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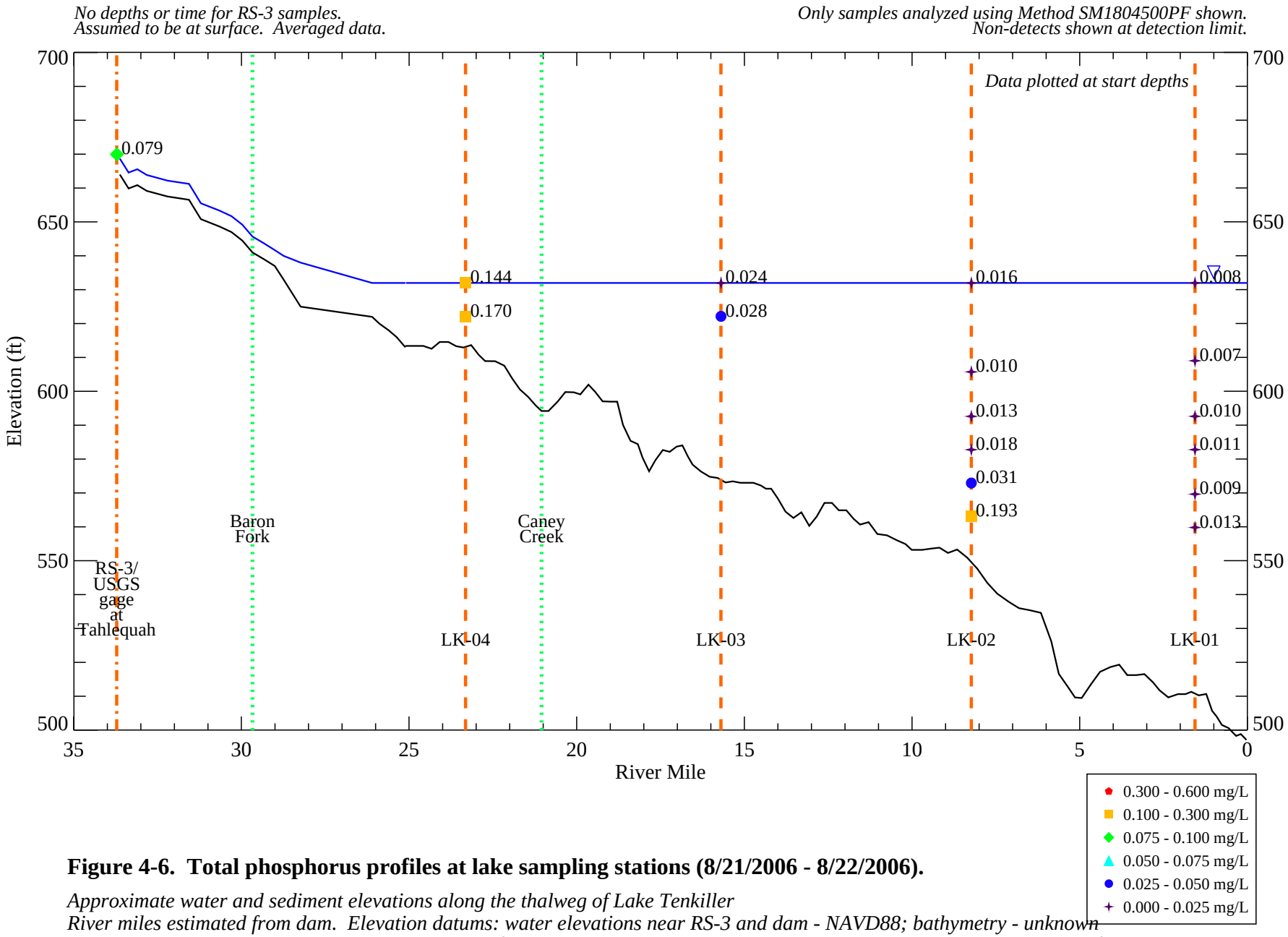

Figure 4-6. Total phosphorus profiles at lake sampling stations (8/21/2006 - 8/22/2006).

Approximate water and sediment elevations along the thalweg of Lake Tenkiller
River miles estimated from dam. Elevation datums: water elevations near RS-3 and dam - NAVD88; bathymetry - unknown
Data sources: gage height corresponding to 1300 cfs at Tahlequah (near RS-3) - USGS; normal pool height - Army Corp of Engineers
Plaintiff's Database 2005-2007; data elevations estimated from normal pool elevation

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PRIVILEGED AND CONFIDENTIAL
ATTORNEY WORK PRODUCT
PREPARED AT REQUEST OF COUNSEL

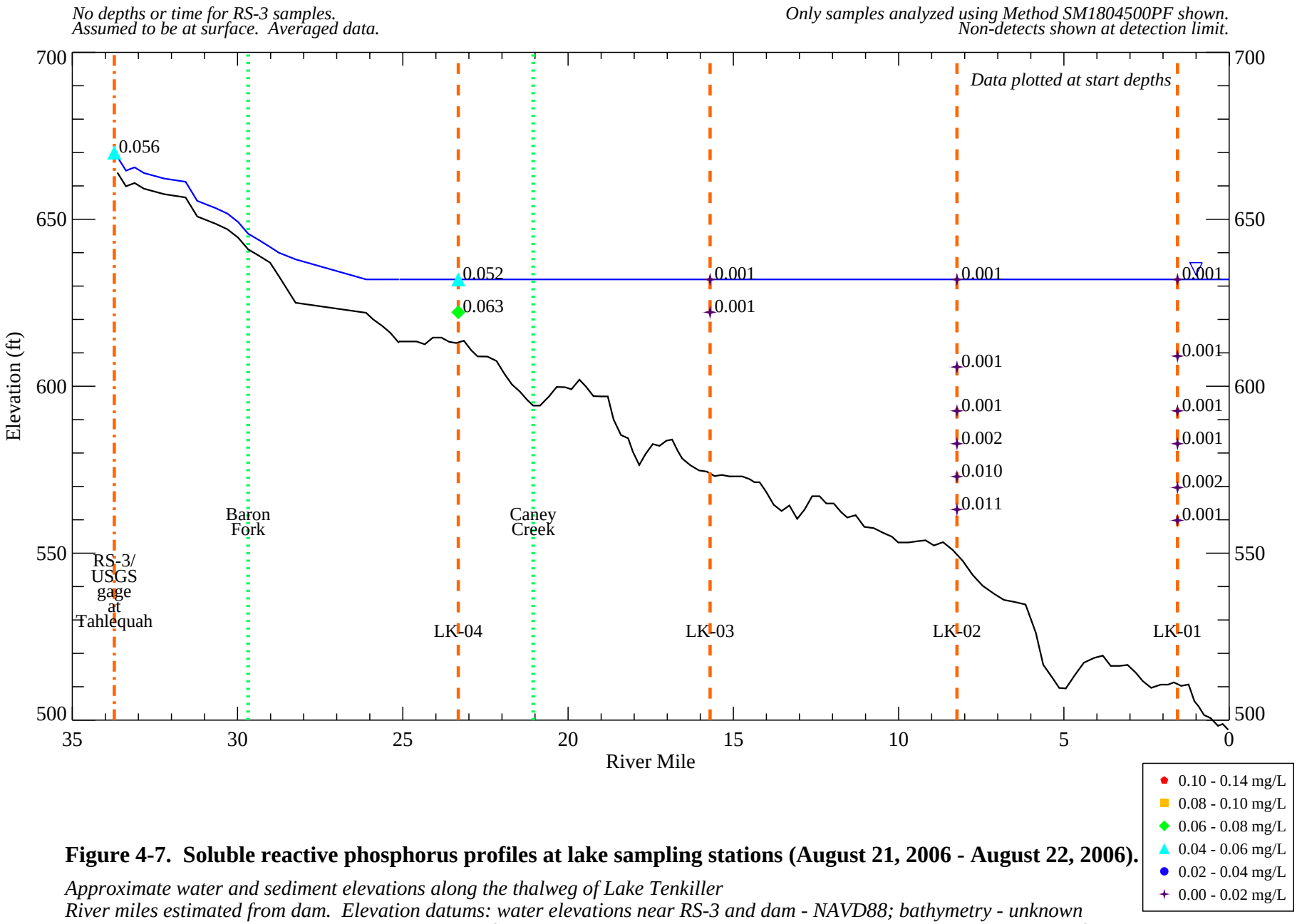

Figure 4-7. Soluble reactive phosphorus profiles at lake sampling stations (August 21, 2006 - August 22, 2006).

Approximate water and sediment elevations along the thalweg of Lake Tenkiller
River miles estimated from dam. Elevation datums: water elevations near RS-3 and dam - NAVD88; bathymetry - unknown
Data sources: gage height corresponding to 1300 cfs at Tahlequah (near RS-3) - USGS; normal pool height - Army Corp of Engineers
Plaintiff's Database 2005-2007; data elevations estimated from normal pool elevation

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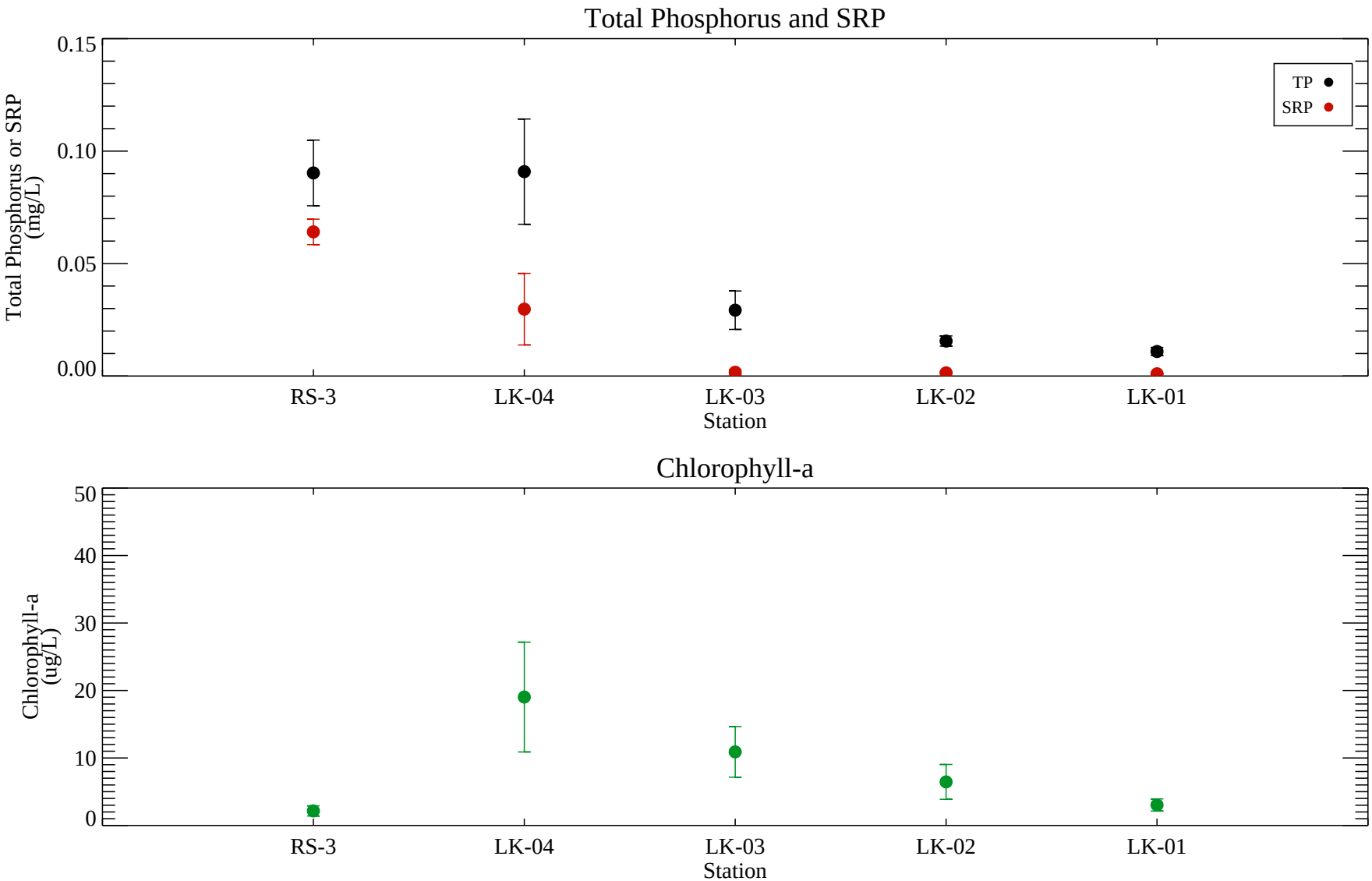

Figure 4-8. Spatial distribution of summer total phosphorus, SRP, and chlorophyll-a in Lake Tenkiller (2006).

Data source: Plaintiff data collected 2005 - 2008. Only surface samples considered at lake stations. Error bars are at +/- 2 standard errors. Only method SM18-4500PF for TP, SRP considered. Non-detects assigned detection limit values. RS-3 includes data from the collocated station RS000654.

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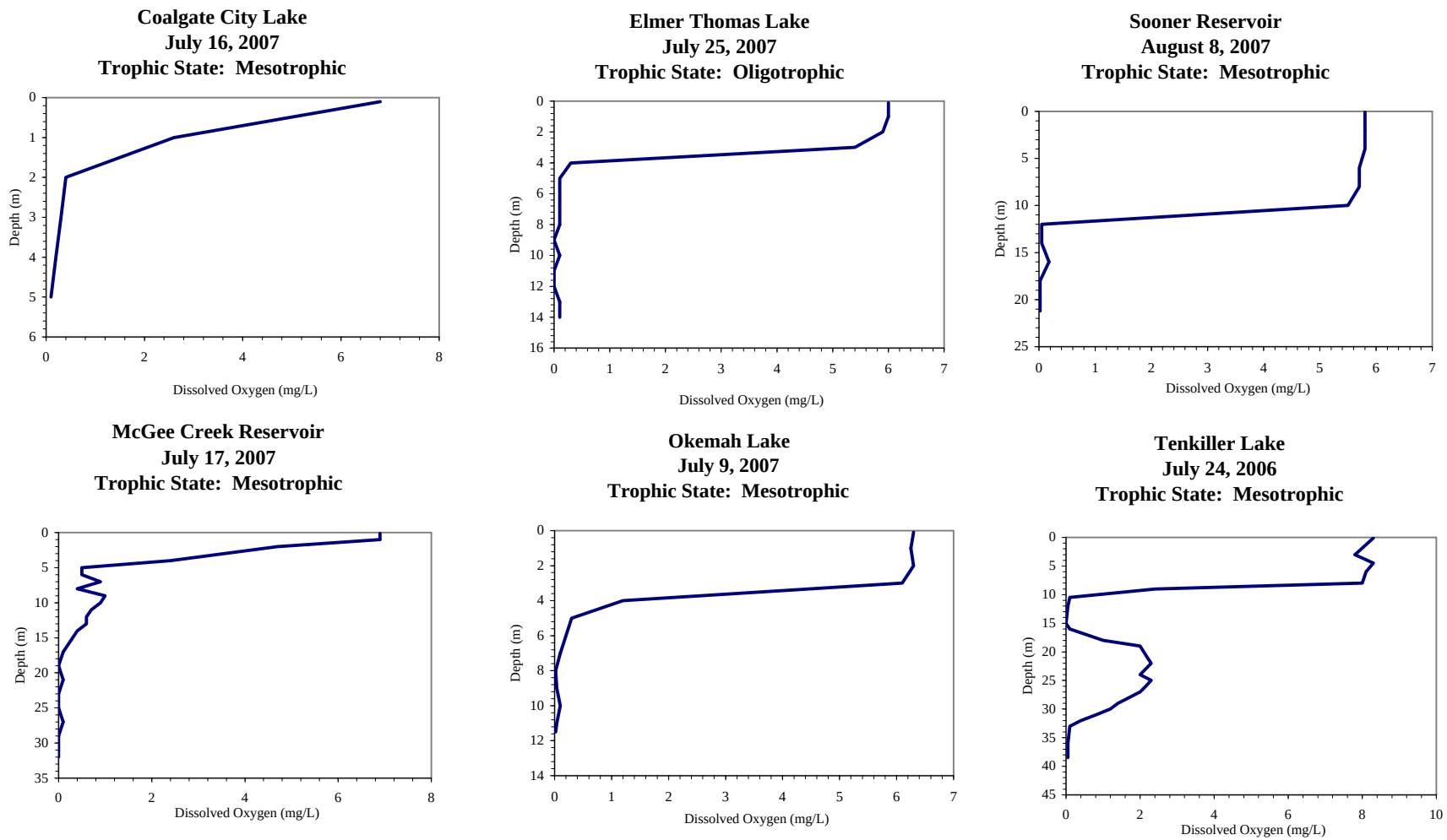
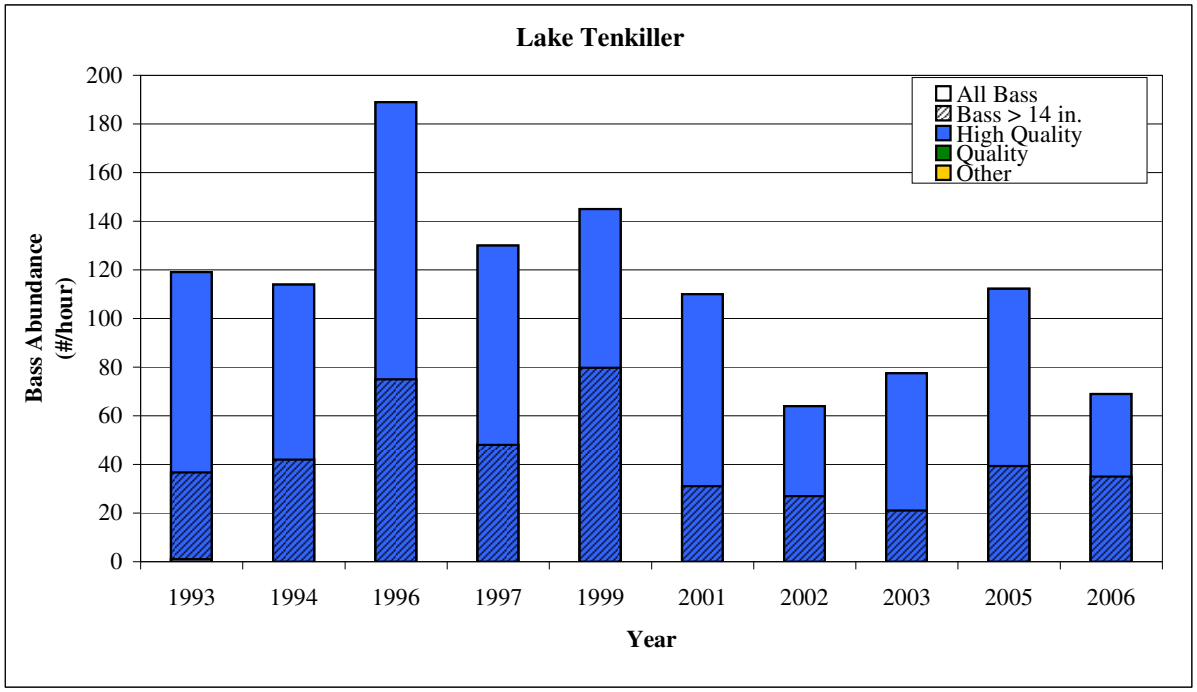


Figure 4-9. Dissolved oxygen profiles for various Oklahoma reservoirs in summers 2006 and 2007.
Data source: 2007 Beneficial Use Monitoring Program Report



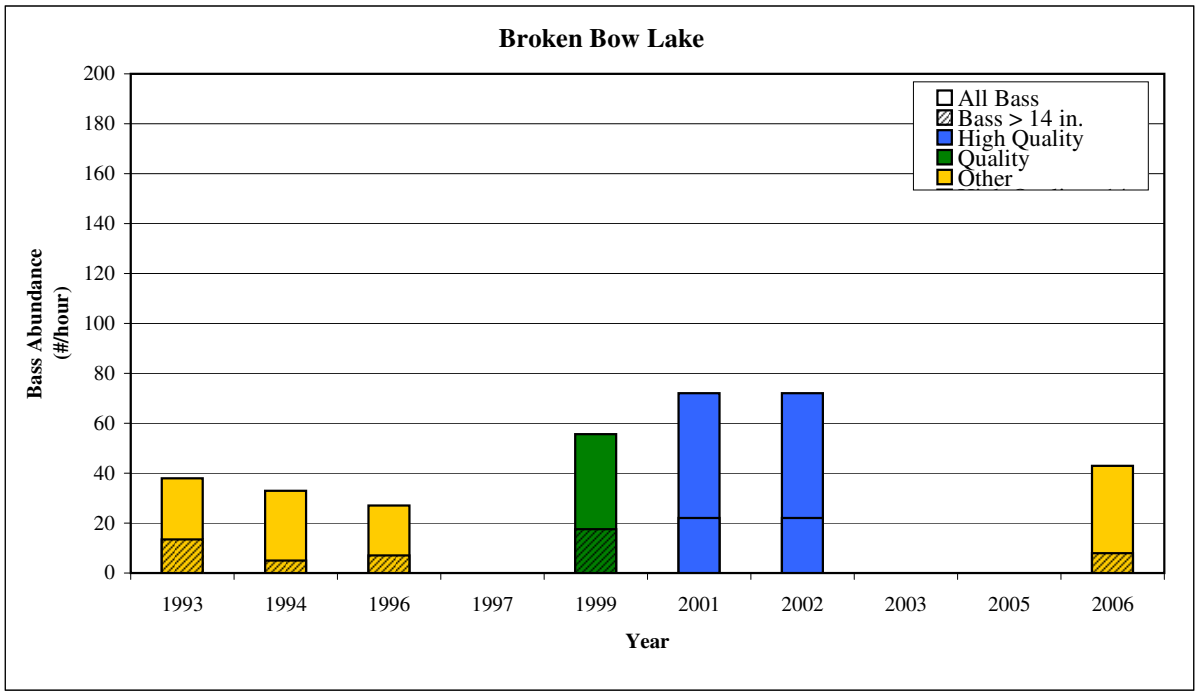


Figure 4-10. Comparison of Oklahoma Department of Wildlife Conservation spring largemouth bass electrofishing surveys 1993-2006 in Lake Tenkiller and Broken Bow Lake.[1]

[1] *Data downloaded from www.wildlifedepartment.com on 6/12/08.*

High Quality Fishery: 60 or more bass per hour of electrofishing with 15 or more bass at least 14 inches in length.

Quality Fishery: 40 or more bass per hour of electrofishing with 10 or more bass at least 14 inches in length.

Note: missing years indicate no fish collection in the lake for that year; fish collections not conducted in Broken Bow in 1997, 2003, or 2005

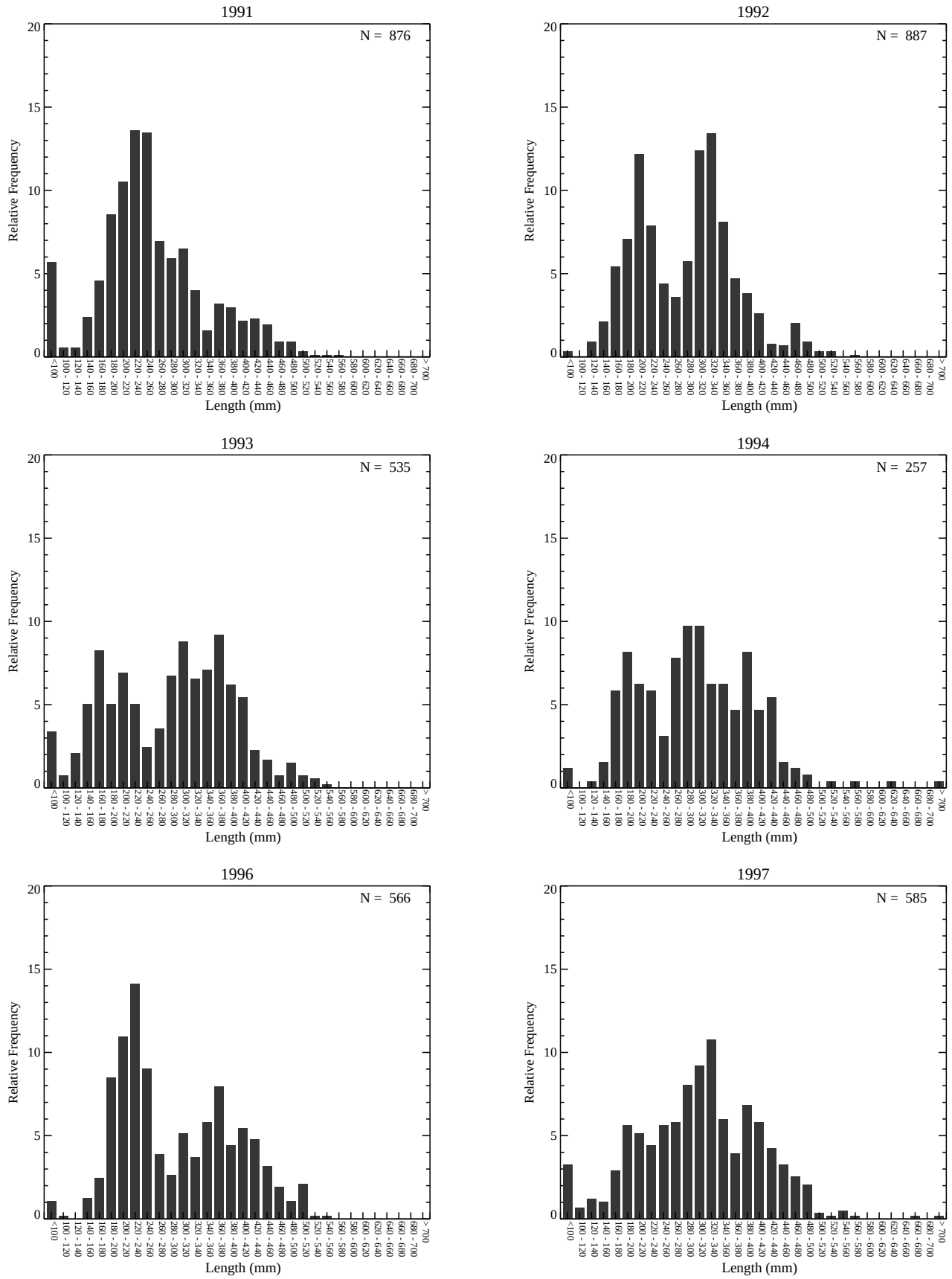


Figure 4-11. Length frequency in spring of largemouth bass in Lake Tenkiller.

Data source: Oklahoma Department of Wildlife Conservation - bass electrofishing.

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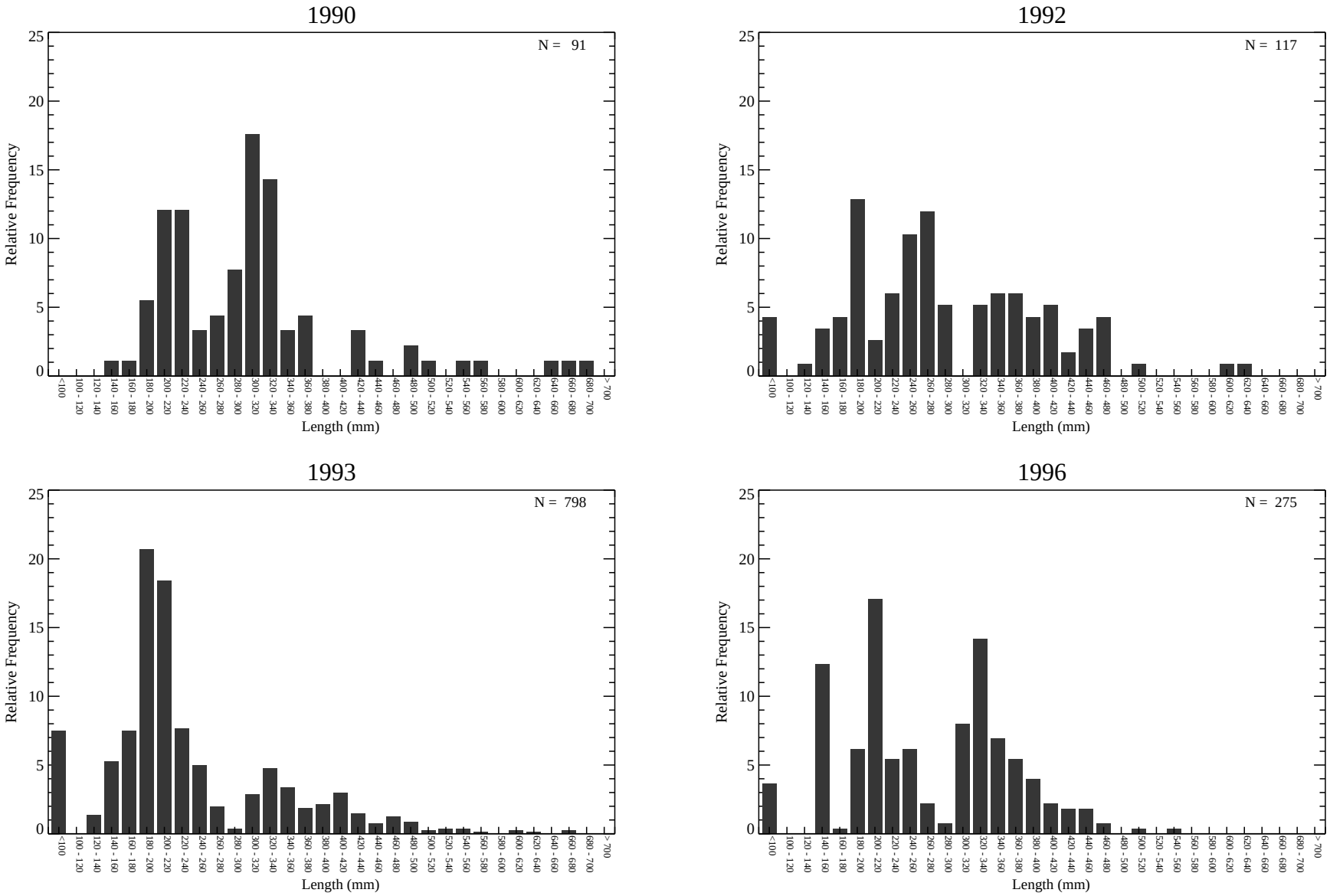

Figure 4-12. Length frequency of white bass in Lake Tenkiller (all zones).

Note: Data source is Oklahoma Department of Wildlife Conservation - gillnetting (1993 is research netting).

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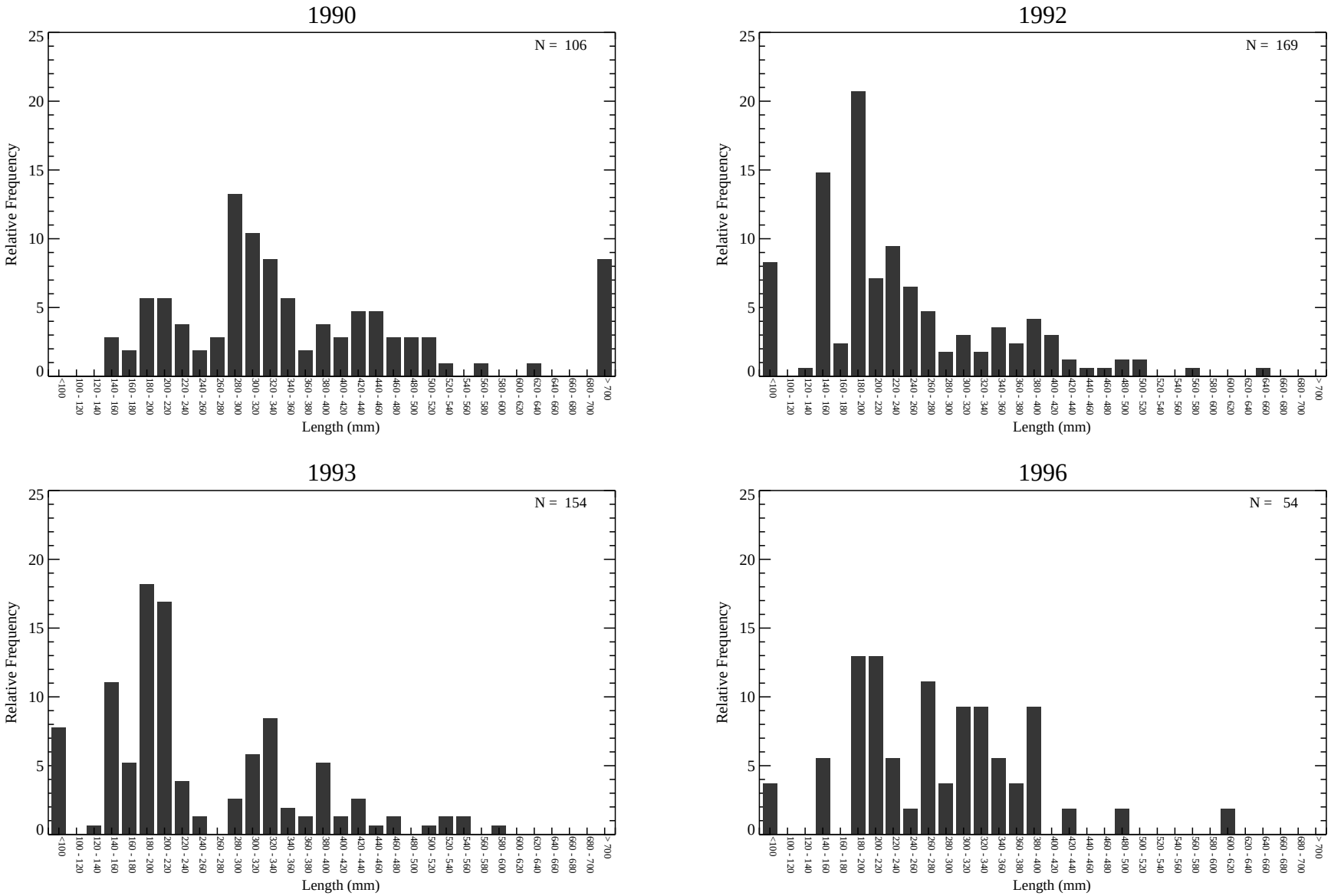

Figure 4-13. Length frequency of channel catfish in Lake Tenkiller (all zones).

Note: Data source is Oklahoma Department of Wildlife Conservation - gillnetting (1993 is research netting).

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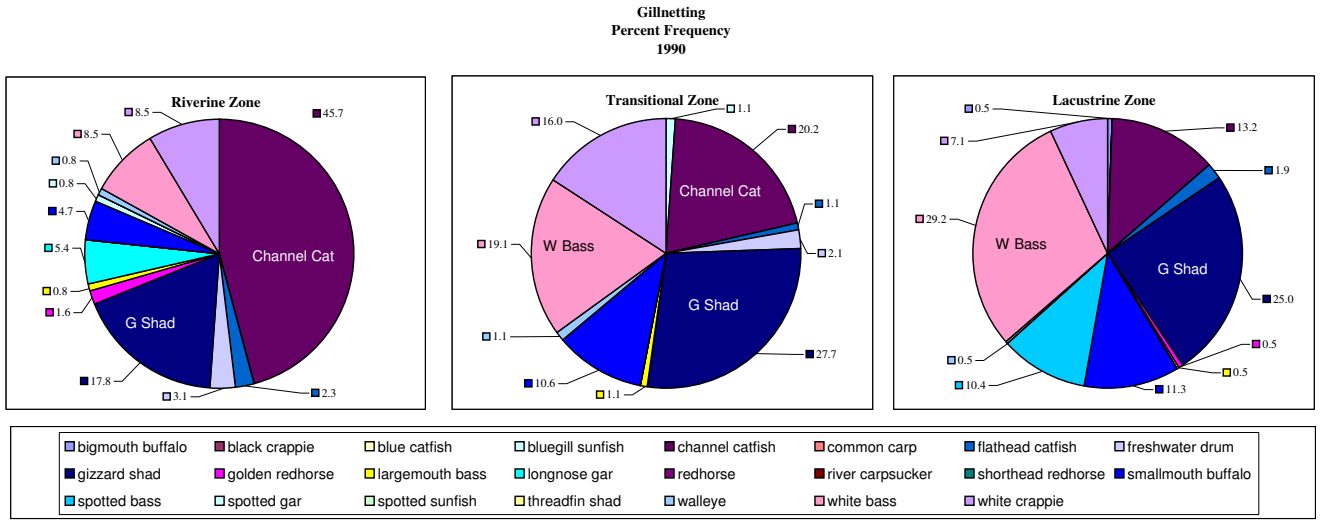


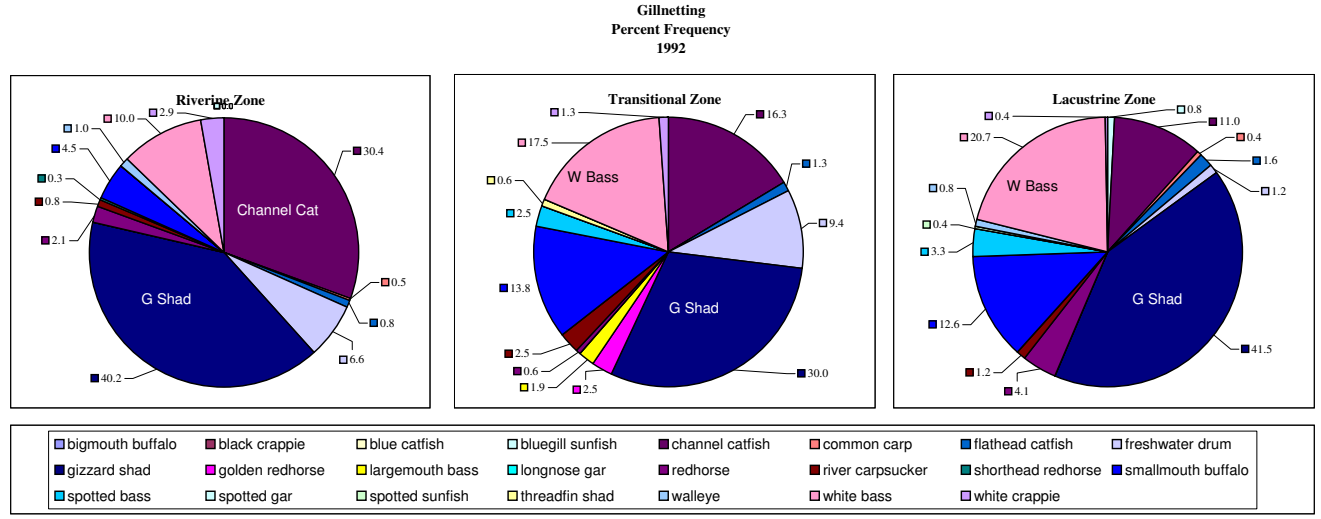
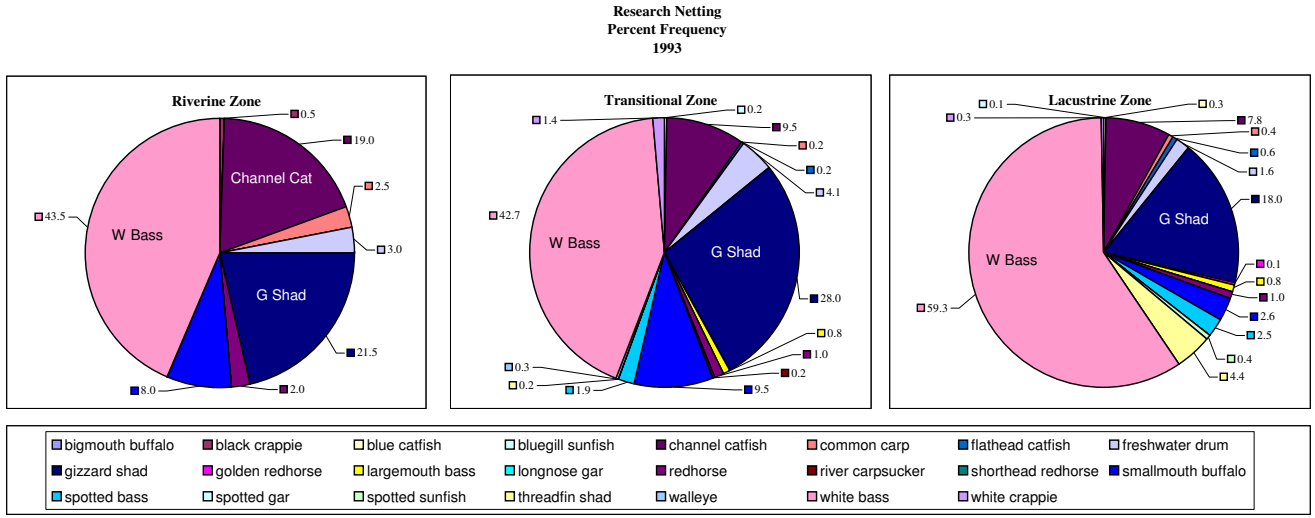


Figure 4-14. Percent frequency of fish species in Lake Tenkiller based on ODWC gillnetting data: 1990 and 1992.



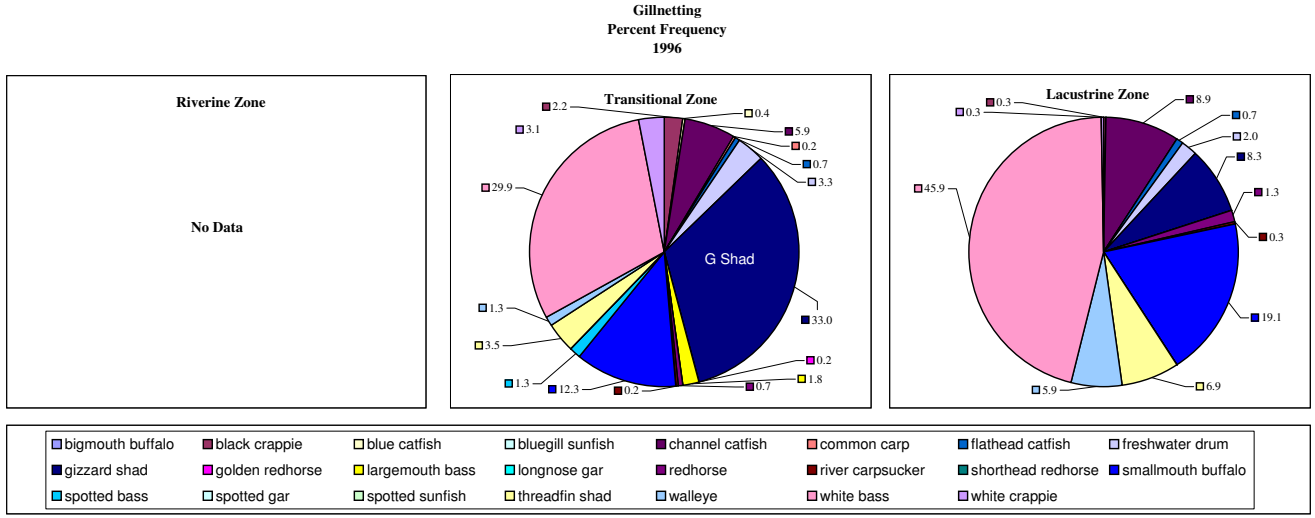


Figure 4-15. Percent frequency of fish species in Lake Tenkiller based on ODWC gillnetting data: 1993 and 1996.

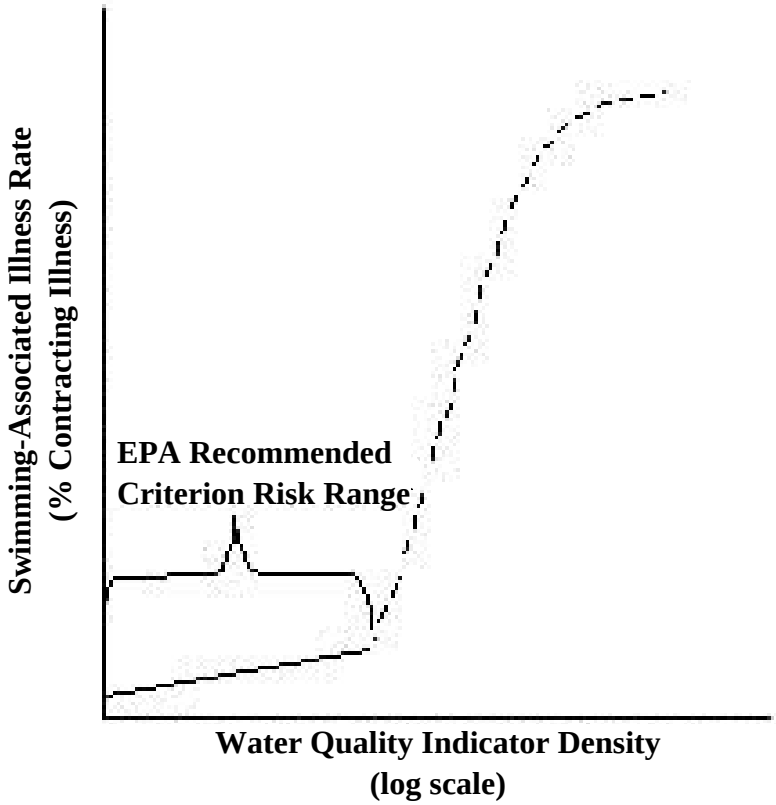


Figure 5-1. EPA conceptual relationship between illness rates and bacterial indicator density. Reproduced from USEPA (2004).

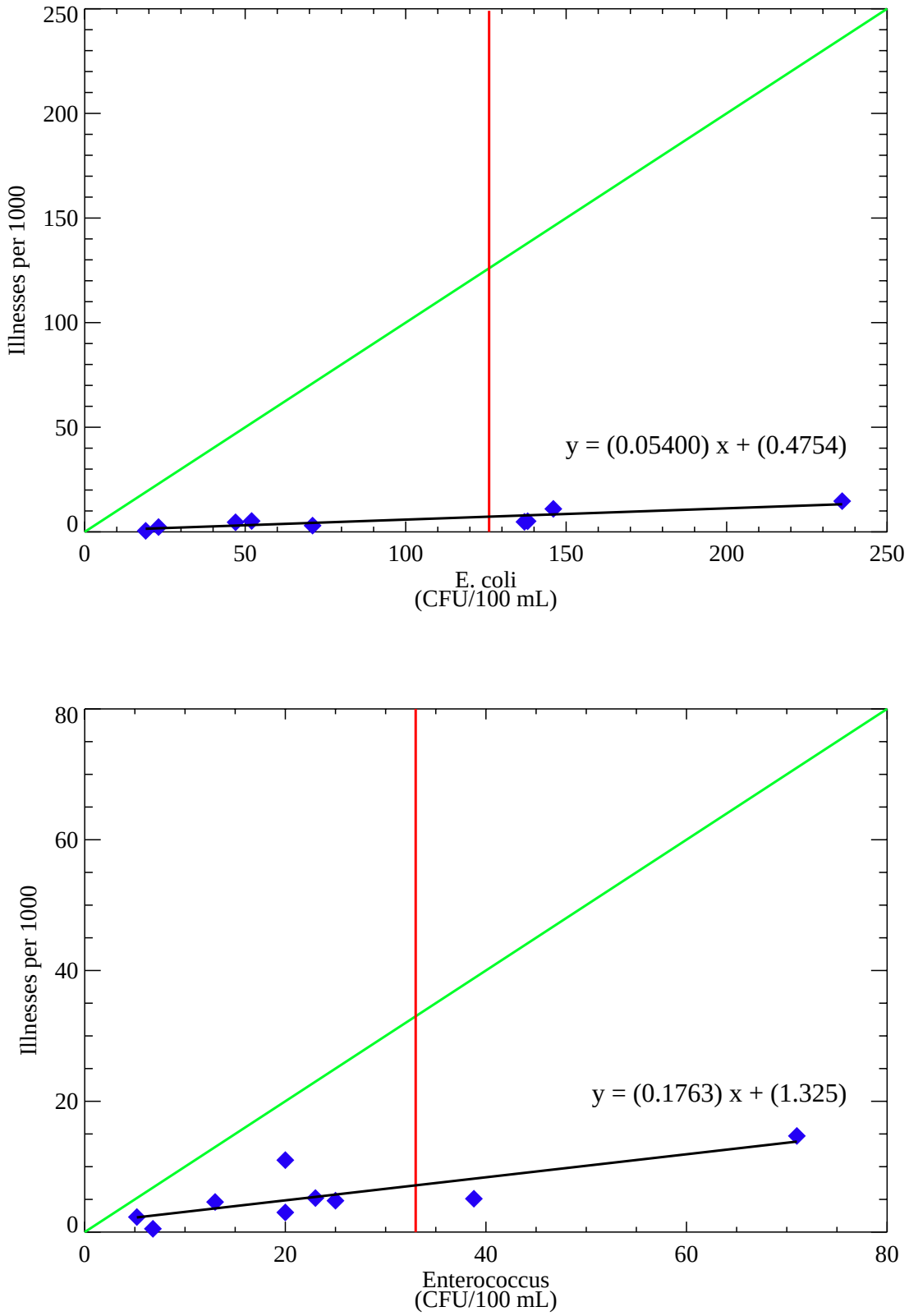


Figure 5-2. Epidemiological data used to set current USEPA water quality criteria.

Data points (blue diamonds), and water quality criteria thresholds (red vertical lines) are taken from Table 3 of USEPA (1986). The 1:1 line for bacteria density vs. illness rate per 1000 is shown in green. The equation for linear regression is presented next to the regression line.

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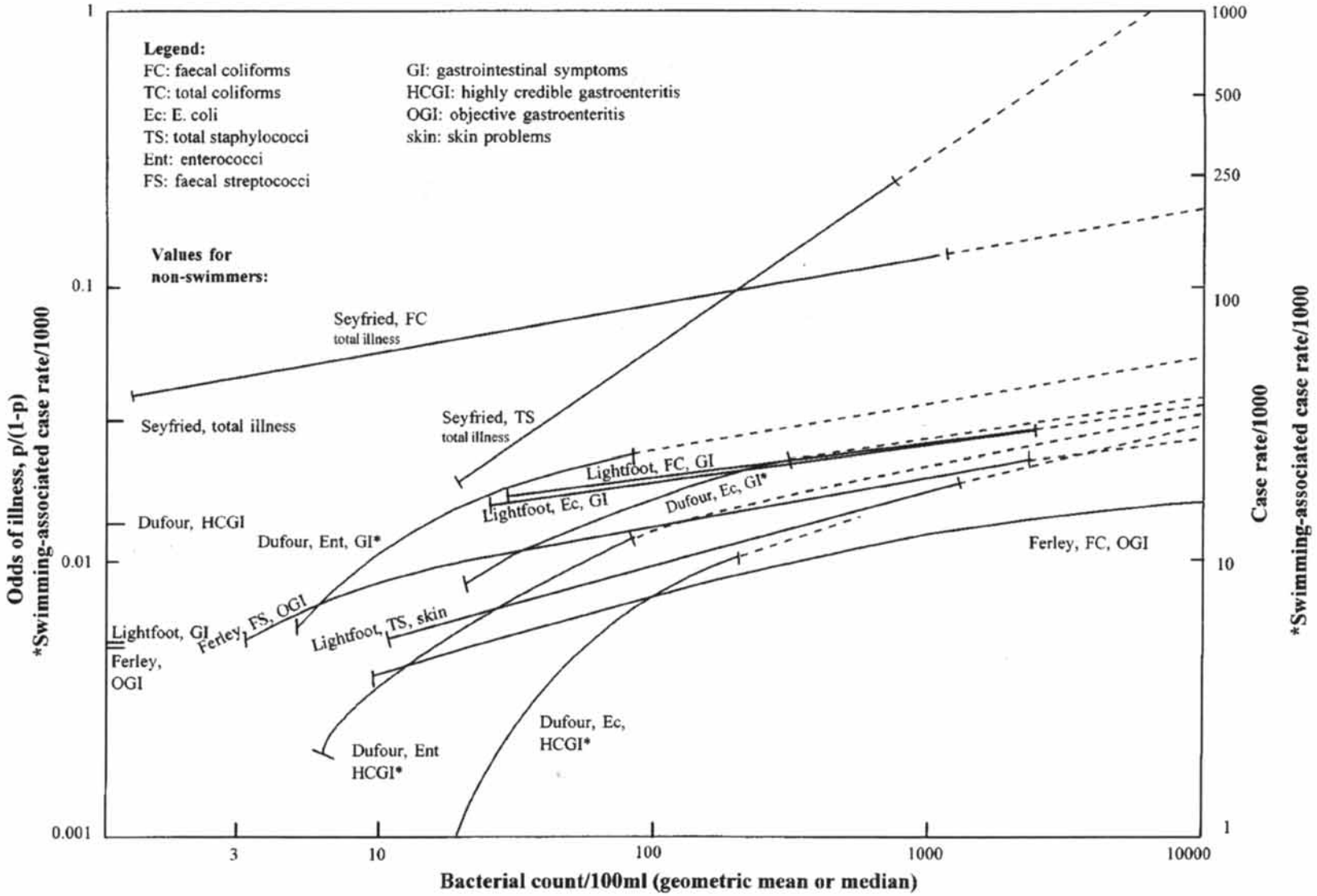


Figure 5-3. Relationship between illness risk for swimmers and indicator bacteria count in multiple freshwater epidemiological studies. Reproduced from Prüss 1998.

KS

Oolagahl Lake

Lake O the Cherokees

Keystone Lake

Tenkiller Lake

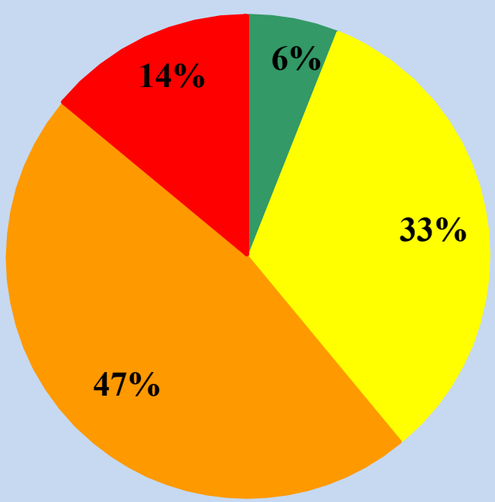
Eufaula Lake

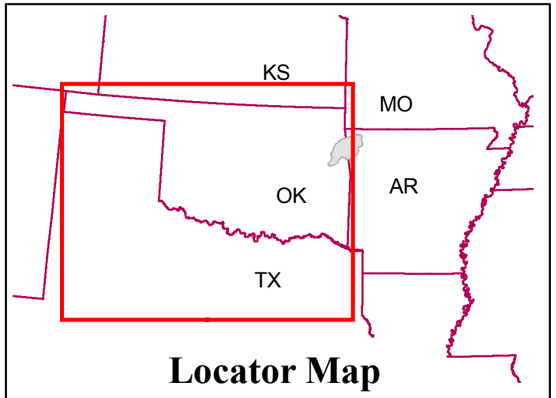
Hugo Lake

Pine Creek Lake

Broken Bow Lake

TX





Locator Map

Legend

Trophic State Index

- Oligotrophic (<=40)
- Mesotrophic (41 - 50)
- Eutrophic (51 - 60)
- Hypereutrophic (>= 61)
- Rivers
- Lakes
- Illinois River Watershed

**This map was replicated from the 2007 BUMP. The TSI values represent the most recent data and were taken from the Lake Monitoring and Results Discussion of the report. Coordinates for Wayne Wallace could not be found and is not displayed on this map.*

Figure 6-1.
2004-2007 BUMP (OWRB) sample lakes in Oklahoma.

OIClln:114

January 2009

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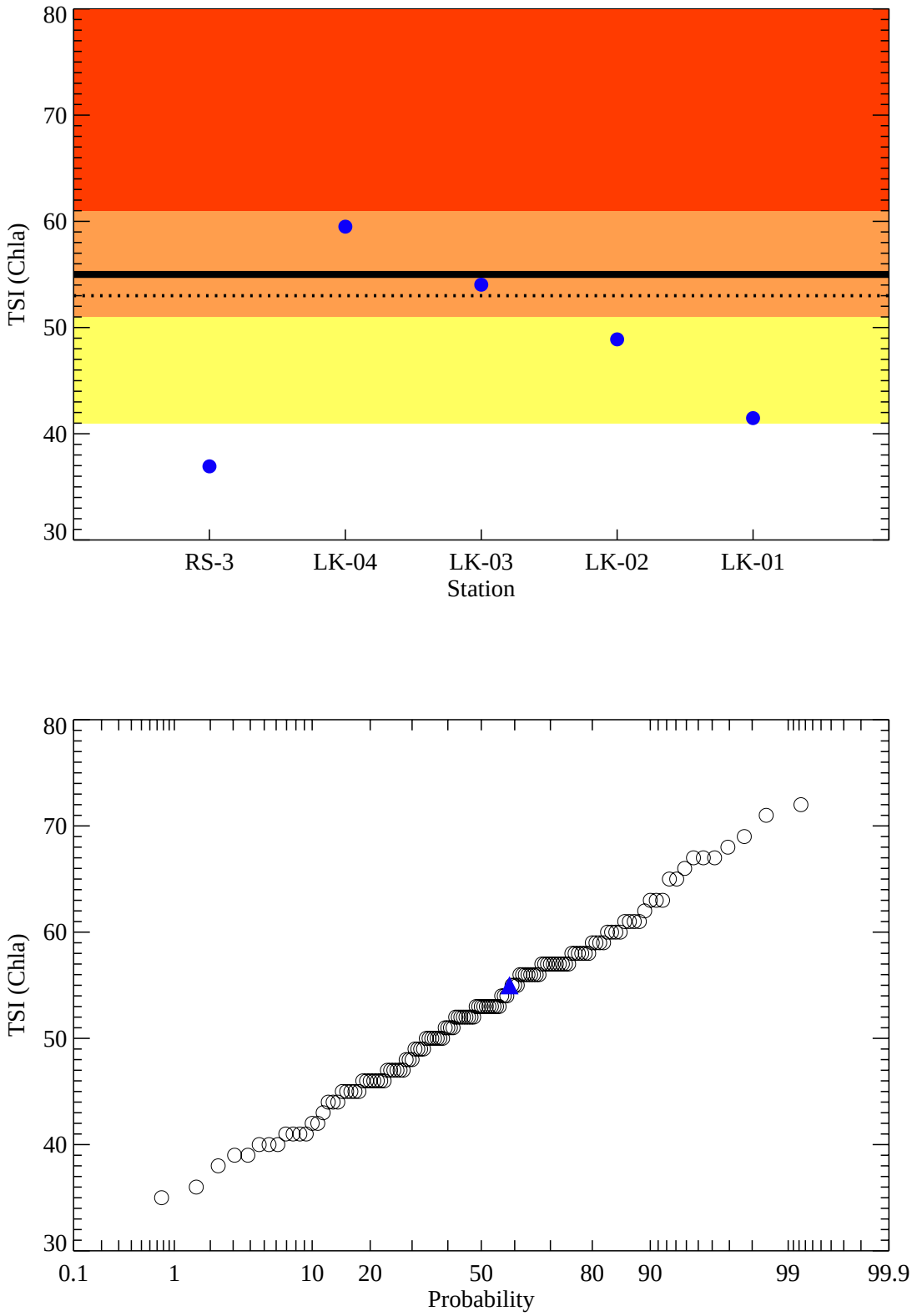

Figure 6-2. Spatial and probability distribution of summer TSI (chlorophyll-a).

Tenkiller data in the first panel comprise surface samples from summer 2006.
Points in the second panel are all BUMP TSI measurements in Oklahoma.
The blue point in the second panel represents TSI of Lake Tenkiller.
TSI = 9.81 ln Chlorophyll a (ug/L) + 30.6.
Data: OWRB - BUMP (2007), Plaintiff's Database 2004-2008.

- Mesotrophic range
- Eutrophic range
- Hypereutrophic range
- Mean BUMP TSI
- BUMP value at Tenkiller (55)

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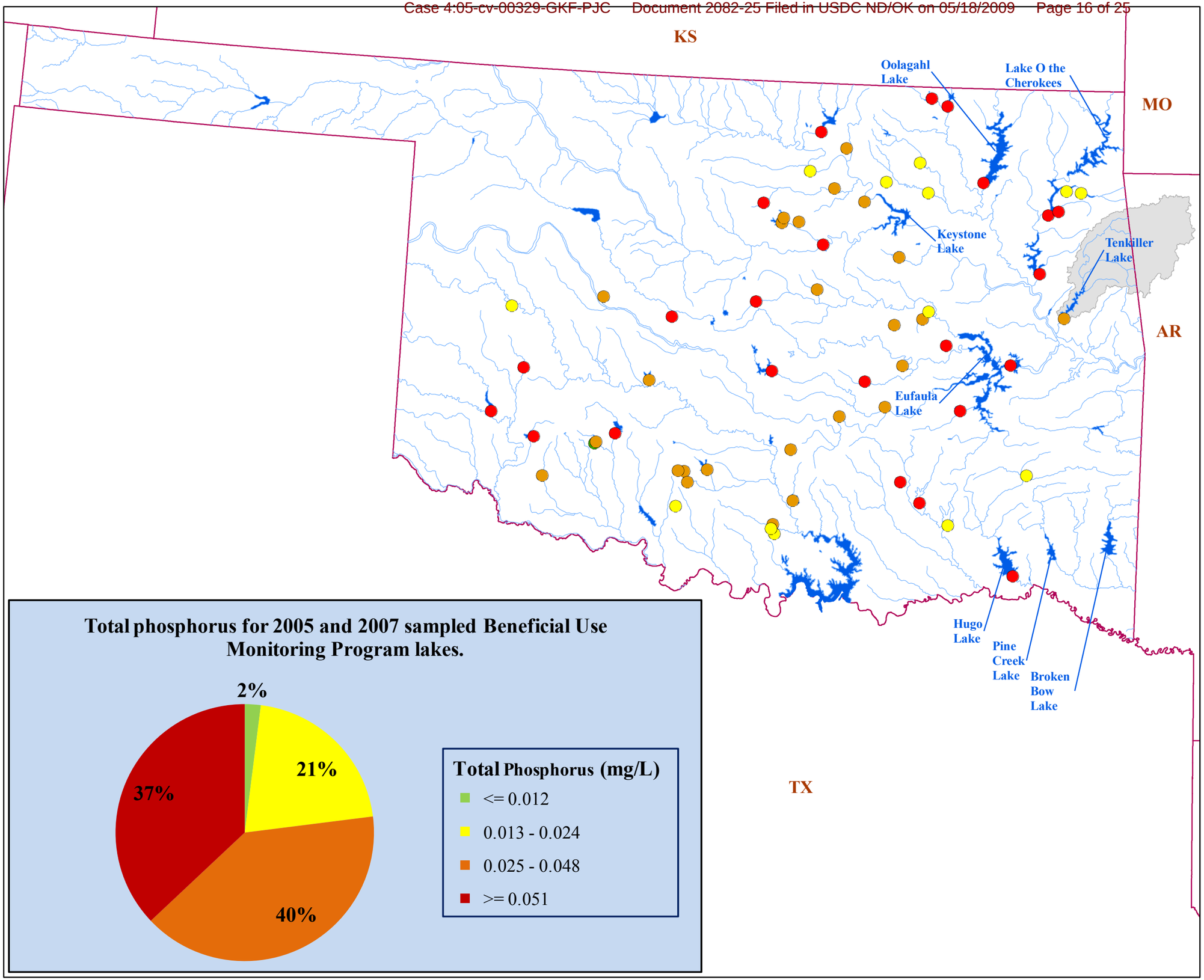

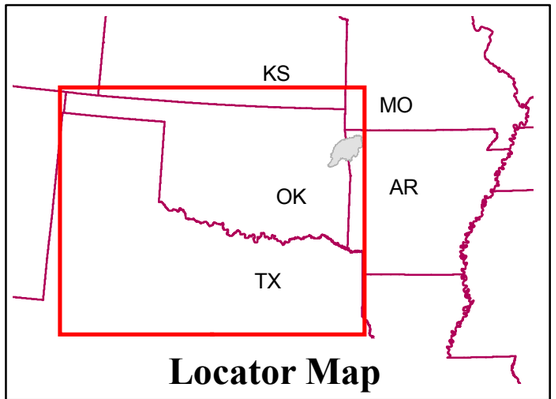

Legend

Total Phosphorus* (mg/L)

- <= 0.012
- 0.013 - 0.024
- 0.025 - 0.048
- >= 0.051
- Rivers
- Lakes
- Illinois River Watershed

**This map was created from data in the 2005 and 2007 BUMP. The Total phosphorus (calculated from TSI values) values represent the most recent data and were taken from the Lake Monitoring and Results Discussion of the report (Table 5). Coordinates for Wayne Wallace could not be found and is not displayed on this map.*

Figure 6-3. Total phosphorus for 2005 and 2007 BUMP (OWRB) sampled lakes in Oklahoma.

OICiln:114 January 2009

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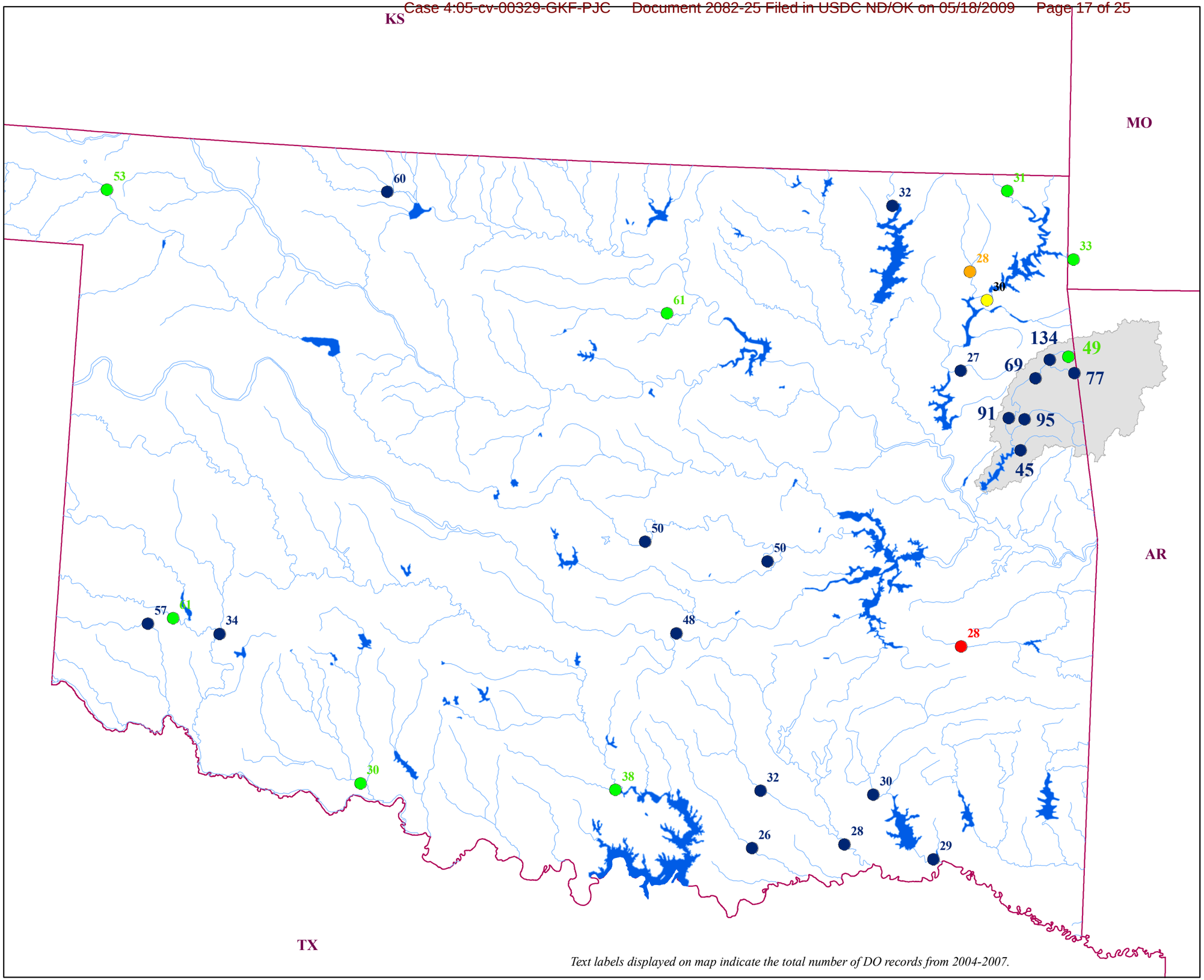
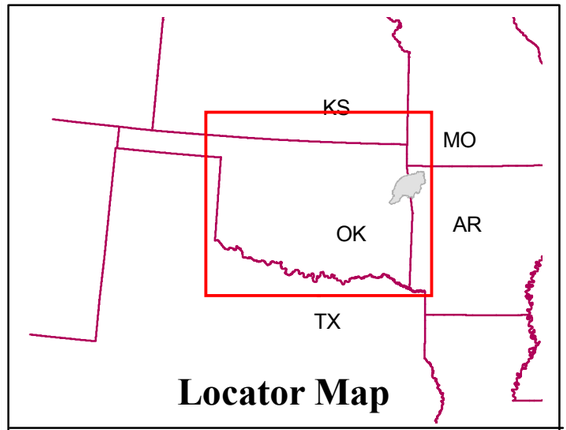


Text labels displayed on map indicate the total number of DO records from 2004-2007.



Locator Map

Legend

Dissolved oxygen*

- 0 years with > 10% below screening level
- 1 year with > 10% below screening level
- 2 years with > 10% below screening level
- 3 years with > 10% below screening level
- 4 years with > 10% below screening level
- Rivers
- Lakes
- Illinois River Watershed

**These values represent the number of years that a given station exceeded the standard and for streams and rivers only.*

Notes:

1) This analysis is based on habitat specific DO screening levels:

a) For warm water habitat 4.0 mg/L between June 16 and October 15 and 5.0 mg/L for the rest of the year.

b) For cold water habitat 5.0 mg/L between June 16 and October 15 and 6.0 mg/L for the rest of the year.

2) Data sources: ADEQ, OWRB, USGS, Storet, Storet-Modern and Plaintiffs' data collected 2005 - 2007.

3) To assure sufficient data for determining frequency of exceedance, all sampling stations which meet the following criteria are shown:

- 8 or more DO records per year in at least 2 years from 2004-2007

- 1 or more DO records per quarter (3-month period) for at least 3 quarters each year.

Figure 6-4. Dissolved oxygen exceedances for the state of Oklahoma, 2004-2007.

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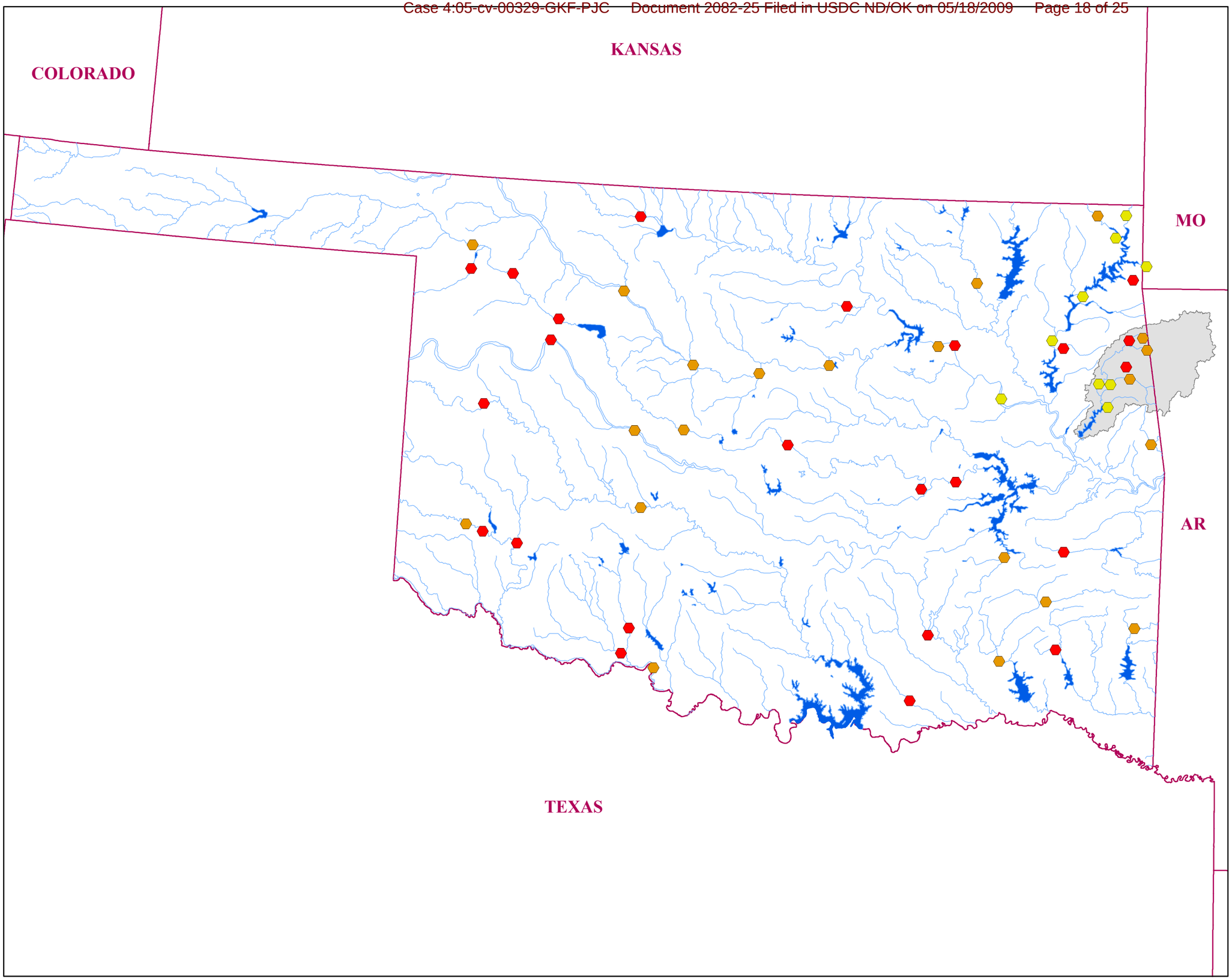
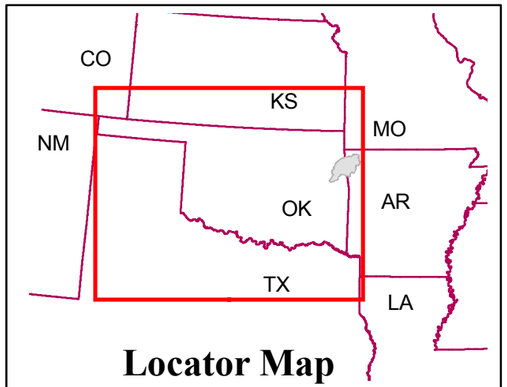
January 2009





Locator Map

Legend

Enterococci

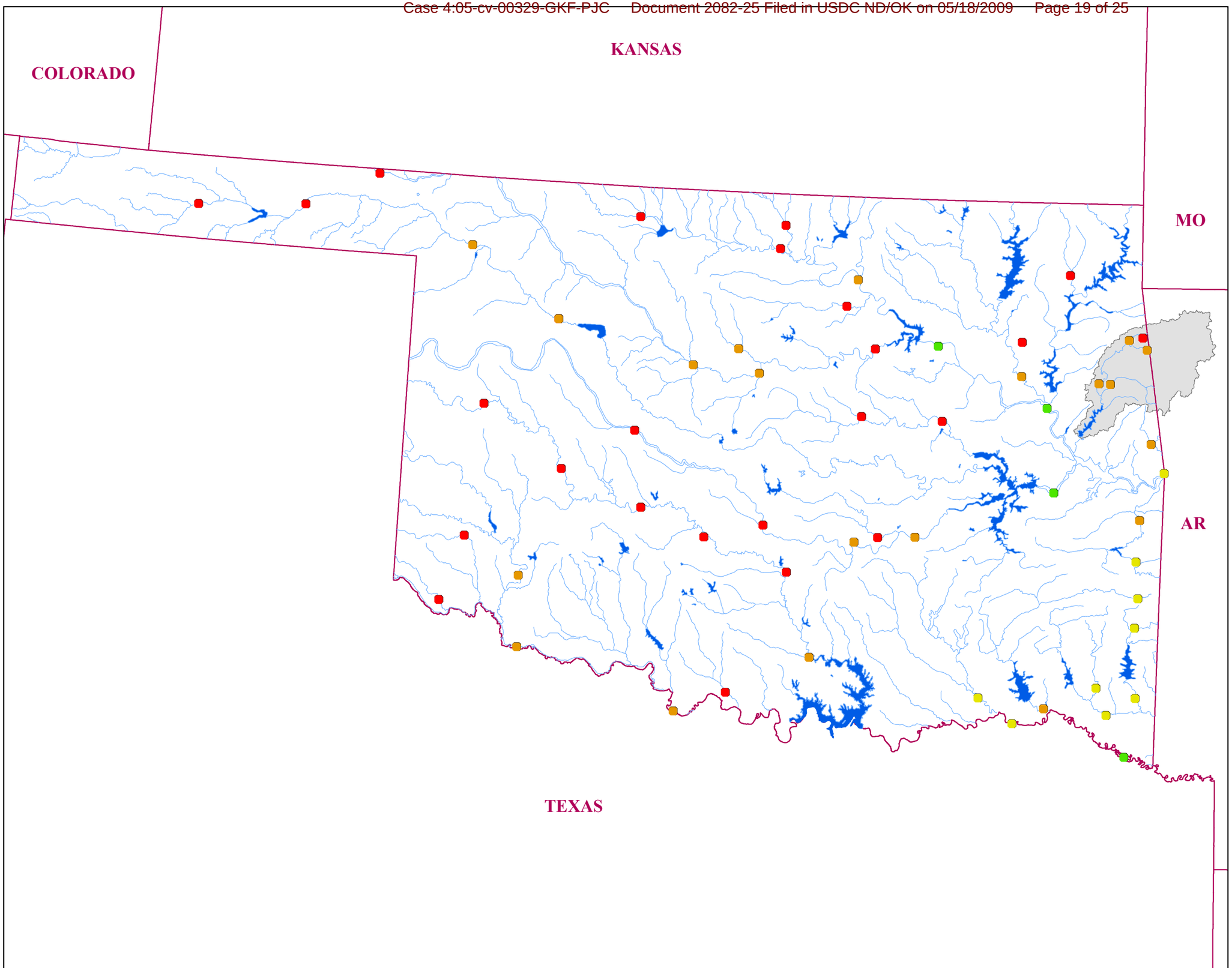
- < 33 (1<x threshold)
- 33 - 66 (1-2x threshold)
- 66 - 164 (2-5x threshold)
- >= 164 (>=5x threshold)
- Rivers
- Lakes
- Illinois River Watershed

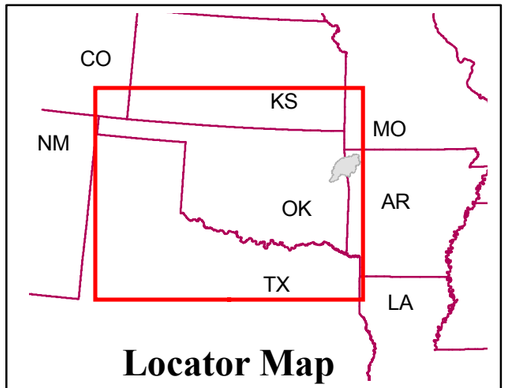
Notes:
1) Data represent the May - September time period.
2) Stations with fewer than 5 data records were omitted.
3) Samples below the quantitation limit were averaged in at the quantitation limit.
4) Units for bacteria are cfu/100 ml or mpn/100 ml.
Data sources may include: Plaintiffs' data collected 2005 - 2007, OKCC, OWRB, USGS and STORET-Modern.

Figure 6-5a.
2003 Enterococci seasonal geometric mean counts at sampling locations throughout Oklahoma.

OICiln:114

January 2009





Locator Map

Legend

Enterococci

- < 33 (< 1x threshold)
- 33 - 66 (1-2x threshold)
- 66 - 164 (2-5x threshold)
- >= 164 (>=5x threshold)
- Rivers
- Lakes
- Illinois River Watershed

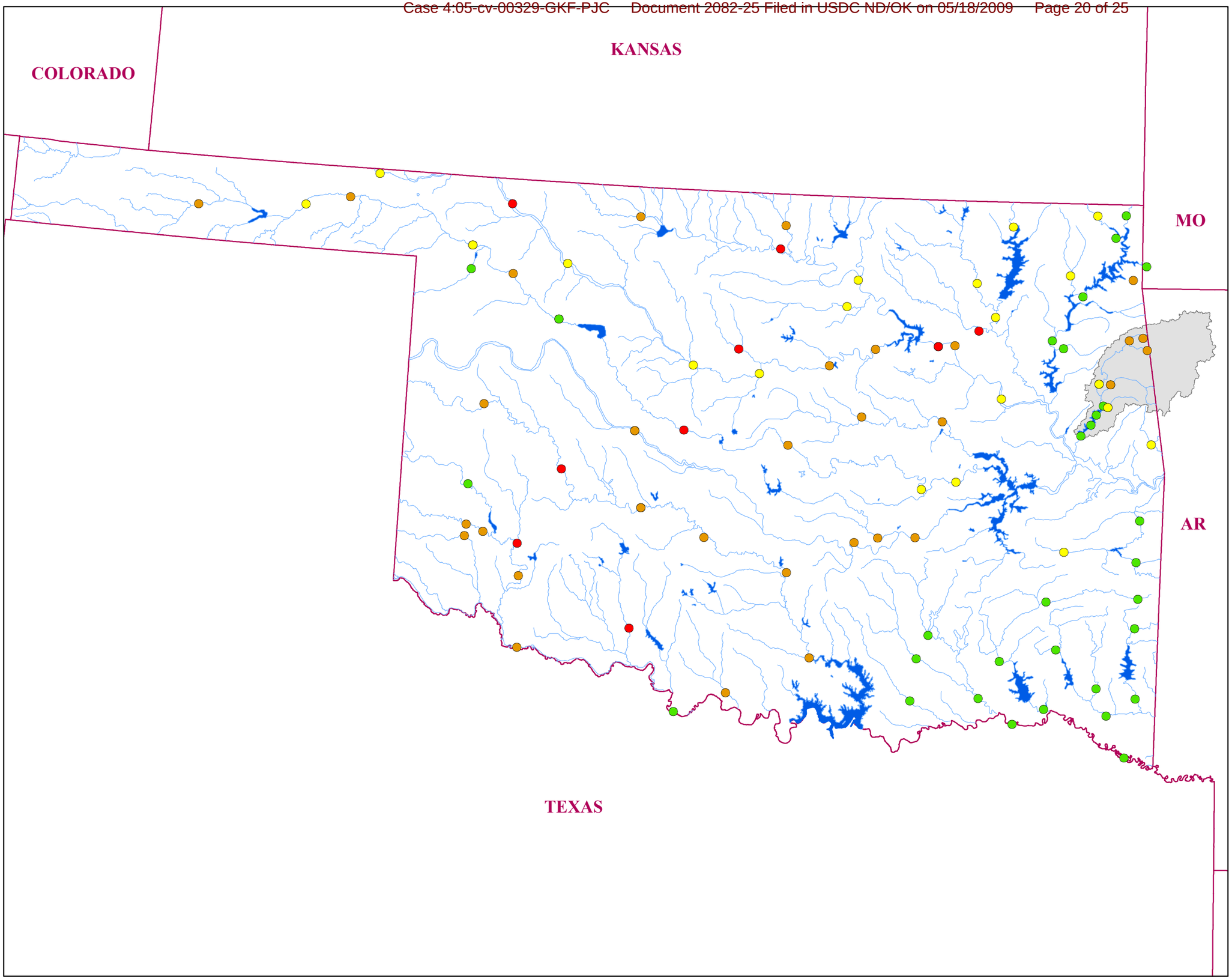
Notes:
1) Data represent the May - September time period.
2) Stations with fewer than 5 data records were omitted.
3) Samples below the quantitation limit were averaged in at the quantitation limit.
4) Units for bacteria are cfu/100 ml or mpn/100 ml.
Data sources may include: Plaintiffs' data collected 2005 - 2007, OKCC, OWRB, USGS and STORET-Modern.

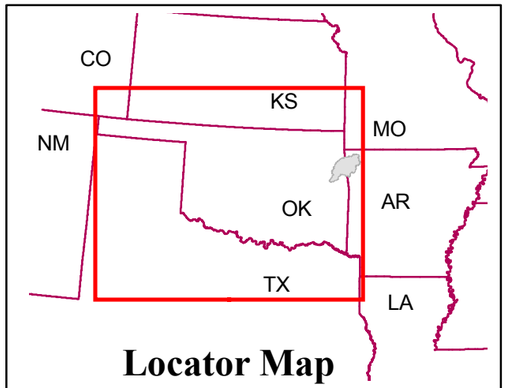
Figure 6-5b.
2004 Enterococci seasonal geometric mean counts at sampling locations throughout Oklahoma.

QEA Quantitative Environmental Analysis, LLC

OICiln:114

January 2009





Locator Map

Legend

Enterococci

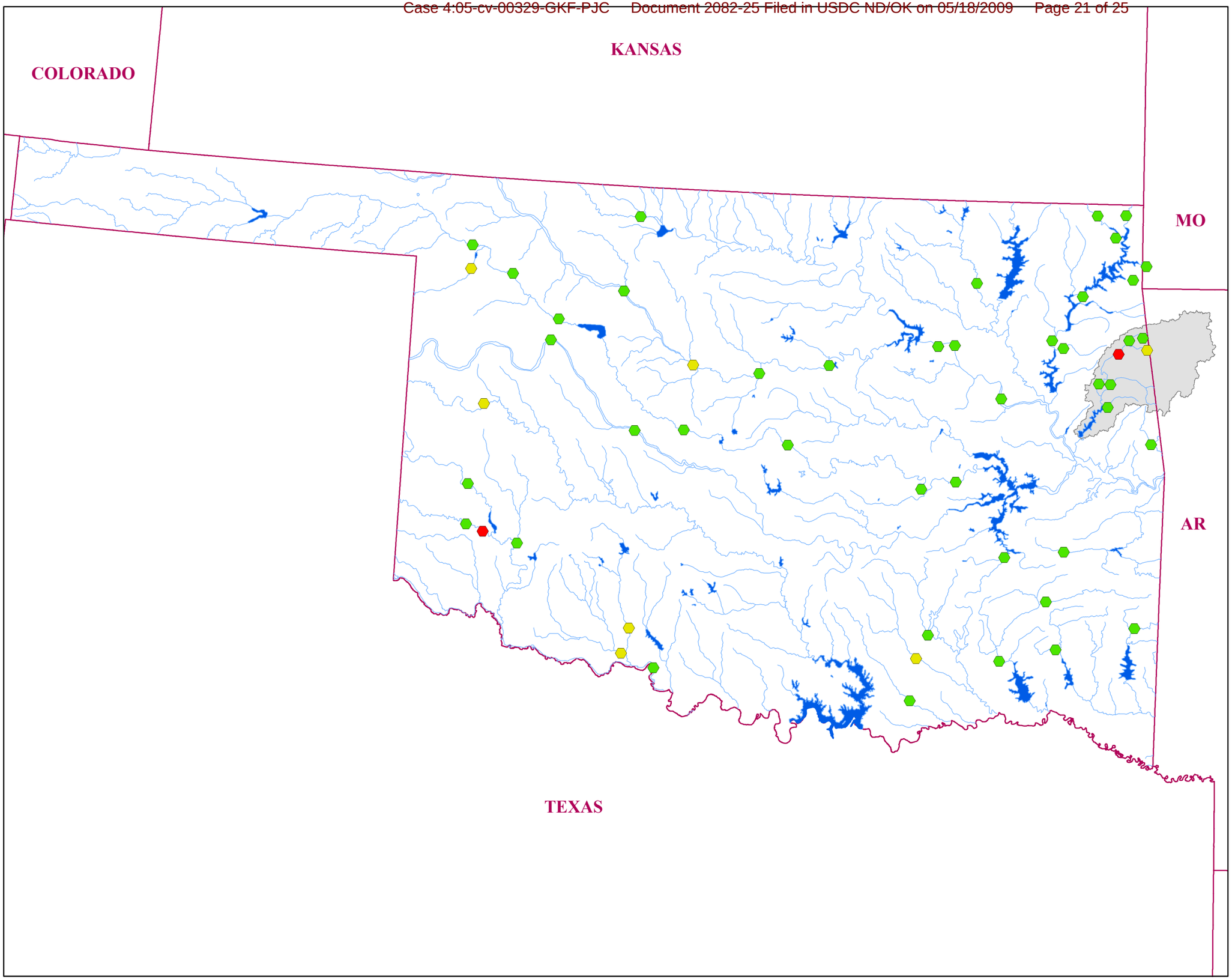
- < 33 (< 1x threshold)
- 33 - 66 (1-2x threshold)
- 66 - 164 (2-5x threshold)
- >= 164 (>=5x threshold)
- Rivers
- Lakes
- Illinois River Watershed

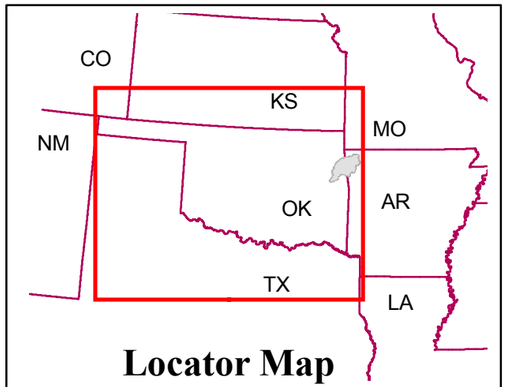
Notes:
1) Data represent the May - September time period.
2) Stations with fewer than 5 data records were omitted.
3) Samples below the quantitation limit were averaged in at the quantitation limit.
4) Units for bacteria are cfu/100 ml or mpn/100 ml.
Data sources may include: Plaintiffs' data collected 2005 - 2007, OKCC, OWRB, USGS and STORET-Modern.

Figure 6-5c.
2006 Enterococci seasonal geometric mean counts at sampling locations throughout Oklahoma.

OICiln:114

January 2009





Locator Map

Legend

E. coli

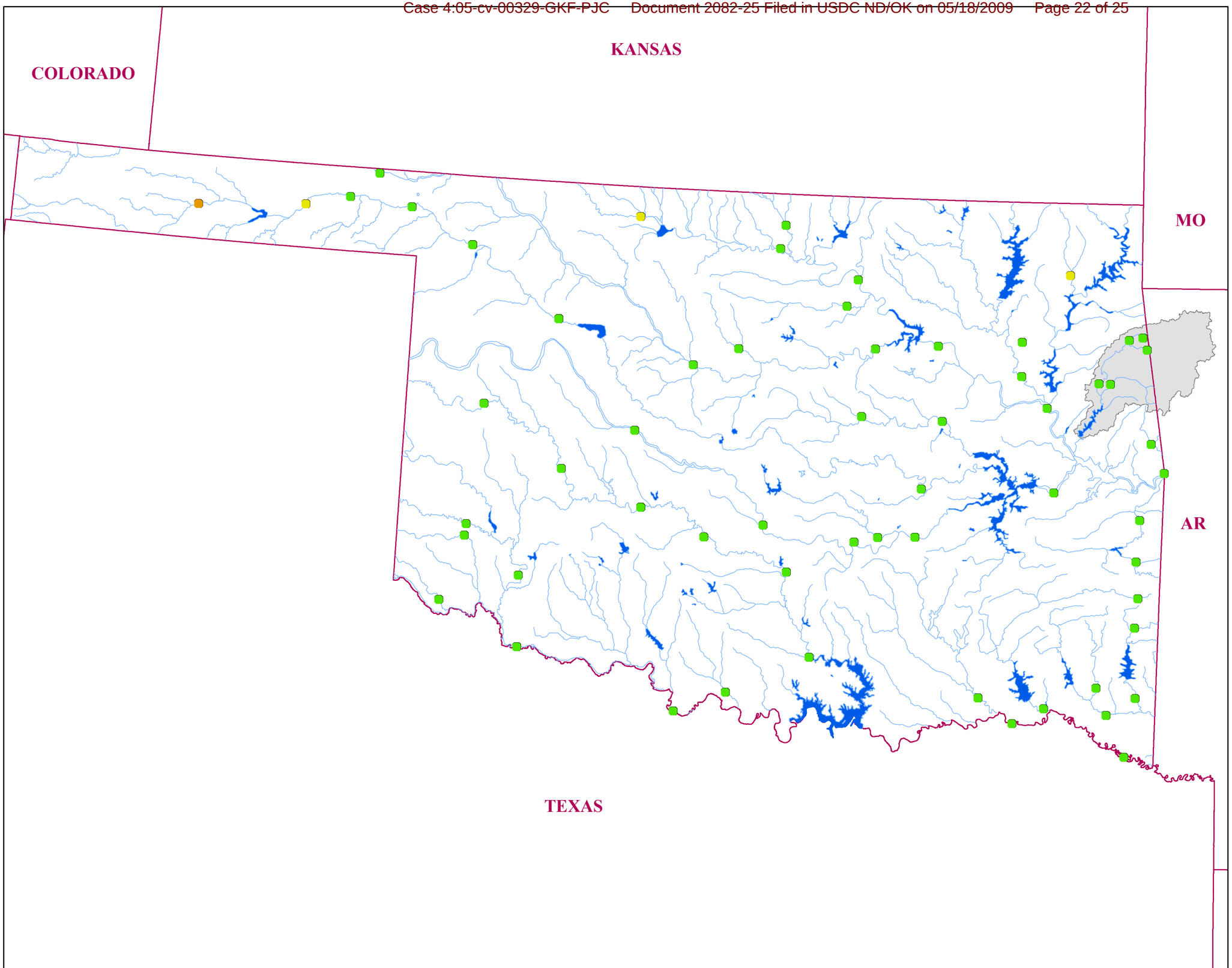
- < 126 (<1x threshold)
- 126 - 252 (1-2x threshold)
- 252 - 630 (2-5x threshold)
- >= 630 (>=5x threshold)
- Rivers
- Lakes
- Illinois River Watershed

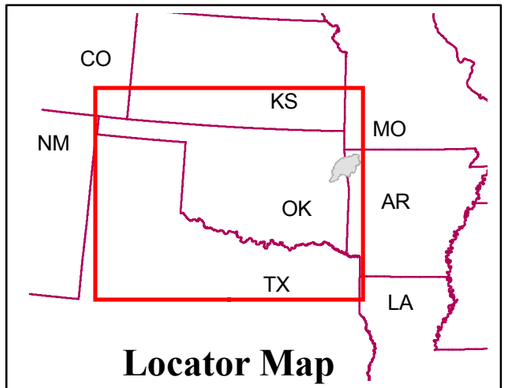
Notes:
1) Data represent the May - September time period.
2) Stations with fewer than 5 data records were omitted.
3) Samples below the quantitation limit were averaged in at the quantitation limit.
4) Units for bacteria are cfu/100 ml or mpn/100 ml.
Data sources may include: Plaintiffs' data collected 2005 - 2007, OKCC, OWRB, USGS and STORET-Modern.

Figure 6-5d.
2003 *E. coli* seasonal geometric mean counts at sampling locations throughout Oklahoma.

OICiln:114

January 2009





Locator Map

Legend

E. coli

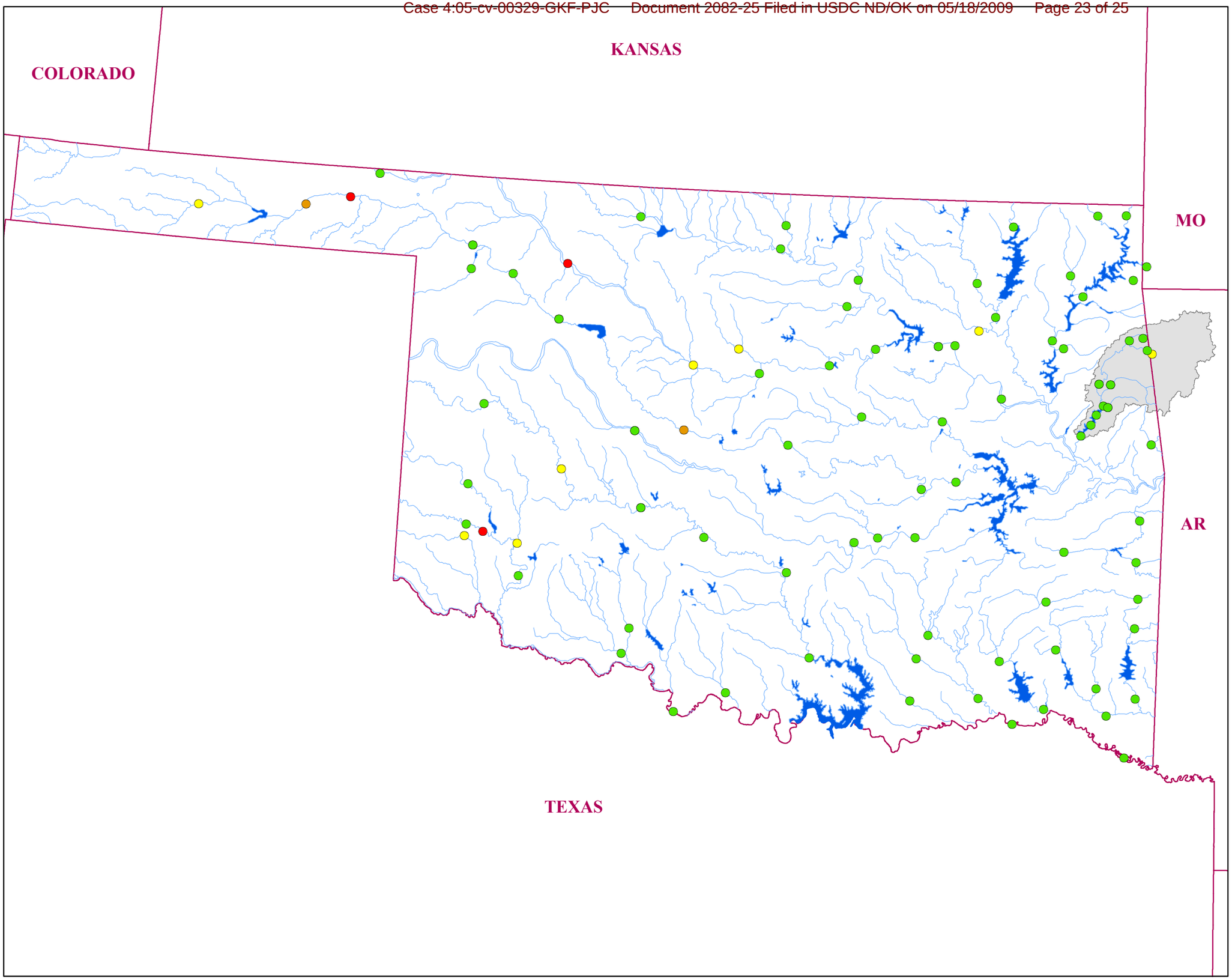
- < 126 (<1x threshold)
- 126 - 252 (1-2x threshold)
- 252 - 630 (2-5x threshold)
- >= 630 (>=5x threshold)
- Rivers
- Lakes
- Illinois River Watershed

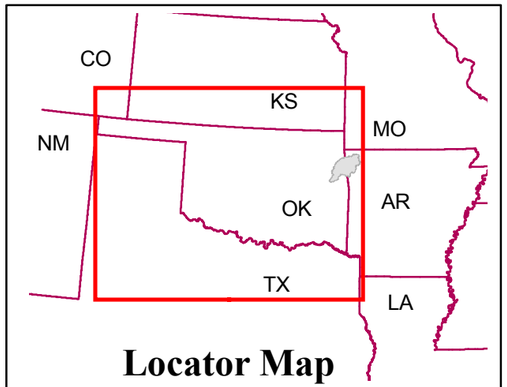
Notes:
1) Data represent the May - September time period.
2) Stations with fewer than 5 data records were omitted.
3) Samples below the quantitation limit were averaged in at the quantitation limit.
4) Units for bacteria are cfu/100 ml or mpn/100 ml.
Data sources may include: Plaintiffs' data collected 2005 - 2007, OKCC, OWRB, USGS and STORET-Modern.

Figure 6-5e.
2004 *E. coli* seasonal geometric mean counts at sampling locations throughout Oklahoma.

OICiln:114

January 2009





Locator Map

Legend

E. coli

- < 126 (<1x threshold)
- 126 - 252 (1-2x threshold)
- 252 - 630 (2-5x threshold)
- >= 630 (>=5x threshold)
- Rivers
- Lakes
- Illinois River Watershed

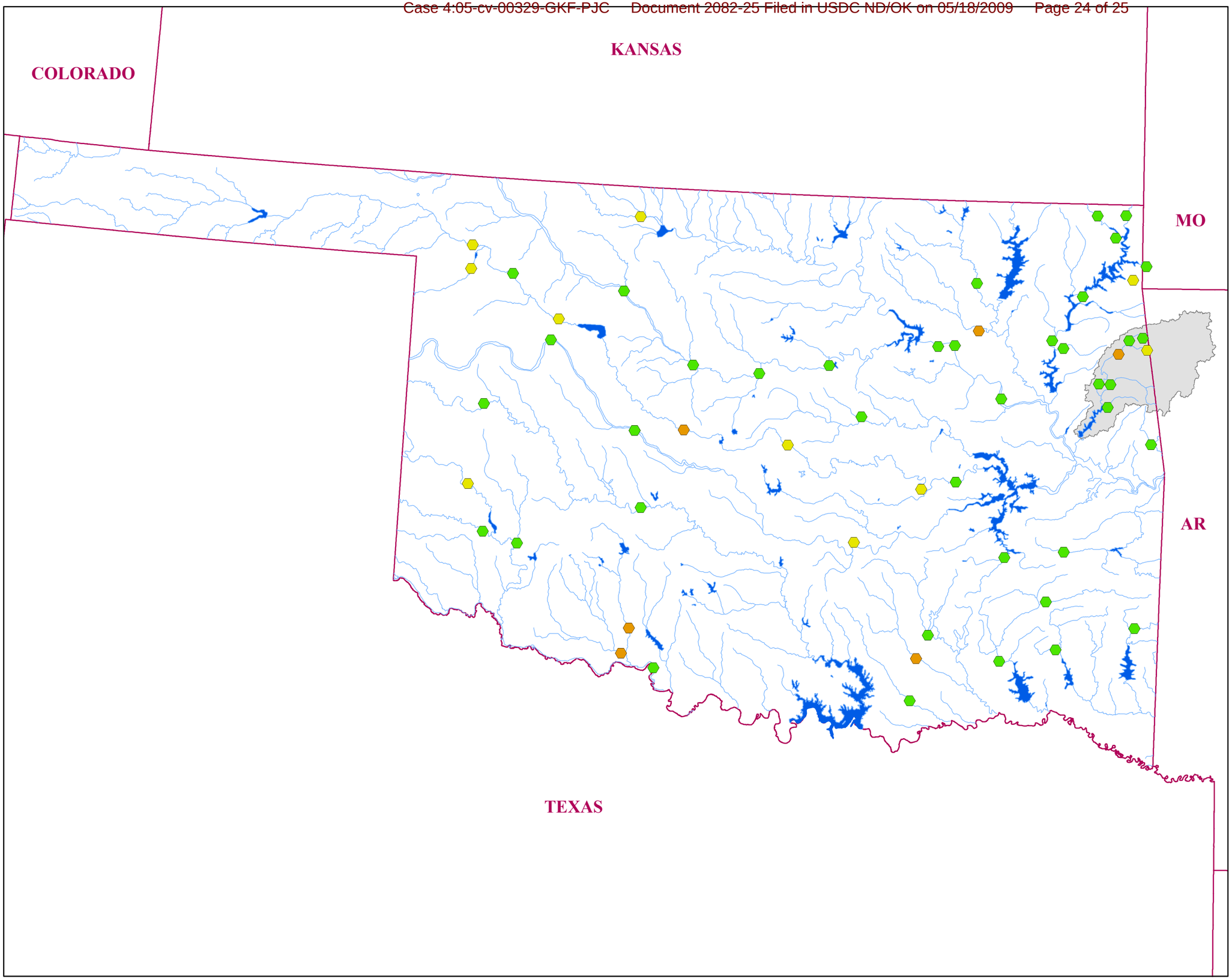
Notes:
1) Data represent the May - September time period.
2) Stations with fewer than 5 data records were omitted.
3) Samples below the quantitation limit were averaged in at the quantitation limit.
4) Units for bacteria are cfu/100 ml or mpn/100 ml.
Data sources may include: Plaintiffs' data collected 2005 - 2007, OKCC, OWRB, USGS and STORET-Modern.

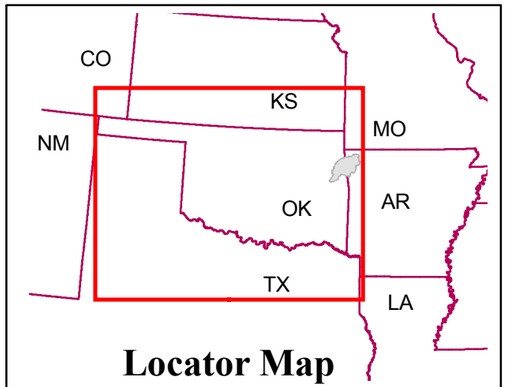
Figure 6-5f.
2006 *E. coli* seasonal geometric mean counts at sampling locations throughout Oklahoma.

OICiln:114

January 2009

CALL - \\Frodo\D_Drive\QEA_Syracuse\Jobs\OICiln\GIS\Projects\Chicken\Bacteria_locs_OKstate.mxd





Locator Map

Legend

Fecal Coliform

- < 200 (<1x threshold)
- 200 - 400 (1-2x threshold)
- 400 - 1000 (2-5x threshold)
- >= 1000 (>=5x threshold)
- Rivers
- Lakes
- Illinois River Watershed

Notes:
1) Data represent the May - September time period.
2) Stations with fewer than 5 data records were omitted.
3) Samples below the quantitation limit were averaged in at the quantitation limit.
4) Units for bacteria are cfu/100 ml or mpn/100 ml.
Data sources may include: Plaintiffs' data collected 2005 - 2007, OKCC, OWRB, USGS and STORET-Modern.

Figure 6-5g.
2003 Fecal Coliform seasonal geometric mean counts at sampling locations throughout Oklahoma.

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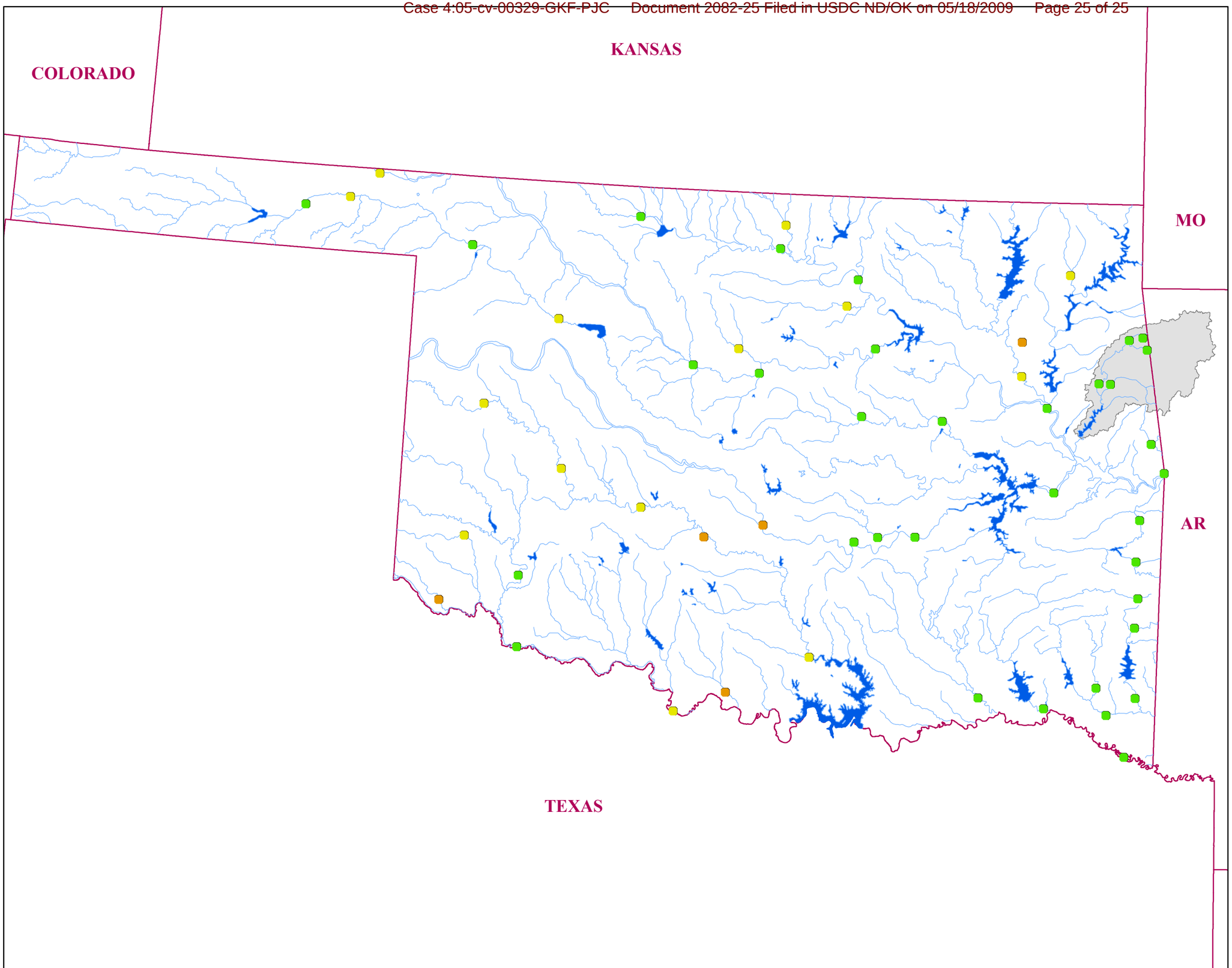

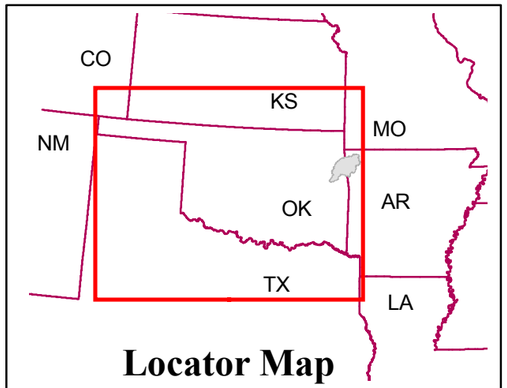

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Figure 6-5h.
2004 Fecal Coliform seasonal geometric mean counts at sampling locations throughout Oklahoma.

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