Utah Lake Water Quality Study (ULWQS)
Science Panel
June 10, 10:00 AM to 11:30 AM
Virtual Meeting
Meeting Summary

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

Steering Committee Members and Alternates: Eric Ellis and Rich Mickelsen

Members of the Public: Renn Lambert, LaVere Merritt, and David Richards,

Utah Division of Water Quality (DWQ) staff: Scott Daly and John Mackey

Technical Consultants: Kateri Salk and Mike Paul

Facilitation Team: Heather Bergman and Samuel Wallace

ACTION ITEMS

Who	Action Item	Due Date	Date Completed
Samuel Wallace and Heather Bergman	Send the question on what dataset to use for the CNP Budget Study for Powell Slough and Mill Race to the Science Panel to solicit feedback.	June 21	
	Send the handout with the process for answering the initial charge questions to the Science Panel.	June 21	
Samuel Wallace	Schedule a meeting for the CNP Budget Study Task Group.	June 30	
CNP Budget Study Task Group	Use the feedback from the Science Panel to decide what dataset to use for Mill Race and Powell Slough.	June 30	
Tetra Tech, Peak Facilitation Group, and Scott Daly	Work offline to subdivide the initial charge questions into different categories and send a sign-up sheet to take volunteers from the Science Panel to answer those questions.	June 30	
	Put together some baseline information (e.g., available reports and data) as a starting point for the Science Panel groups to discuss answering the charge questions.	June 30	

DECISIONS AND APPROVALS

- The Science Panel will continue to move forward with the CNP Budget Study as DWQ and the Wasatch Front Water Quality Council (WFWQC) address data discrepancies in Lindon Drain.

- Tetra Tech will work offline to subdivide the initial charge questions into different categories and take volunteers from the Science Panel to answer those questions. Tetra Tech will put together some baseline information (e.g., available reports and data) as a starting point for the Science Panel groups.

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

CARBON, NITROGEN, AND PHOSPHORUS (CNP) BUDGET STUDY - FLOW OVERVIEW

Kateri Salk, Tetra Tech, presented an overview of the flow data for the CNP Budget Study. Her comments are summarized below.

- At the last Science Panel meeting, participants discussed the methodologies that the WFWQC and DWQ used to collect streamflow data from 2015 to 2020. DWQ used the US Geological Survey (USGS) methodology; WFWQC used the USGS methodology too but with fewer partial sections than recommended as best practice. DWQ monitored 16 sub-catchments, and WFWQC monitored 13 sub-catchments. Tetra Tech found that the distributions of flow were similar across 11 of the 13 sub-catchments. For two of the sub-catchments, Lindon Drain and Spanish Fork, DWQ's data points had a wider distribution than WFWQC's data points. Due to these results, the Science Panel decided to retain both entities' flow values for the external mass balance model for 11 sub-catchments but retain only DWQ data for the external mass balance model for the Lindon Drain and Spanish Fork sub-catchments.
- To estimate total nitrogen for the entirety of Utah Lake, Tetra Tech used 552 data points from DWQ and 111 data points from WFWQC. To estimate total phosphorus for the entirety of Utah Lake, they used 550 data points from DWQ and 168 data points from WFWQC.
- WFWQC had 17 total nitrogen data points and ten total phosphorus data points for Lindon Drain. They also had seven total nitrogen data points and five total phosphorus data points for Spanish Fork. Tetra Tech left these data points out of the analysis based on the Science Panel's decision to only use DWQ data for these two catchments. Overall, these data points do not represent a large number in the total sample size for Utah Lake, but they do represent a larger proportion of data points in the specific sub-catchments.
- WFWQC's data points had a smaller flow distribution than DWQ's data points in the Lindon Drain and Spanish Fork sub-catchments. In Lindon Drain, WFWQC flow values tend to be greater than DWQ's flow values. The flow data in the Spanish Fork sub-catchment follows a similar pattern, with WFWQC flow values being greater than DWQ's flow values. In the

Spanish Fork sub-catchment, WFWQC has fewer samples taken during the low flows of the summer months, which may explain a difference in the data distribution.

Science Panel Discussion

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

- In the Lindon Drain sub-catchment, the point source discharge from the nearby power plant moved from upstream to downstream, so DWQ chose a sampling site downstream from the point source discharge. DWQ started sampling in 2017 and has not moved the sampling site since then. The WFWQC sampling site was originally at the lake and moved to a position upstream from the DWQ sampling site on the main channel. DWQ and WFWQC staff will visit the sampling sites in Lindon Drain to investigate why there may be discrepancies in their data. The differences in the data in Lindon Drain would likely represent a 1% difference in the total load calculations, so it is not a high priority to correct the data. Still, DWQ and WFWQC should correct it in the long term.
- In the Spanish Fork River sub-catchment, the WFWQC sampling site may have been upstream from a diversion, which is why the WFWQC flow values are higher than the DWQ flow values.
- WFWQC will likely resolve many of the discrepancies in the data by analyzing the upstream/downstream position of the monitoring sites relative to DWQ.
- WFWQC added their 2019 and 2020 data into the water quality database. It may take a while to get access to it, but it may help resolve discrepancies in the data distribution. Updating the analyses with updated data from Lindon Drain and Spanish Fork River sub-catchments and WFWQC's 2019 and 2020 data would impact the timeline for completing the study.
- WFWQC had some monitoring sites located on open water at compromise elevation. In 2015 and 2016, the Utah Lake elevation was low enough that WFWQC could collect data from those sites. Since the Science Panel is interested in modeling at the low and high lake level, the data from these sites would be useful for modeling the low lake level scenario. Considering that drought conditions will be common moving forward, the low lake level data is relevant to modeling and understanding the low lake level scenario. These considerations should be accounted for as the Science Panel moves into the overall lake modeling. Neither the Lindon Drain and Spanish Fork River sampling sites are below compromise elevation for DWQ and WFWQC.
- Some of the data WFWQC collected on upstream sites will be useful for other questions in future Science Panel studies.
- The Science Panel should not pause the CNP Budget Study to wait until DWQ and WFWQC have had a chance to explore their data discrepancies. Overall, the DWQ and WFWQC datasets are converging, but they will not ever completely converge. Because addressing the data discrepancies in the Lindon Drain sub-catchment would likely result in a 1% difference in the total load calculation, the Science Panel should continue to move forward with the analysis.
- The purpose of the CNP Budget Study is to come up with a contemporary estimate for bulk loads coming to Utah Lake, building off previous studies. The next phase of the Science Panel's work will involve watershed modeling and building time-series input models. There is time between now and the watershed modeling effort for the Science Panel to incorporate what they learn from exploring sampling sites into future analyses.
- The Science Panel will continue to move forward with the CNP Budget Study as DWQ and the WFWQC address data discrepancies in Lindon Drain.

CNP BUDGET STUDY – LAKE ELEVATION AND DATA OVERVIEW

Kateri Salk, Tetra Tech, presented an overview of the lake elevation and corresponding data for the CNP Budget Study. Her comments are summarized below.

- Utah Lake experiences large variability in elevation levels from year to year and within years. This variability is demonstrated by graphics illustrating the maximum and minimum annual elevation in Powell Slough and Provo Bay.
- At the last Science Panel meeting, Science Panel members discussed whether to generate loads based on the compromise elevation or low lake elevation. If the compromise elevation represents the lake boundary, Tetra Tech will generate loads from the sampling site directly upstream of the compromise elevation boundary. If the low lake level represents the lake boundary, Tetra Tech will generate loads from the downstream location based on the inundated sites. It was not possible to calculate loads based on an intermediate boundary due to data limitations at the intermediate sites. The Science Panel decided to analyze the load at both compromise and low lake elevation at Powell Slough and Mill Race to see the difference in the results.
- Science Panel members discussed whether to use tributary monitoring data or discharge monitoring reports (DMR) data for the load calculations. The Science Panel decided to use DMR data when a wastewater treatment plant (WWTP) is near the tributary outflow, which occurred in the Timpanogos Special Service District, Powell Slough, and Mill Race watersheds. The Science Panel also decided to use tributary data when WWTPs are far from the tributary outflow, which occurred in the Spring Creek – Springville, Dry Creek – Spanish Fork, and Benjamin Slough watersheds. The CNP Budget Study report includes loads generated from both sources.

Science Panel Discussion

Science Panel members discussed the lake elevation levels and the corresponding data. Their comments are summarized below.

- Even when the Utah Lake elevation is high, Mill Race is long. If the Utah Lake elevation is low, Mill Race travels across Provo Bay. Data from Theron Miller and Greg Carling show that nutrient attenuation occurs in Mill Race, from 3 milligrams/liter at the end of the pipe to 1 milligram/liter where Mill Race enters Provo Bay. These findings indicate a big discrepancy between the end-of-pipe data and the data at the mouth of the river. Not only does the nutrient concentration decrease between the end-of-pipe and the tributary outflow, but so does the flow. Powell Slough follows the same pattern but to a lesser degree.
- The WWTPs where Tetra Tech used DMR data to generate loads are not all the same distance from the tributary outflow.

CNP BUDGET STUDY – POWELL SLOUGH DATA RESULTS OVERVIEW

Kateri Salk, Tetra Tech, presented an overview of the data results for Powell Slough based on the DMR and tributary data at different lake elevations. Her comments are summarized below.

- At Powell Slough, Tetra Tech used two downstream tributary monitoring sites (sites 4995210 and 4995230) to calculate the nutrient load based on the low lake elevation. They used the Orem WWTP DMR data to calculate the nutrient load based on the compromise lake elevation. Based on their calculations, they found that:
    - The total nitrogen load based on DMR data was 279.52 metric tons/year, and the total nitrogen load based on tributary monitoring data was 294.86 metric tons/year.
    - The total phosphorus load based on DMR data was 45.92 metric tons/year, and the total phosphorus load based on tributary monitoring data was 32.87 metric tons/year.

Science Panel Clarifying Questions
Science Panel members asked several clarifying questions about the Powell Slough data results. Questions are indicated in italics with corresponding answers in plain text.

Are there any differences in flow values and nutrient concentrations between the DMR data and the tributary monitoring data? A decrease in flow between the two sampling stations may suggest a sub-surface pathway for flows, and a sub-surface pathway could have many implications for nutrient loading. For example, a sub-surface pathway through a calcite-rich matrix would sequester phosphorus.
It depends on whether the Science Panel wants to consider Powell Slough as part of Utah lake. This question for the Science Panel is an important decision point.

What data and tributary monitoring sites did Tetra Tech use to estimate nutrient loads?
Tetra Tech used a summation of the data from sites 4995210 and 4995230 to estimate nutrient loads at low lake level. The monitoring sites represent two distinct flows coming from the sub-catchment.

Science Panel Discussion
Science Panel members discussed the Powell Slough data results and whether to define the boundary of Utah Lake as compromise elevation or low lake elevation. Their comments are summarized below.

- The differences in total phosphorus between the DMR data and tributary data at Powell Slough are interesting. The phosphorus could be taken up by organic matter, precipitating out of the water column, or ending up in the sediment. Calcite may also be taking phosphorus out of the water. Researchers could take sediment samples during drought conditions to collect evidence and identify where the phosphorus is going.
- WFWQC has conducted sediment sampling for calcite and soluble reactive phosphorus (SRP) studies and found no loss in SRP.
- Areas of the Jordan River are both sources and sinks of nitrogen depending on the presence of organic matter and whether it is in a depositional zone. Powell Slough is slow and organic matter rich. Depending on lake level, times of production, and senescence of the surrounding wetlands, Powell Slough could be a nitrogen source as organic matter decomposes. Nitrogen is more elusive to track based on time of year and location on the river.
- The 30% reduction in phosphorus from the DMR data and tributary monitoring data is significant and deserves a discussion from the Science Panel. The difference in nitrogen values is less important than discussing the difference in phosphorus values.
- Every time the Utah Lake elevation rises, sequestered nutrients will come up unless they were permanently bound. Due to the pH of and amount of calcite in the Utah Lake, a rise in Utah Lake elevation may also render nutrients more biologically unavailable. Utah Lake is roughly two pH higher than Powell Slough. These are all variables the Science Panel should consider.
- One of the tributary monitoring sites (site 4995210) is below compromise lake elevation. DWQ and WFWQC both monitor this site. Due to fluctuation in Utah Lake levels, they do not sample the site regularly, so the number of samples may be low. There are about half fewer samples from both monitoring sites 4995210 and 4995230 than for other tributary monitoring sites that are not periodically inundated.
- Utah Lake is an extremely complex system, and the Science Panel will need to make some assumptions for defining the system. The Science Panel should be more conservative in

their analysis, which would mean counting things more broadly. Including Powell Slough as part of Utah Lake would be the more conservative assumption because it would involve counting the Powell Slough system as something important to the functioning of the whole Utah Lake system.
- The Science Panel should use the compromise elevation as the Utah Lake boundary and use the downstream tributary monitoring data to determine attenuation dynamics. Compromise elevation is a conventional definition of the system.
- Something is happening between the effluent and the lake. The Science Panel has other studies that will help inform the questions around attenuation, including the littoral sediment study and the water quality models. The water quality models will account for Utah Lake fluctuation, so there may be an opportunity to characterize what is happening between the downstream and upstream sites.
- Drought will make it less likely that Utah Lake will reach compromise elevation, making it less relevant for studying the Utah Lake system.
- The Science Panel decided to use both compromise elevation and low lake elevation to estimate external nutrient loading in a previous meeting. It would be helpful to have one decision on the Utah Lake boundary to calculate the nutrient load and come to specific conclusions for Powell Slough and Mill Race.

CNP BUDGET STUDY –MILL RACE DATA RESULTS OVERVIEW

Kateri Salk, Tetra Tech, presented an overview of the data results for Mill Race based on the tributary monitoring data at different lake elevations. Her comments are summarized below.

- At Mill Race, Tetra Tech summed the data from two sampling sites (site 4996540 and 4996566) to calculate nutrient loads using tributary monitoring data at compromise elevation. Tetra Tech also explored using an additional downstream tributary monitoring site (site 4996536) to calculate nutrient loads for low lake elevation. There was only one data point for total nitrogen at the downstream sampling site and three data points for total phosphorus. The number of data points available at the downstream location was not sufficient for calculating nutrient loads.
- Tetra Tech calculated nutrient loads using DMR data from Provo WWTP.
- Based on their calculations, they found that:
    - The total nitrogen load based on DMR data was 318.31 metric tons/year, and the total nitrogen load based on tributary monitoring data was 257.41 metric tons/year.
    - The total phosphorus load based on DMR data was 51.88 metric tons/year, and the total phosphorus load based on tributary monitoring data was 27.27 metric tons/year.

Science Panel Discussion

Science Panel members discussed the Mill Race data results. Their comments are summarized below.

- The phosphorus loads estimated using tributary monitoring data were half of the phosphorus loads estimated using DMR data. The DMR data is just a theoretical number for what is reaching Utah Lake, but the reality is that only about half of the load is reaching Utah Lake.
- Mill Race is a defined channel, and someone should conduct a separate mass balance on it. The calcite study will provide more information on what is occurring to phosphorus. Irrigation at the golf course could also be a factor impacting phosphorus loads.
- Mill Race is a good opportunity for a longitudinal study to measure the nutrient concentrations and flows along Mill Race. A Brigham Young University (BYU)

undergraduate has conducted this study in the past. They found that the loads decreased along Mill Race, but they did not take the study so far as to determine why the loads were decreasing.

- The CNP Budget Study should use the tributary monitoring data to estimate the loads rather than the DMR data. The tributary monitoring data sites are downstream from the golf courses.
- Between the Provo WWTP and the tributary monitoring site, flow increases. The DMR flow makes up 83% of the tributary monitoring flow. This dynamic means there is an increase in flow and a decrease in loading, which suggests nutrient concentrations are going down substantially.
- Samuel Wallace and Heather Bergman will send the question on what dataset to use for the CNP Budget Study for Powell Slough and Mill Race to the Science Panel to solicit feedback. The CNP Budget Study Task Group will use the feedback from the Science Panel to decide what dataset to use for Mill Race and Powell Slough.

CNP BUDGET STUDY FINDINGS – NUTRIENT BUDGETS

Kateri Salk, Tetra Tech, presented the nutrient budget findings from the CNP Budget Study. The results of the Budget Study were processed using DMR data, but Tetra Tech will revise the findings based on the decision from the Science Panel on which dataset to use. Her presentation is summarized below.

- Total organic carbon (TOC) loads were highest for Provo River and Spanish Fork River. These findings were expected because both rivers have high flows, a large watershed area, and no WWTPs.
- Total nitrogen loads were highest for Timpanogos, Powell Slough, and Mill Race sub-catchments. These sub-catchments have WWTPs and differing flows and watershed sizes. The total nitrogen load for these three sub-catchments was generated using DMR data, while the total nitrogen load for the other three sub-catchments with WWTPs was derived using tributary monitoring data. Among sub-catchments without WWTPs, Provo River and Spanish Fork had the highest total nitrogen loads, which is not surprising given their high flows and large watershed area.
- Total phosphorus loads were highest for Timpanogos, Powell Slough, and Mill Race sub-catchments. The Spanish Fork and Provo River watersheds had the highest total phosphorus loads for sub-catchments without WWTPs.
- Tetra Tech generated a map for unmonitored and monitored watersheds that visually shows the different load sizes using a color spectrum as an indicator.
- In future analyses, Kateri Salk will calculate the load per unit area. This analysis will serve as a good check to ensure the unmonitored watershed load estimates are not far off compared to monitored watersheds. Tetra Tech will also create additional visualizations for individual sub-catchments based on flow, concentration, and load.
- Tetra Tech graphed the relative nutrient budget based on the inputs from watersheds with WWTPs, watersheds without WWTPs, unmonitored watersheds, atmospheric sources, and groundwater. For both total nitrogen and total phosphorus, most of the nutrient loads were coming from watersheds with WWTPs.
- Tetra Tech also estimated how much of the nutrient budget leaves Utah Lake via the Jordan River. About 5% of the total nitrogen load and 7% of the total phosphorus load is lost via the Jordan River each year. These estimates are lower than previous estimates and may be due to differences in the timeframe of the studies.
- Denitrification, anammox, and nitrous oxide represent total nitrogen outputs, but Tetra Tech does not have enough data to include these processes in the total nutrient budget.

- The CNP Budget Study nutrient budget estimates are similar to the nutrient budget estimates from other previous studies. The CNP Budget Study used direct measurements data to estimate nutrient loads, while other studies used model data. Tetra Tech put the findings from all the studies into the same unit (metric tons/year) to compare the findings.

Science Panel Discussion

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

- No organic carbon estimates are being provided for the WWTPs. WWTPs do have a discharge permit for total suspended solids (TSS). The Science Panel could estimate the amount of organic carbon from WWTPs, assuming that 90% of the TSS is volatile carbon and 50% is organic. That is something to potentially unpack from DMR data beyond the direct TOC and dissolved organic carbon (DOC) data.
- The Timpanogos WWTP has been optimizing their discharge, and the Provo WWTP is also updating their facilities to improve their nutrient discharge levels. The CNP Budget Study is still using DMR data from before the optimization of their discharge. The findings for the nutrient budgets will vastly change once they account for the optimization.
- There were multiple perspectives on how to address WWTP improvements in the CNP Budget Study.
    - One perspective was that to conduct a nutrient mass balance, the Science Panel should look at what has happened in Utah Lake. They can then use new data from WWTP improvements to project the nutrient budgets forward. To determine Utah Lake's capacity to remove phosphorus coming through the inflows, the Science Panel should know how much phosphorus has come in over the past five years. The Science Panel chose the 2015 to 2020 period as a recent window to understand how Utah Lake functions. At some point, the Science Panel has to choose a window because they cannot continue to postpone the Study waiting for the next dataset.
    - Another perspective was that the other ongoing Science Panel experiments observe Utah Lake in real-time, including the lower loads from WWTPs, making the current research not contemporary with the CNP Budget Study. The Science Panel should adjust its models as new data comes in. The CNP Budget Study and watershed model will not be accurate if it only accounts for older data. Considering that some WWTPs are putting out half the nutrients than they did during the window of the CNP Budget Study, using the past numbers will put an unfair target on WWTPs. The Science Panel should use the most recent data and look retrospectively at the trends over the past five to ten years. Some WWTPs, like Timpanogos WWTPs, have consistently achieved phosphorus levels at 1 milligram/liter or less.
    - Another perspective was that the CNP Budget Study uses the DMR data from some WWTPs, including the Timpanogos WWTP. The CNP Budget Study would therefore account for any reduction in nutrient loads from 2015 to 2020.
- The atmospheric deposition component of the nutrient budget will be larger than 8% of the nutrient budget for total nitrogen and 2% of the budget for total phosphorus. WFWQC and a BYU professor are preparing a report for their Atmospheric Deposition Study that shows much higher nutrient input from atmospheric deposition. They also have USGS data that is comparable to the atmospheric deposition levels shown in the report. The report should be ready next month. The current atmospheric deposition levels should act as a placeholder until the Atmospheric Deposition Study report is released.
- The current Atmospheric Deposition Study has limited information on bioavailability at this time. The Atmospheric Deposition Study investigators are beginning the bioavailability

aspect of the Atmospheric Deposition Study. They are collecting dust samples from the near vicinity of samplers and samples from Sevier Lake and the west desert. The researchers are trying to get a forensic record of the sediment composition from the source and locally around Utah Lake. The investigators will determine the composition of the dust and do speciation of those samples. The investigators will be working on that component of the Study this year.

- If the Science Panel can be flexible and modify the model with new data in the future, then there is no issue with developing a model now. The Science Panel should be flexible and recalculate the models with new data, such as new discharge data and data from the Atmospheric Deposition Study, Littoral Sediment Study, and Phosphorus-Binding Study, as it becomes available. There is support among the Science Panel for revising models as new data becomes available.
- The goal of the CNP Budget Study is to characterize conditions from 2015 to 2020. This approach allowed Tetra Tech to use a larger set of samples across the period. By definition, the Study characterizes the average conditions in that time window, which will change in the future.

CNP BUDGET STUDY FINDINGS – HYDROLOGIC BUDGET

Kateri Salk, Tetra Tech, presented the hydrologic budget findings from the CNP Budget Study. Her presentation is summarized below.

- In terms of the hydrologic budget, monitored sub-catchments make up 92% of the total tributary inflow, and tributary inflow makes up 78% of the total inflow to Utah Lake.
- On average, between 2015 and 2020, there is a net positive storage increase of 83,500 acre-feet/year, which is 17% of the total inflow.
- The tributary and overland flow estimates are in the range of other previous studies. The total inflow is also comparable to previous studies. The Jordan River outflow was lower than previous studies, potentially because there were several dry years in the 2015 to 2020 period.
- Tetra Tech improved the evaporation estimate by incorporating the fluctuation in lake elevation into the evaporation estimate. Evaporation makes up a larger component of the outflow in the CNP Budget Study compared to other studies because of a reduced streamflow in the Jordan River on average over the Study's timeframe.

Science Panel Comments

The estimated evaporation rate for Utah Lake at compromise elevation is 6.5 inches of water evaporating per month.

CNP Budget Study Next Steps

- The Science Panel will form a CNP Budget Study Task Group to discuss the CNP Budget Study report. The Task Group will include Theron Miller, Mitch Hogsett, Mike Brett, Ryan King, James Martin, and Hans Paerl.
- The Task Group will discuss which dataset to use for the Mill Race and Powell Slough watersheds, the results of the SedFlux modeling, and how to adjust the dataset based on the findings from the Atmospheric Deposition Study.

Public Comments

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

- Regarding the discussion on whether to use compromise elevation or low lake elevation, Utah is in a megadrought, and compromise elevation will not happen very often. Many significant lakes across the West, including Great Salt Lake, Lake Mead, and Lake Powell, are reaching historically low levels.

INITIAL CHARGE QUESTION PROGRESS REPORTING

Mike Paul, Tetra Tech, presented the next steps for creating a progress report on the initial charge questions. His presentation is summarized below.

- The purpose of this exercise is for the Science Panel to start thinking about how to answer the ULWQS Steering Committee's charge questions in the near term. This presentation discusses the process for quantifying uncertainty and the amount of agreement in evidence to develop answers to the charge questions.
- The four charge questions are:
    - What was the historic condition of Utah Lake, and how has it changed?
    - What is the current state of Utah Lake related to nutrients?
    - What additional information is needed for defining nutrient criteria development?
    - Is there an alternate stable state that can be reached under current water and fishery management?
- There were a variety of sub-questions created for each of these four charge questions.
- The Science Panel developed the Uncertainty Guidance, largely informed by the work of the Intergovernmental Panel on Climate Change (IPCC). The Uncertainty Guidance outlines how to compile and evaluate evidence, evaluate confidence, and evaluate likelihood. The IPCC has developed new schematics that are not in the current Uncertainty Guidance, which the Science Panel could consider incorporating.
- The process has several steps: 1) identify the evidence available, 2) evaluate the evidence and whether the data is sufficient to make a confidence statement, 3) evaluate the confidence and whether the data is sufficient to make a likelihood statement, 4) evaluate the likelihood, and 5) make a likelihood estimate.
- The first step in the process is to compile and evaluate the evidence. The Uncertainty Guidance has a preliminary rubric for what amount of evidence would be sufficient to provide an answer to a charge question. This rubric includes metrics, like how many model runs, independent analyses, and literature reviews would quantify different levels of evidence (low, medium, high). The rubric is preliminary, and the Science Panel can amend it if they want. This structure allows the Science Panel to make statements with limited data as long as there is a statement about the amount of evidence and agreement of available data.
- The second step is to determine whether there is sufficient data to make a confidence statement. This step involves evaluating the quantity of evidence and the agreement of the evidence (there is a rubric for what constitutes agreement) to determine the degree of confidence (low, medium, high). If there is sufficient data, the Science Panel can make a confidence statement.
- The third step is developing a likelihood statement, which involves associating the statement with a numeric probability. There needs to be sufficient data to translate papers, empirical analyses, and mechanistic modeling data into a quantifiable result. There is a preliminary rubric to determine whether there is sufficient data based on the probability of the results, amount of variance, and confidence of the relationship to make a likelihood statement. If there is sufficient data, the Science Panel will put the data through the rubric to make a likelihood statement. There is a guide on how to translate between language and

quantitative probability (e.g., 99-100% likelihood is "virtually certain," and 90-100% likelihood is "very likely").

- Mike Paul developed a handout with an example process for one of the charge questions. For each charge question, the Science Panel will need to develop evidence, confidence, and likelihood summaries with a traceable account that details the evidence and underlying assumptions used in the Science Panel's summaries, provided that there is enough data to make confidence and likelihood statements. Samuel Wallace and Heather Bergman will send the handout with the process for answering the initial charge questions to the Science Panel.
- There are several options for developing responses to the charge question:
    - **Option A:** The contractor takes the first attempt at answering each question and passes it on to the Science Panel for review and revision.
    - **Option B:** Subsets of Science Panel members agree to take the first attempt at answering each charge question and pass it on to the other Science Panel members for review and revision.
    - **Option C:** A mix of Option A and Option B (e.g., subsets of the Science Panel could work with the contractor to evaluate the evidence for each question)

Science Panel Next Steps for Answering the Charge Questions

Science Panel members discussed the next steps for answering the charge questions. Their comments are summarized below.

- Most Science Panel members present (4 of 7) indicated they would prefer to take the Option C approach to develop initial answers to the charge questions. The other three Science Panel members indicated they would prefer to take the Option A approach, with two of the members saying they can live with taking the Option C approach.
- Tetra Tech, Peak Facilitation Group, and Scott Daly will work offline to subdivide the initial charge questions into different categories and take volunteers from the Science Panel to answer those questions. Tetra Tech will put together some baseline information (e.g., available reports and data) as a starting point for the Science Panel groups.

FINAL PUBLIC COMMENTS

Members of the public provided comments on today's meeting. Their comments are summarized below.

- The early reproductive age stage of June Suckers are now successfully spawning in the lower Provo River. Older, larger June Suckers are winding down their efforts. Now it is up to White Bass to keep from eating all their eggs. Carp are frolicking along the lake's shorelines, spawning on vegetation that hopefully will soon be out of water due to decreasing lake levels.
- The CNP Budget Study figures show that 20 to 30 times more nutrients are going into Utah Lake than is needed to maintain algae growth. Utah Lake has essentially the unlimited ability to precipitate phosphorus into sediments. The geochemical interchange between the sediments and the water column determines the nutrient level, particularly for phosphorus. Around 95 to 98% of the phosphorus goes into the sediment. The nitrogen from the atmospheric deposition is extremely important in warding off harmful algal blooms. The atmospheric deposition in Utah Lake is huge compared to other lakes.

NEXT STEPS

- Samuel Wallace will schedule a CNP Budget Study Task Group meeting.
- Tetra Tech, Peak Facilitation Group, and Scott Daly will work offline to subdivide the initial charge questions into different categories and send out a sign-up sheet to take volunteers from the Science Panel to answer those questions.
- The Science Panel will continue to have virtual meetings over the next few months with the goal of having an in-person meeting in August or September.