“Water is for Fighting Over”: Water and the California Delta as a Theme for a Capstone Seminar

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GEOS 185: Capstone Seminar in Environmental Science

- BS in Environmental Science
  - Core: Geology (5 courses),
    Biology (5 courses),
    Chemistry (3 courses)
  - Additional related courses:
    - Humanities (Philosophy, History, or Literature)
    - Policy (US or International)
  - Capstone in Spring semester of Senior year

GEOS 185: Capstone Seminar in Environmental Science

- Designed to integrate all aspects of the major
- Thematic approach
  - Water and the California Delta
    - Local
    - Current
    - Multi-disciplinary
    - Focus of on-going state controversy

"Whiskey is for drinking, water is for fighting over."

- attributed (falsely)to Mark Twain

"Water flows uphill towards money."

- Anonymous quote, from Cadillac Dessert

Water in California

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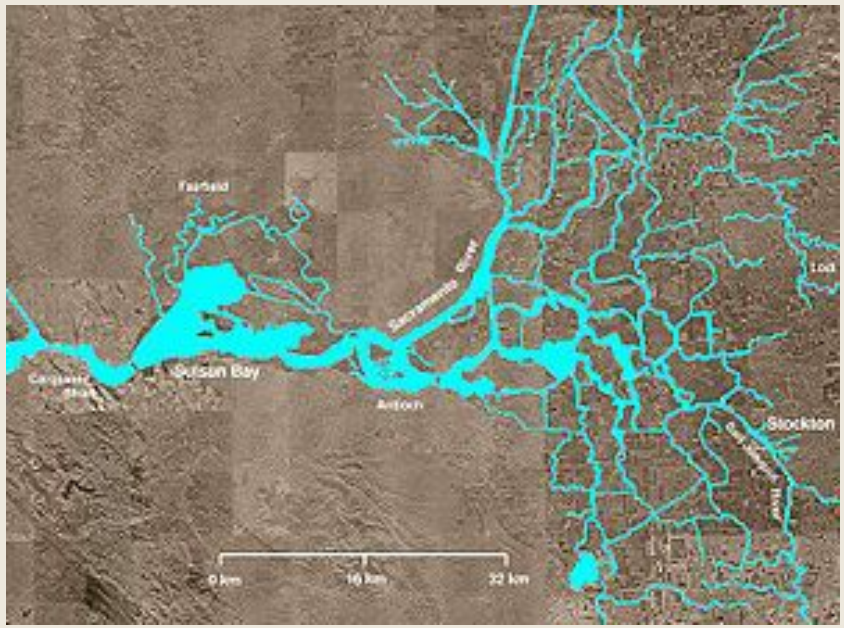
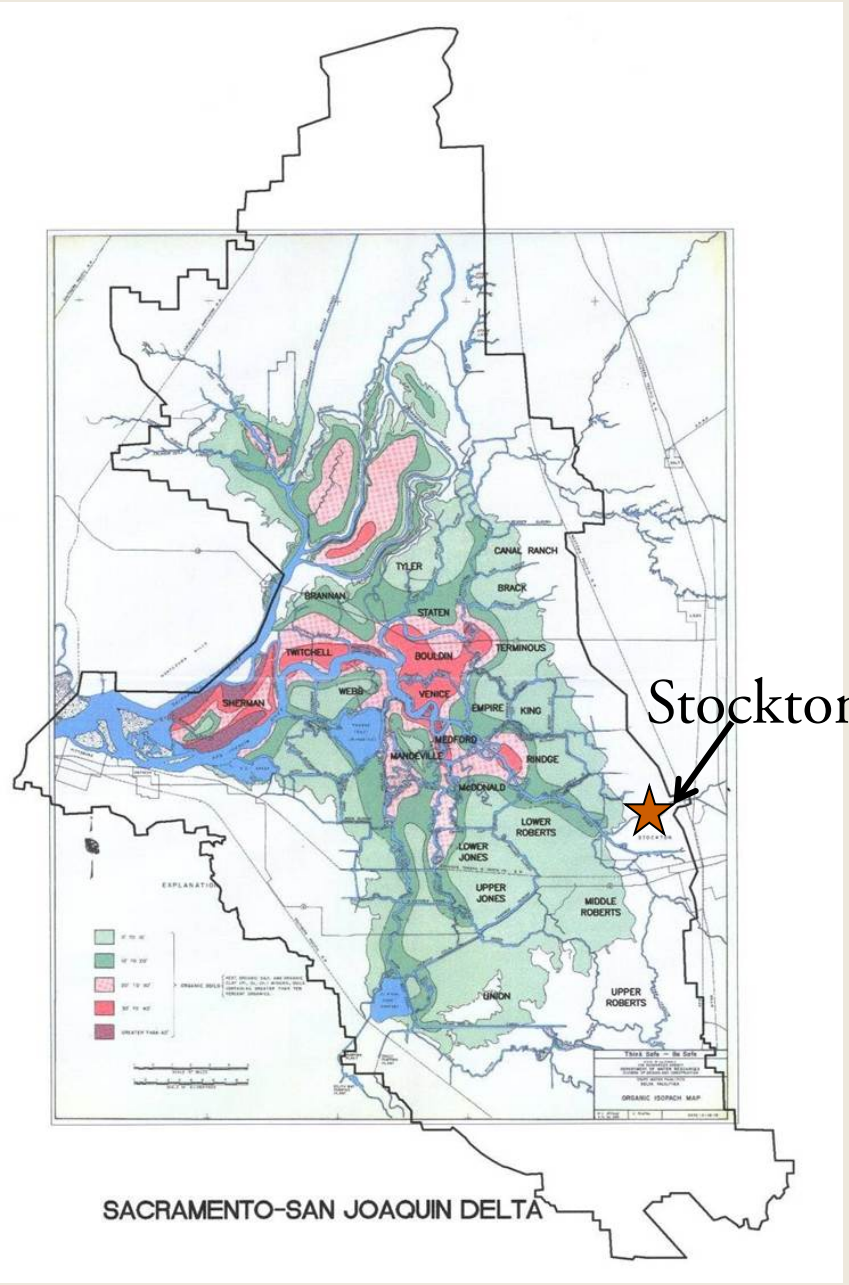
California Delta

- Confluence of the Sacramento and San Joaquin Rivers





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Course Format

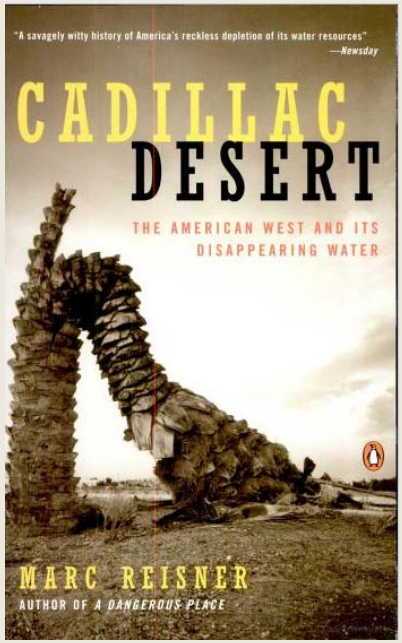
- Readings
- Guest Speakers
- Field Trips
- Student-led discussion/debate
- Research Projects

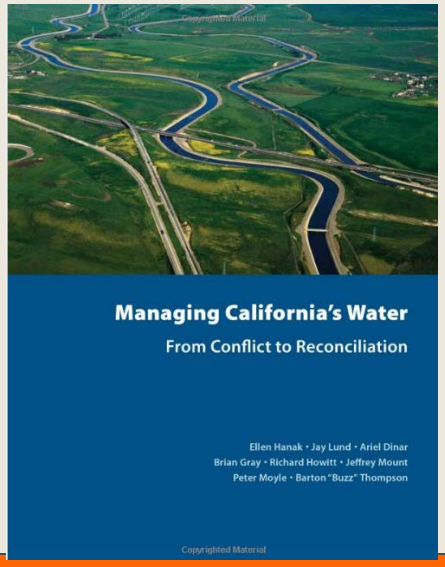
Topics

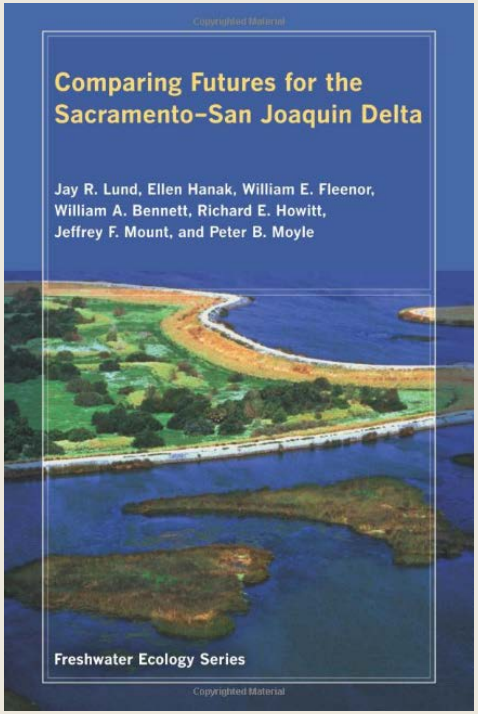
- California water history
- Water law
- Hydrology
- Fish migration
- Endangered species
- Habitat restoration
- Water quality
- Levee construction
- Agriculture
- Economics
- Water conservation

Readings

- "Cadillac Desert"
- PPIC reports
- Student-generated reading lists







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Guest Speakers

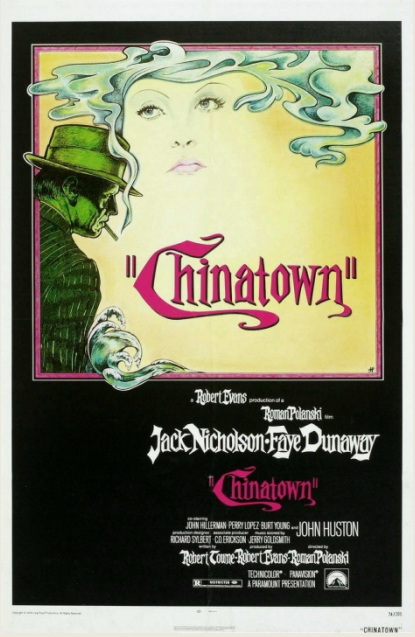
- Delta Historian
- Lawyers
- Biologists
- Farmers
- Policy Makers
- Economist
- Delta recreation journalist

California Water History

- Gold Rush and flooding due to hydraulic mining
  - *Woodruff v. North Bloomfield* Federal decision

California Water History

- Los Angeles Aqueduct (early 1900s)



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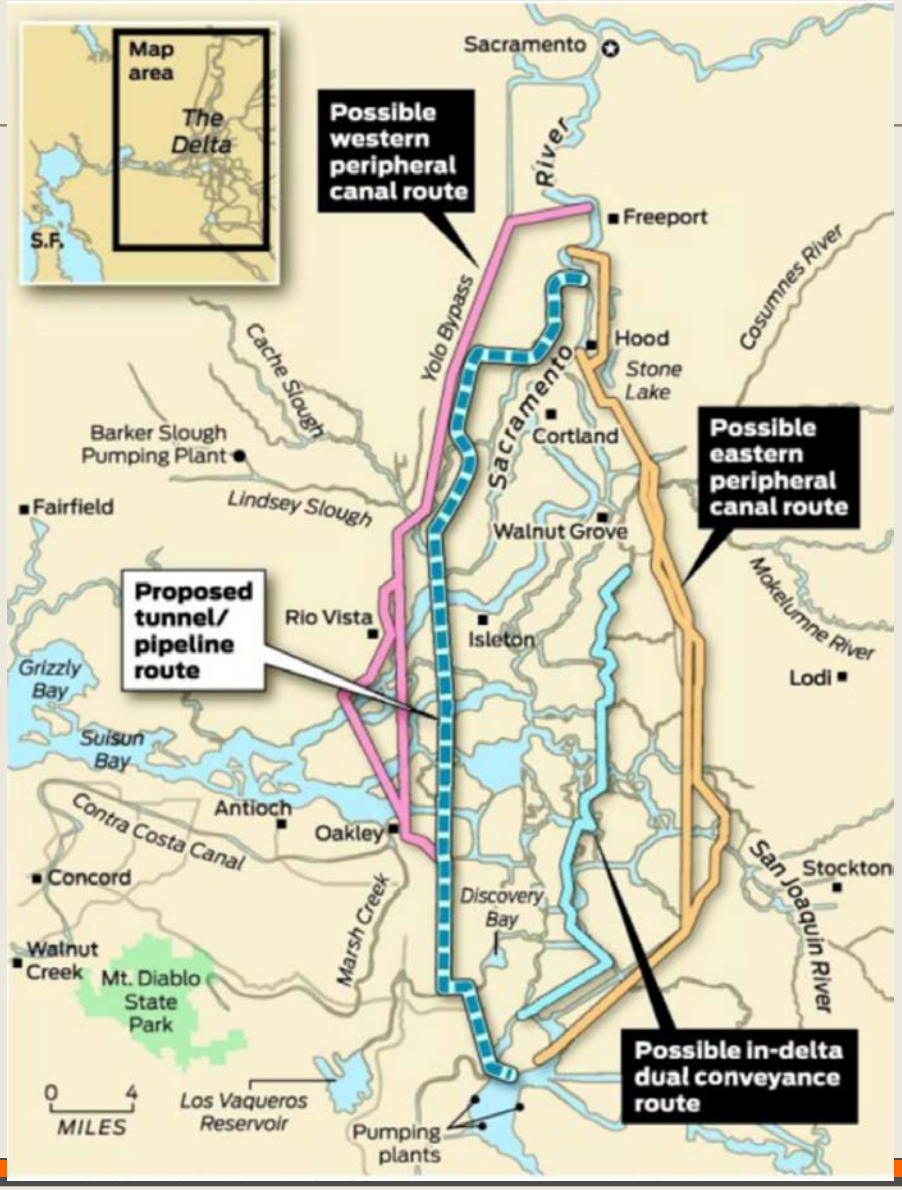
California Water History

- Central Valley Project (Federal – 1930s)
- State Water Project (1960s)
- Promised water deliveries exceed available water
  - Meant to be surplus water
- Significant impact on Delta

California Water History

- Peripheral Canal or Tunnel
  - Ongoing issue
  - HIGHLY controversial
  - On-going focus of CA politics



Water Quality Issues

- Salinity
- Agricultural runoff
- Municipal waste water

Biological Impacts

- Endangered Species
- Invasive Species

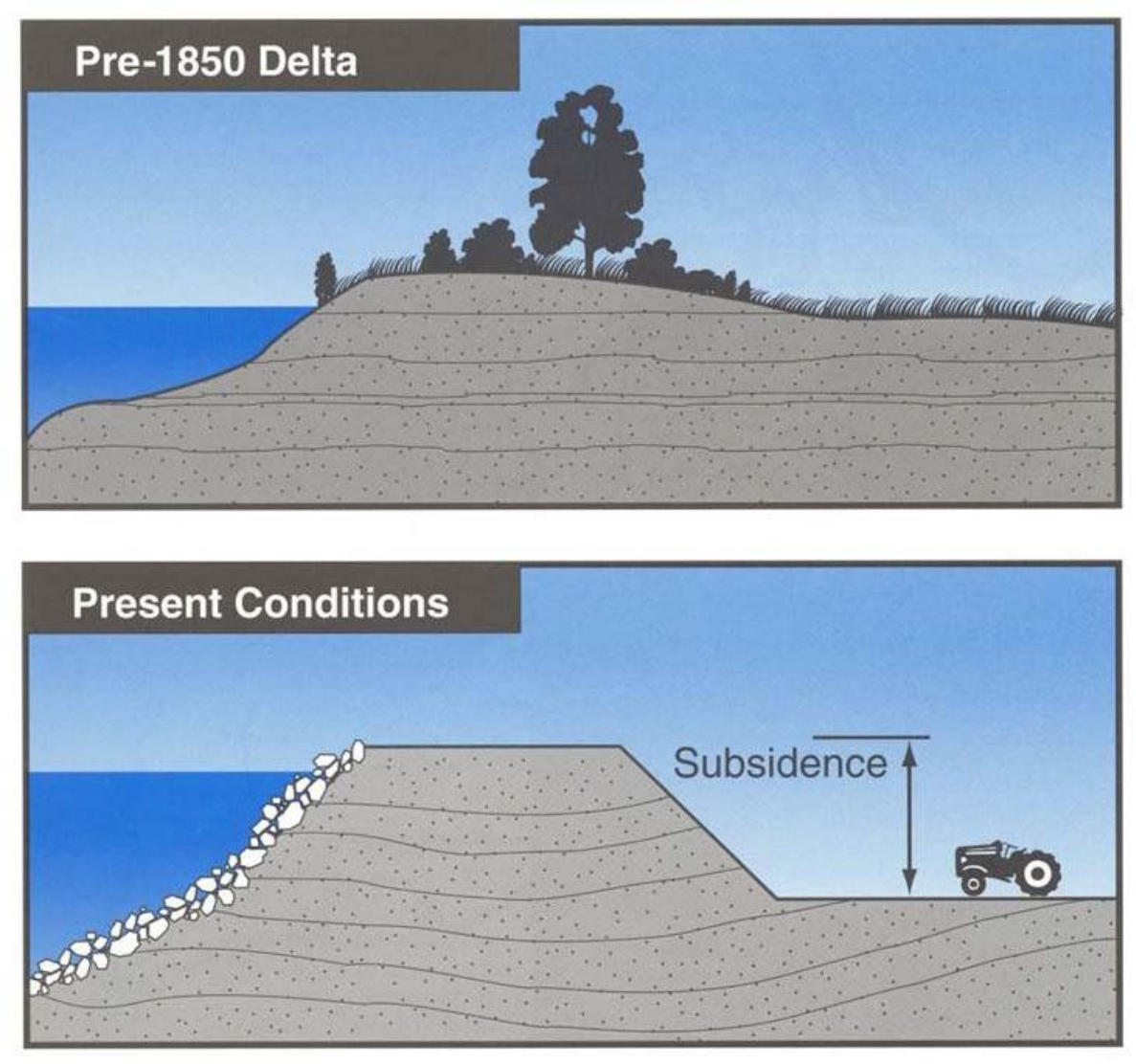
Economic Issues

- Farms vs. Fish?
- Delta vs. southern valley farmers
- Water deliveries vs. water transfers

Levees

Subsidence

Seismic stability



Research Projects

- Focus on aspects of Delta water issues
  - Habitat restoration
  - Improved levee construction
  - Water quality improvements
- Written component
  - To inform policy makers
  - To inform public
- Group poster

Fish, Fields, or Front Yards: A Capstone Seminar's Plan for Balancing Uses of the Sacramento-San Joaquin Delta

Carly A. Hiromoto, Christopher J. Brown, Kaitlen C. Colafrancesco, Win N. McLaughlin

Abstract

California's Sacramento-San Joaquin Delta is the heart of the state's water supply system and estuarine habitat. Water from the Delta supports California's largest industries such as agriculture and recreation while at the same time providing clean drinking water for municipalities. Human interaction has altered the diverse array of ecosystems within the Delta. Reclamation of the Delta over the past 150 years has resulted in an artificial system of levees and dams to create the current state of islands and channels. Ongoing subsidence as well as emerging threats such as climate change endangers the Delta's stability. Historical conflicts between water quality and quantity add other layers of complexity to an already convoluted system. Future stability and vitality is still attainable at the cost of statewide efforts to improve water infrastructure, sustainable agriculture, ecosystem health, and urban conservation and planning. A small, well-designed and managed peripheral canal and improved levee design standards will provide adequate natural flows to maintain the Delta's ecosystems while satisfying the needs of Central Valley farmers. Encouraged responsible agricultural practices and crops through subsidies will maximize water efficiency in the central valley. Reexamination of possible beneficial uses for Delta islands in key locations and enhancing habitat for native species will help to revitalize local ecosystems. Urban improvements in water consumption and conservation through metering, pricing, and limitations on development will decrease municipal demand. If implemented collectively, these measures will alleviate pressures on the Delta while balancing the demands of farmers, ecosystems, and California residents.

This poster focuses on changes in Delta infrastructure and municipal water usage. The goal of these changes are to reduce the water demand from the Delta while also increasing flow through the Delta. These changes will help to improve water quality fin the Delta for municipal users as well as ecosystem health.

Figure 1: Constructed Waterways. This map shows the Delta with constructed waterways highlighted in grey. The large number of constructed waterways in the Delta highlights its engineered status and ever changing system of channels and islands (California Department of Water Resources 1995).

Figure 2: Tyler Island Levee Breach. Levee breaches such as this one on Tyler Island in 1986 show the fragility of the engineered waterways of the Delta (USGS 2009).

Background

Water is a precious commodity, especially since the demand usually results in a short supply. California, with its ever increasing population has been in a drought for the past three years which has caused more strife over the water crisis. As of 2005, the Sacramento-San Joaquin Delta exports 53 million acre-feet of water to be sent south. Approximately 80% of the water exported is used for agriculture, while only 20% is used for municipalities. The sheer volume of the water that travels throughout this system on a daily basis takes a toll on the estuarine ecosystem and the physical structure of the Delta. To limit further degradation of the Delta, other water alternatives like water recycling and desalination need to be considered. In addition urban improvements, a change in infrastructure can reduce the amount of water exported out of the Delta. The presence of a proposed Peripheral Canal will cut exports to a set volume to maintain a stable Delta and preserve the ecological integrity of it. The instability of the Delta is a consequence of a number of variables including climate change, subsidence, and the levees. The aging infrastructure and lack of maintenance of the Delta's engineered anatomy is a growing concern. The urgency of this situation makes it apparent that new mandatory improvements in the infrastructure of Delta and in municipal use need to be implemented to ensure future stability of the heart of California's water system.

Infrastructure: Peripheral Canal

Issue: Water exports from the Delta lead to abnormal flow direction and decreased flow throughout the area. In 2005, 5.3 MAF were exported through the pumping plants in the South Delta.

Solution: Small Peripheral Canal

1. Total capacity will not exceed 70% of 2005 exports
   - 3.7MAF
2. Canal will take from the Sacramento River and shunt water around to the pumping plants in the South Delta
   - See Figure 2 below for route
   - Release points along canal to increase flow in East Delta
   - Use existing pumping facilities
   - Stop forced flow of Sacramento River water N/S through the Delta to the pumping plants
3. Volume being exported will depend on minimum flow
   - Absolute minimum flow will be based on a dynamic model developed by:
     - California Environmental Protection Agency
     - United States Geologic survey
     - California Department of Water Resources
     - California Department of Fish and Game
4. Increased regulation of exported water
   - Agriculture use only
   - Appropriations cannot be sold off-site (all water must be used on the property to which is allotted)

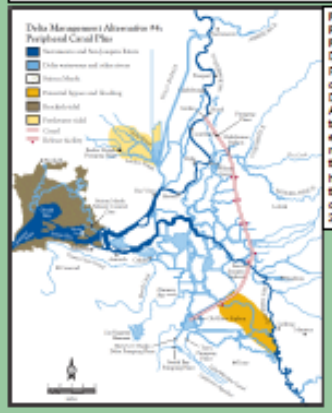


Figure 3: Potential Peripheral Canal Route. Diagram of the Public Policy Institute of California's 4th Delta Management Alternative plan. Red triangles along the east Delta indicate release points from the canal that will help increase flow throughout that side of the Delta. (Lund 2007)

Figure 4: Tracy Pumping Plant. This image shows the Tracy pumping plant where, one point that water leaves the Delta. It is located in the South Delta near the Clifton Court Forebay (San Luis & Delta-Mendota Water Authority)

Figure 5: Desalination Plant Near San Diego. This image shows the desalination plant in Carlsbad, CA. When it opens in 2012, it will be one of the largest in the United States (Boxall 2009).

Urban Water Management

Issue: California is a naturally arid region.

Description: California has a desert climate so water is scarce to begin with, therefore water needs to be conserved.

Solution 1: Implement pumping taxes and subsidies. This solution will decrease water use and promote groundwater recharge. This will be similar to the subsidies we propose for agricultural water conservation. East Stockton can be used as a model for rates and enforcement.

Solution 2: Also implement statewide metering, especially in highly unsustainable areas like Los Angeles and San Diego. The tiered "water tax" would be determined based on land use, distribution and climate/location (rainfall).

Solution 3: Initiate landscaping incentives. Xeriscaping is an alternative to traditional landscaping; "water conservation through creative landscaping". Base incentives on climate/location (average annual rainfall).

Solution 4: Limit further urban development in the Delta and areas that cannot provide for their water demands.

Issue: Pumping and increased exports threaten the fragility of the Delta.

Description: Delta exports currently equal 5.3 million acre-feet per day with 80% being used for agriculture and 20% for municipalities. Municipal use is low compared to agriculture use; limit Delta exports to 70% to be used wholly towards agriculture.

Solution: Southern California will provide its own municipal/urban water through alternative water resources:

- Water recycling
- Desalination
- Importing water

Summary

Reducing the strain on the Delta will require major changes to California's water infrastructure and a change in how municipal water is used and managed. This plan revolves around the use of a small, managed peripheral canal to shunt water from the Sacramento River to the pumping stations that supply water to the Central Valley Project and the State Water Project. A reduction in water being sent to these pumps for agricultural use and water management based on the development of a dynamic minimum flow for the Delta will increase the volume of water traveling through the area.

In order for municipalities in the Southern half of the state to subsist on a decreased amount of water, changes are necessary in how the general public uses water. Statewide requirement of water metering and a tax system based on water use would help decrease municipal use. Initiatives or regulations that will reduce urban water usage, such as xeriscaping and thoughtful land use planning, will further decrease demand. Another solution to ensure adequate water supplies is to invest in water recycling or desalination technology and employ that where possible and environmentally safe.

The purpose of these proposed changes is to reduce the amount of water that is being pulled out of the Delta. By increasing and stabilizing the volume of water flowing through the Delta, water quality will improve throughout the Central Valley. By promoting water management changes, the proposal facilitates the improvement of the Delta ecosystems without forcing unbearable hardships on municipalities or farmers.

Figure 6: Delta Levees. An image of the levee in the Delta. Note the high water level in the waterway compared to the land surface of the Delta "island." Images like this highlight the need for a well-managed Delta. (Neudeck 2010)

References

Boxall, Bettina. (10 November 2009). Public subsidies approved for Carlsbad desalination plant. *Los Angeles Times*. Retrieved from http://www.fox5sandiego.com/news/kswb-desal-subsidies,0,2729473.story

California Department of Water Resources. *Sacramento San Joaquin Delta Atlas*. Available from http://baydeltaoffice.water.ca.gov/DeltaAtlas/

Lund, J., Hanak, E., Fleenor, W., Howitt, R., Mount, J., and Moyle, P. Envisioning Futures for the Sacramento-San Joaquin Delta: PPIC. 2007.Available from http://www.ppic.org/content/pubs/report/R_207JLR.pdf\

Neudeck, Christopher H. 4/06/10. Levees in the Sacramento-San Joaquin Delta.

San Luis &Delta- Mendota Water Authority. Retrieved from www.sldmwa.org

United States Geologic Survey. (2009). *Carbon Farming*. Retrieved from http://ca.water.usgs.gov/Carbon_Farm/index.html

Student Feedback

- "**most intensive science writing** I had while at Pacific" (2010)
- "Trying to write a science document, yet making it still understandable to lawmakers and the public has been exactly what I've now been doing to get funding in grad school." (2010)

Student Feedback

- "I think the capstone class helped to make me a **more informed voter** with a better understanding of how environmental issues are actually handled." (2011)
- "As a foreigner, it helped me **learn more of the history** of the region." (2012)

Student Feedback

- "this class offered a purposeful **real world experience** and gave us a true sense of what environmental science is by **synthesizing** the classes we had previously taken together." (2010)
- "I can say this is the **project I learned the most from** in my entire University life." (2012)

Conclusions

- Ideal topic for capstone
- Connects to current issues
- Integrates multiple disciplines
- Very rewarding to teach
- Students are excited about it