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Water Quality Land Cover Change and Water Quality in Wetlands at the City of Gresham, Or

Evelyn Barajas
Portland State University

Michael Gonzalez
Portland State University

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Water Quality

Land cover change and water quality in wetlands at the City of Gresham, OR

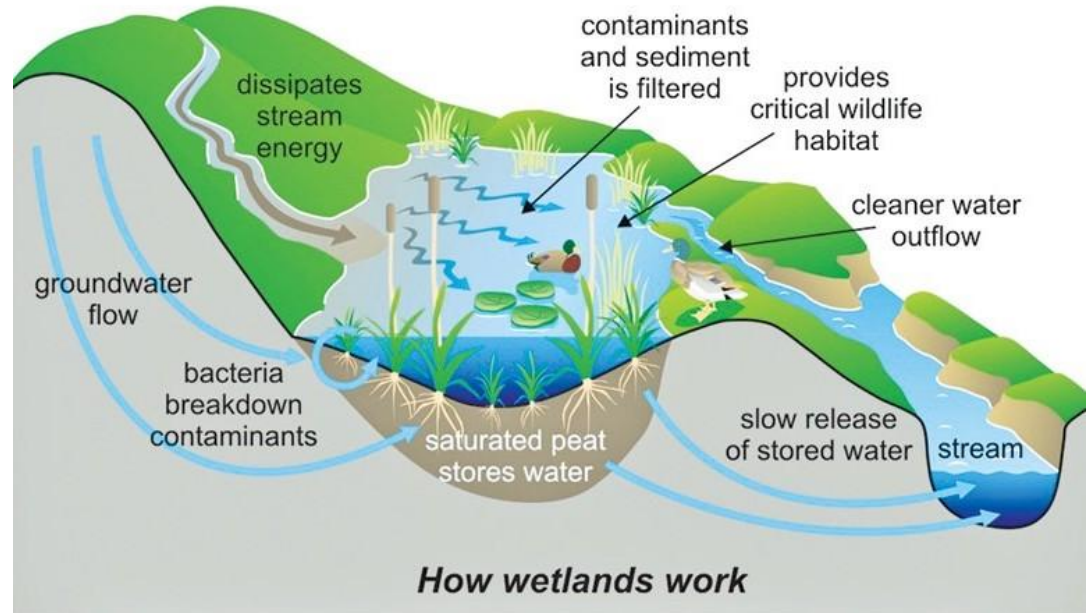
Evelyn Barajas
Michael Gonzalez

Mentors: Professor Heejun Chang and Dr. Jason Sauer
from the Department of Geography, Portland State University

What are wetlands

- Wetlands can be natural or constructed. They act as a filtration process for water, they help prevent flooding, and provide a living space for plant and animal species, in some cases.

Wetlands catch water from rainfall and other sources, vegetation then filters said water and allows for cleaner water to flow into streams. However, this process is not as neat when urbanization and agriculture are present, as they elevate the levels of P and N concentrations found in the wetlands which then flows into streams



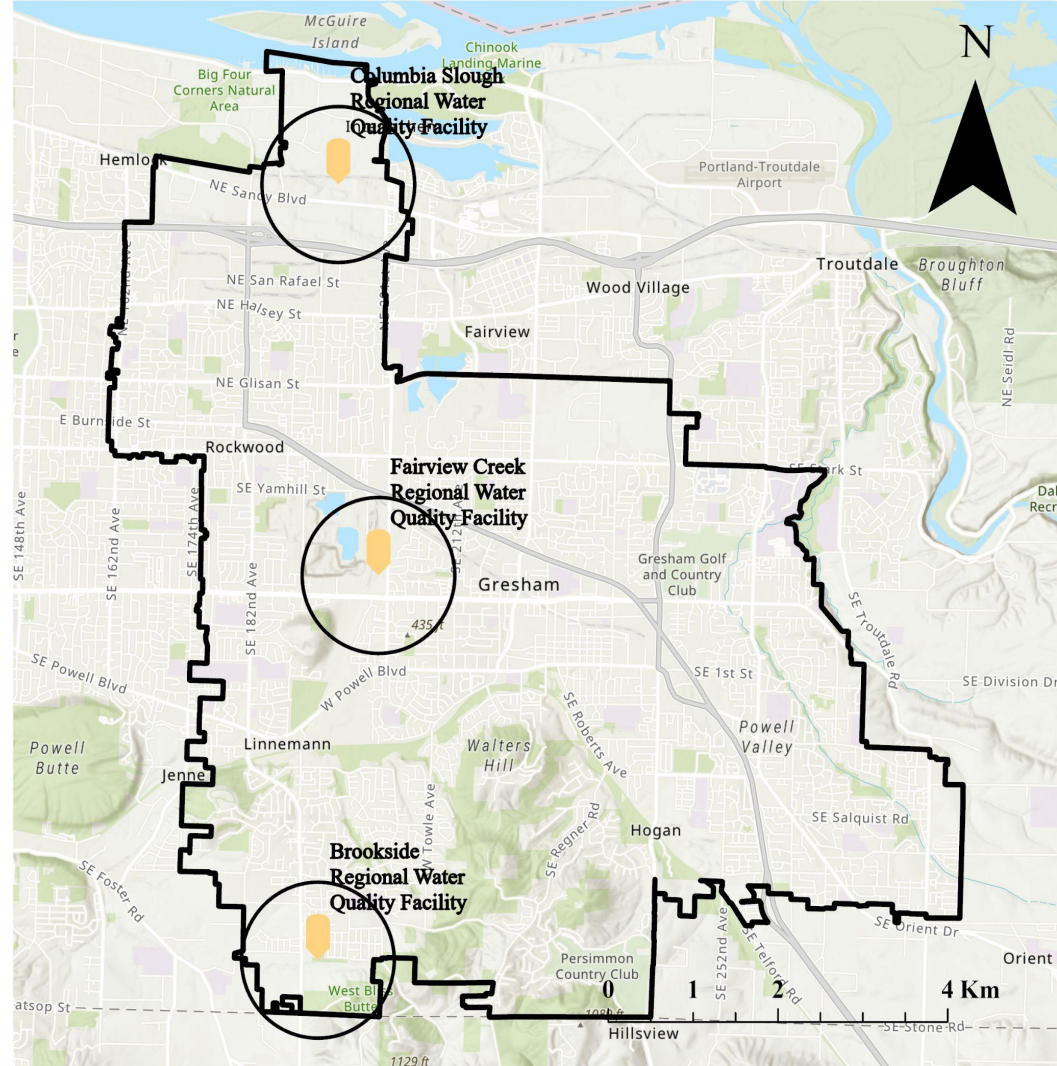
What impact does urbanization have on water quality?

- Land cover change over time has great effects on the quality of water as it can increase sedimentation, nutrient pollution, and erosion.
- Urbanization and agricultural expansion contribute to these problems as they alter vegetation and increase nitrogen (N) and phosphorus (P) loading in the water.
- Climate change is also affected and it's displayed by extreme precipitation - storm intensity, and heat increase. According to Grimm et al. (2008) in *The changing landscape: ecosystem responses to urbanization and pollution across climatic and societal gradients* urbanization contributes to global climate change by the production of greenhouse-gas emissions and alteration of rainfall patterns.

Study Site: Gresham, OR

- Columbia Slough Regional Water Quality Facility
 - Fairview Creek Regional Water Quality Facility
 - Brookside Regional Water Quality Facility
- We chose the city of Gresham as a test site because there is ongoing urbanization
- Use of constructed wetlands to fight the effects that urbanization can have on streams, rivers, and the ocean.

Dr. Jason Sauer ArcGIS work



Focus research on certain chemicals/heavy metals

- $\text{NH}_3\text{-N}$ (Nitrogen in the form of Ammonium)
- $\text{NO}_3\text{-N}$ (Nitrogen in the form of Nitrate)
- TKN (Total Kjeldahl Nitrogen, or Nitrogen in the organic form)
- O-PO_4 (Phosphate)
- Total P (Total Phosphorus)

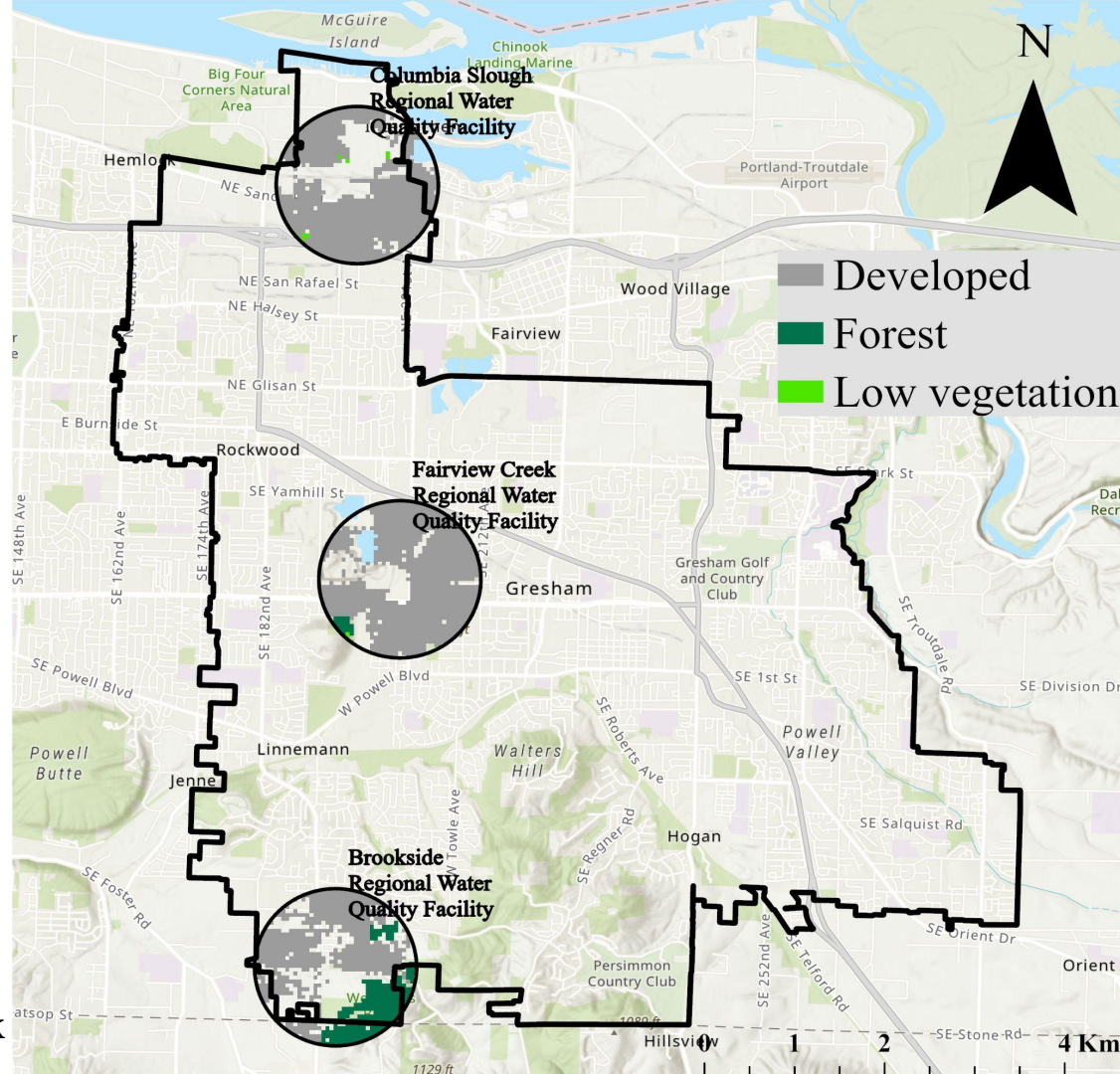
- Total Cu (Total Copper)
- Total Zn (Total Zinc)

- Nitrogen and phosphorus cycles have been damaged and altered due to human activity, looking at the concentration of these chemicals in the facilities will show the impact that land cover and factors like rainfall have on these cycles, and determine any relationship.

- These parameter were chosen for this study because, as an urbanizing city, there is agricultural activity still going on in which the use of fertilizers increase the N and P load on wetlands.

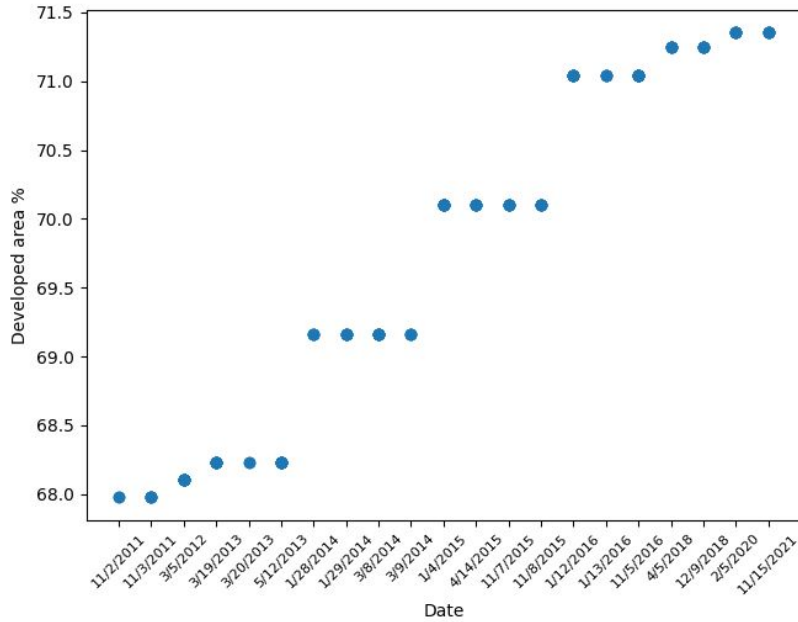
Land cover

- Land characteristics:
 - Developed areas
 - Forested areas
 - Low vegetation areas

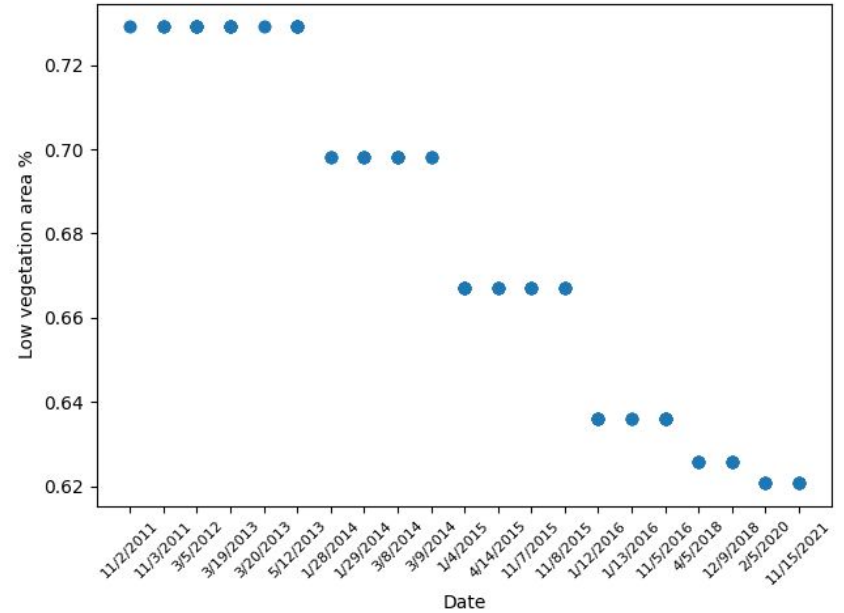


CSWQF land cover over time

CSWQF: Developed Area Percentage Over Time

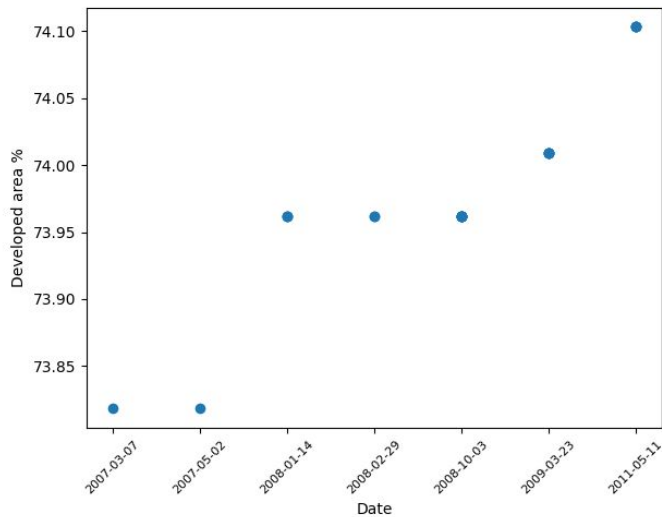


CSWQF: Low Vegetation Area Percentage Over Time

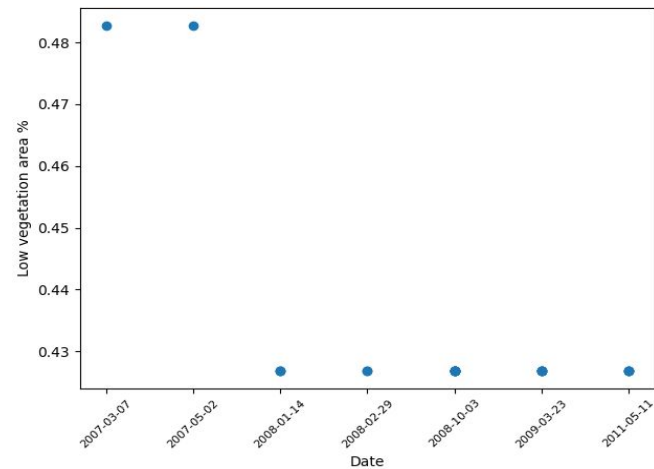


FCWQF land cover over time

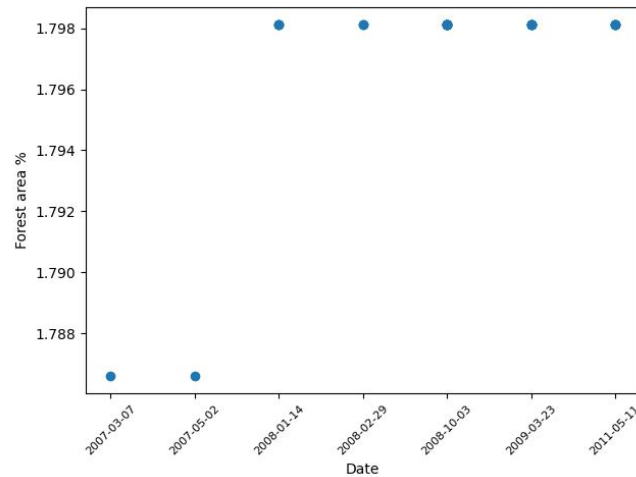
FCWQF: Developed Area Percentage Over Time



FCWQF: Low Vegetation Area Percentage Over Time

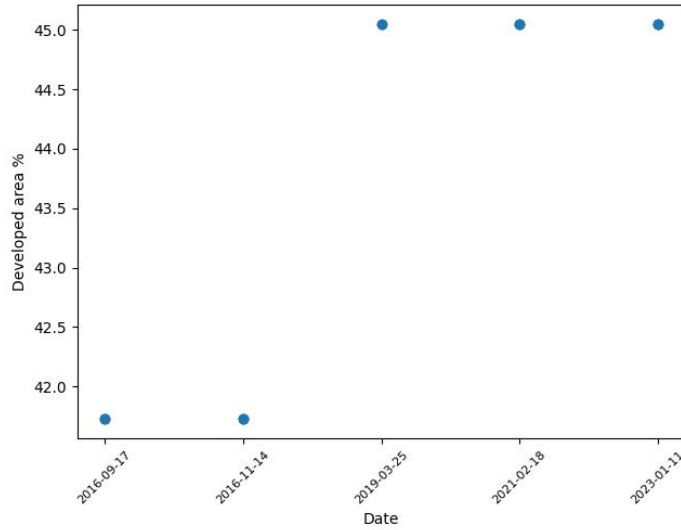


FCWQF: Forest Area Percentage Over Time

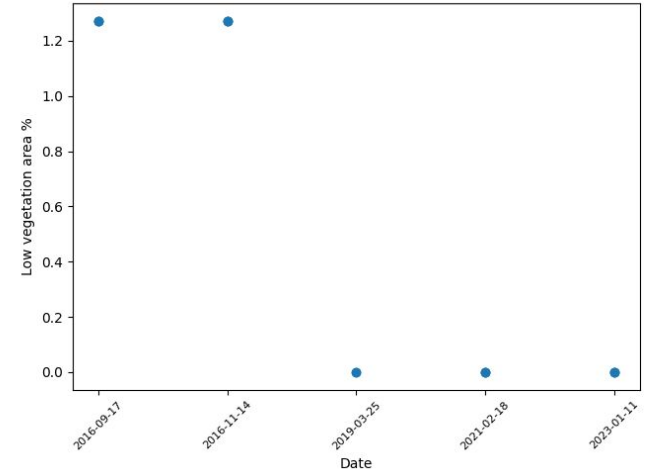


Brookside land cover over time

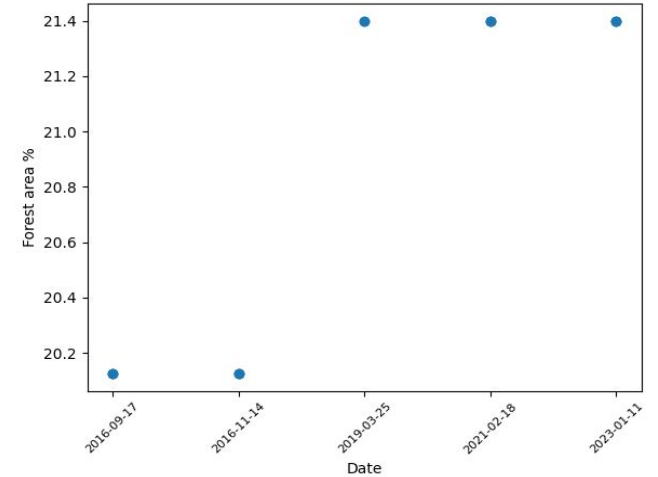
Brookside: Developed Area Percentage Over Time



Brookside: Low Vegetation Area Percentage Over Time



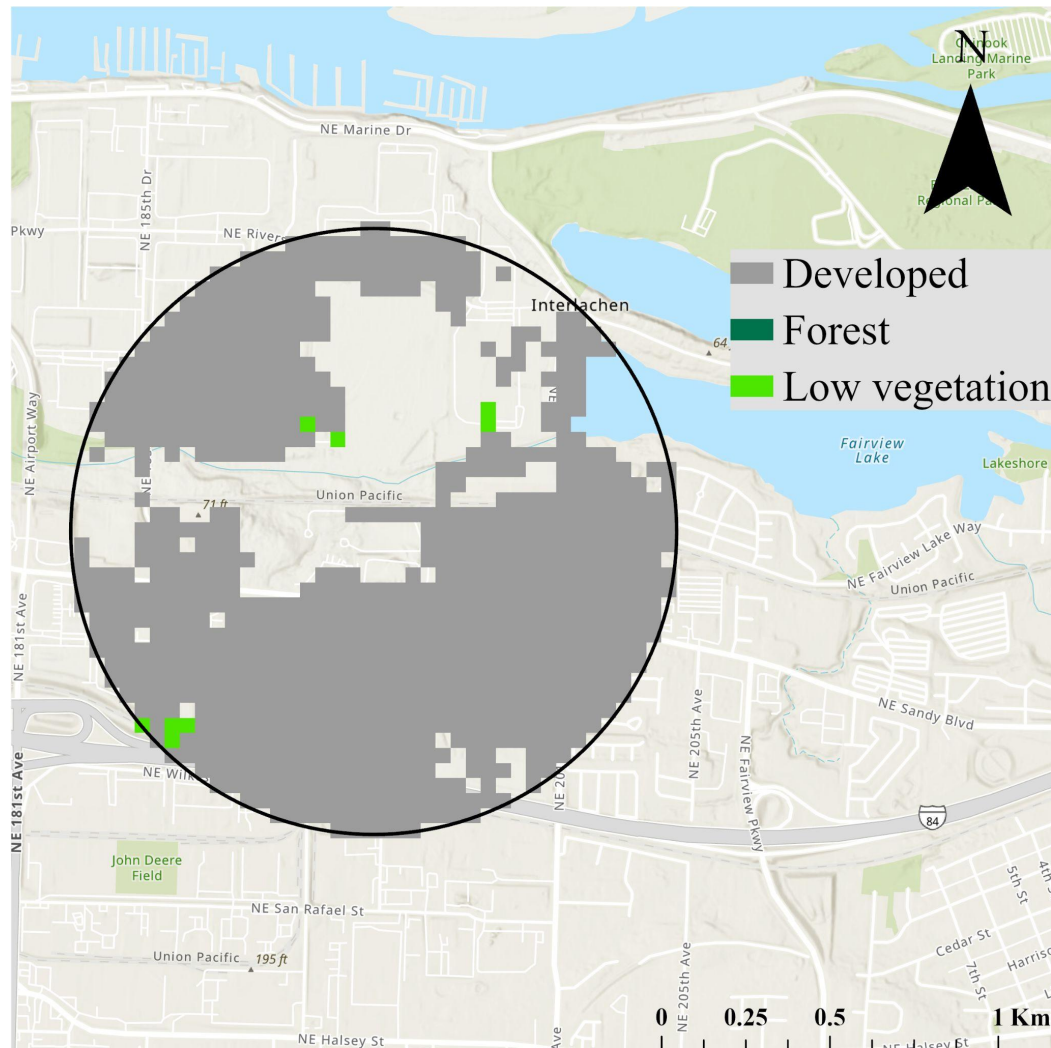
Brookside: Forest Area Percentage Over Time



Columbia Slough Water Quality Facility (CSWQF)

- The Columbia Slough Water Quality Facility is a constructed wetland that has since become a home for beaver and other wildlife
- Had the most data recorded over time

Dr. Jason Sauer ArcGIS work



Beaver activity in the CSWQF and its impact on concentrations

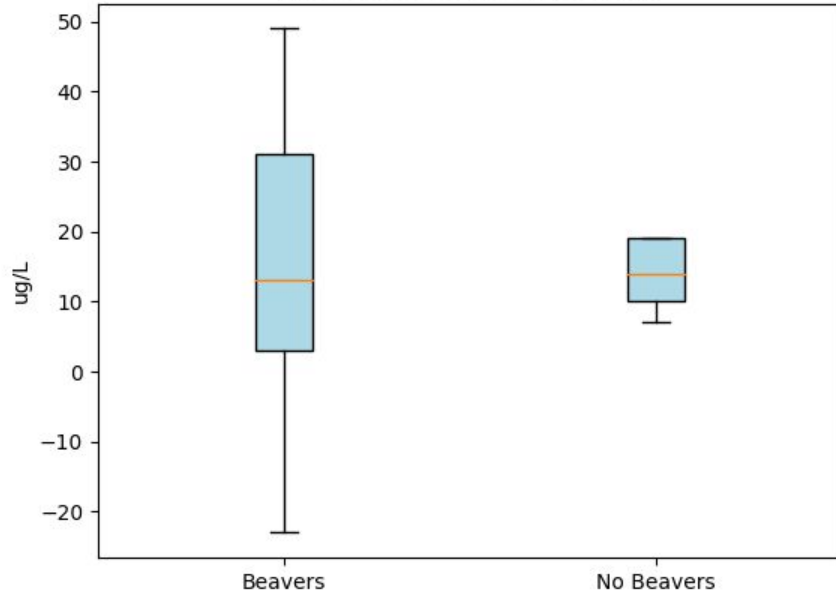
- Apart from urbanization, rainfall, agriculture, beaver activity also had an impact in the water quality at the Columbia Slough water facility.
- Beavers naturally inhabited the CSWQF, they had a positive impact in the reduction of heavy metals and improving water quality by creating dams which catch sediments and heavy metals that would flow into the streams.
- Beavers are now part of the wildlife at the CSWQF.



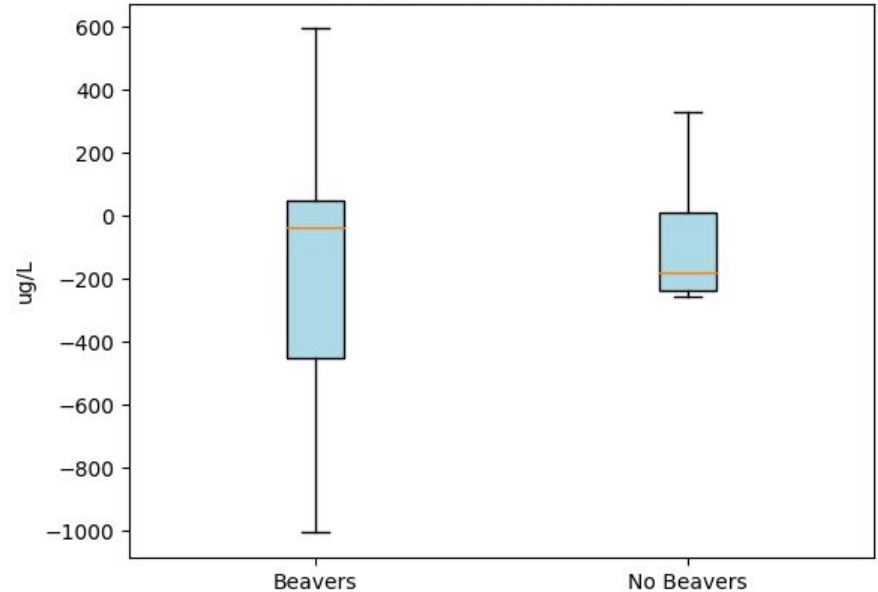
Beaver/No Beaver Activity

- I tested the relationship between concentration levels on dates where beavers were active and not active.
- Conducted a Mann Whitney U Test and boxplots

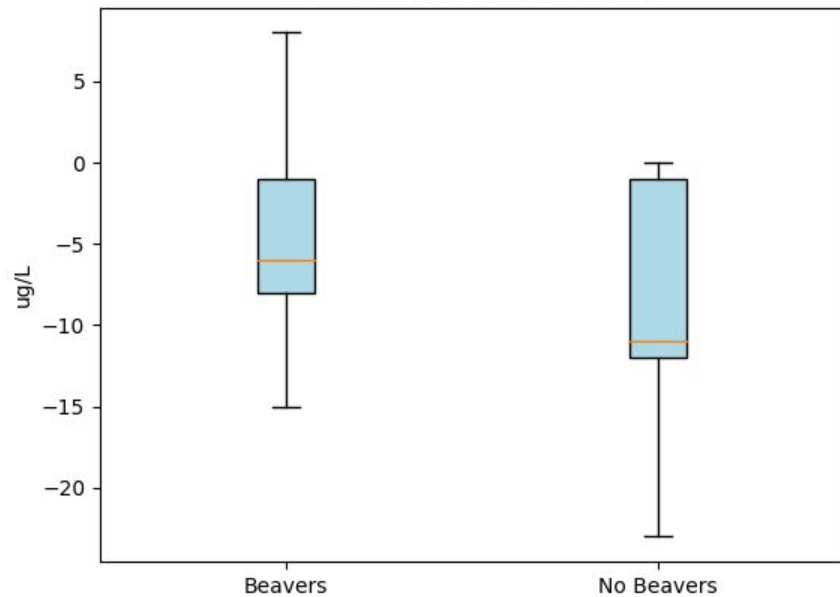
NH3-N: Beavers vs No Beavers



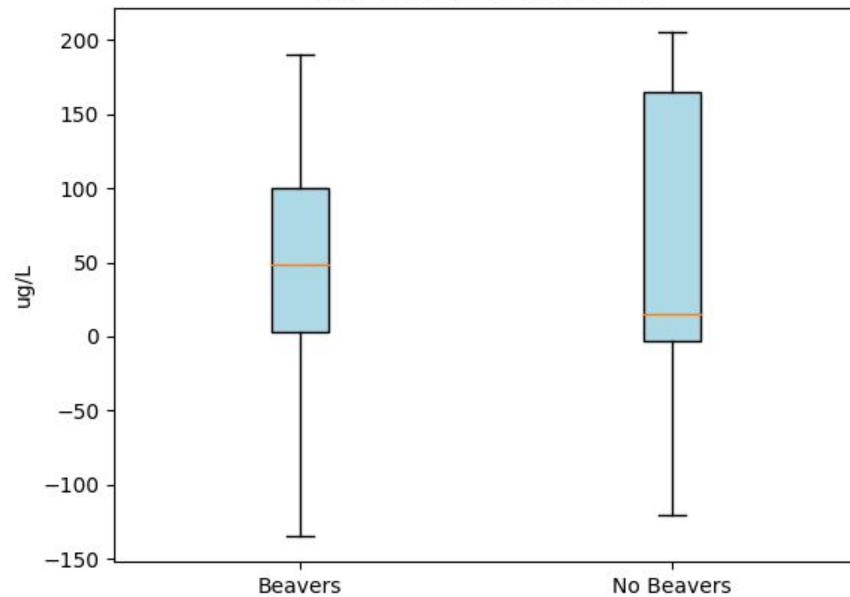
NO3-N: Beavers vs No Beavers



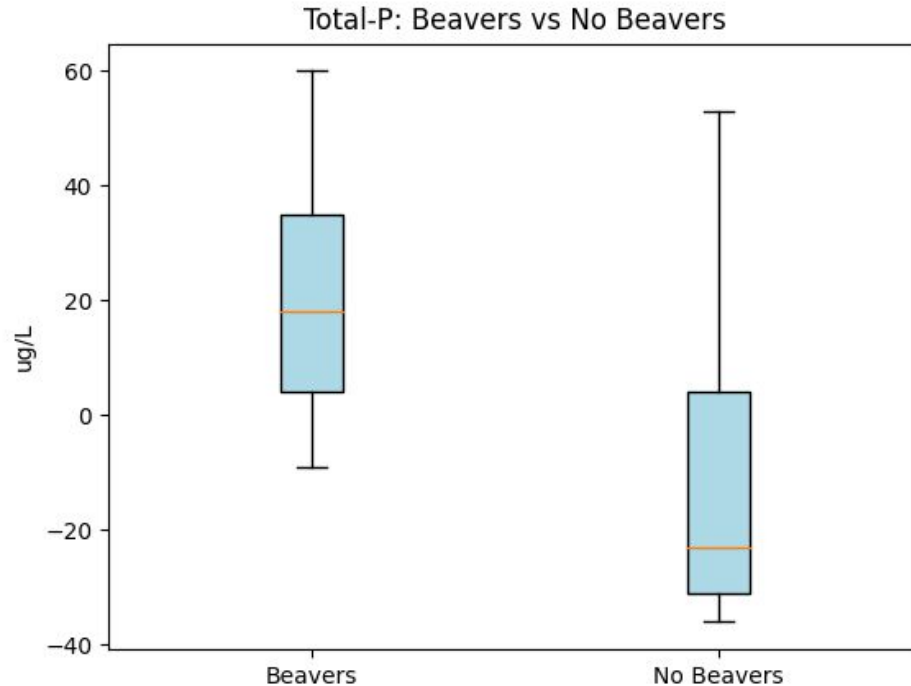
O-PO4: Beavers vs No Beavers



TKN: Beavers vs No Beavers

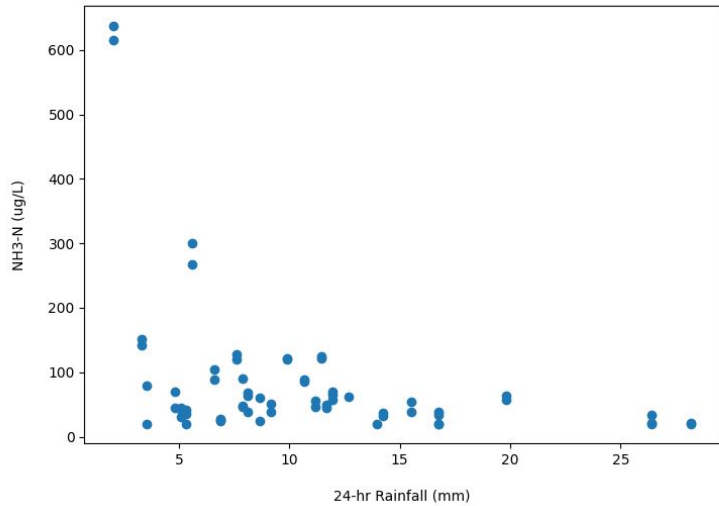
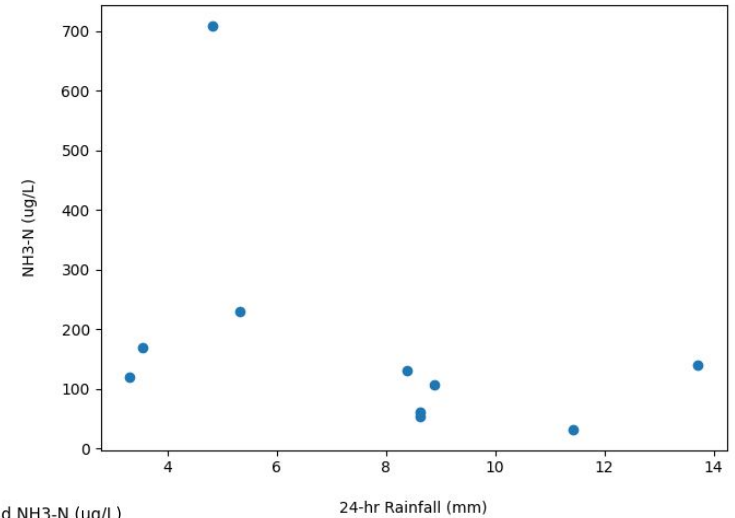
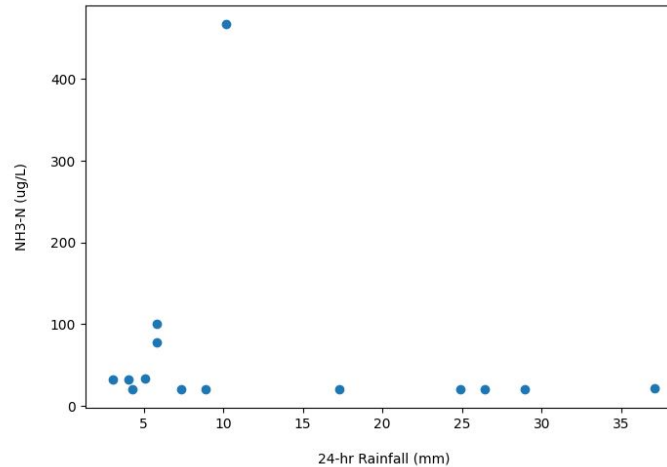


- It was found that the relationship between beaver activity in the CSWQF was not much significant to the nutrients $\text{NH}_3\text{-N}$, $\text{NO}_3\text{-N}$, TKN, O-PO_4 and Total-P concentration level in given dates.



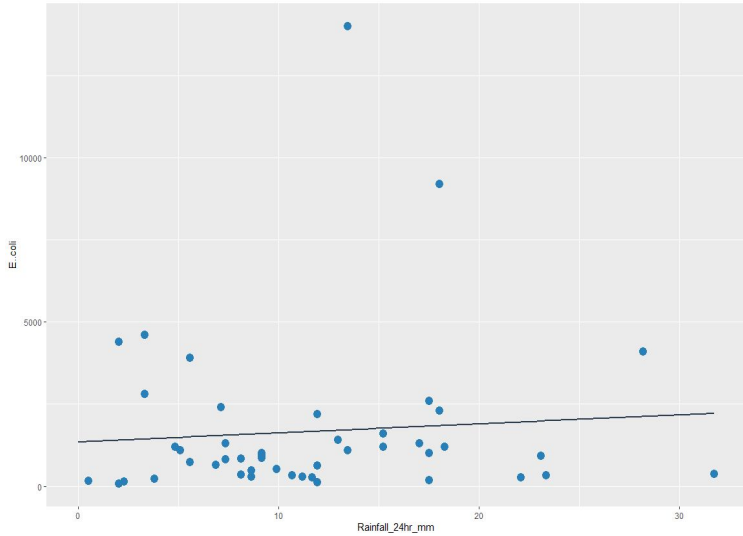
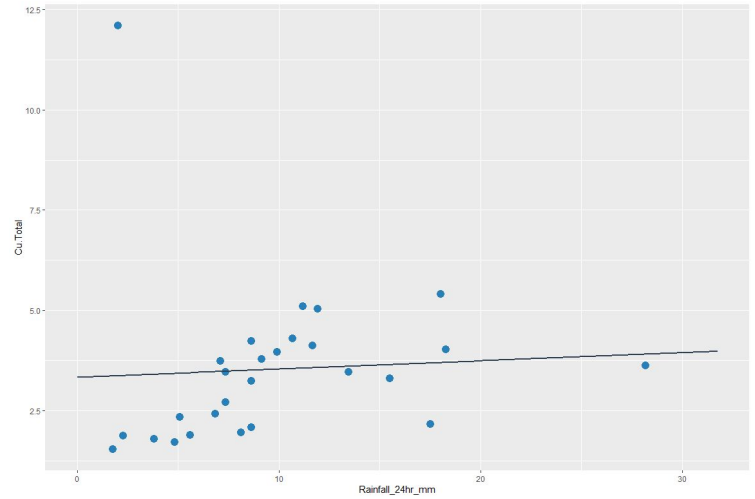
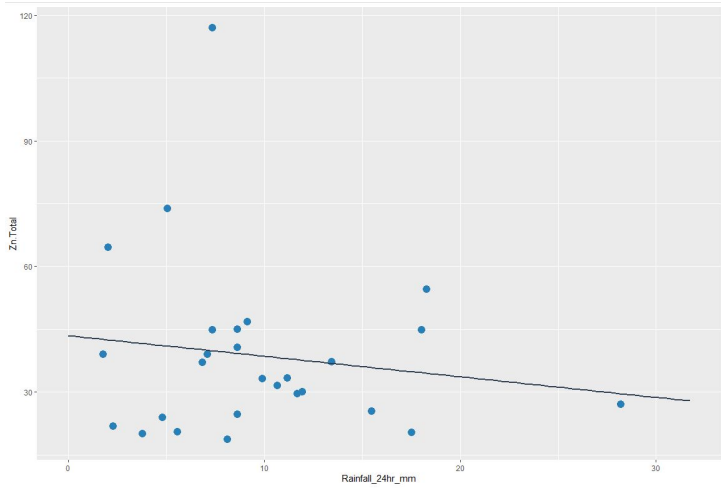
Rainfall

- Rainfall is an important factor when looking at water quality in inlets and outlets of wetlands.
 - Runoffs caused by rainy days carry a lot of debris and harmful nutrients and metals into the water, it is fundamental to understand the relation between rainfall and chemical concentrations in the wetlands by looking at the inlet concentration level and then outlet concentration level to understand how well wetlands are able to filter these harmful concentrations.
- We looked at concentration levels in inlets during 24-hr rainfall periods

CSWQF: Rainfall (mm) and NH₃-N (ug/L)FCWQF: Rainfall (mm) and NH₃-N (ug/L)Brookside: Rainfall (mm) and NH₃-N (ug/L)

Concentrations tend to be higher at the beginning of rain periods because of the **first-flush** where there's buildup concentrations over time. After that first flush concentration dilute because of the constant flow of water.

Rainfall - NH₃-N



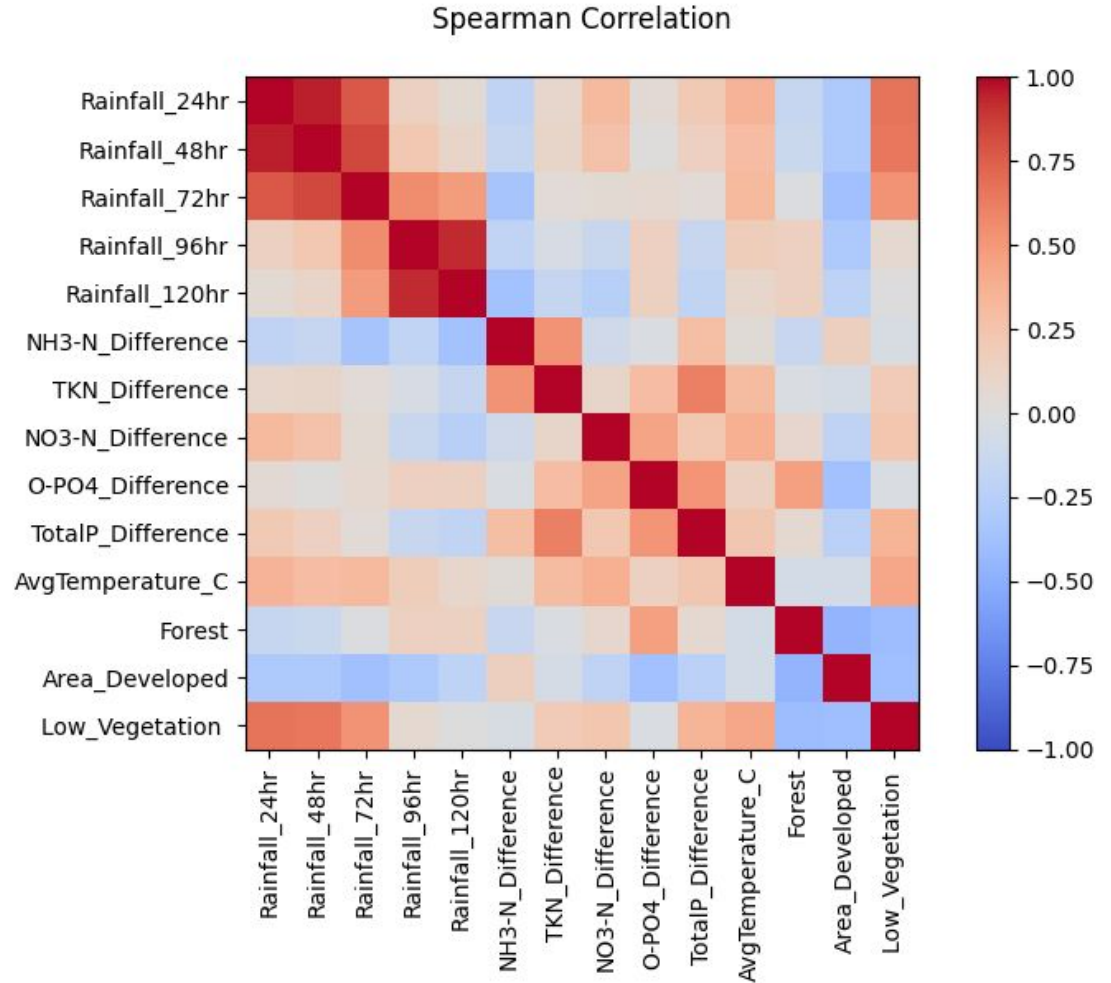
During the season when it starts to rain the first flush the concentrations are high and it gets diluted as the rain progresses. E.coli tends to be more concentrated during rainfall and rain increases the loading and concentrations of feces bacteria.

Analyses

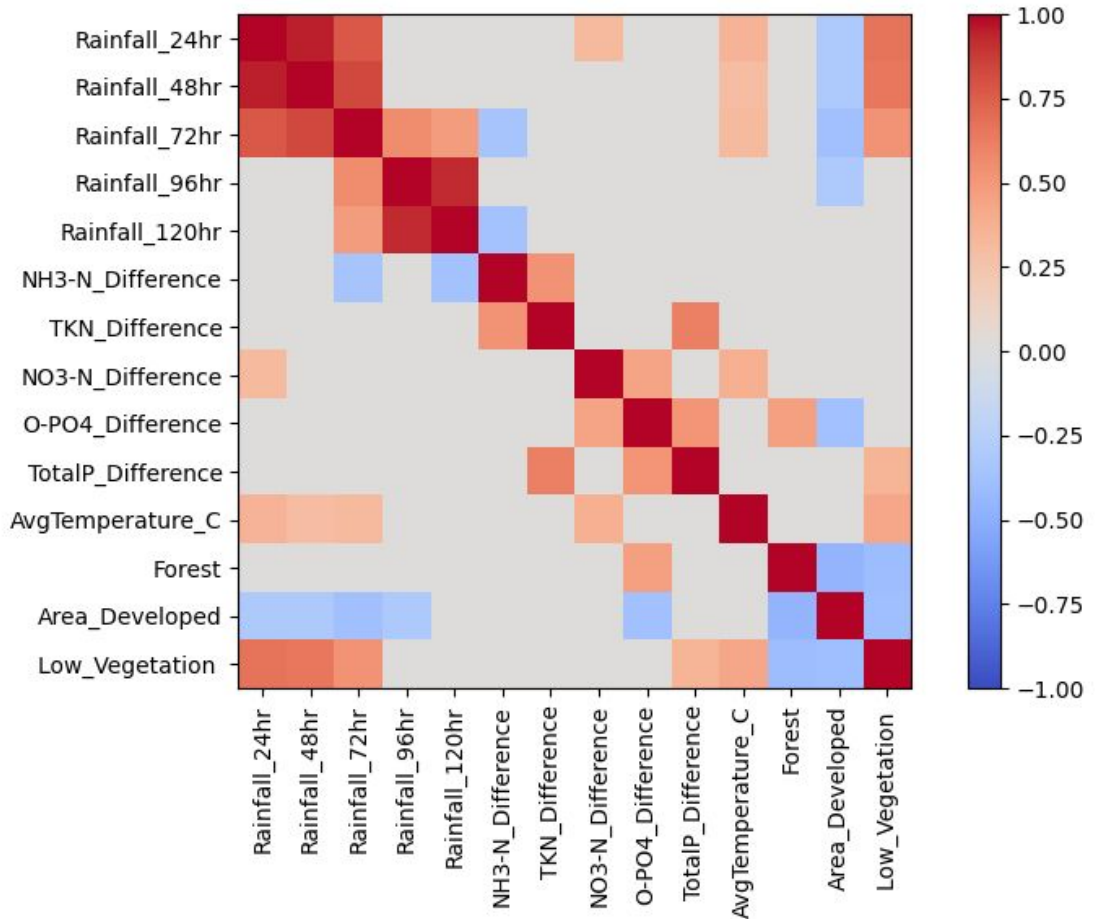
- **Mann Whitney U Test:** compare beavers activity and no beaver activity in the CSWQF.
- **Spearman's Rank:** use of Spearman's rank correlation analysis to identify if there was a correlation between 24, 48, 72, 96, and 120 antecedent rainfall period, developed, forested, and low vegetation areas, and concentration levels at the CSWQF, FCWQF and Brookside facility.

Results

- Values with a p-value < 0.05 represent a significant relationship between one variable and another



Spearman's Rank Correlation



Filtered plot for significant values

- 24hr rainfall was significant for NO₃-N concentration difference
- Forest area significant relation with O-PO₄ concentration difference
- Low vegetation area with Total P

References

- Grimm, N. B., Foster, D., Groffman, P., Grove, J. M., Hopkinson, C. S., Nadelhoffer, K. J., Pataki, D. E., & Peters, D. P. (2008). The changing landscape: ecosystem responses to urbanization and pollution across climatic and societal gradients. *Frontiers in Ecology and the Environment*, 6(5), 264–272.
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1st image citation

- Wetlands are Magicians of Water Quality Improvement. (2019, May 15). WMAP Blog - State of Delaware.
<https://wmap.blogs.delaware.gov/2019/05/15/wetlands-are-magicians-of-water-quality-improvement/>