



Development of Water Quality Standards for Willard Spur

Willard Spur Steering Committee

November 7, 2013



Agenda

- **Update on field conditions and sampling**
- **Update on Science Panel discussion regarding Nutrient Cycling Studies**
- **Path Forward**



9/29/2003
2011

Field Conditions 2013

How dry can it get?

OUTFALL-CNFL
MZ-IN-TAILRACE
OUTFALL-PE
IN-WB-TAILRACE

OUT-WB-TAILRACE

WS-2
WS1
WS-3

WS2

WS3

WS4

WS-6

WS5

Note: Image is from 2003

Image U.S. Geological Survey

Google earth

7306 ft

1993 OUT-HC-WMA-DD

Imagery Date: 8/31/2003 41°24'03.34" N 112°07'07.16" W elev 4208 ft eye alt 35782 ft

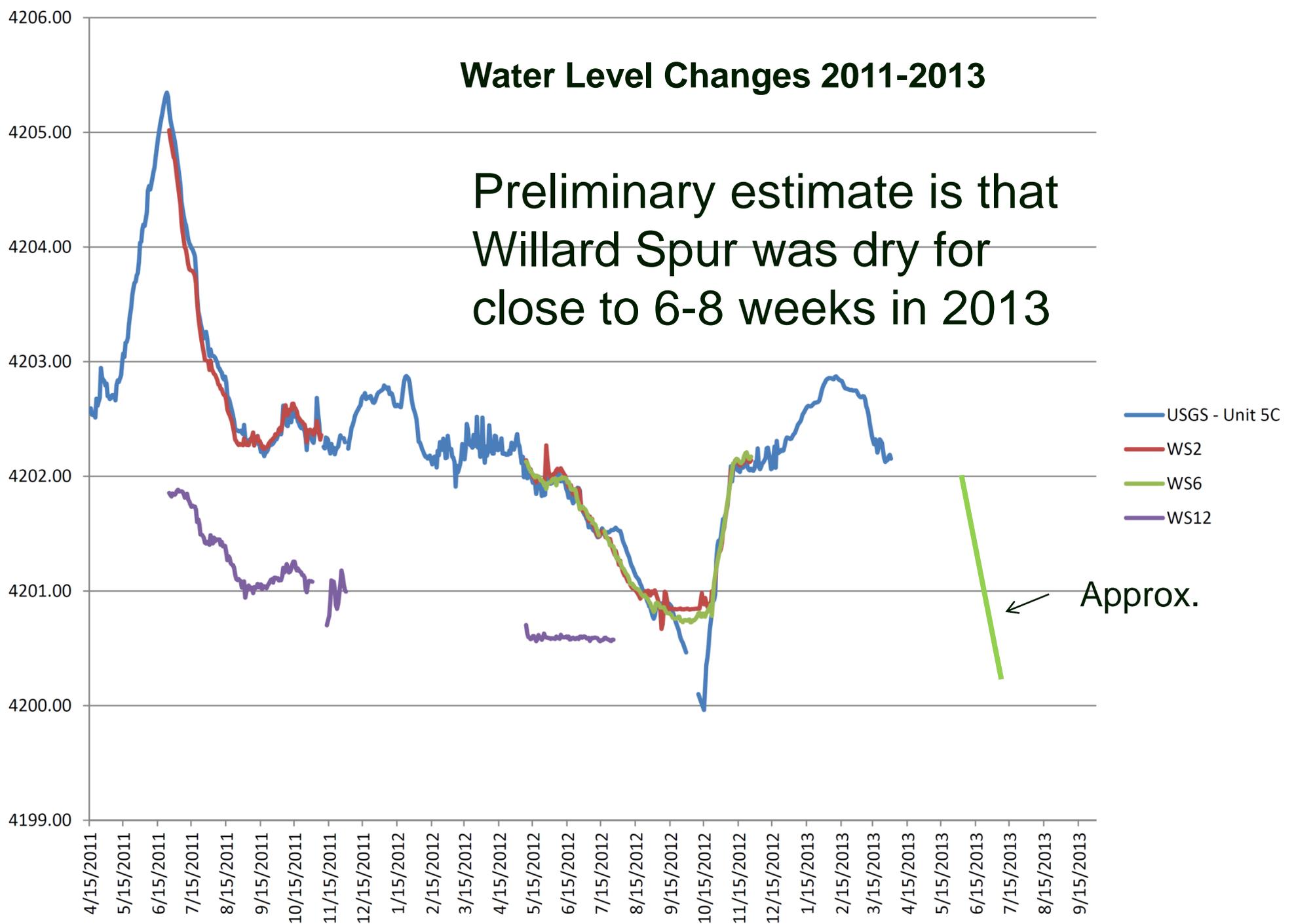
Update on Field Conditions

**Willard Spur was effectively dry
except near inflow points in 2013**



Water Level Changes 2011-2013

Preliminary estimate is that Willard Spur was dry for close to 6-8 weeks in 2013



Approx. ←

Looking E-SE

Willard Bay

Flow From
BRMBR



Aerial photos courtesy John
Luft/UDWR

Date taken: August 19, 2013



Looking S-SW

HCWMA

GSLM

Flow from
BRMBR

August 19, 2013



Looking W-SW

Willard
Bay

HCWMA

GSLM

August 19, 2013





- **Conditions on October 10, 2013**





- **Conditions on October 10, 2013**



Water from BRR-6
@ BRMBR

Water from Harold
Crane WMA

Water along
toe of Willard
Bay

Willard Spur
Open Water

BRMBR

Willard
Bay

Outlet Channel

Plant Outfall Pipeline

August 19, 2013





- **Conditions on October 10, 2013**



No water from BRR11/BRMBR

Water from tailrace is evaporating

Water at toe of Willard Bay

Location of Water on October 10, 2013

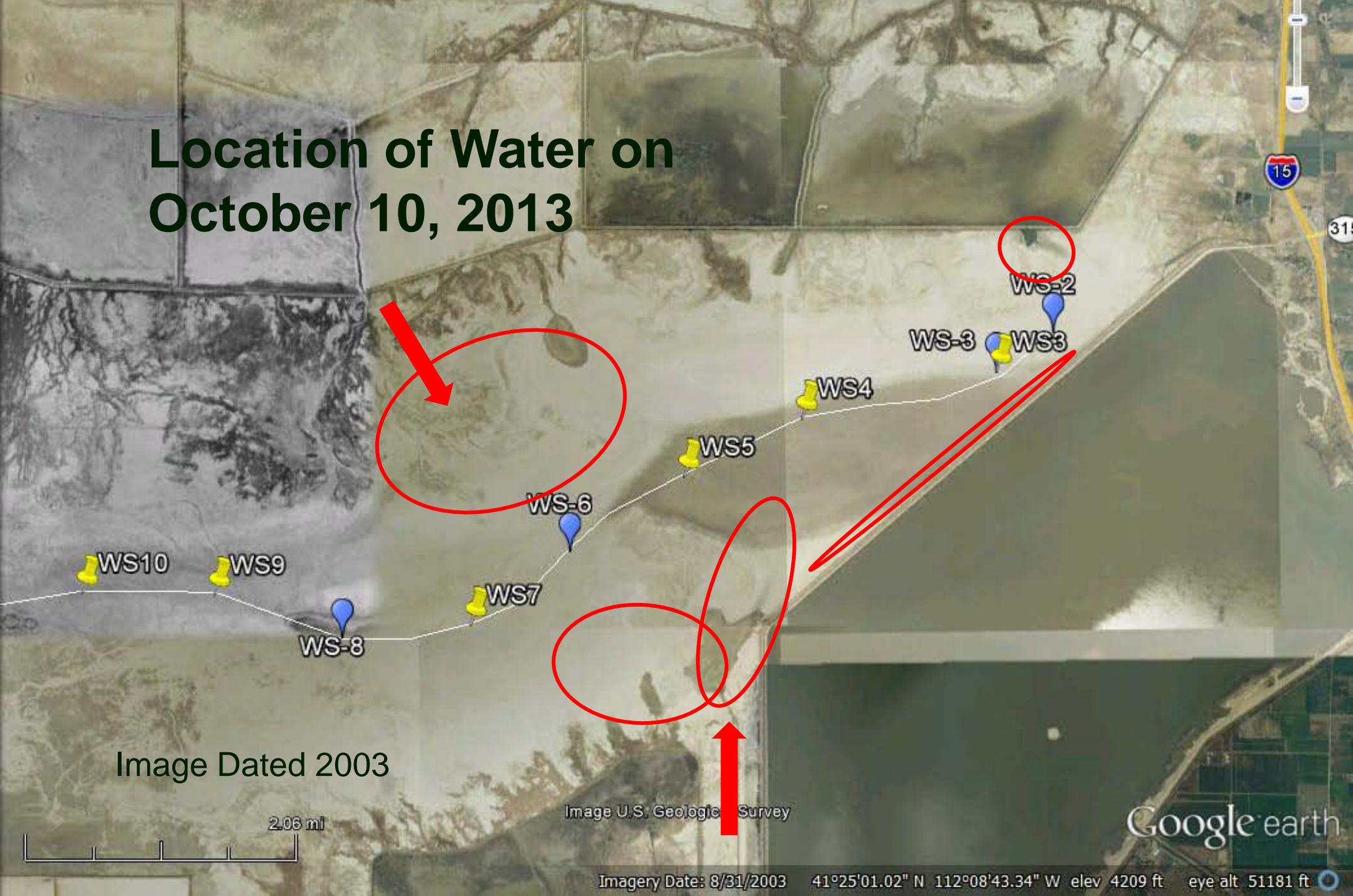


Image Dated 2003

2.06 mi

Image U.S. Geological Survey

Imagery Date: 8/31/2003 41°25'01.02" N 112°08'43.34" W elev 4209 ft eye alt 51181 ft

Google earth



How is 2013 different from 2012?

- **2013 Water levels appear to have been lower than 2012**
- **BRMBR water management different in 2013, currently releasing water to Willard Spur**
- **We saw flow from HCWMA in 2012 but not as much in 2013**



Next Steps in the field

- Bed Load Samplers at WS12



Next Steps

- Bed load samplers



Remnants of SAV/algae near
HCWMA



Next Steps in the Field

- **Final sampling event in November**
- **Will begin de-mobilization of inflow gauge stations in November/December**





Science Panel Meeting

October 30





Science Panel Meeting – October 30

- **Objectives:**

1. Review and discuss observations and preliminary results from nutrient cycling studies.
2. Provide feedback to PIs that will inform their final analyses/reports



UofU Nutrient Cycling Study

- **2013 Objectives**

1. Establish four new test plots

2. Water column nutrient addition

- *Suspending bags of fertilizer in the water column*
- *Goal is to observe response to various levels of nutrients in water column*



UofU Nutrient Cycling Study

- **Even with nutrient additions, there was not much of an increase in nutrient concentrations observed in water/sediment**
 - Perhaps because they are being absorbed rapidly within the plot?
- **Evidence that SAV were taking up added nutrients**

UofU Nutrient Cycling Study

- SAV started to senesce later than in 2012 but was done by early July, there was a difference between the treated/control sites

- High Plot
- Starboard (Inside the Plot)

- High Plot
- Port (Outside the Plot)

But what does this mean?

Photos: Joel Pierson

UofU Nutrient Cycling Study

- Different species of SAV than in 2012
- Epiphytes were not as dominant as 2012
- BDS was much more significant than in 2012
- SAV seemed to respond to nutrient additions
- Algae seemed to respond after SAV had senesced, perhaps internal cycling?
- Experiment was complete in July

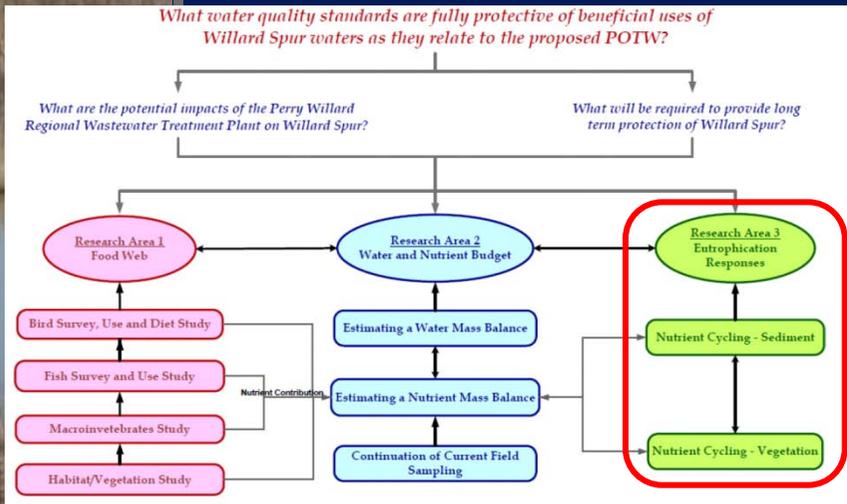
Key questions for all GSL wetlands

UofU Test Plots

UofU Microcosms

DWQ Mesocosms

- How does Willard Spur respond to nutrients?
- What are the assimilation rates for nutrients?
- Where do the nutrients go?



In-situ Nutrient Fluxes

- What is the rate of nutrient uptake just from the water and sediment?



Water column chamber- closed at the bottom

Sediment chamber- open at the bottom

A slow speed submersible pump was used to mix the water column to create well mixed conditions. Care was taken as not to disturb the sediments

In-situ Nutrient Fluxes

- Experiments were successful
- Nutrient uptake rates for water column and sediment are being developed for comparison with DWQ's mesocosm studies

UofU Nutrient Cycling Study

- **Next steps:**
 - Still waiting on results showing how nutrients were taken up by SAV in the plots
 - Evaluating 2013 datasets
 - Draft report by December 15, 2013 for 2013 studies

DWQ Mesocosm Study

- Key questions
 - *What are the uptake rates within Willard Spur? Are they different over time?*
 - *How do plants/algae influence uptake rates and ecosystem processes?*
 - *Where do the nutrients go in a closed system?*



Experimental Design

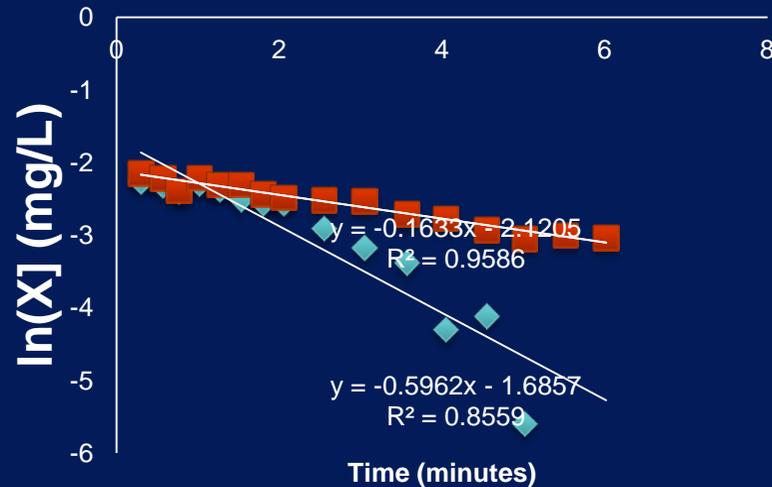


- Addition of nitrate and phosphorous
- Treatments
 - SAV removal (clear phase)
 - With and without mats (green phase)
- 6 hours in duration
 - 15 minute sample interval (first 2 hours)
 - 30 minute interval (last 4 hours)
- Sondes for several days (DO, pH, temperature and cond)
- Nighttime experiments (green period, open water only)
- Repeated for tailrace ~1 week following discharge



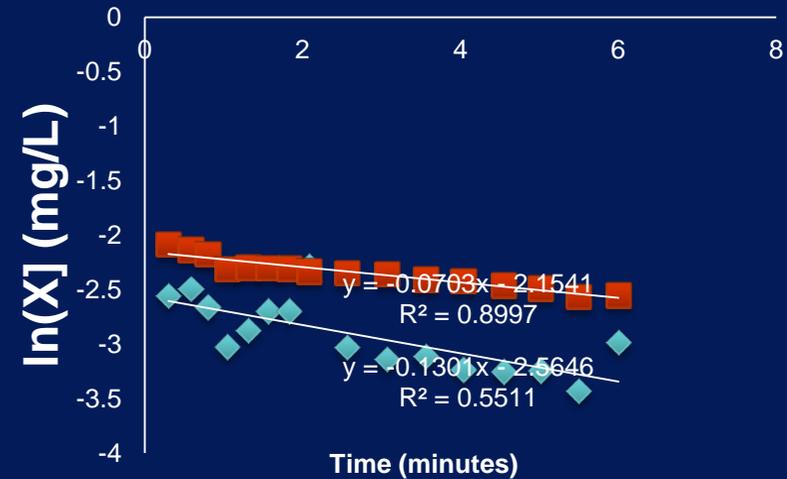
DWQ Mesocosm Study

+SAVA



With SAV

-SAVE



W/O SAV

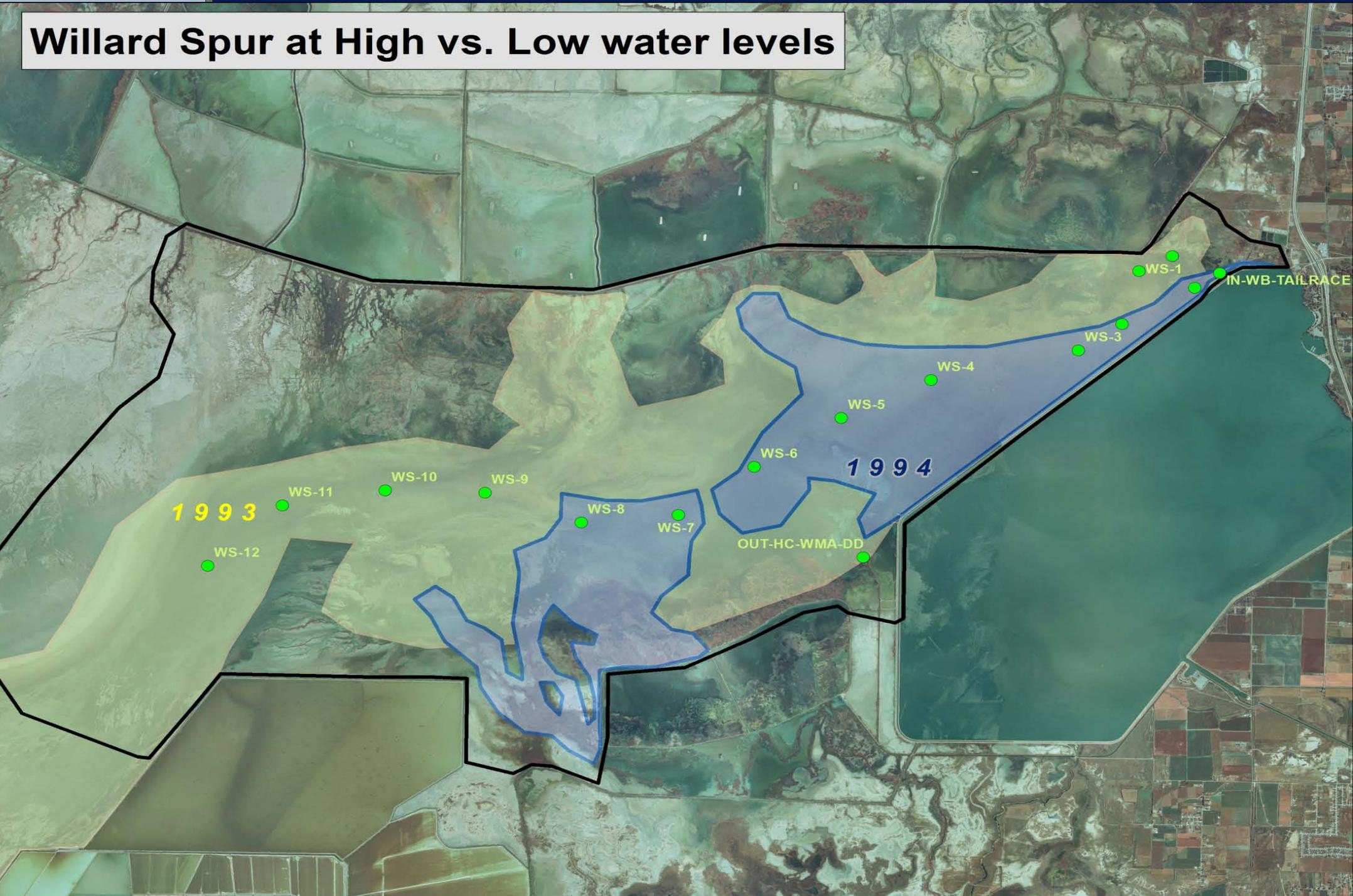


DWQ Mesocosm Study

- **What did we learn?**
 - **SAV play a significant role in assimilating nutrients in Willard Spur**
 - **Developing estimates for nutrient uptake**
 - **Significant uptake capacity in Willard Spur**



Willard Spur at High vs. Low water levels



Gross Uptake: Willard Spur



Control

SRP = ~4,500-15,000 lbs/day

NO₃ = ~123,000-428,000 lbs/day

Max 2011 load TN = 18,895 lbs/day

Max 2011 load TP = 2,487 lbs/day

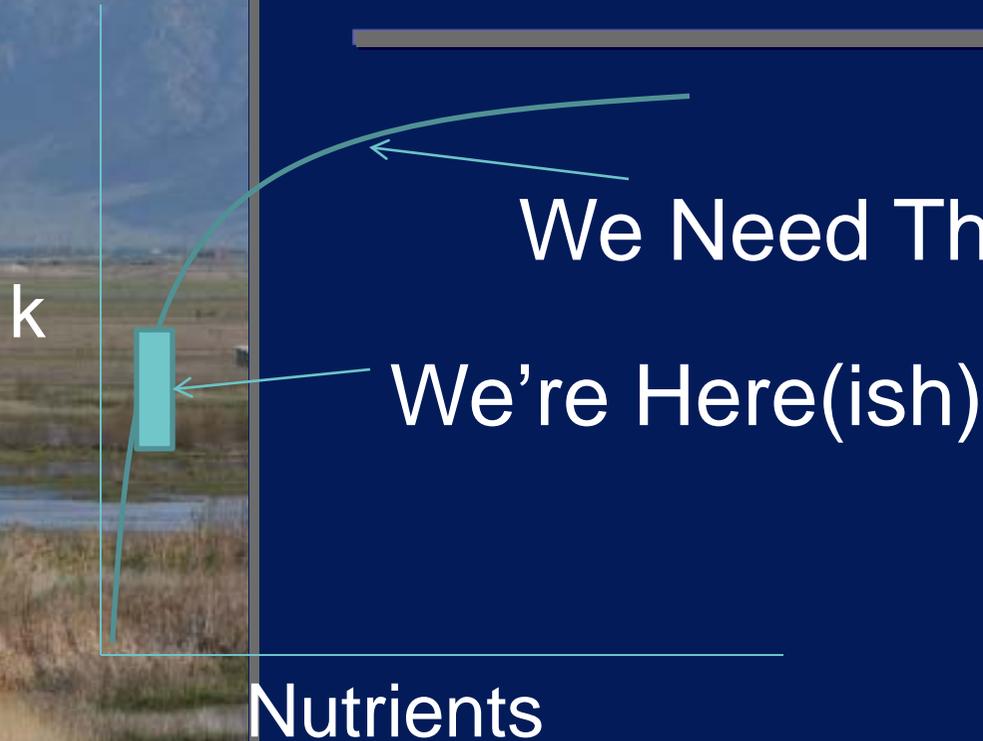


Treatment

SRP = ~2,800-9,900 lbs/day

NO₃ = ~45,000-157,000 lbs/day

Caveats and Next Steps



- **K estimates were based on daytime uptake at one concentration**
 - anchor based on clear and green conditions
 - scale with CPP and CR to extrapolate or model k-max
- **Biological retention is temporary**
 - important differences between algae and macrophytes
- **Need to compare with load estimates**



What about Plant Operations and Impacts?



Plant Operations & Impacts

1. Plant will not discharge to outfall ditch in the future
2. State park lagoons leak to the south, no flow to the west
3. Most of the flow at phragmites is likely irrigation return flow



Google Earth





BRMBR



Did/does the Plant contribute to the phragmites patch?



August 16, 1993



July 15, 1997



July 27, 2002



November 2, 2002



August 24, 2004



July 31, 2006



June 26, 2009



August 11, 2011

FIGURE 1
Time Lapse Aerial Imagery of Irrigation/Plant Outfall Site





Plant Operations & Impacts

- **April 2011 – October 2012**
 - Outfall Ditch **Didn't reach open water July - October**
- **October – December 2012**
 - Willard Bay outlet Channel
- **December 2012 – August 2013**
 - Private wetlands
- **August 2013 – present**
 - Willard Bay outlet channel





Plant Operations & Impacts

- **Plant will discharge to its new pipeline**
- **Private property owner may divert flow as needed onto wetlands**
 - Goal is to irrigate, improve salinity, and improve hay yields
 - Does the flow reach Willard Spur? Or does it evaporate during the critical, dry months?



8/19/2013 11:28:00 am



OUTFALL-CNFL

ACTIVE LOG 006
ACTIVE LOG 006

ACTIVE LOG 005
ACTIVE LOG 012

ACTIVE LOG 001

ACTIVE LOG 012

ACTIVE LOG 013

ACTIVE LOG 007

ACTIVE LOG 007

Water Sample from West End

ACTIVE LOG 008

ACTIVE LOG 009

ACTIVE LOG 011

ACTIVE LOG 011

1274 ft



1993

Google earth

Imagery Date: 8/11/2011 41°25'17.81" N 112°04'16.88" W elev 4230 ft eye alt 9716 ft

Willard Spur
Open Water

BRMBR

Willard
Bay

Water isn't
reaching the
open water
via mudflat

Outlet Channel

Plant Outfall Pipeline



Plant Operations & Impacts

Sediment Sampling



Google earth

Imagery Date: 8/11/2011 41°25'25.24" N 112°04'30.30" W elev 4230 ft eye alt 11704 ft



Plant Impacts

- How much of the nutrient load from the outlet channel flows into Willard Spur?
 - Mesocosm study will help us understand this



October 24, 2013

October 2, 2013

Questions?

Photos at WS6, Courtesy DWQ