# Nutrient-Biota Interactions in Agriculturally Dominated Landscapes: Lessons from the USGS National Water-Quality Assessment (NAWQA) Program

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# Nutrient Enrichment Effects on Stream Ecosystems

**Determine how biological communities and processes respond to varying levels of nutrient enrichment in streams from contrasting environmental settings.**

1. **Biological communities: nutrients, habitat, algae and invertebrates**
2. **Stream metabolism: dissolved oxygen production**
3. **Nitrogen cycling: transport, transformations, uptake**

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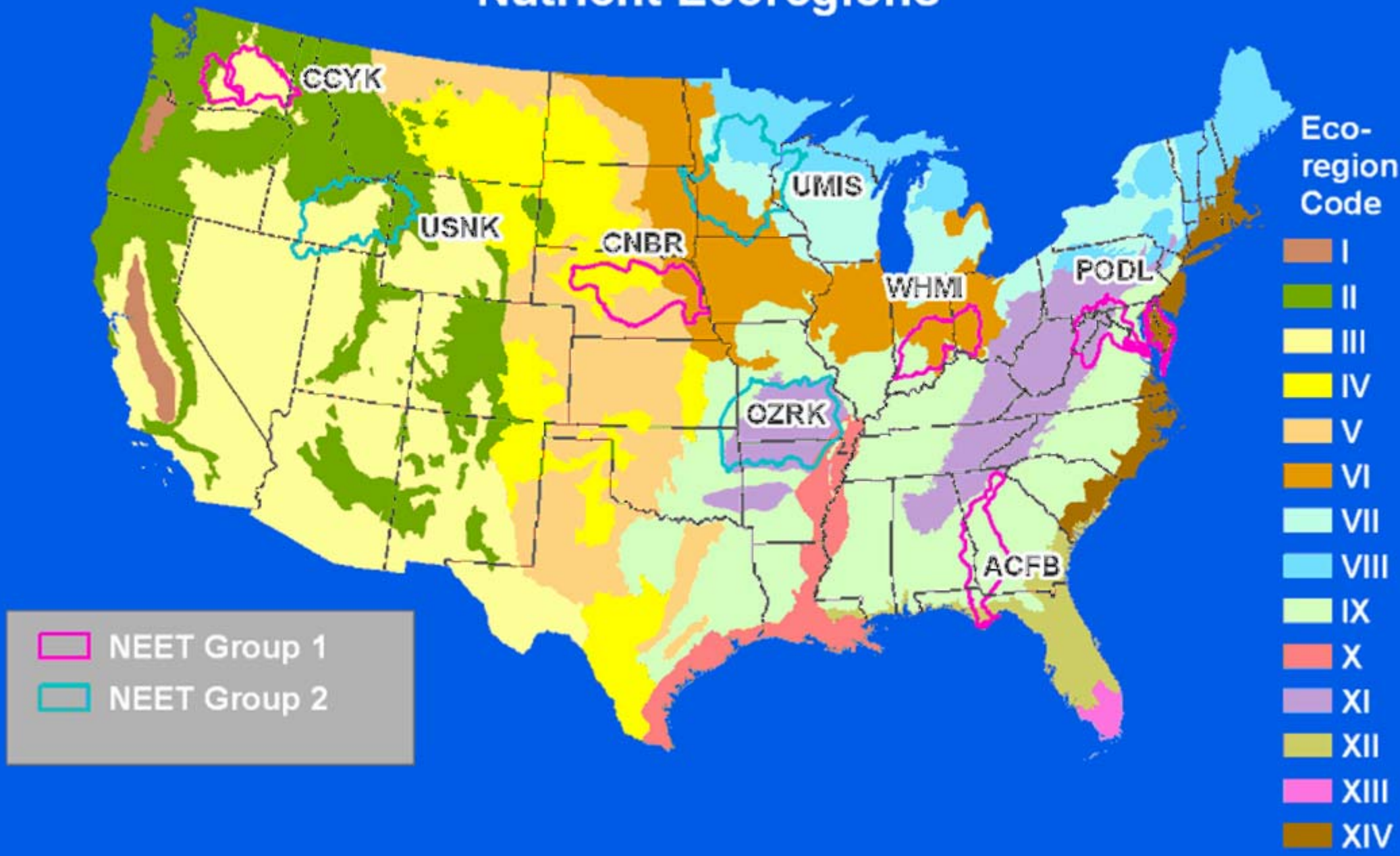
# NEET Groups 1 and 2 Study Unit Nutrient Ecoregions





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# EPA Nutrient Indicators

- Chlorophyll a*
- Algal AFDW
- Community composition
- Community metrics
- Production/respiration
- Secondary production
- pH
- DO
- Hydrologic studies
- Nitrogen*
- Phosphorus*
- Nutrient ratios
- Sediment composition
- Temperature
- Transparency/TSS*

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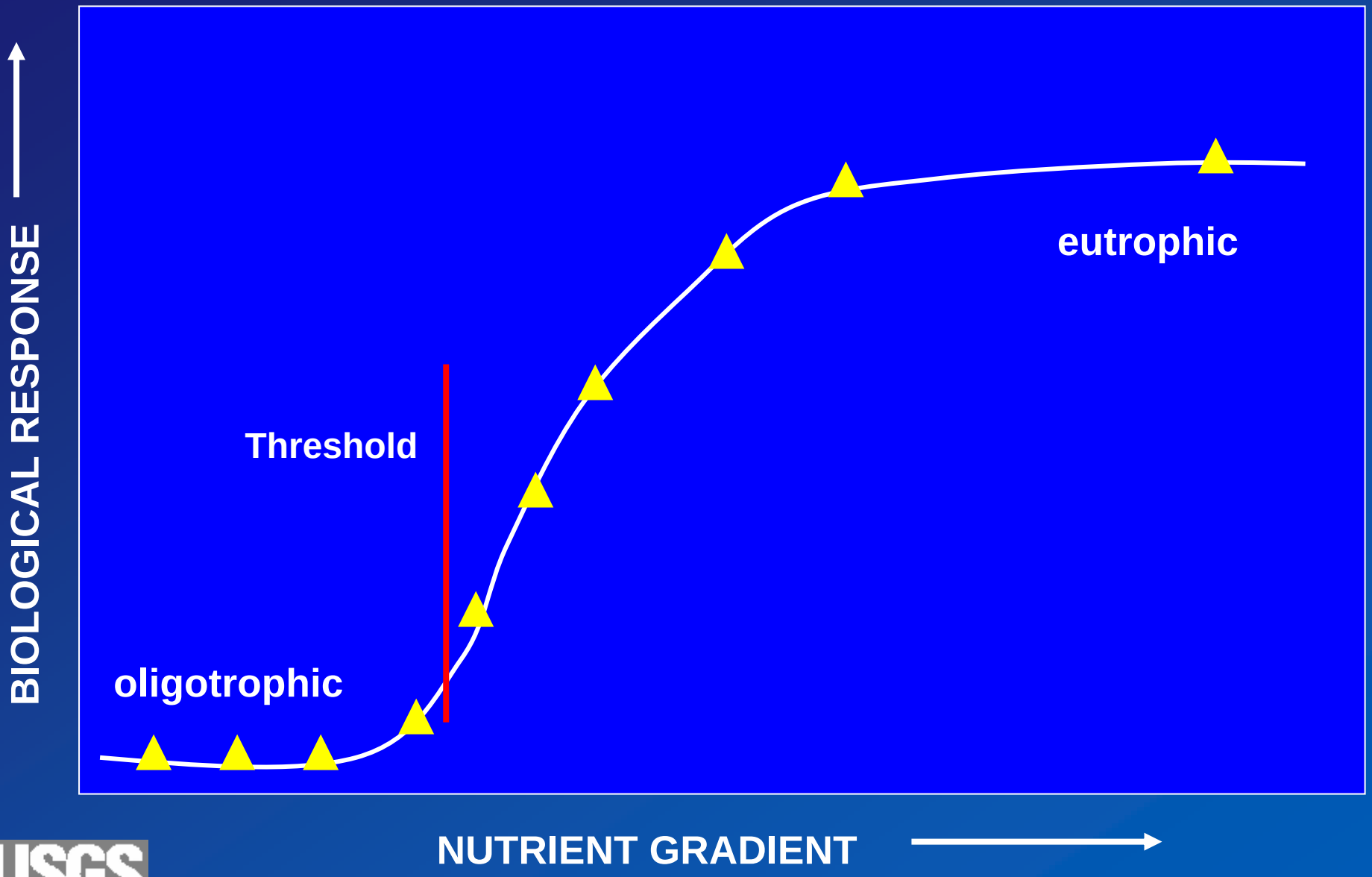
Chlorophyll a [rock/wood, silt/sand, or seston]

# Nutrient Gradient – Response Conceptual Model

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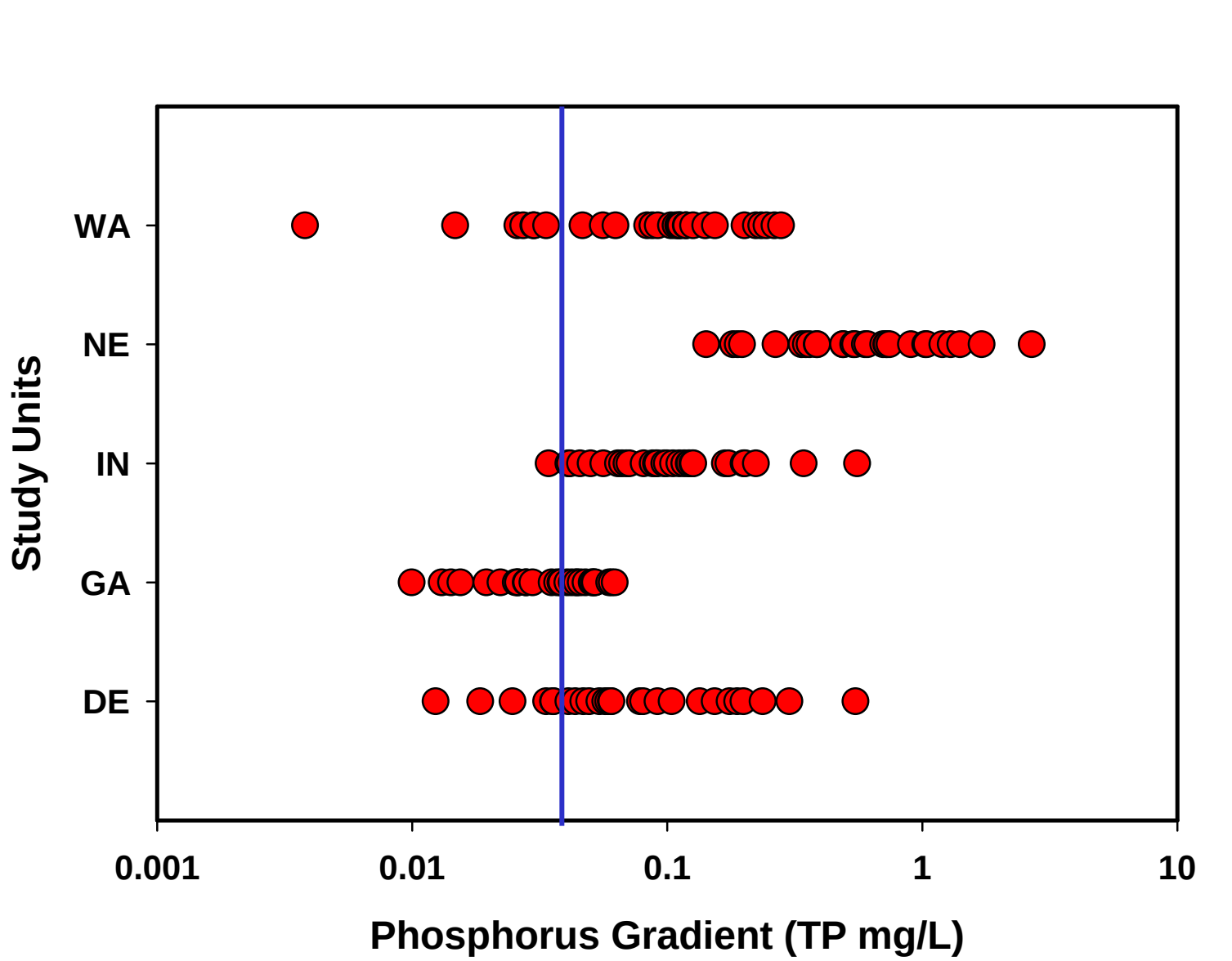
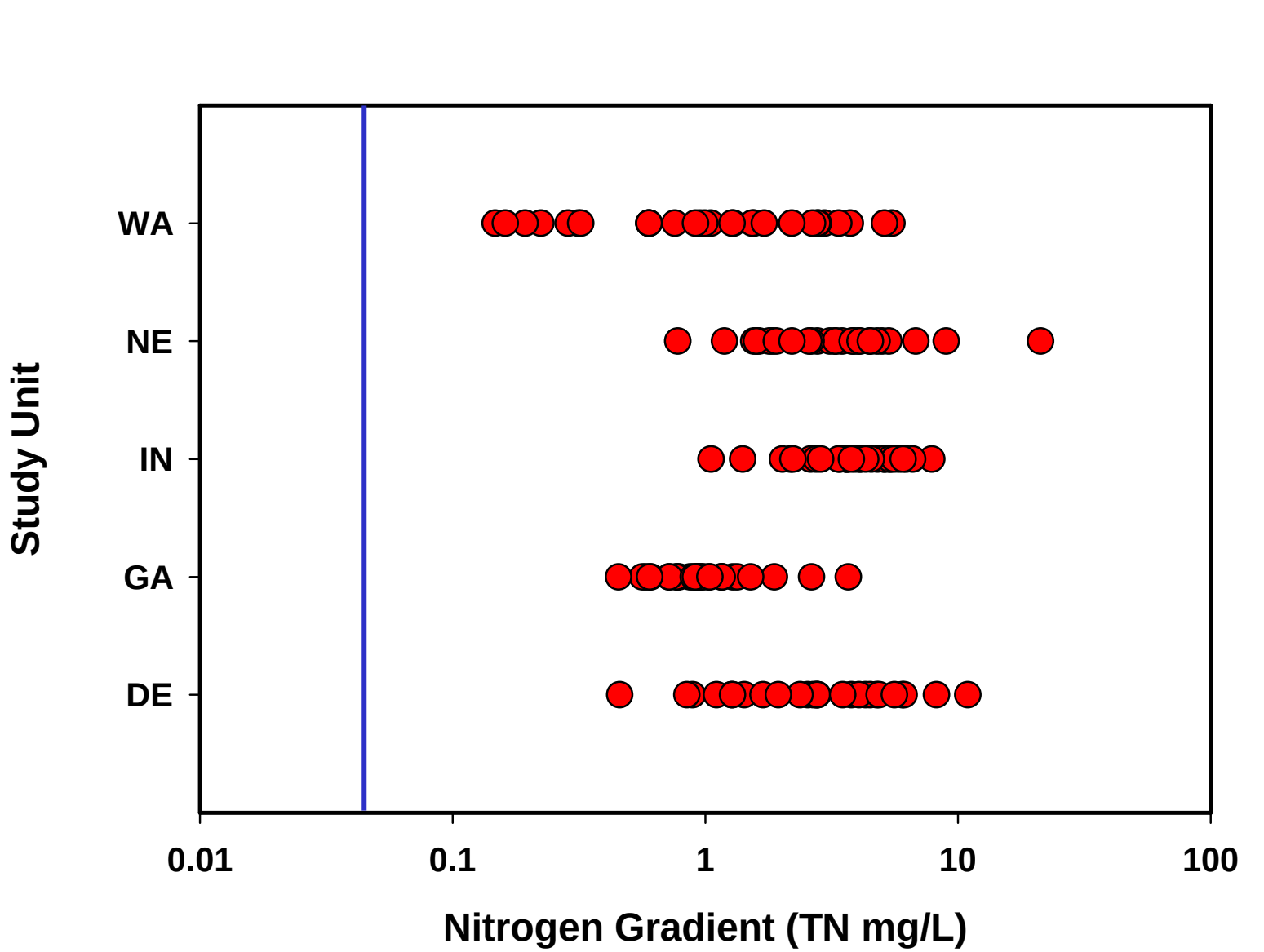
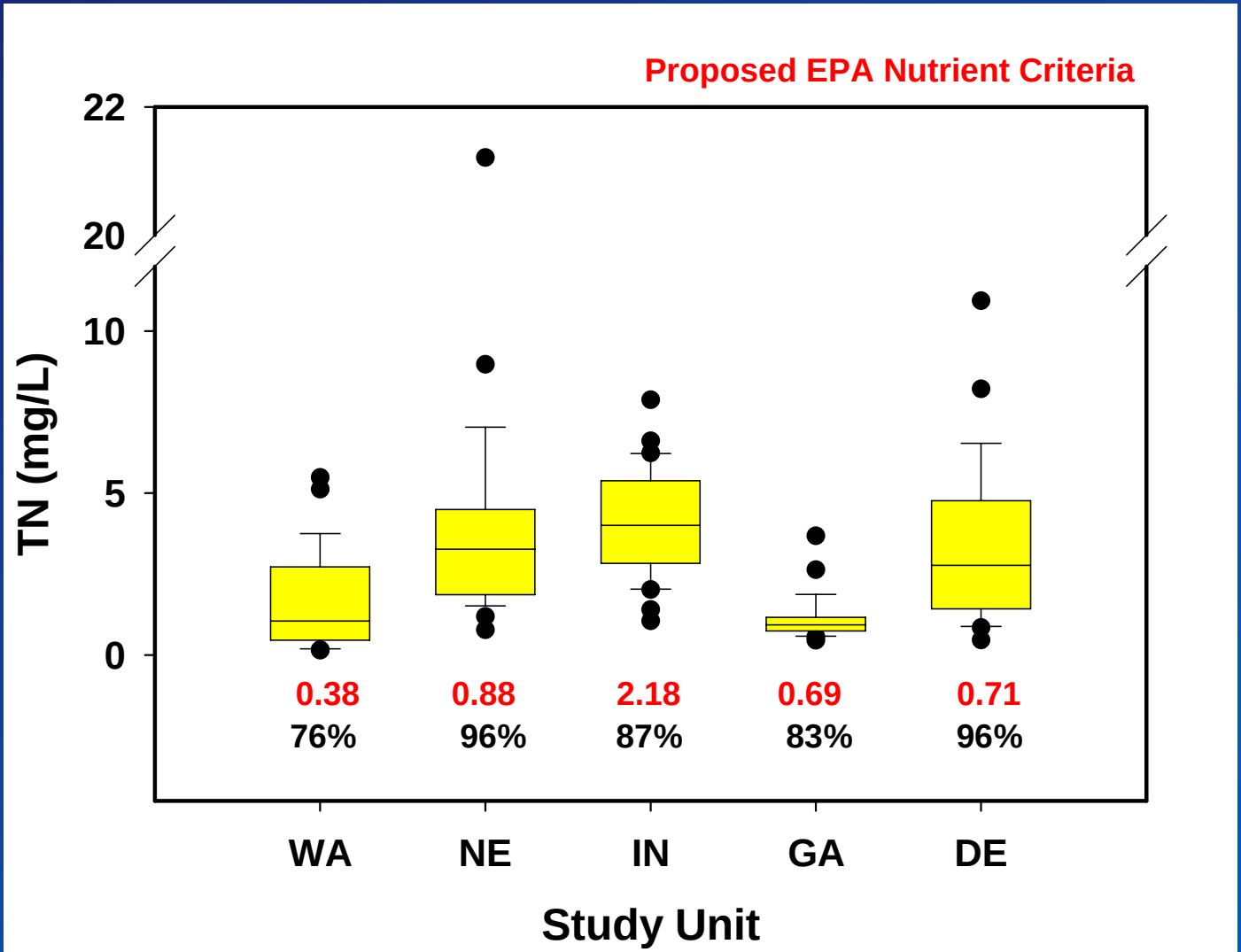
# IN and NE exceeded TP threshold



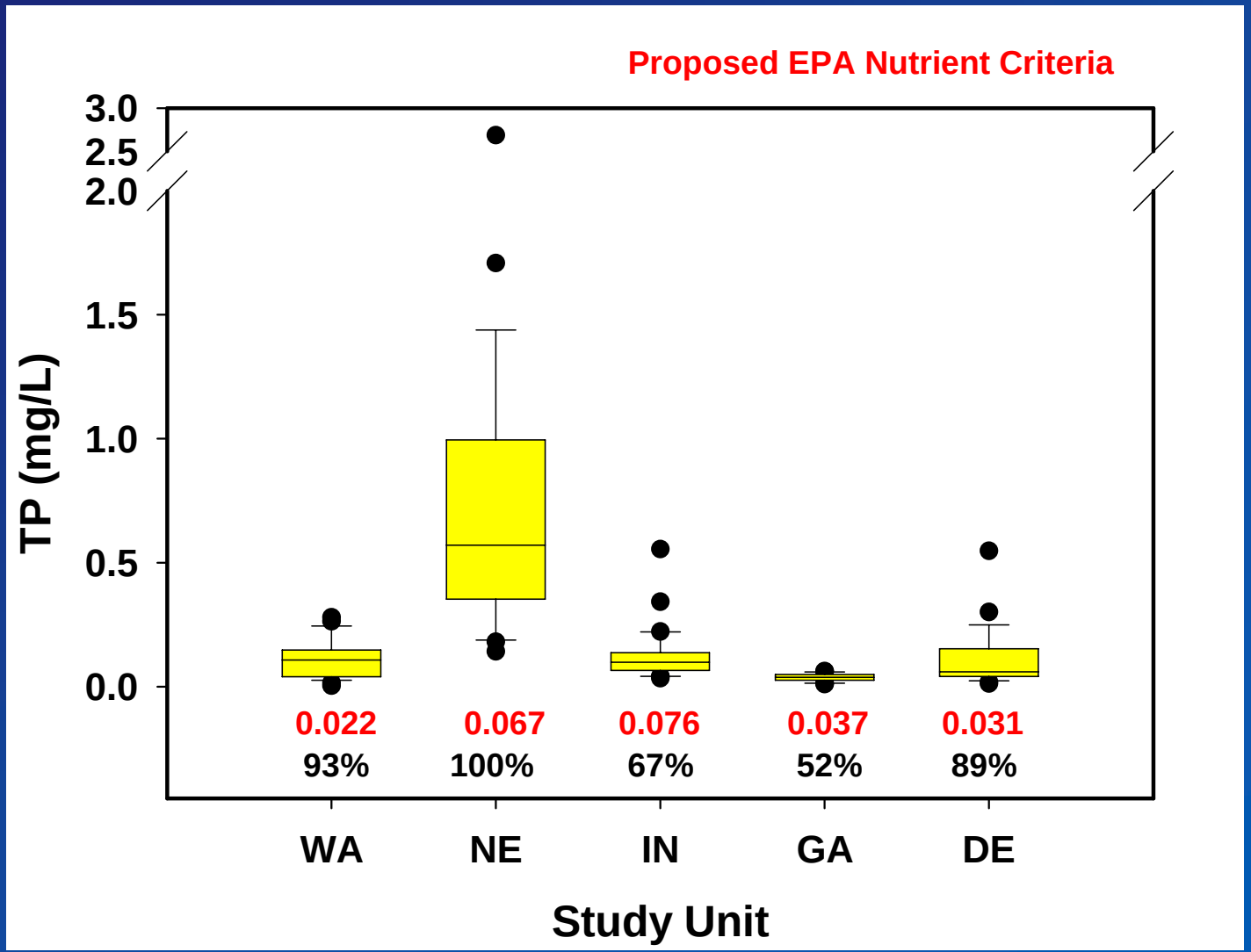
# All study units exceeded nitrogen threshold



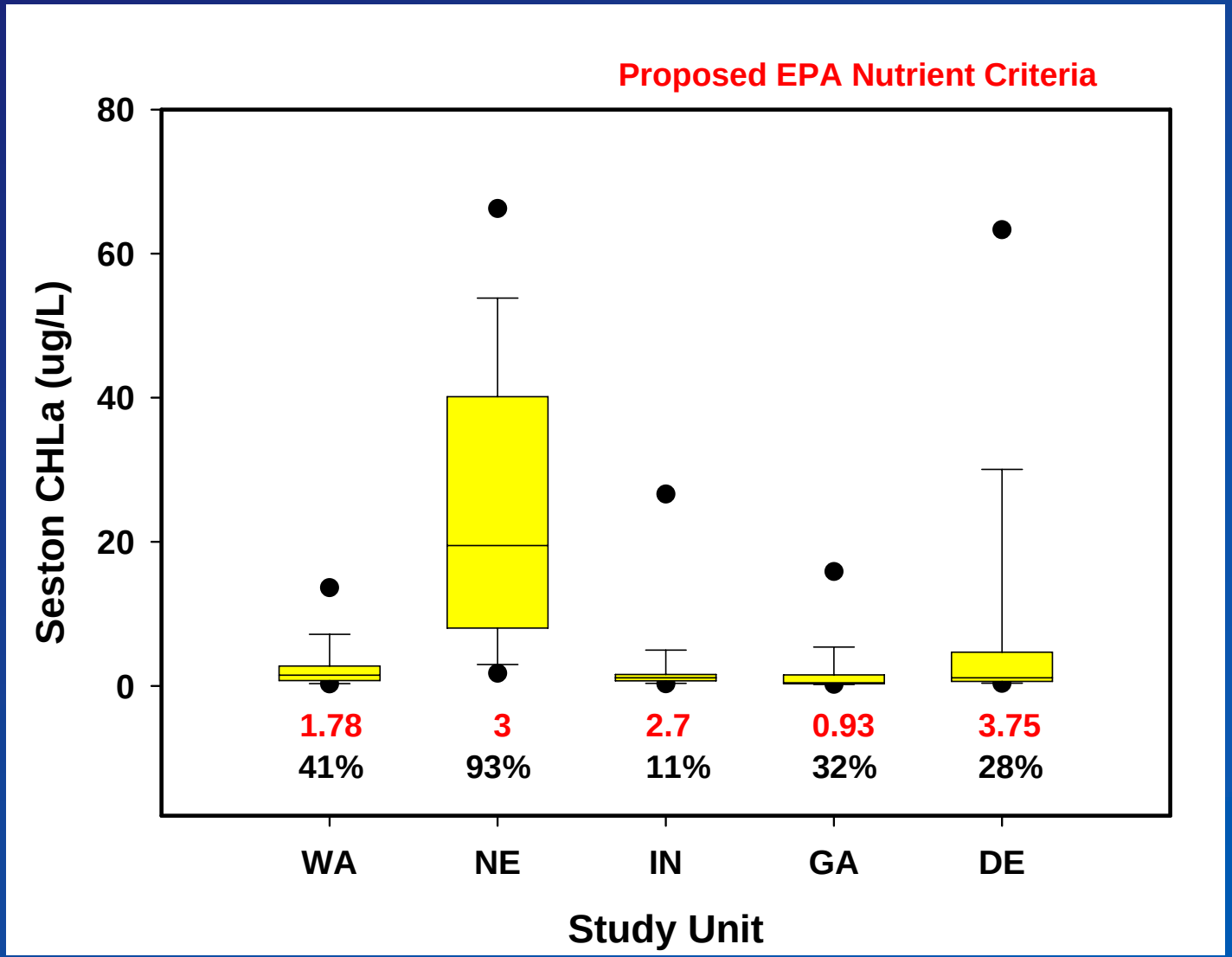
# TN exceeded proposed EPA criteria at 76 to 96% of sites



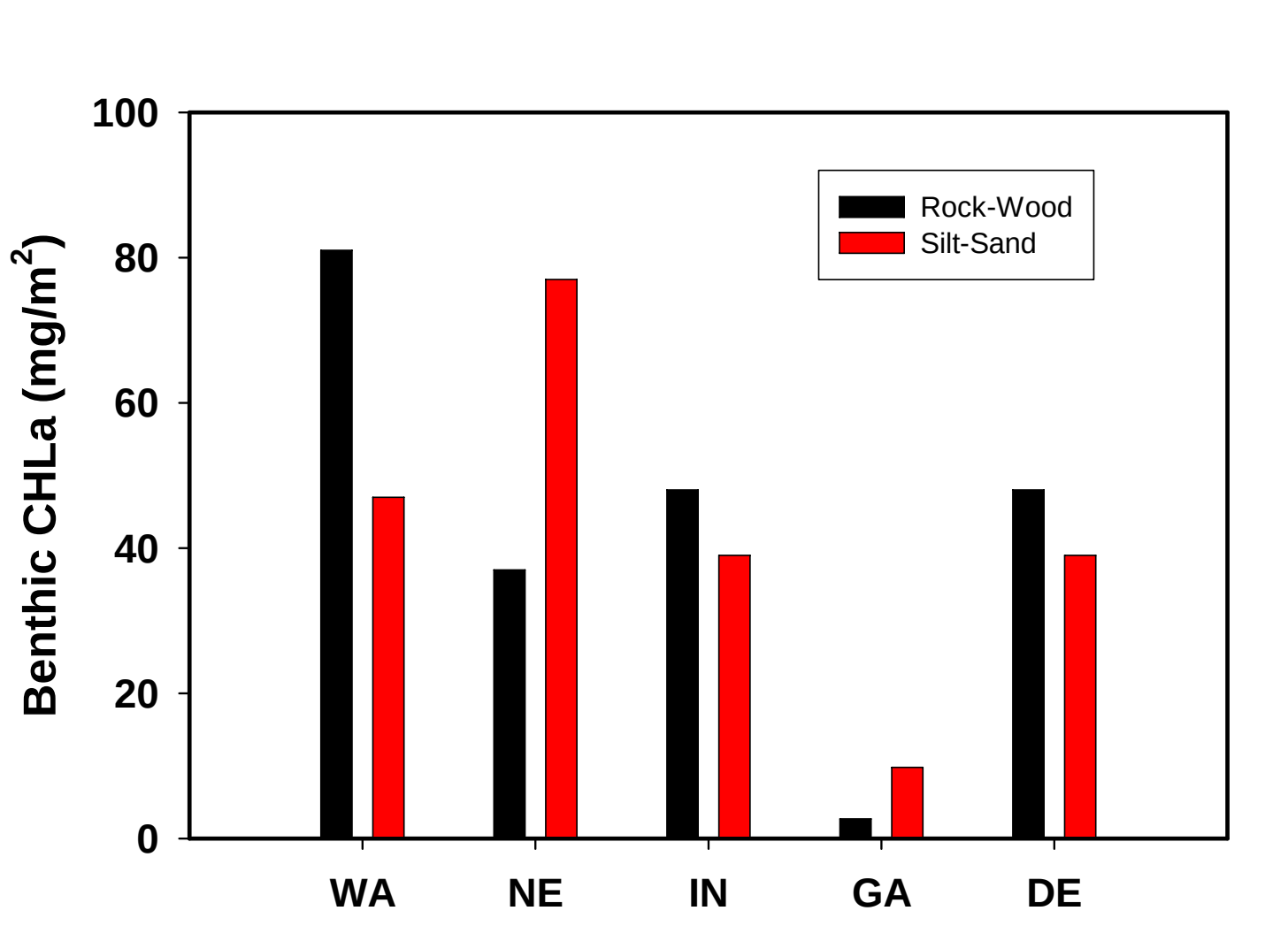
# TP exceeded proposed EPA criteria at 52 to 100% of sites



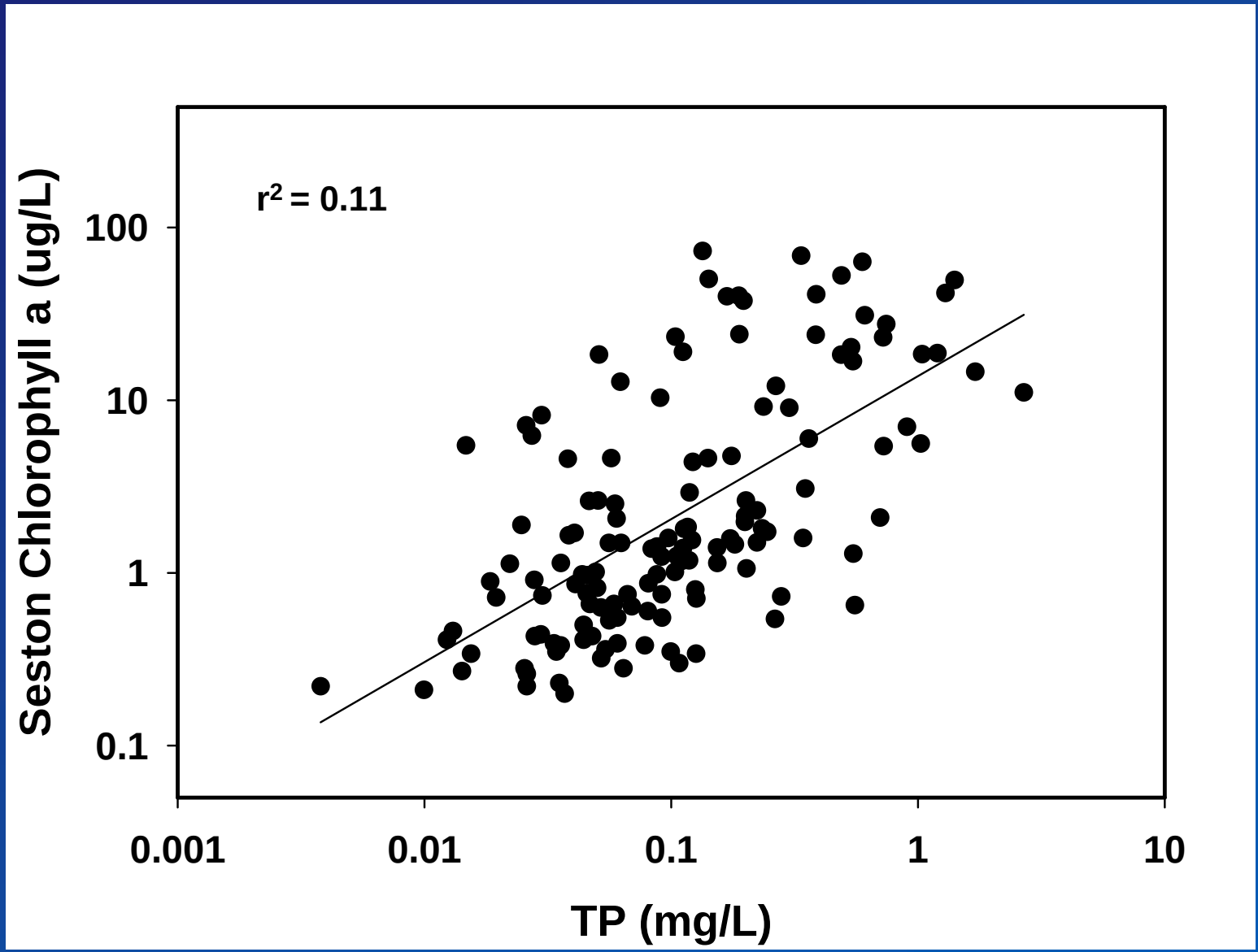
# Seston CHLa exceeded proposed EPA criteria at 11 to 93% of sites



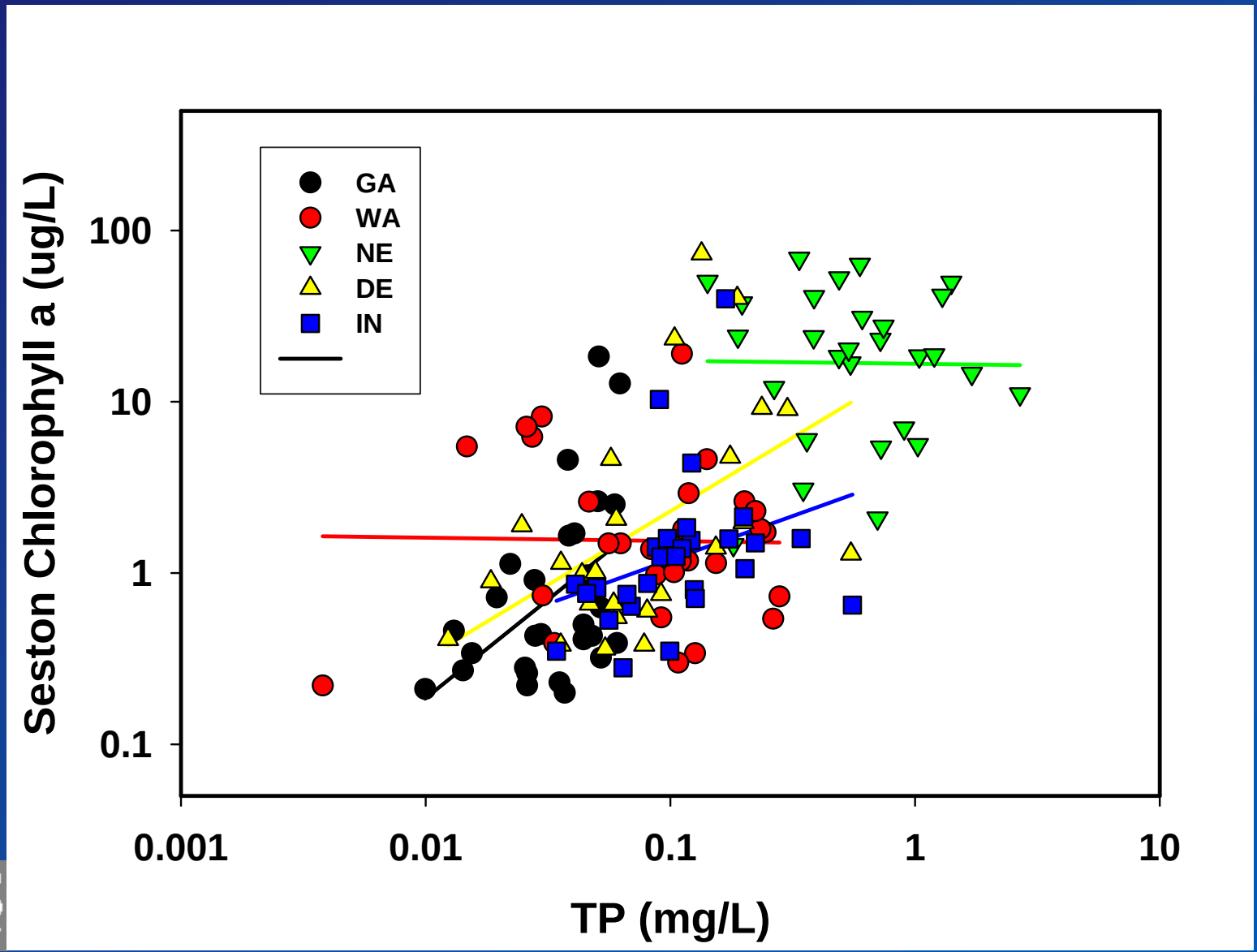
# Chlorophyll a varied by substrate



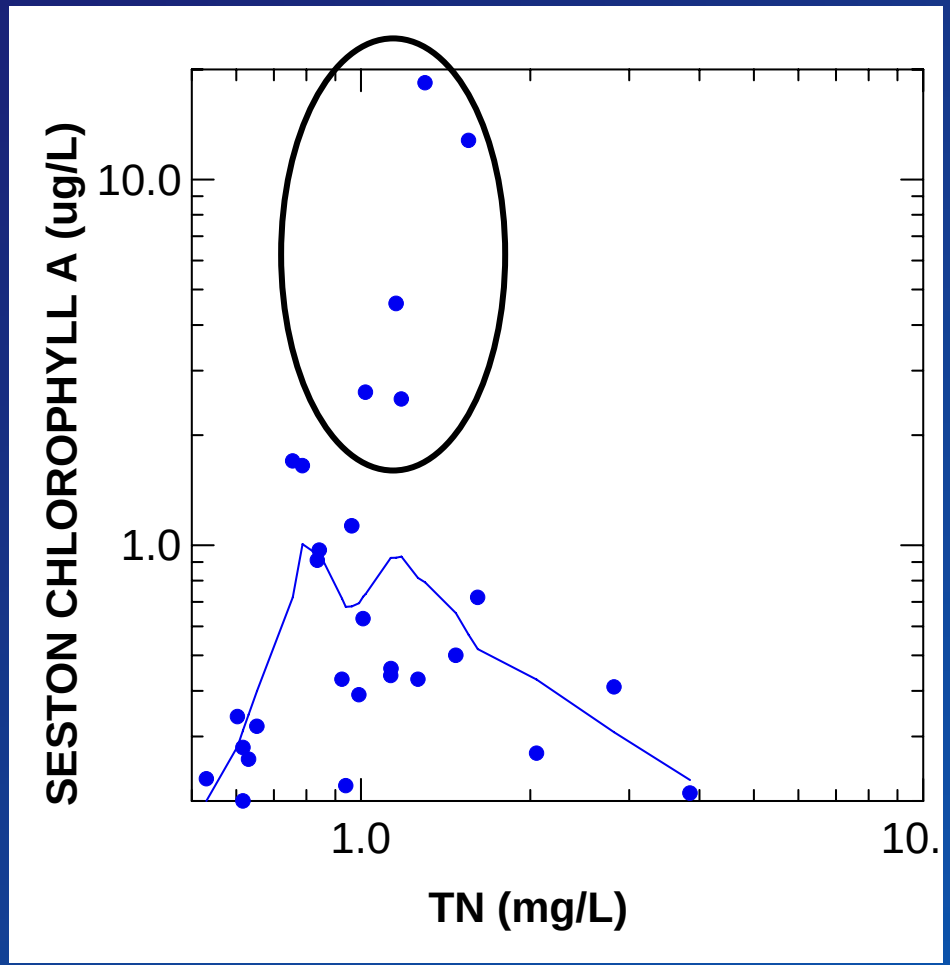
# National TP-CHLa relationship exists, …

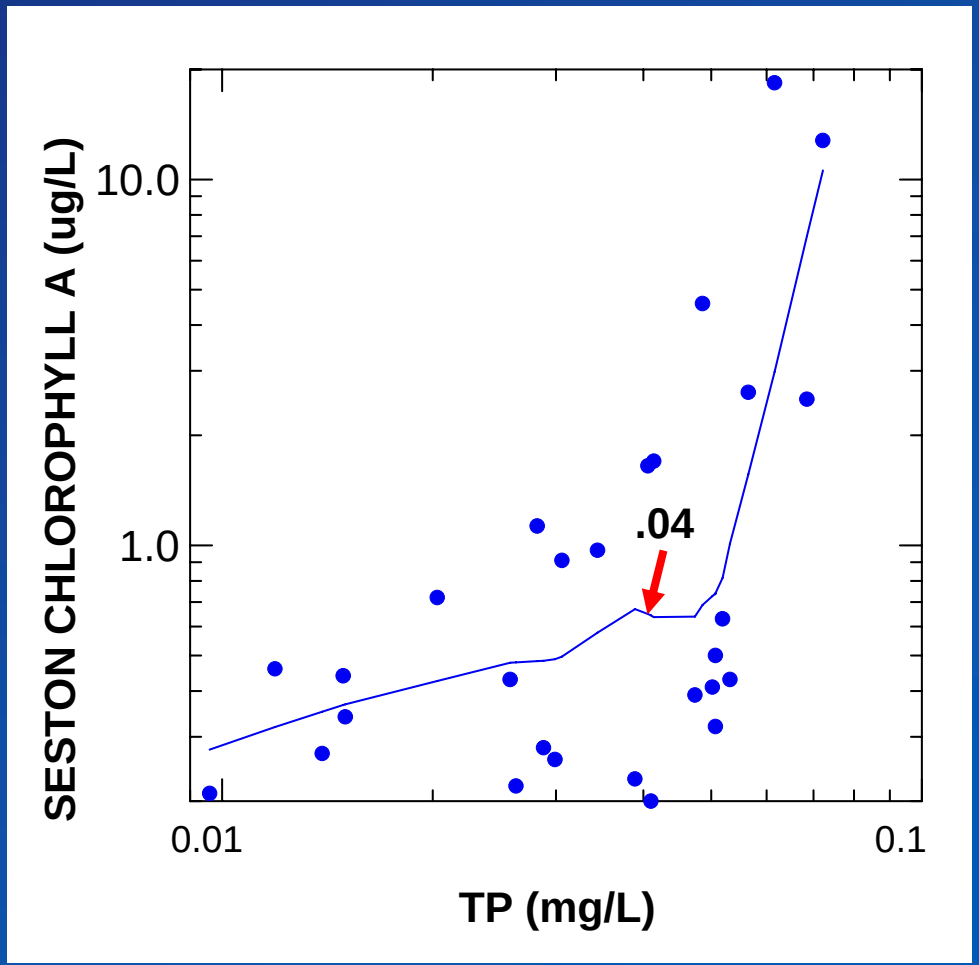


# …but distinct regional differences.



# Seston CHLa vs TP and TN in GA



# Habitat limits CHLa

| | ROCK/WOOD CHLa | SILT/SAND CHLa | SESTON CHLa |
|---|---|---|---|
| TP | 0.24 | 0.36 | 0.62 |
| TN | 0.14 | 0.10 | 0.15 |
| | | | |
| BASE FLOW | -0.02 | -0.34 | -0.34 |
| TEMPERATURE | -0.34 | 0.13 | 0.23 |
| CANOPY | -0.38 | -0.43 | -0.42 |
| SUBSTRATE | 0.44 | 0.37 | -0.10 |

Spearman ($r_s$) correlation matrix (N=142)

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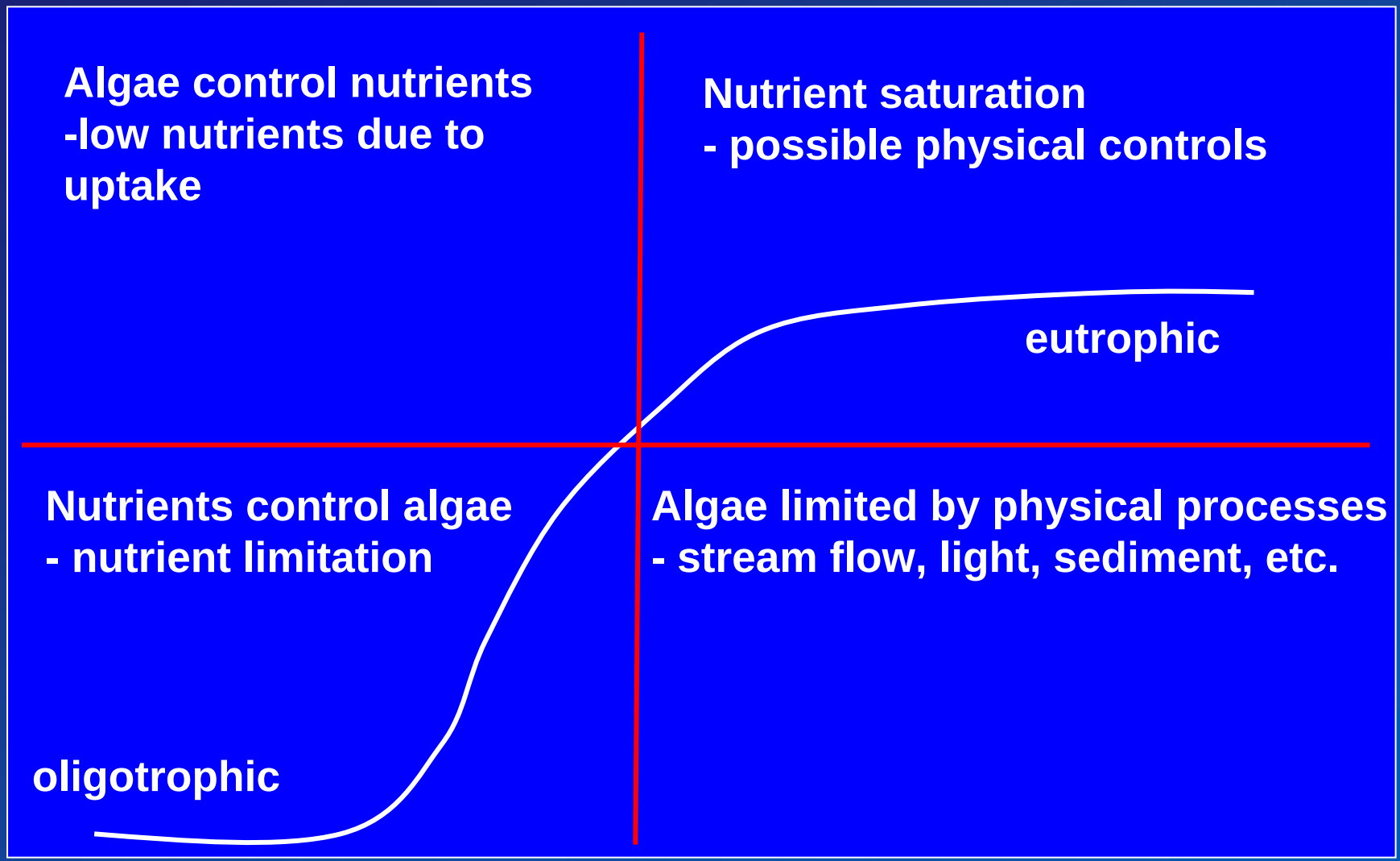
BFI = Base Flow Index, the ratio of base flow to total flow volume for a given year.


Algae control nutrients
-low nutrients due to uptake
Nutrient saturation
- possible physical controls
eutrophic
Nutrients control algae
- nutrient limitation
Algae limited by physical processes
- stream flow, light, sediment, etc.
oligotrophic
CHLOROPHYLL A
NUTRIENT CONCENTRATION

# Implications for Nutrient Criteria

1. Nutrient concentrations and chlorophyll may not always provide the best indication of stream status.

2. Agricultural streams can be nutrient saturated and habitat limited.

3. Need sub-regional and/or stream-type specific predictive models that incorporate nutrients, habitat, and biological components.

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# Contact Information

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**http://water.usgs.gov/nawqa/**

**Nutrient Effects Team:**
**http://pubs.usgs.gov/fs/fs11803/**

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