

NUTRIENT CYCLING IN WILLARD SPUR, GREAT SALT LAKE

BACKGROUND

The Utah Department of Environmental Quality, Division of Water Quality (DWQ), the Willard Spur Steering Committee (SC), and the Willard Spur Science Panel (SP) have been working throughout 2011 to develop a research program to answer the question: *What water quality standards are fully protective of the beneficial uses of Willard Spur as they relate to the proposed publically owned treatment works (POTW) discharge?* These groups have worked throughout 2011 to prepare and execute a baseline sampling plan and discuss and define research objectives for subsequent years. The baseline sampling plan, sampling operating procedures (SOPs), meeting summaries, and proposed research plan can be found at the project website, www.willardspur.utah.gov. The proposed research program includes three different research areas to be phased over a three year period (see Proposed Research Plan document dated October 27, 2011). This request for proposals is for the work to be completed only for Research Area No. 3 – Eutrophication Responses. This work is intended to better understand how nutrients are cycled within Willard Spur and identify critical thresholds in response. These relationships will be important inputs to work completed by others in the other research areas as well as to answering the overall program objective.

DWQ and the Jordan River/Farmington Bay Water Quality Council have previously completed important work to understand how nutrients are cycled in Great Salt Lake wetlands (Cavitt 2006, CH2M HILL 2004, 2006, Gray 2005, 2009, 2010, Miller and Hoven 2007, Rushforth and Rushforth 2006a, 2006b, UDWQ 2009). Much has been learned, however much work remains to understand the natural nutrient cycle in GSL impounded or open water wetlands. The SP feels it is important that we first understand if and when natural responses occur before we can then begin to investigate and understand critical thresholds that trigger an induced change in response in these wetlands.

The objective of Research Area No. 3 – Eutrophication Responses is to understand the key processes that regulate nutrient cycling and to identify indicators that DWQ can use to assess the condition of Willard Spur's wetlands.

SCOPE OF WORK

TASK 1. COORDINATION AND REPORTING

Prepare a workplan document including the scope of work, schedule, level of effort, budget, deliverables, communication plan (e.g., identify line of communication), safety plan, and change management plan (e.g., how you will proactively identify and manage change). Prepare draft and final SOPs and Data Quality Objectives (DQOs) for studies to be completed in Tasks 3 and 4 per EPA, 2006 prior to beginning field or laboratory work. Maintain and update the workplan, SOPs and DQOs as required.

DWQ has prepared a Quality Assurance Project Plan (QAPP) and GSL SOPs that will be reviewed and implemented by the PI. The PI should provide any comments to DWQ and gain endorsement of any changes in methods from DWQ and the SP prior to implementing them. All SOPs will be documented prior to beginning work for review by DWQ, the SP, and possibly an outside, independent peer reviewer.

Required coordination includes the following:

- Facilitate a kickoff meeting with DWQ to discuss the workplan (scope of work, schedule, budget, deliverables), coordination, safety, and how potential changes will be managed.
- Inform DWQ of any changes that may affect the workplan as soon as practicable after they are realized.
- Provide laboratory analytical data to DWQ for integration into program database. The PI is responsible for meeting the requirements of DWQ's QAPP. Data will be made public after review and acceptance by SP after conclusion of project.
- Make monthly telephone contact with DWQ to provide an overview of progress.
- Attend a quarterly project coordination meeting facilitated by DWQ to coordinate efforts among the programs PIs.

- Coordinate activities with other PIs as required; include DWQ in all email correspondence.
- Provide a quarterly progress update to DWQ and the SP at quarterly SP meetings.

It is assumed that analysis of water, sediment, and macroinvertebrate samples will be completed through a separate DWQ contract.

Provide draft and final deliverables as described in the tasks below. It is assumed that all data and draft deliverables will be reviewed by DWQ, the SP, and possibly an outside, independent peer reviewer. The PI will work with DWQ and the reviewers to discuss review comments and identify changes to be included in the final datasets and documents. DWQ will rely upon the SP for their final acceptance of work products.

DELIVERABLES

1. Workplan
2. Review comments for DWQ's GSL QAPP and SOPs (as pertaining to this scope of work)
3. Data Quality Objectives for proposed experiments
4. Detailed SOPs
5. Laboratory QAPP and SOPs if using laboratories for items not specified above
6. Meeting summaries
7. Quarterly progress updates at DWQ Coordination Meetings and SP meetings

TASK 2. LITERATURE REVIEW

The objective of the literature review is to provide an overview of significant literature published on the interaction and effects of nutrients in the water column and sediment on primary producers (e.g., submerged aquatic and emergent vegetation, epiphytes, algae, etc) and macroinvertebrates in freshwater open water wetland systems that are similar to those in Willard Spur. The focus of this review will be upon identifying information and analytical, experimental, and sampling methods that will help identify critical response thresholds to nutrients in Willard Spur.

The literature review should be completed using typical methods of chain-of-citation and electronic database searches and consultation with leading researchers. The PI will use the Zotero interface (www.zotero.org) to collect, organize, cite and share the identified literature. Electronic or hard copies of the original documents will be provided to DWQ. Annotations will be captured as notes within Zotero to describe how each piece of literature confirms or redirects the proposed experimental/sampling approach for Tasks 3 and 4. A technical memorandum will be prepared that includes a summary of methods, an annotated bibliography from Zotero, and key recommendations pertinent to later work elements. A draft will be submitted to DWQ for review by DWQ and the SP. Comments will be discussed with the PI and incorporated by the PI into the final document.

DELIVERABLES

1. An electronic or hard copy of the original documents included in the literature review
2. Draft and Final Technical Memorandum (3 hard copies and an electronic copy)

TASK 3. BASELINE UNDERSTANDING

As described above, the SP is interested in first understanding if, when, and why natural responses or changes occur in the water, sediment, macroinvertebrates, and vegetative communities of Willard Spur's wetlands. Experiments are envisioned for the first year that will provide this understanding but also look at how changed water nutrient concentrations could trigger a response and how sediment with much higher nutrient/organic content (e.g., as found in Farmington Bay wetlands) could influence these relationships. This understanding will provide a baseline of the "natural, existing condition" that can be used to inform experiments completed in Task 4.

The PI will work to answer the following question: *How does the nutrient cycling process (i.e., uptake, storage and release) vary in Willard Spur wetlands throughout the growing season (April – October) and how might increased water column nutrients and sediment nutrients affect these processes?* DWQ requests that the PI propose and complete an experimental study to 1) understand how existing nutrient cycling processes and in-situ conditions change during the 2012 growing season, 2) how increased water nutrient concentrations might trigger a response, and 3) how increased in-situ sediment

nutrients and organics could influence the responses identified in Nos. 1 and 2 above. The PI is expected to identify if and what other factors may contribute to the response observed. DWQ will assist the PI in identifying and securing the agreements required to complete the experimental study in Willard Spur and in an impounded wetland site in Farmington Bay if needed. While a habitat with a water depth of 12-24 inches is the preferred focus, DWQ requests the PI to provide a recommended approach.

The PI will prepare an interim report summarizing methods, observed responses and conditions, and possible trigger mechanisms for conditions observed in experiments conducted in 2012. The interim report should also recommend and prioritize possible indicators that can be used to assess wetland condition (see defining characteristics of indicators in Sutula et al, 2011). The contractor will present the draft interim report to the SP in January 2013 along with recommendations for possible triggers to be investigated as part of Task 4.

DELIVERABLES

Draft and Final Interim Report (7 hard copies and an electronic copy)

TASK 4. DEFINING THRESHOLD VALUES

The objective of Task 4 is to investigate the viability of up to 3 indicators, identified in Task 3, for use in assessing the biological integrity of Willard Spur wetlands. Experiments will be conducted to define possible threshold values for these indicators that define concentrations or loads that can be expected to result in the degradation of key water quality indicators.

The PI is requested to propose and complete experimental studies that will further investigate and define 3 possible indicators as identified in Task 3. The PI should identify and propose an approach, i.e., scope of work, in their proposal to address the following three possible indicators: dissolved oxygen, phytoplankton biomass and productivity, and macroalgal biomass and cover. It is assumed that the actual indicators to be addressed as well as the scope of work for Task 4 could change based upon the results of Task 3. The approach should include the experimental and analytical requirements to define possible threshold values for these indicators that trigger a direct response to nutrients.

The PI will prepare an interim report summarizing the results of the studies completed for Task 4 as well as conclusions and recommendations to the SP. The interim report should at a minimum address the following:

1. Viability of each indicator to be used for assessing wetland condition
2. Factors that may affect the viability of each indicator
3. Determination of the uncertainty related to each indicator
4. Thresholds values for each indicator that would trigger a direct response to nutrients
5. Suggestions for additional primary or secondary indicators and associated research to investigate their viability.

The contractor will present the draft report to the SP in January 2014 along with recommendations for possible triggers to be investigated as part of Task 4. It is assumed that analysis of water and sediment samples will be completed through a separate DWQ contract. The PI is responsible for meeting the requirements of DWQ's QAPP.

DELIVERABLES

Draft and Final Interim Report (7 hard copies and an electronic copy)

TASK 5. FINAL REPORT

The PI will integrate the interim reports (Tasks 3 and 4) into one final report and submit it to DWQ. It is assumed that results and data from this project will be integrated and used by DWQ with results and data from other PIs for the purposes of this research program.

The PI will attend at least quarterly coordination meetings with other PI through December 2014 and at least 2 1-day workshops in the spring of 2015 to discuss results with the other PIs and SP.

DELIVERABLES

Draft and Final Interim Report (25 hard copies and an electronic copy)

PROJECT SCHEDULE

The overall Willard Spur research program will be phased over a three year period beginning in March 2012 and ending in 2015. Time is of the essence and it is critical that the contractor prepare a detailed schedule for review and acceptance by DWQ and then meet key agreed-upon milestones. The successful contractor will be expected to coordinate with the project team on a regular basis. Any issues that could affect reaching any milestone will be expected to be communicated to DWQ as soon as they are identified. DWQ will work with the contractor to identify and implement contingency plans in the event of delays. The contractor is asked to provide a detailed schedule that corresponds with the proposed work and required milestones defined below:

- Kickoff meeting: April 15, 2012
- Submit Literature Review memorandum: June 30, 2012
- Submit Task 3 Interim Report: January 18, 2013
- Submit Task 4 Interim Report: January 17, 2014
- Submit Final Report: June 30, 2014
- Project complete: May 2015

PROJECT BUDGET

DWQ, in consultation with the SP, has identified a maximum budget of \$250,000 for this project. The PI is encouraged to propose an approach that addresses the objectives identified above and provide for contingencies. It is assumed that the identified contingency funds could be used to address any changes in scope of work or, with the approval of the SP, to investigate additional indicators and or factors that materially influence nutrient cycling in these wetlands. The PI is encouraged to leverage DWQ's funds to solicit other funding sources, however all work completed under this contract must be approved by DWQ and the SP.

REFERENCES

Cavitt, J.F., 2006. Productivity and Foraging Ecology of Two Co-existing Shorebirds Breeding at Great Salt Lake, Utah: 2005-2006. Report prepared for Utah Department of Environmental Quality, Division of Water Quality. 2006.

CH2M HILL, 2004. Statistical Analysis of 2004 Data on Wetland Plants and Invertebrates in Farmington Bay, Great Salt Lake, Utah. Technical Memorandum prepared for the Utah Department of Environmental Quality, Division of Water Quality. September 2005.

CH2M HILL, 2006. Analysis of 2005 Data on Wetland Biota and Water Quality in Farmington Bay, Great Salt Lake, Utah. Technical Memorandum prepared for the Utah Department of Environmental Quality, Division of Water Quality. November 2006.

EPA, 2006. Guidance on Systematic Planning Using the Data Quality Objective Process. EPA Office of Environmental Information. Report No. EPA/240/B-06/001. Washington, D.C.

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Miller, T. G and Hoven H.M. 2007. Ecological and Beneficial Use Assessment of Farmington Bay Wetlands: Assessment and Site-Specific Nutrient Criteria Methods Development, Phase I. Progress Report to EPA, Region VIII and Final Report for Grant: CD988706-03. April 2007.

Rushforth, S.R. and Rushforth, S.J., 2006a. A Study of the Periphyton Flora of Samples Collected from East-Shore Great Salt Lake Wetlands: Fall 2004. Report prepared for Utah Department of Environmental Quality, Division of Water Quality. May 2006.

Rushforth, S.R. and Rushforth, S.J., 2006b. A Study of the Phytoplankton Flora of Samples Collected from East-Shore Great Salt Lake Wetlands, Summer 2005. Report prepared for Utah Department of Environmental Quality, Division of Water Quality. May 2006.

Utah Division of Water Quality (UDWQ) 2009. Development of an Assessment Framework for Impounded Wetlands of Great Salt Lake. November 2009.