**Utah Lake Water Quality Study (ULWQS)**
*Science Panel*
**February 17, 9:00 AM to 11:00 AM**
**Virtual Meeting**
**Meeting Summary - FINAL**

**ATTENDANCE:**
*Science Panel Members:* Janice Brahney, Mike Brett, Greg Carling, Mitch Hogsett, Ryan King, James Martin, Theron Miller, and Hans Paerl

*Steering Committee Members and Alternates:* Eric Ellis, Erica Gaddis, Heidi Hoven, and Christopher Keleher

*Members of the Public:* Jeff DenBleyker, Renn Lambert, LaVere Merrit, Jerry Miller, Dan Potts, David Richards, and Soren Simonsen

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

*Technical Consultants*: Rene Camacho, Kevin Kratt, Josh LeMonte, Mike Paul, and Kateri Salk

*Facilitation Team:* Heather Bergman and Samuel Wallace

**ACTION ITEMS**

| Who | Action Item | Due Date | Date Completed |
|---|---|---|---|
| **Science Panel Members** | Post any water quality monitoring data to the Water Quality Data Portal for use in the empirical stressor-response analysis. | March 31 | |
| | Reach out to Scott Daly if they are interested in engaging in the implementation planning process being managed by the ULWQS Steering Committee. | March 31 | |

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

**NUMERIC NUTRIENT CRITERIA (NNC) DEVELOPMENT APPROACH PRESENTATION**
Kateri Salk, Tetra Tech, presented the approach for developing the Utah Lake NNC Technical Support Document. Her presentation is summarized below.
- The purpose of the Utah Lake NNC Technical Support Document (TSD) is to provide the technical and scientific basis for developing the NNC for Utah Lake. The Utah Lake TSD is based on the DWQ's Headwater Streams Nutrient Criteria TSD. The ULWQS Science Panel and Steering Committee will use the Utah Lake TSD to inform their NNC recommendations.
- The TSD will include three separate lines of evidence: the stressor-response analysis, the reference-based analysis, and scientific literature.
  - The stressor-response analysis will be based on empirical models with monitoring data, Utah Lake Nutrient Model scenarios, and the Environmental Protection Agency's (EPA) water quality criteria national models.

- o The reference-based analysis will primarily be based on the paleolimnological reconstruction of past conditions and the Utah Lake Nutrient Model scenario based on minimal human contributions.
- o The scientific literature line of evidence will reference Utah Lake studies and studies in comparable systems.
- The goal of the stressor-response analysis is to connect nutrients, biological responses, and the attainment of designated uses. The first step to conducting the stressor-response analysis is to create a conceptual model that identifies the linkages between nutrients and biological responses. Tetra Tech and the Science Panel will then assemble and explore the available datasets to determine what data they can use in the analysis. Lastly, Tetra Tech and the Science Panel will model the stressor-response relationships using an appropriate statistical approach.
- The Science Panel has already developed a conceptual model for Utah Lake that connects biological responses to nutrients. The stressor-response analysis will be based on the causal connections from the conceptual model.
- The management goals table in the NNC Technical Framework already identifies the specific endpoints and the associated stressor-response analyses to assess that endpoint. The management goals table serves as a guide for what data is available and which stressor-response relationships will be explored as part of the analyses. The table outlines two primary conceptual linkages. The first linkage connects nutrients to primary productivity and clarity. The second conceptual linkage connects primary productivity and clarity to toxins, pH, dissolved oxygen, visitation, public perception, and aquatic communities.
- The EPA has several national stressor-response models. For example, the EPA has a nutrient-chlorophyll model based on Bayesian modeling techniques using National Lake Assessment data. EPA's model allows a user to input site-specific information, such as lake depth, dissolved organic carbon, ecoregion, targeted chlorophyll concentration, and certainty level, to generate site-specific nutrient modeling results. The EPA has models for microcystin-chlorophyll-a, dissolved oxygen-chlorophyll-a, zooplankton-chlorophyll-a, chlorophyll-a-total nitrogen, and chlorophyll-a-total phosphorus relationships.
- The empirical stressor-response data sources include the Water Quality Portal (DWQ and Wasatch Front Water Quality Council (WFWQC) monitoring data), the DWQ harmful algal blooms monitoring program, the June Sucker Recovery Program (for zooplankton data), the user perception survey, and Utah Department of Natural Resources annual visitation data.
- The Science Panel will need to consider several data processing decisions. The first will be deciding what months constitute the growing/recreation season (potentially May to October). The second decision will be to determine what depth constitutes surface water. Lastly, the Science Panel will need to identify the period of interest (whether they should account for all years or apply a cutoff).
- The Science Panel will also need to make data aggregation decisions. The Science Panel will need to figure out the appropriate magnitude, frequency, duration, and extent that measures will be evaluated. Magnitude is "the maximum amount of the contaminant that may be present in a water body that supports the designated use." Frequency is "the number of times the contaminant may be present above the magnitude over the specified period (duration)." Duration is "the period over which the magnitude is calculated." Extent is the spatial aggregation of the data. An example of a statement that contains all these elements is the "mean growing season [duration] total phosphorus of 0.043 mg/liter [magnitude] is not to be exceeded more than one in three years [frequency]."
- The EPA and DWQ have established magnitude, frequency, and duration targets for some variables. For example, microcystin has a duration target of 8 micrograms/liter, a frequency

target of no more than three exceedances in a recreational season, and a duration target of 10 days. Some variables do not have definite targets, such as percent lake surface exceeding algal biomass nuisance thresholds, annual visitation, and chlorophyll-a.
- The last consideration for the Science Panel is how to spatially aggregate samples. The Science Panel could spatially aggregate samples at a single station, regionally throughout the lake, or use a lakewide average.
- One question for the Science Panel to consider is what additional information/discussion they need to identify appropriate aggregations.

### *Science Panel Member Clarifying Questions*
Science Panel members asked clarifying questions on the Utah Lake NNC TSD. Their questions are indicated below in italics, with the corresponding responses in plain text.

*What does a 10-day duration target mean for microcystin concentrations? A 10-date duration target is only helpful if measurements are taken daily.*
The Science Panel will need to consider how this 10-day period maps onto Utah Lake. This duration target is from EPA's recreational guidance. Under this duration target, DWQ would want to evaluate 10-day windows on Utah Lake with no more than three exceedances occurring during those periods. It is a good question to ask how data will determine exceedances if samples are not being collected daily.

*There is a nutrient hot spot in Provo Bay. Are partners still considering having different water criteria for different locations across Utah Lake, like Provo Bay?*
The NNC Technical framework approved by the Steering Committee and Science Panel lays out the possibility of breaking Utah Lake into different regions or areas. It will be up to the Science Panel and Steering Committee to determine whether it is appropriate to assign different criteria to different parts of Utah Lake based on whether the data supports developing criteria for various locations.

*Are swimming and recreation advisories for Utah Lake applied to the entire lake or only to areas where cyanotoxin concentrations are high?*
- Advisories are issued on a site-specific basis. For example, there can be advisories issued for specific marinas. There are times when advisories are issued for all of Utah Lake, but they are usually site-specific.
- Generally, visitation across the whole lake decreases when an advisory is issued, even if the advisory is for a specific location. Site-specific advisories allow those who are more comfortable and familiar with Utah Lake to continue using the lake outside of those specific sites.

### *Science Panel Member Comments*
- One issue with the Utah Lake Data Explorer that often comes up is that the units for the reported values are sometimes unclear. The units should always be clearly specified.
- The frequency target for pH is that it never exceeds a magnitude target of nine. There might be times when there is a spike in pH levels above this target. Occasionally, there may be a 10% exceedance in the pH value, particularly if pH is measured continuously. The pH targets are sometimes relaxed if exceedances are not common.

***Public Clarifying Questions***
Members of the public asked clarifying questions on the Utah Lake NNC TSD. Their questions are indicated below in italics, with the corresponding responses in plain text.

*Does the Paleo Study data indicate a change in the environmental conditions of Utah Lake in the 1970s?*
Yes, the data indicates a big change in the 19th century and another big change in the 1970s.

***Public Comments***
- The pH magnitude target should be expressed as an upper and lower value limit. The lower value limit should be eight because mollusks need a high pH level to form their shells.
- David Richards, Oreo Helix Consulting, wrote a trend analysis for chlorophyll-a over time. This report may be useful for the Science Panel once the WFWQC approves it.
- The modeling for East Canyon Reservoir showed that diatom blooms that occur in May and June decompose rapidly once the water-sediment interface warms to a certain point. The blue-green algae migrate vertically daily to obtain phosphorus from the sediments. The idea that treating phosphorus from wastewater treatment plants only needs to occur during the growing season is not correct. Empirical modeling is helpful, but it does not account for the blue-green algae's ability to migrate to the bottom of the lake.
- Occasional exceedance of pH over a certain level can result in apatite precipitation and phosphorus sequestration into biologically unavailable forms. This dynamic should be considered in the geochemistry modeling and in the context of possibly manipulating pH locally.
- The more site-specific advisories can be, the easier it is for recreators to plan their days. The public is confused by inconsistent advisories.
- There should be a system for alerting the Jordan River Commission and downstream users if there is a water quality advisory issued in Utah Lake near the inlet of the Jordan River. The water quality in Utah Lake has impacts beyond Utah Lake itself.

***Next Steps for the Utah Lake NNC TSD***
- The Science Panel will discuss the aggregation decisions as more concrete data is collected and shared. The Science Panel will continue to discuss the individual lines of evidence as Tetra Tech develops the stressor-response analyses.
- As Tetra Tech begins putting together the empirical stressor-response models, it will be helpful if there is a complete dataset available over the next four or six weeks. All partners with monitoring data should post their water quality information to the Water Quality Data Portal by March 31. Any Science Panel members with other data, like zooplankton data, should also share that data. It can be challenging to revisit and update the stressor-response data later in the process as it requires going through the quality assurance measures again.
- Tetra Tech currently has an up-to-date version of the data from the Water Resources Database that they are using to calibrate the Utah Lake model. The DWQ and WFWQC data are the primary datasets used in the ULWQS. DWQ is finalizing its water year 21 dataset, which will be uploaded to the Water Quality Data Portal soon. WFWQC water quality data is also in the Water Quality Data Portal. Some standalone datasets from various research stations are also being assessed. All that data will be compiled and uploaded into the Water Resources Database. Tetra Tech will use the Water Resources Database to calibrate the model and conduct the stressor-response analyses to keep the source information the same. Science Panel input on what assessments to use to calibrate the Utah Lake model will be helpful at a future meeting.

- The Science Panel will develop the TSD in three phases:
  - **Phase 1:** Conduct the stressor-response analysis
  - **Phase 2:** Evaluate the Utah Lake nutrient models and additional research projects
  - **Phase 3:** Pull together all the analyses into a final TSD document (to occur in winter/spring of 2023)

**UTAH LAKE MODELING UPDATE**
Kevin Kratt and Rene Camacho from Tetra Tech provided an update on the Utah Lake modeling. Their presentation is summarized below.

*Lake Modeling Update*
- The in-lake model has three different components. Tetra Tech is using the Simulating Waters Nearshore (SWAN) software to model wave dynamics, Environmental Fluid Dynamics Code (EFDC) program to model hydrodynamics and sediment transport, and Water Quality Analysis Simulation Program (WASP) to model water quality dynamics.
- Over the past several months, Tetra Tech has been developing the lake model. Kevin Kratt and Rene Camacho have:
  - Reviewed the existing model
  - Prepared an updated Quality Assurance Project Plan (QAPP)
  - Performed a detailed review of sediment diagenesis, especially for littoral cells
  - Coordinate with the EPA for several updates to WASP
  - Setup and calibrated the SWAN wave model
  - Linked SWAN-EFDC and finished the initial hydrodynamic calibration
  - Coordinated with DWQ and the Science Panel on an alternative approach to simulating phosphorus scavenging
  - Started to work on water quality calibration
  - Held bi-weekly calls with DWQ.
- Tetra Tech has received several comments on the lake model QAPP.
  - One comment was that the Provo Airport weather station alone would not reflect the influence of the mountains to the west on wind patterns. Tetra Tech added the Mosida weather station into the model to reflect the influence of the western mountains on wind patterns.
  - Another comment was that the atmospheric deposition rates are based on the previous Science Panel recommendation. The language of the QAPP was updated to indicate that Tetra Tech will incorporate the new Science Panel recommendation for atmospheric deposition rates into the model once the Science Panel has decided on those rates.
  - Another comment was that the calibration of the lake model should be compared to field measurements. The language of the QAPP was reworded to reflect this approach and be consistent with other sections of the document.
  - The last comment was that using the Jordan River Qual2K nitrogen calibration is inappropriate in Utah Lake. Model parameters will be calibrated to observed records to take initial estimates from the Jordan River model.
- A subgroup of the Science Panel recently met to discuss how to simulate phosphorus-binding (p-binding) into the lake model.
  - One approach to simulating p-binding in the lake model is the mechanistic approach. The mechanistic approach would require modeling the full carbon cycle. WASP cannot currently model the carbon cycle, so Tetra Tech would need to modify the code to integrate the carbon cycle. The advantages of the mechanistic approach are that it would fully represent the inorganic carbon cycle and reflect the impacts

of pH. The disadvantage of this approach is that it would be computationally intensive. It is also not clear if all the needed data is available to follow through on this approach.

- o The second approach is to use a partition coefficient to simulate the final results of the phosphorus-binding dynamics. The advantage of this approach is that it is simple and not computationally intensive. It also captures the net impact of the phosphorus settling. The disadvantages are that this approach represents an approximation of p-binding, independent from the pH-carbon cycle relationship.
- The Science Panel Subgroup decided to move forward with the partition coefficient approach.
- The hydrodynamics module includes the EFDC and SWAN programs and essentially simulates the movement of water and sediments. The linkage between the SWAN and EFDC modeling programs helps simulate the impacts of wind-induced waves on sediment transport. More specifically, the EFDC generates grid bottom elevation, wind, water surface elevation, and current outputs for use in the SWAN model. The SWAN model then generates significant wave height, wave length, wave period, and shear stress outputs for use in the EFDC model. The outputs from the hydrodynamic module as a whole include grid cell volumes, velocities, temperatures, and shear stress.
- The WASP model simulates water quality dynamics. The outputs from the WASP model include nutrient concentrations, algae biomass, biological oxygen demand, and dissolved oxygen. The grid cell volumes, velocities, temperatures, and shear stress outputs from the hydrodynamics model are imported as inputs into the WASP model.
- Tetra Tech is using water surface elevation to calibrate the model. They are comparing the simulated data to observed data and using statistical analyses to determine how well the model simulates the observed data.
- Tetra Tech is also using temperature data to calibrate the model. The models have been successful at simulating seasonal temperatures compared to observed data.
- Tetra Tech is calibrating the SWAN model too. One of the most important inputs for the SWAN model is wind velocity, magnitude, and direction. Tetra Tech is using data from three stations (Provo Airport, Lincoln Point, and Mosida) to generate the inputs into the SWAN model. Tetra Tech is primarily using the data from Provo Airport to generate inputs for the model, particularly on the east side of the lake. On the west side of the lake, Tetra Tech is using the data from the Mosida weather station to represent wind velocity, direction, and magnitude. Tetra Tech is then using data on significant wave height from the Provo Marina to compare and calibrate the SWAN model to observed data. The model is performing relatively well at simulating significant wave height and the associated shear stress.

*Watershed Model Update*
- The watershed model is based on the Hydrological Simulation Program – FORTRAN (HSPF). Tetra Tech worked with the Science Panel to rank the watershed models and select the HPSF model.
- Tetra Tech developed the water model QAPP to document the extent of the watershed model and establish the modeling period (2006 to 2011).
- The data used in the watershed model is much different from the lake model data. The data needed for the watershed model includes land use/land cover, wildfires and land cover, imperviousness, soil characteristics, slope, irrigation, onsite wastewater treatment systems, weather, drainage networks, Deer Creek Reservoir releases, diversions and water transfers, permitted discharges, atmospheric deposition, hydrology data for calibration/

corroboration, and water quality data for calibration/corroboration. Tetra Tech is working with DWQ to pull that data together.

- Tetra Tech is using the National Land Cover Data (NLCD) 2016 land cover data to simulate how much precipitation turns into runoff. The NLCD dataset is not very detailed in terms of crop cover, so Tetra Tech is using a different dataset for crop cover and irrigation practices.
- Tetra Tech is collecting data from MS4 permits within the watershed. For each subcatchment, Tetra Tech will use this data to estimate the flow and nutrient loading from stormwater.
- The watershed model will be used in the criteria development and implementation planning so that partners can achieve whatever recommendations the Steering Committee and Science Panel develop.

*Expected Timeline*
- Tetra Tech is currently right in the middle of calibrating the lake model. The plan is to have the lake model completed and calibrated this summer for use by the Science Panel and Steering Committee.
- The expected completion date for the watershed model is the end of 2022. This timeline is one of the reasons for a more simplified approach towards simulating phosphorus binding.

### Science Panel Member Clarifying Questions
Science Panel members asked clarifying questions on the Utah Lake model update. Their questions are indicated below in italics, with the corresponding responses in plain text.

*Will the lake models generate information on lake algal blooms and timing needed to inform future Steering Committee and Science Panel discussions?*
The models can simulate chlorophyll-a and algal populations but not microcystin concentrations. There are modules that simulate the seasonal succession of algae. Overall, models are not as successful at focusing on a specific species or simulating concerns related to color and odor associated with algal blooms. There is a need for a tool that relates the outputs of the WASP model with the microcystin, color, and odor endpoints.

*Can the model be used to simulate the impacts of impounding parts of Utah Lake on in-lake circulation?*
Tetra Tech's scope of work is to analyze the current bathymetry of Utah Lake. The charge of the Science Panel is to characterize Utah Lake as it exists today. If other groups were interested, they could potentially use the model to simulate in-lake circulation under different physical conditions.

*Does dolomite or calcite form in Utah Lake?*
There is dolomite in sediments (average 8% dolomite abundance from Randall et al. 2019), but it is assumed to be allochthonous. There is likely some manganese in calcite that precipitates from the lake water. Apatite precipitation is kinetically unfavorable.

*If dolomite is 8% of the sediments, is this relative to the dry weight of calcite?*
Calcite is 45% of the sediments.

### Science Panel Member Comments
- There is an opportunity for Science Panel members to use different components of the lake model to help inform some of their questions before the model is completed. For example, the hydrodynamics model could inform questions in the ULWQS.

- The partition coefficient used in the phosphorous-binding simulation will need to be dependent on pH values and calcite formation.
- The Science Panel should keep in mind that the goal of the ULWQS is to mitigate harmful algal blooms. One of the challenges with calibrating the model is that most of the observed datasets capture algal populations in terms of the number of cells per volume. It can be difficult to convert cell counts to meaningful biomass estimates to compare and calibrate the model. This dynamic will likely be something the Science Panel will discuss in the future. Most, if not all, of the phytoplankton results documented in Utah Lake are reported in both cell counts and biovolume. Sam Rushforth has a lot of data on the relationship between cell counts and biovolume for various species, including most cyanobacteria. He could be a resource in the future.
- The strength of the ULWQS is that it synthesizes multiple lines of evidence. The lake model is only one line of evidence to understand the processes in Utah Lake. The stressor-response empirical analysis will also link data from the model outputs to assessment endpoints.
- The Utah Lake model should incorporate the buoyancy of blue-green algae into the model. There is a lot of literature on the buoyancy of blue-green algae that could help inform an approach to modeling the vertical migration of blue-green algae in Utah Lake.

*Public Comments*
- The prefrontal winds coming from the southwest are insignificant compared to the major winds from the northwest. There is a spit extending off Bird Island due to the impacts of the northwest winds. The northwest winds result in major waves and sediment resuspension. For modeling purposes, Tetra Tech should rely on the data from Lincoln Beach as that data better reflects the winds coming from the northwest.
- Tetra Tech should incorporate the vertical migration of blue-green algae into the model. The East Canyon Reservoir model, which is published and publicly accessible, incorporated the vertical migration of blue-green algae and could serve as an example for the Utah Lake model.
- Wind has a large effect on whether green or blue-green algae is dominant. Under windy conditions, green algae will tend to dominate. Under calmer weather, blue-green algae will be dominant.
- Under high wind conditions, blue-green algae cannot get to the sediment. There may be an opportunity to turn off any vertical migration modeling dynamics once the winds reach a certain threshold.

*Next Steps*
Rene Camacho will work on integrating the partition coefficient approach into the model. He will document the approach for integrating the partition coefficient to share with the Science Panel P-Binding and Modeling Subgroup.

**P-BINDING STUDY UPDATE**
Josh LeMonte, Brigham Young University (BYU), provided an update on the Utah Lake P-Binding Study. His update is summarized below.
- The P-Binding Study involves both field sampling and laboratory experiments. Dr. Josh LeMonte and his team have collected field samples from the water column, pore water, and sediments. As part of laboratory experiments, he will be performing kinetics, sorption capacity, and mineralization experiments.

*Field Sampling Update*
- Josh LeMonte and his team sampled the water column at seven different sites: Saratoga Springs, vineyards (one mile west of shore), Pelican Point, Provo Marina, Provo Bay, Bird Island, and Goshen Bay. The team sampled at two discrete depths: near the surface of Utah Lake and just above the sediment-water interface. He and his team are still putting together the bulk data, but they have some preliminary results. The soluble reactive phosphorus (SRP) concentrations ranged from 11.6 to 65.3 micrograms/liter in the bulk water column samples.
- The team did not attempt colloidal fractionation on the water quality samples collected this fall. The team will attempt colloidal fractionation on the next collection of water column samples. Dr. Yan Jin recommended using a centrifuge rather than ultrafiltration for colloidal fractionation. Researchers can process more samples simultaneously using a centrifuge, reducing the time between sampling and colloidal fractionation/analysis. They will conduct the colloidal fraction on spring 2022 samples within six hours of collection.
- Josh LeMonte and his team will collect porewater data for the study. The team made milled HDPE rods with 16 porewater collection wells with a volume of 20 milliliters each. The wells are spaced four centimeters apart. There was a plastic shortage due to COVID that delayed the delivery of the rods.
- Josh LeMonte and the research team successfully installed the porewater sample rod in Provo Bay in late October/early November. However, when they were retrieving the rod from the sediment, they accidentally tore the membranes in the sample rod, resulting in the loss of the sample. They are adjusting the construction of the rods to make it easier to extract them from the sediment for future samples.
- The research team collected bulk sediment samples via an Eckman dredge from the seven sites. They recently completed the sequential extraction of the bulk sediments. Most of the total phosphorus concentrations across the lake were around 700 milligrams/kilogram, except Provo Bay, where the total phosphorus concentration was 957 milligrams/kilogram.
- The research team is using a synchrotron to look at speciation in the samples. The synchrotron uses a multimodal approach to combine light z elements (phosphorus, calcium) with heavier x elements (iron, manganese). The research team submitted four synchrotron proposals. There is a significant delay in using the synchrotron due to COVID 19. The team submitted a proposal on January 31, which included Dr. Ryan Tappero of Brookhaven National Laboratory, to hopefully accelerate the process.
- The team has some preliminary results from the synchrotron. In Provo Marina, much of the iron falls into fully oxidized iron three, with some variations. In Provo Bay, there is a difference in iron speciation within the sediments. Past researchers have suggested there may be a minor iron phase controlling phosphorus. The results of the Provo Bay sample suggest there are different iron phases controlling and playing a role in the release and absorption of phosphorus.
- The research team also collected freeze cores from all seven sites. The depths of the freeze cores occurred at a range of 60 to 110 centimeters.

*Lab Experimentation Updates*
- In addition to the fieldwork, the research team is also conducting batch sorption experiments. They are comparing the experiments to previous work conducted by Randall et al. and Taggart et al. To properly model isotherm data via the Freundlich or Langmuir models, researchers are using high phosphorus loading (greater than 200 milligrams/liter) in addition to low phosphorus loadings that are more environmentally relevant. The

preliminary results of the batch sorption experiments show a large range in phosphorus sorption capacity across sampling sites. The phosphorus sorption capacity in the main body of the lake was not high compared to the sorption capacity in Provo Bay. It is interesting to consider how different iron phases affect sorption capacity.

- The research team conducted stirred flow kinetic experiments to gather data on sorption and solid-phase partitioning. The preliminary results from those experiments indicate that the speed of the reaction is fast, especially if there is active calcite in the sediment. The research team is modifying their experimental design to capture the time of the kinetics more accurately.
- The redox-controlled microcosm experiments look at the pH and oxidation-reduction potential (Eh) buffer capacity in the sediment and water. The team is looking for pH buffers, such as phytoplankton, that will allow them to maintain the lake pH through the experiments.

### Science Panel Member Clarifying Questions
Science Panel members asked clarifying questions on the P-Binding Study update. Their questions are indicated below in italics, with the corresponding responses in plain text.

*How close is the P-Binding Study to generating outputs that can be used in the lake model?*
- The expected timeline is for the P-Binding Study research team to generate data to give to the modelers in the next six weeks. The goal for the P-Binding Study research team is to hand over this data in April and then complete the study in September.
- The P-Binding Study research team just received their redox probes.
- Moving forward, the Science Panel can expect future coordination between the modeling team and the P-Binding Science Panel Subgroup.

### Science Panel Member Clarifying Questions
Science Panel members asked clarifying questions on the P-Binding Study. Their questions are indicated below in italics, with the corresponding responses in plain text.

*What size of colloids can be separated using centrifugation?*
Josh LeMonte will need to revisit the experiment proposal to determine what size colloids can be separated using the centrifuge.

### Science Panel Member Comments
Algae and cyanobacteria may be recycled multiple times throughout the growing season. Overall, the water column removed phosphorus much faster than it was released from the sediments due to organic matter decay.

### Public Clarifying Questions
Members of the public asked clarifying questions on the P-Binding Study. Their questions are indicated below in italics, with the corresponding responses in plain text.

*The synchrotron presents results on a ten-by-ten micrometer plot. Considering how small this plot is, how much data is needed to statistically verify differences in iron speciation between Provo Bay and Provo Marina?*
The research team will use the data from the bulk samples to run any statistical analyses. The purpose of the synchrotron analyses is to uncover new insights into the chemical species in the system, not necessarily to confirm statistical differences.

*Public Comments*
- The vertical migration of cyanobacteria has a large impact on chemistry. The results of the P-Binding Study should be put into the context of the daily kinetics of the algae.

**NEXT STEPS**
- The Steering Committee is moving forward with the Implementation Planning Framework to develop an implementation plan for managing nutrients in Utah Lake. The Implementation Planning Framework is a Steering Committee product, but several Science Panel members have expressed interest in engaging in the implementation planning process. Any Science Panel members interested in engaging in the implementation planning process should contact Scott Daly.
- DWQ recently signed a contract with consultants to develop and distribute the Utah Lake recreation survey. The consultants will be meeting with Steering Committee members to begin scoping the process.
- At the next Science Panel meeting, members will discuss the WFWQC atmospheric deposition research. DWQ has been working with Theron Miller and Leland Myers to gather their research on atmospheric deposition. The Science Panel will need to consider this new information and revise the atmospheric deposition recommendation accordingly for future modeling work. Science Panel members should expect the meeting to occur in early to mid-March.