Mitigating Non-Point Source Pollution with Constructed Wetlands

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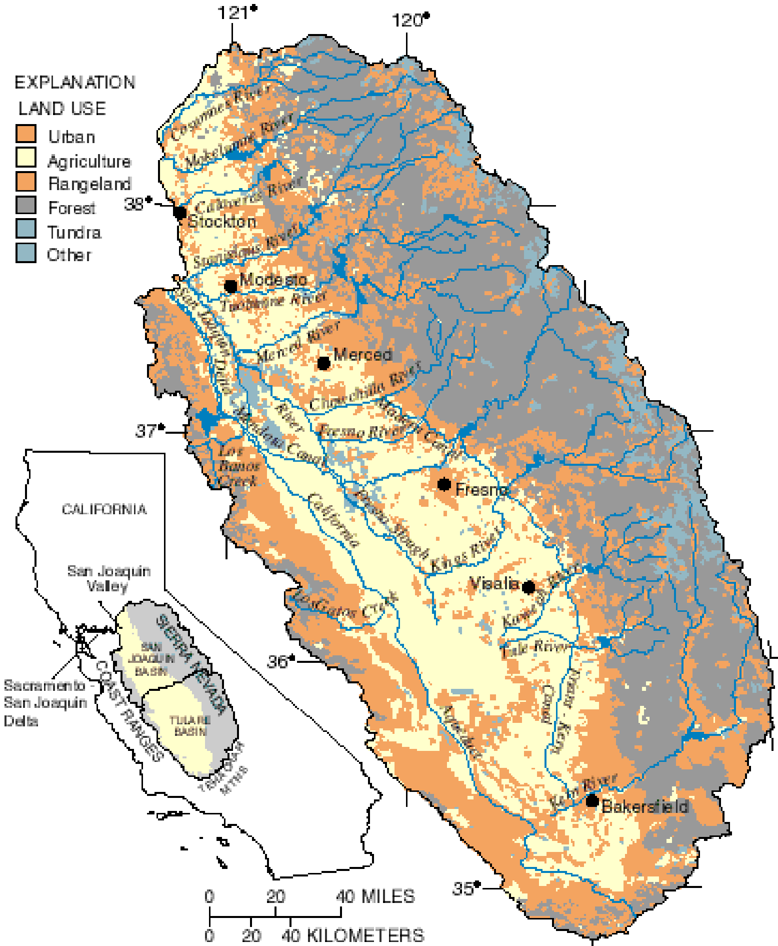
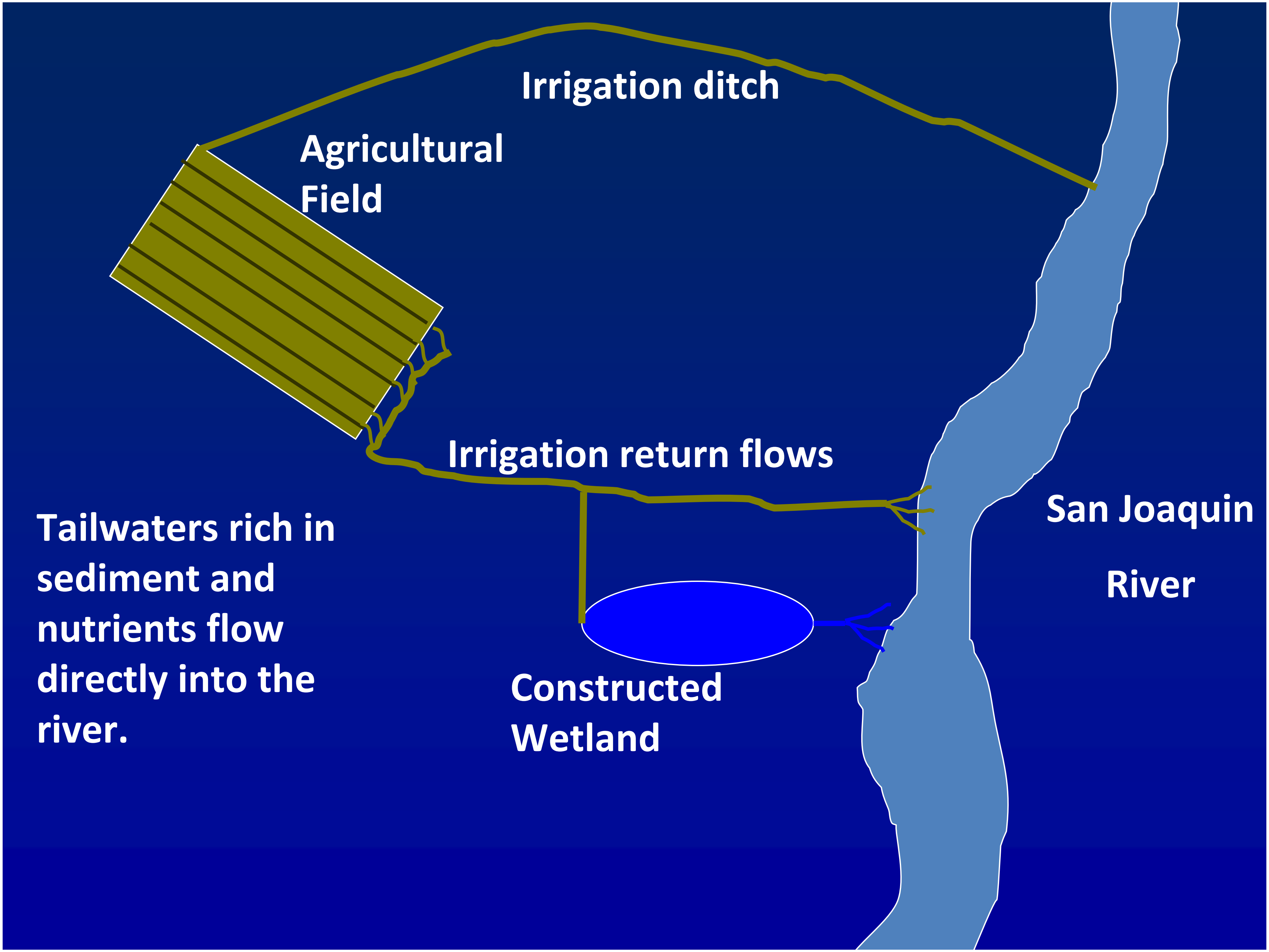
Irrigated Agriculture in the Central Valley




Irrigation ditch
Agricultural
Field
Irrigation return flows
San Joaquin
River
Tailwaters rich in
sediment and
nutrients flow
directly into the
river.
Constructed
Wetland

Objectives

- Monitor water quality at input and output locations of four constructed wetlands

- Investigate the role of wetland characteristics (design, size, depth, volume & shape) on contaminant removal.

- Identify the potential for adverse impacts of CWs on water quality of the San Joaquin River and find ways to fix them.

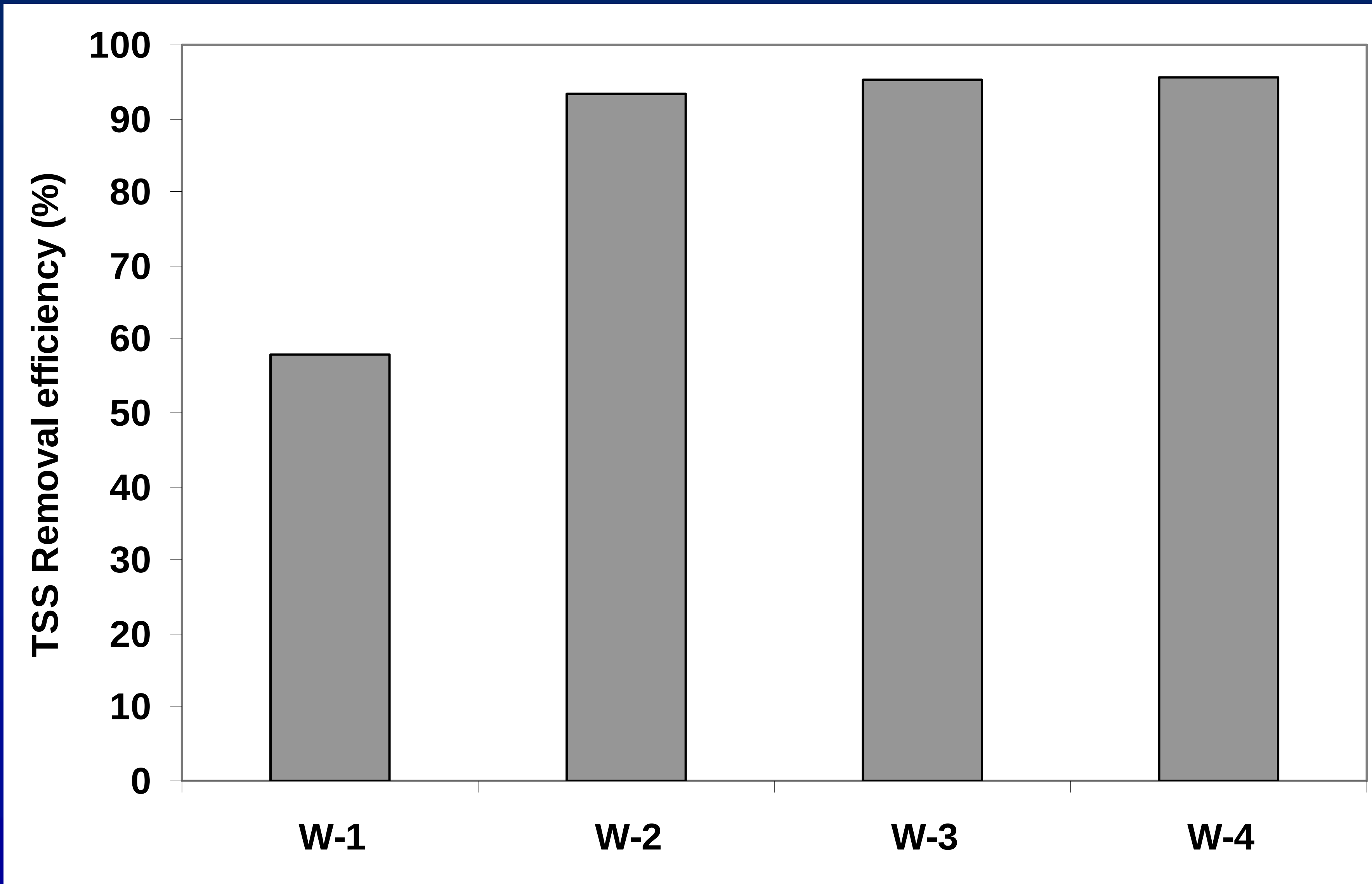
Summary of wetland characteristics

Wetland Id.	Hydraulic residence time (days)	Area (ha)	Design	Contributing farmland (acres)
W-1	2.5	7.3	open water	~4,000
W-2	0.9	2.3	dendritic,	~800
W-3	1.6	2.5	dendritic,	~800
W-4	11.6	~150	open water	> 4,000

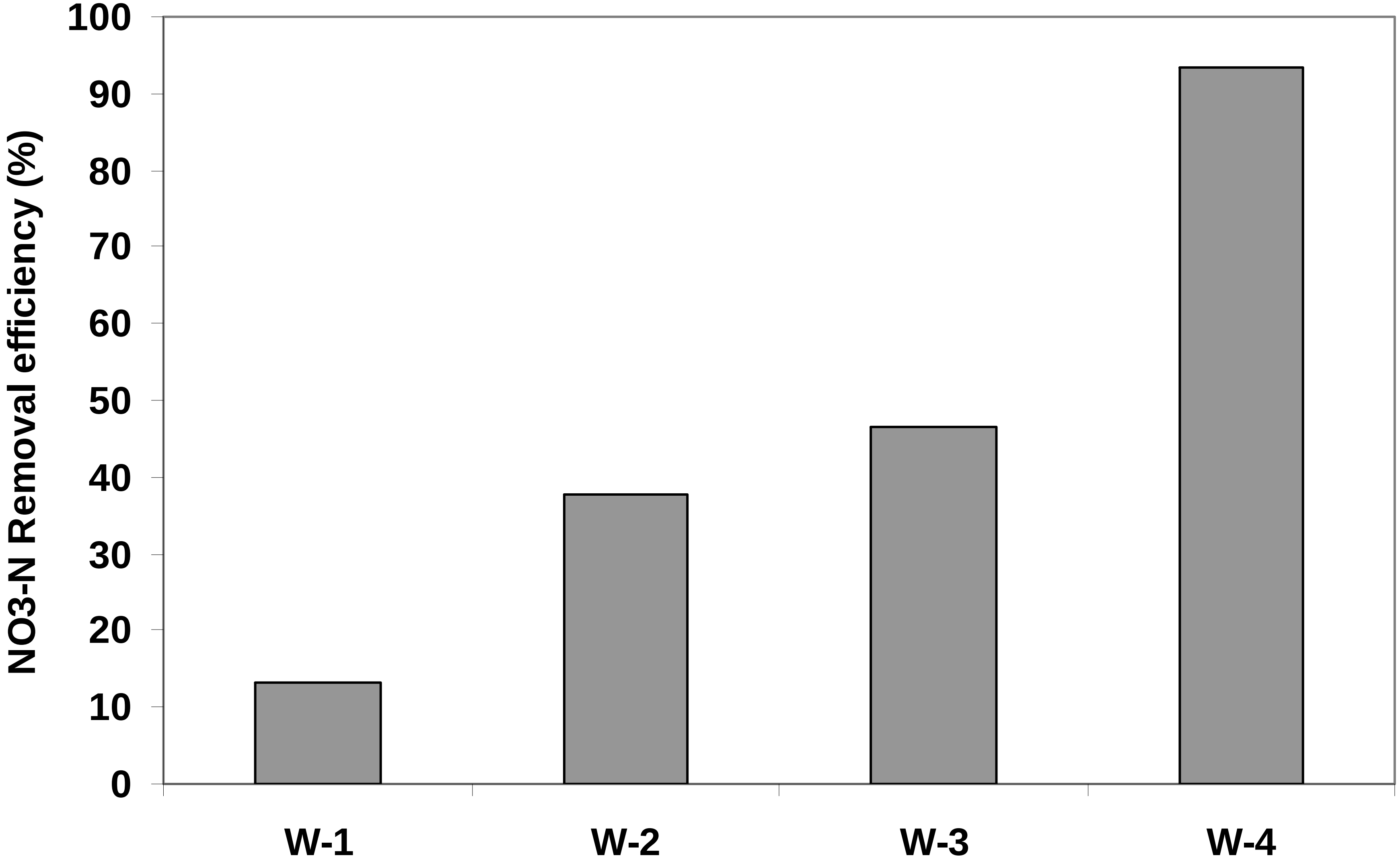
Inlets/outlets

- Weekly grab samples are collected during the irrigation season. Auto-samplers used to capture weekly variability.
- Weirs and area velocity meters installed to measure flow.

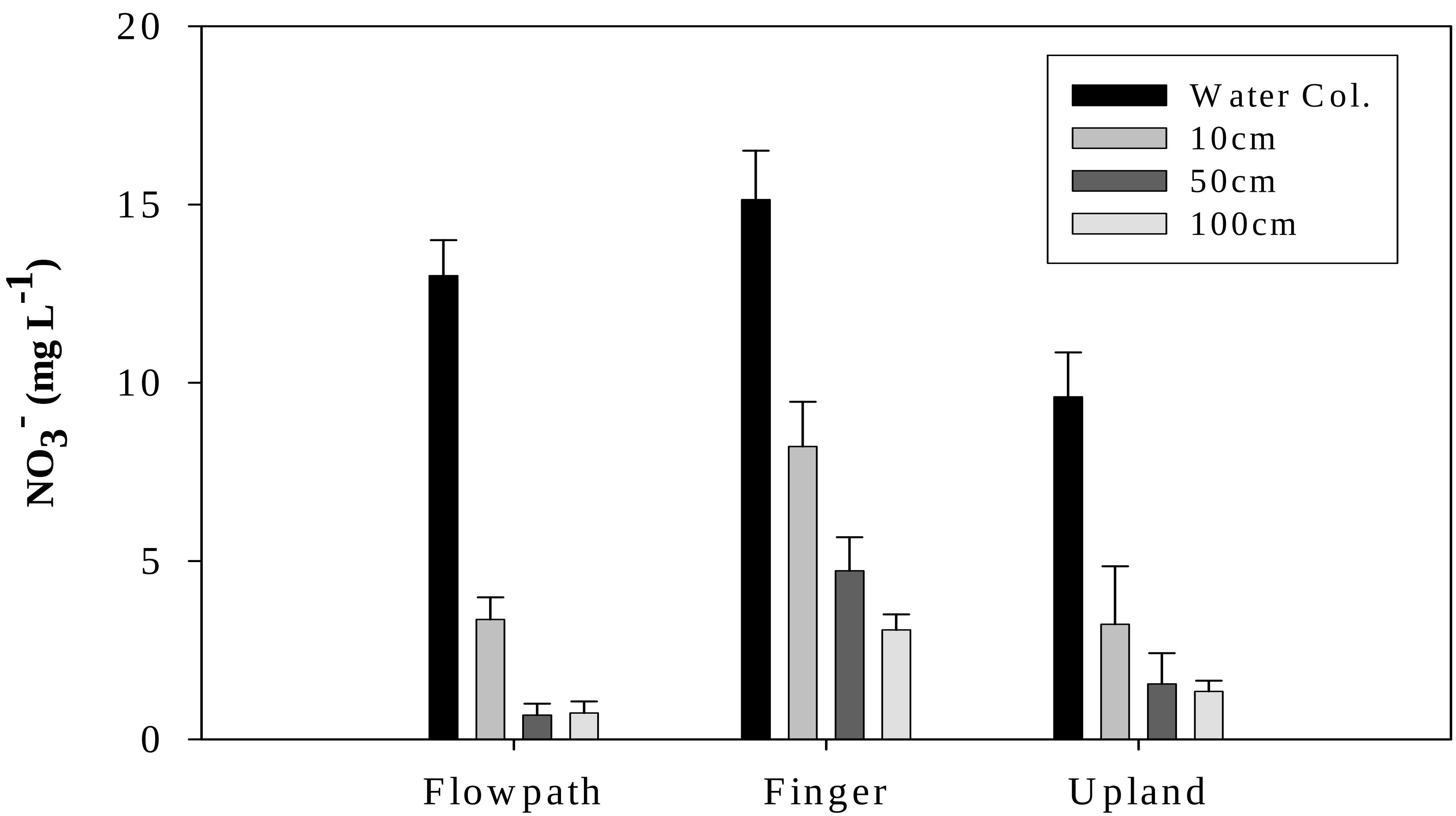
Total suspended sediment removal efficiency



Nitrate-N removal efficiency

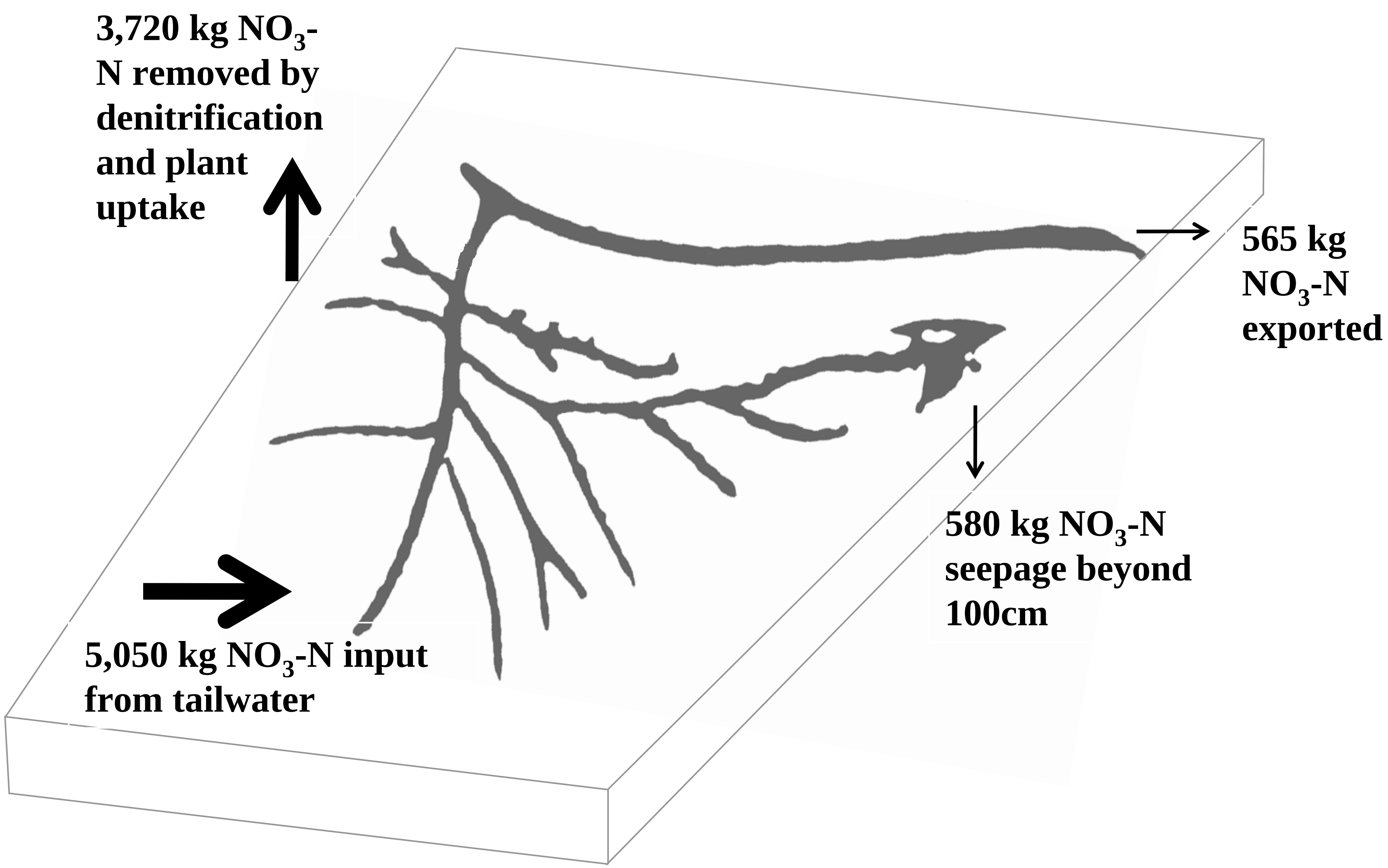


Fate of Nitrate-N in water lost as deep percolation

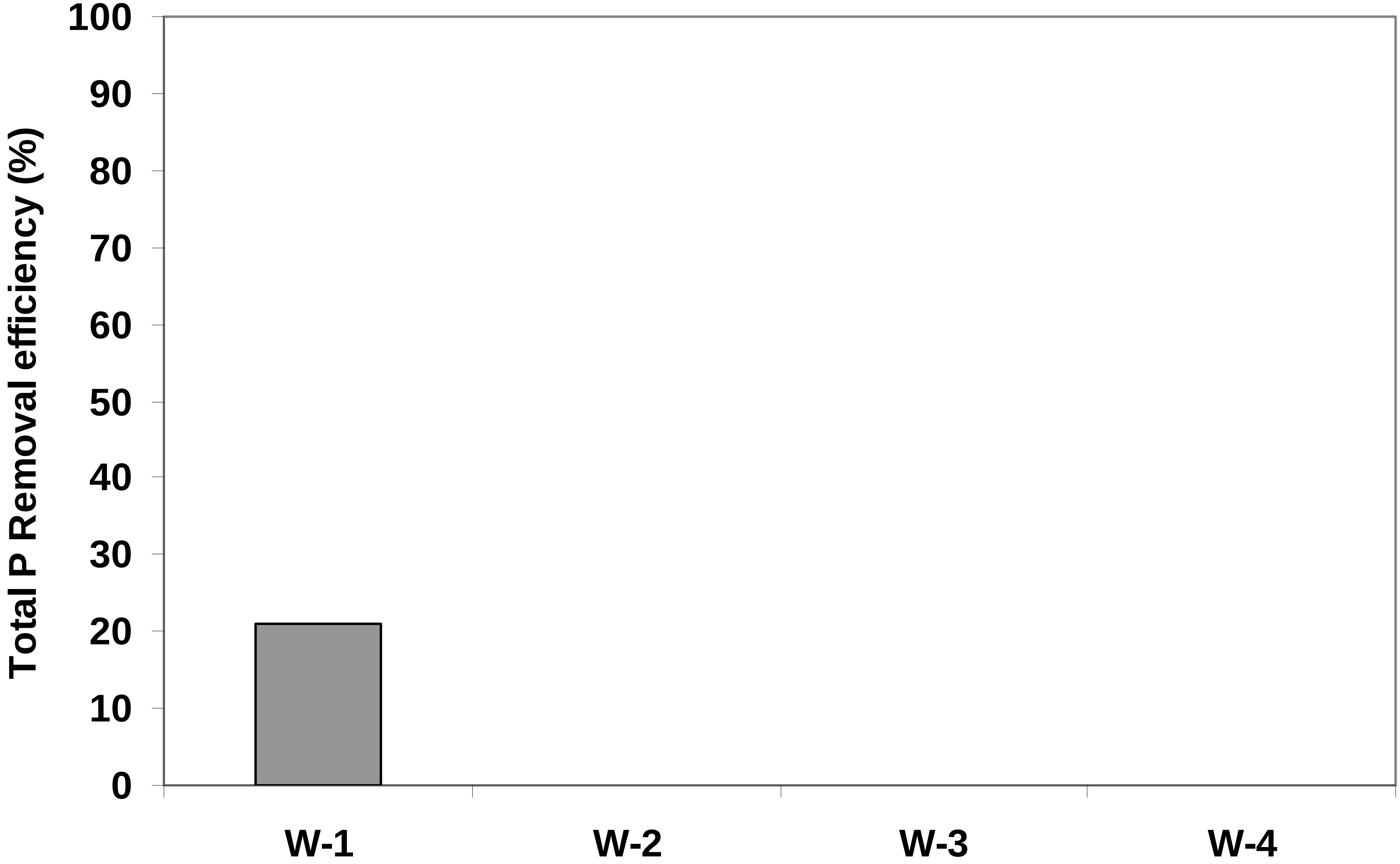


Denitrification is the main mechanism for nitrate removal; occurs in soils where oxygen content is low (low redox potentials).

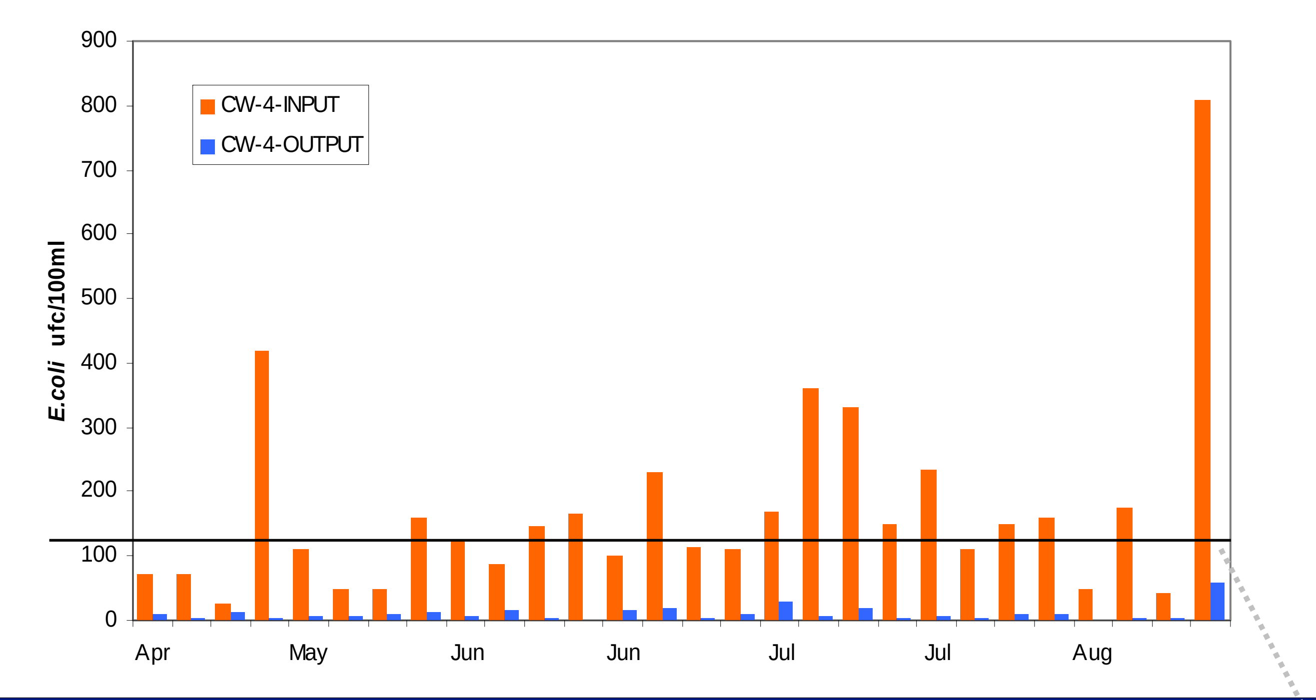
Nitrate mass balance for a constructed wetland

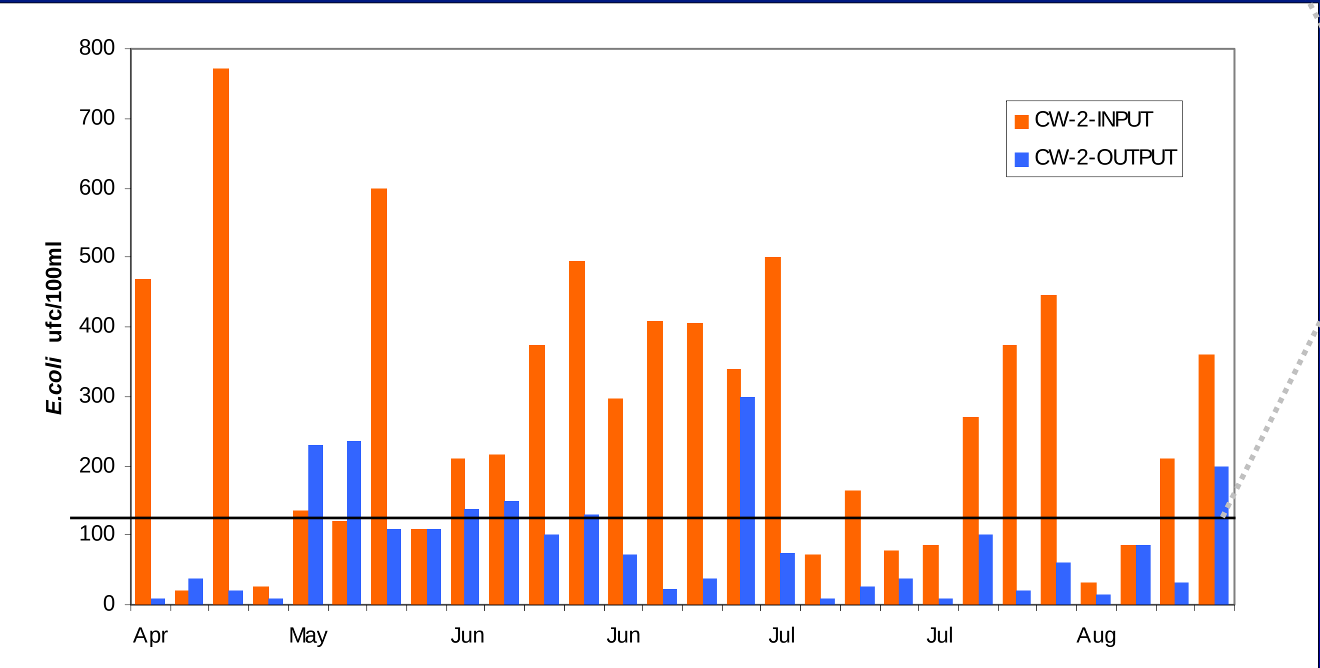


Total P removal efficiency



Temporal trends in E.coli concentration at W2 and W4 in 2007



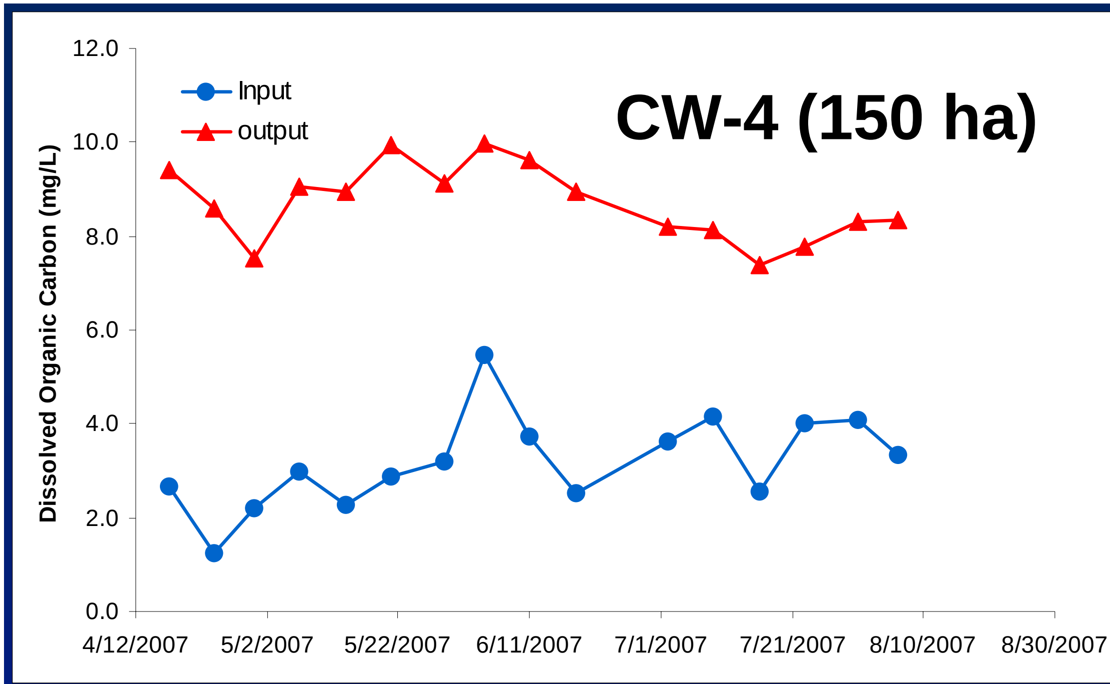


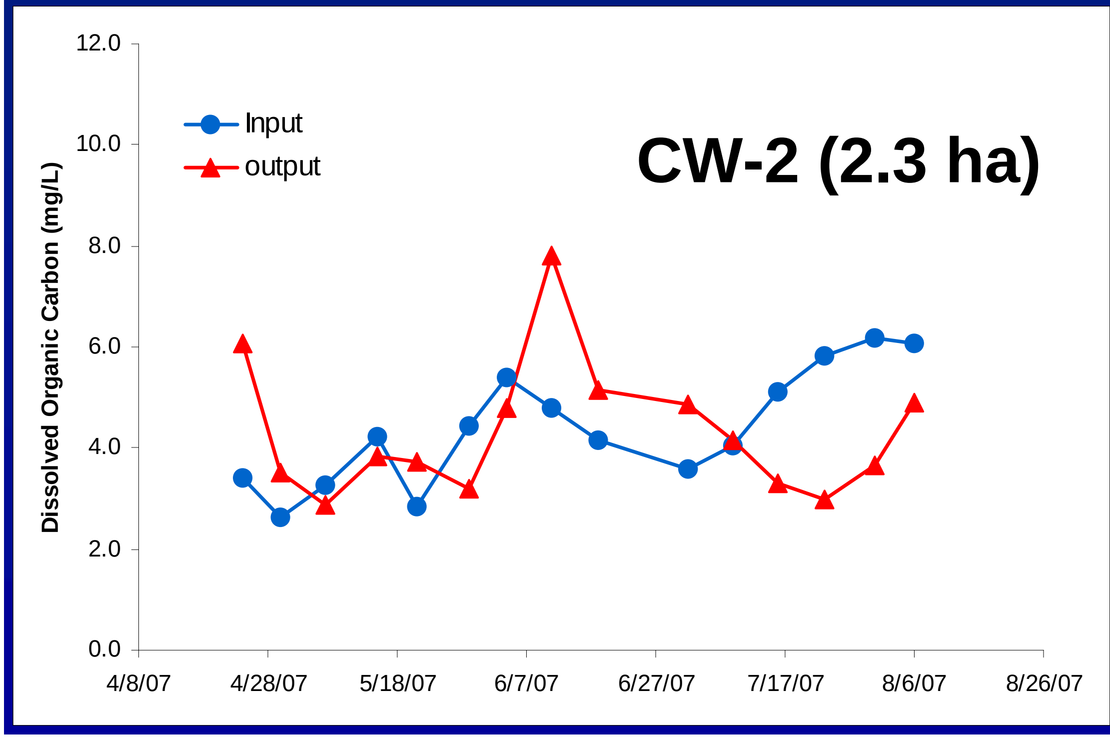
Maximum *E. coli* concentration for water quality regs. in CA.

Pyrethroid removal efficiencies at CW-2

Compound	Concentration in water (ng l^{-1}) Inlet	Outlet	Removal %
Bifenthrin	2.60	0.21	84
Cyhalothrin	3.26	0.17	90
Cypermethrin	20.5	3.61	64
Esfenvalerate	0.89	0.03	77
Permethrin	77	5.82	94
Chlorpyrifos	3.03	1.62	52
Diazinon	19.45	3.65	82

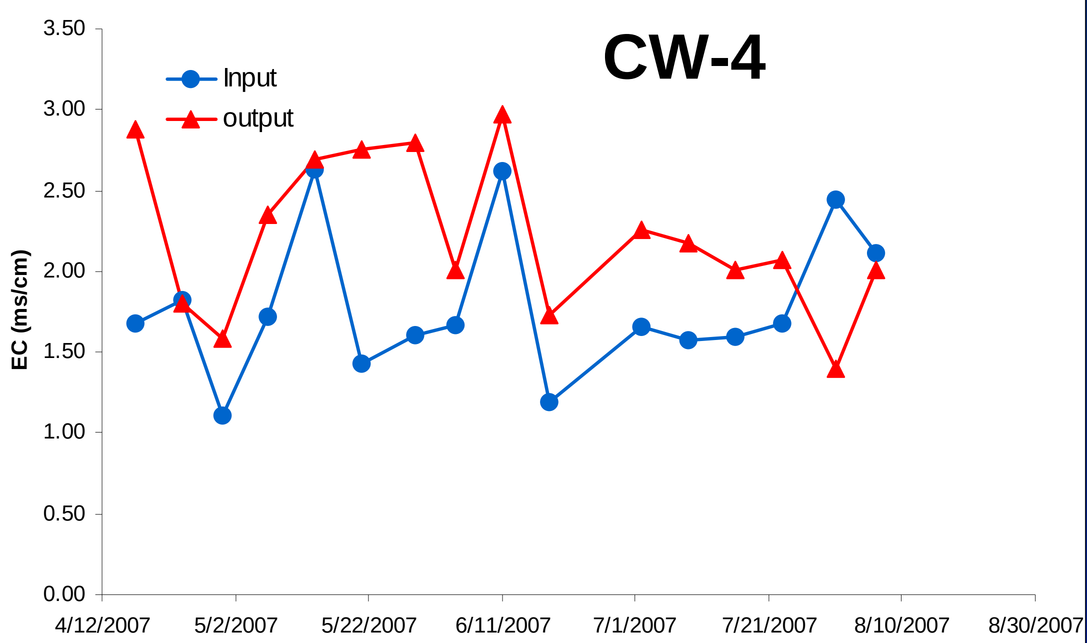
Dissolved organic carbon

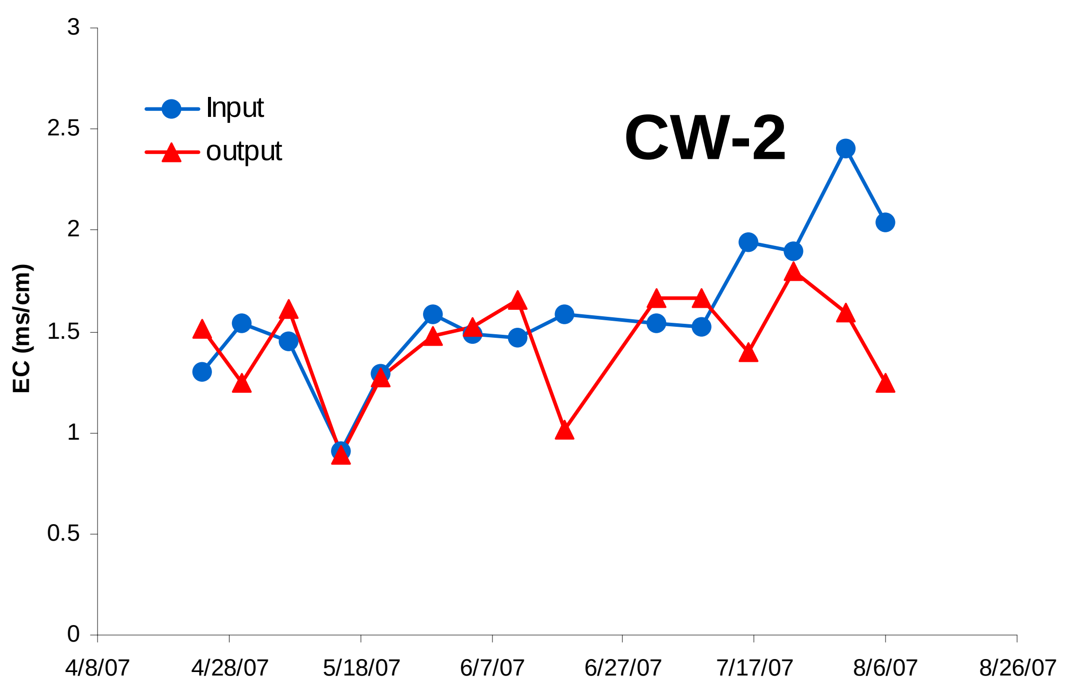




Large wetlands with long residence times are sources of DOC. Small wetlands with short residence times are not, but are less efficient at contaminant removal.

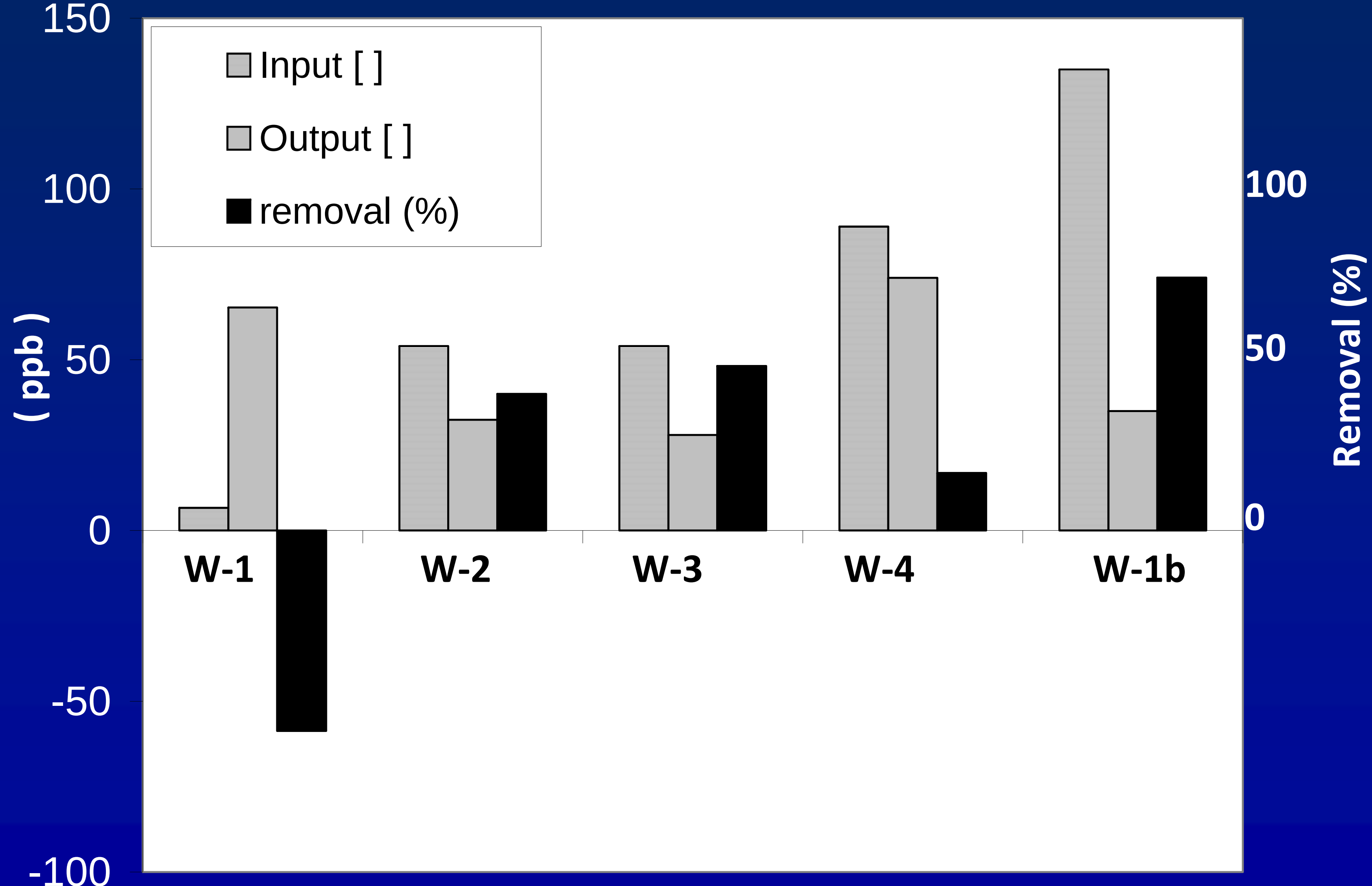
Electrical Conductivity





Similar tradeoffs should be considered when source water is saline. Long residence times increase salinity in output water.

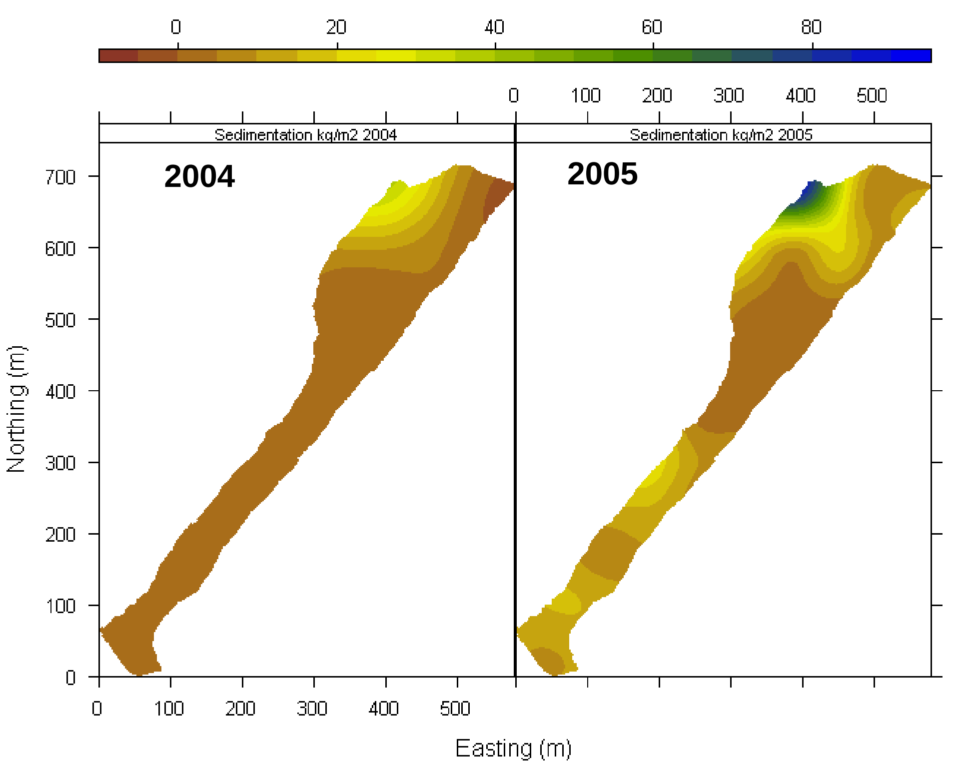
Average chlorophyll-a concentration and removal efficiency CW-1



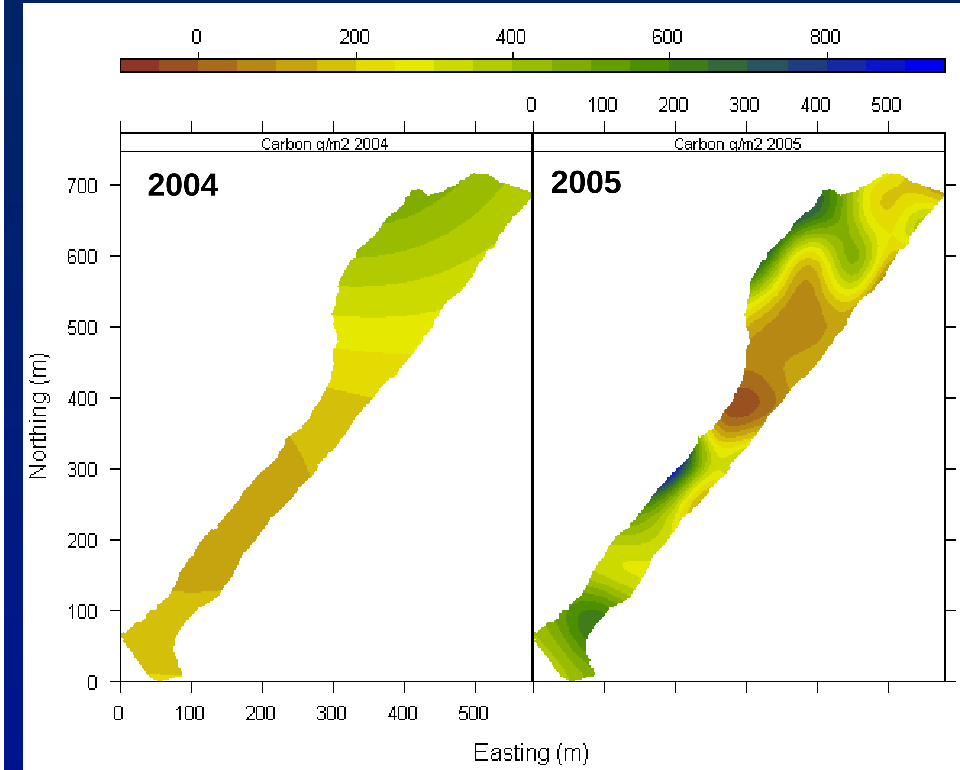
Changes in plant canopy through time

Carbon Sequestration

Sediment Accumulation (kg m^{-2})



Soil Carbon Accumulation (g m^{-2})



	Sediment Load	Sediment Carbon Load	Biomass Carbon Load	Total Carbon Load
	--------------------	----------kg yr^{-1}----------	--------------------	
2004	423,952	21,178	17,288	38,433
2005	871,595	21,480	0	21,480

Project funded by State Water Resources Control Board (agreement no. 05-055-555-0), UC Center for Water Resources, and Kearney Foundation of Soil Science

Thank you

Jiayou Deng, Neil Brauer, Jon Maynard, James Chang, Jeannie Evatt, & Tony Orozco