Urban Runoff Assessment of Burlington, Vermont

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Introduction:

Urban areas contribute up to 18% of the total phosphorus load into Lake Champlain. This has negative consequences on the ecosystems that depend on the lake. Since Burlington is comprised of 16-35% impervious surface, it is important to reduce the amount of urban runoff it produces. Lake Champlain International (LCI) has been absolutely instrumental in promoting sustainable and environmentally friendly stormwater management practices. As a result, the results and data our group produced will be given to LCI, in order to aid a program called BLUE. BLUE is an innovative program that certifies residential properties as watershed friendly and will help both residents and communities integrate best management practices (BMPs) to reduce water pollution stemming from stormwater runoff. Our investigations included personally locating and evaluating storm drains throughout Burlington, collecting information from city residents *via* Front Porch Forum, and GIS map analysis. We found that areas of highest risk include neighborhoods bordering the Winooski river, areas adjacent to North Beach, and neighborhoods close to the south end (below the hill section). Areas of moderate-risk include parts of downtown Burlington, UVM's campus and several neighborhoods west of campus and in the Old North End.

Methods:

Our research consisted of three aspects, including GIS analysis, community outreach, and in person field investigation.

- GIS Analysis - We used ArcGIS and data provided by VCGI to analyze the slope, cover, and perviousness of Burlington's topography
- Community outreach- Our research group used Front Porch Forum (FPF) to canvas Burlington residents for their opinions of their local stormwater infrastructure performance
- In-Person Investigations - Our research group examined stormwater drains throughout downtown Burlington to assess their performance after a large rain event

After our analysis and upon arriving at our conclusions, we made recommendations to LCI as to which neighborhoods would benefit most by implementing BLUE certified BMP's.

Maps & Figures

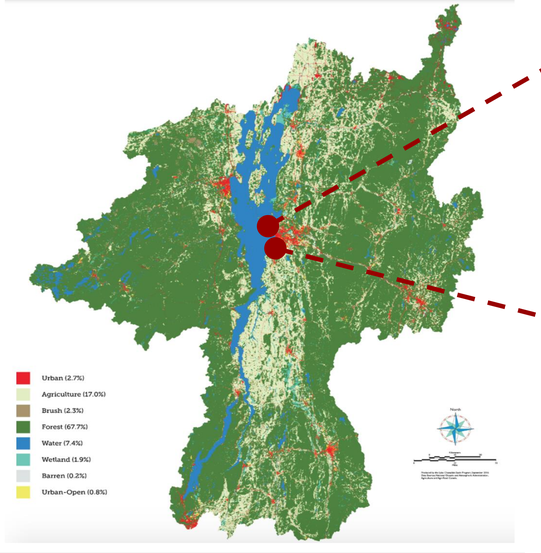

Figure 1 is a map created by the VT DEC, which shows landcover within the Lake Champlain basin. A large majority of land within the basin is forested. However, urban areas, which only comprise 3% of the total area within the basin, contribute up to 18% of the phosphorus load delivered into Lake Champlain.

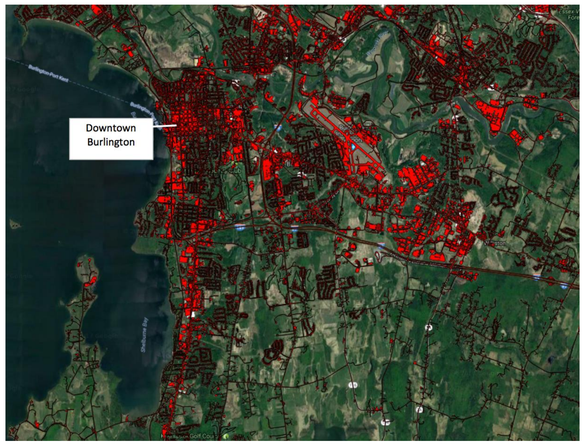

Figure 2 Is a map representing impervious surfaces within Burlington, VT. Locations on the map highlighted in red are classified as Impervious. Examples of common impervious surfaces include roads, buildings, and sidewalks. The issue with impervious surfaces is that they do not allow water to permeate, resulting in excess runoff. A serious problem arises when that runoff water contains pollutants and nutrients.

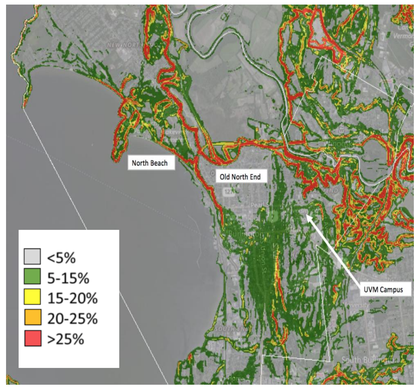

Figure 3 This image shows the slope of Burlington, VT. Areas outlined in red contain the steepest slope, whereas areas in green and grey are gentler slopes. This map is important to our report because stormwater will runoff at higher speeds in areas containing steeper slopes. Water moving at a higher velocities will cause more erosion, and as a result will contribute larger amounts of sediment, nutrients, and pollutants into Lake Champlain.

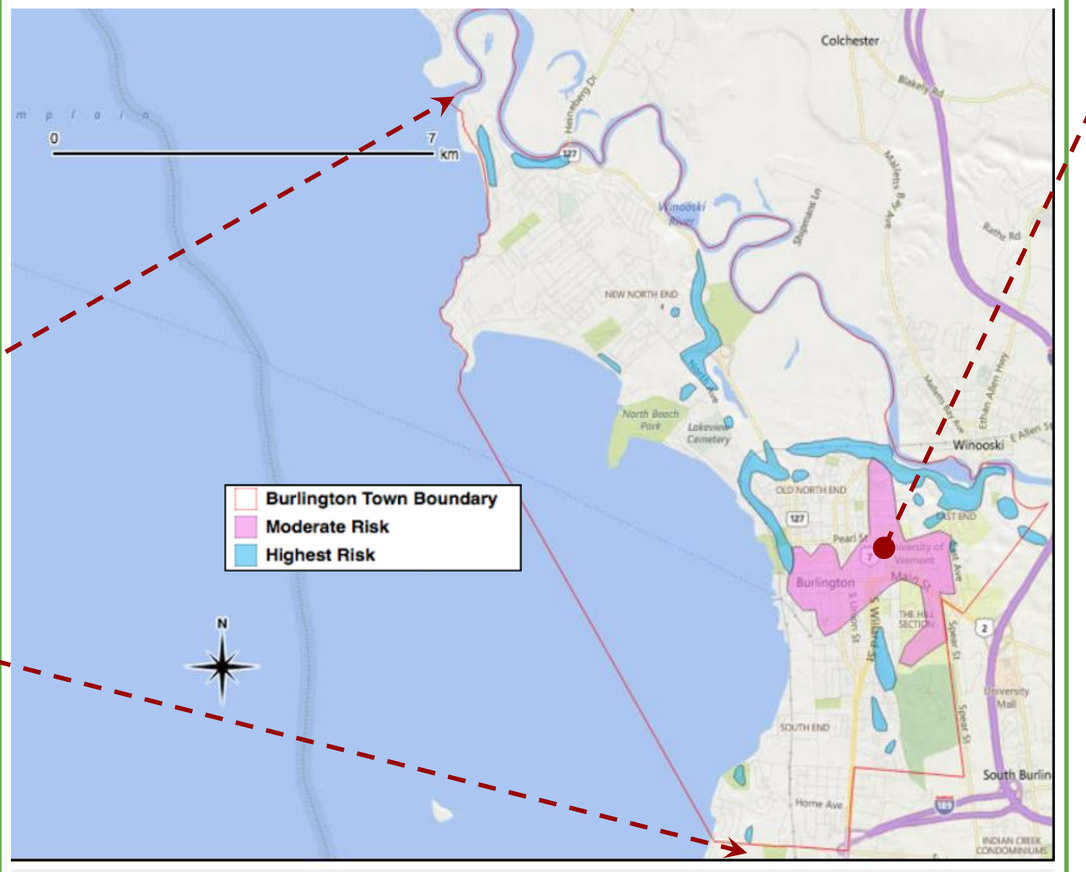

Figure 4 is a heat map featuring the predictive risk layers in Burlington. This map shows high-risk and moderate-risk areas based on slope steepness and percentage of impervious surfaces. Based on our research, areas at high-risk to generating large amounts of stormwater runoff are neighborhoods bordering the Winooski river, areas adjacent to North Beach, and neighborhoods close to the south end (below the hill section). The main area at moderate-risk to generating runoff in high quantities are parts of downtown Burlington, UVM's campus and several neighborhoods west of campus and in the Old North End.

Figure 5 is photo of a malfunctioning storm water inlet. This particular inlet was found on the corner of South Willard Street and Pearl Street. During large rain events, water collects around the inlet, rather than infiltrating into it. This is a common issue for asphalt and concrete surrounding stormwater drains, because they are particularly vulnerable to frost-heaving during Vermont's long winters. When water sits stagnant around an inlet, it increases the chances of it reacting with phosphorus and other contaminants. These inlets lead directly to the sewer. The locations of all these junctions throughout Burlington can be seen in figure 6 **(right).**

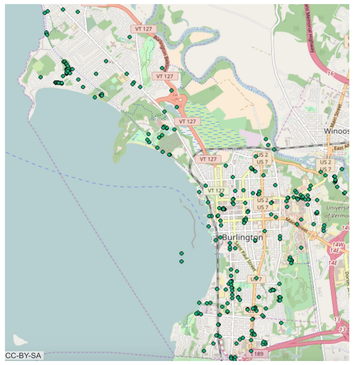

Figure 6 is a map provided by the municipality of Burlington, and shows the location of storm water inlets and curbside drains, and their junction with the city sewer system. Strategic placement of stormwater drains is crucial to mitigate the overland flow of water, and also ease the burden on wastewater treatment plants. During times of high runoff, treatment plants in Burlington often can not handle the large water load. As a result, untreated sewage often reaches lake Champlain in Large quantities. Proper placement of BLUE systems could ease the amount of runoff being dealt with by municipal infrastructure.

Interpretations of Results & Impacts:

- Locations of Burlington's stormwater drains, as depicted in Figure 6, can be paired with high-risk areas, shown in Figure 4, to pinpoint areas of concern. This, combined with results from personal investigations and FPF, allowed us to identify high-risk neighborhoods. This analysis also included a holistic assessment of risk factors such as impaired stormwater infrastructure, slope steepness, and impervious surfaces.

- The highest risk areas include the Old North End by the Winooski River and the Lake Champlain Waterfront by Battery Park. Areas of moderate risk include parts of downtown Burlington, UVM's campus, several neighborhoods west of UVM, and the Old North End. These are the neighborhoods that the BLUE program at LCI should target.

- Our study will be useful for BLUE by accomplishing their goal of implementing BMPs in the areas of concern. This will help prevent polluted stormwater runoff from reaching Lake Champlain.

References:

Conley, D. J., H. W. Pearl, R. W. Howarth, D. F. Boesch, S. P. Seitzinger, K. E. Havens, C. Lancelot, and G. E. Likens. "ECOLOGY: Controlling Eutrophication: Nitrogen and Phosphorus." *Science* 323.5917 (2009): 1014-015. Web.

Cowen, W.F., and Lee, G.F. "Leaves as Source of Phosphorus." *Environmental Science & Technology* 7.9 (1973): 853-54. 10.1021/es60081a006. Web. 2 Mar. 2017.

Lake Champlain Basin Program. "Facts." *Lake Champlain Basin Program*. N.p., 2017. Web. 05 Apr. 2017.

Lake Champlain International. "BLUE Certification Program." *BLUE Certification Program | Lake Champlain International*. N.p., 2017. Web. 05 Apr. 2017.

Meals, Donald W., Budd, Lenore F.. "Lake Champlain Basin Nonpoint Source Phosphorus Assessment." Journal of the American Water Resources Association 34.2 (1998): 251-65. Web.1.

Withers, P.j.a., and H.p. Jarvie. "Delivery and Cycling of Phosphorus in Rivers: A Review." *Science of The Total Environment* 400.1-3 (2008): 379-95. *ScienceDirect*. Web. 6 Apr. 2017.

Wright, S.F. "Glacial Geology of the Burlington and Colchester 7.5' Quadrangles,Northern Vermont." Glacial Geology of the Burlington/Colchester Quadrangles. 2009. UVM

Acknowledgments:

We would like to thank VCGI, VTANR, and LCI for the data used in this report. We would also like to thank Juliana Dixon, Breck Bowden, and Jesse Gourevitch for all the help they provided us throughout our research and the making of this report.