Advancing the concept of real-time water quality management in the San Joaquin Basin

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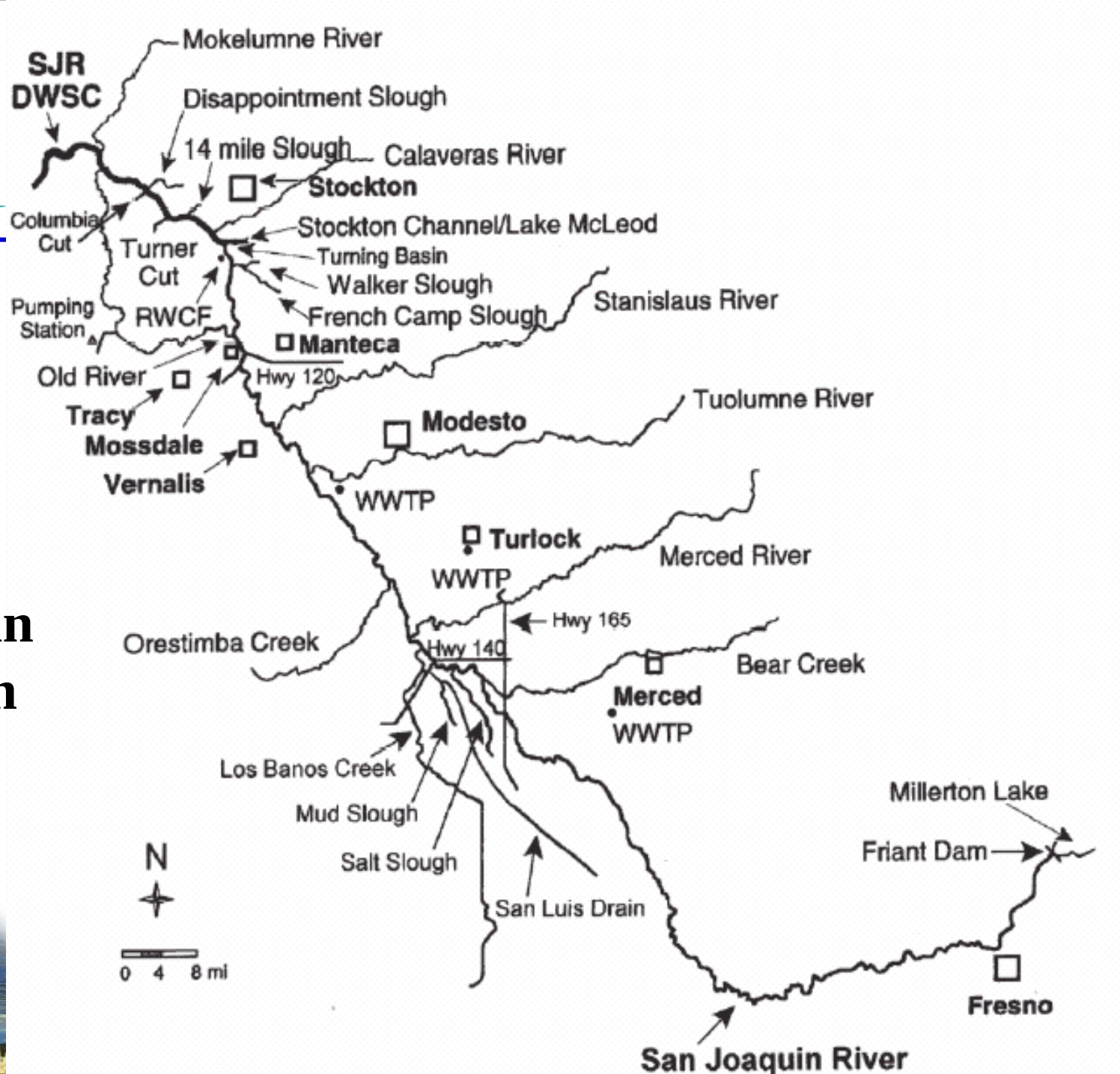
San Joaquin River Basin



BACKGROUND – WATER QUALITY

- Selenium, boron and salt are primary constituents of concern in the San Joaquin River. Transport of salt and boron is well understood.

- Water quality often exceeds CRWQCB conc. limits
  salt : 700 uS/cm as EC April-Aug.; 1,000 uS/cm as EC Aug. – April
  boron : 0.8/1.0 ppm ; selenium : 5 ppb ; DO : 5 mg/l (6 mg/l Sept-Nov)

- Real-Time Water Quality Management utilizes SJR assimilative capacity to safely discharge contaminant loads under less punitive regulatory constraints than a strict TMDL

- Agricultural and wetland dischargers may have unrealized flexibility of operation which with real-time coordination, improve compliance with SJR water quality objectives

DEFINITIONS

ASSIMILATIVE CAPACITY

The mass load of a pollutant that can be safely discharged to a receiving water without exceeding the water quality objective or standard for that pollutant.

REAL-TIME WATER QUALITY MANAGEMENT

A coordinated and cooperative set of actions based on real-time forecasts of river water quality to consistently meet water quality objectives

ALTERNATIVE TO SALT TMDL LOAD MANAGEMENT

Real Time Component: Allows additional loading above and beyond base loads

- Total loading capacity based on real-time river assimilative capacity for salinity
- Loading capacity allocated according to a predefined TMDL methodology
- Load allocations are dynamic

REQUIREMENTS FOR A REAL-TIME WATER QUALITY TMDL

- Development and maintenance of a real-time water quality monitoring system.
- Flow and water quality control infrastructure must be in place or under development.
- Institutions responsible for long-term stakeholder cooperation and coordination to continuously match real-time contaminant loads with assimilative capacity.

REAL-TIME MONITORING, MODELING AND MANAGEMENT PROJECTS

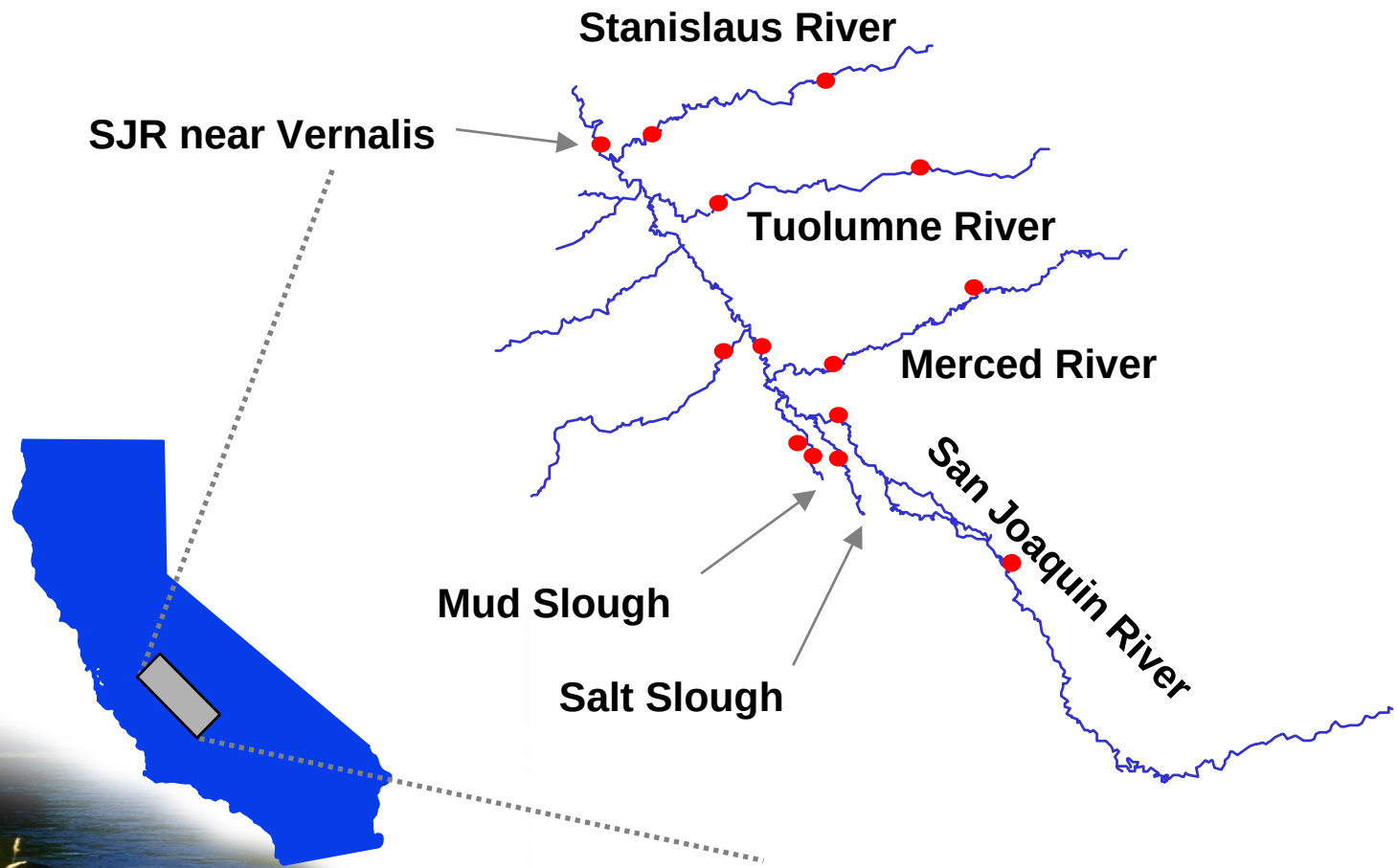
- Real-time salt and boron management in the SJR
- Grassland Bypass Project selenium load management
- Seasonal wetland water quality management in Grasslands Ecological Area
- Real-time management of SJR dissolved oxygen

REAL-TIME WATER QUALITY MANAGEMENT IN THE SAN JOAQUIN RIVER

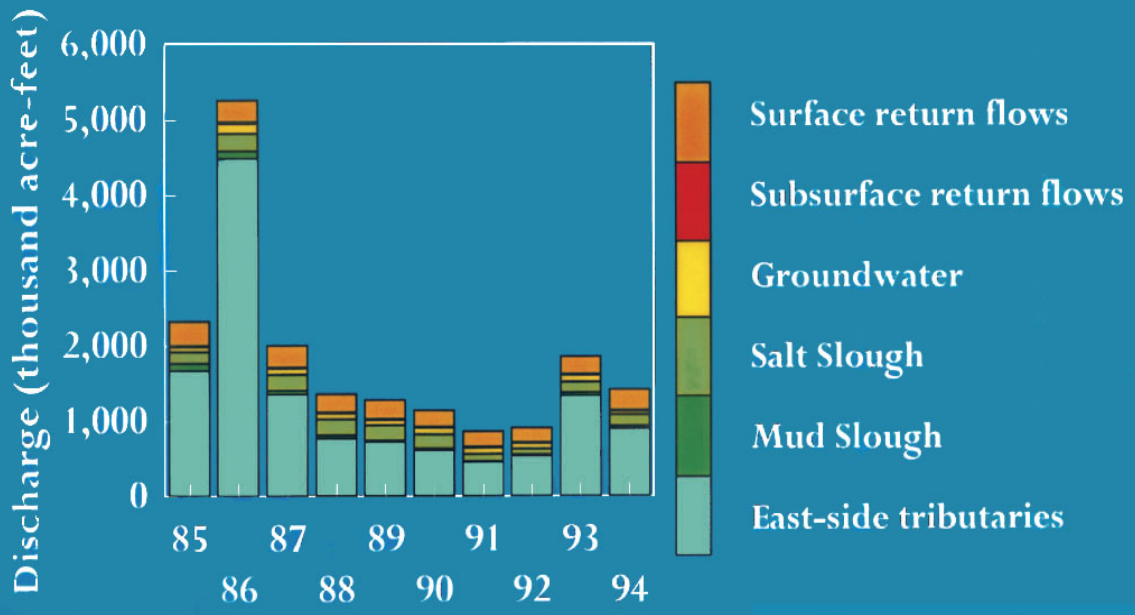
REAL-TIME WATER QUALITY MANAGEMENT IN THE SAN JOAQUIN RIVER

- Is the backbone of all real-time water quality management projects
- Weekly simulations of flow and EC using SJRIODAY model
- 14-day forecasts of San Joaquin River assimilative capacity
- Web posting of model results and forecasts
- Coordination with SJR VAMP

LOWER SAN JOAQUIN RIVER BASIN REAL TIME MONITORING STATIONS

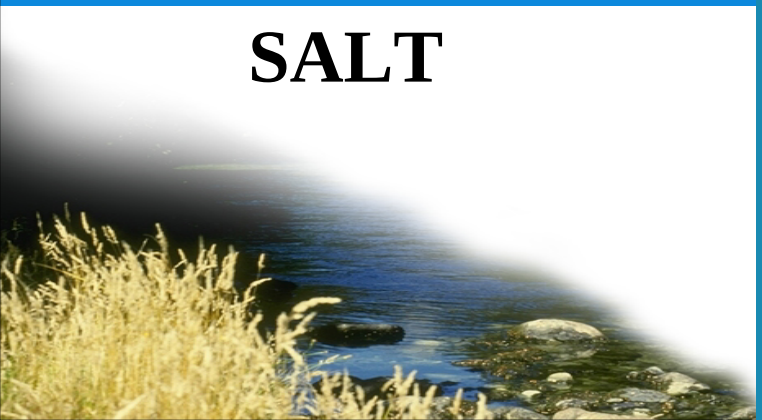


Lower San Joaquin River Discharge

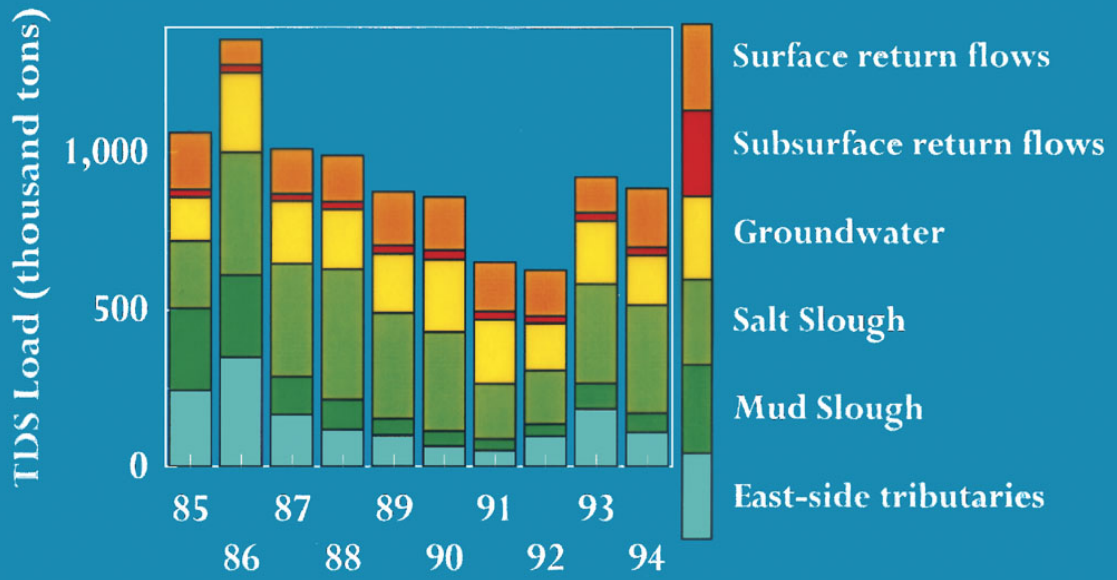


FLOW

SALT

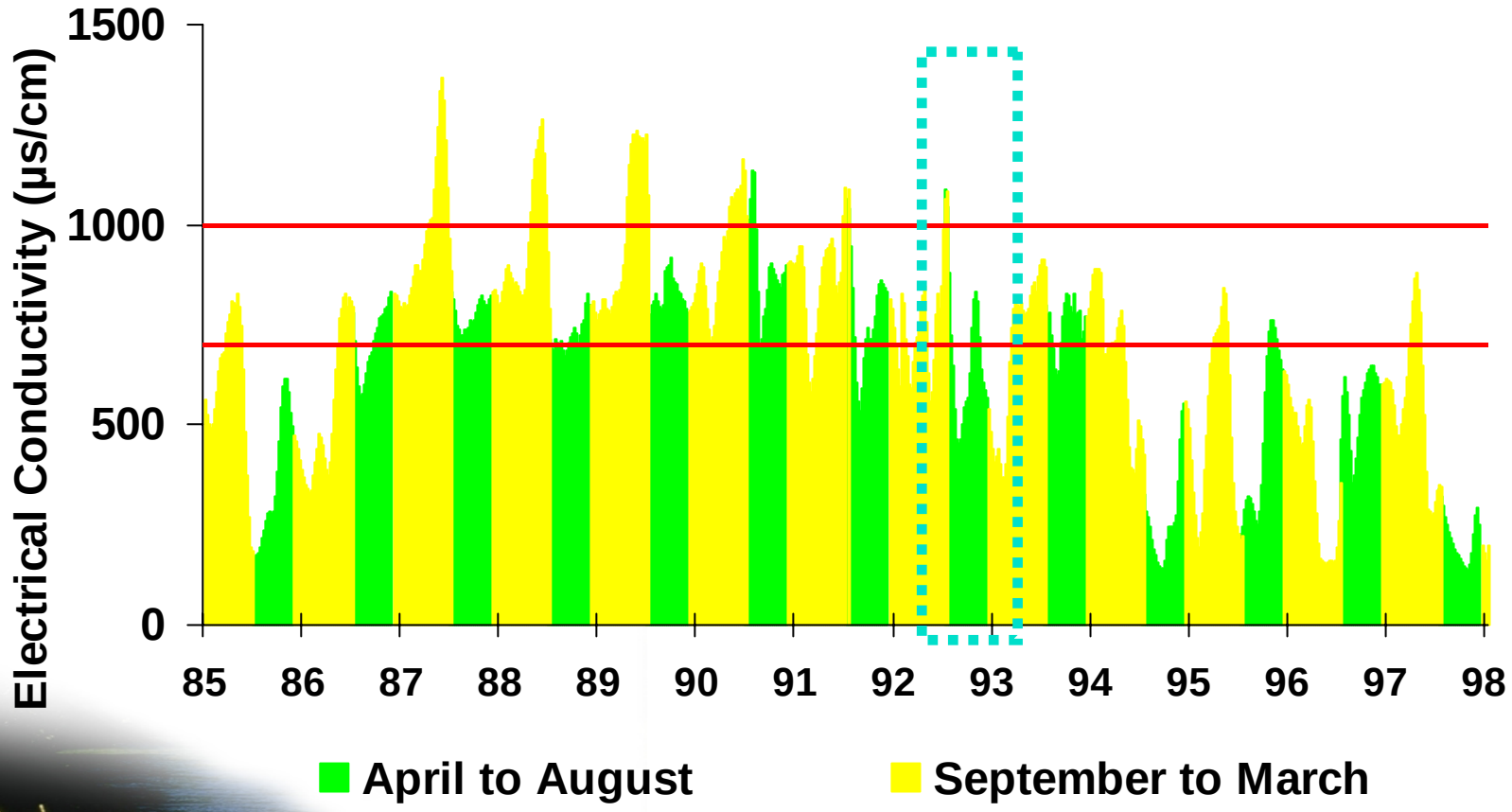


Lower San Joaquin River TDS Load



SAN JOAQUIN RIVER NR. VERNALIS

30 Day Running Average Electrical Conductivity



SAN JOAQUIN RIVER NR. VERNALIS

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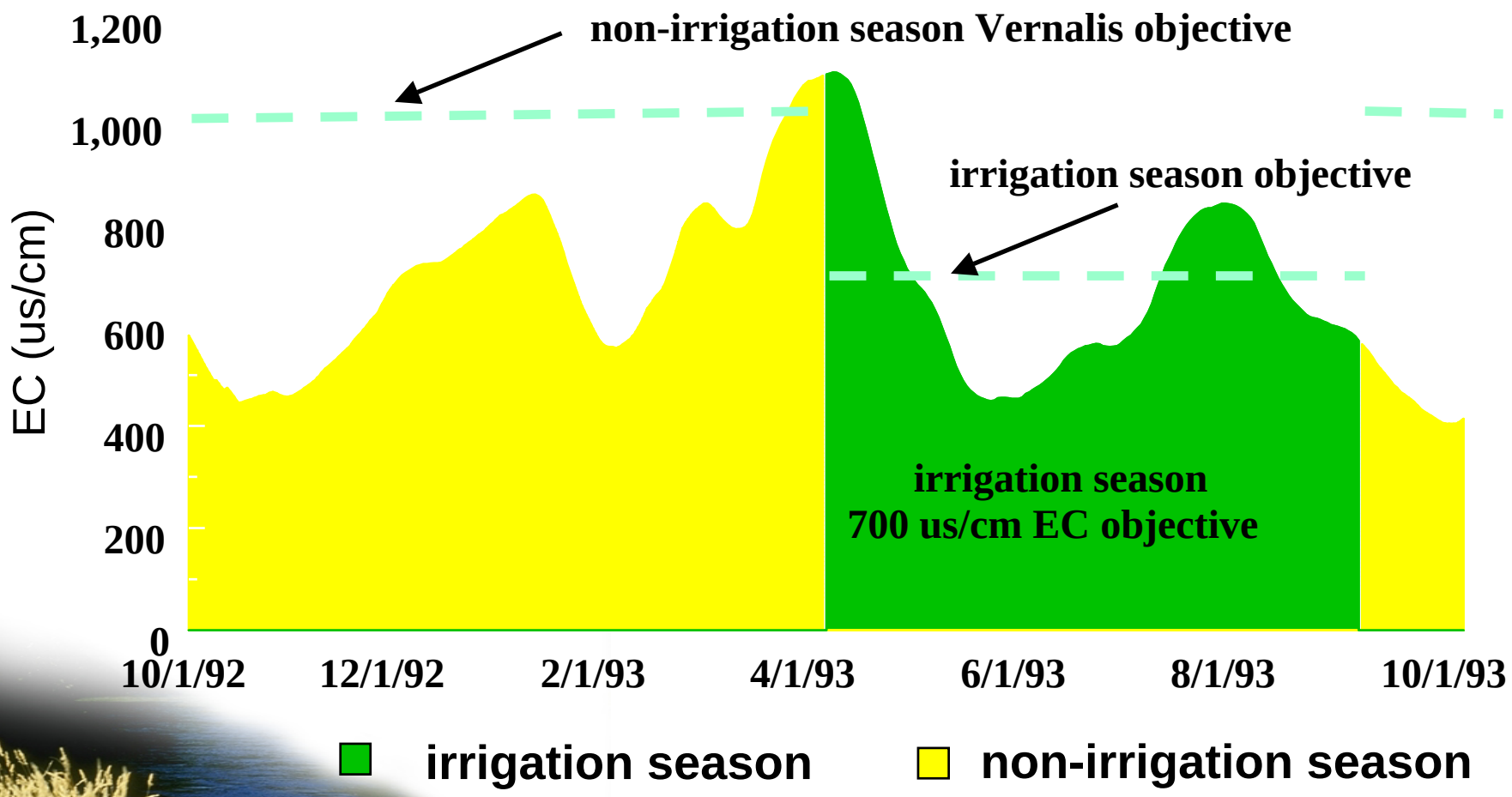
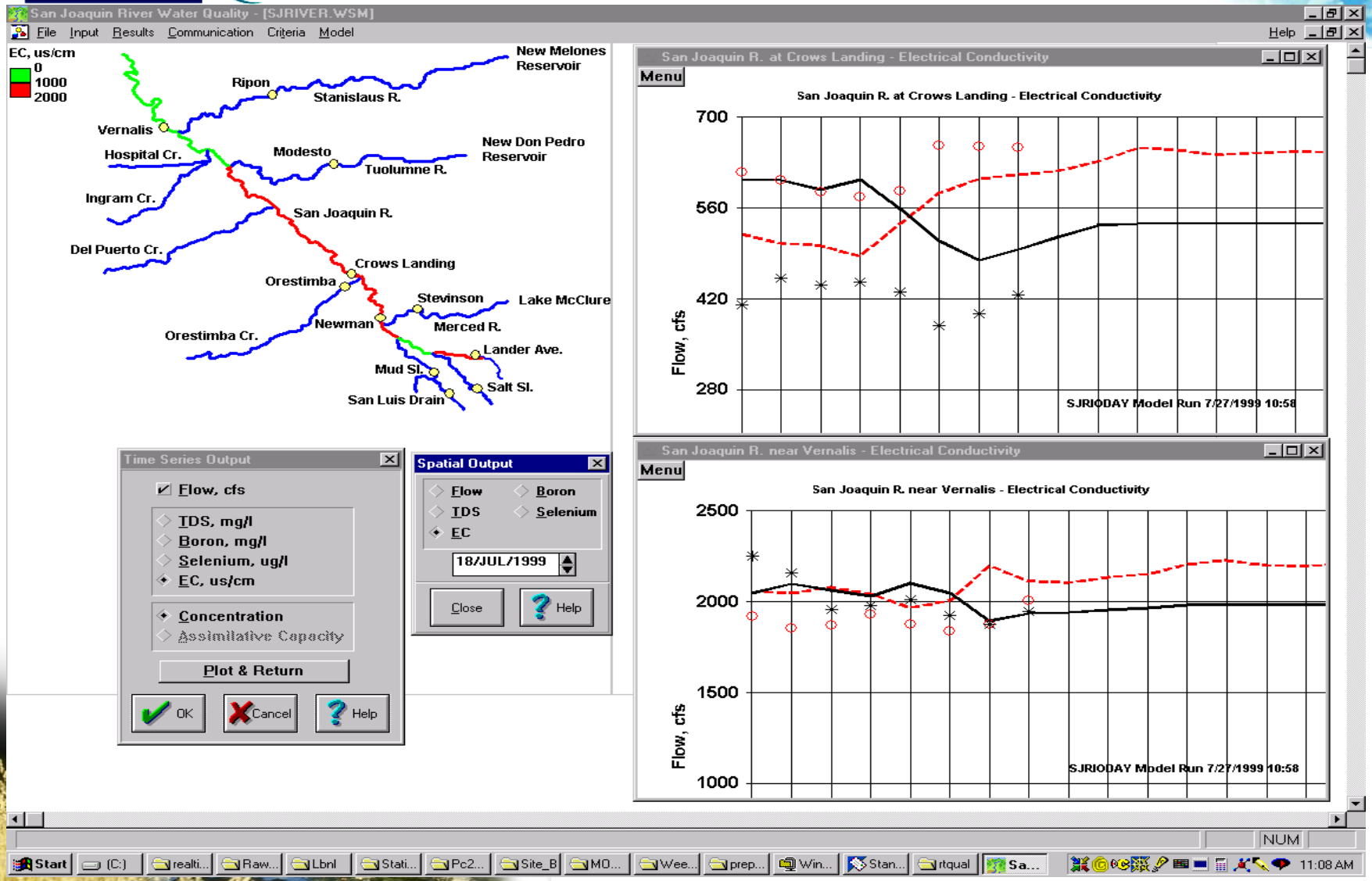


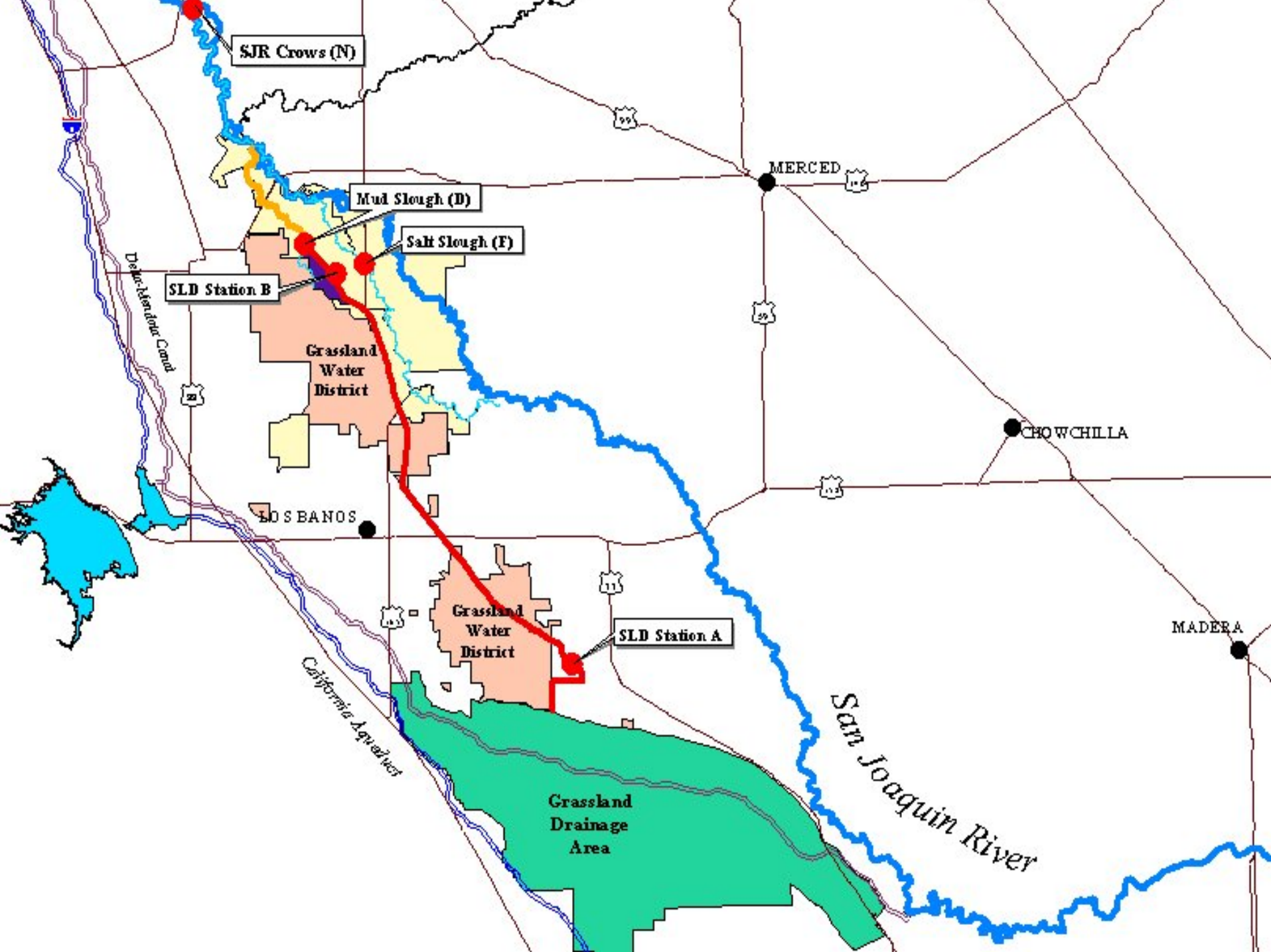
SAN JOAQUIN RIVER WATER QUALITY FORECASTING MODEL



GRASSLAND BYPASS PROJECT SELENIUM LOAD MANAGEMENT

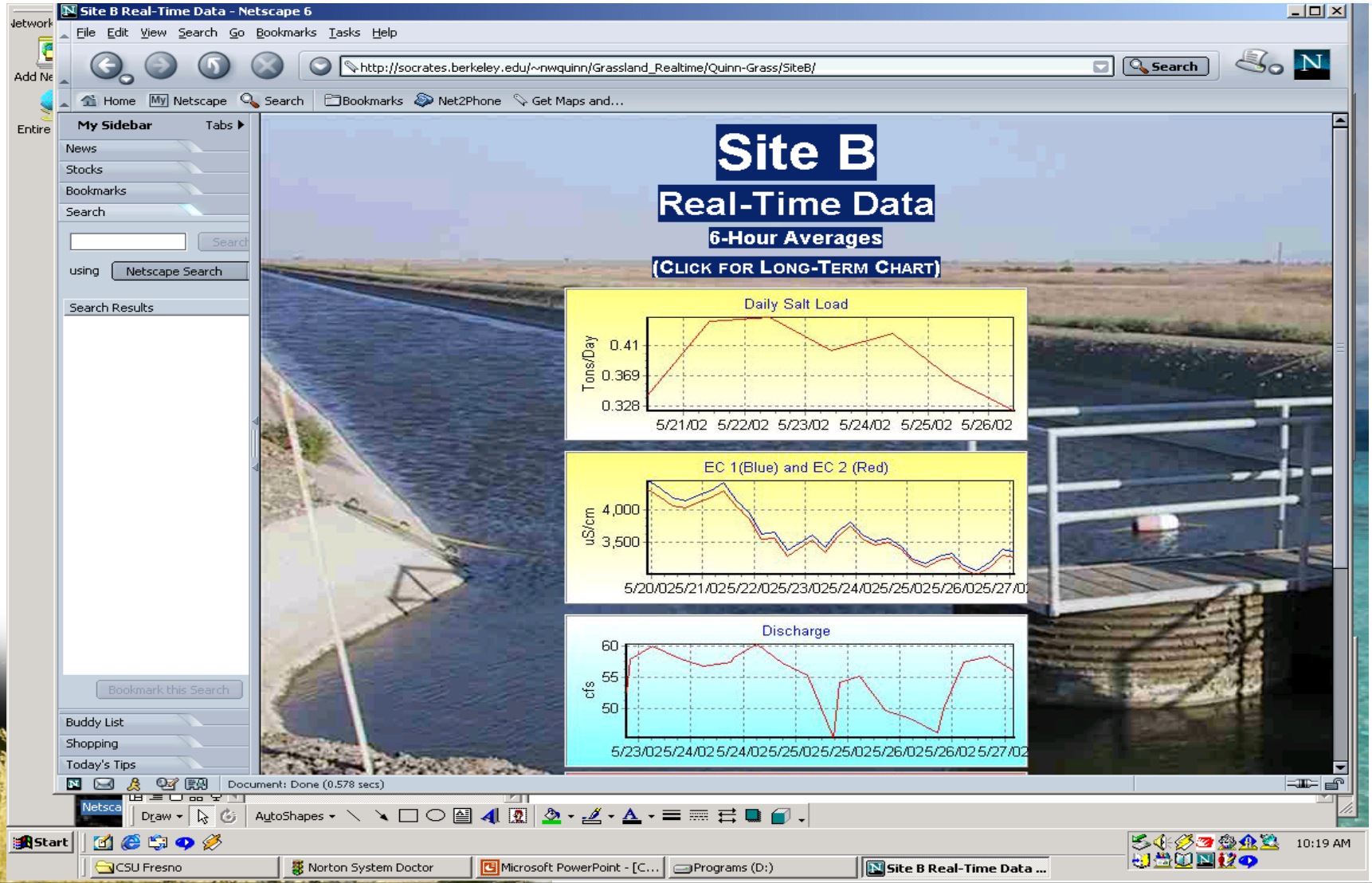
GRASSLAND BYPASS PROJECT SELENIUM LOAD MANAGEMENT

- Selenium load limits measured near SLD terminus. Declining selenium load limits to meet receiving water objectives
- Partitioning selenium loads during unforeseen and uncontrollable flooding (e.g. 1997 El Nino)
- Water District level sump monitoring, separation of tile and tail water, recirculation of drainage,district blending
- Water conservation, conversion to water efficient irrigation technologies


SJR Crows (N)
Mud Slough (D)
Salt Slough (F)
SLD Station B
Grassland Water District
Delta-Mendota Canal
MERCED
CHOWCHILLA
LOS BANOS
Grassland Water District
SLD Station A
MADERA
California Aqueduct
Grassland Drainage Area
San Joaquin River

SAN LUIS DRAIN : SITE B

REAL-TIME MONITORING SITE B ON THE SAN LUIS DRAIN

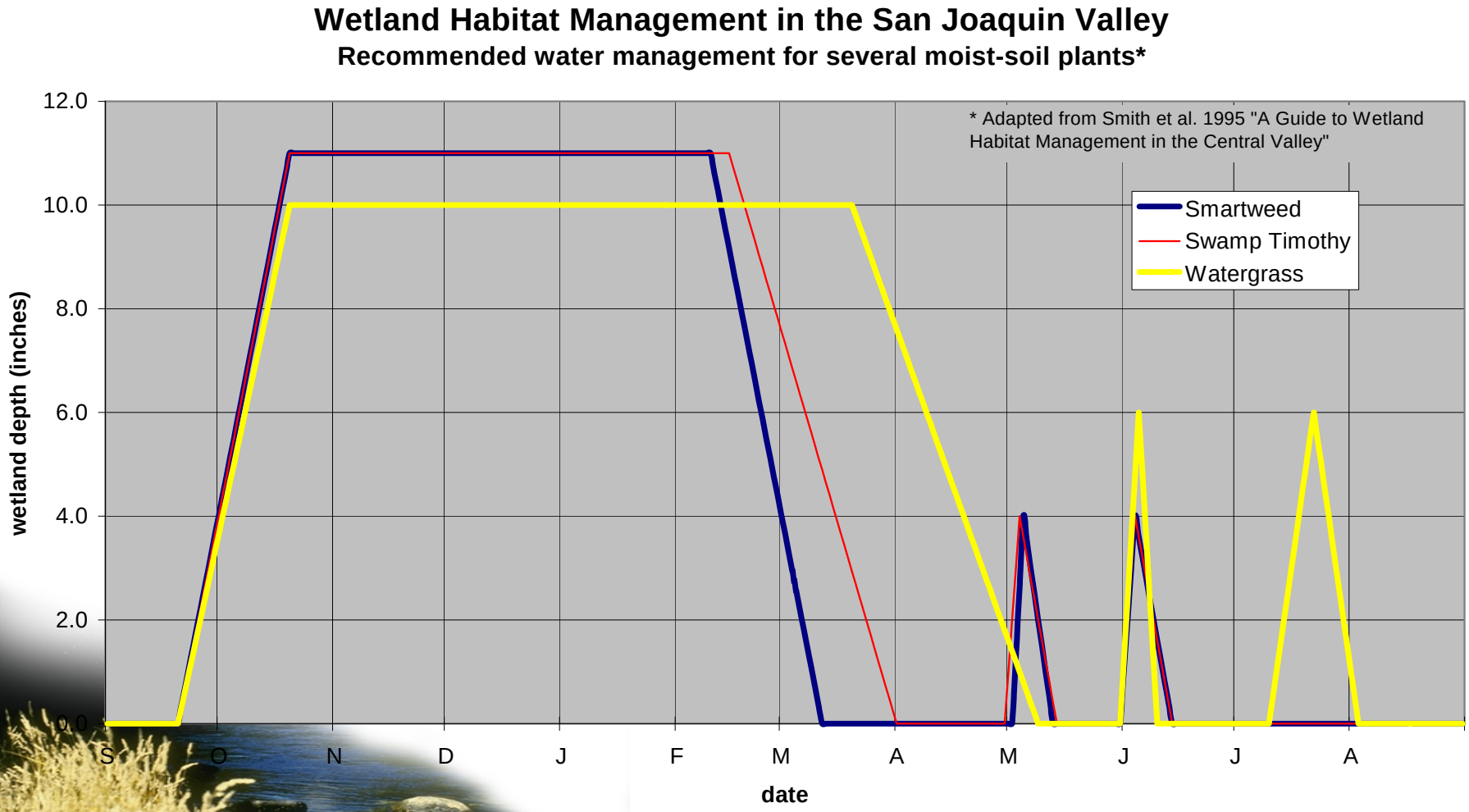


GRASSLAND WATER DISTRICT ADAPTIVE SALINITY MANAGEMENT

CALFED GRASSLAND WD ADAPTIVE SALINITY MANAGEMENT PROJECT

- Flow/EC monitoring at GWD outlets
- Monitoring/adaptive management of habitat
  - early drainage release
  - flow through wetland management
- Develop flow and salt forecasting capability
- Improve coordination of discharges with basin assimilative capacity for salinity (EC)

WATER MANAGEMENT FOR MOIST SOIL PLANT HABITAT



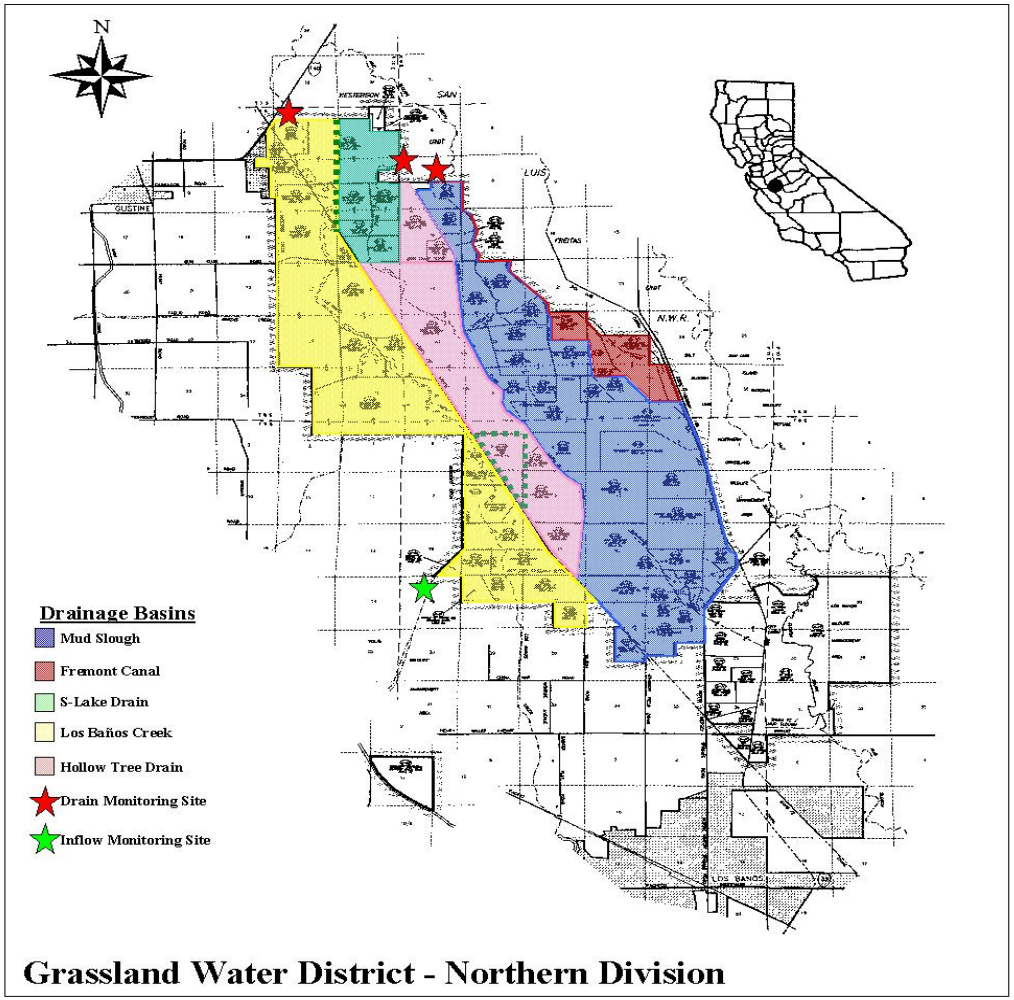
WETLAND DRAWDOWN

Wetland drawdown during spring months (Mar-April).

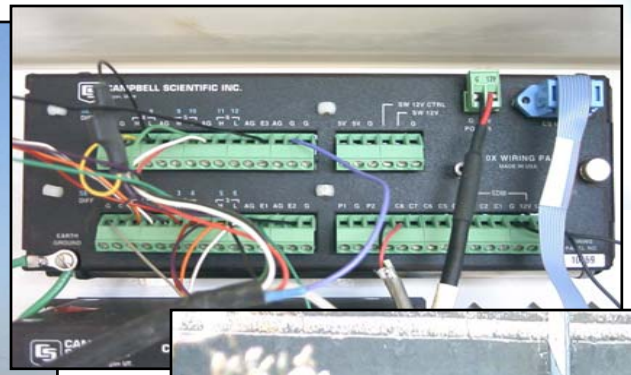
REAL-TIME SALINITY MANAGEMENT TECHNICAL ISSUES

- Development of reliable salinity budgets.
- Assessment of the reliability of existing techniques for estimating ET of wetland moist soil plants.
- Simulation of salt evapoconcentration in seasonal wetlands for salt load forecasting
- Human factors integrated into decision support tools to aid technology transfer to water managers

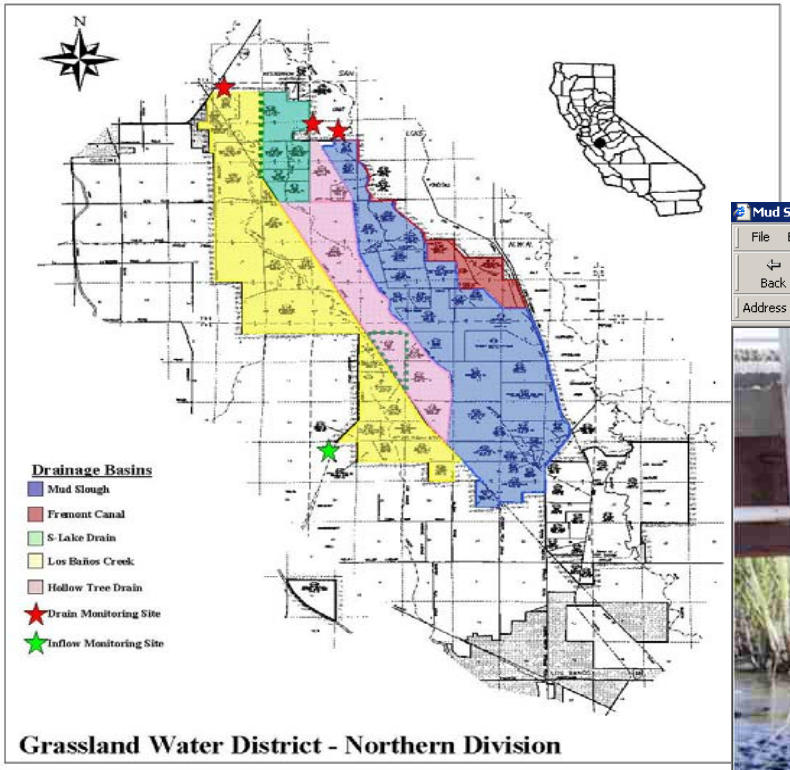
GWD Drainage Basins

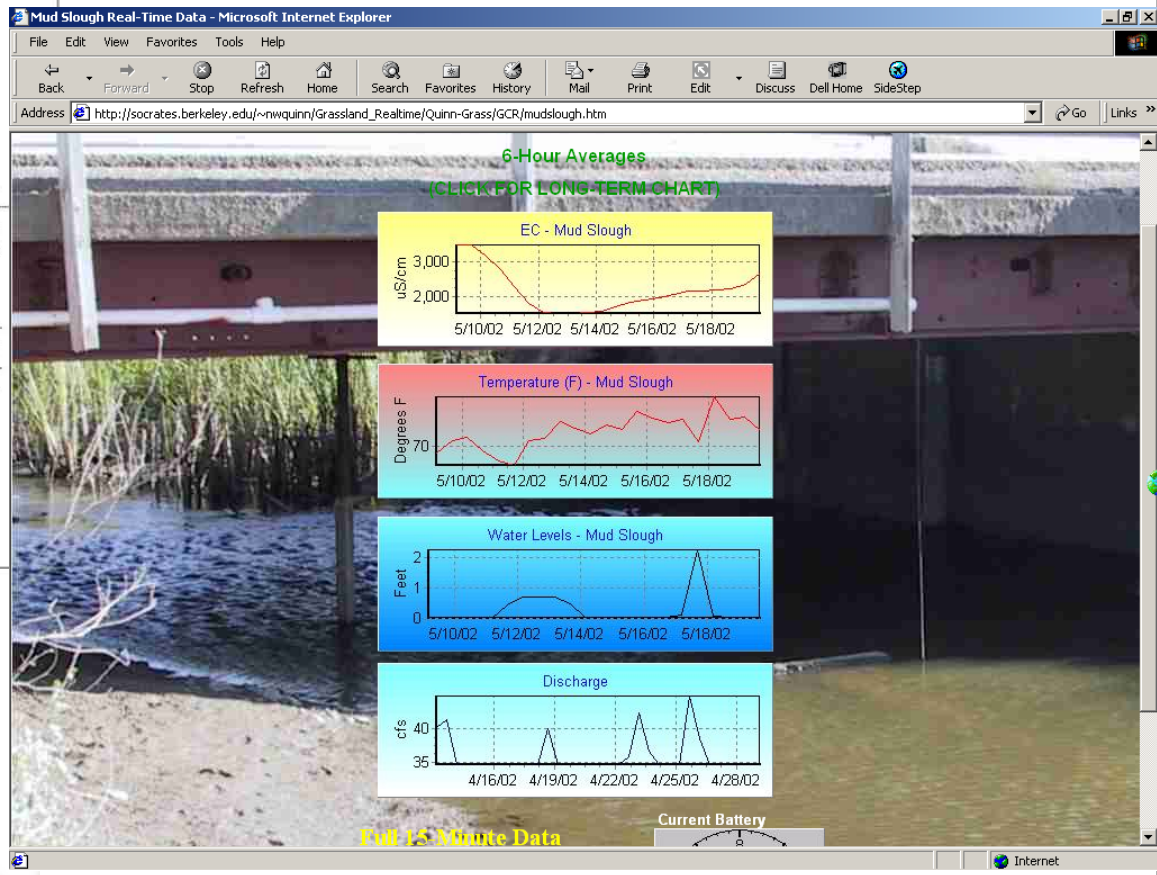


WATER QUALITY MONITORING

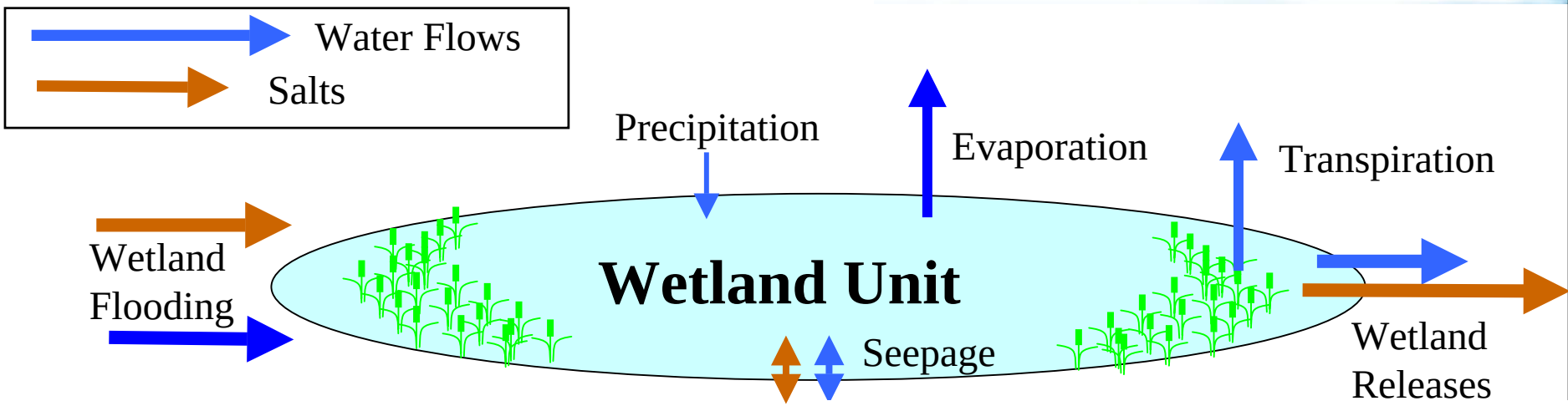


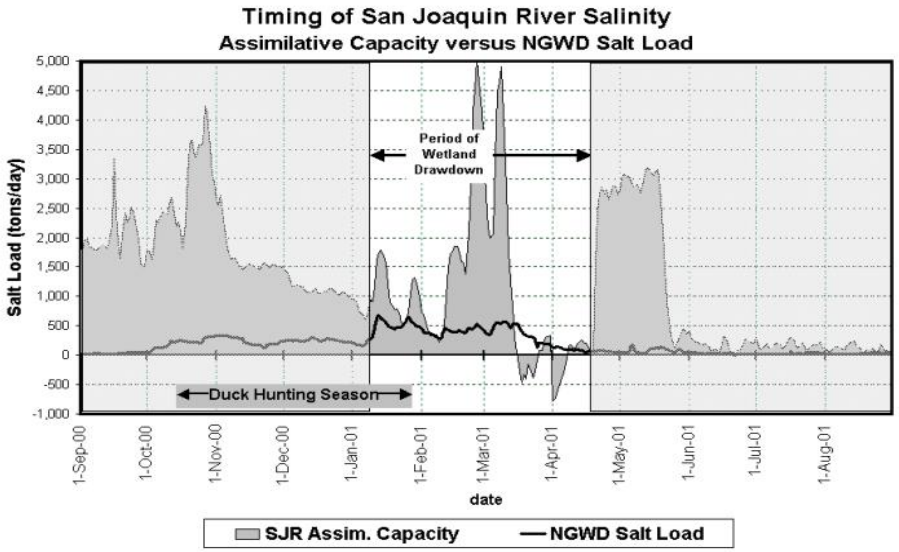
NORTH GRASSLAND WD DRAINAGE MONITORING AND MANAGEMENT



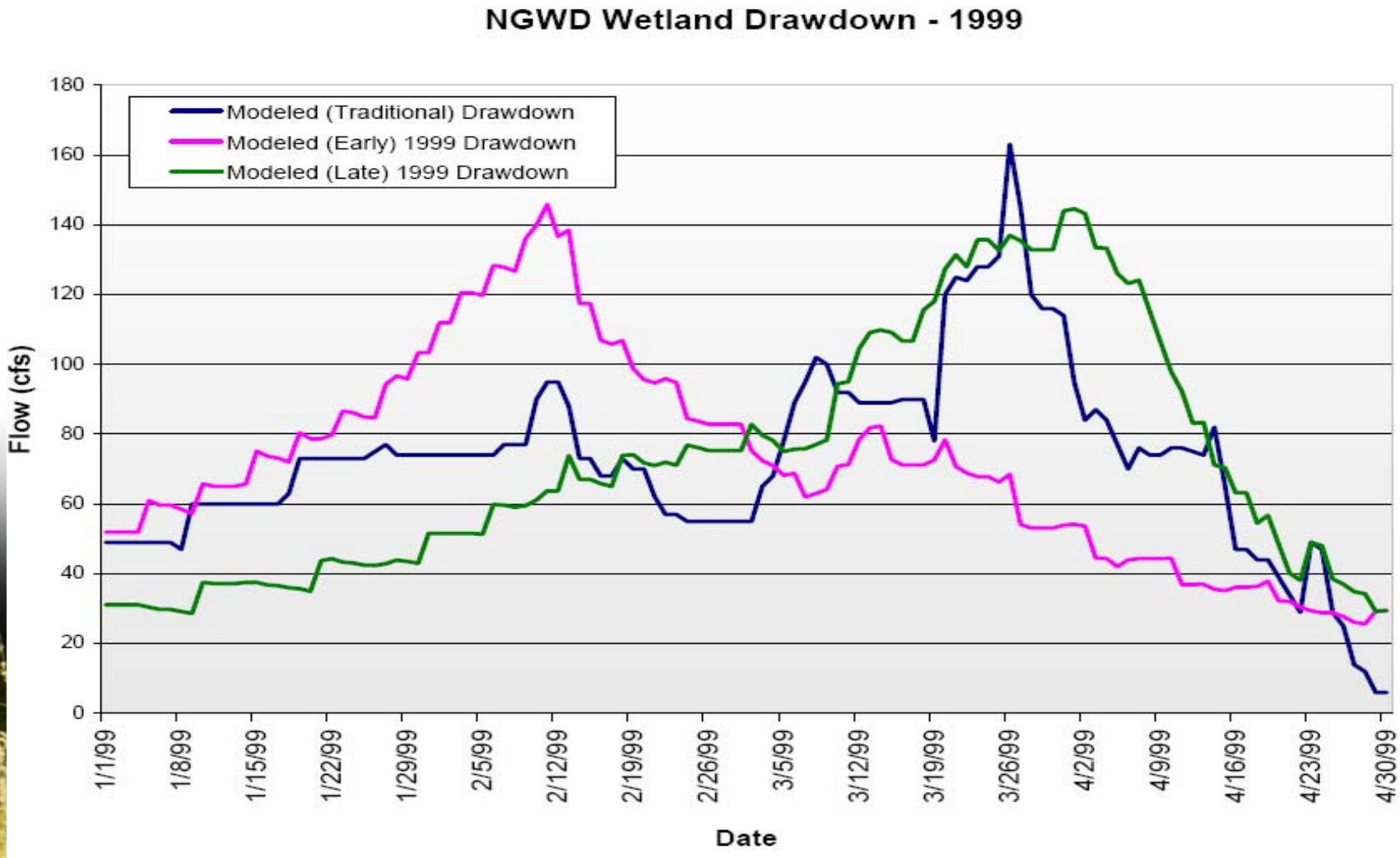


WETLAND WATER QUALITY MODEL

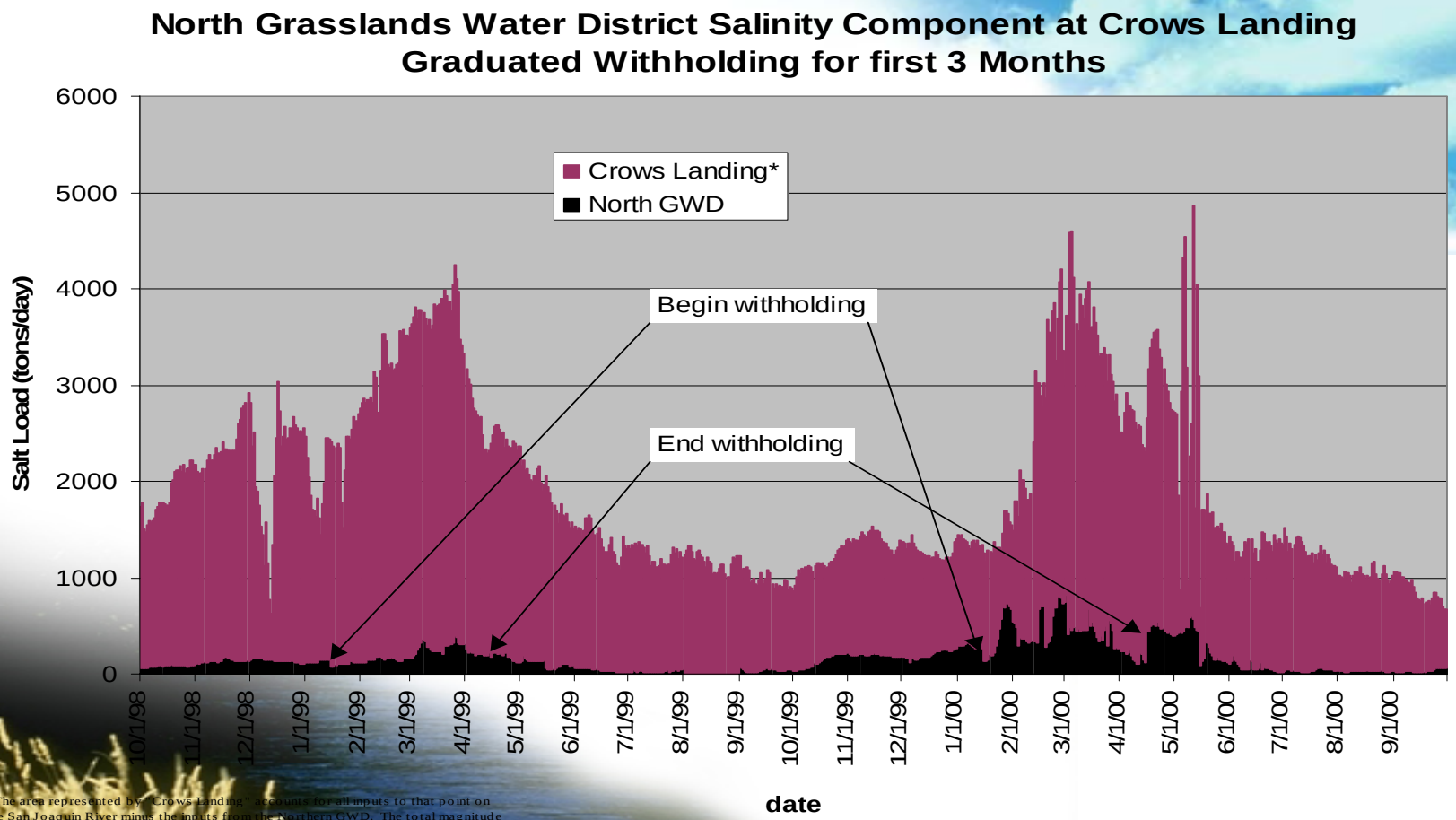




COMPARISON OF FLOW FOR MODELED TRADITIONAL, EARLY AND LATE SEASONAL WETLAND DRAWDOWN



WATER QUALITY MODELING

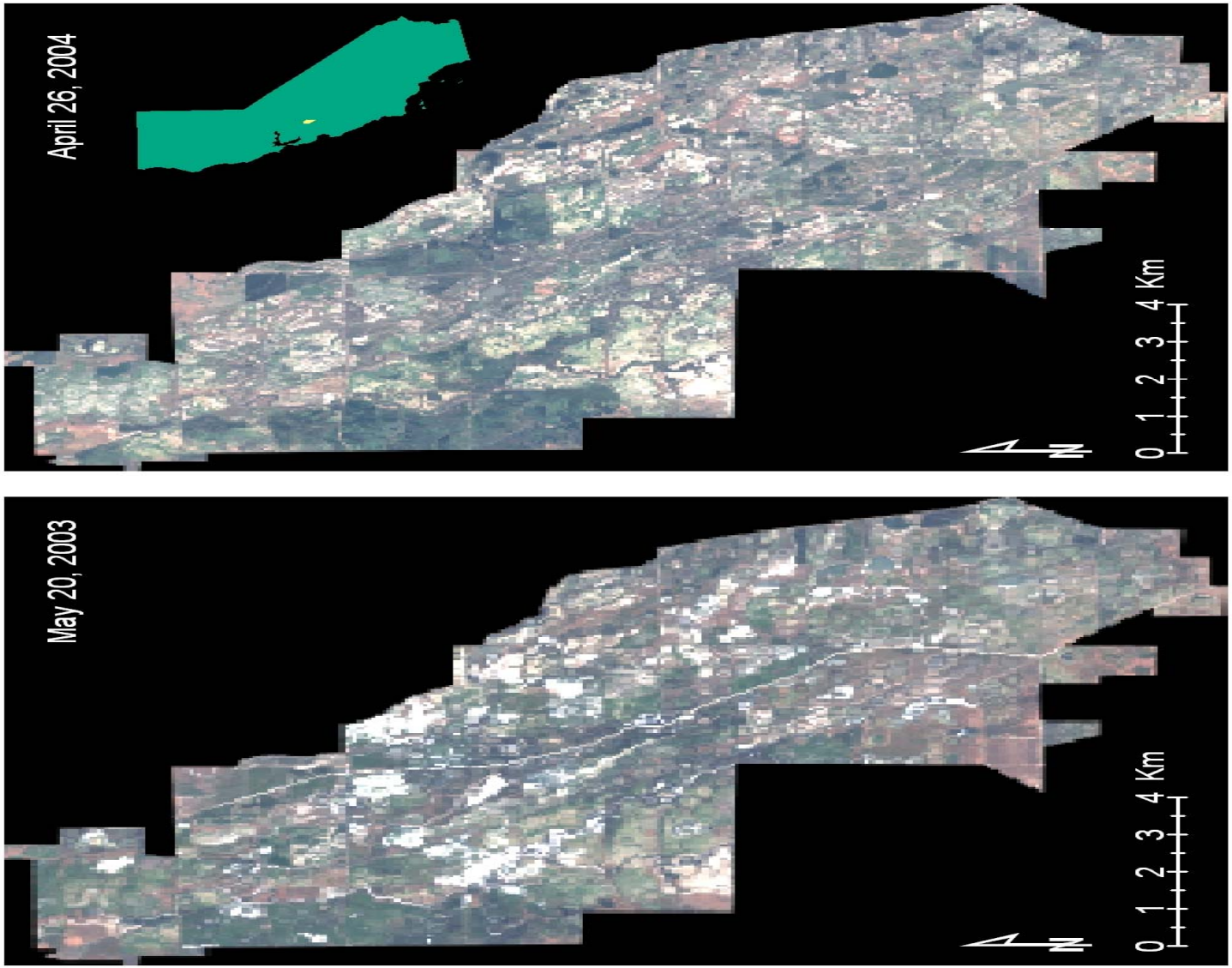


*The area represented by "Crows Landing" accounts for all inputs to that point on the San Joaquin River minus the inputs from the Northern GWD. The total magnitude shown, however, is the total salt load at the Crows Landing station.

SALINITY MANAGEMENT IMPACTS ASSESSMENT USING REMOTE SENSING

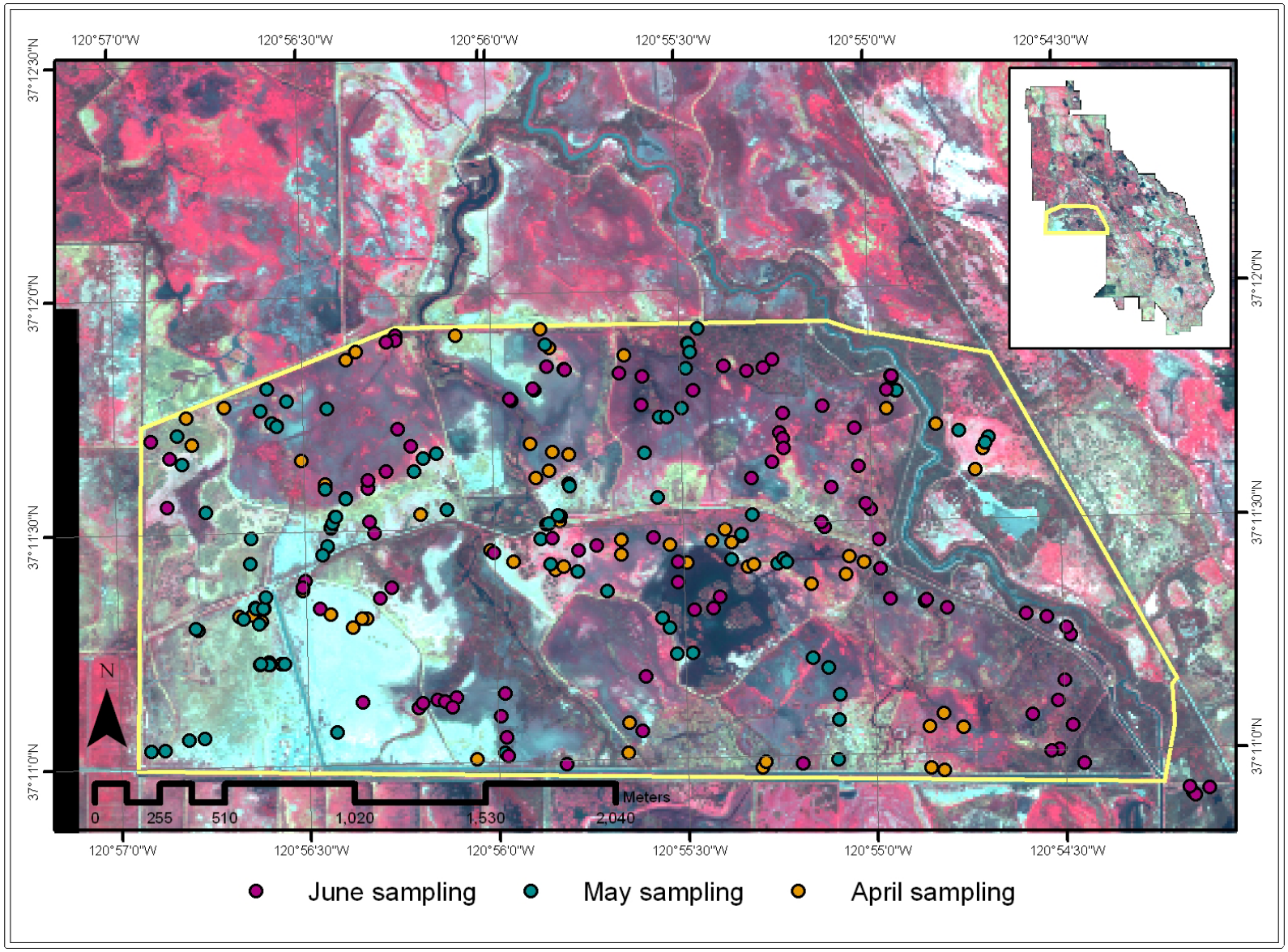
- Acquisition of high resolution multispectral satellite imagery
- Development of spectral signature file using ground-truthed moist soil plant vegetation data
- Pattern recognition using segmentation algorithms in E-Cognition software
- Mapping of moist soil vegetation using supervised classification for North Grasslands and San Luis National Wildlife Refuge

REMOTE SENSING OF WETLAND MOIST SOIL PLANT VEGETATION



REMOTE SENSING OF WETLAND MOIST SOIL PLANT VEGETATION

HIGH RESOLUTION MULTISPECTRAL IMAGERY OF THE SALINAS DUCK CLUB



SPECTRAL SIGNATURE FILE – 2004

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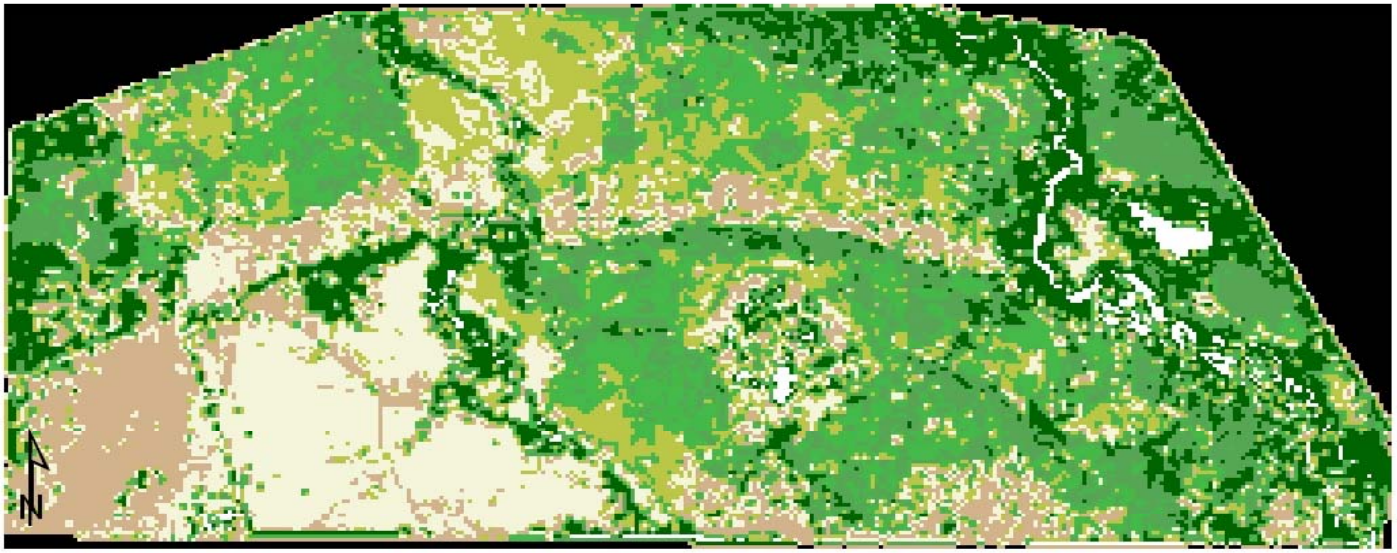
Class #	>	Signature Name	Color	Red	Green	Blue	Value	Order	Count	Prob.	P	I	H	A	FS
1	>	buildings		1.000	1.000	1.000	2	5	78	1.000	X	X		X	
2		water		0.398	0.620	0.659	16	119	2881	1.000	X	X		X	
3		scirpus		0.537	0.593	0.647	11	152	1716	1.000	X	X		X	
4		bare soil / iodine		0.751	1.000	1.000	1	158	1460	1.000	X	X		X	
5		litter / senescent grass		0.789	0.808	0.788	7	159	1214	1.000	X	X		X	
6		dock5-15		0.738	0.753	0.754	6	166	101	1.000	X	X		X	
7		moist soil / shallow flooding		0.561	0.704	0.716	8	176	1203	1.000	X	X		X	
8		alkali bulrush5-15		0.712	0.776	0.777	4	179	38	1.000	X	X	X	X	
9		saltgrass - verdant		0.926	0.722	0.706	10	1	11	1.000	X	X	X	X	
10		swamp tim0-25 weed0-15		0.856	0.929	0.880	13	223	378	1.000	X	X		X	
11		mustard		0.834	0.697	0.712	74	288	19	1.000	X	X	X	X	
12		pepperweed		0.868	0.783	0.787	79	293	142	1.000	X	X		X	
13		saltgrass 50-75 / poison hemlock		0.770	0.731	0.726	110	330	226	1.000	X	X		X	
14		wild rye5-35-litter0-75/star15-35-litter25-50		0.748	0.709	0.717	111	333	603	1.000	X	X		X	
15		smartweed/cocklebur verdant		1.000	0.698	0.683	114	335	1033	1.000	X	X		X	
16		baltic rush / alkali bulrush25-35		0.647	0.623	0.655	116	337	336	1.000	X	X		X	
17		swamp timothy35-75		0.692	0.667	0.673	138	361	876	1.000	X	X		X	
18		bermuda grass25		0.798	0.647	0.663	152	375	18	1.000	X	X	X	X	
19		swamp timothy35-75 / watergrass		0.904	0.815	0.788	153	376	907	1.000	X	X		X	
20		bermuda grass35-75 / water hyacinth		1.000	0.662	0.666	154	377	938	1.000	X	X		X	

MAXIMUM LIKELIHOOD CLASSIFICATION FOR SALINAS CLUB - 2003

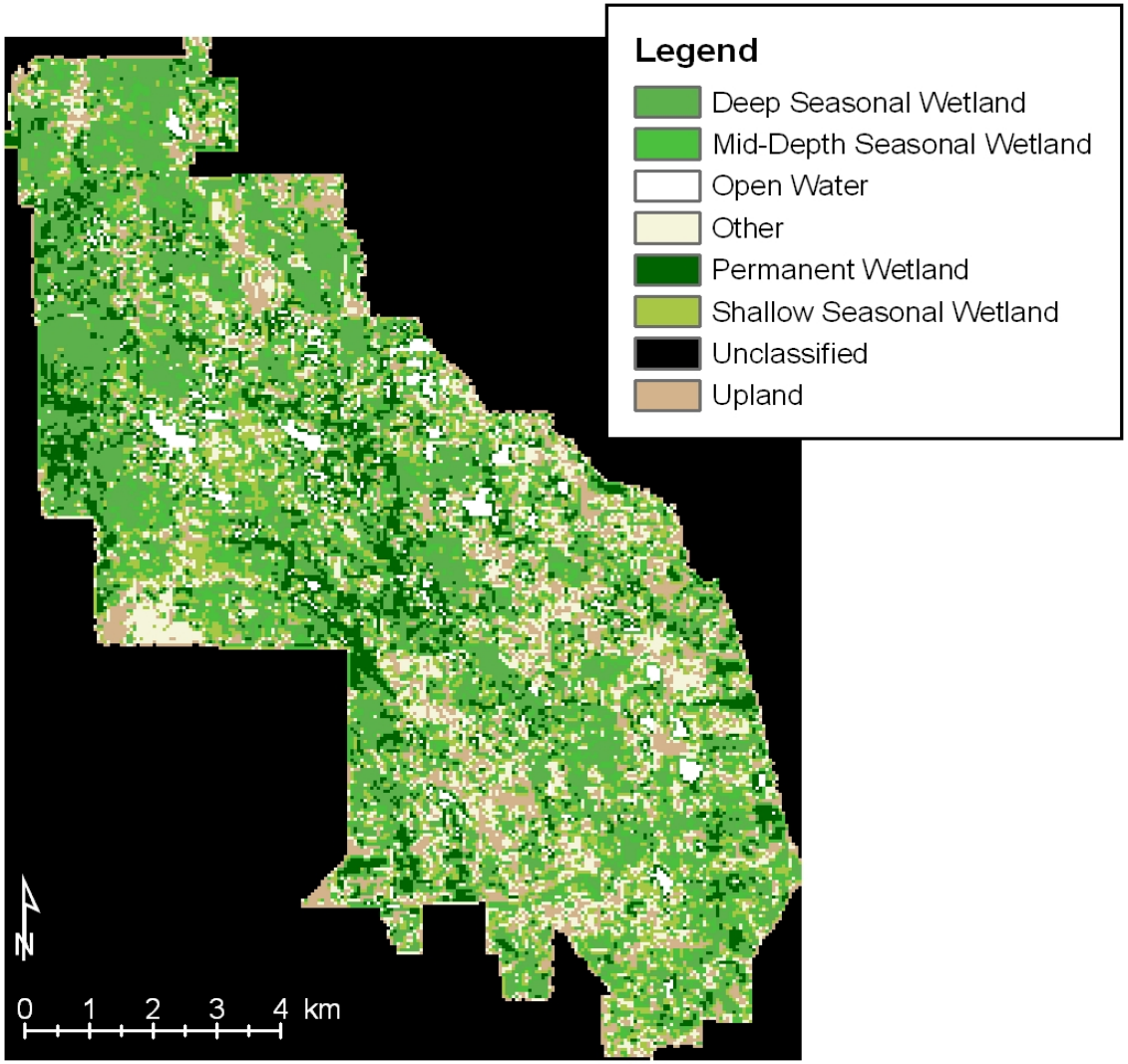


0 0.5 1 1.5 2 km

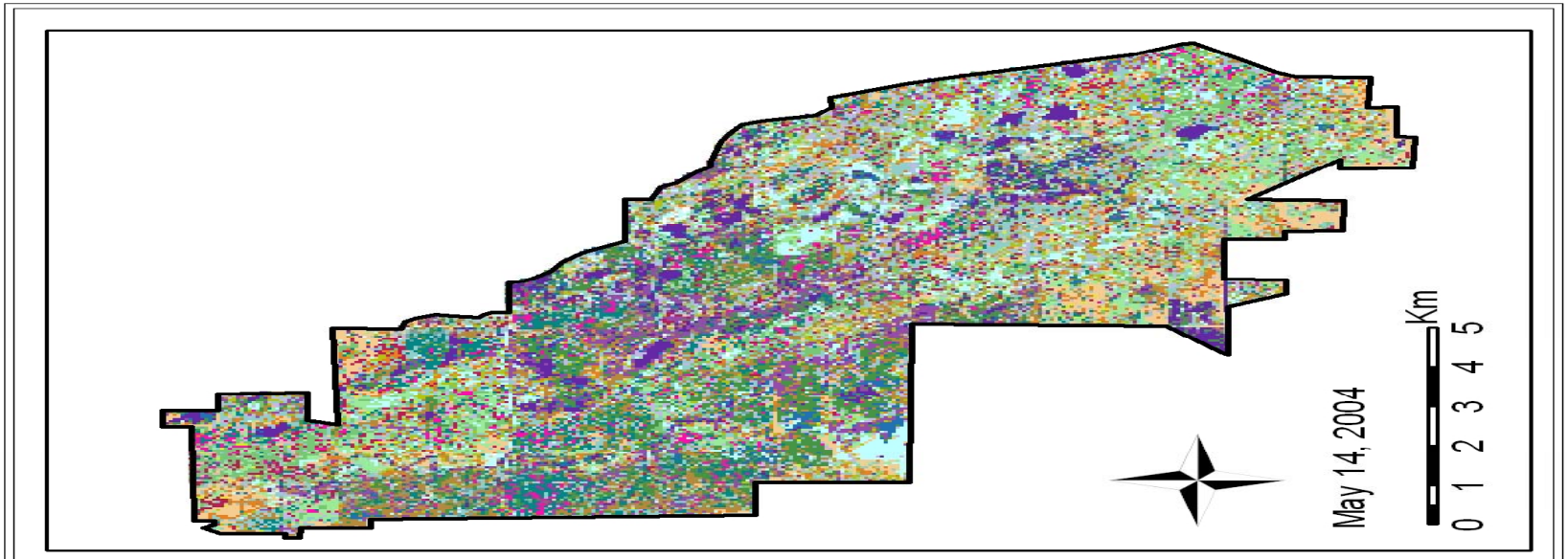
Legend

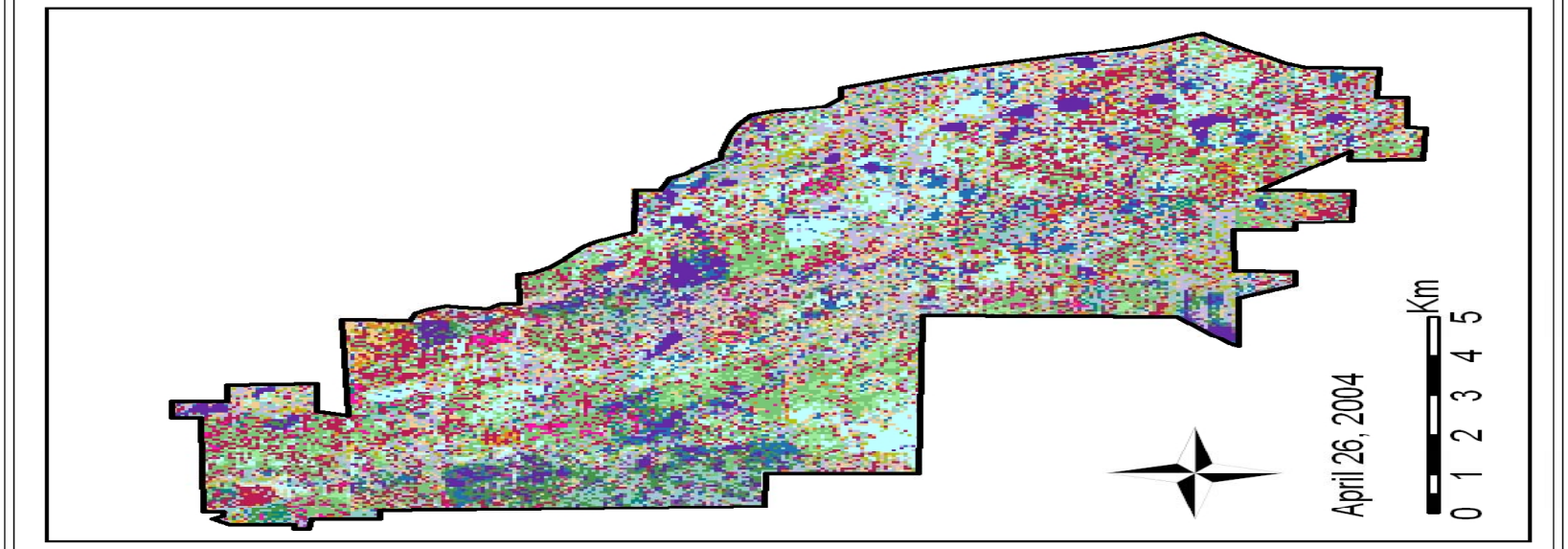
- Deep Seasonal Wetland
- Mid-Depth Seasonal Wetland
- Open Water
- Other
- Permanent Wetland
- Shallow Seasonal Wetland
- Unclassified
- Upland

MAXIMUM LIKELIHOOD CLASSIFICATION OF NORTHERN GWD – MAY 2003

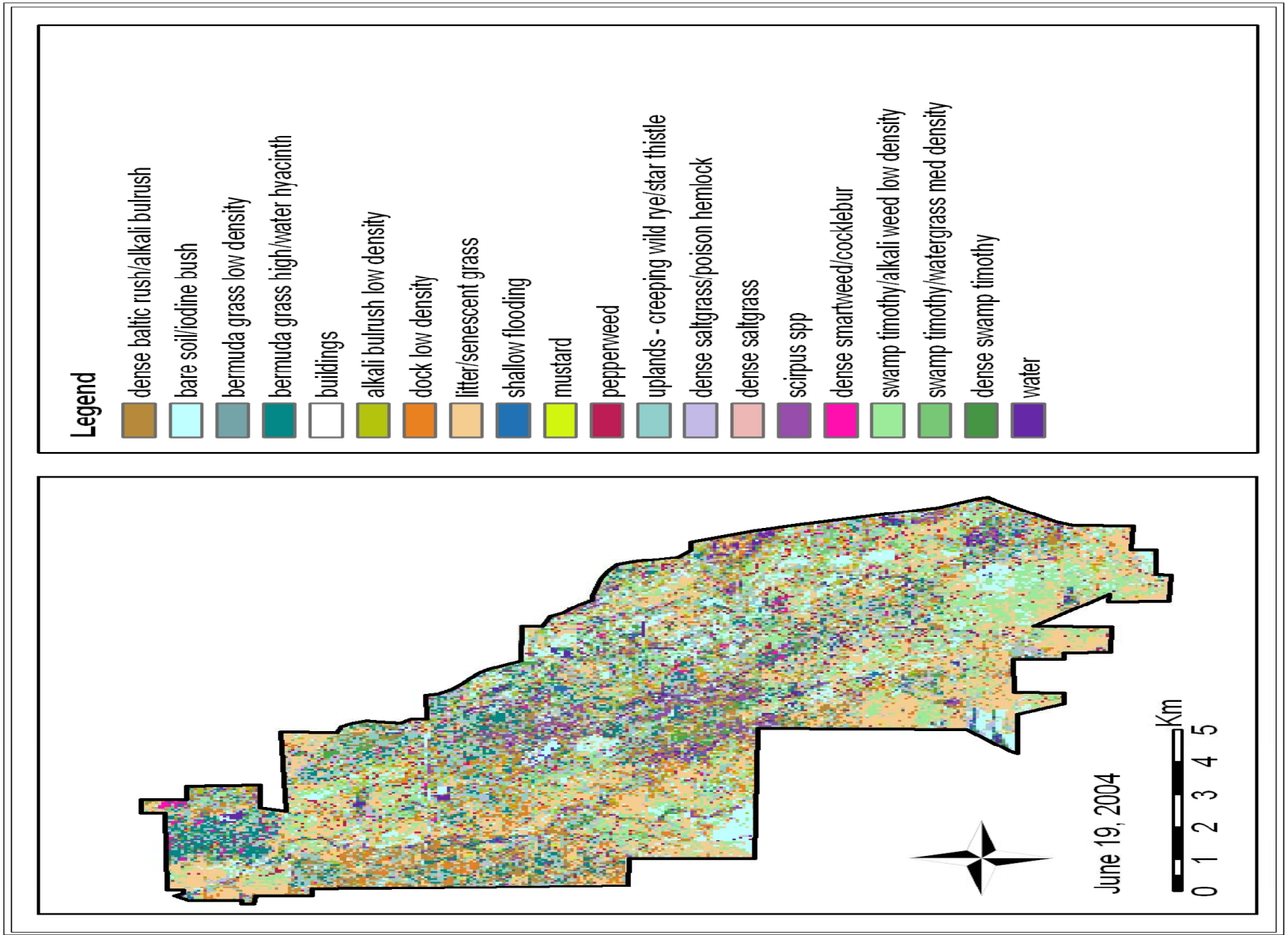


MAXIMUM LIKELIHOOD CLASSIFICATION OF NORTHERN GWD - APRIL AND MAY 2004





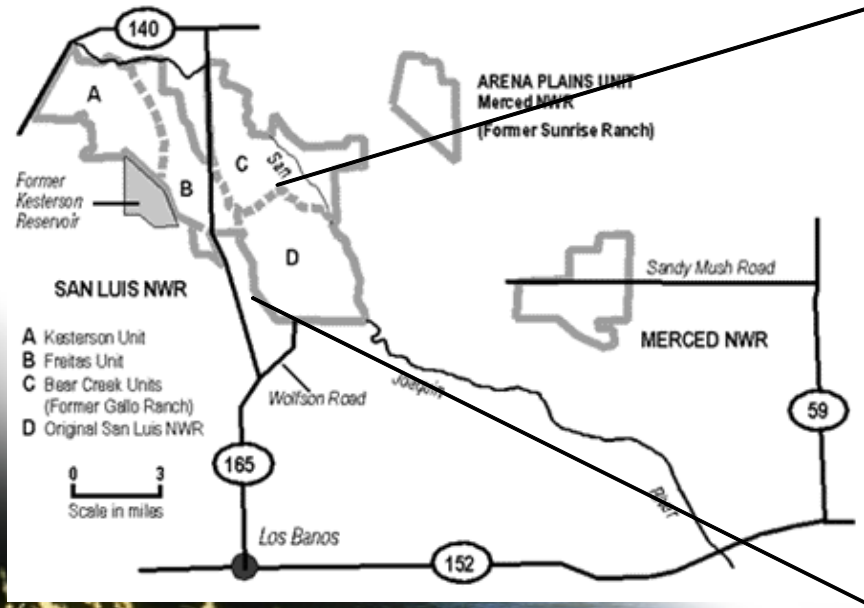
MAXIMUM LIKELIHOOD CLASSIFICATION OF NORTHERN GWD - JUNE 2004

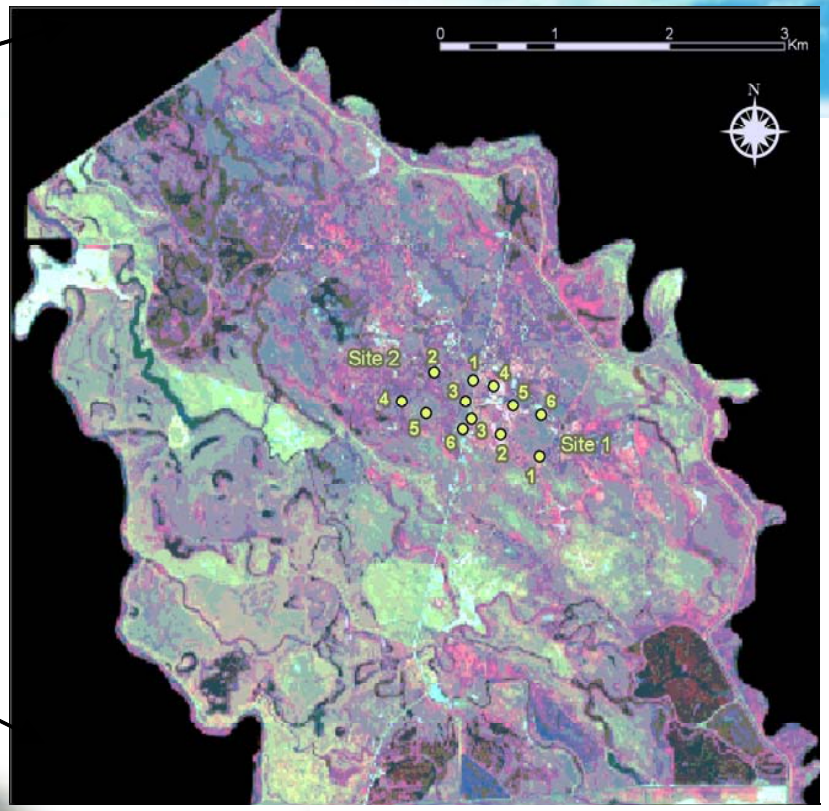


SALINITY MANAGEMENT IMPACTS ASSESSMENT USING EM MAPPING

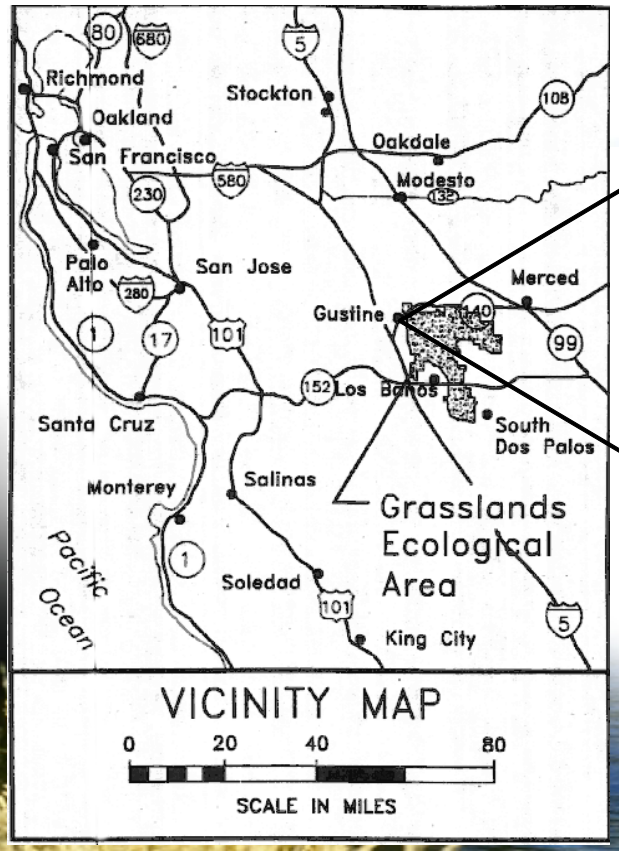
- Development of a sampling grid
- Continuous EM data acquisition from a motorized rig
- Data processing in the field to determine soil sampling grid
- Soil samples taken at 2 depths, bagged and taken to lab for saturated extract soil salinity determination
- EM data calibrated against lab EC values to produce final salinity map
- Maps show soil salinity trends and impacts due to poential future changes in drawdown management practices

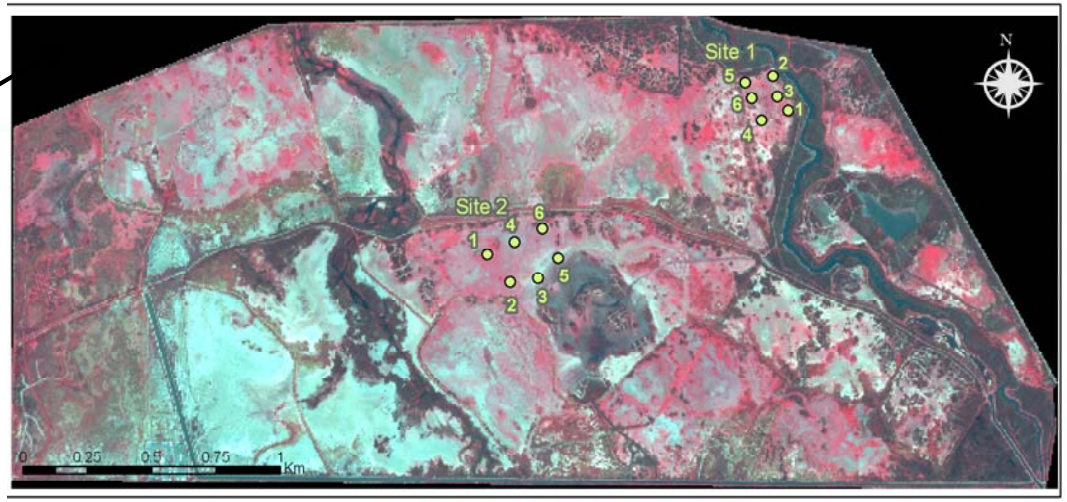
LOCATION OF SITES SURVEYED AT THE SAN LUIS NATIONAL WILDLIFE REFUGE





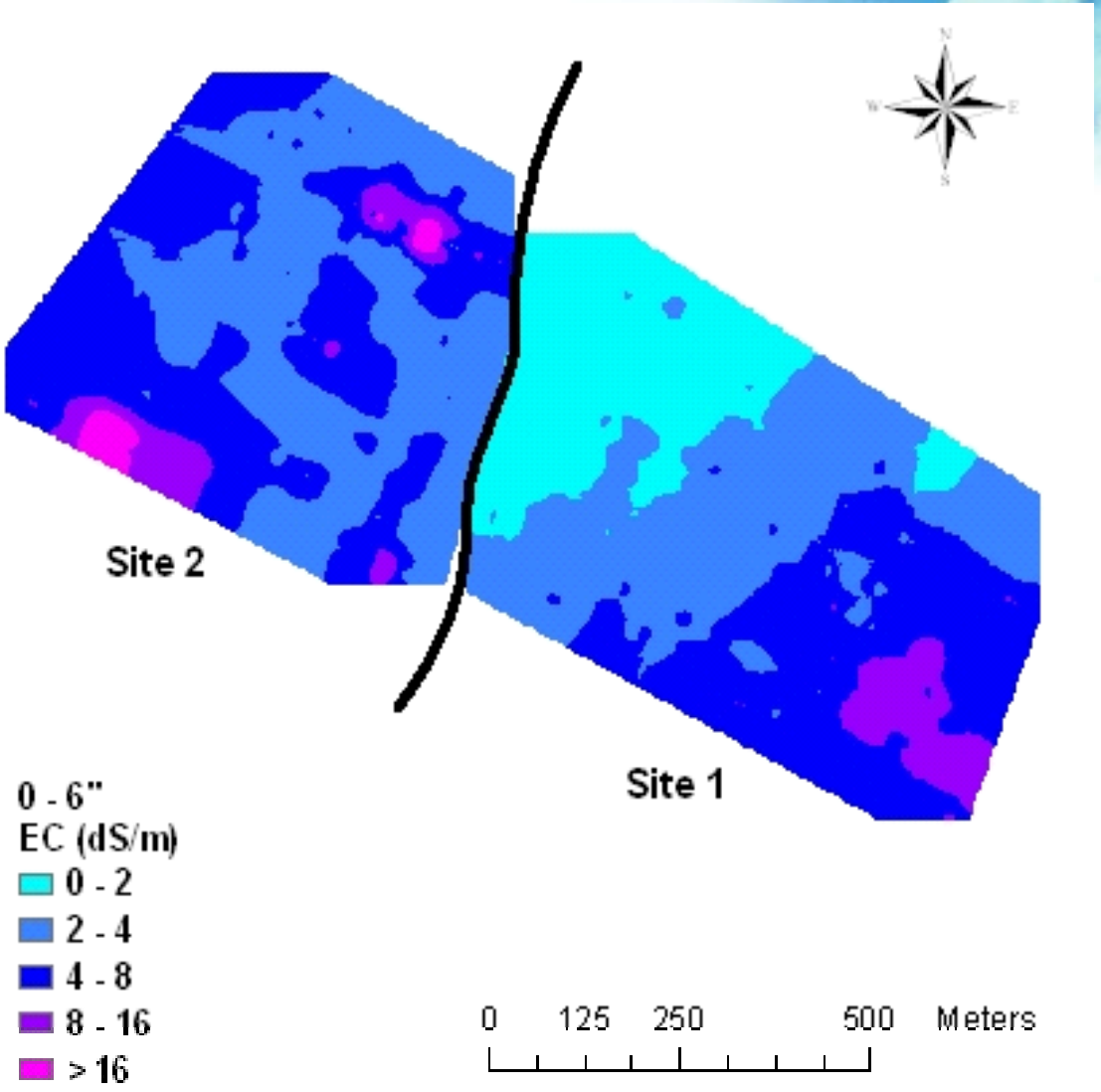
LOCATION OF SITES SURVEYED AT THE SALINAS DUCK CLUB



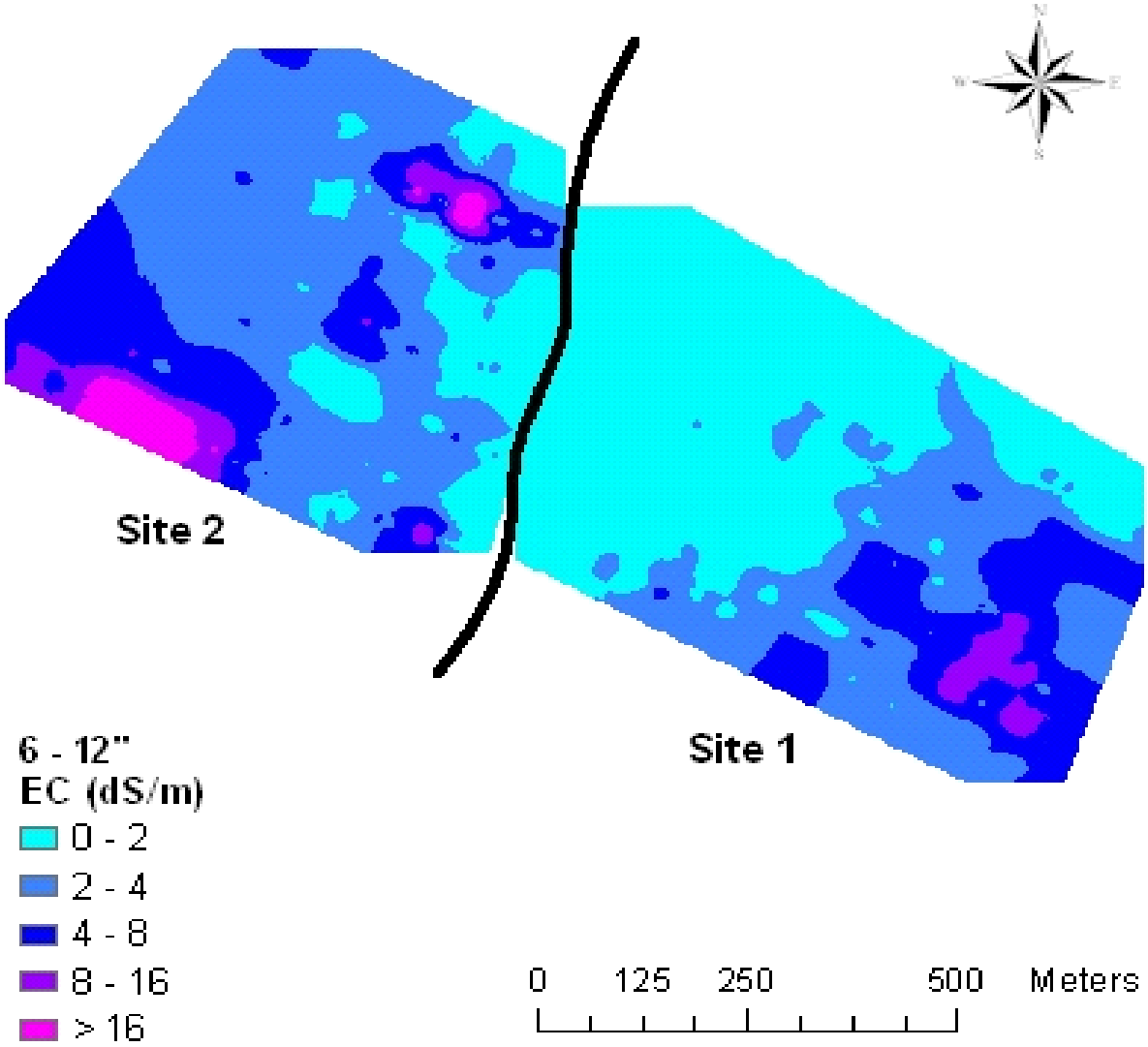


GEONICS EM-38 DUAL MODE METER FOR SOIL SALINITY MAPPING

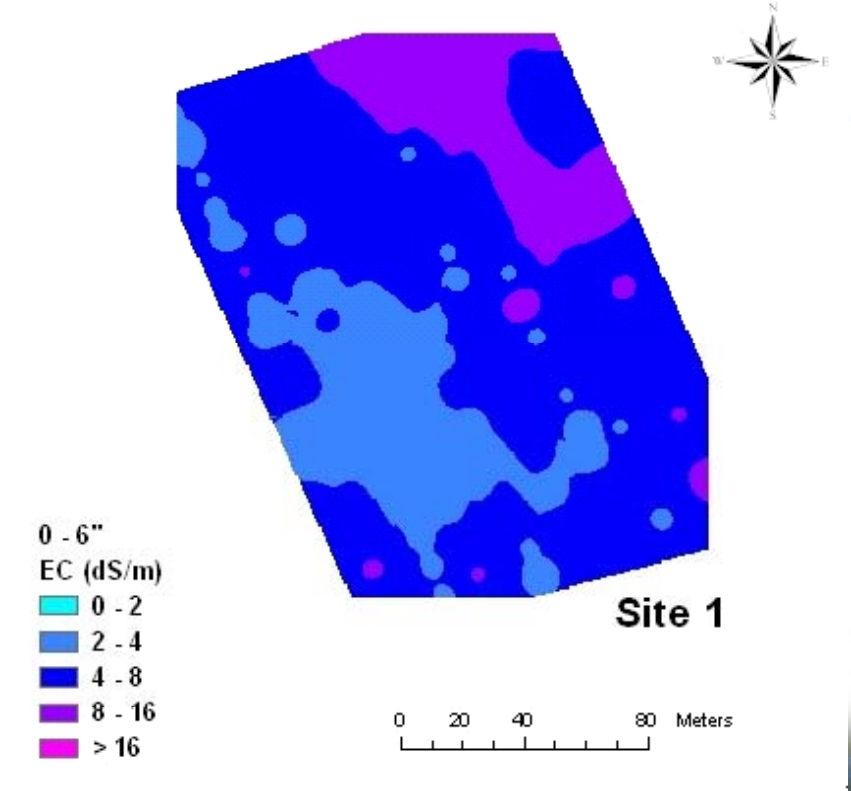
SOIL SALINITY ESTIMATED AT 0-6” DEPTH AT TWO SITES IN SAN LUIS NWR IN 2004

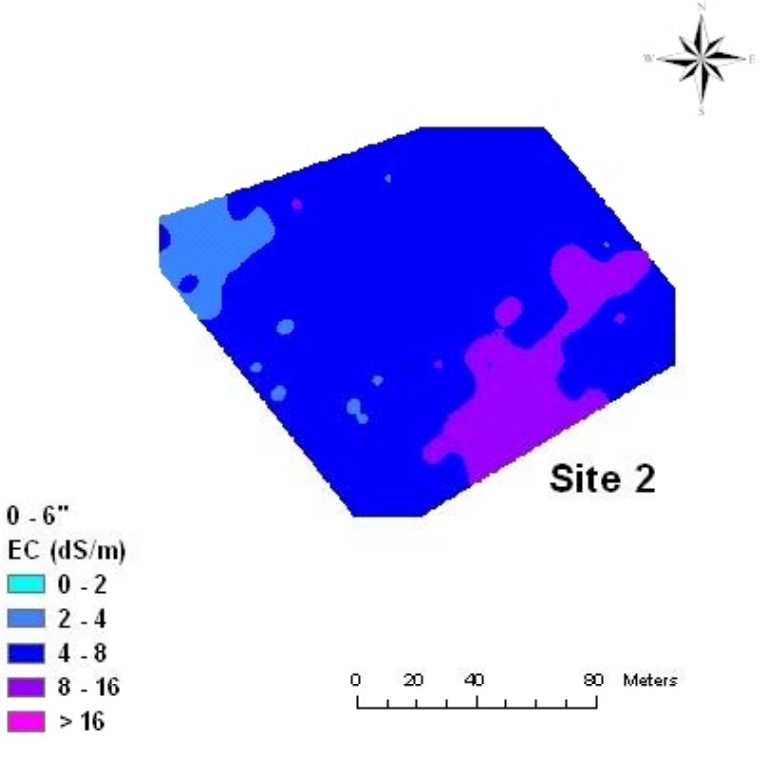


SOIL SALINITY ESTIMATED AT 6-12” DEPTH AT TWO SITES IN THE SAN LUIS NWR IN 2004

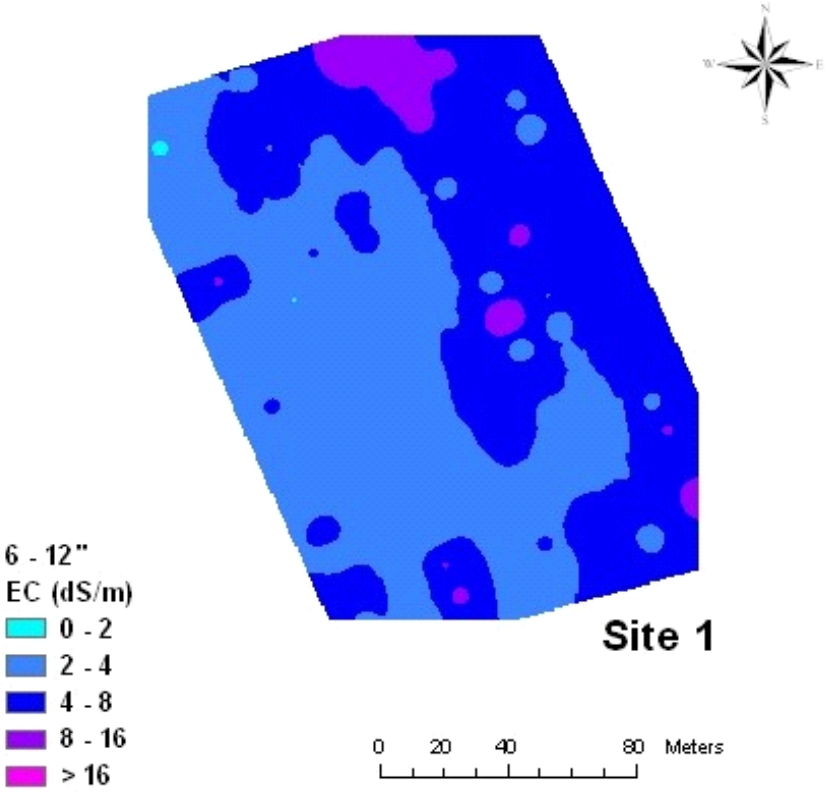


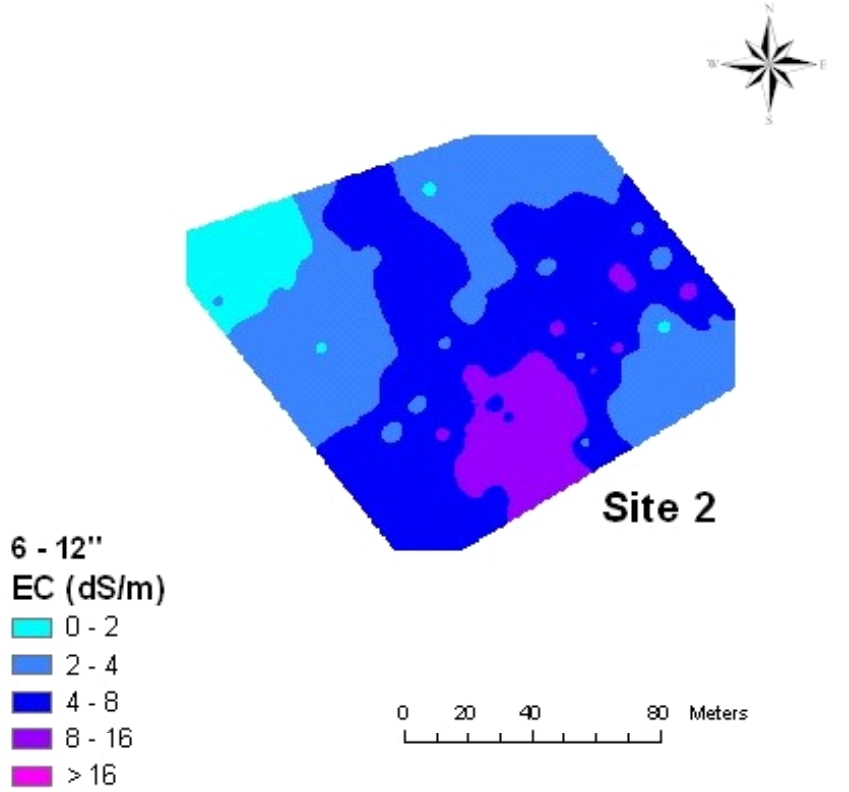
SOIL SALINITY AT 0-6” DEPTH AT TWO SITES ON SALINAS DUCK CLUB IN 2004





SOIL SALINITY AT 6-12” DEPTH AT TWO SITES ON SALINAS DUCK CLUB IN 2004





SUMMARY

- Technical TMDL's for salt and boron and dissolved oxygen creates incentives for real-time water quality monitoring and management
- Studies demonstrate need for close cooperation of agencies, local stakeholders and regulators
- Gaming models, river water quality simulation models and decision support software required to achieve CRWQCB real-time water quality management goals
- Proof of concept – validated by demonstration