

High Rock Lake Chlorophyll a Evaluation for Key Locations

Picture from usawaterviews.com

UNRBA – 9/3/19 Meeting
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Presentation Topics

1. Brief Background

- NC Nutrient Criteria SAC
- General Limnological Concepts Important for Reservoirs

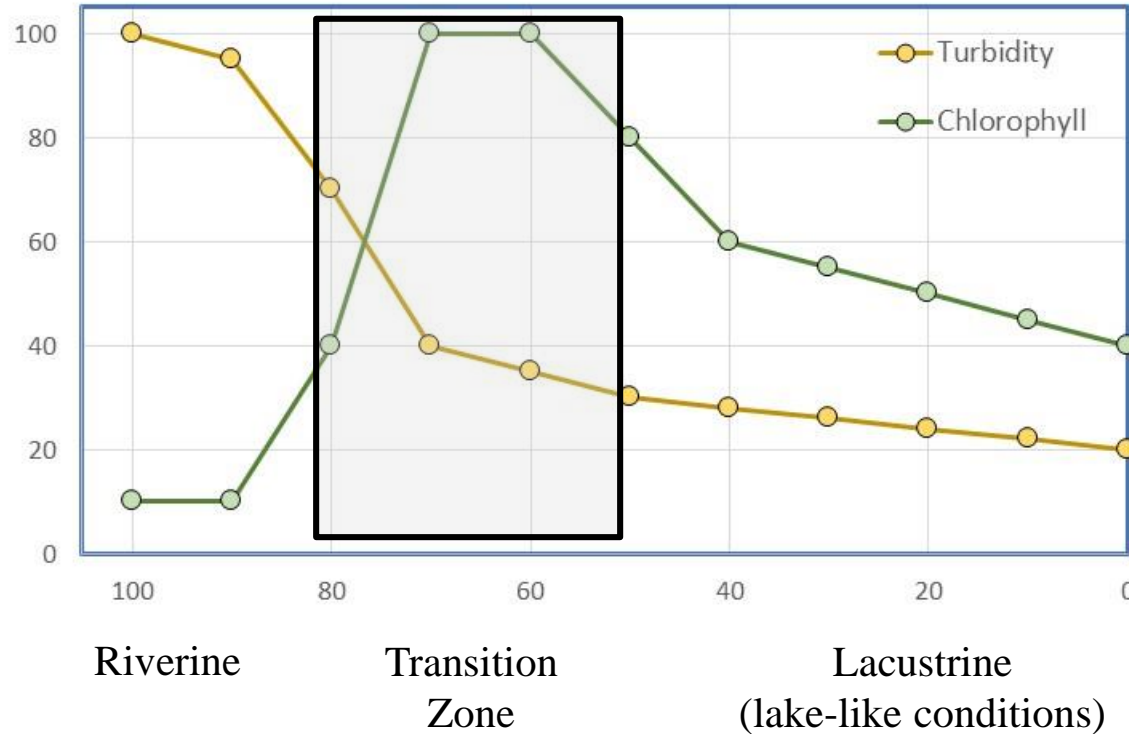
2. HRL Pilot Study

- Designated Uses for Nutrient Criteria Consideration
- High Rock Lake Data Evaluation
- Proposal Under Consideration

NC Nutrient Criteria Effort

- **Membership Defined – Feb 2015**
- **Initial Meeting – May 2015**
- **Approach Is Pilot Study For Each of Three Waterbody Types**
 - **Reservoir - High Rock Lake**
 - **Estuary – Albemarle Sound**
 - **River – Middle Cape Fear River**

General Limnological Concepts



Turbidity Decreases
Algal Growth Peaks

Turbidity Decreasing
Algal Biomass Decreasing

Predictable Spatial Patterns

Downstream Shift at Higher River Flow

Productivity Depends on Endpoint:

- Total Productivity for Fishery Is a Spatial Average;
- Acute Effects Would Be in Transition Zone

Zones as defined by Princeton Hydro.com

General Limnological Concepts

Water Level in Reservoirs Is Managed for Multiple Purposes – Power Generation, Recreation, and Flood Control Are Examples

It is Typical for Month-to-Month Variation in the Water Elevation for the Shallow Zones Along the Margins of Reservoirs

Reservoirs Typically Experience Intermittent to Prolonged Stratification at Low to Moderate River Flows – Affects Variations in Dissolved Oxygen and pH

During Summer Months – River Flow can Actually Shift to Mid-Depth or the Lower Portion of the Water Column

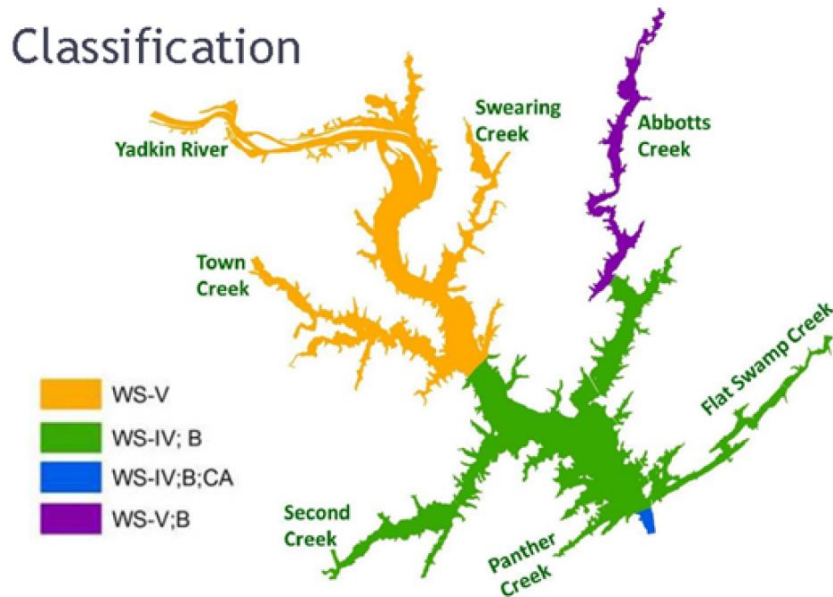


Approach for High Rock Lake

- **Background on Waterbody and Assigned Uses**
- **Develop Set of Candidate Metrics**
- **Evaluate Available Data**
 - Water Quality Parameters
 - Algal Community and Toxins
 - Fish Community
- **Revise Candidate Metrics**

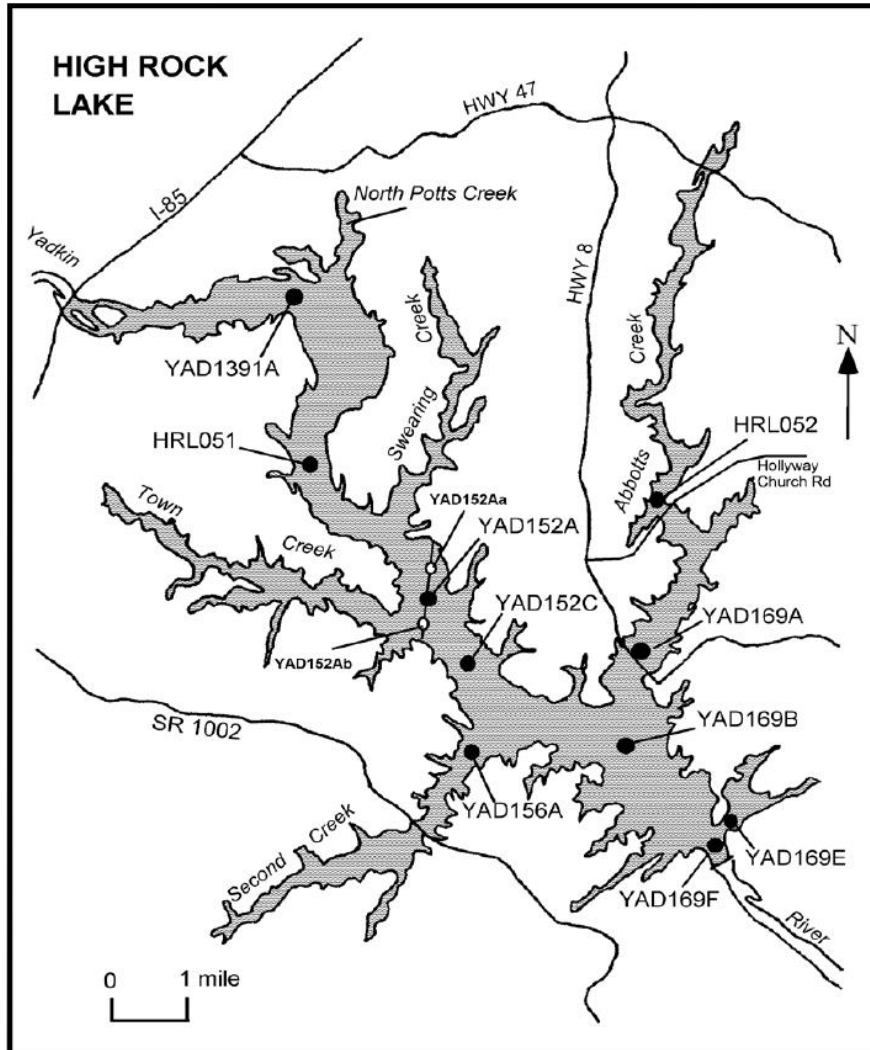
High Rock Lake – Progress to Date

- **Discussions on Parameters to Consider and Attainment Status of Current Uses**
- **Dissolved Oxygen, pH and Turbidity/Clarity**
- **Existing Standards and Potential Changes**



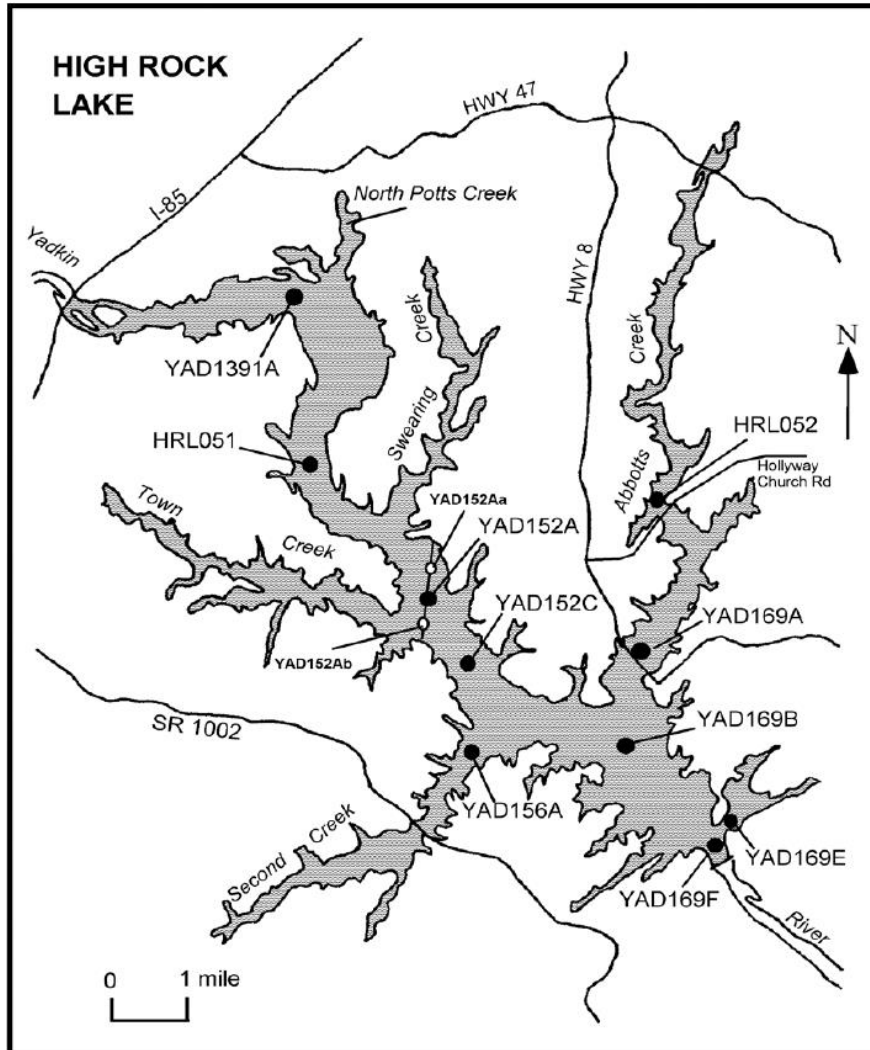
- **Water Supply**
- **Primary Recreation**
- **Aquatic Life**
- **Unclear If Impacts to Uses**

High Rock Lake - Observations



- **Peak Chlorophyll a Level at YAD152C (transition zone)**
- **Cyanobacteria Often the Dominant Algal Group**
- **Algal Blooms Generally Dispersed in Water Column**
- **High Dissolved Oxygen and pH Can Occur in Surface Waters**
- **Low Levels of Algal Toxins Present (Below Concentrations of Concern)**
- **Reservoir Is Eutrophic in Terms of Productivity**

Description of Evaluation

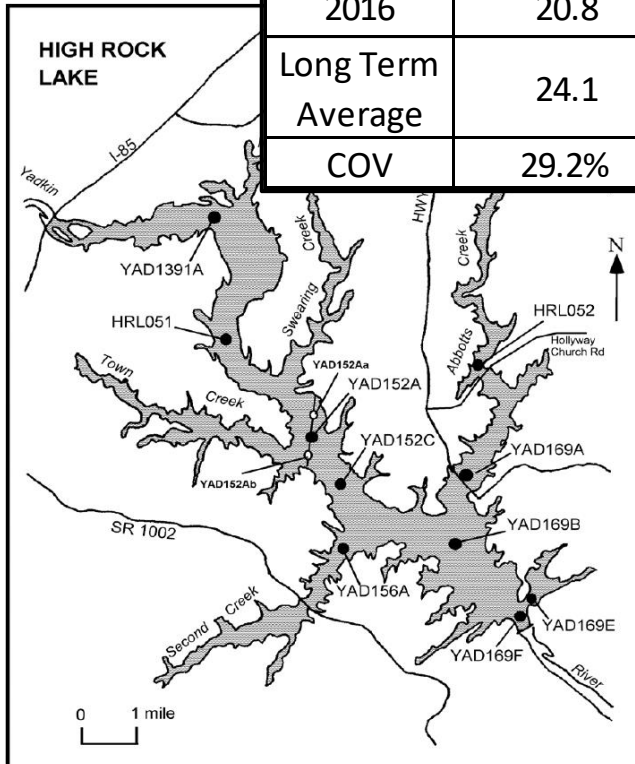


- Characterize Chla Spatial Variability
- Data for 2006-2016 NC DWR surveys during April-October
- Utilize Monte Carlo Approach to Expand Limited Measured Data to Potential Conditions in Other Years
- Create 100 Synthetic Sample Records for Four Locations
- HRL051, YAD152A, YAD152C, YAD169B, and YAD169A

High Rock Lake – Existing Condition

Table 1. Growing Season (April-Oct) geomean by sampling location

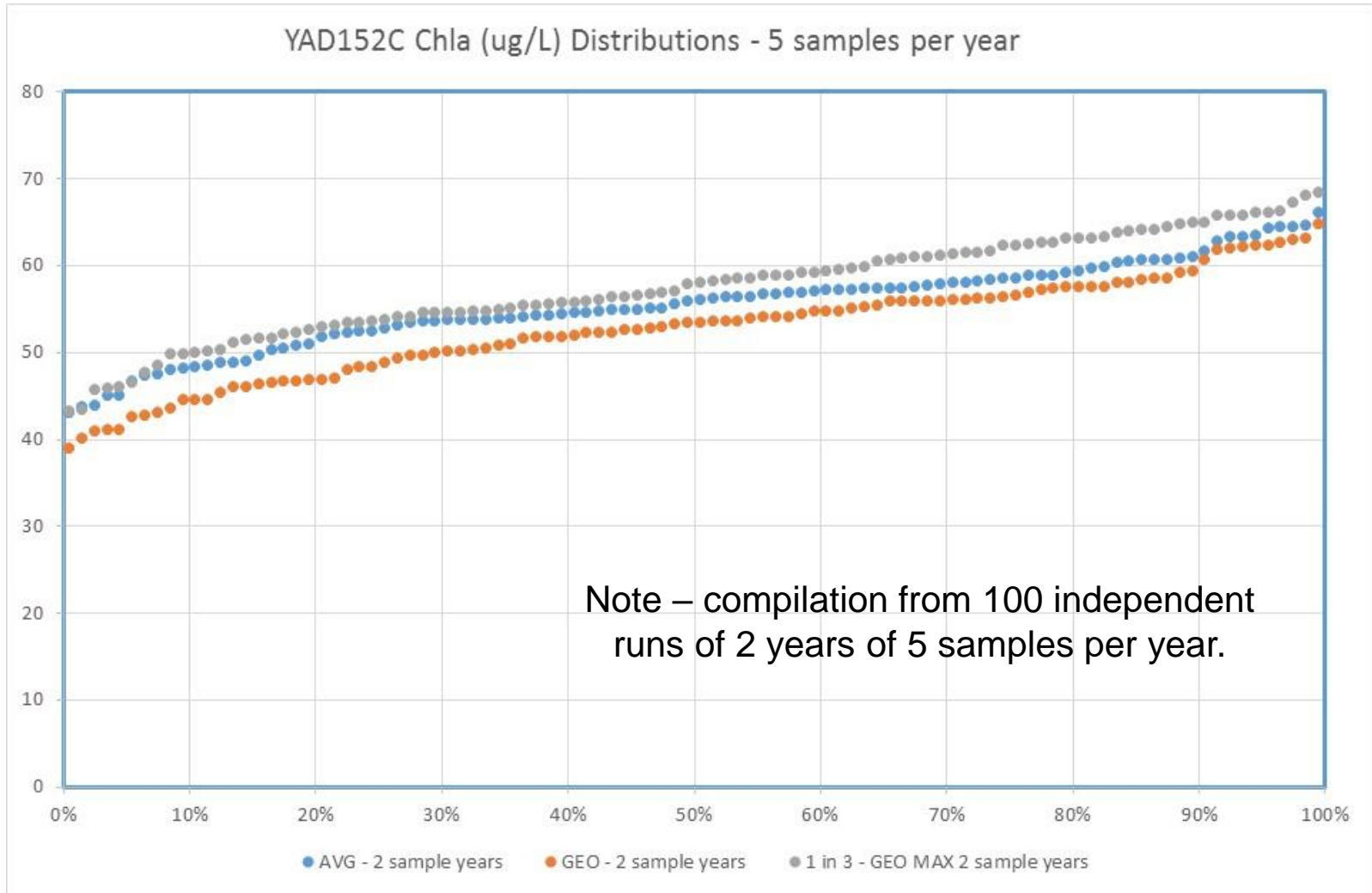
Year	HRL051	YAD152A	YAD152C	YAD169B	YAD169F
2006	27.3	51.2	59.6	38.3	34.6
2008	34.1	49.2	53.4	40.3	32.5
2009	16.9	42.1	53.0	43.4	36.0
2011	30.7	50.1	55.6	42.5	36.5
2016	20.8	52.3	58.7	44.3	36.1
Long Term Average	24.1	47.9	55.2	42.0	34.8
COV	29.2%	8.3%	5.5%	5.8%	4.7%



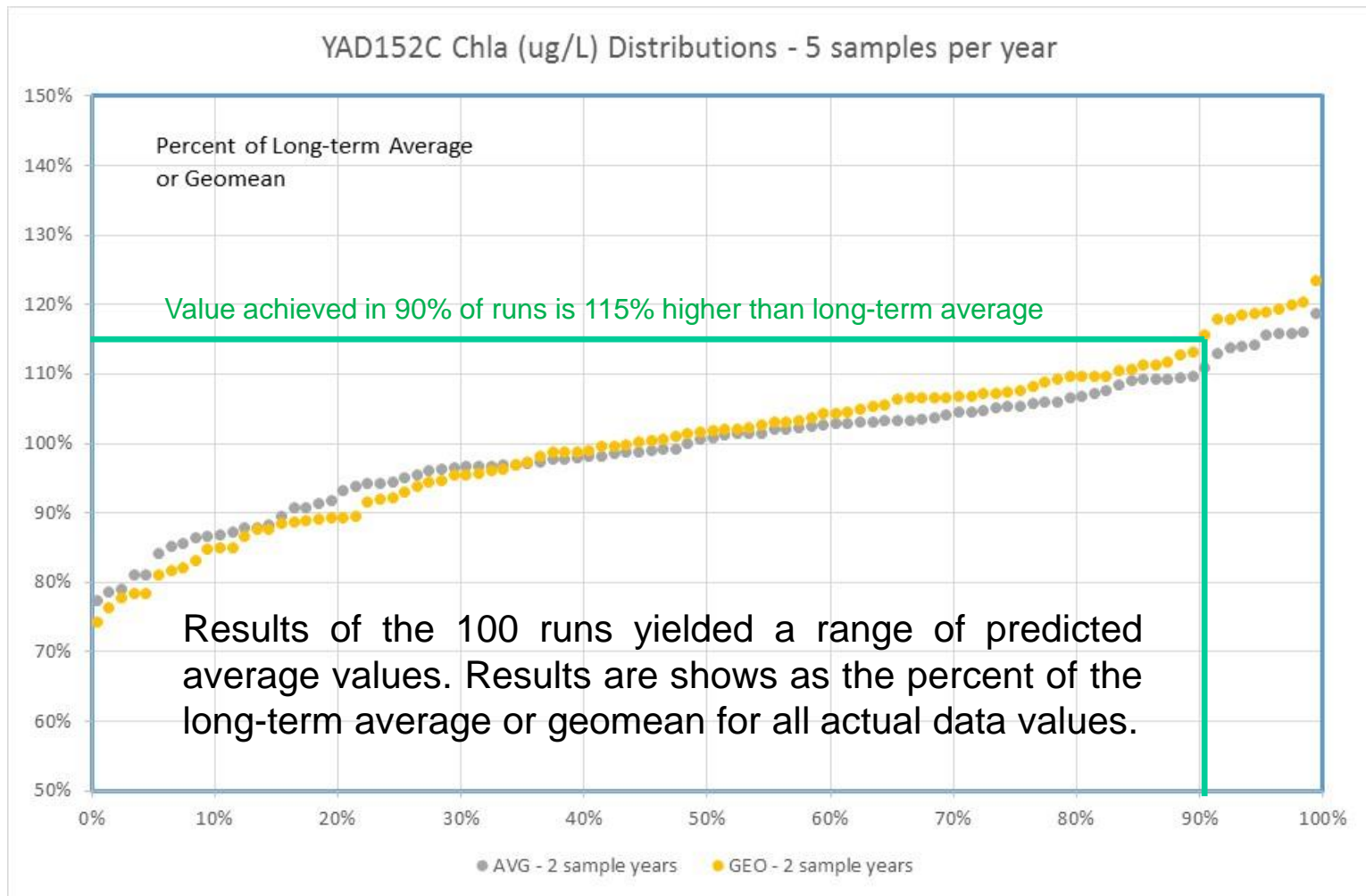
- Transition = 24-55 $\mu\text{g/L}$ Chla
- Lacustrine = 35-42 $\mu\text{g/L}$ Chla

Year-to-Year Variability Higher in Upstream Reach of the Reservoir

Comparison of Summary Metrics

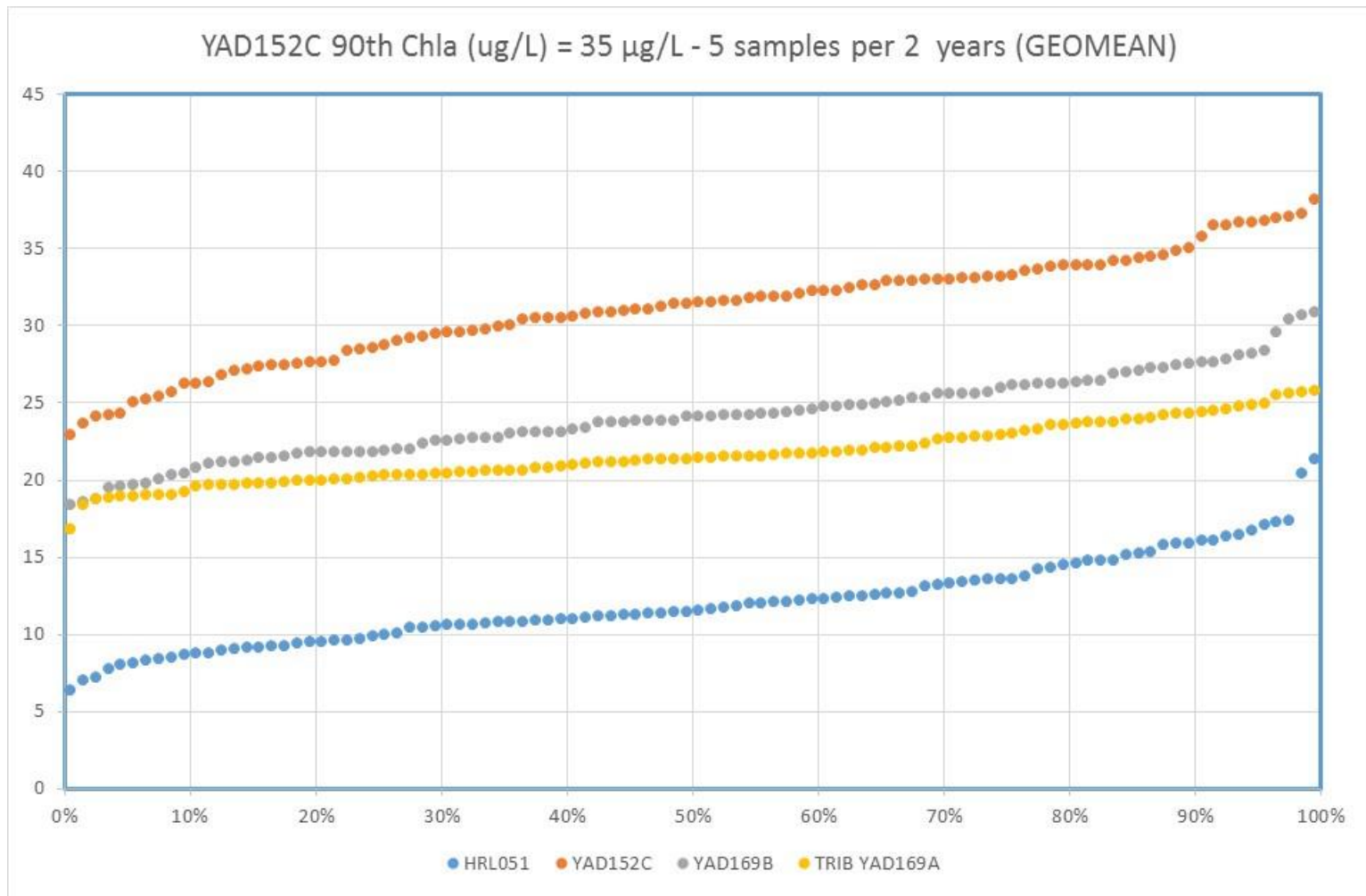


Comparison of Summary Metrics



Note – 100 independent runs of 2 years of 5 samples per year.

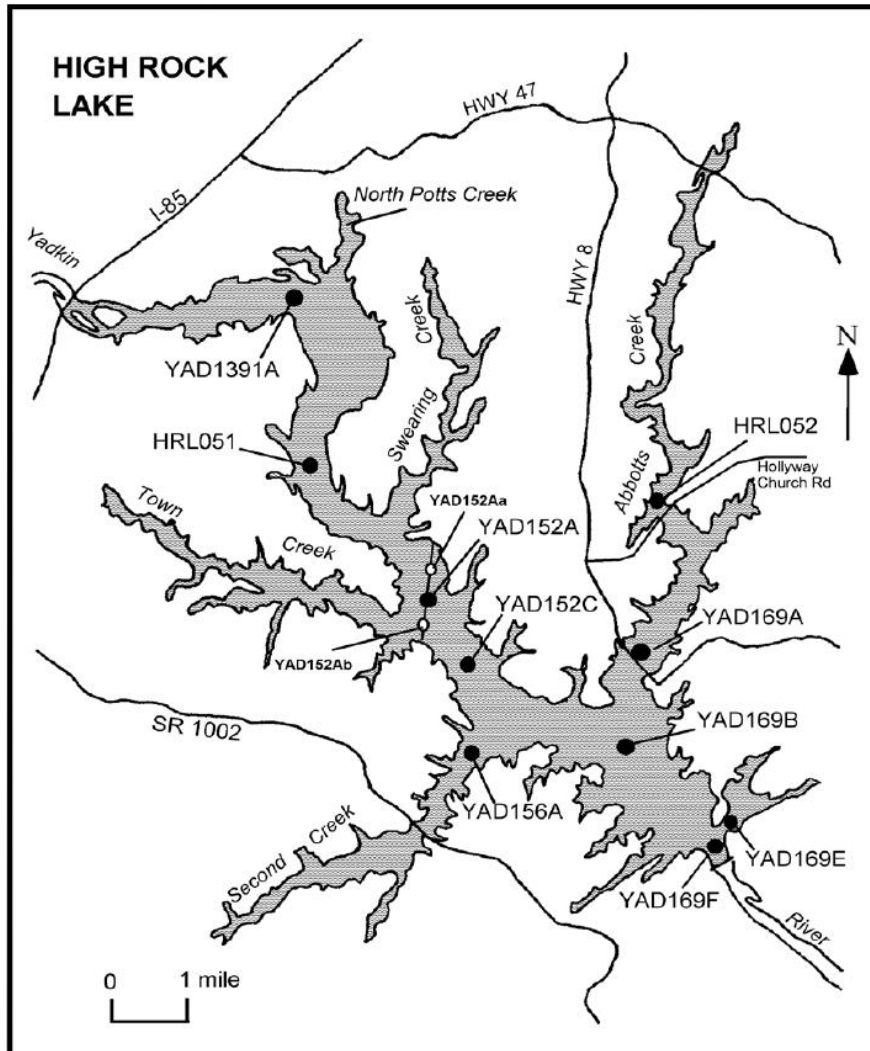
Compliance with 35 $\mu\text{g/L}$ Maximum



Note – based on 100 independent runs of 2 years of 5 samples per year expressed as Geomean. Locations done separately.



Derivation of Criterion Value



- **Minimum Chla for productive fishery is 20-25 $\mu\text{g/L}$**
- **For Individual Location Approach: threshold value for which 90% of random runs would comply is about 115% of the long-term average for peak in transition zone (YAD152C)**
- **Compliance with a maximum Chla at YAD152C would result in average Chla in lacustrine zone at minimum for productive fishery**
- **Not a clear impact to water supply and recreational uses**

Current Proposal for Chla Standard

- o Long-term Geomean for Chla during the months of April through October – not greater than 35 µg/L for each assessment unit (under discussion)

Table 2. Proposed Chlorophyll <u>a</u> Standard for High Rock Lake.		
Parameter	Selection	Notes on Selection
Chl <u>a</u> Criterion	35 µg/L	Not to Exceed; Each Assessment Unit
Period	Multi-Year Geomean	Calculated Geomean for Assessment Period
Season	April-October	Applies to all seasons but assessed as geomean for growing season months
Spatial Considerations	Open Waters	Applies to waters with typical depth greater than 10 feet; shallow waters and isolated coves to be addressed through narrative criteria; all data within an assessment unit are incorporated into the calculated geomean
Confidence	TBD	No Agreement in Concept – potential for statistical confidence in assessment of impairment decisions

Note – NCSAC Agreed in Concept in Dec 2018; Final Agreement will be based on detailed write-up

