Land use intensity and water quality in the Newnans Lake watershed.

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Newnans Lake is a hyper-eutrophic lake in north-central Florida; phosphorus (P) has been identified as the main constituent of concern in the lake, and, consequently, the focus of pollutant load reduction goals (PRLG). The low-relief lake basin consists of plio-pleistocene sediments overlying the Hawthorn Formation, a regional interbedded clay aquitard that is massively enriched in apatite minerals. As such, geologic P loading from matrix-water interactions within and above the Hawthorn is potentially large. We used multiple lines of evidence to determine the relative importance of geologic P as a source. Here we describe relationships between land cover and water quality (N and P concentrations) in the watershed. We hypothesized that the expected relationship (i.e., increasing pollutant load with increase landscape development intensity) would hold for N but would not for P, suggesting that geologic sources are predominant. Contributing area were identified using Light Detection and Ranging (LIDAR) elevation data; land use intensity in that contributing area was computed using the Landscape Development Intensity index (LDI) derived from a 2004 raster land use map. We observed strong correlation between LDI and total N ($r = +0.73$) and the fraction of N in mineral form ($r = +0.79$). Covariance between soluble reactive P (SRP) and LDI was negative ($r = - 0.17$) though not significant. Moreover, SRP concentrations for three main creeks (Lake Forest – urban, Little Hatchett – industrial, Hatchett – forested) showed that the most urbanized basin (Lake forest Creek) had the lowest SRP concentrations. Finally N: P molar ratios are extremely low throughout the basin (median = 3:1), especially at sites where the land surface is predicted to be in contact with the Hawthorn Formation. Overall discordance between N and P responses to land use intensity suggest other factors, in particular geologic sources, as strong confounders of the SRP vs. LDI relationship.

Keywords: water quality; landscape development intensity index; contributing area; time series analysis.