

# TSSD Utah Lake Solutions: Geochemistry

*Science Panel Coordination Meeting*

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ULWQS TSSD Limnocorral Study

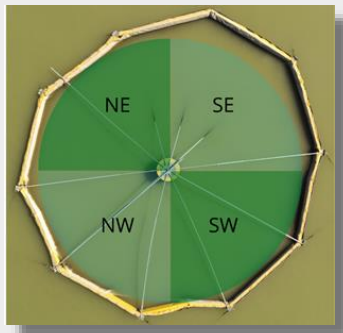
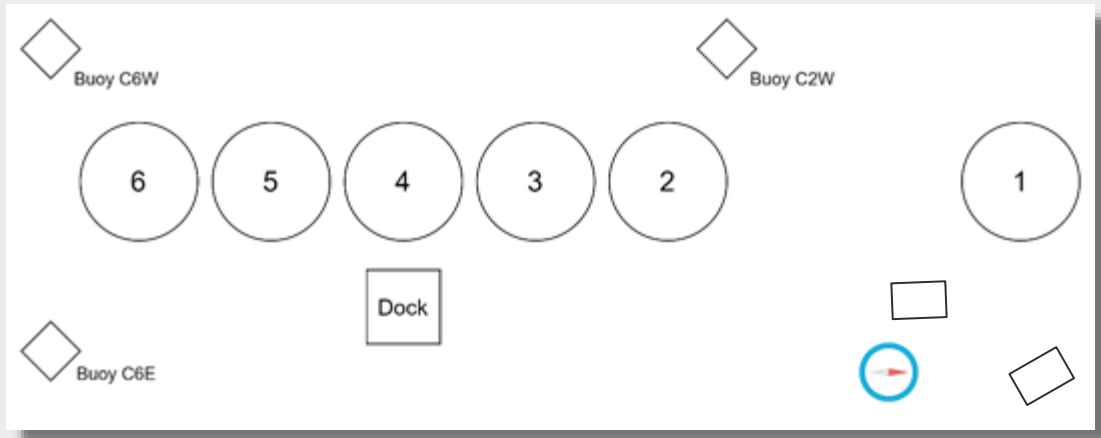




# Project Background

ULWQS TSSD Linnocorral Study





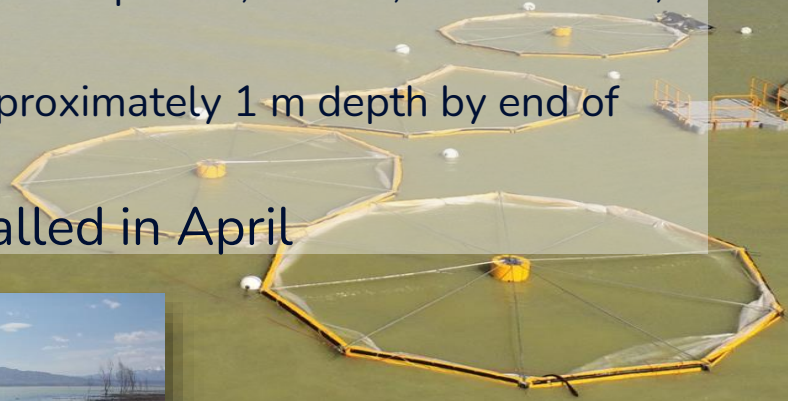
Corral and Exclosure Layout

## Corral Location



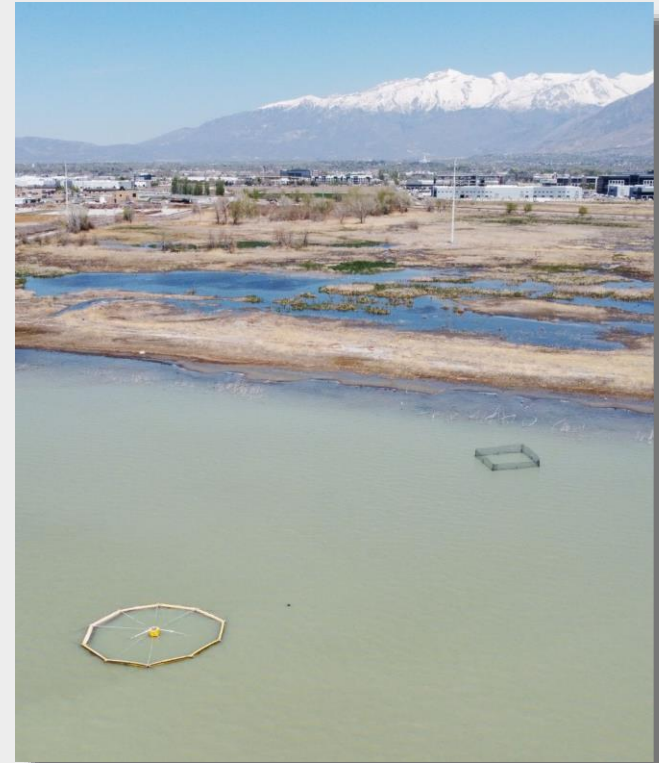
# Methods

- Using Limnocorrals to produce isolated mesocosms
  - Experimental containments where we can control various parameters but retain the complexity of the Lake
  - 10 m in diameter, at 2 m depth  $\sim 1,900 \text{ m}^3$ ,  $\sim 1.9\text{e}6$  liters, or  $\sim 500,000$  gallons.
    - Decreased to approximately 1 m depth by end of summer
- Constructed and installed in April



# Limnocorrals

- Installed 6 limnocorrals and 2 carp exclosures
- Limnocorrals used for geochemical and ecological studies



# Sampling Overview

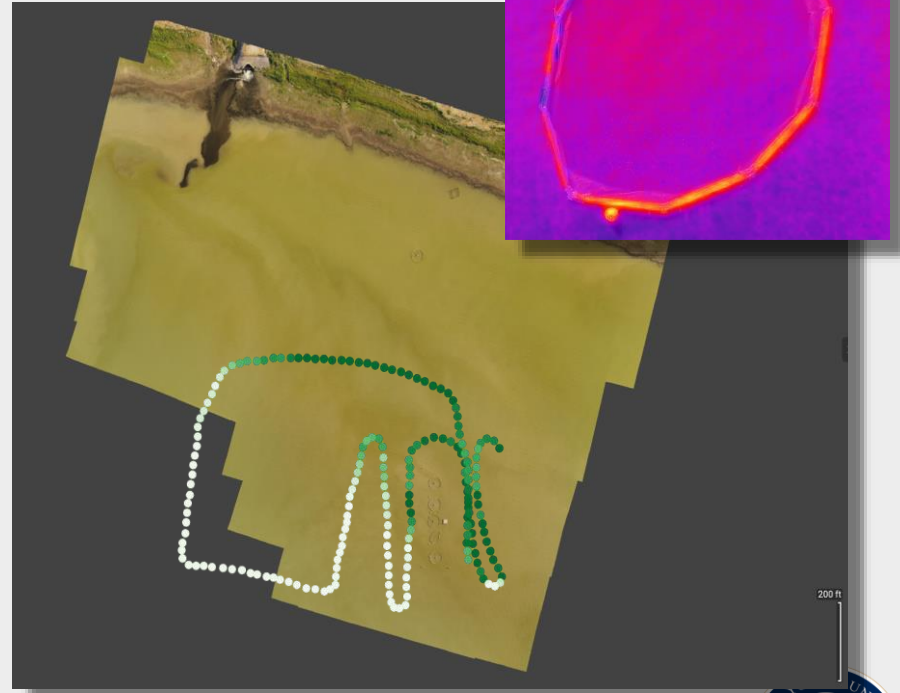


ULWQS TSSD Linnocorral Study



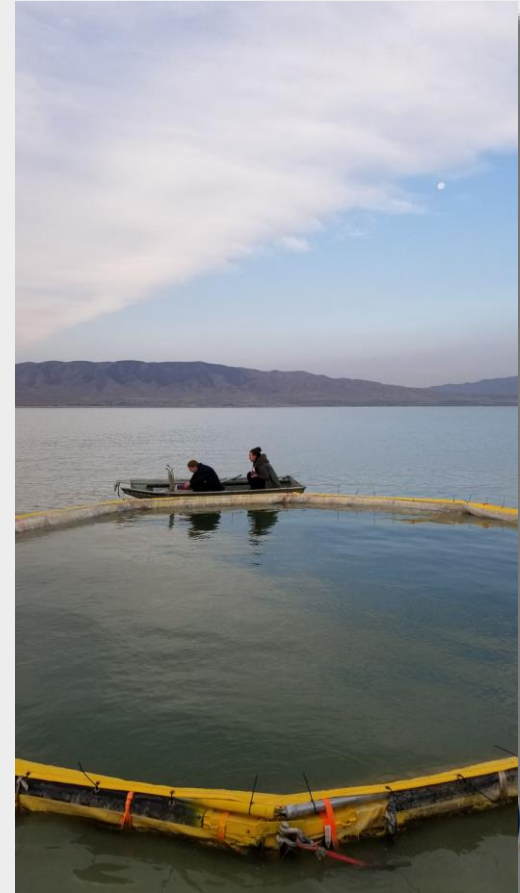
# Field Procedures (summary)

- Both water and probe samples
- Water samples
  - 1 per corral
  - At least 1 lake sample per trip
  - At least 1 trip sample (bottle blank) per trip
  - 1 field duplicate per trip
- Probe Samples
  - Vertical profiles
    - 1 in each corral in quadrant with water sample
    - 1 lake profile
    - readings ~1 cm
  - 1 reading in each of the other 3 quadrants
    - approximately 0.5 m depth
  - Data tracks
    - Surface tracks around corrals
- Aerial Photos
  - Visual
    - ~400 feet - all corrals
    - ~20 feet - single corral
  - Thermal Images
  - Gridded flights to accompany probe data tracks



# Water Samples - Field methods summary

- Sampled at “elbow depth” following State SOP
  - Same place on every trip: SW quadrant of corral or buoy for lake sample
  - Rinsed sample bottle 3 times - dump outside corral
  - Rinsed dip sampler 1 time
  - New pre-labeled bottle for each trip - no bottle reuse
- Field blank
  - Deionized water from the lab, filled sample bottle at the location of the last field sample
- Samples placed on ice in cooler
- Tested or frozen within 48 hours



# Probe Samples - Field methods summary

- YSI Sondes
  - Barometer, Conductivity, Specific Conductivity, Salinity, nLF conductivity, TDS, Temperature, resistivity, Sigma-T, Sigma, Chlorophyll (rfu), Chlorophyll (ug/l), PC (rfu), PC (ug/l), Turbidity, TSS, DO (% sat), DO (mg/l), Pressure (depth), pH, ORP
  - Calibrated weekly
  - Used probe extenders to take samples near center of corral
  - Allowed probes to equilibrate for 5 minutes before reading
  - Visually watched probe readings to identify any anomalies and re-sample

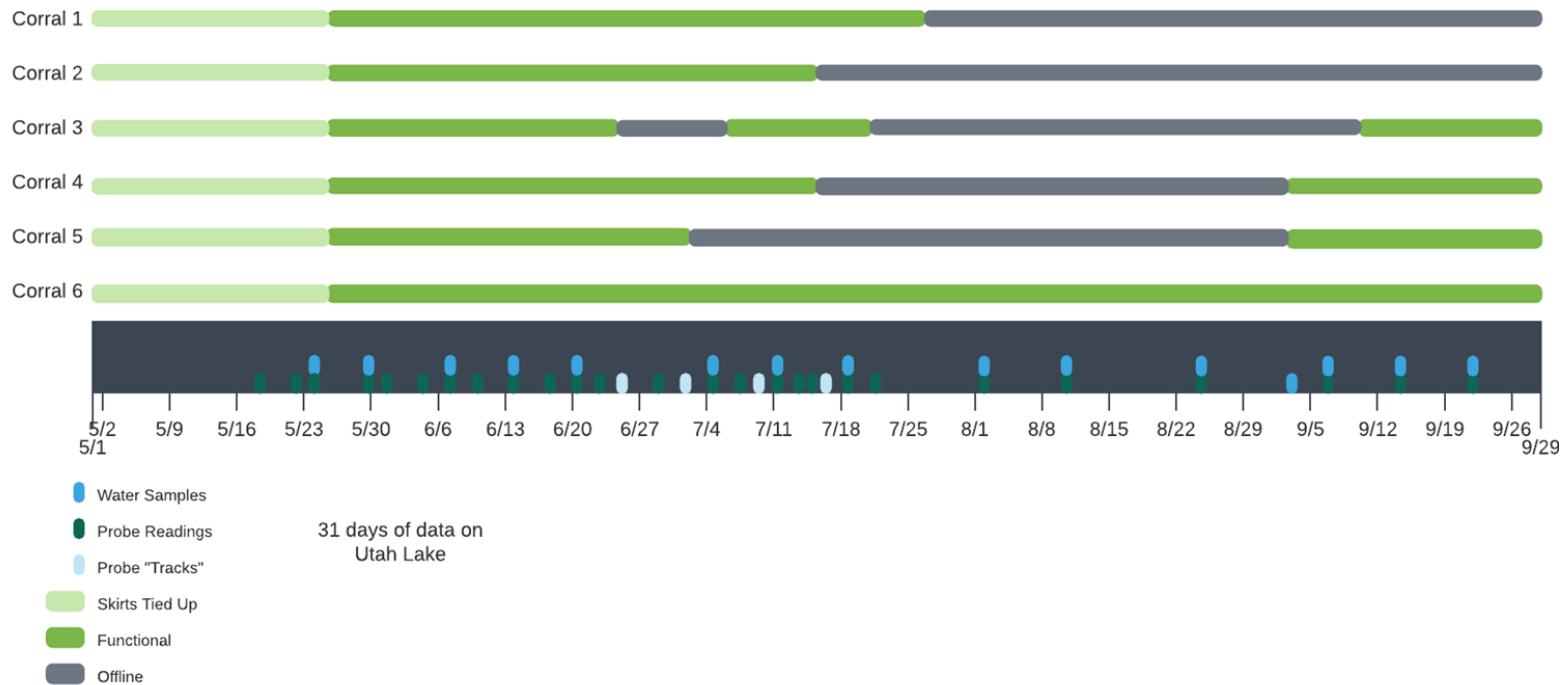




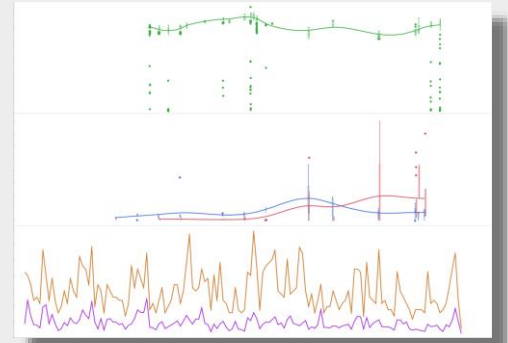
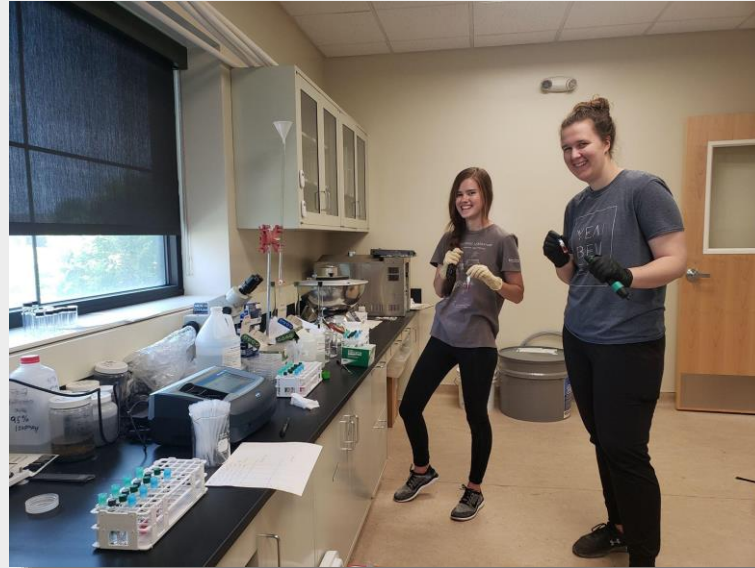
# Sampling Schedule



# Corral and Sampling Schedule

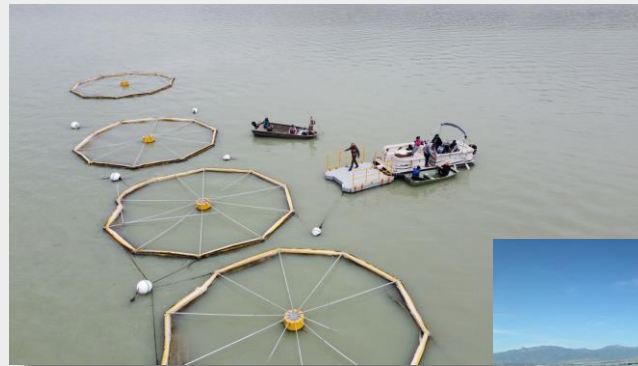


# Analytes and Data



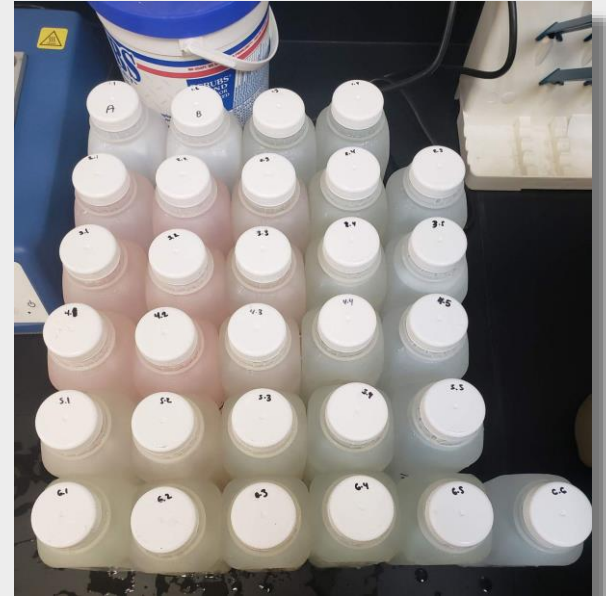
# Sample Overview

- 126 total water samples
- 153,327 probe data points
- Additional water samples (not included in total)
  - jar tests, filter tests, etc
- Cost of analysis: ~\$67/sample
  - not including labor
- Unfiltered and filtered samples:
  - ICP, Reactive P, TOC
  - Filter sizes: 1.5um, 0.7um, 0.45um
- 163,104 total data points
  - including probe data



# Analytes and Number of Samples

- Used 4 different laboratories and probes
- TSSD lab - certified
  - Nitrite, Nitrate, Ammonia, Reactive P, Total P, Total Nitrogen, COD, TSS, VSS, TDS, TOC
- BYU Environmental Analytical Lab
  - ICP at ppb - Aluminum, Arsenic, Boron, Barium, Calcium, Cadmium, Cobalt, Chromium, Copper, Iron, Potassium, Magnesium, Manganese, Molybdenum, Sodium, Nickel, Phosphorus, Lead, Sulfur, Selenium, Silicon, Strontium, Titanium, Vanadium, Zinc
  - Reactive Phosphorus
- BYU Geology lab
  - Ion Chromatograph - PO<sub>4</sub>, Chloride, Nitrate, Fluoride, and Sulfate
    - Original and diluted samples
- BYU Environmental Engineering Lab
  - Rhodamine (for dilution experiments)
- YSI ProDSS Multiparameter Water Sondes
  - Barometer, Conductivity, Specific Conductivity, Salinity, nLF conductivity, TDS, Temperature, Resistivity, Sigma-T, Sigma, Chlorophyll (RFU), Chlorophyll (ug/l), PC (RFU), PC (ug/l), Turbidity, TSS, DO (% sat), DO (mg/l), Pressure (depth), pH, ORP



# TSSD

Parameter	# of data points
Nitrite (NO2-N)	124
Nitrate (NO3-N)	124
Ammonia (NH4-N)	124
Unfiltered Reactive P (PO4-P)	124
Filtered Reactive P (PO4-P)	102
Total P (P)	116
Total Nitrogen	16
COD	95
TSS	95
VSS	95
TDS	95
TOC	56

# YSI Sondes

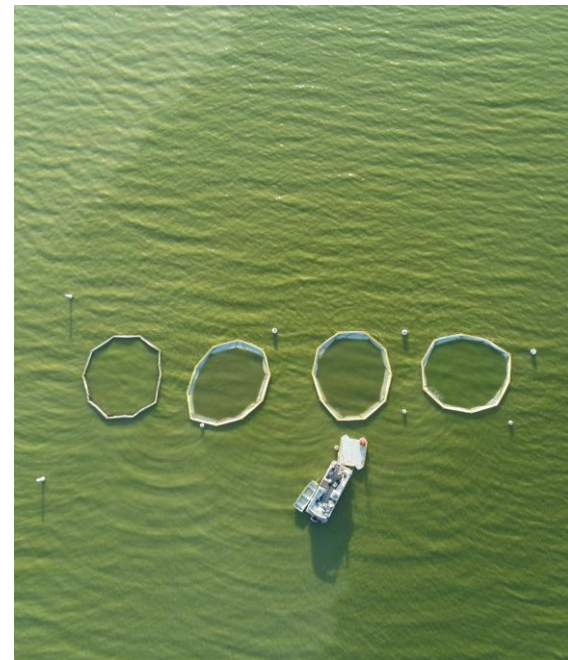
Parameter	# of data points
Barometer	9546
Conductivity (µS/cm)	9546
Sp Conductivity (µS/cm)	9546
Sal (psu)	9546
nLFCond (µS/cm)	9546
TDS (mg/L)	9546
Temp (F)	9546
Resistivity (ohms-cm)	9546
Sigma-T (s t)	9546
Sigma (s)	9546
Chlorophyll (RFU)	5229
Chlorophyll (µg/L)	5229
PC (RFU)	5229
PC (µg/L)	5229
Turbidity (FNU)	3466
TSS (mg/L)	3466
ODO (% Saturation)	5229
ODO (mg/L)	5229
Pressure (psi a)	9546
pH	3084
pH (mV)	3084
ORP (mV)	3847

# BYU Environmental Analytical Lab

Parameter	# of data points
Al1670-Digested	169
Al1670-Filtered	169
As1890-Digested	169
As1890-Filtered	169
B_2497-Digested	169
B_2497-Filtered	169
Ba4554-Digested	169
Ba4554-Filtered	169
Ca3179-Digested	169
Ca3179-Filtered	169
Cd2265-Digested	169
Cd2265-Filtered	169
Co2286-Digested	169
Co2286-Filtered	169
Cr2835-Digested	169
Cr2835-Filtered	169
Cu3247-Digested	169
Cu3247-Filtered	169
Fe2382-Digested	169
Fe2382-Filtered	169
K_7664-Digested	169
K_7664-Filtered	169
Mg2852-Digested	169
Mg2852-Filtered	169
Mn2576-Digested	169
Mn2576-Filtered	169

Parameter	# of data points
Chloride	29
Nitrate	29
Fluoride	29
Sulfate	29
Phosphate	29

Parameter	# of data points
Mo2020-Digested	169
Mo2020-Filtered	169
Na5895-Digested	169
Na5895-Filtered	169
Ni2316-Digested	169
Ni2316-Filtered	169
P-1782-Digested	169
P-1782-Filtered	169
Pb2203-Digested	169
Pb2203-Filtered	169
S-1820-Digested	169
S-1820-Filtered	169
Se1960-Digested	169
Se1960-Filtered	169
Si2516-Digested	169
Si2516-Filtered	169
Sr4077-Digested	169
Sr4077-Filtered	169
Ti3088-Digested	169
Ti3088-Filtered	169
V_3093-Digested	169
V_3093-Filtered	169
Zn2138-Digested	169
Zn2138-Filtered	169
PO4-P (Lachate)	16



163,104+ datapoints on Utah Lake 05/25-09/27

BYU TSSD Limnocorral Study



# Laboratory QA/QC

- TSSD - per trip
  - Bottle blanks
  - Laboratory blanks (DI water)
  - Standards
    - Nitrate, Nitrite, Ammonia, Total P, Reactive P, COD
  - OPR (recovery)
    - Nitrate, Nitrite, Ammonia, Total P, Reactive P
  - A spike and A spike duplicate
    - Nitrate, Nitrite, Ammonia, Total P, Reactive P, COD
- ICP
  - Calibration standard (calibrate instrument for run)
  - Plant Check or Probe Check standard
  - Nano-pure water samples dispersed in tray
  - Re-read calibration standard every 15 samples to determine pass/fail



# Corral Behavior

A photograph taken from the perspective of someone on a pontoon boat. In the foreground, the grey vinyl seating and metal railings of the boat are visible. Two people are standing on a small wooden platform or deck in the middle of the water. The person on the left is wearing a dark t-shirt with the number '18' on the back. The person on the right is wearing a blue shirt. They are looking towards a large, rectangular floating structure in the water, which appears to be a corral or a large net. The water is calm with some ripples. In the background, there are blue mountains under a clear blue sky with a bright sun in the upper left corner, creating a lens flare effect. The overall scene is bright and sunny.

# Rhodamine Dilution Experiment



Corrals did not fully mix until the next day--the dye was only mixing with the top foot of water

No way to get background levels for successive days, so varying background fluorescence levels may have interfered with this data

Rhodamine degrades in sunlight

Significantly higher turbidity in Corral 6 may have interfered with color and sorption of dye



