Effects of West Chester University Road Salt Usage on Water Quality of the Plum Run

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ABSTRACT

This study examines urban influences on the water quality of the Plum Run, a tributary to the Brandywine Creek. The west branch of the Plum Run originates underneath West Chester University of Pennsylvania (WCUPA) as storm water sewers. Therefore, storm water run-off from WCUPA has the potential to pose a significant threat to the Plum Run and the downstream Brandywine Creek. The threat increases during the winter months when the use of road salt is employed as a de-icing agent to roads and sidewalks in an attempt to keep them safe for travel. When road salt is transported to surface waters via storm water run-off, it threatens the ecological health of the entire watershed, but especially those influenced by urban land use.

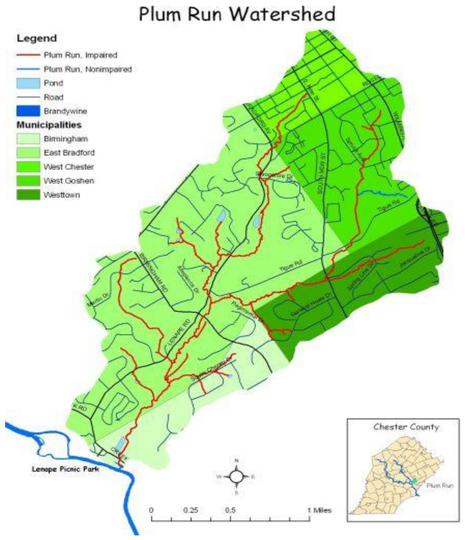

Image Source: Brandywine Valley Association

Impacts of Road Salt Usage on Freshwater Streams

- The introduction of sodium chloride (NaCl) in surface waters via storm water runoff results in elevated toxicity levels which can be threatening or even deadly to various aquatic life forms.
- In a 2005 study conducted by the Institute of Ecosystem Studies, scientists found chloride concentrations that were 25% that of the concentration of seawater in streams located in Maryland, New York, and New Hampshire during the winter. Residual concentrations were up to 100 times greater than un-impacted forest streams during summers.

Storm Sewer on WCU campus

Plum Run- WCU South Campus

Simple Approach to Determining the Likelihood of Chloride Presence in Streams.

WCU Snow Removal Plan

The University has 30 acres of parking lots, over three miles of roadways, and 6.6 miles of sidewalks. The Grounds Department begins each winter season with a twenty ton start-up inventory of rock salt that usually supplies 75 percent of demand during mild winters.

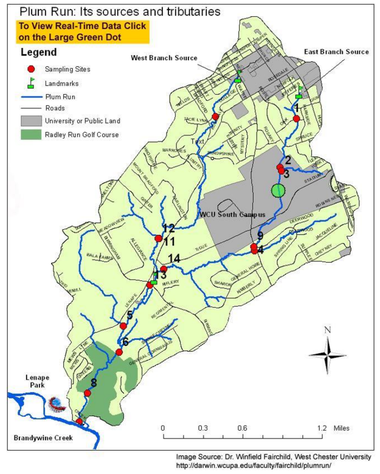

Image Source: Dr. Winfield Fairchild, West Chester University http://darwin.wcupa.edu/faculty/fairchild/plumrun/

Salt Storage Shed – WCU South Campus

Methods

This project explored the statistical significance of seasonal differences in Specific Conductivity values and Turbidity values for the Plum Run Streams. Seasons are defined as (1) the weeks during which salt is applied to streets, and (2) the weeks during which salt is not applied to streets. It is expected that both Specific Conductivity and Turbidity have higher values, to a statistically significant degree, during those weeks when salt is applied to streets.

Preliminary analysis (Table 1) indicates that neither the Specific Conductivity data nor the Turbidity data are normally distributed. The Mann-Whitney U test was chosen to test the difference of medians.

	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Specific Conductivity	0.182	53	0	0.809	53	0
Turbiditiy	0.467	53	0	0.151	53	0
a. Lilliefors Significance Correction						

Results

Results of the Mann-Whitney *U* Test indicate that there is a statistically significant difference in the median value of Specific Conductivity by Season (standardized $U = -5.212$, $p = 0.000$) with a mean rank of 34.93 for the weeks during which salt is applied to the streets located within the Plum Run watershed. The mean rank for the weeks during which salt was not applied to the streets was 11.58. This is as expected.

Results also report that there is no statistically significant difference in the media value of Turbidity by Season (standardized $U = 0.056$, $p = 0.956$). This was not as expected.

	Application Season				
	Salt Applied	No Salt Applied			
	n = 35	n = 18	Mann Whitney U	Z	p-value
	Mean Rank	Mean Rank			
Specific Conductivity	34.93	11.58	37.5	-5.212	0
Turbidity	27.09	26.83	312	0.056	0.956

Conclusions

With a growing environmental awareness of the effects of road salt on the environment, understanding local hydrological processes and direct anthropogenic impacts on them is absolutely critical to ensuring the long term viability local water resources. Therefore by studying West Chester University's impact on the Plum Run and looking critically at the University's current salt use practices, there is potential to gain valuable insight into the campus's impact on the environment. Additionally, by identifying winter maintenance practices in need of improvement, there exists an opportunity to reduce the amount of road salt being applied on campus and thus improving the water quality of Plum Run and the Brandywine Creek.

References

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