Utah Lake Water Quality Study (ULWQS)
Science Panel
August 3, 12:00 PM to 3:00 PM
Virtual Meeting
Meeting Summary - DRAFT

ATTENDANCE:
Science Panel Members: Mike Brett, Greg Carling, Mitch Hogsett, Theron Miller, Michael Mills, and Hans Paerl

Steering Committee Members and Alternates: Eric Ellis and John Mackey

Members of the Public: Zach Aanderud, Paul Abate, Jeff DenBleyker, Eric Duffin, Tina Laidlaw, Renn Lambert, Leland Myers, Dan Potts, David Richards, and Soren Simonsen

Utah Division of Water Quality (DWQ) staff: Scott Daly, Jodi Gardberg, Chris Otto, and Ashley Sumner

Technical Consultants: Kateri Salk

Facilitation Team: Heather Bergman and Samuel Wallace

ACTION ITEMS

Who	Action Item	Due Date	Date Completed
Scott Daly	Provide a nomination form to Science Panel members to indicate who they would like to fill empty Science Panel seats.	August 31	
Theron Miller	Reach out to Wood Miller to see if he can provide the data from his study in an Excel file. (DWQ can transfer the photocopied data into an Excel file if an Excel file is not available.)	August 31	
Science Panel Members	Reach out to Samuel if there are any papers in the Atmospheric Deposition Resources folder that are proprietary and cannot be shared with the public.	August 10	August 10
	Email their regular availability to Samuel Wallace if they are interested in participating in the Atmospheric Deposition Subgroup.	August 10	August 10

DECISIONS AND APPROVALS
No formal decisions or approvals were made at this meeting.

GROUND RULES AND PROCESS COMMITMENTS OVERVIEW
Heather Bergman, Peak Facilitation Group, gave an overview of the Science Panel ground rules and process commitments. The ground rules and process commitments of the Science Panel are listed below.

- The Science Panel process commitments are:
    - Seek to learn and understand each other's perspective
    - Encourage respectful, candid, and constructive discussions

    - Seek to resolve differences and reach consensus
    - As appropriate, discuss topics together rather than in isolation
    - Make every effort to avoid surprises
- The Science Panel ground rules are:
    - Focus on the task at hand
    - Have one person speaking at a time
    - Allow for a balance of speaking time by providing succinct statements and questions
    - Listen with respect

SCIENCE PANEL MEMBERSHIP UPDATES

Scott Daly, DWQ, provided updates on Science Panel membership. His comments are summarized below.

- James Martin and Ryan King, unknowingly from one another, decided to step down from their role as Science Panel members due to undisclosed personal reasons. In the past year, Soren Brothers, an ex-officio member, also stepped down from the Science Panel to take a new job.
- Several members of the ULWQS Steering Committee have also stepped down from their roles, including Neal Winterton, Nancy Mesner, and Ella Sorenson.
- According to the Science Panel Operating Procedures, the first step for recruiting new Science Panel members is to receive input from current Science Panel members about who should fill those seats based on their expertise. The Steering Committee will take the Science Panel members' recommendations and nominate someone to fill the empty Science Panel seats. Scott Daly will provide a nomination form to Science Panel members to indicate who they would like to fill empty Science Panel seats.

SCIENCE PANEL OPERATING PRINCIPLES

Heather Bergman, Peak Facilitation Group, provided an overview of Science Panel decision-making protocols according to their operating principles. Her comments are summarized below.

- The Science Panel operating principles define a quorum as two-thirds of Science Panel members. Since seven people are left on the Science Panel, five Science Panel members must be present to make a decision.
- The Science Panel aims to work toward a consensus recommendation for water quality criteria.
- Science Panel decisions will be based on a simple majority. However, the operating principles state that the Science Panel will strive to achieve the full support of recommendations where possible and as time permits. Without consensus, Science Panel members may choose to articulate areas of agreement and disagreement and why differences continue to exist.

DRAFT SYNTHESIS DOCUMENT OVERVIEW

Kateri Salk, Tetra Tech, provided an overview of the draft synthesis document. Her comments are summarized below.

Draft Synthesis Document Overview

- The goals of the presentation are to summarize the atmospheric deposition work to date, apply the Uncertainty Guidance Framework to evaluate sources of evidence, and recommend atmospheric deposition estimates to the EFDC/WASP modeling team.
- The synthesis document compiles and reviews all sources of evidence and evaluates confidence using the Science Panel's Uncertainty Guidance Framework. The synthesis

document also synthesizes recommendations based on previous Science Panel recommendations and the third-party review conducted by David Gay. A Science Panel subgroup provided edits on the document. The synthesis document is meant to present a compilation of previous and current Science Panel work; it is not a proposed recommendation from Tetra Tech.

- Before the meeting, Science Panel members provided comments on the synthesis document. One comment indicated concerns about using estimates from 2015 to 2020 rather than the most up-to-date loads to calibrate the model, particularly publicly owned treatment work (POTW) loads. The reason for using this period is that the EFDC/WASP needs to be calibrated with known data. The years 2015 to 2020 are the most recent years with complete datasets. Once completed, the calibrated model can run scenarios to simulate current and future reductions in loads.
- The mass balance analyses use data from the same five-year period because data are available for those years, and the period is consistent with other analyses.
- There are several decision points for the Science Panel to develop an overall recommendation on atmospheric deposition. The Science Panel will need to consider the uncertainty framework and how to evaluate sources of evidence. They will then need to consider areal fluxes, attenuation, load (a function of areal fluxes and load), and speciation. Regarding speciation, the model requires specific chemical species.

Uncertainty Guidance Framework Overview

- The Uncertainty Guidance Framework evaluates evidence by type (derivation of evidence), amount, quality (rigor with which the evidence was derived), and agreement. Each line of evidence is evaluated using a confidence matrix which plots evidence based on the type, amount, quality, and agreement.
- The atmospheric deposition evidence can be categorized as direct studies, local and regional dust models, mass balance and other constraining analyses, and global reviews.
- There were five types of atmospheric deposition evidence:
    - Direct, screened (either physically or through quality assurance, quality control (QA/QC) procedures)
    - Direct, unscreened
    - Dust measurements
    - Mass balance
    - Global review
- The quality of evidence evaluation ascribed higher quality to direct studies, medium quality to indirect local studies (dust measurements and mass balance analyses), and lower quality to global reviews. Additionally, studies that followed the Science Panel and third-party recommended methodologies were assigned higher quality.
- Olsen et al. (2018), Reidhead (2019), Miller W. (2021), Barrus et al. (2021), and Hogsett (2022, which uses Barrus data) were all considered direct studies. Tetra Tech identified which studies collected unscreened and screened samples, incorporated QA/QC protocols, and had available raw data.
- The indirect studies included local and regional dust models, mass balance analyses, and a global review. Tetra Tech identified which of the studies incorporated QA/QC protocols.
- Ahead of the meeting, Science Panel members commented on the Uncertainty Guidance Framework. The comments indicated:
    - Concerns with the treatment of outliers by Hogsett and assignment of baseline versus total loads
    - Concerns about leaving out Wood Miller and Barrus data from recommendations

    - Concerns about the sample size used for mass balance and dust analyses
    - Perception of a double standard of Science Panel's raw request for Brigham Young University (BYU) data
- The Science Panel will need to recommend how to use the Uncertainty Guidance Framework. Potential discussion points include the evaluation of confidence for the studies and the estimated range of atmospheric deposition according to the lines of evidence.

UNCERTAINTY GUIDANCE FRAMEWORK SCIENCE PANEL DISCUSSION

Science Panel members discussed the Uncertainty Guidance Framework. Their comments are summarized below.

- The draft synthesis document did not consider the data from Wood Miller (2021) or Reidhead (2019) and conditionally considered Barrus et al. (2021) data. This data was not considered in the draft synthesis document because the Science Panel recommended that data from screened samplers should be prioritized over unscreened samplers. A synthesis report should include this data when estimating atmospheric deposition loads.
- Having raw data could increase confidence in the different lines of evidence.
- The only difference between the Olsen et al. (2018) and Reidhead (2019) results is that the two studies relied on different kriging methods. Olsen used an average atmospheric deposition value to assume attenuation rates across the lake. Reidhead assumed there was zero deposition occurring in the middle of Utah Lake.
- One of Olsen's samplers was near a gravel pit. The gravel pit is a source of deposition to the lake.
- Dr. Gay, the National Atmospheric Deposition Program (NADP) advisor for the atmospheric deposition studies, noted that they often get unclear samples. They do not take out a data point when there is contamination, like insects. They catalog the contamination in the metadata and then determine whether to use it. In Olsen's study, he removed any samples that had any source of contamination.
- The Wood Miller data collected bulk depositions samples. The research team only collected data after a rainstorm. Since some dry deposition could have been blown away between storms, the Wood Miller data is a conservative estimate for atmospheric deposition.
- The Barrus et al. (2021) data includes the data from Reidhead (2019) and Olsen et al. (2018). The data includes wet and dry deposition.
- There was some contamination from insects in the buckets. Adding screens to the buckets decreased the nutrient fluxes in the samples.
- The raw data for Wood Miller (2021) is in a photocopied table in the report. The summary statistics are also compiled in the report. An Excel file for the report would be helpful to assess the data distribution. The data distribution could help the Science Panel examine the potential explanations for extreme data results. Theron Miller can reach out to Wood Miller to see if he can provide the data from his study in an Excel file. DWQ can transfer the photocopied data into an Excel file if an Excel file is not available.
- Wood Miller analyzed the raw dataset he collected. The raw data is reported in concentrations. It is possible to translate the raw concentration data in Wood Miller's study to fluxes if the surface area of the collection bucket opening is known.
- Metadata would be useful to understand which samples might have sources of contamination.
- In atmospheric deposition studies, it is common to get large outliers due to discrete events. The Science Panel should not remove any outliers simply because they are outliers. They should evaluate the outliers and potential mechanisms for their occurrence.

- There have been multiple versions of the Atmospheric Deposition Summary Report. It would be helpful to have the most up-to-version to ensure Science Panel members have the most current information.

Public Comments

Members of the public commented on the Uncertainty Guidance Framework. Their comments are summarized below.

- Transferring Wood Miller's data into an Excel file is a major task. This request needs to come with a clear expectation of how the raw data will be used.
- In February 2021, the Wasatch Front Water Quality Council (WFWQC) sent the Wood Miller dataset to Erica Gaddis. This dataset should be admitted into the lines of evidence because WFWQC provided it to DWQ.

SCREEN AND UNSCREENED DATA DISCUSSION

Science Panel members discussed the integration of screen and unscreened data. Their comments are summarized below.

- A recent study from Dr. Janice Brahney explored the impact of screens on bulk atmospheric deposition samples. Her research indicated that 97% of the material got through the screen, and the screen captured about 3% of the material. This study suggests that screens do not significantly decrease deposition results.
- The amount of precipitation in 2019 was three times larger than in 2020. Since screens do not result in a large decrease in dust deposition, a decrease in precipitation likely explains why there was a large decrease in atmospheric deposition rates from 2019 to 2020. Similarly, this pattern occurred in every dataset in 2020, suggesting that precipitation events greatly impact atmospheric deposition.
- There is concern about the impact of bugs on samples before screens were installed. The *Review, Chronology, and Summary of the Atmospheric Deposition Program* Report prepared by Theron Miller discusses the impact of terrestrial insects on the samples.
- Barrus et al. (2021) conducted a statistical evaluation of how screens impacted study results. The study found a difference between screened and unscreened data.
- Dr. David Richards took a different statistical approach to analyze the difference between screened and unscreened samples and samples at different table heights. He found that table height did not significantly affect the results, but screens versus unscreened samplers did. David Richards' analysis was updated and has not yet been shared with the Science Panel.
- Between the 2019 unscreened data and 2020 screened data at Mosida, the total inorganic nitrogen concentrations decreased by six times, and the total phosphorus concentration decreased by 7.4 times.
- The Science Panel will need to consider how to spatially interpolate the atmospheric deposition loading values at each site. Kriging is one method to do so. Kriging is often used in complex datasets; with a dataset with a limited number of sites, it would be equally as effective to calculate an arithmetic mean.

Public Comments

Members of the public commented on the screen and unscreened data. Their comments are summarized below.

- The WFWQC provided the Olsen dataset to DWQ and received minor comments. Following the Reidhead Study, WFWQC received the comment to install screens on samplers. The

Science Panel should not remove data because the samplers were unscreened. Unscreened data is still useful and should be considered while developing a recommendation.
- Using the screened data from 2020 but not the unscreened data from 2018 to 2019 assumes that the screens are the primary driver of different results and that the wind and rain data are the same from year to year. The wind and rain data will vary from year to year and affect results.
- The Science Panel should consider the number of samples and the amount of research when evaluating the different lines of evidence. Studies with a limited number of samples should not have the same weight as studies with a more robust dataset.
- The Science Panel does not appear to have access to all the papers and studies available. They should have access to all the available studies and papers.
- Utah Lake scientists have been assessing atmospheric deposition in depth since 2017. The Science Panel is taking on a big and complex issue and has worked hard to provide answers.
- The synthesis document should consider the data from all the studies and not remove studies because there are outlier data.
- There are two types of precipitation on Utah Lake. There are monsoons, which deposit a lot of rain on parts of the lake. The occurrence of monsoons may explain why peaks occur in some samplers and not others. The second type of precipitation is from frontal storms that move over Utah Lake via the southwest prevailing winds, known as the Hatu Winds. The frontal storms occur in the fall and spring, while the monsoon storms occur more in summer. The difference in storms could explain variability in the atmospheric deposition data.
- Large insect hatches occur on Utah Lake. These large insect hatches could affect atmospheric deposition.

Science Panel Responses to Public Comments

Science Panel members responded to public comments. Their responses are summarized below.

- Aquatic insect hatches do not add nutrients to the lake, but terrestrial insects do.
- The bucket flux data from 2017 and 2018 were not included because the 2017 samplers collected five months of data and the 2018 samplers collected eight months of data. It was not possible to calculate an annual load for these years with these datasets.
- WFWQC extrapolated data across the wintertime to calculate an annual load. Less atmospheric deposition occurs in the wintertime, so it has less of an overall impact on annual loads than the atmospheric deposition occurring in the summer and springtime.
- The data provided in Greg Carling's samples should be considered as one line of evidence in the synthesis. It should not be used as a maximum or minimum constraint.

SCIENCE PANEL ATMOSPHERIC DEPOSITION ANALYSIS NEXT STEPS

Science Panel members discussed the next steps for analyzing atmospheric deposition. Their comments are summarized below.

- The Science Panel will form a subgroup that will meet regularly to discuss assumptions, aggregate data, and discuss results related to atmospheric deposition. The subgroup members will begin by developing an analysis plan to guide their work.
- The Science Panel could explore mechanisms to explain outlier data in several ways. Potential assessments to explore mechanisms for outlier data include:
    - Evaluating metadata for specific outliers (metadata is not needed for every data point)
    - Aligning outlier data with meteorological data

    - Evaluating whether nitrogen and phosphorus spikes from atmospheric deposition occur simultaneously or if they occur separately from each other
    - Comparing bulk deposition data to wet deposition data to see how well the data aligns
- The Science Panel subgroup could also evaluate the data distribution in Wood Miller's bulk deposition study to further assess outliers.
- Another way to assess atmospheric deposition is to compare summer fluxes to in-lake water quality using the closest water quality sampling site to the atmospheric deposition sampler. There were different perspectives on whether measuring in-lake water quality is an effective method for measuring the impact of atmospheric deposition on nutrient loading in the lake.
- Another analysis is to improve the mass balance constraining analysis by:
    - Integrating sediment accumulation rates from Dr. Steve Nelson's and Dr. Janice Brahney's research
    - Accounting for carp removal
- The Science Panel should carefully evaluate sedimentation accumulation rates in Utah Lake to incorporate into a mass balance analysis. In other lakes, the sedimentation accumulation rates were not reflective of in-lake conditions.
- There may be an opportunity to invite Dr. David Gay, the scientific advisor from NADP, to provide comments on how to move forward with the atmospheric deposition analysis.
- It would be helpful to review 2021 WFWQC atmospheric deposition data if possible. The students hired to collect data from the wet and dry samplers did not follow through on their responsibilities. As a result, there is no data from the wet and dry samplers for the first half of 2021.
- Another potential analysis is to compare lake sediment nutrient concentration data to atmospheric deposition data to observe how well sediment nutrient concentrations align with atmospheric deposition loading data. There were different perspectives on how effective this analysis would be.

Public Comments

Members of the public commented on the Science Panel's analytical tasks. Their comments are summarized below.

- Comparing the atmospheric deposition sampler data to the spatial distribution of phosphorus concentrations in the sediment bed will likely not be an effective methodology due to the limited number of core samples. It will be difficult to develop an accurate mass balance analysis since the cores are not sampled across the lake.
- This process should not be considered a public process if people are not allowed to participate openly. People must be allowed to share their perspectives without the worry of denigration.
- The amount of metadata available is small. If the Science Panel wants to request metadata, they should identify what specific metadata points they want and in what format.
- The WFWQC brought Dr. David Gay on as a technical reviewer for the atmospheric deposition studies. The WFWQC did not expect that he would act as a technical advisor for the whole Science Panel; it is not appropriate for the Science Panel to put him in that role.
- The Science Panel should run the Utah Lake model with a range of values. A range of values would give decision makers a larger perspective and help them understand that significant variability exists. Similarly, the model should be calibrated twice to incorporate a range of atmospheric deposition values.
- The rules of public comment should be equally applied to all public members.

- One suggestion for filling an open Science Panel seat is Dan Potts. He regularly attends ULWQS Science Panel meetings and has a bachelor's and master's in fishery management. He has worked with the June Sucker Recovery Implementation Program, focusing on carp removal. Dan Potts could help represent anglers on the Science Panel.

Science Panel Responses to Public Comments

Science Panel members responded to public comments. Their responses are summarized below.

- The modeling team is looking to calibrate the model. They require one input dataset to calibrate the model, which includes atmospheric deposition. Once the model is developed, there is a possibility to conduct a sensitivity analysis to assess a range of atmospheric deposition values and how that would impact the lake's conditions.

NEXT STEPS

- DWQ has received requests from members of the public to access the Atmospheric Deposition Resources Folder on the Science Panel Google Drive. Science Panel members should reach out to Samuel Wallace if there are papers in the Atmospheric Deposition Resources folder that are proprietary and cannot be shared with the public.
- The ULWQS Atmospheric Deposition Subgroup will begin meeting over the next few weeks. Science Panel members interested in participating should email their regular availability to Samuel Wallace.