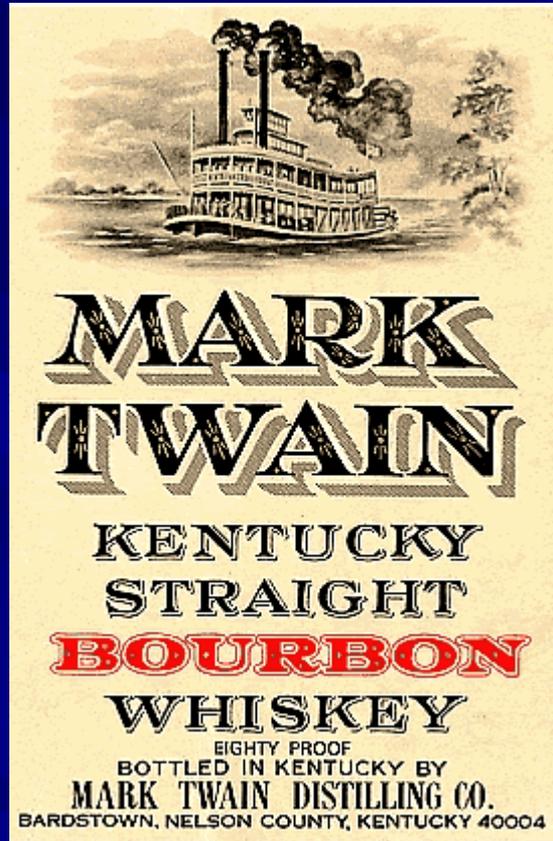


# TO SAN DIEGO'S TAP: WATER WARS AND THE LIFE AND DEATH OF THE SALTON SEA

Rick Gersberg, Ph.D

Professor of Environmental Health  
Graduate School of Public Health  
San Diego State University

# Whiskey is for Drinking



But, “Water is for Fighting”



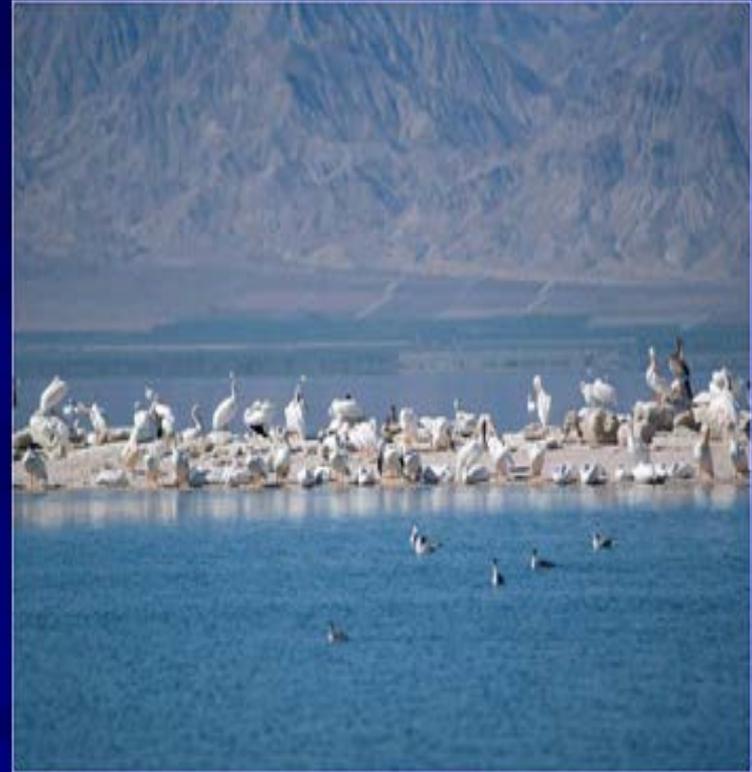
As California is facing the most serious drought of modern times, the Salton Sea is the latest battle in the American West's water wars!

California's  
oft maligned,  
oddly beautiful  
and downright  
weird  
**salton  
sea**



# Salton Sea

- The Salton Sea, is California's largest inland lake.
- It supports a spectacular bird population that is among the most concentrated and most diverse in the world ( more than 400 species and subspecies in all have been spotted at the Salton Sea).
- Sadly, this crucial stopover on the Pacific Flyway for migratory and wintering shorebirds and waterfowl and is dangerously close to collapse from several environmental threats, but particularly water transfers.



# QUANTIFICATION SETTLEMENT AGREEMENT (QSA) SETTLEMENT AGREEMENT

- Transfers agricultural water from the Imperial Irrigation District (IID) to the cities of southern California including San Diego.
- *“We believe a higher and better use is to move the water from agricultural uses in the Valley (the essence of the deal) to the thirsty parts of San Diego County.”. If this succeeds, sadly the Salton Sea will be ultimately left to dry up.”*
- IID and other QSA parties are compelled to mitigate impacts on the Salton Sea caused by the water transfer(s). Through 2017, the State Water Resources Control Board made such mitigation a requirement of its approval of the agricultural to urban water transfers authorized by the QSA



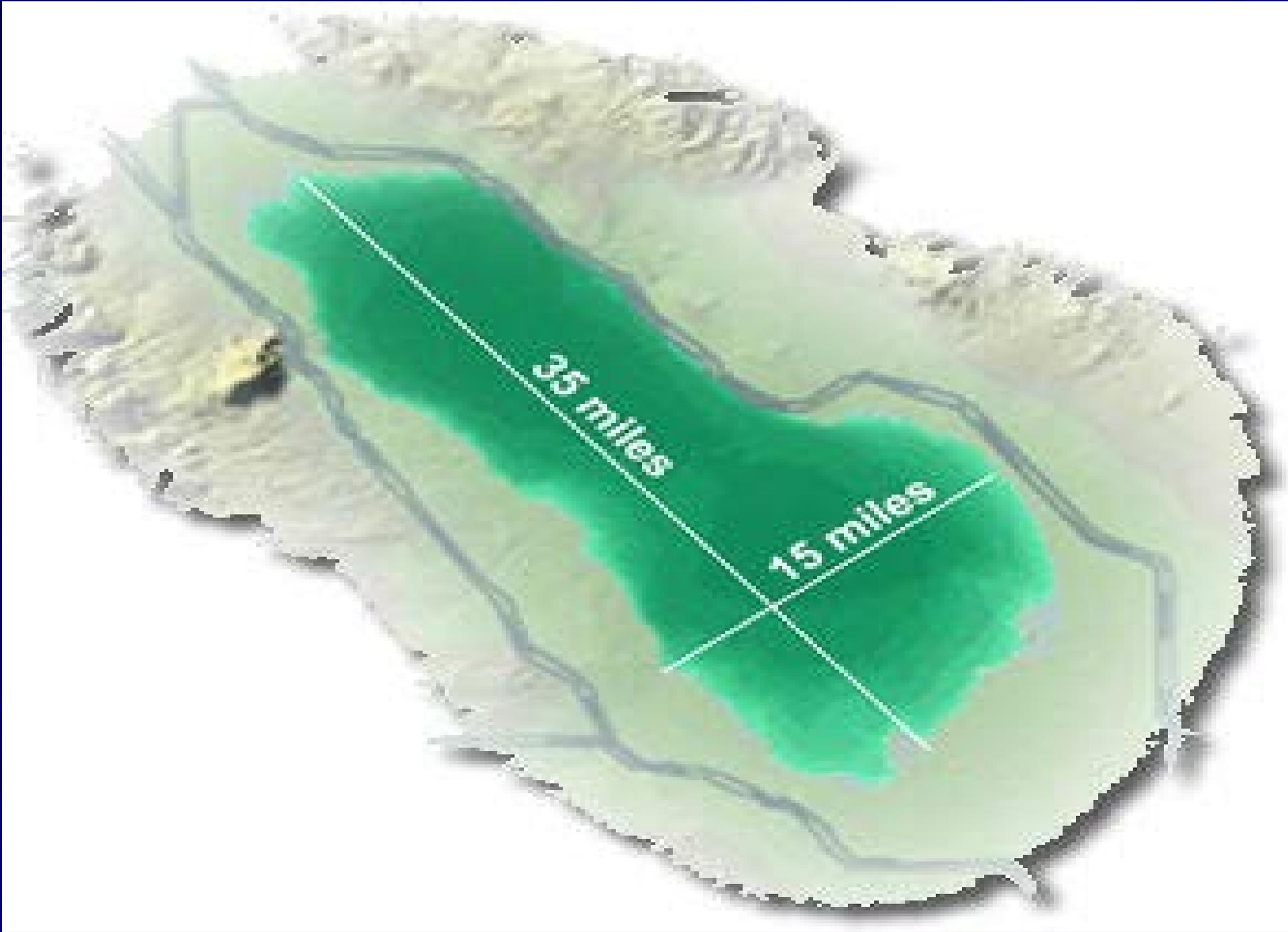


**Legend**

- Lake
- Meadow
- Highway
- Watershed

**Explanation**

This map shows the Salton River watershed area, which is a 90-mile-long system. The map is based on the National Wetlands Inventory Database.





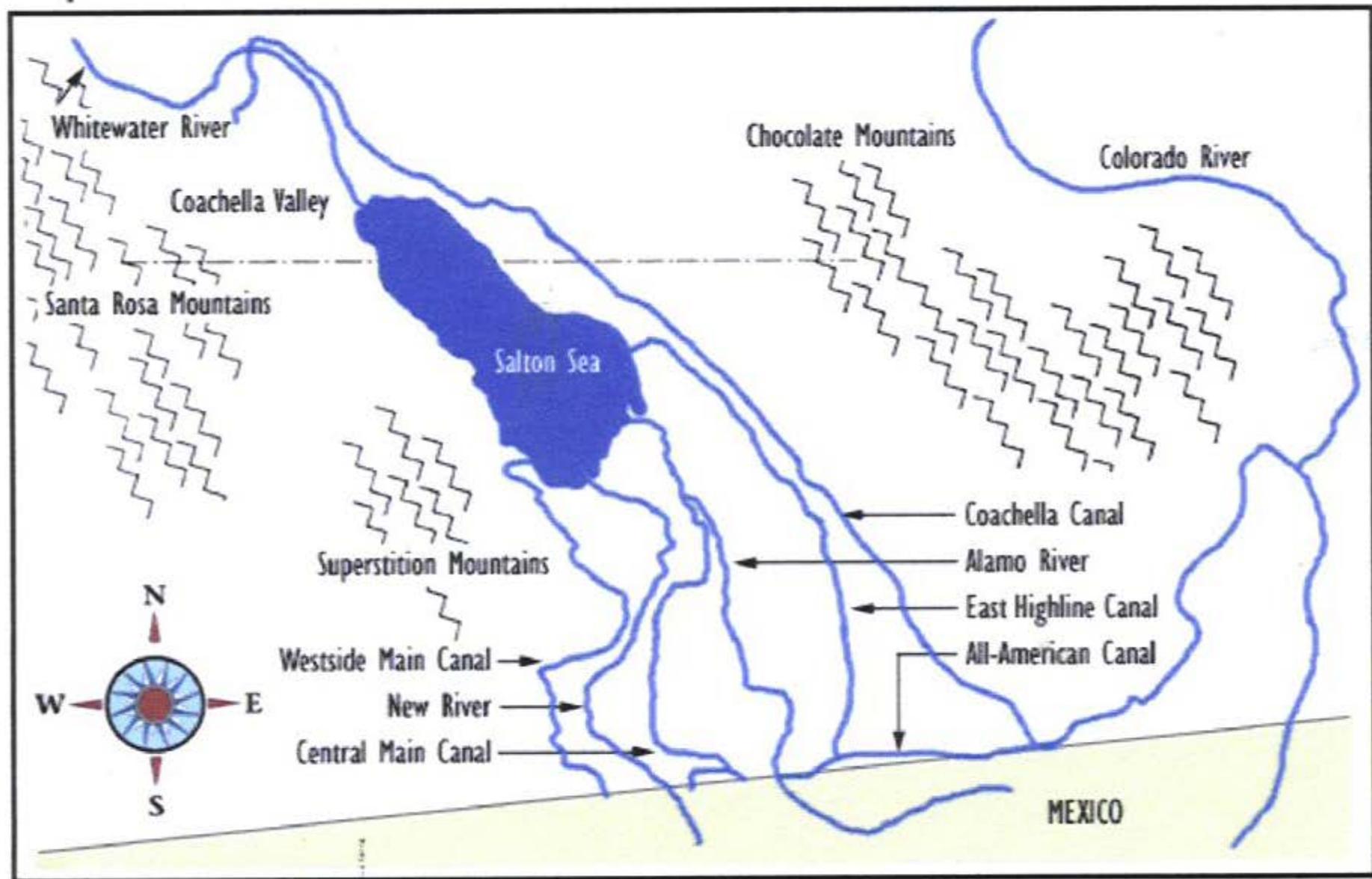








# Map of the Salton Sea Area

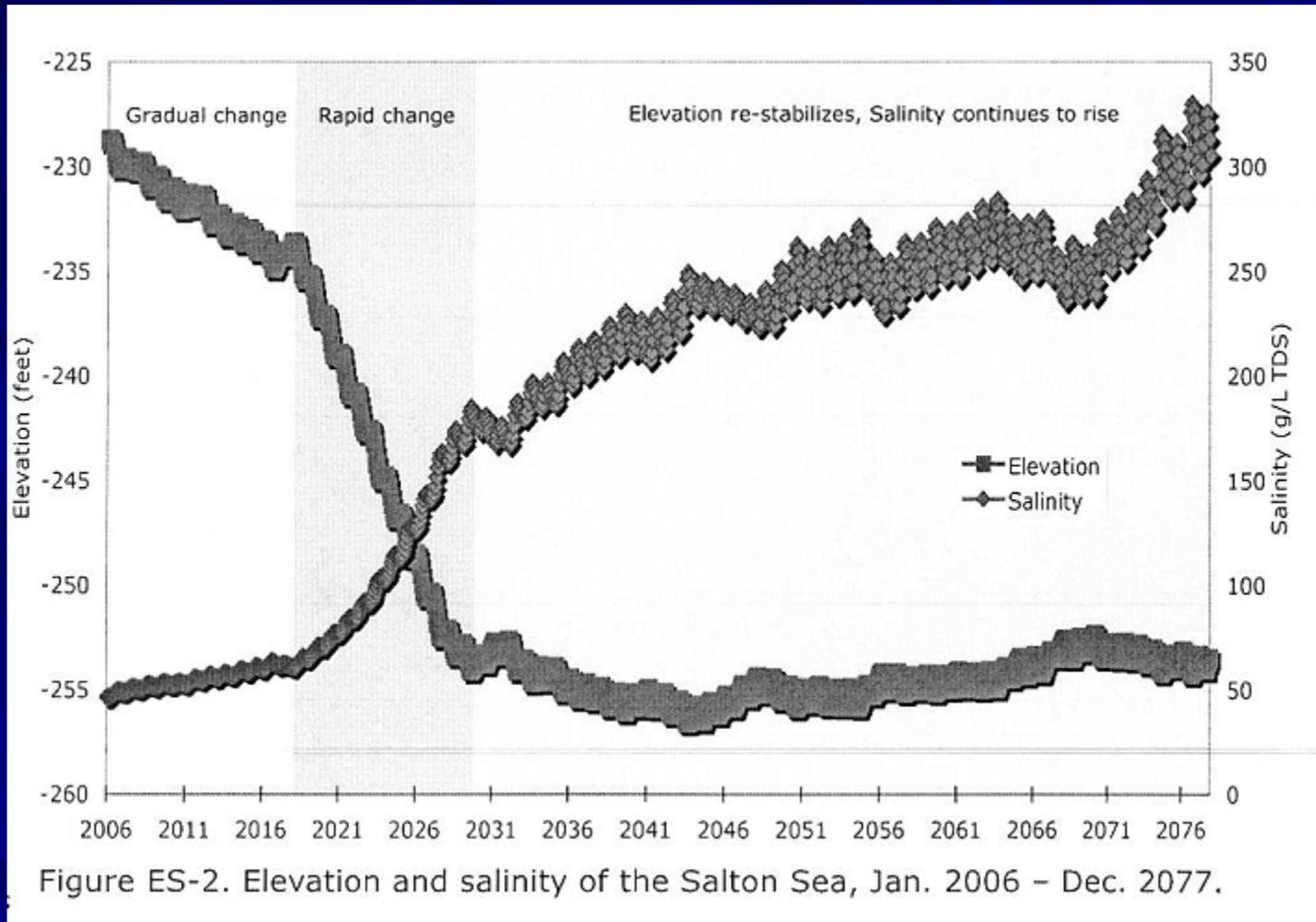




# Salton Sea

- Created in 1905 through irrigation canal failure
- Landlocked repository for agricultural drainage
- Heavily used by migratory waterfowl, including endangered species
- Flows are expected to decrease by as much as 50% over next decade as Imperial Irrigation District sells water to thirsty urban region of San Diego
- Salinity and toxic selenium increasing every year
  - Without human intervention, sea will eventually become “toxic and hypersaline” and unable to support fish, waterfowl

# Future of the Salton Sea





# PLAN 2

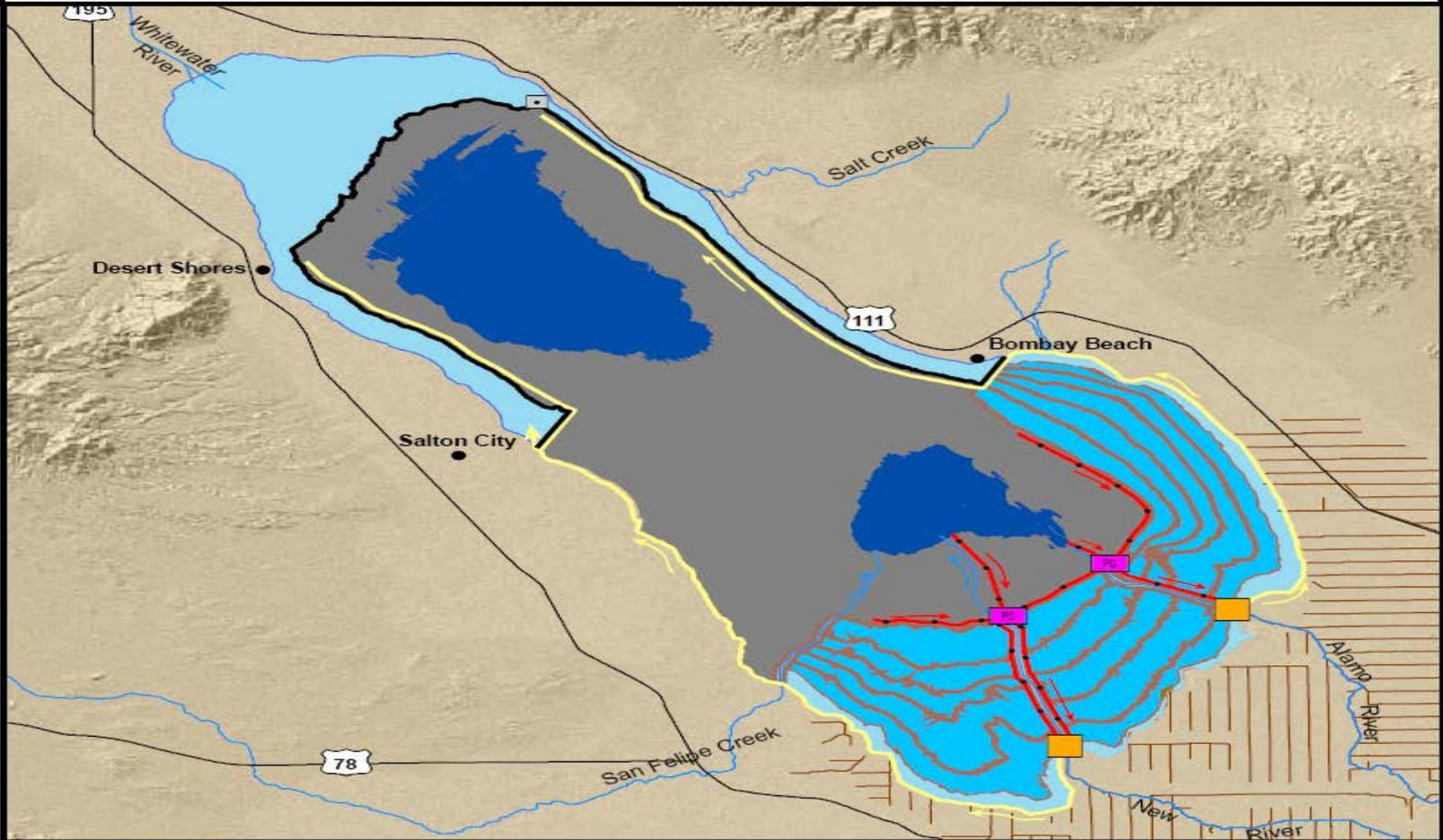
## The big canal

A second proposal to reduce salt levels calls for construction of a 100-mile canal from the sea to the Gulf of California. Less salty ocean water would flow north into the inland lake, located 228 feet below sea level, while brinier water from the Salton Sea would be pumped into the gulf.



**LEGEND**

- |   |                        |   |                                  |   |                 |
|---|------------------------|---|----------------------------------|---|-----------------|
|   | Marine Sea             |   | Overflow/Spillway                |   | Highways        |
|  | Brine Sink             |  | Saltwater Pump Station           |  | AQM Canal       |
|  | Exposed Playa          |  | Sedimentation/Distribution Basin |  | Saltwater Canal |
|  | Saline Habitat Complex |  | Agricultural Drain               |  | Barrier         |
|   |                        |   |                                  |  | River/Creeks    |



**DRAFT**



**PROPOSED PREFERRED ALTERNATIVE  
AT YEAR 2078**

SALTON SEA ECOSYSTEM RESTORATION PROGRAM

**Table 2**  
**Estimated Capital and Operations and Maintenance Costs For Preferred Alternative**  
(In Million Dollars, 2006 Dollars)

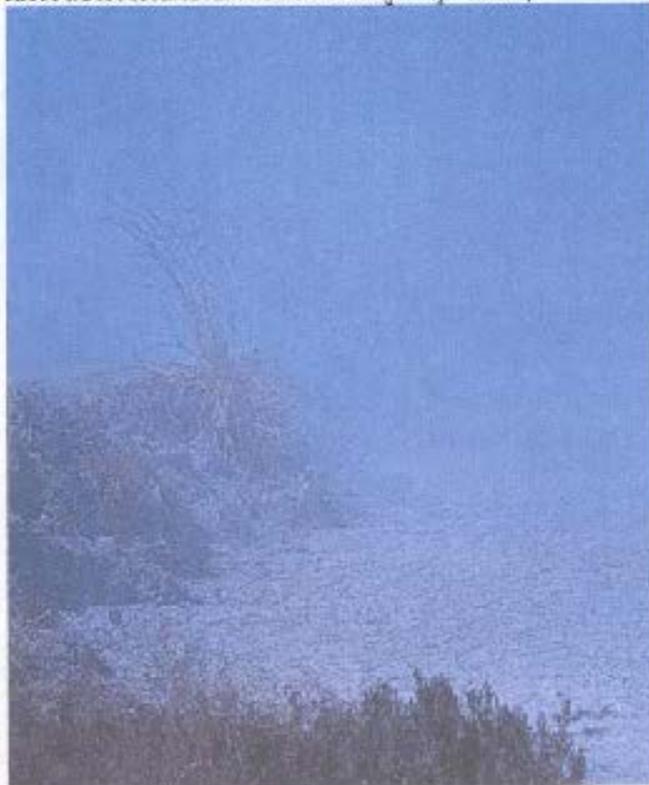
Items	Capital Cost	Annual Operations and Maintenance Cost at Build-out
Barriers	\$3,991	\$27
Saline Habitat Complex (including Early Start Habitat)	\$758	\$10
Water Conveyance	\$168	\$6
Air Quality Management	\$891	\$99
Subtotal	\$5,808	\$142
Additional Miscellaneous Items at 5% of Subtotal Above	\$290	—
Total Construction Cost	\$6,098	—
Contingencies at 30% of Total Construction Cost	\$1,830	—
Subtotal	\$7,928	—
Engineering, Administration, and Legal at 12% of Subtotal Above	\$951	—
<b>Total Capital Costs</b>	<b>\$8,879</b>	<b>\$142</b>

Note: Costs do not include cost of Demonstration Project, permits, land or easement acquisition, or interest on borrowing funds.



# Fugitive Dust

PHOTO 1: ECST STORM EVENT AT DAY'S ROAD (photo by Mit friend)



- ⌘ **ARB Estimates**  
**Fugitive Windblown**  
**Dust Contributes 180**  
**tons per day of PM10**  
**Emissions in the**  
**Salton Sea Air Basin**  
**(vs. 14.2 tons/day from**  
**Farming Operations; 8.1**  
**tons/day from**  
**Construction/Demolition)**

**LEGEND**



Marine Sea  
 Brine Sink  
 Exposed Playa  
 Saline Habitat Complex



Overflow/Spillway



Saltwater Pump Station



Sedimentation/Distribution Basin



Agricultural Drain



Highways



AQM Canal



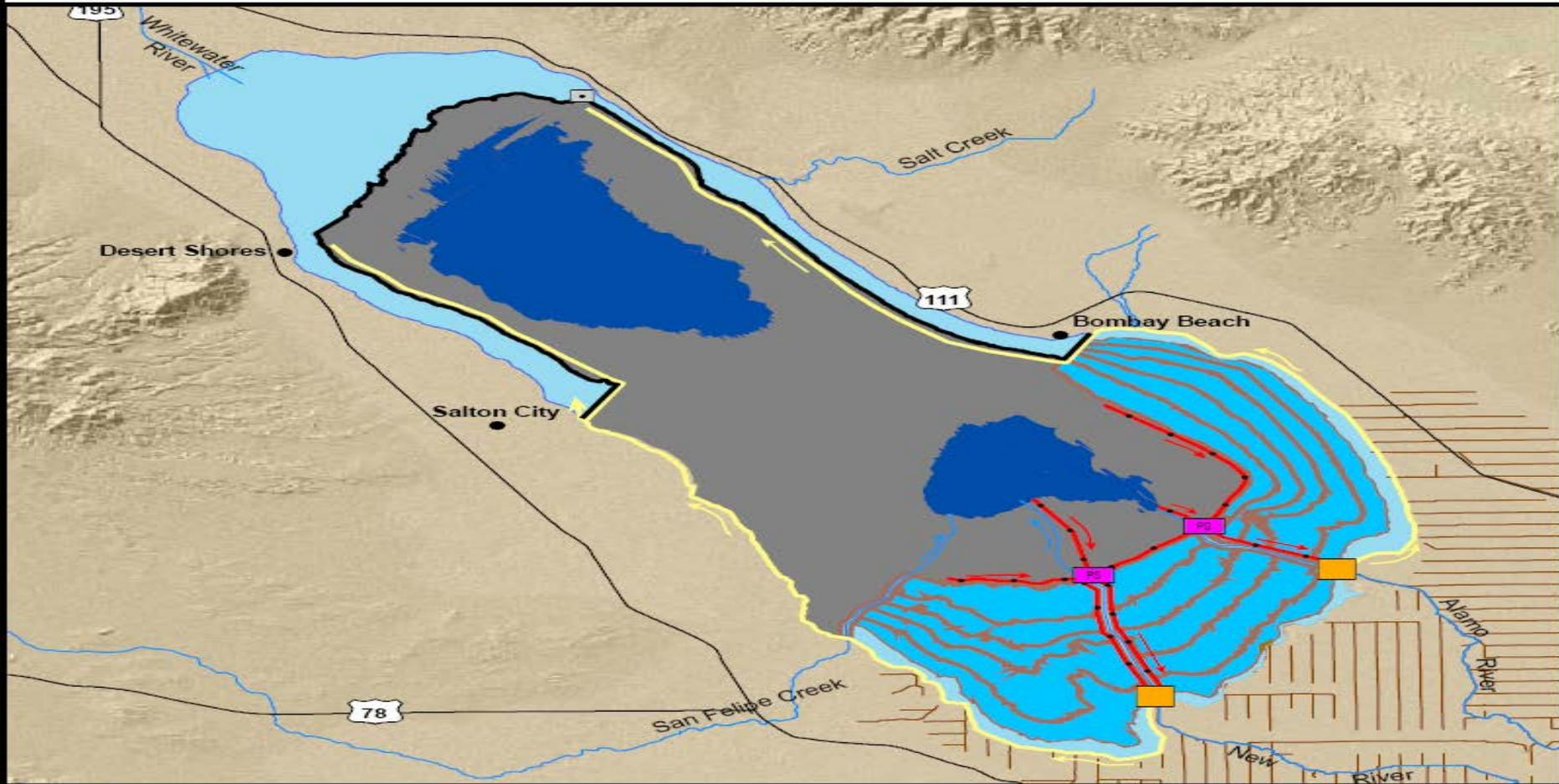
Saltwater Canal



Barrier



River/Creeks



**DRAFT**



**PROPOSED PREFERRED ALTERNATIVE AT YEAR 2078**

SALTON SEA ECOSYSTEM RESTORATION PROGRAM

# Selenium in the Salton Sea Area

- ~90% freshwater inflow to Salton Sea is agricultural drainwater
- Mean Se concentration has been increasing in Salton Sea, especially sediments, and in biomass as it bioaccumulates in wildlife
- Elevated Se levels in food chain organisms and bird eggs
- CalEPA's OEHHA issued advisory limiting fish consumption



# The “Kesterson Effect”

Named after 1980s event at Kesterson National Wildlife Refuge in San Joaquin Valley, CA where thousands of fish and waterfowl were poisoned by Se from irrigation drainwaters used for wetland management

- Imperial Valley has irrigated drainwaters and alkaline soils that promote the formation of water-soluble forms of Se
- Arid climate of the Imperial Valley -where evaporation leads to salt buildup
- Drainage into wetlands and aquatic habitats and biomagnification through the food chain

# Selenium Can't Be Ignored

A. Gadwall (Kesterson Reservoir, CA) with arrested development of lower bill, and missing eyes



B. Northern Pintail (Tulare Lake Bed, CA) with Arrested development of lower bill, and missing eyes



C. Redhead (Green River Basin, Utah) with Spoonbill narrowing of upper bill



E. Black-neck stilt (Kesterson Reservoir, CA) with Missing eyes, malformed bill, limb deformities, and exencephaly





# Constructed Wetlands and Salton Sea Restoration

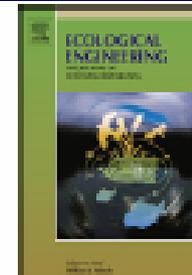
- In the future, as many as 35 wetlands (as much as 2,000 hectares) will be constructed for water quality improvement at the New River (Citizens Congressional Task Force on the New River).
- The purpose of this demonstration-scale constructed wetlands was to demonstrate the ability of constructed wetland technology to improve the water quality of the New River before it flows into the Salton Sea.

# California's Wetlands:

1780: 5 million acres

1999: 450,000 acres





## The fate of selenium in the Imperial and Brawley constructed wetlands in the Imperial Valley (California)

Paula I. Johnson<sup>a,\*</sup>, Richard M. Gersberg<sup>a</sup>, Mark Rigby<sup>b,c,1</sup>, Sujoy Roy<sup>b</sup>

<sup>a</sup> Graduate School of Public Health, San Diego State University, 5500 Campanile Drive, San Diego, CA 92182-4162, United States

<sup>b</sup> Tetra Tech, 3746 Mt. Diablo Blvd., Suite 300, Lafayette, CA 94549, United States

<sup>c</sup> Marine Science Institute, University of California, Santa Barbara, CA 93106-6150, United States

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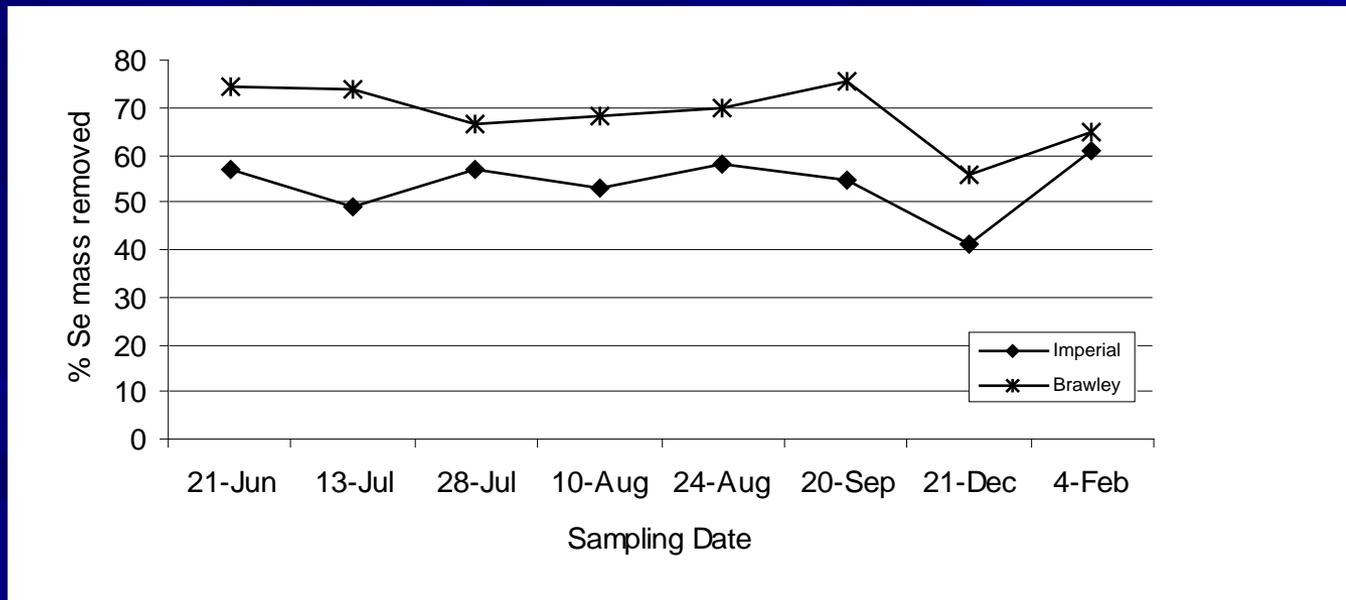
Bioaccumulation

### ABSTRACT

The New River Wetlands Project is comprised of two constructed treatment wetland sites supplied with water from the New River and agricultural drainage water from the Imperial Valley in California. Bioaccumulation of selenium has created toxic conditions for wildlife in similar wetlands in other areas. Selenium levels in water (at wetland inflow and outflow), sediments, plants, invertebrates, and fish were analyzed for both wetland sites from 2006 to 2007. An average of 56% of the total mass of selenium in the inflow was removed at the Imperial site, and 70% was removed at the Brawley site. Most of the retained selenium (8 kg at the Imperial site and 2 kg at the Brawley site) was in the sediments. Less than 1% of the selenium accumulated in plant tissues. Mass balance calculations estimated that 17–61% of the selenium was lost through volatilization. After 6 years of operation of these wetlands, concentrations of selenium in fish and invertebrates were at or above threshold ranges for reproductive effects in birds and fish. Constructed wetlands are an efficient method for removing selenium from agricultural drainwater, although they need to be monitored over the long-term for potential risks posed by bioaccumulation of selenium.

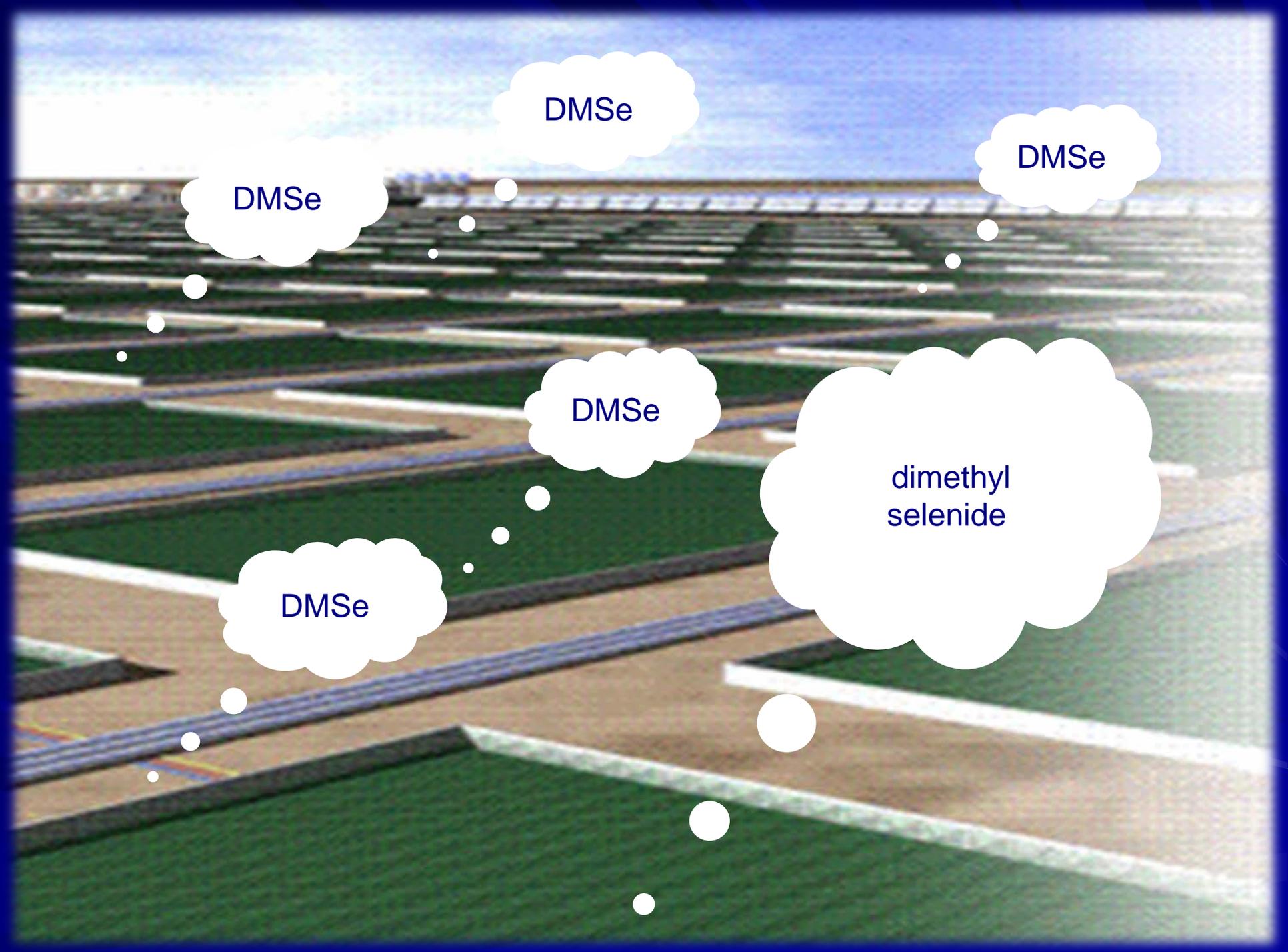
# Results – Se mass removal efficiency

Percent Se mass removed from inflow water after passage through the wetlands



– 54%

– 69%



DMSe

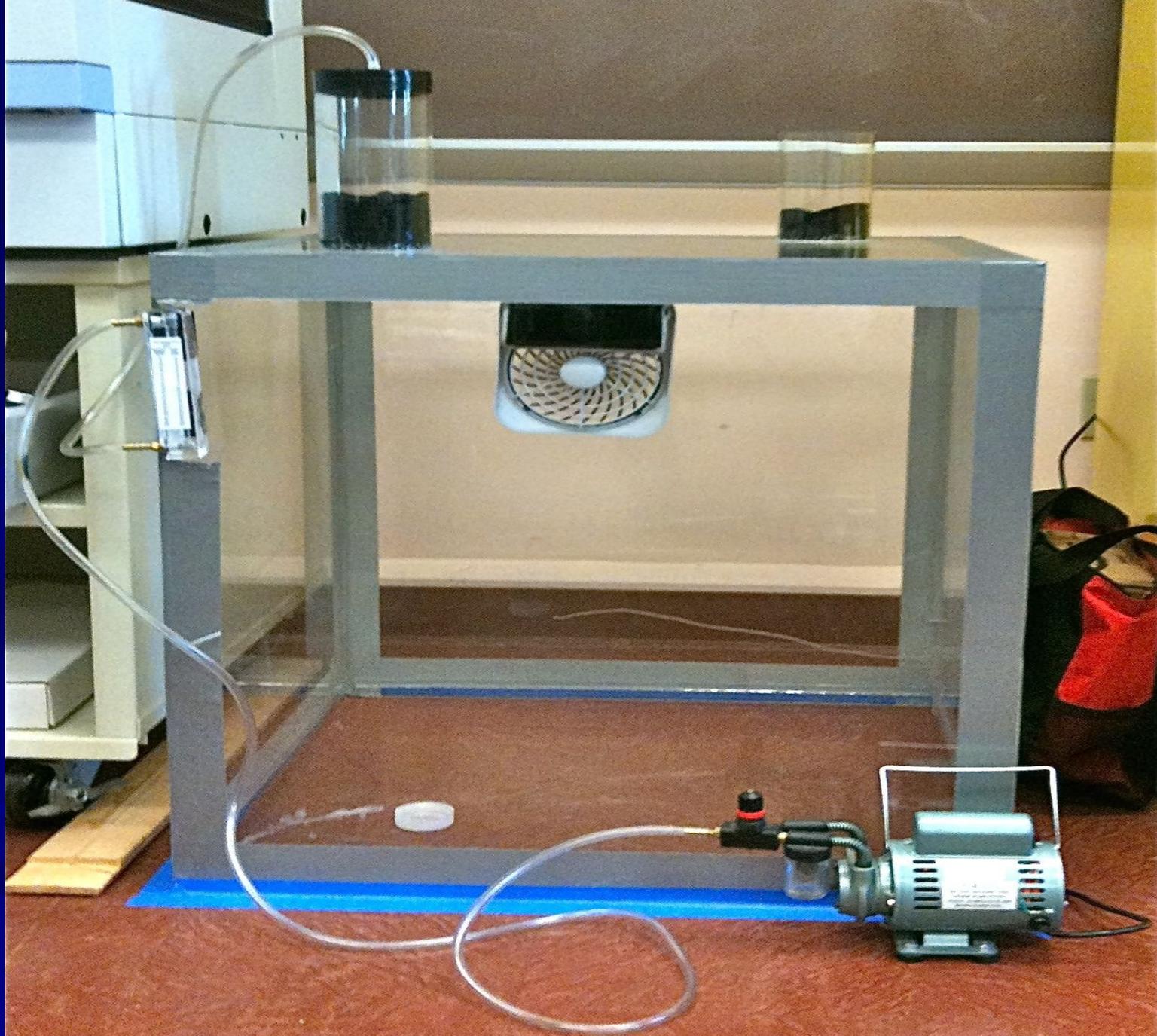
DMSe

DMSe

DMSe

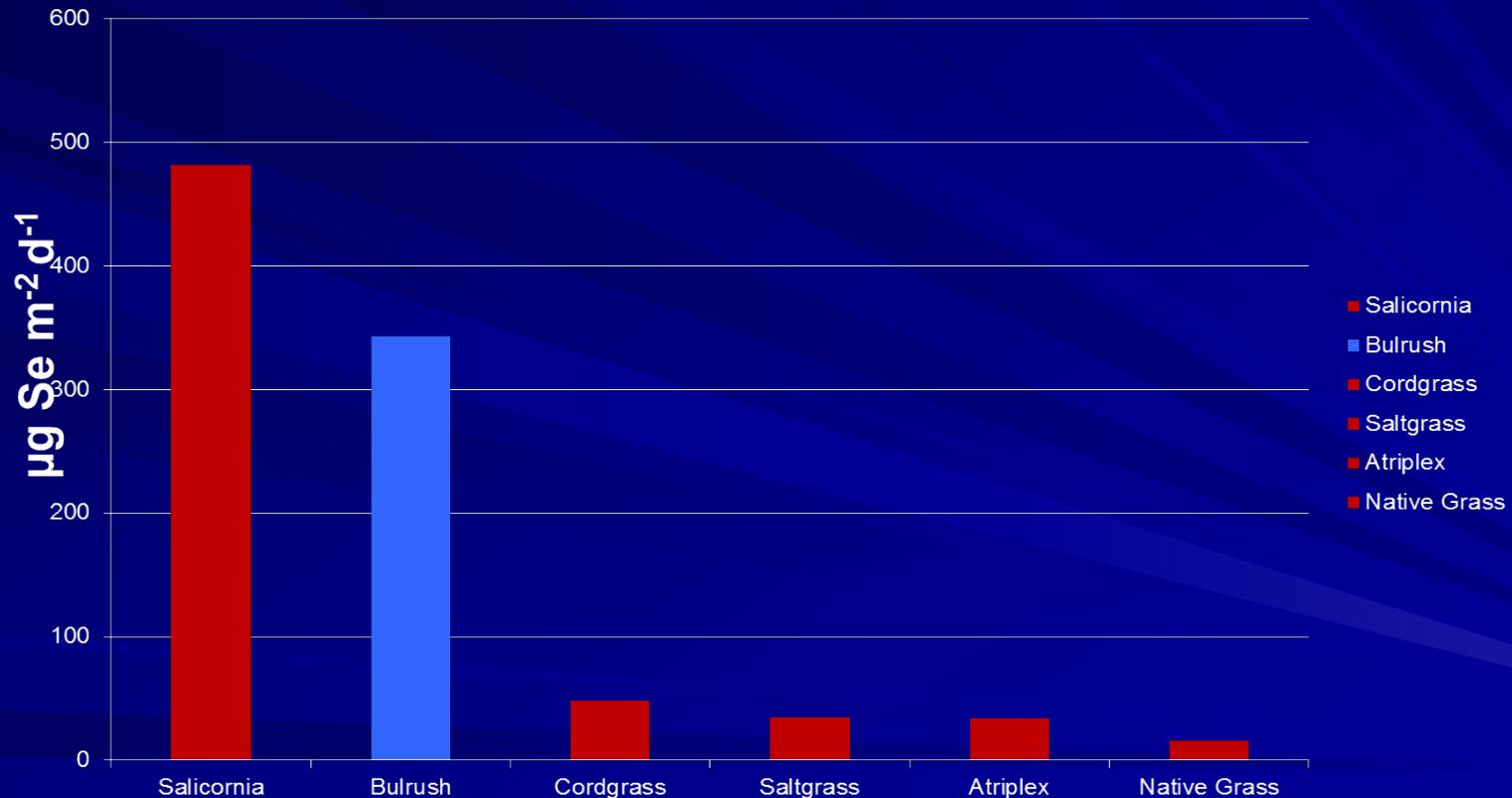
dimethyl  
selenide

DMSe





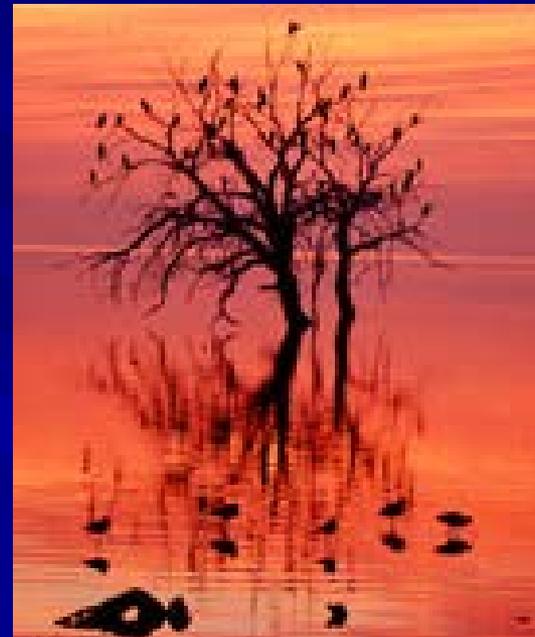
# Maximum Rates of Selenium Volatilization



Red Bars from Lin et al, 2002

# THE TROUBLED SEA

- The Salton Sea stands with one foot in purgatory and one in hell. To simply survive for a while in purgatory, much less make it to paradise, will require a massive public-relations battle and a fierce fight for cash waged in the shadow of San Diego's water demands.
- And it will require a feat of environmental engineering like none other the American West has ever seen.



“I wish to make it clear to you, there is not sufficient water to irrigate all the lands (in the West) which could be irrigated... I tell you, gentleman, you are piling up a heritage of conflict!

John Wesley Powell, speech,  
1893