NDEP Bureau of Water Quality Planning

Review of Lahontan Reservoir Water Quality Standards

Focus Group Meeting #1 Discussion on Background

March 5, 2013

Focus Group Activities

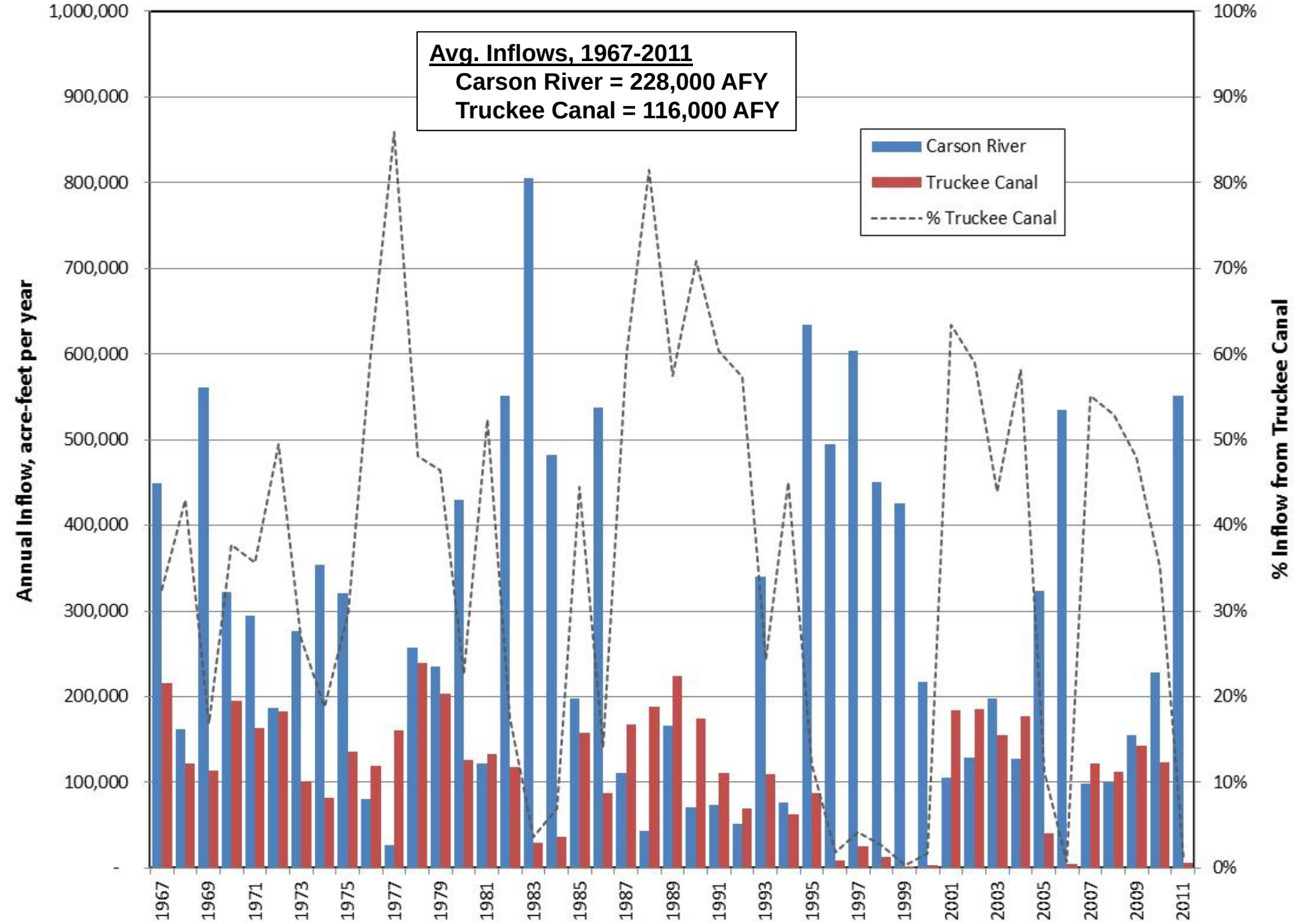
- Ongoing opportunity for stakeholder input as NDEP works through the technical aspects of the review
  - Hopefully address concerns early on
- Chance to delve into the more detailed aspects of the standards review process
- General topics of discussion
  - Background
    - Reservoir characteristics
    - Water Quantity/Management
    - Uses
    - WQ
  - Beneficial Use Review
  - Numeric Criteria
  - Antidegradation Criteria (RMHQs)

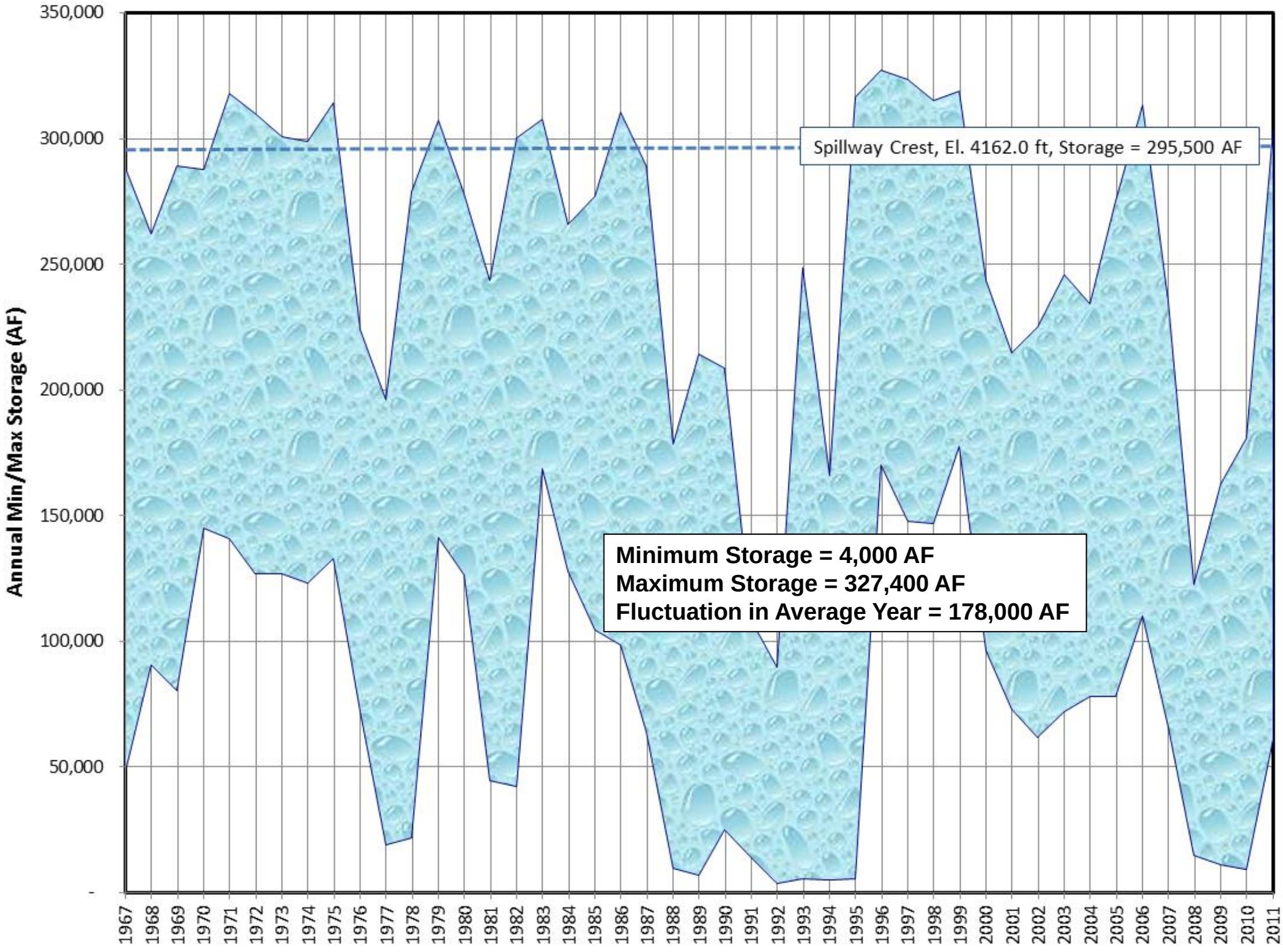
Key Elements of Water Quality Standards

1) Designated beneficial uses
2) Criteria to protect beneficial use
3) Antidegradation provision (RMHQs)

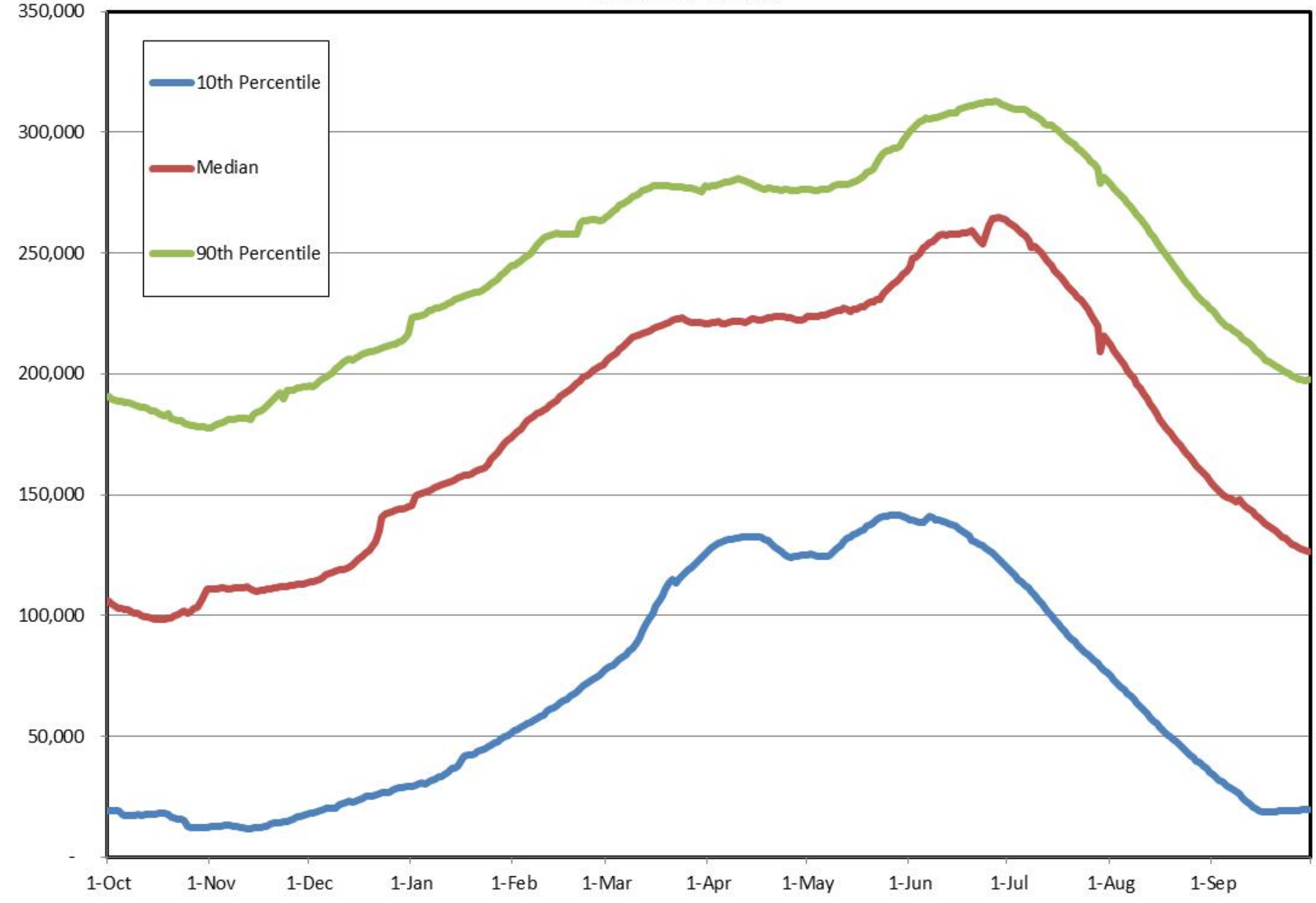
Current Reach in NAC 445A.1824

- Capacity = 295,000 AF (318,900 AF with flashboards)
- Surface area = 13,470 acres (at spillway)
- Max. Depth Active Storage = 92 feet (from outlet invert to spillway)
- 3 basins


Avg. Inflows, 1967-2011
Carson River = 228,000 AFY
Truckee Canal = 116,000 AFY
Carson River
Truckee Canal
% Truckee Canal
Annual Inflow, acre-feet per year
% Inflow from Truckee Canal
1,000,000
900,000
800,000
700,000
600,000
500,000
400,000
300,000
200,000
100,000
-
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
1967
1969
1971
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011


Annual Min/Max Storage (AF)
350,000
300,000
250,000
200,000
150,000
100,000
50,000
-
Spillway Crest, El. 4162.0 ft, Storage = 295,500 AF
Minimum Storage = 4,000 AF
Maximum Storage = 327,400 AF
Fluctuation in Average Year = 178,000 AF
1967
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011

Lahontan Reservoir - Historic Storage Levels (1967-2011) Compared to Recent Years



Dry Conditions not uncommon

- Storage = 22,700 AF (11/7/2012)
- Upper Basin has gone dry about 35% of years
- Middle Basin has gone dry about 28% of years

Middle Basin – 11/7/2012

Current Uses

- Irrigation – Primary use for project
- Aquatic life
  - Game fish
    - White bass
    - Smallmouth and Largemouth bass
    - Wipers – stocked
    - Channel and white catfish
    - Black and White Crappie
    - Yellow perch
    - Walleye – stocked
  - Nongame
    - Sacramento blackfish (commercial fishery)
    - Carp
    - Black and brown bullhead

Current Uses

- Livestock watering
- Recreation (contact and non-contact)
  - Lahontan State Recreation Area – 3rd most visited state park
  - Boating/Skiing
  - Swimming
    - 6 cases of reactions (skin rash, shortness of breath) in swimmers in last 7 years
  - Fishing
  - Algae complaints not uncommon

Current Uses

- Indirectly used for drinking water
  - Influences wells/springs used by State Park
  - Recharging groundwater in Lahontan Valley
- Industrial supply - Hydroelectric power generation
- Wildlife

Fish Kills

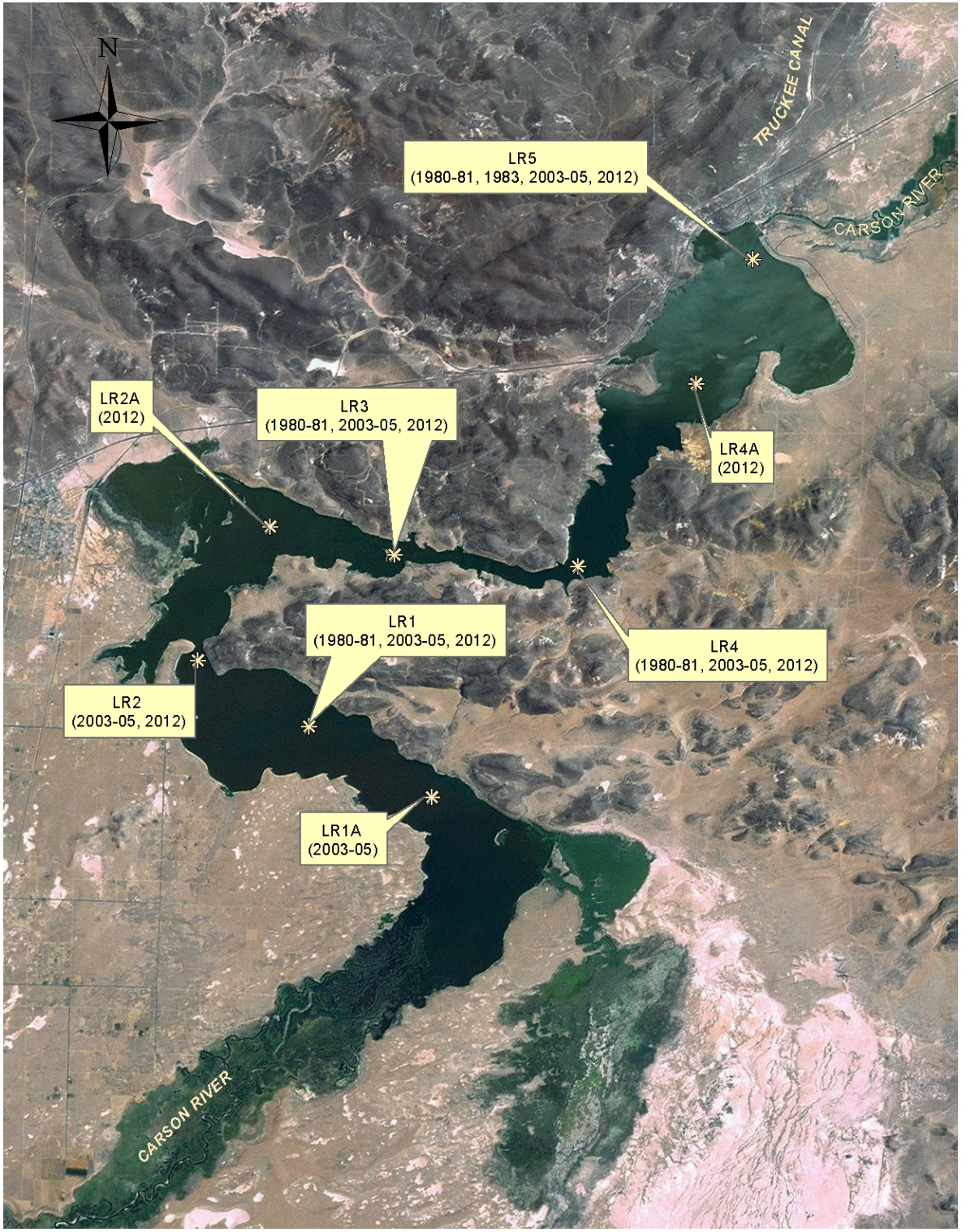
- Significant Fish Die-offs in 1980, 81, 1991
- 1980 - Cause uncertain – Possible factors
  - Cyanobacteria present
  - However low level of toxins found
  - Stress from unsuccessful spawning
  - Extensive Columnaris infection
- 1981 - Cause uncertain - Possible factors
  - Cyanobacteria
  - Columnaris infection
- 1991 – Cause uncertain
  - Newspaper states that kill was caused by cyanobacteria toxins – however no scientific evidence has been provided
  - VERY LOW STORAGE LEVELS

Fish Consumption Advisory

- Nevada Health Division fish consumption advisory
  - Recommends that NO fish be consumed from Lahontan Reservoir
- NDOW
  - 1 meal per month of Sacramento blackfish
- Fishing activities still take place but harvest levels have declined as a result of the advisory
- Some people still eating the fish

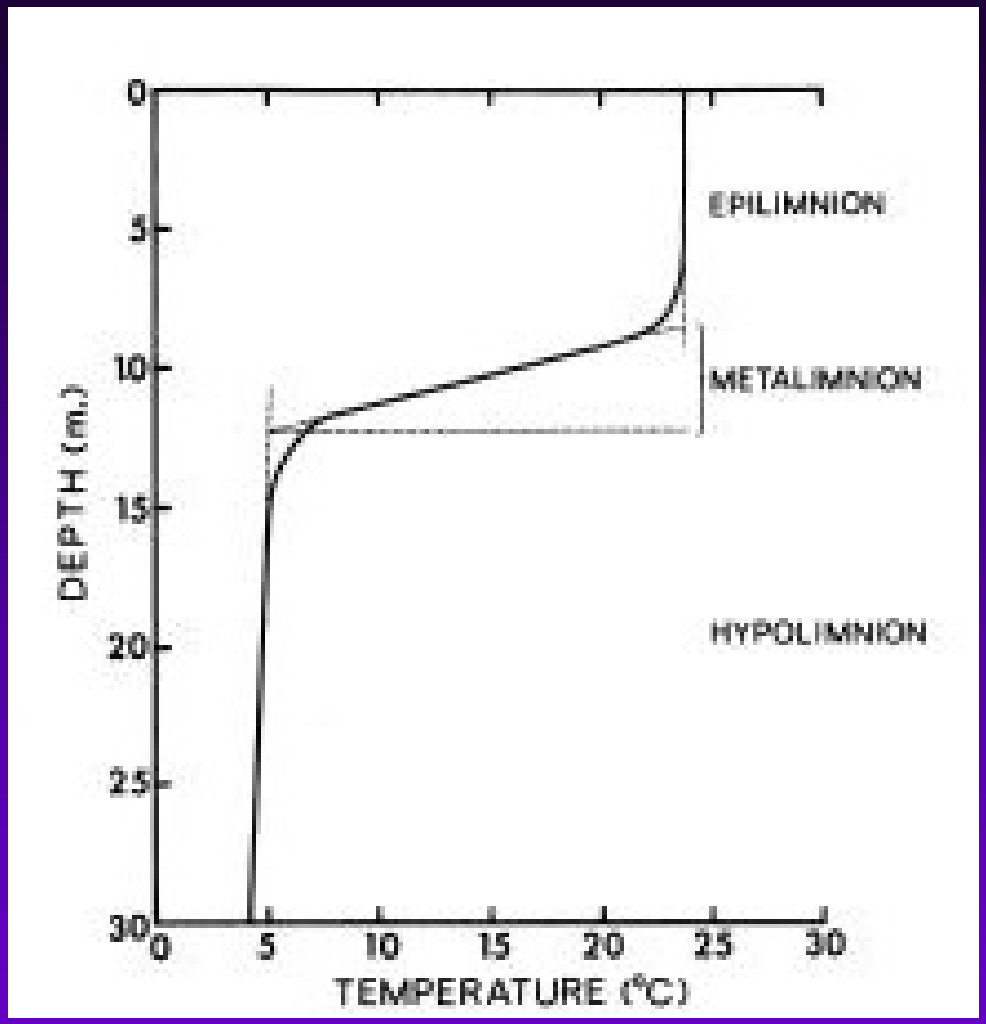
Quagga Mussels

- Considered “Positive” for the presence of quagga in 2011
  - 2012 Sampling – “Negative”
  - If continued “Negative” for 2-3 years, could be reclassified
- Damage infrastructure
- Quaggas are prodigious water filterers, removing substantial amounts of phytoplankton and suspended particulates from the water

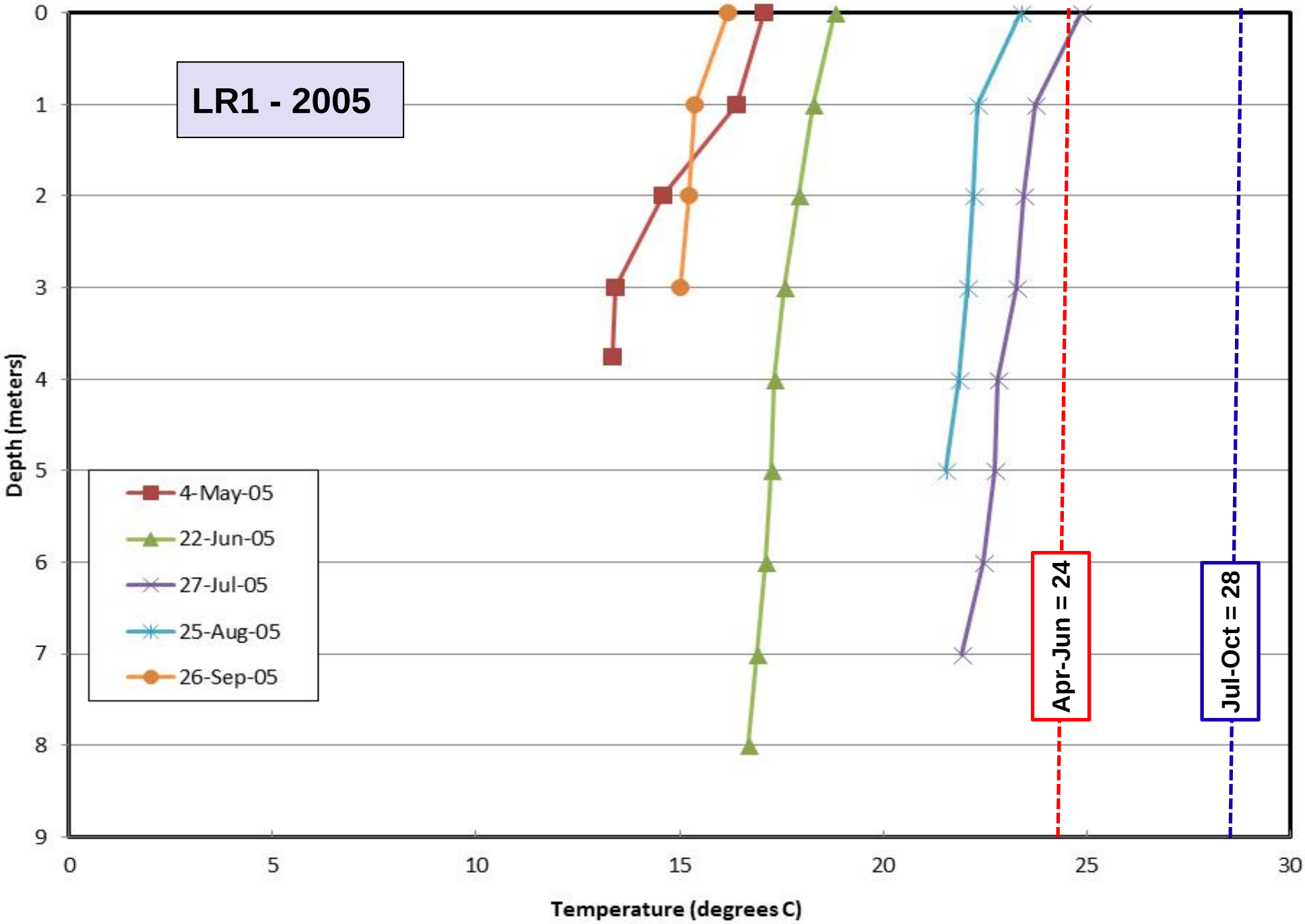


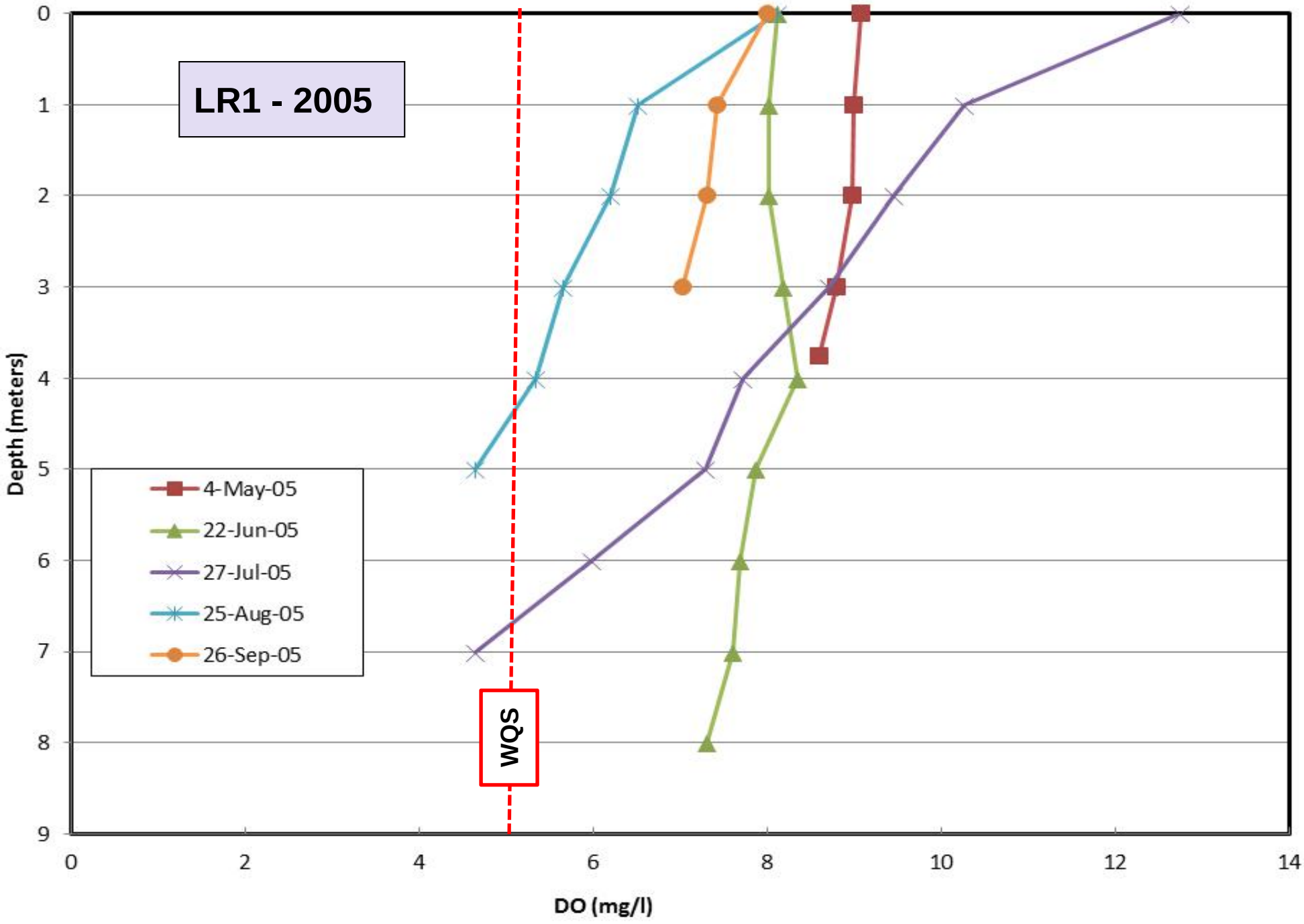
Lahontan Reservoir Monitoring Sites

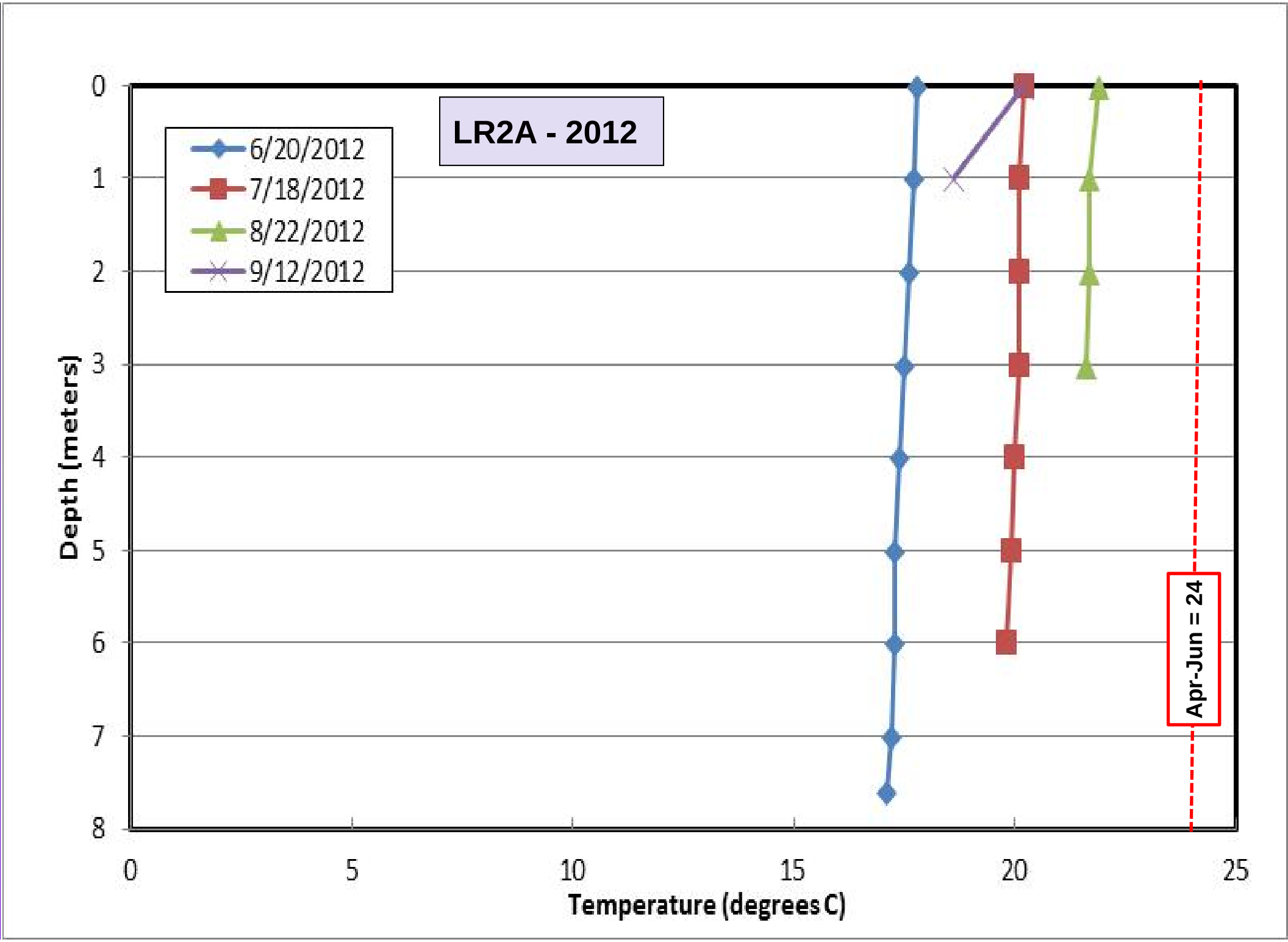
1980-81, 1983, 2003-05, 2012

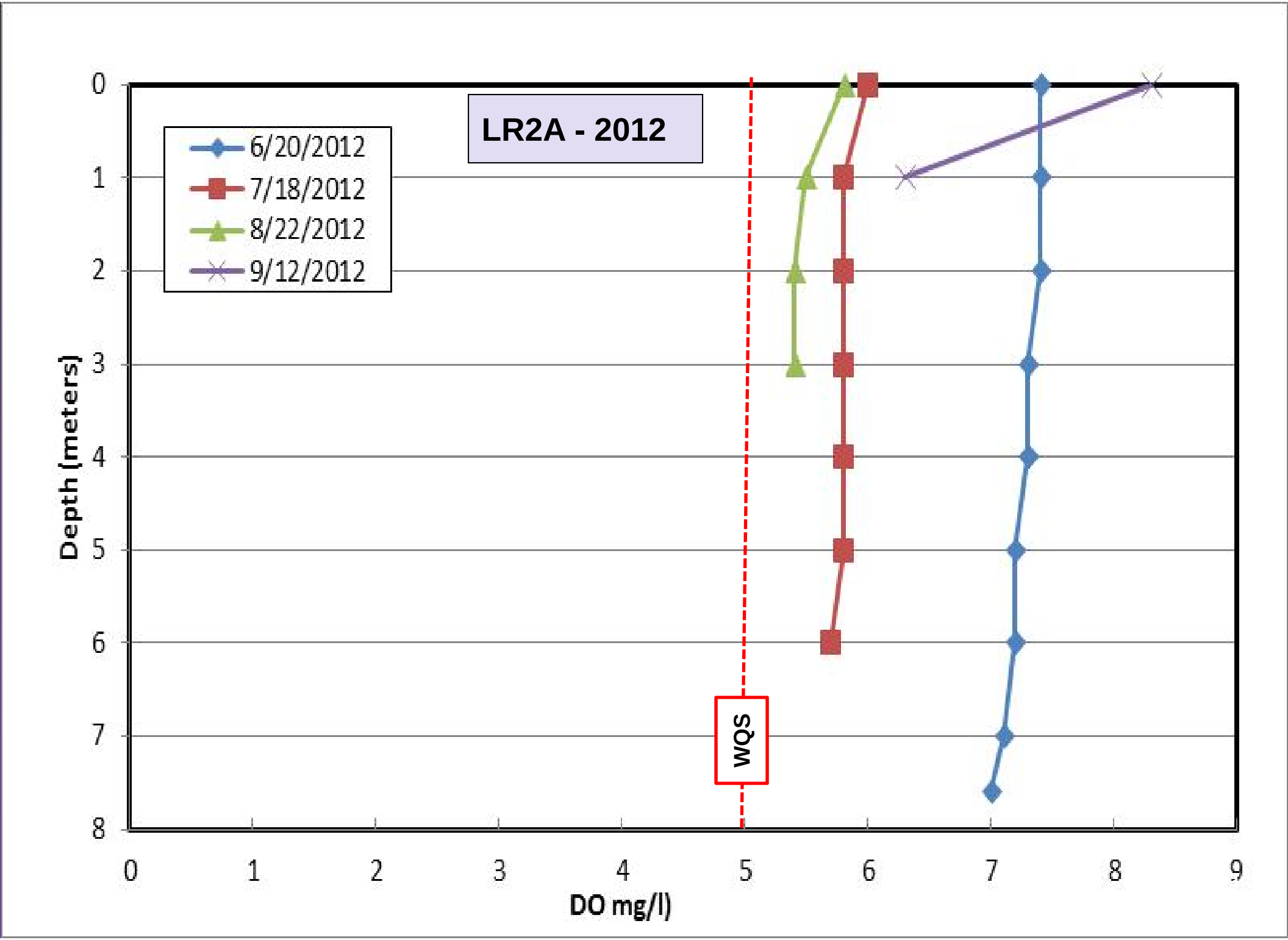


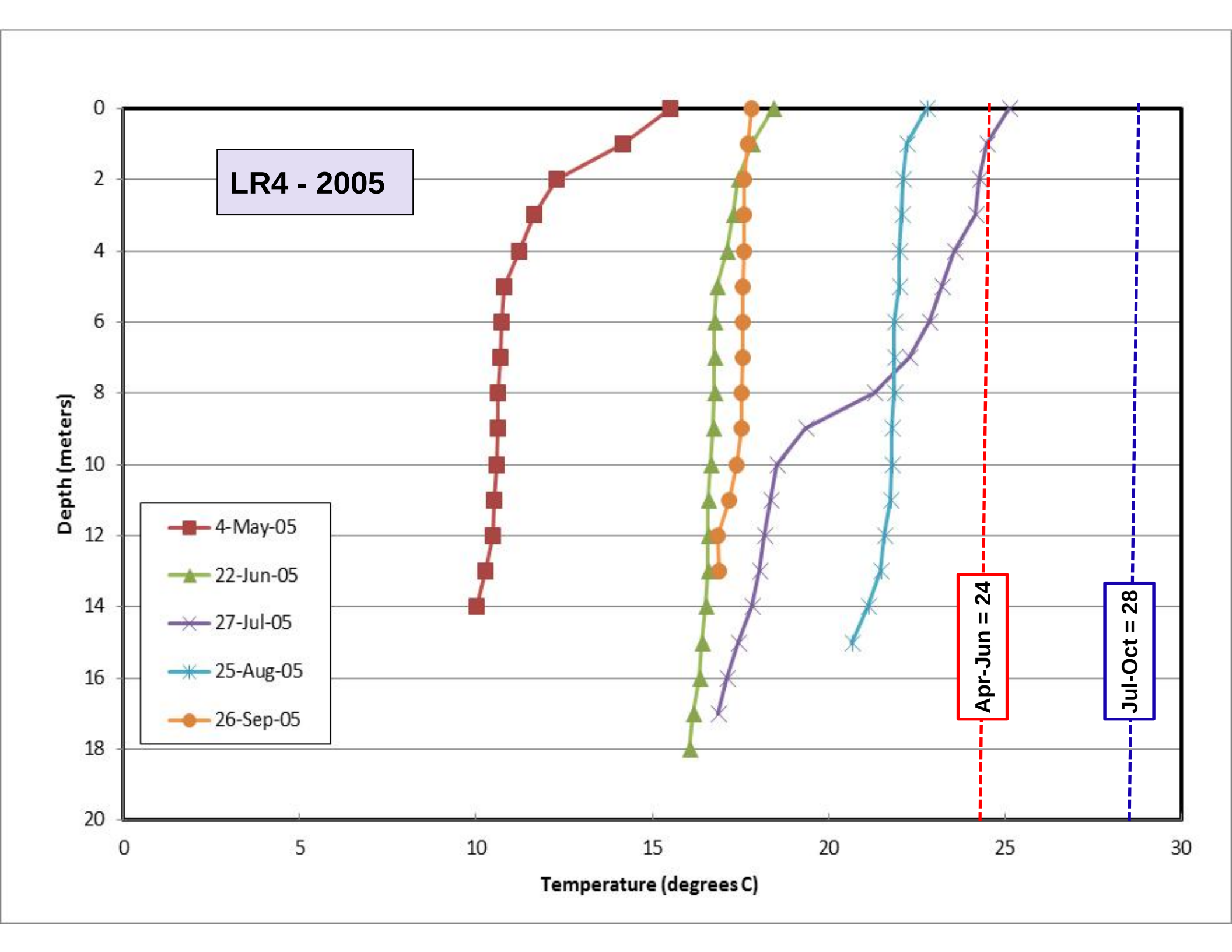
- Thermal stratification is an important consideration as it affects how water quality can vary throughout the water column.
- During periods of stratification, there is little to no water quality interaction between the epilimnion and hypolimnion.
- Once stratification ends, the water quality may become mixed throughout the water column.
- 1 degree C per meter

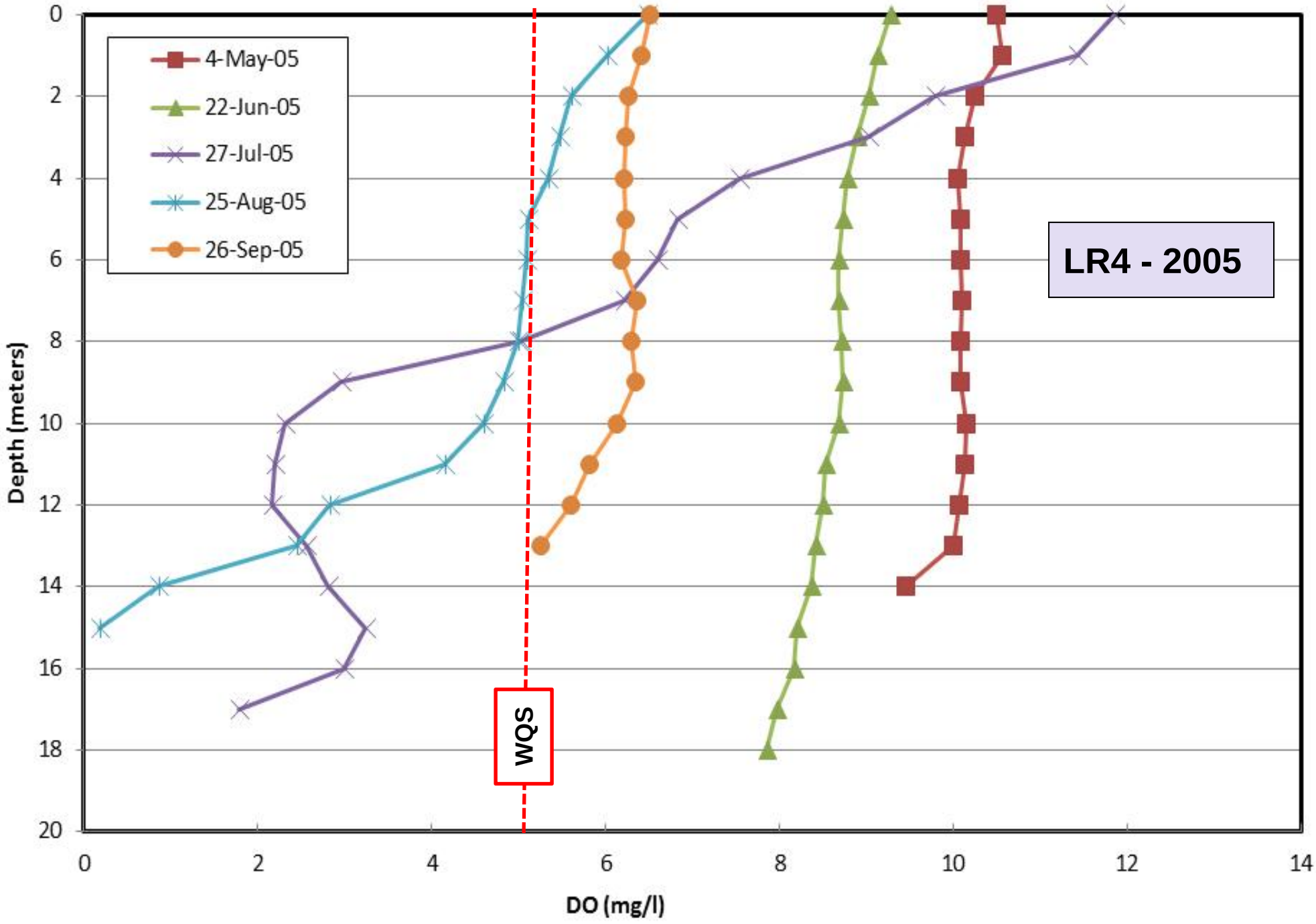

LR1 - 2005
Depth (meters)
0
1
2
3
4
5
6
7
8
9
0
5
10
15
20
25
30
Temperature (degrees C)
4-May-05
22-Jun-05
27-Jul-05
25-Aug-05
26-Sep-05
Apr-Jun = 24
Jul-Oct = 28


LR1 - 2005
Depth (meters)
0
1
2
3
4
5
6
7
8
9
0
2
4
6
8
10
12
14
DO (mg/l)
4-May-05
22-Jun-05
27-Jul-05
25-Aug-05
26-Sep-05
WQS


LR2A - 2012
6/20/2012
7/18/2012
8/22/2012
9/12/2012
Depth (meters)
0
1
2
3
4
5
6
7
8
0
5
10
15
20
25
Temperature (degrees C)
Apr-Jun = 24


LR2A - 2012
6/20/2012
7/18/2012
8/22/2012
9/12/2012
WQS
Depth (meters)
DO mg/l)
0
1
2
3
4
5
6
7
8
9


LR4 - 2005
Depth (meters)
0
2
4
6
8
10
12
14
16
18
20
0
5
10
15
20
25
30
Temperature (degrees C)
4-May-05
22-Jun-05
27-Jul-05
25-Aug-05
26-Sep-05
Apr-Jun = 24
Jul-Oct = 28


4-May-05
22-Jun-05
27-Jul-05
25-Aug-05
26-Sep-05
LR4 - 2005
WQS
Depth (meters)
DO (mg/l)
0
2
4
6
8
10
12
14
16
18
20

Stratification Summary

- Upper basin – DRI “too shallow to stratify very often; fine sediments tend to stay suspended”
  - However some minimal stratification has occurred
- For the northern 1/2 of the reservoir, stratification occurred at most sites for a short period of time during June-September, and then disappeared by September/October.
- DRI – “During the cold winter months, the lake is well mixed by strong winds, and water quality is generally uniform with depth.”

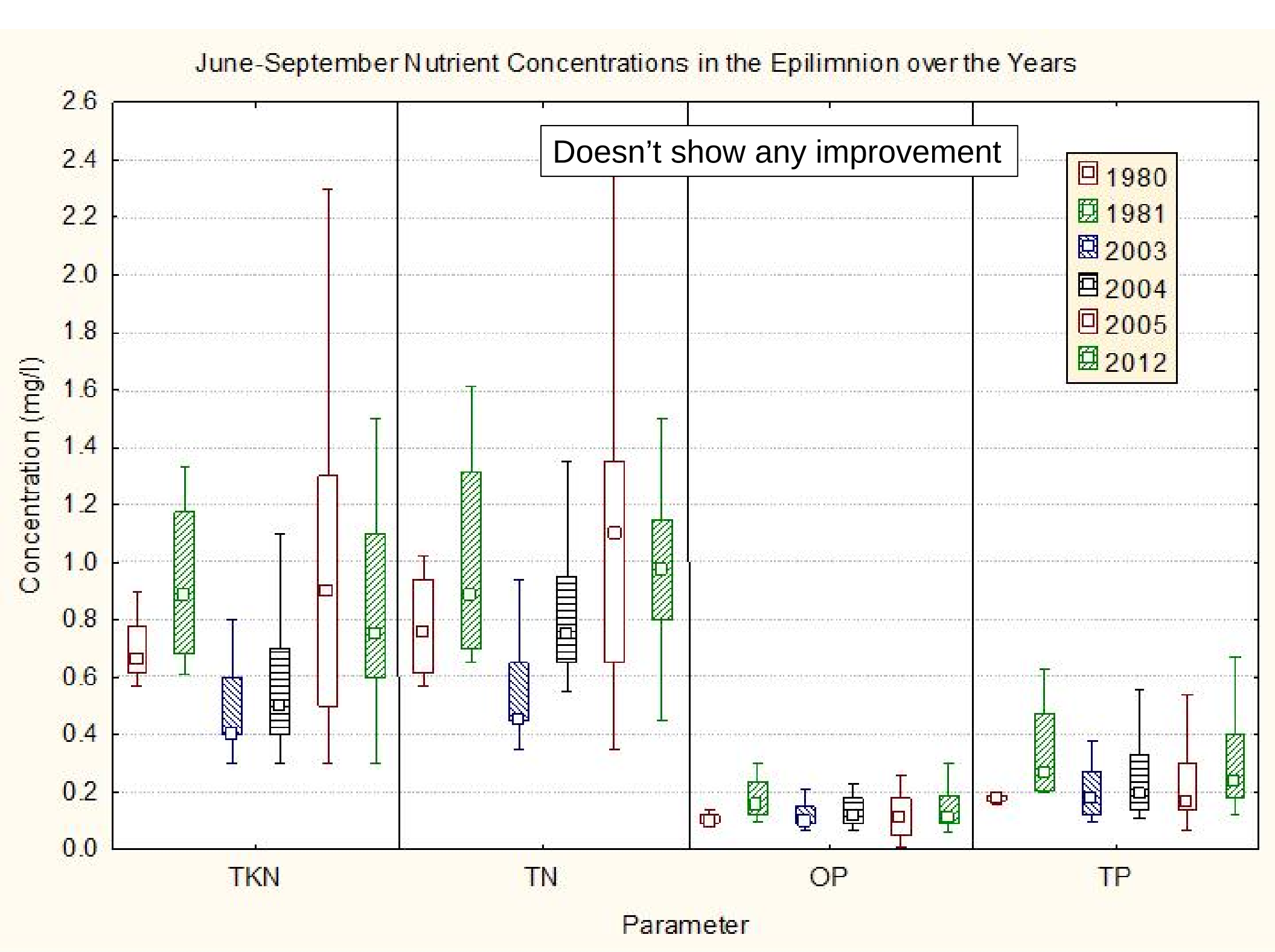
Nutrient Loads

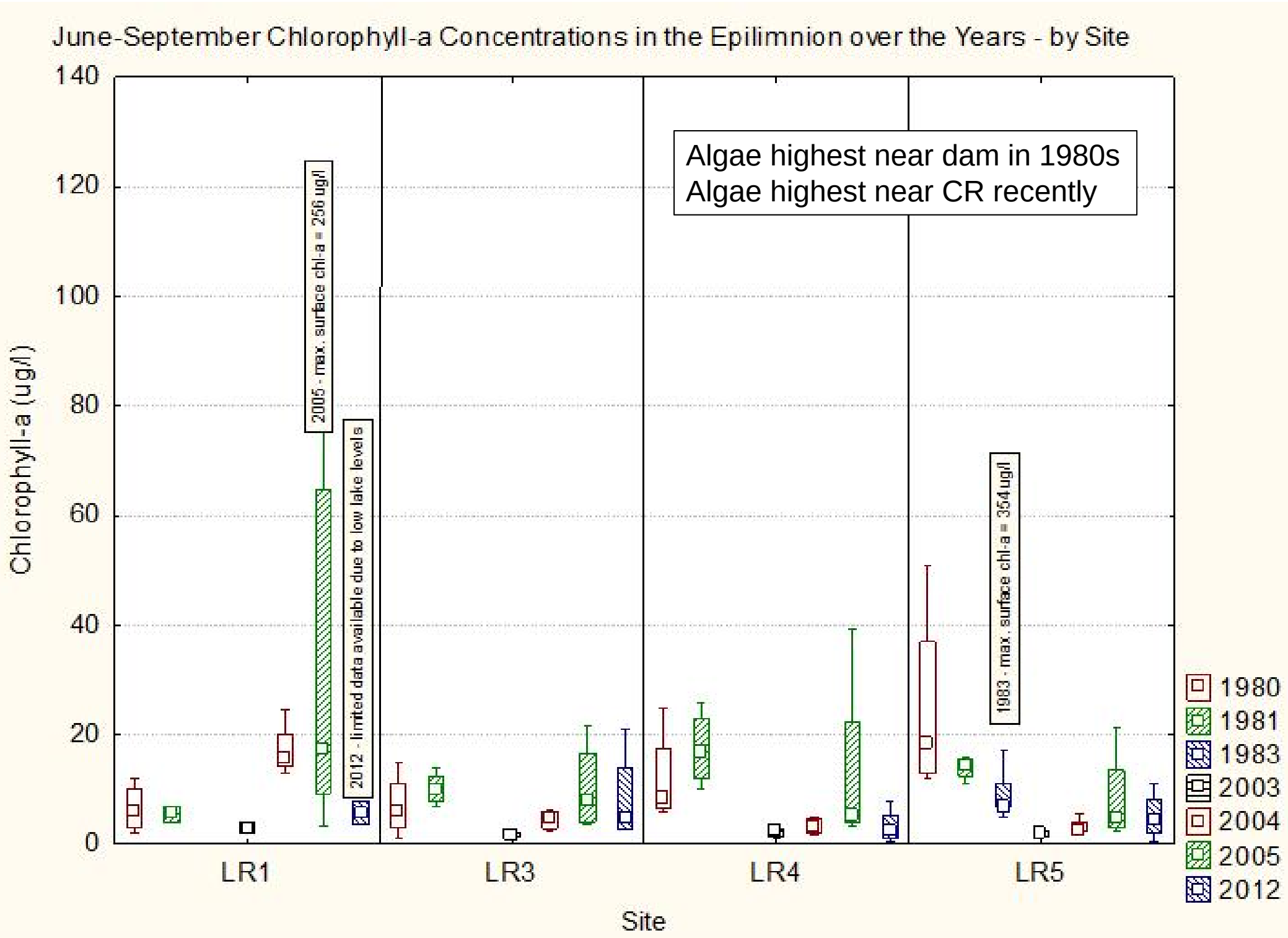
Since 1980s, TN/TP decreased about 50%

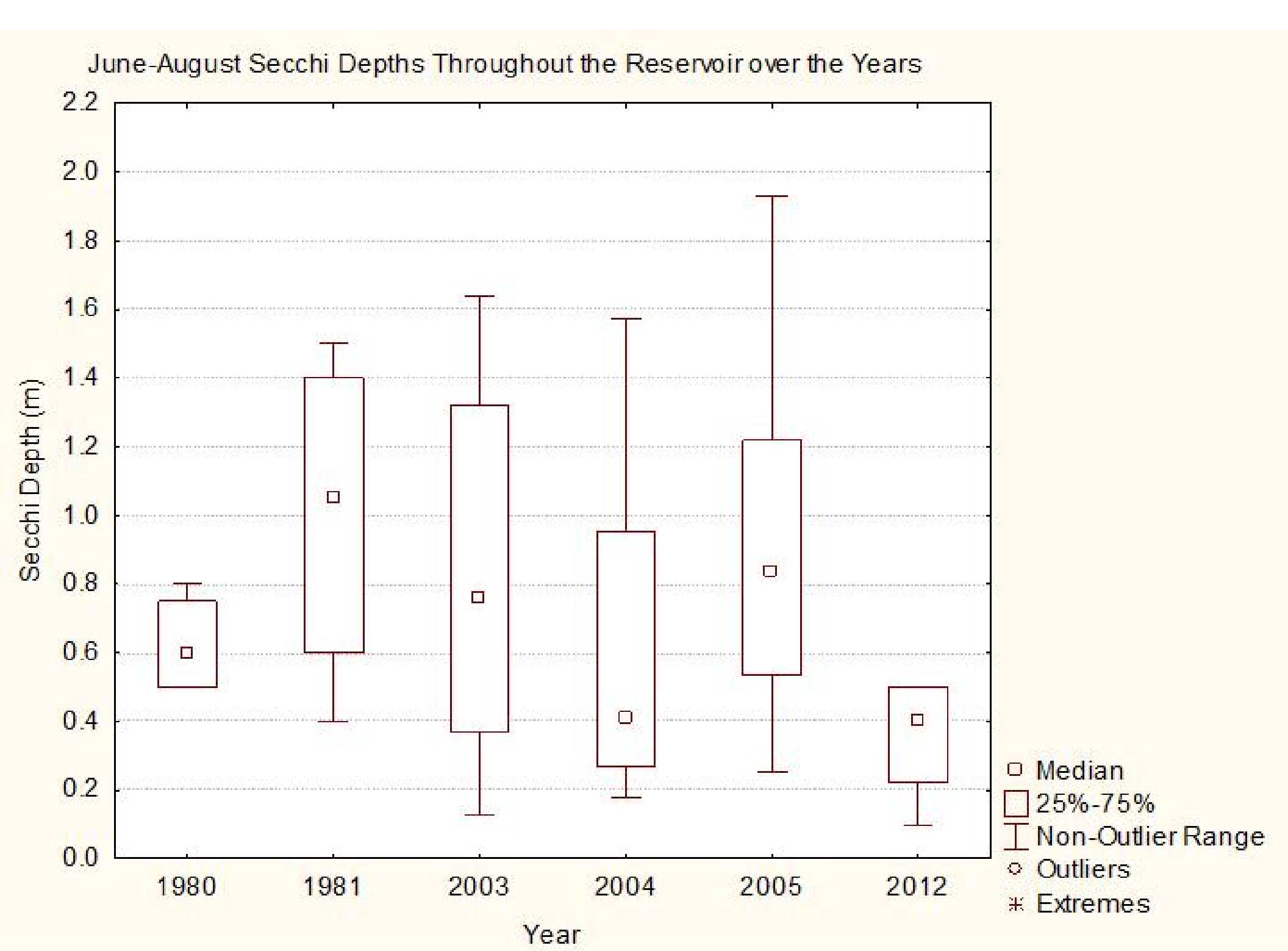
Description	1990-2005 Average	Flow-weighted TN/TP Concentration (mg/l)
Carson River		
TN (tons/year)	192	0.52
TP (tons/year)	74	0.20
Avg. Annual Flow (AF)	270,000	---
Truckee Canal		
TN (tons/year)	80	0.66
TP (tons/year)	10	0.08
Avg. Annual Flow (AF)	88,000	---
Sediment Release		
TP (tons/year)	30	0.13 (based upon 170,000 AF average storage)
Total		
TN (tons/year)	272	0.56
TP (tons/year)	114	0.17 (river and canal only)
Avg. Annual Flow (AF)	358,000	---

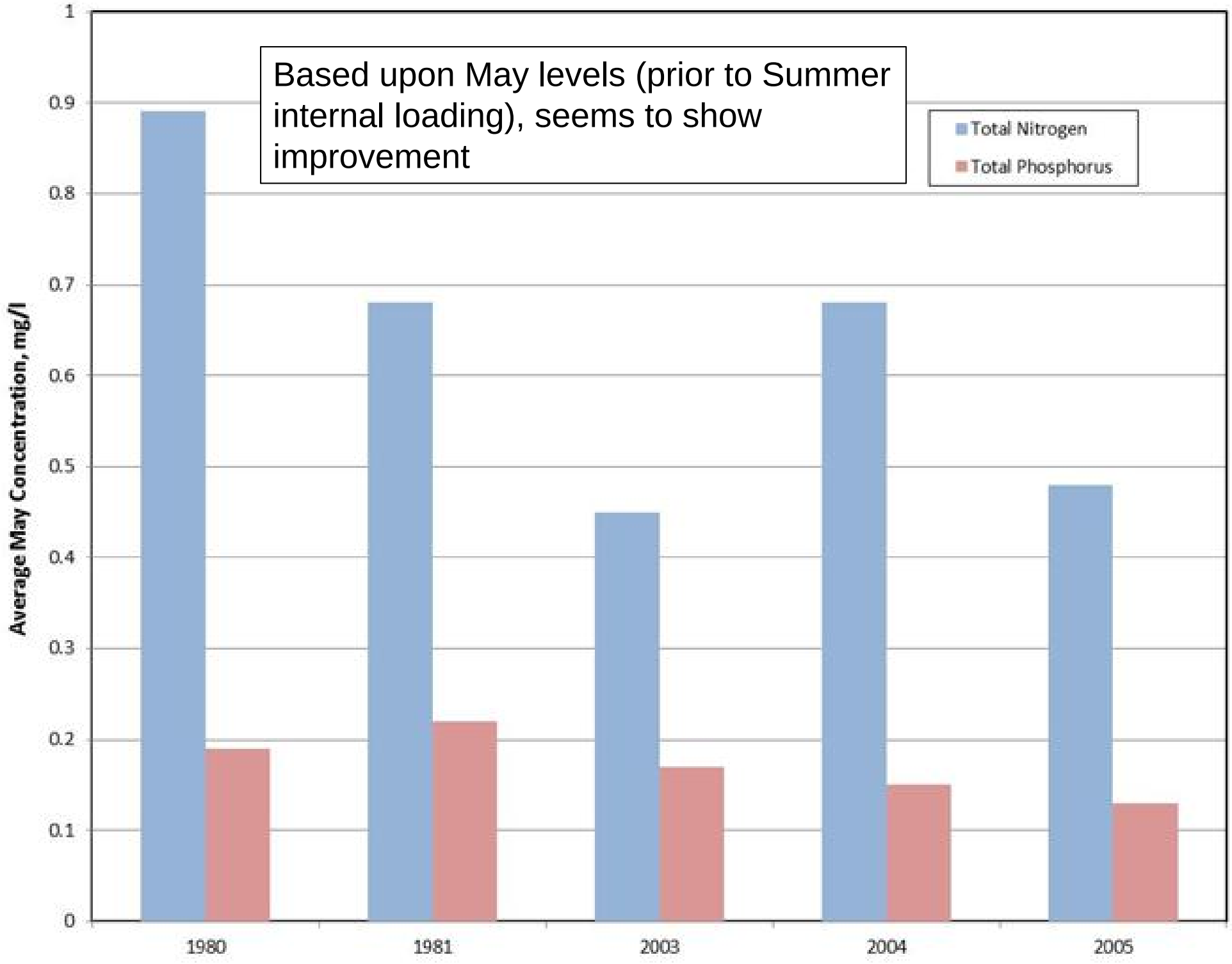
Decreased Loads = Improved WQ?

- Difficult to determine if WQ has improved from available data
- Conditions highly variable with storage levels


June-September Nutrient Concentrations in the Epilimnion over the Years
Doesn't show any improvement
1980
1981
2003
2004
2005
2012
Concentration (mg/l)
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
TKN
TN
OP
TP
Parameter


June-September Chlorophyll-a Concentrations in the Epilimnion over the Years - by Site
Algae highest near dam in 1980s
Algae highest near CR recently
2005 - max. surface chl-a = 256 ug/l
2012 - limited data available due to low lake levels
1983 - max. surface chl-a = 354 ug/l
Chlorophyll-a (ug/l)
140
120
100
80
60
40
20
0
LR1
LR3
LR4
LR5
Site
1980
1981
1983
2003
2004
2005
2012

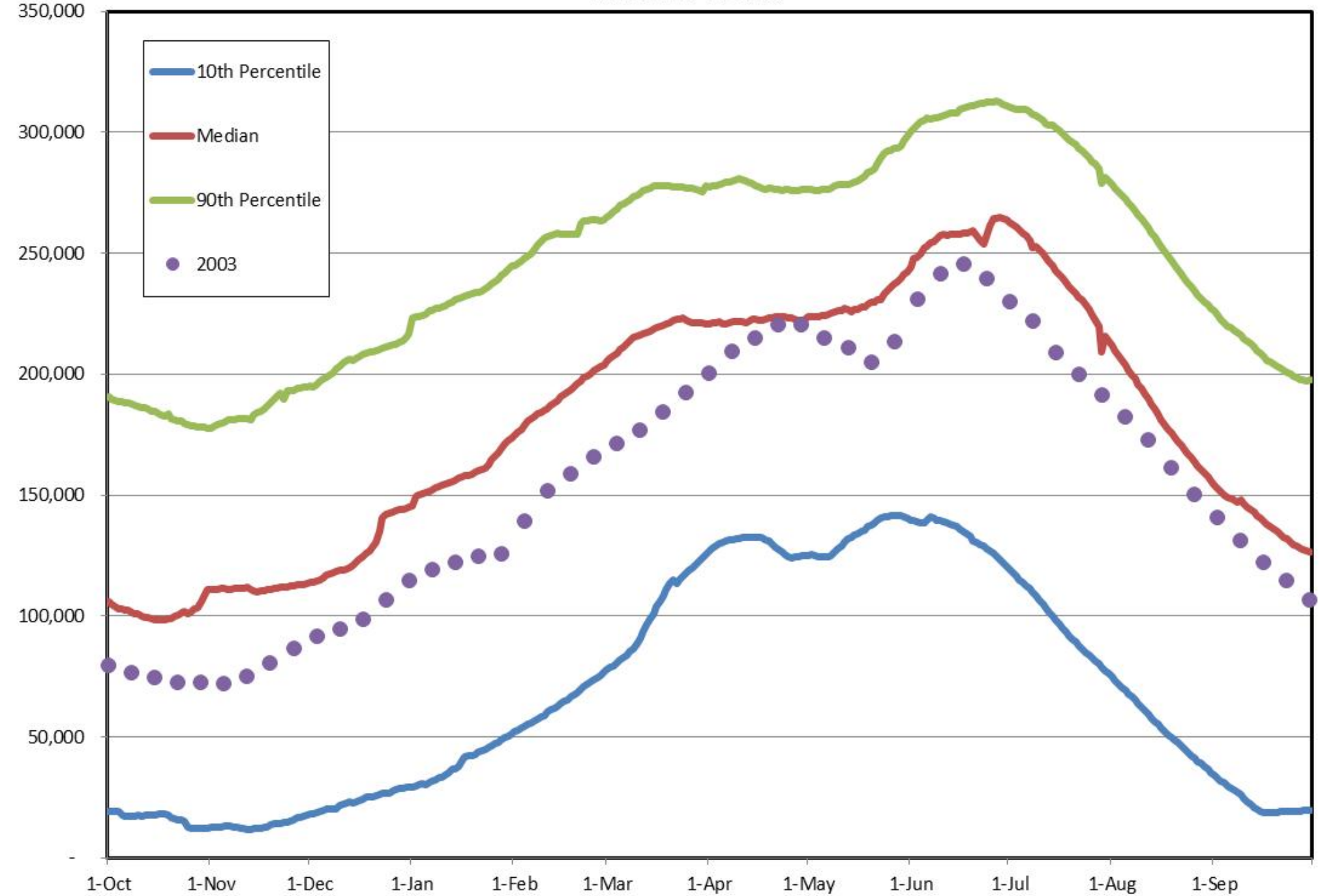

June-August Secchi Depths Throughout the Reservoir over the Years
Secchi Depth (m)
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1980
1981
2003
2004
2005
2012
Year
Median
25%-75%
Non-Outlier Range
Outliers
Extremes


Based upon May levels (prior to Summer internal loading), seems to show improvement
Total Nitrogen
Total Phosphorus
Average May Concentration, mg/l
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1980
1981
2003
2004
2005

Overall WQ – 2003-05; 2012

- Variable!
  - WQ tends to be worse near Carson River and best near Dam
  - Varies with storage levels
- 303(d) List
  - Total Phosphorus
  - Total Suspended Solids
  - Turbidity
  - Iron
  - Mercury in Fish Tissue and Sediment

Lahontan Reservoir - Historic Storage Levels (1967-2011) Compared to Recent Years



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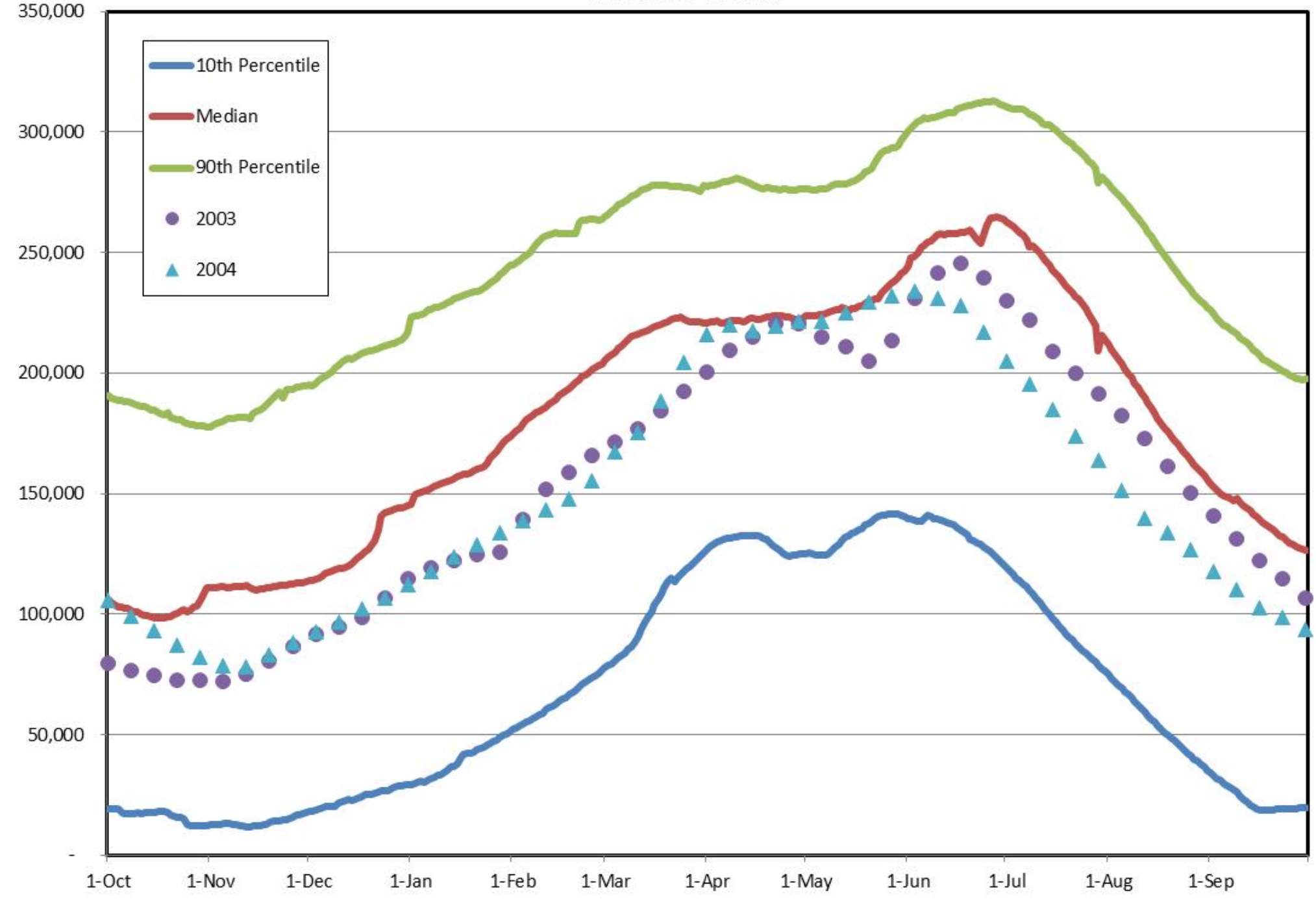

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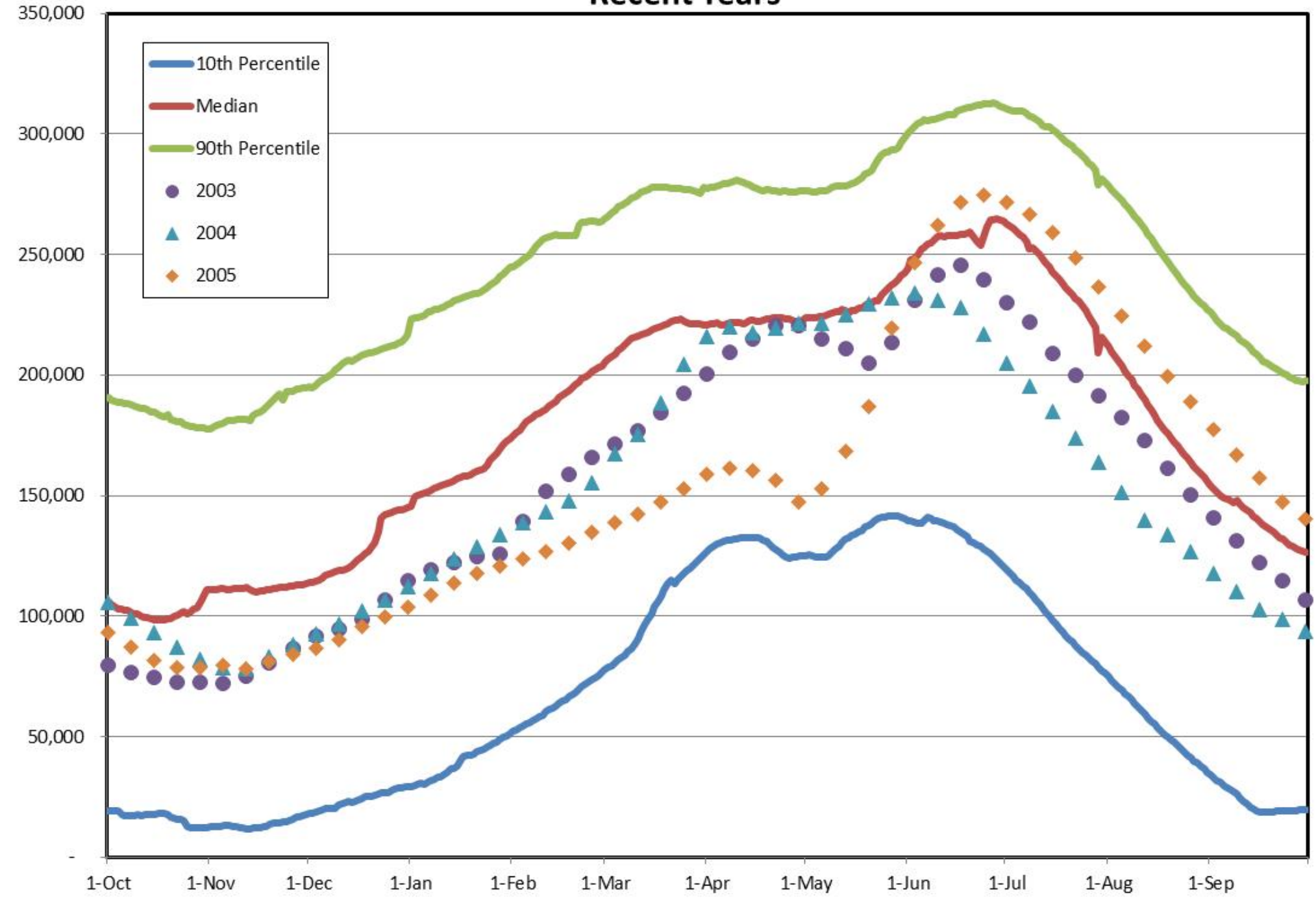
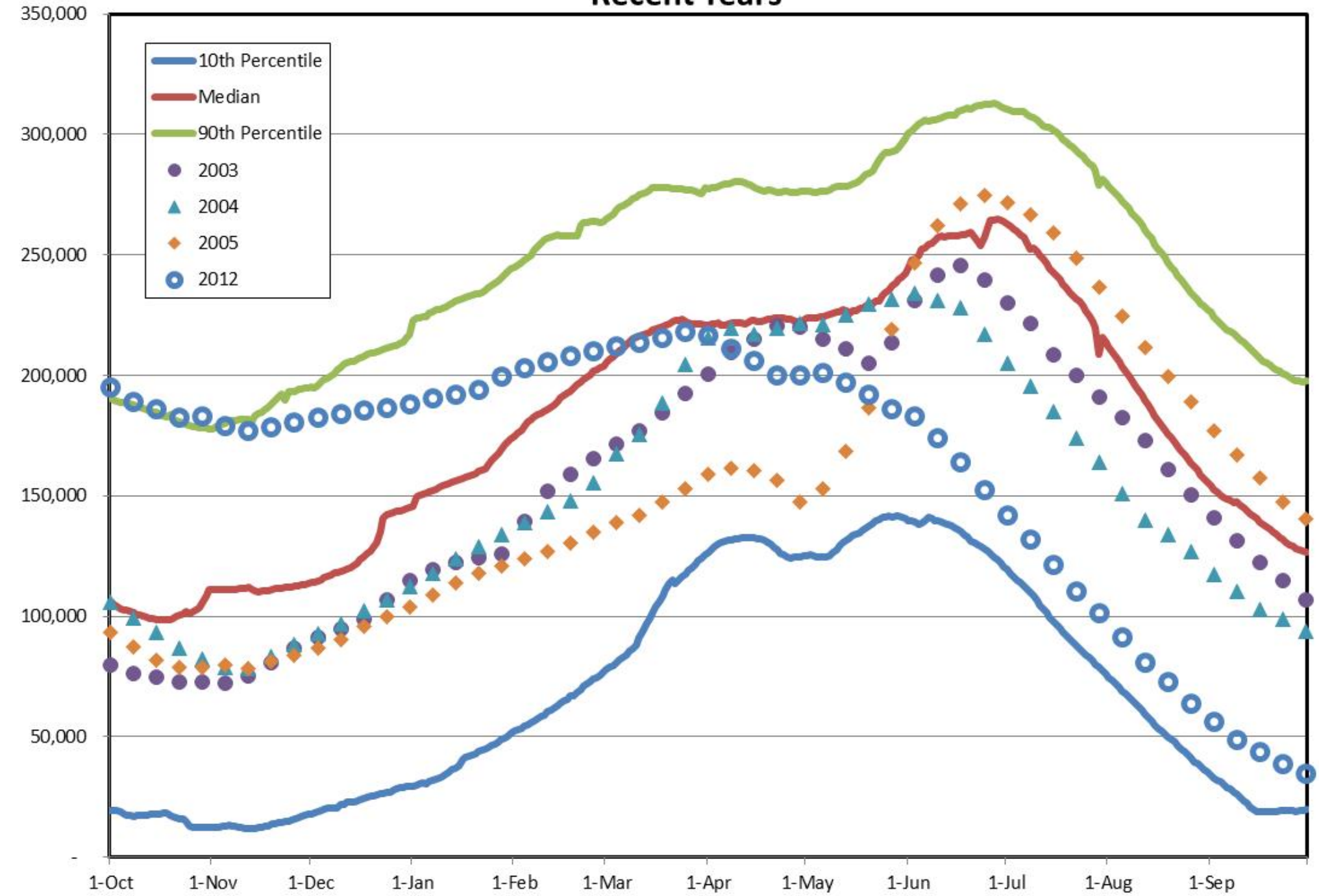
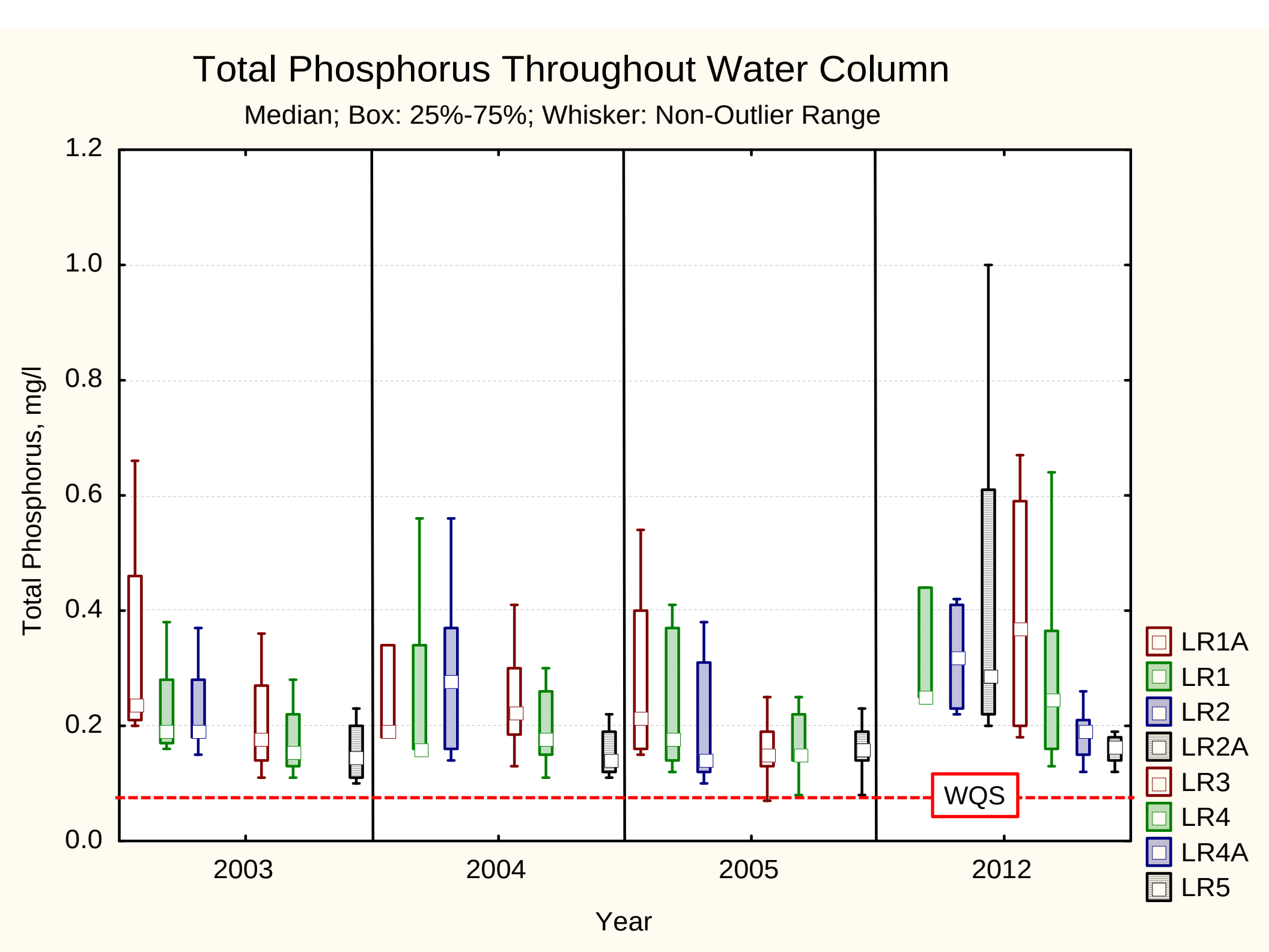
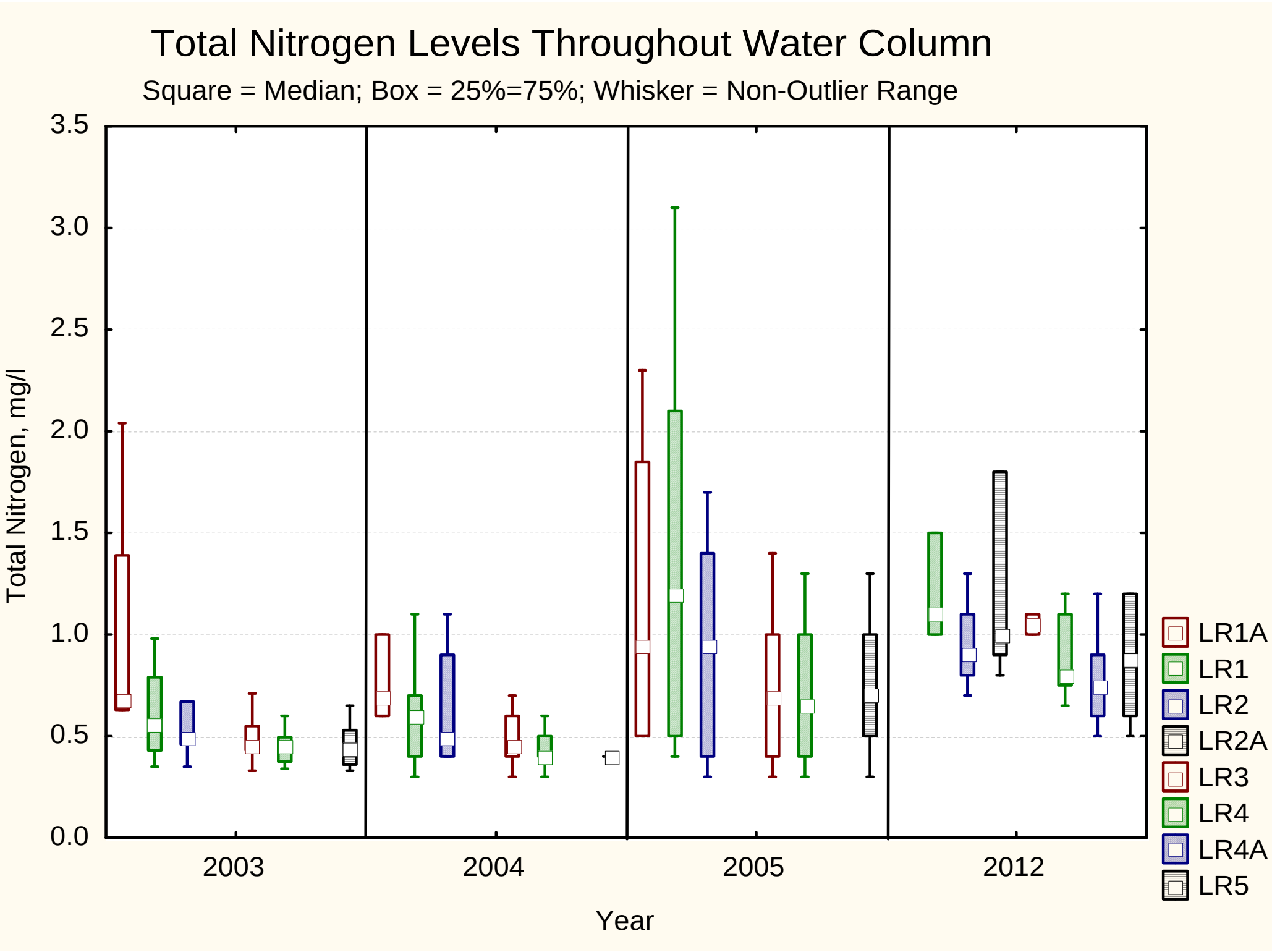
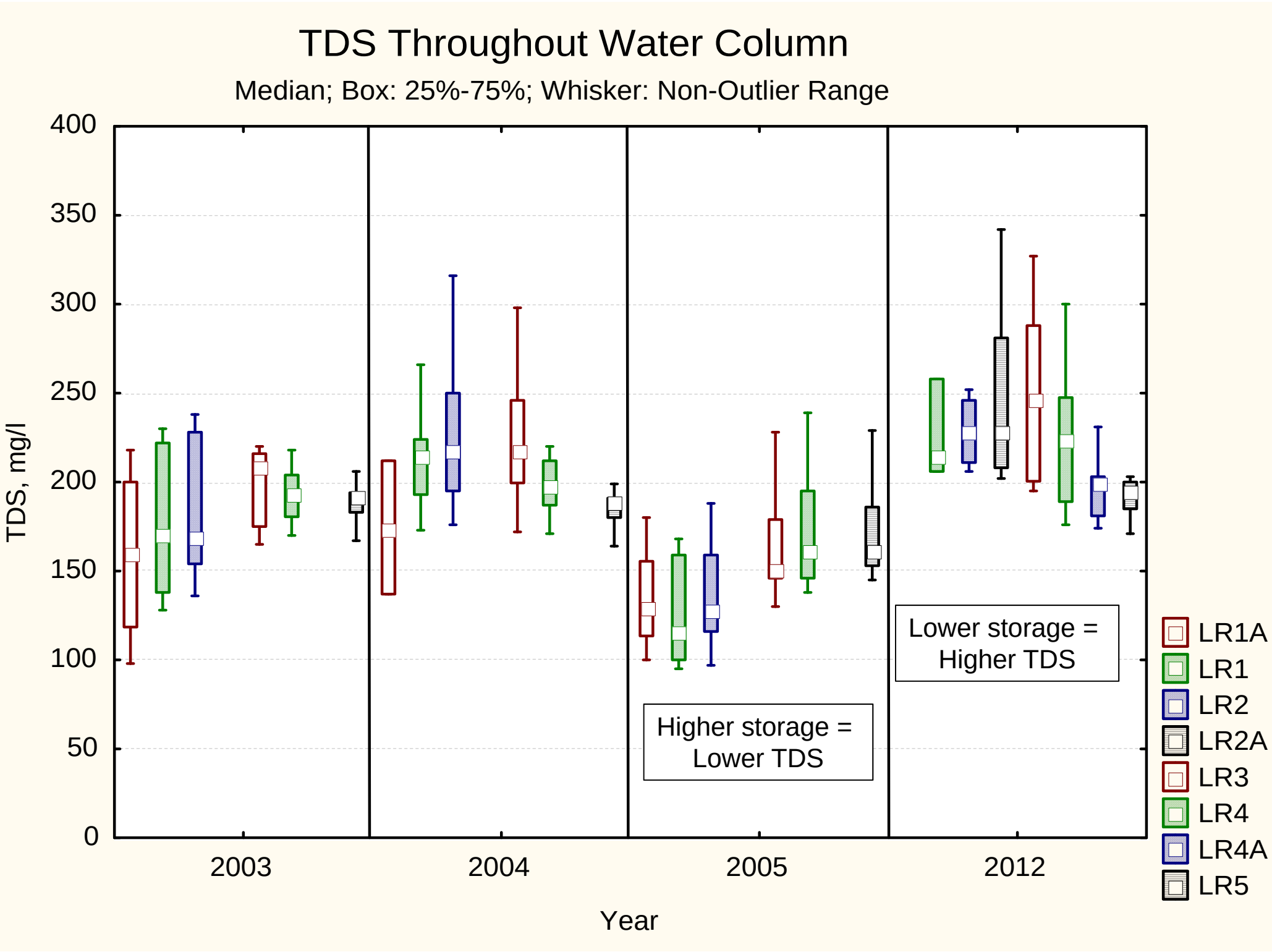


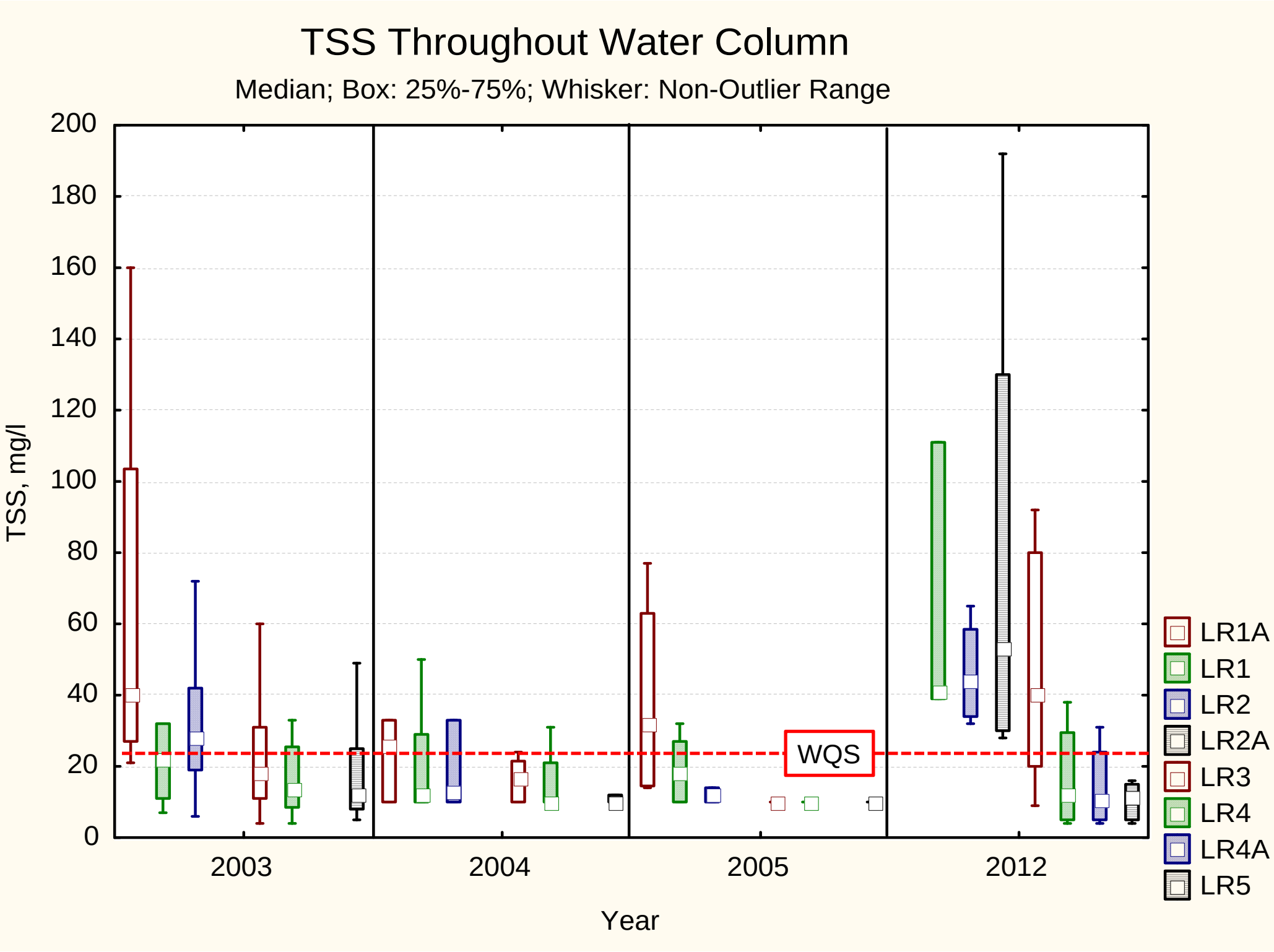
Lahontan Reservoir - Historic Storage Levels (1967-2011) Compared to Recent Years

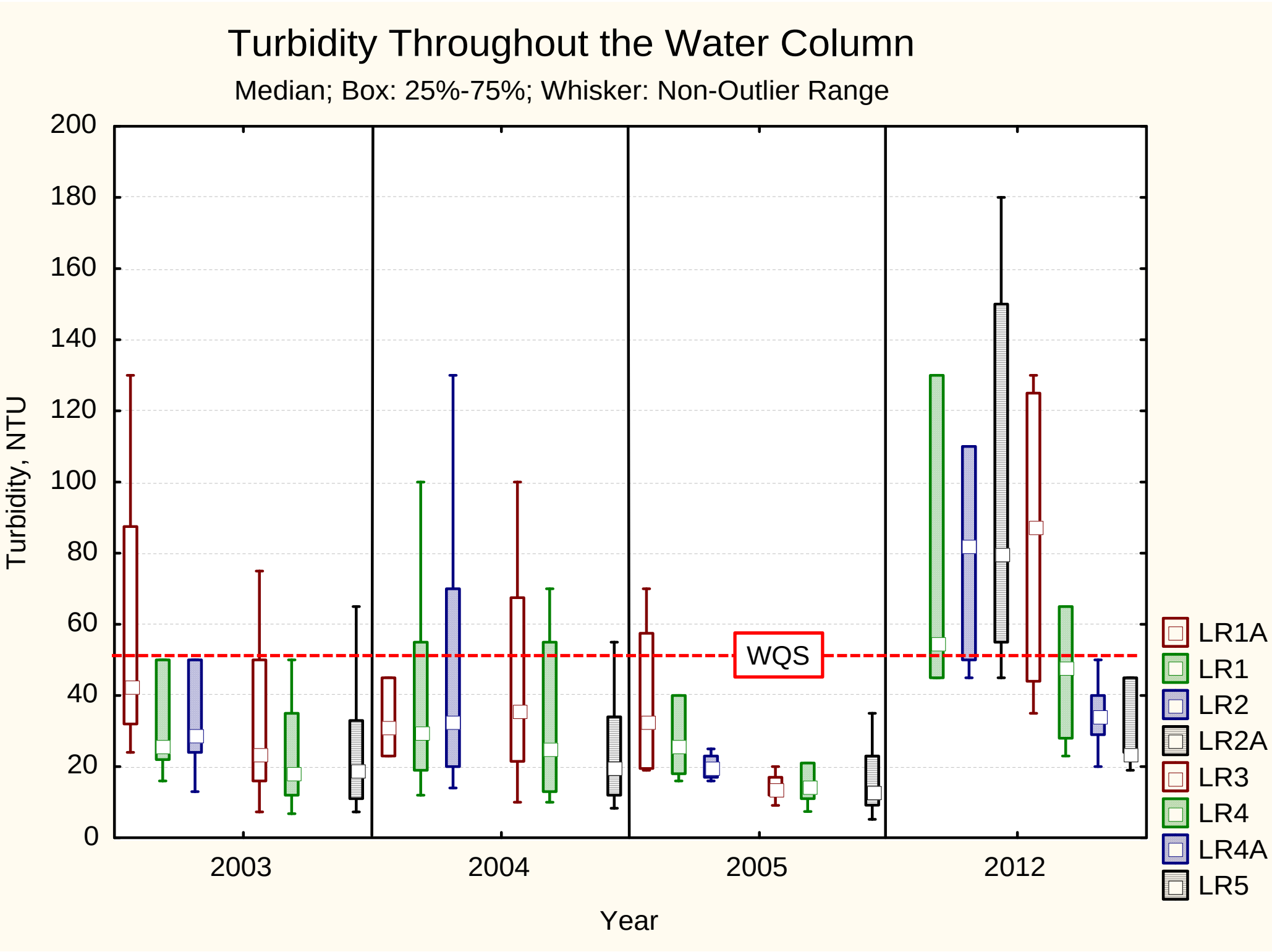


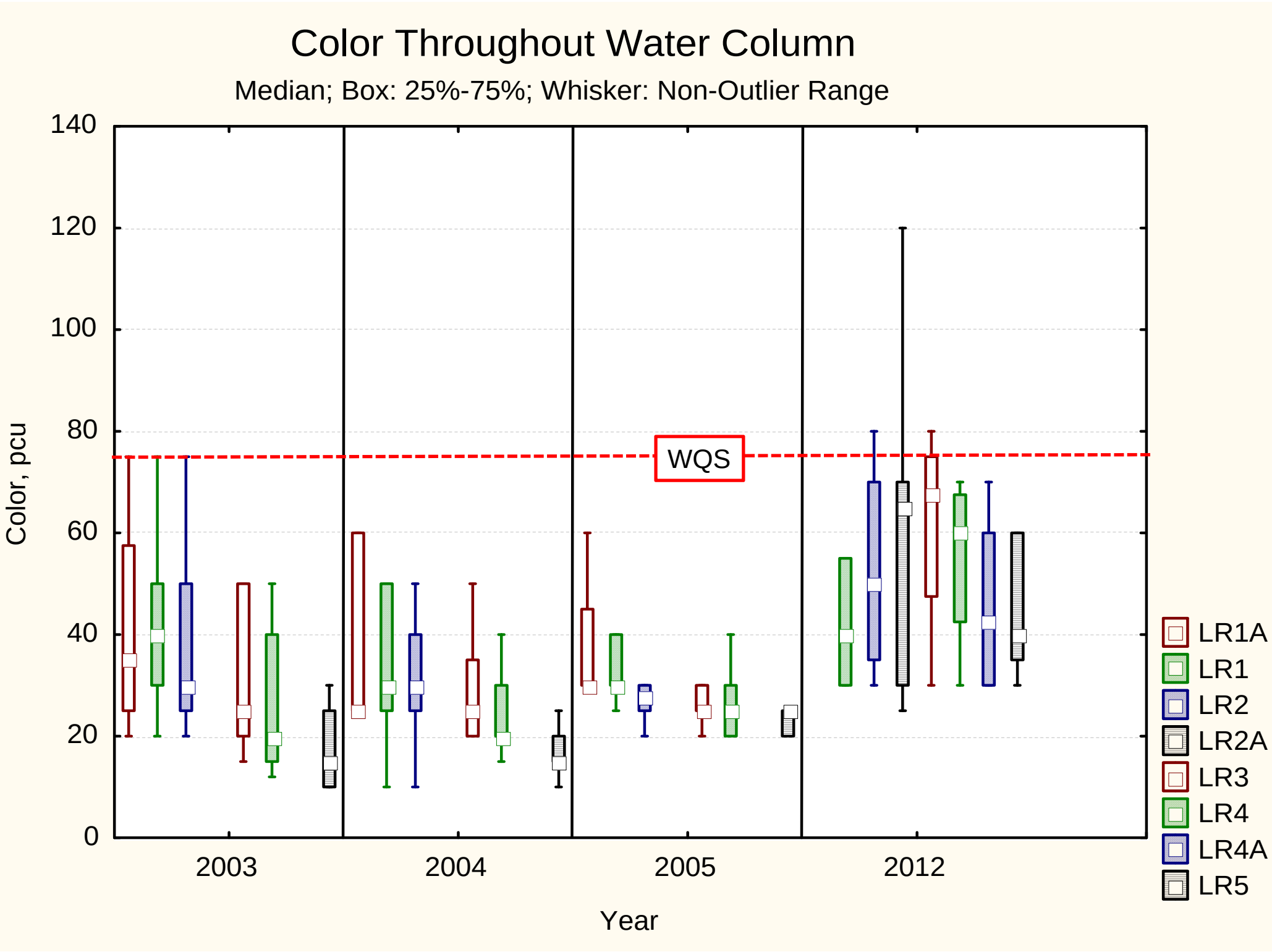

Total Phosphorus Throughout Water Column
Median; Box: 25%-75%; Whisker: Non-Outlier Range
Total Phosphorus, mg/l
1.2
1.0
0.8
0.6
0.4
0.2
0.0
2003
2004
2005
2012
Year
WQS
LR1A
LR1
LR2
LR2A
LR3
LR4
LR4A
LR5

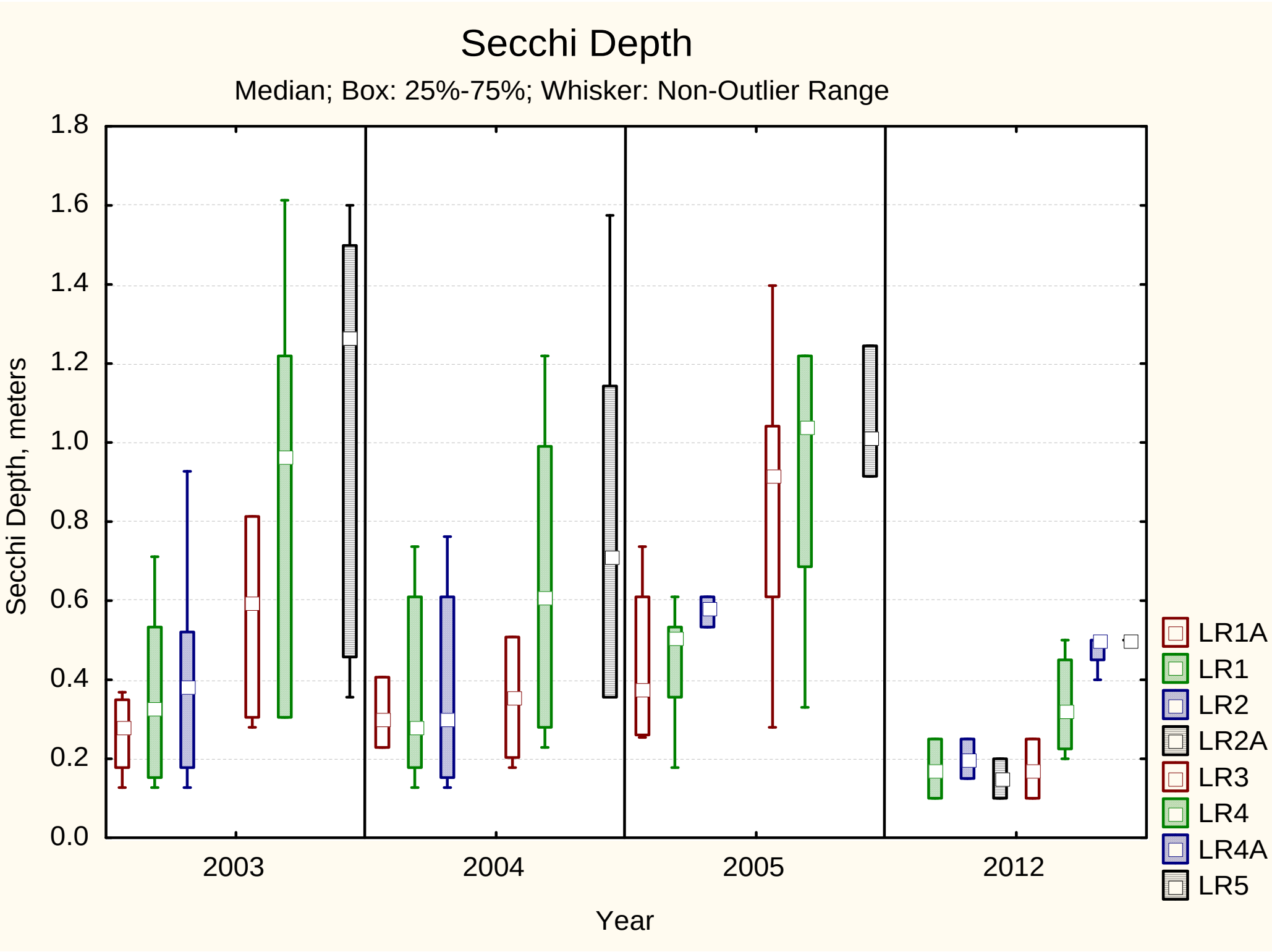

Total Nitrogen Levels Throughout Water Column
Square = Median; Box = 25%=75%; Whisker = Non-Outlier Range
Total Nitrogen, mg/l
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
2003
2004
2005
2012
Year
LR1A
LR1
LR2
LR2A
LR3
LR4
LR4A
LR5


TDS Throughout Water Column
Median; Box: 25%-75%; Whisker: Non-Outlier Range
TDS, mg/l
400
350
300
250
200
150
100
50
0
2003
2004
2005
2012
Year
Higher storage = Lower TDS
Lower storage = Higher TDS
LR1A
LR1
LR2
LR2A
LR3
LR4
LR4A
LR5

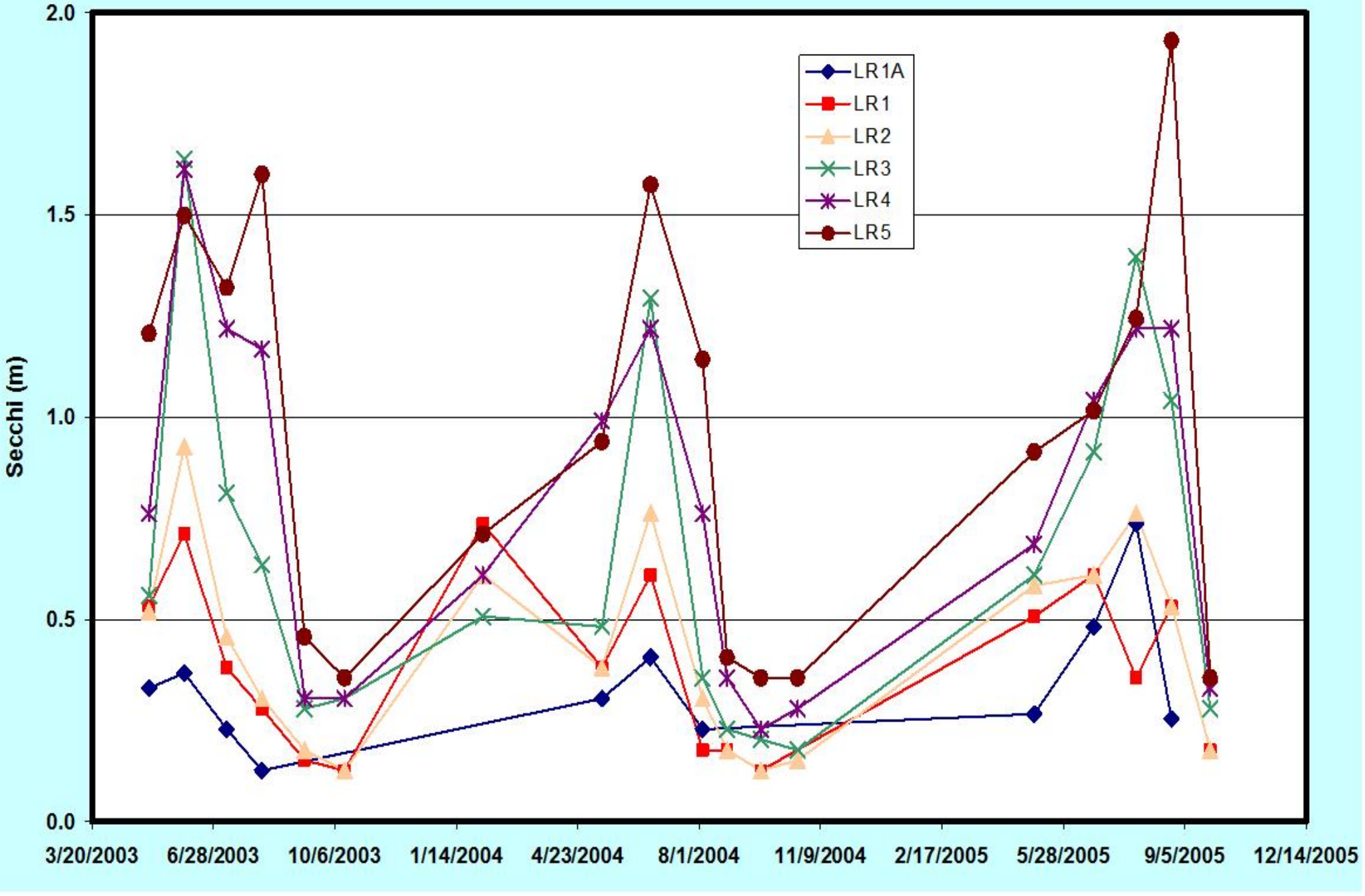

TSS Throughout Water Column
Median; Box: 25%-75%; Whisker: Non-Outlier Range
TSS, mg/l
200
180
160
140
120
100
80
60
40
20
0
2003
2004
2005
2012
Year
WQS
LR1A
LR1
LR2
LR2A
LR3
LR4
LR4A
LR5

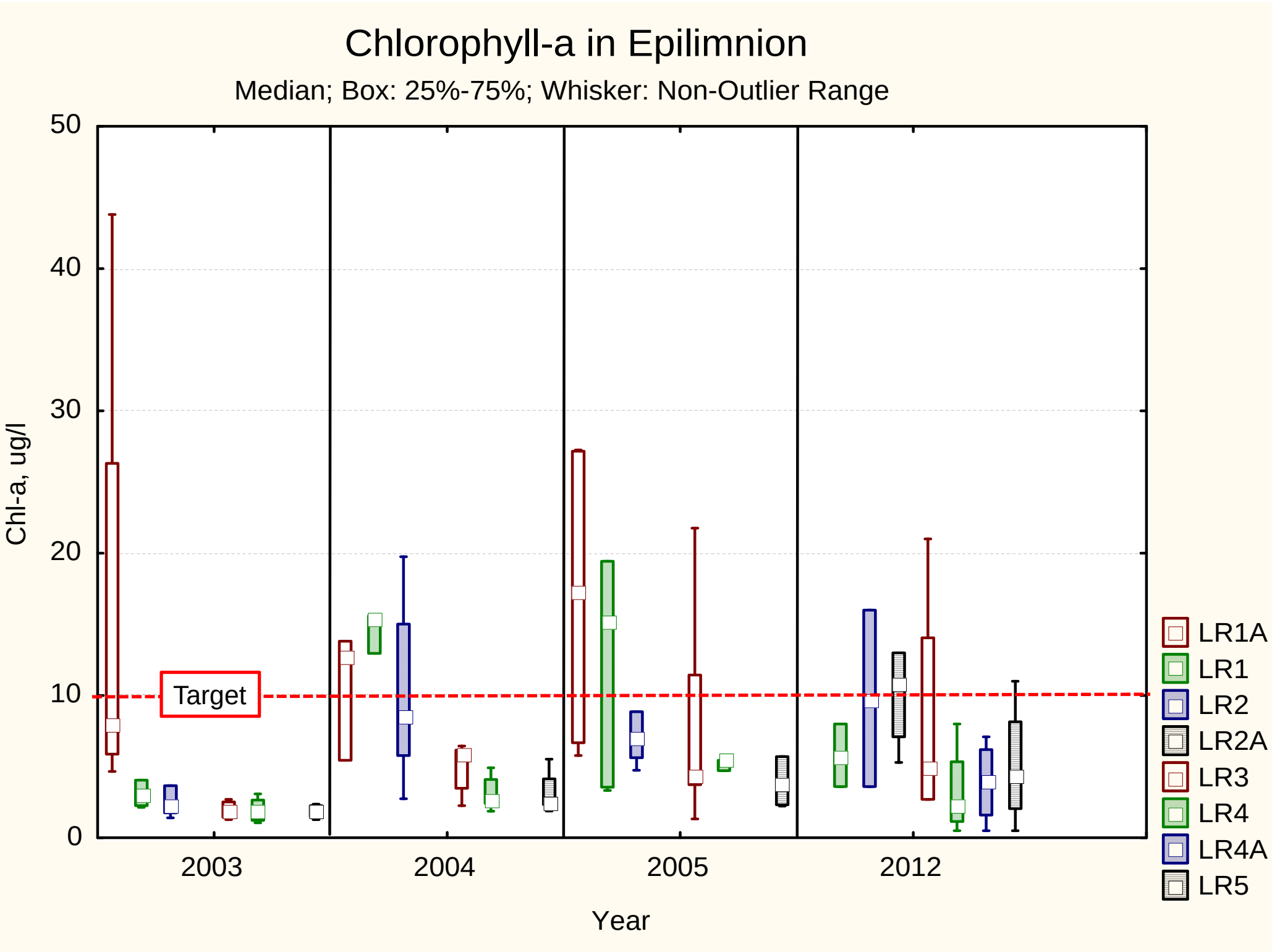

Turbidity Throughout the Water Column
Median; Box: 25%-75%; Whisker: Non-Outlier Range
Turbidity, NTU
200
180
160
140
120
100
80
60
40
20
0
WQS
2003
2004
2005
2012
Year
LR1A
LR1
LR2
LR2A
LR3
LR4
LR4A
LR5


Color Throughout Water Column
Median; Box: 25%-75%; Whisker: Non-Outlier Range
140
120
100
80
60
40
20
0
Color, pcu
WQS
2003
2004
2005
2012
Year
LR1A
LR1
LR2
LR2A
LR3
LR4
LR4A
LR5

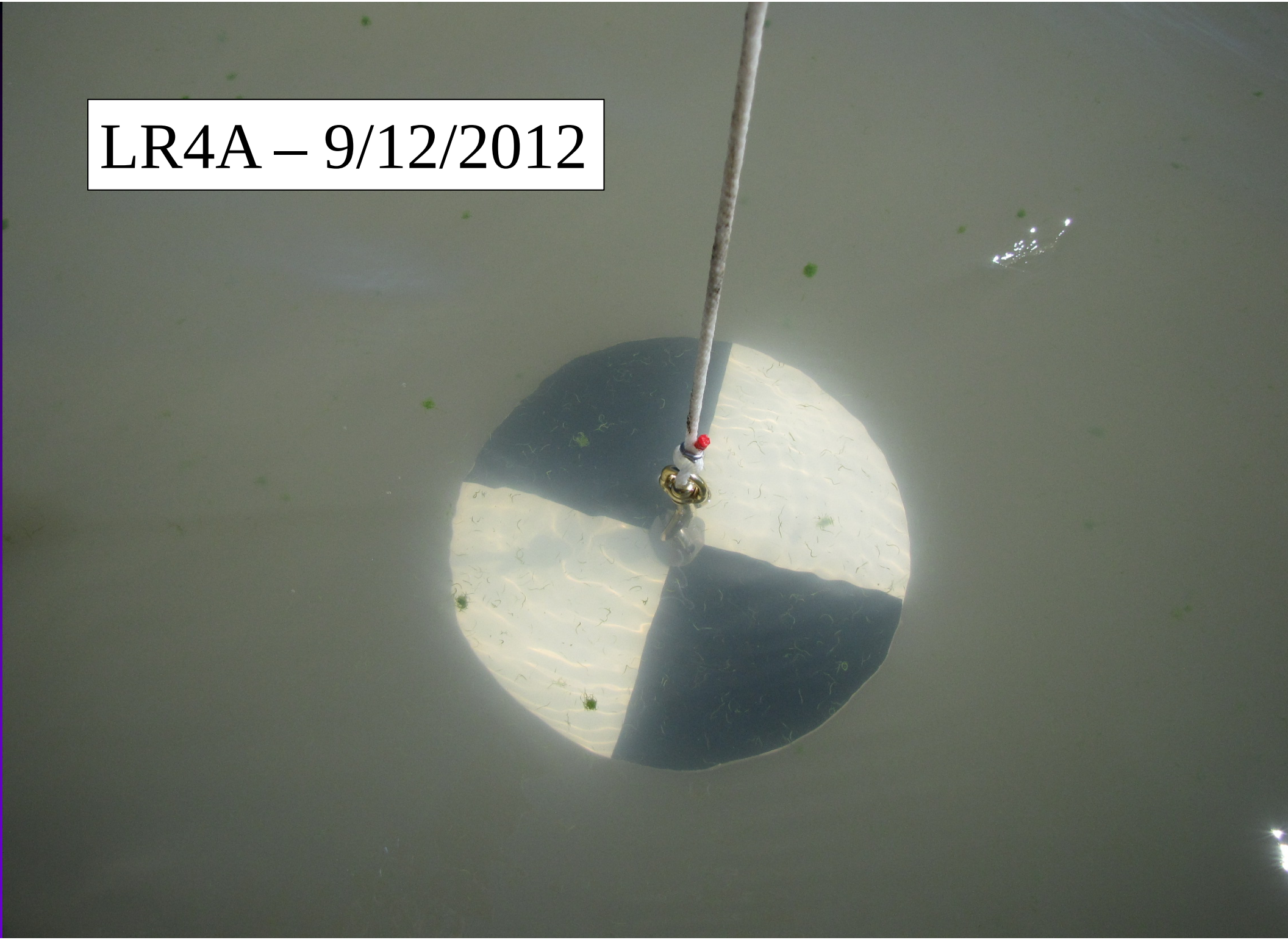

Secchi Depth
Median; Box: 25%-75%; Whisker: Non-Outlier Range
Secchi Depth, meters
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
2003
2004
2005
2012
Year
LR1A
LR1
LR2
LR2A
LR3
LR4
LR4A
LR5

Lahontan Reservoir Secchi Data - 2003-05




Chlorophyll-a in Epilimnion
Median; Box: 25%-75%; Whisker: Non-Outlier Range
50
40
30
20
10
0
Chl-a, ug/l
Target
2003
2004
2005
2012
Year
LR1A
LR1
LR2
LR2A
LR3
LR4
LR4A
LR5


LR4 – 9/12/2012


LR4A – 9/12/2012


LR5 – 9/12/2012

Algae characteristics

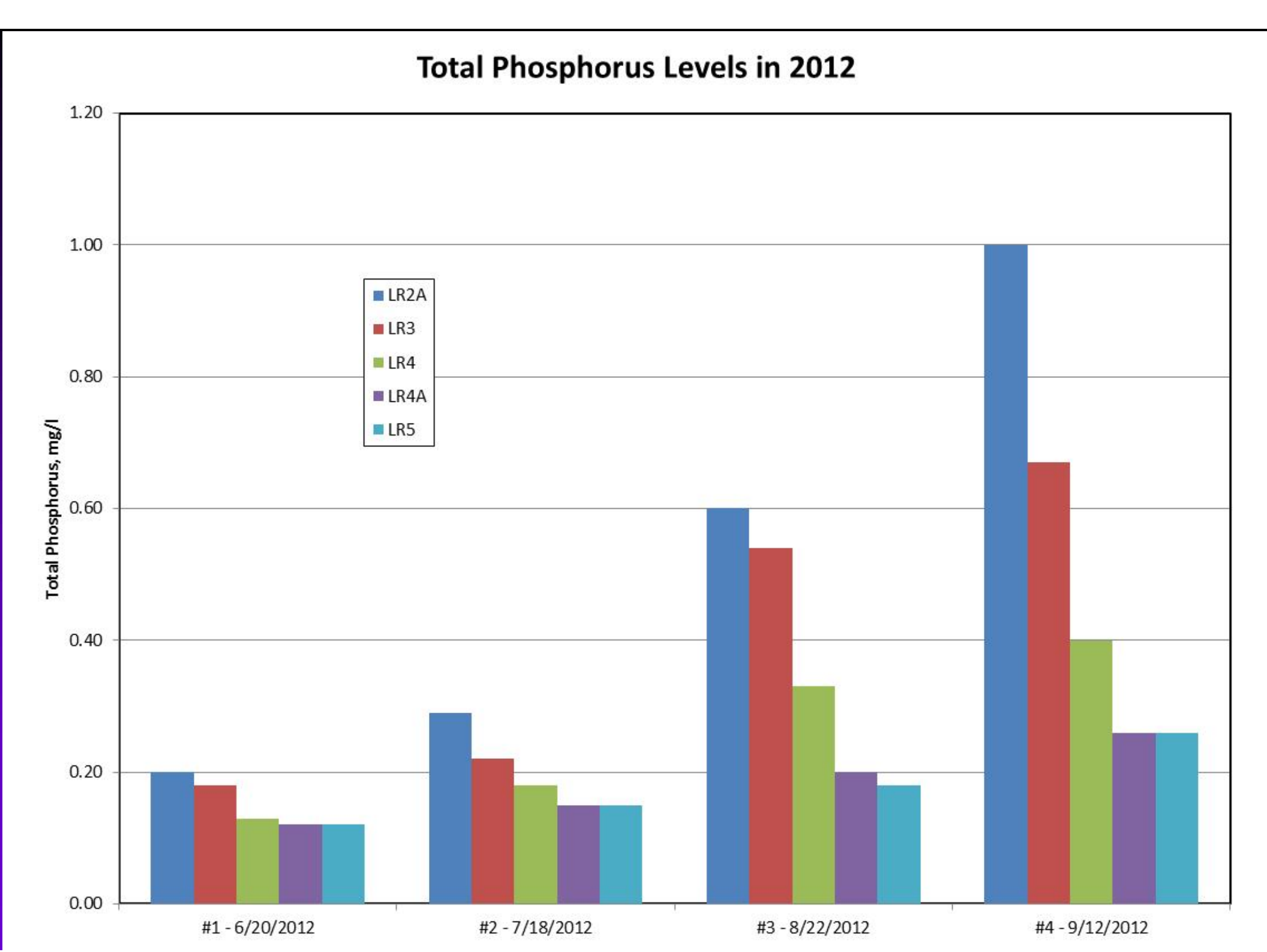
- 1980-82
  - 97% Aphanizomenon
  - ~2% Anabaena
- 1983
  - 98.3% cyanobacteria (mostly Aphanizomenon)
- 2004
  - 5% to 51% Aphanizomenon
- Cyanobacteria (AKA blue-green algae)
  - Fixes nitrogen from atmosphere
    - Generally occurs when Nitrate levels are low
      - Allowing it to outcompete other algae
    - Introduces N to system
  - Can produces toxins – much uncertainty as to when

N:P Ratio

- Tool to identify nutrient limitations
  - TN:TP < 10 = Nitrogen Limited
  - TN:TP > 17 = Phosphorus Limited
- Nutrient not limiting until reaches low levels
- TN:TP 1980-81, 1983, 2003-05, 2012
  - Mostly < 5.0 = Nitrogen limited
  - 1980-81: nitrates dropped near 0
  - 2003-05: nitrates often dropped below reporting limit
  - 2005
    - N:P spiked at 11.9 – 16.9. Coincided with algal bloom 7/27/2005
    - Cyanobacteria fixing nitrogen??

Internal TP loading

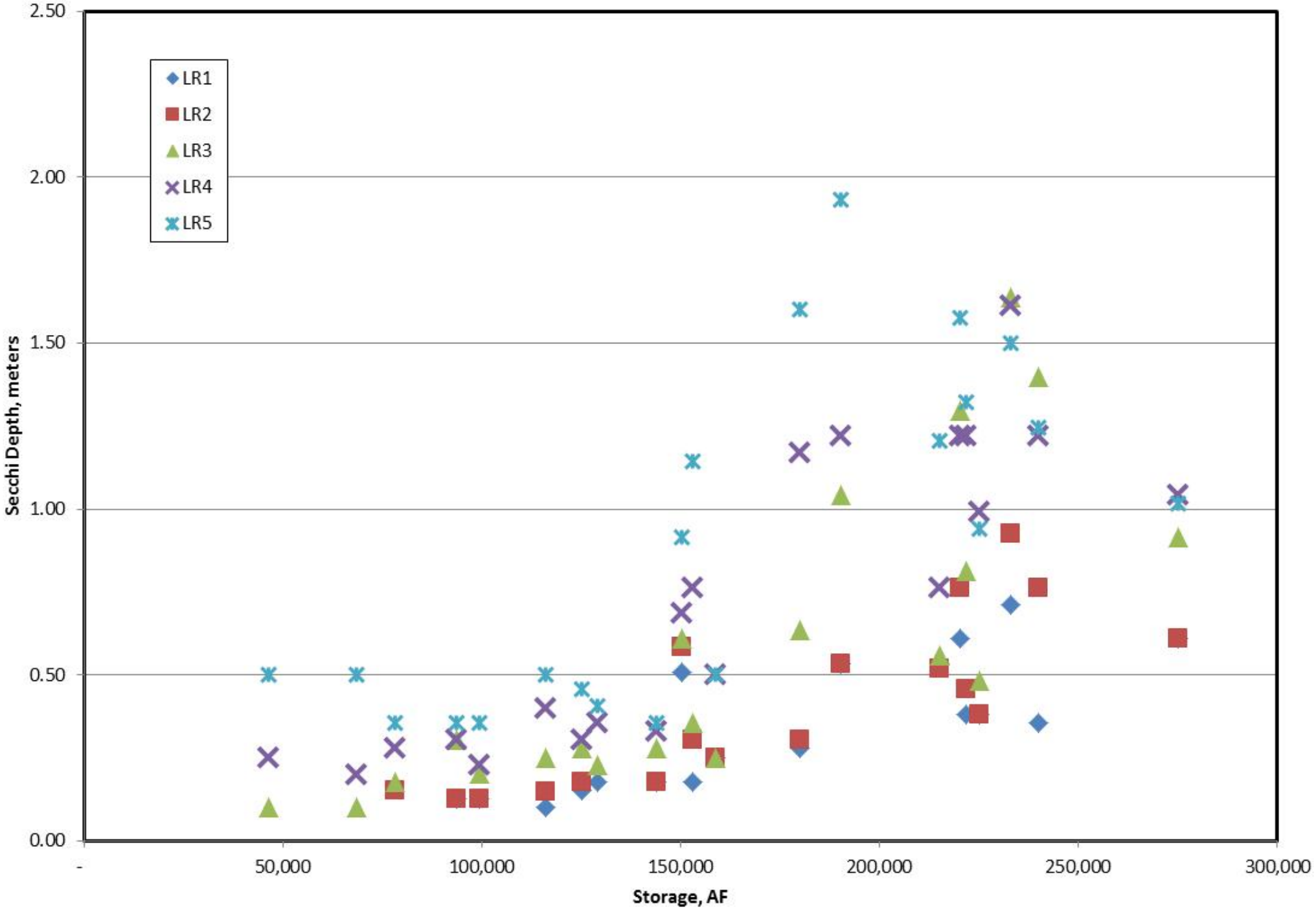
- ~25% of TP loading from internal sources
- 2012 was a good test of this concept
  - Minimal inflows from River and Canal from June – Sep
  - Increases due to internal sources


Total Phosphorus Levels in 2012
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Total Phosphorus, mg/l
LR2A
LR3
LR4
LR4A
LR5
#1 - 6/20/2012
#2 - 7/18/2012
#3 - 8/22/2012
#4 - 9/12/2012

WQ v. Storage

- WQ can vary from year to year depending on storage levels

Secchi Depth at Various Storage Levels



Truckee Canal Impacts

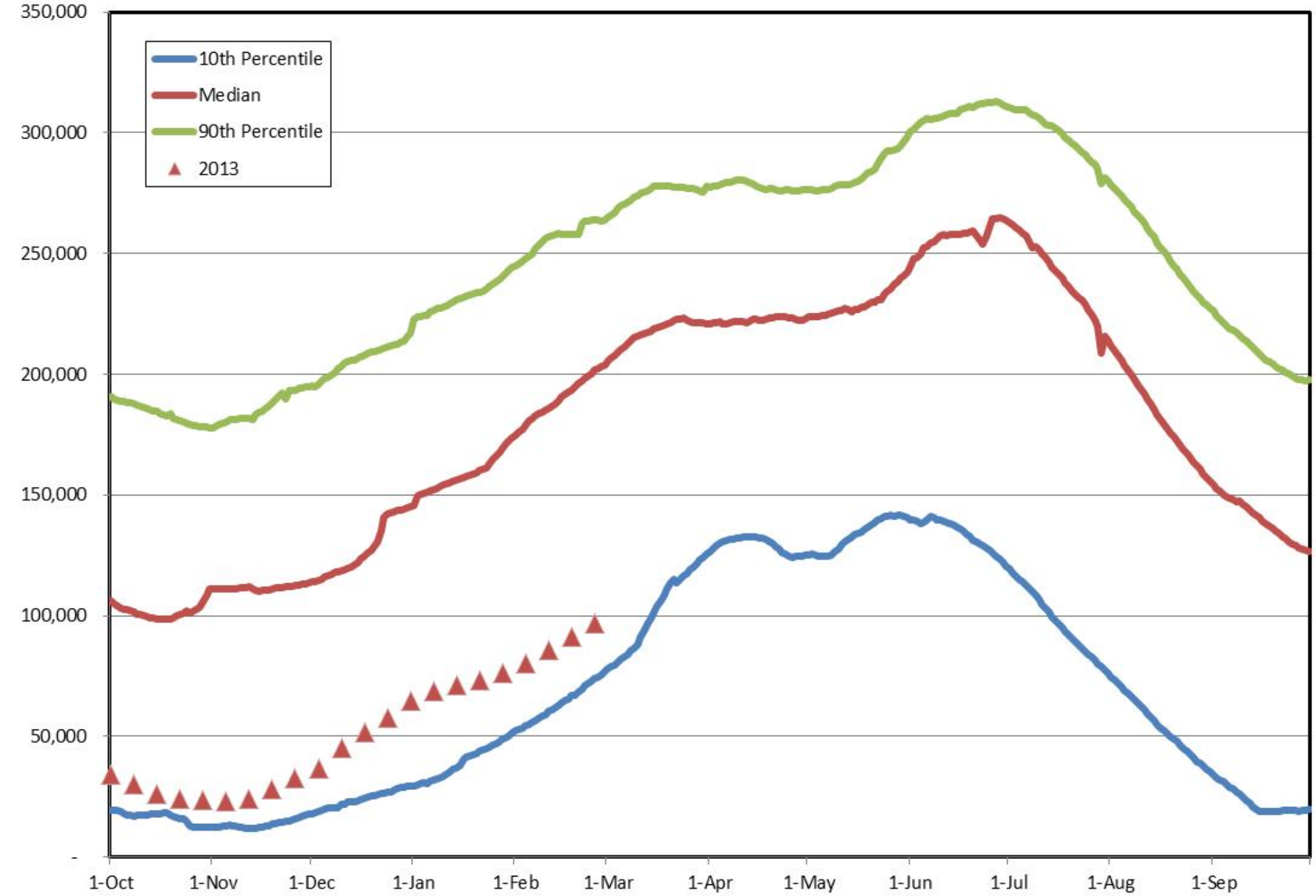
- ~30% inflow has come from Truckee Canal (1967-2011)
- DRI concluded that TC water does not short circuit to outlet works
- TC v. CR WQ
- Truckee Canal Contribution
  - ~30% TN Load
  - ~10% TP Load

	Carson River	Truckee Canal
TP	~0.20 mg/l	~0.08 mg/l
TN	~0.52 mg/l	~0.66 mg/l
TDS	~250 mg/l	~180 mg/l
TSS	~40 mg/l	~15 mg/l

Additional Data

- NDEP is considering collecting additional data in 2013
  - However, storage levels are a concern

Lahontan Reservoir - Historic Storage Levels Compared to Recent Years



Next Meeting

- June/July??
- Discuss
  - Beneficial uses
  - Numeric criteria

- Supporting Documentation

http://ndep.nv.gov/bwqp/lahontan_rvw.html

Thank You

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