What's in the Water? Tracing Sediment Transport and Deposition along five reservoirs

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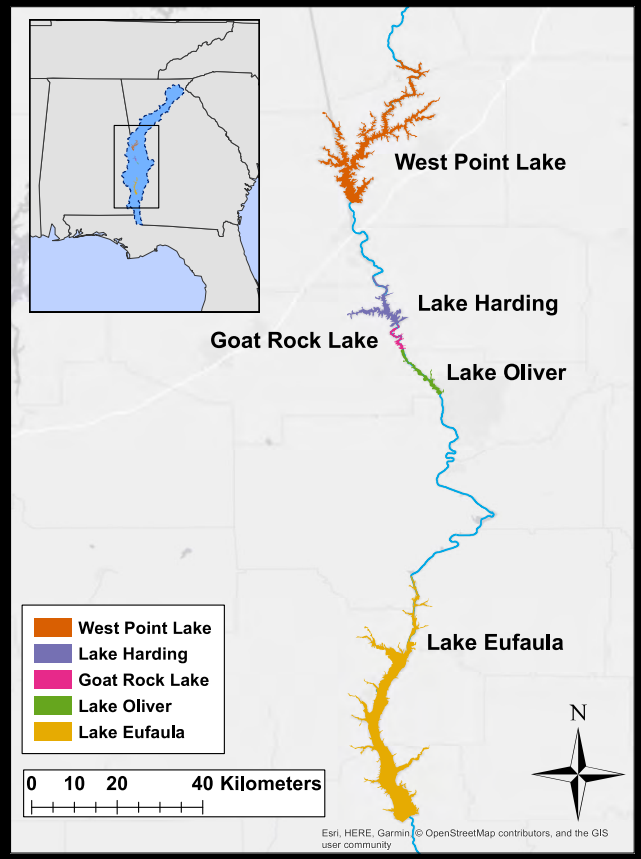
@Waters_Paleolim



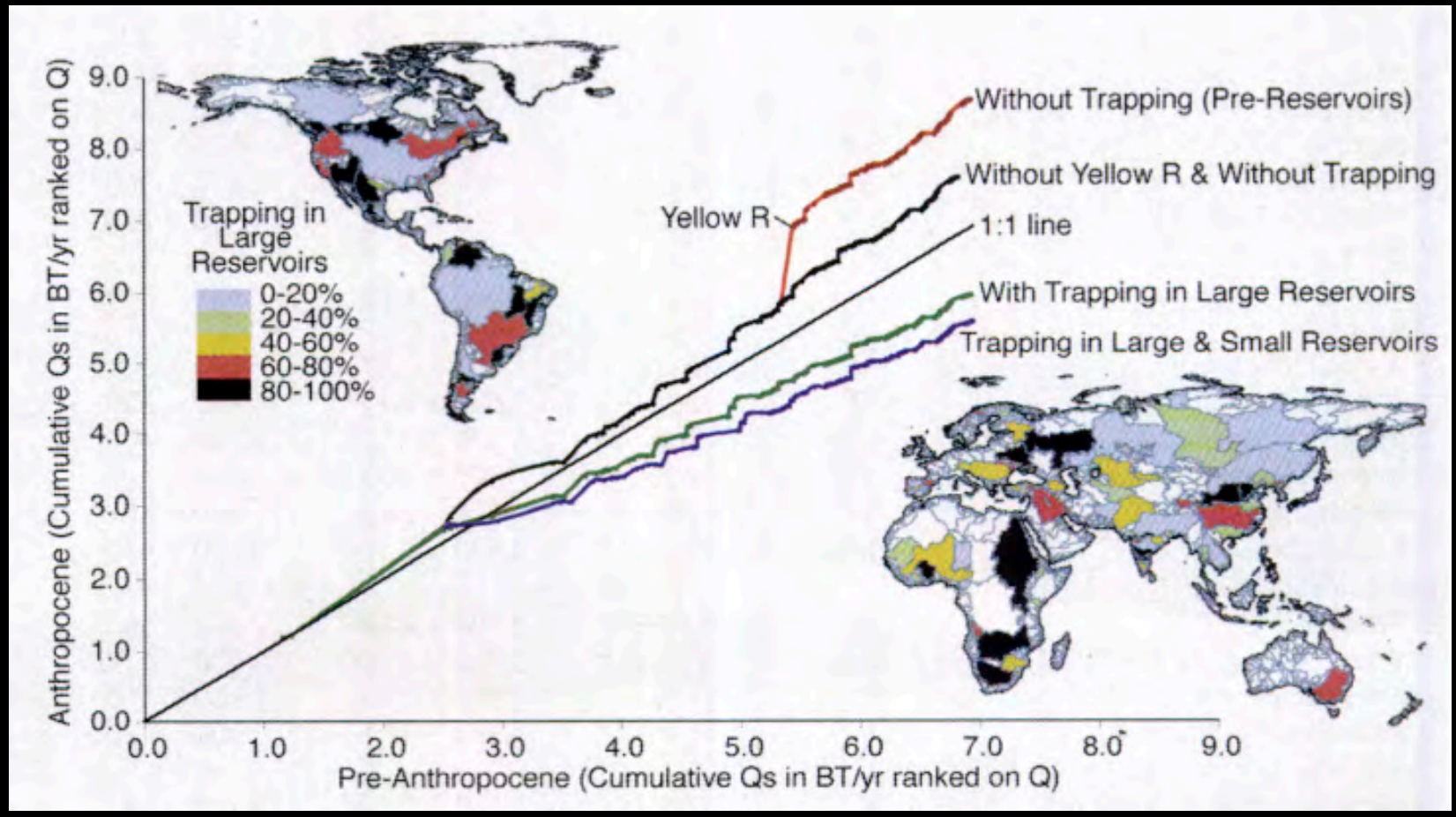
Thanks

- William Kent
- Dawson Ingram and Warren Wagner
- Steve Golladay

Photo: Steve Golladay

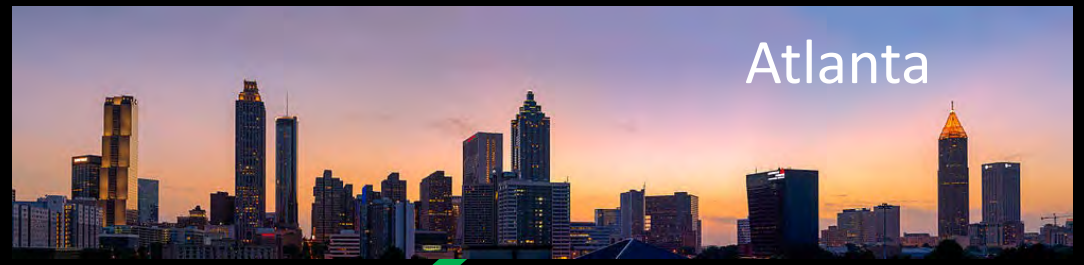
Reservoir Sediment Flux

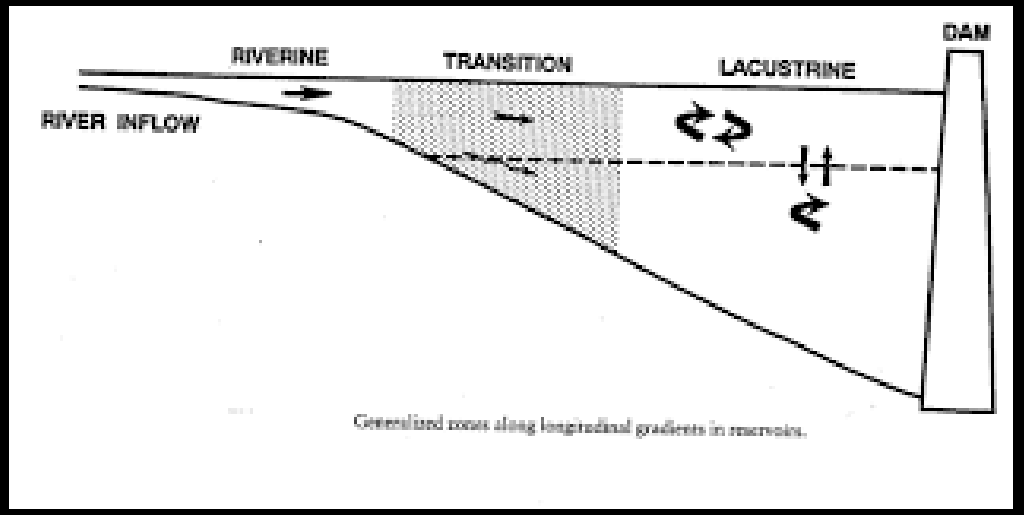
- **<u>26%</u>** of global sediment is stored in reservoirs (Syvitski et al., 2005, Science)
- **<u>12%</u>** of global river phosphorus is stored in reservoirs (Maavara et al., 2015 PNAS)

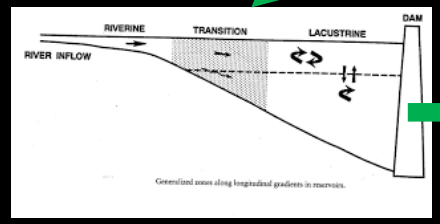


(Syvitski et al., 2005, Science)

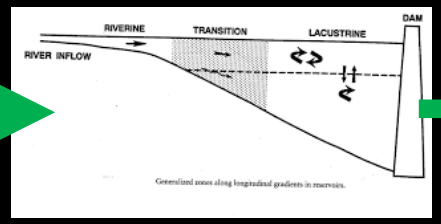
Reservoir Zonation



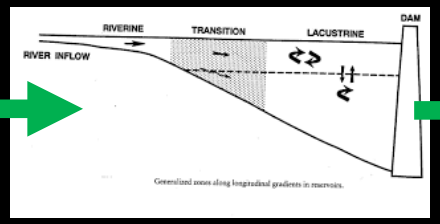




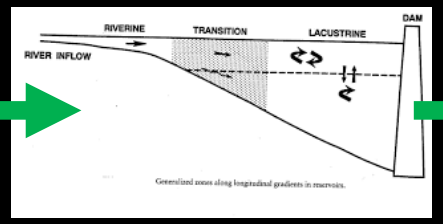
West Point



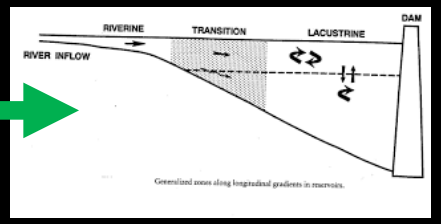
Harding



Goat Rock



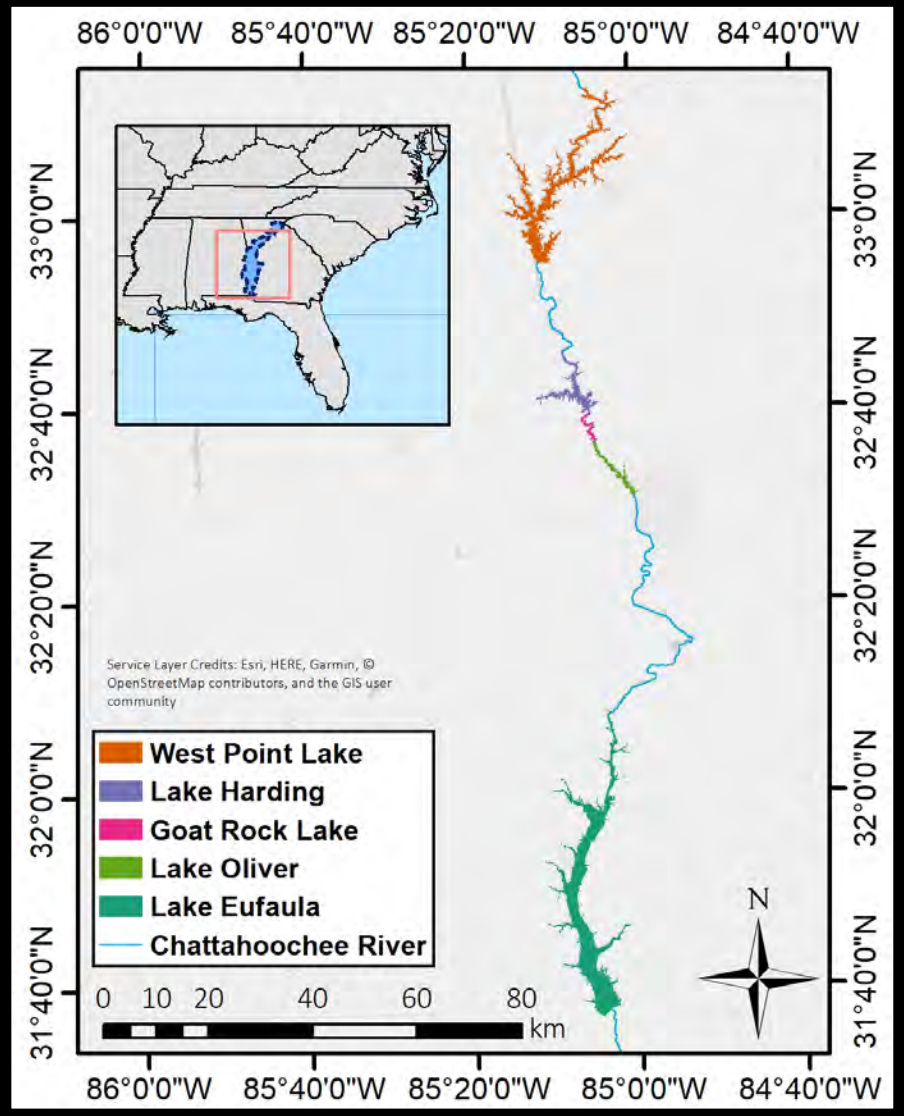
Oliver



Eufaula

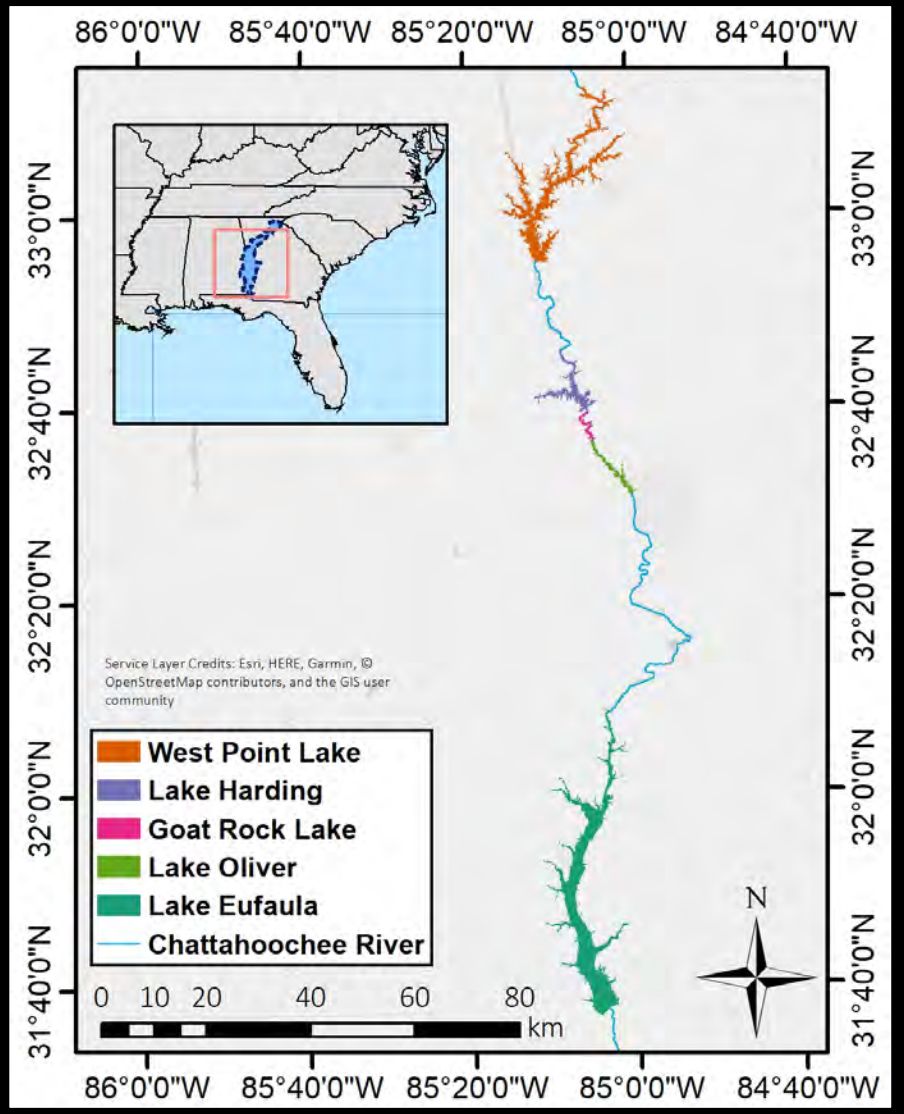
Experimental Design: Spatio-Temporal Approach

- Reservoirs of Study
  - West Point Lake
  - Lake Harding
  - Goat Rock Lake
  - Lake Oliver
  - Lake Eufaula
- Sediment Cores-time
- Surface sediment surveys-space
- Analyses: nutrients, metals, other elements, pigments, isotopes

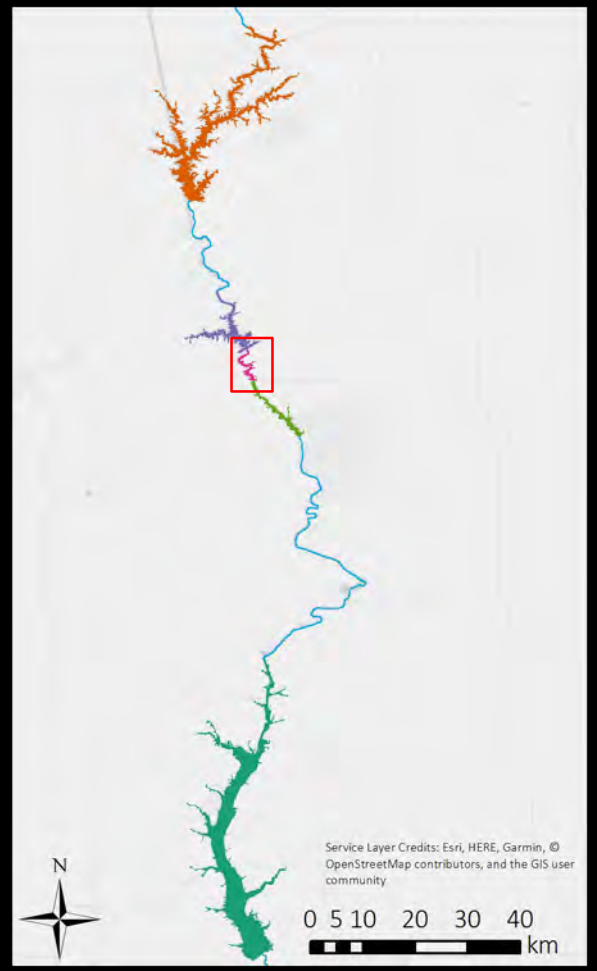


Background

- Dominant Urban Input: Atlanta
- Dam Age
  - WP-1975
  - Ha-1926
  - GR-1914
  - OL-1962
  - EU-1963
- Historic P inputs
  - 1960s-pop increase in ATL
  - 1972 CWA
  - 1988 ATL peak P loading
  - 1993 ATL P decreases



P Movement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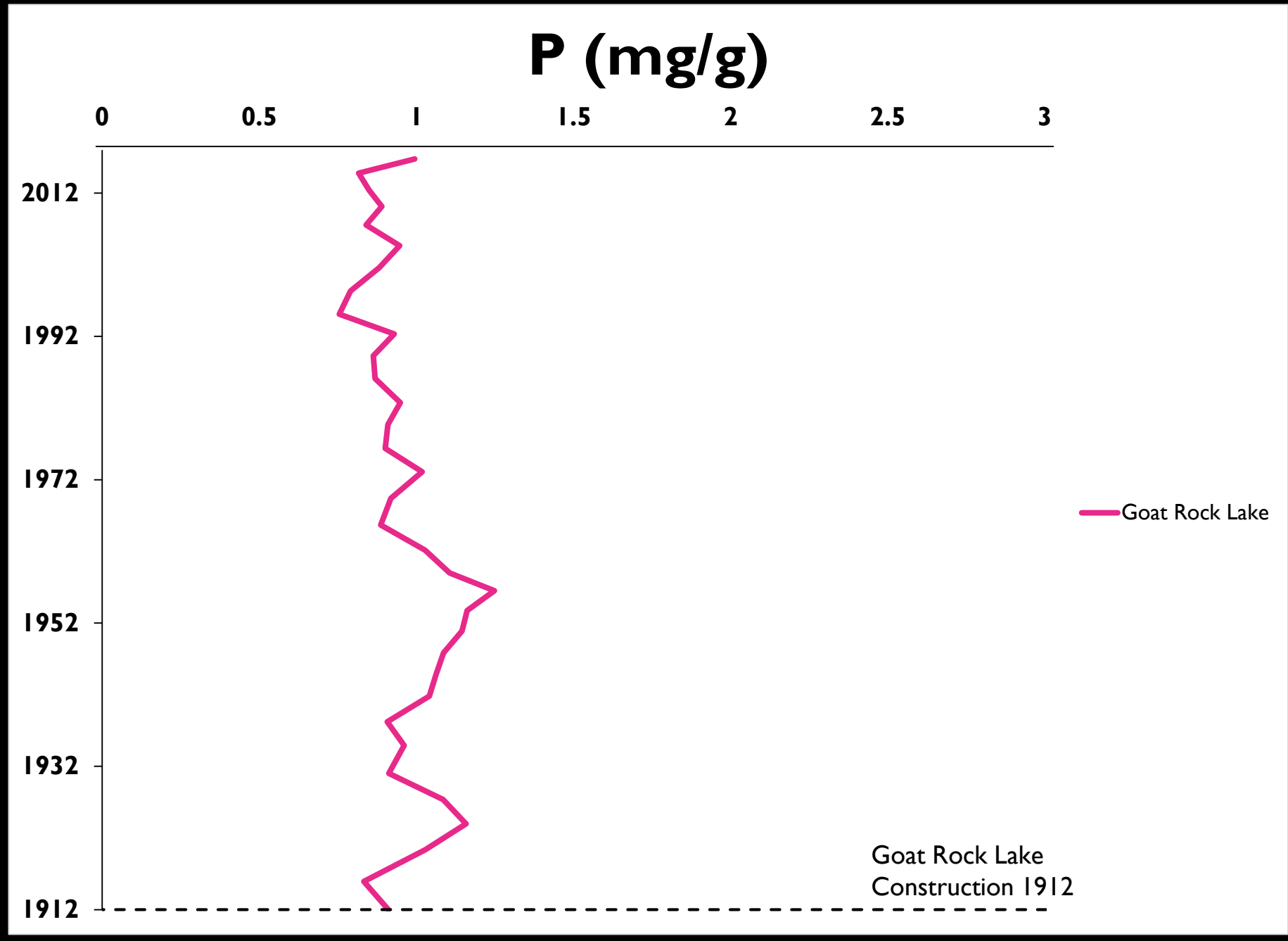
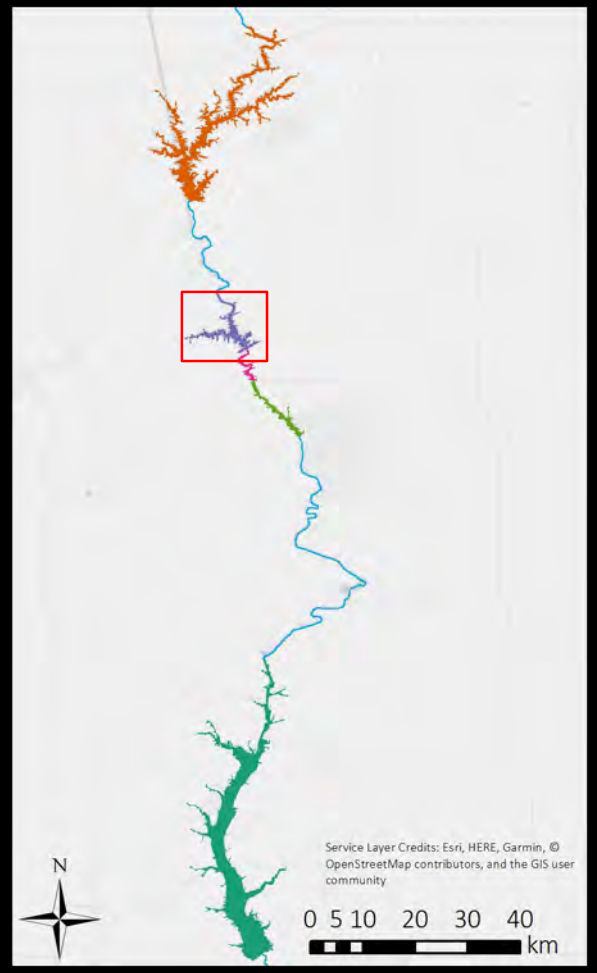
Service Layer Credits: Esri, HERE, Garmin, © OpenStreetMap contributors, and the GIS user community
0 5 10 20 30 40
km


P (mg/g)
0
0.5
1
1.5
2
2.5
3
2012
1992
1972
1952
1932
1912
Goat Rock Lake
Goat Rock Lake
Construction 1912

P Movement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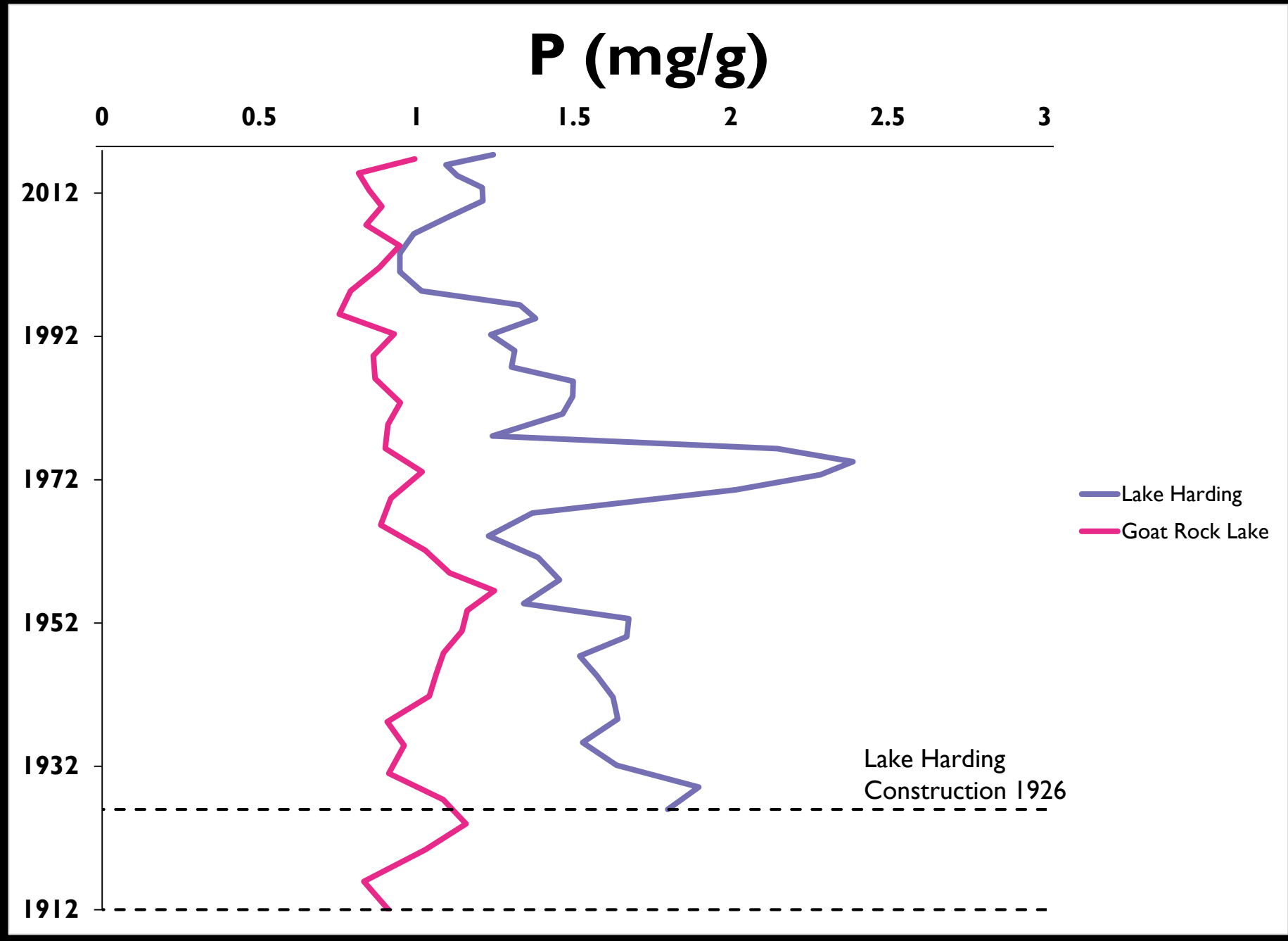
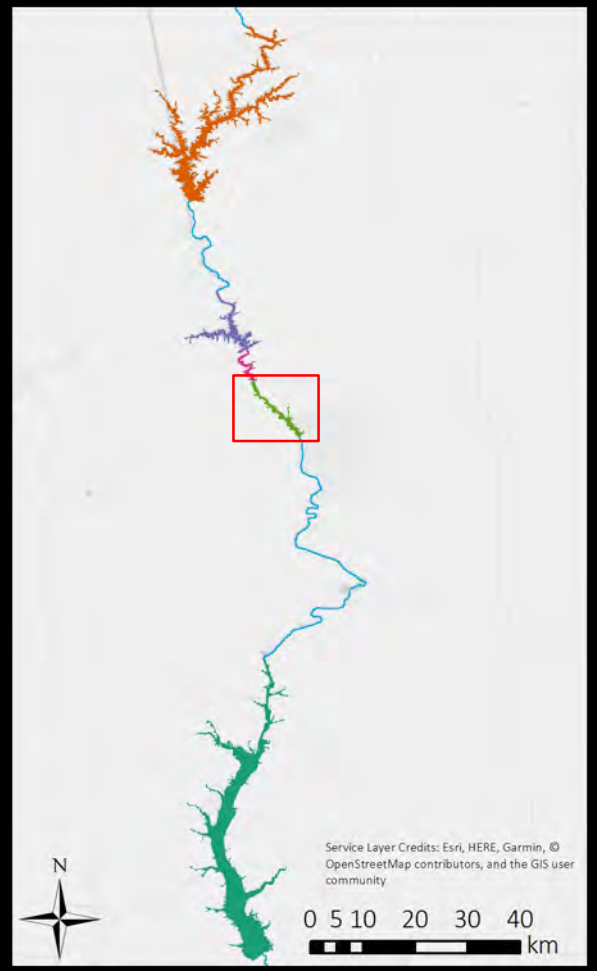
km


P (mg/g)
0
0.5
1
1.5
2
2.5
3
2012
1992
1972
1952
1932
1912
Lake Harding
Goat Rock Lake
Lake Harding
Construction 1926

P Movement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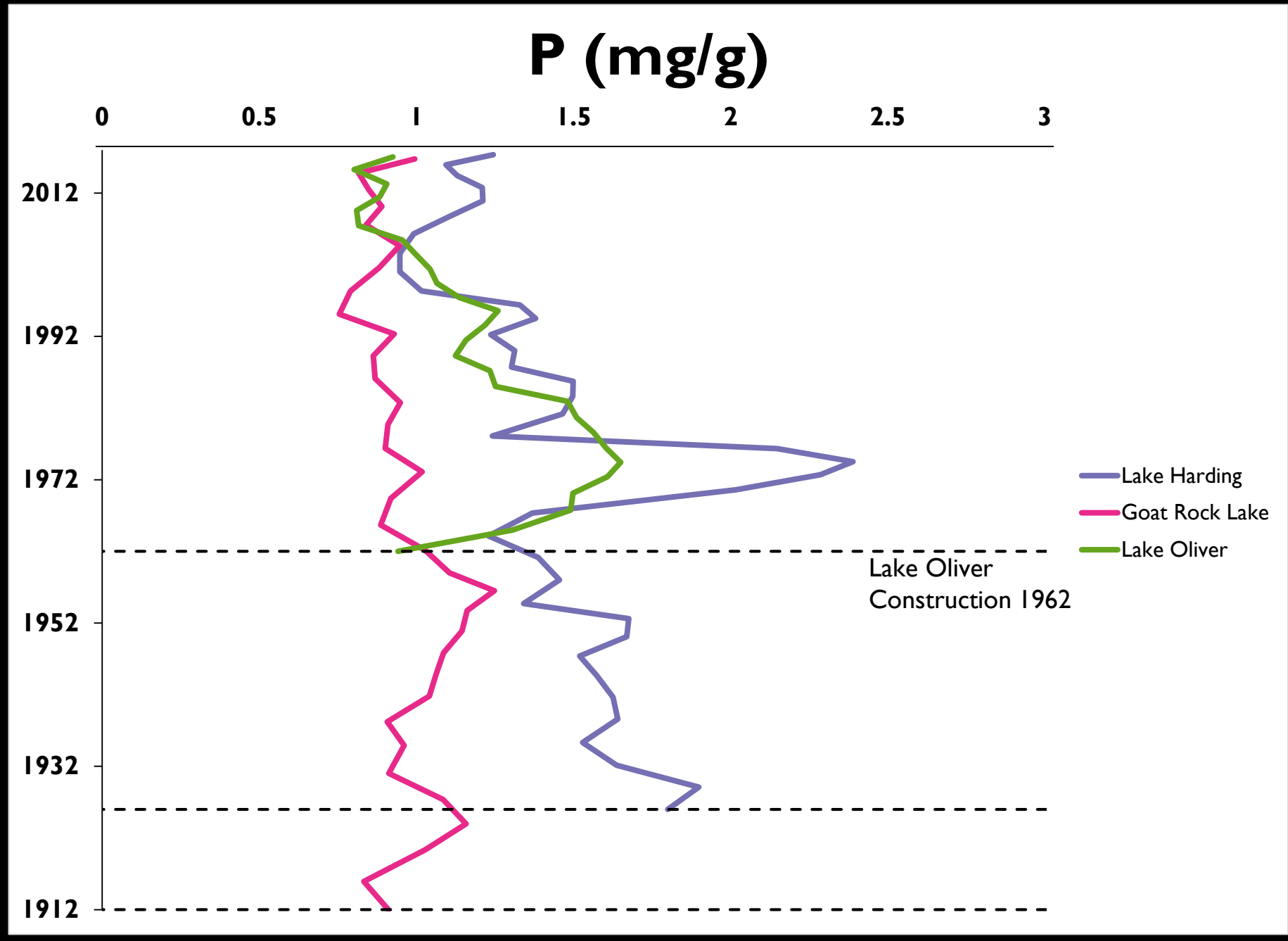
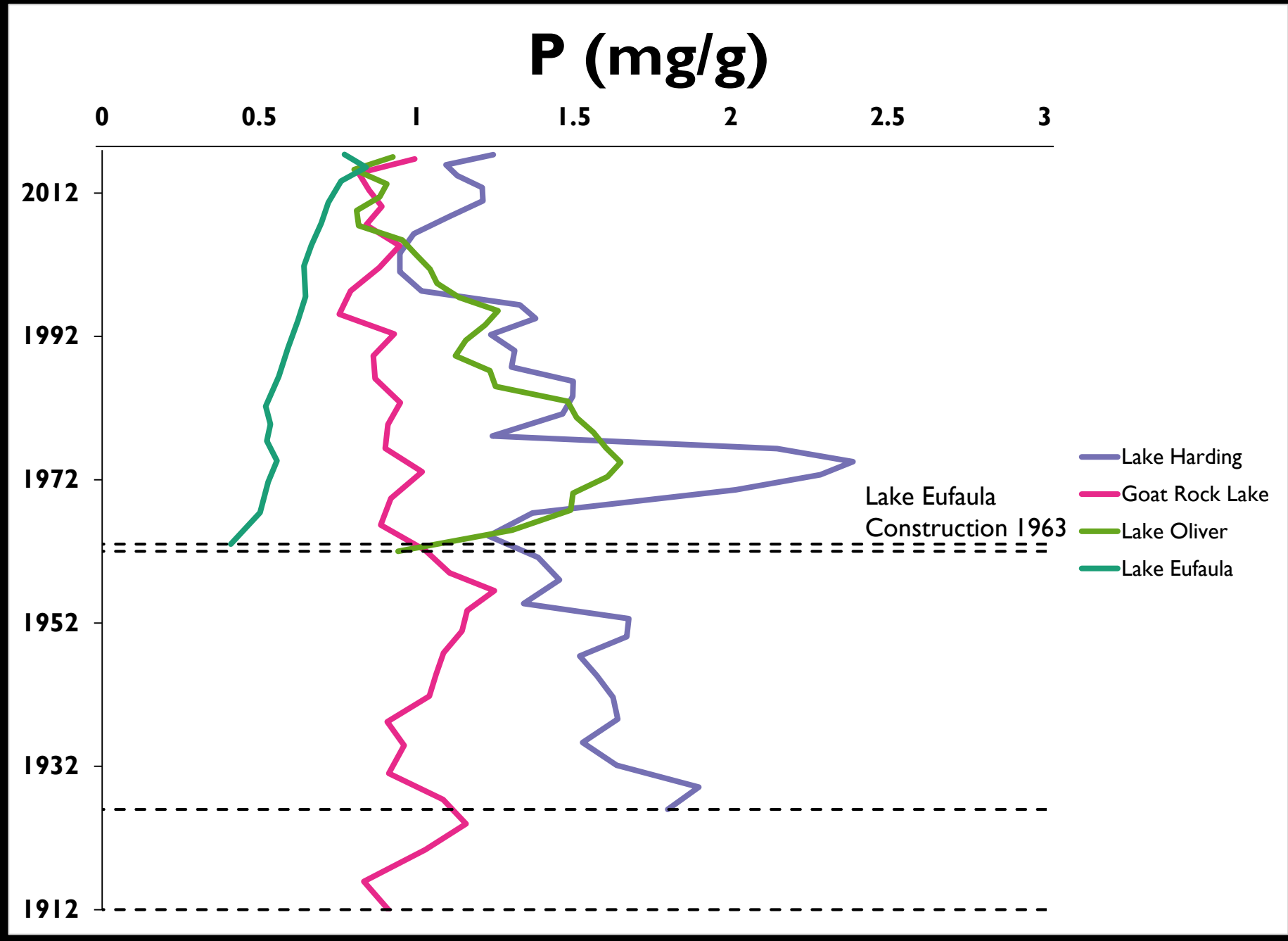
0 5 10 20 30 40
km

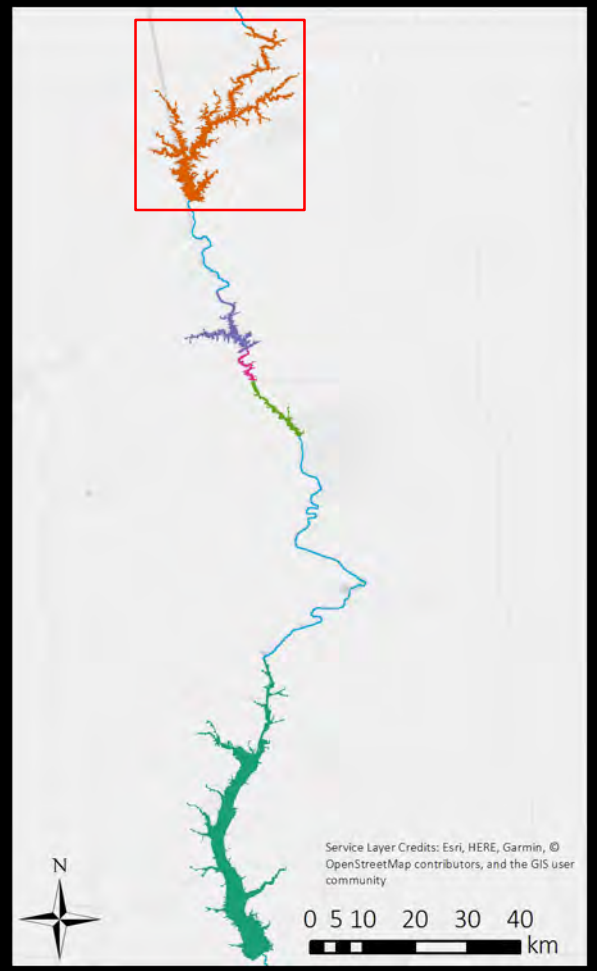

P (mg/g)
0
0.5
1
1.5
2
2.5
3
2012
1992
1972
1952
1932
1912
Lake Oliver
Construction 1962
Lake Harding
Goat Rock Lake
Lake Oliver

P Movement


N
Service Layer Credits: Esri, HERE, Garmin, © OpenStreetMap contributors, and the GIS user community
0 5 10 20 30 40
km


P (mg/g)
0
0.5
1
1.5
2
2.5
3
2012
1992
1972
1952
1932
1912
Lake Eufaula
Construction 1963
Lake Harding
Goat Rock Lake
Lake Oliver
Lake Eufaula

P Movement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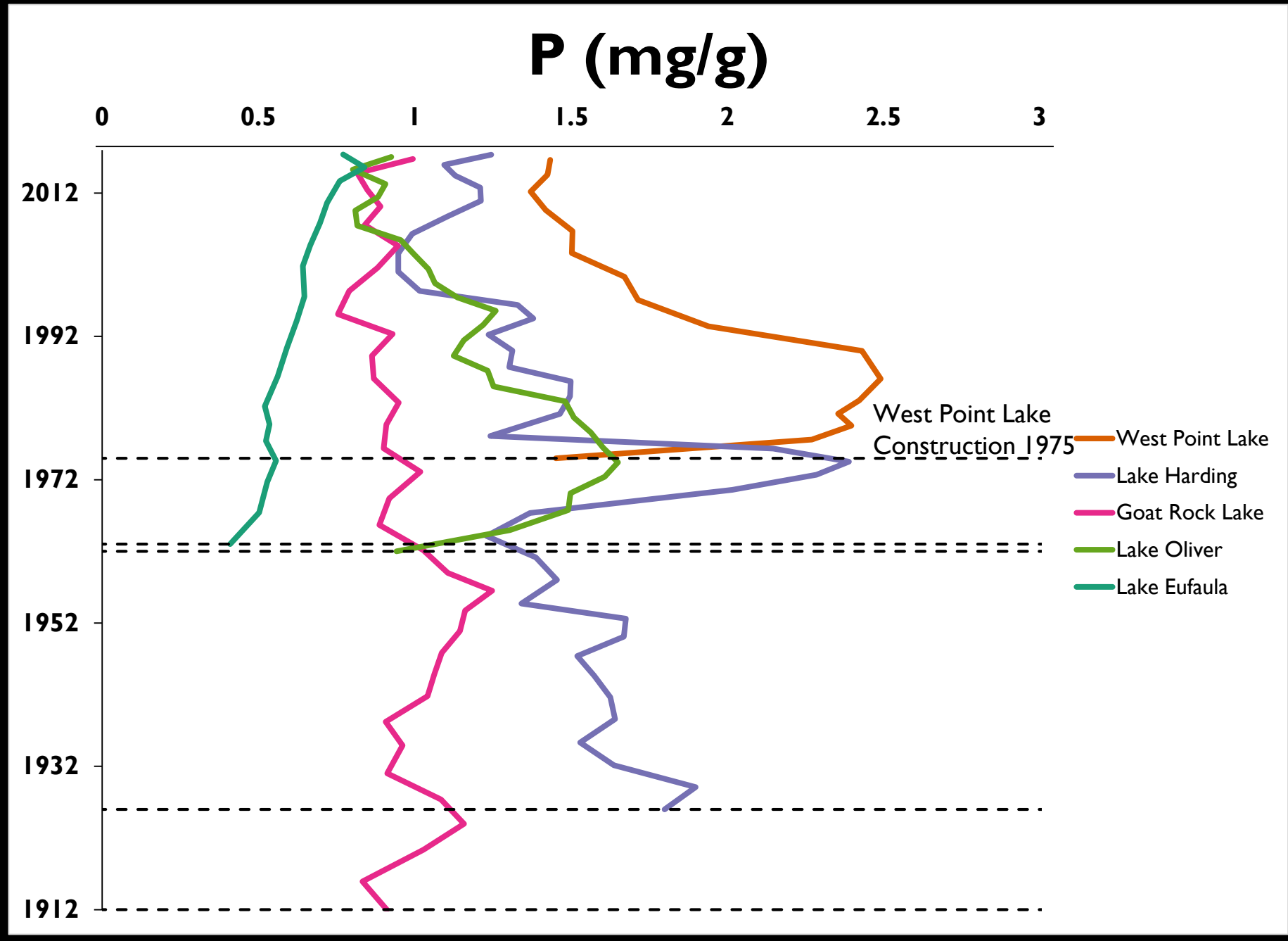
km


P (mg/g)
0
0.5
1
1.5
2
2.5
3
2012
1992
1972
1952
1932
1912
West Point Lake Construction 1975
West Point Lake
Lake Harding
Goat Rock Lake
Lake Oliver
Lake Eufaula

P Movement


N
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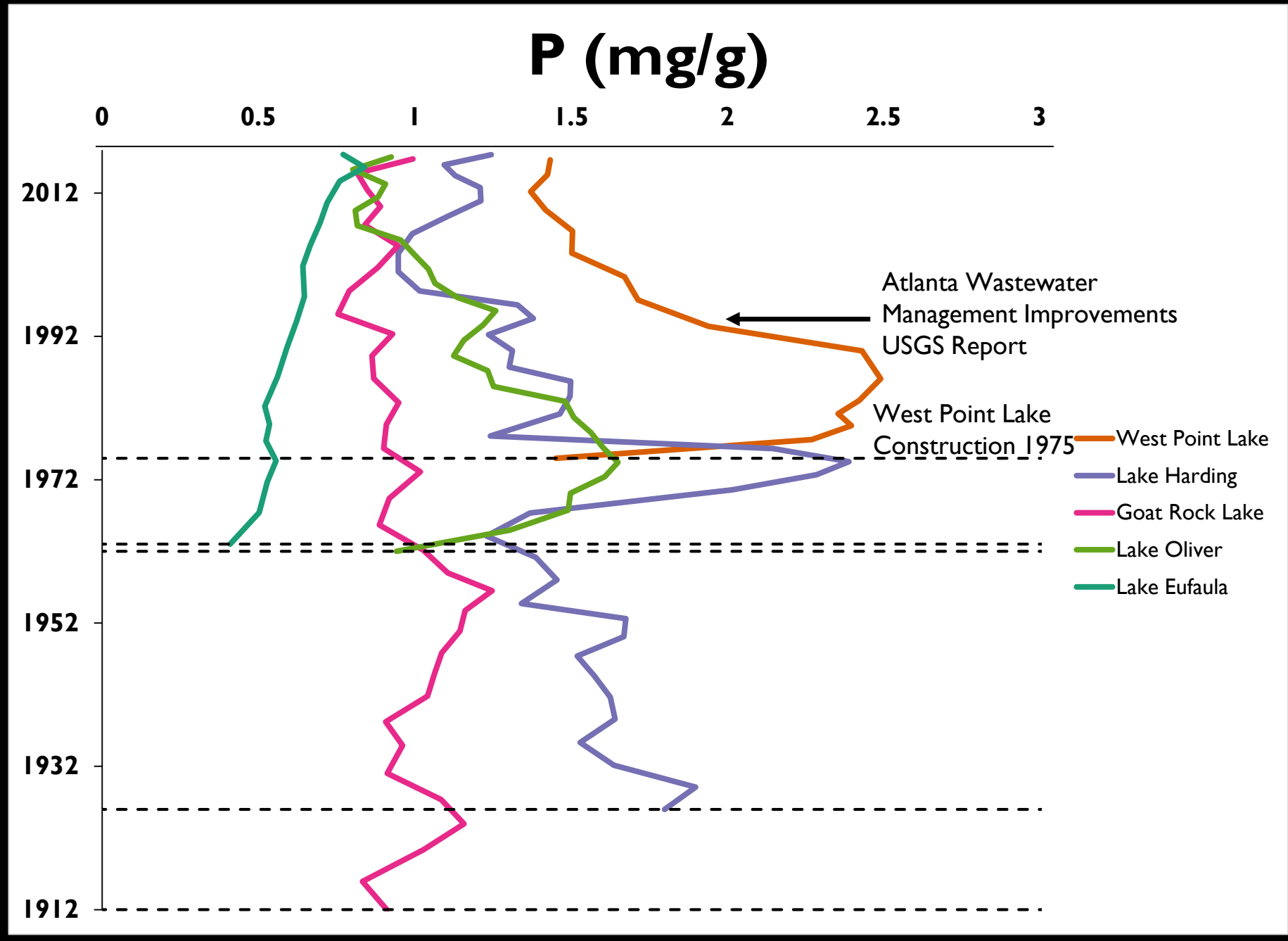
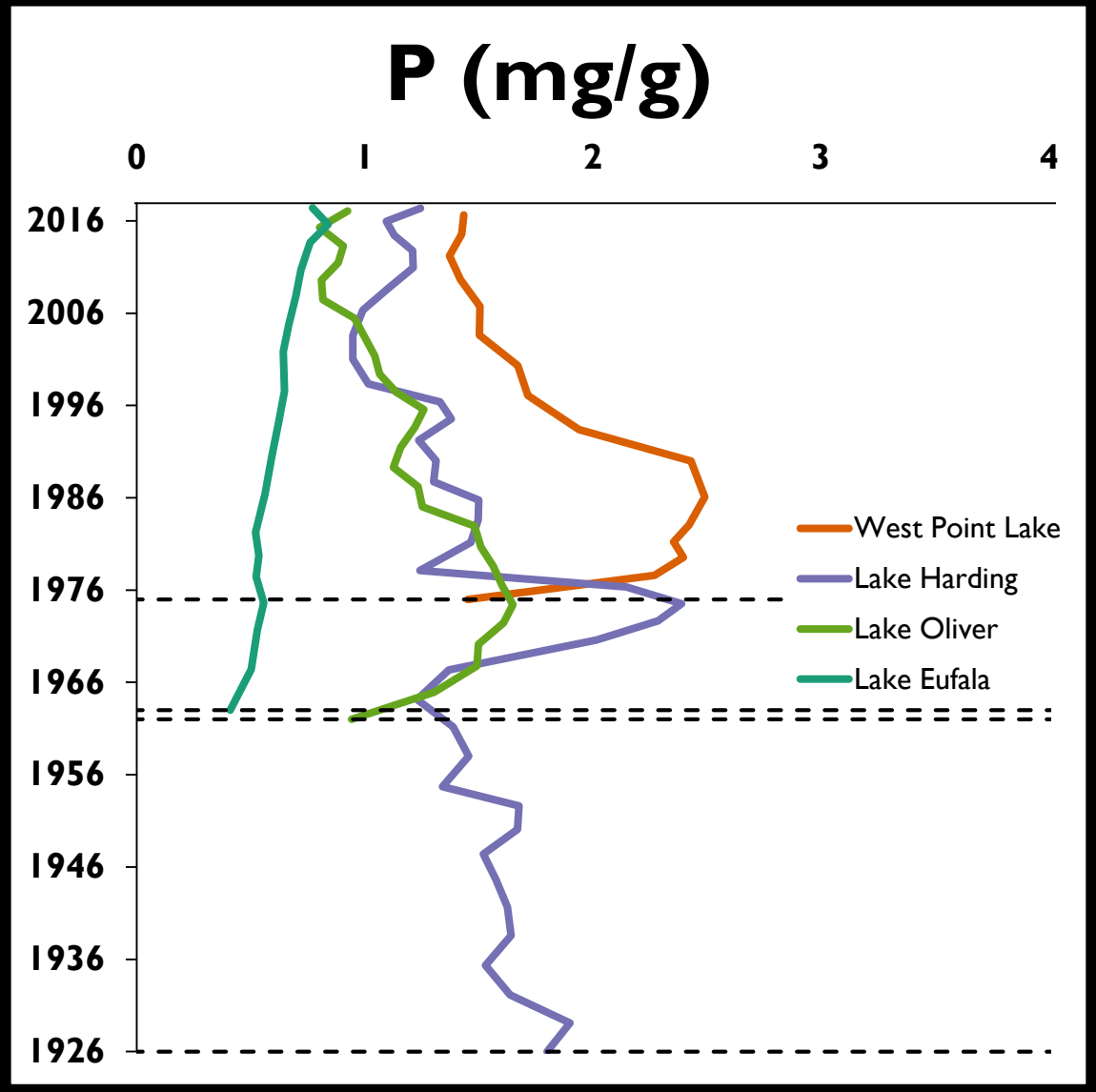
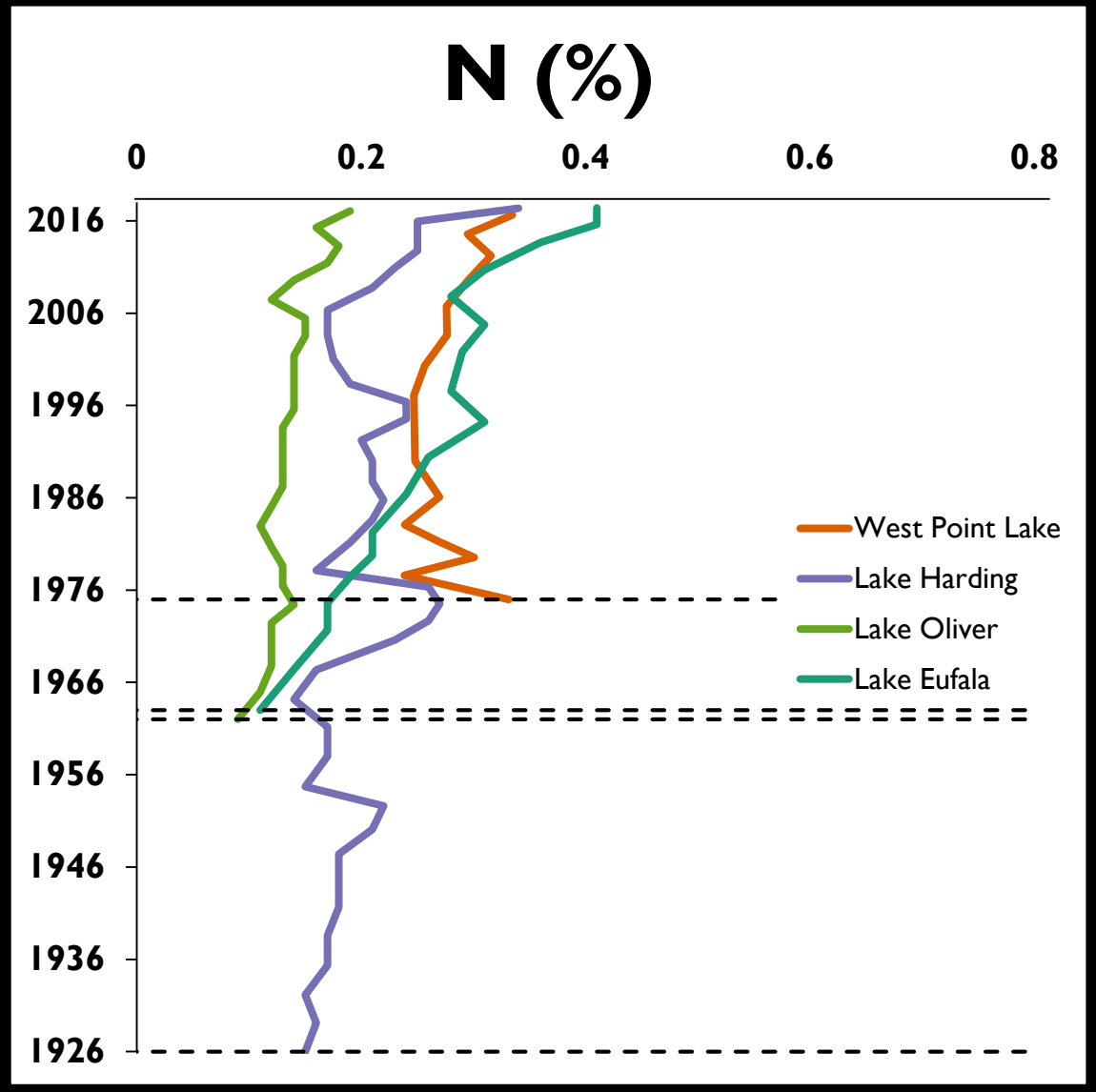
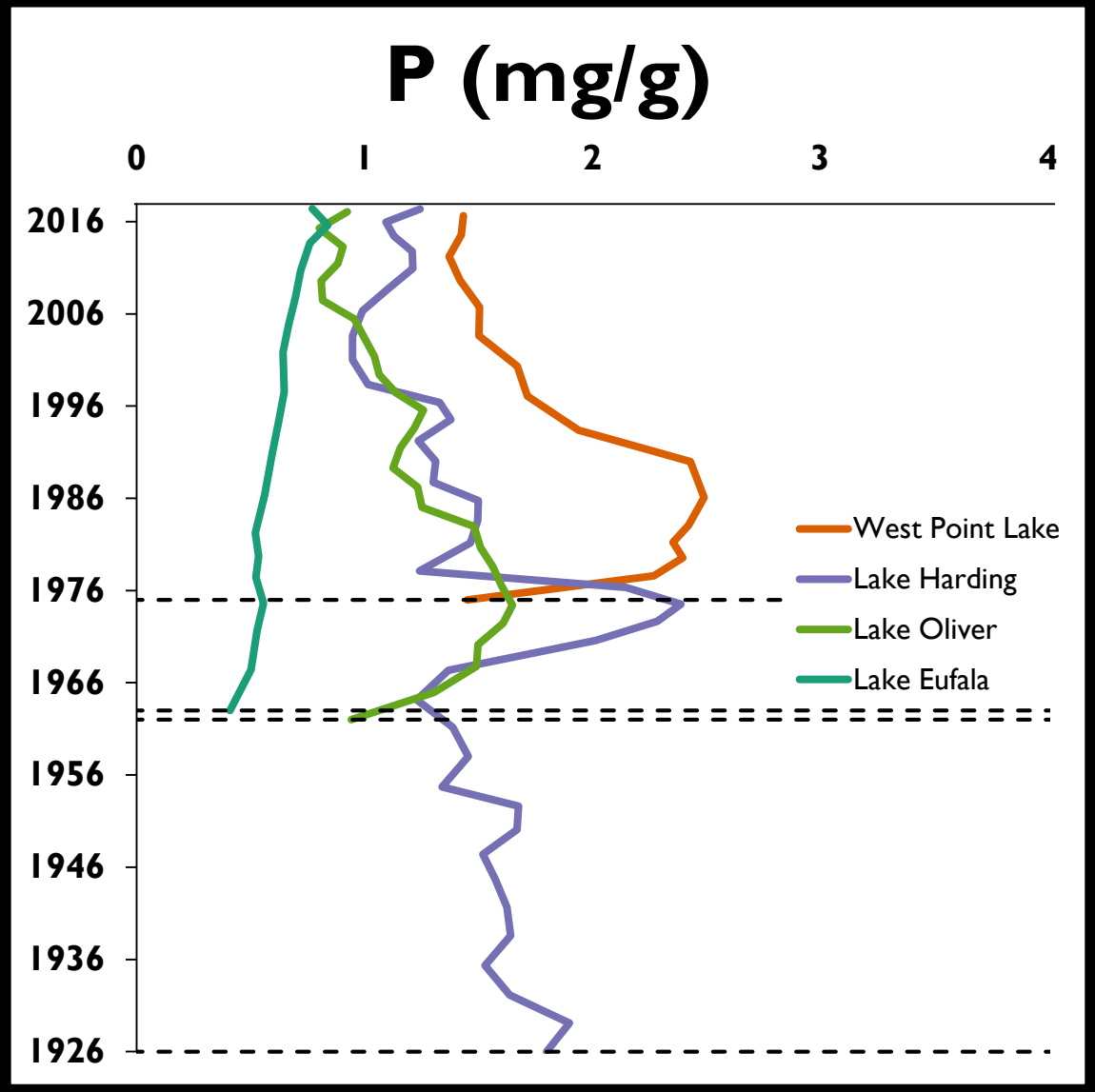
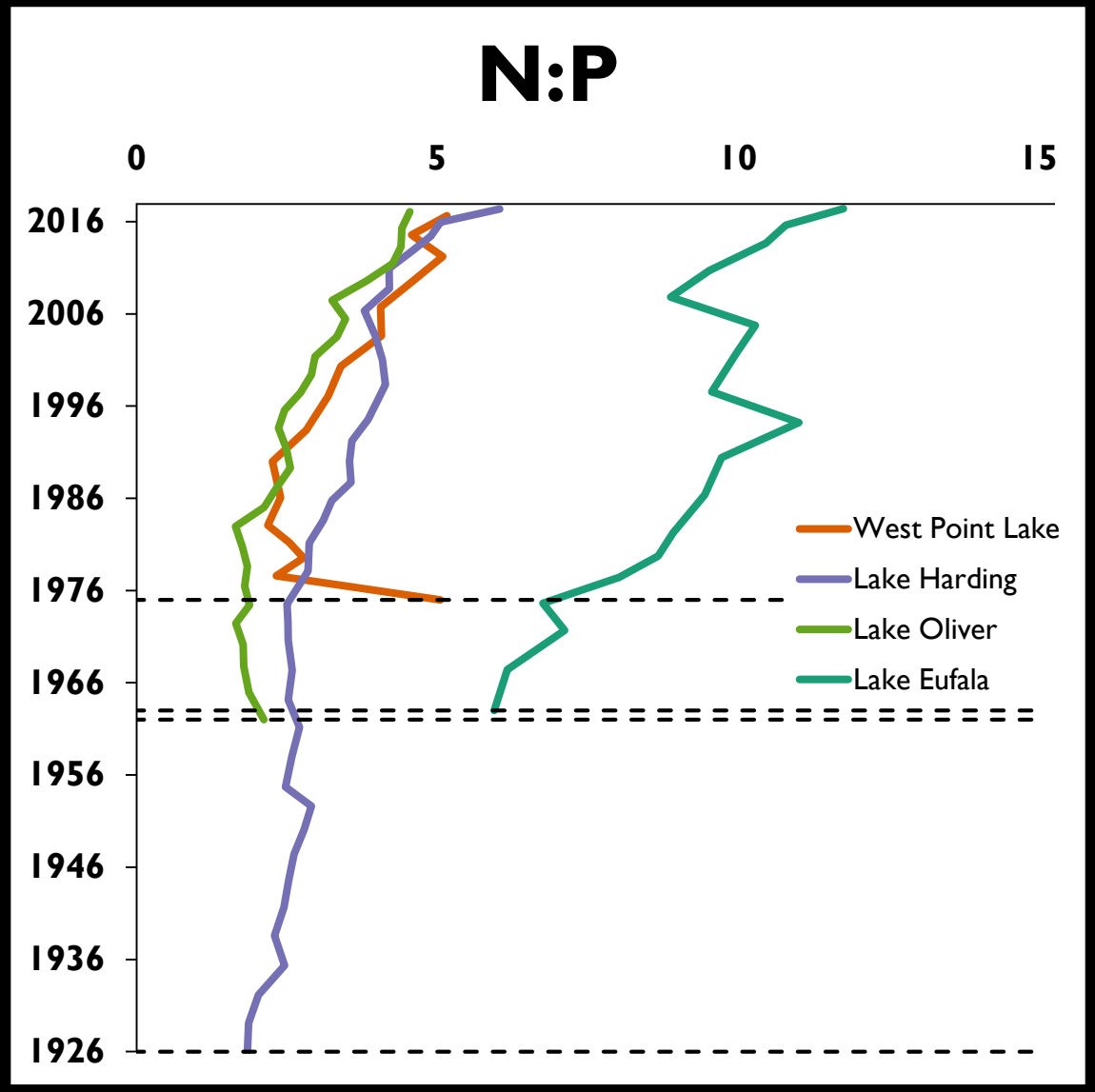
0 5 10 20 30 40
km


P (mg/g)
0
0.5
1
1.5
2
2.5
3
2012
1992
1972
1952
1932
1912
Atlanta Wastewater Management Improvements USGS Report
West Point Lake Construction 1975
West Point Lake
Lake Harding
Goat Rock Lake
Lake Oliver
Lake Eufaula


P (mg/g)
0
1
2
3
4
2016
2006
1996
1986
1976
1966
1956
1946
1936
1926
West Point Lake
Lake Harding
Lake Oliver
Lake Eufala

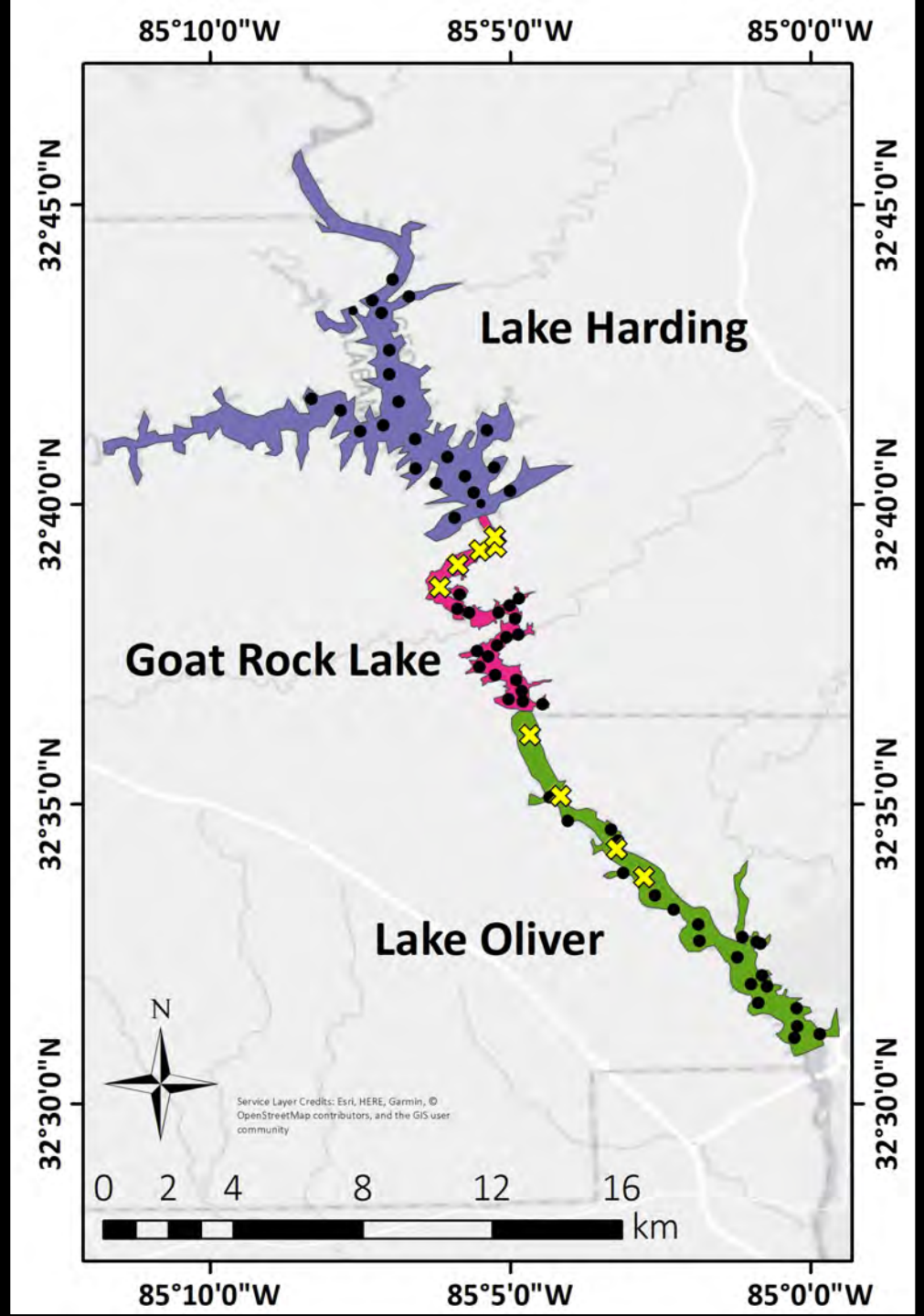

N (%)
0
0.2
0.4
0.6
0.8
2016
2006
1996
1986
1976
1966
1956
1946
1936
1926
West Point Lake
Lake Harding
Lake Oliver
Lake Eufala

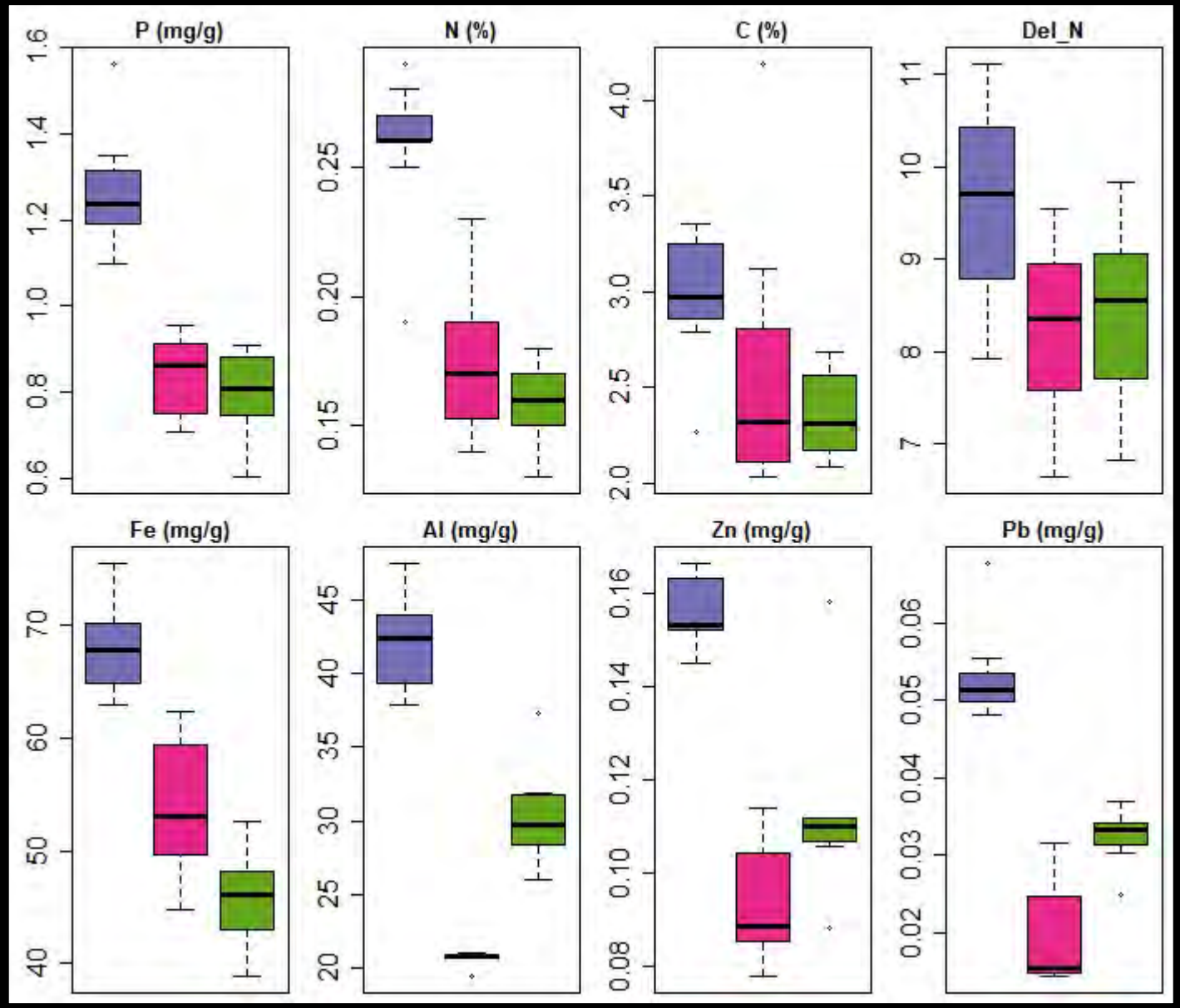

P (mg/g)
0
1
2
3
4
2016
2006
1996
1986
1976
1966
1956
1946
1936
1926
West Point Lake
Lake Harding
Lake Oliver
Lake Eufala


N:P
0
5
10
15
2016
2006
1996
1986
1976
1966
1956
1946
1936
1926
West Point Lake
Lake Harding
Lake Oliver
Lake Eufala

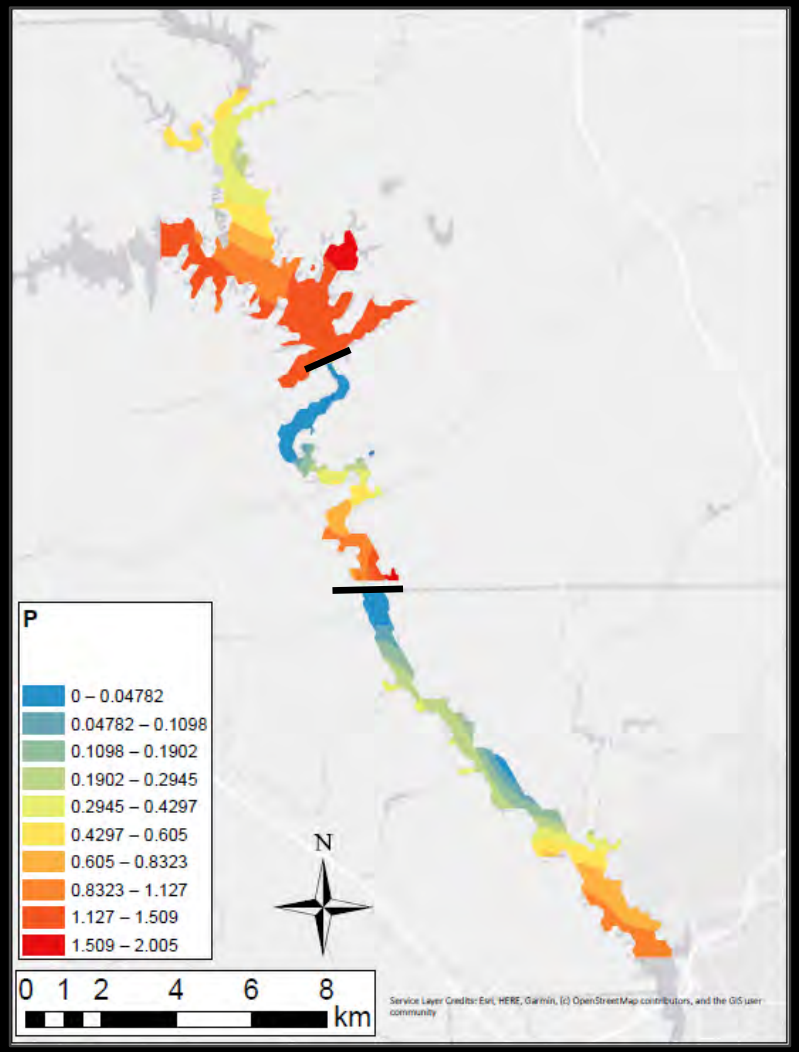
SURFACE SEDIMENTS

Dam Pool

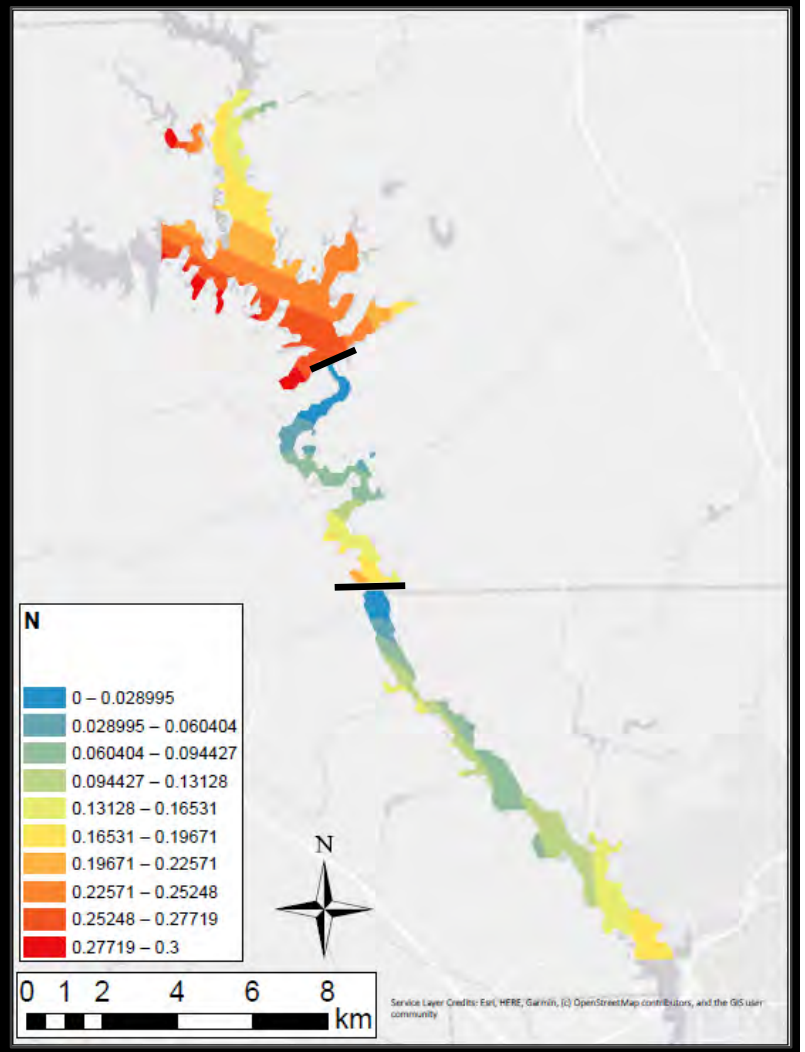

85°10'0"W
85°5'0"W
85°0'0"W
32°45'0"N
32°40'0"N
32°35'0"N
32°30'0"N
Lake Harding
Goat Rock Lake
Lake Oliver
N
Service Layer Credits: Esri, HERE, Garmin, © OpenStreetMap contributors, and the GIS user community
0 2 4 8 12 16
km


P (mg/g)
N (%)
C (%)
Del_N
Fe (mg/g)
Al (mg/g)
Zn (mg/g)
Pb (mg/g)

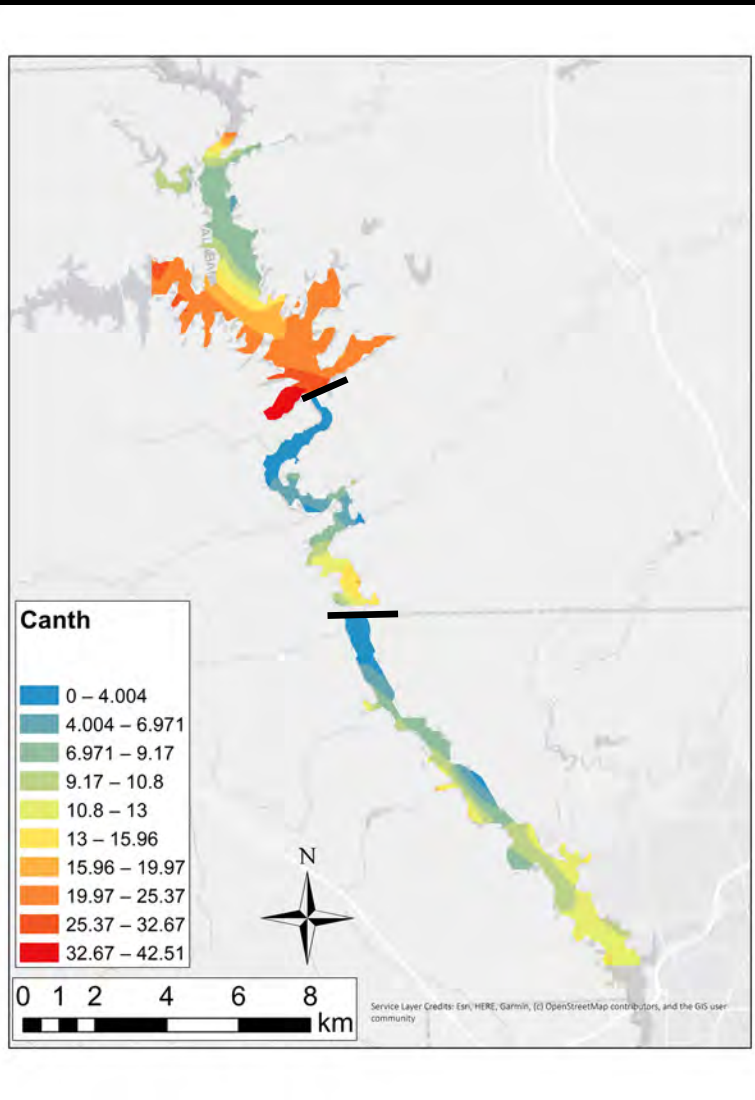
P


P
0 – 0.04782
0.04782 – 0.1098
0.1098 – 0.1902
0.1902 – 0.2945
0.2945 – 0.4297
0.4297 – 0.605
0.605 – 0.8323
0.8323 – 1.127
1.127 – 1.509
1.509 – 2.005
N
0 1 2 4 6 8
km

N


N
0 – 0.028995
0.028995 – 0.060404
0.060404 – 0.094427
0.094427 – 0.13128
0.13128 – 0.16531
0.16531 – 0.19671
0.19671 – 0.22571
0.22571 – 0.25248
0.25248 – 0.27719
0.27719 – 0.3
N
0 1 2 4 6 8
km

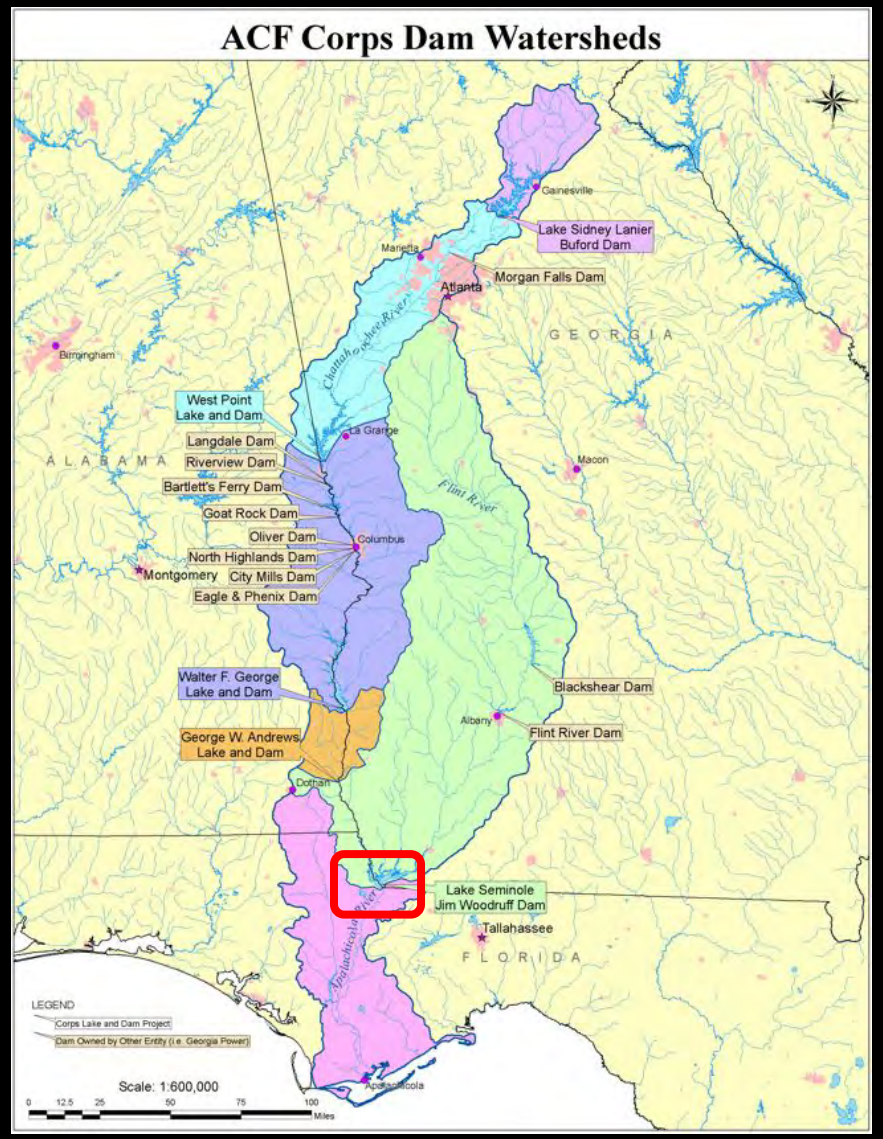
Cyanos


Canth
0 – 4.004
4.004 – 6.971
6.971 – 9.17
9.17 – 10.8
10.8 – 13
13 – 15.96
15.96 – 19.97
19.97 – 25.37
25.37 – 32.67
32.67 – 42.51
N
0 1 2 4 6 8
km

INFERENCES

- Reservoir placement is the primary driver of P movement in reservoir strings
- Residence time can influence down stream sediment deposition and transport
- Residence time is inversely related to phytoplankton production
- Other reservoir strings? Atlanta/Cities?

APALACHICOLA-CHATTAHOOCHEE-FLINT (ACF) RIVER BASIN

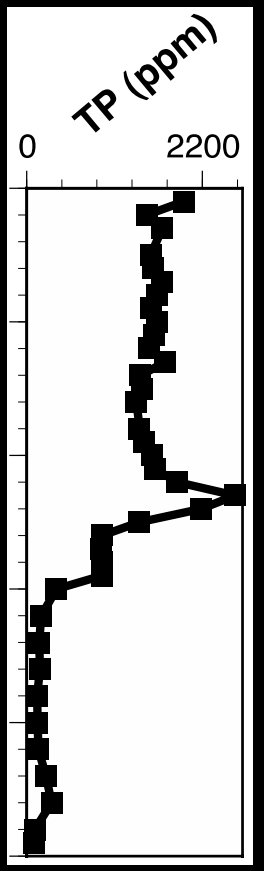


- Run-of the River
- Agricultural Land Use
- Groundwater Influences
- Lake Seminole

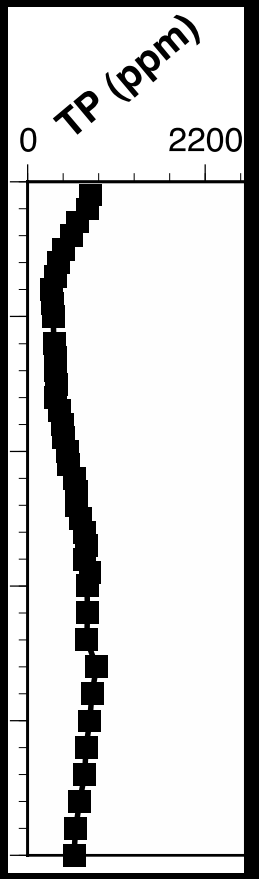
SEDIMENTARY PHOSPHORUS

Lake	Sed.TP (mg/g)	Ref
Lake Seminole-Flint	**1.9**	**This study**
Lake Griffin	1.8	Schelske et al., SJRWMD 1999
Lake Apopka	1.34	Kenney et al., J. Paleo 2002
Lake Okeechobee	1.0	Torres et al., J. Paleo 2012
Everglades-WCA2A	0.8	Waters et al., J. Paleo 2012
Lake Taihu, China	0.65	Jinglu et al., J. Paleo 2007
Beaver Res, AR	0.55	Winston et al., J. Paleo 2014

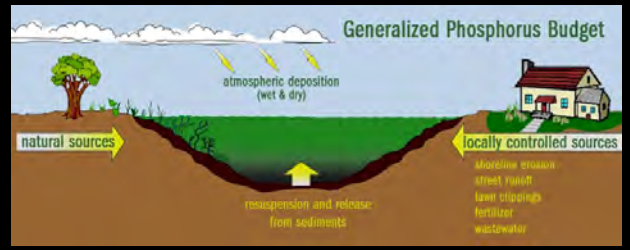
Waters et al. 2015

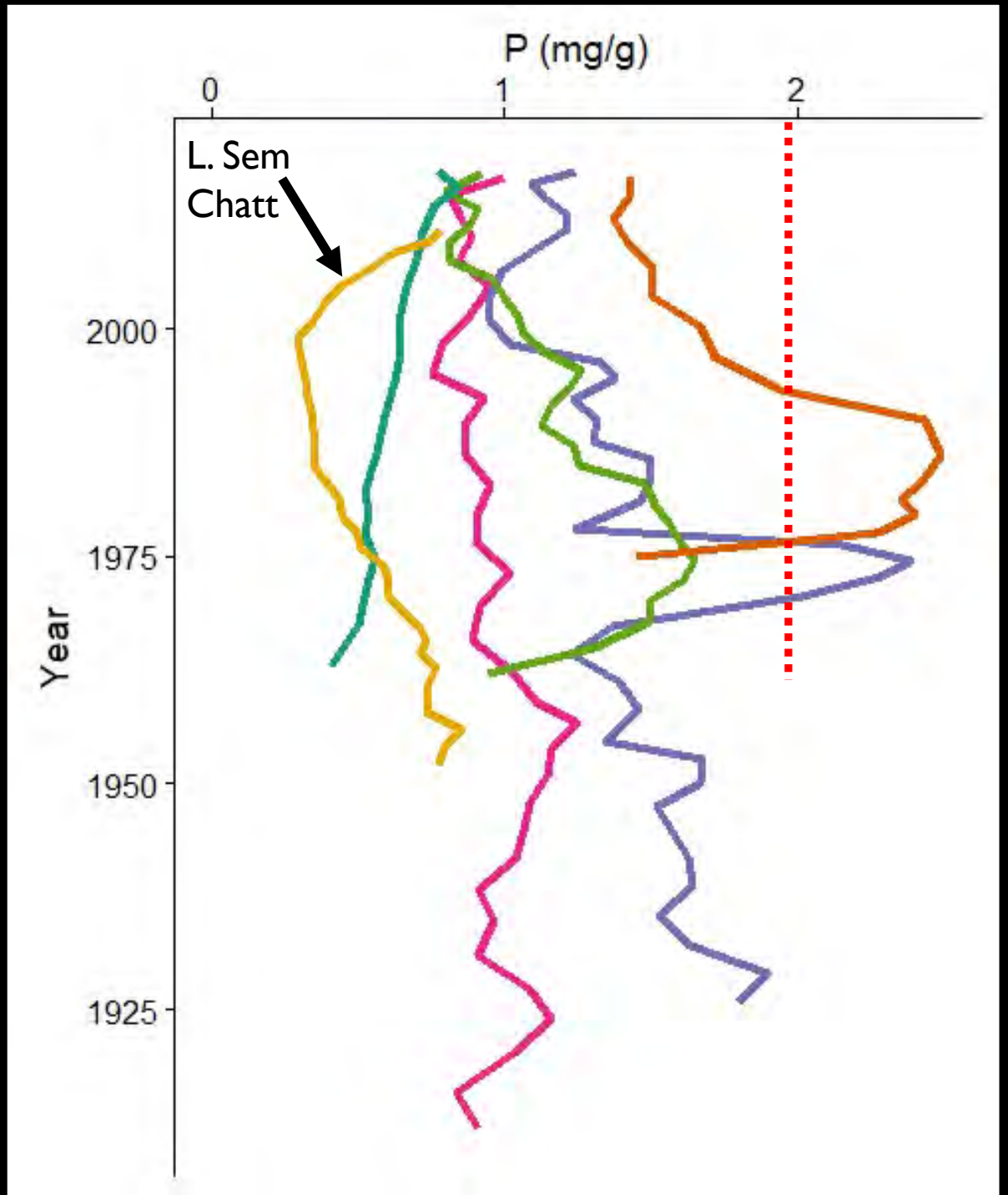


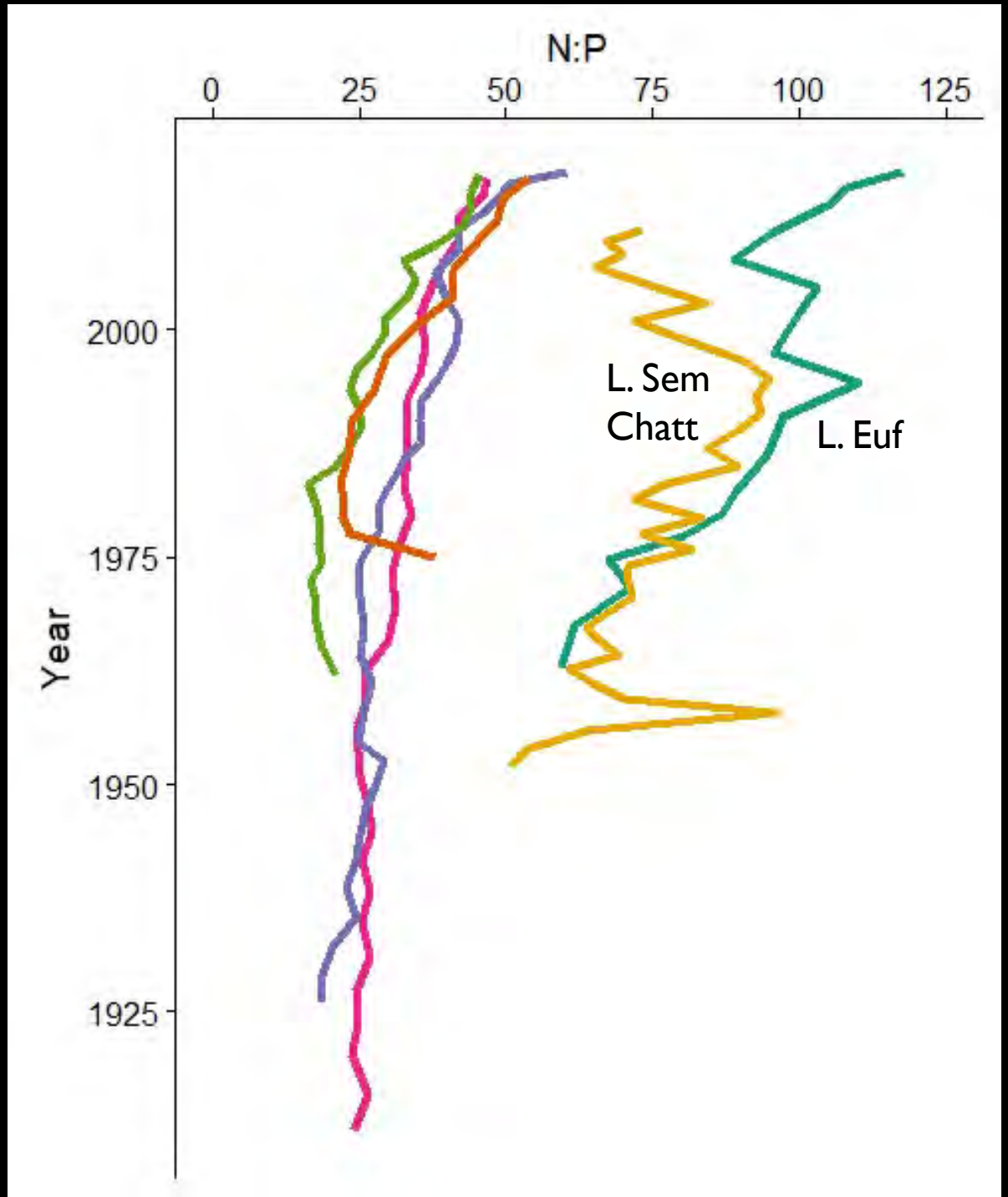
Flint Side



Chatt Side

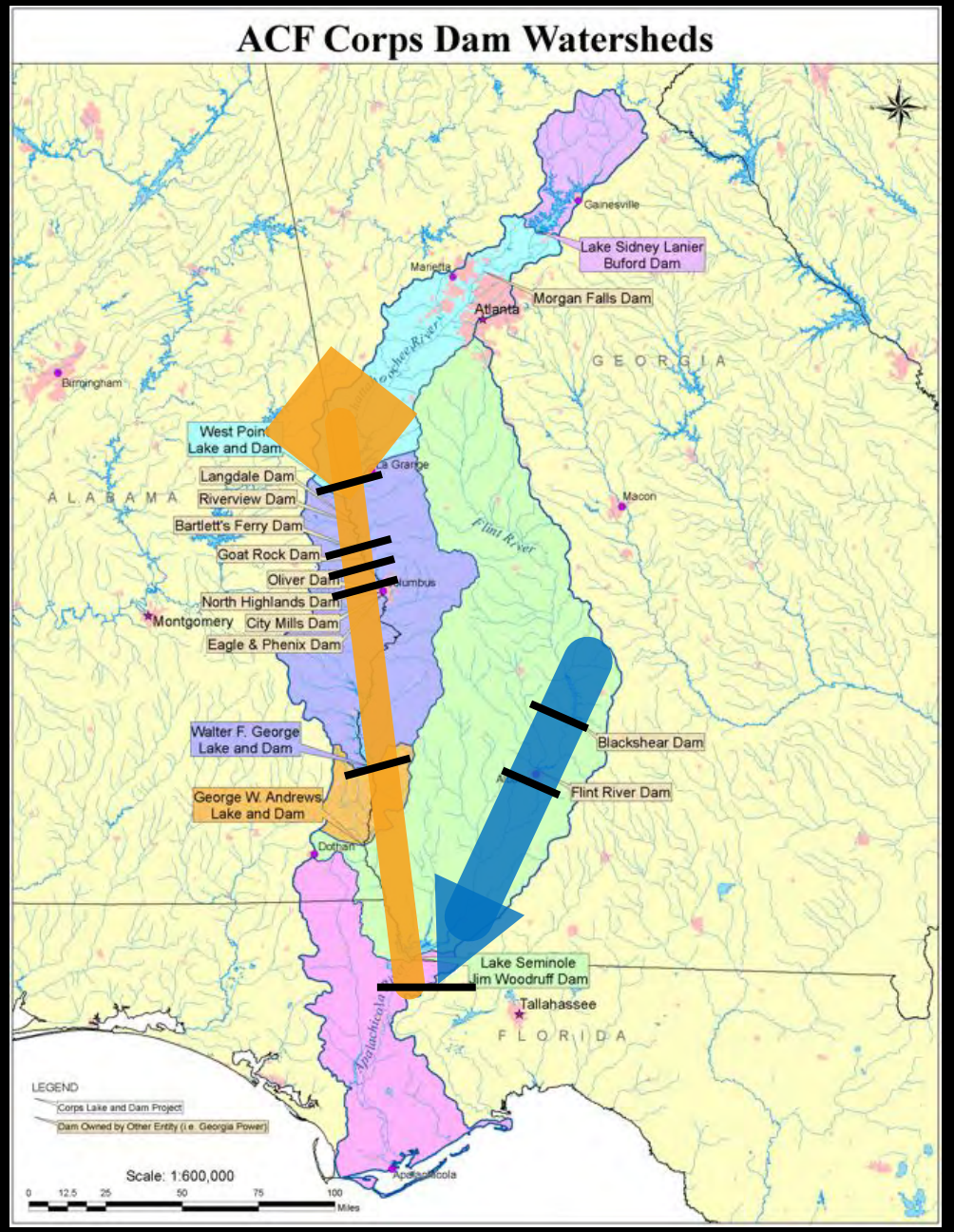



P (mg/g)
0
1
2
L. Sem
Chatt
2000
1975
1950
1925
Year


N:P
0
25
50
75
100
125
2000
1975
1950
1925
Year
L. Sem
Chatt
L. Euf

NEXT STEPS

AMOUNT AND/OR TRANSPORT FOR THE FLINT



Auburn PaleoEnvironmental Lab

Mud, Water, Caves, Curiosity

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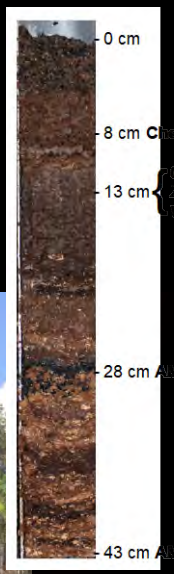
@Waters_Paleolim



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Georgia Power

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Thanks!!