



Provide Access to Clean Water: *Laura Moore*



1 - *Laura Moore*, Civil and Environmental Engineer, 2023

Hello! My name is Laura Moore and I am a 2023 Villanova Civil and Environmental Engineer with a minor in Sustainable Studies. While I grew up in Leesburg, Virginia, my second home was in San Juan, Puerto Rico. This led me to select the grand challenge of providing access to clean water. Growing up I would visit my mother's family annually in Puerto Rico. Although this was a vacation for me, my eyes were never blind to the injustices on the island. In 2017, Hurricanes Irma and Maria tore through the island leaving nothing but destruction in their wake. This experience was the first time I began to understand the value of engineering from a humanitarian perspective. My education in humanitarian engineering has deepened with my involvement in Villanova's Engineering Service Learning Program. My participation in this program taught me how water is the first resource needed for a community to feel secure and established. These two experiences led me to pursue the National Academy of Engineers, Grand Challenge Scholars Program.

I hope to continue to pursue my passion for humanitarian engineering and global awareness through Villanova's Masters of Sustainable Engineering after my graduation in May 2023.

Talent

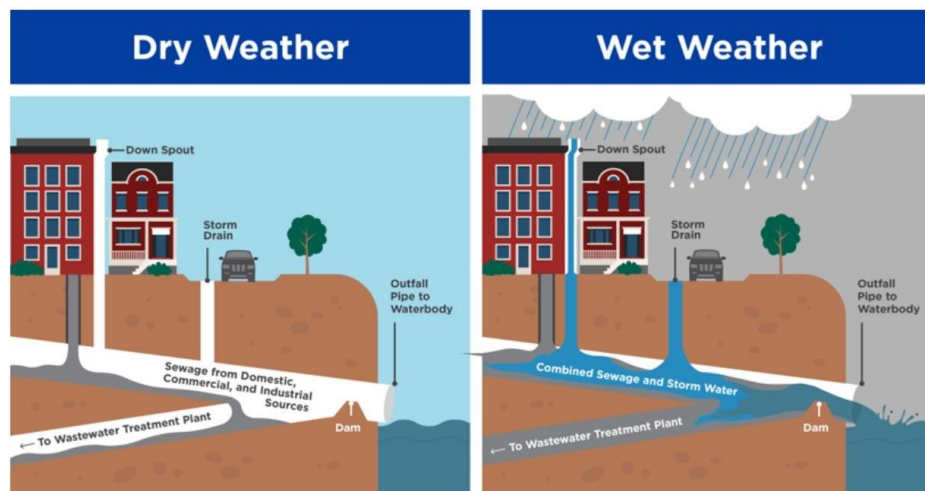


Throughout my sophomore and junior year, 2020-2022, I worked with Dr. Virginia Smith and Dr. Bridget Wadzuk on learning about the impacts of redlining and urban flooding. Beginning to learn about flooding

in Philadelphia was impactful to me as I had seen the detrimental effects of flooding in Puerto Rico only to see it now in my backyard. This research was focused on two neighborhoods, Manayunk and Eastwick, in Philadelphia, PA. Redlining is when a community of racial minorities is intentionally removed from benefits because they are deemed as "hazardous." This strongly correlates to the impact of urban flooding because in the studied areas there was little to no stormwater infrastructure in largely impervious regions. When a significant amount of an area is composed of impervious surfaces, rainwater cannot infiltrate the ground leading to significant amounts of runoff and flooding. This is even more important to note in cities like Philadelphia because it operates with a combined sewer system. As seen in the figure below, both sewage and rainwater enter the same system. When there is a significant inflow, the system overflows into surrounding rivers. The overflow then pollutes the water quality. The goal of this project was to collect flooding data and survey the residents where stormwater infrastructure was inadequate.



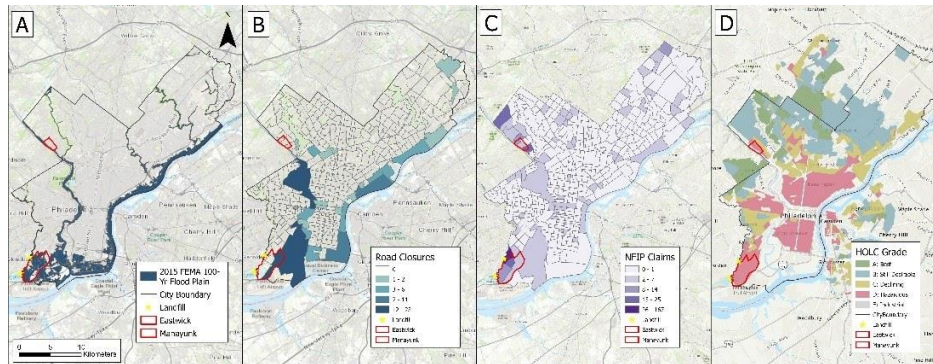
2 - <https://whyy.org/articles/philly-region-braces-for-heavy-rain-flash-floods-and-isolated-tornadoes-brought-by-ida/>



3 - <https://rvah2o.org/combined-sewer-system/>

I created maps in ArcGIS to show the differences in road closures, FEMA floodplains, and NFIP flood claims. A significant aspect of this project was learning how the history of gentrification and redlining have affected the frequency and impact of flooding. From this work an article titled *Challenges and the Need for Accounting for Equity in Urban Stormwater* was submitted to the journal *Nature: Urban*

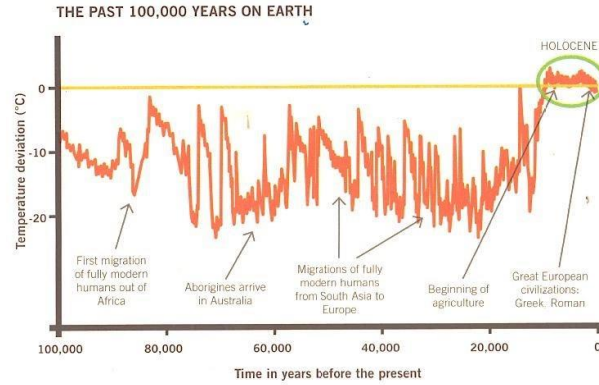
Sustainability for publication as of September 2022 and is currently in review. This paper communicates the value of community participation in designating the locations of stormwater infrastructures, especially in urban environments. As this project continues, the outcome will be to provide data to these neighborhoods to present to their government representatives for better flood prevention and stormwater infrastructure.



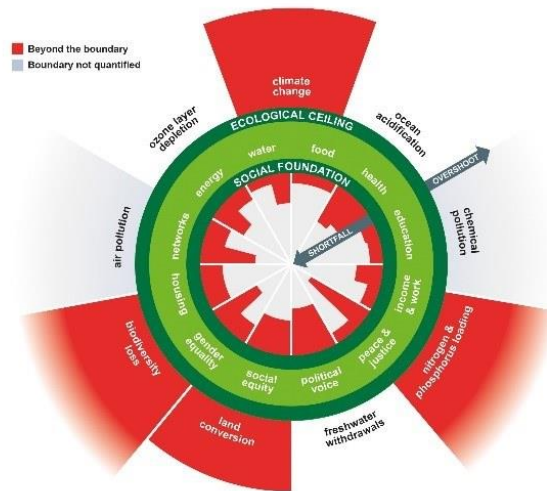
Multidisciplinary



During my time at Villanova University, I completed a Sustainable Studies minor through the College of Liberal Arts and Sciences. I took various courses that emphasized the importance of people with different backgrounds working together. One of my favorite classes was Justice in Sustainability. This course taught me about the interconnectedness of sustainability in environmental justice and social justice. I learned about how the people that are the most vulnerable are the most impacted by climate change. Furthermore, this course showed the connection between science and theology. I learned about the United Nations Sustainability Goals and the Vatican's Laudato Si' Goals. From this class, my interest and passion in sustainability deepened as it reminded me of the people impact.



4 - Over the past 10,000 years temperatures have changed. The Holocene is the time period when organized civilizations began. Here, it is clear to see how important it is to be aware of climate change and global warming.



5 - The Oxfam Donut shows the different boundaries we must be conscious of exceeding to ensure we can keep Earth habitable.

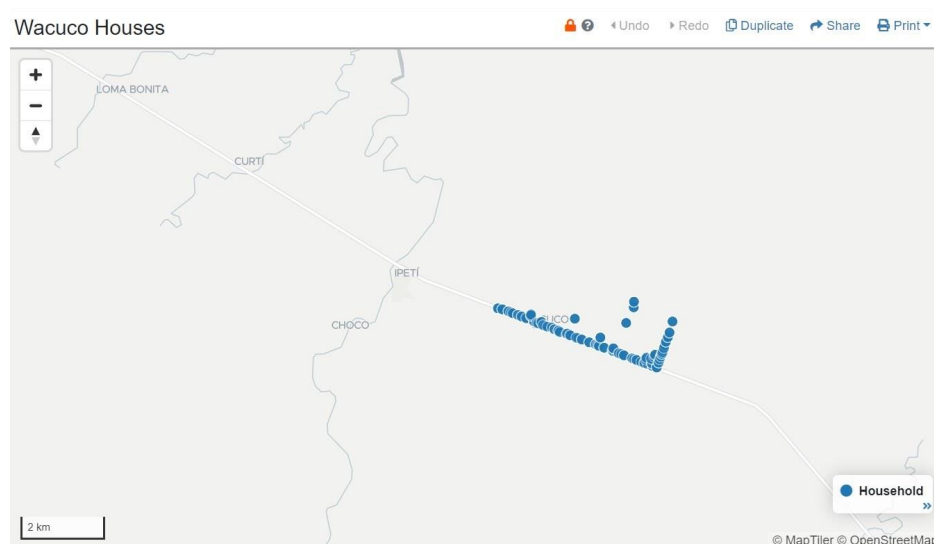
Viable Business/Entrepreneurship



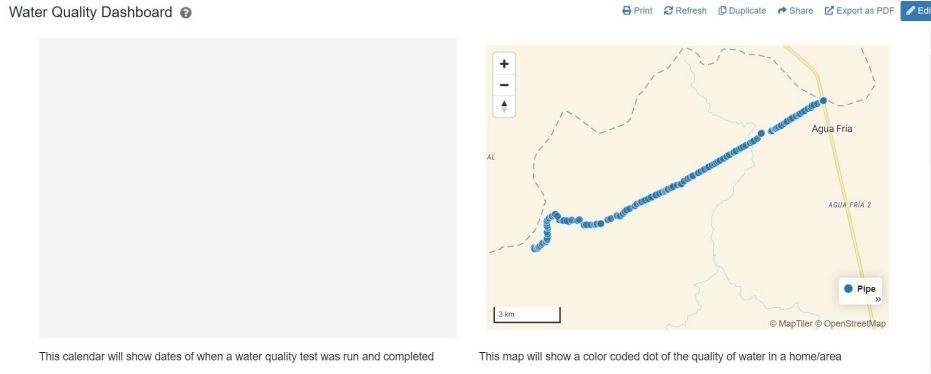
In the Fall of 2020, I began working as part of the Panama Team for the Villanova Engineering Service Learning Program which was centered around water equity. Our work led to the development of a user registry system on mWater and Microsoft Access. mWater is a program that is used by international non-governmental agencies and non-profit organizations to track water use and organize water systems in underdeveloped communities. We selected this program after comparing multiple options from various companies. During Spring 2021, I continued work on this project through a 10-hour-per-week independent study working with our partner, Aqua America. I used mWater to create a user registration system. To create this system, I made various community and maintenance surveys, multiple dashboards to communicate with the community and stakeholders, and maps to visualize the systems. By developing this program through mWater and communicating with Catholic Relief Services, I have learned the value of having a business operating system to store user information and calculate payments automatically. Currently, this community does all tracking and payments by paper, but this is not sustainable because the papers deteriorate. With this new program, the leader of the water system will be able to equitably distribute and require payments by users and track community water usage. This independent study taught me how important it is to track water usage and community payments for a sustainable community-based water system.



6 - mWater is the selected program from the research in this independent study.



7 - Maps were created on mWater with imported GPS data points of home locations for the different communities. Survey responses will be linked to each point for the water meter readers to be able to track water usage between readings. A Microsoft Access program is being developed by AQUA America to link to these surveys to automatically calculate the cost.



8 - Three dashboards were created so that the community members, water committee leaders, and donors can follow the functionality of the system, track water quality test results, and maintenance requests.

9 - Here one can see an example of a survey that will be used to register new users of the water system. This survey collects the users information, water meter number, and the current water meter reading. All the surveys were translated into Spanish to be used by the community members. A tablet was provided to the community to use this system.

Multicultural



During the Spring of 2020, I participated in the Villanova Engineering Service Learning (VESL) program for the first time. I was blessed with the opportunity to travel to a rural community in Panama and work with our local partner to construct a parish community center. On the trip, I learned how to survey and communicate with the local people about their needs for this building. For this project, I created a rendering using SketchUp and a drawing on Autocad. While Covid-19 interrupted traveling for some time, I returned to Panama in the spring of 2022 to launch the mWater program. During this trip, I installed air-release valves to increase the flow of water to the community. In the Spring of 2022, I traveled again to the community to launch the mWater program, install an ultrasonic water meter, and retrieve soil samples at a nearby site in preparation for the construction of a water quality lab and storage facility. I am going into my seventh semester with VESL and I am the undergraduate team leader for the Panama projects.



10 - Installing pipes for the Community Parish Center.

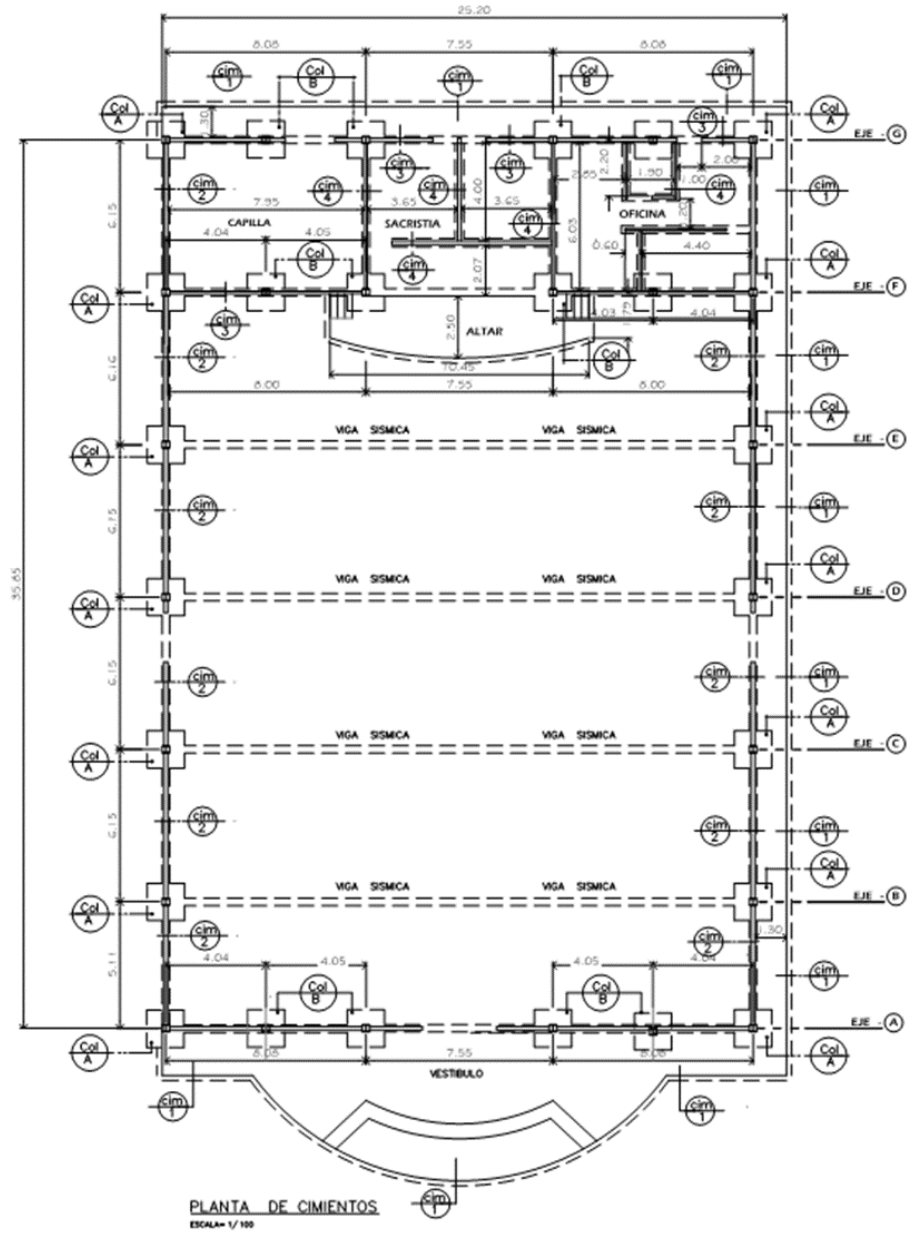


11 - Working on AutoCAD in the field.

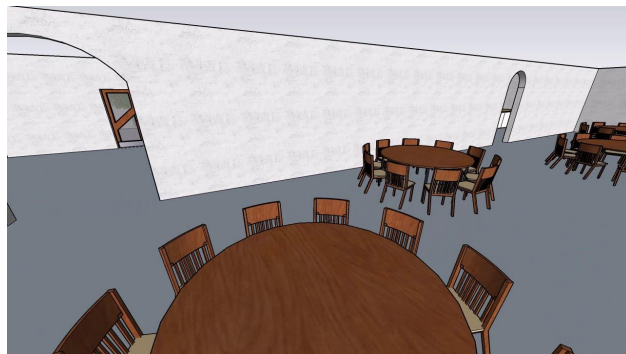




12 - Air release valve installed on the water system.



13 - This is the final overview drawing of the Parish Community Center. The drawing was created on AutoCAD based off of field measurements of the built foundation in the Spring of 2020.



<https://sway.cloud.microsoft/JqlijUrG80jnVQs#content=rUx2eFtIWQJGik>

14 - A video was created from the mockup created on SketchUp from designs made on AutoCAD.



<https://sway.cloud.microsoft/JqlijUrG80jnVQs#content=tEY72LNqTsO2K2>

Social Consciousness





“More than 70% of the population in Eastern and Southern Africa have no access to basic sanitation services,” equaling approximately 340 million people (McMahon & Shaw, 2019). Uganda is one of the leading countries with no access to these services. Communities with poor sanitation are at higher risk of poor health, environmental degradation, malnutrition, reduced productivity, and loss of income. Additionally, with these illnesses, the communities have poor economic growth, as children miss school and parents miss workdays. My senior Capstone project consisted of designing systems to provide access to clean water and practice proper sanitation and hygiene for a rural village in Ibaako, Uganda.

Our capstone group client was Divine Water, a non-profit organization, dedicated to addressing Water, Sanitation, and Hygiene (WASH) issues in Africa. Primarily, Divine Water assists in introducing wells to developing communities, but they have formed a new partnership to assist in developing WASH infrastructure. Divine Water has partnered with Kibo Group: a non-profit organization in Uganda that will be aiding in the implementation, groundwork, and communications in Ibaako related to the Capstone project.

The project in Ibaako involves three main aspects: a pit latrine design with an anaerobic digestion component, a contactless water taps for the community, and Assessment of Impact evaluation. The pit latrine design will ensure the stability of the pit latrines and soil. The anaerobic digestion system will be used to manage latrine waste more effectively. The contactless water tap will provide potable water to the community and ensure proper sanitation. The Assessment of Impact surveys will ensure that the proposed design meets all the needs of the community while evaluating existing infrastructure and education programs. My Capstone group, Caritas Engineering aims to use this infrastructure to create safer latrine options and to greatly reduce illnesses due to the lack of sanitation infrastructure.

Divine Water and Kibo Group requested Caritas Engineering to design the pit latrines and taps for the community. Caritas Engineering consists of five Civil and Environmental engineers from Villanova University with sufficient background in geotechnical, water resources, environmental, and structural engineering to ensure that the village of Ibaako will have adequate latrine and tap designs. Throughout

the Fall 2022 and Spring 2023 semesters, Caritas Engineering distributed surveys, designed, tested, and aided in implementing the latrine and water tap designs.

Caritas Engineering's goal is to provide a sustainable and efficient latrine and water tap for the community to access clean water and practice proper sanitation and hygiene. The specific challenges included prioritizing safety in the latrines through soil stability and keeping a tap design as simple as possible. Additionally, the anaerobic tank connected to the latrines functions with little intervention to prevent contamination while extending the latrines' lifespan. Although the designs are focused on efficiency, keeping each design simple is necessary for the community to accept and utilize the water and sanitation services. Therefore, Caritas Engineering worked directly with the clients to ensure each design's efficiency, sustainability, and usability.

McMahon, G., and R. Shaw. 2019. *A twin-pit ventilated improved pit latrine*. "Sanitation and hygiene." n.d. Accessed December 5,

2022. <https://www.unicef.org/esa/sanitation-and-hygiene>.