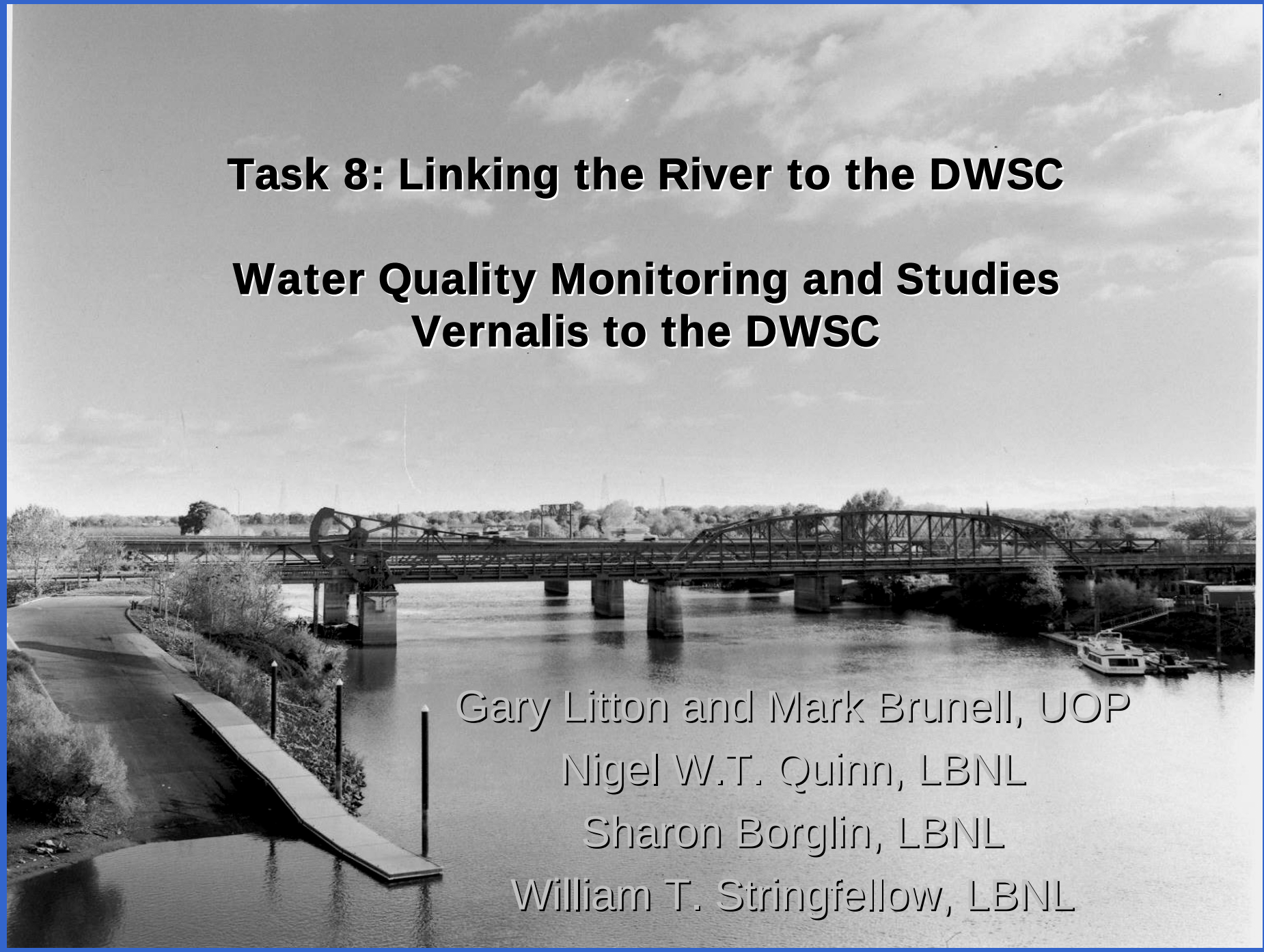
Upstream Studies Linking the San Joaquin River to the Deep Water Channel

Gary Litton and Mark Brunell

UOP



Task 8: Linking the River to the DWSC

Water Quality Monitoring and Studies
Vernalis to the DWSC

Gary Litton and Mark Brunell, UOP
Nigel W.T. Quinn, LBNL
Sharon Borglin, LBNL
William T. Stringfellow, LBNL

Motivation

- Chlorophyll *a* model prediction is 3x the measured chl *a* concentration at Channel Point using Mossdale input.[1]
- Model DO is approximately 2 mg/L less than observations at Channel Point.[1]
- Contradictory data for algal growth and decay between Vernalis and the DWSC.[2,3,4]
- Significant loss of algal biomass below Vernalis [1,3]

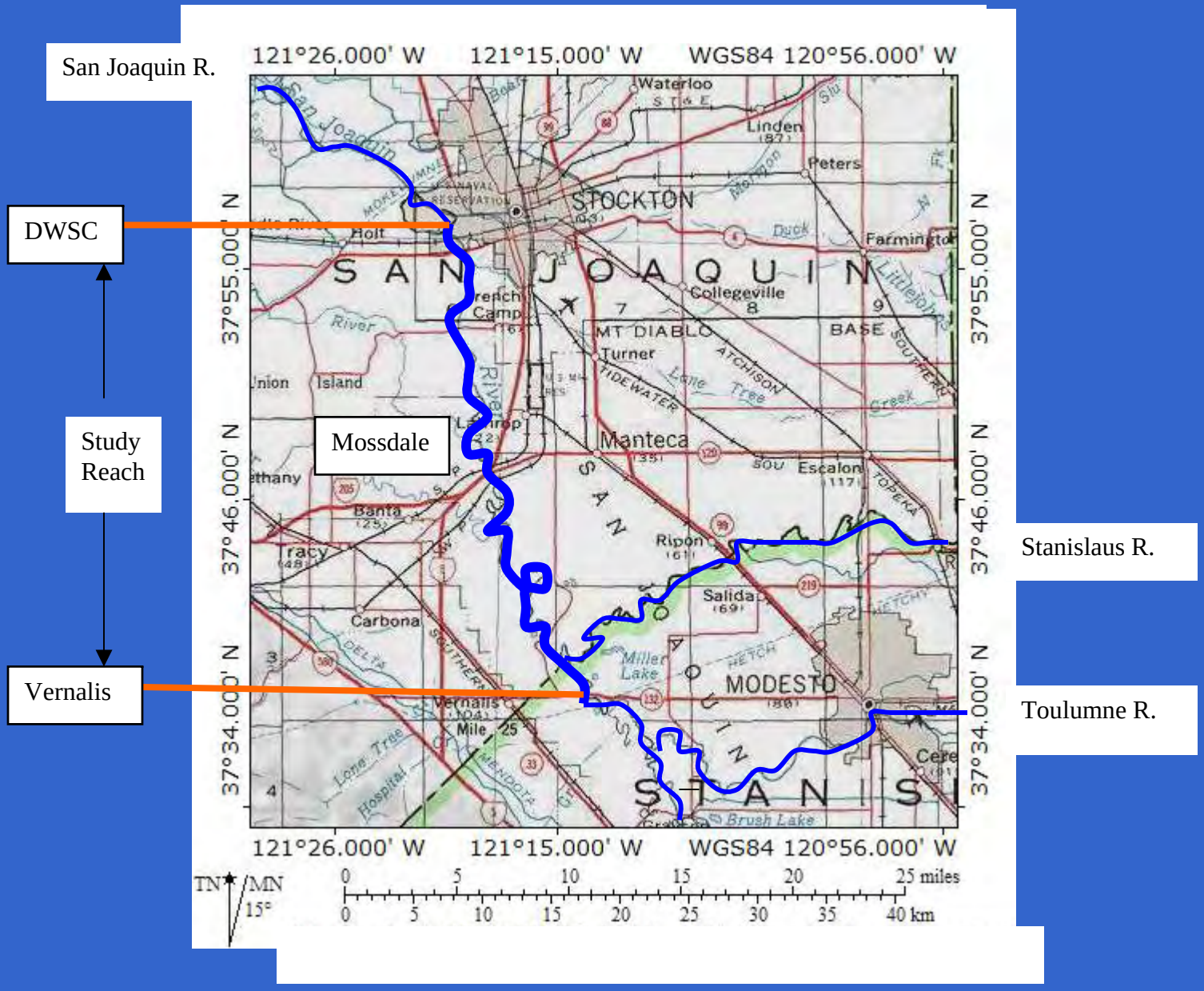
[1]Jones & Stokes, 2002. *Evaluation of Stockton Deep Water Ship Channel Model Simulations of 2001 Conditions: Loading Estimates and Model Sensitivity*, Prepared for the CALFED Bay-Delta Program 2001 Grant 01-N61, Sacramento, CA

[2]Jones & Stokes, 1998. *Potential solutions for achieving the San Joaquin River dissolved oxygen objectives*. Prepared for the City of Stockton Department of Municipal Utilities, Sacramento, CA.

[3]Lehman, P., 2001. *The Contribution of Algal Biomass to Oxygen Demand in the San Joaquin River Deep Water Channel*, Final Draft Report, San Joaquin River Dissolved Oxygen TMDL Steering Committee, Department of Water Resources, Central District, Sacramento, CA.

[4]Foe, C., M. Gowdy, and M. McCarthy, 2002. Draft Strawman Allocation of Responsibility Report, California Regional Water Quality Control Board, Central Valley Region, January, Sacramento, CA.

Task 8 Study Location



Objectives

- Quantify oxygen demands entering the DWSC.
- Characterize the growth and decay of algae from Vernalis to the DWSC.
- Identify and enumerate algal species in an effort establish sources of different species and their fate along the river.
- Assess algal losses associated with grazing of zooplankton and benthic macroinvertebrates.
- Estimate BOD decay and nitrification rates.
- Estimate losses of organic matter associated with settling and agricultural diversions.
- Provide a comprehensive data set for model calibration upstream of the DWSC.

Approach Overview

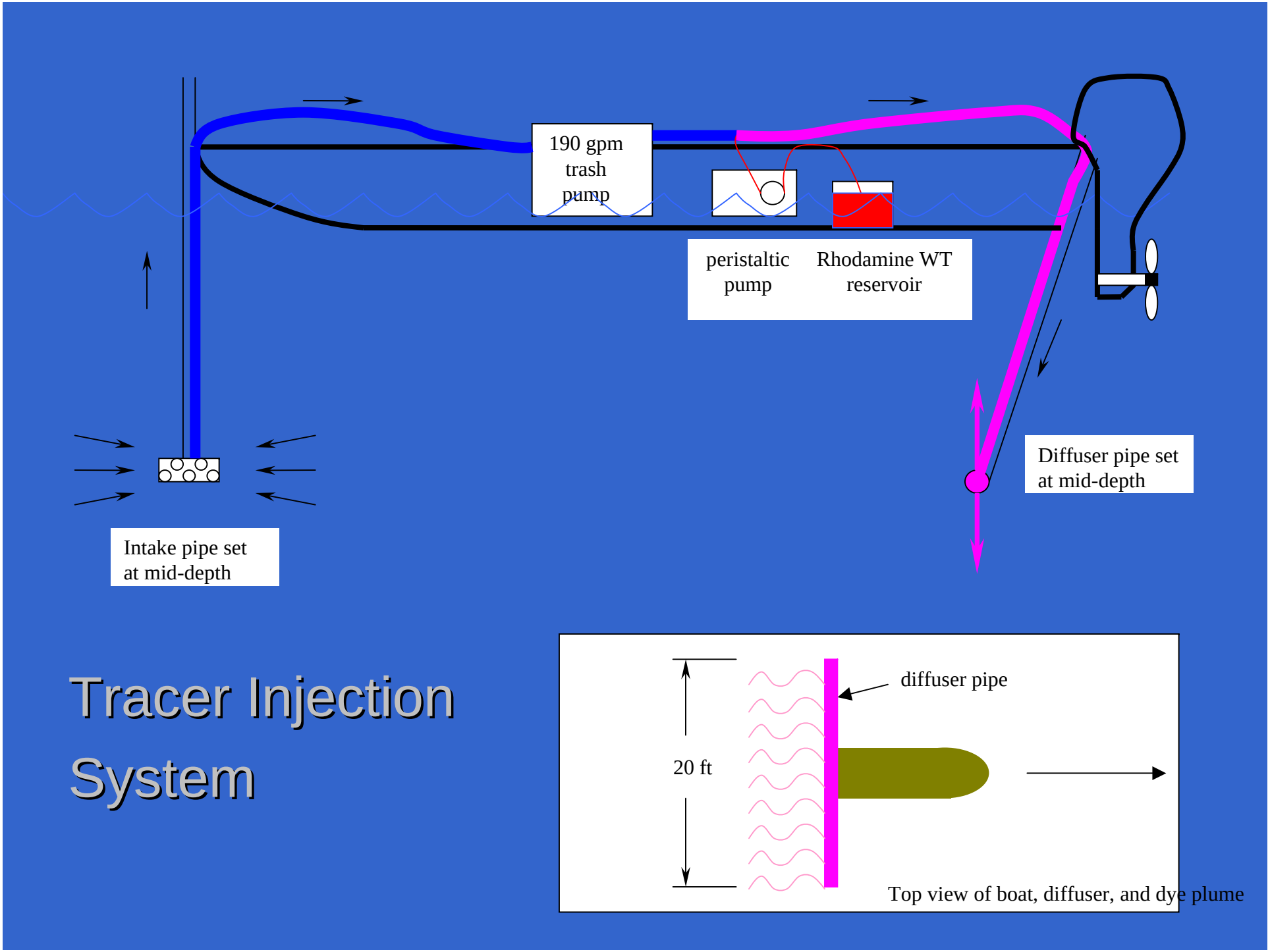
- Track a slug of water (Lagrangian monitoring) to assess the mass losses of a conservative tracer and reactive substances (i.e., chlorophyll, pheophytin, BOD, ammonia).
- Deploy three continuous monitoring stations at fixed locations for extended periods (≈7 days).
- Augment field work with laboratory measurement of BOD decay and nitrification kinetics.
- Assess algal productivity with field light/dark bottle experiments.
- Assess algal grazing

Water Quality Parameters

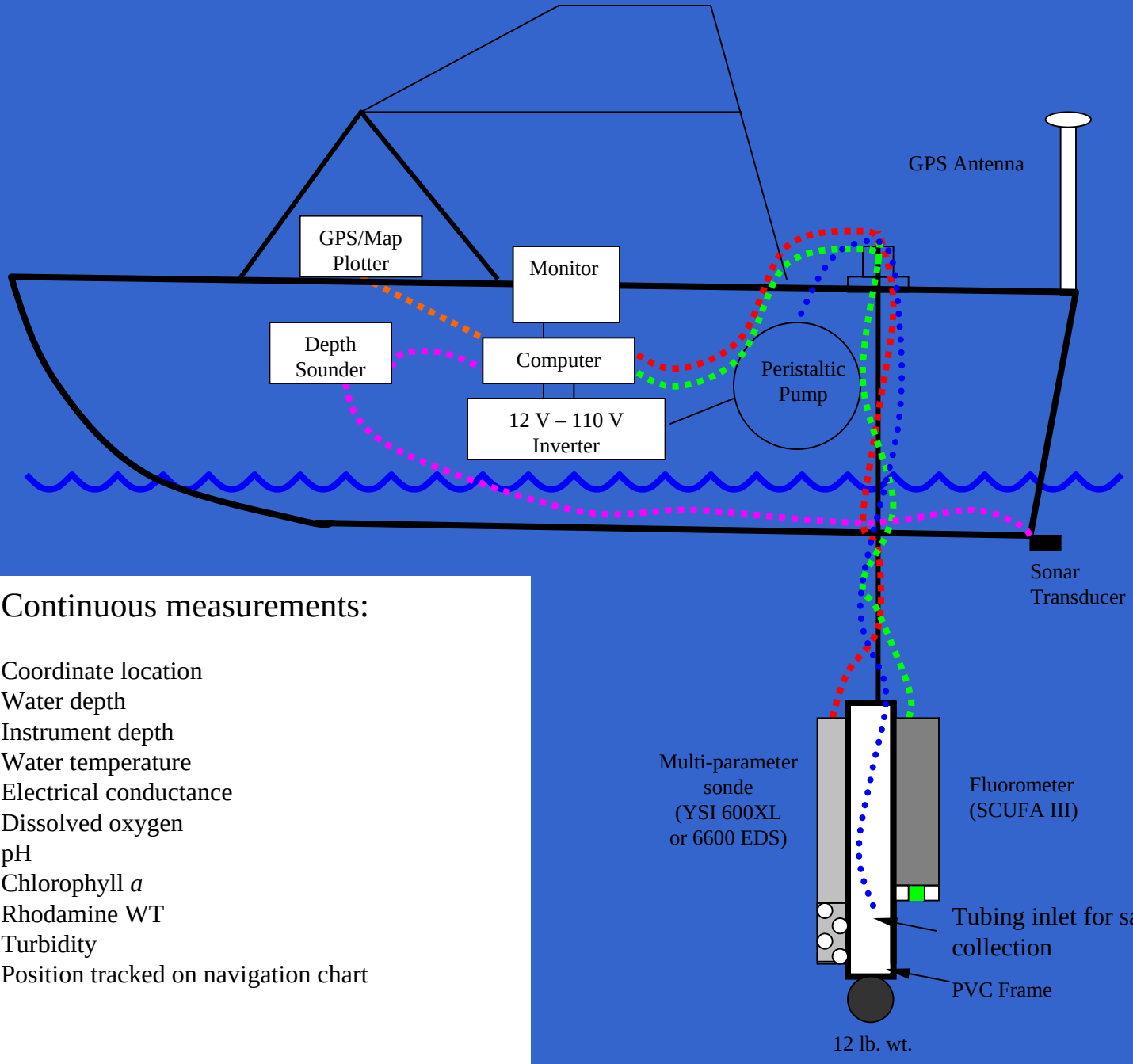
- Continuous/instantaneous field measurements:
  - Fixed stations: temp, DO, chl a, EC, pH, turbidity
  - Lagrangian: + rhodamine WT, water depth, location
  - Light intensity profiles (discrete measurements)
- Laboratory measurements:
  - VSS, TSS, chl *a*, ph *a*, BOD, CBOD
  - N-series: TKN, total NH_3, NO_2, NO_3
  - Nitrification kinetics

Lagrangian Monitoring

-Inject tracer and track between Vernalis and the DWSC
-Measure water quality parameters within plume to assess changes in chlorophyll *a*, pheophytin *a*, DO, BOD, VSS, etc.
-Monitor tracer mass to assess dispersion characteristics and losses with agricultural diversions.



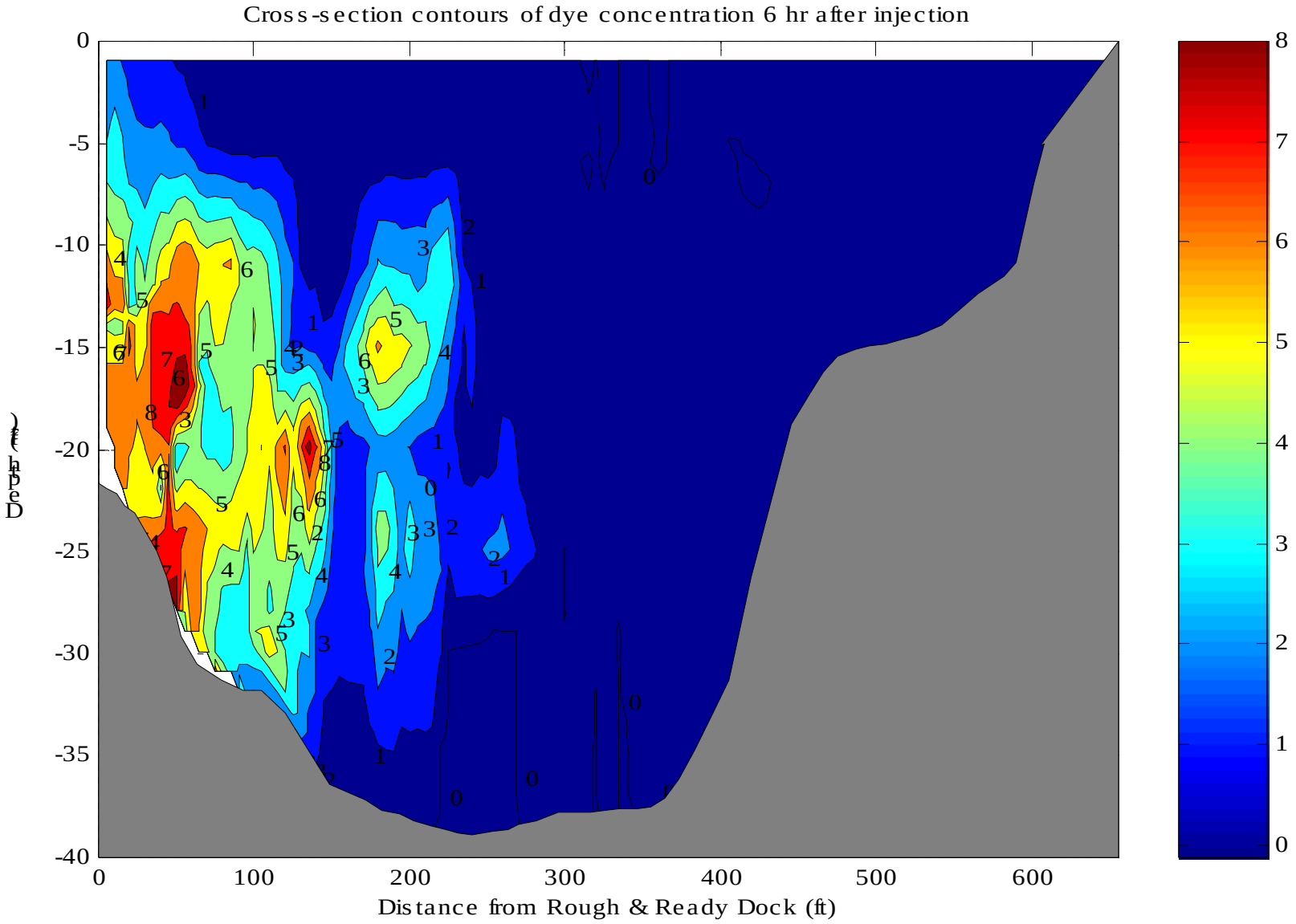
Tracer Injection System



Continuous measurements:

Coordinate location
Water depth
Instrument depth
Water temperature
Electrical conductance
Dissolved oxygen
pH
Chlorophyll *a*
Rhodamine WT
Turbidity
Position tracked on navigation chart

Rhodamine WT Contours in the DWSC



Upstream Grazing Study

- Purpose:
  - Determination of the magnitude and diversity of the grazing community, thereby suggesting an influence on the algal community

Grazing Study Objectives

- Zooplankton diversity and abundance
  - Species identifications
  - Estimates of biomass based on length-weight regression analysis and/or biovolumes
  - Grazing impact based on known clearance rates for algae

Zooplankton Sampling

- Sampling will coincide with Lagrangian monitoring.
  - 5 month period (June – October), approximately 4 - 5 consecutive days per month.
  - Two water samples taken each day, therefore ~50 samples.
- At each sampling event, samples will be taken from a range of depths and combined.

Zooplankton Sampling

- Macro- and Mesozooplankton:
  - Schindler-Patalas trap fitted with 160um mesh.
- Microzooplankton:
  - Water pumped from bottom to surface, collected in carboy.
- ID and counting:
  - Zooplankton settled in Utermohl chambers and enumerated with Inverted microscope

Grazing Study Objectives

- Benthic macroinvertebrates
  - Sediment samples for clams, etc., especially the introduced *Corbicula fluminea*.
  - Estimates of diversity, abundance, and biomass
  - Estimation of grazing impact by applying known clearance rates

Benthic Sampling

- Samples taken from 10 fixed stations spaced 3 miles apart
- Samples taken once per month over 5 month period (June – October), therefore ~50 samples taken

Benthic Sampling

- Sediment sampled with Ponar Grab sampler
- Sieving and washing of sediment samples
- Preservation and ID

Expected Outcomes

- Develop a mechanistic understanding of algal growth and decay from Vernalis to the DWSC and associated oxygen demands.
- Estimate the relative contributions of grazing, decay, diversion, and settling to algal losses.
- Development of a comprehensive data set for model calibration.

Anticipated Deliverables

- Comprehensive data set for model calibration
- River bathymetry / influence on algal decay
- Longitudinal dispersion characterization
- Agricultural exports/imports
- Net particulate setting rates
- Longitudinal BOD and CBOD decay
- Nitrification kinetics
- Algal growth/decay rates
- Algal productivity-light intensity curves