

Twitchell Island rice growing area



Delta rice potentially fulfills economic and ecological goals



Rice links to hydrology, subsidence reversal, and carbon sequestration

## Subsidence Mitigation Through Rice Cultivation Research

### Project Goals:

1. Determine the viability of different rice growing methods within the Delta.
2. Determine the rates/amounts of subsidence reversal/land accretion through rice farming.
3. Determine the air and water quality impacts of rice cultivation.
4. Determine the per acre costs/benefits to farmers of different methods of rice cultivation.
5. Provide recommendations for Delta-wide implementation.

### Project Description:

Rice is a wetland crop with an existing agricultural market that has the potential to accrete land mass and sequester carbon. The Subsidence Mitigation Rice Cultivation Research project will determine whether growing rice reverses subsidence, can be grown without deleterious effects to the environment, and is economically feasible in the Delta.

The project area consists of a 300 acre parcel on Twitchell Island. Propositions 84/1E provides the funding sources for this project, which will total \$5,450,000 from 2008-2013. Agriculture and infrastructure improvements will cost \$2,450,000 and research activities will cost \$3,000,000.

A Proposal Solicitation Package (PSP) was issued in March 2008 and a public meeting was held in April 2008. One proposal has been awarded to Reclamation District 1601 (Twitchell Island). Twitchell Island is collaborating with a team of private consultants as well as experts from the University of California and the USGS. A Project Funding Agreement (PFA) has been prepared and is awaiting approval by the appropriate parties.

### Schedule and Milestones:

- March 24, 2008 – Rice Proposal Solicitation Package Posted
- April 25, 2008 – Application Deadline
- May 9, 2008 – Notification of Award
- June 2008 – Notice to Proceed
- Summer 2008 – Field Preparations (Agriculture and Research)
- Spring 2009-2013 – Planting
- Fall 2009-2013 – Harvest
- April and October – Quarterly Reports
- January and July – Semi-Annual Reports
- January 2014 – Project Completion and Final Report

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# Twitchell Island East End Habitat Restoration Project

## Project Goals:

1. Restore 740 acres of emergent wetlands on a 1600-acre property on Twitchell Island.
2. Determine the rates/amounts of carbon sequestered for project.
3. Determine the air and water quality impacts of project.
4. Provide recommendations for Delta-wide implementation.

## Project Description:

The Twitchell Island East End Habitat Restoration Project will restore approximately 740 acres of palustrine emergent wetlands on a nearly 1600-acre property on Twitchell Island that is owned by the Department of Water Resources. The property was previously managed for flood irrigated corn and alfalfa.

Approximately 530,000 cubic yards of material was transported within the site and used to sculpt the swales and create berms for this wetland habitat area. Water levels in each unit will be managed independently to restore the desired emergent wetland conditions throughout the site. Water is proposed to be maintained in the project area year-round, effectively creating a permanent wetland.

Construction began in May 2013, and was completed by November 1, 2013. The ultimate outcome of the restoration project will be hundreds of additional acres of freshwater emergent wetlands. Each wetland unit will be a mosaic of open water channels and emergent vegetation comprised predominantly of California bulrush and narrow leaved cattails. Other native plant restoration components will include installation of native trees and shrub compatible with their respective hydrologic regime as well as a substantial amount of upland transitional area, all of which will provide great diversity of habitat opportunity.

## Schedule and Milestones:

Spring-Summer 2012 – Initial topographic surveys, restoration design

September 2012 – Issue MND, Environmental Permitting

Spring-Summer 2013 – Project Construction and restoration

Fall 2013 – Project implementation: flooding and monitoring

2013-2017 – Carbon measurements, water quality sampling, surveys



*Twitchell Island East End Restoration (in green and blue).*



*Previously, the East End of Twitchell was used as a corn and alfalfa farm*



*The project plans to restore approximately 740 acres of palustrine emergent wetlands, and has the potential to look similar to the Mayberry Farms project on Sherman Island*

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# DWR Wetland Research Facility

## Project Goals:

1. Undertake a long-term study/evaluation of vegetation growth to reverse subsidence in the Delta.
2. Evaluate on-and-off-site impacts of subsidence reversal projects.

## Project Description:

Since 1997, DWR has performed and sponsored studying subsidence reversal on DWR-owned property on Twitchell Island. The project consists of two wetland sites totaling approximately 15 acres. Researchers from USGS and the University of California have monitored land surface elevation changes and carbon accretion due to the accumulation and decay of plant materials.

Studies at this facility have shown that surface elevation changes due to accretion ranges from 3.2 and 5.6 cm/yr (1.3 - 2.2 in/yr), while surrounding areas used for agricultural purposes lost elevation due to subsidence. The new material bulk density is fairly low (i.e. less than 0.1 g/cm<sup>3</sup>) but has a high degree of structural integrity.

Additional research activities proposed by USGS include assessments of water quality impacts, greenhouse gas (GHG) release, and other impacts of tule cultivation in subsided Delta Islands.

Research at the Twitchell site has shown that appropriate land management practices can not only eliminate but also reverse subsidence. Long-term test plots provide significant opportunities for the assessment of impacts of restoration as well as quantification of ecological "co-benefits" from the project's subsidence reversal techniques. The wetland research facility is also serving as a pilot project for the much larger Twitchell East End Wetland restoration.

## Schedule and Milestones:

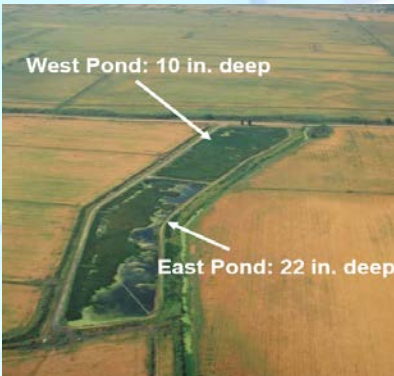
1997 – Project launched

2008-2012 – Data and lessons learned are applied to other Delta subsidence reversal projects

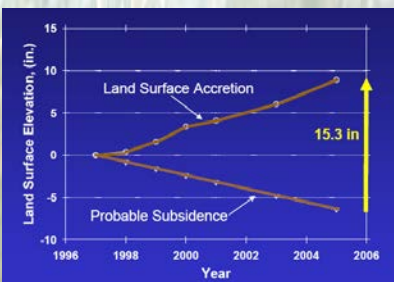
2012 – Began greenhouse gas measurements on wetland using carbon flux towers



Located in the western Delta, Twitchell Island is heavily subsided



Tules and other vegetation are cultivated at the Wetlands Research Facility



Long term data suggests subsidence can be reversed using management techniques

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# Mayberry Farms Subsidence Reversal and Carbon Sequestration Project

## Project Goals:

1. Control and reverse subsidence on a 307-acre property on Sherman Island using permanent flooding techniques.
2. Determine amount of carbon sequestered for project.
3. Study waterfowl use and waterfowl hunting success on permanently flooded delta wetlands.
4. Demonstrate the applicability of tested management practices to Delta and Suisun Marsh.

## Project Description:

The Mayberry Farms Subsidence Reversal and Carbon Sequestration Project is a permanently flooded wetland on a 307-acre parcel on Sherman Island that is owned by the Department of Water Resources (DWR). The project has restored approximately 192 acres of emergent wetlands and enhanced approximately 115 acres of seasonally flooded wetlands.

The Mayberry Farms project was conceived as a demonstration project that provides subsidence reversal benefits and develops knowledge that can be used by operators of private wetlands, including "duck clubs," which manage lands for waterfowl-based recreation. By maintaining permanent water, the growth and subsequent decomposition of emergent vegetation is expected to control and reverse subsidence. The project is also anticipated to provide climate benefits by sequestering atmospheric carbon dioxide (CO<sub>2</sub>). The project has demonstrated, through water quality sampling and wildlife survey data, that it provides year-round wetland habitat for waterfowl and other wildlife.

Construction was in summer 2010 and had a total cost of \$1.6 million. Several projects at the site are currently ongoing and performed routinely by Department staff and their consultants. The Department is collaborating with UC Berkeley researchers to collect GHG data that will be used to develop a Wetland Protocol for Carbon Sequestration in cooperation with the California Air Resources Board's Cap and Trade Program. In addition the Department is working with researchers from the Moss Landing Laboratory and the Central Valley Regional Water Board to monitor Methyl Mercury levels and test BMPs to control MeHg in a permanently flooded and managed wetland.

## Schedule and Milestones:

- 2007 – Develop restoration design
- 2008-2009 –Environmental permitting
- Spring/Summer 2010 –Project construction and restoration
- Summer 2010 –Complete monitoring plan/initiate monitoring
- Fall 2010 –Project implementation: flooding and monitoring
- 2010-2017 – Carbon measurements, water quality sampling, surveys



*A hunting club leases the 307-acre Mayberry Farms property owned by DWR on Sherman Is.*



*Planned restoration has created permanently flooded wetlands for waterfowl habitat and subsidence reversal. Carbon sequestration is measured along with other monitoring to demonstrate the biological and recreational benefits of Delta wetland restoration.*

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# Sherman Island Whale's Mouth Habitat Restoration and Scour Pond Filling

## Project Goals:

1. Reverse subsidence on a section of low-lying Sherman Island by permanently flooding it, while also improving the habitat available to wildlife occurring in the area.
2. Increase stability and reduced seepage on a threatened section of levee.
3. Determine the rates/amounts of carbon sequestered for project.
4. Determine the air and water quality impacts of project.
5. Provide recommendations for Delta-wide implementation.

## Project Description:

The Sherman Island Whales Mouth Wetland Restoration Project will restore approximately 600 acres of palustrine emergent wetlands, within an 877-acre Project boundary, on a nearly 975-acre parcel of property on Sherman Island that is owned by the California Department of Water Resources. The property is currently managed for flood irrigated pasture land which includes a regular and extensive disturbance regime associated with field prepping, disking, and grazing.

Pending permit approvals, construction will begin in May 2014. Initial site preparation includes vegetation removal prior to earth moving activities. Construction will stop by 15 October 2014. If work is not completed in 2014, it will commence again in May 2015 and May 2016 (if necessary). Work will be scheduled to accommodate approved giant garter snake work windows. Earth moving activities will include constructing the site's interior and perimeter berms, loafing islands, swales and potholes.

The ultimate outcome of the restoration project will be hundreds of additional acres of freshwater emergent wetlands. Each wetland unit will be a mosaic of open water channels and emergent vegetation comprised predominantly of California bulrush (*Schoenoplectus/Scirpus californicus*) and narrow leaved cattails (*Typha angustifolia*). Other native plant restoration components will include installation of native trees and shrubs compatible with their respective hydrologic regime as well as a substantial amount of upland transitional area, all of which will provide a diversity of habitat structure and function.

## Schedule and Milestones:

Spring-Summer 2013 – Initial topographic surveys, restoration design

November 2013 – Issue MND, Environmental Permitting

Spring-Summer 2014 – Project Construction and restoration

Fall 2014 – Project implementation: flooding and monitoring

Spring-Summer 2015 – Additional Construction (if necessary)



Current design for Whale's Mouth Wetland and Scour Pond Filling Project (in green and blue).



The current land management of the project site on lower Sherman Island is a flood irrigated pasture



The project plans to restore approximately 600 acres of palustrine emergent wetlands, and has the potential to look similar to the Mayberry Farms project, also on Sherman Island

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# Setback Levee Construction along Mayberry Slough on Sherman Island

## Project Goals:

1. Lower the waterside of 6,100 feet of the existing Sherman Island levee to create functioning intertidal channel margin habitat that will benefit native aquatic species and reduce the load on the setback levee.
2. Successfully transplant Mason's lilaepsis (*Lilaeopsis masonii*), a California Rare Plant, at the project site.
3. Create intermittent habitat that resists colonization and establishment by non-native plant and animal species.
4. Provide monitoring results that will aid in planning future projects for the Delta Levees Program.

## Project Description:

Reclamation District 341, with funding from DWR, constructed four sections of setback levee to increase levee stability along Mayberry Slough on Sherman Island in 2004 and 2005. The Sherman Island setback levee represents an opportunity to reverse some of the ecological damage resulting from levee construction and maintenance, by implementing a habitat development project that will augment the existing riparian vegetation and provide habitat for native species. The project will restore tidal wetland and riparian habitat.

The setback levee totals approximately 6,100 linear feet and cost \$5.8 M. Increased flood protection and a concomitant net gain of habitat in the Sacramento-San Joaquin Delta are goals of the Assembly Bill 360 (AB 360; Delta Levees) Program. Funding is available through Propositions 84/1E.

Construction of the waterside portion of the setback levee was divided into two phases (Phase IIA, Phase IIB), and the two phases were completed in Fall 2008 and 2009, respectively. Plant monitoring and maintenance is ongoing until 2013.

## Schedule and Milestones:

**2007** – Design and Plans Completed

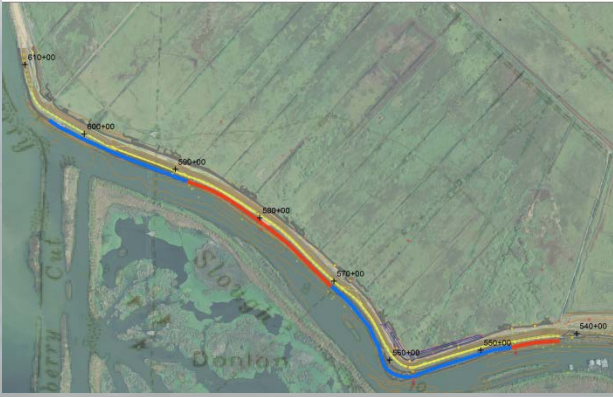
**Summer 2008** – Landside Construction of Setback Levee

**Fall 2008** – First Phase of Waterside Construction completed (2,300 linear feet)

**Spring 2009** – Plant Monitoring and Maintenance begins, preparation for second phase of Waterside Construction

**Fall 2009** – Second Phase of Waterside Construction completed (3,800 linear feet)

**2013** – Plant Monitoring and Maintenance Completed, Final Report



Map of setback levee on Sherman Island. Red portions were constructed in 2008. Blue portions were constructed in 2009.



Conditions of Mayberry Slough Levee prior to construction



Mayberry Slough Levee in 2012, after construction and AB 360 inspection

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Setback Levee on Twitchell prior to vegetation growth



Plant growth is evident one year after the setback construction



The setback levee now has areas where invasive species have overgrown

## Setback Levee and Habitat Restoration Project on Twitchell Island

### Project Goals:

1. Stabilize a threatened levee on the San Joaquin River by constructing a setback levee and bench separated by a channel.
2. Create Emergent Marsh and Shaded Riverine Aquatic habitats to satisfy enhancement element of the DWR AB360 Delta Levees Program.

### Project Description:

On Twitchell Island, a levee which had a steep, unstable waterside slope was identified as both a threat and as an opportunity. This project is located on the high-energy southern shore of Twitchell Island. The goal of the enhancement project was to create Emergent Marsh and Shaded Riverine Aquatic habitats. A predominant feature of the project design was a channel, or "tidal slough," located between a low bench along the Twitchell Island setback levee and a portion of the original levee that was maintained as a waterside berm.

The project created of 1.4 acres of Emergent Tidal Marsh and 1.6 acres of Shaded Riverine Aquatic habitats. Proposition 50 funded the project cost of \$3,000,000, which included design, construction and planting/maintenance.

While the project has been successful in creating Shaded Riverine Aquatic habitat along the bench and waterside berm, the creation of Emergent Marsh habitat has been less successful. Tules (*Scirpus* spp.) planted along the channel margins have become established at many locations. However, water hyacinth (*Eichornia crassipes*) has invaded extensive portions of the channel. In 2005 additional openings in the channel were created to allow for more tidal actions, which lessened the water hyacinth problem. By 2008 the cottonwood, willow, and alder trees had formed a canopy over the channel providing for more Shaded Riverine Aquatic habitat. Many species of bird and river otters have frequented the project area.

### Schedule and Milestones:

1996-1999 – New Setback Levee Designed and Constructed

2000-2005 – Habitat Planting and Maintenance Period

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