Carters Lake Modeling and Standards Revisions

May 23, 2012

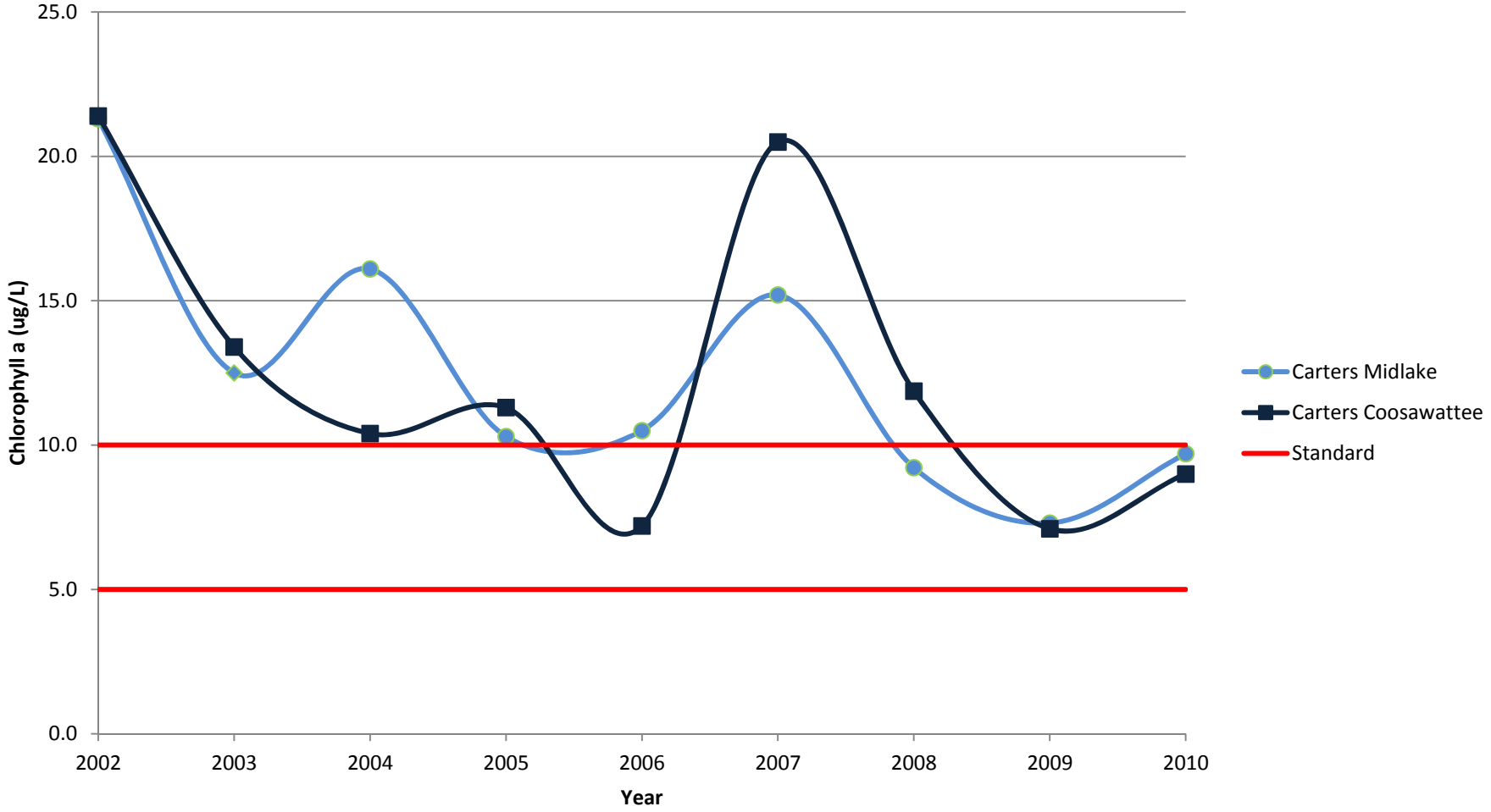
Presented by:

Elizabeth Booth, GA EPD

Outline

- Monitoring Data
- Modeling and Database Tools
- Data Sources
- Model Calibration
  - Watershed - LSPC
  - Lake – EFDC
- Scenarios
- Lake Standard Revisions
- Next Steps
- Questions

Carters Lake Growing Season Average Chlorophyll *a*



Modeling and Database Tools

- Watershed Model
  - Loading Simulation Program C++ (LSPC)
- Hydrodynamic Lake Model
  - Environmental Fluid Dynamics Code (EFDC)
- Water Quality Lake Model
  - Environmental Fluid Dynamics Code (EFDC)
- Database Management
  - Water Resources Database (WRDB)

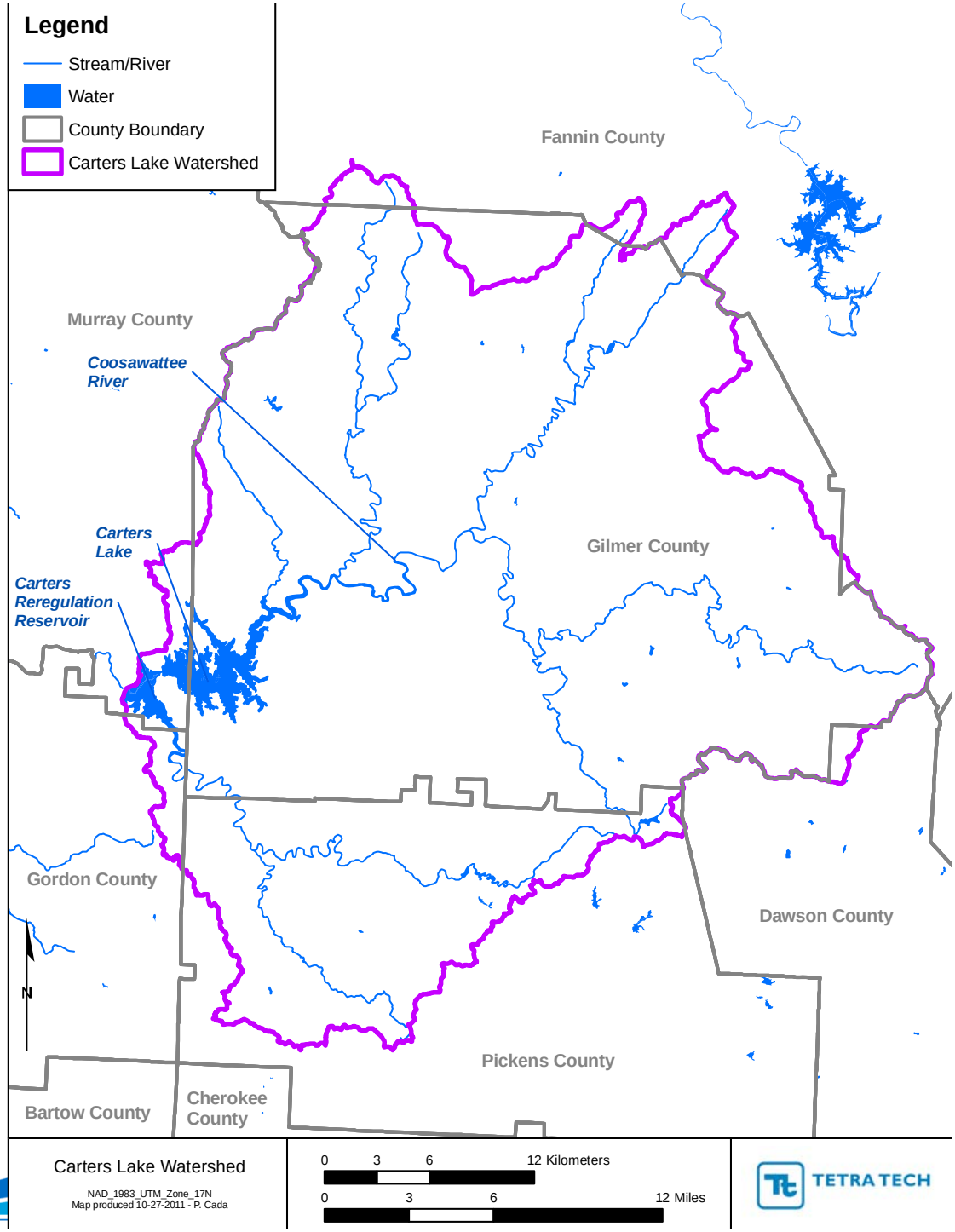
Data Sources

- National Hydrography Dataset (NHD)
- Georgia 12-digit HUC Coverage
- Digital Elevation Map (DEM)
- Georgia Land Use Trend (GLUT)
- SSURGO Soil Coverage
- Agricultural Irrigated Areas

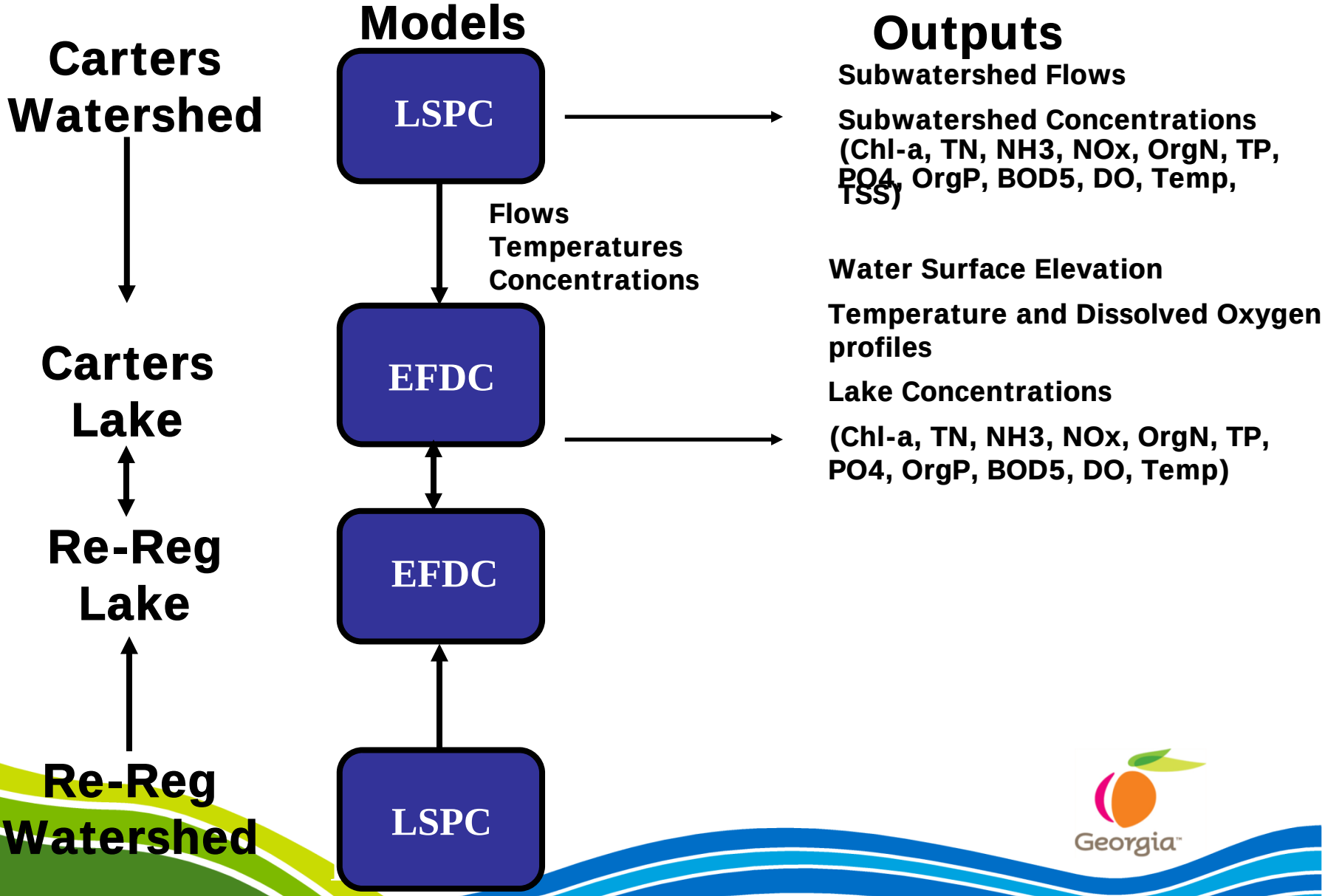
Data Sources

- Septic Systems
- Chicken Houses (Carters Watershed)
- Meteorological Data
- Point Sources
- Water Withdrawals
- Algal Growth Potential

Carters Lake Watershed



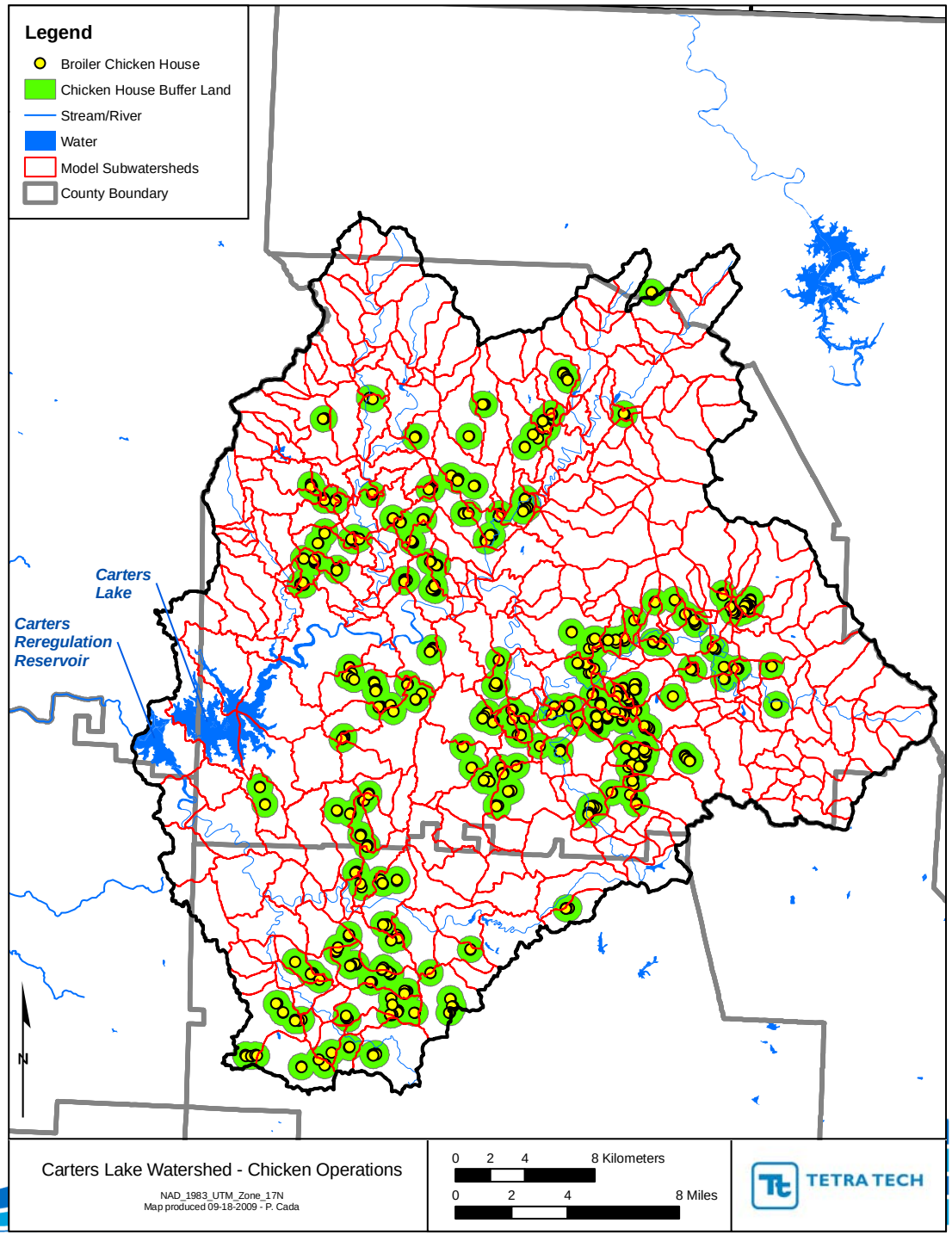
Carters Models



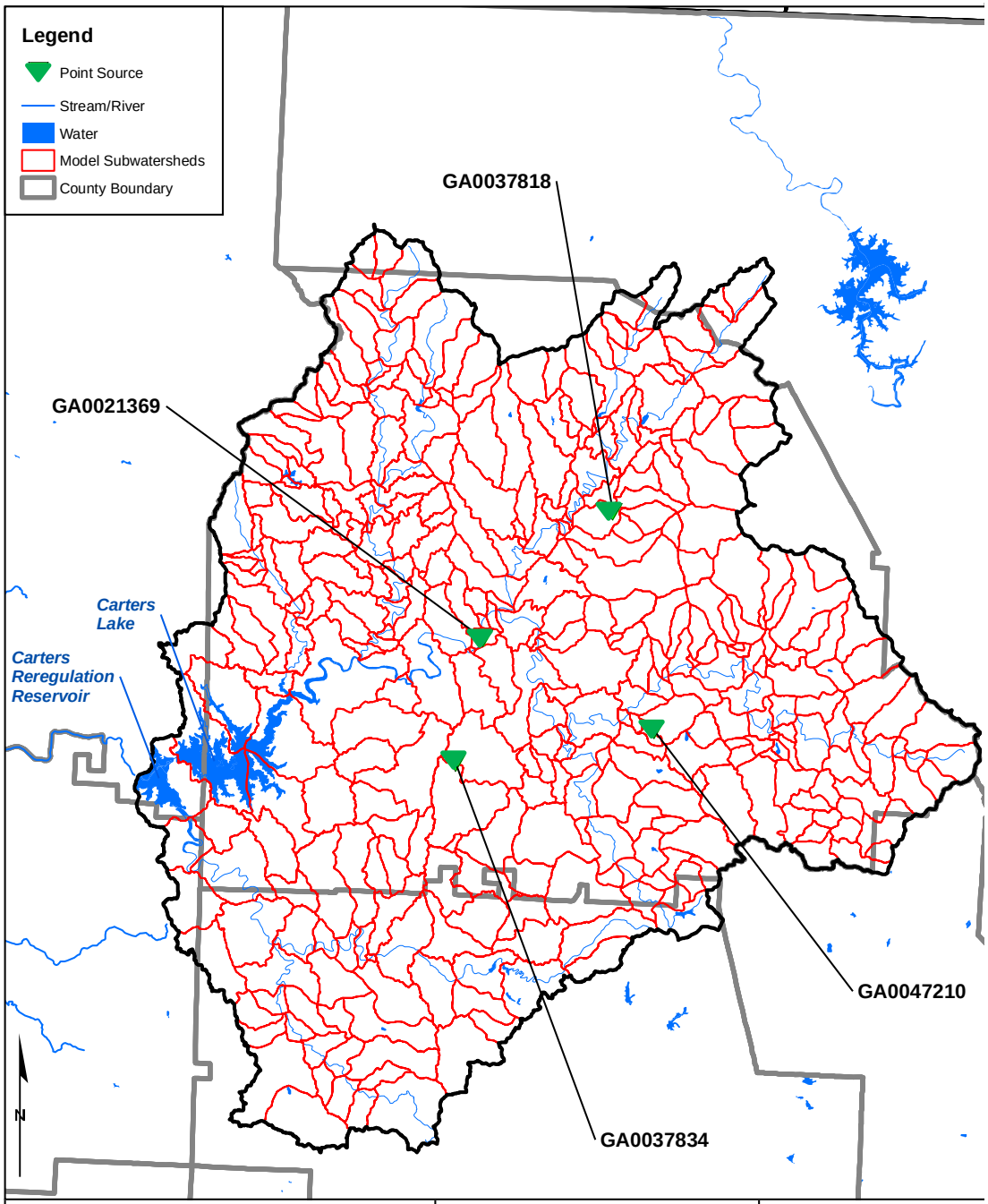
Carters Lake Watershed Model Calibration

Load Simulation Program C++ (LSPC)

Chicken House Locations in the Carters Watershed LSPC Model



Point Sources



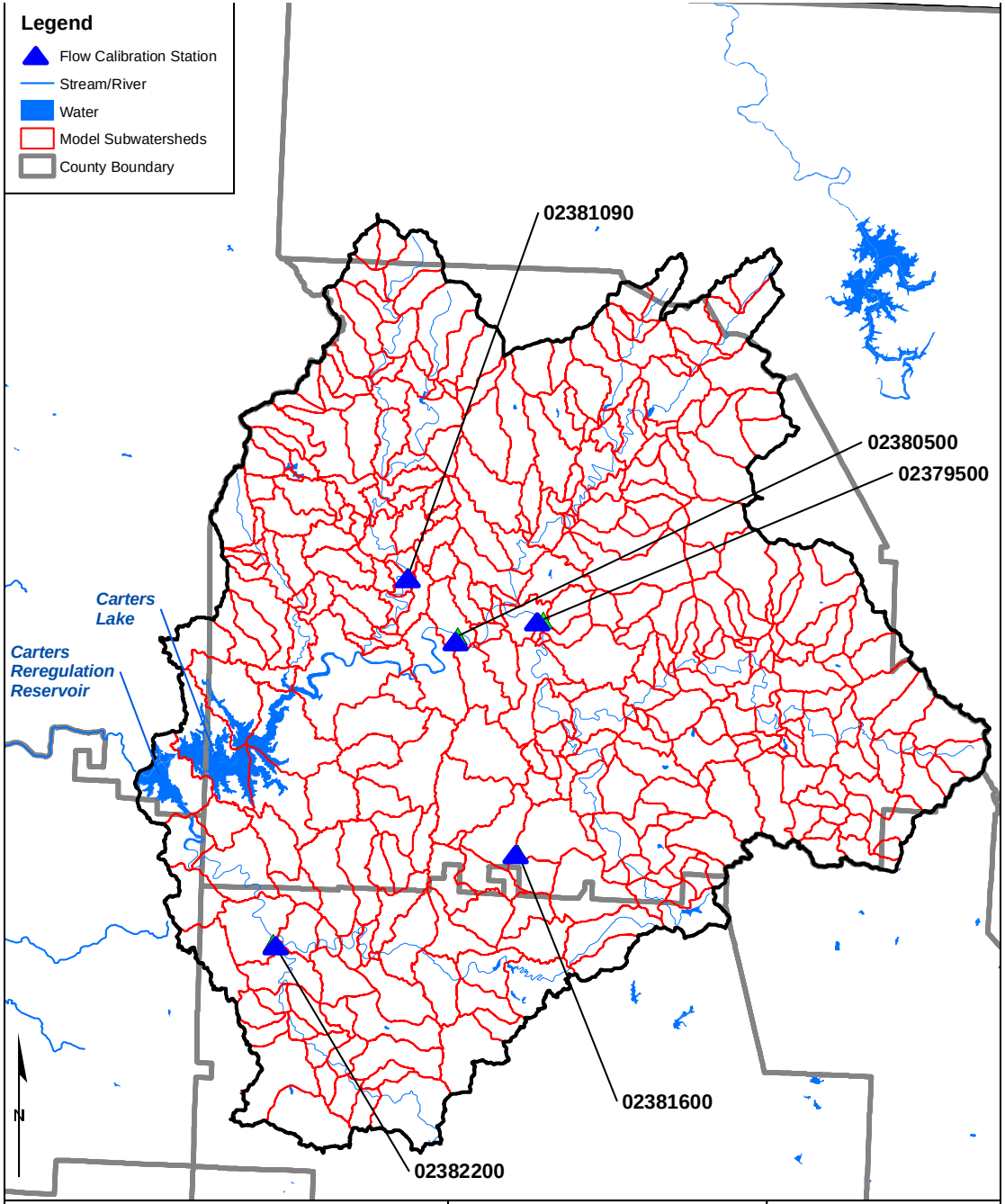
Carters Lake Watershed - Point Sources

NAD_1983_UTM_Zone_17N
Map produced 09-18-2009 - P. Cada

0 2 4 8 Kilometers
0 2 4 8 Miles

TETRA TECH

Hydrology Calibration Locations in the Carters Watershed LSPC Model



Carters Lake Watershed - Flow Calibration Stations

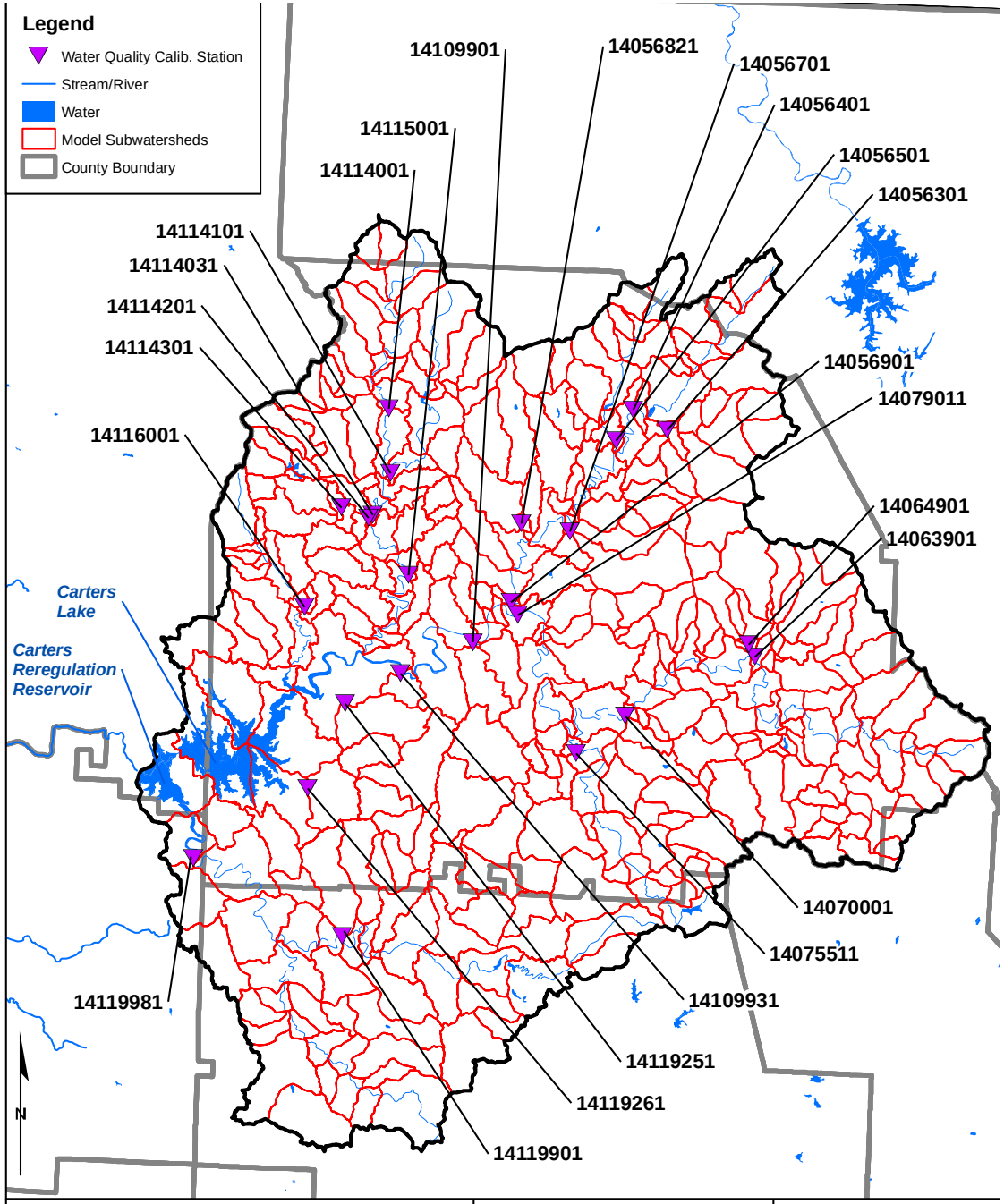
NAD_1983_UTM_Zone_17N
Map produced 10-26-2011 - P. Cada

0 2 4 8 Kilometers

0 2 4 8 Miles

TETRA TECH

Water Quality Calibration Locations in the Carters Watershed LSPC Model



Carters Lake Watershed - Water Quality Calib. Stations

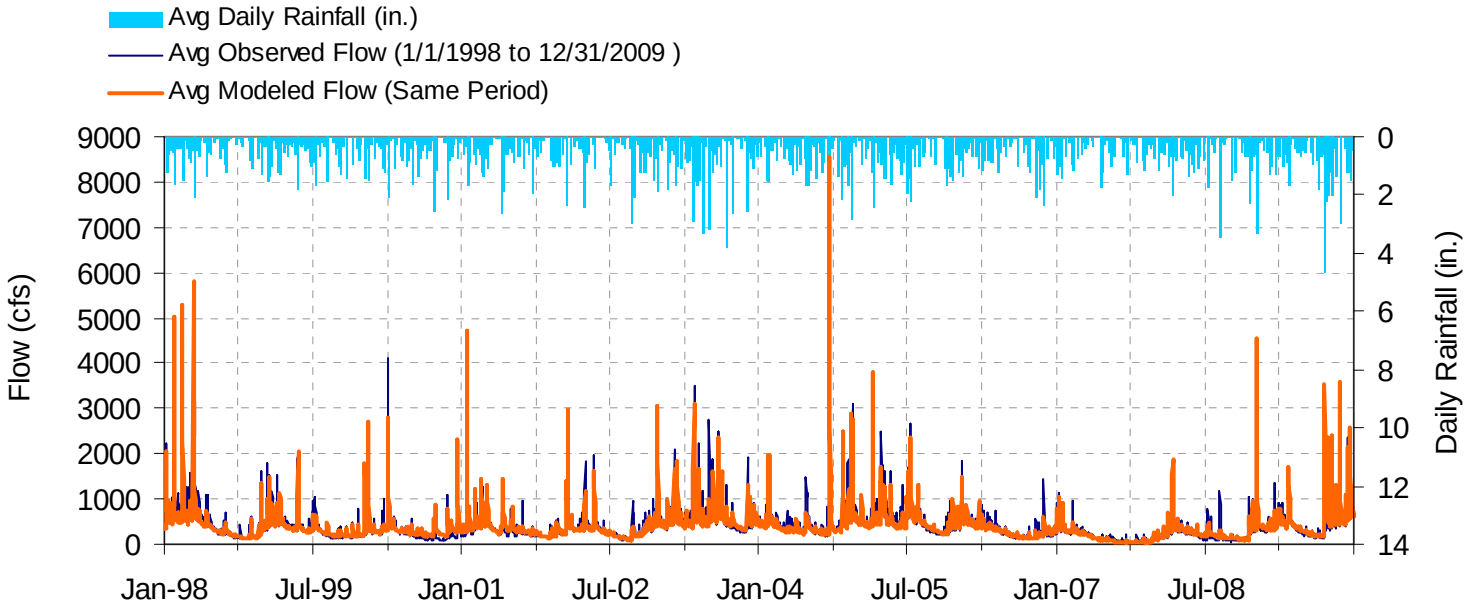
NAD_1983_UTM_Zone_17N
Map produced 10-26-2011 - P. Cada

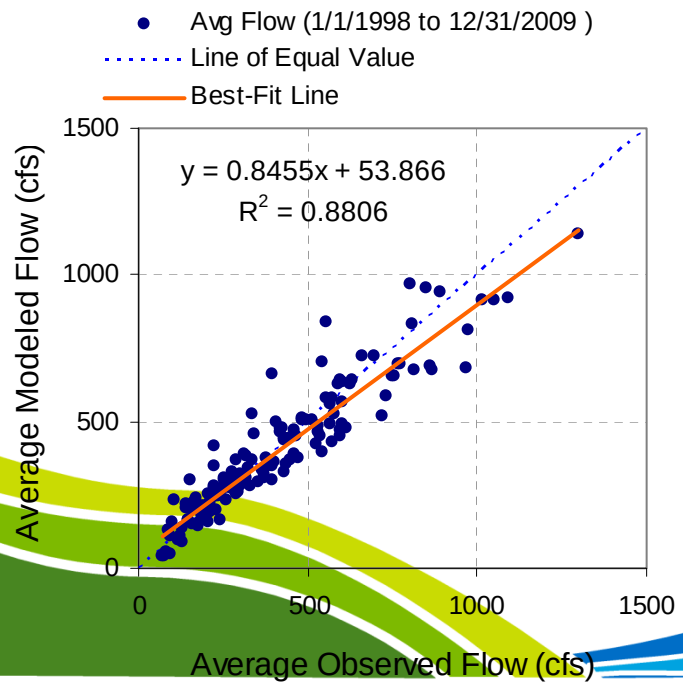
0 2 4 8 Kilometers

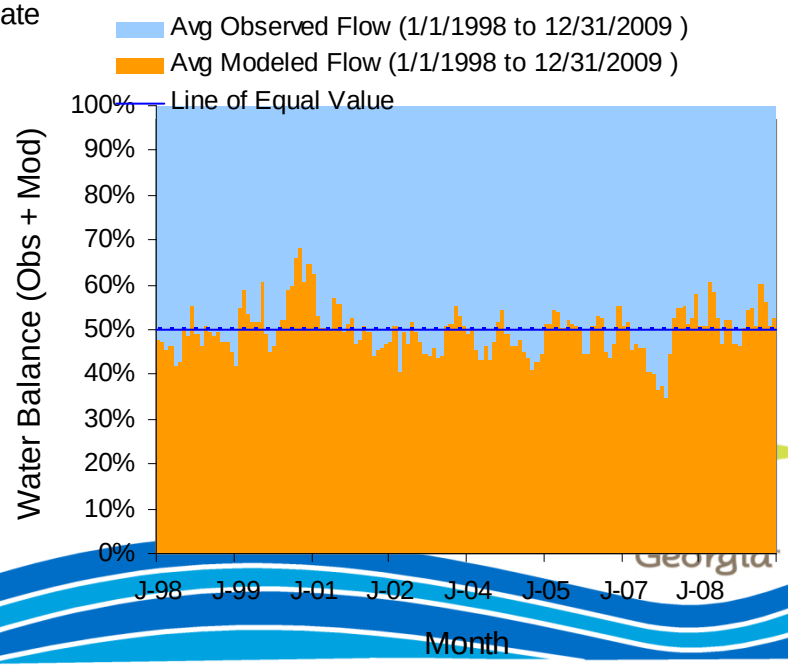
0 2 4 8 Miles

TETRA TECH

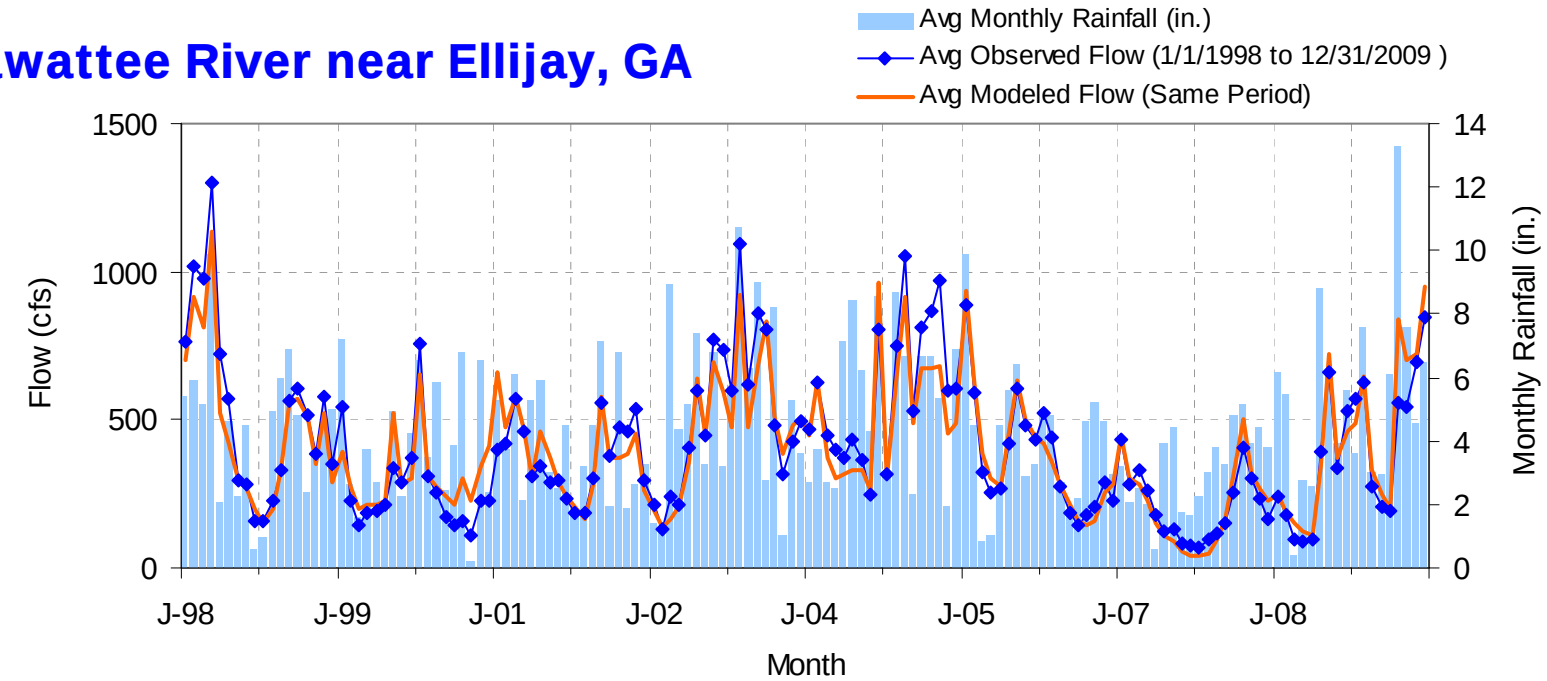
Coosawattee River near Ellijay, GA

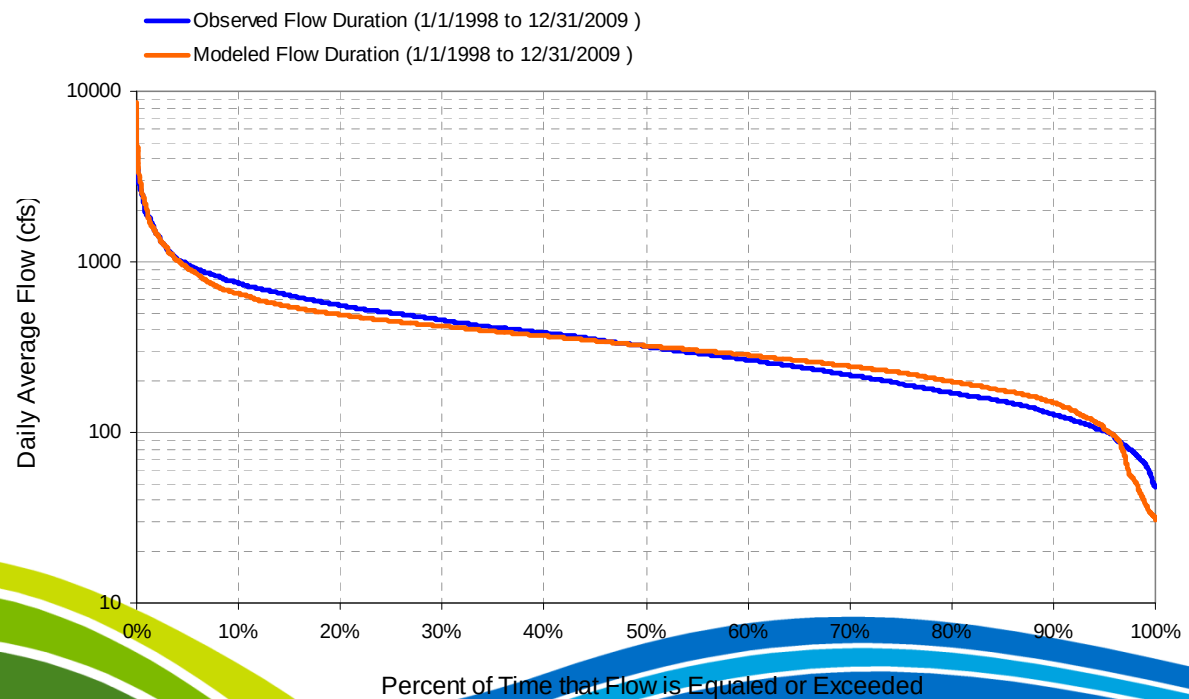




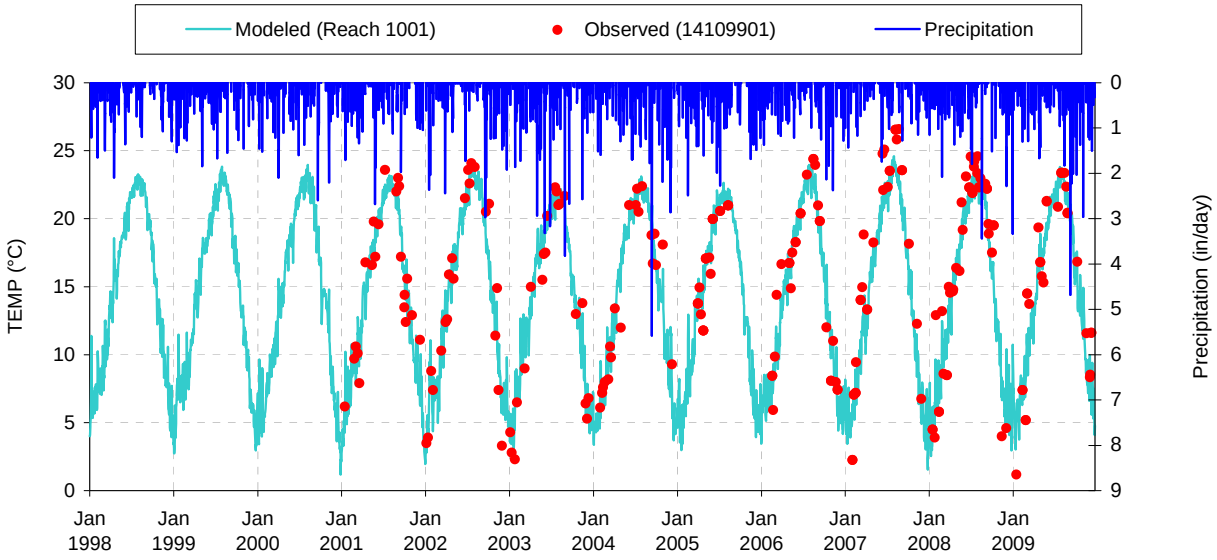


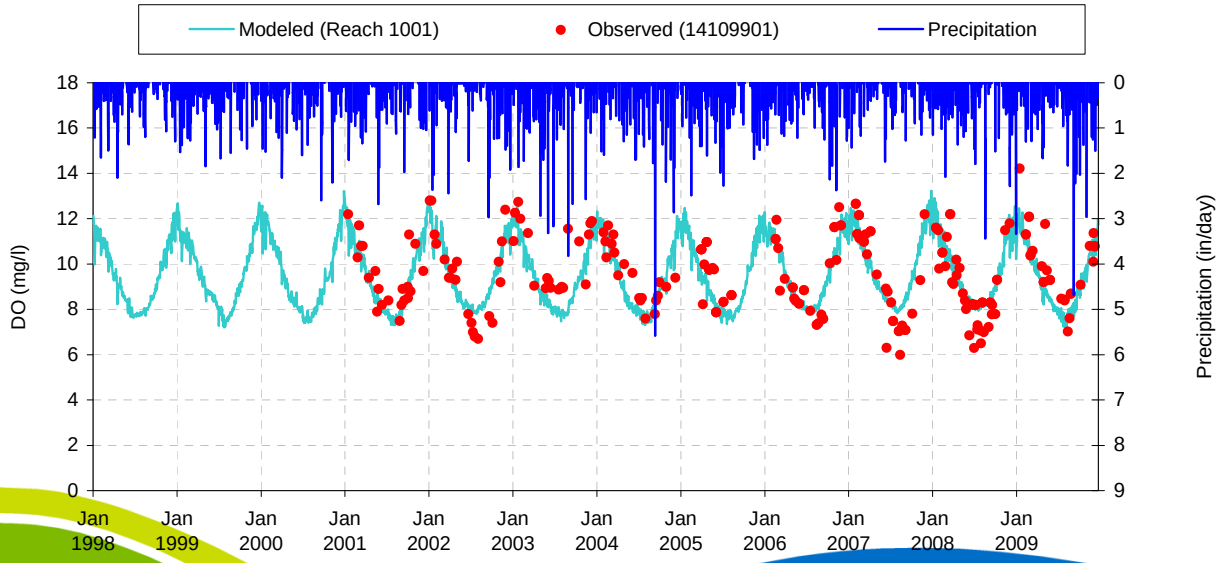
Coosawattee River near Ellijay, GA



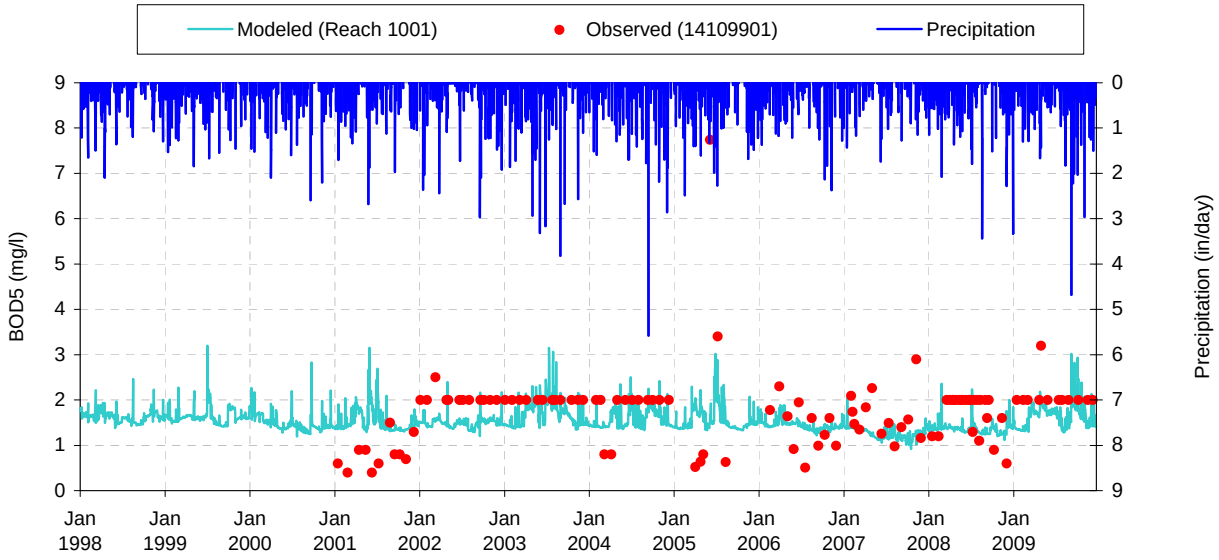


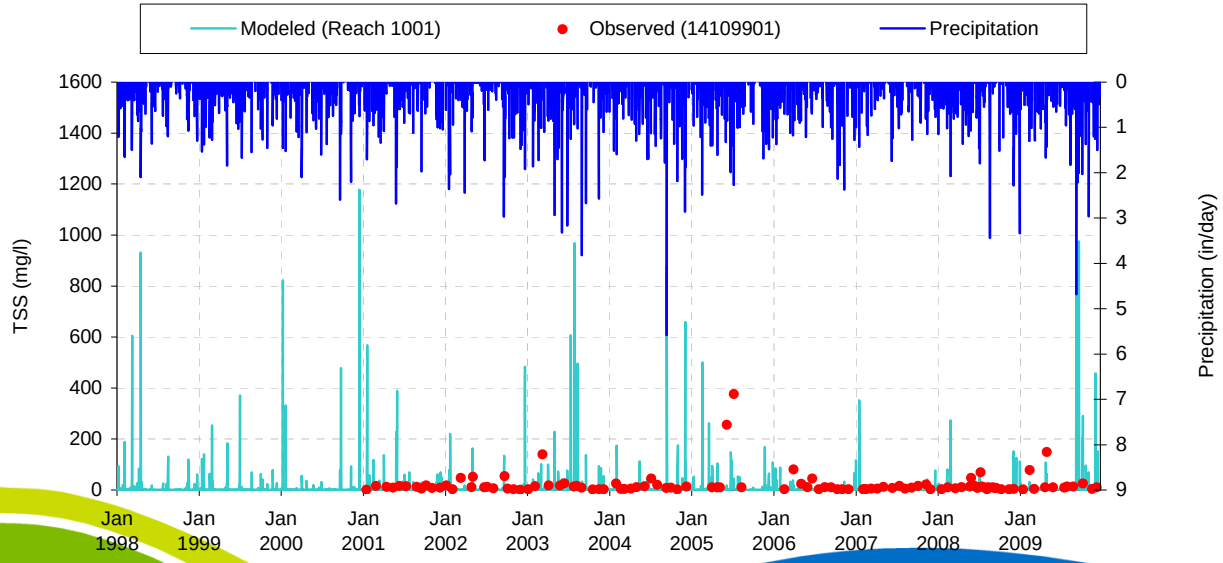
Coosawattee River near Ellijay, GA



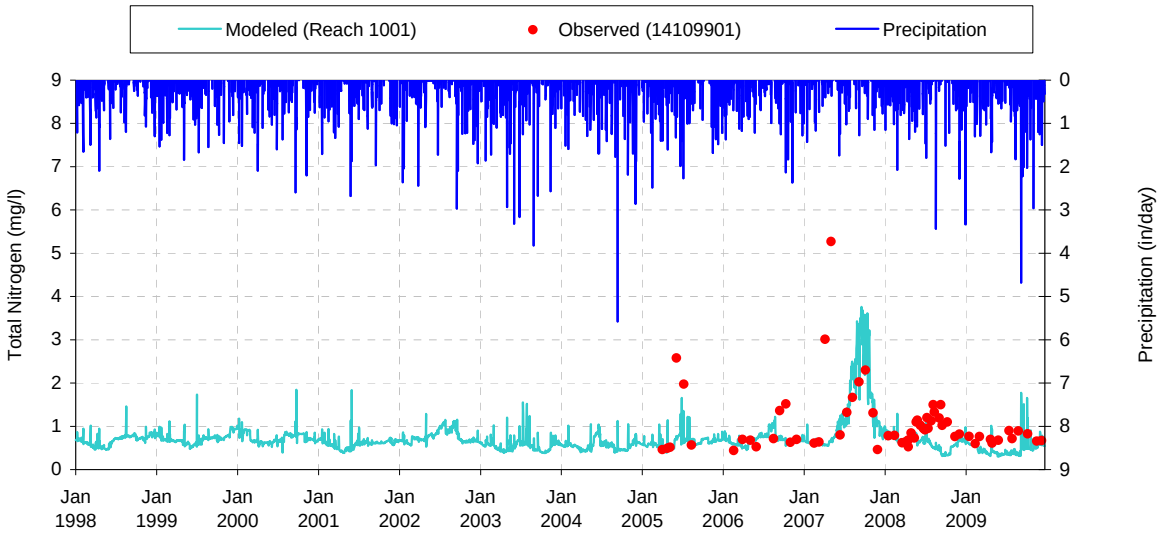


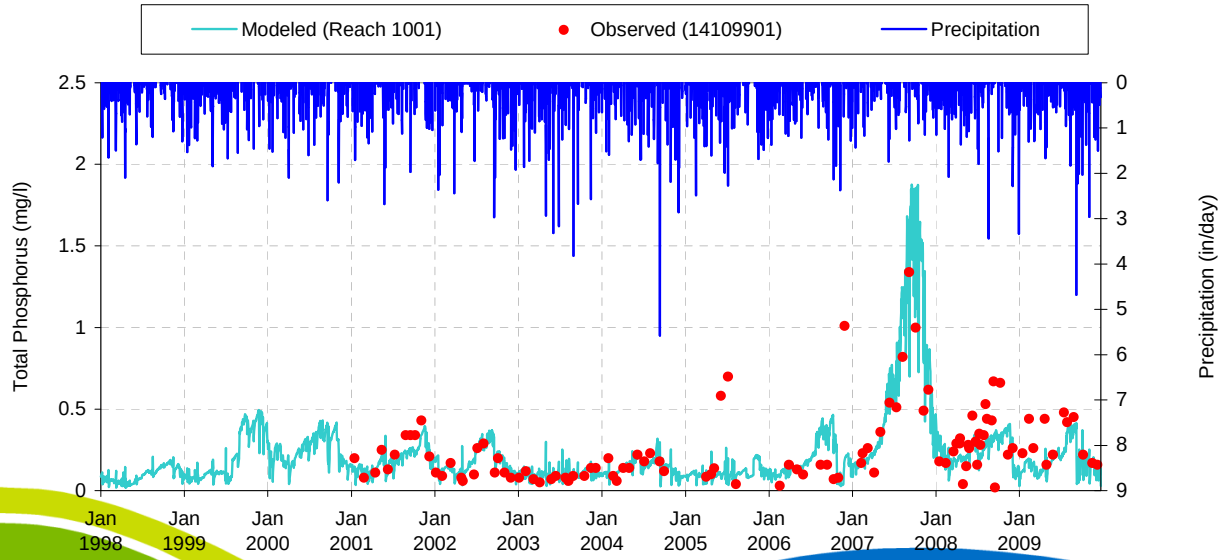
Coosawattee River near Ellijay, GA





Coosawattee River near Ellijay, GA

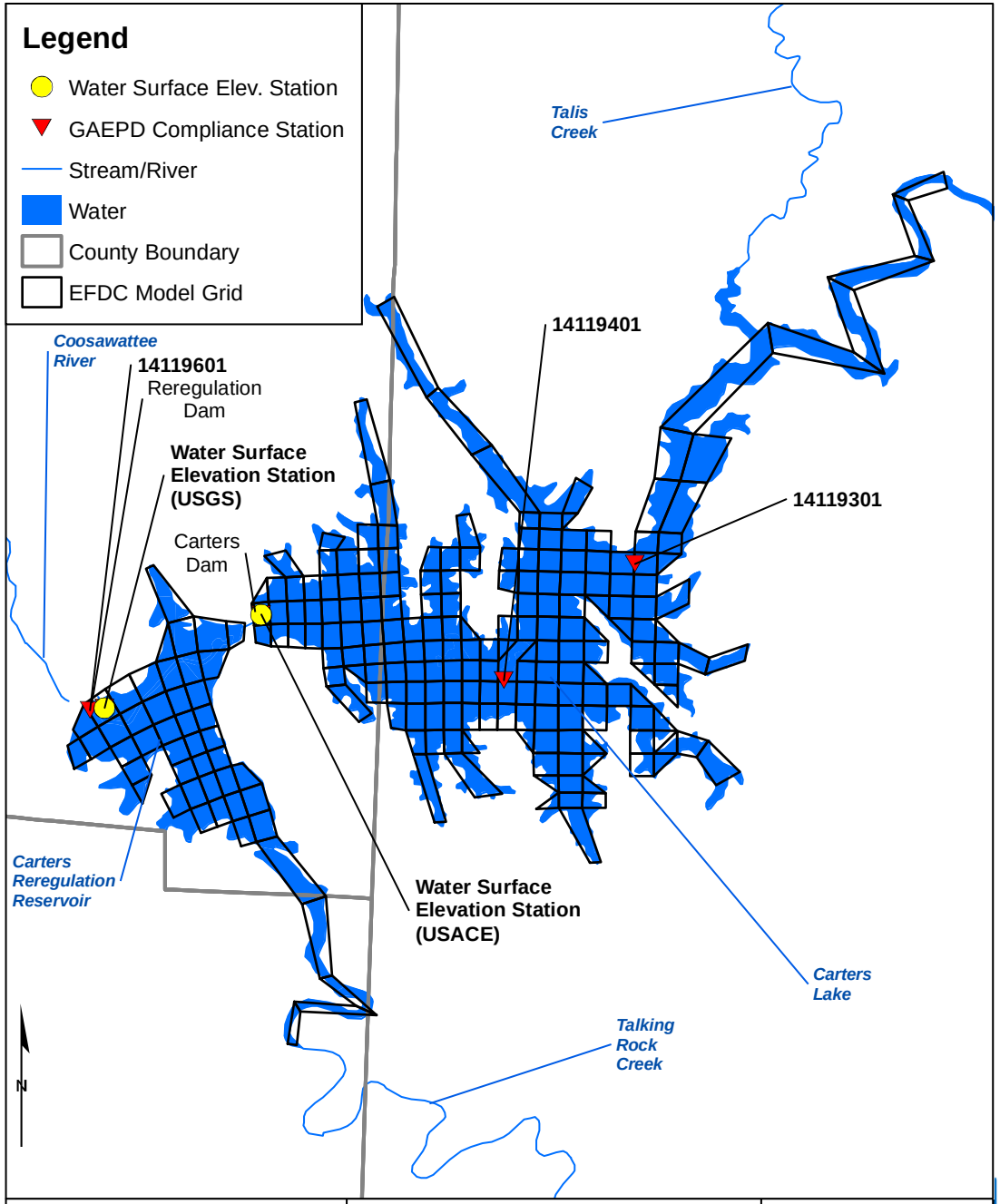




Carters Lake Model Calibration

Environmental Fluid Dynamics Code (EFDC)

Hydrology and Water Quality Calibration Locations for EFDC Model



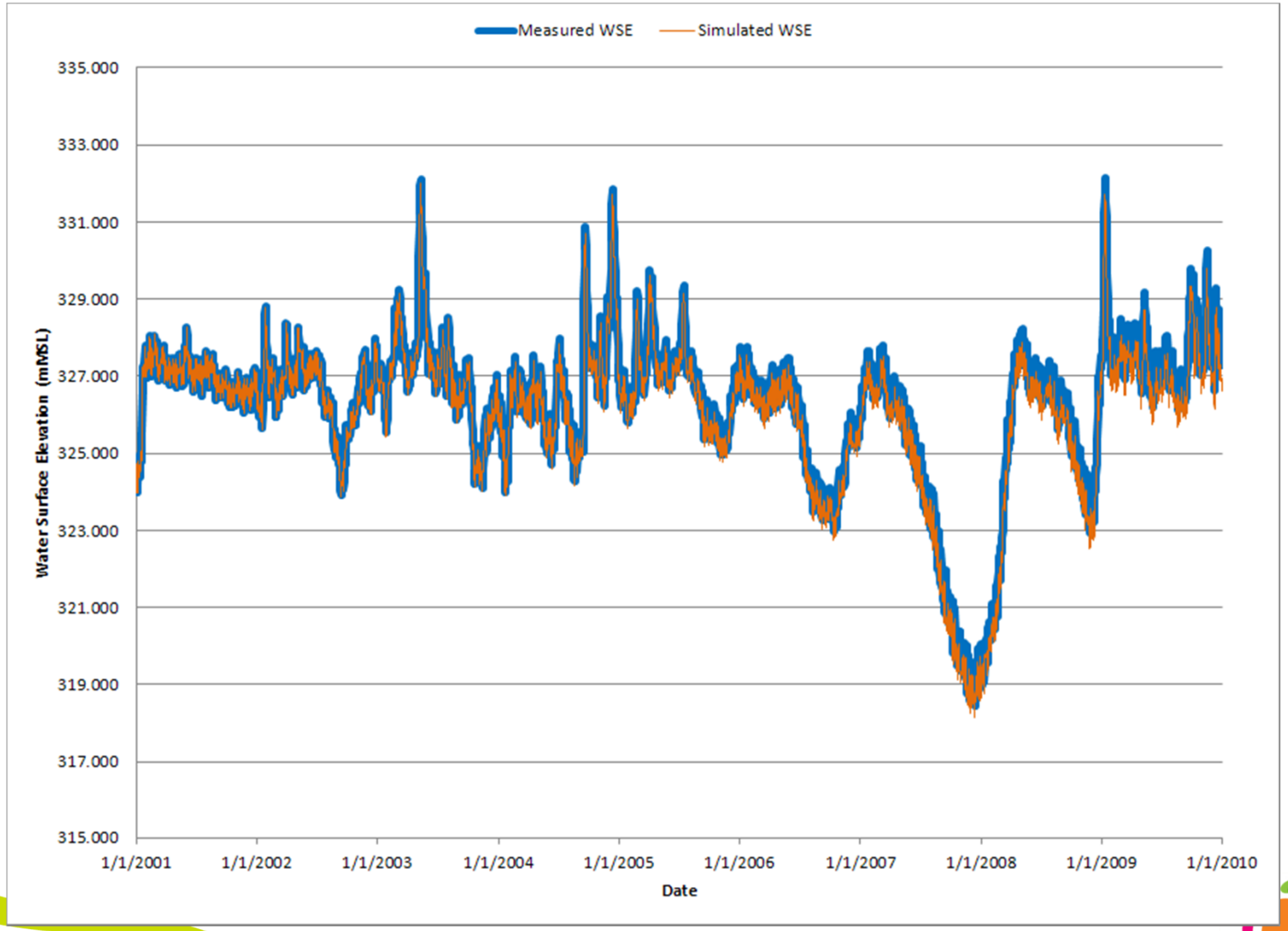
Carters Lake
Model Calibration Stations

NAD_1983_UTM_Zone_17N
Map produced 10-27-2011 - P. Cada

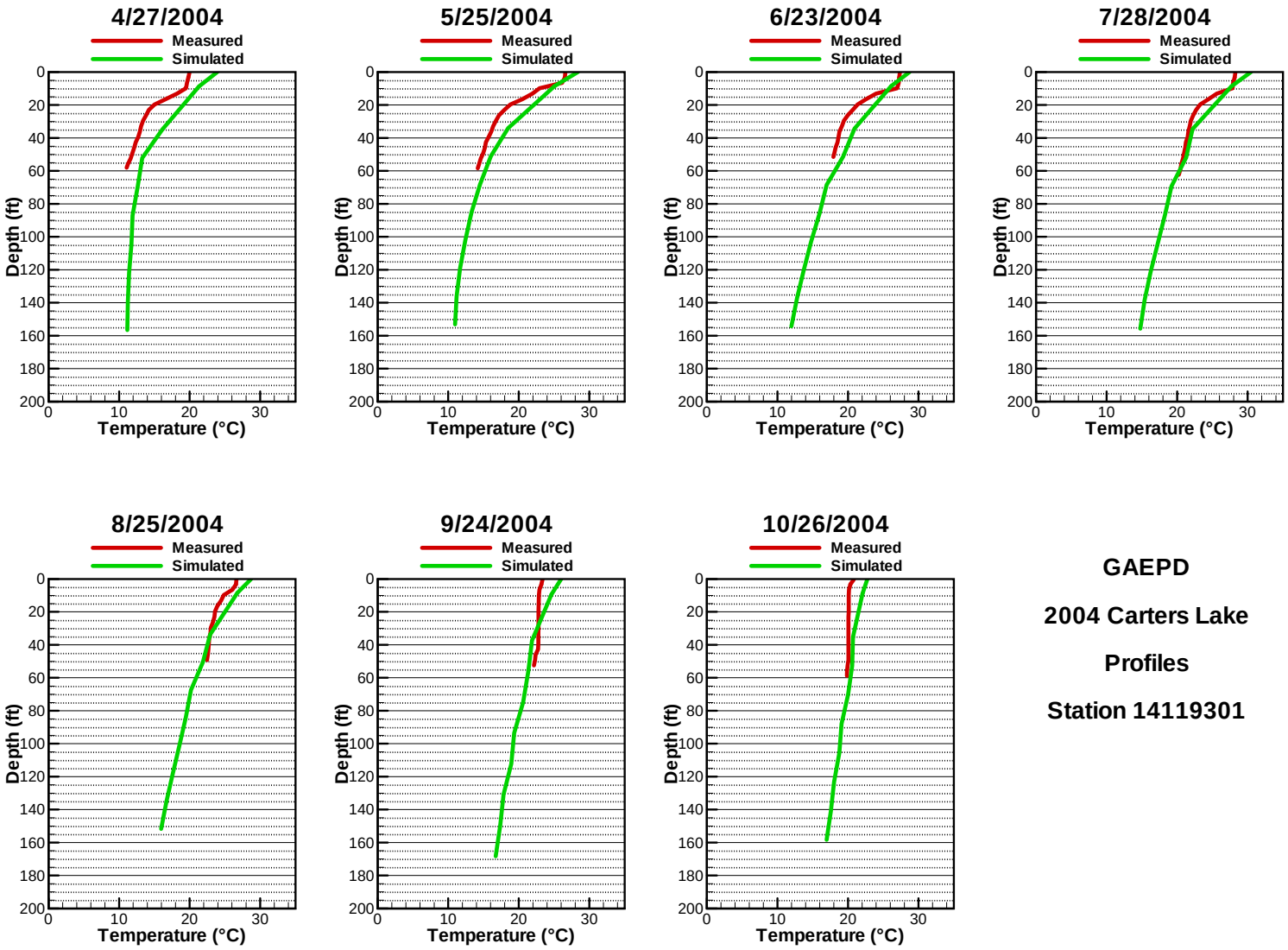
0 0.5 1 2 Kilometers
0 0.5 1 2 Miles

TETRA TECH

Water Surface Elevation at Carters Dam Forebay



Temperature Profile for Carters Lake upstream from Woodring Branch (2004) Wet Year



GAEPD

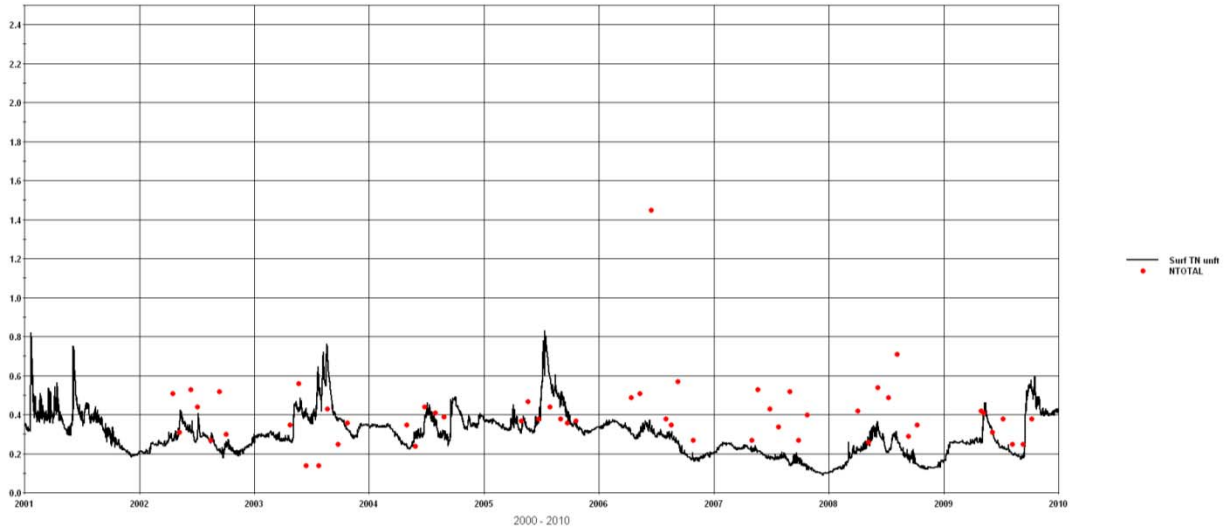
2004 Carters Lake

Profiles

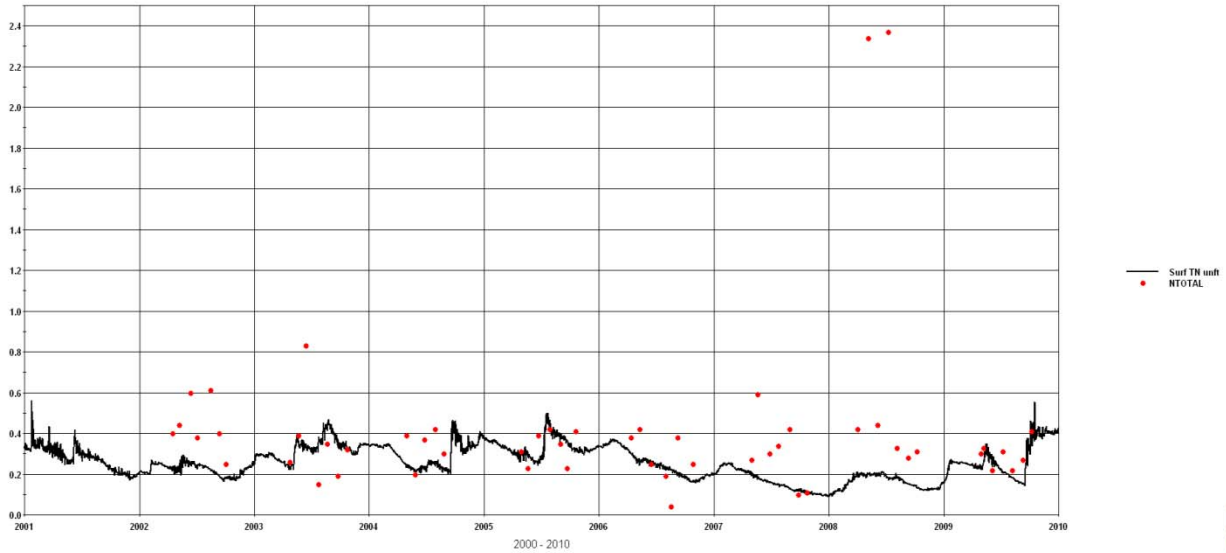
Station 14119301

Total Nitrogen

Carters Lake upstream from Woodring Branch

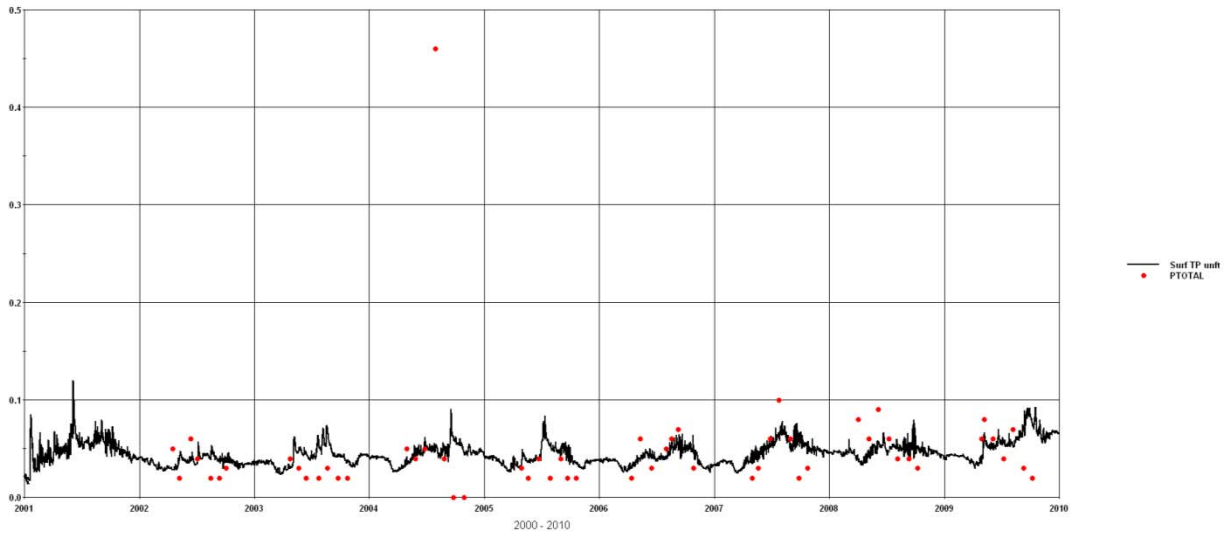


Carters Lake at Coosawattee River embayment mouth

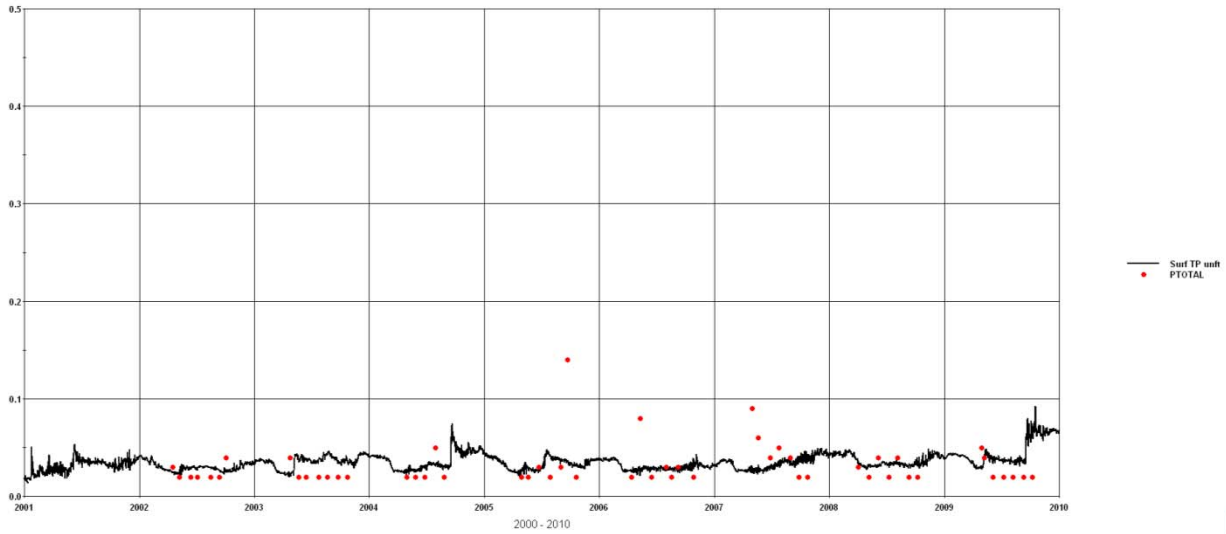


Total Phosphorus

Carters Lake upstream from Woodring Branch

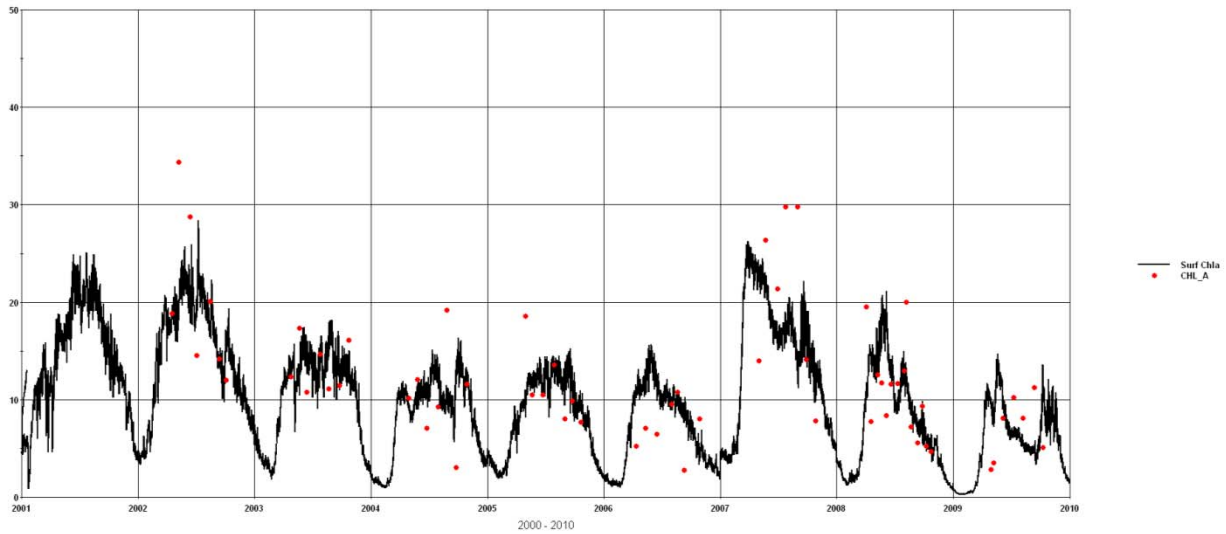


Carters Lake at Coosawattee River embayment mouth

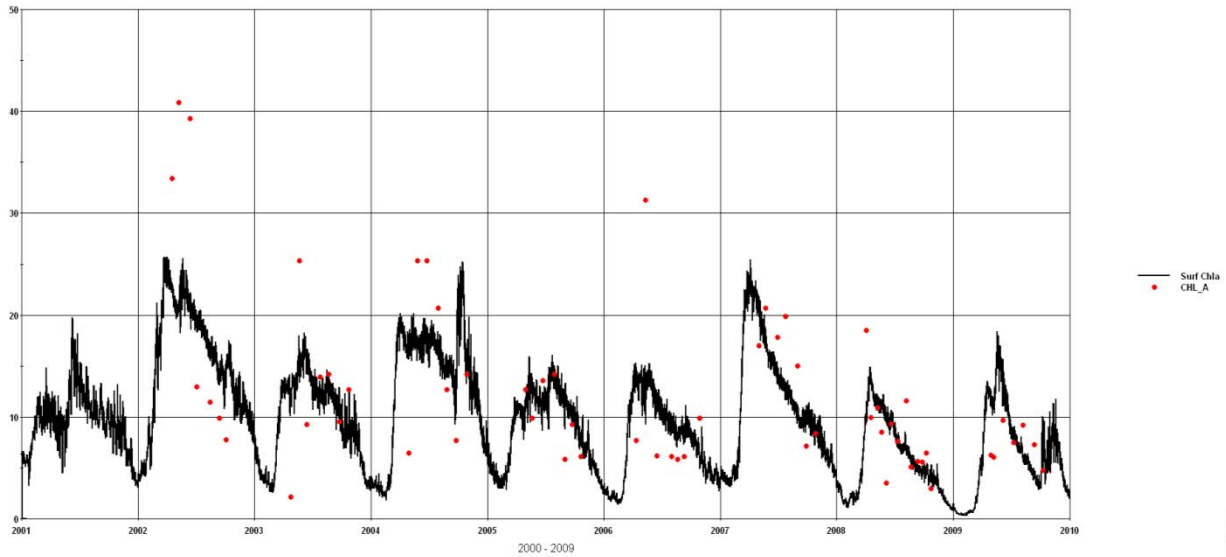


Chlorophyll-a

Carters Lake upstream from Woodring Branch

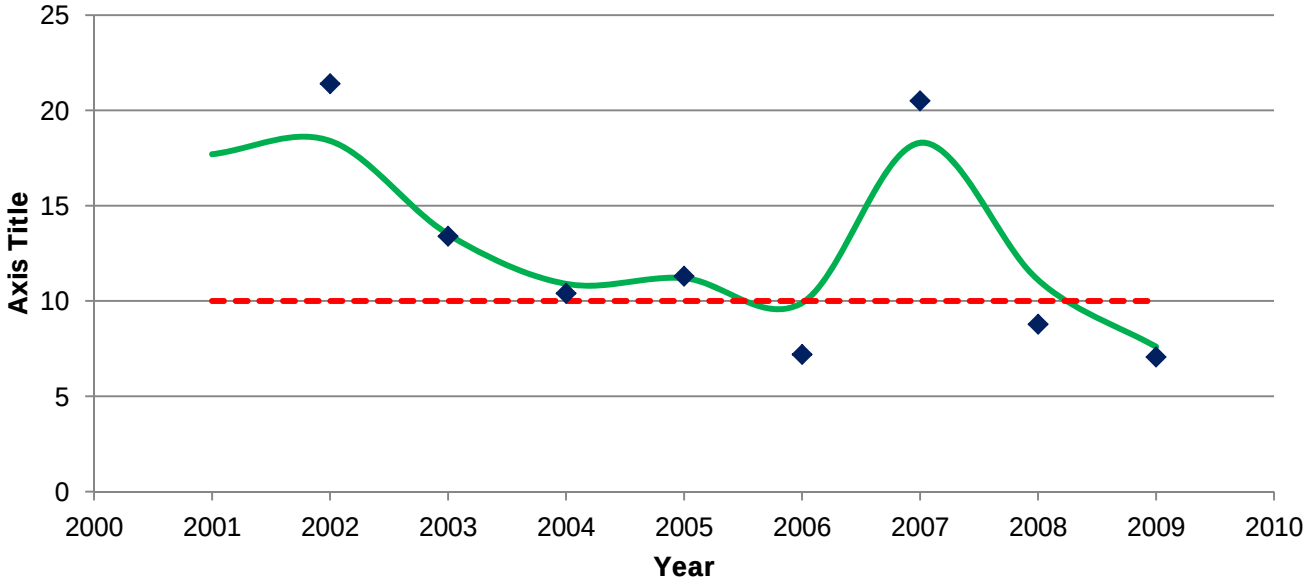


Carters Lake at Coosawattee River embayment mouth

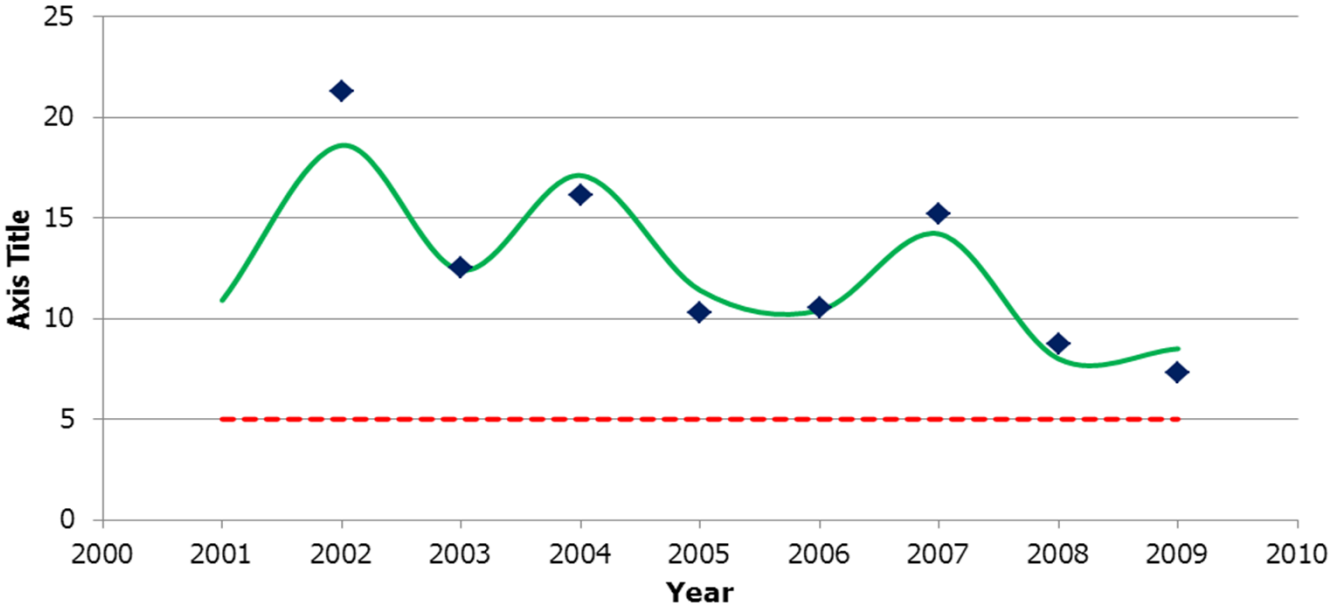


Chlorophyll-a Calibration

Carters Lake at Coosawattee River embayment mouth



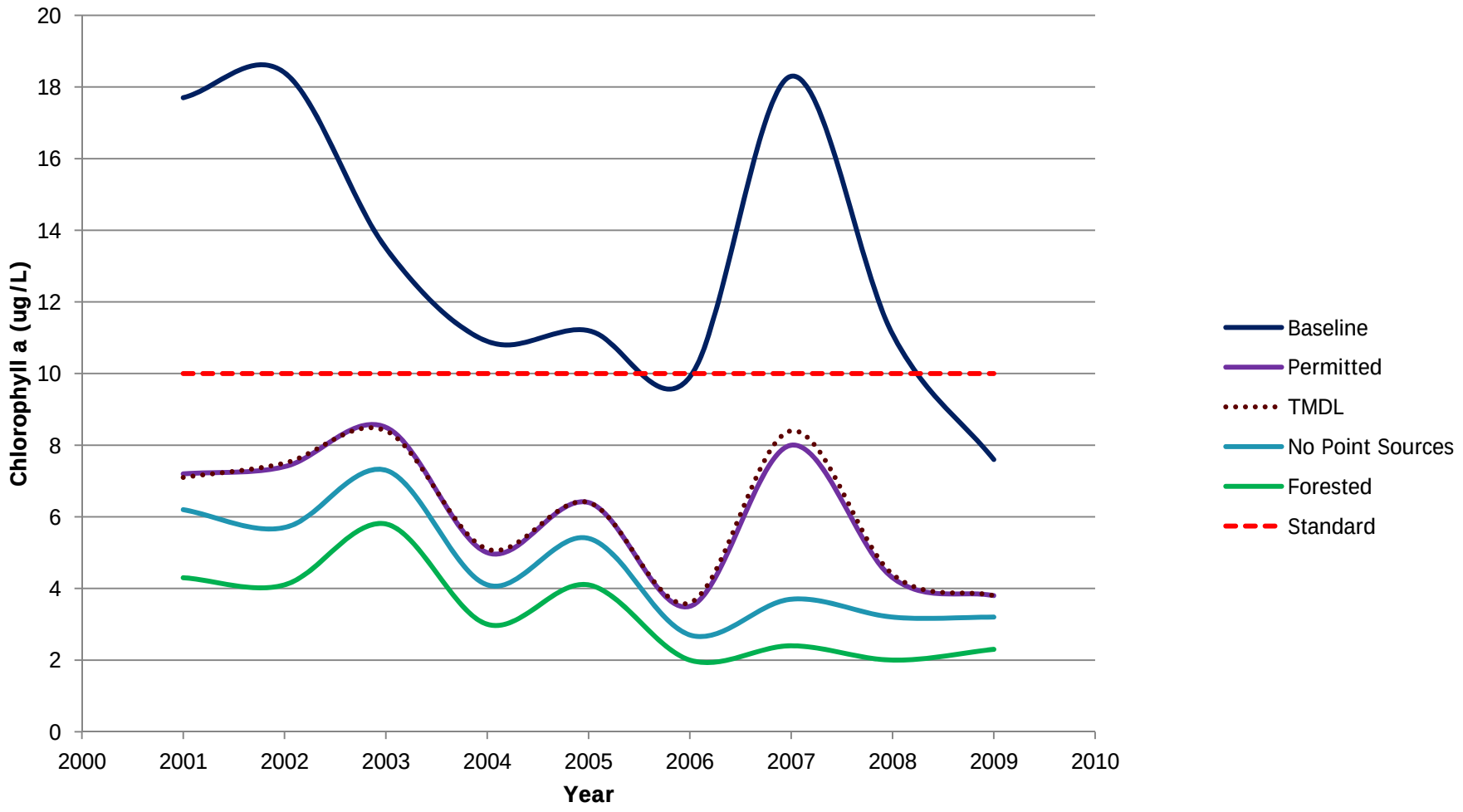
Carters Lake upstream from Woodring Branch



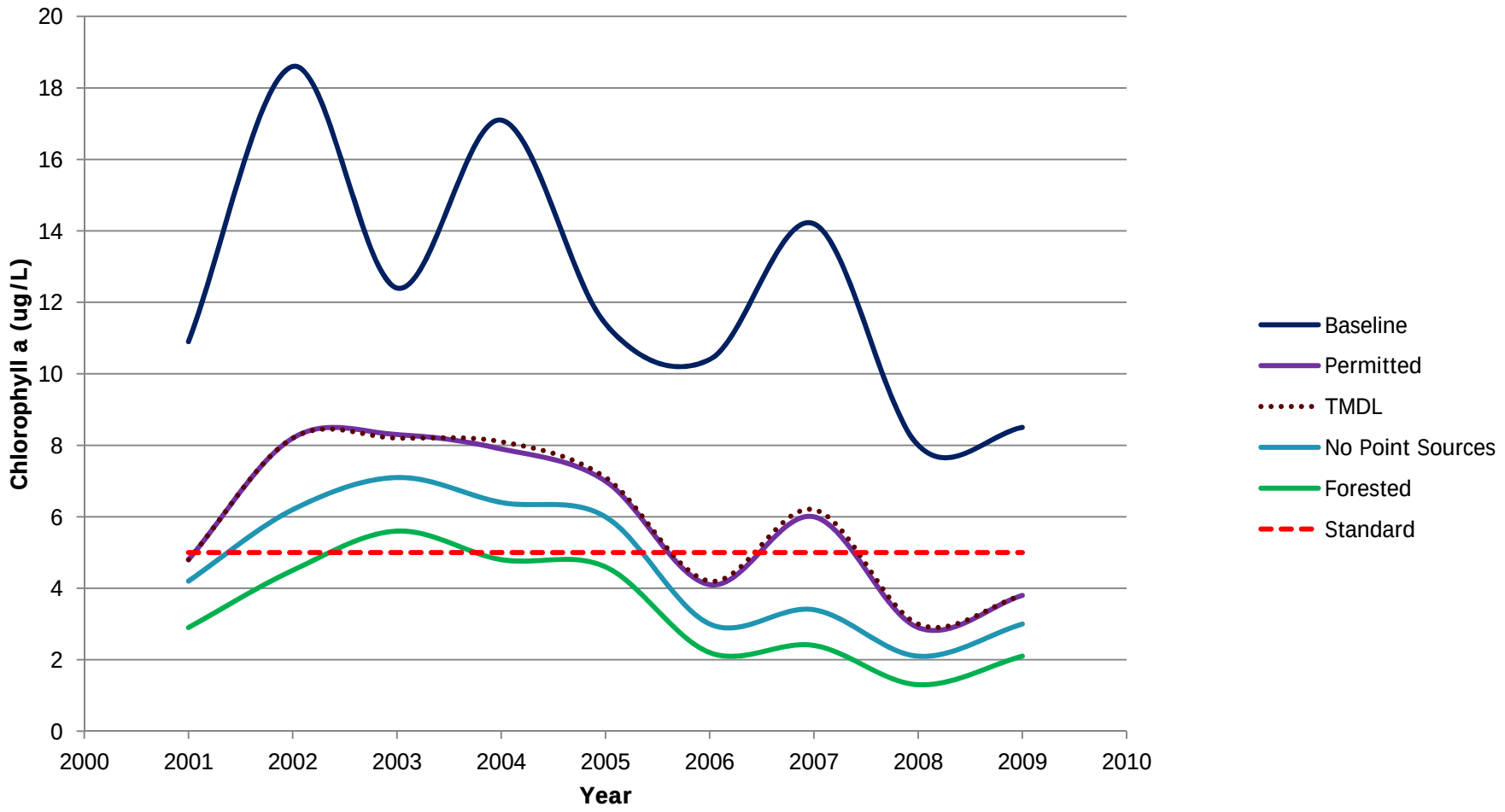
Scenarios

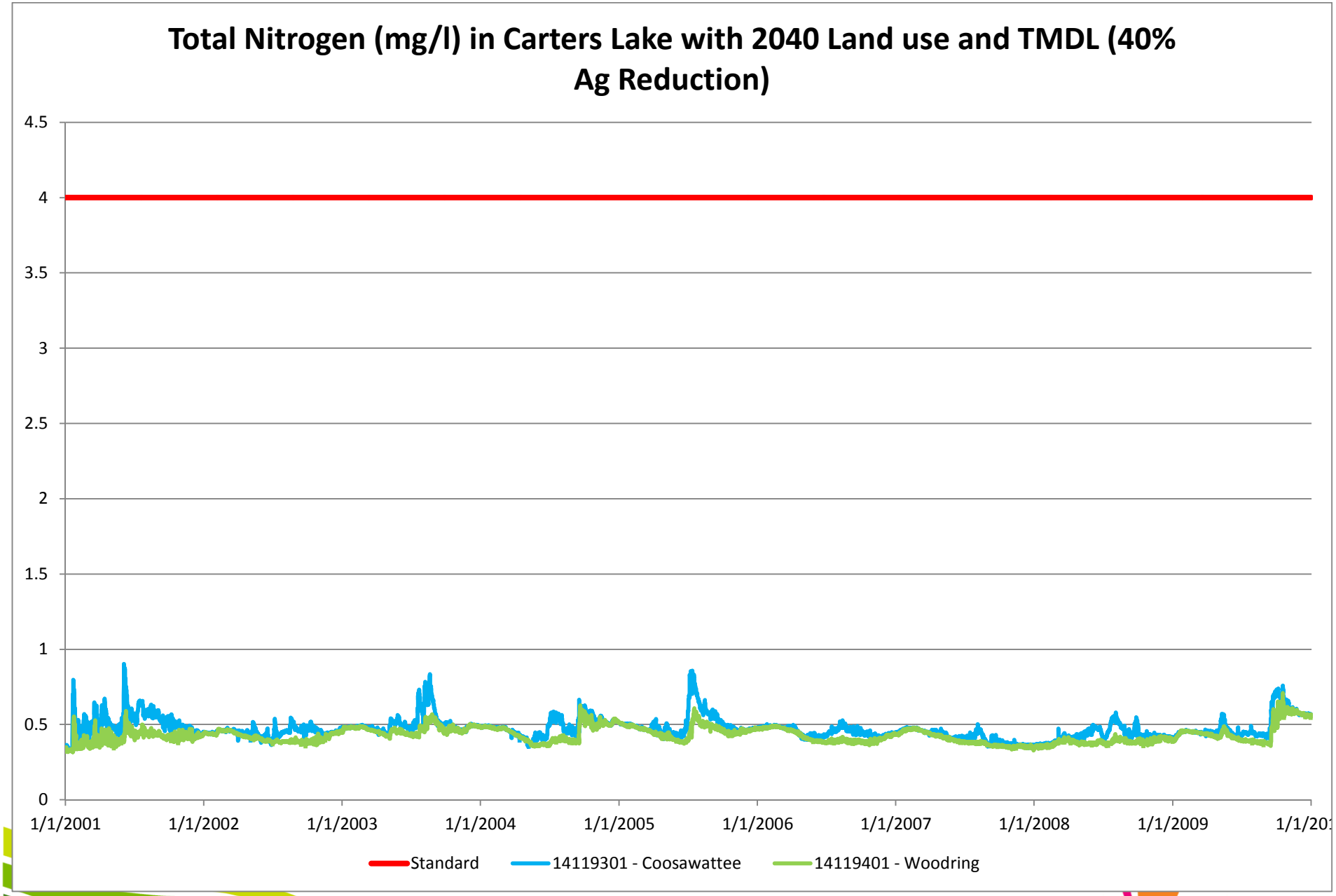
- Calibration Baseline
- Full Permit
  - All Point Sources input at Current Permitted Flows & Concentrations
  - 2005 Land Use
  - Septics
- No Points Sources or Water Withdrawals
- All Forested
- Future Landuse with TMDL Reductions
  - All Point Sources input at Current Permitted Flows & Concentrations
  - 2040 Land Use
  - Septics updated to 2040 numbers
  - 40% reduction in agricultural load

Carters Lake at Coosawattee River embayment mouth



Carters Lake upstream from Woodring Branch




Total Nitrogen (mg/l) in Carters Lake with 2040 Land use and TMDL (40% Ag Reduction)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
1/1/2001
1/1/2002
1/1/2003
1/1/2004
1/1/2005
1/1/2006
1/1/2007
1/1/2008
1/1/2009
Standard
14119301 - Coosawattee
14119401 - Woodring

Total Nitrogen – Growing Season Average

Scenario	5th %ile	25th %ile	Median	75th %ile	95th %ile	Max
Measured	0.29	0.33	0.36	0.42	0.66	0.93
Baseline	0.31	0.36	0.39	0.50	0.71	0.78
Full Permit	0.49	0.53	0.57	0.62	0.82	0.87
TMDL	0.47	0.50	0.53	0.57	0.76	0.81
All Forested	0.18	0.23	0.26	0.29	0.46	0.52
No Point Source	0.30	0.37	0.40	0.48	0.70	0.77
2040 Permit and Landuse	0.47	0.50	0.54	0.58	0.77	0.83

Georgia

Phosphorus: Total Lake Loading

Baseline Calibration

Year	Total Phosphorus (lbs/yr)									
	Standard	2001	2002	2003	2004	2005	2006	2007	2008	2009
Lake Volume (Acre-Ft)		377,129	373,595	377,509	373,714	375,044	360,502	339,020	352,401	381,423
Annual Load of Phosphorus (lbs)	172,500	155,502	133,102	**190,356**	**180,395**	163,072	125,430	119,451	129,145	**242,877**
Specific Loading (lbs/Acre-Ft)	0.46	0.41	0.36	**0.50**	**0.48**	0.43	0.35	0.35	0.37	**0.64**

Permitted

Year	Total Phosphorus (lbs/yr)									
	Standard	2001	2002	2003	2004	2005	2006	2007	2008	2009
Lake Volume (Acre-Ft)		377,130	373,602	377,506	373,711	375,047	360,506	339,025	352,410	381,433
Annual Load of Phosphorus (lbs)	172,500	77,362	72,215	130,492	110,093	105,993	59,793	36,039	53,280	137,586
Specific Loading (lbs/Acre-Ft)	0.46	0.21	0.19	0.35	0.29	0.28	0.17	0.11	0.15	0.36

Georgia

Phosphorus: Total Lake Loading

Forested

Year	Total Phosphorus (lbs/yr)									
	Standard	2001	2002	2003	2004	2005	2006	2007	2008	2009
Lake Volume (Acre-Ft)		377,127	373,592	377,505	373,711	375,047	360,511	339,033	352,421	381,433
Annual Load of Phosphorus (lbs)	172,500	46,375	42,348	92,890	76,409	70,458	33,375	15,335	26,297	97,437
Specific Loading (lbs/Acre-Ft)	0.46	0.12	0.11	0.25	0.20	0.19	0.09	0.05	0.07	0.26

TMDL

Year	Total Phosphorus (lbs/yr)									
	Standard	2001	2002	2003	2004	2005	2006	2007	2008	2009
Lake Volume (Acre-Ft)		377,137	373,603	377,514	373,713	375,041	360,500	339,019	352,402	381,409
Annual Load of Phosphorus (lbs)	172,500	77,930	72,959	130,168	110,260	106,465	61,196	37,528	54,665	136,850
Specific Loading (lbs/Acre-Ft)	0.46	0.21	0.20	0.34	0.30	0.28	0.17	0.11	0.16	0.36

Georgia

Total Phosphorus Load to Major Tributaries

Calibration Baseline

Year	Total Phosphorus (lbs/yr)									
	Standard	2001	2002	2003	2004	2005	2006	2007	2008	2009
Coosawattee River @ Georgia Hwy 5	151,500	119,600	96,500	126,800	126,900	109,400	94,900	104,900	105,300	**177,600**
Mountaintown Creek at US Hwy 76	8,000	5,000	5,500	**12,100**	**10,500**	7,900	3,100	1,600	2,700	**14,600**

Permitted

Year	Total Phosphorus (lbs/yr)									
	Standard	2001	2002	2003	2004	2005	2006	2007	2008	2009
Coosawattee River @ Georgia Hwy 5	151,500	36,000	31,100	60,700	53,200	47,100	24,800	16,800	23,800	66,700
Mountaintown Creek at US Hwy 76	8,000	5,000	5,500	**12,100**	**10,500**	7,900	3,100	1,600	2,700	**14,600**

Georgia

Total Phosphorus Load to Major Tributaries

All Forested

Year	Total Phosphorus (lbs/yr)									
	Standard	2001	2002	2003	2004	2005	2006	2007	2008	2009
Coosawattee River @ Georgia Hwy 5	151,500	15,500	12,600	36,000	31,700	24,000	8,200	3,800	7,300	40,400
Mountaintown Creek at US Hwy 76	8,000	3,700	4,100	**9,800**	**8,700**	6,300	2,200	1,100	1,800	**12,100**

TMDL

Year	Total Phosphorus (lbs/yr)									
	Standard	2001	2002	2003	2004	2005	2006	2007	2008	2009
Coosawattee River @ Georgia Hwy 5	151,500	36,300	31,800	60,200	53,000	47,200	25,900	17,900	24,700	65,900
Mountaintown Creek at US Hwy 76	8,000	4,900	5,400	**11,800**	**10,300**	7,800	3,100	1,700	2,700	**14,300**

Georgia

Revise Total P Load Mountaintown Creek

16,000 lbs/yr

Station Name	Chlorophyll a Standard	2001	2002	2003	2004	2005	2006	2007	2008	2009
Carters Lake at Coosawattee River embayment	10 (current)	7.38	7.86	8.25	5.12	6.32	3.68	8.32	4.58	3.88
Carters Lake upstream from Woodring Branch	10 (proposed)	4.81	8.28	7.98	7.91	6.89	4.11	6.09	2.99	3.79

Proposed Chlorophyll a Standards

- Chlorophyll a: For the months of April through October, the average of monthly photic zone composite samples shall not exceed the chlorophyll a concentrations at the locations listed below more than once in a five-year period:

1.	Carters Lake upstream from Woodring Branch	10 ug/L
2.	Carters Lake at Coosawattee River embayment mouth	10 ug/L

- Total Nitrogen: Not to exceed a growing season average of 1 mg/L as nitrogen in the photic zone.

Proposed Chlorophyll a Standards

- Phosphorous: Total lake loading shall not exceed 172,500 pounds or 0.46 pounds per acre-foot of lake volume per year.

- Major Lake Tributaries: For the following major tributaries, the annual total phosphorous loading at the compliance monitoring location shall not exceed the following:
  1. Coosawattee River at Old Highway 5 — 151,500 pounds
  2. Mountaintown Creek at U.S. Highway 76 — 16,000 pounds

Georgia

Next Steps

- Brief the DNR Board
- Public Notice for 45 days
- Hold Public Hearing
- Final presentation to the DNR Board
- Send standards to EPA for approval

Questions?

Elizabeth A. Booth

404 675-1675

elizabeth.booth@dnr.state.ga.us