An Analysis of Nitrate Levels and Movement in the Raritan River

Jeffrey Vieser[1], Carissa Wilkerson[2], Robert Chant[1], Scott Glenn[1]

[1] Rutgers University, Institute of Marine and Costal Sciences

[2] Hampton University

Purpose:

The Raritan River is a highly urbanized and understudied river. Throughout the past century, NOAA and the USGS have monitored the river and collected data on it. This data has never been significantly analyzed. This study is an attempt to acquire and analyze nitrate data on the river. Using the historical data as well as new equipment to examine the river, we hope to learn how nitrate is flowing through the river and its surrounding basin. Three particular characteristics that we are focused on examining are:

- The concentration of nitrate throughout the river.
- The effects of rainfall on nitrate levels.
- How the nitrate reacts to mixing with the salty waters coming in from the Raritan Bay.

Methods:

This study is centered on the use of a CTD outfitted with an optical nitrate sensor (SUNA), as well as on the use of historical data. The CTD/SUNA unit was used to take profiles of salinity, temperature, optical backscatter, depth, and nitrate on the Raritan River. Historical data was obtained from the websites of the USGS, NOAA, and the UCC (Utah Climate Center). All analysis was performed in MATLAB.

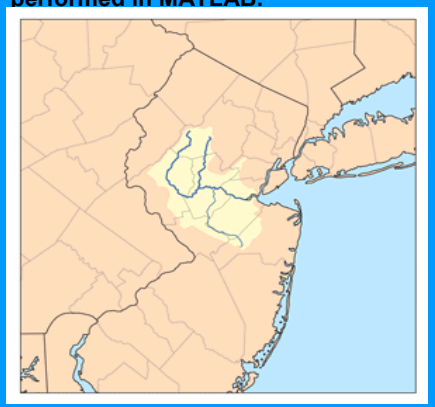

Figure 1:

This Map displays the Raritan River Watershed. It is comprised of the North Branch Raritan River, the South Branch Raritan River, and the Millstone River. Its total area is 1,105 square miles.

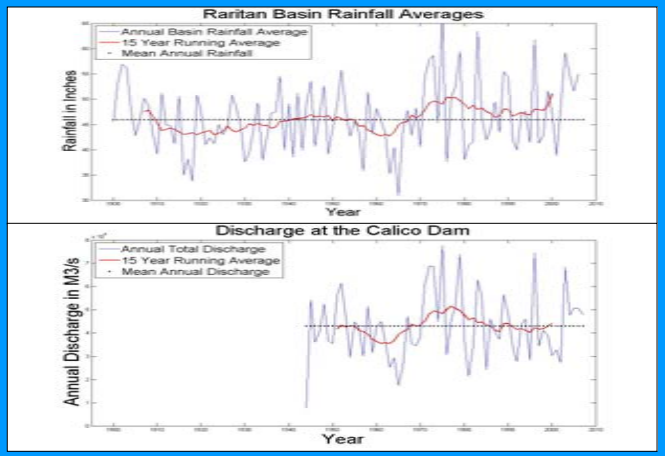

Figure 2+3:

These figures show the correlation between rainfall and river discharge in the Raritan River.

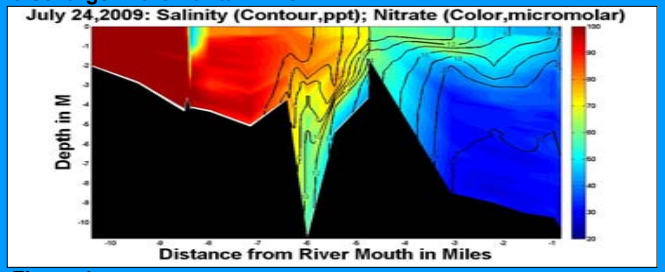

Figure 4:

This figure presents the along channel concentration of nitrate plotted against a salinity contour. There appears to be an inversely proportional relationship outside the observed nitrate levels at river mile 8.5.

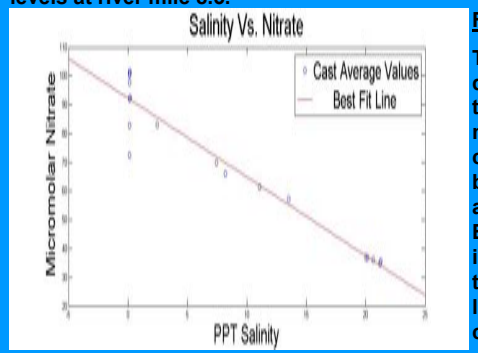

Figure 5:

This plot demonstrates the strong negative correlation seen between nitrate and salinity. Excluding the initial outlier, there is a strong linear correlation.

River Name	NO3 µm	Flow Cuf/s	Weighted NO3 µm	% of Bay NO3
Hudson	14	21,400	214	68%
Raritan	100+	1,400	100	32%

Table 1:

This Table shows nitrate movement through the major rivers which feed Raritan Bay. It is important to note the large variation in water flow as compared to the much smaller variation in nitrate flow.

Discussion:

In our analysis we found that the river appears to be discharging nitrate at extremely high levels, with the concentration of nitrate in River's fresh water being over 100µm. This value is well above what we anticipated and reveals the significance of the River as a source of pollution to the bay. We also discovered that this high value does not change in response to rainfall events. This means that nitrate offloading increases with increasing flow because more water is mixing into the bay at a constant nitrate concentration.

While looking at Figures 4 and 5, it also appears as if nitrate concentration is inversely proportional to salinity. This suggests that biological uptake of nitrate is overwhelmed by mixing such that the relationship appears conservative. The apparent conservative mixing of nitrate is suggestive of the existence of some other limiting nutrient or of low light levels limiting biological nitrate uptake.

Future Work:

Future studies will be geared at both increasing the size of the available data set on the Raritan, and investigating anomalies in the data such as the nitrate anomaly at river mile 8.5, and the depth anomaly at river mile 6.

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