

About Siobhan Merrill

Introduction



My name is Siobhan Merrill and I am a Civil Engineering major with a minor in Sustainability Studies at Villanova University, and during my undergraduate career I have sought to pursue the Grand Challenge Scholars Program that builds upon providing others with access to clean water.

As an engineer, I am committed to the goal of providing communities with access to clean water through innovative problem solving. I aspire to work directly with communities in helping them access this basic right and plan to continue educating myself and others on the systems in place that lead to the unequal allocation of resources, such as clean water.. By pursuing a career in international development and water resources, I will be working to attain a more equitable world for all, within the sector of environmental and water equality.

I am from the East End of Long Island, and have grown up surrounded by water- the Long Island Sound and Peconic Bay. While living on the East End I often swam at the beach, went surfing, volunteered with beach cleanups, and combed the beach for beach glass, that my mother and I would later make into jewelry. Through this upbringing I have cultivated a passion for the environment and climate change, as well as community development work. Once at Villanova, I began engaging with the community and also

developed a passion for addressing and solving social and climate justice issues. I have pursued a Grand Challenge Scholars Program (GCSP) with a focus on providing access to clean water to combine my passion for addressing societal inequities, the environment, and community improvement. Pursuing a GCSP has helped to continuously remind me of my goals and aspirations, and has allowed me to reflect on the impact my actions have on the communities I am, and will be, working in. By centering many of my experiences at Villanova around the theme of my challenge, I have learned about the role water plays in people's lives around the world, and have been empowered and inspired to address the inequalities that surround this resource.

I will continue to work in the water resources sector after graduation, and aim to provide various communities nationally, and internationally, with access to clean and healthy water in a sustainable way. This may include implementing water infrastructure such as wells, distribution systems, treatment facilities, and green storm water infrastructure. The communities I aim to work with both nationally and internationally, are those whose voices are underrepresented. Additionally, it is my goal to work in a water resources engineering role for an organization like WSP, Tetra Tech, CRS or USAID whose initiatives on providing communities with access to clean water with entrepreneurship opportunities woven in, have demonstrated the power that sharing knowledge and skills have in creating opportunities for others.



1 - Sunset on the East End of Long Island.



2 - This is a photo of me surfing- one of my favorite hobbies to do at home!

Research/Creativity



3 - Villanova University's Stormwater Wetlands- a green infrastructure site on campus used to decrease the stormwater runoff entering Philadelphia's sewage system.

Throughout my four years of undergraduate education at Villanova I have worked for the Villanova Urban Stormwater Partnership ¹ within the Villanova Center for Resilient Water Systems (VCRWS)² under faculty members Dr. Traver, Dr. Wadzuk, and Dr. Komlos and under the supervision of Amanda Garzio- Hadzick. During my time working in the soil and water testing labs at Villanova I have gained valuable experience working to further advance the evolving field of sustainable stormwater management. In addition, I gained a mentor and various other student connections along the way. Doing research with VUSP during my time at Villanova has connected me to countless individuals all with similar passions to mine, and has opened up countless doors full of opportunities and friendships for me to take advantage of.

From September 2017 to May 2021 I participated in water testing for the VCRWS labs. In the water resources lab I have assisted in water testing (nutrients, metals etc.), lab maintenance, and fieldwork. Water samples are collected following storm events and tested to assess the effectiveness of the green storm water infrastructure at these locations in improving the quality of water coming through them. I have helped graduate students at various field sites to gather data and assist in site maintenance. The water parameters are then evaluated to help assess the impact and effect the green water infrastructure has on storm water.

From September 2018 to May 2021 I participated in soil testing for VCRWS. I am involved with a site on campus, "The Commons"³. The Commons are a student housing development on Lancaster Avenue developed with new storm water infrastructure, including nine rain gardens to handle the site's storm water runoff. As an intern I worked with another undergraduate to gather soil core samples and conduct infiltration tests at these rain garden locations. These samples were then tested and processed for various properties. Testing includes soil classification, organic content, plasticity, and density. The soil

¹<https://www1.villanova.edu/university/engineering/faculty-research/Resilient-Water-Systems/Villanova-Urban-Stormwater-Partnership.html>

²<https://www1.villanova.edu/university/engineering/faculty-research/Resilient-Water-Systems.html>

³<https://www1.villanova.edu/villanova/engineering/research/resilient-water-systems/vusp/research/LancasterAvenue.html>

parameters are also evaluated to help assess the impact and effect the green water infrastructure has on storm water.

During my final semester at Villanova from January 2021 to May 2021 I have begun assisting with on campus research lead by Dr. Bridget Wadzuk. Utilizing an in depth mapping platform ArcGIS, we have worked to digitize the on-campus storm water network. SWMM (Storm Water Management Model) was used to simulate flows to the on campus constructed storm water wetland. The goal of this research is to create a comprehensive overview of where the water enters and exits the network throughout all of campus.

Through interdisciplinary engineering research—environmental, geotechnical, water resources—the Villanova Center for Resilient Water Systems (VCRWS) has created resilient solutions to global water challenges since 2003 and I am proud to say that I have been able to contribute to this throughout my experience at Villanova.

My participation and engagement with VCRWS has given me the ability to observe the soil and water quality and quantity research process from collection to analysis. It has taught me how to work through a process from beginning to end, analyze situations and problem solve, and work towards bettering communities. Through working for VCRWS I have furthered this goal of providing access to clean water to the communities we work in, by helping to improve the water quality of storm water runoff and reducing the quantity of water entering Philadelphia's combined sewer system all while contributing to fairly new the network of green stormwater infrastructure data and analysis.

My work with VCRWS has also helped me explore my interest in the overlap between social issues and technical research. How mitigating flood and standing water in a community, or analyzing the contaminants in their water to provide groups with evidence of water mistreatment, can provide agency to people once hindered by these conditions. Clean water issues aren't just environmental problems, they are public health issues as well, which we as engineers have the power to address.



4 - Myself and another undergraduate at "The Commons" collecting soil cores for testing.

Multidisciplinary Solutions



I decided my freshman year that I would pursue a minor in Sustainability Studies. While my major, Civil Engineering, is focused on creating various infrastructure for society, I wanted to also use my education to learn about how I could build and provide for the world in a way that would do the least amount of harm to the natural world. Sustainability contains a multitude of concepts all which intersect with social, racial and climate inequities. Through this minor I was able to study the intersection of sustainability concepts and solutions to our consumeristic culture with engineering and water resources.

Pursuing this minor has given me the knowledge and tools to assess problems and situations more holistically, evaluating all aspects of the communities and environment that may be affected. Sustainability studies focuses on the interdisciplinary perspective of the concept of sustainability. Instruction in this concept includes sustainable development, geography, environmental policies, ethics, ecology, city and regional planning, economics, natural resources, sociology and anthropology.

Through the class "Justice through Agriculture" I learned the role food and agriculture play in society and the environment and how they are crucially connected to issues of racial, social, economic, environmental, and health justice. The influence of cultural, scientific, and economic perspectives on agricultural practices and food availability and vice versa were evaluated and studied. Sources from multiple disciplinary, cultural and socio-economic perspectives helped us assess what factors hinder or empower food production and access locally, regionally, nationally and internationally. I conducted field work at a local suburban farm that uses a restorative health farm model that provides organic produce to those struggling with food security in Montgomery County.

This course taught me the importance agriculture has in our lives and the. The system of production and access that exists in this country and the world controls our health and wellbeing as individuals, and a society.

Each of the assignments I completed throughout the semester explored a facet of water resources access and quality. I explored the life cycle of a produce in an assignment "Tracking the Life of a Strawberry" and evaluated all impacts that result from the cultivation and distribution of a strawberry. The strawberry industry has greatly impacted water quality in California. A large part of the workforce there consists of migrant workers who lack access to various human rights as a result of their citizenship status. By compromising their water quality and access, already struggling and compromised communities are negatively impacted even further. Exploring the agriculture industry and analyzing the

effect it has on local communities' water resources, specifically when these communities are underrepresented and whose rights are often infringed upon, broadened my systems thinking immensely.

I have also learned and explored the ideas of water quality and quantity access in regards to the following: fast fashion industry, plastic usage, transportation industry, medicine, urbanization and development, migrant refugee camps, public health, agriculture, and food. With each discipline and topic I have studied, I have furthered my understanding of sustainability issues and engaged in multidisciplinary and multifaceted dialogue that has explored the relationship between these concepts and their relation to clean, healthy water and the communities with access to it. These studies have furthered the pursuit of my theme as I have learned about issues various communities face regarding access and quality to water right here in the United States. This has provided me with more background, analytical tools, and knowledge to work to address these problem in my future.



5 - This is an image of Willow Creek Preserve⁴ an organic farm my class and I volunteered at while taking the class "Justice through Agriculture".

Entrepreneurship



During the summer of 2020 I worked with Catholic Relief Services Madagascar as a Water, Sanitation and Hygiene remote intern. Originally I planned to live in Madagascar and work for CRS in person,

⁴<https://www.willowcreekfarmpreserve.org/>

however, due to the COVID-19 pandemic, the internship was moved to be remote. The projects conducted over the summer were very varied and focused on water - collection, treatment, distribution, education, and business. The following describes the various components of the projects I worked on.

1. I developed a WASH (Water, Sanitation and Hygiene) education manual to be used by the Villanova Engineering Service Learning Program as a way to educate students about WASH practices implemented in developing areas. The goal of this project was to educate Villanova students on what WASH is, who engages in this work, why its an important issue to address and how it has helped people globally. The topics of the manual included water testing and distribution, the methods of various infrastructure and sanitary inspections, water and infrastructure standards, project sustainability and more. As I had previously participated in these trips I was able to include information that I wish I had known at the time I went on them and will help adequately prepare students for their international service trips.
2. I also developed a web tool that would help water managers and field operators in Madagascar more consistently and systematically collect data on their systems. I created an ArcGIS dashboard⁵ to be used for water quality and quantity information collection and management- to be implemented by Catholic Relief Services (CRS), Rural Access to New Opportunities in Water, Sanitation, and Hygiene (RANO WASH), and Care Consortium on a system wide level. ArcGIS is a geographic information system for working with maps and geographic information maintained by the Environmental Systems Research Institute and an ArcGIS Dashboard is a data management tool and the one I created can be found here⁶. The dashboard includes points throughout the eastern coast of Madagascar that denote various water infrastructure points (tanks, house connections etc.). The dashboard enables water project managers to collect water infrastructure data for specific locations using the map and its respective surveying tools. The purpose of this is to provide public and private water operators with a holistic and functional tool to assess their infrastructure and those being served. Creating this dashboard allowed me to display the potential for CRS to adopt a new data management tool while curating my technical skills.
3. I performed a water quality assessment of a water storage tank with high iron content. As this internship was virtual, my assessment relied on videos and photos to gain an understanding of the basic water treatment techniques used by CRS. While difficult, the challenge of assessing this treatment system required me to problem solve and think critically about what was creating the problem. Suggestions for improvements within the system were presented to CRS.
4. I developed a Drone Manual⁷ to aid in the use of watershed and water quantity management. A step by step tutorial/guide was developed so individuals working with the UAV (unmanned aerial vehicle) may utilize it within future projects in both CRS Madagascar and V ESL. This project may help CRS by providing immediate real time topographic information and may be used when analyzing flood planning, agriculture planning, watershed surveillance and remote monitoring as well as provide additional teaching materials. The drone will be used for watershed surveillance, watershed delineation, teaching, post-disaster assessment, security.

⁵<https://villanova.maps.arcgis.com/apps/opsdashboard/index.html#/67e4b0b8927146bfb0dbe3d3600595ca>

⁶<https://villanova.maps.arcgis.com/apps/opsdashboard/index.html#/67e4b0b8927146bfb0dbe3d3600595ca>

⁷https://drive.google.com/file/d/1S8gVw_zjGhszz52-l2NhzM2vWi1uxDz6/view?usp=sharing

The focus of these projects was to support local partners and students in providing access to clean water to community members. My internship with CRS was an incredible experience and has impacted me immensely. I learned how to create project goals for myself and self motivate to finish tasks that I had outlined. I also learned how to listen and work with clients/partners to meet their needs, while also suggesting and providing realistic outcomes and results. What I loved most about this internship was that I was able to create tangible solutions to water issues facing people globally.



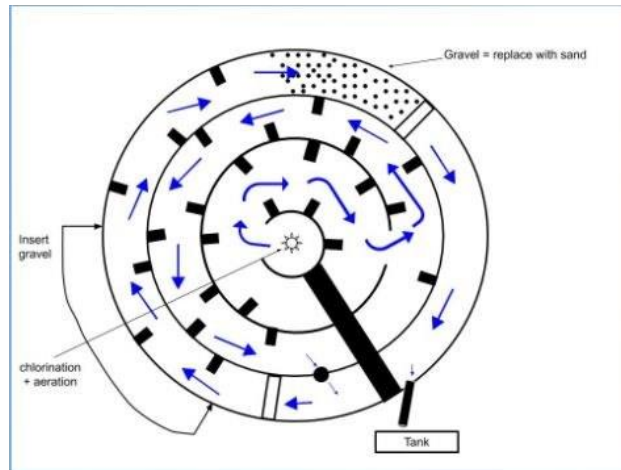
6 - Screenshot of the ArcGIS Dashboard created for CRS. The tab shown here offers water operators and CRS staff the ability to report water quality at various points within the distribution system.



7 - Screenshot of the ArcGIS Dashboard created for CRS. This tab shown here offers water operators and CRS staff the ability to report water meter reading and maintenance updates throughout the water distribution system.



8 - Photo of the water tank the treatment review was completed for.



9 - Schematic of water tank that the treatment review was completed for.

Global/Multicultural Experience



NUI Galway
OÉ Gaillimh

College of Engineering and
Informatics

Semester abroad in Galway, Ireland- Fall 2020.

Class: Environmental Engineering⁸

Class Description: Characterization and measurement of water parameters, regulations, septic tank design and on-line resources used in the planning applications, 'passive' wastewater treatment using constructed wetlands and sand filters and issues of public acceptance; wastewater and water treatment at municipal-scale, including growth and food utilization kinetics, attached and suspended culture system.

The class "Environmental Engineering" has helped me learn how to physically build and create solutions for providing access to clean water for communities. I learned how to treat wastewater and improve the quality of drinking water given different parameters which has equipped me with the skills and knowledge to solve these problems in the future. The teaching style was different in Ireland. Unlike Villanova, the only grades we received were based on a midterm and final exam, with no homework, projects, or assignments. This difference in teaching style required me to create a personal schedule to keep up with the material and self assess myself on a regular basis. Dr. Mark Healy taught our class, which consisted of Irish and American students. He did a wonderful job of making the Villanova students feel included in the class and made sure to explain aspects of wastewater engineering that referred to Irish concepts so that the Americans in the classroom understood the material.

I come from a very Irish family, my name itself, Siobhan, is Gaelic and means "God is gracious". I chose to study abroad in Galway, Ireland to be closer to my Irish heritage and to be somewhere with a rich

⁸<http://www.nuigalway.ie/course-information/module/CE3105>

culture and near the water. Ireland is full of kind, friendly people, beautiful mountains and water bodies, fun cities, and great music. It was amazing to be somewhere where my family could have once been and to explore a country on my own and meet new people.

My experience studying in Ireland also taught me how to adapt to a different culture. I lived in the city of Galway, Ireland, for five months with another Villanova student and an Irish student. Living in the city and with an Irish student was an incredible experience. I often discussed politics and current events with my roommate, enjoyed traditional "trad" Irish music in the local pubs, and went on runs by the coasts and farms of the surrounding area. To get involved with the local community and also take advantage of living in a coastal area, I joined the National University of Ireland, Galway (NUIG) Surf Club. Joining the surf club brought me to new places in Ireland and also helped me meet people who love the water and the environment. Through this experience I met people majoring in zoology, passionate about saving wildlife, and environmental science, passionate about climate justice, and ended up competing in a surf competition by the end of the semester! Joining the surf club while I was living in Ireland and getting to know the Irish students involved in Surf Club showed me that people are passionate about the earth everywhere, and that I am not alone in the fight for climate justice and climate equity.



10 - This picture of Dingle Harbor was taken during a surf trip that I participated in.



11 - The River Corrib running through the center of Galway, Ireland. I would pass this river everyday on the walk to school!



12 - A classic snapshot of the beautiful streets of Galway.



13 - These iconic houses located near the Spanish Arch overlook the intersection of the River Corrib and Atlantic Ocean. My friends and I would often go for walks and have picnics here.

Social Consciousness

Under the Villanova Center for Humanitarian Engineering and International Development⁹ through the Villanova Engineering Service Learning (VESL)¹⁰ program I have completed over 25 hours of service in the countries of Nicaragua, India, and Tanzania.

During a 1 week service learning trip to Nicaragua my fellow Villanovans and I with a local engineering partner surveyed 7 km of terrain for the construction of a gravity fed water system that would provide clean water to a community lacking access. The community's current water supply consisted of a series of above ground pipes that the community had placed by hand from the source to a central location in the community. With no treatment or distribution system, water access to the community was lacking and quality was poor. Two years after our visit with the continued partnership of the University and the organization and engineering companies utilized, the gravity fed distribution began to provide community members with clean water to various locations and households in the area. While in Nicaragua, our team also engaged in the construction of the source intake for Centro de Niños school for children.

During a 2 week service learning trip to India I engaged in a STEM day for children, agricultural review, the implementation of rooftop rainwater harvesting, and site evaluations for small-scale biogas reactors. The STEM education day for young community members consisted of a series of experiments, two of which contributed to Mark Orebiyi's masters thesis. Using a sandcastle experiment and a relay race with water, students' general knowledge of the water cycle and soil properties were tested in fun and engaging ways. The Villanova team conducted an agricultural assessment of the community that observed organic gardens, local tribe practices, allocation of water resources and irrigation services, and the functioning of the local environment and farming yields that resulted from an increase in flooding severity and intensity due to climate change. This increase in flooding intensity but decrease in duration of the rainy season resulted in an increase in drought period. The agricultural assessment sought to provide the partner with potential solutions and suggestions on how to alleviate this stress on the local farms and farmers.

In Tanzania, the Villanovan team partnered with CRS and assessed potential locations for pilot biogas programs, as well as traveled to various latrine locations where members of the CRS entrepreneurs program were finishing up building the latrines. While there, we assessed the existing latrines in the community, evaluated the potential locations for biogas pilot sites, and learned about the CRS mission and steps they take to meet it. Lastly, we presented what we learned to members at the CRS national headquarters on information learned and acquired throughout the trip.

The experience that I have had with VESL and working on water resources in an international context has provided me with valuable engineering experiences where I have learned how to sustainably provide communities with access to clean water that while enacting and supporting local practices and cultural considerations. I have learned to work with a diverse set of team members, have adapted to cultures and situations, and have come to see the extreme need for clean water that exists in various

⁹<https://www1.villanova.edu/university/engineering/faculty-research/humanitarian-engineering-international-development.html>

¹⁰<https://www1.villanova.edu/university/engineering/villanova-engineering-experience/service-learning.html>

parts of the world. These experiences have provided me with confidence and problem solving skills that I will need to address this problem.



14 - India: Photo of the STEM day students conducting the sandcastle experiment.



15 - India: Image of 2 students conducting the sandcastle experiment.



16 - India: Photo of local irrigation practices.



17 - India: Photo of irrigation practices used by a local tribe. They implement a series of trench distribution systems.



18 - India: This is a photo of myself and the woman who hosted me while I was working in the town, Prashantagiri. Her name is Rosa, but she had me call her Amma, which means mother in Malayalam, the local Indian dialect.



19 - India: Image of a storage tank we helped install that will collect water from the rooftop of the users house.



20 - Tanzania: Image of latrines we visited at a Tanzanian school.



21 - Tanzania: Photo of the Villanovan and CRS teams in Tanzania at the local CRS headquarters.



22 - Tanzania: Members of the Villanova team with local entrepreneurs hired by CRS to construct latrines for a local school.



23 - Tanzania: Photo of myself assessing a site being considered for the implementation of a biogas reactor.



24 - Nicaragua: Photo of myself while helping to build the water intake tank.



25 - Nicaragua: Photo of the Villanovan team with construction workers helping to build the water intake tank and distribution system.