Path Forward Committee Meeting
August 6, 2024

Agenda

- Opening Comments, Agenda Review/Revisions
- City of Durham State of Our Streams
- Modeling and Regulatory Support Status
- Concerns with Development and Construction in the Falls Lake Watershed (Upcoming Board Discussion)
- Year Three of IAIA Ended June 30th
- Continued Rule Development for Jordan Lake and High Rock Lake Watersheds
- Falls Lake Rules Readoption Process
- Evaluation of a Specific Falls Lake 303(d) Assessment Methodology and Site-Specific Chlorophyll-a Standard
- Communications Support
- Other Status Items
- Closing Comments

Opening Comments, Agenda Review/Revisions

City of Durham State of Our Streams

City of Durham State of Our Streams

- The City of Durham developed two videos to share the latest “State of Our Streams” performed by the City
- There is a short version (less than one minute) and a long version (less than three minutes).
- We will preview a video during the PFC meeting and post a link on the UNRBA website.

Modeling and Regulatory Support Status

Watershed Model Report

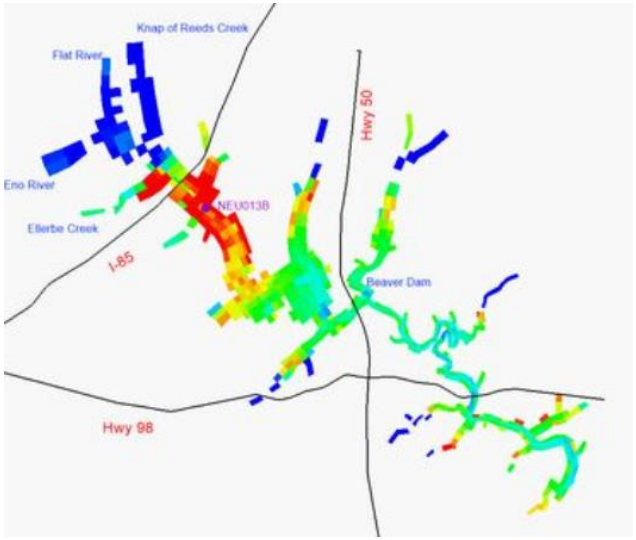
- The UNRBA submitted the final watershed modeling report and watershed modeling files to DWR and the EMC in December 2023.
- The Executive Director requested a formal statement from DWR as specified in Section (5)(f)(iii) of the Falls Lake Rules which require that “the Division shall assure that the supplemental modeling is conducted in accordance with the quality assurance requirements of the Division.”
- The UNRBA submitted and the Division approved the UNRBA Modeling Quality Assurance Project Plan, and this document represents “the quality assurance requirements of the Division.”
- On July 31, 2024, Karen Higgins provided an email confirmation that the watershed modeling report met the provisions of the QAPP. The Executive Director has requested a formal response from the Director.

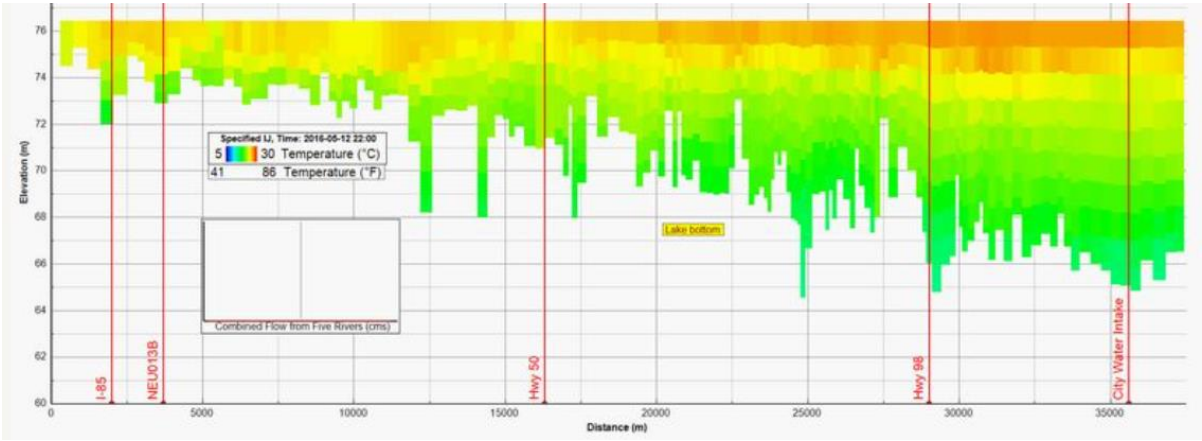
Lake Model Report and Modeling Files

- The UNRBA also submitted lake modeling files for two of three lake models (WARMF and EFDC) and a draft lake modeling report.
- The modeling team has received comments on the draft report from PFC members and DWR and is responding accordingly
  - Points of clarification
  - Requests for summaries of varies aspects of modeling (uncertainties, applications, etc.)
- The third lake model (statistical/Bayesian) has recently been completed and results will be shared with the PFC during the meeting.
- Additional information about the statistical model has been incorporated in the redline version of the report.
- The redline report will be provided to the PFC and DWR in the next month.
- The UNRBA will submit a final lake report and appendices to DWR for review and approval under Falls Lake Rule 15A NCAC 02B .0275

EFDC Lake Simulation Videos

- The EFDC model simulations for key parameters have been converted into videos for the May to October 2016 period
- Examples of these videos will be shown during the meeting
  - Plan view (looking down from the sky)
  - Profile view (along the deepest part of the lake from the most upstream, shallow end down to the deepest part near the dam)
- Once PFC input has been received, the videos will be refined and posted to the UNRBA website and/or You Tube.

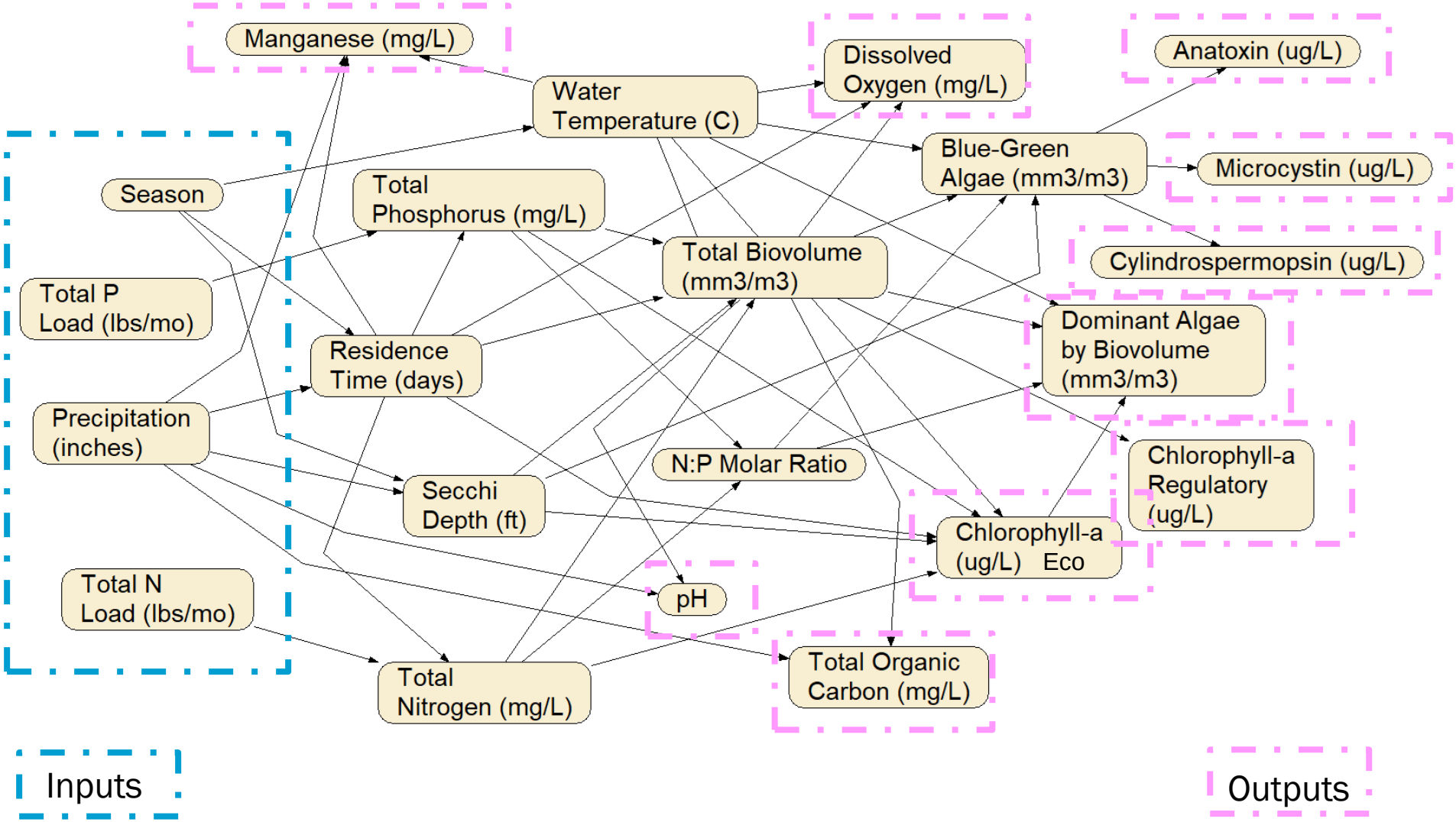




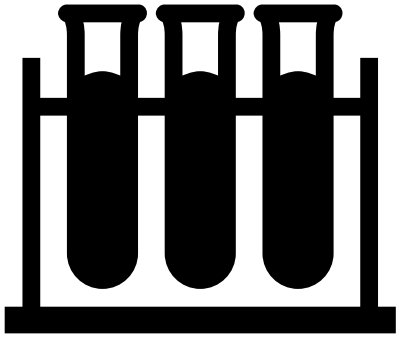
Statistical/Bayesian Model Demonstration

- All data from entire lake “binned” by one of three methods
- Data split into three sets by lake unit (Upper, Middle, Lower)
- One model per lake unit
- Model represents an interactive summary of all *observed* data and the probabilistic relationships among variables

Statistical/Bayesian Model

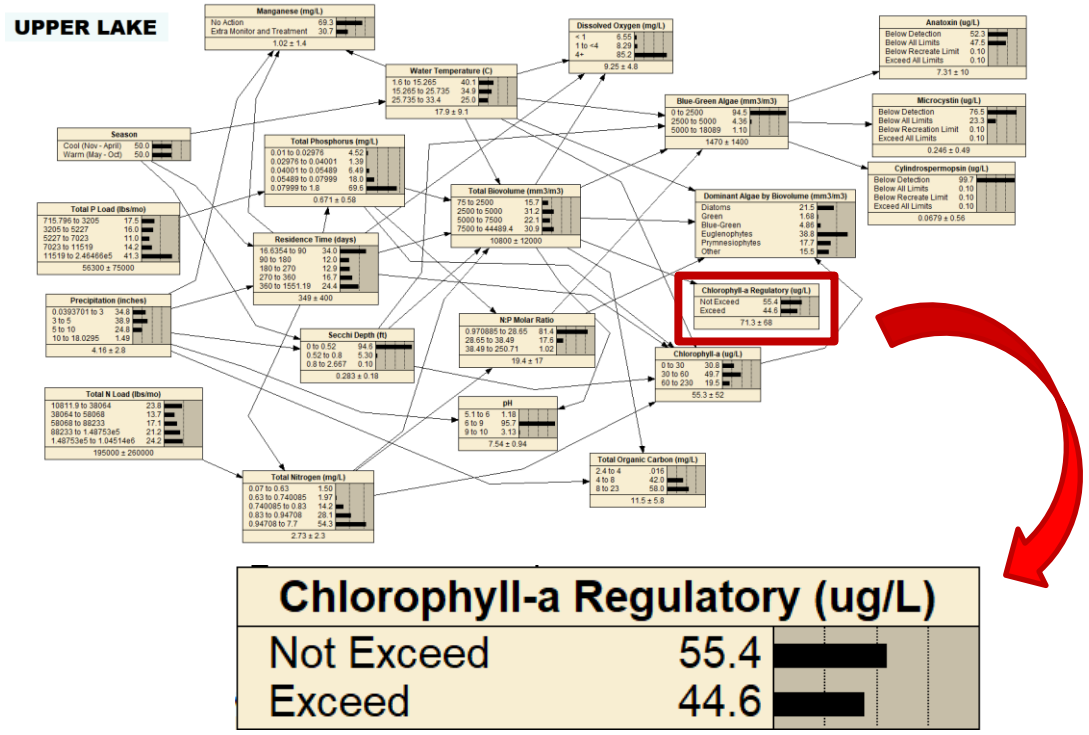


Updating expectations based on data

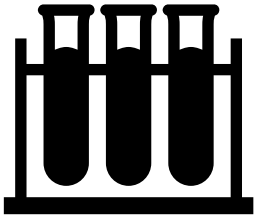


Imagine there is a $1000 prize to correctly guess if a mystery sample from Falls Lake exceeds Chlorophyll-a standard.

The only information you have is:
(1) that the sample came from somewhere within the upper lake.
(2) the default model – the overall probability distributions for all variables given all data received about that lake unit.



In the absence of any other information, the best guess would be: Not Exceed.

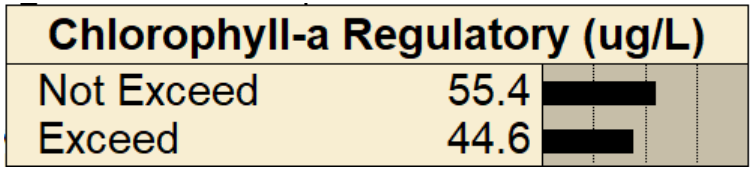


But suppose you could have one more piece of information.

Entering this one piece of information into the model will update it so we only see the probability distributions based on the data under this condition.

Which would you choose?

Probability distribution of chlorophyll-a in Upper lake – model fit to all data

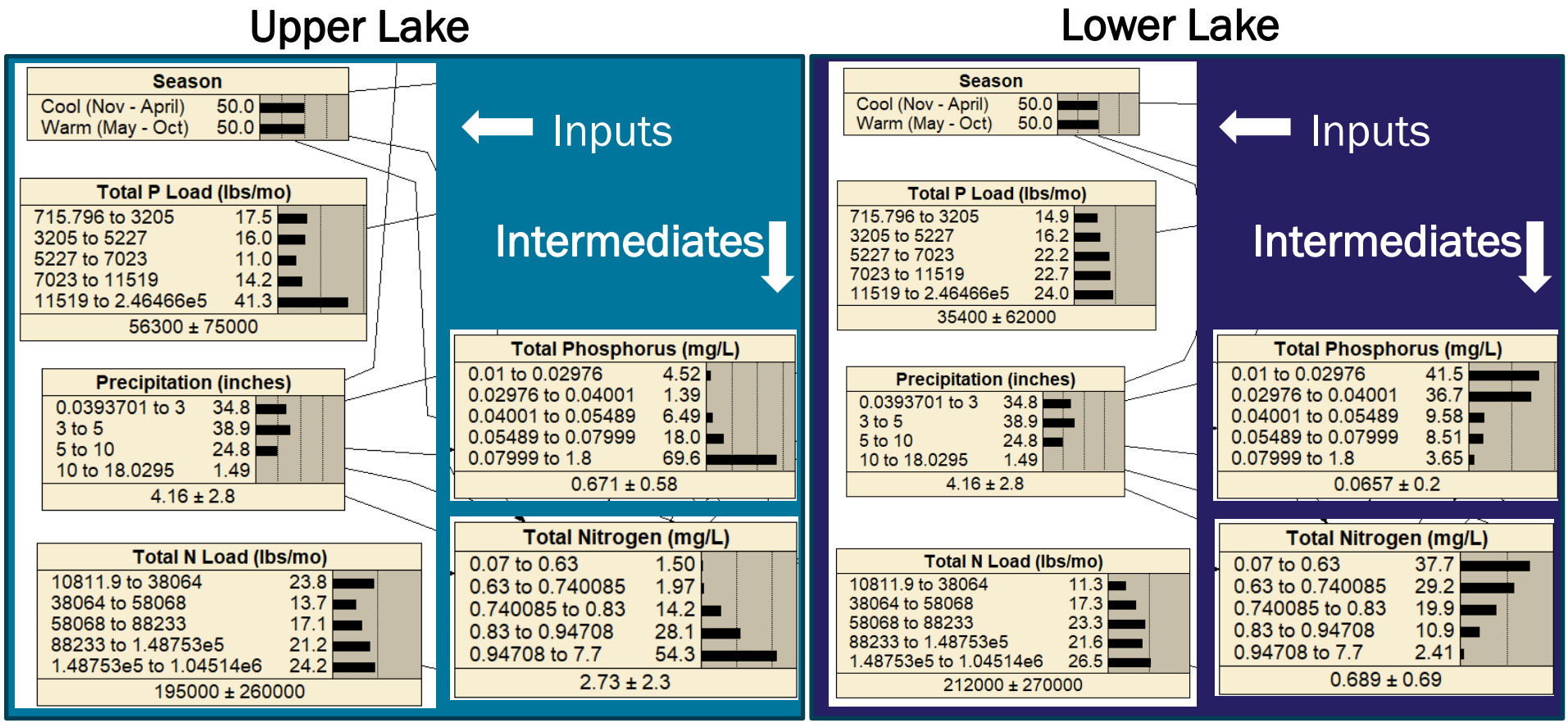


Total Nitrogen Load

Total Biovolume

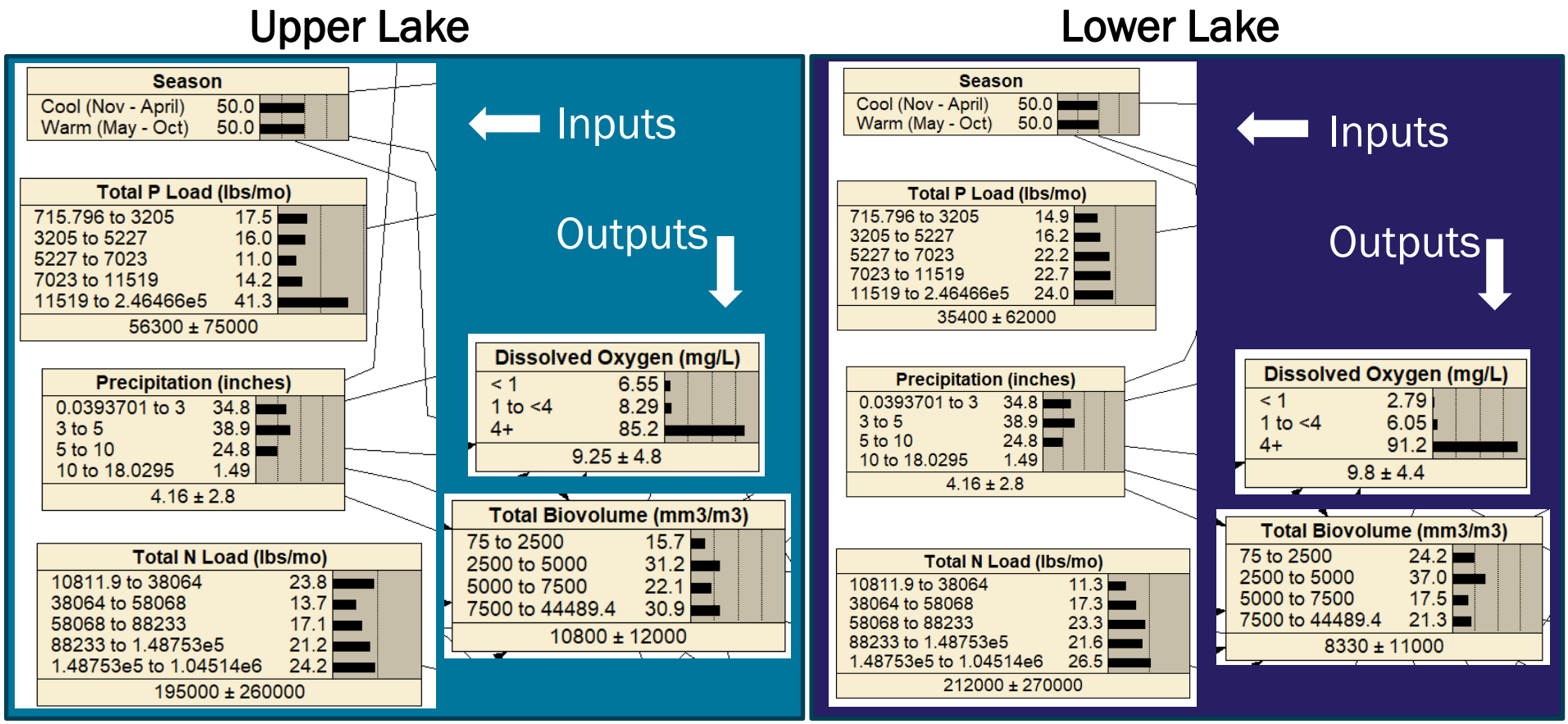
Residence Time

The probability distributions of nutrient concentrations differ between lake units. Upper lake more likely to be High while lower lake more likely to be Low

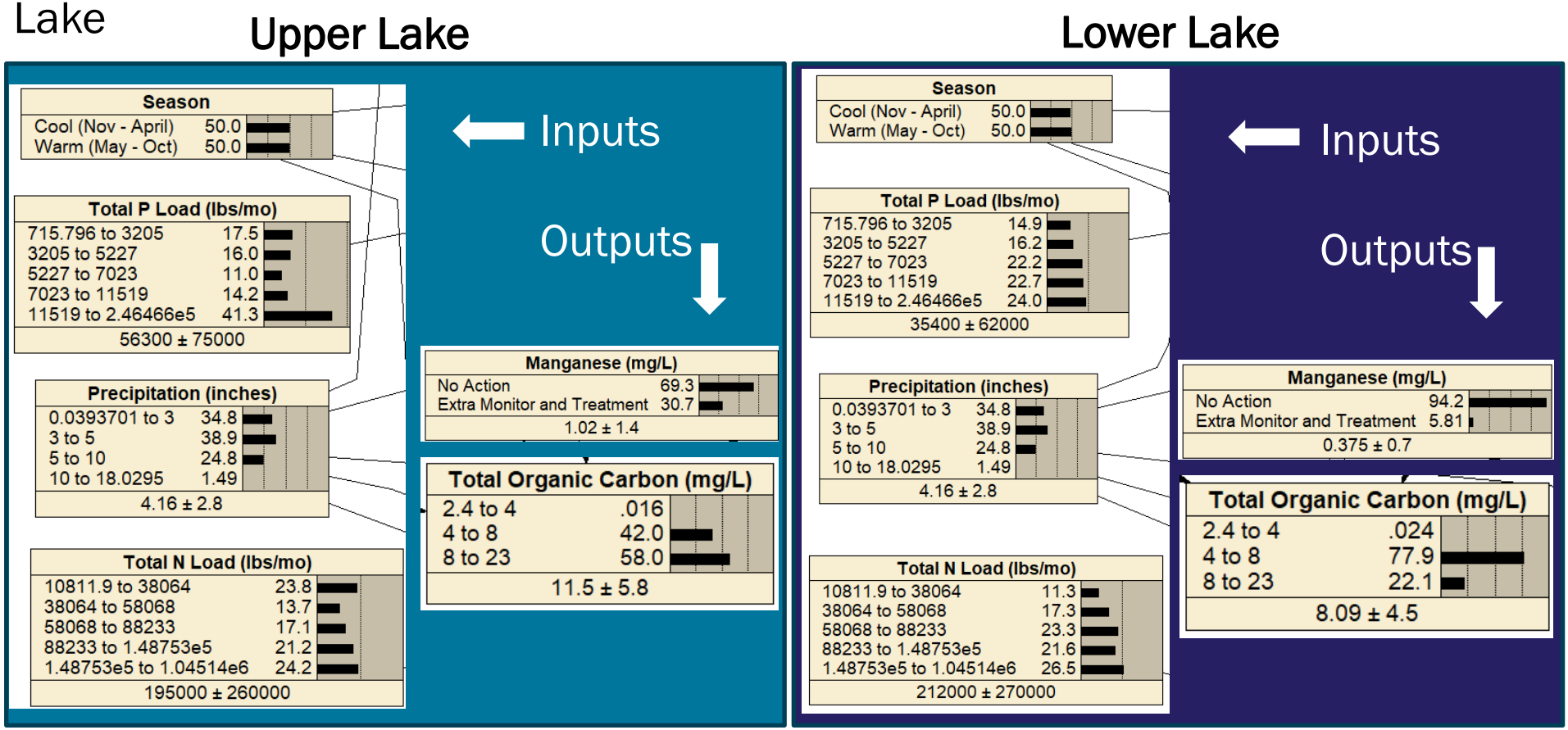


Range of observed values and their probability distributions

All values possible (high variance); small differences between lake units



Manganese and TOC show more difference between lake units. In the absence of specific input selections, both have higher probability of High values in Upper Lake



Bayesian Network models support questions such as:

- **Scenario analysis:**

  "What if…?"

  What if there is a very wet warm season with very high nutrient loads?

  What if the nutrient loads were instead low?

- **Risk/opportunity attribution:**

  "When is a [state I want or don't want] most likely to occur?"

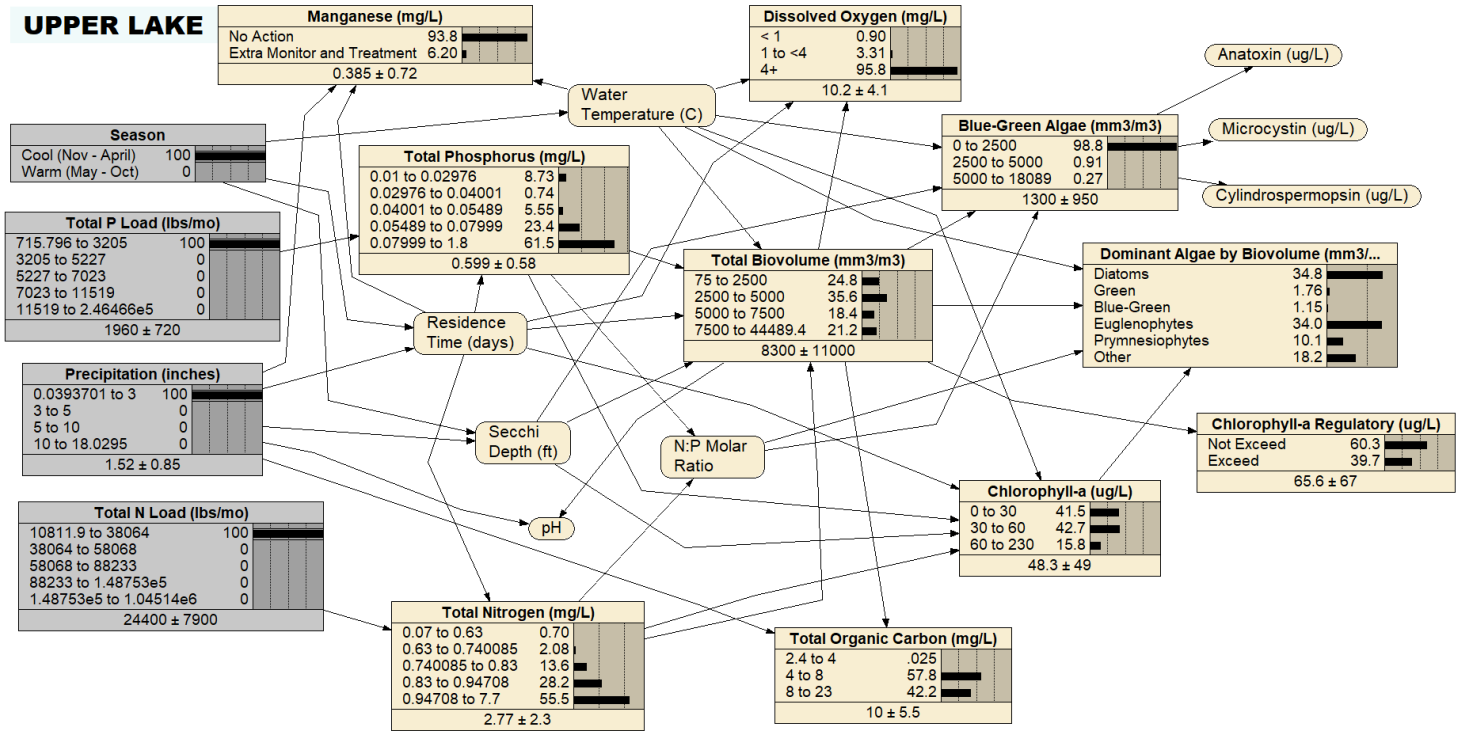
  Under what conditions is a high manganese value most likely?

- **Sensitivity analysis:**

  "What variables give me the most clues about the state of the system?"

  Which variables are most useful (and how useful) to predict an algal bloom?

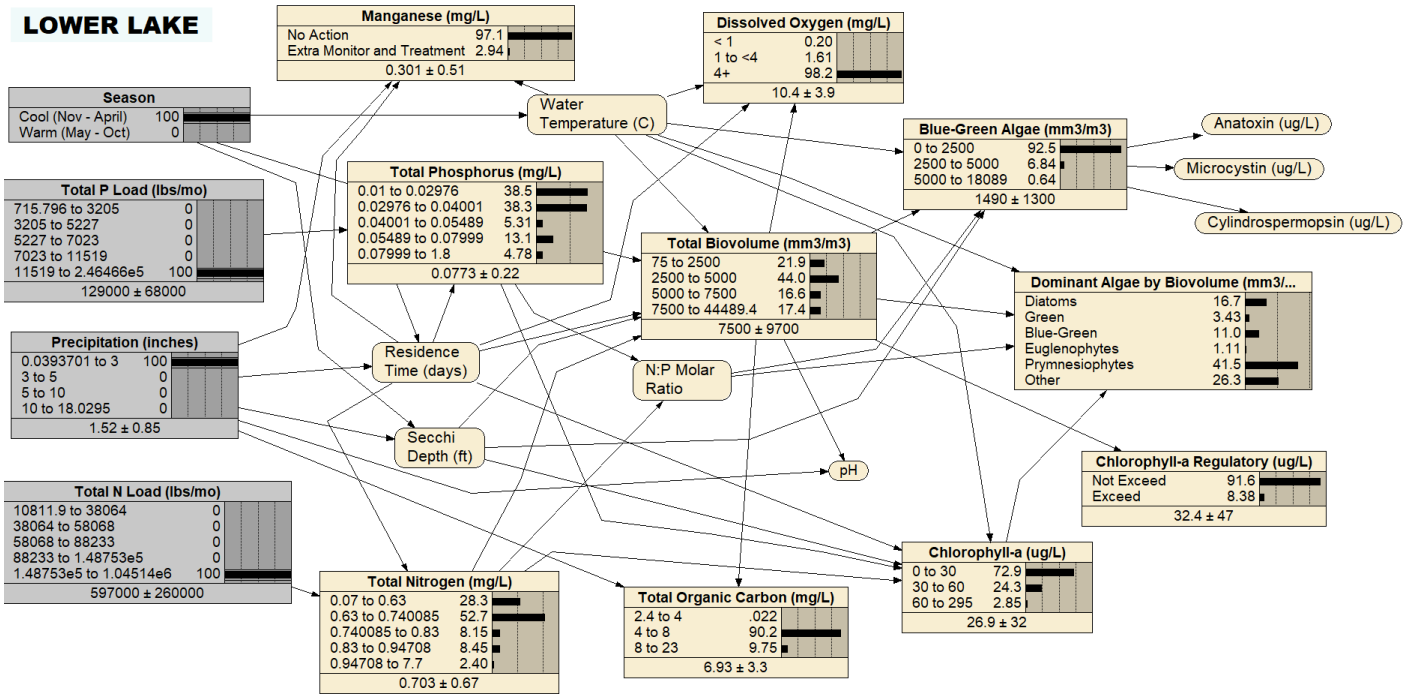
Example Scenario Analysis (shown in Netica)



Cool, Dry, **Low** TP and TN loads….

- Compare sets of inputs to observe changes in the probability distributions of the intermediate and output nodes.
- Grey boxes have selected values and the remaining boxes (yellow) adjust to show conditional probably under that scenario.

Example Scenario Analysis (shown in Netica)



Cool, Dry, **High** TP and TN loads….

- For any given scenario, the upper and lower lake can have very different probability distributions for their outcomes.
- In both, the probability of TN and TP loads do not well anticipate the TN and TP concentrations.
- High vs Low nutrient loads neither strongly nor consistently influence the probability distribution of chlorophyll-a values.

Scenario Analysis Summary

Upper Lake:

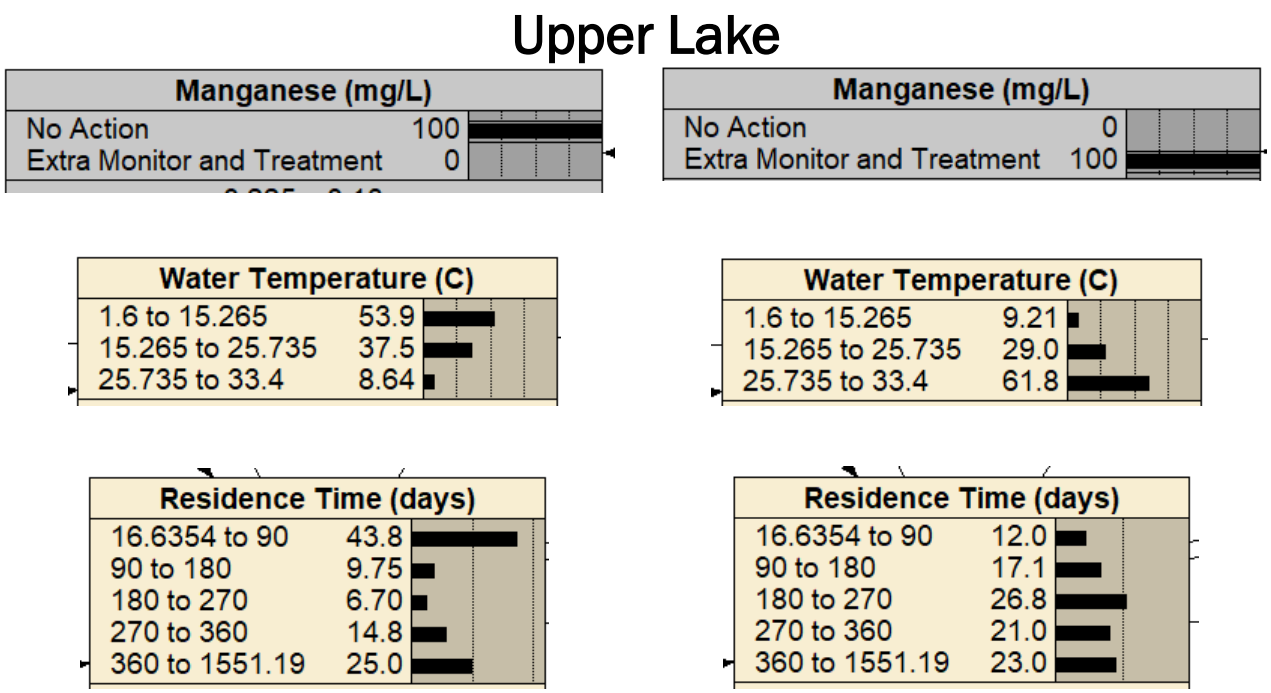
- Nutrient concentrations are most often high, even in the presence of low load.
- Precipitation (residence time) and season (temperature) often have stronger influence on distributions of other variables than nutrient loads or concentrations.
- Chlorophyll-a distribution is most likely to exceed in cool season if it is also dry, and in warm season under average rain conditions.
- In warm seasons under average rain conditions, algae community is most likely dominated by Euglenophytes and Prymesiophytes.

Lower Lake:

- Nutrient concentrations are most often low, even in the presence of high load.
- Scenario inputs have near zero influence on the probability distribution of chlorophyll-a.

This model is generally consistent with other models developed by different means with different data subsets (WARMF Lake and EFDC for 2015 to 2018).

Example Risk/Opportunity Assessment (shown in Netica)

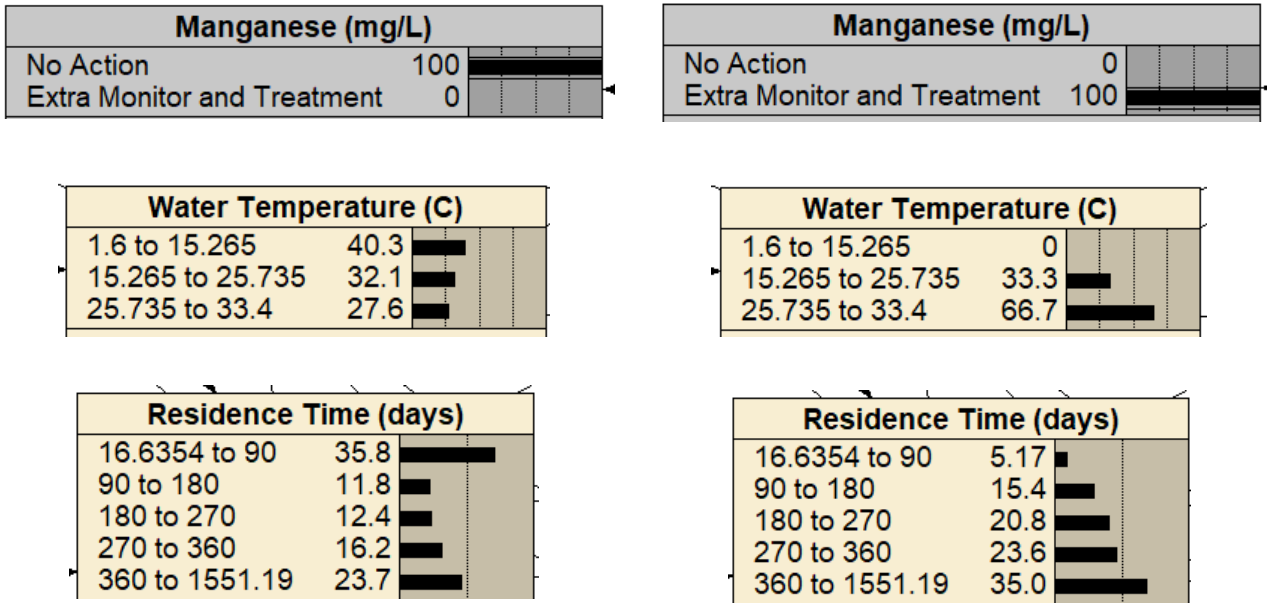


- Enter a value for one of the variables to observe the probability distribution associated with that value for each of the other variables in the node
- Both directly connected and indirectly connected nodes can change
- NOT implying cause-effect relationships – only the probabilities* given one (or more) known values

**posterior probabilities*

Example Risk/Opportunity Assessment (shown in Netica)

Lower Lake

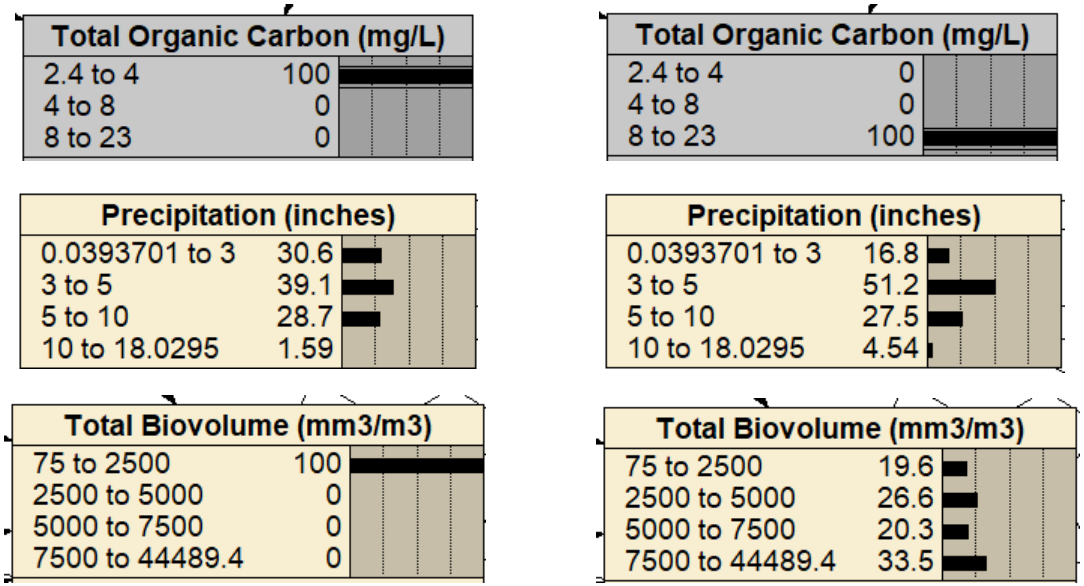


- Similar to Upper lake, except when Extra Monitoring and Treatment is selected, the probability distributions shift towards even longer residence times and higher temperatures

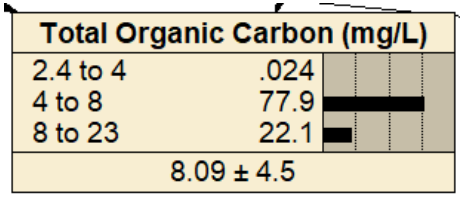
Example Risk/Opportunity Assessment (shown in Netica)

Lower Lake

Upper Lake looked very similar



- A value of low TOC has only occurred when Total Biovolume is low (2 to 3 observations of low TOC per lake unit). Default:



- Based on this limited data, low TOC does not have much explanatory value for Precipitation
- A value of high TOC shifts the probability distribution of Precipitation towards more typical values rather than very low Precip.
- A high TOC does not have as much explanatory value for Total Biovolume as low TOC (but there are also many more observations)
- Most TOC in lower lake is within 4 to 8 mg/L

Risk/Opportunity Summary

All lake units:

- Toggling between Exceed/Not Exceed or High/Low on the various output nodes shows that both outcomes have occurred under a wide range of input values.
- Changing an outcome value typically results in a bigger change in the probability distribution of Season (temperature) and Precipitation (residence time) values than either TN or TP load values.

It is very difficult to evaluate all these relationships at once – therefore we can use Sensitivity Analysis tools in Netica.

Example Sensitivity Analysis (in Netica)

- "The degree to which variation in one variable is explained by other variables"
- "Evaluate sensitivity of a response variable to the probability distributions of other variables."

Upper Lake

Total Biovolume	% Variance Reduction
Total Biovolume (mm3/m3)	100
Chlorophyll-a Regulatory	9.23
Water Temperature (C)	8.06
Residence Time (days)	5
Season	4.69
Dissolved Oxygen (mg/L)	4.5
Blue-Green Algae (mm3/m3	3.33
Chlorophyll-a (ug/L)	2.97
Total Nitrogen (mg/L)	2.69
Total Organic Carbon (mg	2.28
Dominant Algae by Biovol	1.33
Total Phosphorus (mg/L)	0.9
Manganese (mg/L)	0.755
pH	0.523
N:P Molar Ratio	0.199
Secchi Depth (ft)	0.103
Microcystin (ug/L)	0.0951
Precipitation (inches)	0.04
Total N Load (lbs/mo)	0.02
Total P Load (lbs/mo)	0.0043
Anatoxin (ug/L)	0.00332
Cylindrospermopsin (ug/L	0

Chlorophyll-a (regulatory)	% Variance Reduction
Chlorophyll-a Regulatory	100
Total Biovolume (mm3/m3)	9.29
Water Temperature (C)	1.49
Season	0.92
Residence Time (days)	0.745
Dissolved Oxygen (mg/L)	0.614
Chlorophyll-a (ug/L)	0.452
Blue-Green Algae (mm3/m3	0.384
Total Organic Carbon (mg	0.348
Total Nitrogen (mg/L)	0.286
Dominant Algae by Biovol	0.232
Manganese (mg/L)	0.178
Total Phosphorus (mg/L)	0.114
pH	0.0274
N:P Molar Ratio	0.0268
Secchi Depth (ft)	0.0159
Precipitation (inches)	0.0138
Microcystin (ug/L)	0.0107
Total N Load (lbs/mo)	0.00313
Total P Load (lbs/mo)	0.00092
Anatoxin (ug/L)	0.000319
Cylindrospermopsin (ug/L	0

Total Biovolume

- Most sensitive to Chlorophyll-a (regulatory), water temperature, and residence time, but all have low sensitivity
- TN and TP concentration and load all have very low or near zero explanatory value

Chlorophyll-a (regulatory)

- Most sensitive to Total Biovolume, but with low sensitivity
- Nutrient concentrations and load have near zero explanatory value

Example Sensitivity Analysis (in Netica)

- "The degree to which variation in one variable is explained by other variables"
- "Evaluate sensitivity of a response variable to the probability distributions of other variables."

Lower Lake

Total Biovolume	% Variance Reduction
Total Biovolume (mm3/m3)	100
Dominant Algae by Biovol	6.55
Residence Time (days)	3.81
Blue-Green Algae (mm3/m3	3.3
Chlorophyll-a (ug/L)	2.67
Total Nitrogen (mg/L)	2.42
Total Organic Carbon (mg	2.14
Total Phosphorus (mg/L)	2.01
Chlorophyll-a Regulatory	1.76
Water Temperature (C)	1.67
Season	1.42
Dissolved Oxygen (mg/L)	0.812
Secchi Depth (ft)	0.808
Precipitation (inches)	0.424
Microcystin (ug/L)	0.226
Total N Load (lbs/mo)	0.132
Manganese (mg/L)	0.128
Cylindrospermopsin (ug/L	0.112
N:P Molar Ratio	0.0417
pH	0.0247
Total P Load (lbs/mo)	0.0176
Anatoxin (ug/L)	0.000485

Chlorophyll-a (regulatory)	% Variance Reduction
Chlorophyll-a Regulatory	100
Total Biovolume (mm3/m3)	2.16
Dominant Algae by Biovol	0.328
Blue-Green Algae (mm3/m3	0.195
Residence Time (days)	0.157
Total Nitrogen (mg/L)	0.0957
Chlorophyll-a (ug/L)	0.0802
Water Temperature (C)	0.0677
Season	0.0645
Total Phosphorus (mg/L)	0.054
Total Organic Carbon (mg	0.0527
Precipitation (inches)	0.0195
Dissolved Oxygen (mg/L)	0.0181
Microcystin (ug/L)	0.0164
Secchi Depth (ft)	0.00914
Cylindrospermopsin (ug/L	0.00904
Manganese (mg/L)	0.00608
Total N Load (lbs/mo)	0.00585
Total P Load (lbs/mo)	0.000998
Anatoxin (ug/L)	0.000742
pH	0.000233
N:P Molar Ratio	0.000116

Total Biovolume

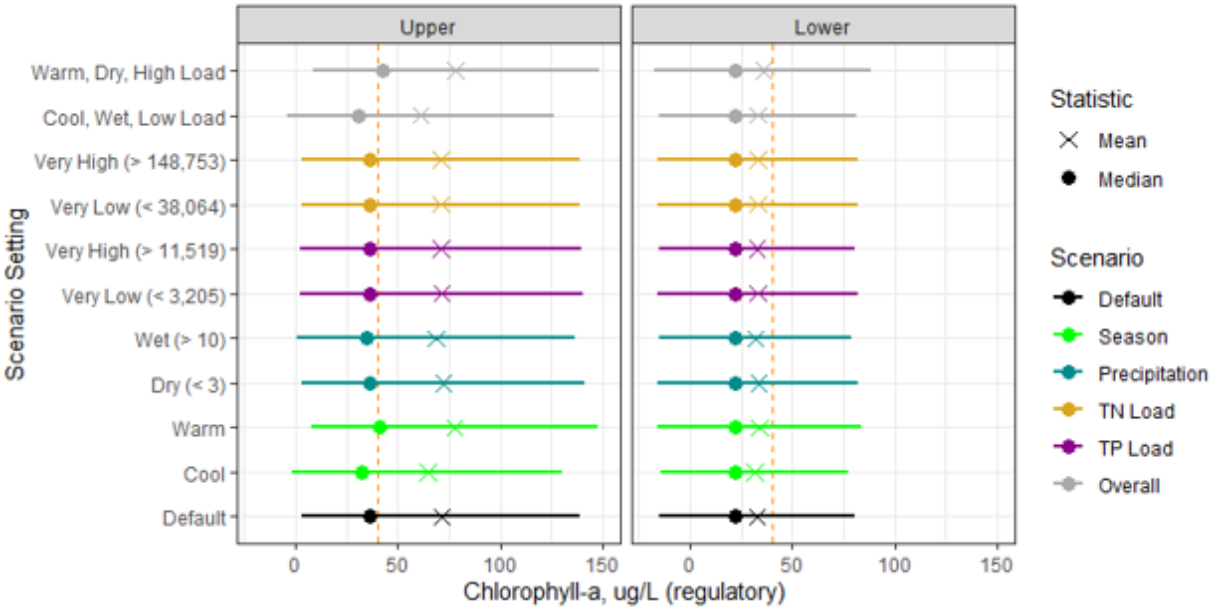
- Most sensitive to Dominant Algae but it has low sensitivity
- Both TN and TP concentration have very low explanatory value
- N and P load have almost zero explanatory value

Chlorophyll-a (regulatory)

- Most sensitive to Total Biovolume, but it is extremely low
- Nutrient concentrations and load have near zero explanatory value

Scenarios and Sensitivity Analysis Summary

- Strong left skew (most data lie to the left of the mean X and a long tail of rare values stretches out to the right)
- Wide SD (line) indicates many values are possible (have been observed) under all scenarios. There is high variability in chlorophyll-a under all scenarios.
- Mean and median values are higher in upper lake than lower lake, and standard deviations are larger.
- No scenario has much effect in the lower lake (all medians and means are below the 40 ug/L limit).
- In the upper lake, season (water temperature) has the highest impact on expectations, but even here is weak.



- Switching from Very High to Very Low load seems to have no measurable effect on expectations - all values are possible (have been observed) under both extremes.

Statistical/Bayesian Model Key Findings

Nutrients and Chlorophyll-a

- Nutrient loading and nutrient concentrations are not closely coupled. Regardless of load, the upper lake more often has higher concentrations and the lower lake more often has lower concentrations
- Season (temperature) and precipitation (residence time) generally have greater explanatory value than nutrient loads or concentrations
- Chlorophyll-a and total biovolume are sensitive to each other in the Upper lake (9%), but for both parameters, their sensitivity to nutrient concentrations and loads are low or near zero
- Chlorophyll-a's probability distribution always includes both the possibility of exceeding and not exceeding the standard. The probability of moderate chlorophyll-a (30-60 mg/L) is high in many cases. The most likely outcome in most cases (often 90% or higher) is NOT exceeding the standard.
- Very different conditions are required to raise the risk of exceedance in the upper compared to the lower lake

Manganese

- High values most often occur with high temperatures and long residence times

Total Organic Carbon

- High values most often occur with normal precipitation

Concerns with Development and Construction in the Falls Lake Watershed (Upcoming Board Discussion)

Concerns with Development in the Falls Lake Watershed

- In June, the PFC discussed concerns with development in the Falls Lake Watershed being raised by several groups and in the context of the new development rules
- The Chair of the June Board meeting suggested the Board take up this discussion in September
- In July, the Executive Director met by phone with representatives from Sound Rivers, who had published a blog post discussed by the PFC in June
- To prepare for the September Board meeting, the Executive Director asked Ryan Eaves to present the Durham County ordinance updates during the meeting
- The modeling team will be conducting additional data analyses on turbidity in Falls Lake related to other water quality measurements for discussion in September

Placeholder Slide for Durham County Development Ordinance Updates

Year Three of the IAIA Ends June 30th

Year Three of the IAIA Ended June 30th

- The third-year of the Stage I Existing Development Interim Alternative Implementation Approach (IAIA) ended June 30th
- Annual reports from each participant are due to John Huisman at the Division of Water Resources (DWR) with a copy to the Executive Director and Alix Matos by September 30, 2024.
- The latest version of the template is available here
  - Save a copy of this latest version 6.3
  - Replaces “JuridictionName” and “FY” in the file name with your organization’s name and FY24
  - Review the “Instructions” tab and “Column Explanations” tab
  - Enter FY204 projects into the “User Input” tab
    - Blue cells are dropdown menus
    - Purple cells are automatically populated
    - Green cells are user entered values or text
- The PFC will discuss questions or issues as needed.

Continued Rule Development for Jordan Lake and High Rock Lake Watersheds

Continued Rule Development for Jordan Lake and High Rock Lake Watersheds

- We continue to monitor DWR's
  - Draft proposal for changes to post-construction stormwater rules for the High Rock Lake Watershed
  - Rules readoption process for Jordan Lake Watershed
- We are concerned that these processes will impact
  - The Falls Lake rules readoption process and timeline
  - Could be inconsistent with the UNRBA's recommendations
- We also are concerned that seeking more aggressive development controls for the Falls Watershed will put at risk existing and future management efforts required under the Falls Rules.
- The UNRBA seeks to ensure that productive programs continue in the Falls watershed and are not inadvertently put at risk by seeking new and potentially more restrictive requirements for new development.

Falls Lake Rules Readoption Process

Status of Falls Lake Rules Readoption

- The UNRBA submitted the UNRBA Concepts and Principles for the Reexamination and Consensus Principles II in November 2023.
- The NC Collaboratory submitted their final report in December 2023
- These submittals trigger the initiation of the Falls Lake Rules Readoption Process. The following activities are ongoing:
  - UNRBA will continue to pursue a legislative change to § 77-141
  - We hope and anticipate that DWR staff are developing the list of activities, milestones, and actions for rules readoption, and a proposed plan for incorporating the assistance and engagement of the UNRBA in this process
  - The Executive Director and support team have begun drafting a very preliminary set of proposed revisions to the Rules to support the Rules Readoption process based on the UNRBA recommendations (see next slide)

Developing Preliminary Set of Rules

- For existing land use in the watershed, we anticipate a similar approach to how the IAIA is structured and currently implemented
- The Legal Group will develop a strategy for rules readoption to be reviewed by the PFC
- The process will include stakeholder engagement and outreach to interest groups that have not had significant engagement to this point, as well as to all of our stakeholders
- Workgroups will include UNRBA members, staff from DWR, representatives of agriculture, development, wastewater treatment plants, etc.
- The workgroup process needs to begin soon
- UNRBA will coordinate the schedule of this effort with DWR so our efforts can be integrated with the overall process
- These workgroups need to include the work and input from the Collaboratory's report.

Schedule for Rules Readoption

- The UNRBA is engaging on every aspect of this process and how other actions or proposals may impact our efforts to achieve a balanced and productive set of new rules.
- The UNRBA will continue to identify opportunities to work with other stakeholders as we begin coordinating, collaborating, and supporting DWR in rules review process
- June to December 2024
  - DWR to begin rule making and their stakeholder process
  - Meetings with the Chairs of the Environmental Management Commission (EMC) and its Water Quality Committee
- 2026/2027
  - DWR anticipates rules readoption

Evaluation of Specific Falls Lake 303(d) Assessment Methodology and Site-Specific Chlorophyll-a Criteria

Evaluation of Falls Lake Specific Assessment Methodology and Site-Specific Chlorophyll-a Criteria

- The UNRBA continues to focus on our primary priority: coordination with DWR and stakeholders in the development of a revised management strategy through the rules review process.
- Noting that two additional goals remain under consideration:
  - Modifications of the 303(d) water quality assessment method for chlorophyll-a in Falls Lake
  - Development of a proposed site-specific chlorophyll-a criteria
- As approved by the Board in June, Dr. Marty Lebo was provided with a new contract to continue this work and he is coordinating his efforts with the statistical modeling effort
- Nathan Hall is also an important contributor to these discussions and evaluations.

Communications Support

Communications Support

- The UNRBA continues to coordinate with DWR
  - Rules readoption process
  - Potential modifications to the water quality assessment methods
  - Development of a site-specific chlorophyll-a criteria for Falls Lake
- The work with DWR will intensify greatly following submittal of the UNRBA's and NC Collaboratory's recommendations in December 2023.
- We still seek to have additional meetings to gather input from NC Collaboratory staff, researchers, and representatives of NGOs.
- As we have continued to do, we encourage our jurisdictions to identify additional communication needs and to request support from the UNRBA team as needed

Additional Information and Activities

- A template slide deck has been drafted for use by UNRBA members to present the recommendations for a revised nutrient management strategy; comments from the PFC will be used to finalize the slide deck
- Planning for a joint stakeholder workshop with DWR and UNRBA on the rules readoption process (tentatively scheduled for the November Board meeting date, but may have to be moved out if progress to set this up with DWR cannot be made)
- We continue to promote participation in a synthesis workshop by the NC Collaboratory researchers regarding the intersection of research studies and insights for the rules readoption process
- American Rivers has offered to coordinate a series of videos related to their 2023 Neuse River as “River of the Year” and how the work being done in the upper part of the basin helped contribute to that designation.

Coordination with Stakeholders

- The UNRBA will continue to identify opportunities to work with other stakeholders as we move through rules readoption.
- The “open” nature of all UNRBA meetings remains a key component of our transparent communications approach.
- We encourage member representatives and interested individuals to speak up about ideas and opportunities to communicate our work and the importance of our recommendations on a revised strategy and a site-specific standard.

Other Status Items

Other Status Items

- DWR Neuse Watershed Model / Delivery Factors for WWTP
- Inquiries and Issues Regarding Nutrient Credits
  - Soil improvement practice
  - Repair/replacement of failing onsite wastewater treatment systems

Future Meetings Currently Scheduled:

Next PFC Meeting: September 3, 2024, 9:30 AM to Noon

Next BOD Meeting: September 18, 2024, 9:30 AM to Noon

Closing Comments
Additional Discussion