



Barr Engineering Co.
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Lake Mitchell

Water Quality Evaluation

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Background

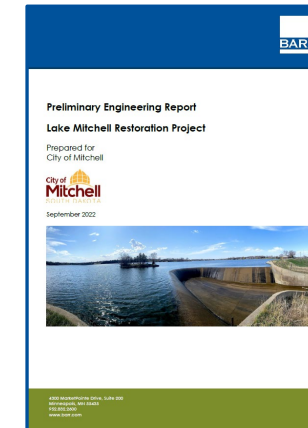
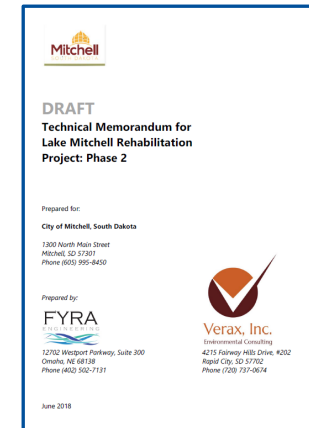
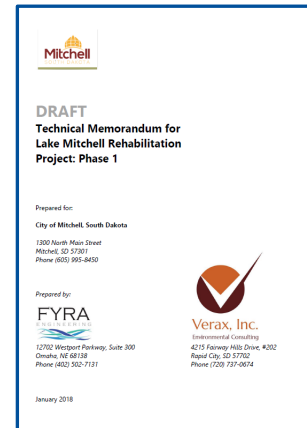
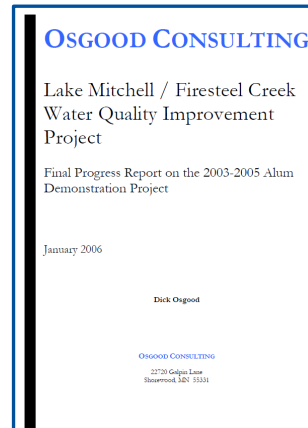
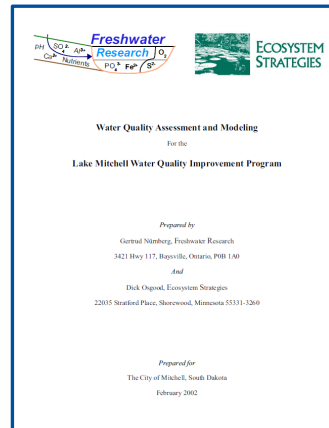
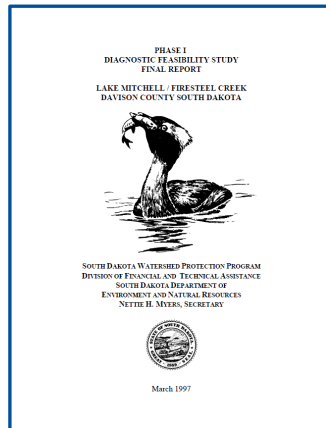
Water Quality Evaluation

Conclusions and Recommendations



Previous Lake Studies

- Numerous studies over several decades
 - Consistent conclusion: water quality impaired by *external* and *internal* nutrient loading
- 2022 Preliminary Engineering Report (Barr)
 - Defined a conceptual dredging project that removes ~ 1/2 accumulated sediment



Background

Water Quality Evaluation

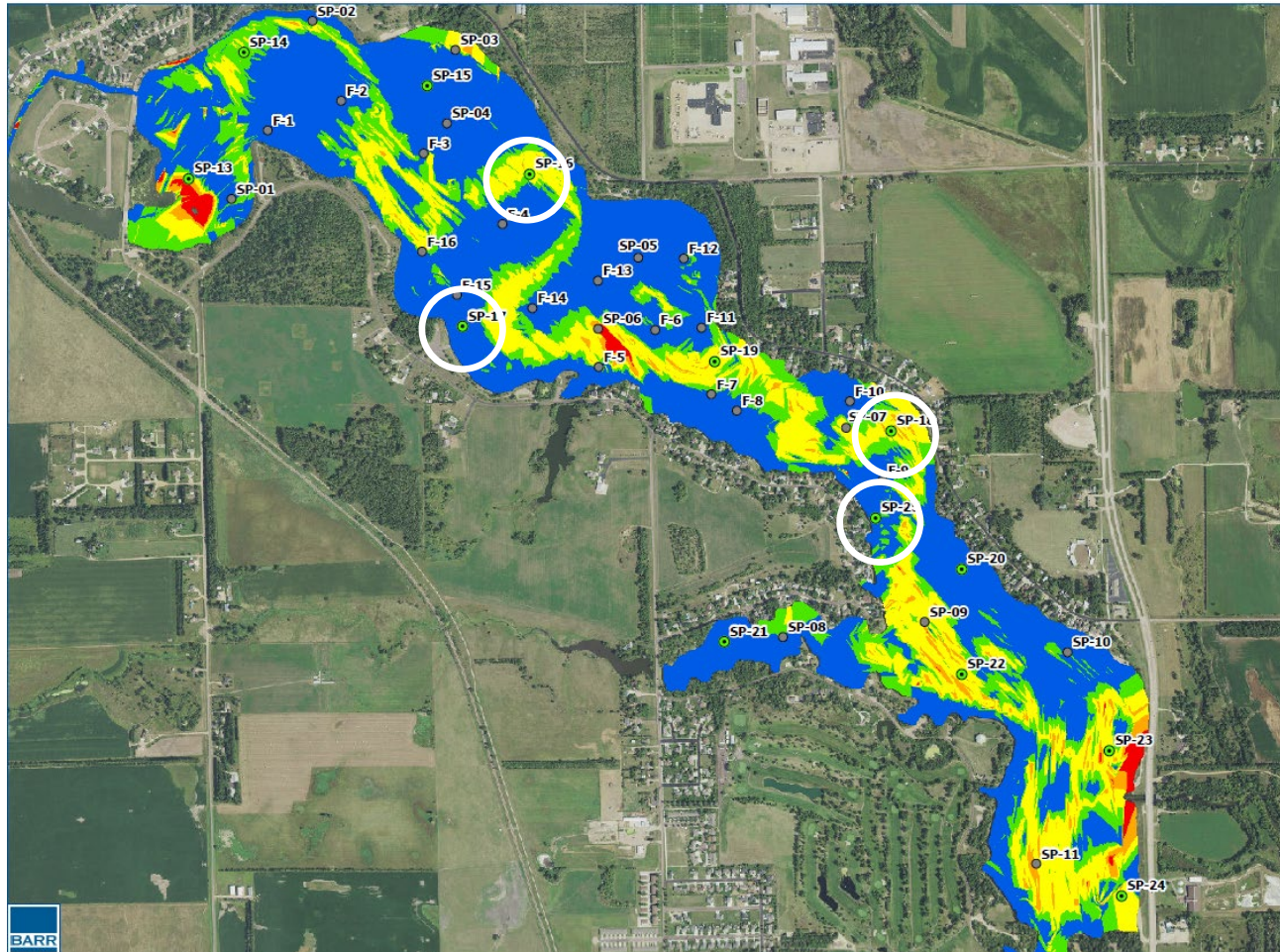
Conclusions and Recommendations



Water Quality Evaluation

Data Gaps	WQ Evaluation Scope
1. What is the native sediment quality?	Sediment Investigation and Lab Release Experiments
2. Does the presence of carp contribute to water quality degradation?	Carp Population Survey
3. What is a realistic water quality target?	Review and summarize previous reports and studies
4. What are the estimated water quality outcomes in different scenarios?	Water Quality Evaluation using watershed and lake data

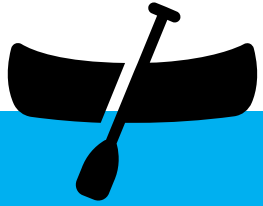
Sediment Investigation



Adapted from 2018 Technical Memo (FYRA)



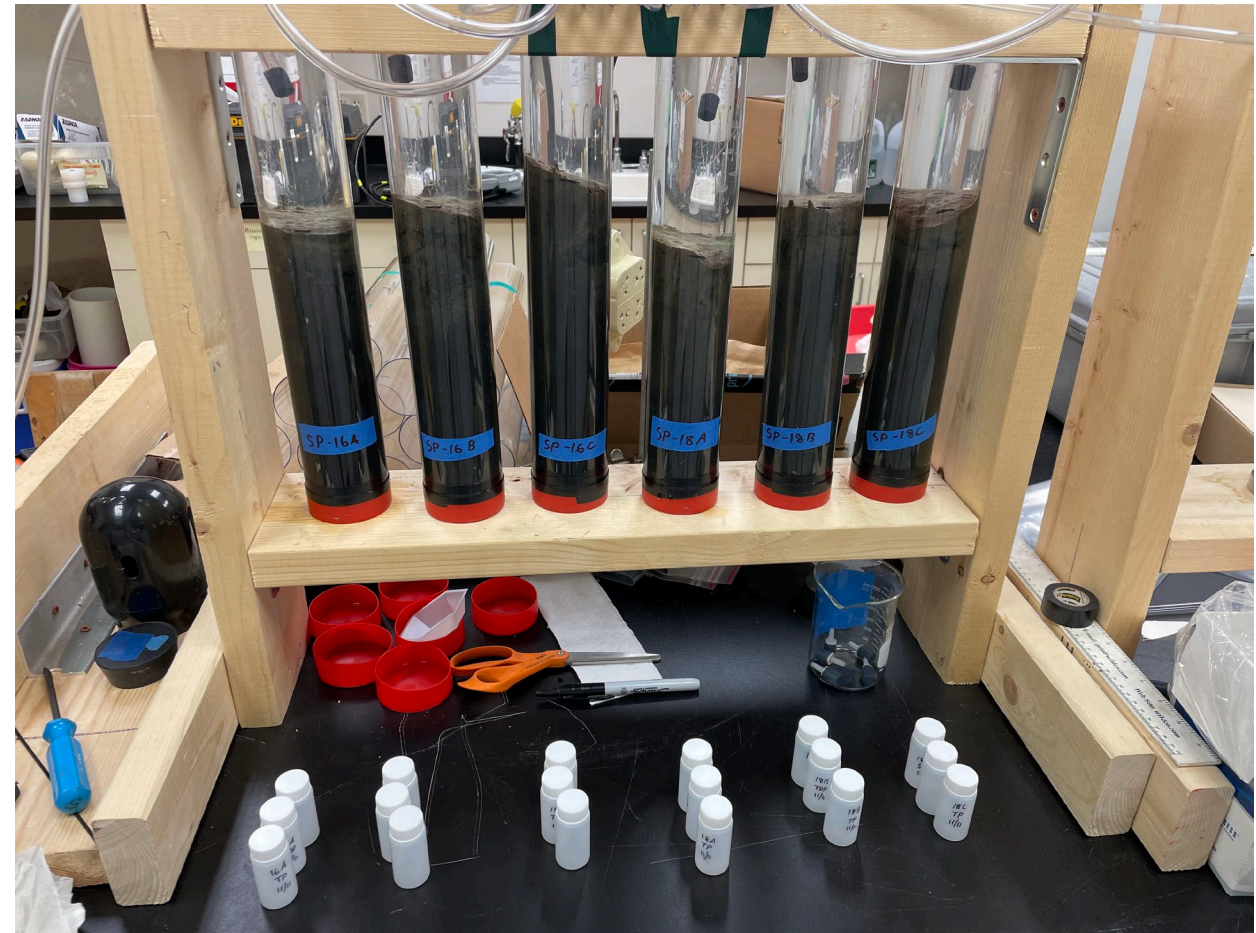
Column Release Experiments



Water Column

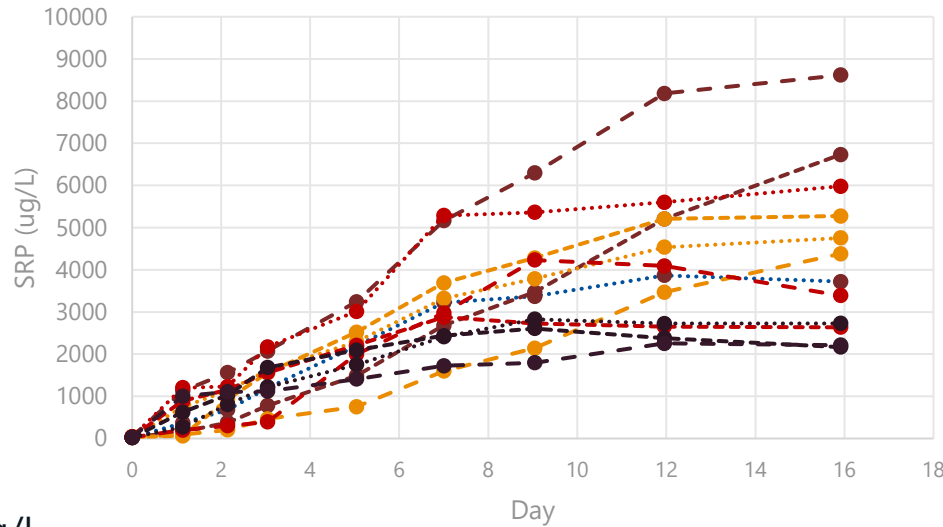
★ Surficial (Accumulated) Sediment

★ Deeper (Native) Material



Sediment Investigation – Column Release Experiment

Soluble Reactive Phosphorus Release – Surficial Sediment

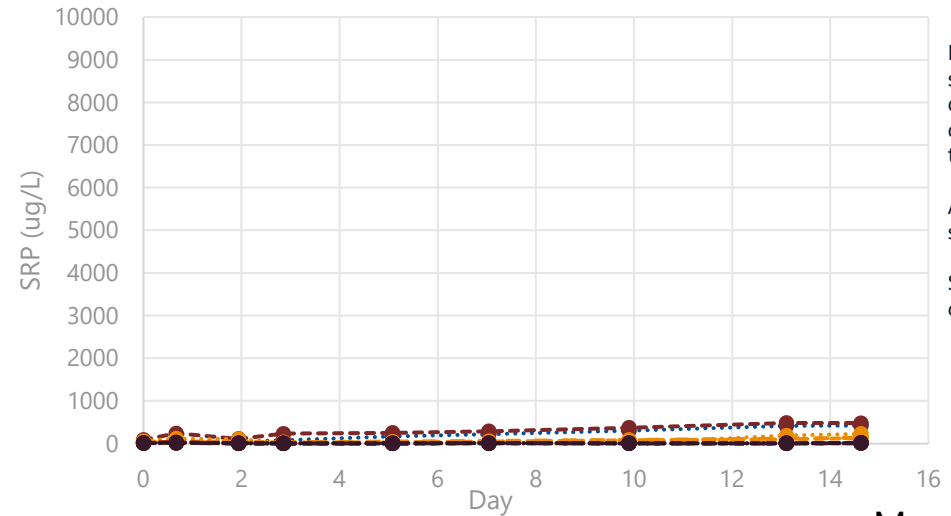


Data represent sediment samples collected from 2 surficial locations, each in triplicate (6 total).

Aerobic and anoxic simulations.

SRP is measured in water column over time.

Soluble Reactive Phosphorus Release – Deeper Sediment



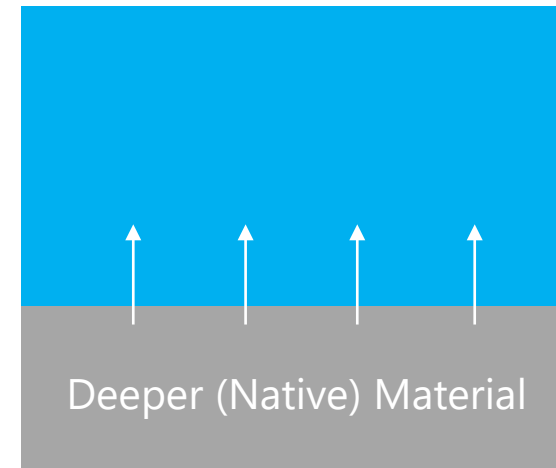
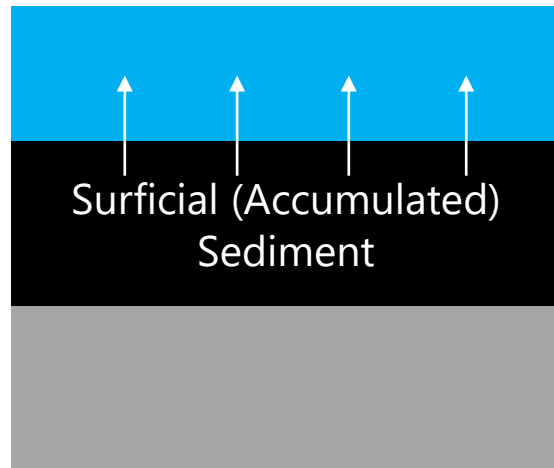
Data represent sediment samples collected from 2 deeper locations, with duplicate or triplicate (5 total).

Aerobic and anoxic simulations.

SRP is measured in water column over time.

Mean_{t16}: 4,400 ug/L
Max_{t16}: 8,600 ug/L

Mean_{t15}: 145 ug/L
Max_{t15}: 478 ug/L



For reference: Lake Mitchell TMDL is 139 ug/L Total Phosphorus (TP)

Sediment Investigation – Conclusions

- Phosphorus release in surficial sediments is extremely high
- Significant (orders of magnitude) reduction in release rate for deeper sediments/native material
- Phosphorus concentrations are higher in northern portions of lake



Removal of soft sediment expected to result in less internal loading

Carp Study

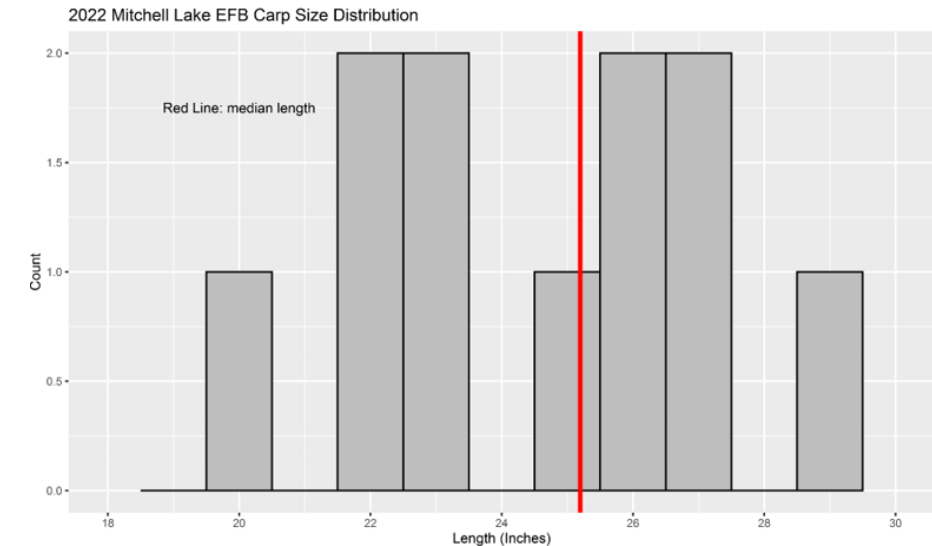
- 3 electrofishing surveys in 2022
- Survey Results: 25 kg/ha (23 lbs/ac) biomass [management threshold: 100 kg/ha (90 lbs/ac)]



2022 Lake Mitchell Carp Management Report
November 25, 2022



Carp not observed at density that would be expected to be significant contributor to water quality impairments



Potential Water Quality Targets - What Defines Success?

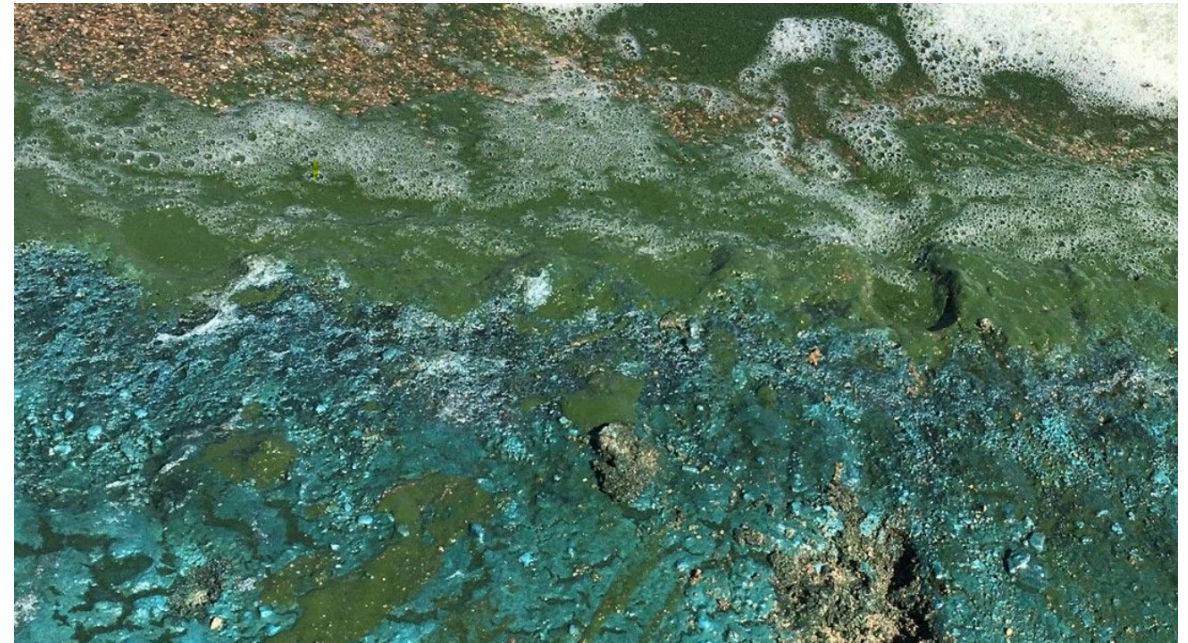
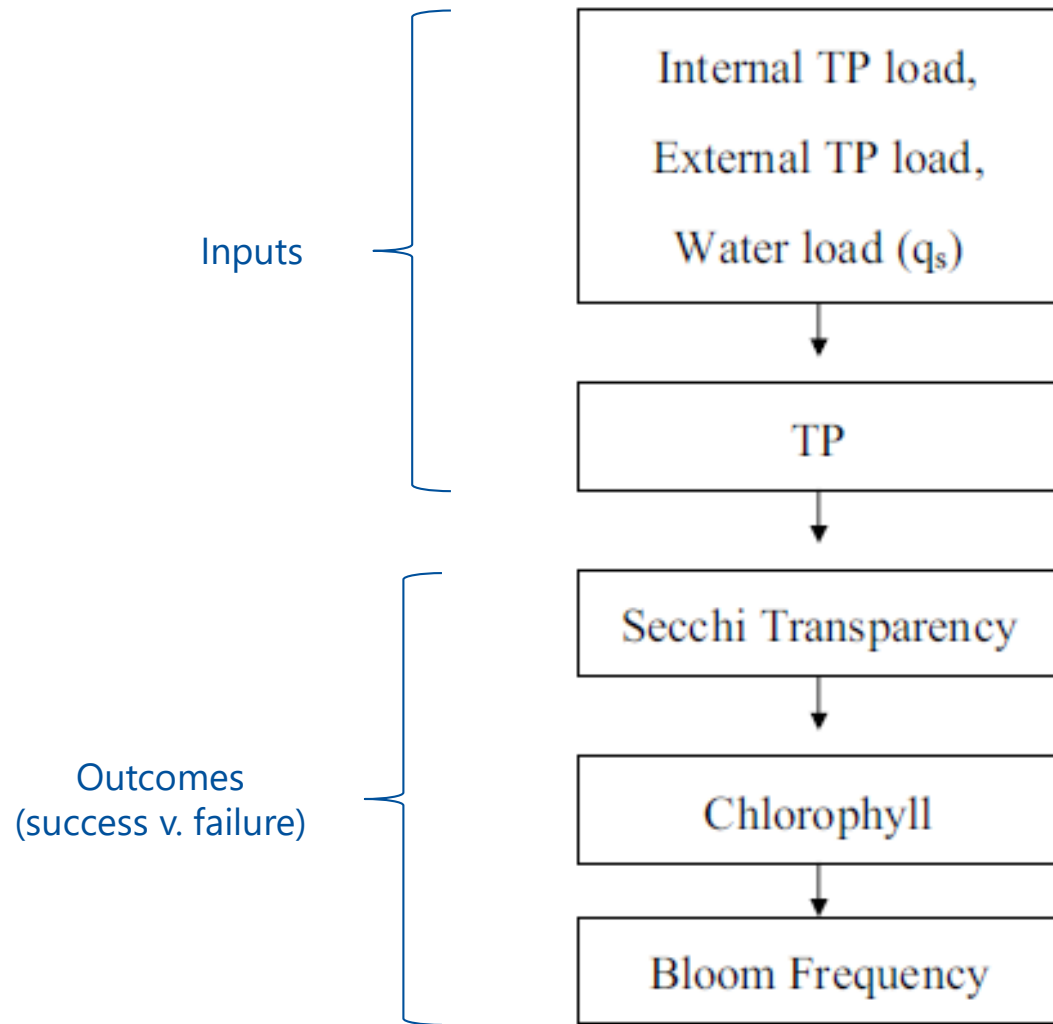


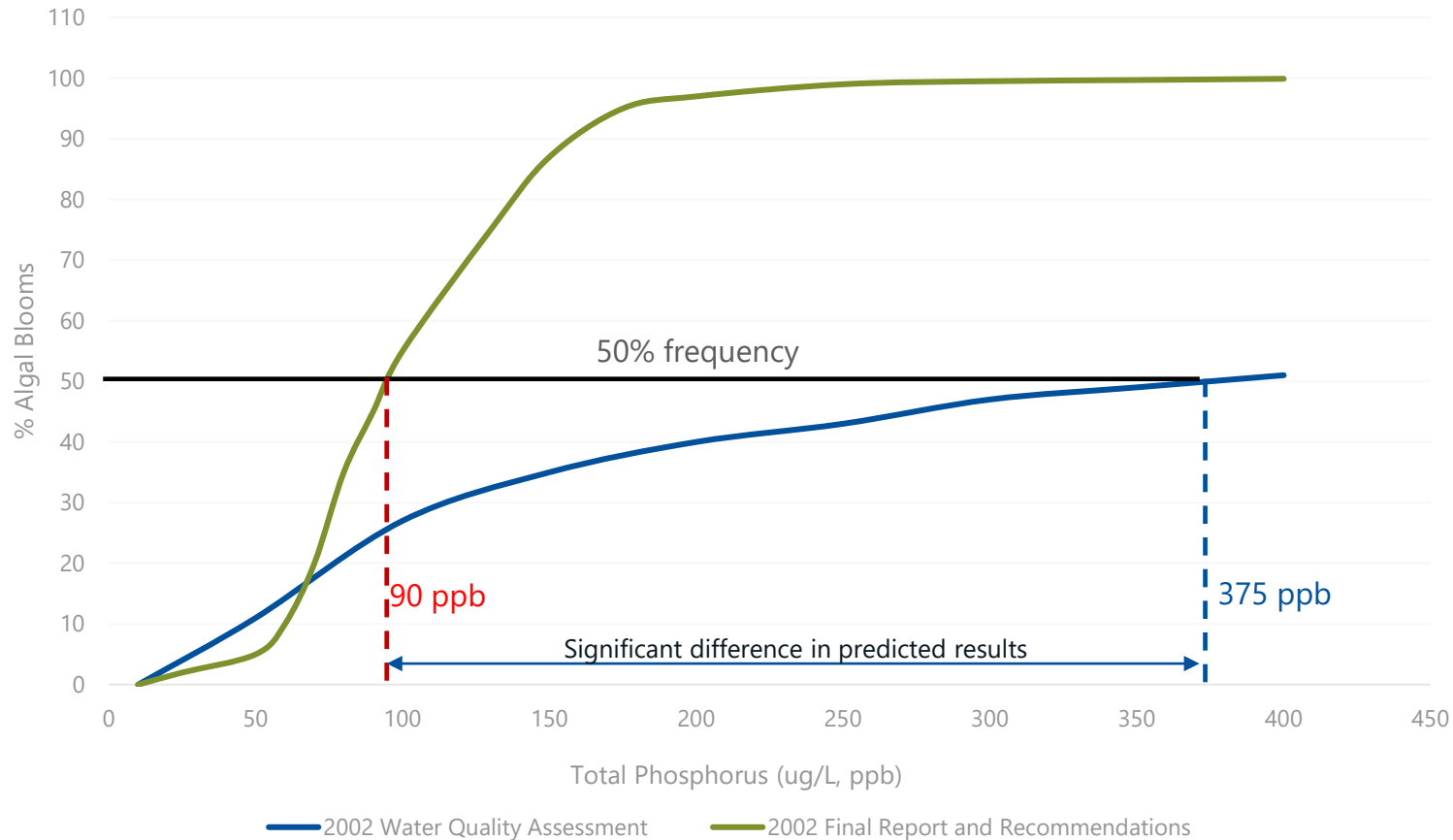
Photo: DANR

Figure 5-1 from 2002 *Water Quality Assessment and Modeling (Freshwater Research)*

Potential Water Quality Targets

Correlation of Total Phosphorus to Algal Growth

% Predicted Algal Blooms Based on TP Conc (ppb)



- 90 ppb
 - Published Provisional Goal (2002)
 - Based on Ecoregion correlations
 - Estimated to result in 50% algal bloom frequency

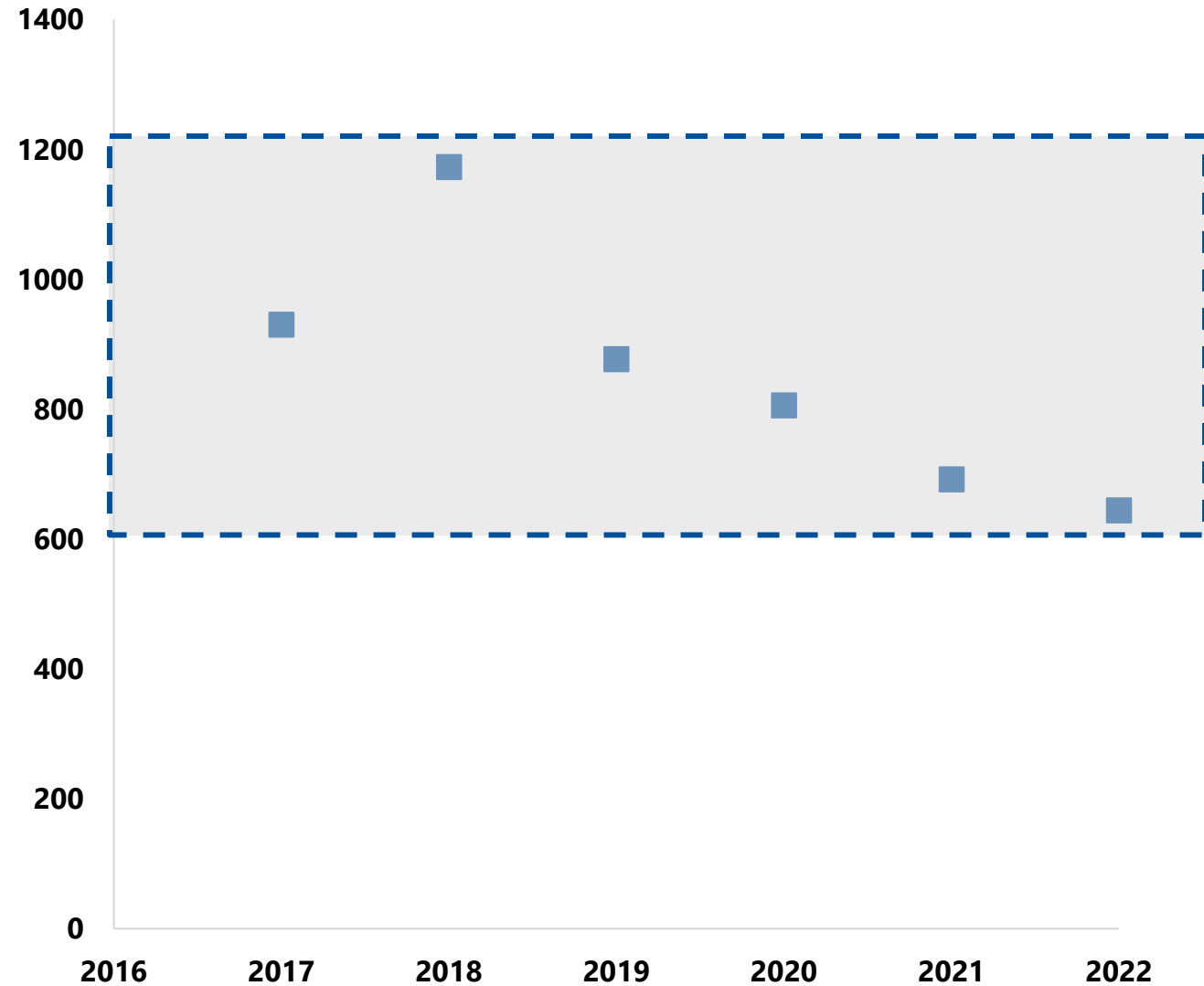
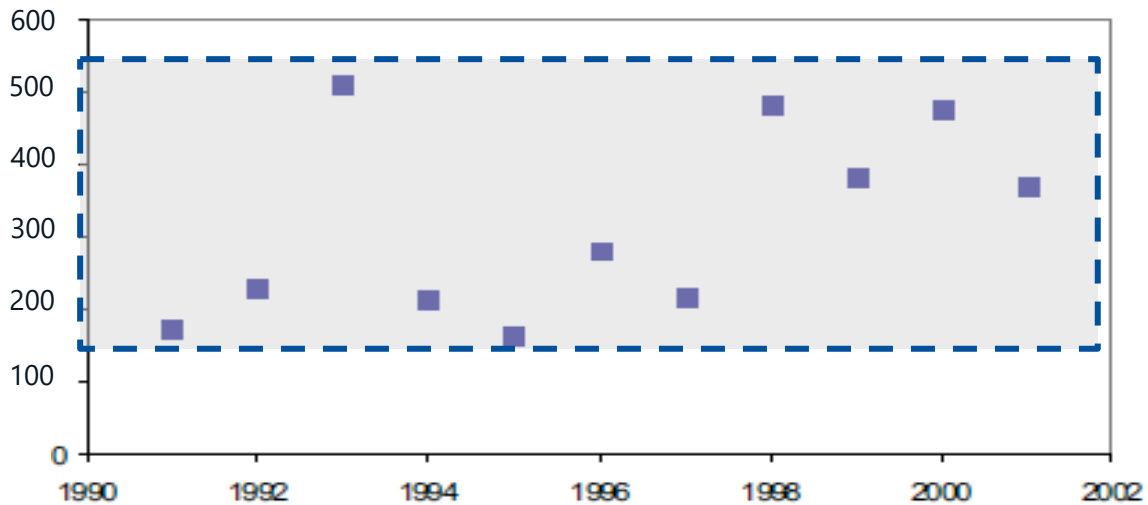
- ~375 ppb
 - Based on Lake Mitchell data and empirical equation (2002)
 - Estimated to result in 50% algal bloom frequency

- 139 ppb
 - Total Maximum Daily Load (TMDL, 1997)
 - Based on meeting trophic state index value for Chl-a (close to a mesotrophic lake designation)



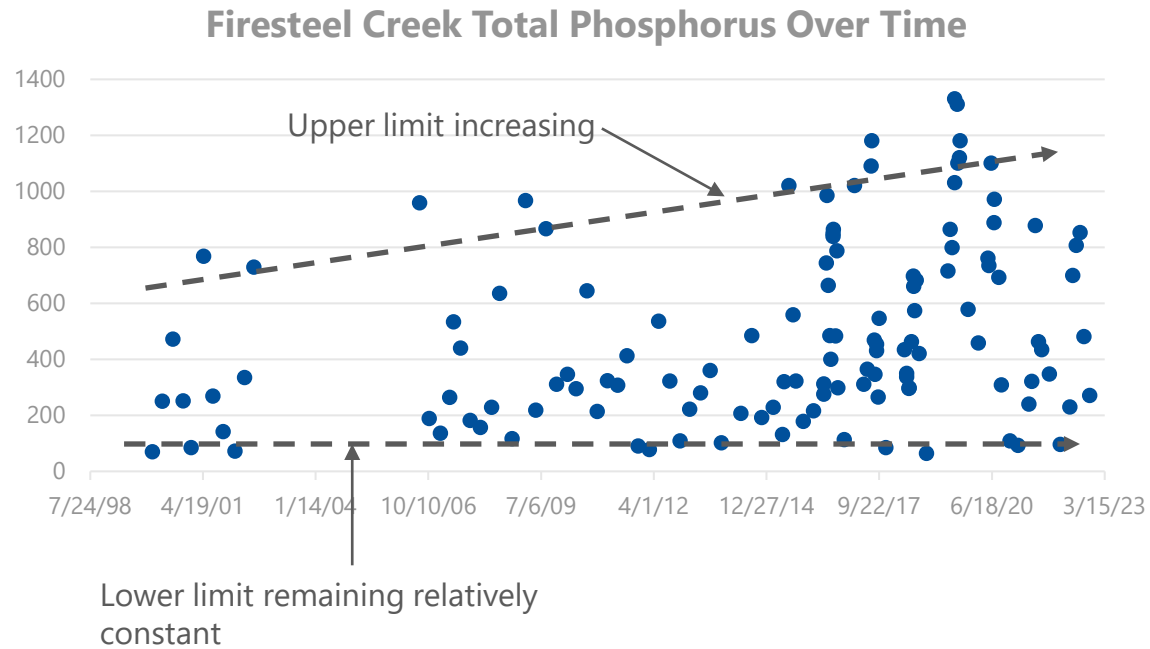
Lake Water Quality Trends

Lake Mitchell phosphorus concentrations have continued to increase since previous studies

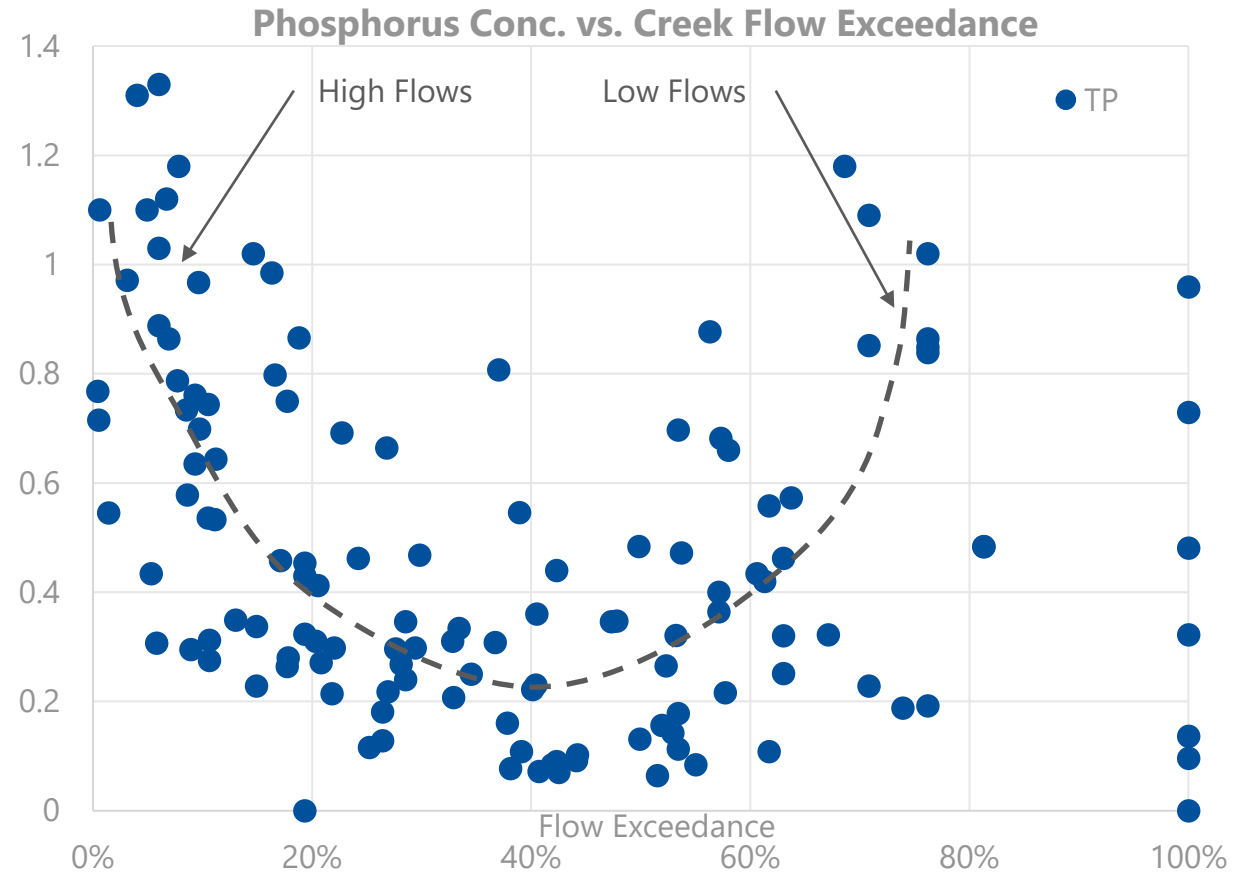


Watershed Trends

Watershed loading has continued to increase since previous studies



Highest concentrations are during either low or high flows, lower during "normal" flows



Water Quality Estimates

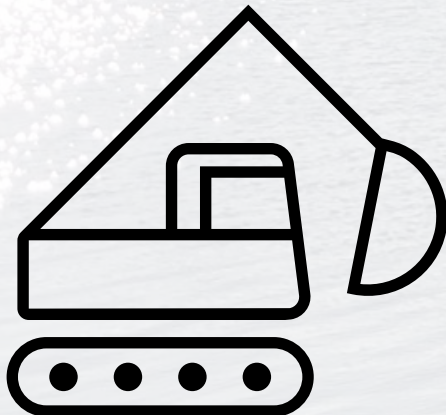


Leaflet | Powered by Esri | USGS The National Map: Orthoimagery. Data refreshed December, 2021., USGS The National Map: National Hydrography Dataset

Water Quality Estimates - Scenarios

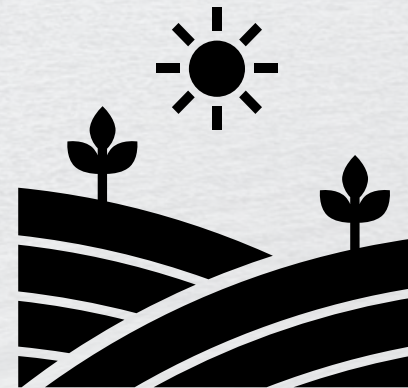
- Different combinations of in-lake and watershed improvements
- Results represent phosphorus concentration at lake center during normal flow conditions

In-Lake Scenarios



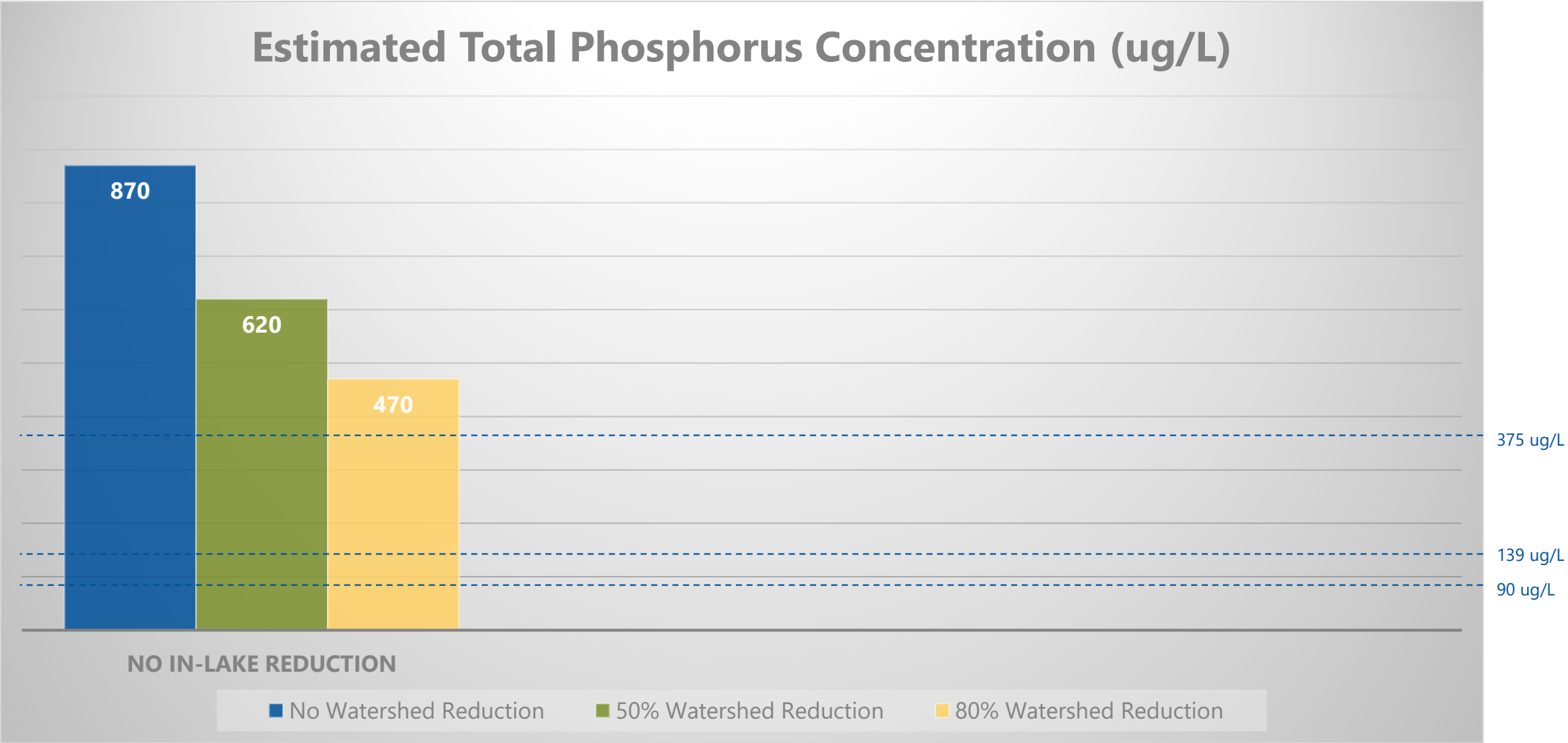
- Do Nothing
- 50% Reduction
- 85% Reduction

Watershed Scenarios

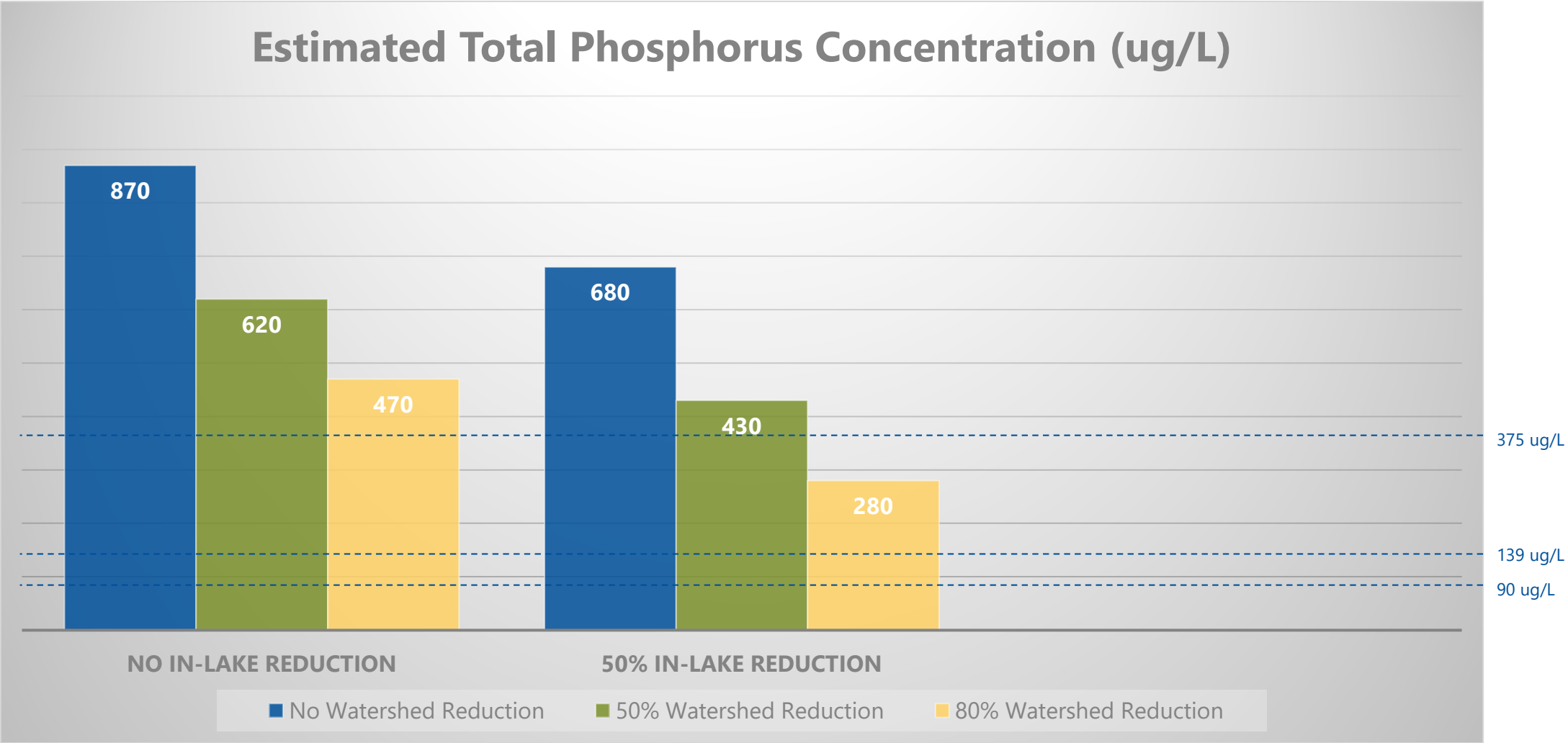


- Do Nothing
- 50% Reduction
- 80% Reduction

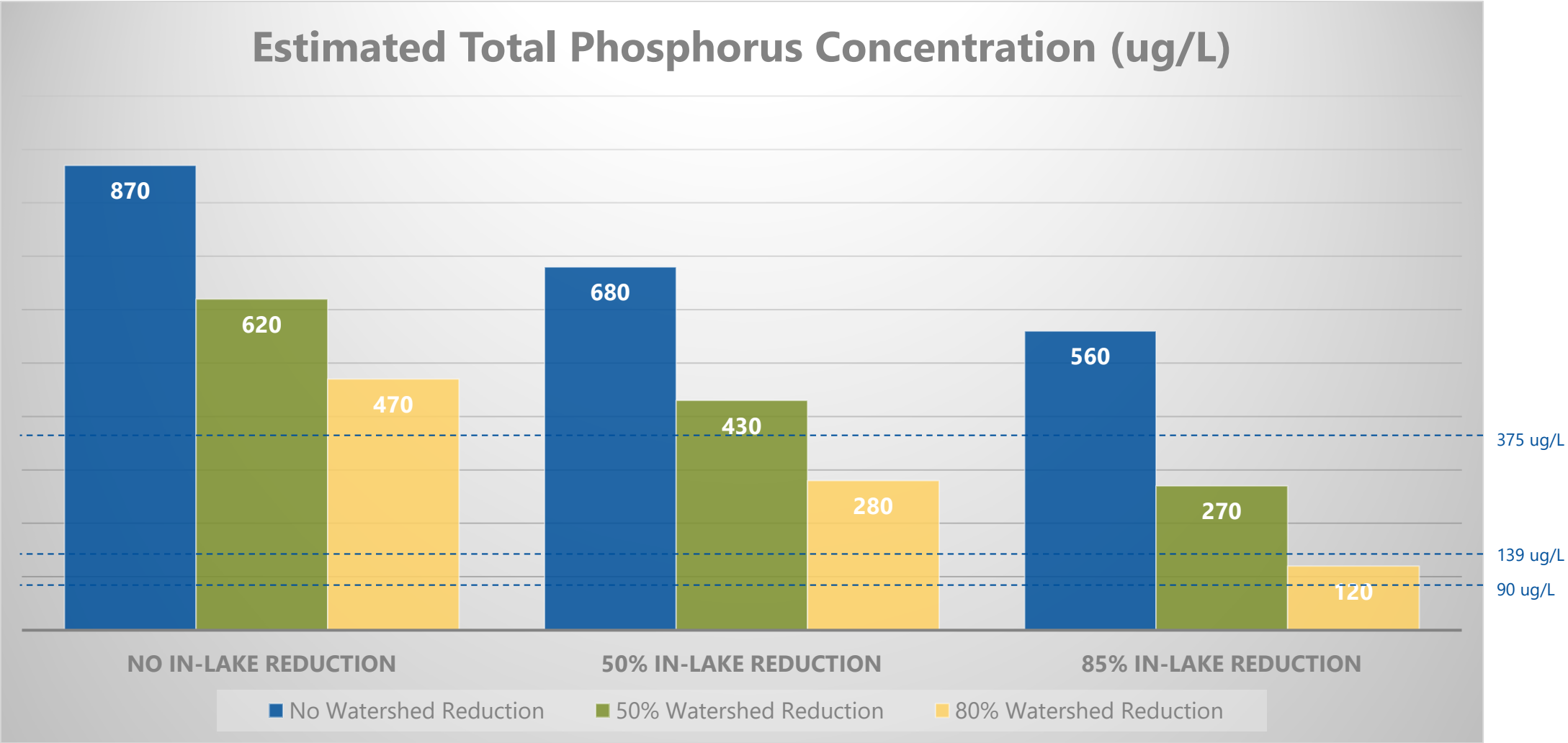
Water Quality Estimates - Results



Water Quality Estimates - Results



Water Quality Estimates - Results



Background

Water Quality Evaluation

Conclusions and Recommendations



Conclusions

- Water quality is poor (elevated TP in lake, watershed, and sediment)
- Water quality has degraded over last several decades
- Removal/treatment of sediment expected to reduce internal TP loading
- Watershed improvements expected to reduce external TP loading
- Reducing internal or external TP loading will improve water quality
- Without both components, it is unlikely that water quality targets will be consistently achieved

Recommendations – Parallel Paths

- Continue to invest in watershed improvements
 - Perform cost-benefit analysis of potential projects
- Perform internal load control project
 - Optimize dredging
 - Northern portion of lake
 - Areas of widespread thin deposits
 - Perform alum treatment in select areas
 - Include near-lake BMPs
 - Perform cost-benefit analysis and plan for annual in-lake O&M
 - Reductions likely after watershed improvements are realized



Thank you



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for more information