Co-concentration dependence of the London penetration depth in single crystals of Ba(Fe$_{1-x}$Co$_x$)$_2$As$_2$ R.T. GORDON, C. MARTIN, H. KIM, M.A. TANATAR, N. NI, S.L. BUD’KO, P.C. CANFIELD, J. SCHMALIAN, R. PROZOROV, Ames Laboratory and Department of Physics and Astronomy, Iowa State University — The in-plane London penetration depth, $\lambda_{ab}(T)$, has been measured in single crystals of Ba(Fe$_{1-x}$Co$_x$)$_2$As$_2$ for several values of $x$ using a tunnel diode resonator (TDR) technique. The low temperature behavior of the variation of the penetration depth follows a clear power law behavior, $\Delta \lambda(T) \propto T^n$, for all measured Co concentrations with $n$ varying between 2 on the underdoped side to about 2.5 at the optimal doping. This non-exponential behavior in $\Delta \lambda$ indicates the existence of a significant number of superconducting quasiparticles, which is characteristic of a superconducting gap function possessing some type of nodal structure. The overall change in the superfluid density as a function of doping will be discussed. R. T. Gordon et al. arXiv:0810.2295 (2008).