Downstream Water Quality and Quantity Impacts Of Water Storage Systems in a Mississippi Delta Watershed

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Overview

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- Introduction
- Methods
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- Long-term Goals

Background

- The MS River Basin contains about 65% of the nation's harvested cropland (Kolpin, 2000).
- The Mississippi and Atchafalaya Rivers contribute over 85% of the total nutrient load to the Gulf (Dunn, 1996).
- In 2010, the hypoxic zone in the northern Gulf of Mexico was one of the largest recorded since a team of researchers began routine mapping of the Gulf in 1985 (Rabalais and Turner, 2010).

Background

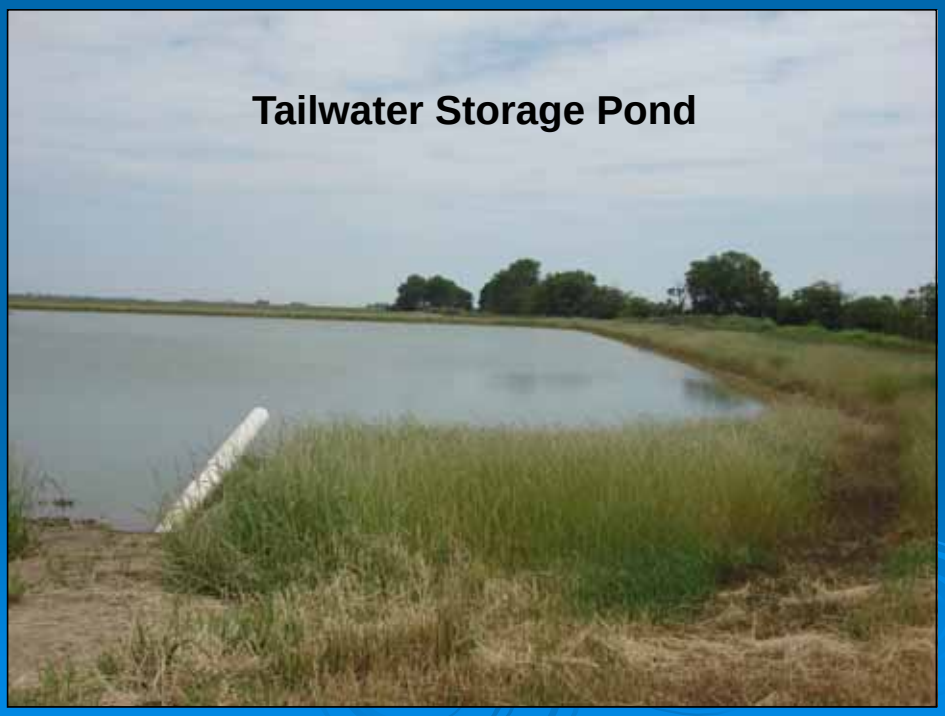
- The size of the Gulf hypoxic zone in 2010 covered 20,000 km^2, far from the 2015 goal of 5,000 km^2, set by the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force (Rabalais and Turner, 2010).
- In 2010, the NRCS launched the Mississippi River Basin Healthy Watersheds Initiative……..

Background

Tailwater Recovery Ditch

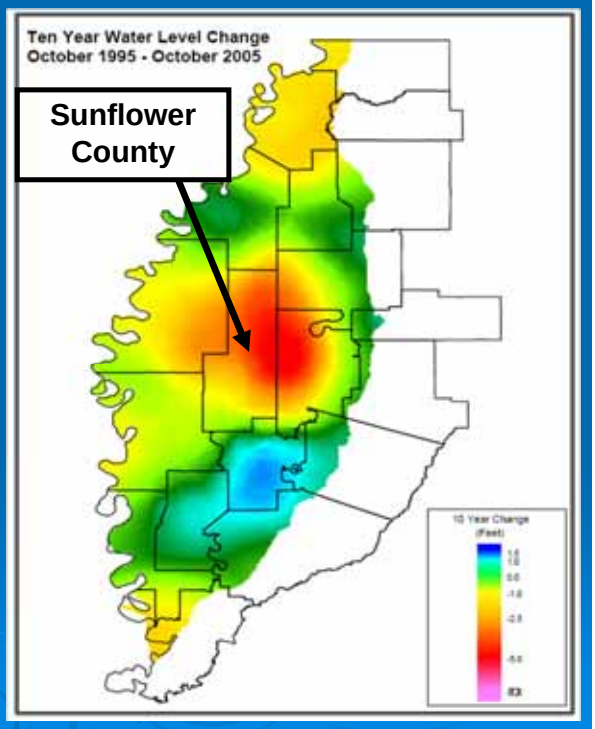
Background

Tailwater Storage Pond



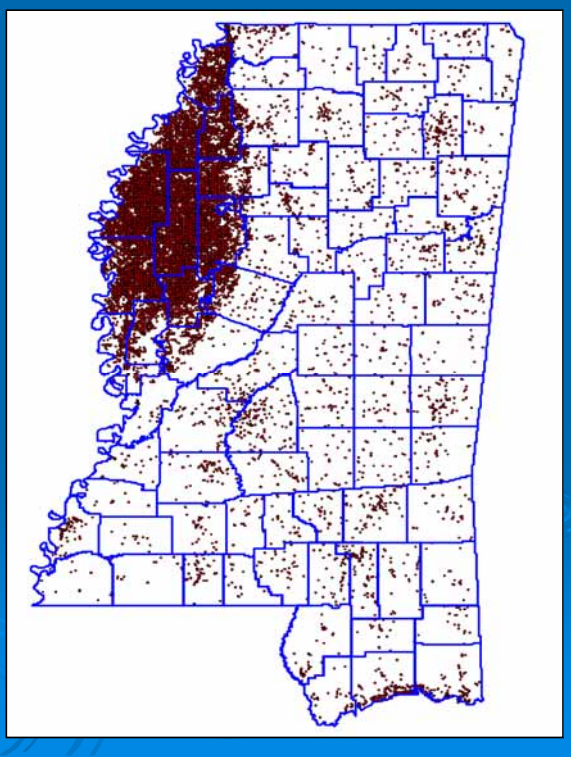
Background

- Since the 1970's, groundwater levels in the MS Alluvial Aquifer have decreased (100,000 to 300,000 acre-feet/year) due to an increase in irrigated acres (YMD Water Management Plan, 2006; USDA-NRCS, 1998).



Background

- There are currently around 15,786 groundwater permits in the Delta, which are dependent on the MS Alluvial Aquifer (DEQ, YMD).



Motivation

- Two main impediments to sustainability of agroecosystems in the MS Delta:
  1. Declining groundwater levels in the MS Delta Alluvial Aquifer
  2. Nutrient loads to the MS River and the Gulf of Mexico
- On-farm water storage systems can potentially address both of these issues concurrently

Introduction

GOAL

Determine the watershed-scale impacts of water storage systems on water quality and quantity, using the example of Porter Bayou Watershed, Mississippi.

Introduction

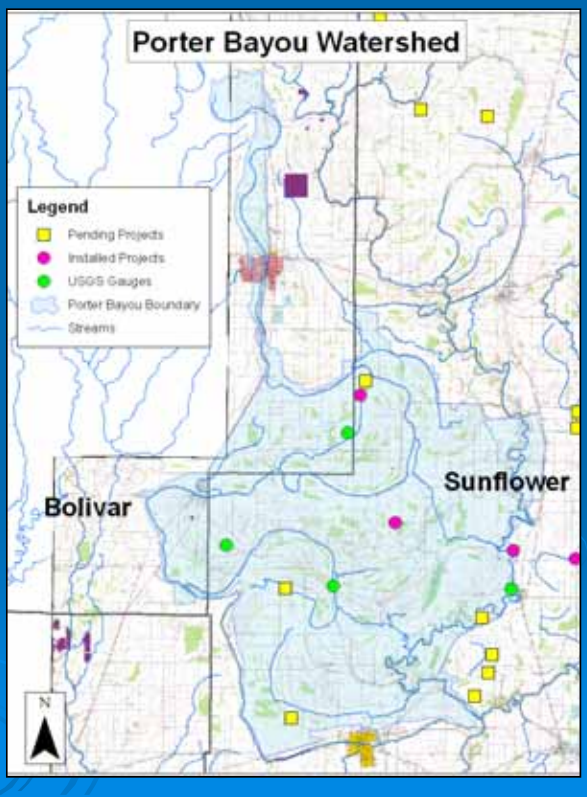
- **OBJECTIVE ONE** (Research)**: Determine the downstream nitrogen and phosphorous concentrations of effluent from water storage systems.**
- **OBJECTIVE TWO** (Research)**: Quantify the effects of water storage systems on downstream flow levels through a watershed.**
- **OBJECTIVE THREE** (Outreach)**: Increase the adoption of on-farm water storage technology and dissemination of potential benefits.**
- **OBJECTIVE FOUR** (Education)**: Enhance the science education of middle and high school students by promoting the benefits of water conservation and environmental stewardship.**

Introduction

- **EPA Priority Watershed (HUC 08030207)**
- **Drains into Big Sunflower River**
- **2008 TMDL report indicated reduction of nutrients could be accomplished with the installation of BMPs (MDEQ).**

Introduction

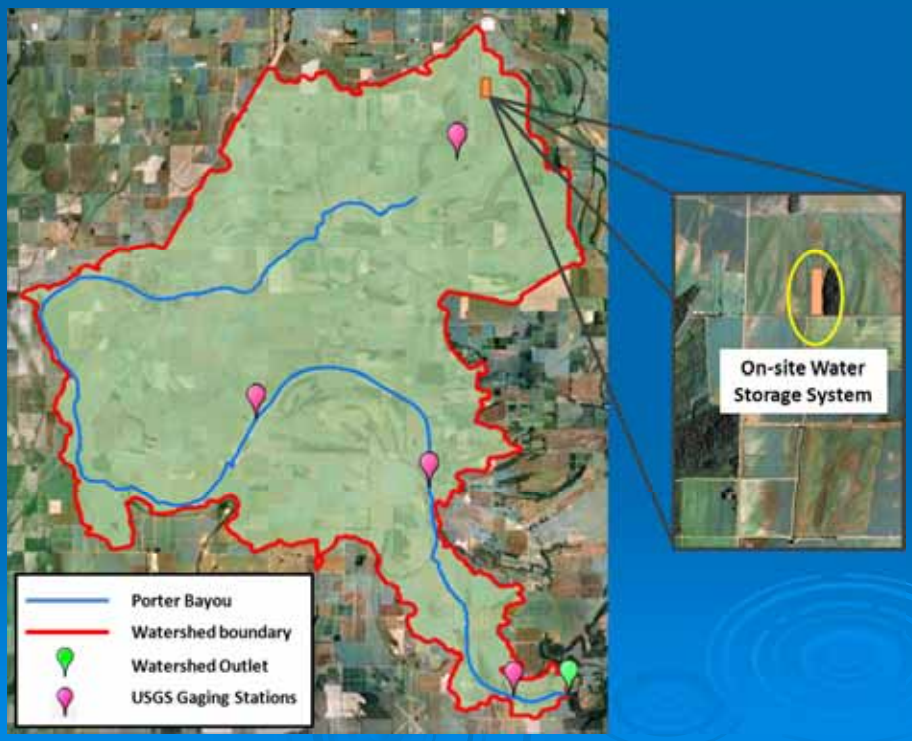
- Originally planned on one site – Metcalf/Britt Farm
- Added Pitts Farm



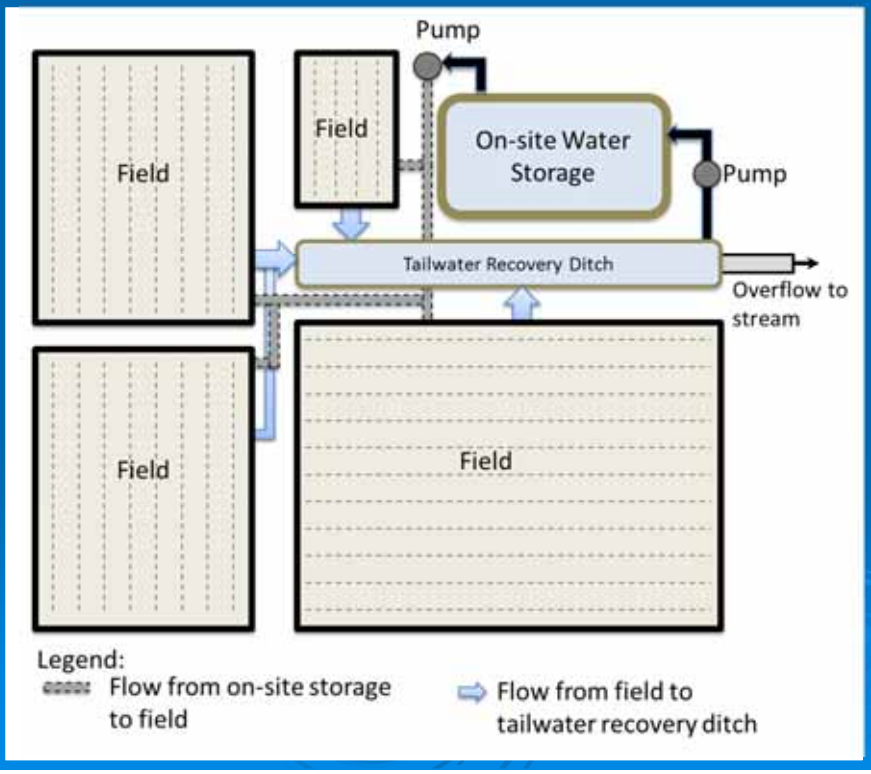
Introduction

- Ratio of 16 acres irrigated area : 1 acre reservoir
- Reservoir depth is 8 feet
- TWR ditch at 0.3 ac-ft. per acre, with minimum 10 ac-ft. of storage on any system
- 4 ft. berm and minimum 6” overflow pipe

Introduction



Introduction



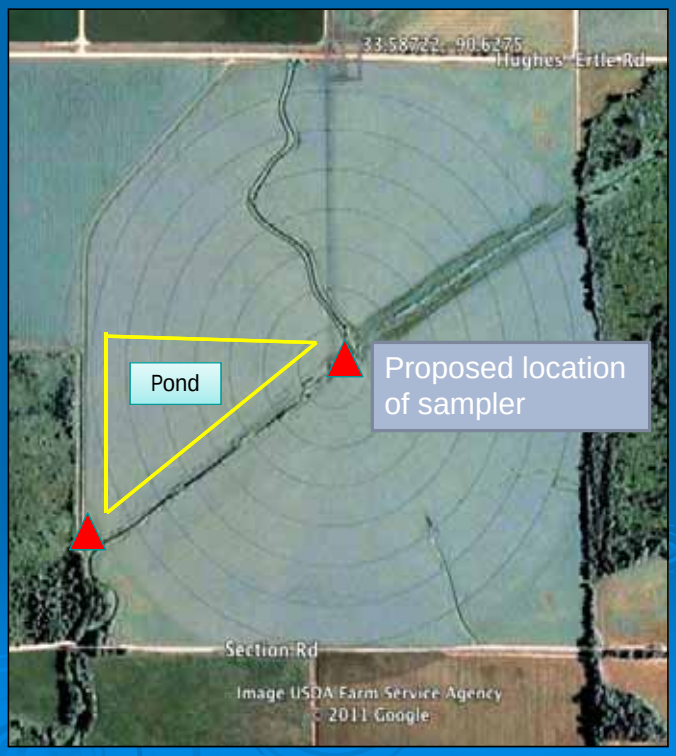
Methods

- Analyze for pH, conductivity, TSS, total nitrogen, ammonia, nitrite + nitrate, total phosphorus, and orthophosphate.
- Sample every 3 weeks March – Oct. and during rainfall events

Methods

- Installed water level sensor in each TWR ditch
- Each site will have a weather station
- Each site will be sampled at inlet(s), in TWR ditch, in reservoir, and at outlet.

Methods



Methods

- Have one year of streamflow data prior to installation of system at Metcalf/Britt site
- At least two additional systems were recently added in headwater area of Porter Bayou
- Lengthy history of record for flow at USGS gauge near watershed outlet
- Changes in streamflow before and after installation of system(s)?
- Cumulative effects on downstream volume as number of operational systems increases?

Preliminary Results

Expected Outcomes:

- Level of nutrient reduction that can be achieved by using a water storage system.
- Changes in stream flow patterns caused by the presence of water storage systems in the watershed. Information generated by this research will help assist in the placement of storage reservoirs.
- Farmers and landowners that are better informed of the water quality and quantity benefits of using on-farm storage systems.
- Students that are trained and educated in the area of water quality.

Preliminary Results

- Results from February 11, 2012 sampling date

Sample ID	DP-Ortho (mg/L)	TP-Ortho (mg/L)	TP-Org (mg/L)	NH3-N (mg/L)	TKN (mg/L)	TSS (mg/L)	Turbidity (NTU)
LB	0.000	0.000	0.000	0.006	0.000	0.0	0.0
M-Inlet	0.109	0.104	0.167	0.160	4.522	18.5	49.6
M-TWR	ND	0.203	0.238	0.353	3.593	597.5	771.8
M-Pond	ND	0.207	0.301	0.388	1.912	293.0	334.8
M-Outlet	ND	0.053	0.136	0.153	2.335	25.0	65.3
PF-Inlet 1	0.015	0.118	0.189	1.562	5.507	43.0	47.6
PF-Inlet 2	ND	0.091	0.243	0.267	3.474	82.0	81.0
PF-Y	0.088	0.201	0.277	0.489	5.881	61.5	104.3
PF-Pond	ND	0.344	0.466	0.425	9.927	1327.0	1279.8
PF-Outlet	ND	0.045	0.175	0.168	5.157	59.5	62.4

Long-term Goals

- Model watershed effects of on-farm storage systems and use models to target placement (AnnAGNPS, etc.)
- Collaboration with USDA-ARS Sed Lab in Oxford (Drs. Locke and Bingner)
- Continue to pursue funding for optimization and management improvements
- Cost:benefit?, economics?

Partners

- Mr. Boyer Britt and Mr. Walter Pitts
- Delta F.A.R.M.
- MS Department of Environmental Quality
- MS Wildlife Federation
- USDA-NRCS
- Yazoo MS Delta Joint Water Management District
- USDA-NIFA-NIWQ Program