Stormwater Runoff Water Quality Newsletter
Devoted to Urban/Rural Stormwater Runoff
Water Quality Management Issues

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Volume 10 Number 10/11 (double issue) Editor: Anne Jones-Lee, PhD
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The subject of this double issue of the Newsletter is the resource management crisis and water quality issues of the Sacramento San Joaquin Delta and San Joaquin River. It provides an overview discussion of these issues as well as links to additional information.

The Sacramento San Joaquin Delta (Delta), pictured, in part, in Figure 1 and mapped in Figure 2, is the West Coast's largest estuary (covering about 490,000 acres) and is a key element of California's water supply for domestic, agricultural, and aquatic life use. It provides domestic water supply for about 23 million people throughout the state, and irrigation water and water transport for the Central Valley's $2-billion agricultural industry in corn, grain, hay, alfalfa, vegetables and fruit. About 65% of the Delta's area is in agricultural use. The Delta also supports significant recreation; its 12-million user-days per year include 0.5-million boaters, and visitors to 290 shoreline recreational areas and 300 marinas. As discussed below, the Delta is also an important aquatic life habitat and supports significant fisheries. More than 0.5-million people live within the Delta area. [Delta physical facts from Delta Protection Commission - http://www.delta.ca.gov/pdf/Sacto-SanJoaqin_fact.pdf]

Despite its importance to the state and nation, the Delta is in a water and resource management crisis, including severe water quality problems caused to a considerable extent by runoff/ drainage from irrigated agriculture. This newsletter reviews these issues and provides information on two forthcoming conferences that will address water quality issues of the Delta and San Joaquin River (SJR), including potential water quality impacts of runoff/discharges from California Central Valley irrigated agriculture.

Figure 1. Areal Photo of Delta (photo from the "ACWA News," September 17, 2007; with permission)

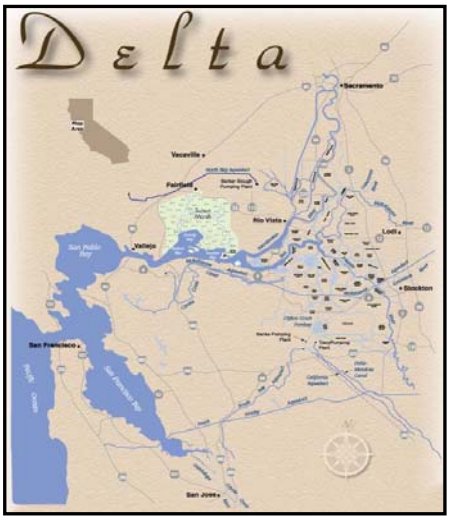

Figure2. Map of the Delta (from Delta Protection Commission - http://www.delta.ca.gov/pdf/Sacto-SanJoaqin_fact.pdf)

Physical Character of the Delta
The Delta is formed by the confluence of the Sacramento and San Joaquin Rivers, two of the largest rivers in California, originating in the Sierra Nevada mountains and flowing through the intensely farmed Central Valley. The rivers flowing into the Delta (Sacramento, San Joaquin, Mokelumne, and Cosumnes) with their tributaries carry about half of the state's total annual runoff. The Delta is maintained as a tidal fresh-water system, connected to the salt water of San Francisco Bay, and ultimately to the Pacific Ocean through the Golden Gate.

Before the late 1850s when dredging of channels through the Delta and creation of Delta islands began, the Delta was a large wetland area with extensive vegetation. Over the years, much of the wetland area was drained and earthen levees were constructed by dredging to create channels and islands (See Figure 2). The islands began to be farmed, causing oxidation of the peat soils. Because of the oxidation, many of the Delta "islands" are now below sea level and maintained by levees. The Delta presently incorporates nearly 60 major unclaimed islands, numerous unleveed channel islands, and 1,100 miles of levees.

The levees protecting the islands and their agriculture are structurally unstable; levee failure leads to flooding of the islands. There is concern about potential flooding of the islands during river flood-flows and associated with levee failure that may result from seismic activity. Increases in sea level could also contribute to flooding of the islands. Flooding of an island leads to increased entrance of marine waters into the Delta. Flooding of multiple islands could cause much of the Delta to become saline and thereby prevent its water from being used for domestic or agricultural purposes. Water releases from the Sierra Nevada reservoir head waters are managed to help keep the marine waters from entering the fresh water of the Delta.

Biological Resources
The aquatic and terrestrial resources of the Delta include 52 species of mammals, 22 of reptiles and amphibians, 225 of birds, and 54 of fish. Aquatic life resources of the Delta are significant and complex. The Delta is relied upon by important anadramous fish, including salmon, striped bass, steelhead trout, American shad, and sturgeon, that migrate up the Delta to Sierra river spawning grounds and whose young migrate down the Delta to the ocean. Several endangered or threatened fish species, including the Delta smelt, are of great concern and focus at this time. The Delta with its estimated 260 invasive species, has been characterized as one of the most "invaded" estuaries; some of the non-native species, including several clams and the Brazilian waterweed *egeria,* are having significant adverse impacts on the aquatic habitat and food web resources of the Delta.

Resource Management Issues in the Delta
Significant and competing water resource management concerns in the Delta include fisheries, domestic and agricultural water supply, aquatic life habitat, and recreation.

In the 1990s the state and federal agencies responsible for Delta resource management developed a multi-agency organization (CALFED Bay Delta Program) to work toward better management of Delta resources. According to the CALFED website, the CALFED Bay Delta Program is a unique collaboration among 25 state and federal agencies that came together with a mission: to improve California's water supply and the ecological health of the San Francisco Bay/Sacramento San Joaquin Delta. Information on CALFED is available at, http://calwater.ca.gov/index.aspx.

The Public Policy Institute of California (PPIC) developed an informative introduction to the current resource management issues for the Delta and discussed realistic management philosophies and approaches in the report,

> Jay Lund, Ellen Hanak, William Fleenor, Richard Howitt, Jeffrey Mount, and Peter Moyle, "Envisioning Futures for the Sacramento-San Joaquin Delta," Public Policy Institute of California, February (2007).
> http://www.ppic.org/content/pubs/report/R_207JLR.pdf

The PPIC summarized that report in a "Research Brief" entitled, "Dealing with the Delta: Envisioning Futures, Finding Solutions," Public Policy Institute of California, Research Brief February (2007). http://www.ppic.org/content/pubs/rb/RB_207JLRB.pdf

That summary put forth that *"new ways of thinking about the Delta should be taken into account"* as the state responds to the crisis in the Delta, specifically,

- *"A Delta that is heterogeneous and variable in terms of its salinity levels and water flows is more likely to support native species than is a homogeneously fresh or brackish Delta."*
- *"Going forward, Californians will need to recognize that the Delta cannot be all things to all people. Tradeoffs are inevitable. The challenge will be to pursue an approach that yields the best outcomes overall, accompanied by strategies to reasonably compensate those who lose Delta services."*

It reported five major points about the current and future state of the Delta:

- The current management of the Delta as a freshwater resource is unsustainable for almost all stakeholders.
- Seeing the Delta as a functioning ecosystem with fluctuating flows and salinity, as it once was, allows new solutions to emerge for the Delta's problems.
- Most users of Delta services are adaptable.
- There are promising alternatives to Delta management.
- *"Significant political decisions will be needed to make major changes in the Delta. Incremental, consensus-based solutions are unlikely to prevent a major ecological and economic catastrophe of statewide significance."*

With these points of reference taken into account in Delta management, the PPIC advanced three categories of management alternatives:

- Freshwater alternatives – that preserve and augment the current goal of keeping the Delta freshwater;
- Fluctuating Delta alternatives – that manage the Delta as a more complex and fluctuating mosaic of uses; and
- Reduced-Exports alternatives – that reduce dependence on the Delta for anthropogenic purpose, or abandon the Delta entirely.

PPIC's summary is recommended for its insights into issues of management of Delta resources, and its bold reporting that the Delta cannot be everything to every interest. It did not, however, delve into the issues of water quality management and requirements for the Delta that will have to be met, irrespective of the other aspects of resource management, to fulfill state and federal

regulatory requirements. Fulfilling these requirements could significantly impact decisions made about other aspects of managing Delta resources.

Federal Court Ruling on Delta Water Exports

The Association of California Water Agencies (ACWA) [www.acwa.com] has published the following summary of a federal court order that reduces the amount of water exported from the Delta to Central California, the San Francisco Bay area, and Southern California. [From *ACWA News* **35**(19) September 17, 2007; presented here with permission of ACWA]

This court ruling arose from the significant declines in the numbers of certain types of small fish, including Delta Smelt, a federally listed endangered species, in the Delta during the past three years. This decline, referred to as the Pelagic Organism Decline (POD), has stimulated an intensive study program to try to understand the cause(s) of this decline. Potential causes include:

- toxicity due to pollutants (pesticides and "unknowns") in Delta waters
- export pumping of water from the southwestern Delta by the federal (US Bureau of Reclamation (USBR)) and state (Department of Water Resources (DWR)) export projects. These projects typically export about 10,000 to 13,500 cfs of Delta water. The export pumps capture large numbers of some types of fish at certain times of the year. The court ruling is intended to reduce the capture of Delta smelt.
- reduction in the food supply, especially zooplankton.
- toxins from bluegreen algae (*Microcyctis*) adversely affecting fish and or other aquatic organism populations. Lehman (DWR staff) reviewed the potential for toxins associated with *Microcystis* to be a factor in the POD. That review is available at, http://science.calwater.ca.gov/pdf/workshops/POD/CDFG_POD_Microcystis_biomass_and_toxicity.pdf

An overview of the POD program and links to additional POD information can be found on the POD "homepage" at: http://science.calwater.ca.gov/pod/pod_index.shtml. That website also provides additional reports being developed on current studies regarding the cause of the POD.

A copy of an independent external review of the CALFED Interagency Ecological Program's (IEP) 2005 POD activities, entitled, "*Review Panel Report: San Francisco Estuary Sacramento-San Joaquin Delta Interagency Ecological Program on Pelagic Organism Decline,"* is available online at: http://science.calwater.ca.gov/pdf/workshops/POD/IEP_POD_Panel_Review_Final_010606_v2.pdf.

California Departments of Water Resources (DWR) and Fish & Game (DFG)

The DWR and DFG have considerable responsibility for managing the resources of the Delta. Their activities in this regard are summarized on their websites, [http://www.cd.water.ca.gov/delta/links.cfm] and [www.delta.dfg.ca.gov/]. The DWR, DFG, and the US Army Corps of Engineers have developed a "Delta Risk Management Strategy" website [http://www.drms.water.ca.gov/news/] that provides links to press releases from the agencies on Delta issues, as well as newspaper articles on Delta resource management issues. M. Weiser, staff writer for the Sacramento Bee newspaper, has also developed a series of articles on the Delta resource/water management issues that can be found by searching the Internet for "Weiser Sacramento Bee Delta."

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From *ACWA News* 35(19) September 17, 2007

"Court Ruling to Have Sweeping Water Impacts; Cuts in Deliveries Loom in Wake of Court-Ordered Reduction in Delta Pumping

In a landmark ruling with sweeping implications for statewide water supplies, U.S. District Court Judge Oliver Wanger on Aug. 31 ordered the state's two largest water projects to reduce deliveries by up to one-third of previously available water supplies, or as much as two million acre-feet, to protect a threatened fish species, the Delta smelt.

The reductions will begin this winter and will be felt by State Water Project and Central Valley Project customers. The two projects funnel water through the Sacramento-San Joaquin River Delta to more than 25 million Californians and 2.5 million acres of productive farmland.

The highly anticipated ruling marks the single largest court-ordered redirection of water in state history and potentially the largest action ever taken under the federal Endangered Species Act (ESA). Sweeping impacts are expected, especially in hard-hit agricultural areas from the San Joaquin Valley to San Diego where lack of

Court Decision Impacts

The decision by U.S. District Court Judge Oliver Wanger will reduce deliveries by the State Water Project and the federal Central Valley Project by as much as one-third, or about 2 million acre-feet, depending on whether it's a dry, average or wet year.

Cuts will be felt in the Bay Area, Central and Southern California, with rationing possible in some areas. Many SWP contractors are awaiting formal allocation information from the Department of Water Resources to determine how the reductions will affect local deliveries.

For many agencies, the ruling is considered a "regulatory drought" and triggers a multi-year drought contingency, since 2007 water a dry year. If next year is dry, it will accentuate the problem.

Specific impacts include:

- Up to 236,000 acres of farmland could be fallowed on the west side of the San Joaquin Valley, reducing agricultural output by as much as $292 million.
- Regional economic losses could total up to $475 million and up to 4,000 lost jobs in agriculture-related industries.
- Santa Clara Valley Water District, which serves Silicon Valley, may have to impose mandatory cutbacks on its 1.7 million customers. It will also have to reduce groundwater recharge in the area and have less water available for in-stream releases for steelhead trout, red-legged frogs and western pond turtles.
- Metropolitan Water District of Southern California already is asking customers to save 20 gallons of water a day, and may consider mandatory cuts for the first time since 1991. The reduction will be addressed through multi-year drought contingency planning.
- Zone 7 Water Agency in the south San Francisco Bay Area will lose a major share of its water supply and will rely more heavily on groundwater reserves meant for drought protection and other emergencies. Customers are being asked to reduce water use.
- Alameda County Water District will draw on its dry year water reserves, which include local groundwater storage and banked water storage in the south San Joaquin Valley. No rationing is anticipated in the coming year, unless it is extremely dry. —*A CWA Special Projects Coordinator Lisa Lien-Mager*

water will affect jobs and productivity. New development in urban areas also could feel the effects in the near term.

Wanger's ruling will compel many local water agencies to rely on alternative or reserve water supplies, including local groundwater. Water use restrictions — including rationing — are expected in some areas, particularly where dry conditions already have affected water availability. The situation could be dire if drought conditions continue next year.

"This puts in vivid and real terms the deepening crisis we are seeing in the Delta," ACWA Executive Director Timothy Quinn said. "It's an ecological crisis and it's a water supply crisis. While many factors are affecting the ecosystem, this reinforces the fact that our Delta water infrastructure doesn't work for the environment or for the state's economy."

Background on Ruling

The ruling followed several days of evidentiary hearings before Wanger on what actions should be taken by the two projects to better protect the smelt, a native Delta fish whose decline earlier this year triggered a voluntary shut-down of the State Water Project's Delta pumps for 10 days in June. Pumping by the Central Valley Project also was limited during that time.

Wanger ruled in May that permits under which the two projects export water from the Delta are inadequate and do not comply with the federal Endangered Species Act. The ruling came in a case brought by the Natural Resources Defense Council and five other groups.

Reductions in pumping ordered Aug. 31 are part of interim actions to protect the fish while state and federal agencies develop a long-term plan. It is anticipated, however, that the long-term plan will call for similar reductions in deliveries.

The vulnerability of the Delta was also the focus of a high-level summit Aug. 21 in Los Angeles featuring U.S. Sen. Dianne Feinstein and Gov. Schwarzenegger. That session highlighted problems such as declining species and risks posed by earthquakes, climate change and aging levees. — *A CWA Special Projects Coordinator Lisa Lien-Mager*"

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State Water Contractors Statement

The State Water Contractors (SWC), an organization whose mission is to provide information of use to CA State Water Project contractors and others interested in California's waters, has developed the following summary of the current problems with the Delta (taken from http://www.swc.org/pdf/bd_fact-sheet.pdf)

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"Preserving The Delta & California's Water Supply in 2007
Fact Sheet

The San Francisco/Sacramento San Joaquin Bay-Delta ("Delta"), a 700-mile maze of sloughs, canals, waterways and islands located where the San Joaquin and Sacramento rivers converge, is the largest estuary on the West Coast and California's main water supply hub. The Delta is one of the most important aspects of California's water delivery system – serving millions throughout Northern, Central and Southern California – and is home to hundreds of species of fish and wildlife. In addition to supporting an important ecosystem, water that moves through the Delta is indispensable to the agricultural industry and businesses that drive our state's economy.

However, scientists and government leaders agree the Delta is failing. Aged and vulnerable levees, climate change, mounting regulatory uncertainties, and a struggling ecosystem plague the Delta more so today than ever before. The Delta's deteriorating condition has made it an increasingly unreliable pathway for delivering water to 25 million Californians, businesses and farms throughout the state. Improvements to the current water conveyance system must be made in order to ensure a safe and reliable water supply and protect the Delta's fragile ecosystem. 2007 will be a critical year for state leaders to identify and pursue real solutions for California and all its residents.

***The Delta Is Critical To California's Environmental, Public & Economic Health**...*

- *Provides drinking water for more than 25 million residents throughout California.*
- *Transfers water for 2/3 of the state's population. Millions of Californians rely on water that moves through the Delta for at least a portion of their drinking water including Northern, Central and Southern California. Some regions are 100% dependent on water supplies that move through the Delta.*
- *Is the largest single drinking water source in the nation.*
- *Sends water to some 7,000 agencies or cities that have permits to develop and use water supplies transferred through the Delta and its watershed region.*
- *Irrigates more than 7 million acres of prime California agricultural lands, which produce 45% of the fruits and vegetables grown in the U.S.*
- *Helps support California's $1.6 trillion economy, the 6th largest in the world.*
- *Provides habitat for 700 native plant and animal species and is the largest estuary on the West Coast.*
- *Is traversed by energy, communications and transportation facilities that are vital to the state's economic health.*
- *Serves as a popular recreation area.*

The Delta Is Failing; New Challenges Are Creating Greater Vulnerabilities...

- *Mounting legal and regulatory challenges threaten the reliability of California's water supply today and in the coming years. A recent temporary shutdown of pumps carrying water from the Delta, undertaken to protect endangered fish species, has diminished our statewide contingency or emergency water supplies that would be needed for a major catastrophe, such as an earthquake, major levee failure, etc.*
- *Many of the 1,100 miles of aged and deteriorating levees throughout the Delta are at risk for failure due to earthquakes and major flood events. Scientists have warned there is a 66% chance of a catastrophic earthquake or massive flood event occurring within the next 50 years. Islands in the Delta would flood, the state's drinking water supply would be contaminated and drastic changes in the Delta's ecosystem would occur.*
- *Rising sea levels caused by climate change threaten to contaminate our drinking water supply by pushing salty water from the San Francisco Bay into the Delta's freshwater. Already, sea levels at the Golden Gate Bridge have risen nearly 1/2 foot. Scientists predict that the sea level will rise another 1/2 foot to 3 feet during the next 100 years.*
- *Declining fish populations and invasive species continue to plague the Delta.*
- *Catastrophe in the Delta, such as an earthquake or flood event, could cut off water supplies to 25 million Californians, 7 million acres of farmland and businesses throughout California, effectively shutting down the state's operations, threatening the*

health and safety of the general public and causing a significant blow to the state's economy.

- *Compounding all these challenges is this year's record low rainfall that has driven California into a severe drought.*

Public Water Agencies Have A Mandate & Obligation To Protect & Preserve...

- *State leaders and local public water agencies have a mandate and obligation to protect public health and the economy by ensuring that the state has a safe and reliable drinking water supply. Our job is not to just find any answers, but to find the right answers. The public deserves this commitment.*
- *Growing consensus among scientists and government leaders is that the current condition of the Delta is unsustainable and action needs to be taken. The non-partisan Public Policy Institute of California stated earlier this year that the Delta "could become an environmental and economic disaster due to changing conditions, deterioration, and increasing vulnerabilities to its system of levees."*
- *Collectively, we must find a balanced solution that will protect the environment in and around the Delta, while also protecting the state's water supply that millions of people depend on.*

Improvements In Delta Conveyance Must Be Pursued In 2007...

- *Delivering water through the Delta is simply no longer reliable – improvements to the current water conveyance system must be made.*
- *The Delta Vision Task Force, created by Governor Schwarzenegger, will make recommendations in Fall 2007 on the best options for addressing the challenges that the Delta faces, including conveyance, and the State Water Contractors are committed to participating in this effort.*
- *The Governor and Legislature, with all stakeholders, must decide upon and begin to move forward with solutions in 2007 in order to ensure that Californians will continue to have a safe and reliable water supply and the Delta ecosystem can be preserved."*

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Additional information about this organization's activities is available at www.swc.org.

"Delta Vision" Issues

As noted above, the CALFED Bay Delta Program was instituted to develop an overall management approach for Delta resources. However, environmental groups and others found that that program did not fulfill its intended objectives in this regard; governance of the Delta was not effective in protecting the resources of the Delta while allowing large amounts of Delta water to be exported. This stimulated the state legislature and the governor to call for reorganization of the management of the Delta. By executive order, Governor Schwarzenegger created "Delta Vision" with the objective of developing a new governance approach for, and durable management of, the Delta. As described on its website [http://deltavision.ca.gov] Delta Vision is building on work of the Bay Delta Program and broadening the focus to identify a strategy for managing the Delta as a sustainable ecosystem that would continue to support an array of environmental and economic functions important to the state. The key component of Delta Vision is the independent Blue Ribbon Task Force appointed by the governor to define and carry out the Vision.
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On October 12, 2007, John Kirlin, Executive Director of Delta Vision, addressed a CALFED Science Program workshop with a presentation entitled, "Governing the Delta: Principles for a New Vision." His introduction gave voice to the values options and choices that need to be articulated in order to manage the Delta, and cited the Blue Ribbon Task Force as having recommended ecosystem function and water uses as co-equal in highest rank of importance. Elements cited as needing "governance" to achieve "durable vision for sustainable management of the Delta" included: operations of water systems, ecosystem improvement process, water quality, land use in and near the Delta, watershed actions, and statewide policies affecting water rights, uses, transfer, and pricing. The webcast of his and the other workshop presentations, as well other CALFED webcast workshops devoted to Delta resource management issues, can be viewed online at no cost through http://science.calwater.ca.gov/workshop/calendar.shtml (or directly at:
http://www.visualwebcaster.com/VWP/SkinPlayer/Player.asp?e=42397&w=320&h=310&s=True&ch=&sm=True&c=False&c1=False&mc=&qo=False&p=False&i=True&pp=False&cp=False&v=True&mc=False&a=True&sid=75241&aid=76615&pl=&pr=&st=ps&num=9999&y=41413&u=0&pid=1&pt=2&pc=False&cuts=6&t=CALFED+Science+Workshop]

The Delta Vision review includes consideration of such approaches as developing a peripheral canal or an isolated through-Delta canal to enable the transport of Sacramento River water to the export pumps. While an isolated facility that would convey the higher-quality Sacramento River water around the Delta or through the Delta to the export pumps would improve the quality of water exported, it would have significant adverse impacts on the Southern and Central Delta water quality. This is because as the Delta is currently managed, the Sacramento River water provides dilution for the more highly polluted San Joaquin River water, lessening the potential adverse water quality impacts in the Delta. This issue has been reviewed to some extent in recent CALFED workshops available at:
http://science.calwater.ca.gov/workshop/workshop_dci.shtml

At this time the Delta Vision is developing its initial report setting forth a course of action to address the Delta resource management issues.

The Water Environment Foundation (WEF) is actively involved in the Delta Vision program by holding workshops at which Delta Vision issues are discussed. The WEF website presents information on Delta Vision and proceedings of past workshops at, http://www.water-ed.org/deltavisionworkshops.asp.

The potential impact of the water quality impairment issues discussed below could become an important factor in influencing the allowed approach for altered diversions of water from the Delta. Of particular concern is the potential for some of the proposed approaches to cause further deterioration of Delta water quality, which could be found to be in violation of Clean Water Act anti-degradation requirements. It will be important for those who develop alternative management approaches for Delta exports to carefully consider how the exports will impact Delta water quality.

Delta Water Quality Issues
The water quality of the Delta is influenced by its two major tributaries, the Sacramento River and San Joaquin River, as well as within-Delta discharges/runoff from urban areas and irrigated agriculture. Water quality management in the Delta and its tributaries is the responsibility of the

Central Valley Regional Water Quality Control Board (CVRWQCB), the State Water Resources Control Board (SWRCB), and the US EPA.

Sacramento River and North Delta Water Quality Issues. The primary source of water for the Delta is the Sacramento River, which, during periods of low-flow typically contributes 10 to 20 times more flow to the Delta than the San Joaquin River. The CVRWQCB/SWRCB/USEPA 2006 list of Clean Water Act (CWA) section 303(d) "impaired" waterbodies includes the reach of the Sacramento River from Knights Landing to the Delta at Sacramento as being impaired by mercury and "unknown toxicity." Table 1 shows current 303(d) listings for the "North Delta," the area of the Delta dominated by the inflow of the Sacramento River. It shows that mercury levels violate water quality standards there, as well. The mercury in these waters is derived from former mercury mining operations in the Coast Range and gold mining in the Sierra Nevada mountains. It is of concern because it bioaccumulates to excessive levels in some types of edible fish, causing them to be hazardous for use as food especially by pregnant women and young children.

Water quality problems in the North Delta caused by organophosphate pesticides are being addressed to some extent through the implementation of a TMDL (total maximum daily load). Excessive bioaccumulation of the legacy pesticides (DDT, dieldrin) and the industrial chemical, PCBs, in edible fish is also a problem in the North Delta. Pyrethroid-based pesticides derived from their use in urban and agricultural areas are likely causing aquatic life toxicity in the water and sediment of the Sacramento River and North Delta.

Notwithstanding these problems, the Sacramento River water is of higher quality than that of the San Joaquin River and the south Delta with respect to salinity, TOC, nutrients, and several other pollutants of concern to water utilities. This has led to the proposal of a peripheral canal or through-Delta canal to transport Sacramento River water directly to the export pumps without mixing with San Joaquin River or Delta (from irrigated agriculture) water as it does now. Such an approach would also reduce the potential for the capture of fish such as Delta smelt by the export pumps, and thereby potentially provide a more reliable water supply for water exporters. However, this would also adversely affect the aquatic life-related water quality characteristics of water in the central and southern Delta since that water would no longer receive dilution by the Sacramento River.

Delta Water Quality Issues. In addition to having severe resource management issues related to water supply, fisheries, etc., the Delta itself has several significant water quality problems that affect the quality of the water for domestic water supply and aquatic life. Drs. G. Fred Lee and Anne Jones-Lee began work on Delta water quality issues in 1989 while they held university graduate-level professorships in New Jersey. At that time they were asked to be consultants on Delta water quality as it may impact the quality of water stored in proposed Delta island reservoirs. After moving to Davis, California and completing that work, they continued to keep abreast of issues and do work related to Delta water quality. In the early 2000s, they served as coordinating PIs for the $2.5-million CALFED-supported study of the low-DO problem in the SJR DWSC (San Joaquin River Deep Water Ship Channel) near the Port of Stockton. Through that work they became more knowledgeable and experienced with Delta water quality problems in the south and central Delta as well as in the San Joaquin River. After completing the synthesis report for the low-DO project in 2003, they continued to devote time, albeit unsupported, to the development of the first, and still the only, comprehensive report on Delta water quality issues.

Additional information on Drs. Lee and Jones-Lee's work on the Delta and its tributaries is available at, http://www.members.aol.com/annejlee/Delta-SJR-exp.pdf.

Drs. Lee and Jones-Lee continue to update, and disseminate, technical information on water quality issues in the Sacramento San Joaquin Delta and San Joaquin River. They have been invited to discuss their findings on Delta and San Joaquin River water quality at two upcoming professional conferences: the CA/NV American Water Works Association (AWWA) Fall 2007 Conference in Sacramento, CA on October 24, 2007, and the Central Coast Agricultural Water Quality Coalition's *Agriculture and the Environment - 2007* Conference in Monterey, CA on November 7, 2007. Key topic areas, and references to their recent work in them, are summarized below.

Overview of Delta Water Quality. The Fall 2007 CA/NV AWWA conference will provide two days of presentations on Delta water supply and water quality issues (www.ca.nv.org). In the session devoted to Bay Delta Water Quality, Drs. Lee and Jones-Lee will present:

> 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). [PowerPoint Slides available on their website at http://www.members.aol.com/GFLEnviroQual/DeltaWQCANVAWWAOct07.pdf].

That report includes a summary of the CVRWQCB/SWRCB/USEPA June 2007 updated CWA Section 303(d)-listed areas of the Delta for which TMDLs will need to be developed as a result of the area's containing one or more constituents in concentrations that exceed water quality objectives. A summary of that listing is presented in Table 1.

Table 1

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

	Location (see key below)													Potential Sources (see key below)				
Pollutant*/Stressor	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		
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					X	
Zinc												X					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 Mokelume 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

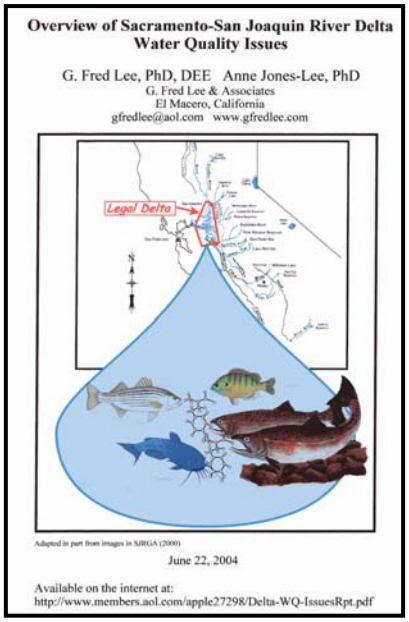
Table 2 lists additional water quality issues that Drs. Lee and Jones-Lee have found to be adverse to beneficial uses of the Delta but that are not listed by the regulatory agencies as impairments. The existing and potential water quality problems listed in Table 2 are based on Drs. Lee and Jones-Lee's experience in work on water quality evaluation and management. As discussed in their report the failure of the regulatory agencies to list these constituents for the Delta is due to a variety of reasons such as not having appropriate numeric water quality standards against which the concentrations of constituents can be evaluated.

Table 2

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

As discussed in their presentation, over 60% of the listed pollutants that are present in sufficient concentrations to cause violations of water quality standards/objectives (Table 1), as well as those that are listed in Table 2, are derived from stormwater runoff and irrigated agriculture tailwater and/or subsurface drain water. Lee and Jones-Lee's October 2007 AWWA conference presentation updates their 2004 comprehensive report on Delta Water Quality Issues:



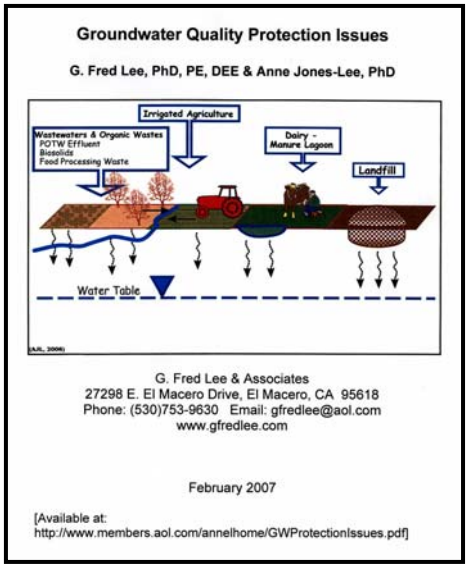
Lee, G. F. and Jones-Lee, A., "Overview of Sacramento-San Joaquin River Delta Water Quality Issues," Report of G. Fred Lee & Associates, El Macero, CA, June (2004). [Available at: http://www.members.aol.com/apple27298/Delta-WQ-IssuesRpt.pdf]

This report provides a detailed discussion of known and potential violations of water quality standards as known in the early 2000s. It includes discussion of significant deficiencies in the CALFED Interagency Ecological Program's (IEP) and State and Regional Water Boards' water quality monitoring/evaluation programs that define the magnitude and extent of water quality impairments in the Delta channels. Of particular concern discussed by Lee and Jones-Lee in their 2004 report is the inadequacy of monitoring/evaluation of aquatic life toxicity that is occurring in Delta waters that could be adverse to fish and fish food organisms. Subsequent to the release of their 2004 report, the POD expert panel found that the monitoring that was being conducted to determine the occurrence, magnitude, and extent of aquatic life toxicity that could be impacting the POD was highly deficient. This situation led to the development of a limited-scope aquatic life toxicity monitoring program in Delta waters as part of the POD studies. While that crash program and the CVRWQCB's irrigated-agriculture waiver monitoring program in the Delta are providing some information on the potential for aquatic life toxicity to be a factor in the POD, a greatly expanded program will need to adequately address this issue.

The Lee and Jones-Lee 2004 report on Delta water quality issues also discusses the potential impact of the federal and state water export projects on Delta water quality issues. While required by the SWRCB D-1641 Water Rights decision, the IEP Delta water quality monitoring program has not been conducted to evaluate the impact of the water exports on Delta water quality. An updated report is being prepared by Lee and Jones-Lee based on their 2007 AWWA conference presentation.

Groundwater Quality Protection Issues

The appropriate management of the state's water resources will require the integrated management of surface and groundwater resources. Of particular importance is the conjunctive use of surface waters by which wet-year surplus runoff water is injected in the storage capacity of drawn-down aquifers. The injected water is recovered from the aquifers during periods of reduced surface water supplies. In order to fully utilize conjunctive use of surface and groundwaters it is important to protect the quality of the water in the aquifer and the aquifer's hydraulic characteristics. While the CA Porter-Cologne Water Quality Control Act requires protection of groundwater quality, the state and regional water quality control boards have been permitting, and continue to permit, land surface activities such as municipal and industrial/commercial waste disposal, and allow irrigated agriculture, without adequate restrictions to prevent groundwater pollution. At the October 2007 CA/NV AWWA conference, Lee and Jones-Lee will present a discussion of groundwater quality protection issues that are pertinent to the utilization of the Central Valley water resources. Their presentation:



Lee, G. F., and Jones-Lee, A., "Groundwater Quality Protection Issues," Presented in part at CA/NV AWWA Fall Conference, Sacramento, CA, PowerPoint Slides, G. Fred Lee & Associates, El Macero, CA, October (2007). [Available on their website at:
http://www.members.aol.com/annejlee/GWProtectionIssues-sli.pdf]

is an overview of information in a report they prepared in the winter of 2007 that discusses groundwater pollution that is occurring in the Central Valley of California, and the need for greater regulatory attention to preventing such pollution.

Lee, G. F. and Jones-Lee, A., "Groundwater Quality Protection Issues," Report of G. Fred Lee & Associates, El Macero, CA, February (2007)
[Available at: http://www.members.aol.com/annelhome/GWProtectionIssues.pdf]

Additional information about the Bay Delta Water Quality sessions at the CA/NV AWWA Fall 2007 Conference in available at:
http://ca-nv-awwa.org/CA-NV/conferences/fall/baydelta.pdf.

San Joaquin River Water Quality Issues

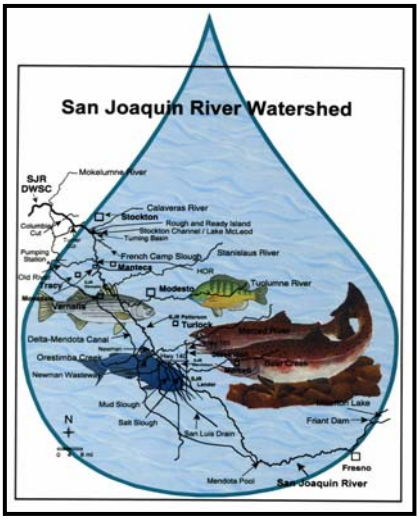
The San Joaquin River and its east-side tributaries arise in the Sierra Nevada mountains with high-quality rainfall and snow-melt waters. Upon entering the Central Valley floor, the SJR is dammed and the high-quality water diverted for irrigated agriculture. Downstream of the dam, the SJR flow is largely comprised of irrigation tailwater and/or subsurface drainwater. Those waters contain elevated concentrations of a variety of pollutants from the agricultural activities. The Central Coast Agricultural Water Quality Coalition's *Agriculture and the Environment - 2007* Conference that will be held in Monterey, CA, November 7, 2007, will include 3 concurrent sessions over 2.5 days on agricultural and environmental quality issues. At that conference, Drs. Lee and Jones-Lee will present the paper,

> Lee, G. F., and Jones-Lee, A., "Water Quality Issues of Irrigated Agricultural Runoff/Discharges—San Joaquin River, Central Valley, California," Presented at Agriculture and the Environment - 2007 Conference, Central Coast Agricultural Water Quality Coalition, Monterey, CA, November (2007). [Available at http://www.members.aol.com/GFLEnviroQual/SJR-WQ-Ag-Monterey.pdf].

The PowerPoint slides for that presentation are available on their website:

> Lee, G. F., and Jones-Lee, A., "Potential Water Quality Impacts of Agriculture Runoff/Discharges in the Central Valley of California," Presented at Central Coast Agricultural Water Quality Coalition's 2007 National Conference on Agriculture & the Environment, Monterey, CA, PowerPoint Slides, G. Fred Lee & Associates, El Macero, CA, November (2007).
> [http://www.members.aol.com/GFLEnviroQual/SJRAgImpactsMontereyNov2007.pdf]

Their paper and presentation at the Central Coast Agricultural Water Quality Coalition's Conference updates the report on San Joaquin River water quality issues they developed in the summer of 2006.



Lee, G. F. and Jones-Lee, A., "San Joaquin River Water Quality Issues," Report of G. Fred Lee & Associates, El Macero, CA, June (2006). [Available at: http://www.members.aol.com/annejlee/sjr-WQIssues.pdf]

Table 3 presents a summary of the current CWA 303(d) listings of impaired water quality in the San Joaquin River that will be discussed in their presentation.

Table 3

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

Table 4 lists constituents that Drs. Lee and Jones-Lee find should or could be listed as causes of SJR water quality impairment, and will be discussed at the conference.

Table 4

SJR & Downstream 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 — *E. coli*, 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
Could Be Listed - Need Investigation for Potential Impacts	
Herbicides	Toxicity to algae
Sulfate	Impact on bioaccumulation of mercury
PBDEs	Bioaccumulation
Aquatic sediment toxicity (pesticides, nutrients/algae/sediment ammonia, heavy metals, PAHs, other chemicals)	Toxicity
Unrecognized pollutants (pharmaceuticals & other unregulated chemicals dischargd by confined-animal facilities - dairies, feedlots, etc. - & domestic wastewaters	

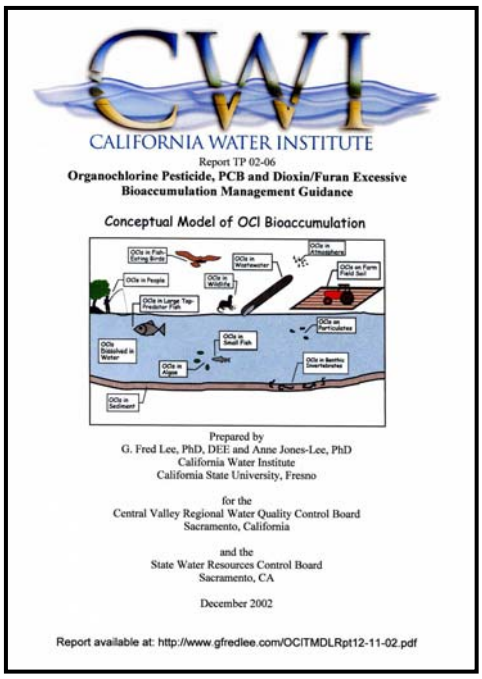
Pyrethroids
bifenthrin lambda cyhalothrin efenvalerate/fedvalerate permethrin

A review of the origins of the pollutants that are, or could be, causing violations of water quality standards (Tables 3 and 4) shows that over 80% are agricultural sources.

Additional information about the Central Coast Agricultural Water Quality Coalition's 2007 National Conference on Agriculture & the Environment is available at: http://www.agwaterquality.org/2007conference.

Excessive Bioaccumulation of Organochlorine
Legacy Pesticides in Central Valley Fish

The State Water Resources Control Board (SWRCB) has been collecting data on the bioaccumulation of organochlorine (OCl) "legacy" pesticides (such as DDT, dieldrin, chlordane, and toxaphene) in fish in Central Valley waterbodies since the late 1970s. In the late 1990s the CVRWQCB, DeltaKeeper, and others collected additional data on OCls in fish tissue. In 2002, under contract with the SWRCB through CSU Fresno Water Institute, Lee and Jones-Lee developed a comprehensive report discussing those data.



Lee, G. F. and Jones-Lee, A., "Organochlorine Pesticide, PCB and Dioxin/Furan Excessive Bioaccumulation Management Guidance," California Water Institute Report TP 02-06 to the California Water Resources Control

A set of PowerPoint slides covering the key information in that report is available at:
Lee, G. F. and Jones-Lee, A., "Excessive Bioaccumulation of Organochlorine Legacy Pesticides and PCBs in California Central Valley Fish," Made available at US EPA, California OEHHA and ATSDR 2004 National Forum on Contaminants in Fish, Report of G. Fred Lee & Associates, El Macero, CA, January (2004). http://www.members.aol.com/duklee2307/OCl-slides-SanDiego.pdf

Updated Information on OCl Bioaccumulation in Central Valley Fish.

Beginning in the spring of 2007 Lee and Jones-Lee initiated a review of the 2005 data on the body burden of OCls in the approximately 400 fish collected by the CVRWQCB (C. Foe) from Central Valley locations; about half of those fish were collected in the Delta. Lee and Jones-Lee are in the process of updating their 2002 report to incorporate those data. They are developing a report in which those data will be discussed:

> Lee, G. F., and Jones-Lee, A. "Update of Organochlorine (OCl) "Legacy" Pesticide and PCB Concentrations in Delta and the Central Valley Fish" Report of G. Fred Lee & Associates, El Macero, CA (in preparation).

When completed, it will be posted on the Lee and Jones-Lee website, www.gfredlee.com in the Surface Water Quality section Pesticides subsection at
http://gfredlee.com/pswqual2.htm#pesticide.

Lee and Jones-Lee are also reviewing the CVRWQCB Irrigated Lands Ag Waiver water column monitoring data for the Delta; they are finding that the concentrations of some of the legacy pesticides such as DDT in some water samples are sufficient to bioaccumulate to excessive concentrations in edible fish. There is also the potential for the DDT to be acutely toxic to some aquatic life.

CVRWQCB Irrigated Lands Conditional Waiver Program

The CVRWQCB is developing a water quality management program to control pollution of runoff/discharges from irrigated agriculture to Central Valley waters. Information on that program is available at:
http://www.swrcb.ca.gov/rwqcb5/water_issues/irrigated_lands/index.htmAgriculture

While the US EPA does not have the authority to regulate, or to cause states to regulate, agricultural discharges of pollutants, the state of California's Porter-Cologne Act Water Quality Control Act
[www.swrcb.ca.gov/water_laws/docs/portercologne.pdf] gives the SWRCB the regulatory authority to require agricultural sources of pollutants to control their discharges to state waters so that they do not cause violations of state water quality standards/objectives.

Several years ago, the CVRWQCB developed the irrigated lands conditional waiver program ("ag waiver" program) that requires that irrigated agricultural discharges (including stormwater runoff, tailwater discharges, and subsurface drain discharges) be monitored at a downstream location by agricultural interests in waterbodies, rivers and streams that receive potentially significant amounts of agricultural runoff/discharge.

Ultimately, in a decade or two if the currently proposed expanded ag waiver monitoring program is fully implemented, it will potentially provide a regulatory mechanism to control the extensive pollution of the SJR and Delta. M. Lopez-Read, Chief, Monitoring and Assessment Unit of the Irrigated Lands Conditional Waiver Program of the CVRWQCB, will present a discussion entitled, "Monitoring Data Review – Three Years with Irrigated Lands Conditional Waiver Program," at the October 23-25 Bay Delta Water Quality Symposium in Sacramento, as part of the 2007 CA/NV AWWA Annual Fall Conference, on October 24, 2007. Information concerning that conference is available at: http://ca-nv-awwa.org/CA-NV/conferences/fall/baydelta.pdf.

While there will be no "Proceedings" for that conference, Ms Lopez-Read has indicated that she will make available, via email, a copy of the PowerPoint slides for her presentation. She can be contacted at *mread@waterboards.ca.gov*.

M. Lopez-Read will also present a discussion entitled, "Central Valley Monitoring for Irrigated Agriculture – Approach and Results," at the 2007 Conference on Agriculture and the Environment in Monterey, CA on November 7, 2007. Information on that conference is available at *http://www.agwaterquality.org/2007conference*.