Appendix 8.E. Nitrogen and Phosphorus Concentrations, Fluxes, and Loads in the St. Johns River

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There is major existing nutrient impairment along most of the SJR and its tributaries. In response to the impairment, the SJRWMD has developed Pollutant Load Reduction Goals, and the FDEP and USEPA have adopted Total Maximum Daily Loads (TMDLs) and developed Basin Management Action Plans (BMAPs). These plans include nutrient load allocations for local governments and entities and projects to reduce these loads. Progress to reduce nutrient loadings is variable throughout the SJRWMD, in part due to the phased approach of implementation. Substantial reductions have occurred in point source loads in the lower St. Johns River. Some areas of the Upper Ocklawaha basin also have seen substantial reductions in nutrient loading and concomitant reductions in nutrient and chlorophyll *a* concentrations in the basin's waterways, while in other areas TMDLs have yet to be developed. The river's nutrient enrichment status is summarized in Tables 1 and 2 that contain average annual phosphorus and nitrogen concentrations, discharge, and areal loading since ~1995 and associated TMDL targets.

Table 1. Average annual phosphorus concentrations, fluxes and loads along the SJR.

Location (River km)	Concentration (mg P L^{-1})		Discharge (m^3 s^{-1})	Flux (10^6 g P yr^{-1})		Contributing Area (km^2)	Areal Flux (10^6 g P km^{-2} yr^{-1})	
	TMDL	Current		TMDL	Current		TMDL	Current
[1]Jacksonville (38)	0.114	0.193	248.1	892	1,509	19,824	0.045	0.076
[2]Shands Bridge (81)	0.056	0.090	185.4	327	528	17,359	0.019	0.030
[3]Palatka (128)	0.058	0.067	157.0	285	333	15,533	0.018	0.021
[4]Lake George outlet (176)	0.051	0.071	112.1	180	253	9,297	0.019	0.027
[5]Lake Monroe outlet (262)	0.070	0.097	68.7	152	210	6,338	0.024	0.033
[6]Lake Harney inlet (310)	0.070	0.097	58.1	128	178	5,155	0.025	0.034
[7]Christmas (344)	0.090	0.095	40.3	114	121	3,877	0.029	0.031
Without Correction for Seawater								
[1]Jacksonville (38)	0.099	0.143						

Table 2. Average annual nitrogen concentrations, fluxes and loads along the SJR.

Location (River km)	Concentration (mg N L^{-1})		Discharge (m^3 s^{-1})	Flux (10^6 g N yr^{-1})		Contributing Area (km^2)	Areal Flux (10^6 g N km^{-2} yr^{-1})	
	TMDL	Current		TMDL	Current		TMDL	Current
[1]Jacksonville (38)	1.04	1.57	255.4	8,381	12,672	19,824	0.423	0.639
[2]Shands Bridge (81)	1.06	1.37	185.4	6,194	8,006	17,359	0.357	0.461
[3]Palatka (128)	1.27	1.29	157.0	6,304	6,366	15,533	0.406	0.410
[4]Lake George outlet (176)	1.10	1.54	112.1	3,896	5,459	9,297	0.419	0.587
[5]Lake Monroe outlet (262)	1.18	1.69	68.7	2,555	3,660	6,338	0.403	0.577
[6]Lake Harney inlet (310)	1.18	1.49	58.1	2,163	2,731	5,155	0.420	0.530
[7]Christmas (344)	1.18	1.99	40.3	1,499	2,528	3,877	0.387	0.652
Without Correction for Seawater								
[1]Jacksonville (38)	0.800	1.09						

Notes:

1. Jacksonville load estimated at the long-term sampling station at river kilometer 26, station abbreviation "JAXSJR17". N and P concentrations adjusted to freshwater equivalent by using salinity to establish the proportion of fresh and marine water, and applying an average marine water TP concentration of 0.072 mg/L and TN concentration of 0.325 mg/L. Current condition concentrations based on monitoring data from 1998 - 2007. Sampling for most of this period consisted of same-day high and low tide, surface and below-pycnocline samples, which were averaged to a daily mean, and then averaged to monthly means and finally annual means. TMDL concentrations were similarly derived, using simulated, vertically-averaged daily means from 1995 - 1999. Discharge based on USGS gauging station #02246500, located on the Acosta Bridge in Jacksonville, 9 km upstream of the JAXSJR17 sampling station.
2. Shands Bridge mean TN and TP concentrations determined from biweekly sampling from 1998 - 2007, condensed to monthly means and then annual means. Discharge determined by the product of the measured discharge at Palatka and the simulated ratio of discharge at Shands Bridge:Palatka. TMDL concentrations determined from assimilative capacity simulations 1995-99, also condensed to monthly means and then annual means.
3. Palatka mean TN and TP concentrations determined from biweekly sampling from 1998 - 2007, condensed to monthly means and then annual means. Discharge determined as the sum of the USGS station at Buffalo Bluff (#02244040) and Dunns Creek (#02244440) for the same time period. TMDL concentrations determined from assimilative capacity simulations 1995-99, also condensed to monthly means and then annual means.
4. Lake George current mean TP and TN concentrations determined from the annual mean of the monthly means from 1995 - 2009, for six stations at the outlet or at various locations in the northern (downstream) one third of the lake. Outlet discharge for load calculation determined as the difference between Buffalo Bluff (USGS #02244040) and the Ocklawaha River (USGS #02243960) for the same period. The TMDL TP concentration of 0.051 mg/L was determined from the Florida morphoedaphic index, an empirical model that predicts the assimilative capacity for TP based on alkalinity and color (Lowe et al., in draft). The proportional reduction needed in TP from the current condition was applied to estimate the TMDL TN concentration.
5. Lake Monroe concentrations calculated first as monthly average of stations (LMAC, LM-OW-NE, LM-OW-S) within Lake Monroe; final value is the average of annual averages for years 1995 – 2009. TMDL values are from Gao (2009).
6. Lake Harney concentrations calculated first as monthly average of stations (CLH, LH-OW-NE, LH-OW-SW) within Lake Harney; final value is the average of annual averages for years 1995 – 2009. TMDL values are from Gao (2009).
7. Christmas values are average of annual averages for station SRS (St. Johns River at Highway 50) during years 1995 to 2009. TMDL for N from Gao (2009) for the river just downstream, while the P target concentration is an estimate (Keenan SJRWMD, pers. comm.).

Other Data Sources

Contributing watershed areas were obtained from the SJRWMD ArcHydro network.

References

Gao, X., 2009. TMDL Report: Nutrient and Dissolved Oxygen TMDLs for the Middle St. Johns River Segments between the Inlet of Lake Harney (2964) and the St. Johns River above the Wekiva River (2893C). Florida Department of Environmental Protection, Tallahassee, Florida.