Utah Lake Water Quality Study (ULWQS)
Steering Committee-Science Panel Joint Meeting
January 19, 11:00 AM to 2:00 PM
Virtual Meeting
Meeting Summary - FINAL

ATTENDANCE:
Steering Committee Members and Alternates: David Barlow, Craig Bostock, Sam Braegger, Gary Calder, Chris Cline, Eric Ellis, Erica Gaddis, Heidi Hoven, Chris Keleher, Rich Mickelsen, Jay Olsen, Mike Rau, Dennis Shiozawa, Jesse Stewart, Brad Stapley, Ben Stireman, Neal Winterton, Gerard Yates

Science Panel Members: Janice Braheny, Mike Brett, Greg Carling, Mitch Hogsett, Ryan King, James Martin, Theron Miller, Michael Mills, Hans Paerl

Members of the Public: Jeff Anderson, Jason Broome, Morgan Faulkner, Renn Lambert, LaVere Merrit, David Richards, Erik Sewell, and Soren Simonsen

Utah Division of Water Quality (DWQ) staff: Scott Daly and Jodi Gardberg

Technical Consultants: Mike Paul and Kateri Salk

Facilitation Team: Heather Bergman and Samuel Wallace

ACTION ITEMS

Who	Action Item	Due Date	Date Completed
ULWQS Steering Committee	Submit any additional comments or feedback on the interim charge question reports via email.	Feb. 2	
Scott Daly, Samuel Wallace, and Heather Bergman	Write an executive summary for the Implementation Planning Framework for initial review by Chris Cline, Chris Keleher, and Heidi Hoven and final review by the Steering Committee.	Feb. 9	
Scott Daly and Rich Mickelsen	Work together to reach out to the POTW community to review and provide input on the Implementation Planning Framework.	Feb. 9	

DECISIONS AND APPROVALS
The Steering Committee approved moving forward with the Implementation Planning Framework with the proposed changes shared during the meeting incorporated.

INTERIM CHARGE QUESTION REPORT PRESENTATION
Kateri Salk, Tetra Tech, presented on the interim charge question reports. Her presentation is summarized below.

Overview

- The interim charge question report presentation and discussion goals are to 1) present the outcomes from the interim charge question reports and 2) facilitate Steering Committee and Science Panel interaction to ensure any Steering Committee questions are answered.
- Several years ago, the Steering Committee proposed four overarching questions about Utah Lake:
    - What was the historical condition of Utah Lake with respect to nutrients and ecology pre-settlement and along the historical timeline with consideration of trophic state shifts and significant transitions since settlement?
    - What is the current state of the lake with respect to nutrients and ecology?
    - What additional information is needed to define nutrient criteria that support existing beneficial uses?
    - Is there an improved stable state that can be reached under the constraints of current water and fishery management?
- The Science Panel developed 32 more detailed sub-questions based on the Steering Committee's four questions.
- The 32 questions were divided into six themes. Six Science Panel subgroups were formed to discuss and respond to the charge questions for each theme.
- As part of the evaluation of the charge questions, each subgroup described the evidence available for each question (i.e., data and studies). Each subgroup then evaluated the evidence type (e.g., literature, field observations, etc.), amount, quality (i.e., rigor with which the evidence was derived), and agreement (i.e., did the studies come to the same conclusion). Each Science Panel subgroup then used a matrix that accounts for the agreement and evidence (type, amount, and quality) to assign a confidence level to their responses.
- After evaluating the confidence for each response, the subgroups also had the option to evaluate each response's likelihood (i.e., the quantification of uncertainty). The likelihood evaluation was not conducted for this iteration of the charge question responses.

Interim Responses to the Charge Questions

Historical Condition Charge Questions

- A good amount of the evidence for the historical condition charge question responses came from the ULWQS commissioned paleolimnological studies and published literature.
- The Science Panel subgroup had high confidence (high amount, high quality) in their response on the presence and species of diatoms and macrophytes in the sediment cores.
- The Science Panel subgroup had high confidence (high amount, high quality) in their response on the historical change of Utah Lake from oligo-mesotrophic conditions to eutrophic conditions.
- The Science Panel subgroup had high confidence (high amount, quality, and agreement) in their response on the historic nutrient conditions in the sediment cores.
- The Science Panel subgroup had high confidence (high quality, medium amount, and high agreement) in their response on the historical water quality and trophic state of Utah Lake based on phytopigment and DNA evidence.
- The Science Panel subgroup had low confidence in their response on the nutrient regime of Utah Lake, assuming no inputs from human sources. Additional evidence from the EFDC/WASP model will help simulate conditions and provide evidence for this charge question.

Macrophytes and Diatoms Charge Questions

- The Science Panel subgroup had medium confidence (medium amount, low-high quality, high agreement) in their response on the environmental requirements for present and historical macrophyte species.
- The Science Panel subgroup had medium confidence (low direct evidence and literature, high quality, high agreement) in the response on the role of lake drawdown on macrophyte recovery.
- The Science Panel subgroup had high confidence (high amount, med-high quality, high agreement) in their response on the relationship between carp, wind, and macrophytes on non-algal turbidity and nutrient cycling.
- The Science Panel subgroup had low confidence in their response on the shift to macrophyte-dominated state following nutrient reductions. The EFDC/WASP model will help simulate conditions and provide another line of evidence to help answer this charge question.

Sediment Charge Questions

- The Science Panel subgroup had low confidence (low amount, high quality) in their response on calculating equilibrium phosphorus concentration between sediment and water column. More studies are forthcoming that will provide additional evidence to this charge question.
- The Science Panel subgroup had high confidence (high amount, quality, and agreement) in their response on sediment oxygen demand and nutrient release dynamics in Utah Lake.
- The Science Panel subgroup had medium confidence (limited evidence, high quality) in their response on the impact of stratification on anoxia and phosphorus release.

Harmful Algal Blooms (HABs) Charge Questions

- The Science Panel subgroup had medium confidence (limited evidence, high quality) in their response on the spatial distribution of HABs and proximity to nutrient sources.
- The Science Panel subgroup had high confidence (robust evidence, high agreement) in their response on the nutrient and phosphorus limitation of primary production and HABs.
- The Science Panel subgroup had medium confidence (limited evidence, medium quality) in their response on the role of lake elevation on HABs.
- The Science Panel subgroup had medium confidence (evidence varies by constituent) on the role of other factors on HAB formation.
- The Science Panel subgroup had low confidence in their response on the role of calcite scavenging on phosphorus. More evidence is forthcoming for this question, particularly from the ongoing Phosphorus-Binding Study.
- The Science Panel subgroup had high confidence (robust evidence, high agreement, and quality) in their response on the relationship between light extinction and algae, total suspended solids, and turbidity.
- The Science Panel subgroup had high confidence in their response on the extent nutrient reductions can reduce HABs.

Aquatic Life Charge Questions

- The Science Panel subgroup had medium confidence (limited evidence, high quality) in their response on the paleo record of carp over time.
- The Science Panel subgroup had medium confidence in the range of values for carp contribution to nutrient cycling but had low confidence in the mean value for carp contribution to nutrient cycling.

- The Science Panel subgroup had high confidence (high amount, medium-high quality, high agreement) in their response on the impact of carp removal on macrophytes, nutrients, and water clarity.
- The Science Panel subgroup had low confidence in the relative impacts of wind and carp on non-algal turbidity but had medium confidence in their response on the overall impacts of wind and carp on non-algal turbidity. A limited amount of Utah Lake-specific analyses is available to respond to this question.
- The Science Panel subgroup had medium confidence (limited evidence, high quality) in their response on early life stages in Utah Lake. Parts of Utah Lake meet the needs of the early life stages of wildlife species, but more information is needed on the distribution of birds and fish to answer this question.
- The Science Panel subgroup lacked information to provide a response on which species are sensitive and need protection from nutrient impacts.

Criteria Development Charge Questions
The criteria development charge question was "what additional information is needed to define nutrient criteria that support existing beneficial uses?" This charge question is unique from the other ones because it is not informed directly by studies and data. The subgroup responded to this charge question using the managemental goals table and technical framework approved by the Science Panel and Steering Committee. The management goals table identifies the assessment endpoint for each management goal. It also indicates whether the management goal is relevant to developing in-lake nitrogen and phosphorus criteria and whether the assessment endpoint is quantifiable given the available information. The Numeric Nutrient Criteria Technical Framework has a table that displays how each stressor-response relationship will be evaluated (by empirical stressor-response data and/or a mechanistic model output).

Future Studies and Next Steps
- Forthcoming studies that will help improve the confidence to charge questions include:
    - Lake model (EFDC-WASP)
    - Watershed model (HSPF)
    - Empirical stressor-response analysis
    - Paleolimnological study
    - Phosphorus binding study
    - Littoral sediment study
    - Limnocorral study
    - Atmospheric deposition study
    - Nutrient mass balance analysis
    - FWS & USGS toxin study on aquatic life
    - DWQ monitoring program additions
    - Food web model (being conducted by Dr. David Richards)
    - Multi-metric index of biological integrity study (MIBI) (being conducted by Dr. David Richards)
    - Recreation survey
- These studies are all Utah-Lake-specific studies. As more studies are completed, the Science Panel will incorporate them to increase confidence. Once all the studies are completed, the remaining gaps in knowledge will be filled with literature-derived information.
- At today's meeting, Steering Committee members will have the opportunity to provide comments and considerations to guide Science Panel research, analysis, and final response development.

- The expected timeline is to complete the remaining Science Panel studies during the first half of 2022. The goal is to complete the lake and watershed models by the end of 2022. Once the studies and models are completed, the Science Panel will update the charge question responses in 2023.

Steering Committee Clarifying Questions

Steering Committee members asked clarifying questions about the charge question responses. Their questions are indicated in italics, with the corresponding response in plain text.

How does the Science Panel weigh varying findings from different studies in their confidence evaluation compared to an individual paper?

- The strength of using a meta-analysis approach is that the evaluators can take various findings from different studies. If all the studies agree and use approved methods, the evaluators can have high confidence in the response. If there are different findings across studies, this approach allows the evaluators to weigh the findings (quality of evidence and number of sources that agree and disagree) to assess their confidence in the response. This approach accounts for individual studies and creates an unbiased way to assess individual studies.
- The scientific process allows science to be debated. The Science Panel is attempting to take the available studies, data, and research and put them into a meaningful format for policymakers. The confidence assessment is an approach that allows the Science Panel to wrestle with various uncertainties and disclose them upfront and clearly to policymakers.
- The Science Panel oversaw a Bioassay Study that looked into whether nitrogen and/or phosphorus were limiting in the control of algal blooms. The study concluded that nitrogen and phosphorus were both limiting but at different times of the year. Researchers used to think that either nitrogen or phosphorus was a limiting factor in the past. The literature has evolved to indicate that phosphorus and nitrogen can both be limiting but at different times in the year. The meta-analysis approach allows the Science Panel to account for recent studies and different methodologies to develop their response and assess their confidence.

What opportunities pop out to the Science Panel as the most important for controlling nutrients and algal blooms?

- The Science Panel needs to better understand where the soluble and bioavailable forms of phosphorus and nitrogen in the lake are coming from. The Science Panel needs to do more research into phosphorus cycling and the presence of nitrogen-fixers to better understand nutrient dynamics in the lake.
- There are problems with HABs in Utah Lake, but the HABs situation would be much worst if Utah Lake was not good at sequestering phosphorus. Utah Lake has the inherent ability to sequester phosphorus above and beyond most lakes.

Has the Science Panel prioritized the studies based on how many questions they would address and how much uncertainty they would resolve?

Many of the studies listed in the presentation are underway and proceeding simultaneously. Several years ago, the Science Panel identified knowledge gaps and the studies needed to fill those gaps. The Science Panel ranked those studies and came up with the list shared at today's meeting.

The Steering Committee has discussed cyanotoxins a lot, but there are no responses related to cyanotoxins. Will the Science Panel be addressing that in the future?
The relationship between algal biomass and toxicity can vary widely. Toxin production is not only subject to nutrients but also light, temperature, and the species composition of the cyanobacteria community. Overall, there is a direct relationship between nutrients and toxin potential; reducing the biomass of toxigenic algae will result in a reduction of the toxicity potential. A nutrient control strategy will ultimately have a beneficial effect for this reason.

The Science Panel is developing an in-lake and watershed model. Will the information from the ongoing studies be put into the model?

- The Science Panel is not directly developing the model. They are working with Tetra Tech to develop the model.
- There are some outstanding variables that the Science Panel and Tetra Tech need to gather information on to develop the model. For example, one of the ongoing studies is looking at the issue of calcite sorption. This study will produce information that will inform model inputs.
- The Tetra Tech team is updating the modeling framework for simulating in-lake conditions. Those updates are underway, and the information from ongoing studies will be incorporated to the extent that it becomes available.

The June Sucker Recovery Program has an interest in reestablishing macrophytes in Utah Lake. The Science Panel indicated they have low confidence in their response related to the shift to macrophyte-dominated state following nutrient reductions. What research is the Science Panel conducting to increase their confidence in their response?

- The Timpanogos Special Service District (TSSD) is conducting a Limnocorral Study to address questions around reestablishing macrophytes in Utah Lake. This study involves adding subaquatic vegetation and carp to the limnocorrals to better understand macrophyte re-establishment. Dr. David Richards is also developing a food web model to provide information on this question.
- One of the output variables in the in-lake model is light intensity in the water column. Light intensity impacts macrophytes' ability to grow in Utah Lake. Understanding how nutrients impact light intensity in the water column will help provide information on macrophyte re-establishment in Utah Lake.

The Science Panel presented a value for the average light penetration into the water column needed for macrophyte growth. The average seemed low, considering aquatic vegetation in the region has a lower tolerance for light penetration and turbidity. What species did the Science Panel use to calculate the average?
The species evaluated for literature-derived light compensation points were: Ceratophyllum demersum, Elodea canadensis, Myriophyllum spicatum, Potamogeton pectinatus, Potamogeton praelongus. The range of vales was 3.5-45 µmol m-2 s-1. The mean +- standard deviation was 6.9 ± 1.9 µmol m-2 s-1.

In the historical condition charge question responses, the Science Panel did not use the findings from a published study and used findings from an unpublished study. Should the Science Panel discount published studies because they did not use current methods and then cite unpublished studies?

- The Science Panel commissioned the unpublished studies. It takes a lot of time to complete unpublished studies and have students publish their theses. For that reason, those studies are not published yet, but they are on their way to being published.

- The Science Panel discounted one conclusion from one study. The conclusion from the study was related to sedimentation rate. This study did not use a particular method to date the sediment cores; instead, they made an estimate based on wiggle matching. The study concluded that the deposition rate was two centimeters per year, which is a very high rate. This sedimentation rate is not a reasonable estimate considering it is an order of magnitude higher than sediment deposition in any other lake.

In the ULWQS Paleolimnological Study, how were the sediment cores dated to identify pre and post-1880 conditions? Does ash from the Geneva Steel plant provide a marker in the lake for the 1940s? Have any pollen studies been completed with cores? Water well drilling records could be informative for sediment core dating.

- Researchers used two different methods to date the sediment cores: lead-210 and cesium dating. There was some record of lead-210 in the sediment cores even though deposition rates of lead-210 are low in this area. Additionally, due to the nuclear bomb testing in Nevada, researchers were able to use cesium data to improve their records. Researchers see a sharp transition around 1880 in their sediment cores, which ecologically coincided with the introduction of carp.
- A consulting laboratory is looking at pollen in the sediment cores, but they have not yet completed the pollen data record.

Do water levels and invasive species have any impact on sediment deposition?
Carp can affect our sediment record. With all sediment proxies, there are younger sediments on top and older sediments on the bottom. Sediment disturbances can blur the distinction from year to year. Because of the continual disturbance of carp, there is more significant blurring in the sediment cores. Still, the impact of carp does not reverse the sediment deposition process.

Will reducing phosphorus and nitrogen have any real impact on the nutrients in the lake, or will phosphorus and nitrogen just be released from the sediment?

- There are both external sources and internal sources (e.g., sediment release) of nutrients into Utah Lake. The sediments are internally recycling nutrients already there; the sediments are not a separate external source. Decreasing external sources of nitrogen and phosphorus into Utah Lake would likely decrease the amount of internal cycling in the long term.
- Utah Lake has a high capacity to sequester phosphorus in its sediment. Reducing the external inputs puts less phosphorus into the Utah Lake, and the capacity of the lake to store phosphorus should result in a linear reduction in in-lake nutrient concentrations.

If we reduce phosphorus and nitrogen coming into the lake, what is the timeline for the sediment phosphorus and nitrogen to impact the lake?

- Dr. Mike Brett has been calculating the mass balance for Utah Lake. His calculations indicate that the timeline would be relatively short – a few years. The mass balance for a non-steady state system suggests that the lake should stabilize at a new equilibrium in five years or less.
- This timeline is similar to other systems. It takes about two years for the organic material to decompose and impact sediment fluxes. This system is complicated because the phosphorus is tied up in calcium and iron, which may be released under certain conditions.
- Climate is another factor to consider in the timeline. Cyanobacteria respond to changes to temperature, lake stratification, and other environmental factors. Cyanobacteria can store

nutrients and have a high capacity to go through lean times. The extent that the blooms will be reduced may lag behind the mass balance calculation.

- The Science Panel is still tackling what the new sediment equilibrium would look like in Utah Lake under different conditions. Under anaerobic conditions, the sediments in Utah Lake could release a large amount of phosphorus, but under aerobic conditions, the phosphorus may be re-sequestered.
- Goel and Carling found that as the water column phosphorus concentrations decreased, there was an additional phosphorus release from the sediment. There may be a delay in establishing a new equilibrium because of this dynamic.
- The Science Panel still needs to discuss how much phosphorus release comes from biological conditions versus chemical conditions. Phosphorus bound with iron would be released under anoxic conditions due to biological decomposition. On the other hand, phosphorus bound with calcium would be released by a large change in pH. The amount of iron-bound phosphorus is lower than the amount of calcium-bound phosphorus in Utah Lake.
- Following a HAB, organic matter settles on the sediments and decomposes. This decomposition can lead to the release of nutrients. Sometimes, burying the nutrient-rich sediment layer with less contaminated sediment prevents the organic matter from releasing nutrients from a nutrient-rich layer.
- The Science Panel still needs to discuss what they might expect regarding the timeline for establishing a new equilibrium.

The sediment interim charge question report states frequent wind-driven resuspension brings surface sediments into contact with the water column. What does this dynamic look like in Utah Lake?
The relationship between wind shear and sediment resuspension will be included in the EFDC/WASP in-lake model. The model will help quantify the impacts of wind on sediment resuspension. Wind scenarios can be put into the model to estimate impacts. The amount of sediment resuspended depends on the sediment properties (e.g., characteristics, critical shear stresses). There will be some uncertainty associated with calculating sediment resuspension, but the modelers can conduct sensitivity analyses to determine a range of impacts.

What is the relationship between carp and nutrients?
There is a lot of literature available on the excretion rate of fish and its impact on nutrient cycling, particularly carp. Carp recycle phosphorus and nitrogen in the lake from their consumption of benthic organisms. Carp is the most dominant fish in Utah Lake by biomass, so the amount of nutrient recycling from carp is large.

Is macrophyte recovery not happening because of nutrients?

- Utah Lake is subject to large elevational changes. When lake elevation decreases, small macrophytes are exposed. The abrasion of the sand from wave action and ice in the winter impacts the ability of macrophytes to reestablish. The sediments themselves have plenty of nutrients for macrophyte growth.
- The reduction of light penetration in Utah Lake inhibits macrophyte growth. One potential change needed to facilitate macrophyte recovery is increased water clarity. Water clarity is impacted by sediment resuspension and phytoplankton growth. Reducing nutrients in the lake will reduce phytoplankton biomass and, in turn, may increase water clarify for light penetration.

Is nitrogen removal easier than phosphorus because of the denitrification process?
Nitrogen is very mobile through the sediments and water column. Nitrogen concentrations can be reduced more quickly because it does not have the same sequestration dynamics as phosphorus.

Public Clarifying Questions
Members of the public asked clarifying questions on the interim charge question reports. The questions are indicated in italics, with corresponding responses in plain text.

DWQ conducted copper and peroxide treatments to manage HABs. Dr. David Richards collected data on zooplankton and phytoplankton following those treatments that he can share with DWQ. Does the DWQ have reports or data on those treatments?
The data on the phytoplankton response to those treatments came in just last week. The studies and data from DWQ are forthcoming.

There is an emerging thought that benthic primary production shifted to water column production in the 1970s. Are there any perspectives from the Science Panel on this emerging thought?
The historical information indicates that the shift from an oligo-mesotrophic system to a eutrophic system occurred in the late 1800s. Dr. Janice Brahney may be able to provide a more specific perspective on this question in the future.

Science Panel Comments
Science Panel members provided comments on the interim charge question reports. The comments are included below.

- Lake currents also influence the spatial distribution of HABs. While concentrations are found near treated wastewater inflow, lake currents can be important in the actual distribution of the blooms across the lake. Utah Lake is shallow, so wind-generated currents tend to follow a classical shallow lake pattern. While prevailing winds come from the southwest and northwest (depending on the season), daily canyon winds are very important. These are generated by the cool air in the higher elevations in the Wasatch Back. In the mornings, the cooler air flows down the canyons into Utah Valley. This is especially the case with Spanish Fork Canyon (see Hales 1940. Characteristics of prevailing winds at the Provo Municipal Airport. Proc UT Acad Sci 25:117-123). These morning winds generate a shallow water circulation pattern. An in-lake current flows across the lake from the east to the west, starting near the mouth of Provo Bay to the Knolls on the west side of the lake. There, the current splits into two longshore currents, one going south, the other going north—the northern longshore current flows to just south of Pelican Point, where it turns to the east. The south longshore current follows the western shore into Goshen Bay and leaves the shore near Mosida, forming a large, attached spit (known as Sucker Point by the Loys because they could always harvest suckers at that point). ERTS satellite images from the 1970s show strong phytoplankton blooms in August and September that follow these currents, especially the northern ones. I suspect that these are most important during high-pressure periods. The formation of the shoreline beach structures near Pelican Point and Mosida indicate a long presence of this circulation pattern, and a second spit separating White Lake from Goshen Bay indicates similar circulation during a higher elevation of Utah Lake. Both the Provo airport and Spanish Fork airport will have more recent data on wind patterns which would allow long-term information on the role of canyon winds on lake circulation. The canyon winds may have weakened a bit in recent years.[*]

[*] This comment was submitted in writing via a Google Spreadsheet before the meeting. The comment was shared with the Science Panel and Steering Committee during the meeting break.

Interim Charge Question Report Next Steps
Steering Committee members can submit any additional comments or feedback on the interim charge question reports via email over the next two weeks.

INTERIM CHARGE QUESTION REPORT KEY TALKING POINTS DISCUSSION
Erica Gaddis, DWQ, will be giving a 20-minute presentation to the Utah State Legislature on water quality. Elected officials have asked her to summarize the state of the ULWQS and key findings. She will be using the interim charge question reports to pull together talking points. Steering Committee and Science Panel members discussed any key talking points to include in that presentation. Their comments are summarized below.

- The sooner nutrient inputs are reduced, the sooner there will be an improvement to Utah Lake. Because denitrification rates are lower than nitrification rates, reducing nitrogen inputs will have a mass balance effect on Utah Lake. The Bioassay Study suggests that reducing nitrogen concentrations will reduce algal biomass.
- One talking point should be that the relationships in Utah Lake are not linear. There is a lot of elasticity in how the system responds.
- A statement as to where the process is in terms of completion (e.g., how many more years to do the remaining studies and complete the remaining process, what year a decision might be made) would be helpful to the legislators and public.

IMPLEMENTATION PLANNING FRAMEWORK PROPOSED CHANGES OVERVIEW
Scott Daly, DWQ, incorporated several changes to the Implementation Planning Framework based on Steering Committee feedback during their December 14 meeting and one comment made by a Steering Committee member between the December 14 meeting and this meeting. Scott shared the proposed changes with meeting participants. His comments are summarized below.

- The Implementation Planning Framework is a planning document that the Steering Committee has been working on to guide Phase III (the implementation phase) of the ULWQS. Phase III will occur in parallel to Phase II (development of the numeric nutrient criteria) of the ULWQS. The Science Panel has not directly engaged with the framework until this meeting.
- The framework was developed with input from the publicly owned treatment works (POTW) community and the Steering Committee. The draft Implementation Planning Framework was shared with the Steering Committee and discussed during their December 14 meeting.
- The only change made to the introduction section of the Implementation Planning Framework is the addition of a figure to show the different elements of Phase II and Phase III of the ULWQS and how they will occur simultaneously.
- Phase II of the ULWQS includes the Science Panel research program, development of the in-lake and watershed models, and development of the numeric nutrient criteria. The *Phase II Work Element* section was modified to indicate that the final product of Phase II is the Numeric Nutrient Criteria Technical Support Document. The Numeric Nutrient Criteria Technical Support Document will incorporate all the analyses identified in the Numeric Nutrient Criteria Technical Framework. The Science Panel and Steering Committee will take the results from the document and develop a nitrogen and phosphorus numeric nutrient criteria recommendation that meets management goals. The expected timeline for developing the numeric nutrient criteria was modified to indicate that the expected end date is June 2023.
- At the December 14 meeting, Steering Committees discussed "how clean is clean." This language was added to the framework.

- No changes were made to the *Build Partnerships* section of the framework.
- The *Watershed Characterization* section lays out the process for identifying non-point and point sources in the watershed and how much loading is coming from them. This section was modified to explicitly mention internal nutrient cycling as an in-lake source of nutrients. A reference to climate-related impacts, including drought and fire, was added as a source to assess, as well. The section was also modified to reference the years 2040 and 2060 as appropriate planning horizons for evaluating future growth and land-use scenarios. This section also mentions that part of the implementation planning process involves quantifying loading under reference conditions without anthropogenic influence.
- The *Assess Potential Nutrient Management Implementation Strategies* section lays out the process for identifying potential nutrient implementation management strategies for significant sources. A fifth scenario (to be determined mg L-1 total phosphorus and to be determined mg L-1 total inorganic nitrogen representing the limit of technology) was added as a point source planning scenario. This section was also modified to specifically reference the assessment of in-lake and ecological restoration scenarios to identify solutions for addressing *in-lake* phosphorus and nitrogen. Lastly, this section was modified to indicate that the Steering Committee will assess the potential to preserve dedicated perennial instream flows to the Great Salt Lake System as part of the implementation planning process.
- The *Permit Implementation* section was modified to indicate the correct year (2022) as the start date for the work. The section was also modified to indicate that the Steering Committee, DWQ, and ULWQS technical support contractors will discuss the parameters and effluent quantity (e.g., load versus concentration) to be included in a Utah Pollutant Discharge Elimination System (UPDES).
- No changes were made to the *Cost and Feasibility* section.
- The *Assemble the Implementation Program* section was modified to outline a more deliberative monitoring and adaptive management process. The description is still general, so the Steering Committee and Science Panel will need to have further in-depth discussions on monitoring and adaptive management in the future.
- In Appendix A of the document, which provides a summary of Steering Committee and POTW comments, a Steering Committee member had a question about what was meant by the term "entity." A clarification was added to the summary that the term "entity" was discussed at the August 5 POTW meeting and referred to individual POTW facilities.

Steering Committee Clarifying Questions

Steering Committee members asked clarifying questions about the Implementation Planning Framework. Their questions are indicated in italics with corresponding responses in plain text.

How will the Science Panel engage in the implementation planning process?

The document does not explicitly identify how the Science Panel will engage in the process. The Steering Committee has the option to check in with the Science Panel for their expertise as needed. At the beginning of the process, the Steering Committee has an action item to consider how to pull expertise and technical support into the implementation planning process.

Steering Committee Comments

Steering Committee members provided comments on the proposed changes to the Implementation Planning Framework. Their comments are summarized below.

- Row 8 in the Build Partnership Section refers to the ULWQS Public Engagement Communication Plan. There is also a link to the plan in the document. When the plan was

developed, the Steering Committee decided that they did not have enough information to begin engaging the public. The inclusion of this plan in the Implementation Planning Framework does not commit the Steering Committee to use that plan in public engagement efforts. The Implementation Planning Framework commits the Steering Committee to engage with the public, but what that effort looks like will have to be a subject of future Steering Committee discussions.

- As part of the adaptive management discussion, there should be a bullet that explicitly calls out the need to review the program on a five-year cycle to identify what is working well, what is not working well, and where there are opportunities for improvements. A bullet was added to the Implementation Planning Framework explicitly identifying a "five-year review cycle" for the implementation program.

Public Comments

Members of the public commented on the Implementation Planning Framework. Their comments are summarized below.

- Using the term "reference conditions without anthropogenic influence" does not account for the impacts that Native Americans had on the lake pre-Mormon settlement. The document should use another term that does not imply there were no anthropogenic influences per-Mormon settlement.

Implementation Planning Framework Next Steps

- Scott Daly, Samuel Wallace, and Heather Bergman will write an executive summary for the Implementation Planning Framework for review by Chris Cline, Chris Keleher, and Heidi Hoven. Steering Committee members will then review the executive summary for approval.
- The Implementation Planning Framework should be brought to the POTW community for their input. Rich Mickelsen and Scott Daly will work together to reach out to the POTW community to review and provide input on the Implementation Planning Framework.
- At the next Steering Committee meeting, members will discuss implementing the Implementation Planning Framework. One of the discussion topics will be how to generate the resources needed to put the Implementation Planning Framework into action. They will also need to discuss if the Steering Committee will complete some elements of the implementation process in subgroups.
- The Steering Committee participants agreed to move forward with the Implementation Planning Framework with the proposed changes incorporated.

NEXT STEPS

- The Utah Governor is looking to allocate funding for water quality improvement projects on Utah Lake. The Science Panel and Steering Committee should provide input on what projects the funding should be allocated towards at a future meeting.
- The Science Panel should expect to meet in mid-February to discuss the watershed modeling effort and stressor-response analyses. Science Panel members should also plan on having a meeting in late February to mid-March to discuss atmospheric deposition and develop a recommendation for an atmospheric deposition loading value.
- The Steering Committee should expect to meet in late February to discuss the next steps for the Implementation Planning Framework.

AFTER-MEETING DISCUSSION

Tetra Tech is currently assembling the data and information needed to develop the watershed model. Tetra Tech is missing some data points related to point sources, stormwater, water diversions, and land management activities. Following the meeting, several Steering Committee members stayed after to discuss how to provide the data needed for the watershed model.