

## WATER QUALITY TESTING AT VARIED URBAN RUNOFF LOCATIONS SHOWS IMPACTS ON STREAM HEALTH

Dane Kranjac, Dakota Crowley, Daniel Parker

### ABSTRACT

*Runoff often influences multiple factors of water quality, most often negatively affecting the ecosystem downstream from the point source. In a four week study of water quality and the effects of runoff in Blind Brook watershed south of Westchester County Airport, our group tested three sites with varying activities and runoff present (Airport Site, Golf Course Site and Anderson Hill Rd Site) where runoff was observed from airport traffic, agricultural activity and roadway traffic. At each site a YSI meter was used to quantify levels of dissolved oxygen, pH, conductivity, turbidity, temperature, dissolved solids, and other water quality parameters. The results varied from test to test with some outliers in the data that were unexplained. Over the testing cycle some trends were observed with turbidity, pH, DO%, temperature, Conductivity, and Total Dissolved Solids. The overall highest at the airport over all testing days with DO (mg/L) and TDS showing similar trends regardless of outliers on two separate days. All other sites show similar trends overtime with varying levels not greatly exceeding those observed at the airport site.*

Keywords: Airport Runoff, Human Interaction, Pollution, Urban Runoff, Tributary-Long Island Sound

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### INTRODUCTION

Runoff in the New York area and around the world is a huge problem for ecosystem resilience as well as water quality. Runoff from urbanized areas and from agriculture are the main sources of pollutants that find their way into waterways like the local Blind Brook watershed. Runoff impacts ecosystems in a variety of ways, and frequently contains common pollutants such as motor oil, grease, and solid deposits of metals, many of which stem from local roadways and vehicles which may then enter the waterway (MacKay et al. 2011). Agricultural additions to runoff commonly include fertilizers, dirt, pesticides and other toxic chemicals used in the industry, but are also frequently found in developed areas which use materials such as turfgrass (Phillips and Bode 2004). These pollutants negatively impact the quality of the water, in turn

making the environment prone to modification via eutrophication and other processes which lead to die-offs and succession by organisms more suited to the toxic environment. This may make recovery difficult, especially if toxins are continually released. Bodies of water exposed to an increased runoff volume and total suspended solids will increase the cyanobacteria biomass, causing greater chances for a water ecosystem to undergo eutrophication (Silva et al. 2019).

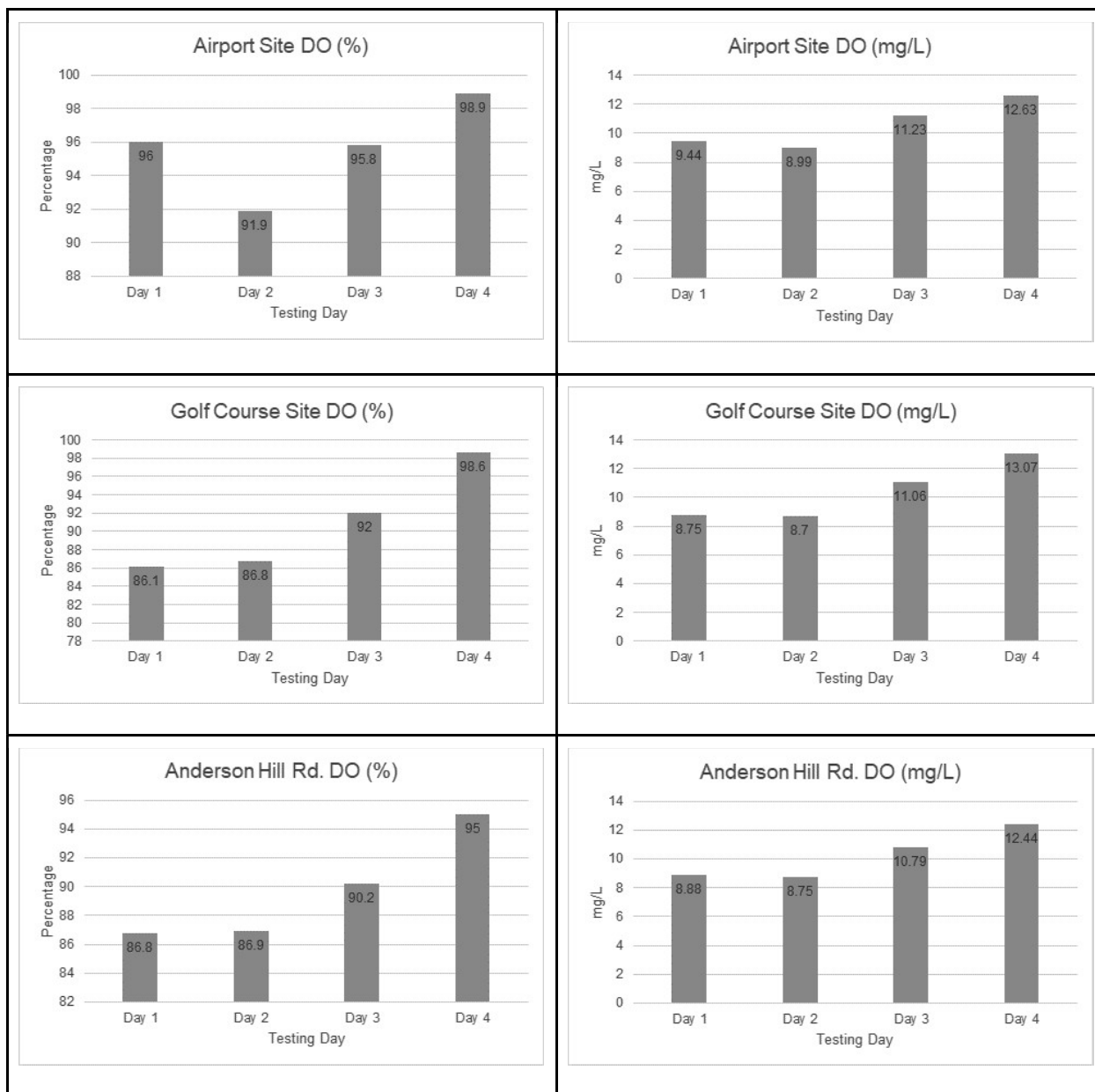
The Blind Brook watershed is a waterway heavily affected by runoff because of its proximity to the Westchester County Airport, Blind Brook Club Golf Course, and Anderson Hill Road. Previous studies have determined that urban and suburban developments such as those near the Blind Brook watershed may accelerate the movement of storm runoff and its carried pollutants into local streams and groundwater supplies (Burns et al. 2005). In fact, materials from airfield pavement, such as those which may be found at the Westchester County Airport, have previously been shown to lead to concerning levels of aquatic toxicity in runoff (Corsi et al. 2009). Urban stormwater carrying runoff pollution into tributaries and rivers is increasing the chemical oxygen demand for these locations showing that the ecosystem is becoming pressured in a way that it cannot sustain in terms of supplying chemical oxygen demand to biological communities without the need for human intervention to prevent ecosystem damage or regime shift (Luo et al. 2012).

We will use the YSI water quality tester to determine the differences between our three test sites each located in close proximity to locations producing source and non-source runoff into the Blind Brook. Deicers at the airport are common with showing reduced DO as well as contain additives like ammonia which impact aquatic life and human health due to their toxicity in water. Runoff associated with agriculture results in high levels of nitrogen and phosphorus into the water sources resulting in increased nitrate and ammonia levels. Runoff from roadways as well as non-deicer pollutants from runways are most commonly petroleum by-products that sit on the asphalt surface till rain events which were not extensively studied during our four test days.

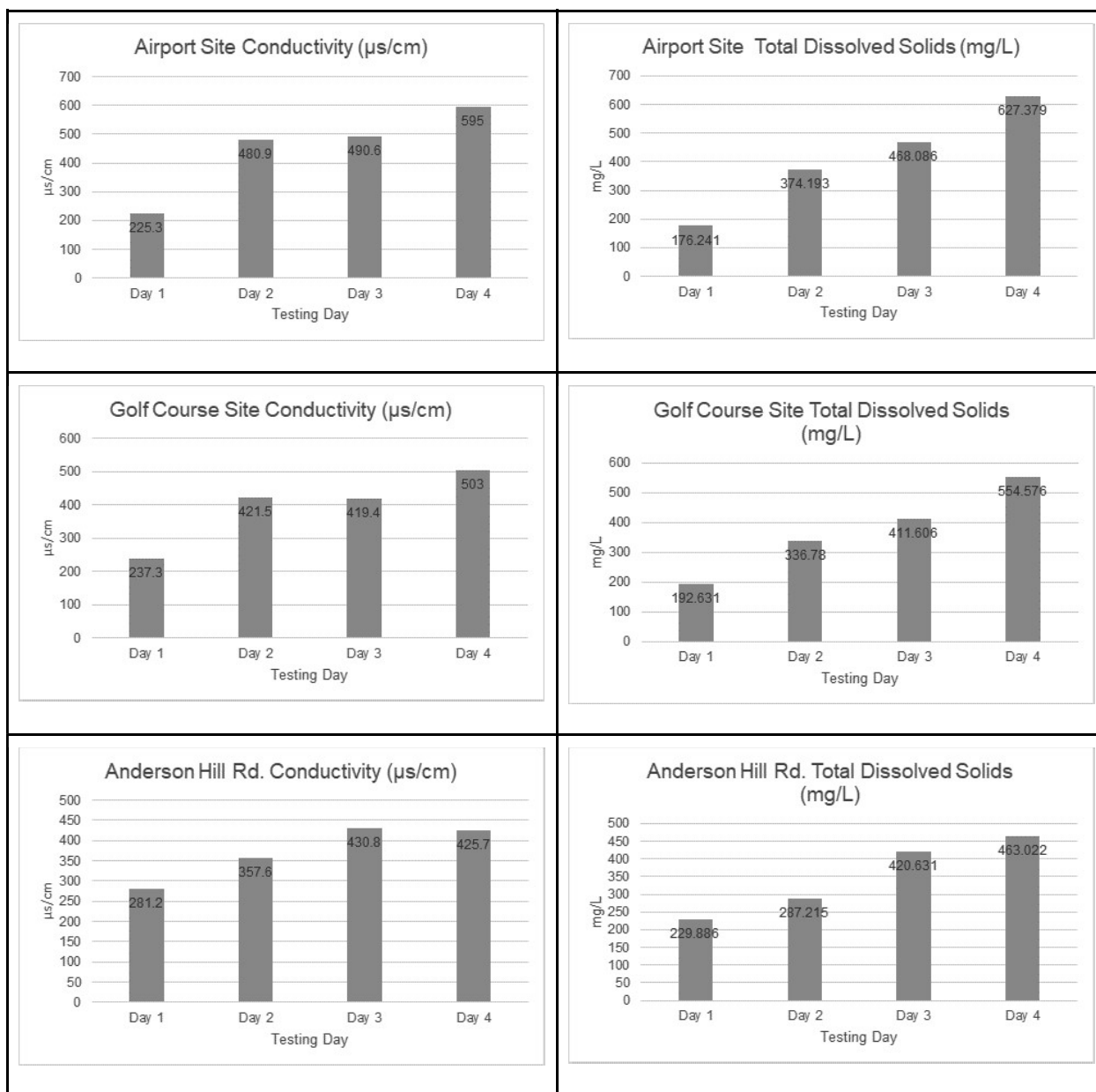
## METHODS

Our group used the YSI water quality testing unit to test for dissolved oxygen, pH, conductivity, turbidity, temperature, dissolved solids, and other water quality parameters. To determine flow rate we measured the amount of time a bottle with a little water inside could float down a 3 meter section of the Blind Brook Tributary. We tested these parameters at three locations on the Blind Brook Tributary to determine the differences the different environments and runoff types affected the water quality within each location of the Blind Brook.

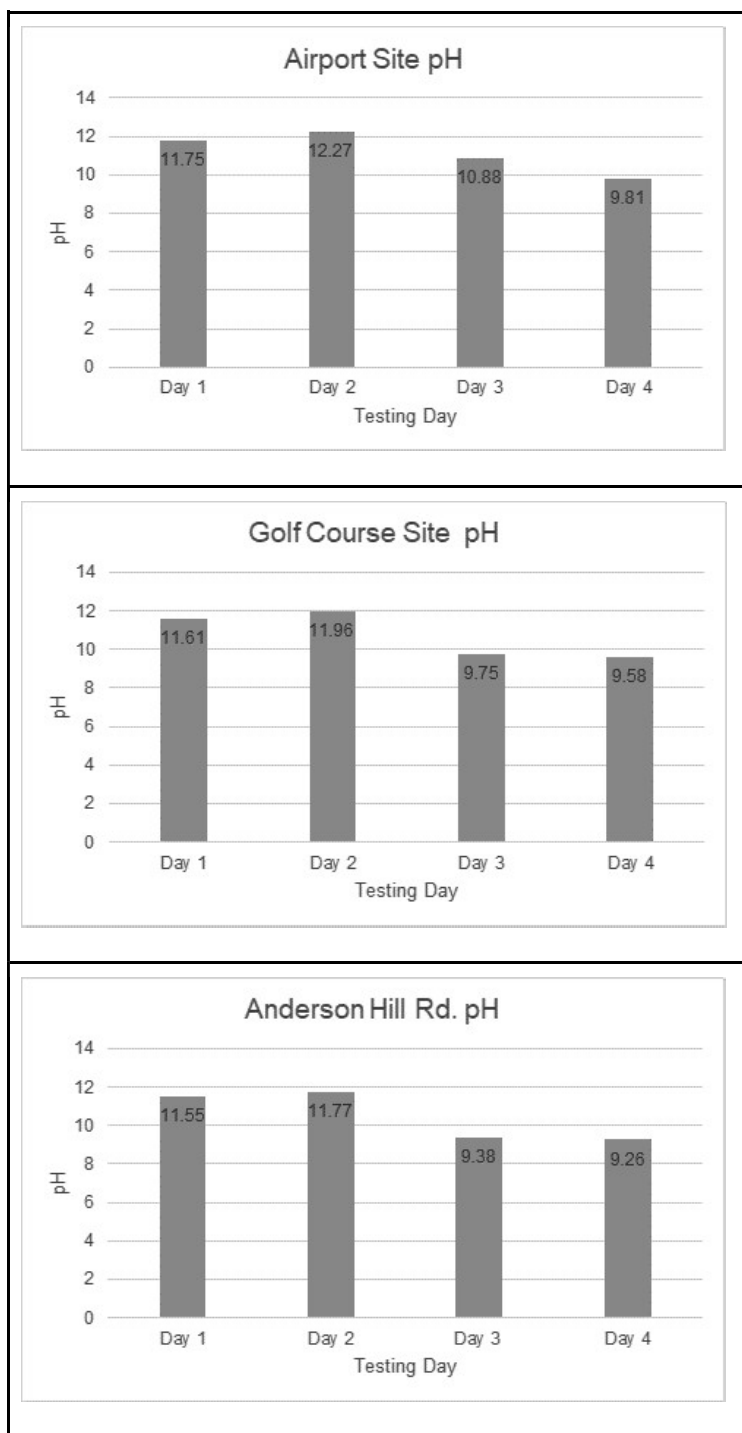
## RESULTS



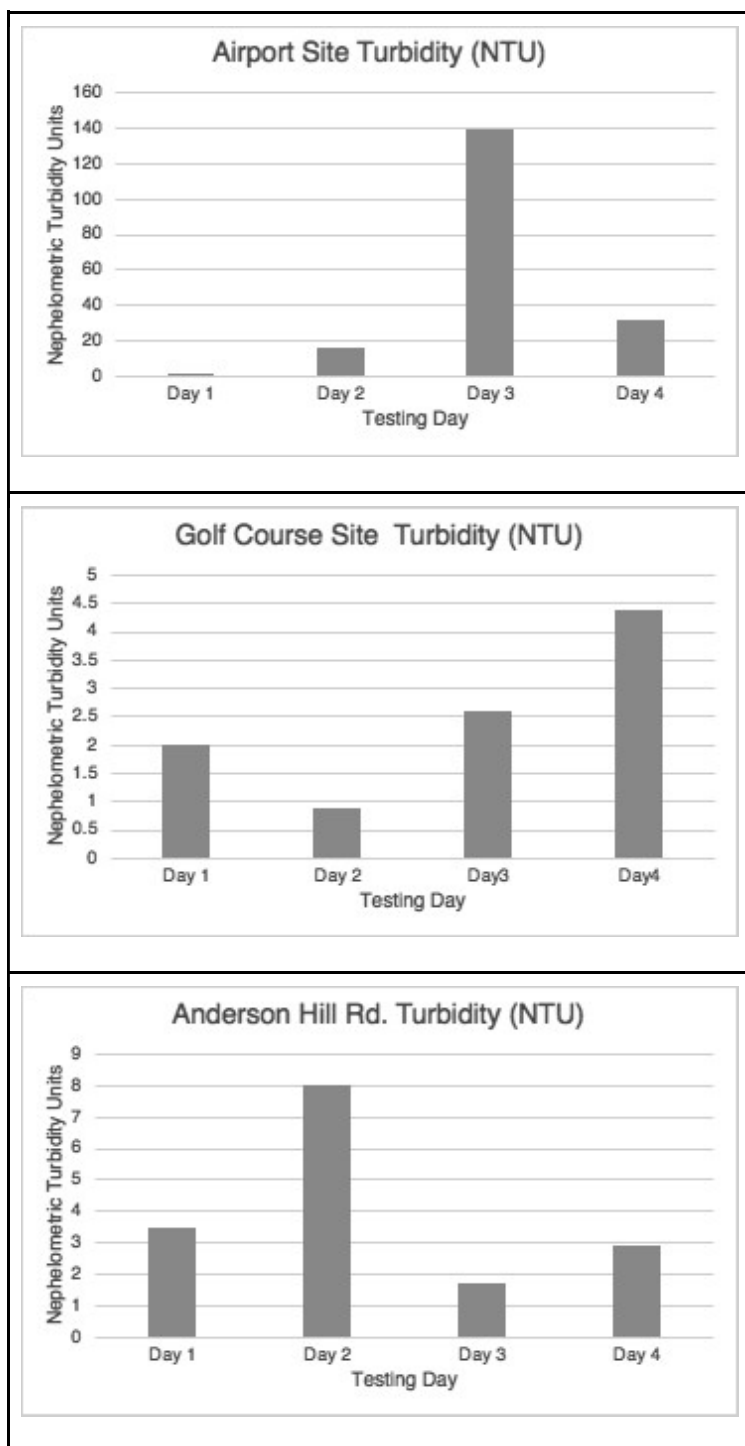
Average percent dissolved oxygen (DO%) was highest at the Airport site (95.65%), while the average percent dissolved oxygen was the lowest at the Anderson Hill Rd. site (89.725%), and the Golf Course site being the second highest average percent dissolved oxygen for the three sites (90.875%). Average dissolved oxygen (DO mg/L) was highest at the Airport site (10.5725 mg/L), while the average dissolved oxygen was lowest at the Anderson Hill Rd. site (10.215 mg/L), and the Golf Course site having the second highest average dissolved oxygen (10.395 mg/L).



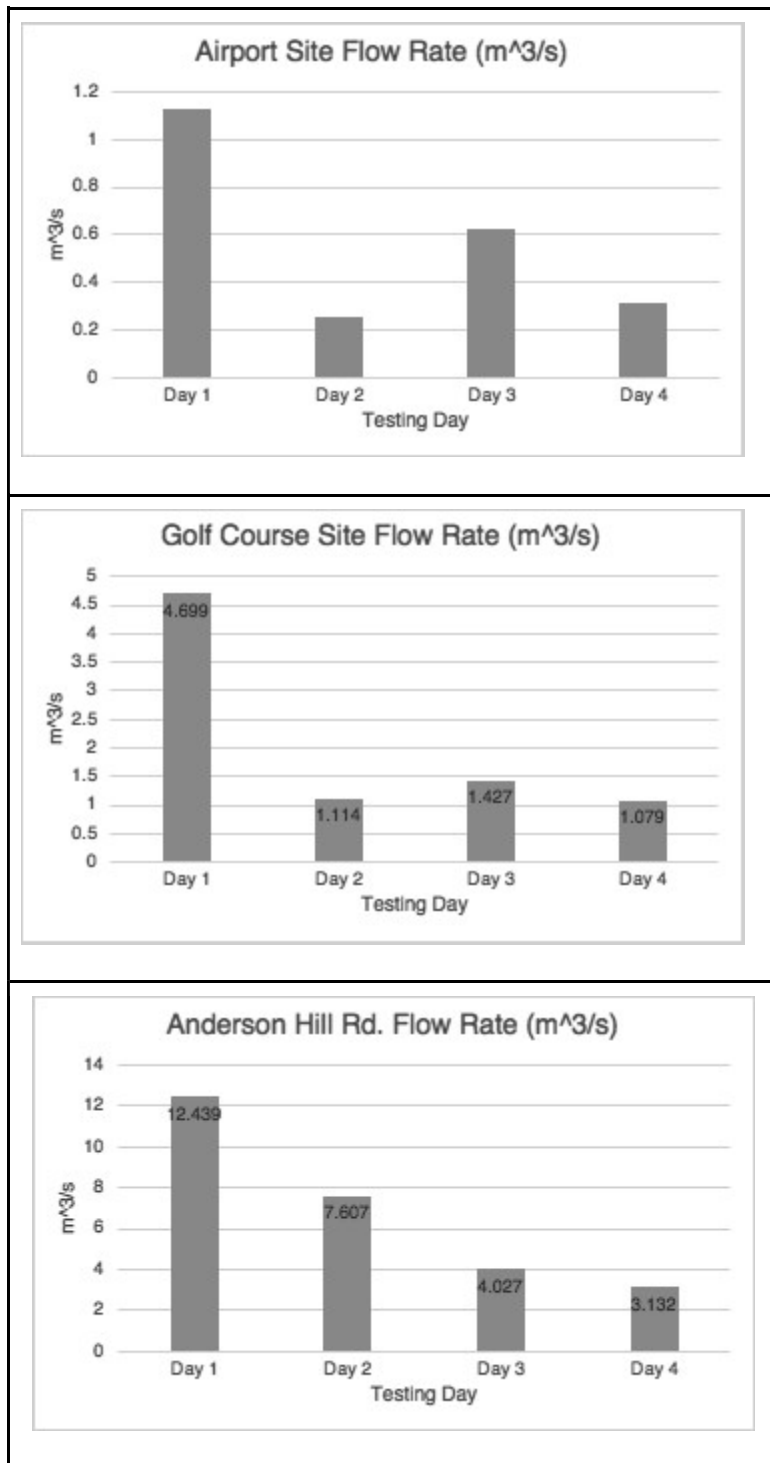
Average conductivity (us/cm) was the highest at the Airport Site (447.95 us/cm), while the lowest average conductivity was at the Anderson Hill Rd. site (373.825 us/cm), and the second highest was at the Golf Course site (395.3 us/cm). Average total dissolved solids (TDS mg/L) were the highest at the Airport site (411.47475 mg/L), while the average total dissolved solids were the lowest at the Anderson Hill Rd. site (350.1885 mg/L), and the second highest were at the Gold Course site (373.89825 mg/L).



The pH level at the Airport site was the highest (11.775), while the pH level at the Anderson Hill Rd. site was the lowest (10.49), and the Golf Course site having the second highest pH (10.725).



The average turbidity (NTU) was highest at the Airport site (47.5 NTU), while the average turbidity was lowest at the Golf Course Site (2.475 NTU), and the Anderson Hill Rd. site having the second highest average turbidity level (4.025 NTU).



Average flow rate ( $\text{m}^3/\text{s}$ ) was highest at the Anderson Hill Rd. site ( $6.80125 \text{ m}^3/\text{s}$ ), while flow average rate was lowest at the Airport site ( $0.58025 \text{ m}^3/\text{s}$ ), and the Golf Course site having the second fastest average flow rate ( $2.07975 \text{ m}^3/\text{s}$ ).

The average temperature (Celcius) was highest at the Airport site (11.425 °C), while the average temperature was lowest at the Golf Course site (10.15 °C), and the second highest average temperature was the Anderson Hill Rd. site (10.175 °C). These graphs were not shown because the steady decrease in temperature was because of moving into the winter season as we tested.

## DISCUSSION

In the course of this field study, we sought to determine the differences, if any, between the water quality observed at three different locations along the Blind Brook as it flows across SUNY Purchase campus. The key differences between the three locations were, going from north to south downstream, the first location is immediately adjacent to water catchment areas on the property of Westchester County Airport near to their runways, the second location is about halfway south along the east side of campus and is near a golf course and housing development, the third location is just south of where the stream crosses under Anderson Hill road just off campus. The comparison of these three types of adjacent uses, commercial airport, housing/recreational, and roadway, was the main investigation of our project. We observed that the first location, on average, had a higher water temperature, and slower flow rate, as well as higher levels of DO, pH, and total dissolved solids, as compared with the subsequent two locations. It is difficult to infer a strong trend, based on limited sampling events, but implies that there is likely a higher nutrient concentration at that point in the stream near the airport. The Airport Site and the Golf Course site had the highest levels of total dissolved solids, pH, and conductivity are markers of having high nutrient levels as well as showing that runoff from these locations affects the Blind Brook significantly. High nutrient levels, pH, and total dissolved solids usually correlate to high phosphorus, nitrogen, and other fertilizers as well as shows that these sites are directly affecting the health of the tributary. The conductivity of the water is its ability to have electrical current run through it. Conductivity is directly related to pH, Salinity, and Total Dissolved Solids. Seeing the results show high Total Dissolved Solids and seeing High Conductivity levels as well as these results increasing as the DO% and DO mg/L went up.

The results varied from test to test with some outliers in the data that were unexplained nevertheless, over the testing cycle some trends were observed with turbidity, pH, DO% and Temperature all being the overall highest at the airport over all testing days with DO(mg/L) and TDS showing similar trends regardless of outliers on two separate days. All other sites show similar trends overtime with varying levels not greatly exceeding those observed at the airport site. The average turbidity was highest at the Airport site (47.5 NTU) and the Anderson Hill Rd. site (4.025 NTU) compared with the Golf Course Site site (2.475 NTU) most likely because the the Airport Site and the Anderson Hill Rd. site are in close proximity to vehicle traffic where dumping is caused by runoff directly going in clouding the water while at the Golf Course site with fertilizers and sprays being applied that get into the Blind Brook through groundwater contamination which gets into the stream causing higher total dissolved solids but low turbidity. At the Airport Site and the Golf Course site they saw a trend that the average pH, Total Dissolved Solids, and Conductivity had their highest levels compared with the Anderson Hill Rd. site. This could imply that the dumping of runoff into these sites is highest at the Airport and Golf Course sites. Pollution of ecosystems can be caused by the relatively high levels of de-icing agent, cleaning products used on the planes and equipment, fuel, and other sources of emissions deposited into biological communities by runoff. The pollution caused by runoff affects soil quality, groundwater quality, and stream/lake/ocean/etc. waters (Sulej et al. 2011).

## CONCLUSION

Throughout our field study we showed that the Runoff from the Airport and the Golf Course site had the highest levels of total dissolved solids, pH, and conductivity showing that there is high salinity



caused by pH increase which can damage the Blind Brook ecosystem. The Tributaries of the Long Island Sound see large volumes of sewage, industrial waste, etc. due to heavy urbanization. These added pressures being put on the Long Island Sound are increasing the amount of dissolved trace metals as well as inorganic nutrients. These are causing a potential toxic effect on the biological communities of the Long Island Sound, its tributaries, and the surrounding areas along the East River of New York. (Sweeney et al. 2004) The high conductivity levels seen at the airport site, anderson hill rd. site, and the golf course site all seem to confirm higher dissolved trace metals in the waters of the Blind Brook. the high total dissolved solids seen at the three sites also seems to point at increased runoff pollution making its way into the water. The highest levels of conductivity and total dissolved solids in the water seen where on the 4th day while from day 1-4 of testing increases were seen each day and this could be from the movement into the winter season causing higher levels of de-icing agent, fuel, and other pollutants to be released into the Blind Brook.

Total dissolved solids show that there is a large amount of runoff entering the water at these two locations. The dissolved oxygen showed high levels at each of the three sites because the movement of the water across the rocks in the Blind Brook as well as the trees and shrubs surrounding the Tributary contribute to high oxygen levels. This would not occur if there was less oxygen transfer because of the surrounding ecosystem because bacteria and algae blooms would use the increased nutrients as well as the increase in the pH and conductivity to use up all the oxygen during the process of them feeding on the nutrients. This shows that the parts of the Tributary close to the Airport and the Golf course are most heavily affected by runoff because of their proximity to the runoff as well as these sites having slower flow rate causing the runoff, nutrients, etc. to pool and concentrate in these locations.

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