Delta by this project.”*

*“An area of the Delta of importance and with which Dr. Lee is particularly familiar is the Central Delta where the Sacramento River mixes with the San Joaquin River below Columbia Cut.”*

*“A properly developed EIR/EIS would have included a detailed analysis of potential errors in predicting constituent concentrations in the various Delta channels and in predicting the changes in flow and associated impacts on constituent concentrations, distribution, and effects. As it stands now Chapter 8 of this EIR/EIS does not reliably inform the public or decision-makers about the magnitude of the errors in estimates and conclusions inherent in the BDCP analysis of the impact of the diversions on Delta water quality/beneficial uses.”*

# Expertise & Experience

- >50 yrs Professional Experience Water Quality Evaluation/Management – Summary Resume (Exhibit CSPA-5)
  - Environmental Engineering, Aquatic Chemistry, Water Quality/Public Health
  - Investigation/Management Water Quality Problems: Domestic Water Supply; Beneficial Uses of Surface, Ground, Estuarine, Nearshore Marine Waters
- Education
  - BA San Jose State University – Environmental Health Science
  - MSPH University North Carolina, Chapel Hill
  - PhD Harvard University – Environmental Engineering (minors: Water Chemistry, Public Health)
- Recent Honors
  - Fellow, ASCE; Outstanding Senior Life Member, Sacramento Section ASCE

# Expertise & Experience

- >25 yrs Delta Water Quality Issues – Exhibit CSPA-60

Lee, G. F., and Jones-Lee, A., “Experience in Reviewing Delta Water Quality Issues,” G. Fred Lee & Associates, El Macero, CA, April 3 (2011). <http://www.gfredlee.com/SJR-Delta/GFLAJL-Delta-EXP-REV.pdf>

- Consultant to Delta Wetlands, Inc. 1989

- Used DWR & USGS Data on Delta Water Quality Characteristics to Assess Anticipated Utility of & Water Quality in Proposed Delta Island Water Supply Reservoirs

- US EPA-Appointed US Representative to Steering Committee for \$50-million, 5-yr OECD Eutrophication Study

- 200 Waterbodies in 22 Countries – Western Europe, North America, Japan, Australia
- Investigate Aquatic Plant Nutrient Load-Eutrophication Response Relationships & Models
- Responsible for Synthesizing & Evaluating US Portion
- Assessment & Documentation of Predictive Capabilities of Nutrient Load-Response Models Developed
- Subsequently Expanded Data Base and Model Evaluation for >750 Waterbodies Worldwide

# Expertise & Experience

- Delta Water Quality Issues (cont'd)
  - Findings of Delta Wetland Islands Evaluation
    - Proposed Island Reservoirs Would Have Poor Water Quality
      - Excessive Growths of Algae & Aquatic Plants Due to Amounts of Nutrients (N & P) in Delta Channel Waters Relative to Morphological Characteristic & Hydraulic Residence Time of Proposed Reservoirs
      - DWR Staff Subsequently Drew Similar Conclusion
  - Consultant to DeltaKeeper (W. Jennings) on Low-DO in SJR DWSC near Stockton
  - Advised SJR DWSC Low-DO TMDL Steering Committee on Low-DO Problems in DWSC

# Expertise & Experience

- Delta Water Quality Issues (cont'd)
  - Selected to Help Rewrite Originally-Rejected Proposal for CALFED Support to Investigate Causes, Implications & Potential Remedies for Low-DO; Revised Proposal Was Funded
  - Selected PI for \$2-million, 12-Investigator CALFED Low-DO Project
  - Developed Synthesis Report of Project Findings (Exhibit CSPA-62):

Lee, G. F., and Jones-Lee, A., "Synthesis and Discussion of Findings on the Causes and Factors Influencing Low DO in the San Joaquin River Deep Water Ship Channel near Stockton, CA: Including 2002 Data," Report Submitted to SJR DO TMDL Steering Committee/Technical Advisory Committee and CALFED Bay-Delta Program, G. Fred Lee & Associates, El Macero, CA, March (2003).  
<http://www.gfredlee.com/SJR-Delta/SynthesisRpt3-21-03.pdf>
  - Developed Supplemental Reports, Including (Exhibit CSPA-63):

Lee, G. F. and Jones-Lee, A., "Supplement to Synthesis Report on the Low-DO Problem in the SJR DWSC," Report of G. Fred Lee & Associates, El Macero, CA, June (2004). <http://www.gfredlee.com/SJR-Delta/SynthRptSupp.pdf>

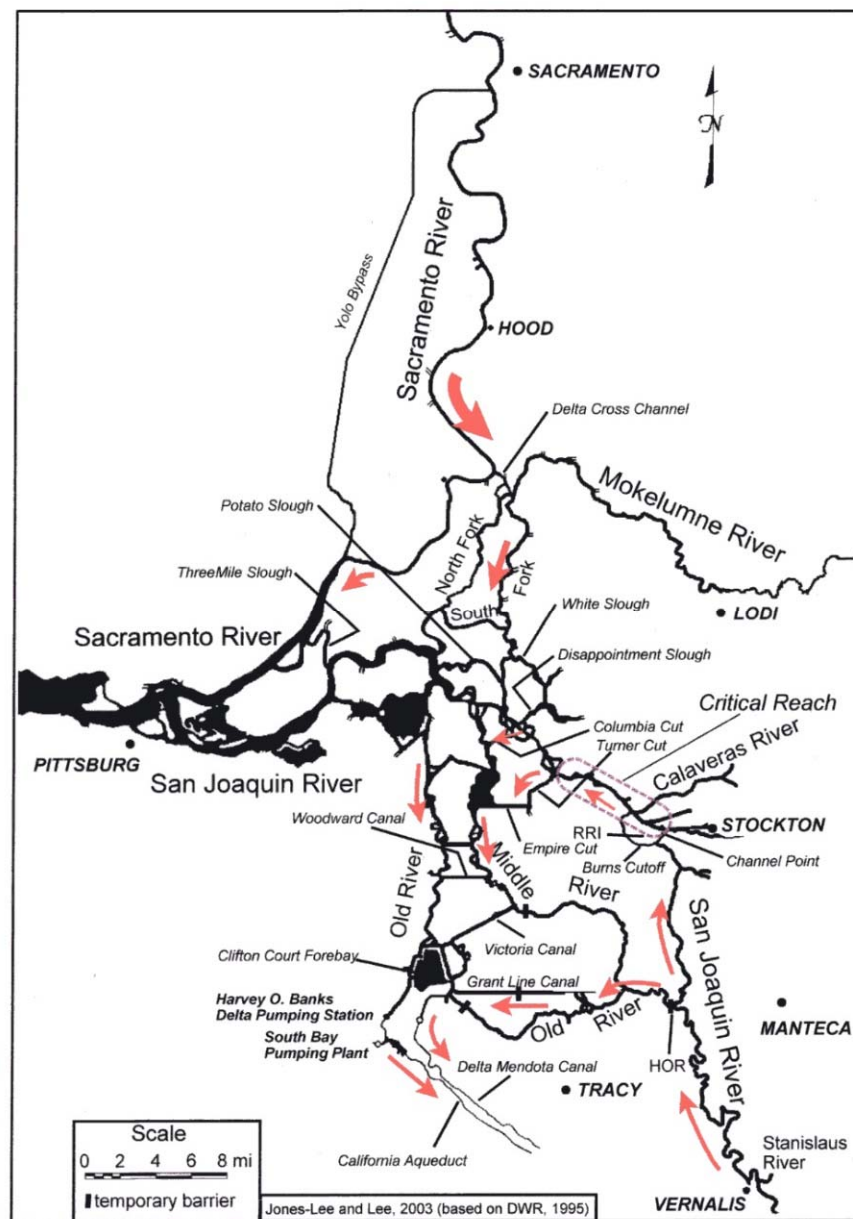


Figure 1 – Exhibit CSPA-64  
Map of the Delta

- San Joaquin River (SJR)
- Turner Cut
- Columbia Cut
- Flow Direction

# Low-DO Study

- Low-DO Condition Rarely Occurs Downstream of Turner Cut
- Additional Sampling Cruises of Central Delta Channels Including Turner Cut & Columbia Cut
  - Findings Report – Exhibit CSPA-65

Lee, G. F., Jones-Lee, A. and Burr, K., "Summary of Results from the July 17, 2003, and September 17, 2003, Tours of the Central Delta Channels," Report of G. Fred Lee & Associates, El Macero, CA (2004). <http://www.gfredlee.com/SJR-Delta/Central-Delta-Tours.pdf>
- Cruises Confirmed: SJR DWSC Water Is Drawn into Central Delta Primarily via Turner Cut & to Lesser Degree, Columbia Cut

# Inadequacies of WaterFix Impact Assessment

- Understanding Impacts of DWR/USBR North Delta Exports
  - DWR Water Quality Sampling Cruises on SJR from Prisoners Point in Western Delta to Port of Stockton – Summer-Fall
  - Example of Results Shown in Figure 2 (Exhibit CSPA-66) and Figure 3 (Exhibit CSPA-67)

[Results Made Available by Jenna Rinde, Environmental Scientist  
Department of Water Resources Division of Environmental Services Bay-Delta Monitoring and Analysis Section West Sacramento, CA  
[jenna.rinde@water.ca.gov]]

Figure 2 – Exhibit CSPA-66  
DO Summary Report for Stockton Ship Channel: 15 August 2016

[from: jenna.rinde@water.ca.gov]

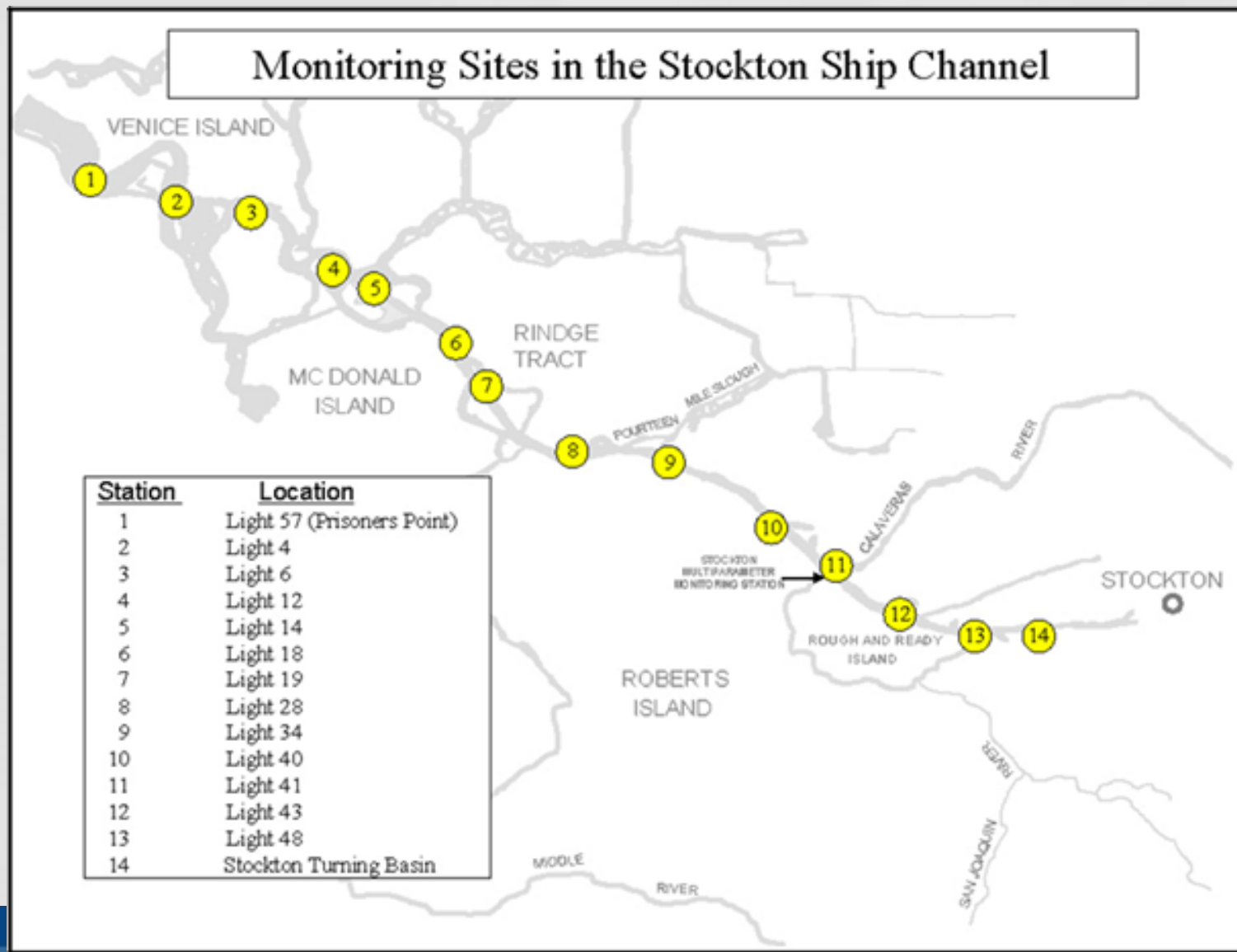
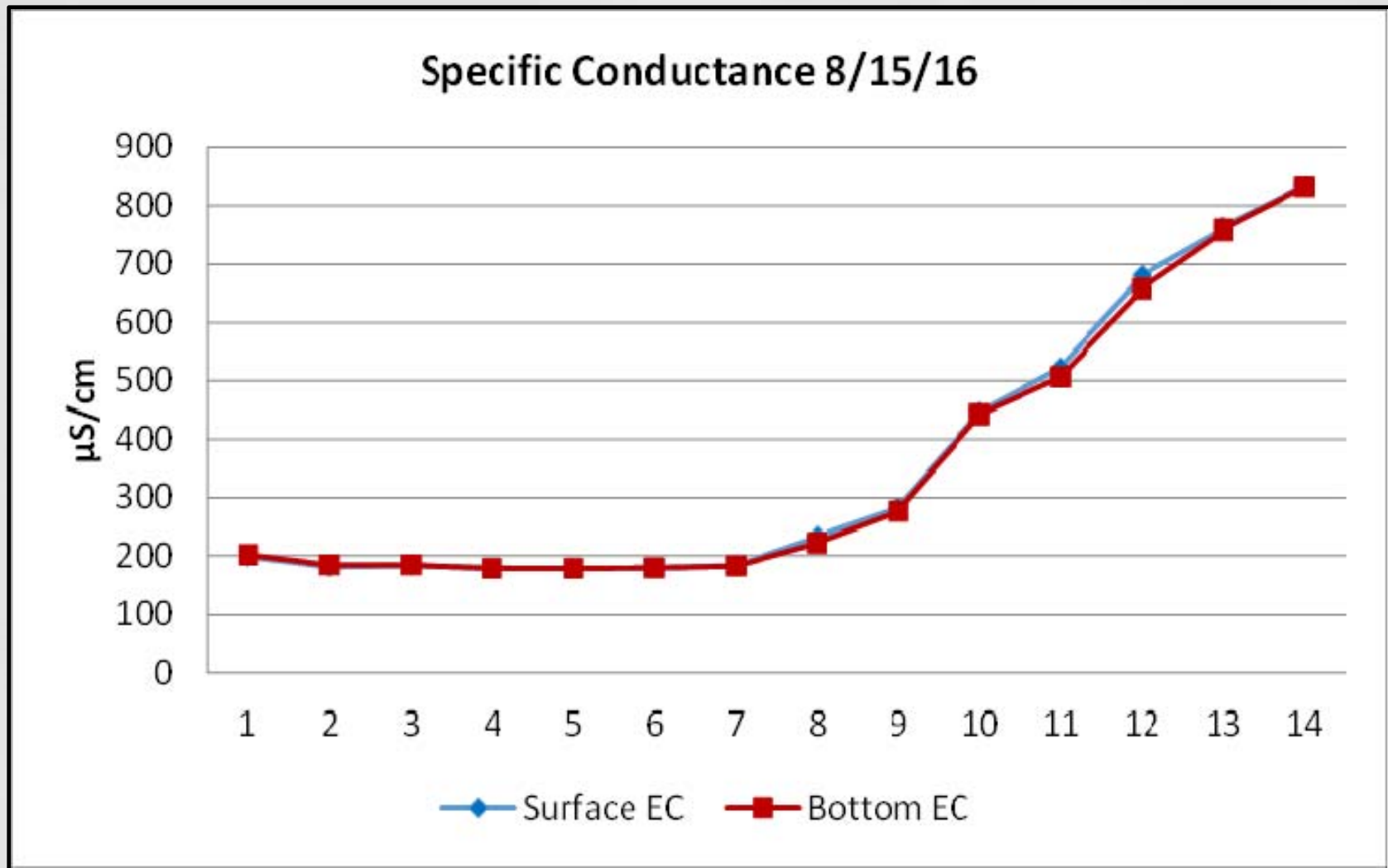


Figure 3 – Exhibit CSPA-67

Specific Conductance of DWSC 8/15/16 [from: jenna.rinde@water.ca.gov]



# Significance of Findings of DWR Cruises

- Sacramento River Water Drawn across Central Delta to South Delta Export Pumps at Banks & Jones Pumping Stations
  - EC of SJR at Stations 12 & 13 (Where SJR Enters DWSC)
    - ~700-750 uS/cm
  - No SJR Water in DWSC Downstream of Station 7
  - All Upstream SJR Water & Its High Pollutant Load Is Drawn into Central Delta
- With WaterFix Diversions
  - South Delta Export Pumps Will Withdraw  $\geq 45\%$  of Exported Water from South Delta
  - Strong Pull of Sacramento River Water to South Delta Will Continue
  - SJR Water & Its Pollutants Will Continue to Be Drawn into Central Delta

# “Impaired Waterbodies” (Exhibit CSPA-68)

[[http://www.waterboards.ca.gov/water\\_issues/programs/tmdl/integrated2012.shtml](http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2012.shtml)]

- *“Listing a water body as impaired in California is governed by the Water Quality Control Policy for developing California's Clean Water Act Section 303(d) Listing Policy. The State and Regional Water Boards assess water quality data for California's waters every two years to determine if they contain pollutants at levels that exceed protective water quality criteria and standards. This biennial assessment is required under Section 303(d) of the Federal Clean Water Act.”*
- *According to D. McClure (CVRWQCB Staff, Personal Communication to G. Fred Lee, August 24, 2016) This Is Currently Applicable*

## Table 1 – Exhibit CSPA-69

### Current US EPA 303(d) List of Water-Quality-Limited Segments – Sacramento River

[[http://www.swrcb.ca.gov/centralvalley/water\\_issues/tmdl/impaired\\_waters\\_list/2008\\_2010\\_usepa\\_303dlist/20082010\\_usepa\\_aprvd\\_303dlist.pdf](http://www.swrcb.ca.gov/centralvalley/water_issues/tmdl/impaired_waters_list/2008_2010_usepa_303dlist/20082010_usepa_aprvd_303dlist.pdf)]

Region	Waterbody Name	Pollutant	Pollutant Category
5	Sacramento River (Knights Landing to the Delta)	Chlordane	Pesticides
5	Sacramento River (Knights Landing to the Delta)	DDT (Dichlorodiphenyltrichloroethane)	Pesticides
5	Sacramento River (Knights Landing to the Delta)	Dieldrin	Pesticides
5	Sacramento River (Knights Landing to the Delta)	Mercury	Metals/Metalloids
5	Sacramento River (Knights Landing to the Delta)	PCBs (Polychlorinated biphenyls)	Other Organics
5	Sacramento River (Knights Landing to the Delta)	Unknown Toxicity	Toxicity

Table 1 – Exhibit CSPA-69 (cont'd)

# Current US EPA 303(d) List of Water-Quality-Limited Segments – Stockton Ship Channel (SSC)

[[http://www.swrcb.ca.gov/centralvalley/water\\_issues/tmdl/impaired\\_waters\\_list/2008\\_2010\\_uspa\\_303dlist/20082010\\_uspa\\_aprd\\_303dlist.pdf](http://www.swrcb.ca.gov/centralvalley/water_issues/tmdl/impaired_waters_list/2008_2010_uspa_303dlist/20082010_uspa_aprd_303dlist.pdf)]

Region	Waterbody Name	Pollutant	Pollutant Category
5	Delta Waterways (SSC)	Chlorpyrifos	Pesticides
5	Delta Waterways (SSC)	DDT	Pesticides
5	Delta Waterways (SSC)	Diazinon	Pesticides
5	Delta Waterways (SSC)	Dioxin	Other Organics
5	Delta Waterways (SSC)	Furan Compounds	Other Organics
5	Delta Waterways (SSC)	Group A Pesticides	Pesticides
5	Delta Waterways (SSC)	Invasive Species	Miscellaneous
5	Delta Waterways (SSC)	Mercury	Metals/Metalloids
5	Delta Waterways (SSC)	Organic Enrichment/Low DO	Nutrients
5	Delta Waterways (SSC)	PCBs	Other Organics
5	Delta Waterways (SSC)	Pathogens	Fecal Indicator Bacteria
5	Delta Waterways (SSC)	Unknown Toxicity	Toxicity

## Table 1 – Exhibit CSPA-69 (cont'd)

### Current US EPA 303(d) List of Water-Quality-Limited Segments – Central Delta

[[http://www.swrcb.ca.gov/centralvalley/water\\_issues/tmdl/impaired\\_waters\\_list/2008\\_2010\\_usepa\\_303dlist/20082010\\_usepa\\_aprvid\\_303dlist.pdf](http://www.swrcb.ca.gov/centralvalley/water_issues/tmdl/impaired_waters_list/2008_2010_usepa_303dlist/20082010_usepa_aprvid_303dlist.pdf)]

Region	Waterbody Name	Pollutant	Pollutant Category
5	Delta Waterways (central portion)	Chlorpyrifos	Pesticides
5	Delta Waterways (central portion)	DDT (Dichlorodiphenyltrichloroethane)	Pesticides
5	Delta Waterways (central portion)	Diazinon	Pesticides
5	Delta Waterways (central portion)	Group A Pesticides	Pesticides
5	Delta Waterways (central portion)	Invasive Species	Miscellaneous
5	Delta Waterways (central portion)	Mercury	Metals/Metalloids
5	Delta Waterways (central portion)	Unknown Toxicity	Toxicity

## “Impaired Waterbodies”

- *SWRCB/USEPA 303(d) List of WQO Violations Limited Compared to a Comprehensive List of Constituents & Areas of Delta That Are Experiencing Impaired Water Quality*
- *Current Water Quality Monitoring Program for Delta Waters Grossly Deficient to Adequately Evaluate Current Water Quality Standard Violations*
- *Deficiencies Recognized for Many Years – e.g., Exhibits CSPA-70, CSPA-71, CSPA-72*
- *Several Attempts to Significantly Improve Current Delta Water Quality Monitoring Program – Deficiencies Remain*

# Deficient Delta Water Quality Monitoring

- *Review of Delta Water Quality Issues & Water Quality Monitoring Needs*

- *Exhibit CSPA-70: Lee, G. F. and Jones-Lee, A., "Overview of Sacramento-San Joaquin River Delta Water Quality Issues," Report of G. Fred Lee & Associates, El Macero, CA (2004). <http://www.gfredlee.com/SJR-Delta/Delta-WQ-IssuesRpt.pdf>*
- *Exhibit CSPA-71: Lee, G. F., and Jones-Lee, A., "Overview—Sacramento/San Joaquin Delta Water Quality," Presented at CA/NV AWWA Fall Conference, Sacramento, CA, PowerPoint Slides, G. Fred Lee & Associates, El Macero, CA, October (2007). <http://www.gfredlee.com/SJR-Delta/DeltaWQCANVAWWAOct07.pdf>*
- *Exhibit CSPA-72: Lee, G. F., and Jones-Lee, A., "Delta Water Quality Standards Violations" and "Comments on Water Quality Sections of the Delta Vision Strategic Plan, Third Staff Draft – dated August 14, 2008," Submitted to Delta Vision Blue Ribbon Task Force, Sacramento, CA. Report of G. Fred Lee & Associates, El Macero, CA, September 1 (2008). <http://www.gfredlee.com/SJR-Delta/DeltaVisionWQViolations.pdf>*

- *CVRWQCB Has Initiated Program to Develop a More Comprehensive Water Monitoring Program*

*[[http://www.swrcb.ca.gov/centralvalley/water\\_issues/delta\\_water\\_quality/comprehensive\\_monitoring\\_program/](http://www.swrcb.ca.gov/centralvalley/water_issues/delta_water_quality/comprehensive_monitoring_program/)]*

# Impact of WaterFix on Central Delta Water Quality

- SJR DWSC at Turner Cut – High Pollutant Concentrations/Loads
  - Drawn into Central Delta Primarily via Turner Cut
- Sacramento River Water Drawn into Central Delta
  - Mixes with SJR DWSC Water
  - Dilutes Pollutants from SJR DWSC – Aiding Water Quality
- Proposed WaterFix North Delta Diversion of Sacramento River:
  - Will Reduce Volume/Flow of Sacramento River Water Entering Central Delta
  - Will Increase Adverse Impacts of Pollutants in Turner Cut on Water Quality/Beneficial Uses of Central Delta Waters

# Delta ISB Comments to Delta Stewardship Council on WaterFix Partially Recirculated DEIR/SDEIS

[<http://deltacouncil.ca.gov/docs/final-delta-isb-comments-partially-recirculated-draft-environmental-impact-reportsupplemental>]

- Transmittal Letter & Comments: Exhibit CSPA-74
- Summarized Overall Conclusion of ISB Regarding Technical Merit & Deficiencies of WaterFix RDEIR/SDEIR:

*“We focused on how fully and effectively it considers and communicates the scientific foundations for assessing the environmental impacts of water conveyance alternatives.”*

*“The effects of California WaterFix extend beyond water conveyance to habitat restoration and levee maintenance. These interdependent issues of statewide importance warrant an environmental impact assessment that is more complete, comprehensive, and comprehensible than the Current Draft.”*

# Algae & Aquatic Plants

- ISB Comments Summary of WaterFix Draft REIR/SEIS Water Quality Discussion of Impacts of Tunnel Diversion Project. Comments Included the Following, Referencing Chapter 8:
  - *“8-75, line 6: The failure to consider dissolved P (DP) should be addressed; there is much greater uncertainty. The adherence of some P to sediment does not prevent considerable discharge of P as DP. Also on page 8-95 line 40, qualify predictions due to lack of consideration of DP.”*
- Amount of Dissolved P Transported into Central Delta by Sacramento River Significantly Impacts Phytoplankton Population in Central Delta
  - Reducing P Load & Concentrations Reduces Algal Biomass in Delta – Even When Available P Is Surplus
- Proposed WaterFix Diversion of Sacramento River Water Will
  - Reduce Amount of Sacramento River Water That Enters Central Delta
  - Effectively Increase Phosphorus Input to Central Delta
  - Effectively Increase Phytoplankton Population in Central Delta

# Algae & Aquatic Plants

- Reduced Dilution of P Concentration in Central Delta Leads to
  - Impaired Water Quality Including:
    - Increased Algae & Aquatic Plants
    - Odors
    - Low DO
    - Sediment Toxicity
    - Floating Scum
    - Blocked Ag Water Intake Screens
  - Adverse Impacts/Injuries to Public/Users of Central Delta Will Be Discussed in Testimony Presented in Part 2 of This Hearing
    - ~~fishing~~
    - ~~boating~~
    - ~~swimming~~
    - ~~aesthetic quality of water~~

# Algae & Aquatic Plants

- Increasing Aquatic Plant Biomass Adversely Affects Water Quality/Beneficial Uses & Injures Public Interests
- My Experience
  - >50 years Investigating Impacts of P Concentrations & Loads, & Water Inflow on Amount of Algae, Blue-green Algae/Bacteria, & Aquatic Weeds (e.g., Water Hyacinth, Egeria) in Hundreds of Waterbodies in US & Abroad, Including an Ice-Covered Antarctic Lake
  - Published >100 papers/Reports on These Issues
- Dr. Erwin van Nieuwenhuyse's Findings
  - Described Response of Avg. Summer Chlorophyll Concentration in Delta to an Abrupt & Sustained Reduction in P Discharge from Sac Regional Sanitation District WWTP
  - Important Information on Impact of Sac Regional Phosphorus Discharge on Planktonic Algae in Delta

# Algae & Aquatic Plants

- **Key Publications Discussed & Incorporated into Testimony:**
  - **Exhibit CSPA-75** - vanNieuwenhuyse, E., “Response of Chlorophyll to Reduced Phosphorus Concentration in the Delta and the Rhine River,” Presentation at CWEMF Technical Workshop, Sacramento, CA, March 25 (2008).  
<http://www.cwemf.org/workshops/DeltaNutrientsWrkshp/VanNieuwenhuyse.pdf>
  - **Exhibit CSPA-76** - van Nieuwenhuyse, E., “Response of Summer Chlorophyll Concentration to Reduced Total Phosphorus Concentration in the Rhine River (Netherlands) and the Sacramento– San Joaquin Delta (California, USA),” Can. J. Fish. Aquatic, Sci. 64(11):1529-1542 (2007).  
[<http://www.ingentaconnect.com/content/nrc/cjfas/2007/00000064/00000011/art00006>]
  - **Exhibit CSPA-77** - Lee, G. F., “Developing Site-Specific Nutrient Criteria & Allowable Discharge Limits,” presentation at the CWEMF Technical Workshop on Delta Nutrient Water Quality Problems: Nutrient Load – Water Quality Impact Modeling,” Sacramento, CA, March 25 (2008).  
<http://www.cwemf.org/workshops/DeltaNutrientsWrkshp/GFredLeeOverview.pdf>
  - **Exhibit CSPA-78** - Lee, G. F., and Jones-Lee, A., “Synopsis of CWEMF Delta Nutrient Water Quality Modeling Workshop – March 25, 2008, Sacramento, CA,” Report of G. Fred Lee & Associates, El Macero, CA, May 15 (2008).  
[http://www.gfredlee.com/SJR-Delta/CWEMF\\_WS\\_synopsis.pdf](http://www.gfredlee.com/SJR-Delta/CWEMF_WS_synopsis.pdf)

## South Delta – Old River

- Low-DO Studies of DWSC Showed Diversion of SJR into Old River at Head of Old River Resulted in More Severe Low-DO Problems in DWSC
  - Reduced SJR Flow through DWSC
  - Increased Residence Time of SJR Water & Oxygen-Demanding Materials in DWSC
  - Result: Greater Low-DO Problems
- Arranged Special Cruise of South Delta Channels
  - Summary of Findings:

Exhibit CSPA-80 - Lee, G. F., Jones-Lee, A. and Burr, K., "Results of the August 5, 2003, Tour of the South Delta Channels," Report of G. Fred Lee & Associates, El Macero, CA, February (2004). <http://www.gfredlee.com/SJR-Delta/South-Delta-Tour.pdf>

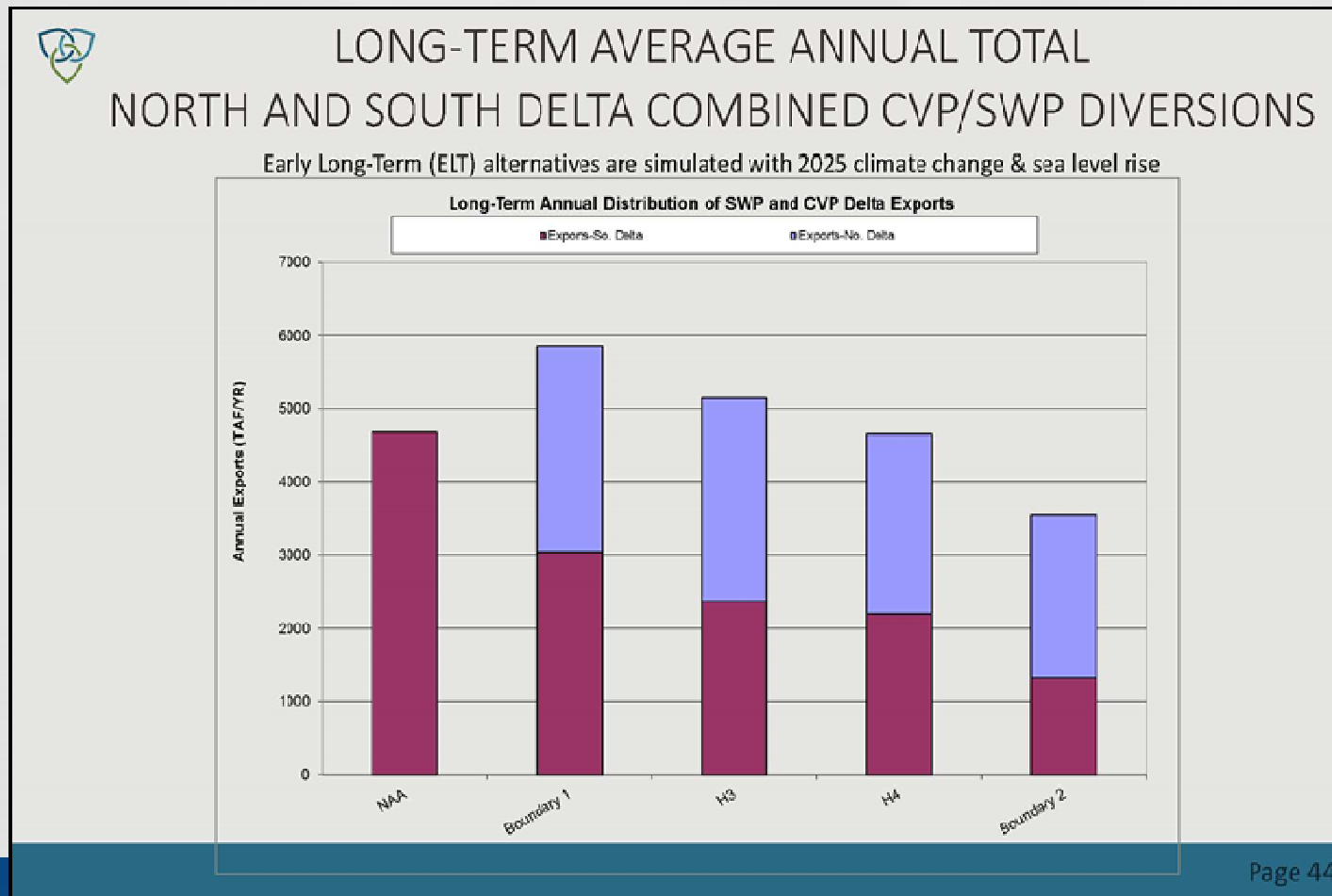
# South Delta Cruise Findings

- ~~Recent Large Fish Kill in South Delta Channel near Tracy Blvd Bridge~~ South Delta Channel Fish Kills Will Be Discussed in Testimony Presented in Part 2 of This Hearing
  - ~~DWR Continuous DO Monitoring: DO Low Night Before Cruise~~
- Low-DO Condition
  - ~~Likely Cause of Fish Kill~~
  - Results from Low Flow in Channel
    - Owing to Presence of DWR Barrier at Western End of That Part of Old River Channel
    - Impacted by Pumping at Banks & Jones Export Pumps
- Proposed WaterFix North Delta Water Diversions on Sacramento River Will, at Times, Result in Decrease in Amount of Water Exported by South Delta Diversions

# Impact of WaterFix on South Delta

- Amount of South Delta Water Exported Will Be Less Than Occurs during NAA (no action alternative)

Exhibit DWR-5-errata



# Reduced Pumping from South Delta

- Can Be Expected to
  - Reduce Flow of Water thru South Delta Channel at Barrier
  - Increase Residence Time of Water in Channel between Tracy Blvd Bridge & Barrier
  - At Times, Result in Greater DO Depletion Than Would Occur under NAA
- This is Another Potentially Significant Adverse Impact of Proposed North Delta Diversion of Sacramento River Water
  - Should Have Been Evaluated by DWR/USBR

# Effects of Delta Flow Diversions - USGS Scientists' Review

- Exhibit CSPA-73 - Monsen, N., Cloern, J., and Burau, J., "Effects of Flow Diversions on Water and Habitat Quality: Examples from California's Highly Manipulated Sacramento-San Joaquin Delta," San Francisco Estuary & Watershed Science, 5(3):1-16, July (2007).  
<http://repositories.cdlib.org/jmie/sfews/vol5/iss3/art2>
- Excerpts from Abstract
  - *"We use selected monitoring data to illustrate how localized water diversions from seasonal barriers, gate operations, and export pumps alter water quality across the Sacramento-San Joaquin Delta (California)."*
  - *"Reduction of export pumping decreases the proportion of Sacramento- to San Joaquin-derived fresh water in the central Delta, leading to rapid increases in salinity."*
  - *Delta Cross Channel gate operations control salinity in the western Delta and alter the freshwater source distribution in the central Delta. Removal of the head of Old River barrier, in autumn, increases the flushing time of the Stockton Ship Channel from days to weeks, contributing to a depletion of dissolved oxygen."*
  - *Each shift in water quality has implications either for habitat quality or municipal drinking water, illustrating the importance of a systems view to anticipate the suite of changes induced by flow manipulations, and to minimize the conflicts inherent in allocations of scarce resources to meet multiple objectives."*

# Effects of Delta Flow Diversions - USGS Scientists' Review

- Monsen et al. (Exhibit CSPA-73) Table 1 - Water Quality Comparison between the Sacramento River, San Joaquin River, and In-Delta Agricultural Return Water for Water Years 1999-2001

Water Quality Parameter	Sacramento at Freeport <sup>1</sup>	San Joaquin at Vernalis	In-Delta Agricultural Return Water <sup>2</sup>
Specific Conductance (mmhos cm <sup>-1</sup> )	144 ± 28	621 ± 183	562 ± 206
pH	7.8 ± 0.2	8.0 ± 0.4	6.8 ± 0.4
Alkalinity (mg CaCO <sub>3</sub> L <sup>-1</sup> )	55 ± 12	85 ± 24	83 ± 18
Dissolved Oxygen (mg L <sup>-1</sup> )	9.8 ± 1.4	9.6 ± 1.4	5.5 ± 2.1
Nitrite+Nitrate (mg N L <sup>-1</sup> )	0.12 ± 0.05	1.62 ± 0.59	
Orthophosphate (mg P L <sup>-1</sup> )	0.024 ± 0.007	0.107 ± 0.054	
Dissolved Organic Carbon (mg C L <sup>-1</sup> )	1.84 ± 0.53	2.83 ± 0.47	14.1 ± 7.7
Total Dissolved Selenium <sup>3</sup> (nmol L <sup>-1</sup> )	0.91 ± 0.27	8.6 ± 2.5	Negligible <sup>4</sup>

<sup>1</sup> USGS Water Quality Database (WY1999-WY2001) for Sacramento (USGS 11447650) and San Joaquin (USGS 11303500) rivers unless otherwise noted.

<sup>2</sup> California Department of Water Resources Municipal Water Quality Investigations Program (WY1999-WY2001) for Bacon Island Pumping Plant (DWR B9V75881342), and Twitchell Island Pumping Plant 1 (DWR B9V80661391) (CDWR 2003); DOC data only from Bacon Island. Different crops produce varying levels of DOC, agricultural return water DOC is expected to vary significantly throughout the Delta.

<sup>3</sup> Sacramento river average from two studies (1984-2000). San Joaquin average from 1997-2000 sampling period. (Cutter and Cutter 2004)

<sup>4</sup> Personal communication AR Stewart, 14 May 2003

Sacramento River Water Has Much Lower Concentrations of Several Potential Pollutants Than SJR

## Effects of Delta Flow Diversions - USGS Scientists' Review

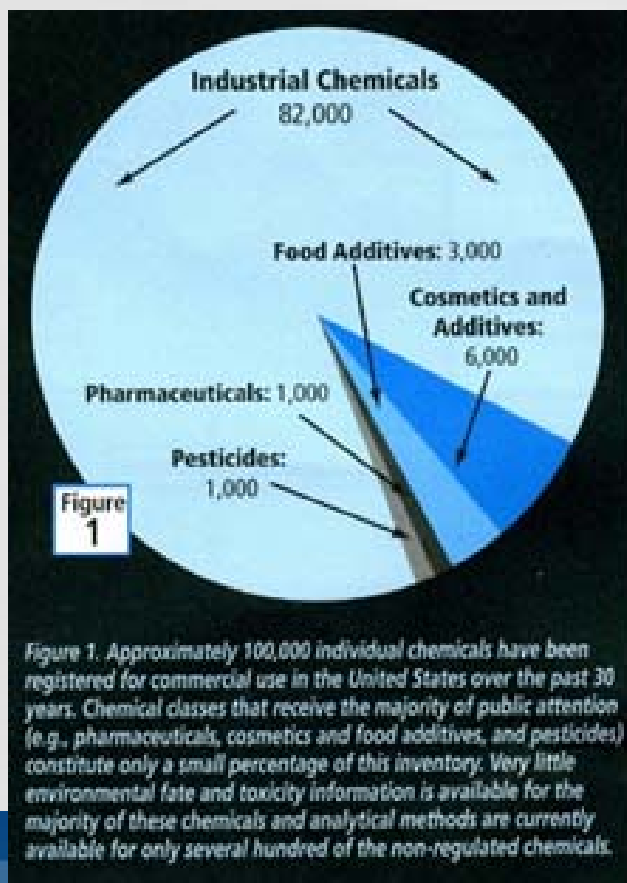
- Monsen et al. (Exhibit CSPA-73) Highlighted Importance of Considering Effects of Manipulation of Delta Water on Pollutant Impact: Will Be Discussed in Testimony for Part 2 of This Hearing (Excerpts)
  - ~~Processes that change concentration fields of pollutants are ecologically important because the toxicity and accumulation of pollutants in food webs are concentration dependent.~~
  - ~~The new pyrethroid pesticides are extremely toxic to invertebrates with sublethal effects at concentrations measured in parts per trillion~~
  - ~~the herbicide diuron inhibits phytoplankton photosynthesis in the Delta at concentrations  $> 2 \text{ ug L}^{-1}$~~
  - ~~phytoplankton accumulate methyl mercury at concentrations 10,000 times those in water~~
  - ~~bioaccumulation of toxic metals (e.g. copper, cadmium, silver, chromium) in invertebrates and fish depends on concentrations of those elements in water and prey~~
  - ~~We have learned empirically how individual diversions modify salt concentrations across the Delta, but we have not yet considered how they modify distributions of land-derived pollutants and their threats to wildlife or human health.~~

# Unrecognized & Unregulated Pollutants

- Experience in Developing, Evaluating, Applying Water Quality Criteria, Standards, Objectives for Protection of Water Quality, Including Invited Peer-Reviewer for
  - NAS-NAE “Blue Book” of Water Quality Criteria
  - AFS Peer-Review Panel for US EPA “Red Book” of Water Quality Criteria
  - US EPA “Gold Book” of Water Quality Criteria
- Summary of Experience in Exhibit CSPA-81:
  - G. Fred Lee and Anne Jones-Lee Expertise and Experience in Water Quality Standards and NPDES Permits Development and Implementation into NPDES Permitted Discharges <http://www.gfredlee.com/exp/wqexp.htm>
- DWR/USBR Evaluation of Impact of North Delta Sacramento River Diversions Relies on Exceedance of Limited Number of WQOs
  - Highly Unreliable for Evaluating Impacts on Water Quality/Beneficial Uses

# Unrecognized & Unregulated Pollutants

- Increasing Concern about Impacts of Unmonitored, Unregulated, & Unrecognized Chemicals in Receiving Waters
  - Especially Those Waters – Like the Delta – That Receive Large Amounts of Agricultural Runoff & Domestic Inputs
- Exhibit CSPA-82 – Numbers of Chemicals Registered for Commercial Use in US



Source:

Published in *Estuary News* 18(6) December (2009).  
[<http://www.sfestuary.org/pages/newsletter.php>]  
(Based on Figure 1 in: Muir, D., and Howard, P., "Are There Other Persistent Organic Pollutants? A Challenge for Environmental Chemists," *Environ. Sci. & Technol.* 40:7157-7166 (2006); subsequently updated in: "Managing Contaminants of Emerging Concern in California: Developing Processes for Prioritizing, Monitoring, and Determining Thresholds of Concern," Report of California Ocean Protection Council et al. workshop, "Managing Contaminants of Emerging Concern in California: A Workshop to Develop Processes for Prioritizing, Monitoring and Determining Thresholds of Concern," Costa Mesa, CA, April 28-29 (2009); [<http://www.nwri-usa.org/pdfs/CACCECReport.pdf>] and updated further for *Estuary News*.)

# Unrecognized & Unregulated Pollutants

- Ignored in Evaluation of Water Quality/Beneficial Use Impacts of WaterFix
  - Concern for Potential Impacts of Individual Unregulated Chemicals & Unrecognized Pollutants
  - Potential Additive & Synergistic Impacts between/among Regulated & Unregulated Chemicals That Can Impact Water Quality
- Short-Sighted Evaluation Leading to DWR/USBR Conclusion That WaterFix Tunnel Diversions Will Not Cause Adverse Impacts to Delta Water Quality
  - While Sacramento River Water Likely Contains Some Unregulated Pollutants
    - In General Much Higher Quality Than SJR
    - Reduction of Sacramento River Water Flow Will Certainly Diminish Water Quality at Confluence of Sacramento & San Joaquin Rivers

# Unrecognized & Unregulated Pollutants

## ● Issues Discussed in Numerous Publications Including:

- **Exhibit CSPA-83.** Lee, G. F., and Jones-Lee, A., "Enhanced Delta Flows Needed to Help Control Water Quality Impacts of Delta Pollutants," Testimony for CA State Water Resources Control Board Public Workshop: Comprehensive (Phase 2) Review & Update to Bay-Delta Plan Workshop 1: Ecosystem Changes and the Low Salinity Zone, Sacramento, CA, September 5, 2012, Report of G. Fred Lee & Associates, El Macero, CA, August 17 (2012). [http://www.gfredlee.com/SJR-Delta/Lee\\_Testimony\\_BayDelta\\_Workshop\\_1.pdf](http://www.gfredlee.com/SJR-Delta/Lee_Testimony_BayDelta_Workshop_1.pdf)
- **Exhibit CSPA-84.** Lee, G. F., and Jones-Lee, A., "Discussion of Water Quality Issues That Should Be Considered in Evaluating the Potential Impact of Delta Water Diversions/Manipulations on Chemical Pollutants on Aquatic Life Resources of the Delta," Report of G. Fred Lee & Associates, El Macero, CA, February 11 (2010). [http://www.gfredlee.com/SJR-Delta/Impact\\_Diversions.pdf](http://www.gfredlee.com/SJR-Delta/Impact_Diversions.pdf)
- **Exhibit CSPA-85.** Gross, E.S., Lee, G. F., Simenstad, C. A., Stacey, M., Williams, J.G., (Expert Panel Members), "Panel Review of the CA Department of Fish and Game's Quantifiable Biological Objectives and Flow Criteria for Aquatic and Terrestrial Species of Concern Dependent on the Delta," DFG Water Rights Program Documents Senate Bill X7 1 DFG Implementation, Submitted to California Department of Fish and Game, October (2010). [http://www.gfredlee.com/SJR-Delta/Final\\_Panel\\_Review\\_DFG\\_BOFC\\_Draft.pdf](http://www.gfredlee.com/SJR-Delta/Final_Panel_Review_DFG_BOFC_Draft.pdf) Also available at [http://www.dfg.ca.gov/water/water\\_rights\\_docs.html](http://www.dfg.ca.gov/water/water_rights_docs.html)
- **Exhibit CSPA-86.** Lee, G. F., and Jones-Lee, A., "Review of Need for Modeling of the Impact of Altered Flow through and around the Sacramento San Joaquin Delta on Delta Water Quality Issues," and "Summary: Water Quality Modeling Associated with Altered Sacramento River Flows in & around the Delta," Report to CWEMF Stormwater Committee, by G. Fred Lee & Associates, El Macero, CA, March (2009). <http://www.gfredlee.com/SJR-Delta/Model-Impact-Flow-Delta.pdf>

# Summary of Key WaterFix Operation Impacts

- Amount of P Entering Turner Cut Influenced by Amount of SJR DWSC Water Entering
  - Affected by South Delta Export Pumping of South Delta Water
  - WaterFix Operations Will Impact Amount of P Entering Central Delta
    - Will Impact Aquatic Plant Growth & Water Quality/Beneficial Uses of Central Delta
- Less Water Entering Turner Cut Will
  - Increase Residence Time of Pollutants in Central Delta
  - Increase Water Quality Impacts/Harm from Aquatic Plants
- P Carried into Central Delta via Sacramento River
  - Impacts Phytoplankton Growth & Impacts/Harms Central Delta Water Quality
- Operation of Proposed WaterFix Diversions Will
  - Increase Pollutant Concentrations in Central Delta
  - Increase Residence Time of Pollutants in Central Delta
  - Increase Water Quality Impacts/Harm to Users of Central Delta Water
  - Increase Water Quality Impacts/Harm to South Delta Old River Channel Users Due to Increased Water/Pollutant Residence Time
- **All of These Impacts/Harms to Delta Water Users Should Have Been Evaluated by DWR/USBR in Its Petition to Change Point of Diversion of Sacramento River Water**