



State of Utah

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Lieutenant Governor

Department of
Environmental Quality

Amanda Smith
Executive Director

DIVISION OF WATER QUALITY
Walter L. Baker, P.E.
Director

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Clyde L. Bunker
Merritt K. Frey
Gregg A. Galecki
Jennifer M. Grant
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Executive Secretary

Utah Water Quality Board Meeting
DEQ Building Board Room #1015
195 North 1950 West
Salt Lake City, Utah 84116
September 24, 2014

Work Meeting Begins @ 8:30 a.m.

- Great Salt Lake Jodi Gardberg
1. Nutrients and Cyanobacteria in Farmington Bay - Leland Myers
2. Update on Great Salt Lake Water Quality Efforts - Jodi Gardberg and Erica Gaddis

Board Meeting Begins @ 9:30 a.m.
AGENDA

- A. Water Quality Board Meeting – Roll Call
B. (Tab 1) Minutes:
Approval of Minutes for August 27, 2014 WQ Board Meeting.....Myron Bateman
C. Executive Secretary’s ReportWalt Baker
D. Presentation 2014 NPS AwardsNancy Mesner & Carl Adams
1. Professional category 2. Educator category 3. Volunteer category
E. A Final Great Salt Lake Water Quality Strategy.....Jodi Gardberg, Chris Bittner and Erica Gaddis
F. (Tab 2) Funding Requests:
1. Financial Status Report, hardship grants.....Emily Cantón
2. Request to Authorize Funding: for the Investigation of Nitrogen Transformation Rates in Utah Streams.....Nicholas von Stackelberg
G. (Tab 3) Rulemaking:
1. Change in Proposed Rule R317-1-3.3, Technology-based limits for Phosphorus (Impacts of TBPEL on Industry)John Mackey
H. (Tab 4) Other Business:
1. Update on 2014 Integrated Report.....Jim Harris & Emilie Flemer
I. (Tab 5) News Articles:

Next Meeting October 29, 2014
DEQ Building Board Room 1015
195 North 1950 West
Salt Lake City, Utah 84116

Revised 09/18/14

In compliance with the American Disabilities Act, individuals with special needs (including auxiliary communicative aids and services) should contact Dana Powers, Office of Human Resources, at (801) 536-4412, TDD (801) 536-4414, at least five working days prior to the scheduled meeting



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MEMORANDUM

TO: Utah Water Quality Board

THROUGH: Walter L. Baker 

FROM: Jodi N. Gardberg

DATE: September 16, 2014

SUBJECT: Great Salt Lake Water Quality Strategy Implementation Activities and Related Water Quality Efforts

Since the Division of Water Quality (DWQ) introduced the Great Salt Lake Water Quality Strategy (the Strategy) in 2012, DWQ has implemented activities outlined in the Strategy's Core Components 1. Developing Numeric Criteria and 2. Strategic Monitoring and Research. DWQ will provide an overview of these activities in this work meeting as well as other DWQ Great Salt Lake water quality efforts. In addition, Leland Myers from the Central Davis Sewer District will present preliminary results from a concentrated effort to sample and analyze nutrients and cyanotoxins in Farmington Bay.



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MINUTES

UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY

UTAH WATER QUALITY BOARD

DEQ Building Board Room 1015

195 North 1950 West

Salt Lake City, Utah 84116

August 27, 2014

UTAH WATER QUALITY BOARD MEMBERS PRESENT

Myron Bateman	Jennifer Grant	Shane Pace
Leland Myers	Gregg Galecki	Merritt Frey
Hugo Rodier	Clyde Bunker	Amanda Smith

DIVISION OF WATER QUALITY STAFF MEMBERS PRESENT

Walt Baker, Leah Ann Lamb, Erica Gaddis, Jeff Studenka, Kari Lundeen, Jim Bowcutt, John Mackey, Lisa Nelson, John Cook, Emily Cantón, Judy Etherington, Chris Bittner, Jeff Ostermiller, Carl Adams, Marsha Case, Jenny Nicholas.

OTHERS PRESENT

<u>Name</u>	<u>Organization Representing</u>
Dale A Christensen	SLCWREC
Jim Olson	Water Works Eng.
Jeff DenBleyker	CH2M Hill
Johnathan Ward	Zions Bank
Tom Ward	Salt Lake City
Jeff Hiatt	Payson City
Travis Jockumsen	Payson City
David Tuckett	Payson City
Mike Luers	Snyderville Basin
Mike Boyes	Snyderville Basin
Craig Ashcroft	Carollo Engineers
Jesse Stewart	Salt Lake City
Brad Rasmussen	Aqua Engineering
Gary Vance	J-U-B Engineers
Jeff Beckman	Bowen Collins
Cory Christiansen	Water Works Engineers

Myron Bateman called the Board meeting to order at 9:36 a.m. and took roll call for the members of the Board.

APPROVAL OF MINUTES OF THE JUNE 25, 2014 MEETING

Motion: It was moved by Mr. Pace and seconded by Mr. Myers to approve the minutes of the June 25, 2014 Water Quality Board meeting with one correction. Rule Making R317-1-7.62, “Representative Ure”, should read as “Commissioner Ure”. The motion was unanimously approved.

EXECUTIVE SECRETARY REPORT

- Mr. Baker acknowledged Faye Bell’s retirement to the board; Jenny Nicholas will be coordinating the Board Meetings moving forward.
- Carl Adams will go over the legislative audit on how funding to Conservation Districts will be affected, and how roles may be changing.
- John Mackey has accepted the position as Section Manager of the Engineering Section.
- Recruitment starts for John Whitehead’s position in the next few weeks.

FUNDING REQUESTS

Financial Status Report: Ms. Cantón updated the Board on the “Summary of Assistance Program Funds” as shown on page 2.1 of the Board Packet.

Snyderville Basin Water Reclamation District Funding Authorization: Ms. Nelson introduced Mike Luers, General Manager; Mike Boyle, Operations Manager; and Craig Ashcrost, Carollo Engineers. Snyderville is requesting funding in the amount of \$22,150,000, with an interest rate of 2.5%, for a 20-year term period. This is a change from the previous request of \$19,350,000 and interest rate of 2.8%. The change is due to the cost increasing by \$3.7 million as a direct result of the Echo-Rockport TMDL. Ms. Nelson noted that special consideration #2 regarding the Water Conservation and Management plan does not apply to the District, and should not be included in the authorization. Ms. Nelson also requested that Snyderville lower the interest rate to one percentage point below the commercial bond market. Currently that rate is 3.5%.

Motion: Following the discussion concerning the proposed loan and interest rate, Mr. Myers made the motion to approve the loan and interest rate with amended loan terms to include that the interest rate will either be 2.5% OR one percentage point below the commercial bond market, as determined by the financial advisor, at the time of pre-closing conference call, whichever is greater. Mr. Bunker seconded the motion. The motion was unanimously approved.

Payson City Request for Planning Advance: Mr. Cook introduced Brad Rasmussen, Aqua Engineering; Travis Jockumsen, Public Works Director; David Tuckett, City Manager; and Jeff Hiatt, Waste water Manager. Payson City is requesting planning advance in the amount of \$88,000, to investigate improving redundancy in the existing treatment system, expansion of the existing system, and treatment for nutrient removal. Payson City requested that repayment date be August 27, 2019.

Motion: Mr. Myers moved we authorize the Planning Advance with the change of the repayment date to September 1, 2017. If requested by Payson, the date could be extended to 2019, if necessary. Mr. Pace seconded the motion. The motion was unanimously approved.

RULEMAKING

Request to Adopt R317-10 Certification of Wastewater Works Operators: Ms. Etherington explained the public notice for comments was out for 30 days. With no comments received on the proposed rule change Ms. Etherington requested the rule be approved and take effect immediately.

Motion: It was moved by Mr. Bunker and seconded by Mr. Myers to approve R317-10 effective August 27, 2014. The motion was unanimously approved.

Request to Adopt R317-12, Sales Tax Rule: Mr. Cook explained the public notice for comments was out for 30 days. With no comments received on the proposed rule change, Mr. Cook requested the rule be approved and take effect immediately.

Motion: It was moved by Mr. Myers and seconded by Mr. Pace to approve R317-12 effective August 27, 2014. The motion was unanimously approved.

Change in Proposed Rule, R317-1-3.3, Technology-based Limits for Phosphorus: Mr. Mackey explained that the draft rule was out for public comment for 60 days. Comments were received and a response summary was prepared and included in the memo to the Board. Changes were made to the rule to address the comments, thus the request to proceed with a Change in Proposed Rule (also attached to the Board memo.). Mr. Mackey requested that the Change in Proposed Rule go out for an additional 30-day public comment period, as required.

Motion: Following the discussion concerning the comments and rule changes, it was moved by Ms. Frey, and seconded by Mr. Galecki to approve the Change in Proposed Rule for R317-1-3-1, and have an additional 30-day public comment period, as required. The motion was unanimously approved.

Information Item: Water Quality Standards 2014 Triennial Review: Mr. Bittner updated the Board on the status of the 2014 Water Quality Standards Triennial Review process. WQ conducted a public hearing and comment period on the draft list of priorities and only received comments from EPA. The list of priorities was discussed with the Water Quality Standards work group who will advise on any changes. Staff will return to the Board with any proposed changes to the Standards. The Board had no questions, and no motion was necessary.

OTHER BUSINESS

- i. Update on the Utah Department of Agriculture and Food (UDAF) /Conservation Commission Audit:** Mr. Adams discussed the Legislative Performance Audit of the Governance of Conservation Districts and how its recommendations could affect DWQ. Utah Association of Conservation Districts (UACD) technical staff could be made employees of the Utah Conservation Commission/UDAF. DWQ prefers to retain technical staff as "District employees." Changes subsequent to the audit have yet to be decided.
- ii. Proposed FY2016 Fee Schedule:** Mr. Baker discussed the fee schedule for FY2016. No action from the Board was required. Proposed changes to our fees include:

- Construction Dewatering Permit from \$110 to \$150, a revenue increase of \$6,000
- Industrial Stormwater Permit (5 years) from \$100 to \$150, a revenue increase of \$15,000.
- Instituting a Construction Stormwater Permit (project based fee) at \$20, a revenue increase of \$1,000.
- A total of \$22,000 per year revenue increase.

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MEMORANDUM

TO: Utah Water Quality Board

THROUGH: Walter L. Baker, P.E. 

FROM: Carl Adams

DATE: September 24, 2014

SUBJECT: Presentation 2014 NPS Awards

Each year the Utah Water Quality Task Force identifies those who have made a real difference in the protection and management of water quality in the state.

These awards acknowledge the extra efforts made by Utah citizens that improve and protect our state's water quality, those who go above and beyond the call of duty, who have been leaders in their community, and who have been instrumental in changing people's behavior or in improving water quality in the state.

Three individuals were selected to receive the award this year:

Leighann Gilson

Leighann was nominated for her work as an educator, reaching thousands of children in the Jordan River Watershed through her "Drop by Drop" educational program.

Through her involvement with Water for People, Leighann Gilson developed "Drop by Drop", a program that takes young children on a virtual water tour of different countries, introducing concepts such as water filtration, gravity fed systems, watershed protection, and water contamination. This program is now used by Rotary Clubs all over the world. She also organized and now implements the successful annual Draper City Stormwater fair. This activity, sponsored by public and private partnerships, incorporates all aspects of being a water steward in a fun and interactive way. It teaches over 900 kids each year about protecting our watershed, not polluting our stormwater, and about conserving this precious resource.

For her innovative and active work in educating children on protecting our water.

Mary Perry

Mary was nominated for her work as a dedicated volunteer for Swaner Preserve and EcoCenter, including participation in many stream restoration activities, and her leadership in the East Canyon Creek Watershed committee's educational campaigns.

Mary Perry is an avid flyfisher and naturalist who has become a committed and outspoken advocate for East Canyon Creek and the ecosystem that depends upon it. As a volunteer for Swaner Preserve, she has participated in many stream restoration activities, including willow plantings, fish surveys, and helping to calibrate Swaner's water quality station. She is also an active member of the East Canyon Creek Committee, providing leadership in a variety of educational campaigns, including their successful "scoop the poop" campaign and recent efforts on educating the public on the impact of illegal water withdrawals on the stream ecosystem.

For over 10 years of her volunteer efforts in protecting East Canyon Creek.

Mike Luers

Mike was nominated for his vision and leadership in protecting East Canyon Creek. His efforts as general manager of Snyderville Basin Water Reclamation District and active involvement on the East Canyon Watershed Committee are particularly noteworthy, demonstrating how a permitted discharger in a watershed can be one of the leading advocates for protection of downstream waters.

As the general manager of the Snyderville Basin Water Reclamation District, Mike Luers has been the catalyst for positive change in the East Canyon Watershed for over a decade. He has served on the East Canyon Watershed Committee since its inception and has been an integral part of the committee's well-known successes.

Under Mr. Luers' leadership, East Canyon WWTP goes well beyond the minimum required. The plant has reduced phosphorus loads to the river so significantly that it is no longer considered the cause of impairment in East Canyon Creek. Mr. Luers has also embarked on innovative studies of endocrine disrupting compounds in the plant's effluents to determine what future treatment will be necessary to protect aquatic organisms. These findings will be important in protecting all Utah's waters.

Under his leadership, SBWRD donates money and time in support of many initiatives that benefit the watershed, including support for Park City's annual watershed festival that educates over 500 local 4th graders and co-funding multiple USGS gauging stations on East Canyon Creek.

For demonstrating true environmental stewardship and leadership.



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MEMORANDUM

TO: Utah Water Quality Board

THROUGH: Walter L. Baker, P.E. 
Leah Ann Lamb
Erica Gaddis, Ph.D.

FROM: Jodi N. Gardberg

DATE: September 16, 2014

SUBJECT: A finalized Great Salt Lake Water Quality Strategy

In March 2012, the Division of Water Quality (DWQ) launched a Great Salt Lake Water Quality Strategy (the Strategy) designed to lay out a path to fill critical knowledge gaps, improve the precision and clarity of DWQ's water quality management decisions, reduce regulatory uncertainty, and improve all partners' capacity to be stewards of Great Salt Lake water quality. The need for the strategy stemmed from the lack of numeric criteria for the lake, repeated appeals of UPDES permits, permits based on technology based effluent limits, complications associated with sampling and analyzing hypersaline water, and difficulties estimating water quality effects from potential development. The Strategy was composed of 5 interrelated but independent Core Components: 1) Development of Numeric Criteria, 2) Strategic Monitoring and Research, 3) Wetland Program Plan, 4) Public Outreach, and 5) Resource Plan. The Strategy was public noticed and presented to stakeholders individually and at conferences. Two hundred substantive comments to the documents were received from 11 prominent Great Salt Lake stakeholders. In response, DWQ has worked for the last 2 years to revise and improve the Strategy as well as begin implementation of activities scheduled in Core Components 1 and 2. DWQ returns to the Water Quality Board to present a finalized Great Salt Lake Water Quality Strategy that addresses stakeholder concerns, incorporates new data and information and includes new core components (see the final Strategy documents at). DWQ is seeking support for the finalized Strategy and requests endorsement from the Water Quality Board.

**HARDSHIP GRANT FUNDS
FINANCIAL PROJECTIONS**

HARDSHIP GRANT FUNDS (HGF)	1st Qtr FY 2015 July - Sept 2014	2nd Qtr FY 2015 Oct - Dec 2014	3rd Qtr FY 2015 Jan - Mar 2015	4th Qtr FY 2015 Apr - June 2015	1st Qtr FY 2016 July - Sept 2015	2nd Qtr FY 2016 Oct - Dec 2015	3rd Qtr FY 2016 Jan - Mar 2016	4th Qtr FY 2016 Apr - June 2016	1st Qtr FY 2017 July - Sept 2016	2nd Qtr FY 2017 Oct - Dec 2016	3rd Qtr FY 2017 Jan - Mar 2017	4th Qtr FY 2017 Apr - June 2017	1st Qtr FY 2017 July - Sept 2017
Funds Available													
Beginning Balance	\$ -	\$ 3,082,920	\$ 2,149,573	\$ 1,822,181	\$ 2,768,325	\$ 2,275,741	\$ 2,404,858	\$ 2,639,445	\$ 3,809,548	\$ 3,297,258	\$ 3,429,430	\$ 3,748,959	\$ 4,838,259
Federal HGF Beginning Balance	6,839,928	-	-	-	-	-	-	-	-	-	-	-	-
State HGF Beginning Balance	243,182	-	-	-	-	-	-	-	-	-	-	-	-
2013 Principal Forgiveness Amount	495,019	-	-	-	-	-	-	-	-	-	-	-	-
2014 Principal Forgiveness Amount	600,934	-	-	-	-	-	-	-	-	-	-	-	-
Interest Earnings at 0.5%	8,854	3,854	2,687	2,278	3,460	2,845	3,006	3,299	4,762	4,122	4,287	4,686	6,048
UWLF Interest Earnings at 0.5%	16,791	13,445	13,003	13,920	15,951	17,262	18,494	20,187	22,419	23,731	24,970	26,596	29,021
Hardship Grant Assessments	-	-	192,284	972,065	424,412	-	160,030	930,197	402,201	-	247,015	860,685	379,454
Interest Payments	-	111,855	62,634	234,881	63,592	109,010	53,057	216,420	58,327	104,319	43,257	197,334	53,019
Advance Repayments	-	2,041,500	-	-	-	-	-	-	-	-	-	-	-
Total Funds Available	8,204,708	5,253,573	2,420,181	3,045,325	3,275,741	2,404,858	2,639,445	3,809,548	4,297,258	3,429,430	3,748,959	4,838,259	5,305,802
Project Obligations													
Blanding City - Planning Advance	(39,900)	-	-	-	-	-	-	-	-	-	-	-	-
Eagle Mountain City - White Hills - Construction Grant	-	-	(598,000)	-	-	-	-	-	-	-	-	-	-
Echo Sewer SSD - Construction Grant	(251,000)	-	-	-	-	-	-	-	-	-	-	-	-
Eureka City - Construction Grant	-	(1,146,000)	-	-	-	-	-	-	-	-	-	-	-
Francis City - Construction Grant	-	(808,000)	-	-	-	-	-	-	-	-	-	-	-
Long Valley SID - Construction Grant	-	(1,150,000)	-	-	-	-	-	-	-	-	-	-	-
Payson City - Planning Advance	(88,000)	-	-	-	-	-	-	-	-	-	-	-	-
Planned Projects													
Green River - Construction Grant	-	-	-	(277,000)	-	-	-	-	-	-	-	-	-
Non-Point Source Project Obligations													
(FY10) DEQ - Nutrient Reduction Benefit Study	(5,053)	-	-	-	-	-	-	-	-	-	-	-	-
(FY11) DEQ - Economic Study of Nutrient Removal	(23,730)	-	-	-	-	-	-	-	-	-	-	-	-
(FY11) Twelve Mile Canyon	(48,587)	-	-	-	-	-	-	-	-	-	-	-	-
(FY11) DEQ - Willard Spur Study	(285,778)	-	-	-	-	-	-	-	-	-	-	-	-
(FY12) UDAF	(966,461)	-	-	-	-	-	-	-	-	-	-	-	-
(FY13) DEQ - Great Salt Lake Advisory Council	(400,000)	-	-	-	-	-	-	-	-	-	-	-	-
(FY13) North Summit Pressurized Irrigation Co.	(348,460)	-	-	-	-	-	-	-	-	-	-	-	-
(FY14) Utah Farm Bureau	(21,810)	-	-	-	-	-	-	-	-	-	-	-	-
UACD - FY 2014	(79,695)	-	-	-	-	-	-	-	-	-	-	-	-
FY 2009 - Remaining Payments	(35,000)	-	-	-	-	-	-	-	-	-	-	-	-
FY 2010 - Remaining Payments	(79,012)	-	-	-	-	-	-	-	-	-	-	-	-
FY 2011 - Remaining Payments	(39,376)	-	-	-	-	-	-	-	-	-	-	-	-
FY 2012 - Remaining Payments	(149,831)	-	-	-	-	-	-	-	-	-	-	-	-
FY 2013 - Remaining Payments	(369,689)	-	-	-	-	-	-	-	-	-	-	-	-
FY 2014 - Remaining Payments	(794,245)	-	-	-	-	-	-	-	-	-	-	-	-
FY 2015 - Remaining Payments	(966,162)	-	-	-	-	-	-	-	-	-	-	-	-
FY 2016 Allocation	-	-	-	-	(1,000,000)	-	-	-	-	-	-	-	-
FY 2017 Allocation	-	-	-	-	-	-	-	-	(1,000,000)	-	-	-	-
FY 2018 Allocation	-	-	-	-	-	-	-	-	-	-	-	-	(1,000,000)
Non-Point Source Projects in Planning													
*DEQ - Nitrogen Transformation Study	(130,000)	-	-	-	-	-	-	-	-	-	-	-	-
Total Obligations	(5,121,788)	(3,104,000)	(598,000)	(277,000)	(1,000,000)	-	-	-	(1,000,000)	-	-	-	(1,000,000)
HGF Unobligated Funds	\$ 3,082,920	\$ 2,149,573	\$ 1,822,181	\$ 2,768,325	\$ 2,275,741	\$ 2,404,858	\$ 2,639,445	\$ 3,809,548	\$ 3,297,258	\$ 3,429,430	\$ 3,748,959	\$ 4,838,259	\$ 4,305,802



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MEMORANDUM

TO: Utah Water Quality Board

THROUGH: Walter L. Baker, P.E.
Leah Ann Lamb
Erica Gaddis, Ph.D.

FROM: Nicholas von Stackelberg, P.E.

DATE: September 16, 2014

SUBJECT: Request to Authorize Funding for the Investigation of Nitrogen Transformation Rates in Utah Streams

The Division of Water Quality (DWQ) is requesting a grant in the amount of \$150,000 to investigate and recommend methods of measuring nitrogen transformation rates in Utah streams and rivers. This work follows previous studies to parameterize and calibrate water quality models used to develop more accurate waste load allocations for regulated discharges. The research is intended to support the goals of DWQ's nutrient reduction program, which is focused on minimizing the impacts on waterbodies associated with excess nitrogen and phosphorus pollution. The study will provide information about suitable monitoring methods to determine site-specific in-stream rate processes affecting the fate and transport of nitrogen. Rate constants are critical parameters in the water quality models with application for development of site-specific numeric nutrient criteria (NNC), total maximum daily load (TMDL) water quality studies, and wasteload allocations for UPDES permits. In addition, the research will support the implementation of the Technology Based Effluent Phosphorus Limits Rule and potential future technology-based effluent limits for nitrogen. It is anticipated that many of Utah's wastewater treatment facilities will need to demonstrate, through monitoring and modeling, that their effluents have acceptable water quality impacts in receiving waters.

Background

In 2010, the Water Quality Board authorized funding for research to support the development of NNC. Part of that research project involved the population and calibration of nine QUAL2Kw water quality models of point source impacted stream reaches in Utah. The nutrient modeling project, which was completed in 2013, recommended procedures for data collection, model population, and model calibration to support site specific analyses of eutrophication (Neilson et al., 2013). These procedures have subsequently been adopted and broadly implemented to

support wasteload allocations for wastewater treatment plant discharges, greatly enhancing the confidence in and defensibility of water quality based effluent limits to meet in-stream dissolved oxygen criteria.

Modeling of nitrogen processing in streams requires assumptions about the rate of various biological and chemical processes. The model defaults to textbook values unless the modeler prescribes a known value. The previous study derived rates that resulted in the best match (calibration) to nitrogen concentrations measured in the stream. Site-specific measurement of the rates was beyond the scope of the first phase of the study but would improve the model's accuracy in representing these processes. Therefore, one of the primary recommendations from the study was to further investigate methods for measuring model rate parameters in order to reduce the parameter set requiring calibration. Due to its importance in algal growth dynamics and demand on oxygen through nitrification, nitrogen transformation rates were identified as particularly sensitive parameters that ideally would be based on observation, rather than calibration.

Research Proposal Development

Subsequently, DWQ staff worked with faculty at Utah State University to develop a research plan to address this recommendation. The objective of the research is to investigate methods to measure nitrogen transformation rates in streams in order to recommend one or more methods that provide representative estimates based on precision and measurement error; time, material and personnel requirements; and overall cost. The methods need to be broadly applicable for receiving waters in Utah such that DWQ can conduct the investigations on an as-needed basis during permitting. The following nitrogen transformation rates will be evaluated: nitrification, denitrification, and ammonification rates in the water column and sediment. In addition, the significance of dissimilatory nitrate reduction (DNR), anaerobic ammonia oxidation (ANAMMOX) and nutrient assimilation into stream biomass will be assessed.

The work plan proposes to measure nitrogen transformation upstream and downstream of two point source impacted reaches in representative streams and rivers in Northern Utah during two seasons of the year. A combination of in situ and laboratory measurement techniques will be employed, including research grade methods to be used for assessing measurement error associated with each of the techniques. A total of eight methods are proposed to be evaluated.

The research proposal has been reviewed by DWQ staff for consistency with program goals and objectives, and peer reviewed by another USU faculty member. The research proposal is attached to this memorandum for reference.

Budget

The following requested budget is based on the proposal submitted by Utah State University

Research Plan: \$135,000

Administration and Contingency: \$15,000

Total: \$150,000

Staff Recommendation

DWQ staff recommends that this research project be funded with a Hardship Funds Grant of \$150,000. The intention is to contract with the Utah Water Research Laboratory (UWRL) at Utah State University to complete the work. The reasons for contracting with USU include: demonstrated expertise of the UWRL in this type of applied research; cost-effectiveness of contracting with another State organization; continuity and consistency with the previous research proposal, including participation on the project team of the Principal Investigator;

References

Dupont, R.R., Sorensen, D.L., and Neilson, B.T., Evaluation of Optimal Methods for Measuring Nitrogen Transformation Rates in Utah Streams. Research Proposal for Utah Department of Environmental Quality, Division of Water Quality, Salt Lake City, UT.

Neilson, B.T., Hobson, A.J, von Stackelberg, N., Shupryt, M. and Ostermiller, J. 2012. Using Qual2K Modeling to Support Nutrient Criteria Development and Waste Load Analyses in Utah. Final Draft. Report to Division of Water Quality, Utah Department of Environmental Quality, Salt Lake City, UT. 47 pp.

Evaluation of Optimal Methods for Measuring Nitrogen Transformation Rates in Utah Streams

Prepared for: Division of Water Quality, Utah Department of Environmental Quality

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Problem Description

With a March 16, 2011 memo, the US Environmental Protection Agency launched a “Working Partnership with States to Address Phosphorus and Nitrogen Pollution through Use of a Framework for State Nutrient Reductions.” One element of the state framework is to ensure the effectiveness of point source permits for municipal and industrial wastewater treatment facilities relative to reducing the impact of nutrients on effluent receiving waters. The Utah Division of Water Quality (UDWQ) has responded by establishing a nutrient reduction program (<http://www.nutrients.utah.gov/>). UDWQ recently proposed a rule setting technology-based limits for controlling phosphorus pollution and is drafting other rules for implementing the state’s nutrient control strategy. Technology-based limits for nitrogen may soon be proposed. It is anticipated that many of Utah’s wastewater treatment facilities will need to demonstrate by monitoring and modeling that their effluents have acceptable water quality impacts in receiving waters. The work proposed here will provide information about adequate monitoring methods and will provide fundamental information about in-stream processes affecting nitrogen transport and fate that will be useful in parameterizing water quality models.

The primary objectives of this study are to: 1) using sites on Utah streams that receive treated wastewater effluents such as East Canyon Creek and the Little Bear River as pilot test areas, evaluate maximum nitrification, denitrification, and ammonification rates in the water column and sediment, and assess the significance of dissimilatory nitrate reduction (DNR), anaerobic ammonia oxidation (ANAMMOX) and nutrient assimilation into stream biomass for evaluating the significance of each component of the N cycle in impacting surface water quality and for the generation of site specific rate constants for modeling efforts; 2) use a range of methods for the quantification of nitrogen transformation rates (from “research grade” ^{15}N tracer methods to conventional BOD methods) occurring upstream and downstream of these discharge locations; and 3) to recommend one or more methods that provide representative estimates of nitrification, denitrification, ammonification, DNR, ANAMMOX, and assimilation rates for background and impacted site locations based on precision and measurement error; time, material and personnel requirements; cost; etc.

This study design requires the collection of multiple samples from these field site locations to repeat all of the methods in triplicate so that measures of precision and comparison of results among the methods will be possible. Both sediment and water samples will be collected at two critical times in the year (August and November/December), and in sufficient quantity at a single time to allow all of the studies to be carried out with similar materials. In addition, a series of in-stream chamber studies and reconnaissance sampling will be conducted to evaluate the significance of nutrient uptake and assimilation into stream biomass. The details of the sample collection, experimental design, data reduction, and reporting effort are provided below.

Work Plan

Study Areas

Two stream reaches will be selected for study in collaboration with UDWQ staff. For the purposes of this proposal, two reaches of East Canyon Creek approximately 90 m downstream and 210 m upstream of the Snyderville Basin Water Reclamation District's East Canyon Treatment Plant discharge near Park City, Utah (Figure 1), and two reaches of approximately 190 m downstream and 450 m upstream from the Wellsville Sewage Treatment Lagoons discharge near Logan City, Utah, (Figure 2) are specified as example surface waters of interest. These locations were selected to be in areas of previous water quality study and modeling (SWCA 2010; Hobson 2013; Neilson et al. 2012).



Figure 1, East Canyon Creek study sites



Figure 2, Little Bear River study sites

Experimental Design

The overall experimental design will involve the analysis of nitrogen transformation rates (and subsequent oxygen consumption rates where applicable) for the various water column and sediment samples, and in situ chamber samples collected at the locations identified in Figures 1 and 2. Figures 3 (water column) and 4 (sediment) describe the connection of each of the various nitrogen transformation processes to modeling variables within QUAL2K along with evaluation methods to be used in this study to quantify these transformation rates.

As nitrogen atoms move downstream they cycle through various ecosystem compartments. Some of these compartments are continuously transported downstream while others, e.g., attached vegetation, surface biofilms and sediments, are essentially fixed at one location but interact with the mobile water compartment. This conceptual model of atoms moving into and out of compartments where they are immobilized or mobilized and transformed by biogeochemical processes has been called “nutrient spiraling” (Newbold et al., 1981).

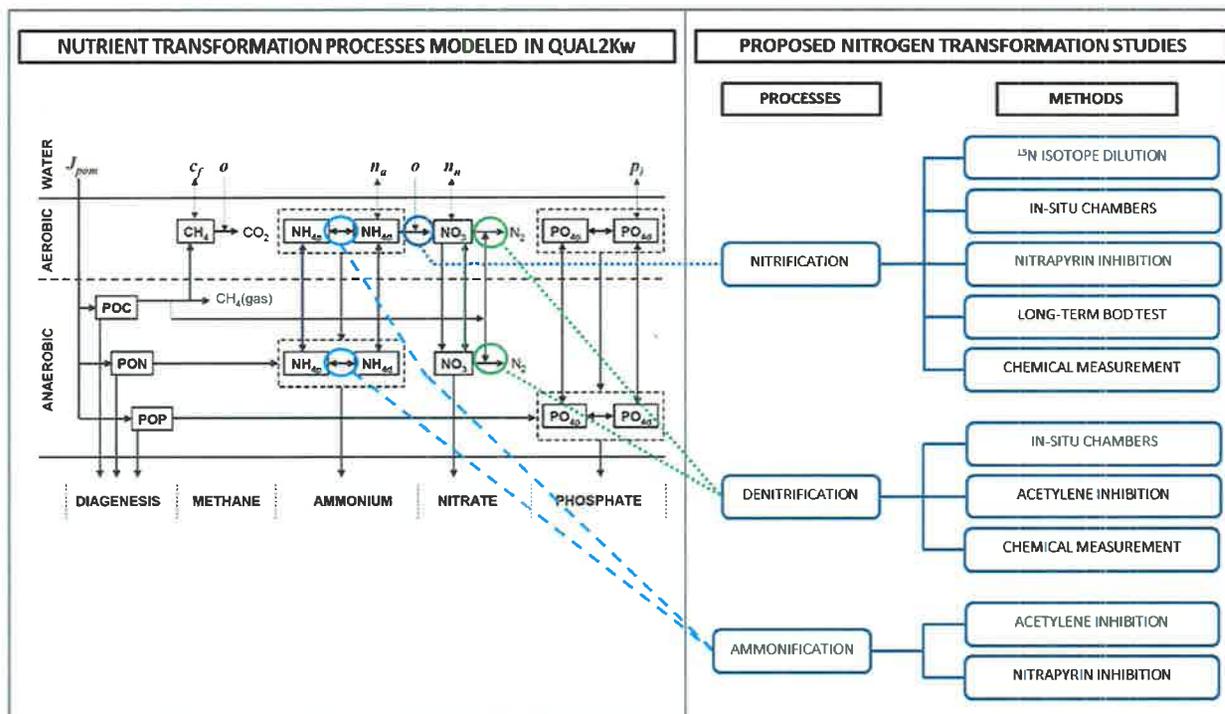


Figure 4. QUAL2K modeling parameters, nitrogen transformation processes, and evaluation methods to be used for sediment rate determinations in this study. Figure modified from Pelletier and Chapra (2008).

Based on monitoring data from previous studies (Neilson et al., 2012) and the stream ecology literature (Webster and Valett, 2006), nitrogen is assumed to enter the streams study reaches principally as $\text{NO}_3\text{-N}$ in the treatment plants effluents. Relatively small amounts of $\text{NH}_4\text{-N}$ enter in the effluents and small amounts of $\text{NO}_3\text{-N}$ and $\text{NH}_4\text{-N}$ enter the reaches with upstream flow, surface water runoff and groundwater infiltration. Nitrogen fixation is assumed to contribute only small amounts of nitrogen (biomass-N and $\text{NH}_4\text{-N}$) because the reach is nitrogen rich. Nitrogen is removed from spiraling within the reach principally by denitrification as N_2 gas, by export as dissolved and particulate matter, and by burial in the sediments. Anaerobic ammonium oxidation (ANAMMOX) may also remove some nitrogen as N_2 . Where the reach sediments are rich in organic matter available to provide carbon and energy to bacteria and archaea that are capable of reducing $\text{NO}_3\text{-N}$ to N_2 , denitrification is likely to occur. Where organic matter is readily available, $\text{NO}_3\text{-N}$ may also be reduced to $\text{NH}_4\text{-N}$ through the process of dissimilatory nitrate reduction to ammonia (DNRA) in the water column and sediments (Nizzoli et al., 2010).

Detailed descriptions of each nitrogen transformation assessment method, sampling and analytical requirements, as well as data reduction and endpoint of each method are summarized in the task descriptions that follow.

Work Plan, Task 1 - Sample Collection, Storage, and Initial Concentration Measurements

Prior to collection of water column and sediment core samples, three dissolved oxygen and temperature measurements will be carried out in-situ at approximately 15 cm above the streambed at evenly spaced locations across the stream to determine initial conditions. Composited water samples will then be collected from each sample site location less than 15 cm above the streambed for nutrient sample analyses and nitrogen transformation incubation studies (Hou et al. 2012).

At each sample site location, three transects of 5 evenly spaced cores across the stream will be collected to evaluate the spatial variability of N-cycling processes. Transects will be parallel to each other and approximately 15 cm apart. Intact cores 5 cm deep and 3.5 cm in diameter will be collected into transparent plastic sleeves, capped, double bagged and returned to the laboratory chilled in ice water. At the laboratory, the cores will be transferred to an anaerobic glove bag, cut open and the surface, light colored (oxidized) sediment will be separated from the dark colored, reduced sediment. Each of the oxidized sediment samples will be removed from the glove bag and stored under refrigeration in the air until analyzed. The reduced portion of each core will be stored in a H_2 -free, anaerobic glove bag at 15 ± 2 °C. Prior to analysis, the cores from each transect will be composited using an equal weight from each of the 5 cores. The composited material will be kneaded in a plastic bag until uniform in appearance. Sampling and analysis from two, randomly selected, core composites will be done in triplicate to provide an estimate of the component of variance contributed by laboratory subsampling and analytical error.

Sufficient water column and sediment sample volumes will be collected to carry out the series of nitrogen transformation method evaluation studies shown in Figures 3 and 4. Table 1 summarizes the volumes of water and mass of sediment to be collected at each of the three sampling locations. Within 24 h of collection, triplicate 5 g samples of sediment from each location will be centrifuged to generate a sediment solution, will be filtered (0.2 μm) and either analyzed immediately or stored overnight, under refrigeration, for analysis the next day for initial concentration values of nitrogen species at each location. NH_4^+ will also be extracted from the sediment with 2 N KCl and the concentration determined. Parallel triplicate water analyses will be performed for nitrogen species in water column samples collected at each sampling location. Details of each analytical method to be used for nitrogen species determination are described below.

Table 1. Volume of Water, Mass of Sediments or Field Measurements to be Collected at Field Locations for Completion of Proposed Studies

Method	Locations	Replicates	Treatments	Water	Sediment	Total Water/ Location (mL)	Total Sediment/ Location (g)
^{15}N Isotope Dilution	4	3	1	500	50	1500	150
Isotope Pairing	4	3	1	300	50	900	150
$\delta^{15}\text{N}$ in Macrophytes	4	3	1	N/A	N/A	12 In Stream Measurements	
In-Situ Chamber	4	3	1	N/A	N/A	12 In Stream Measurements	
Nitrapyrin Inhibition	4	3	2	300	25	1800	150
Acetylene Inhibition	4	3	1	500	50	1500	150
Long-Term BOD Test	4	3	2	700	25	4200	150
Substrate/Product Chemical Measurement	4	3	1	500	50	1500	150
GRAND TOTAL/LOCATION						11,400	900

Work Plan, Task 2 – Nitrogen Transformation Studies

Isotope Specific Methods

^{15}N Dilution Method for Nitrification and Denitrification Rate

Because of the dynamics of nitrogen transformations in biologically active systems, the measurement of changes in stable isotope concentrations over time has become a standard method for quantifying gross nitrogen transformation rates. The ^{15}N Dilution Method (Norton and Stark, 2011) is a common stable isotope method, and involves the addition of 98 atom% K^{15}NO_3 to reactors in sufficient quantity to enrich the nitrate pool in ^{15}N by 10 to 50 atom% based on background NO_3^- concentration. As nitrification proceeds under aerobic conditions, this ^{15}N is diluted out by the oxidation of unlabeled NH_4^+ during reactor aeration. Gross denitrification rates under anaerobic conditions can be determined through subsequent monitoring of ^{15}N disappearance through nitrate consumption when aeration is stopped. Initial NH_4^+ and NO_3^- concentrations will be determined in Task 1 using EPA Method 350.1 Alkaline phenate method using a Seal AQ2 instrument and ion chromatography, respectively, at the Utah Water Research Laboratory Environmental Quality Laboratory, while initial ^{15}N concentrations and ^{15}N enrichment in the dissolved nitrogen pool above background ($\delta^{15}\text{N}$) will be determined using isotope ratio mass

spectrometry in replicate samples. $\delta^{15}\text{N}$ will be determined in dissolved solids collected after drying water or sediment solution samples at 80°C . $^{15}\text{NO}_3^-$ will be analyzed by first removing ammonium by raising the pH with MgO, adding NaCl and boiling the solution. Nitrate will then be reduced to NH_4^+ using Devarda's alloy and collected on filter paper disks using a diffusion procedure from Stark and Hart (1996). Isotope ratio mass spectrometry for $\delta^{15}\text{NH}_4^+$ will be performed in Dr. John Stark's laboratory in Utah State University's Biology Department. Details of the reactor configuration, sampling times, and operating conditions to be used for this nitrogen transformation rate evaluation technique are provided in Table 2. Nitrification and denitrification rates determined using the ^{15}N Dilution Method represent the most rigorous method available for determining gross transformation rates. Results from this method will be considered the "best estimates" of potential nitrogen transformation rates at the study sites, and will be the values to which results from all other methods will be compared.

Table 2. Reactor Configuration, Sampling Requirements and Analytical Methods to be Used for the ^{15}N Dilution Method

^{15}N Dilution Method Requirements	Water Column Reactor	Water + Sediment Reactor
Reactor Configuration	500 mL Wide Mouth Conical Flask, Two-Hole Stopper; Open During Aeration, Sealed w/Out Aeration	
Reactor Numbers	Triplicate Reactors, Three Site Locations	
Reactor Components	250 mL Water	30 g Sediment, 200 mL Water
Sampling Times	Reactors Subsampled @ 2, 4, 12, 24 hr w/Aeration; 2, 4, 12, 24 hr w/Out Aeration	
Operating Conditions	200 rpm for 24 hr (aeration); 30 rpm 24 hr (unaerated) @ 15°C	

$\delta^{15}\text{N}$ in Macrophytes

Nitrification and volatilization of ammonia both enrich ^{15}N in NH_4^+ while denitrification and other biological processing of nitrate enriches ^{15}N in NO_3^- . N in effluents from wastewater treatment plants can be enriched as much as 25 ‰ ($\delta^{15}\text{N} \leq 25$ ‰). This creates a signature that can be used to trace the nitrogen in a stream below a wastewater treatment plant outfall. The methods of Hood et al. (2014) will be used to estimate the fraction of N in macrophyte and filamentous algae biomass that comes from the treated wastewater downstream from the wastewater treatment facilities. Effluent samples collected in the summer, fall and winter will be analyzed for $\delta^{15}\text{N}$ in NO_3^- to estimate the average and range of $\delta^{15}\text{NO}_3^-$. Stream water will also be collected at the study locations for $\delta^{15}\text{NO}_3^-$ analysis. Material from three mats of macrophytes from each study location will be collected during late summer when the standing biomass is relatively high. In the laboratory, the material will be cleaned with tap water to remove invertebrates, and visible inorganic material. After drying at 60°C for 48 h, the material will be ground with a mortar and

pestle and weighed into tin capsules for $\delta^{15}\text{N}$ analysis. Analysis will be done in Dr. John Stark's laboratory in Utah State University's Biology Department.

In Situ Chambers for N-Assimilation, ANAMMOX, Denitrification and DNRA

Biological uptake of nitrogen in streams can account for substantial amounts of short-term removal of nitrogen and can, indirectly, contribute to permanent removal by enhancing denitrification (Mulholland et al., 2008). The in situ benthic chamber/plot method of O'Brien et al. (2012) for labeling stream macrophyte and biofilm biomass with $^{15}\text{NO}_3\text{-N}$ will be used to assay $\text{NO}_3\text{-N}$ assimilation and the fate of assimilated N. An aluminum frame, 0.6 x 0.3 m inserted 13 cm into the stream sediments will outline a plot. A clear acrylic plastic chamber, 0.6 x 0.3 x 0.15 m will be sealed to the frame to isolate the plot. A small submersible pump and flexible tubing fastened to the walls of the chamber will be used to circulate the water in the chamber. $^{15}\text{NO}_3\text{-N}$ will be added to the chambers to provide an enrichment of about 10 atom% ^{15}N to label biological compartments. The chambers will be sealed to the frames for approximately 24 h. Oxygen concentration in the chamber will be monitored with a dissolved oxygen probe and, if necessary, black plastic film will be used to block solar radiation and prevent oxygen saturation above ambient conditions. Total assimilation will be measured as the removal of $^{15}\text{NO}_3\text{-N}$ from the chamber corrected for leakage. Leakage will be determined using a Br^- tracer. After the 24 h monitoring period, the chambers will be removed and the plot will be exposed to ambient stream conditions. Near peak sun hours, at various multiple day intervals, e.g., 2, 7, 15 d after initial labeling, the chamber will be resealed to the frame for approximately 3 h. The in situ chamber studies will be conducted in two phases at each time of the year, beginning with the site downstream the effluent discharge point and ending with the one upstream, in order to avoid downstream interference by the upstream site ^{15}N enrichment.

The $\delta^{15}\text{N}$ abundances of NO_3^- and NH_4^+ as well as $^{29}\text{N}_2$ and $^{30}\text{N}_2$ will be determined at the start and end of each sampling period. Small amounts of macrophyte and sediment material will be collected from within the plot at the end of each sampling period and the $\delta^{15}\text{N}$ of the dried material will be determined.

Denitrification, assimilation, ANAMMOX, and DNRA will be quantified from chamber water using isotope pairing techniques. The procedures reported by Hou et al. (2012), Trimmer et al. (2003), and Thamdrup and Dalsgaard (2002) will be followed with some modifications; for example, no laboratory slurry experiments will be conducted because in situ chambers will be used. Denitrification and ANAMMOX will both be estimated in the study because isotope pairing techniques that determine denitrification only are reported to grossly overestimate this process (Hood et al., 2014; Hsu and Kao, 2013). Water samples will be collected in serum bottles and brought back to the lab where a headspace will be created by sparging the sample with He while simultaneously removing some of the water from the serum bottle. ^{15}N -labeled product quantification will be used to estimate potential rates ($\mu\text{mol } ^{15}\text{N kg}^{-1} \text{ h}^{-1}$) of denitrification, DNRA, ANAMMOX and assimilation in the water column (Hou et al., 2012). Analysis of dissolved $^{29}\text{N}_2$ and $^{30}\text{N}_2$ will be done by the UC Davis Stable Isotope Facility.

The $\delta^{15}\text{N}$ of NO_3^- and NH_4^+ will be determined by putting water samples through a diffusion process similar to that described in Stark and Hart (1996). Sediment samples will go through a KCl extraction, and this extract will also be used in the diffusion process. Analysis of the diffusion generated samples will be done at Dr. John Stark’s laboratory in Utah State University’s Biology Department.

Non-Isotope Specific Methods

Nitrapyrin Inhibition Method for Nitrification and Ammonification Rate

One of the several available methods for quantifying the rate of ammonia oxidation is the nitrapyrin inhibition method described by Henricksen and Kemp (1988), Kemp and Dodds (2002), Arango et al. (2008), and Norton and Stark (2011), among others. In this inhibition method, two sets of reactors are aerobically incubated, one with sediment/stream water + dimethyl sulfoxide (DMSO) and another with sediment/stream water + nitrapyrin dissolved in DMSO, with $\text{NH}_4^+\text{-N}$ monitored in both sets of reactors over time. Nitrapyrin is an effective nitrification inhibitor, and as ammonification (in the sediment-amended reactor) and nitrification proceed, $\text{NH}_4^+\text{-N}$ in the uninhibited reactors decreases during reactor aeration. Ammonification rates in the sediment-amended reactors are determined by the difference in $\text{NH}_4^+\text{-N}$ concentrations between the nitrapyrin inhibited reactors at time t and time 0 , while gross nitrification rates are determined from the difference in $\text{NH}_4^+\text{-N}$ over time between the inhibited and uninhibited reactors, accounting for ammonification rates. $\text{NH}_4^+\text{-N}$ concentrations will be determined in these reactors using EPA Method 350.1 Alkaline phenate method using a Seal AQ2 instrument at the Utah Water Research Laboratory Environmental Quality Laboratory. Details of the reactor configuration, sampling requirements, and analytical methods to be used for this nitrogen transformation rate evaluation technique are provided in Table 4. Results from this method will be compared to the “best estimates” of potential nitrogen transformation rates at the study sites provided by the ^{15}N Dilution Method described above.

Table 4. Reactor Configuration, Sampling Requirements and Analytical Methods to be Used for the Nitrapyrin Inhibition Method.

Nitrapyrin Inhibition Method Requirements	Water Column Reactor	Water + Sediment Reactor
Reactor Configuration	250 mL Wide Mouth Conical Flask, Two-Hole Stopper; Open During Aeration	
Reactor Numbers	Triplicate Reactors, Three Site Locations, with & without Inhibition	
Reactor Components	150 mL Water	20 g Sediment, 100 mL Water
Sampling Times	Reactors Subsampled @ 0, 2, 4, 12, 24 hr w/Aeration	
Operating Conditions	200 rpm for 24 hr (aeration) @ 15°C	

Acetylene Inhibition Method for Denitrification and Ammonification Rate

A corollary method to the nitrapyrin inhibition method for quantifying the rate of denitrification is the Acetylene Inhibition Method described by, for example, Henricksen and Kemp (1988), Kemp and Dodds (2002), and Arango et al. (2008). In this method, a set of reactors are anaerobically incubated with sediment/stream water + acetylene, with nitrous oxide (N₂O) monitored in the reactors over time. Acetylene is an effective inhibitor of both nitrification and the step in the denitrification process from N₂O to nitrogen gas. As denitrification occurs, NO₃⁻-N is converted to N₂O and accumulates within the headspace of acetylene inhibited reactors. Ammonification rates in the sediment-amended reactors can be determined in this assay by the difference in NH₄⁺-N concentrations between these acetylene inhibited reactors at time t and time 0. Gross denitrification rates are determined from the rate of accumulation of N₂O over time. Chloramphenicol, 0.1 g/L, is added to the reactors to inhibit denitrifying enzyme synthesis so that the activity of enzymes present at the initiation of the assay is determined. As indicated above, 2 N KCl extracted NH₄⁺-N concentrations will be determined in these reactors using EPA Method 350.1 Alkaline phenate method using a Seal Analytical AQ2 instrument, while N₂O concentrations will be measured in reactor headspace by gas chromatography and electron capture detection. All analyses will be carried out at the Utah Water Research Laboratory Environmental Quality Laboratory. Details of the reactor configuration, sampling requirements, and analytical methods to be used for this nitrogen transformation rate evaluation technique are provided in Table 5. Results from this method will be compared to the “best estimates” of potential nitrogen transformation rates at the study sites provided by the ¹⁵N Dilution Method and the Isotope Pairing Method described above.

Table 5. Reactor Configuration, Sampling Requirements and Analytical Methods to be Used for the Acetylene Inhibition Method.

Acetylene Inhibition Method Requirements	Water Column Reactor	Water + Sediment Reactor
Reactor Configuration	250 mL Septa Sealed Serum Bottles	
Reactor Numbers	Triplicate Reactors, Three Site Locations	
Reactor Components	200 mL Water, 50 mL Headspace	40 g Sediment, 150 mL Water, 50 mL Headspace
Sampling Times	Reactor Headspace Subsampled @ 0, 0.5, 1, 1.5, 2, 4 hr	
Operating Conditions	30 rpm for 4 hr @ 15°C	

Long-Term BOD Test Method for cBOD and Nitrification Rate

Conventional BOD methods have been used by McCutcheon (1987) to estimate nitrification rates in streams, and these procedures will be evaluated in this study to determine their applicability to nitrogen transformation processes taking place in the streams at the selected study sites. This method involves conducting long-term (~20 day) BOD tests with and without nitrification inhibition with nitrapyrin, and comparison of oxygen

consumption patterns due to carbonaceous BOD with those involving both carbonaceous and nitrogenous BOD expression. As indicated in the nitrapyrin inhibition method above, with the addition of this nitrification inhibitor, ammonia oxidation does not proceed, and oxygen consumption reflects heterotrophic carbon oxidation alone. Nitrification rates using this method are estimated based on: 1) the difference in oxygen consumption between inhibited and uninhibited reactors, and 2) nitrification rates fitted to a BOD equation reflecting oxygen consumption due to ammonia oxidation, accounting for the lag-phase associated with nitrification (McCutcheon, 1987). This methodology should generally be familiar to water reclamation facility staff, and uses standard BOD and DO measurement equipment. In addition, it provides data for measuring cBOD rate coefficients that have also been of interest for water quality modeling in Utah streams. Details of the reactor configuration, sampling requirements, and analytical methods to be used for this nitrogen transformation rate evaluation technique are provided in Table 6. Results from this method will be compared to the “best estimates” of potential nitrogen transformation rates at the study sites provided by the ¹⁵N Dilution Method described above.

Substrate/Product Chemical Measurement Method for Nitrification and Denitrification Rate

The final nitrogen transformation rate to be evaluated in this study involves the monitoring of nitrogen species (NH₄⁺-N, NO₂⁻-N, NO₃⁻-N) over time without inhibition to document the

Table 6. Reactor Configuration, Sampling Requirements and Analytical Methods to be Used for the Long-Term BOD Method.

Long-Term BOD Method Requirements	Water Column Reactor	Water + Sediment Reactor
Reactor Configuration	300 mL BOD Bottles	
Reactor Numbers	Triplicate Reactors, Three Site Locations, with and without Nitrapyrin Inhibition	
Reactor Components	300 mL Water	10 g Sediment, 290 mL Water
Sampling Times	Reactor DO Subsampled @ 0, 0.5, 1, 2, 3, 4, 5, 6, 8, 12, 16, 20 days	
Operating Conditions	Dark @ 20°C for 20 days	

release, production, and consumption of nitrogen species during both aerobic and anaerobic periods of incubation. These net nitrogen transformation rate measurements will be carried out using procedures similar to those indicated for the ¹⁵N Dilution Method except that analyses will be for unlabeled nitrogen species rather than ¹⁵N. As indicated above, NH₄⁺-N concentrations will be determined via EPA Method 350.1 Alkaline phenate method, while NO₂⁻-N + NO₃⁻-N will be determined via EPA Method 353.2 Cadmium coil reduction method, both using a Seal Analytical AQ2 instrument. As in all other sediment assays, NH₄⁺-N will be extracted from sediment using 2 N KCl. All analyses will be carried out at the Utah Water Research Laboratory Environmental Quality Laboratory. Details of

the reactor configuration, sampling requirements, and analytical methods to be used for this nitrogen transformation rate evaluation technique are provided in Table 7. Results from this method will be compared to the “best estimates” of potential nitrogen transformation rates at the study sites provided by the ¹⁵N Dilution Method, as well as the other inhibition and long-term BOD methods described above.

Table 7. Reactor Configuration, Sampling Requirements and Analytical Methods to be Used for the Substrate/Product Chemical Measurement Method.

Substrate/Product Chemical Measurement Method Requirements	Water Column Reactor	Water + Sediment Reactor
Reactor Configuration	500 mL Wide Mouth Conical Flask, Two-Hole Stopper; Open During Aeration, Sealed w/Out Aeration	
Reactor Numbers	Triplicate Reactors, Three Site Locations	
Reactor Components	250 mL Water	30 g Sediment, 200 mL Water
Sampling Times	Reactors Subsampled @ 0, 2, 4, 12, 24 hr w/Aeration; 0, 2, 4, 12, 24 hr w/Out Aeration	
Operating Conditions	200 rpm for 24 hr (aeration); 30 rpm 24 hr (unaerated) @ 15°C	

Work Plan, Task 3 – Data Reduction and Nitrogen Transformation Rate Estimates

¹⁵N Dilution Method

The data reduction approach for this method is to use $\delta^{15}\text{N}$ values measured over time from triplicate samples during an aeration period as well as an unaerated anaerobic period to calculate gross nitrification and denitrification rates, respectively. The Gross Nitrification Rate is calculated from this method during the aerobic period when active ammonia oxidation is taking place using Equation 1 (Norton and Stark, 2011),

$$\text{Gross Nitrification Rate} = \left(\frac{P_0 - P_t}{t} \right) \left(\frac{\log \frac{P_0}{P_t}}{\log \frac{I_0}{I_t}} \right) \quad (1)$$

where P = NO_3^- -N concentration, I = ¹⁵N atom percent enrichment, and 0 and t = initial and subsequent incubation times when samples are collected for analysis, respectively.

This method is applied to the determination of Gross Denitrification Rate though the monitoring of the loss of nitrate and ¹⁵N to the gas phase as nitrate is converted to nitrogen gas. Equation 2 (Norton and Stark, 2011) is used to calculate a Gross Denitrification Rate, noting that here, 0 represents the time at the beginning of the unaerated period, and t represents subsequent time intervals during this anaerobic period.

$$\text{Gross Denitrification Rate} = \left(\frac{P_0 - P_t}{t} \right) \left(\frac{\log \frac{P_0}{P_t}}{\log \frac{I_0}{I_t}} \right) - \left(\frac{P_t - P_0}{t} \right) \quad (2)$$

$\delta^{15}\text{N}$ in Macrophytes

The longitudinal trend for incorporation of wastewater treatment plant effluent N into macrophytes and filamentous algae will be determined using analysis of covariance of NO_3^- concentration, $\delta^{15}\text{NO}_3^-$, and biological material $\delta^{15}\text{N}$ versus distance downstream from the wastewater treatment plant discharge, where distance will be treated as a covariate.

In Situ Chambers for N-Assimilation, ANAMMOX, Denitrification and DNRA

A mass balance approach will be used for added $^{15}\text{NO}_3^-$ -N in the stream bottom plots, based on the disappearance of ^{15}N within the chamber corrected for leakage and apparent denitrification. Cumulative production of $^{15}\text{NO}_3^-$, $^{15}\text{NH}_4^+$, and $^{15}\text{N}_2$ from each plot will be calculated by integrating the rates of remineralization over the 15 day study period. Changes in concentrations and isotope enrichment of NO_3^- , NH_4^+ , and N_2 will be used in the isotope mixing model of Gilbert et al. (1982) to calculate NO_3^- uptake rates and denitrification during $^{15}\text{NO}_3^-$ addition; ammonium uptake and mineralization rates and nitrification and denitrification rates during the period following labeling.

Isotope pairing technique will be used to estimate potential assimilation, ANAMMOX, denitrification and DNRA. The following equations will be applied to estimate production rates.

$$P_{29} = A_{29} + D_{29} \quad (3)$$

where P_{29} is the total $^{29}\text{N}_2$ production rate; and A_{29} and D_{29} represent contributions of ANAMMOX and denitrification to the total $^{29}\text{N}_2$ production rate, respectively. Production rates of $^{29}\text{N}_2$ due to denitrification can be obtained from the following equation (Nielsen 1992; Risgaard-Petersen et al. 2003).

$$D_{29} = P_{30} \times 2(1 - F_N)F_N^{-1} \quad (4)$$

where D_{29} is the rate of denitrification originating from randomly paired ^{14}N and ^{15}N from either $^{14}\text{NO}_3^-$ or $^{15}\text{NO}_3^-$; P_{30} is the total production rates of $^{30}\text{N}_2$; and F_N represents the fraction of ^{15}N in NO_3^- . Denitrification and ANAMMOX rates based on $^{15}\text{NO}_3^-$ will be estimated from the following equations.

$$D_t = D_{29} + 2P_{30} \quad (5)$$

$$A_{29} = P_{29} - D_{29} \quad (6)$$

where D_t and A_{29} are denitrification and ANAMMOX rates for $^{15}\text{NO}_3^-$, respectively. The following equation (modified after Porubsky et al. 2008) will be used to estimate DNRA rates from the chamber experiments.

$$R_{DNRA} = ([^{15}\text{NH}_4^+]_{Final} - [^{15}\text{NH}_4^+]_{Initial})A^{-1}T^{-1} \quad (7)$$

where $[^{15}\text{NH}_4^+]_{Initial}$ is the initial $^{15}\text{NH}_4^+$ concentration, and $[^{15}\text{NH}_4^+]_{Final}$ is the concentration of $^{15}\text{NH}_4^+$ at the end of the experiments; and A and T are the surface area of the sediment-water column interface in the frame (m^2) and incubation time (hours), respectively. Cation exchange between $^{14}\text{NH}_4^+$ and $^{15}\text{NH}_4^+$ is not considered in the N transformation rates.

Assimilation rates based on $^{15}\text{NO}_3^-$ will be determined from the following equation.

$$R_{Assimi} = F_{^{15}\text{NO}_3^-} - D_t - A_{29} - R_{DNRA} \quad (8)$$

where R_{Assimi} represents the microbial nitrate assimilation rate; $F_{^{15}\text{NO}_3^-}$ is the total $^{15}\text{NO}_3^-$ removal from the experiments; and D_t , A_{29} , and R_{DNRA} are denitrification, ANAMMOX and DNRA rates based on $^{15}\text{NO}_3^-$, respectively.

Nitrapyrin Inhibition Method

Two nitrogen transformation rates can be determined using this method, the nitrification rate and the ammonification rate in water column and water + sediment reactors. Gross Ammonification Rates will be calculated as the difference between NH_4^+ -N concentrations in nitrapyrin inhibited reactors at time t and time 0 as shown in Equation 9.

$$\text{Gross Ammonification Rate} = \left(\frac{\text{Ami}_t - \text{Ami}_0}{t} \right) \quad (9)$$

where Ami = NH_4^+ -N concentration in the nitrapyrin inhibited reactors, and 0 and t = initial and subsequent incubation times when samples are collected for analysis, respectively.

Gross Nitrification Rates are determined with this procedure from the difference in NH_4^+ -N over time between the inhibited and uninhibited reactors, corrected for ammonification rates observed in the inhibited reactors. Assuming that ammonification occurs at the same rate in both the inhibited and uninhibited reactors, the gross nitrification rate can then be expressed as shown in Equation 10, where Amu = NH_4^+ -N concentration in the uninhibited reactors.

$$\text{Gross Nitrification Rate} = \left(\frac{\text{Ami}_t - \text{Amu}_t}{t} \right) \quad (10)$$

Acetylene Inhibition Method

Two nitrogen transformation rates can be determined using this method, the denitrification rate and the ammonification rate in water column and water + sediment reactors. Gross Ammonification Rates will be calculated as the difference between $\text{NH}_4^+\text{-N}$ concentrations in acetylene inhibited reactors at time t and time 0 as shown in Equation 11.

$$\text{Gross Ammonification Rate} = \left(\frac{\text{Amia}_t - \text{Amia}_0}{t} \right) \quad (11)$$

where $\text{Amia} = \text{NH}_4^+\text{-N}$ concentration in the acetylene inhibited reactors, and 0 and t = initial and subsequent incubation times when samples are collected for analysis, respectively.

Gross Nitrification Rates are determined with this procedure from the difference in $\text{NH}_4^+\text{-N}$ over time between the inhibited and uninhibited reactors, corrected for ammonification rates observed in the inhibited reactors. Assuming that ammonification occurs at the same rate in both the inhibited and uninhibited reactors, the Gross Nitrification Rate can then be expressed as shown in Equation 12, where $\text{Amua} = \text{NH}_4^+\text{-N}$ concentration in the uninhibited reactors.

$$\text{Gross Nitrification Rate} = \left(\frac{\text{Amia}_t - \text{Amu}_t}{t} \right) \quad (12)$$

Long-Term BOD Test Method

Both a carbonaceous BOD (cBOD) and nitrification rate can be determined using data generated from this method. The cBOD rate can be estimated from nitrapyrin inhibited oxygen consumption data analyzed using the Thomas Method or via non-linear least-squares regression analysis (McCutcheon, 1987). Nitrification rates are determined by first determining net oxygen consumption associated with nitrogenous BOD (nBOD), then fitting these nBOD data using non-linear least squares regression. The nBOD oxygen values are calculated at each time, t , using Equation 13, with $\text{TBOD}_t = \text{Total BOD at time } t$ in the uninhibited BOD test.

$$\text{nBOD}_t = \text{TBOD}_t - \text{cBOD}_t \quad (13)$$

From these nBOD $_t$ (L_N) data, Nitrification Rates, K_N , are determined by minimizing the mean square error of data fitting to the nitrogenous BOD curve shown in Equation 14 (McCutcheon, 1987), with t_{lag} = the lag period in days to the start of nitrification estimated from the nBOD data, and L_{N0} = the ultimate nitrogenous BOD of the sample.

$$L_N = L_{N0} \exp[-K_N(t - t_{\text{lag}})] \text{ for } t \geq t_{\text{lag}} \quad (14)$$

Substrate/Product Chemical Measurement Method

Both Net Nitrification and Net Denitrification rates can be determined from data collected using this method. Uninhibited reactors are sampled over time for nitrogen species ($\text{NH}_4^+\text{-N}$, $\text{NO}_2^-\text{-N}$, $\text{NO}_3^-\text{-N}$), and changes in species concentrations are used to estimate nitrogen transformation rates as shown in Equation 15 for nitrification during reactor aeration, and in Equation 16 for denitrification following the cessation of oxygen input

$$\text{Net Nitrification Rate} = \left(\frac{Am_0 - Am_t}{t} \right) \text{ for } t = 0 \text{ to } t_d \quad (15)$$

$$\text{Net Denitrification Rate} = \left(\frac{N_{t_d} - N_{(t_d + \Delta t)}}{\Delta t} \right) \text{ for } t \geq t_d \quad (16)$$

where Am = NH_4^+ -N concentration, and N = NO_2^- -N + NO_3^- -N concentrations at time 0, time t , and at the beginning of denitrifying conditions at t_d , and Δt = cumulative time after the start of denitrification.

Work Plan, Task 4 – Method Results Discussion and Recommendations

The results of each nitrogen transformation rate estimation method evaluated in this study will be compared to the results of the corresponding “research grade” isotope methods to allow final recommendations for one or more methods that provide representative estimates of nitrification, denitrification, and ammonification rates, and the significance and rate of ANAMMOX and DNR for background and impacted site locations. Comparisons, discussion and recommendations will be based on the method’s precision and measurement error; time, material and personnel requirements; costs; multi-parameter estimate capabilities; and applicability to water column and/or sediment sample matrices.

Timeline

Table 8 presents a timeline proposed for the research plan for two field sampling sites described above. It is anticipated that initial sample collection will take place no later than mid to late-August 2015, with a second seasonal sampling event occurring 3 to 4 months later in November/December, 2015, with all experimental studies completed by Month 8 of the project. Isotope analyses are anticipated to be completed within 6 to 12 weeks of sample collection, and final data analyses and data reduction are scheduled for completion by Month 9 of the study. Data reporting, recommendations and draft report submission for Agency review is anticipated by Month 9 after initiation of the study. After Agency review in Month 10 of the study, final report revision (Month 11) and submission is anticipated by Month 12 of the study.

Table 8. Timeline for the Completion of Proposed Work at Two Field Sites

	Mo 1	Mo 2	Mo 3	Mo 4	Mo 5	Mo 6	Mo 7	Mo 8	Mo 9	Mo 10	Mo 11	Mo 12
Task Description												
Task 1 Sample Collection	■	■		■	■							
Task 2 Nitrogen Transformation Studies												
Short-Term Tests	■	■		■	■							
Long-Term BOD Test	■	■		■	■							
Isotope Analysis	■	■	■		■	■	■	■				
Task 3 Data Reduction			■	■	■	■	■	■	■			
Task 4 Discussion & Recommendations							■	■	■			
Draft Report Preparation								■				
Draft Report Agency Review									■	■		
Draft Report Revisions											■	■
Final Draft Report Submission											■	■

Budget

Table 9 presents a budget for the proposed research plan described above. This budget is presented as fixed price and will be valid for 90 days following the submission of this proposal.

Table 9. Budget for Completion of Proposed Work at Two Field Sites

Cost Categories	Units	# Units	Unit Rate	Total
Salaries & Wages				
Faculty	Mo	1.5	\$11,419.42	\$ 17,129.13
Post Doc	Mo	6	\$ 3,120.00	\$ 18,720.00
Student, MS	Mo	24	\$ 1,610.00	\$ 38,640.00
Total Salaries & Wages				\$ 74,489.13
Benefits - Staff Faculty/students	%		45.5/8.1	\$ 19,441.19
GRA Ins				\$ 3,752.00
Travel				\$ 1,500.00
Supplies/Analytical Costs				\$ 10,000.00
EQL Usage	hr	3200	\$ 4.35	\$ 13,919.91
Equipment				\$ -
				=====
Subtotal				\$123,102.24
IDC	%		10.00	\$ 12,310.22
				=====
Total Estimated Cost				\$135,412.46

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Amanda Smith
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MEMORANDUM

TO: Utah Water Quality Board

THROUGH: Walter L. Baker, P.E. 

FROM: John Mackey, P.E.
Staff Engineer

DATE: September 24, 2014

SUBJECT: Change in Proposed Rule R317-1-3.3 Technology-Based Limits for Controlling Phosphorus Pollution (Second Amendment)

The purpose of this memorandum is to request authorization from the Utah Water Quality Board to proceed with a second Change in Proposed Rule (CPR2) under the rulemaking that was initiated on April 30, 2014 to amend the subject rule. The proposed amendment institutes a technology-based effluent limit of 1 mg/L total phosphorus, applicable to all non-lagoon wastewater treatment works discharging into surface waters of the state, with exceptions as defined under the proposed rule amendment. Lagoon wastewater treatment works discharges instead receive a cap on total phosphorus discharges.

Background

Public comments on the original proposed Rule amendment were accepted between June 1, 2014 and August 1, 2014. The Division received 38 comments from seven individuals representing wastewater utilities, engineering firms, environmental interest groups, and industry. Staff presented its responses to these comments to the Board on August 27, 2014 and requested the Board to proceed with Change in Proposed Rule (CPR1) to address several important issues raised by commenters. During discussions on CPR1, the Board requested information about how CPR1 would affect industry. Among 64 industrial permits reviewed, staff identified two major dischargers (ATK Launch Systems and Chevron USA) and one minor discharger (Salt Lake Airport) that will likely be affected by the proposed amendment. Nine dischargers (including Kennecott Utah Copper) had measured total phosphorus concentrations less than 0.5 mg/L although in many cases sample numbers were limited to one or two samples. At least 31 dischargers, including two majors, were identified that may have potential to discharge phosphorus but could not be definitively evaluated from the Division's water quality database. Following staff's review, we recommend that the Board delay the implementation of the self-monitoring

for six months to a July 1, 2015 start date to allow time for further evaluation of these and possibly other industrial facilities and determine their potential to discharge phosphorus above the proposed 1 mg/L limit. A Change in Proposed Rule that addresses these issues is attached.

Summary of Changes in Proposed Rule

1. Variance R317-1-3.3.C.1.b was changed to clarify that in cases of economic hardship, an alternative TBPEL or phosphorus loading cap that would not cause economic hardship, may be applied. Previous language indicated first that no TBPEL or cap would be applied, then, in a later sentence indicated that the alternative limits may apply.
2. R317-1-3.3.D.2 provided an off-ramp from monitoring when dischargers demonstrate no reasonable potential to discharge phosphorus or nitrogen. The proposed change allows the Director to make this determination.
3. R317-1-3.3-D.4 establishes the starting date for self-implementation of nitrogen and phosphorus monitoring. The proposed change extends the starting date six months to July 1, 2015.
4. Other changes, such as technical editing, were non-substantive.

Staff Recommendation

Staff recommends that the Water Quality Board authorize continuing with rulemaking for the Change in Proposed Rule. Notice of the Change in Proposed Rule will be published for a 30-day public comment period.

Attachments

1. Change in Proposed Rule (CPR2)

R317. Environmental Quality, Water Quality.

R317-1. Definitions and General Requirements.

R317-1-3. Requirements for Waste Discharges.

3.1 Compliance With Water Quality Standards.

All persons discharging wastes into any of the waters of the State shall provide the degree of wastewater treatment determined necessary to insure compliance with the requirements of Rule R317-2 Water Quality Standards, except that the Director may waive compliance with these requirements for specific criteria listed in Rule R317-2 where it is determined that the designated use is not being impaired or significant use improvement would not occur or where there is a reasonable question as to the validity of a specific criterion or for other valid reasons as determined by the Director.

3.2 Compliance With Secondary Treatment Requirements.

All persons discharging wastes from point sources into any of the waters of the State shall provide treatment processes which will produce secondary effluent meeting or exceeding the following effluent quality standards.

A. The arithmetic mean of BOD values determined on effluent samples collected during any 30-day period shall not exceed 25 mg/l, nor shall the arithmetic mean exceed 35 mg/l during any 7-day period. In addition, if the treatment plant influent is of domestic or municipal sewage origin, the BOD values of effluent samples shall not be greater than 15% of the BOD values of influent samples collected in the same time period. As an alternative, if agreed to by the person discharging wastes, the following effluent quality standard may be established as a requirement of the discharge permit and must be met: The arithmetic mean of CBOD values determined on effluent samples collected during any 30-day period shall not exceed 20 mg/l nor shall the arithmetic mean exceed 30 mg/l during any 7-day period. In addition, if the treatment plant influent is of domestic or municipal sewage origin, the CBOD values of effluent samples shall not be greater than 15% of the CBOD values of influent samples collected in the same time period.

B. The arithmetic mean of SS values determined on effluent samples collected during any 30-day period shall not exceed 25 mg/l, nor shall the arithmetic mean exceed 35 mg/l during any 7-day period. In addition, if the treatment plant influent is of domestic or municipal sewage origin, the SS values of effluent samples shall not be greater than 15% of the SS values of influent samples collected in the same time period.

C. The geometric mean of total coliform and fecal coliform bacteria in effluent samples collected during any 30-day period shall not exceed either 2000 per 100 ml or 200 per 100 ml respectively, nor shall the geometric mean exceed 2500 per 100 ml or 250 per 100 ml respectively, during any 7-day period; or, the geometric mean of E. coli bacteria in effluent samples collected during any 30-day period shall not exceed 126 per 100 ml nor shall the geometric mean exceed 158 per 100 ml respectively during any 7-day period. Exceptions to this requirement may be allowed by the Director where domestic wastewater is not a part of the effluent and where water quality standards are not violated.

D. The effluent values for pH shall be maintained within the limits of 6.5 and 9.0.

E. Exceptions to the 85% removal requirements may be allowed where infiltration makes such removal requirements infeasible and where water quality standards are not violated.

F. The Director may allow exceptions to the requirements of Subsections R317-1-3.2.A, R317-1-3.2.B, and R317-1-3.2.D where the discharge will be of short duration and where there will be no significant detrimental effect on receiving water quality or downstream beneficial uses.

G. The Director may allow that the BOD5 and TSS effluent concentrations for discharging domestic wastewater lagoons shall not exceed 45 mg/l for a monthly average nor 65 mg/l for a weekly average provided the following criteria are met:

1. the lagoon system is operating within the organic and hydraulic design capacity established by Rule R317-3;
2. the lagoon system is being properly operated and maintained;
3. the treatment system is meeting all other permit limits;
4. there are no significant or categorical industrial users (IU) defined by 40 CFR Part 403, unless it is demonstrated to the satisfaction of the Director that the IU is not contributing constituents in concentrations or quantities likely to significantly affect the treatment works; and
5. a Waste Load Allocation (WLA) indicates that the increased permit limits would not impair beneficial uses of the receiving stream.

3.3 Technology-based Limits for Controlling Phosphorus Pollution.

A. Technology-based Phosphorus Effluent Limits (TBPEL)

1. All non-lagoon treatment works discharging wastewater to surface waters of the state shall provide treatment processes which will produce effluent less than or equal to an annual mean of 1.0 mg/L for total phosphorus.

2. The TBPEL shall be achieved by January 1, 2020.

B. Discharging Lagoons -Phosphorus Loading Cap

1. No TBPEL will be instituted for discharging treatment lagoons. Instead, each discharging lagoon will be evaluated to determine the current annual average total phosphorus load based on average flows and concentrations. Absent field data to determine these loads, they will be estimated by the Division.

2. A cap of 125% times the current average annual total phosphorus load will be established and referred to as phosphorus loading cap. Once the lagoon's phosphorus loading cap has been reached, the owner of the facility will have five years to construct treatment processes or implement treatment alternatives to prevent the total phosphorus loading cap from being exceeded.

C. Variances for TBPEL and Phosphorus Loading Caps

1. The Director may authorize a variance to the TBPEL or phosphorus loading cap under any of the following conditions:

a. Where an existing TMDL has allocated a total phosphorus wasteload to a treatment works, no TBPEL or phosphorus loading cap, as applicable, will be applied.

b. If the owner of a discharging treatment works can demonstrate that imposing the TBPEL or phosphorus loading cap would result in an economic hardship, an alternative ~~[-for the users of the treatment works, no]~~ TBPEL or phosphorus loading cap that would not cause economic hardship may ~~[will]~~ be applied. "Economic hardship" for a publicly owned treatment works is defined as sewer service costs that, as a result of implementing a TBPEL or phosphorus loading cap, would be greater than 1.4% of the median adjusted gross household income of the service area based on the latest information compiled by the Utah State Tax Commission, after inclusion of grants, loans, or other funding made available by the Utah Water Quality Board or other sources. ~~[If this variance is granted, the discharging treatment works may receive an alternative TBPEL or phosphorus loading cap that would fail to cause economic hardship.]~~ The Director will consider other demonstrations of economic hardship on a case-by-case basis.

c. If the owner of a discharging treatment works can demonstrate that the TBPEL or phosphorus loading cap are clearly unnecessary to protect waters downstream from the point of discharge, no TBPEL or phosphorus loading cap will be applied.

d. If the owner of the discharging treatment works can demonstrate that a commensurate phosphorus reduction can be achieved in receiving waters using innovative alternative approaches such as water quality trading, seasonal offsets, effluent reuse, or land application.

2. All variances to TBPEL and phosphorus loading caps shall be revisited periodically to determine if the rationale used to justify the conditions in Subsection R317-1-3.3.C remains applicable.

3. For treatment works required to implement TBPEL or a phosphorus loading cap, the demonstration under Subsection R317-1-3.3.C must be made by January 1, 2018. Unless this demonstration is made, the owner of the discharging treatment works must proceed to implement the TBPEL or phosphorus loading cap, as applicable, in accordance with, respectively, Subsections R317-1-3.3.A and R317-1-3.3.B.

D. Monitoring

1. All discharging treatment works are required to implement, at a minimum, monthly monitoring of:

a. influent for total phosphorus (as P) and total Kjeldahl nitrogen (as N) concentrations; and
b. effluent for total phosphorus and orthophosphate (as P), and ammonia, nitrate-nitrite, and total Kjeldahl nitrogen (as N).

2. ~~[If a discharging treatment works demonstrates to the Director that there is no reasonable potential to discharge nitrogen or phosphorus, the monitoring requirement identified in Subsection R317-1-3.3.D.1 will be waived.]~~The Director may authorize a variance to the monitoring requirements identified in Subsection R317-1-3.3.D.1.

3. All monitoring under Subsection R317-1-3.3.D shall be based on 24-hour composite samples by use of an automatic sampler or minimum of four grab samples collected a minimum of two hours apart.

4. These monitoring requirements shall be self-implementing beginning ~~[January]~~July 1, 2015.

3.4 Pollutants In Diverted Water Returned To Stream.

A user of surface water diverted from waters of the State will not be required to remove any pollutants which such user has not added before returning the diverted flow to the original watercourse, provided there is no increase in concentration of pollutants in the diverted water. Should the pollutant constituent concentration of the intake surface waters to a facility exceed the effluent limitations for such facility under a federal National Pollutant Discharge Elimination System permit or a permit issued pursuant to State authority, then the effluent limitations shall become equal to the constituent concentrations in the intake surface waters of such facility. This section does not apply to irrigation return flow.

KEY: water pollution, waste disposal, nutrient limits, effluent standards

Date of Enactment or Last Substantive Amendment: 2014

Notice of Continuation: October 2, 2012

Authorizing, and Implemented or Interpreted Law: 19-5



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Walter L. Baker
Executive Secretary

MEMORANDUM

TO: Utah Water Quality Board

THROUGH: Walter L. Baker, P.E.
Director

FROM: Paul Krauth, PE

DATE: September 15, 2014

SUBJECT: Evaluation of Proposed Technology-Based Phosphorus Effluent Limit (TBPEL) Impact on Utah's Industrial UPDES Permits.

At the request of the Board, staff conducted a review of the potential impact of the proposed Technology-Based Phosphorus Effluent Limit (TBPEL) on industrial dischargers in the state. Staff conducted data search of the *Ambient Water Quality Monitoring System (AWQMS)* which contains Utah sampling data collected by DWQ. The search revealed that historically there was limited or no analysis of nutrients for most industrial discharges.

There are currently sixty-four (64) industrial facilities with individual UPDES permits. Twelve (12) permits are considered "major" facilities with discharge flows in excess of one million gallons per day (MGD). There are also three general permits of concern: Coal Mining Operations, Concentrated Aquatic Animal Feeding Operations, and Drinking Water Treatment Plants. The remaining general permits were not evaluated because they were either considered to be non-discharging facilities (as is the case with Concentrated Animal Feeding Operations) or they were considered to have no reasonable potential to discharge phosphorus. This latter group included Small Municipal Separate Storm Sewer Systems, Construction Dewatering or Hydrostatic Testing, Application of Pesticides, Treated Ground Water, and Construction Activities.

Included in the draft rule is a requirement for monthly monitoring for nutrients for "All discharging treatment works with reasonable potential to discharge phosphorus." There are two concepts involved with this statement; first the definition of *treatment works*. R317-1-1 defines "treatment works" as any plant, disposal field, lagoon, dam, pumping station, incinerator, or other works used for the purpose of treating, stabilizing or holding wastes. There is a group of direct dischargers that do meet the definition of a treatment work. An example of this group would be

Weir Specialty Pumps, which discharges potable water used in leak testing their pumps. So this group should be excluded from the rule by not meeting the definition of a “*treatment work*”.

After the initial data analysis, the Concentrated Aquatic Animal Feeding Operations (Fish Hatcheries) were found to have *no reasonable potential* to discharge phosphorus, based on 882 samples from 22 different facilities. The average phosphorus concentration of this group was 68 micrograms per liter (µg/L), with a maximum concentration of 247 µg/L. There is much less data available for the Coal Mining Operations but, based on the data we have, they appear to have *no reasonable potential*, based on two (2) samples from two (2) different facilities. The average of this group was 64 µg/L, with a maximum of 108 µg/L. Since none of the source waters used by the Drinking Water Treatment Plants begins approach the 1 mg/L limit, their backwash discharges were determined to have *no reasonable potential* either.

All of the remaining facilities were evaluated for *reasonable potential* using the AWQMS water quality data that were collected between year 2000 up to the present. Any facility showing ***all*** results below the 1 mg/L limit was considered to have *no reasonable potential*. Additionally, any facility discharging to a TMDL nutrient limited segment was excluded from this list as the TMDL will supersede the TBEPL.

From this screening process, the following facilities must be considered further for their potential to be impacted by the proposed rule.

Known Phosphorus Impacts

	Facility	Type	Reason	Watershed
1	ATK Launch System	Major	>1 mg/L	Great Salt Lake
2	Chevron	Major	>1 mg/L	Great Salt Lake
1	Salt Lake Airport	Minor	>1 mg/L	Great Salt Lake

Unknown Phosphorus Impacts

	Facility	Type	Reason	Watershed
1	ATI Titanium	Major	No Data	Great Salt Lake
2	CFC - SUFCO Mine	Major	No Data	Western Colorado
1	Air Products	Minor	No Data	Great Salt Lake
2	Alton Coal	Minor	No Data	Lower Colorado
3	Andalex - Centennial Mine	Minor	No Data	Western Colorado
4	Bluffdale Cooling	Minor	No Data	Great Salt Lake
5	CF - Dugout Canyon Mine	Minor	No Data	Western Colorado
6	CF – Soldier Canyon Mine	Minor	No Data	Western Colorado
7	Chamberlain Investments	Minor	No Data	Bear River
8	EFR - Rim Mine	Minor	No Data	Southeast Colorado
9	EFR - Queen Mine	Minor	No Data	Southeast Colorado
10	Fresenius Medical Care	Minor	No Data	Weber River
11	Genwal Resources—Crandal Canyon	Minor	No Data	Western Colorado
12	Harley Dome 1 Produced Water	Minor	No Data	Southeast Colorado
13	Hexcel Corporation—SLC	Minor	No Data	Great Salt Lake
14	Hiawatha Coal Company	Minor	No Data	Western Colorado
15	Holcim (US) inc.	Minor	No Data	Weber River
16	Intermountain Concrete	Minor	No Data	Uinta Basin
17	Nephi Rubber Products	Minor	No Data	Jordan River
18	Nucor Steel	Minor	No Data	Great Salt Lake
19	Oldcastle Precast	Minor	No Data	Weber River
20	Pacificorp Cottonwood - Wilberg Mine	Minor	No Data	Western Colorado
21	Pacificorp - Deer Creek Mine	Minor	No Data	Western Colorado
22	PacifiCorp - James Canyon Wells	Minor	No Data	Western Colorado
23	Pacificorp - Trail Mountain Mine	Minor	No Data	Western Colorado
24	Questar -Wasatch Chemical Superfund	Minor	No Data	Jordan River
25	Saratoga Springs	Minor	No Data	Jordan River
26	Sunnyside Cogeneration	Minor	No Data	Western Colorado
27	Uranium One - Velvet Mine	Minor	No Data	Southeast Colorado
28	West Ridge Resources	Minor	No Data	Western Colorado
29	Western Energy	Minor	No Data	Uinta Basin
30	Western Energy - Ashley Valley	Minor	No Data	Uinta Basin
31	Western - USA Pan American	Minor	No Data	Uinta Basin

Given this large unknown universe, staff recommends that the Board delay the implementation of the self-monitoring for six months to a July 1, 2015 start date. This delay will allow time for the Division to complete an evaluation of these thirty three (33) facilities to determine their *reasonable potential* to discharge phosphorus above the proposed 1 mg/L limit.



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Executive Secretary

MEMORANDUM

TO: Utah Water Quality Board

THROUGH: Walter L. Baker 

FROM: Jim Harris

DATE: September 24, 2014

SUBJECT: Update on Integrated 2014 Report

After presenting to the WQ Board and releasing the Draft 2104 Integrated Report, DWQ staff has compiled public comment and revised some of the assessment methods and results. Staff will be presenting the results of the final version, summarizing the change between the draft and final versions of the IR, and providing an overview of public comment.

Topics will include:

1. Brief summary of public comment focusing on comments that resulted in changes to assessment methods and results.
2. A comparison between the draft report and the final version, highlighting changes in the number of impairments by parameter. (For example: best professional judgment from staff, changes with aluminum methods, precious listing errors etc.)
3. Corresponding information on assessment methods changes and future plans on continued improvements to the IR program.
4. A comparison between 2010/303d and 2014/303d lists for rivers and streams.

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Leaders detail Utah's water challenges

By Amy Joi O'Donoghue, Deseret News

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Published: Tuesday, Sept, 16 2014 7:10 p.m. MDT
Updated: 18 hours ago

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Summary

A joint report to the Utah Water Development Commission described challenges faced by one of the state's most precious resources — from guarding against groundwater depletion, maintaining clean drinking water and ensure adequate supplies.

SALT LAKE CITY — Utah's top authorities on water say the pulse of one of the state's most precious resources indicates it is facing a number of maladies that will only grow worse over time if neglected.

"We only have so much water, and the supply is less reliable because our weather patterns are changing, yet we have the second-fastest growing state in the nation with a growing demand," said Mike Styler, executive director of the Utah Department of Natural Resources.

Styler, joined by Utah water quality head Walt Baker, gave a tag-team presentation Tuesday to members of the Utah State Water Development Commission — the same presentation they delivered hours earlier to Utah Gov. Gary Herbert.

The governor, Styler said, wanted a nuts-and-bolts checkup on all things water in the state — from issues surrounding water right adjudications, streams, rivers and lakes that may be impaired, dams in need of repairs and projects on the table to ensure supplies into the future.

Pointing to the voluminous data contained in the presentation, Styler said it is easy to underscore the vast array of complex challenges that are inherent in a water supply and delivery system for the nation's second driest state.

"We need with legal certainty to be able to provide clean and abundant water to meet Utah's growing needs," he said.

Baker added that critical challenges face the state in terms of water quality, including dollars for a comprehensive plan to address nutrient pollution and other pollution issues that plague 45 percent of the state's waterways.

Styler, backed by Baker in his blow-by-blow descriptions of how Utah water funding goes begging, described a flood of languishing needs or areas of concern that he said will merit attention, sooner rather than later.

Among them:

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• Aging dams in the statewide system that with a \$16 million contribution from state coffers could free up \$30 million from the federal government to fix high-hazard problems

• An estimated 32,000 water rights in the Jordan/Utah Lake basin that need adjudication. With the current staffing levels, Styler estimated that task would take 150 years. With an infusion of \$14.2 million, those troubled water right fights could be resolved in 10 years.

• Infrastructure for new water supply and systems, as well as repairs, that has been put at \$32.6 billion.

Styler said a 1/16 of 1 cent sales tax levy would take care of all those needs, save the most controversial projects like the Lake Powell Pipeline and the Bear Lake Water Development, which seeks to divert water from the Bear River for use along the crowded and growing Wasatch Front.

While state money managers have been willing to dole out dollars over the years to fund a robust transportation system, Styler said the water needs have largely, and quietly, gone begging.

"Now it is water's turn to catch up," he said.

The presentation precedes the Wednesday release of a report by the Utah Foundation that looks at the state's population growth and water resources.

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About the Author



Amy Joi O'Donoghue

Amy Joi O'Donoghue is the environmental reporter the Deseret News, specializing in coverage of issues that affect land, air, water and energy development. She has worked here since 1998 and has been an assistant city [more ..](#)

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