OVERVIEW OF SCIENCE PANEL-APPROVED MATERIALS

Utah Lake Water Quality Study
Steering Committee Meeting
June 4, 2020

GOALS

- Review and update on Strategic Research Plan
- Review and strive to approve Littoral Sediment RFP
- Review and strive to approve C, N, and P budget work plan
- Update on calcite P binding RFP development

SCIENCE PANEL RESEARCH PRIORITIES AND STRATEGIC RESEARCH PLAN

Utah Lake Water Quality Study—Strategic Research Plan

DRAFT

May 22, 2020
Version 4.1

PRESENTED TO

Utah Department of Environmental Quality
Division of Water Quality
PO Box 144870
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PREPARED BY

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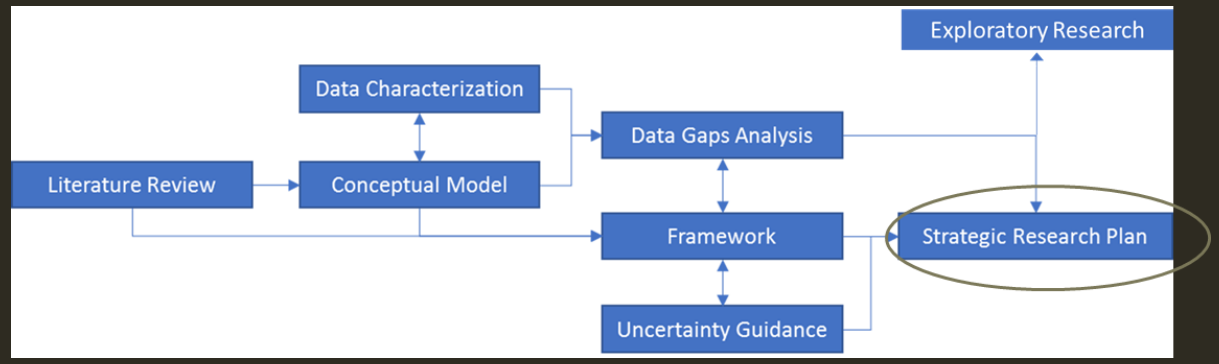
UTAH DEPARTMENT of ENVIRONMENTAL QUALITY

STRATEGIC RESEARCH PLANNING REMINDER

- Workplan (Task 6)
- Develop SRP to:
  - Fill knowledge gaps
  - Identify studies to address initial charge questions and strengthen conceptual model
  - Include problem statement, objectives and approaches
- Exploratory Research Plan: First three RFPs – ignite research actions
- SRP: Current RFPs (Littoral Sediment, CNP Budgets and Calcite P) and Future Work

STRATEGIC RESEARCH PLAN OVERVIEW

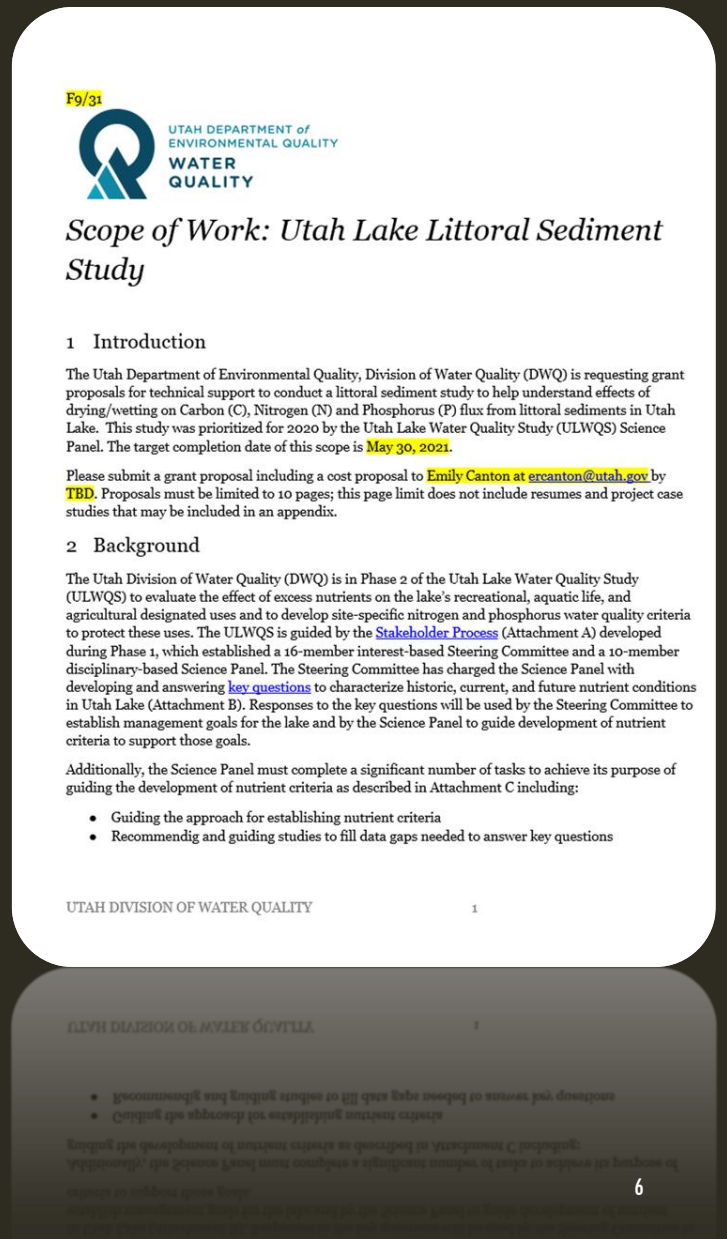
- Introduction: Process, ongoing research
- Mapped charge questions and NNC development needs to existing work
- Summarized research needs
- Laid out research priorities
- Voted to rank – then moved to RFPs



Questions		Being addressed
1.1. What does the diatom community and macrophyte community in the paleo record tell us about the historical trophic state and nutrient regime of the lake?		Partially
	i. Can diatom (benthic and planktonic) and/or macrophyte extent or presence be detected in sediment cores? And if so, what are they?	Paleo RFP
	ii. What were the environmental requirements for diatoms and extant macrophyte species?	No
	iii. How have environmental conditions changed over time?	Data analysis
1.2. What were the historic phosphorus, nitrogen, and silicon concentrations as depicted by sediment cores? (add calcium, iron, and potentially N and P isotopes)		Paleo RFP
1.3. What information do paleo records (eDNA/scales) provide on the population trajectory/growth of carp over time? What information do the paleo records provide on the historical relationship between carp and the trophic state and nutrient regime of the lake?		No
1.4. What do photopigments and DNA in the paleo record tell us about the historical water quality, trophic state, and nutrient regime of the lake?		Paleo RFP

RFP DEVELOPMENT

- Littoral Sediment C, N and P stock and flux
- C, N, and P mass balance: external and internal
- Calcite – P binding
- N-fixation – working with Aanderud lab



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UTAH DEPARTMENT of ENVIRONMENTAL QUALITY
WATER QUALITY

Scope of Work: Utah Lake Littoral Sediment Study

1 Introduction

The Utah Department of Environmental Quality, Division of Water Quality (DWQ) is requesting grant proposals for technical support to conduct a littoral sediment study to help understand effects of drying/wetting on Carbon (C), Nitrogen (N) and Phosphorus (P) flux from littoral sediments in Utah Lake. This study was prioritized for 2020 by the Utah Lake Water Quality Study (ULWQS) Science Panel. The target completion date of this scope is May 30, 2021.

Please submit a grant proposal including a cost proposal to Emily Canton at ercanton@utah.gov by TBD. Proposals must be limited to 10 pages; this page limit does not include resumes and project case studies that may be included in an appendix.

2 Background

The Utah Division of Water Quality (DWQ) is in Phase 2 of the Utah Lake Water Quality Study (ULWQS) to evaluate the effect of excess nutrients on the lake's recreational, aquatic life, and agricultural designated uses and to develop site-specific nitrogen and phosphorus water quality criteria to protect these uses. The ULWQS is guided by the Stakeholder Process (Attachment A) developed during Phase 1, which established a 16-member interest-based Steering Committee and a 10-member disciplinary-based Science Panel. The Steering Committee has charged the Science Panel with developing and answering key questions to characterize historic, current, and future nutrient conditions in Utah Lake (Attachment B). Responses to the key questions will be used by the Steering Committee to establish management goals for the lake and by the Science Panel to guide development of nutrient criteria to support those goals.

Additionally, the Science Panel must complete a significant number of tasks to achieve its purpose of guiding the development of nutrient criteria as described in Attachment C including:

- Guiding the approach for establishing nutrient criteria
- Recommendig and guiding studies to fill data gaps needed to answer key questions

UTAH DIVISION OF WATER QUALITY 1

REMAINING PRIORITIES

- SP Prioritization Effort
- Pursued RFPs for the highest priority elements and littoral sediments
- The SRP "closes the loop" on the remainder
- Reference for future RFP planning and development

	Research ideas	Mean Ranking - Feb 2020	
1	**How large is internal vs external loading (how long would recovery take?)**	**2.3**	✓
2	**Sediment budgets (C, N, and P; nutrient flux chambers)**	**3.6**	✓
3	**Calcite scavenging (how bioavailable is SRP – does bioassay address?)**	**4.3**	✓
4	**Adding modules to the WQ models (sediment diagenesis, calcite scavenging)**	**4.3**	
5	Carp effects on nutrient cycling	7.3	
6	Lake level (effect on macrophytes)	9.2	
7	Bioassays that incorporate sediment (next phase mesocosms)	9.4	
8	Macrophyte recovery potential (Provo Bay demo)	10.0	
9	Lake-level effects on biogeochemistry and nutrient cycling	10.2	✓
10	Environmental controls on toxin production	11.1	
11	Turbidity effect on primary producers	11.2	
12	Resuspension rates from bioturbation	11.7	
13	Carp effects on zooplankton (and does this influence algal response)	11.8	
14	Carp effects on macrophytes	12.1	
15	Toxin Production and N Species	13.7	
16	Recreational surveys	13.8	
17	Macrophyte role (to biogeochemistry)	14.0	
18	Additional atmospheric deposition data	14.6	
19	Alternative models (PCLake – cyano/macrophyte state change)	14.9	

SRP SECTION 4.2 – SPECIFIC RESEARCH PROJECTS

- Lays out strategic research elements for the 19 research priorities
  - Problem Statement
  - Existing Data and Information
  - Objectives
  - Expected Outcome/Outputs
  - Capacity to Address with Mesocosms

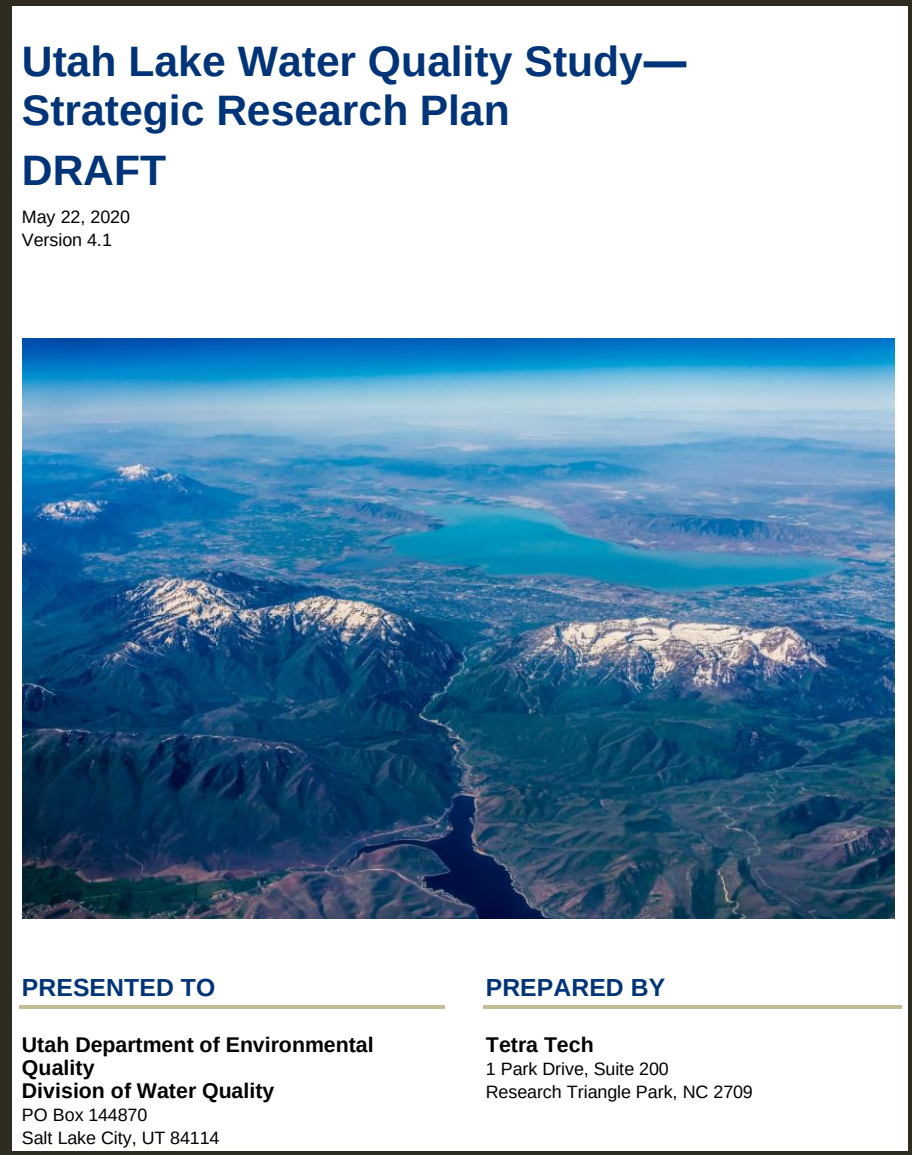
- Does not include approach – to be determined when they become future RFPs

MESOCOSM OPPORTUNITIES

- Mesocosms could address many areas
  - Calcite Binding
  - Carp Effects – turbidity, zooplankton, macrophytes
  - Macrophyte recovery/effects – turbidity, biogeochemistry
  - Lake Level
  - Bioassay Gen 2
  - Turbidity effects on primary producers
  - Toxin controls
- To help SP communication with TSSD planning
- Highlighted in SRP

PROCESS TO FINALIZE

- ~~Complete identifying projects (DONE)~~
- ~~Draft RFP elements (DONE)~~
- Develop RFP components – iterate
  - SP Finalizes RFPs (Littoral, CNP done; Calcite doing)
  - SP Finalizes SRP
- Complete RFPs/SRP
  - RFPs to SC for approval (Littoral, CNP, Calcite doing)
  - RFPs out for bid (Littoral, CNP soon, Calcite later)
  - SRP to SC for approval (Summer)



QUESTIONS/DISCUSSION

LITTORAL SEDIMENT RFP

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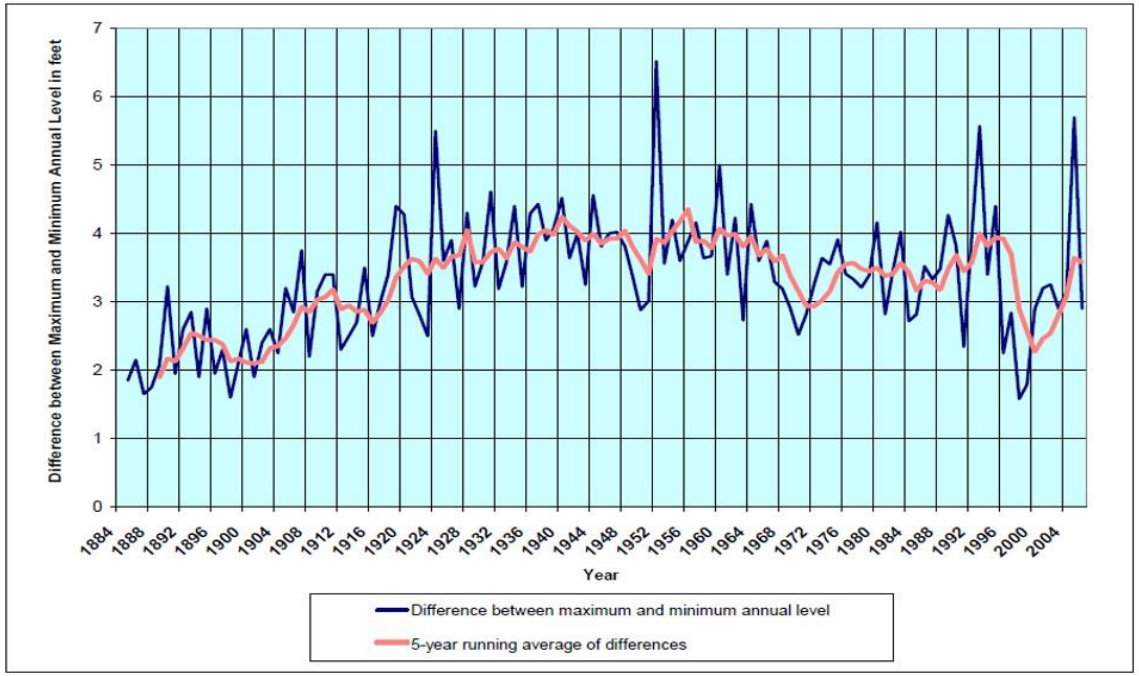
LITTORAL SEDIMENT RFP

- Lake level fluctuates
- Drying = Aeration
- Aeration = Transformation
- Lake level effect on nutrient cycling?
  - Substantial literature evidence for this effect
  - May be both a sink or source of nutrients



LITTORAL SEDIMENT RFP

- Objectives:
  - Review literature on drying effects
  - Measure spatial and temporal extent of drying
  - Measure relationship of drying (duration) and sediment characteristics to rate and magnitude of C, N and P fluxes and oxygen demand
  - Compare the fluxes to other loads

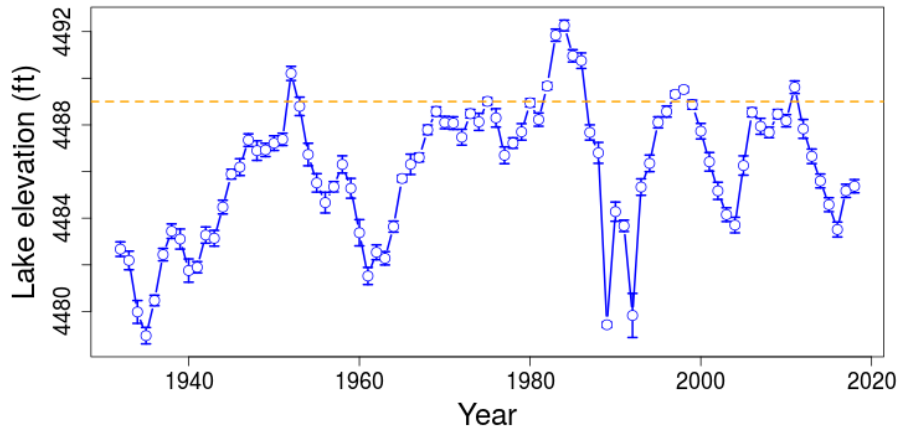
- Outcomes:
  - Literature Review
  - Quantitative relationships linking drying to fluxes
  - Technical Report

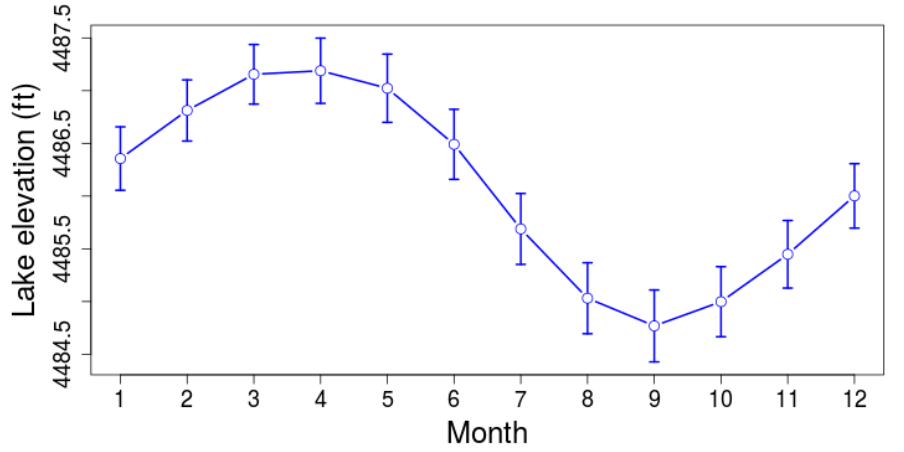
LITTORAL SEDIMENT RFP

- Tasks

1. Lit review (context) and lake level evaluation (quantify extent)

2. Sampling and analysis plan (QC on methods/approach)





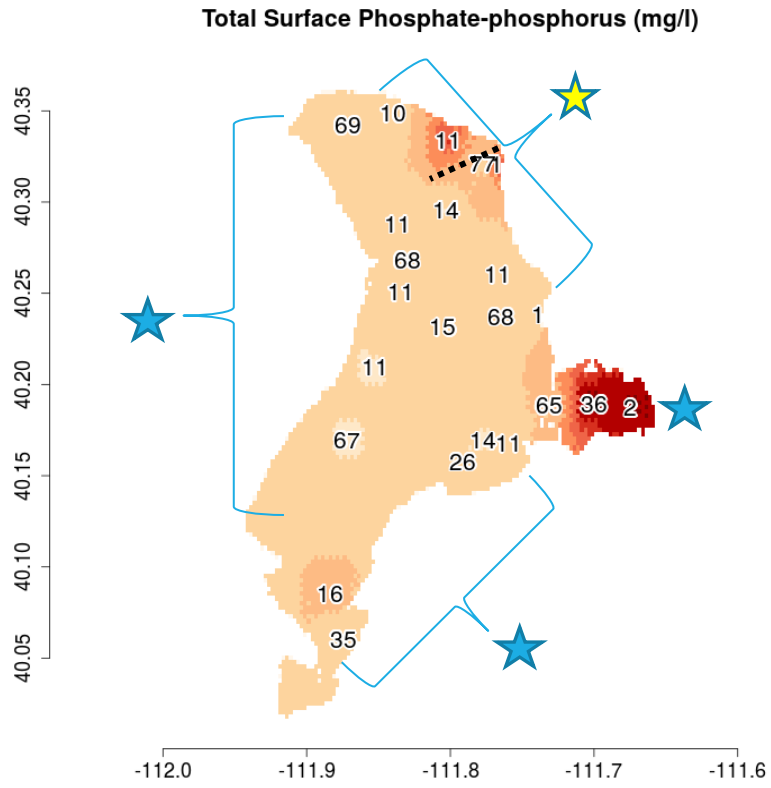
https://markfernandez.shinyapps.io/TEST_UtahLakeDataExplorer2/

LITTORAL SEDIMENT RFP

- Tasks

3. Field collection of cores

   - Provo, Northeast, West, South
   - One site – get a spatial gradient
   - Collect during inundation
   - Initial sediment characterization: sediment and C, N, and P

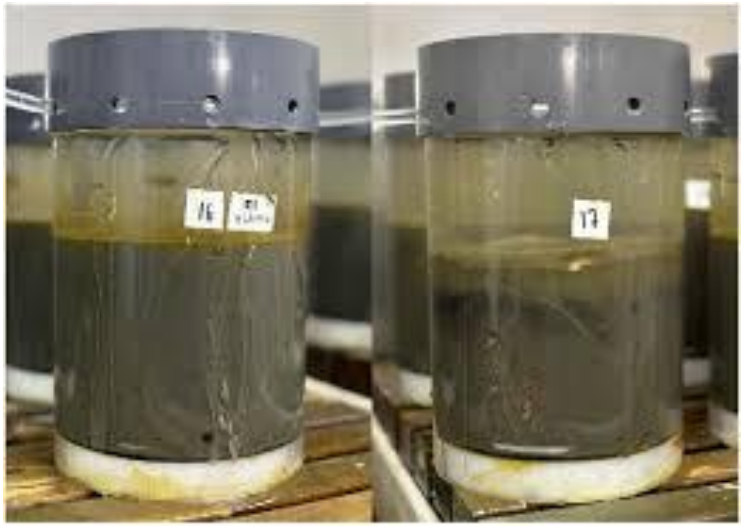


LITTORAL SEDIMENT RFP

- Tasks

4. Laboratory Component

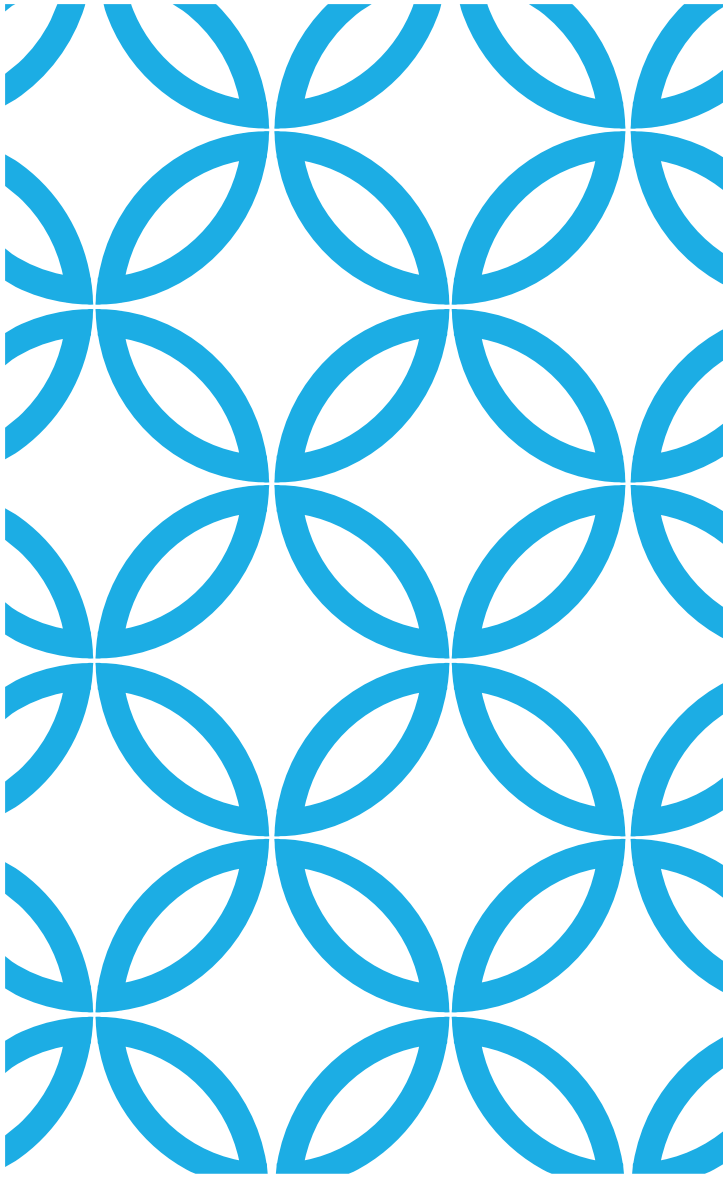
   - Drying of different durations - to be informed by Task 1 (how long are typical drying durations?)
   - Re-wet soils
   - Measure C/N/P release (see next task)



LITTORAL SEDIMENT RFP

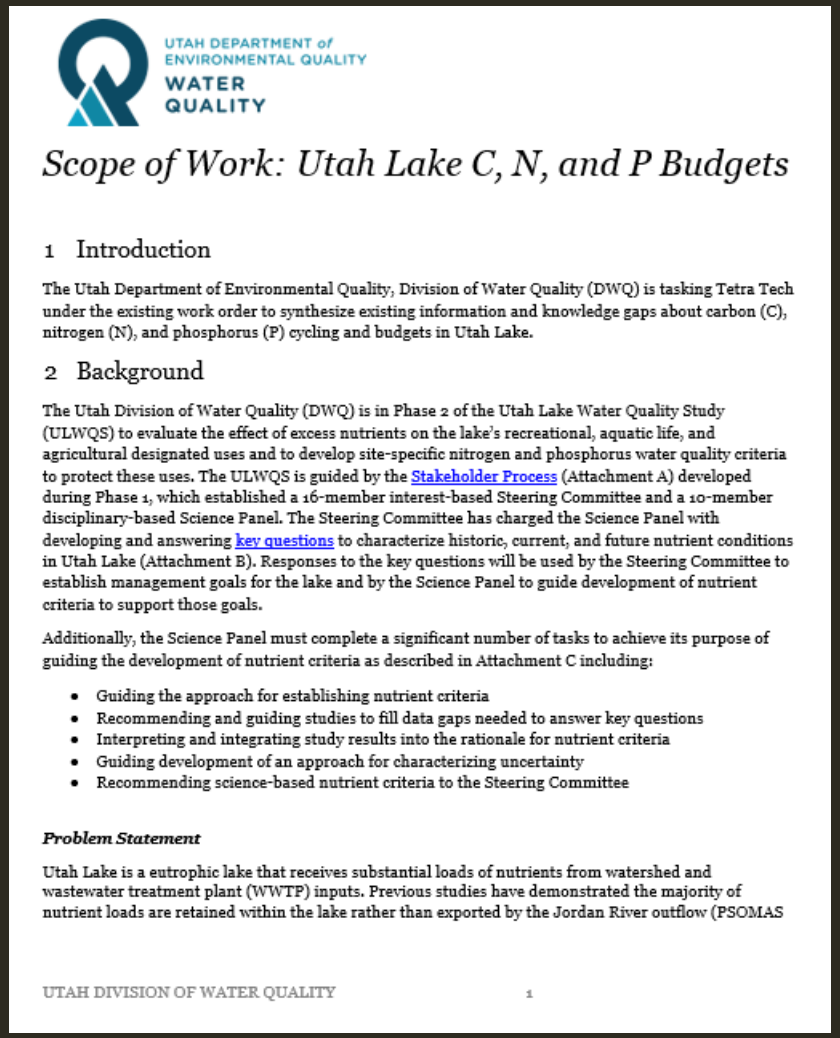
- Tasks

5. C, N, and P analysis
   - Measure C, N and P to water column upon re-wetting.
   - Requesting C, N and P bulk loss as well, as a back up.
6. Draft Technical Report



QUESTIONS/DISCUSSION

C, N, AND P BUDGET WORKPLAN



UTAH DEPARTMENT of ENVIRONMENTAL QUALITY
WATER QUALITY

Scope of Work: Utah Lake C, N, and P Budgets

1 Introduction

The Utah Department of Environmental Quality, Division of Water Quality (DWQ) is tasking Tetra Tech under the existing work order to synthesize existing information and knowledge gaps about carbon (C), nitrogen (N), and phosphorus (P) cycling and budgets in Utah Lake.

2 Background

The Utah Division of Water Quality (DWQ) is in Phase 2 of the Utah Lake Water Quality Study (ULWQS) to evaluate the effect of excess nutrients on the lake's recreational, aquatic life, and agricultural designated uses and to develop site-specific nitrogen and phosphorus water quality criteria to protect these uses. The ULWQS is guided by the Stakeholder Process (Attachment A) developed during Phase 1, which established a 16-member interest-based Steering Committee and a 10-member disciplinary-based Science Panel. The Steering Committee has charged the Science Panel with developing and answering key questions to characterize historic, current, and future nutrient conditions in Utah Lake (Attachment B). Responses to the key questions will be used by the Steering Committee to establish management goals for the lake and by the Science Panel to guide development of nutrient criteria to support those goals.

Additionally, the Science Panel must complete a significant number of tasks to achieve its purpose of guiding the development of nutrient criteria as described in Attachment C including:

- Guiding the approach for establishing nutrient criteria
- Recommending and guiding studies to fill data gaps needed to answer key questions
- Interpreting and integrating study results into the rationale for nutrient criteria
- Guiding development of an approach for characterizing uncertainty
- Recommending science-based nutrient criteria to the Steering Committee

Problem Statement

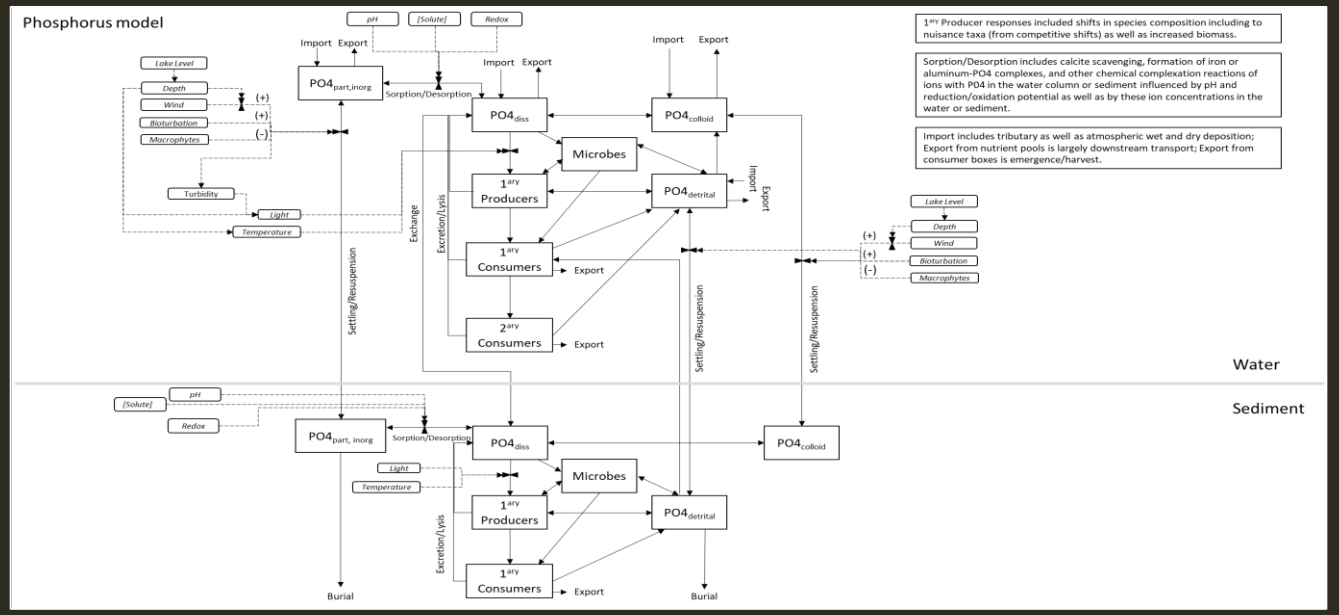
Utah Lake is a eutrophic lake that receives substantial loads of nutrients from watershed and wastewater treatment plant (WWTP) inputs. Previous studies have demonstrated the majority of nutrient loads are retained within the lake rather than exported by the Jordan River outflow (PSOMAS

C, N, AND P BUDGET WORKPLAN

We have a lot of information about stocks and flows of nutrients in Utah Lake

BUT info has not been synthesized

Synthesis needed before we can fill gaps



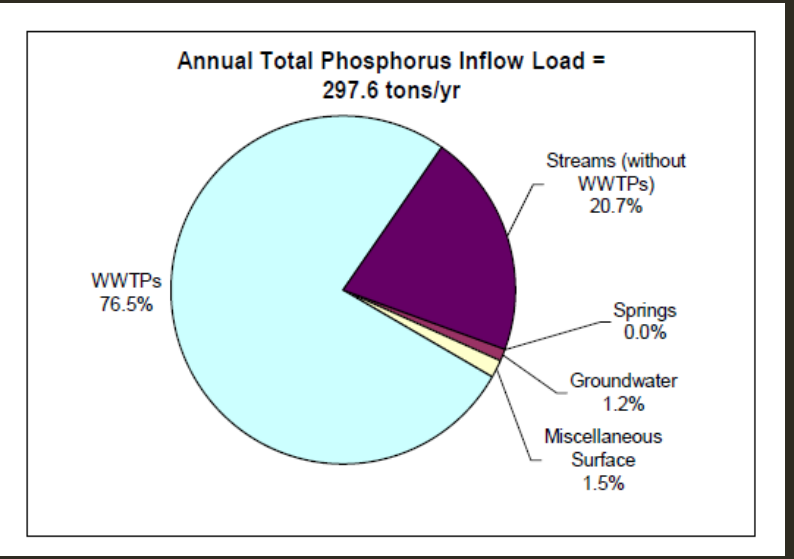
OBJECTIVES

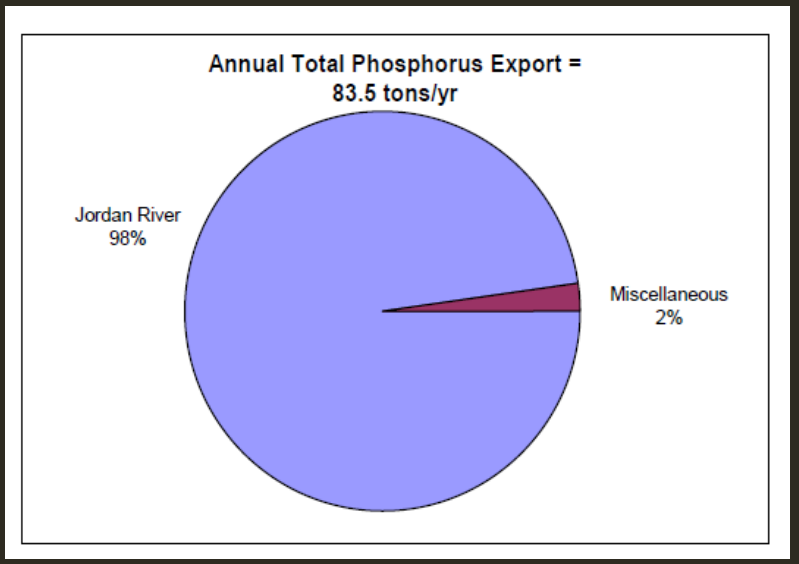
1. Compile a mass balance of the external inputs and outputs of C, N, and P for Utah Lake.
2. Compile all known data on standing stock and flux rates for C, N, and P in Utah Lake
   - Water column processes
   - Sediment processes
3. Create a mass balance model for each element that incorporates information from objectives 1 and 2 and a quantification of uncertainty around estimates.
4. Identify major gaps and uncertainties in existing data and propose future studies to fill these gaps

TASKS

1. Lit review and data compilation
   - Inputs/outputs
   - Water column/sediment stocks and flux data
   - Any data on modifying factors (redox, temperature, binding, etc.)
   - Track metadata: uncertainty (time and space), method, source

2. Generate mass balance models
   - External – from updated input/output data
   - Internal – populate conceptual models
   - SedFlux model – attempt to population and run





Psomas & SWCA 2007

TASKS

3. Evaluate bioavailability
   - Estimate percent of pools that are actively cycled based on literature

4. Identify Data Gaps
   - Based on synthesis and models
   - Existing, but poorly constrained
   - Reasonably filled with literature
   - Gaps to address through research

5. Recommended future studies
6. Report

OUTCOMES

- CNP inputs and outputs to/from Utah Lake
- Relative roles of water column and sediment in cycling
- Actively cycling pools of C, N, and P
- Nutrient budgets to inform future research

QUESTIONS/DISCUSSION

CALCITE P BINDING RFP DEVELOPMENT

UTAH DEPARTMENT of ENVIRONMENTAL QUALITY
WATER QUALITY

Scope of Work: Utah Lake Sediment Calcite-phosphorus binding

1 Introduction

The Utah Department of Environmental Quality, Division of Water Quality (DWQ) is requesting grant proposals for technical support to conduct a study to help understand the role of calcite binding on the uptake and release of phosphorus (P) by sediments in Utah Lake. This study was prioritized for 2020 by the Utah Lake Water Quality Study (ULWQS) Science Panel. The target completion date of this scope is TBD.

Please submit a grant proposal including a cost proposal to Emily Canton at ercanton@utah.gov by TBD. Proposals must be limited to 10 pages; this page limit does not include resumes and project case studies that may be included in an appendix.

2 Background

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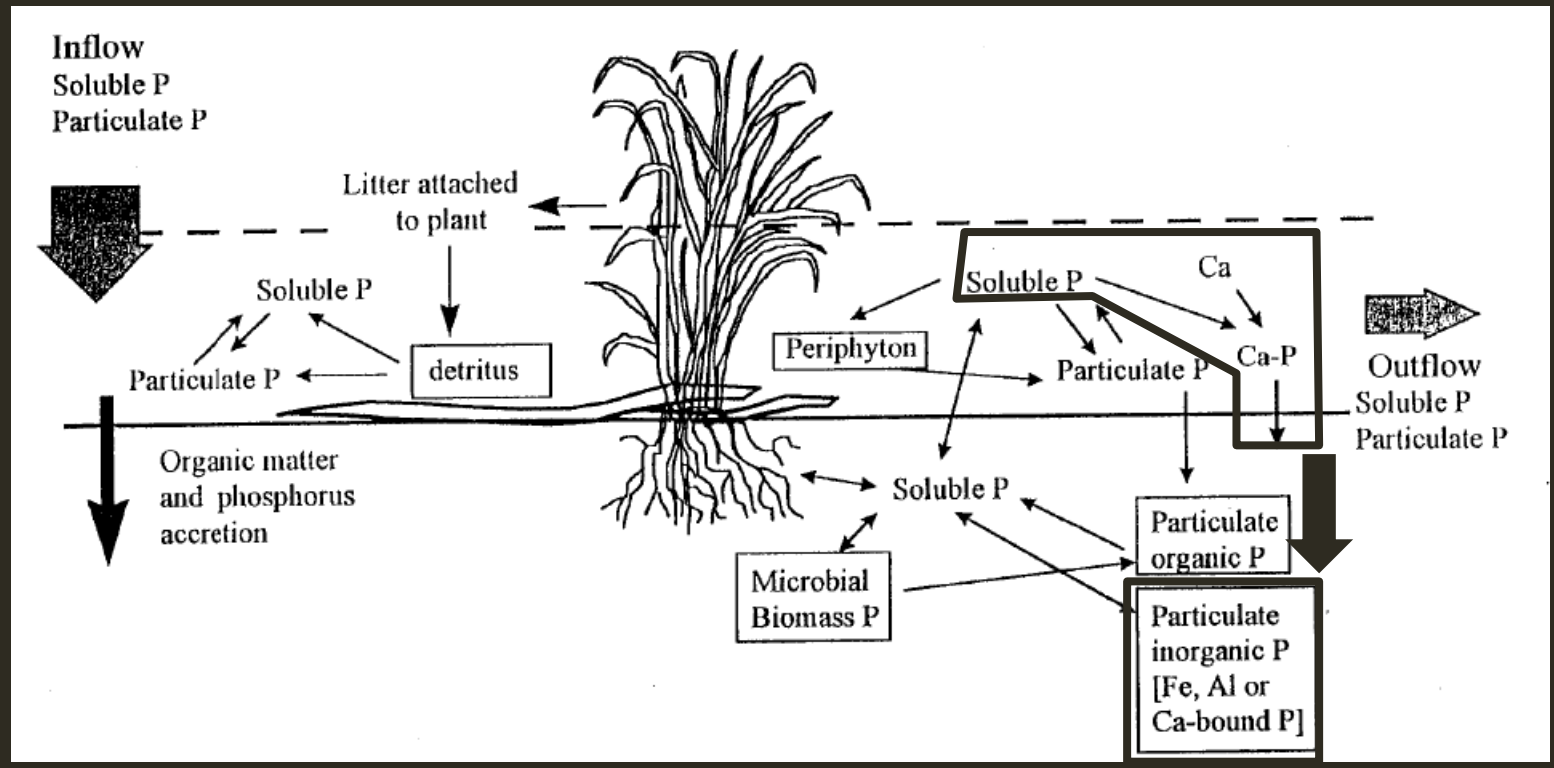
CALCITE P BINDING RFP DEVELOPMENT

Utah Lake retains large majority of external P loads

Potential mechanism: calcite-P binding

- Conditions: high pH, P, Ca
- May be semi-permanent in lakes with high alkalinity and Ca

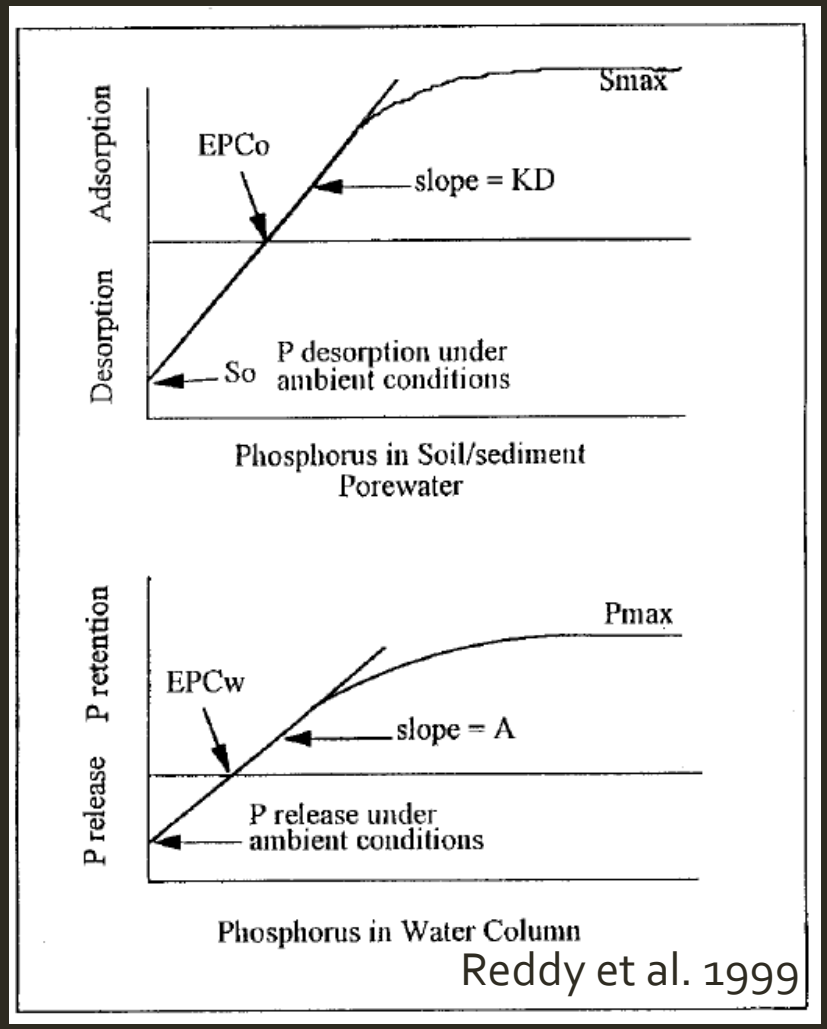


Reddy et al. 1999

CALCITE P BINDING RFP DEVELOPMENT

Utah Lake sediments may change from sink to source in response to lowered P loads

To what extent is sediment P binding reversible, and what is the magnitude/timescale of equilibration?



Reddy et al. 1999

CALCITE P BINDING RFP DEVELOPMENT

- What are the dynamics of sediment P binding, particularly calcite?
- To what extent is calcite binding reversible? Magnitude and timescale of equilibration?
- How bioavailable are P fractions, including Ca-P bound forms?

OUTSTANDING ITEMS FOR INCORPORATION

1. Determine information that will be generated from the paleolimnological study
   - Literature review
   - Sediment chemistry
   - Historical reconstruction
2. Determine objectives/outcomes associated with a sediment mineralogy task
3. Determine what information is needed to add calcite P binding to the Utah Lake mechanistic model (EFDC-WASP)

QUESTIONS/DISCUSSION