Florida Department of Environmental Protection

Bureau of Watershed Restoration

Summary of Water Quality Data and the Existing Monitoring Network : Current & Recent Nitrate Trends in Wakulla Springs & River

Gary Maddox, P.G.
Ground Water Management Section

March 28, 2013





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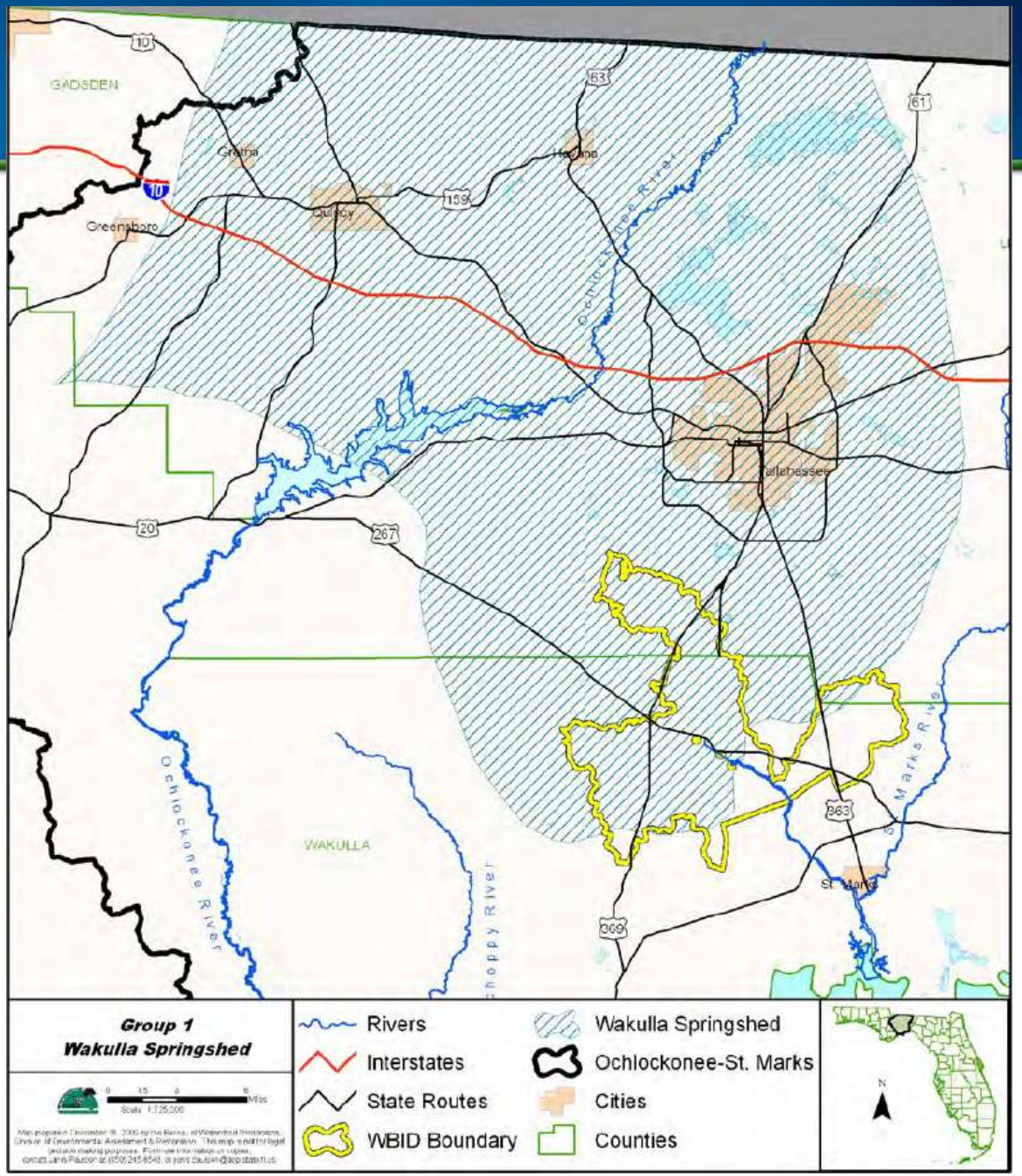
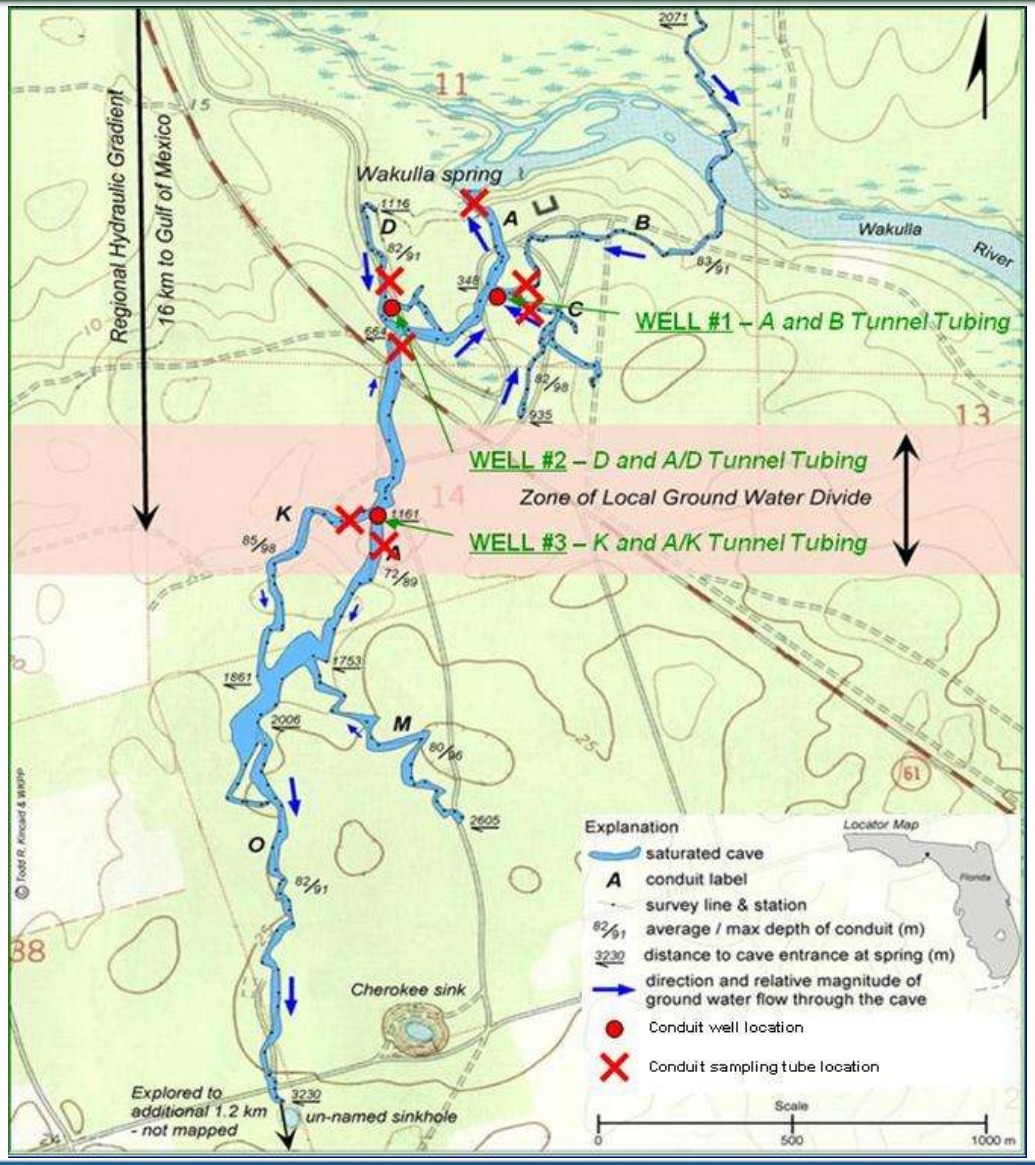
- What potential source areas contribute to water quality in major Wakulla tunnels (based on dye-tracing studies)?

WAKULLA SPRINGSHED & WBID 1006 BOUNDARIES



Springshed coverage from NWFWMD (Barrios), 2008

Wakulla Cave Access Well Locations



Wakulla Main Spring Sampling Tube

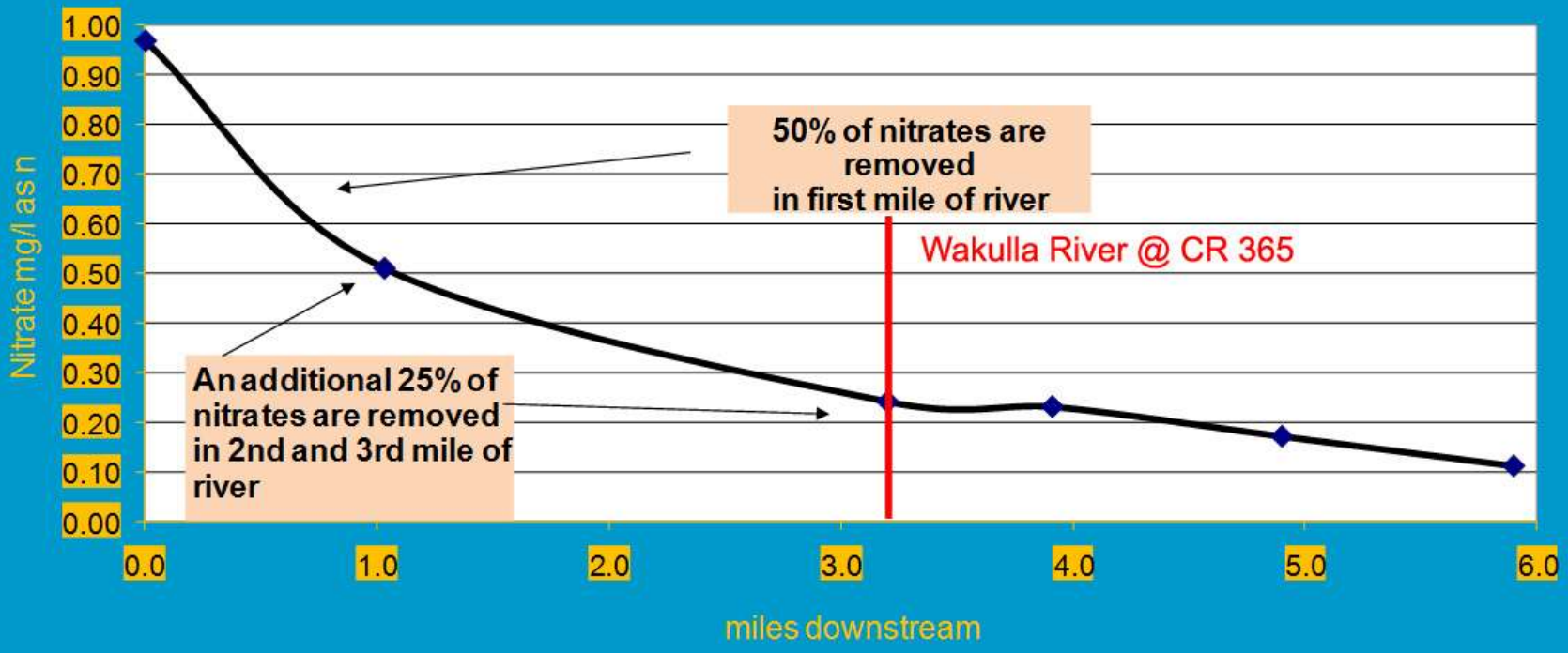
Wakulla B- & C-Tunnel Access Well

Wakulla Surface Water & Ground Water Quality Stations

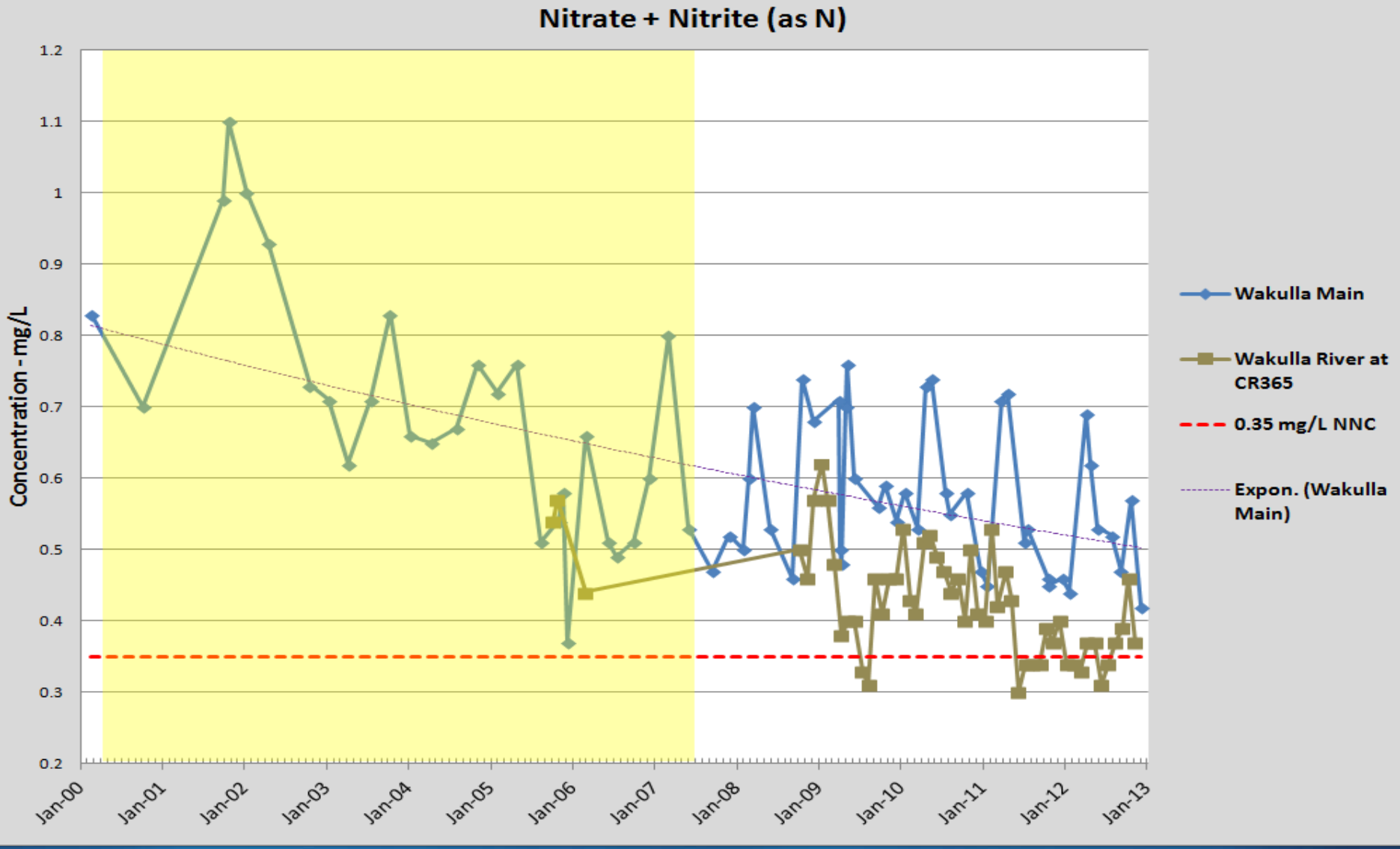
Wakulla River Surface Water Quality Stations @ County Road 365 Bridge

Nitrate Reduction Downstream from Wakulla Main Spring

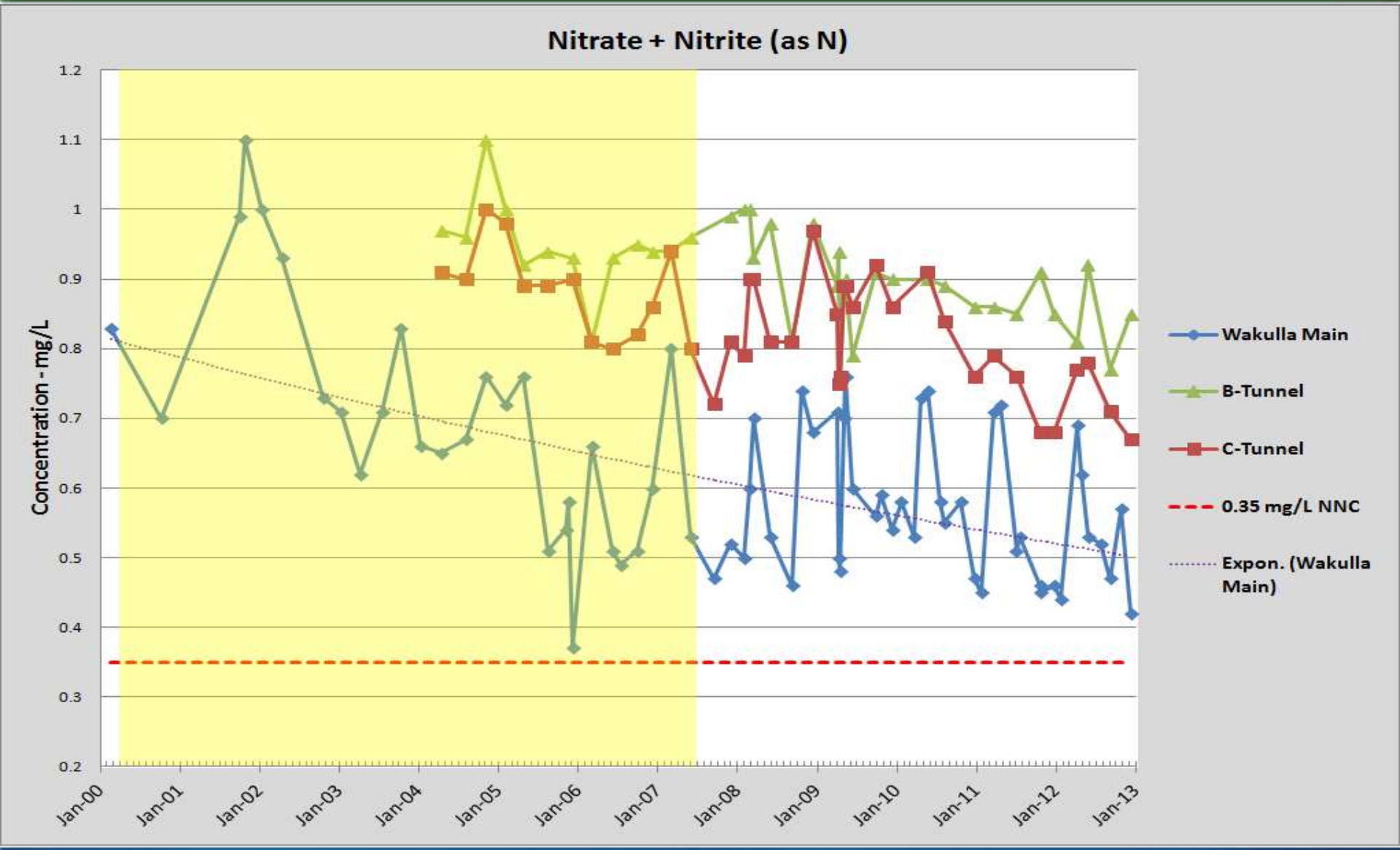
There is a 75% reduction of the nitrates within the Park



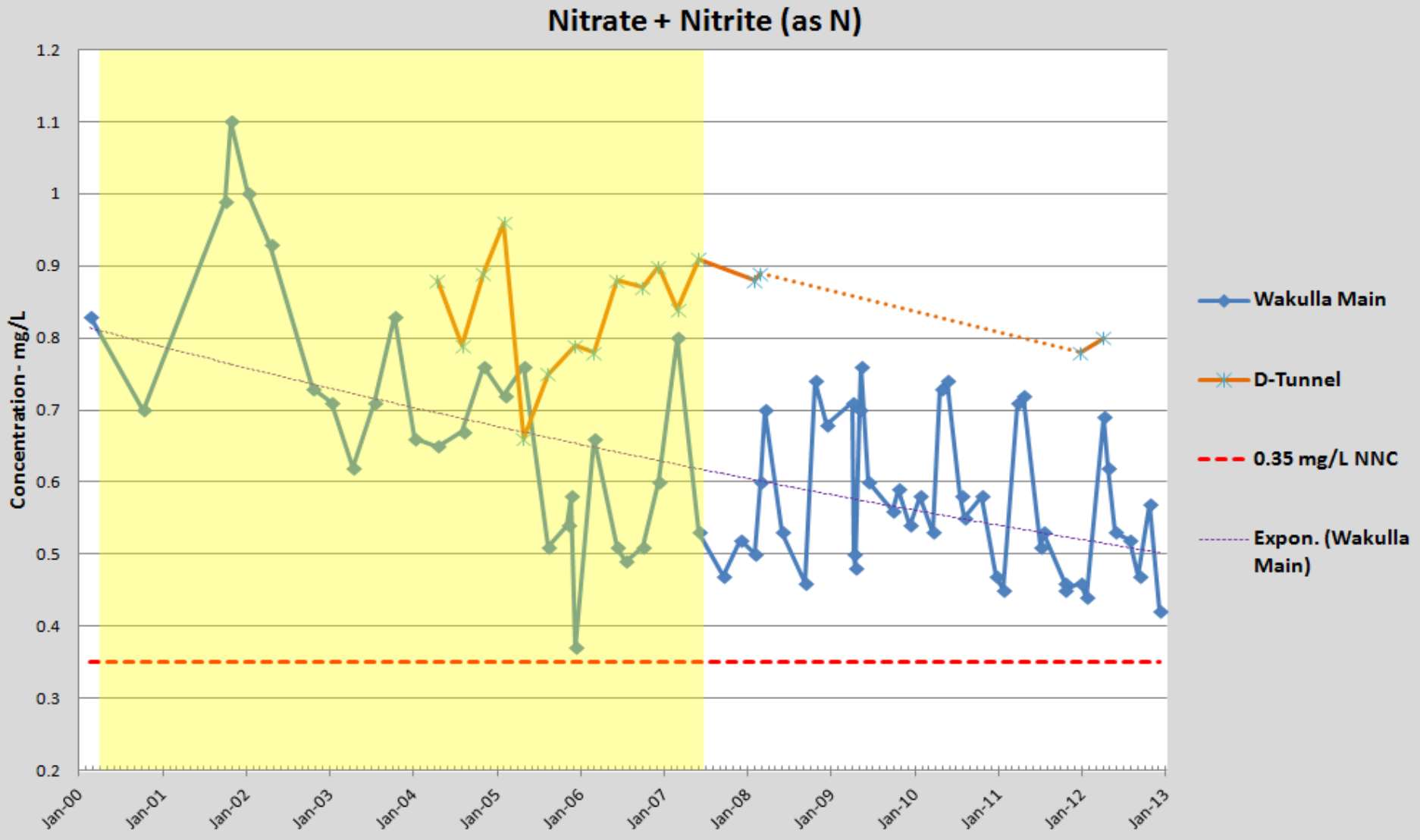
Wakulla Main Spring vs. Wakulla River @ County Road 365 Bridge



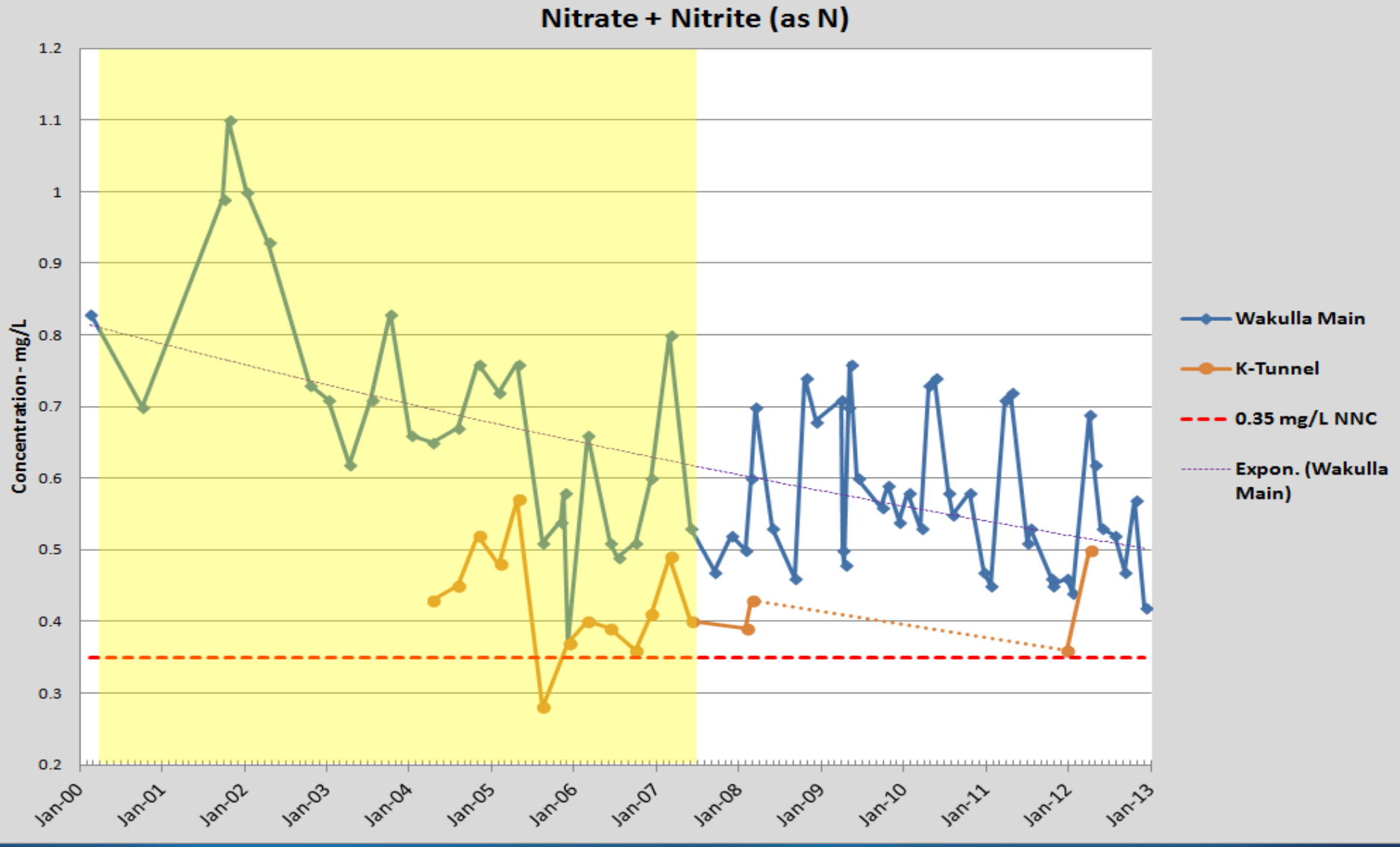
Ground Water Sources – Wakulla Main, B-Tunnel & C-Tunnel



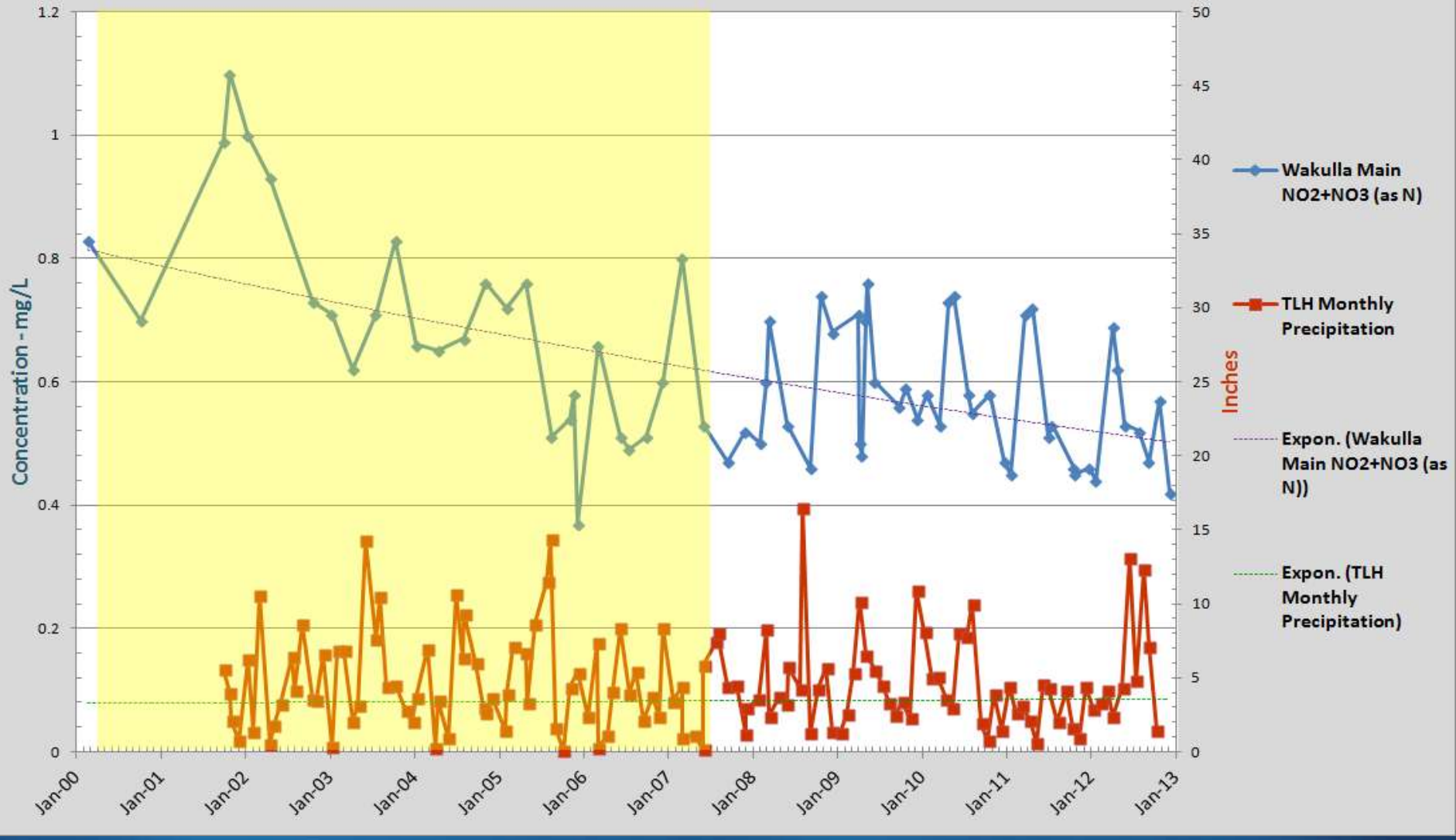
Ground Water Sources – Wakulla Main & D-Tunnel



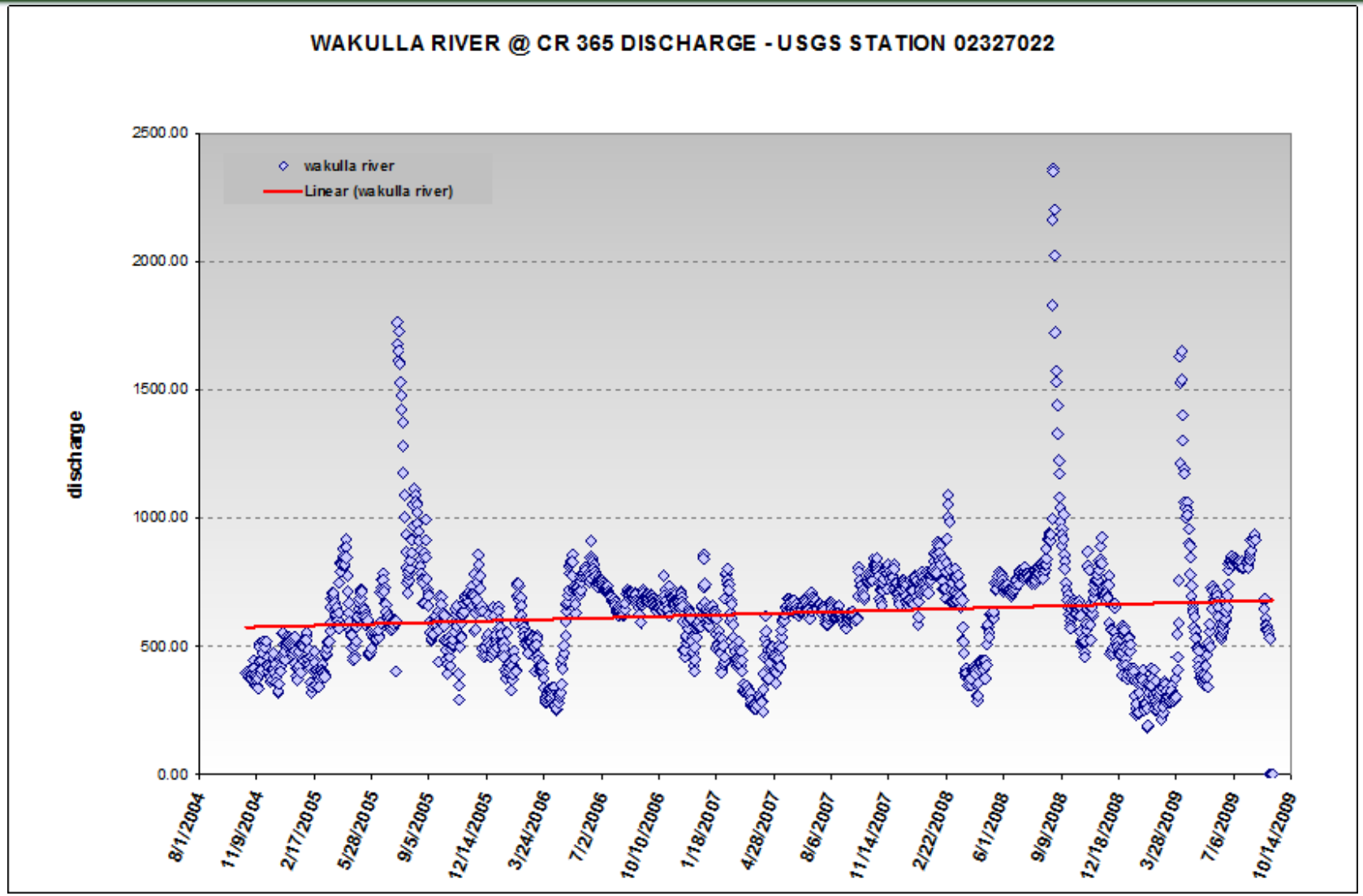
Ground Water Sources – Wakulla Main & K-Tunnel



Wakulla Main Spring Nitrate & Tallahassee Regional Airport Precipitation



Wakulla River Discharge 2004 - 2009



from Harrington, 2010

Relative Contribution from Inventoried Land Surface Nitrogen Sources to 1990-1999 Average N-Loading in Southern Leon and Wakulla Counties

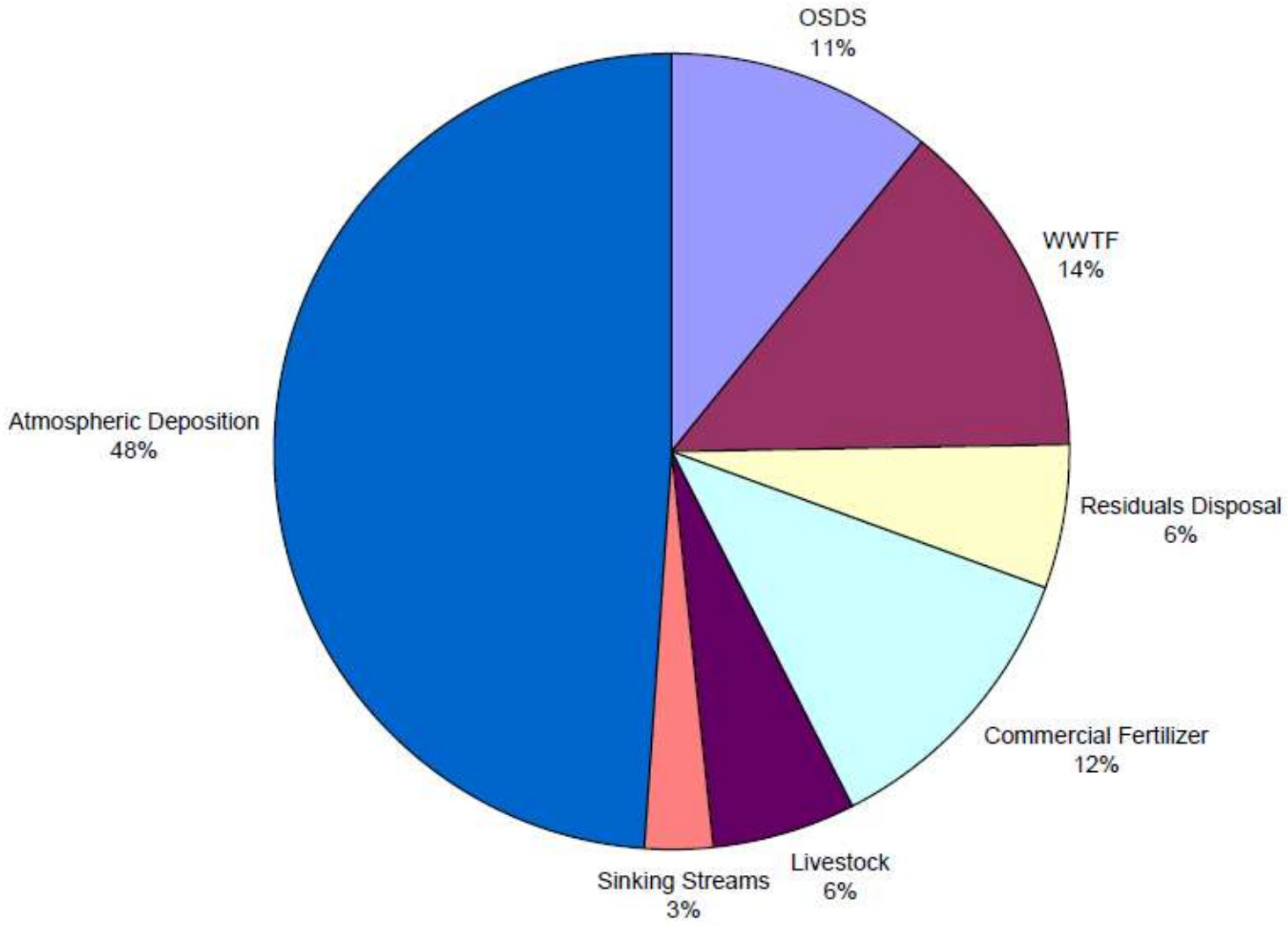
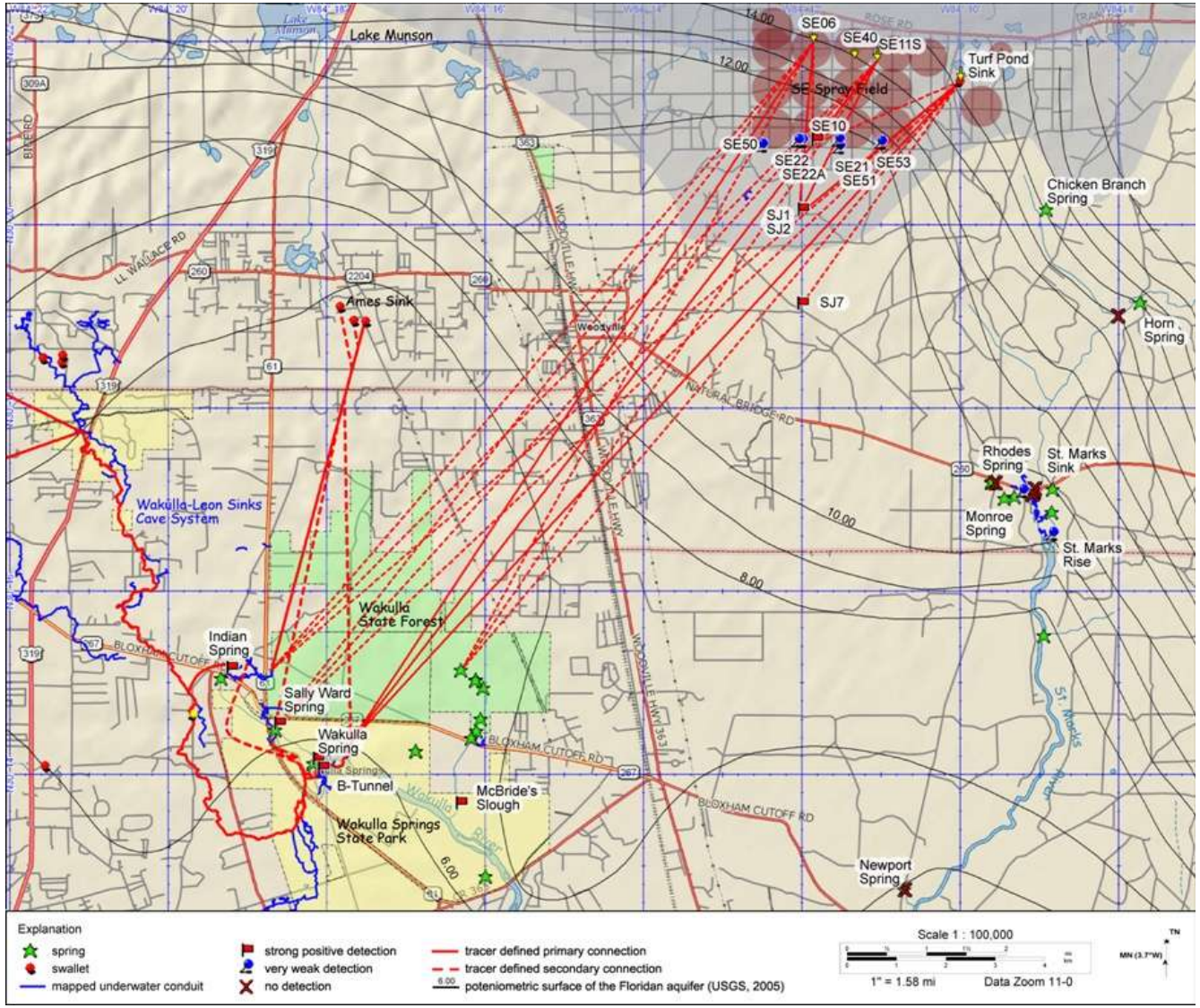


Figure from Chelette, Pratt & Katz, 2002

Dye-Tracing Results (2005-2007)



ESTABLISHED CONNECTIONS:

Fisher & Black Creeks → Wakulla-Leon Sinks Cave System → Wakulla R-Tunnel → Wakulla K-Tunnel

Ames Sink → Indian, Sally Ward, Wakulla B-Tunnel

SE Sprayfield → Indian, Sally Ward, McBride Slough, Wakulla B- Tunnel

Map from Kincaid et al, 2007

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  - ***Recent nitrate concentrations in Wakulla Main, B- and C-Tunnels have dropped relative to the TMDL Verified period;***

  - ***Nitrate concentrations in D-Tunnel <u>may have</u> dropped relative to the TMDL Verified period, but there is too little post-Verified Period monitoring data to confirm this;***

CONCLUSIONS:

- **How do recent (2007-2012) nutrient concentrations in Wakulla Springs & River compare with levels measured during the TMDL Verified Period (February 28, 2000 – June 30, 2007)?**
  - ***Nitrate concentrations in K-Tunnel appear to be relatively constant, but there is too little post-Verified Period monitoring data to confirm this;***

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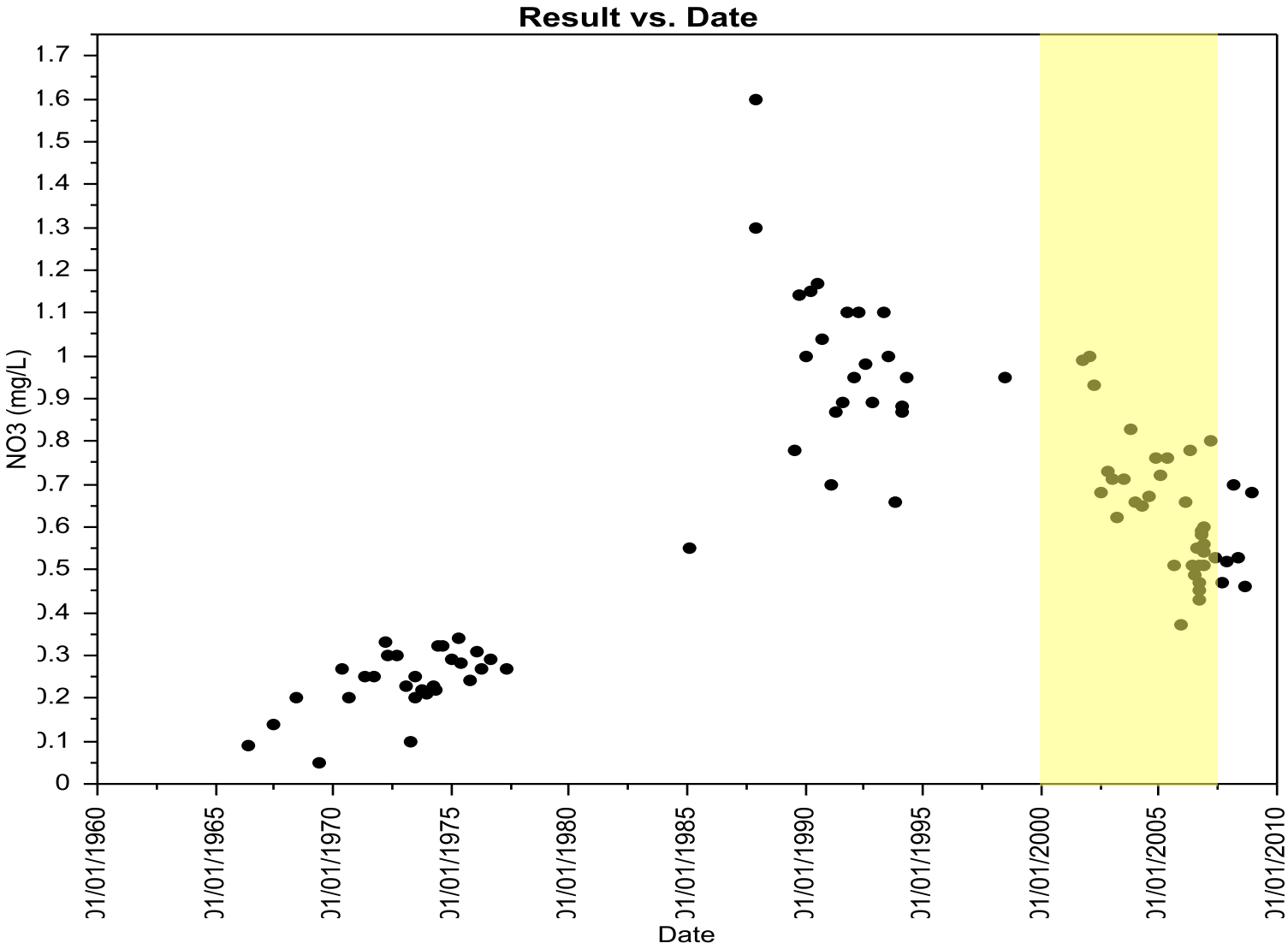
  - ***Nitrate concentrations in K-Tunnel appear to be relatively constant, but there is too little post-Verified Period monitoring data to confirm this;***
  - ***Nitrate trends in the Wakulla River, measured at the bottom of the WBID, mirror those at Wakulla Main Spring, but with lower nitrate levels.***

Wakulla Long-Term Nitrate Trend



SUMMARY STATISTICS

PERIOD OF STUDY:
February 28, 2000 – December 31, 2012

STATION	SAMPLING PERIOD	n	MEAN	MEDIAN	MIN	MAX
Wakulla Main	10/5/2000 - 12/5/2012	69	0.62	0.58	0.37	1.10
Wakulla B-Tunnel	4/12/2004 - 12/5/2012	39	0.91	0.92	0.75	1.10
Wakulla C-Tunnel	4/12/2004 - 12/5/2012	40	0.83	0.83	0.67	1.00
Wakulla D-Tunnel	4/12/2004 - 4/3/2012	17	0.84	0.87	0.66	0.96
Wakulla K-Tunnel	4/12/2004 - 4/3/2012	17	0.43	0.41	0.28	0.57
Wakulla River @ CR 365	10/4/2005 - 8/11/2012	53	0.43	0.41	0.30	0.62

TMDL VERIFIED PERIOD:
February 28, 2000 – June 30, 2007

STATION	SAMPLING PERIOD	n	MEAN	MEDIAN	MIN	MAX
Wakulla Main	10/5/2000 - 5/31/2007	27	0.70	0.68	0.37	1.10
Wakulla B-Tunnel	4/12/2004 - 5/31/2007	13	0.95	0.94	0.81	1.10
Wakulla C-Tunnel	4/12/2004 - 5/31/2007	13	0.88	0.89	0.80	1.00
Wakulla D-Tunnel	4/12/2004 - 5/31/2007	13	0.84	0.87	0.66	0.96
Wakulla K-Tunnel	4/12/2004 - 5/31/2007	13	0.43	0.41	0.28	0.57
Wakulla River @ CR 365	10/4/2005 - 2/28/2006	3	0.52	0.54	0.44	0.57

POST-TMDL VERIFIED PERIOD:
July 1, 2007 – December 31, 2012

STATION	SAMPLING PERIOD	n	MEAN	MEDIAN	MIN	MAX
Wakulla Main	9/13/2007 - 12/5/2012	42	0.57	0.54	0.42	0.76
Wakulla B-Tunnel	11/29/2007 - 12/5/2012	26	0.89	0.89	0.75	1.00
Wakulla C-Tunnel	11/29/2007 - 12/5/2012	27	0.81	0.81	0.67	0.97
Wakulla D-Tunnel	1/31/2008 - 4/3/2012	4	0.84	0.84	0.78	0.89
Wakulla K-Tunnel	1/31/2008 - 4/3/2012	4	0.42	0.41	0.36	0.50
Wakulla River @ CR 365	10/7/2008 - 8/11/2012	50	0.42	0.41	0.30	0.62

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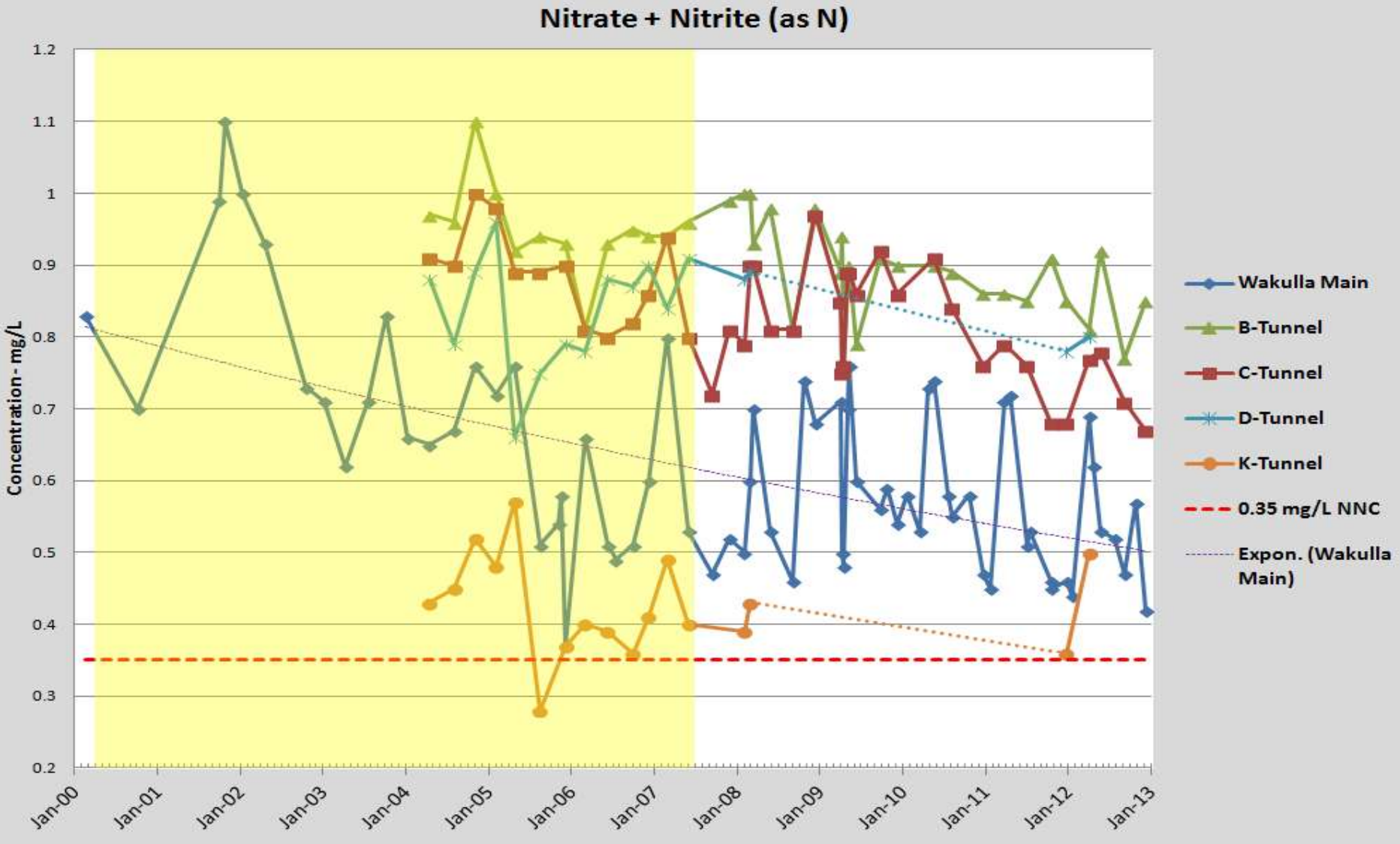
  - ***B-Tunnel has the highest measured mean nitrate concentration;***
  - ***K-Tunnel has the lowest measured Wakulla Tunnel nitrate concentrations. It receives much of it's flow from R-Tunnel (Wakulla-Leon Sinks Cave System).***

Ground Water Sources – Principal Wakulla Tunnels



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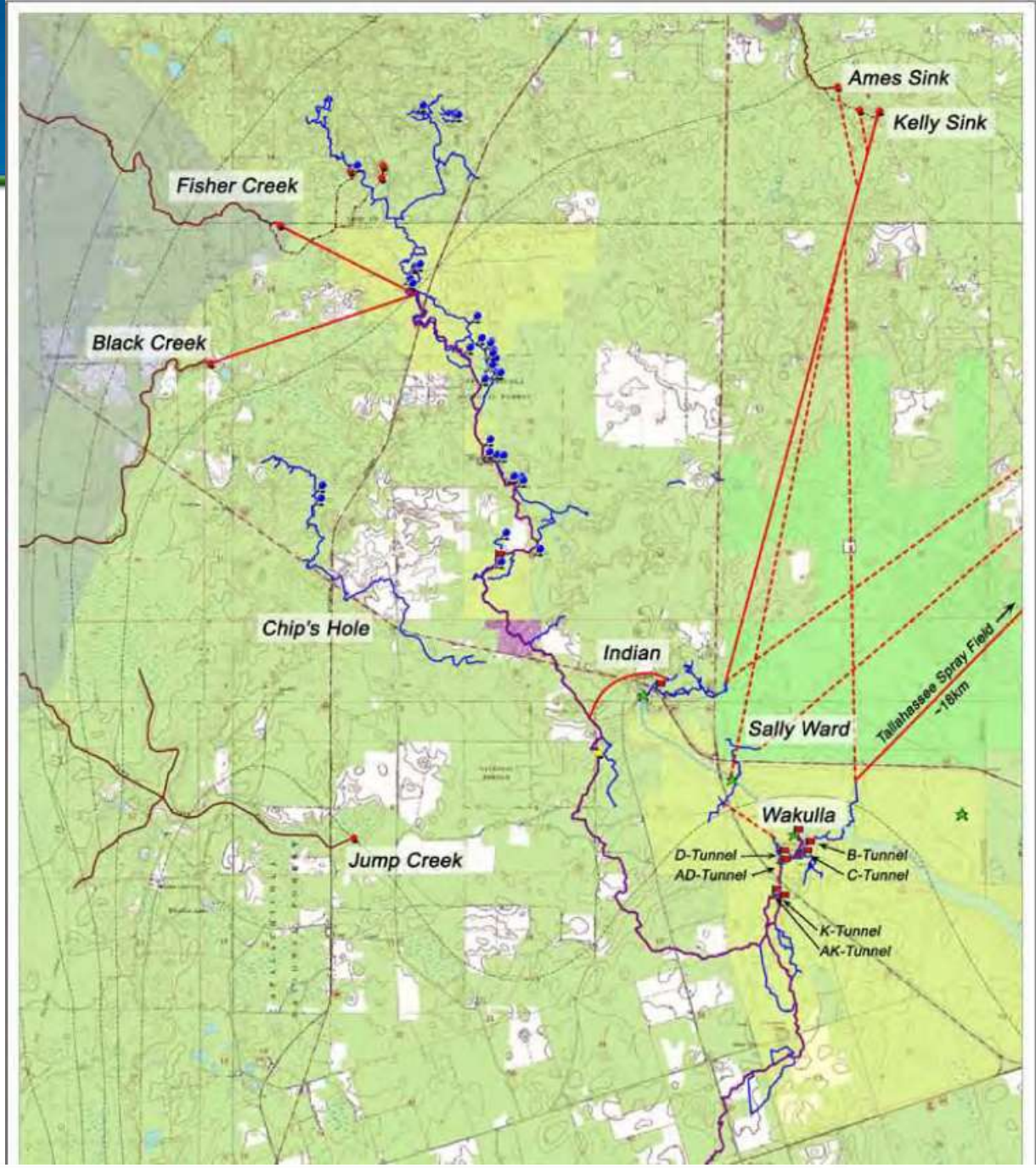
  - ***K-Tunnel:*** *Apalachicola National Forest surface water streams - Fisher Creek, Black Creek via R-Tunnel, and Lost Creek via O-Tunnel; also Spring Creek Springs Group*

WAKULLA TUNNELS & DYE-TRACING RESULTS



Map courtesy of Dr. Todd Kincaid
(H2H Associates)

Questions?