streams in other regions, where they were selected haphazardly or randomly, the IRW streams have higher nutrient concentrations than any of those regions.

Finding: When nutrient concentrations limited algal growth in IRW streams, P was most likely the nutrient that most limited algal growth in streams.

N:P molar ratios during spring 2006 varied from 12.9 to 1024 with a median of 77 and 25th and 75th quartiles of 37 and 142 (Figure 2.5). N:P molar ratios during spring 2007 varied from 20.9 to 1,890 with a median of 152 and 25th and 75th quartiles of 70 and 275 (Figure 2.6). N:P molar ratios during summer 2007 varied from 11.0 to 339 with a median of 77 and 25th and 75th quartiles of 41 and 143 (Figure 2.7). Leibig's law of the minimum posits that only one resource limits growth of organisms at a time. The Redfield ratio of 16:1 atoms of N versus P delineates the relative proportions of N and P that algae need to grow. When the N:P molar ratio is greater than 16, it indicates that N is in relatively greater supply than P, and P most limits algal growth. Absolute nutrient supply also affects algal growth. So if nutrient concentrations are low enough, the Redfield ratio predicts which nutrient is likely most limiting algal growth. If the nutrients concentrations are high, then nutrients do not limit algal growth regardless of the nutrient concentration. If nutrient concentrations can be depleted by organisms, for example when water levels are low and high biomasses of algae occur in the stream, then Redfield ratios predict which nutrient would be most limiting when nutrients become depleted in the future. Benchmarks for P and N limitation have been proposed at 0.030 mg TP/L and 0.50 mg TN/L. Comparing this P benchmark and the 25th percentiles of TP concentrations during spring 2007 in the IRW, algal growth in less than 25 percent of streams was probably P limited to some extent. Comparing this N benchmark and the 25th percentiles of TN concentrations, TN was not a limiting nutrient in some IRW streams.

Finding: Nutrient concentrations in IRW streams were related to poultry house density in watersheds.

Summer 2006

Regression analyses indicated that TP concentrations in IRW streams during summer 2006 were related to poultry house density, but effects were masked statistically by high TP in waters downstream from urban land use (**Figure 2.8**). TP concentrations were very weakly related to poultry house density in a multiple regression model (r^2=0.223) that included both the natural log of poultry house density and the natural log of the percent of watersheds that were urbanized:

$$\ln(TP)=-4.292+0.566*\ln(PCURB)+0.278*\ln(PHD)$$

In this model, the natural log of TP concentration (ln(TP)) was related to the natural log of the percent of urban land use in watersheds (ln(PCURB)) and the natural log of poultry house density plus 1 (ln(PHD)). One was added to poultry house density because minimum poultry house density was 0 and the natural log of 0 can not be determined. This is a standard transformation method. The coefficient associated with urban land use in the model had a small chance of being equal to zero ($p<0.001$), whereas the coefficient associated with poultry house density had a modest chance of being equal to zero ($p=0.134$). I.e. TP concentration was significantly correlated to urban land use, but not to poultry house density when using the 0.05 benchmark for attained statistical significance (p). The -4.292 intercept in this model indicates natural background