Alliance for Aquatic Resource Monitoring's Annual Publication

Stream of Consciousness

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Alliance for Aquatic Resource Monitoring

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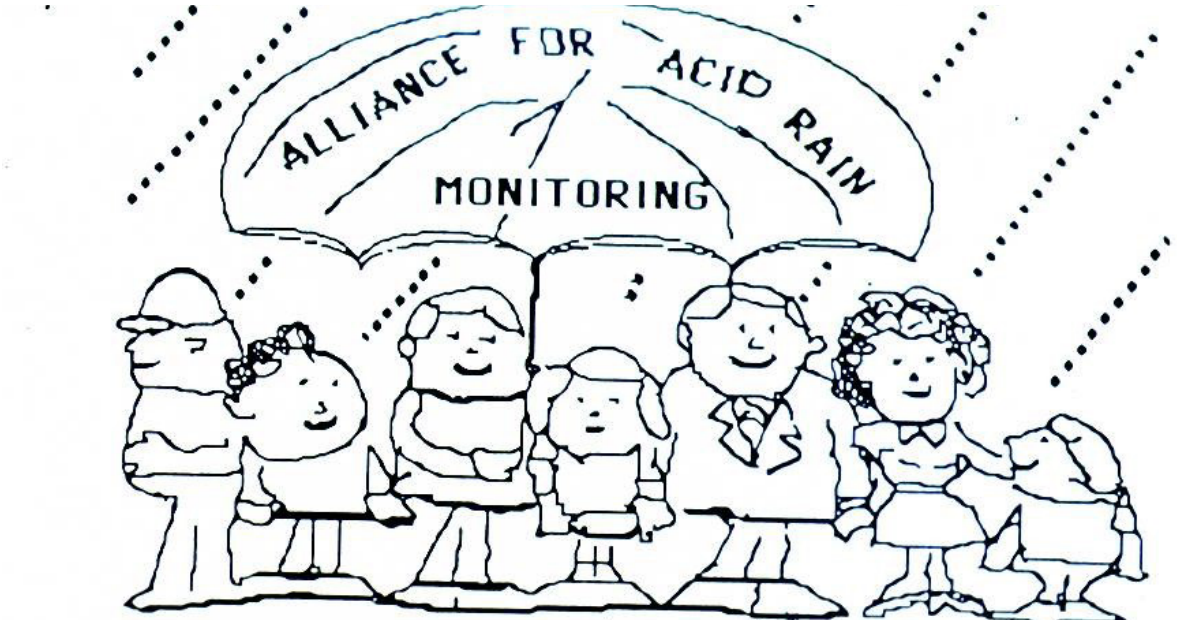


Original logo from 1986

More to a Logo than Meets the Eye

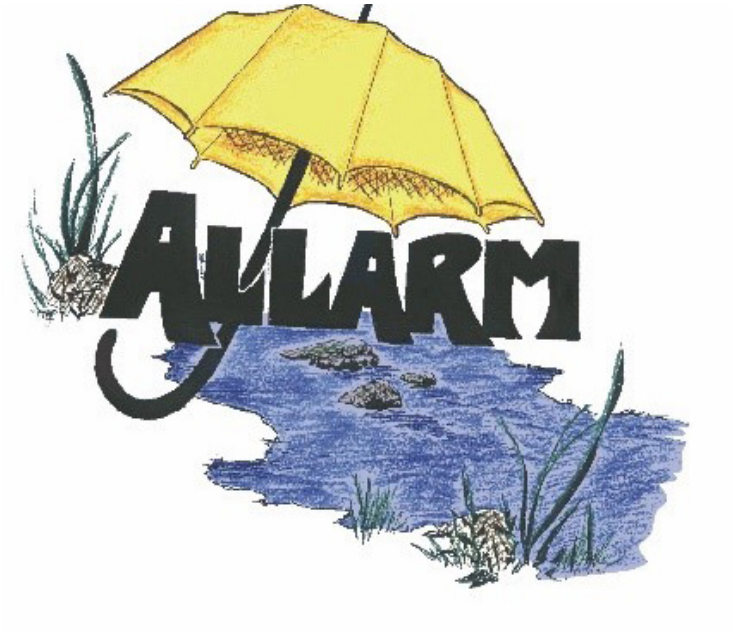
By: Phoebe Galione '21

No matter how many times my interests have flipped around, one thing that has remained constant is my love for both science and art, and my hope that I will be able to integrate both of my passions into whatever my future brings. This semester at ALLARM, I had the opportunity to create a logo for ALLARM's new Susquehanna Stream Team, with the name of the program and ALLARM's mission as the prompt idea. Although I have had the opportunity to make a logo design before, I had never been given this much creative freedom and was excited to see how much I could push myself.

The process started with research. A lot of research. Although my three semesters at ALLARM have painted a basic image in my mind about what I could draw, I wanted to properly represent Stream Team, the Susquehanna River, and its tributaries where volunteers monitor. I looked at other organizations' logos, did research on local flora and fauna, and viewed aerial images of the region for iconic Susquehanna shapes and structures. In the end I narrowed the process down to a few general ideas that tied everything together: the winding of the river with islands in between, the iconic bridges that span the Susquehanna, local fauna, and a desire to somehow bring in the human element and spirit of ALLARM which is so important to who we are.

I started sketching, and coloring, and restarting - trying to find a balance between having a design too complicated to be printed in multiple forms and being too plain. Fortunately, working with digital media on an art tablet allowed for easy rearranging and recoloring as many times as I desired without having to waste countless pieces of paper resketching. After a few weeks of varied success and a wide range of budding designs, an integral point in this process was being able to present multiple drafts to the ALLARM team at one of our Monday staff meetings to gain their opinion on what the most fitting logo would be. A process that seemed so individual now relied on team collaboration to move forward. In the end, we picked a design that began as a for-fun extra sticker design featuring a trout and a sampling pole. Unwittingly I had found a way to connect the human element to the environmental element without losing the spirit of ALLARM. Once this design was picked, then came the fine tuning: things were placed on the logo to keep it from looking cluttered, the colors were picked to work well with the happy spirit of the design and word placement were all considerations that needed to be taken into account. At the end of the semester, I was able to boast a new design as a culmination of the research and work I had done week to week.

ALLARM has a long logo history as well



Logo from 1996-2010

Logo from 2011-2017

Current ALLARM logo

Stream Team logo designed by Phoebe Galione '21

that has developed and changed as the central mission has evolved over the past 33 years. Starting out as the Alliance for Acid Rain Monitoring in 1986, ALLARM's first logo consisted of individuals standing below an umbrella, safe from the rain. Drawn entirely in black and white, this logo emphasized the strong ties to individuals and volunteers – tying in with the original motto, "public education through participation."

In 1996, a new logo was created, moving past black and white and giving the umbrella the bright yellow color, we still have today. This logo, unlike the prior, had a less obvious human presence with more emphasis on water as seen by the stream flowing through the bottom of the design. 1996 was when ALLARM experienced a major shift, changing from the Alliance for Acid Rain Monitoring to the Alliance for Aquatic Resource Monitoring and began working with watershed associations to protect and restore

PA streams.

The next logo design was made in 2011 to celebrate ALLARM's 25th anniversary. This is the first logo to implement the use of digital design and melded together aspects of the prior two logos. While still keeping the yellow umbrella and the stream, the 2011 logo brought back the human aspect through the two figures at the bottom. The entire organization name as well as the establishment date were added.

The most recent ALLARM logo was created in 2017 as an update to the 2011 design. Aside from a bit of adjusting of the logo visual itself such as making the umbrella the second "L" and shifting the figures around, the most significant change is the use of linework. Linework is what is used in many cases to contain color, almost like a coloring book, in a particular shape. The 2011 logo had all design elements surrounded by black lines, however this was transitioned away in 2017 to a lineless style, making a more fluid design while incorporating solely blues, greens and yellows.

I am proud to say that I was able to contribute to the ALLARM logo history, making a design for Stream Team volunteers. Although ALLARM's name, mission and logo have changed, ALLARM continues to work with volunteers in order to make positive change for communities and environmental health all while still carrying our yellow umbrella.

Meredith Jones '20 instructs York Stream Team members on how to properly clean lab equipment.

Teamwork has a Place in Stream Quality Monitoring

By: Meredith Jones '20

In the three years that I have spent working at the Alliance for Aquatic Resource Monitoring, I have participated in a dozen or so workshops and experiences collaborating with community members and groups with the goal of providing them with the resources they need to address their watershed concerns. Two of these occasions, however, stand out as being a slight departure from the typical relationship between ALLARM and its community partners. The first occurred in the fall of 2018 in York County, Pennsylvania and was the pilot training workshop for ALLARM's then brand new monitoring program called Susquehanna Stream Team. The reason why this event felt like a new iteration of ALLARM's water quality monitoring work was because it was. Years' worth of conversations with key partners to inform a study design coupled with lessons learned from past monitoring programs culminated in the formation of Stream Team. This program was created to engage community members in their watersheds to collect baseline stream data in Susquehanna River tributaries.

York County Stream Team learning how to monitor stream health with macroinvertebrates.

Specifically, Stream Team is an opportunity for community members to monitor their local waterways using a standard protocol. I connected with this mission and was honored to be involved in the rollout of the new program and to train the first set of Stream Team volunteers. Almost exactly one year later, in November of 2019, I had the opportunity to return to York to train a second group of enthusiastic volunteers from the county on stream monitoring protocols. This dual experience solidified my interest in the format and function of the Stream Team program as it had attracted such a strong group of volunteers from a single county in a short time frame. Stream Team, now a year and a half old, has flourished and grown to be an engine of data collection fueled by passionate volunteers throughout the Susquehanna River watershed. There have been workshops in Cumberland County, York County, and Columbia County since its formation and a strong community of volunteers and monitoring sites has been cultivated. At the end of 2019, Stream Team's pilot year, the program had established forty-seven monitoring sites throughout the three counties, with over one hundred active volunteers.

The goal of Stream Team is to accumulate data of known quality in tributaries of the Susquehanna River. These data are, at least initially, collected in order to establish a baseline understanding of stream health. Baseline data are useful as they identify "typical" conditions in the stream; so, if something changes or a pollution event occurs, it can be easily detected. As such, the parameters for Stream Team volunteers are centered around achieving an overall understanding rather than a targeted conclusion. All Stream Team volunteers are trained to collect data on their stream's temperature, pH, conductivity, and nitrate levels. ALLARM collaborated with County Conservation District watershed specialists, the Lower and Middle Susquehanna Riverkeepers, the Chesapeake Monitoring Cooperative (CMC), and Penn State Extension's Master Watershed Stewards coordinators to develop the monitoring protocol. Volunteers uses kits and meters that are in compliance with our federally approved quality assurance plan, while still being user friendly and accessible. This means that our Stream Team volunteers are able to enter a workshop with no knowledge of any of the aforementioned parameters or their use in terms of stream health and leave with a full understanding of what they are doing and why it is important.

Of course, many of the volunteers involved in this program already have a working knowledge of watershed ecology prior to joining a Stream Team. This is because the Penn State Extension Master Watershed Stewards program has been an effective educational resource in many Susquehanna counties, and many of its graduates have gone on to join ALLARM's Stream Team. This trend demonstrates the importance of providing opportunities for volunteer monitoring and citizen science in any community as there is a consistent interest in environmental stewardship and participation in one's natural spaces. Programs like Stream Team provide an avenue for direct involvement in local watersheds without requiring a pollution crisis or targeted stream health campaign. As its name indicates, Stream Team is built upon a foundation of collaboration. This includes ALLARM's partners in the program such as the Middle and Lower Susquehanna Riverkeepers as

well as the Campbell Foundation who help to support and aid volunteers with direct site assistance as well as equipment access.

Additionally, ALLARM has made it a priority to directly engage volunteers on a regular basis. This helps to foster rapport and close relationships with volunteer monitors as they continue to engage with their local streams and tributaries through data collection and interpretation workshops. In this relationship there exists a mutual sense of dependability which strengthens the overall program as ALLARM can rely on our volunteers to collect valuable, high quality data and they can reach out to us with ease whenever challenges arise.

One aspect of the development of Stream Team which helped to facilitate the close relationship between ALLARM and Stream Team volunteer monitors was the slow rollout of the program, which took the nuances of each involved county into consideration. This has promoted a high level of direct communication with individual volunteers through email, phone calls, and in person meetings. A product of this continuous communication is the clarity of understanding of ALLARM's monitoring protocols, as demonstrated by the fact that every Stream Team group has passed ALLARM's Quality Control standards so far. This means that the chemical data being collected are of known quality and can be applied to any future goals that the community desires to pursue. The next steps for Stream Team will be expanding the understanding of these chemical data through further data interpretation workshops as well as including biological methods of data collection, such as macroinvertebrate monitoring, which has already taken place in the first York County group and is upcoming in Cumberland County. The important part of the data story related to Stream Team is that the communities have passion and pride for their data and are invested in ensuring its quality is of a high standard. With these goals in mind, their data have many possible uses, such as signaling a need for more precise monitoring methods or implementation of restoration features like riparian buffers.

Collecting data in a team rather than individually also builds a sense of community and dependability amongst Stream Team members. This is because the team members rely on one another to monitor each month and navigate chemical monitoring techniques together. Generally, the monitoring teams consist of between two and three people, and the group aspect of the monitoring process has been reported to make it far more enjoyable and engaging. In this way, teamwork is what makes the program effective. ALLARM is also using our past experiential knowledge with regards to prioritizing volunteer retention and appreciation. This may manifest in future events such as a volunteer appreciation picnic to acknowledge the time and effort put forth by our volunteers on a consistent basis, as well as to recognize that ALLARM is just as much a part of the Stream Teams as the individual community members are. Macroinvertebrate monitoring workshops are also an important part of reinforcing this relationship as they can revive the energy of the group and connect the volunteers with the stream in a more interactive way during the workshop session. During these workshops, volunteers are able to experience the process of getting into the stream, rolling up their sleeves, and collecting and sorting macroinvertebrates, or water bugs. The expansion of Stream Team so far has been fun and collaborative and there are several other counties that ALLARM is looking to include in the program throughout the Susquehanna River basin. Though I am finishing up my final semester at ALLARM, I am honored to have been involved in the very first Stream Team workshop and to have witnessed the program's incredible development in real time. This program has demonstrated to me that the power behind data collection truly lies with the community. After all, stream work makes the dream work!

Macroinvertebrates as an Education Tool

By: Abby Kaija '20

Macroinvertebrate monitoring has a role in ALLARM's goal to educate and engage volunteer monitors about their local waterways. At the close of 2018, Alliance for Aquatic Resource Monitoring (ALLARM) rolled out a new program called Stream Team. The purpose of Stream Team is to engage volunteer teams to collect scientific data of known quality that can inform local approaches to achieving improved watershed health. The chemical parameters tested are water temperature, pH, nitrate-nitrogen, and conductivity. ALLARM also equips volunteers with the tools and skills to collect and identify benthic macroinvertebrates.

Watershed Coordinators Abby Kaija (left) and Matt Zaremba (right) instructing volunteers on macroinvertebrate collection and surveying methods.

Benthic (meaning bottom-dwelling) macroinvertebrates are small aquatic animals with no backbone that are visible without a microscope. Many macroinvertebrates are the aquatic larval stages of insects, however, crustacean and worms are also included. They are found in freshwater streams during a portion of their lives and common macroinvertebrates can range from mayflies, stoneflies, caddisflies, beetles, dragonflies, crayfish, to snails. A majority of macroinvertebrates attach to the streambeds via rocks, vegetation, sticks, or sand/sediment. Macroinvertebrates collect and shred leaves as well as scrape algae off rocks. These aquatic animals are a vital link in the food web between producers like leaves/algae and high consumers like trout. Macroinvertebrates are used as reliable biological indicators of stream health because they respond to stream disturbances and stressors. A valuable characteristic of macroinvertebrates is that each organism has a different level of pollution tolerance. Some macroinvertebrates are sensitive to pollution whereas others are tolerant. Therefore, the health of the stream can be quantified based on the diversity and number of macroinvertebrate species. Chemical water testing acts as a snapshot of stream health at the moment of sample collection. Pairing chemical monitoring with biological tests like the examination of macroinvertebrate populations allows for a more well-rounded understanding of a stream system. Macroinvertebrates respond to stressors and are good indicators of stream health because of how long they live in the stream system. Long-term biological conditions are important to continually assess. These organisms live the entirety of their lives in the riparian and stream system, meaning their presence in different quantities can indicate water quality changes as well as allow for an analysis of a greater density and depth of data. It is important to note, chemical and physical conditions influence the biology of a stream. When benthic macroinvertebrates thrive, algae and fish populations tend to thrive as well. ALLARM is empowering volunteers to use macroinvertebrate identification as a tool to measure the stream. This is valuable to community members and all who live in the watershed. As a watershed coordinator at ALLARM, my goal for the year was to learn more about macroinvertebrates and communicate how important they are as bioindicators of stream health. Curating a collection of

macroinvertebrates cast in resin was a perfect opportunity to complete a meaningful project that would benefit ALLARM. I was able to apply my knowledge of macroinvertebrate identification from the past summer I spent working at Stroud Water Research Center. Also, Macroinvertebrates.org, an in-depth explorable resource for stream insect identification, launched in the summer of 2019 and serves as a valuable learning tool. Matt Zaremba, a senior watershed coordinator, helped collect specimens and supplies for casting macroinvertebrates in resin. We went to two different sites for collecting macroinvertebrates. Choosing a good site to collect macroinvertebrates was a challenge. We had to consider the time of year, the depth of the stream, and the streams morphology. The first site was the Yellow Breeches where we were able to collect a diverse set ranging from snails to caddisflies to stoneflies. The second site we traveled to was Mountain Creek where we found plenty of mayflies, crayfish, scuds, and aquatic worms. We preserved the macroinvertebrates in isopropyl alcohol (rubbing alcohol) and returned to the ALLARM. The next step was to attempt with the process of casting. We carefully aligned the legs, tails, and other important features allowing them to dry for two hours. Then we mixed the casting resin with a catalyst and poured the first of three layers into a silicon mold. After the first layer set for one hour, we poured the second layer, and each specimen was gently placed in the resin. Finally, we poured the third layer to ensure that macroinvertebrate would be suspended in the center of the resin cube. With each round of casting macroinvertebrates, the specimens had fewer bubbles and were better oriented. The central challenge we encountered was how to buff the resin so that the surface was clean and clear. These preserved bugs were kept in the hopes of using them as an educational tool at workshops. In October 2019, ALLARM hosted the first Stream Team Macroinvertebrate workshop with volunteers from York County to culminate their first entire year as a Stream Team! Fifteen Stream Team volunteers attended the workshop. During the workshop, I presented on key traits for identifying macroinvertebrates in ALLARM's protocol. I learned that teaching requires a confident understanding of the information. The macroinvertebrates cast in resin were a valuable tool for volunteers to see preserve specimens from Pennsylvania streams. Illustrations and two-dimensional photographs are limited in their ability to show all characteristics of each unique organism. The volunteers looked at each sample under the microscope or in good lighting

A crayfish caught while sampling for macroinvertebrates at York County Stream Team Macroinvertebrate Workshop waves hello!

After collecting the macroinvertebrates, volunteers are seen here picking them off the net and sorting them by their similarities.

and saw the three-dimensional characteristics. It was rewarding to see volunteers interacting with the macroinvertebrates in resin and distinguish the difference between a mayfly and stonefly. The tool sparked conversations about which macroinvertebrates are pollution sensitive as well as questions about what they might find at the sites they regularly monitor. The York Country Stream Team Macroinvertebrate workshop allowed volunteers to hit the ground running and collect data to understand the health of their streams. Spending a semester using macroinvertebrates as an education tool was incredible. I learned about macroinvertebrates, teaching and the power of science to engage people who care about healthy streams.

Watershed Coordinator Abby Kaija '21 guides York County Stream Team volunteers on how to identify and sort aquatic macroinvertebrates as a water quality monitoring technique.

Meet Our New Assistant Director, Suzanne Hartley

By: Isabel Ruff '21

In January 2020, Suzanne Hartley became ALLARM's new assistant director. In this role, she manages the lab and oversees quality assurance and quality control practices, which ensures the validity and accuracy of samples collected and work done. Quality assurance is the plan for maintaining a high standard of quality in all aspects of the monitoring program (Herron et. al., 2004). Quality control includes procedures that are put in place to ensure accuracy of the work (Herron et. al., 2004). Suzanne helps conduct quality control lab testing for volunteer partners and teaches students how to do the same.

After receiving a bachelor's degree in Biology from Millersville University, Suzanne worked in Alaska as a research technician on the University of Alaska Fairbank's Susitna-Watana Hydroelectric Project. She researched stream productivity by looking at aquatic insects to see how the potential addition of the Susitna-Watana Hydroelectric Dam would impact the juvenile salmon population in that river. Suzanne then earned her master's degree at North Carolina State University studying house sparrows, which are invasive and compete with native

Suzanne Hartley practicing nitrate-nitrogen testing with our lab team (Left to right: Matt Zaremba, Isabel Ruff, Hiba Aoid, Suzanne Hartley)

bluebirds for nesting cavities. She worked with Sparrow Swap, which is a citizen science project that finds different management strategies to reduce the impacts of house sparrows through management strategies such as switching house sparrow eggs with fake eggs to reduce populations; and, looks into using the eggs as an indicator of environmental contaminants. Suzanne's research with Sparrow Swap helped spark her interest in community science.

After earning her degree and knowing that she wanted to return to the field of aquatics, she found ALLARM; which, according to her, has "perfectly combined [her] interest in data science with community science and aquatics". She is excited to work with aquatic insects again for the upcoming Macroinvertebrate Training Workshop. Suzanne is looking forward to interacting with community members and meeting with ALLARM's broad group of partners. She is interested in supporting both community members and students by helping teach quality control and data interpretation as well as "get[ting] people pumped to explore streams".

Outside of ALLARM, Suzanne likes to cook, garden, and take care of her many house plants. She is watching the early spring flowers start to grow and is currently planning her garden for the summer. We are looking forward to growing with her and are excited to have her on the team.

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Understanding Volunteer Engagement, Management, and Recruitment

By: Angelo Tarzona '21

During my five semesters at ALLARM, I have participated in the Stormwater Education Program, conducted spatial analysis through Geographic Information System (GIS), helped with community workshops, participated in LeTort Spring Run monitoring and analysis, and conducted research on volunteer engagement, policy, and retention. My time at ALLARM has been fulfilling, to say the least!

I had the opportunity to work full time at ALLARM during the summer of 2019, which gave me a glimpse behind scenes of what it is like to effectively collaborate with volunteers. I immediately delved into my main research project: best practices that other non-profit community science organizations to engage, recruit, and celebrate volunteers. I first gathered information from Dickinson's Library System and outside sources such as: guidebooks, blogposts, and webpages regarding best practices for volunteer engagement, management/policy, and recruitment. As ALLARM engages volunteers for the Stream Team Program, I have worked on gathering sources that can better inform our approaches.

The following is a compilation of some guidelines from my research. I found that the central theme of this research is how volunteers engage with an organization because they may feel aligned or misaligned with the mission of the group. There are three categories that I used to establish the guidelines I found throughout my research: Engagement, Management, and Recruitment.

Watershed Coordinator Shante Toledo '21 instructs Stream Team volunteers on how to use a syringe to measure the volume of water needed for chemical testing.

Volunteer Engagement

When organizations are planning to engage with volunteers, an efficient way of approach is to assess the type of volunteers they are looking for. This assessment will help the group conceptualize how they should plan for volunteers to be involved in their mission. This defines how a group wants to engage with their volunteers, it is also encouraged to keep an open mind when interacting with volunteers. This is an ongoing process to know them and what they are trying to get out from volunteering. Some of the best practice tips that I found when engaging with new volunteers and volunteers that are already a part of the group are:

- Introducing or reminding volunteers about the vision of the organization and align projects that are in the interest of the volunteer (The Conservation Volunteers, 2011).
- For organizations, be aware that the volunteer's motivation varies per person, an efficient way to handle this is to simply ask what they are interested in doing for the organization. In addition, having a list of activities or duties prepared for the volunteer could be a helpful way to let them decide which area of the program they want to be involved in (Rehnborg et al., 2009).

Volunteer Policies & Agreements

The purpose of having a volunteer policy along with a volunteer agreement is to create a safe and inclusive space in the organization for all volunteers. Although volunteers might have a lot of paperwork to complete during a program orientation it is important to have clear guidelines to inform expectations. From the organization, this document could also serve to share their mission, what the volunteers can expect from the program, and present conduct guidelines for volunteers as well as the members of the organizations. Some helpful ideas when organizations are thinking about developing a volunteer management/policy are:

- Before writing the document, make sure the organization is supporting this motive. It is easier to write this type of document when the stakeholders, staff, and other members of the organization are onboard with this idea (Ellis, 2005).
- Ensure the rights and responsibilities of the volunteers whenever they are with the organization. At this part of planning, it is recommended to have volunteers present with the organization members to voice their opinions on what is appropriate for the document (Ellis, 2005).
- Encourage volunteers to comment on the volunteer rights and policies if they have questions or concerns, an efficient way to sign these documents is sending them online paperwork and letting them fill it out before the orientation. If the online documents are limited to the volunteer, have them come early to sign documents before the orientation. Discussing the volunteer management/policy during their orientation could be an effective way for them to interact with the document (Green et al, 2016).

Volunteer Recruitment

With the rise of technology in the past decade or so, connecting with different people throughout different networks is much easier. This can benefit the organization's volunteer recruitment agenda. Although sometimes volunteer recruitment could be tricky, there are ways to be efficient and tailor to the type of volunteers that the organization is looking for. Note that throughout this process, it is always encouraged to keep an open mind whenever recruiting volunteers.

- Create a volunteer description sheet and post it on the organization's website, hand it out in public, or post it on an announcement board for the community to help spread the word about the volunteer program of the organization (Hager et al., 2004).
- Think about the networks that the organization are familiar with, can those networks post the organization's recruitment opportunity for their volunteer and members? (Hager et al., 2004)
- Encourage the current volunteers of the organization to let their friends, family, and other people in their circle know about a volunteer opportunity from the organization that they are a part of (Hager et al., 2004).

The tips and guidelines that I found throughout my research could change as we find ways to interact with volunteers. As a watershed coordinator for ALLARM, I find that engaging with volunteers about what they are passionate about could help them interact more with the organization. Creating a safe environment for volunteers and the organization members to voice their opinions during meetings and events. Finally, encouraging them to spread the word about a volunteer opportunity could increase volunteer participation.

Watershed Coodinator Angelo Tarzona '21 guides Stream Team members through their introductory chemical monitoring packet.

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The Value of the Chesapeake Data Explorer for Local Monitoring Groups

By: Katherine Altamirano '20

The Chesapeake Data Explorer was developed by the Chesapeake Monitoring Cooperative (CMC) as a tool to centrally house water quality data collected in the Chesapeake Bay watershed. The development of the Data Explorer underscores the importance of nontraditional or non-agency monitoring data collected by 600+ entities throughout the Bay watershed. While the larger mission of the Data Explorer strives to coalesce data to help inform water quality of the whole watershed, the more accessible benefit of this tool has been its usability for local monitoring groups. The Data Explorer offers groups a place to store and share their data. ALLARM is one of the partners associated with the Chesapeake Monitoring Cooperative (CMC). CMC is a network of organizations which provide support to groups collecting volunteer-based water quality and macroinvertebrate monitoring data across the Chesapeake Bay watershed. CMC is comprised of ALLARM, Alliance for Chesapeake Bay, Izaak Walton League, and University of Maryland Center for Environmental Science. The value of this tool is in its accessibility and growing data records. For a number of watershed organizations and other data producers, the development of an online database has not been feasible. The Data Explorer creates the opportunity for data producers to move their data from data sheets and excel files online, enabling data to be used beyond its original purpose. One of the more useful aspect of this tool is the ability to query data to render a file of only the type of data you are trying to access. By creating queries of monitoring data, users can download generated data files filled with the specified parameters requested. This option allows users to search by parameter, geographical and political boundaries, data type, groups, and stations. Users can search for data at any scale to download and use in their analysis. This gives users a more accessible experience with the data explorer because they can answer their larger water quality questions with more ease. The CMC also provides water monitoring resources such as field data sheets, monitoring protocols, and data interpretation manuals on their website. These manuals are available to anyone visiting the CMC website and contribute to consistent and uniform data being entered in the data explorer. These resources also include a highly in-depth data interpretation manual which includes fundamental statistics and data visualization tools. The website also includes manuals as well as videos to make the Data Explorer more accessible to volunteer monitors. The Data Explorer has been a game changer for ALLARM, its community partners, and volunteers. For example, ALLARM has collected data on the LeTort Spring Run for 25-years for the LeTort Regional Authority. It was the first dataset that ALLARM integrated into the Data Explorer and for the first-time people outside of the watershed can view and interpret the data. Additionally, ALLARM has worked with partners like Antietam Watershed Association and the Ridge and Valley Streamkeepers – they have collected high-quality data for decades and for the first time, members of the Bay community and public can view their data and draw their own conclusions about the health of the watershed. Finally, as ALLARM developed Susquehanna Stream Team, having an online location for monitors to upload their monthly data is incredible. At the 6-month point in monitoring, Stream Team volunteers are trained to use the Data Explorer. The creation of the Chesapeake Data Explorer was intended to integrate water quality data collected in the Chesapeake Bay watershed into one database. While this tool is helpful in assessing the health of the watershed on a larger scale, it has provided significant value to community organizations to share their water quality findings at a regional level.

Stories of Dickinson College Stormwater BMP's

By: Karan Shakya '20

Outside of Kaufman Hall, where the ALLARM offices reside, there has been recent construction on West Louther Street that had many students, faculty, staff members, and residents asking: what is it? and why is it being built? The answer to these questions can be intricate and has great implications on how stormwater runoff is managed at Dickinson College.

Let's start with the basics then – what is stormwater? In more natural settings or pervious surfaces, such as those of a forest or an open field, rain and snowfall infiltrates into the ground and percolates into deeper groundwater or nearby lakes and streams. However, in an impervious surface, such as those of an urban space or a constructed area, rain and snowfall cannot infiltrate the ground and accumulates in the surface – this accumulated surface

Link to the Story Map:

https://storymaps.arcgis.com/stories/b0c84964ed4b445e99329229a56dac70

Top: Finished sidewalk view of stormwater curb garden; Bottom Left: In-progress photos of the best-management practice being installed on West Louther Street; Bottom Right: Storm drain located within the stormwater curb garden installed on West Louther Street

water is called stormwater, which washes over the land untreated. While stormwater eventually makes its way to nearby water bodies through drainage or surface runoff, it often picks up pollutants such as fertilizers, pesticides, road salts, heavy metal residues, pet wastes, and septic substances on the way that degrades the quality of water bodies (Greenville County Soil & Water Conservation District).

In Carlisle, stormwater is discharged untreated into the LeTort Spring Run – a stream that flows into the Conodoguinet Creek. Stormwater, in Pennsylvania and several other states, is identified as a major cause of non-point pollution for water bodies which has prompted the Carlisle Borough to take steps to address this (EPA, 2018). Through the 'Municipal Separate Storm Sewer System (MS4)' Carlisle has worked to educate about and manage stormwater runoff. The MS4 provides a framework that helps the Borough comply with its commitments to reduce stormwater pollution. The borough has also implemented a Stormwater Fee which acts as a fee to residents depending on their impervious surface area (Hoopes, 2018). This fee also helps fund additional creations of Best Management Practices or BMP's. BMP's are steps that can be implemented to reduce or filter the amount of stormwater pollutants being discharged into the water bodies.

Dickinson College, in its efforts to reduce the total amount of stormwater runoff from its buildings and parking lots, has built several BMP's throughout campus. The new construction near West Louther Street is a BMP – more specifically it is a bio-retention basin. Bio-retention basins are landscape depressions or shallow basins that are constructed to filter and mitigate stormwater runoff. The soil layer above this basin helps filter out large pollutants and the geotextile fabric underneath helps further filter and store stormwater runoff. These basins have drainpipes underneath which helps quickly clear our stormwater runoff which helps prevent flooding in the surface.

In addition to the bio-retention basin, Dickinson College also has other types of BMP's that mitigate the outflow of stormwater. There are several rain gardens around campus. These rain gardens are shallow depressions or inclined surfaces which are filled with water-tolerant plants which filter and temporarily store stormwater. Dickinson has constructed an underground detention basin near the Kline Center where stormwater is stored in underground plastic containers wrapped in geotextiles. Near the Kline Center, there are also vegetated planters which are indents in street curbs that soak the rain stormwater which, otherwise, would have flooded the streets. Another ingenious BMP in the campus is the permeable pavements. These pavements are specifically made with pervious asphalt which enables any stormwater to filterz into the ground from pavements and parking lots. Finally, Dickinson College has several rain barrels which are containers which store stormwater. Rain gardens are among the easiest BMP's to implement and the water stored in these containers can be used for a variety of purposes (Chesapeake Stormwater Network).

In order to highlight and advertise all the different BMP's around Dickinson College, I had the opportunity to create an ArcGIS Story Map. Story Maps are a remarkable communication tool that allows information to be presented in a visual and interactive way. All of Dickinson's BMP's are highlighted in the Story Map with pictures and information on how they were constructed, and can be accessed online via the link at the bottom of this article. In addition to information on Dickinson College, the Story Map also has a link to Penn State Extension's YouTube playlist called 'Stormwater Basics'. This playlist contains comprehensive information on stormwater management, how BMP's work, and why understanding stormwater runoff is an important topic to a community.

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MS4 and Stormwater

By: Olivia Spildooren '21

Anyone who lives in Carlisle has probably had to navigate the streets after a heavy rain either by foot or by car and encountered raging rivers on the side of the road or deep puddles getting close to being small lakes that always happen to be right where the crosswalks are located. Living in Carlisle means you are very aware of stormwater as it can be a source of frustration and inconvenience. In addition, any Carlisle resident will know something about the beautiful LeTort Stream that runs through the town's highly frequented public park and along the often trod LeTort Trail by cyclists, runners and dog walkers alike.

Stormwater is rain or snow that can runoff over impervious surfaces such as roads, sidewalks, driveways, parking lots or areas with lots of paved ground (CBF, 2019). This precipitation goes into storm drains and directly to the LeTort without treatment. Stormwater can pick up many pollutants on its way to the LeTort such as car oil, fertilizer or pet waste (Penn Future, 2017). This can affect the health of the stream as well as the people who interact with it. Not only could the aesthetic beauty of the clear LeTort water be marred by stormwater pollution it can also introduce illness causing bacteria to the waterways. Pet-waste especially can contain harmful bacteria that can accumulate in bodies of water and cause human or even pet sickness from interactions (CBF, 2019).

There are many established plans in place for stormwater management going on in Carlisle to improve traveling conditions during storms as well as to protect the health of the beloved LeTort stream. There are even many examples of stormwater management projects on Dickinson Campus. The initiative for these comes from the MS4 permit that the Borough of Carlisle has to maintain. MS4 stands for Municipal Separate Storm Sewer System. This means that Carlisle's sewer system has two separate pipes: one for sewage that flows to the water treatment facility and one for stormwater that flows directly to the LeTort untreated (Penn Future, 2017). Because of this, the MS4 permit requires Carlisle to create a Stormwater Management Plan that will reduce the amount of harmful pollutants discharged into the LeTort which connects to bigger water bodies like the Susquehanna River and Chesapeake Bay (NACLA, 2018). This plan must include Best Management Practices (BMPs) that focus on six Minimum Control Measures (MCM) including:

This new stormwater catchment basin will reduce the amount of flooding on West Louther Street and filter out litter or pollutants before water flows to the LeTort.

Rain barrels outside against buildings funnel stormwater from the roof and collect it to be used to water plants around Kaufman Hall at Dickinson College's campus.

1. **Public education and outreach on stormwater impacts**
2. **Public involvement/participation**
3. **Illicit discharge detection and elimination**
4. **Construction site stormwater runoff control**
5. **Post-construction stormwater management in New and Re-Development Activities**
6. **Pollution prevention/Good Housekeeping for Municipal Operations (NRC, 2008)**

ALLARM assists mainly MCM numbers 1,2 and 6 on the MCM list. We are most well-known for public education and outreach events like water monitoring training, adopt a storm drain and educational materials to teach you how to prevent or reduce personal pollution that flows to the LeTort. In addition, there was a new BMP constructed this Fall on West Louther street in front of the Kaufman academic building. These rainwater catchment basins were installed with on either side of West Louther Street in front of Kaufman. Their construction was monitored so that it considered construction site stormwater runoff control. These basins funnel stormwater into them to reduce street flooding as well as have special soil which can filter out litter or pollutants that may be washed along to the LeTort. In addition, when the basins were dug out of the ground the crew replaced the old six-inch diameter pipe that drained to the LeTort with a 19-inch pipe to accommodate higher volume stormwater flows (personal correspondence).

Many other stormwater development projects have been constructed around campus over the years. These include: pervious pavement, rain gardens, rain barrels as well as curb cutouts located around various campus buildings such as Kaufman, the Quarry or the Klein Fitness Center. A story map, created by our own ALLARM watershed coordinator Karan Shakya, with photos of these projects and their functions (see p. 14). These projects have greatly improved the stormwater flows to be less drastic around campus. However, these projects have not been implemented as widely around the town of Carlisle. While these projects are effective, they also can be costly, take time to construct and there may not be full-time staff dedicated to projects. This is one of the reasons for the new implementation of a stormwater fee. Stormwater fees have been implemented across the country and have even shown up in other Pennsylvanian cities like Lancaster and Philadelphia (PEC, 2017). Stormwater effects everyone and so this fee is meant to equitably source funding for stormwater management projects like the ones on Dickinson's campus (Valderrama and Hammer, 2018). This fee is different than a tax because it is applied to buildings usually exempt from taxes such as churches, government buildings as well as large parking lots since they contribute a lot of impervious surface. In the past, stormwater management projects were funded by property taxes, grants and loans (Penn Future, 2017). This fee will provide a long-term and stable source of revenue to support the projects. In addition, it will make long-term projects easier because of stable funding and will allow full-time staff to be dedicated to stormwater (Carlisle Borough, 2017).

Stormwater management is a lot more complex than just what meets the eye as it flows down the street. Policy is in place to regulate water quality standards for the beloved LeTort and subsequently the mighty Susquehanna and Chesapeake Bay. However, this is not a problem that will be solved completely by policy. Doing one's own part in reducing the amount of pollutants you send to a storm drain like cleaning up oil spills from your car or bagging your pet's waste as well as contributing to the collective stormwater fee are big steps in improving the health of the LeTort and the possibility of getting to future floodless streets.

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Volunteer Monitors Set the Stage for Understanding Road Salt Impacts

By: Rachel Krewson '20

It is one of the best feelings to watch beautiful white snowflakes fall from the sky, maybe even catch some in your mouth. But once they land, snow and ice create some of the most dangerous travel conditions. In today's fast-paced U.S. society, treacherous commutes are not typically an excuse to slow down the work schedule. Our trusty tool for improving winter road conditions is road salt, but what impact is this having on our surroundings?

The amount of road salt used in the U.S. has doubled since 1975 (Kelly "Road Salt: The Problem"). So where does all this salt end up? When applied, some salt crystals bounce off of the sides of roads and are not effective in melting snow or ice. Additionally, salt can run off into local streams and lakes, or even penetrate the ground and pollute soil and groundwater. Once dissolved into these systems, it can persist and amass for decades since there are no natural processes that break down chlorides (Kelly "Road Salt: The Problem"; Shaw, Marjerison, Bouldin, Parlange & Walter 2012; NH Department of Environmental Services).

When this happens, it causes significant changes to aquatic environments. "Rising salt concentrations could pose a hazard to freshwater organisms that cannot survive brackish conditions" (Kelly "Fewer fishtails"). A toxicity study in 2010 found that weight loss and decreased survival of water fleas and fathead minnows occurred at chloride concentration levels of 1050 mg/L and 1810 mg/L respectively. These toxic levels were recorded in more than half of urban sampling sites in Milwaukee during the winter (Corsi, Graczyk, Geis, Booth & Richards 2010). The majority of these samples from 2007 also fell above the acute water-quality criteria concentration of 860 mg/L, and all but one of the samples were above the 230 mg/L chronic water-quality criteria concentration set by the EPA (Corsi et al. 2010). Not only does salt change the chemistry of aquatic ecosystems, but it also alters the biogeochemistry of wetland sediments enough for fungal and bacterial mats to thrive and to significantly decrease pH (Kim & Koretsky 2012). Any significant change to an environment—such as a change in pH where each unit represents a ten-fold change in hydrogen ion concentration—can drastically alter the biological community that can survive in the ecosystem.

Not only are road salts a threat to aquatic organisms; but, it could also harm human health. Across the northeastern US, road salt has infiltrated groundwater as well as surface water, impacting drinking water supplies. For those with illnesses like hypertension—otherwise known as high blood pressure—this can cause a major health hazard when they are restricted to low-sodium diets (EPA). Several water supply wells have been abandoned

Impacts of Road Salts on Landscape and Other Commodities

Source: Milwaukee Riverkeeper

in New Hampshire due to chloride contamination (NH Department of Environmental Services). Since dissolved salt can also cause corrosion of water use infrastructure, it is also impeding society's reliance upon infrastructural systems (EPA). Additionally, once the salt is dissolved in water, there is no easy solution to remove it (Kelly "Fewer fishtails", EPA).

Volunteer monitoring is a great tool for gaining a deeper understanding of the true quantity of road salts that are impacting local waterways. A group of volunteer monitors in Wisconsin began a specific road salt monitoring program after a suggestion from a USGS researcher in Fall of 2010. Water Action Volunteers Stream Monitoring Program staff worked with USGS to develop and expand the program after it began in Madison and Milwaukee in February 2011 (Water Action Volunteers). Through the Milwaukee Riverkeeper, this monitoring effort is still very active today. They measure conductivity and send a water sample to the Wisconsin State Lab of Hygiene to analyze chloride concentrations within two days of weather events that cause the use of road salt (Milkwaukee Riverkeeper "Become a Road Salt Monitor"). The volunteer monitoring program, similarly to Corsi et al. 2010, has discovered many impaired streams with many stream samples measuring above both acute and chronic EPA chloride standards (Milwaukee Riverkeeper "Road Salt in Our Rivers"). Volunteers have also learned that field conductivity measurements provide a proportionate measure of chloride in monitored streams and can simplify their process and cost by using conductivity as a proxy for chloride levels.

What can be done with all this information? In order to reduce the impact of road salts on our environment, it is critical to cut back on road salt use. One way to increase efficiency is to apply brine, a salt water solution, to spray down roads before a snowstorm is expected because it stays on the road better than salt crystals. Successful brine application reduces 45% of the salt that bounces off roadways (Kelly "Fewer fishtails"). Additionally, the temperature of the road should be considered before applying road salt since it is only effective when road temperatures are warmer than 15°F (Cassidy "Road salt versus salt brines").

Although road salts are necessary to the current U.S. lifestyle, excess use is harmful to aquatic environments, human health, and infrastructure lifetime. Volunteer monitoring programs—such as the Water Action Volunteers Stream Monitoring Program—can be highly effective to gather preliminary data across wide regions on the impacts of road salt. It is possible to still cut back on road salt use, through smart and timely application, and still make roads safe for daily commutes.

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Submerged Aquatic Vegetation (SAV)

By: Matt Zaremba '20

Figure 1. Elodea submerged in a stream (Source: Beziat, M. (2018))

If you peer into the water of Letort Spring Run, and many other limestone streams throughout central Pennsylvania, beneath the surface you may see a various shade of green moving below the surface. These underwater plants, known as Submerged aquatic vegetation (SAV) , are rooted, vascular plants which grow underwater, with occasionally with short periods of air exposure. SAV's can be found throughout marine, estuarine, and riverine environments and are commonly found in dense or sparse beds with one or multiple species living together. These aquatic plants are rooted in the streambed they, often do not reach the surface. However, since they still require a lot of light in order to grow, they cannot thrive in deep waters where light does not penetrate Blue Water Media, Inc., 2011). ALLARM monitors SAV's on Letort Spring Run, because they are a useful indicator of the health of a stream's ecosystem, and are an indicator to what other organisms might be found in an aquatic community.

SAV's provide a great number of ecosystem benefits, such as creating shelter for fish and shellfish to evade predators. They are also a source of food for many waterfowl, fish, aquatic invertebrates, and mammals. In marine environments, SAVs can help protect shorelines by dissipating energy from waves, preventing erosion and stabilizing sediment at the bottom. They also contribute to recreation and to the economic value of ecosystems by creating habitats for fishing, crabbing, and birding, as well as providing calmer areas for studying wildlife (Blue Water Media, Inc., 2011).

While most SAV are beneficial, some SAV are invasive and can be problematic in waterways. Invasive and non-native species both originally come from other places around the globe and have been introduced to new environments, but unlike non-native species, invasives compete with native species. This competition deprives local populations of SAV's from resources such as soil nutrients and even light if the invasives can grow above or within beds of native species. This can cause problems such as the decline of the species, or at worst the loss native species where the invasives are present. There are many invasive species of submerged aquatic vegetation in Pennsylvania, a lot of which can be seen in our local waterways. Pennsylvania's Field Guide to Aquatic Invasive Species by Sea Grant Pennsylvania is a great resource for identification of invasive species in your own backyard and can be found online for free (Sea Grant Pennsylvania, 2015).

One common and beneficial SAV is Elodea, which is native to the temperate regions in the Americas. Elodea provides habitats for many small fish, macroinvertebrates, and amphibians as well as providing a food source for muskrats and waterfowl. However, it can become dominant due to its high-volume reproduction through fragmentation, the ability to grow from small fragments broken from the main plant. Overabundance of Elodea can be a sign of high nutrient conecntrations such as nitrogen and phosphorus. While Due to its prevalent use as an aquarium plant and in water gardens for the cover it provides, Elodea has become an invasive plant around the world and is difficult to remove because of its hardiness (Rizzo, Boser, & Swistock, 2009). Hydrilla is a common weed SAV that looks similar to Elodea. Like Elodea, Hydrilla reproduces mainly vegetatively, and because it has also been used extensively in aquariums it has become a widespread invasive. Its presence makes the surface of water bodies difficult to use recreationally, and it blocks light from other vegetation. It can be distinguished from Elodea from the number of leaves per whorl – usually more than three radiate from a single point on the stem, whereas Elodea always has three, and Hydrilla can grow in much larger beds (Sea Grant Pennsylvania, 2015) Because SAV's can look similar to each other it sometime can be difficult to identify them without getting into the stream and grabbing a sample or taking a look under the microscope. Next time you are at a stream, take peak to see if there is a garden of SAV's hidden just below the surface.

It is important for ALLARM to understand local SAV communities because they can be used as water quality indicators and help track the health of a stream. Since some species of plants can tolerate pollution better than others, SAV communities can give a picture of a water body's level of pollution and can help to track how these changes over time. In our monthly LeTort monitoring trips, we survey SAV's at each site.

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Sending Off Our Community Science Specialist

By: Isabel Ruff '21

Figure 1. Community Science Specialist Helen Schlimm (far left) with student Watershed Coordinators before a Stream Team Workshop (Fall 2019)

After working at ALLARM as a student for two years, Helen Schlimm became ALLARM's first community science specialist in the summer of 2017. Her role is to support monitors in the Chesapeake Bay Region, with both the Chesapeake Monitoring Cooperative (CMC) and Stream Team. Helen has accomplished much over the past three years and we will be sad to see her leave in June.

Helen coordinates ALLARM's role within the CMC, which is a group of organizations that provides technical, pragmatic, and outreach support and integrates volunteer-based water quality and macroinvertebrate monitoring data into the Chesapeake Bay Program (CBP) partnership (Chesapeake Monitoring Cooperative, 2019). The CMC gathers and shares data collected by groups that fall within the Chesapeake Bay watershed to provide the CBP with accurate information so they can make more informed decisions about how to best go about Bay restoration (Chesapeake Monitoring Cooperative, 2019). Helen supports volunteers in this area by participating on the weekly calls with members and overseeing the data integration process into the Chesapeake Data Explorer.

Helen was integral in the development of the Chesapeake Data Explorer, which is a database that allows for accessibility of data collected by the volunteer monitoring groups in this program. She began with the database creation and development, but now that it has been established, her main role is to format data into the system and teach volunteers how to upload their data as well. The Chesapeake Data Explorer includes water quality and benthic macroinvertebrate data from volunteers throughout the Chesapeake Bay watershed that can be downloaded and used (Chesapeake Monitoring Cooperative, 2020). Additionally, advancements made by the CMC have allowed for greater accessibility of the resources, so the current priority is increasing outreach so that these resources can be utilized.

Helen also supports volunteers for ALLARM's

Figure 2. Members of CMC touring ALLARM's lab with Helen Schlimm (Summer 2019)

Figure 3. Helen instructing first-year students about chemical water quality monitoring techniques (Fall 2019).

new Susquehanna Stream Team program. Local groups for each county can monitor their streams to collect baseline data that can be used for decision making on both the community and regional levels, as well as contributing to the Chesapeake Data Explorer. Helen's role is to support volunteers within this program by being the first line of communication, creating the newsletter, and overseeing the planning and meetings for each county group. The work done by these local communities is important when creating a detailed picture of the Chesapeake Bay Watershed.

Helen is excited to see the continued population of the Chesapeake Data Explorer with new data, and she enjoys the trainings and workshops because she has the opportunity meet new volunteers and see familiar volunteers again. Utilizing citizen science and community science have been a highlight of her time with ALLARM, and she hopes they continue to be a component of her career in the future. According to Helen, "[it's important to] include all people in the fold of science and work for those common goods and protect the environment, but also keep people's best interests in mind" and find that balance. She is proud of all she has learned and accomplished in her time at ALLARM and she would like to carry these experiences forward.

Helen has much to be proud of from her time here and her presence will be missed. I have enjoyed getting to know her this year because we initially met two years ago when I was a first-year student taking Integrative Environmental Science, which is one of the introduction courses for the Environmental science major. During one of the labs, staff from ALLARM came to lead us in an exercise where we learned about some of the geology of the area, but particularly how it affected the streams and the organisms within them. Helen led a group of four students, including me, through sampling techniques in one of our local creeks, and while I cannot remember what we discovered, I have very positive memories from that day. It has been a lovely experience getting to work with her.

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The Importance of Attending the Chesapeake Watershed Forum as an Undergraduate Student

By: Hiba Aoid '21

The ALLARM family was able to attend the Alliance for the Chesapeake Bay's 14th Annual Chesapeake Watershed Forum which took place this year in Shepherdstown, West Virginia, on November 15 – 17, 2019. With 2019 marking the 3rd year in a row both ALLARM's full staff and student watershed coordinators attended the meeting.

The Bay Forum, is a meeting of over 400 restoration and protection practitioners coming together with the goal of inspiring local action towards clean waterways. The forum was organized in different sessions throughout the day ranging in categories from organizational development, science and restoration, justice, equity, diversity & inclusion, communication and outreach, innovative collaborations, environmental education, and workforce development. With such a diverse array of topics there was a session for every interest at the Bay Foruconferencem.

This year's theme focused on how diverse and innovative collaboration can lead to better outcomes. This circulates around the idea that through new and diverse partnerships, we can achieve bigger, more innovative goals which we are unable to attain on our own. Such a central idea is important in exposing undergraduate students to the importance of collaborative work, networking, and reaching out to different parties to help push oneself further in one's personal and career goals. This conference was an excellent space for different organizations, groups, and students with the common goal of a healthy Chesapeake Bay Watershed, to connect, share ideas and experiences, and find collaborators.

A few of the many great opportunities the Forum provided for students to network and mingle with others in the scientific community was during mealtimes. During breakfast for example, tables were labelled with different topics, so attendees could pick a table and strike up a conversation with someone new around a common interest. There was also a myriad of different social events, from settling for s'mores around a campfire to attending poster sessions where the latest research and projects were presented. Through socializing, this forum was a rich and diverse space where students could find prospective mentors, future employers, and partners.

As a first-time student attendee, my first day started with an early morning spiritual walk facilitated by four leaders from different faith traditions. A diverse interfaith experience which enabled me to practice healthy ways that benefit both mental health and inspire forging a deeper commitment towards preserving and caring for nature. Right after, I attended a young professionals networking session. This session created a safe space for young professionals of color and allies to network, share their stories, and learn from each other the tools to rise and surpass our own challenges in professional fields. My next session, similarly, focused on understanding bias and building your impact in the workplace. This session provided a different perspective on how to approach bias and evaluate our own biased tendencies and how to develop tools and strategies to disrupt these biases.

During my time at the Chesapeake watershed forum, not only did I learn a lot and was provided with different tools for my professional toolbox; but, I was also able to meet different people ranging from undergraduate students such as myself, to early career professionals, to other people at various stages in their career. All of these people knew something I did not and provided me with new insight on the work being done to protect and restore the Chesapeake Bay Watershed. Overall, I enjoyed myself, not only forging new connections and finding new resources, but also bonding with my fellow watershed coordinators from ALLARM. I appreciated getting to know them better in a different setting outside of work.

One of the many bulletin boards present at the forum to foster community and connection

Grace Messimer '23 (far right) training Stream Team volunteers how to wash their used lab equipment.

The Role of Volunteers to Help Our Nation's Waters

By: Grace Messimer '23

The Alliance for Aquatic Resource Monitoring's volunteer monitoring program provides volunteers with opportunities to learn about their local waterways, water quality, and how to use scientific knowledge to implement watershed assessments. Volunteers help their communities through focusing on water quality concerns that affect everyone. ALLARM is one of about 1700 water monitoring programs in the country, and without volunteer monitors, we would be unable to track water quality to the scale that we are able to. Volunteers collect samples from local streams and rivers, and then test samples for diverse parameter such as pH, conductivity, and nitrate-nitrogen levels to assess the health of the waterway. Volunteer monitors play a significant role assessing the health of waterways across the nation. It is a privilege to work with volunteers, who are passionate about helping their local watersheds.

To ensure that volunteer data is scientifically credible, volunteers send in duplicate samples periodically to ALLARM for quality control (QC) where we test the sample using volunteer and lab equipment. Through this process, the ALLARM lab team can validate that volunteers are using their equipment correctly.

Testing waterways is essential to make sure that they are healthy for community and species that rely on them. With recent deregulations concerning environmental laws, including the Clean Water Act, thousands of waterways have compromise protection. Despite these rollbacks

on water policy, volunteers can test water in their local community to track changes in their water quality over time. This is vital, as this water could be used as drinking water for the community and wildlife that are dependent on the freshwater resources. Since these waterways might not be tested often, having volunteers collect samples on a monthly basis helps to identify any water quality concerns which can be found and reported. Additionally, volunteer monitoring data collection is efficient and provides long-term monitoring of an area, as there is little to no widespread and long-term water quality monitoring by professionals (Addy, Green, Herron, and Stepenuck).

Volunteer monitors are vital to monitoring local watersheds for water quality, and the quality control done by organizations such as ALLARM ensures that the data is accurate and can be widely used. Volunteer monitors have the opportunity to learn and use their knowledge of water quality to help their local community in various ways, and the nationwide use of volunteer monitoring is vitally important right now.

Stream Team members learning to measure out samples for water quality testing.

Works Cited

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Senior Reflections from the Class of 2020

Rachel Krewson '20 helps volunteers test their samples for nutrients.

Katherine Altamirano '20 acid washes our lab equipment.

Matthew Zaremba '20 working with volunteers to identify macroinvertebrates.

Karan Shakya '20 (center) speaks to students at Craighead House about the importance of monitoring streams.

Meredith Jones '20 facilitating a pH test for volunteers at an in-office event.

Rachel Krewson

It's strange to look back on the last three years at ALLARM, in part because I can't picture those years without ALLARM. I began to work for this organization as a shy sophomore. Starting in the laboratory, I learned what it meant to have standard procedures and to perform quality assurance and quality control for water sampling. I loved getting into a nitrate or orthophosphate groove during chemical analysis to start my day. During staff meetings, I was immediately welcomed into the ALLARM community – a space full of warm, passionate hearts and open minds. The meetings brought context into everything I was doing in the lab. I was thrilled to be making a difference through the community workshops and help fellow PA citizens investigate the health of their local environments. As I became more comfortable, my confidence in my skills grew and I felt more connected to these people and ALLARM's mission than ever. Before I knew it, I developed as a leader and as an environmental professional. This organization has been a huge part of who I have grown to be: a female scientist, an engaged community member, a leader and a learner. I hope to bring all that ALLARM has given me to the next stages of my life, where I will enter the Environmental Consulting field. Thank you to the ALLARM staff for making the office feel like home and for creating a family I will cherish forever.

Karan Shakya

My ALLARM journey began in the Fall semester of my junior year when I was hired as a part-time Watershed Coordinator. My responsibilities revolved around GIS where I made maps for workshops and identified Site-IDs for monitoring volunteers. This was a time when I was looking for opportunities where I could apply what I had learned from my courses into a practical setting. ALLARM, through its projects and community events, provided me with just that platform to reflect on my skills of data presentation and communication to deliver outputs.

Then after I studied abroad during the Spring semester in Norwich, UK, I re-joined ALLARM for my Senior year. This time I was hired as a fulltime Watershed Coordinator which allowed me to commit more of my time on other ALLARM projects. I continued to work with GIS, where I looked into how the geology and land use of a community impacted stream health. I also built StoryMaps, an online data visualization tool that allowed me to use pictures and maps to highlight the different BMP's around Dickinson. I expanded my time preparing for community events such as Stream Team, Macroinvertebrate workshops, and the Stormwater Steering Committee. Through these community events, I got the chance to interact with several community partners, volunteers, and stakeholders who were all working to ensure that the relationship between community and environment remained strong. I got to train volunteers on water monitoring, guide participants on submitting their water quality data, and teach interested people on how to identify different species of micro-invertebrates.

Now, as I move beyond my steps at Dickinson, I can only look back at my time in ALLARM with fond memories. Working in ALLARM has been an extremely strong experience for me and one that I intend to utilize later. Ideas of community knowledge sharing, community science, and citizen empowerment are crucial ideas that relate to my interest. I am keen on taking these important themes and tools into the field of development and agriculture economics – which is the next step I will be taking graduate school.

Katherine Altamirano

I decided to join ALLARM after my first year at Dickinson when an advisor recommended exploring the organization. From my first semester at ALLARM, I felt like I was giving a purpose to the education I was receiving in my courses at Dickinson. It has been such a privilege to have had the opportunity to apply my practical environmental science education in a meaningful way while connecting with communities across Pennsylvania. During my time with ALLARM I have attended community events, trained several volunteer monitoring groups on water quality monitoring practices, and have built my professional capacity while working within an incredibly supportive team. I have also created maps and GIS tools for ALLARM during these three years which have been used to support community members in several stages of their monitoring process. I am so proud that these materials will live on in support of ALLARM's mission. My favorite memories with ALLARM are the days I have spent with my fellow watershed coordinators on road trips and community events. It has been so special to support my peers and help to grow the amazing community which ALLARM fosters. I will always regard ALLARM as being one of the best decisions I have made during my time at Dickinson to supplement my education and support my growth as a person.

Matthew Zaremba

I first found out about ALLARM my first semester at Dickinson when I found an ALLARM sticker laying in the grass outside my dorm. I thought about how cool the name was – it sounded very official and important. Little did I know how impactful joining ALLARM would be for my time at Dickinson. The time I have spent as part of the ALLARM family has been full of opportunities and challenges that have helped me grow my own capacity and expand my horizons as to what is possible in a career in the field of science. I am so fortunate to have been able to go on every LeTort monitoring trip since I joined ALLARM, enabling unforgettable experiences with coworkers that have helped me build my confidence in doing scientific fieldwork. Applying the technical skills I have gained through doing quality control tests on volunteer samples has helped me not only in mentoring other students to do the same, but in building the capacity of community volunteers as well. Engaging with community members through workshops has been a great way to learn more about myself, especially my dedication to spreading knowledge about our world's ecosystems and how we as humans affect them in our daily lives. It has also allowed me to recognize the importance of effective science communication in the face of a world increasingly full of conflicting and confusing information. From the moment I started working at ALLARM I felt valued as a team member and that I have been an important part of an organization that is making significant ripples in the scientific community. I will forever be grateful to the ALLARM family for all the kindness, support, advice, and learning opportunities that I have experienced being part of the team.

ALLARM in Pictures

The ALLARM team and volunteers from York County Stream Team smile after training to monitor for macroinverte-brates

Katherine Altamirano '20 speaks to Dickinson College parents and alumni about the LeTort Spring Run

Matthew Zaremba '20 (right) and Rachel Krewson '20 (left) work together to collect a stream sample

Penn State Master Watershed Stewards visit ALLARM to learn more about our water quality monitoring goals

Angelo Tarzona '21 speaking at the Watershed Specialist Conference

The ALLARM team at the 2019 Chesapeake Bay Watershed Forum

Members of the Chesapeake Bay Foundation and the Chesapeake Monitoring Cooperative visit ALLARM to practice our monitoring techniques, connect with the ALLARM team, and learn more about ALLARM's volunteer engagement and procedures

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