Innovations and lessons learned: 
real-time water quality monitoring 
and management in seasonal wetlands

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Development of a public domain, web accessible decision support system used to forecast San Joaquin River assimilative capacity and wetland salinity loading

….that will foster coordination and cooperation between wetland managers leading to increased compliance with State water quality objectives.
WETLAND HABITAT MANAGEMENT IN THE SAN JOAQUIN VALLEY

Recommend water management for several moist-soil plants*

* Adapted from Smith et al. 1995 "A Guide to Wetland Habitat Management in the Central Valley"
WETLAND DRAINAGE MANAGEMENT ALTERNATIVES

I. Shallow Seasonal Wetlands - (0-6”)
   - Early Drawdown (Early February)
   - Mid Drawdown (Mid February)
   - Late Drawdown (Early March)

II. Mid Depth Seasonal Wetlands - (6-18”)
   - Early Drawdown (Mid March)
   - Mid Drawdown (Early April)
   - Late Drawdown (Mid April)

III. Deep Seasonal Wetlands - (18-36”)
   - Early Drawdown (Early May)
   - Late Drawdown (Mid May)
WETLAND DRAWDOWN

Wetland drawdown during spring months (Mar-April).
Water Quality Modeling

North Grasslands Water District Salinity Component at Crows Landing
Actual Management Plan

- 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.
Timing of San Joaquin River Salinity
Assimilative Capacity versus NGWD Salt Load

Salt Load (tons/day)

Period of Wetland Drawdown

Duck Hunting Season

SJR Assim. Capacity

NGWD Salt Load
PREREQUISITES FOR A REAL-TIME WATER QUALITY TMDL

- Flow and water quality control infrastructure must be in place or under development
- Development and maintenance of a real-time drainage discharge and water quality monitoring system
- Institutions responsible for long-term stakeholder cooperation and coordination to continuously match real-time contaminant loads with assimilative capacity
Installation of telemetered flow, EC and temperature monitoring stations in State, federal and private wetlands

GIS-based wetland salinity management model developed to assist WD in managing wetland spring drawdown

Trial implementation of real-time management concept in six paired wetland sites – treatment will be delayed drawdown to coincide with VAMP period.

High resolution satellite imagery and soil EM surveys used to quantitatively evaluate impact of delayed wetland drawdown schedule on long term habitat health and sustainability
Water Quality Modeling

North Grasslands Water District Salinity Component at Crows Landing
30% Withholding for first 3 Months

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

Begin withholding
End withholding
WATER QUALITY MONITORING
FORECAST MODEL WEBSITE

Grassland Water District

Grassland Water District / Grassland Drainage / Mud Slough at Gun Club Road /

Weekly Graphs

Updated Once a Week

These are graphs of the past week’s worth of data. Every week these graphs are updated with fresh data. However, the data in these graphs is only provisional for now. It has not been cleaned of errors and discrepancies. In the future, non-provisional data will be posted as well.

Weekly Graphs
Monthly Graphs
Downloadable Data
Archived Data
Formulas
QA Data
Weekly Graphs
Stage
Temperature
EC
Discharge
Salt Load
Battery Voltage
Monthly Graphs
Stage
Temperature
EC
Discharge
Salt Load
Battery Voltage

all data on this site is strictly provisional unless otherwise noted
WATER QUALITY MODELING

- Monitoring network will furnish the data necessary to develop and calibrate a daily salinity mass balance model for the Grassland Ecological Area wetlands.

- The WETMANSIM model will assist wetland managers in timing and coordinating salt export during periods of high SJR assimilative capacity.
The decision support system (DSS) will provide a set of analytical tools:

- Computation of GWD wetland water requirements
- Estimation of wetland salinity loads in seasonal wetlands
- Scheduling of discharge from individual management areas
- Selection of seasonal wetland best management practices
FACTORS THAT DETERMINE SUCCESS (after MYSIAK, 2005)

UNFREEZING: Establish conditions for change – develop incentive and regulatory policies

MOVING: Design, develop, implement, persuade using information technology, models and assurances

RE-FREEZE: Achieve organizational, operational change consistent with objectives
Recognize institutional constraints of participating wetland entities: Federal and State agencies have autonomy over wetland management decisions; private wetland managers answerable to private duck club boards.

Utilize carrot and stick: habitat incentive programs are powerful agents of change with private entities that are not as well funded as State and Federal agencies.

Collaborations with regulatory entities to develop interim targets and load objectives to create a transition period and allow management to adjust incrementally (adaptively).
Adaptive management dictates a feedback mechanism to prevent irreversible damage to wetland resource through real-time salinity management.

Learning by doing develops experiential knowledge base that can guide future actions and operations. This is necessarily a long-term strategy given the inter-annual variability of climate and water supply allocations.

By its nature a long-term planning strategy – 10 to 15 year planning horizon for technology transfer and institutional adoption.
INSTITUTIONAL ASSURANCES

- Assurances necessary to reduce perceived risk of adoption – otherwise easier to employ litigation to avoid change
- Assurances can only be given by statutory bodies with institutional clout to make long-term promises
- Assurances need to be backed up with data collection to better understand long-term trends – otherwise no proof of harm
- Needs to be understood that system impacts can take years to develop and though physically reversible may be institutionally difficult to remedy or irreversible
Wetland managers are working towards implementation of real-time management tools to manage salinity in the San Joaquin River. ...but we need to understand what impact, if any, changes in management practices would have on habitat quality.

Accurate soil salinity and vegetation maps are important tools for evaluating water needs for wetlands, developing Best Management Practices and documenting trends in habitat quality.
1. Image Acquisition

Note the recognition of the vegetation ring in the shallows edges of the pool.

2. Signal Processing

3. Pattern Recognition

4. Classification
Salinas Club (duck club in NGWD)  
- 6 km²

San Luis National Wildlife Refuge  
- 30 km²
- Multiple sampling locations conducted during 2 week window surrounding image collection dates
- Sampling sites selected with assistance of local land managers knowledgeable about species distribution.
- Sites located in all accessible wetland basins
Dominant land cover classes - May 14, 2004:

12.7% uplands – creeping wild rye / yellow star thistle
9.0% dense baltic rush / alkali bulrush
7.8% dense swamp timothy
7.3% medium dense swamp timothy / watergrass
7.1% litter / senescent grass
7.1% bare soil / iodine bush
SOIL SALINITY ESTIMATED AT 0-6” DEPTH AT TWO SITES IN SAN LUIS NWR IN 2004
Success of current wetland DSS project can be enhanced by adaptive management practices and stakeholder assurances.

Integrated water basin management demands integration of data acquisition, processing, modeling, forecasting, information dissemination and decision support (with feedback) functions.

Current real-time water quality management project will likely take 10 years to fully implement and will be the exemplar for future basin resource management.