

Overview

Sacramento/San Joaquin Delta Water Quality

G. Fred Lee, PhD, PE, DEE & Anne Jones-Lee, PhD

G. Fred Lee & Associates

El Macero, CA

ph: 530-753-9630

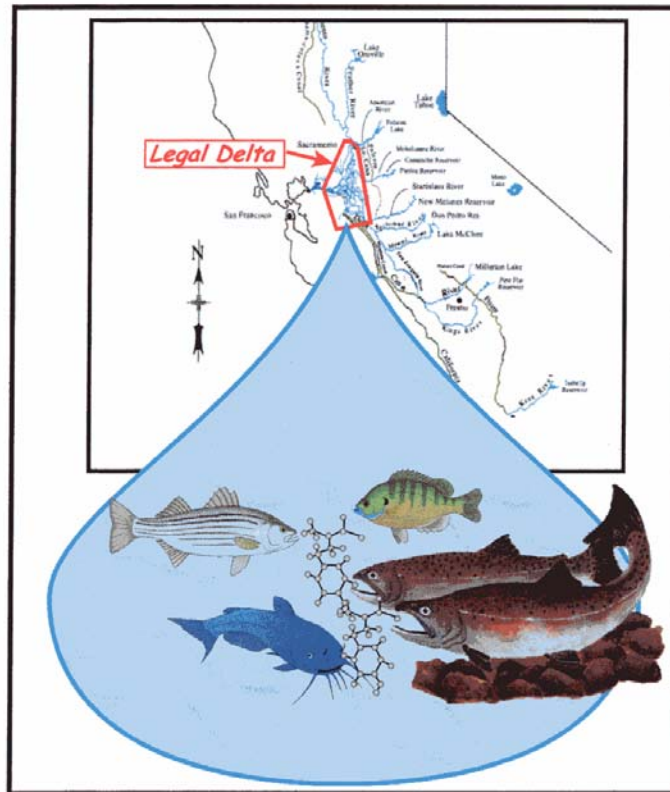
gfredlee@aol.com  www.gfredlee.com

◀ Review of Delta Water Quality Issues ▶

Presented at CA/NV AWWA Fall Conference, Sacramento, CA, October (2007)

Overview of Sacramento-San Joaquin River Delta Water Quality Issues

G. Fred Lee, PhD, DEE Anne Jones-Lee, PhD
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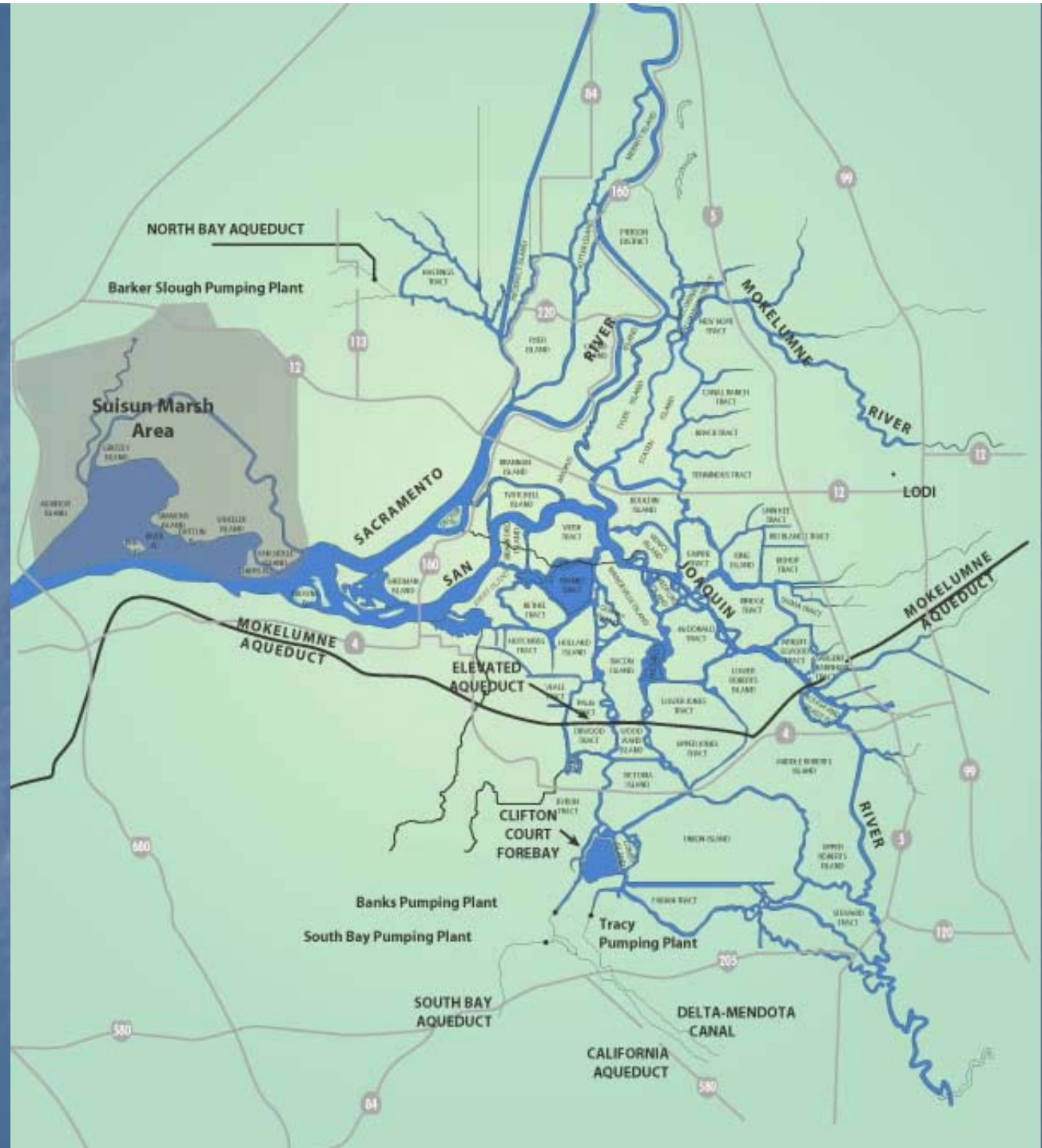
Adapted in part from images in SJRGA (2000)

June 22, 2004

Available on the internet at:
<http://www.members.aol.com/apple27298/Delta-WQ-IssuesRpt.pdf>

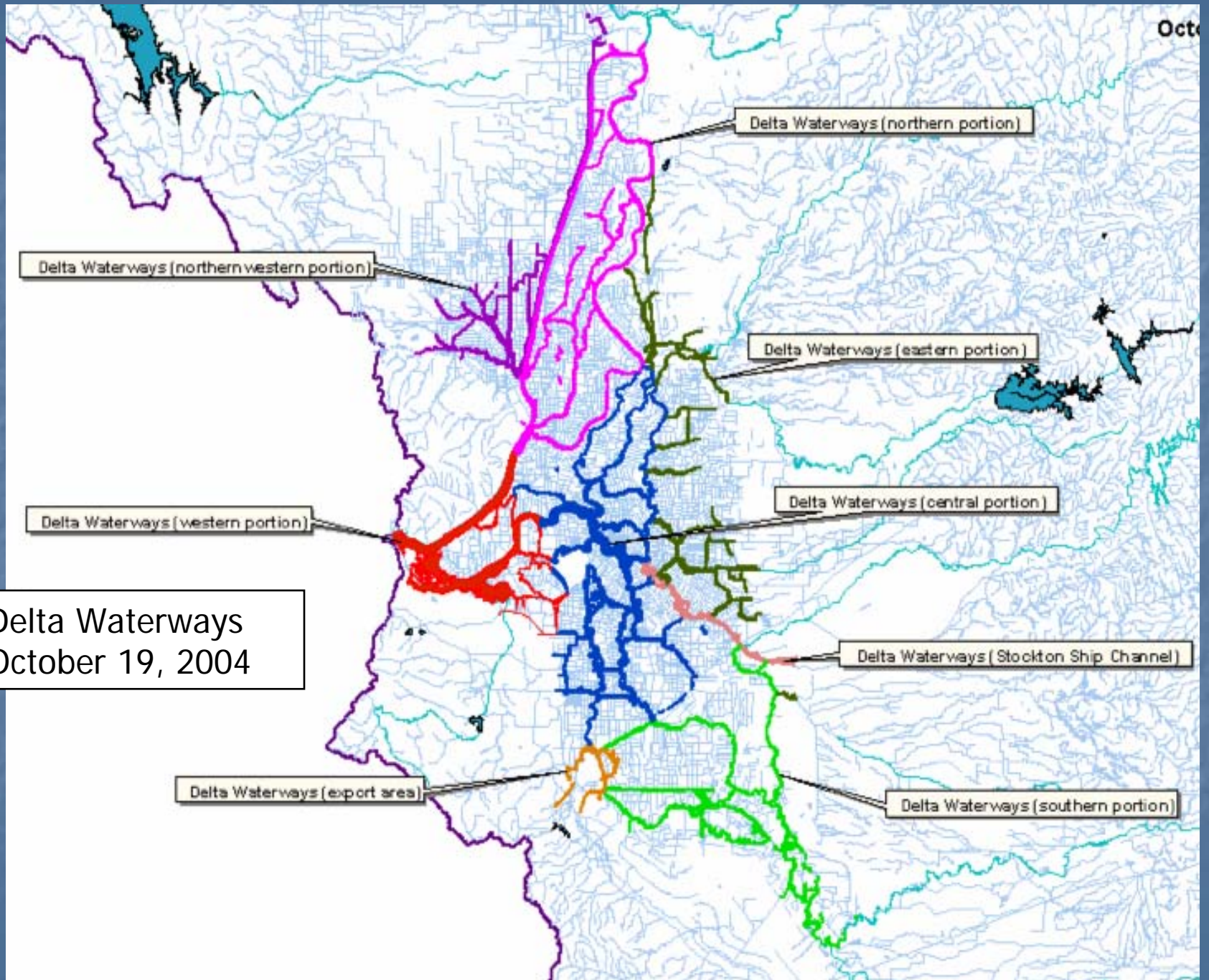
Map of Delta

(CA Dept Fish & Game, 2005)



CWA 303(d) Requirements

- Monitor Waterbodies to Determine Exceedances of Water Quality Standards
- If Exceedance Found:
 - List Waterbody as CWA Section 303(d) “Impaired”
 - Develop a TMDL (Total Maximum Daily Load) for Pollutant(s) Exceeding Water Quality Standard



Delta Waterways
October 19, 2004

2006 CWA 303(d) List of "Impaired" Delta Waterbodies (SWRCB, June 2007)

Pollutant*/Stressor	Location (see key below)													Potential Sources (see key below)				
	CD	ED	SE	ND	NW	SD	SC	WD	SJ	MS	OR	MR	MDR	Ag	R/S	SU	AM	Other
Chlorpyrifos	X	X	X	X	X	X	X	X						X	X			
Diazinon	X	X	X	X	X	X	X	X						X	X			
DDT	X	X	X	X	X	X	X	X	X					X				
Group A Pesticides (legacy)	X	X	X	X	X	X	X	X	X					X				Formerly-used pesticides
EC/TDS			X		X	X		X	X					X				
Exotic Species	X	X	X	X	X	X	X	X	X							X		
Mercury	X	X	X	X	X	X	X	X	X								X	
Unknown Toxicity	X	X	X	X	X	X	X	X	X					X		X		
Dioxin/Furan								X										Point source; McCormick/Baxter; Contaminated sediment
Pathogens								X			X				X			Non-boating recreation; tourism
PCBs				X				X								X		Point source
Low DO											X		X			X		Hydromodification
								X							X			WWTP ammonia
										X					X			
Copper																	X	
Zinc																	X	
Boron										X				X				
Toxaphene										X						X	X	

Location Designations
CD - Central Delta
ED - Eastern Delta
SE - South Delta export area
ND - North Delta
NW - Northwestern Delta
SD - Southern Delta
SC - Stockton Ship Channel
WD - Western Delta
SJ - Lower San Joaquin River
MS - Mormon Slough
OR - Old River - South Delta
MR - Lower Mokelumne River
MDR - Middle River

Group A Pesticides	
aldrin	heptachlor epoxide
dieldrin	hexachlorocyclohexane
chlordane	(incl. lindane)
endrin	endosulfan
heptachlor	toxaphene

Pyrethroids
bifenthrin
lambda cyhalothrin
efenvalerate/fedvalerate
permethrin

Source Designations
Ag - Agriculture
R/S - Urban runoff/Storm sewers
SU - Source unknown
AM - Abandon mine
WWTP - Domestic wastewaters

CWA - Clean Water Act
 * Violates water quality objective

Delta Impaired Waters Not Listed on CWA 303(d)

Should Be Listed	Known Impairments
Nutrients - N & P	Excessive growth of algae & macrophytes
TOC/DOC	Trihalomethanes formed in water treatment
Pyrethroid pesticides used in agriculture & urban areas	Watercolumn & sediment toxicity
Could Be Listed - Need Investigation for Potential Impacts	Sources
PBDE - polybrominated diphenylethers	Domestic wastewater discharges
PPCP - pharmaceutical & personal care products	Domestic wastewater discharges
Pharmaceuticals & hormones	Dairy & animal husbandry operations
Other unregulated chemicals	Various

2006 CWA 303(d) List of Water Quality Limited ("Impaired") Reaches of San Joaquin River (SWRCB, June 2007)

Pollutant*/Stressor	River Reach (see key below)							Potential Sources (see key below)		
	FMP	MPB	BMS	MSM	MTR	TRS	SDB	Ag	SU	RE
DDT		X	X	X	X	X	X	X		
Group A Pesticides (legacy)		X	X	X	X	X	X	X		
EC/TDS		X	X	X				X		
Exotic Species	X								X	
Mercury			X	X	X	X	X			X
Unknown Toxicity		X	X	X	X				X	
						X	X	X		
Boron		X	X	X				X		
Toxaphene							X		X	
Selenium				X				X		

River Reach Designations

FMP - Friant Dam to Mendota Pool
 MPB - Mendota Pool to Bear Creek
 BMS - Bear Creek to Mud Slough
 MSM - Mud Slough to Merced River
 MTR - Merced River to Tuolumne River
 TRS - Tuolumne River to Stanislaus River
 SDB - Stanislaus River to Delta Boundary

Group A Pesticides

aldrin	heptachlor epoxide
dieldrin	hexachlorocyclohexane
chlordane	(incl. lindane)
endrin	endosulfan
heptachlor	toxaphene

Source Designations

Ag - Agriculture
 SU - Source unknown
 RE - Resource Extraction

CWA - Clean Water Act

* Violates water quality objective

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EC/TDS		X	X	X				X		
Exotic Species	X								X	
Mercury			X	X	X	X	X			X
Unknown Toxicity		X	X	X	X				X	
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Boron		X	X	X				X		
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SJR & Downstream of Vernalis Impaired Waters Not Listed on CWA 303(d)

Should Be Listed	Known Impairments
PCBs	Excessive bioaccumulation in edible fish
Pathogen-indicator organisms — <i>E. coli</i> , fecal coliforms	Contact recreation
Nutrients (nitrogen & phosphorus compounds)	Excessive fertilization High pH (photosynthesis/respiration) Low DO in Delta (algal decomposition)
Alternatives to OP pesticides (including pyrethroid-based pesticides*)	Watercolumn toxicity Sediment toxicity
Total organic carbon & other chemicals such as bromide	Disinfection byproducts (trihalomethanes) developed in treatment of downstream waters for domestic water supply
Excessive sediment	Erosion, turbidity

Pyrethroids
bifenthrin lambda cyhalothrin efenvalerate/fedvalerate permethrin

Sacramento River 303(d) Listings

- Sacramento River Is Only Listed as “Impaired” by “Unknown Toxicity” and, in Some Sections, by Mercury
 - Also, TMDLs Adopted for
 - OP Pesticides
 - Diazinon
 - Chlorpyrifos
- Overall, Sacramento River Has High Water Quality Compared with Delta and San Joaquin River
 - Especially for Domestic Water Supply Use

Summary of Delta Water Quality Issues

◀ Current (Active) SJR Watershed TMDLs ▶

- **Selenium**
 - Source: Agricultural Drainage
 - Concern: Aquatic Life and Water Fowl
- **Salinity** at Vernalis, Total Dissolved Solids (TDS), Electrical Conductivity (EC)
 - Source: Agricultural Drainage & Other Sources
 - Concern: Adverse to Agriculture & Domestic Water Supplies
- **Boron**
 - Source: Agricultural Runoff/Drainage
 - Concern: Adverse to Agriculture
- **Organophosphorus (OP) Pesticides** (Diazinon, Chlorpyrifos)
 - Source: Agricultural Runoff
 - Concern: Toxic to Aquatic Life
- **Oxygen-Demanding Substances** (BOD/Algae, Ammonia, Organic N)
 - Source: Agricultural Drainage/Runoff
 - Concern: Low DO in DWSC & South Delta; Adverse to Aquatic Life

Summary of Delta Water Quality Issues

◀ Pending TMDLs (to Be Developed) ▶

■ Mercury

- Source: Former Gold & Mercury Mining Activities
- Concern: Bioaccumulation in Edible Fish
Neurotoxin to Fetuses & Young Children
Sulfate Impacts Bioaccumulation of Mercury

■ Organochlorine “Legacy” Pesticides (e.g., DDT, Chlordane, Dieldrin, Toxaphene)

- Source: Agricultural Drainage/Runoff
- Concern: Excessive Bioaccumulation in Edible Fish – Cancer in Humans

■ PCBs - Industrial Chemicals

- Source: Industrial Discharges
- Concern: Excessive Bioaccumulation in Edible Fish – Cancer in Humans

■ Dioxins/Furans

- Source: Industrial Chemicals; Combustion Byproduct
- Concern: Excessive Bioaccumulation in Edible Fish – Cancer in Humans

Summary of Delta Water Quality Issues

◀ Pending TMDLs (to Be Developed) ▶

- **Pathogen-Indicator Organisms** (*E. coli*, Fecal Coliforms)
 - Source: Agricultural & Urban Runoff/Discharges
 - Concern: Diseases (Contracted from Contact Recreation - Swimming)
Drinking Water Quality
- **Toxicity of Unknown Cause**
 - Source/Cause: Unknown
 - Concern: Adverse to Aquatic Life
- **Salinity** Upstream of Vernalis
 - Source: Agricultural Drainage/Runoff
 - Concern: Adverse to Agriculture & Domestic Water Supplies

Heavy Metals

Copper and Zinc

Source: Former Mining

Concern: Aquatic Life Toxicity

Summary of Delta Water Quality Issues

◀ Potential Future TMDLs (to Be Evaluated) ▶

Based on Water Quality Problems in the Delta & Downstream, Need Water Quality Objectives for Some Potential Problems

- **Nutrients** – Excessive Fertilization (Nitrogen and Phosphorus Compounds)
 - Source: Agricultural & Urban Drainage & Discharges
 - Concern: High pH, Low DO (Associated with Photosynthesis/Respiration)
 - Hyacinths and Egeria - Impair Recreation, Domestic Water Supplies Tastes and odors

- **Alternative Pesticides** to OP Pesticides (Including Pyrethroid-Based Pesticides)
 - Source: Agricultural & Urban Drainage & Discharges
 - Concern: Causing Toxicity to Aquatic Life; Watercolumn & Sediment Toxicity

- **PBDEs** - Fire Retardants
 - Source: Urban Sources - Wastewaters & Stormwater Runoff
 - Concern: Excessive Bioaccumulation in Edible Fish – Cancer in Humans

- **Total Organic Carbon** & Other Chemicals That Develop into Disinfection Byproducts (Trihalomethanes) in Treated Domestic Water Supplies (e.g., **Bromide**)
 - Source: Agricultural, Wetland & Urban Drainage/Discharge
 - Concern: Cancer in People Who Use Treated Domestic Water Supplies

Summary of Delta Water Quality Issues

◀ Potential Future TMDLs (to Be Evaluated) ▶

- **Excessive Sediment, Erosion, Turbidity**
 - Source: Erosion from Agricultural Lands
 - Concern: Shoaling Water Depth
Adverse to Light Penetration
- **Herbicides**
 - Source: Agricultural & Roadside Drainage/Runoff
 - Concern: Toxicity to Algae & Other Aquatic Plants
- **Sediment Toxicity Aquatic** (Pesticides, Nutrients/Algae/Sediment **Pollutants** Ammonia, Heavy Metals, PAHs and other Chemicals)
 - Source: Agricultural & Urban Discharges/Runoff
 - Concern: Toxicity to Aquatic Organisms; Human Health Effects
- **Unrecognized Pollutants** (Pharmaceuticals & Other Unregulated Chemicals Discharged by Confined Animal Facilities (e.g., Dairies, Feedlots) & Domestic Wastewaters)
 - Source: Agricultural & Urban Wastewater Discharges
 - Concern: Toxicity / Sublethal Impacts on Aquatic Life
Human Health Effects

Typical Environmental Sample Analysis

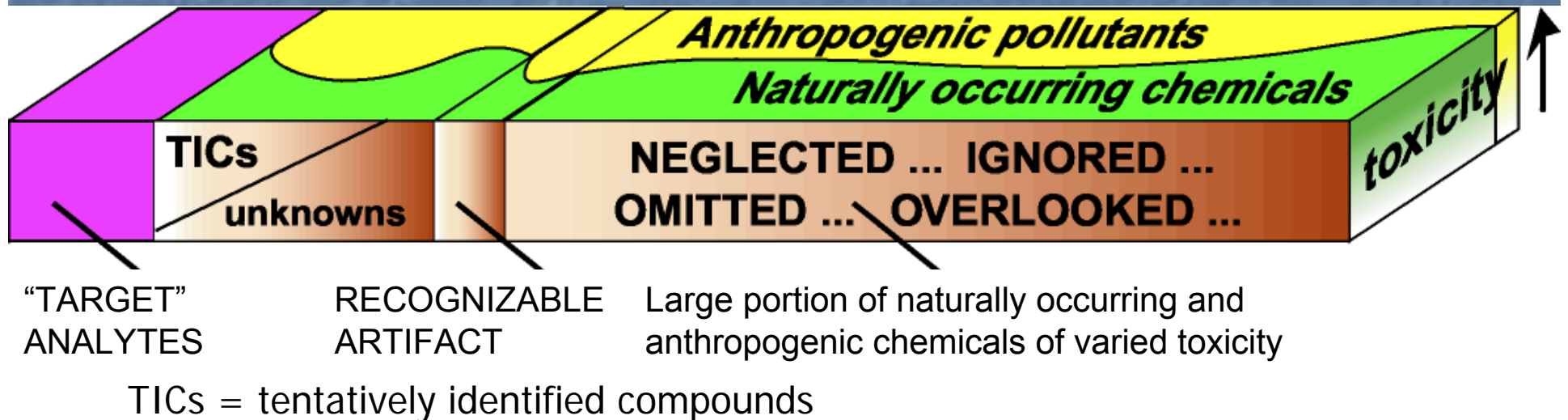


Figure from: Daughton, C. C., “The Critical Role of Analytical Chemistry,” July (2002)

<http://www.epa.gov/nerlesd1/chemistry/pharma/critical.htm>

Impact of Export Projects

- Up to 13,500 cfs Exported from Southwestern Delta for Domestic & Agricultural Water Supply by Federal (USBR) & State (DWR) Projects
- Impacts:
 - Exports Allowed to Occur without Evaluation of Impact on Delta Water Quality
 - IEP Monitoring Has Not Evaluated Impacts Even Though Required by SWRCB Water Rights Decision D-1641
 - Low Water Levels in South Delta Impair Recreation & Availability of Irrigation Water

Impact of Export Projects

Flow Patterns in Delta Greatly Changed

- Draw Sacramento River Water through Central Delta
 - Low Primary Production in Areas of Delta Dominated by Sacramento River Water
- Contribute to SJR DWSC & South Delta Low DO Problems – Dead Zones in South Delta
- Alter Location and Impacts of Pollutants

Impact of Export Projects (Cont)

- Loss of Chinook Salmon Homing Signal
 - SJR Watershed Home Stream Water Signal in Western Delta & San Francisco Bay during Fall & Winter
- Contribute to Pelagic Organism Decline (POD)?
 - Delta Smelt & Other Fish
 - Capture at Export Pumps
 - Court Ruling That Exports Must Be Reduced during Winter to Protect Fish

Altered Conveyance “Peripheral Canal”

- Drastically Change Delta Water Quality
- Poor Water Quality in SJR to Be Much Larger Factor in Delta Water Quality
- Currently: Large Amounts of Sacramento River Water Drawn to Export Pumps - Dilutes Adverse Impacts of SJR-Derived Pollutants in Central & Southern Delta
- Increased Adverse Impacts of Pollutants from SJR & within Delta
 - Increase in Selenium, TOC/DOC, Salinity, Nutrients
 - Bioaccumulation of Hg as Influenced by Sulfate in SJR
 - OCIs/PCBs Bioaccumulation, Etc.
- Change in Location of Aquatic Life Toxicity Could Be Significant at Critical Location for Certain Types of Fish

Future

- Delta Water Quality Problems Difficult to Correct through TMDLs, for Most Pollutants
- Future Export Manipulations — via Peripheral Canal or Through Delta Conveyance
 - Will Change Water Quality
- Needs Careful Evaluation

Further Information
Consult Website of
Drs. G. Fred Lee and Anne Jones-Lee



<http://www.gfredlee.com>

<http://www.gfredlee.com/psjriv2.htm>