Utah Lake Water Quality Study (ULWQS)
Science Panel
July 26, 11:30 AM to 1:00 PM
Virtual Meeting
Meeting Summary - FINAL

ATTENDANCE:
Science Panel Members: Mike Brett, Soren Brothers, Greg Carling, Mitch Hogsett, James Martin, Theron Miller, Michael Mills, Hans Paerl

Steering Committee Members and Alternates: Eric Ellis, Erica Gaddis

Members of the Public: Jeff DenBleyker, Renn Lambert, and David Richards

Utah Division of Water Quality (DWQ) staff: Scott Daly, Jodi Gardberg, Nicholas von Stackelberg

Technical Consultants: Kevin Kratt, Michael Paul, and Kateri Salk

Facilitation Team: Heather Bergman

ACTION ITEMS

Who	Action Item	Due Date	Date Completed
Tetra Tech	Distribute a handout with the criteria for selecting a watershed model to the Watershed Model Subgroup for review.	August 15	
	Distribute the CNP Budget Study to the CNP Study Subgroup for final review.	August 15	
	Consider looking at volatile suspended solids as a proxy to determine organic matter sinking rates in the CNP Budget Study.	August 15	
Theron Miller	Distribute the Atmospheric Deposition Study report to the Science Panel once it is complete.	August 15	
Heather Bergman	Send unanswered questions from the chat to Theron Miller to address at the Science Panel's next meeting.	August 1	July 26

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

GROUND RULES OVERVIEW
Heather Bergman, Peak Facilitation Group, gave an overview of the Science Panel ground rules. The ground rules of the Science Panel are listed below.

- 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

CARBON, NITROGEN, AND PHOSPHORUS (CNP) BUDGET STUDY EXTERNAL MASS BALANCE UPDATE

Kateri Salk, Tetra Tech, presented an update of the CNP Budget Study external mass balance analysis. Her presentation is summarized below.

- Tetra Tech received new flow data from the Wasatch Front Water Quality Council (WFWQC). The WFWQC uploaded new flow data to the Water Quality Portal the week of June 10. Tetra Tech incorporated the new data from 2018 forward and re-ran the external mass balance analysis, which increased the sample size for the calculations.
- Lindon Drain was a sub-catchment that previously had inconsistent flow data between WFWQC and DWQ. WFWQC flow values were higher than DWQ flow values. During a recent field site visit, it was discovered that the DWQ site is located upstream of the PacifiCorps Energy discharge site, and the WFWQC site is located downstream of the PacifiCorps Energy discharge site. Previous analyses did not account for these differences in location. Because of the sampling site locations, the WFWQC site represents the total load, and the DWQ site plus the Discharge Monitoring Report (DMR) data represents the total load. Tetra Tech combined all the data from both entities. The PacifiCorps Energy discharge has a flow between 1.7 and 2.6 cubic feet per second (CFS) and a total phosphorus load of 0.17 to 0.33 tons/month.
- The new WFWQC flow data filled in missing data from previous summers for the Spanish Fork River sub-catchment. With the new WFWQC data added, the DWQ and WFWQC flow data across months are comparable. Previously, Tetra Tech only used DWQ data for loading calculations for the Spanish Fork River. With the new data, Tetra Tech used flow data from both entities for loading calculations.
- With the new flow data incorporated, there is a new flow discrepancy between the WFWQC and DWQ data in the Spring Creek – Springville sub-catchment. The WFWQC and DWQ sample the same site in this sub-catchment. Because the Science Panel has not discussed this sub-catchment before, Tetra Tech used both entities' data to calculate the load estimate. Using both entities' data, the total phosphorus loading estimate is 12.82 tons/year. Using only DWQ data, the total phosphorus loading estimate is 8.83 tons/year, and using only WFWQC data, it is 17.68 tons/year. Using both entities ' data, the total nitrogen loading estimate is 55.12 tons/year; using only DWQ data, it is 50.91 tons/year. There was insufficient data from WFWQC alone to estimate total nitrogen loading.
- For Lindon Drain, adding the DMR total phosphorus load data and the WFWQC data, which was not included before, increases the total phosphorus load from 0.87 to 3.65 tons/year. The addition of the DMR data accounts for most of this change. The additional data also increased the total nitrogen load from 29.09 to 36.09 tons/year.
- For Spanish Fork, including the WFWQC data, which was not included before due to flow discrepancies, increased the total phosphorus load from 7.83 to 12.71 tons/year. The new data also increased the total nitrogen load from 48.89 to 53.43 tons/year.
- For Spring Creek – Springville, there is a new flow discrepancy between the WFWQC and DWQ data. Using both WFWQC and DWQ data, including the new WFWQC data, the total phosphorus load increased from 9.44 to 12.82 tons/year, and the total nitrogen load remained the same.
- The Science Panel previously discussed whether to use the tributary data or the DMR data to estimate loads in the Mill Race sub-catchment. Using the tributary data rather than the DMR data decreased the total phosphorus load from 51.88 to 27.29 tons/year and the total nitrogen load from 318.31 to 257.41 tons/year.

- Incorporating all the changes, the total tributary loading for total phosphorus increased from 267 to 268 tons/year, and the total nitrogen loading decreased from 1,787 to 1,723 tons/year. The total loading calculations still fall within the range of previous loading estimates.
- The full CNP Budget Study results are presented in the technical report, including additional detailed data for each sub-catchment in the report's appendix. The report will be circulated to the Science Panel CNP Budget Study Subgroup for review.

CNP BUDGET STUDY SEDFLUX MODELING UPDATE

Kateri Salk, Tetra Tech, presented an update of the CNP Budget Study SedfFux model. Her presentation is summarized below.

- One input into the Sedflux model is organic matter settling rates. Data exists for Utah Lake for sediment content and accumulation as part of the Paleolimnological Study. However, the specific sediment data lacked the density information needed to generate areal input rates. Furthermore, the Utah Lake data is for sediment and not sinking organic matter; sinking organic matter would have a higher proportion of organic matter than sediment. Because the data was not available, Tetra Tech used existing literature to run several scenarios across the probable range for organic matter settling rates.
- The water column depth varies across Utah Lake. For specific observed scenarios, Tetra Tech used measured depths. In the main basin, the measured depths ranged from 1.9 to 3.5 meters. In Provo Bay, the measured depth was about 0.2 meters. To run a range of scenarios to simulate different years, Tetra Tech ran the main basin scenario of 2.0 meters for "shallow" conditions and a Provo Bay scenario of 1.5 meters for "deep" conditions. The range of scenarios shows how the rate of sediment-water column interaction could vary across depths in Utah Lake.
- Tetra Tech compared the results of the SedFlux model to other studies. Soluble reactive phosphorus (SRP), ammonium, and nitrate fluxes were comparable to other studies (Hogsett et al. 2019 and Goel et al. 2020).
- The sediment oxygen demand (SOD) was higher in this CNP Budget Study than in other studies. In the Main Basin, this CNP Budget Study found that the SOD was from 4.90 g m^{-2} d^{-1} to 14.38 g m^{-2} d^{-1}, while previous studies found the SOD to be 0.9 g m^{-2} d^{-1} to 2.04 g m^{-2} d^{-1} (Hogsett et al. 2019) and 2.97 g m^{-2} d^{-1} (Goel et al. 2020). In Provo Bay, this CNP Budget Study found that the SOD was 1.91 g m^{-2} d^{-1} to 14.58 g m^{-2} d^{-1}, while previous studies found the SOD to be 4.61 g m^{-2} d^{-1} (Hogsett et al. 2019) and 0.05 g m^{-2} d^{-1} (Goel et al. 2020).
- In the Main Basin, the ammonium flux is always to the water column regardless of water depth and organic matter sinking rates. The ammonium flux was highest under high organic matter sinking rates. The observed water depth resulted in more variability in diel and seasonal ammonium flux rates than the shallow water depth.
- In the Main Basin, the nitrate flux was highest under the high organic matter sinking rate. There was more variable in nitrate flux under the observed depth scenario than the shallow depth scenario. The direction of the nitrate flux was to the water column in the summer and to the sediment in the spring and fall.
- In the Main Basin, the SRP flux was always to the water column. Similar to the ammonium and nitrate flux, the SRP flux was highest under the high organic matter sinking rate. The flux variability was higher under the observed water depth scenario than the shallow depth water scenario.
- In the Main Basin, the SOD flux was highest under a high organic matter sinking rate. The flux variability was higher under the observed water depth scenario than the shallow depth water scenario.

- There are several potential explanations for why this CNP Budget Study's SOD flux rate is much higher than previous studies. First, SOD was not particularly sensitive to reaction network parameters; changes in network parameters did not notably affect the SOD flux rates. However, SOD was sensitive to initial condition input values, including the water column dissolved oxygen concentrations and the settling rate of particulate organic carbons. Buoys measured the dissolved oxygen concentrations at 15-minute intervals, so that dataset is accurate. The settling rate of particulate organic carbons was based on previous literature, so those rates may be less accurate.
- There are a few hypotheses on why the CNP Budget Study's SOD flux rate is high. First, there is a lot of sediment resuspension, so inorganic material coming into the water column may be diluting incoming particulate organic carbon. This dynamic would result in a lower proportion of organic matter reaching the sediment under the presence of sediment resuspension. Another hypothesis is that the frequent sediment resuspension results in the SOD moving into the water and becoming biological oxygen demand. This dynamic would result in higher SOD in the SedFlux model than in the observed data.
- Overall, the SedFlux may not capture important factors driving SOD, but it appears to do a good job modeling nutrient fluxes.
- In Provo Bay, the fluxes responded similarly to organic matter levels as in the Main Basin. The flux rates were lower under the shallow depth scenario than the deep depth scenario.
- Tetra Tech calculated the lakewide rates of the flux processes by multiplying the rates by the daily lake area. The lakewide rates were highly dependent on organic matter sinking rates and were seasonally variable. Extrapolating yearly rates was challenging because there is not winter data for Utah Lake; extrapolating would likely overestimate the true rates because the expectation is that flux rates would be lower in the winter.
- The full results of the SedFlux model will be in the technical report. The report will be circulated to the Science Panel CNP Budget Study Subgroup for review.

Science Panel Discussion

Science Panel members discussed the CNP Budget Study. Their comments are summarized below.

- SOD greater than 5 g m^{-2} d^{-1} is indicative of sewage sludge, which is not characteristic of the sediments in Utah Lake. Some organic matter could end up in the water column, which could help explain the high SOD results. The supersaturated conditions could also be resulting in oxidation, which would occur at night.
- The Hogsett et al. (2019) study observed positive ammonium, nitrate, and phosphate fluxes. Looking at the system holistically, the water column removed more nitrogen and orthophosphate than the sediment was releasing. The nutrients are disappearing in the water column, and it is uncertain whether the processes for removing the nutrients from the water column are biological or chemical. The technical report will highlight the total phosphorus entering the lake and the day-to-day fluxes between the sediment and water.
- The CNP Budget Study has shown that there is still work to be accomplished. The SedFlux model is the same model used in the overall water quality model. The Science Panel needs some mechanism to continue to develop the standalone model and better define some of the issues where the model is lacking.

Science Panel Clarifying Questions

Science Panel members asked several clarifying questions about the CNP Budget Study. Questions are indicated in italics with corresponding answers in plain text.

Is there not enough field data to constrain the organic matter sinking rate? It is possible to collect total suspended solids and then determine the ash-free dry weight to measure the ratio of organic material to inorganic material.
Mitch Hogsett suggested looking at volatile suspended solids as a proxy to determine organic matter sinking rates. There is some data available on the ratio of volatile suspended solids to total suspended solids. Kateri Salk already has plans to explore that dataset.

If SOD is that high, how does the lake not go anoxic?
There is a lot of interaction with the atmosphere. There may be some reinvigoration of the oxygen at night when high rates of respiration occur. The dissolved oxygen does fall at night, so there are diel fluctuations as well.

Public Comments
Members of the public provided comments on the CNP Budget Study. Their comments are summarized below.

- Spring Creek often does not reach Utah Lake.

INITIAL CHARGE QUESTION REPORTING UPDATE
Kateri Salk, Tetra Tech, provide an update on the initial charge question reporting. Her presentation is summarized below.

- The Science Panel is planning to report out preliminary answers to the charge questions to the Steering Committee.
- At the last meeting, the Science Panel chose to have Science Panel subgroups work with Tetra Tech to evaluate the evidence for each question.
- Since the last meeting, Tetra Tech has grouped the charge questions into six themes, and Science Panel members signed up for each subgroup.
- The six subgroups and the Science Panel members signed up for them are:
    - **Criteria Development:** Theron Miller
    - **Fish, Aquatic Life, Birds:** Michael Mills, Soren Brothers, Theron Miller
    - **Harmful Algal Blooms:** Hans Paerl, Janice Brahney, Theron Miller
    - **Historical Condition:** Michael Mills, Greg Carling, Soren Brothers, Hans Paerl, Janice Brahney
    - **Macrophytes and Diatoms:** Soren Brothers, Janice Brahney, and James Martin
    - **Sediments:** Greg Carling, Janice Brahney, James Martin, and Theron Miller
- The next step for the initial charge question reporting is for Tetra Tech to assemble evidence with the subgroups. Each charge question response will include an evaluation of the evidence, the degree of confidence in the evidence, and the likelihood (pending sufficient confidence). The response will include a summary answer to each question and the traceable account of the evidence (type, amount, degree of agreement, uncertainty).

Science Panel Discussion
Science Panel members discussed the initial charge question reporting. Their comments are summarized below.

- Mitch Hogsett and James Martin volunteered to join the Criteria Development Subgroup.
- Mike Brett volunteered to join the Harmful Algal Bloom and the Fish, Aquatic Life, Birds Subgroup.

Public Clarifying Questions
Members of the public asked several clarifying questions about the initial charge question reporting. Questions are indicated in italics with corresponding answers in plain text.

What questions will the Criteria Development Subgroup be answering, considering the purpose of the ULWQS is to develop criteria?

- The primary question for the Criteria Development Subgroup is "what additional information is needed to define nutrient criteria that support existing beneficial uses?" The Criteria Development Subgroup will identify what additional information is needed for each beneficial use: warm water aquatic life, waterfowl, shorebirds, and water-oriented wildlife; primary contact recreation; and agricultural uses, including irrigation of crops and stock water.
- The Criteria Development Subgroup will take a second look at the measures and targets in the Steering Committee's management goals table and map those measures against the Science Panel's current information. They will account for what information is available to help develop criteria in the future.

WATERSHED MODEL SELECTION PROCESS UPDATE
Kevin Kratt, Tetra Tech, provided an update on the Utah Lake watershed model selection process. His presentation is summarized below.

- Tetra Tech signed a contract with DWQ on July 21, 2021, so the process for developing the watershed model has just begun. The contract scope includes two parts: 1) enhancing the existing in-lake EFDC and WASP models; and 2) developing a watershed model.
- The watershed model is a significant component of the criteria development process. It will help refine the criteria and look at the impact of different watershed management scenarios.
- Tetra Tech will not immediately focus on building the watershed model. Instead, they will focus on developing an approach to select the appropriate watershed model for Utah Lake. They want to begin this task early to give Tetra Tech ample time to build the watershed model.
- The steps for the watershed model selection process are:
    1. Tetra Tech will develop and circulate a list of proposed watershed selection criteria and candidate watershed models.
    2. The Science Panel and Steering Committee will review and propose edits to the criteria and candidate models.
    3. Tetra Tech will proceed with the evaluation and recommend the top model(s).
    4. The Science Panel and Steering Committee will review the evaluation and select and approve a final watershed model(s).
- There is an option to select one watershed model for the ULWQS or to use a combination of watershed models.
- Tetra Tech has drafted model criteria. They grouped the criteria into four categories:
    - The first category is technical criteria. The technical criteria relate to how well the model simulates flow, nutrient loading, and transport processes in the watershed. The criteria list the key parameters the watershed model should simulate.
    - The next category is the source representation criteria. This set of criteria is related to how well the model captures the sources of pollutants. Different models will estimate average monthly loads, and others will estimate average weekly loads. These criteria will help evaluate how well the model captures different land uses and shallow groundwater dynamics.

    - The next category is the usability criteria. The outputs of the watershed model will be used in the lake model, which is the EFDC-WASP model. The watershed model should provide outputs that are usable in the EFDC-WASP model. These criteria also include how long it takes to run the model, its historical use for total maximum daily load (TMDL) development, and ease of use.
    - The next category is the general platform criteria. These criteria include sufficient documentation on model theory and user guide, open-source code, freeware with no licensing fee, stable code during runtime, and ease to modify the model source code. Tetra Tech is not anticipating making changes to the watershed model source code, but it would be helpful if Tetra Tech had the option to modify the source code.
- Tetra Tech will distribute a handout with the criteria for selecting a watershed model to the Watershed Model Subgroup.
- Tetra Tech has identified ten candidate models that they will evaluate using the watershed model selection criteria. Tetra Tech is looking for feedback on any other potential candidate models.

Science Panel Clarifying Questions

Science Panel members asked several clarifying questions about the watershed model selection process. Questions are indicated in italics with corresponding answers in plain text.

The watershed model should characterize in detail different algal groups (e.g., cyanobacteria versus green algae versus diatoms). Capturing the dynamic in different algal groups should be a primary goal for the model if the Steering Committee will use cell counts or toxins as an endpoint. How much can Tetra Tech account for that dynamic in the watershed model?

Tetra Tech has an existing framework for the lake model, which is the EFDC/WASP model. These algal dynamics are more pertinent to the lake model. The watershed model component will mostly be about flows and loads going into the lake.

Will the model have the capacity to make inferences about the phosphorus composition, or will the model only report total phosphorus?

That consideration would be part of the selection criteria. Simpler models will only provide total phosphorus, but more advanced models will break it down further into more components.

What is the modeling going to answer for the ULWQS that field data cannot? The loading data is pretty detailed already.

There has been a lot of discussion about historical loading. It would be possible to simulate historically how different land uses impacted the loads to the lake. The watershed model can look at both point source and non-point source implementation as well.

How do water rights and appropriations fit into the watershed model?

At the beginning of the process, partners agreed that there would be no changes to water rights. The model will address changes in run-off and not water rights.

Science Panel Discussion

Science Panel members discussed the watershed model selection process. Their comments are summarized below.

- One issue specific to Utah Lake is whether phosphorus is scavenging calcite in the water column. Traditional models cannot model that dynamic, so Tetra Tech may need to modify the source code to incorporate that in-lake dynamic. Tetra Tech is looking to enhance the

lake model to capture this dynamic, but they will not need to capture this dynamic in the watershed model.
- The previous University of Utah model looked primarily at water quantity, not quality. It would be worth exploring the University of Utah model to see what they did.
- It would help to consider how the watershed model will be used once it is completed and then let the selection criteria flow from those objectives.
- The level of detail in the watershed model should be compatible with the lake model. There should also be a selection criterion about the ability of the model to run scenarios to generate meaningful outputs that could be paired with the lake scenario modeling.
- In Utah, there is less information on stormwater, historical conditions, and future conditions. The watershed model can help with the process.

Public Comments

Members of the public provided comments on the watershed model selection process. Their comments are summarized below.

- LakeSim could be a candidate model.

Watershed Model Selection Process Next Steps

There will be a subgroup to discuss the selection criteria and a list of candidate watershed models. Mike Brett and Mitch Hogsett volunteered to join the subgroup to discuss the selection criteria and list of candidate watershed models.

ATMOSPHERIC DEPOSITION STUDY PRESENTATION

Theron Miller, WFWQC, presented on the Atmospheric Deposition Study. His presentation is summarized below.

- The atmospheric deposition samplers were located at the Utah Lake pump station, Orem wastewater treatment plant, Bird Island, Lakeshore, and Mosida. They had an additional sampler at Saratoga Bay on the west side of Utah Lake, near a quarry, that did not work. They are looking to re-position another sampler at the Saratoga Bay site shortly. The other samplers have been at the same location, except for the one on Bird Island.
- A 20-year data record from Provo Airport was used to create a wind rose plot. The wind rose plot shows there are northwest and southeast winds. Southeast winds come out of Spanish Fork Canyon towards Utah Lake, and the northwest winds come out of the west desert around the mountain range. There is also a prevailing wind from the southwest, mostly in the afternoon. The Provo airport does not capture that prevailing wind because the West Mountain blocks the wind from reaching the airport. The prevailing wind blows around 10 miles/hour. WFWQC is looking to place more weather locations to better capture the direction, strength, and duration of wind patterns.
- The WFWQC has complied with the National Atmospheric Deposition Program (NADP) siting criteria to minimize impacts from table height, roads, fertilizer use, and more. Dr. David Gay, president of NADP, reviewed the work plan but has not reviewed the latest data set for the Atmospheric Deposition Study.
- The lid of the NADP sampler has a sloped surface to deflect raindrops from entering the bucket. Because the WFWQC sampling buckets had flat lids, researchers used Miner's moss to minimize the amount of splash back that could enter the sampling bucket. They poured four liters of dyed water on the proximal side of the cover to determine how much water would get into the bucket. They found that a minimal amount of splash back entered the bucket.

- The WFWQC placed one set of buckets on a table so that the top of the bucket was about 1.2 meters off the ground. They modified another table, so the top of the bucket was 2 meters off the ground. The 2-meter tall table complied with NADP standards.
- Some bugs get into the samplers. Bees and wasps emerge in May and June, and they last to three to five weeks. The sampler at Mosida collected some bugs, but most did not have any issues with bugs. WFWQC put 500-micron screens held by a stainless steel frame in all the dry side buckets. They have data to show whether it had an effect.
- The sampler at Bird Island sat on a platform four and a half or five meters above the water surface. WFWQC placed lines to hold the platform in place from the wind. They found some Cladophora high on the lines from wave activity on Utah Lake. They recently had to redesign and re-install the platform because the electronics stopped working.
- The WFWQC used the data from every week to interpolate the nutrient input from atmospheric deposition over the calendar year. They would fill in any absent data with the mean of the dataset after the missing data. The WFWQC created a heat map from the nutrients entering the lake via atmospheric deposition.
- They tracked the amount of dissolved inorganic nitrogen and total phosphorus entering the lake via atmospheric deposition in tons in 2019 and 2020. In 2019, more nutrients were entering Utah Lake via atmospheric deposition than in 2020.
- There is a lot of variability in the dataset, which may be due to the use of screens. There are also large spikes in the data, which likely come from big rain or wind events. The weather events are highly variable, especially at a local scale.
- David Richards, OreoHelix Consulting, conducted a negative binomial regression to show the relationships between sample sites. The negative binomial regression produces a more conservative result than kriging.
- The statistical analyses indicate no difference between the results from the low (1.2 meters) and high (2 meters) samplers. Based on this result, past data is still usable. There are remaining questions that the investigators are still answering related to how installing the screen may have affected the results.
- The statistical analyses indicate that more dust and particles enter the NADP sampler than the non-NADP sampler. The 500-micron screens on the samplers are likely capturing dust and aerosols. Only 40% of the space is open to having material pass through the screen mesh. Researchers washed the screens into the samplers, but there is still an opportunity for storms to re-mobilize some of the dust.
- Overall, the non-NADP samplers with the screens represent a more conservative estimate for atmospheric deposition. The NADP recommends not installing screens on samplers and including any insects in the metadata.
- Researchers identified SRP in the wet and dry samples. They also included three liters of distilled water in the dry samples to emulate the lake's surface. They found that the predicted SRP was around two to four milligrams per square meter, and the predicted total phosphorus was between seven to eight milligrams per square meter. These results suggest that around 20 to 40% of the phosphorus entering Utah Lake is SRP. Previous studies found that 1 to 2% of the phosphorus was SRP. Researchers are planning to collect dry samples of dust and aerosols and conduct an extraction analysis to better understand the SRP results as they do not have a lot of confidence in the SRP measurements.
- The total phosphorus and dissolved nitrogen results across all five stations show that with a couple of exceptions, most of the data set show higher numbers at Bird Island than at the shoreline sites. One possible explanation is that inversions occur daily. The inversions result in breezes from the canyons and west side mountains bringing materials to the coolest part

of the valley, Utah Lake. Researchers will continue to collect data and samples over the next couple of years.

- The estimated phosphorus loading from the atmosphere under the best-fit linear regression is 125.26 metric tons per year. The estimated dissolved inorganic nitrogen loading from the atmosphere under the mixed-effects linear regression is 267.12 metric tons per year, which is lower than the geometric mean and median.
- The US Geological Survey (USGS) collected data on nitrogen loading from atmospheric deposition. Their preliminary results indicate higher loading on the east side of the lake. Their estimates range from 265 milligrams per square meter per year to 1,550 milligrams per square meter per year. The estimates collected by the WFWQC and Wood Miller's bulk samplers are within the range of the USGS's samples.
- WFWQC has collected atmospheric deposition data from 2017 to 2020. It would be helpful to revisit the sampling protocols from 2017 to 2019 to clarify the results from those studies.
- The researchers continue to work on the SRP questions and will continue the study for another one to two years. They are finishing a report on the 2020 results, which they will distribute to the Science Panel once it is complete.

Science Panel Clarifying Questions

Science Panel members asked several clarifying questions about the WFWQC Atmospheric Deposition Study. Questions are indicated in italics with corresponding answers in plain text.

Has WFWQC saved any samples so that the Science Panel can look at the composition? The dust being transported around might be from the earth's crust. The phosphorus composition from the earth's crust would differ from the phosphorus composition found in a river.

Can the tables have a column that shows the total nitrogen to total phosphorus ratios? There are spikes in the total nitrogen and total phosphorus that do not align, which would indicate different sources for those nutrients.

Utah State University professors have collected samples in the Alta Mountains to identify the mineralogy of the dust sources. Less research has been conducted on the southwest sources of dust to Utah Lake. It would help to look at those sources more closely. WFWQC has collected some dust samples from five minutes away. Evaluating the mineralogy of the dust and particle sources should be the next phase of the Atmospheric Deposition Study.

Are there prescribed burns in the valley?

Not so much, but there have been wildfires nearby. Smoke from those fires could be affecting Utah Lake.

Science Panel Discussion

Science Panel members discussed the Atmospheric Deposition Study. Their comments are summarized below.

- Dr. Greg Carling, Brigham Young University (BYU), has collected the dust from the Wasatch Front snowpack to the Great Salt Lake. That dust is rich in phosphorus, but less is known about the nitrogen composition of dust. The phosphorus can come from close and far away, but the nitrogen is likely to come from local sources. There are remaining questions about what the local sources of nitrogen are.

Atmospheric Deposition Study Next Steps

- Heather Bergman will send unanswered questions from the chat to Theron Miller to address at the Science Panel's next meeting. The questions are:
    - Are there atmospheric deposition samples that can be further analyzed for phosphorus composition?
    - What are the time units for the NADP comparison? Weekly? Monthly?
    - Maybe your SRP is phosphorus that was originally in a calcium-phosphorus mineral complex?
    - Have researchers ever observed bird droppings on your bulk sampling screen?
    - Are the USGS studies only for looking at nitrogen?
    - Was there a big dust storm in Utah within the last few days?
    - Do spikes in the data correlate to episodes that DWQ's samplers record?
    - What kind of phosphorus is found in atmospheric deposition from wood smoke?

NEXT STEPS

- The CNP Budget Study Subgroup will meet to review the CNP Budget Study report.
- The Watershed Model Subgroup will meet to discuss the watershed model selection criteria.
- The charge question subgroups will meet over the next couple of months to develop responses to the charge questions.
- There will be an in-person UWLQS Steering Committee meeting on August 25. There may be a potential in-person joint Science Panel and Steering Committee meeting during the week of September 20, as well as an individual meeting for both groups. DWQ will share more information over the next couple of weeks.