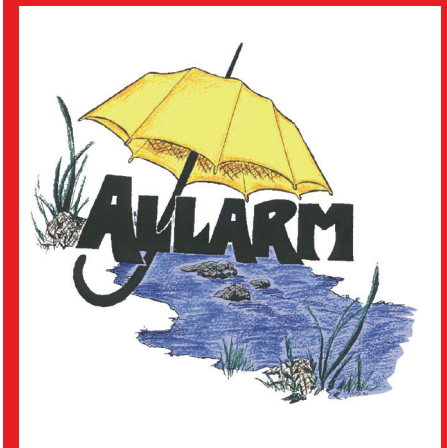
2010 Edition

# Stream of Consciousness

a publication of the Alliance for Aquatic Resource Monitoring






educate. engage. empower.

## Sounding the ALLARM on Marcellus Shale natural gas drilling

*by Benson Ansell*

As most of you know, Pennsylvania is a hot spot for Marcellus Shale gas drilling. At the surface, gas drilling appears to be full of benefits. First of all, the Marcellus Shale basin is believed to hold as much as 500 trillion cubic feet of natural gas, the equivalent of 80 billion barrels of oil (the amount the U.S. uses in about 10.5 years). Additionally, as an energy source, natural gas is cheaper than oil and when burned it produces only about half the carbon dioxide that comes from burning coal (Gjelten 2009).

However, drill a little deeper and realize that the benefits promised by the gas companies come with severe environmental consequences. In order to extract the gas from the shale a mile or deeper underground, gas producers drill vertically and then fracture the rock horizontally by forcing water, sand, and chemical mixture into the formation at a very high pressure. This process (fracking) uses more than a million gallons of water pumped from Pennsylvania streams to fracture each well and then the water comes back to the surface much saltier than ocean water, full of chemicals and dissolved solids that wastewater treatment plants cannot purify (Sapien 2009). These chemicals include metals (barium, strontium, iron, arsenic), toxic organics (benzene and toluene), and naturally occurring radioactive materials (uranium) (Swistock, 2009a;).

As one can imagine, the chemically contaminated wastewater has the potential to cause dramatically negative effects on Pennsylvania's streams, groundwater, and drinking water. For example, in Dimock, Pennsylvania, there was a large 8,000 gallon chemical spill that caused groundwater contamination and fish kills (Lustgarten 2009). Additionally, throughout Pennsylvania, there have been problems associated with the infiltration of methane into homes and water supplies. Results have included poisoned water, dead livestock, and the explosion of

*"Sounding the ALLARM" continued on Page 2*

a home. Furthermore, this past Fall there was a 30-mile fish kill in Dunkard Creek along the border of West Virginia and Pennsylvania. While nothing is definitive, a possible culprit was gas-drilling company CONSOL Energy who may have been discharging wastewater into the stream through and abandoned coal mine

*"Our goal is to help organize and mobilize watershed organizations to effectively monitor local streams under siege."*

(Scherer 2010).That is why there has been an outcry by citizens to do something about the potential destruction of Pennsylvania's waterways. ALLARM has been called upon by different state entities and organizations to take action. Our goal is to help organize and mobilize watershed organizations to effectively monitor local streams under siege. In effect, these groups will act as watchdogs with the goal of collecting strong, reputable data. The hope is that these data will give the monitors a powerful presence that gas companies will have to respect and will therefore become more careful with their practices. These groups will be raising the red flag by performing the roles of early detection and thus prevention of widespread contamination.

There are five steps of action that these groups will be taking:

1. Determine where drilling permits are being issued before the drilling begins

2. Develop a study design (how many sites and parameters will be measured)

3. Monitor the streams:

-Before drilling collect baseline data for the streams being studied (ideally for a year)
-Monitor during drilling

4. Data management and analysis

5. Take action: Notify DEP if levels are significantly above baseline data.

The main indicator that will be used for determining contamination as a result of drilling wastewater is conductivity and total dissolved solids (TDS). TDS lets us know how many ions are dissolved in the water. When dealing with Marcellus shale wastewater this an effective measure because it is full of salts that dissolve into ions $Na^+$ and $Cl^-$. Furthermore, there is state regulation for TDS, so groups should be able to get DEP to take action.

Additionally, groups could measure signature chemicals (Barium, Strontium, total alpha) that are only found in Marcellus Shale wastewater. Groups would measure this 2-4 times a year. If there is a spike in the monitoring data, groups can send water samples to ALLARM for the signature chemical testing. If these results verify that the levels are high, DEP will be notified that there is a chemical spill or leak.

This is our current plan for dealing with the water issues associated with Marcellus Shale gas drilling. While some details of the plan might change, you can expect action in accordance with what I have described to come to fruition in the near future. If you or your organization is interested in monitoring for the potential negative effects of gas drilling, please contact ALLARM at allarm@dickinson.edu.

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***Front page photo: A Marcellus shale natural gas drilling rig in Bradford County, Pennsylvania (credit: Simona Perry)***

*A typical Marcellus shale drilling pad in Bradford County, Pennsylvania. (photo credit: Simona Perry)*

# Filling the void: The status of government regulation over Marcellus Shale natural gas drilling

*by Dylan Shiffer*

Pennsylvania has a history of being an epicenter of energy resource extraction. In 1859 the modern petroleum industry was born in Titusville, Pennsylvania when Edwin Drake successfully drilled the first commercial oil well. The Keystone State has also been a leading producer of coal for over a century. As the price of oil climbs and the environmental impacts of coal become achingly clear, policy makers, industry leaders and energy consumers are seeking cleaner and cheaper alternative fuels. This search has again led them to Pennsylvania and to the Marcellus Shale formation.

The Marcellus Shale formation is ancient rock formation that is buried approximately one mile or more deep. It spans from central New York to Tennessee. The gas field is not a new discovery, but the natural gas it contains has been too difficult to access and too expensive to market. This is no longer the case.

The Marcellus shale gas field is now being considered one of the most significant energy reserves in the United States. It is estimated that there is almost 500 trillion cubic feet of natural gas in the Marcellus shale gas field. If just 10 percent of this gas is recoverable, the recovery rate for the Barnett Shale, a similar field in Texas, the Marcellus Shale would be one of the largest reserves of natural gas in the United States (Engelder and Lash, 2008). Developing the natural gas in the Marcellus Shale field will provide a host of benefits to the United States and to the Commonwealth of Pennsylvania. Cheap, clean burning fuel and unprecedented economic opportunity for rural regions of Pennsylvania are the two primary benefits.

The natural gas contained in the Marcellus Shale field is trapped in very small pockets of rock under high pressure. In industry jargon, the Marcellus shale is called an "unconventional play." Its unconventional nature requires unconventional methods of production. Hydraulic fracturing, or "fracking" is the unconventional method that is being utilized to extract gas from the Marcellus shale field. Drillers use water, sand and various chemicals and inject them into gas wells at extraordinarily high pressure. This formula cracks the pockets of rock open and allows the gas to escape.

*A typical Marcellus shale drilling pad in Bradford County, Pennsylvania. (photo credit: Simona Perry)*

Like any form of natural resource extraction, there are associated environmental impacts from fracking. The primary environmental impact concern with fracking in the Marcellus Shale gas drilling is "the unknown."

"This is a field where there is almost no research," said Geoffrey Thyne, a former professor at the Colorado School of Mines, in a report published by ProPublica. According to ProPublica, there are over 1000 documented cases of water contamination associated with gas drilling throughout the United States. The contamination could originate from both surface spills and underground seepage, but the topic is still plagued by uncertainty.

The gas industry has found a convenient friend in this uncertainty. They claim that because fracturing occurs thousands of feet below groundwater supplies and because there is a cement casing placed in the gas well which separates the well from hydrological zones, the process is environmentally sound. This claim is contestable. The fracturing fluid is injected at high pressure so that it can break the shale - it is plausible that it could fracture the well casing too, especially if the well casing is not well done.

Perhaps just as troubling as the possible water contamination associated with fracking is the amount of water it consumes. Each gas well is usually fracked an average of five times. Much of this water will has to be extracted from Pennsylvania streams. By 2012 it is estimated that 32,000 wells will be drilled annually. This translates to about 100 billion gallons of hazardous wastewater being produced annually from drilling activity (Lustgarten/What We Don't Know, 2009). Determining how to dispose of or treat this wastewater is one of several problems to which there is currently no solution.

In 2005 when the Energy Policy Act was passed, "injections for the purpose of hydraulic fracturing" were exempted from regulation under the Safe Drinking Water Act (Lustgarten/ FRAC Act, 2009). Regulation of fracking is thus left to the states and they often lack the resources to do advanced geological studies that would help to understand the effects of fracking. Gas companies are also exempted from being required to disclose the formula of the chemicals present in the water that they use for fracking. This has serious public health implications. Emergency responders cannot treat a problem well if they don't know what caused it.

Currently there is a bill in both houses of Congress called the Fracturing Responsibility and Awareness of Chemicals Act (cleverly called the "FRAC Act").

***"Filling the Void" continued on Page 17***

# Sustainable Forestry and its role in protecting the Chesapeake Bay

***by Taylor Wilmot***

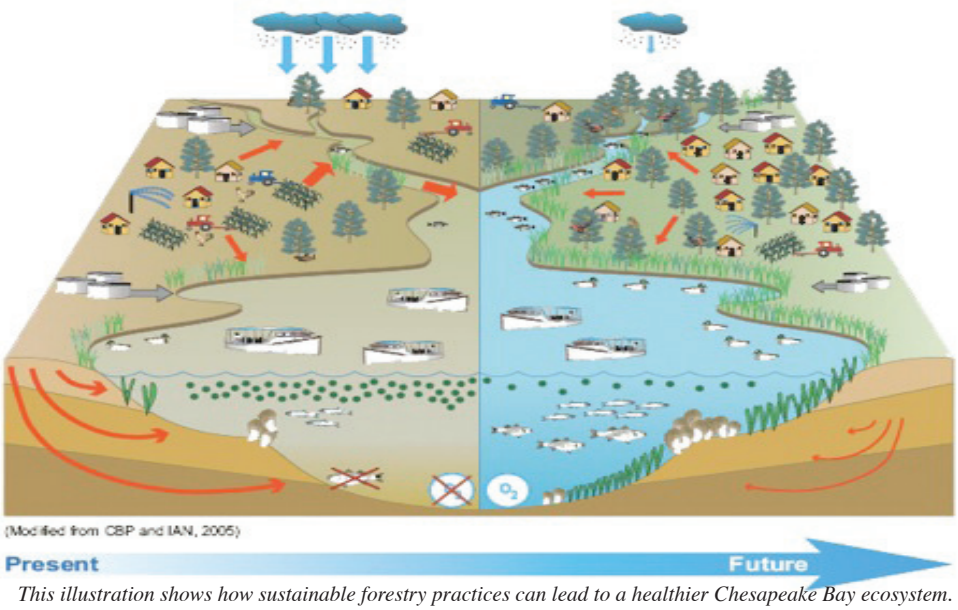
In recent years the restoration of the Chesapeake Bay has been brought to the attention of many Americans. There are many factors contributing to the decrease in quality of the Chesapeake Bay and the overall watershed. One of these factors is the acreage of forest being lost in the Chesapeake watershed each day as a result of development. Addressing these issues would be one way to help restore the Bay in a cost-effective way.

The forests of the Chesapeake watershed play a vital role in the health of the plants, animals, and humans living there. Riparian forests act as sponges to absorb excess nitrates, phosphates, and sediments, which are the primary causes of eutrophication. Therefore, forests help to prevent eutrophication, which is caused by excess amounts of nutrients. When these excess nutrients are introduced to the Bay they lead to an overgrowth of plant life. The rapid growth requires oxygen and, subsequently, causes the death of wildlife in the Bay due to a lack of dissolved oxygen (Chesapeake Quarterly). Areas where this occurs are known as dead-zones and they are already prevalent in the Bay. Forests in the watershed currently buffer about 60 percent of streams and rivers (Chesapeake Bay Program). Unfortunately, the continued loss of forests within the watershed will increase eutrophication and the creation of dead-zones in the Bay.

Forests perform many other crucial functions including cleaning, storing, and slowly releasing about two-thirds of the water that maintains stream flow and replenishes ground water. Forests also protect and filter drinking water for about 75 percent of the watershed's residents (Chesapeake Bay Program). Riparian forests also shade the waterways underneath their canopies, which maintain cooler water temperatures in the summer. At cooler temperatures water is able to store more dissolved oxygen, which is important for wildlife. Along with benefits to the waterways, forests provide food, shelter, nesting places, and safe migration routes for animals in the water and on land (Chesapeake Bay Program). If the forests are not protected, billions of dollars will have to be spent to technologically replace them (Bay Journal). The estimated ecological value of the Bay's forests is 24 billion dollars a year (Chesapeake Quarterly).

Although trends vary in local areas, each day 100 acres of forest in the watershed have been destroyed since the 1980s (Bay Journal). There are multiple factors contributing to the loss of forests in the watershed. By far the largest contributor to deforestation is urban sprawl from the cities of Washington D.C. and Baltimore. As the population of these cities continues to grow more residents will to move out of urban areas and into suburbs (Chesapeake Quarterly). For the future of the forests and the Bay urban sprawl needs to be mitigated. To date urban sprawl has been poorly planned. Forest protection needs to be taken into consideration to maintain the health of the watershed. The current development of the Bay watershed causes the division of forestland by road construction, housing, farmland, and other human projects. It also leads to parcelization or fragmentation, where large areas of land are broken up into smaller parcels. This makes it harder to maintain sustainable management plans (Chesapeake Bay Program).

Environmental initiatives like the Chesapeake Bay Program and their partners are working to protect the forests within the watershed. They have set goals to restore and conserve more forestland, specifically riparian forest buffers. There are also projects to increase canopy cover in urban and suburban areas. Another way to protect the forests is by reaching out to private landowners for support. Residents own 64 percent of the Bay watershed and businesses only own 14 percent of the land (Bay Journal). Land preservation is one of the best solutions to this problem and private landowners can protect their land from development. With the help of many different groups and increased awareness, forests will play a large role in the restoration of the Chesapeake Bay watershed.




*This illustration shows how sustainable forestry practices can lead to a healthier Chesapeake Bay ecosystem.*

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# The Chesapeake Bay struggles to protect blue crabs

*by Katie Tomsho*

The blue crab population in the Chesapeake Bay has been declining at an alarming rate. Beginning with a sharp drop in 1992, the numbers have continued in a downward trend, signaling the existence of problems in the waterways (6). The repercussions of this situation have been cultural, economic, and environmental, affecting the lives of many. Additionally, due to the bay's large size, determining a plan to address the decline has proven to be an interstate struggle.

The Chesapeake Bay watershed encompasses 64,000 square miles, including Delaware, District of Columbia, Maryland, Pennsylvania, Virginia, and West Virginia. This vast area includes more than 150 rivers and contains about 18 trillion gallons of water. Due to its large size, the bay is able to support over 3,600 different species of plants, animals, and fish.

Pollution and overharvesting have been identified as the major issues related to the decline in the crab population. One of the largest sources of pollution has been agricultural runoff, which contributes 318 million pounds of nitrogen and 19 million pounds of phosphorous per year (2). Waste from animal feeding lots contributes one third of the total nutrients that eventually enter the bay (2). Maryland's chicken industry, alone, is responsible for more than half of the inflowing nitrogen and phosphorous (2). A miniscule one percent of the waste that enters into the bay eventually flows into the Atlantic Ocean, leaving the rest to settle. The excess nutrients spur large algae blooms in the water, which prevent sunlight from reaching the deeper water. The effect of this algae growth is twofold. The lack of sunlight prevents aquatic grasses from growing, eliminating a key source of shelter for the crabs. Additionally, as the algae dies and decomposes, it draws oxygen from the water. The resulting hypoxia, or extremely low levels of oxygen, kills clams and worms, decreasing the amount of food available for the crabs. Water testing performed in 2008 indicated that 40% of the entire bay was in a hypoxic state, which greatly effects aquatic life (8).

In addition to pollution, overharvesting has played a vital role in the deterioration of the crab population. Scientists have determined that no more than 46% of each year's total crab population may be harvested if the industry is to remain sustainable (8). However, as the total number of crabs has steadily decreased since 1990, the percent harvested of the entire population has increased (8). In an attempt to reverse the population decline, regulations were set in 2008 in order to protect the female crabs, which have seen an 80% decline over the past 12 years. Maryland and Virginia no longer allow harvesting of female crabs from October to April, and have set a cap on the number of females allowed to be caught in September and October (8). Additionally, Maryland has limited the fishermen's work day to eight hours, sparking a debate over the economic consequences.

The attempted crab population restoration has come at a substantial economic cost to the surrounding region. The limitations on work hours and total catches have prevented fishermen from harvesting to their full capacity.

*"Blue crabs" continued on Page 19*

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*Crab fishing on the Chesapeake Bay. This could be a rare sight in the absence of swift action. (photo credit: http://www.history.com/images/media/slideshow/maryland/maryland-crabs.jpg)*

# Mussels, Eels, and Dams: the loss of a natural filtration service for the Chesapeake Bay

***by Giovania Tiarachristie***

*"The dams are blocking the eel, affecting the stability of the Elliptio population, and thus distressing the quality of our water. Just imagine the filtration in the Bay that we've lost now that the Elliptio's services are lacking." - Lower Susquehanna Riverkeeper Michael Helfrich*

Decades ago, the Susquehanna River was filled with millions of Eastern Elliptio mussels. "You couldn't walk through the Susquehanna or even small streams without stepping on the mussels," said Michael Helfrich of the Lower Susquehanna Riverkeeper, reminiscing about the way his grandparents spoke. Today, however, their numbers have largely declined: there is no more than one Elliptio shell per three square feet in the Susquehanna (Helfrich, 2007), and the youngest mussels are several decades old (Blankenship, 2009).

The Eastern Elliptio (*Elliptio complanata*) has historically been considered a very common native mussel of the Northeastern United States. The Delaware River, similar in properties to the Susquehanna, is estimated to support about 2.2 million mussels per mile, according to Dr. William A. Lellis, Branch Chief of the U.S. Geological Survey's Leetown Science Center, who has done extensive research on the mussels. The Susquehanna River used to support around the same number, but unlike the Delaware, it has experienced a drastic disappearance of the mussels. This decline in Elliptio is causing concern to local scientists and environmentalists, not only for the preservation of a native species, but also for the degeneration of a vital filtration service to the Chesapeake Bay.

First of all, what happened to all of those Elliptio in the Susquehanna?

A study done by the U.S. Geological Survey's (USGS') Northern Appalachian Research Laboratory, which compared the Susquehanna and the Delaware Rivers, suggests that the decline of Elliptio in the Susquehanna is related to the presence of tall dams, which were never built on the Delaware. Eastern Elliptio have a symbiotic relationship with American eel, where the mussel attaches its larvae, known as glochidia, to fish as parasites and rely on them as hosts until the juvenile detaches at a new site and can grow into the next generation of Elliptio (Long, 2008). In the USGS study, it was demonstrated that of fifty fish species, only five would support Elliptio development and that the American eel was the mussel's primary host. But American eel in the Susquehanna have declined simultaneously with the Easter Elliptio. It all began with the completion of the Conowingo Dam in 1928 at the mouth of the Susquehanna (Minkkinen, 2007).

The host, the American eel is catadramous, meaning maturing in freshwater and spawning at sea. The eggs hatch in the Sargasso Sea in winter or early spring, and the larvae travel through the Gulfstream. They grow into a stage called *glass eels* around the continental shelf, before entering estuaries and rivers at about one year in age. At this point, they become *elvers,* active at night and burrowing into the mud during the day. Two to three years later, they metamorphose into *yellow eels*, about one foot long, and migrate upstream where they sexually mature. Years later, as *silver eels*, they migrate downstream. They may stay in the estuary or Bay between ages six and sixteen before journeying back to the Sargasso Sea to spawn and eventually die (Blankenship, 2006).

Unfortunately, dams in the Susquehanna have blocked the American eels' migratory path, restricting the availability of hosts for the Elliptio to reproduce. The eels are unable to pass the hundred-foot dams. Additionally, as large *silver eels*, they are killed passing through turbines as they attempt to migrate downstream to breed (Kepfer, 2008; Walsh, 2007). American eel populations have declined by as much as 99% in the last 20 years due to hydropower plants, over-fishing, introduced disease, and other unidentified causes (US Fish and Wildlife Services, 2006).

The issue at hand, however, is not about another call for duty to conserve a native species. The concern raised by local scientists and environmentalists is mainly due to the fact that mussels are essential to water quality of rivers and, ultimately, the Bay, because they contribute to an extensive natural filtration system that reduces nutrients and sediments. Two million mussels can filter 2-6 billion gallons of water and remove 78 tons of sediments each day - something the Bay could really use (Walsh et al, 2007; Blankenship, 2009). They remove the sediments and deposit the waste as "pseudofeces" on the

*American Eels at the yellow eel stage. (photo credit: http://www.fws.gov/northeast/marylandfisheries/images/graphics/Sideling%20Hill%20subviridis2%20copy%20copy.jpg)*

bottom of the river, where it is consumed by denitrifying bacteria (Blankenship, 2006). Furthermore, Elliptio mussels are more pollution tolerant than other species, demonstrated by their presence in the impaired Codorous Creek (Helfrich, 2007; Walsh, 2007).

The Susquehanna River comprises 43% of the Chesapeake Bay's watershed (Minkkinen, 2007). Thus, the issue of the dams, lack of American eel, and disappearance of Elliptio in the Susquehanna is an issue of a significant crippling of a much needed natural ecological service to the Bay, due to human behavior such as dam building.

Over the past few years, Dr. William A. Lellis and others dedicated to restoration of Susquehanna American eel and Eastern Elliptio populations, have begun introducing catch and transfer schemes and eel ladders projects. Eels are transported from below the Conowingo Dam to upstream tributaries on top of existing beds of Elliptio. Two years ago, over 18,000 were released in the Conestoga River in Lancaster, Conowingo Creek north of the Conowingo Dam, and also in Pine Creek near the New York border (Helfrich, 2010). Other experiments include placing Elliptio glochidia in tanks filled with eels so they would have an ideal opportunity to attach before the eels are released. However, experiments are difficult to monitor because of the instinctive eagerness of the eels to quickly migrate, and it is almost impossible to calculate their numbers, partly because the glochidia (Elliptio larvae) are about the size of a grain of sand until they reach three to five years in age (Blankenship, 2009).

While many scientists continue restoration experiments and research, others are pursuing utilities like Excelon (operator of the Conowingo Dam), and demanding further research, upgrade, and change, as the 2014 date for bi-century dam relicensing approaches. "The process of relicensing takes about 5 years, but Exelon has been avoiding our repopulation study request and instead they're doing a study of cost and benefits of eel ladders," explains Helfrich, the Lower Susquehanna Riverkeeper and ardent pursuer of Elliptio restoration, about the complexity and frustration of efforts to restore the eel population (Helfrich, 2010).


*Eastern Elliptio mussels measured in size. (photo credit: http://www.fws.gov/northeast/marylandfisheries/images/graphics/Sideling%20Hill%20subviridis2%20copy%20copy.jpg)*

Helfrich argues that the lack of American eels in the Susquehanna not only deprives the Bay of a powerful and natural ecological service, but is also harms Atlantic Coastal Fisheries. As the eel population declines, so do stocks of its predators, including tuna and cod. Other game species such as striper, have reported to other feeder fish, creating competition with other species that rely on those same feeder fish. Helfrich also presses an economic argument for repopulation efforts: "It isn't about saving a shellfish and some eel… We're asked to spend tax dollars on sewage treatment updates, pay for farmers to improve their practices, and help businesses improve practices to reduce nutrients and sediments in the Bay… The dams are blocking the eel, affecting the stability of the Elliptio population, and thus distressing the quality of our water. Just imagine the filtration in the Bay that we've lost now that the Elliptio's services are lacking."

Years of research on the eel and mussel provide evidence that the construction of dams has blocked the migratory path of American eel, thus disenabling Elliptio mussels to reproduce due to a lack of host, and consequently, depleting the Chesapeake Bay of a powerful natural filtration service that had subsisted decades ago. Scientists and environmentalists continue to research, experiment, and politically pursue the restoration of the Elliptio population in the Susquehanna River. The next stages of large-scale effects will rely heavily on the response of the dam companies to proposals put forth by scientists, environmentalists, and the community, in the current dam relicensing process prior to 2014.

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# ALLARM hosts the 2009 EPA Region 3 Mid-Atlantic Volunteer Monitoring Conference

***by Maunette Watson***

During the 2009 Dickinson College "Fall Pause," while most Dickinson students were home for the break, the Alliance for Aquatic Resource Monitoring (ALLARM) students were working hard to pull together an important event for the volunteer monitoring community. This event was the 2009 U.S. Environmental Protection Agency (EPA) Mid-Atlantic Volunteer Monitoring Conference, titled "Sustaining and Enhancing Volunteer Monitoring Efforts." This year the biannual conference was held at Dickinson College in Carlisle, Pennsylvania, the first time in Pennsylvania from among the EPA Region III states (which includes Pennsylvania, Maryland, Delaware, Virginia, West Virginia, and the District of Columbia). Dickinson College was chosen as this year's conference location because of its south-central location in Pennsylvania, which is easily accessible to participants from other states within the region. Additionally, Dickinson College was an ideal choice because ALLARM is based at Dickinson and was able to host and organize the event.

Although the conference took place on October 19 and 20, 2009, the planning process began much earlier in the year. The initial planning steps were undertaken by the conference committee, but ALLARM had a large role early on in the planning process. Preliminary tasks included creating save the date flyers, developing a website for information about the conference, and finding and contacting potential speakers. A large component of the planning process was devoted to developing the agenda. "It was very important that the conference be responsive to volunteer needs," said Julie Vastine, the Director of ALLARM, "so a lot of planning went into developing a balanced agenda, where we would educate monitors, increase exposure to emerging topics in the field, and create opportunities for dialogue." Based on these goals, the four track topics that were chosen for the conference were: sustaining volunteer organizations, data use and data sharing, emerging watershed issues, and monitoring workshops. Topics included climate change, gas drilling and monitoring, membership retention and recruitment, volunteer monitoring success stories, and monitoring workshops, among many others.

*James Beckley from the Virgina Department of Environmental Quality presenting at the Mid-Atlantic Volunteer Monitoring Conference.*

One ALLARM employee who played a crucial role in organizing the conference was Katie Tomsho, who was responsible for managing the logistics of the conference. Her tasks included organizing participant information, coordinating session logistics, finding housing for participants, developing the conference menu with Dickinson's Dining Services, and helping to develop the role of the speakers throughout the conference. "I'll admit, when I was first told about the task of helping to organize the conference, it seemed a bit daunting," said Katie, "but Julie was very supportive and helped me to learn how to break tasks down so they were manageable. I learned a lot about organizing and managing my time as a result of this conference." Aside from Katie, six additional ALLARM employees were also involved in coordinating the conference, and were instrumental to its success. These employees were: Benson Ansell, Atandi Anyona, Bre Hashman, Tabha Joshi, Ben Mummert, and Maunette Watson.

A unique aspect of this conference was that the ALLARM students were directly involved in the conference by being responsible for greeting participants in the mornings, helping to guide them to appropriate buildings and rooms, taking photographs, and most importantly, moderating the conference sessions. During each session, an ALLARM student was available to introduce the speakers, ensure that they adhered to their allotted timeframes, and help facilitate the discussions. Benson Ansell, one of the ALLARM students involved with the conference remarks, "I definitely enjoyed moderating. It gave me a much more personal connection with the speakers and got me really involved with the conference." Additionally, one of the ALLARM students was also responsible for leading a portion of a workshop on physical monitoring. In the feedback after the conference, ALLARM received a lot of positive comments about the ALLARM moderators. Julie commented that "people were very impressed by the ALLARM students. Participants were coming up to me

*Conference attendees mingle during the networking session.*

to say that the students were very professional, knowledgeable, and resourceful."

Another distinctive element of the conference that the ALLARM employees were involved in was the breakout sessions. Breakout sessions had been successfully piloted at the EPA Mid-Atlantic Volunteer Monitoring Conference held in Virginia in 2007, so they were incorporated into the 2009 conference as well. According to Julie Vastine, one of the purposes of the breakout sessions was for "volunteers to be able to share their stories and learn from each others' experiences and accomplishments." Overall, the breakout sessions were a success, and one of the feedback comments ALLARM received mentioned that "the overall tone of the conference was positive with focuses on success stories. This was refreshing and motivating, especially in these economic times."

Also incorporated throughout the two days of the conference were three speakers. President Durden of Dickinson College welcomed everyone to the conference on the morning of the first day. During breakfast of the second day, Dickinson College professor and founder of ALLARM, Candie Wilderman, gave a speech on the history and importance of volunteer monitoring. Then during lunch that same day, Dave Arscott of Stroud Water Research Center gave a speech on the importance of forest buffers for stream water quality. Another component of the conference was a poster session on the first day, where participants could display materials while networking with one another. Lastly, at the end of the second day, the conference was brought to a close with a raffle where many participants won prizes such as LaMotte macroinvertebrate flash cards, environmentally related books and movies, and ALLARM T-shirts.

Throughout the two days of the conference, a total of 133 participants attended. Approximately half of the participants were volunteer monitors, and the other half consisted of service providers, environmental organizations, agencies, and a few faculty and students. While the majority of participants were from Pennsylvania and neighboring states, all of the EPA Region III states were represented. There were also non-Region III participants from New Jersey and California. An important aspect of this conference that most likely contributed to the high number of attendees, especially the volunteer monitors, was that the conference was offered free of charge to all participants. This was possible due to the contribution of an EPA 319 grant ALLARM received from the Pennsylvania Department of Environmental Protection (PA DEP), as well as assistance from Dickinson College.

Overall, the 2009 Mid-Atlantic Volunteer Monitoring Conference was a success! ALLARM received a lot of positive feedback after the conference, including "Very smooth-running, well organized conference," "Glad I came; will encourage other watershed members to attend," and "Great conference, food facilities, and speakers!" The conference was a great opportunity for all of those who attended, including the ALLARM students who gained moderation and networking experience, as well as the volunteer monitors who were able to learn about new topics, develop new skills, and connect with their colleagues in the field. Conferences such as these are very important tools for the environmental community. They allow us to reconnect with each other, learn about and discuss important issues, and also remember that at the end of the day, there are others beside ourselves who are also fighting for the same goals.


*Several of the ALLARMies gather for a photo. From left: Director Julie Vastine, Katie Tomsho, Assistant Director Jinnie Woodward, Benson Ansell, Bre Hashman, Atandi Ayona, and Maunette Watson.*

# Stormwater Management: From Metropolis to Municipality

***by Ben Mummert***

Philadelphia has been recognized for progressive stormwater management strategies and its emphasis on pursuing social and economic benefits simultaneous with environmental goals. Can the same principles be applied in Carlisle, and to what result?

In September Philadelphia submitted for review a Long Term Control Plan Update for stormwater as part of a bid to establish itself as one of the nation's greenest cities. The plan incorporates green, "land" and "water-based infrastructure" and recognizes stormwater management's significance to human health, recreation, property values, aesthetics, and jobs. Organizations including the Sierra Club and the Natural Resources Defense Council have offered strong support (Philadelphia Water Department, 2009). Remarkable in scale, the approach may serve as a valuable model to other communities, including Carlisle.

Carlisle has a population of about 18,000 as opposed to Philadelphia's 1,540,000 (US Census Bureau, 2008). It's a small community in comparison to the nation's fifth largest, but they have similarities. Like Philadelphia, Carlisle is an historic community and played a role in the formation the United States. Not surprisingly, both suffer aging infrastructure. As the county seat, Carlisle like Philadelphia, holds a place of prominence in its region. Both places have an ambition to establish a green reputation. Carlisle, for instance, has pursued a road diet that will limit traffic on main streets to make it a more walkable, bikeable, breathable, and attractive town (Hietsch, 2009). Water figured prominently into both locations of settlement. William Penn chose the location for Philadelphia at the mouth of the Delaware. Governor Hamilton situated Carlisle as county seat because he believed LeTort Spring Run would afford bountiful, clean water (Williams, 2006).

A natural treasure, LeTort Spring Run is a cold-water, spring-fed, limestone stream designated in the headwaters as Cold Water Exceptional Value. It draws fishermen and dollars from across the country in pilgrimage and pursuit of its wild brown trout (ALLARM, 2008). However, the stream falls short of its historic glory and suffers nutrient impairment and low-flow due in part to the way stormwater is managed in the Borough.

In Carlisle and Philadelphia, as in most urban areas, surfaces like roofs and pavement, called impervious because water cannot infiltrate into them, represent a high proportion of the landscape. Moreover, as a characteristic of urban density, practices like detention ponds are impractical. Traditional management has, thus, involved collecting runoff and delivering it to waterways as quickly as possible (Burian et al., 2009) In Carlisle, more than 900 storm drains collect runoff and discharge directly into the LeTort.

Stormwater can have major effects on aquatic resources. It directly contaminates waterways with pollutants like oil, metals, fertilizer, litter, and pesticides, thereby compromising their value as resources for drinking water, recreation, wildlife, and aesthetics. Additionally, it can cause stream flow to become "flashy"- because water doesn't infiltrate, precipitation can lead to rapid flooding while at other times streams lack baseflow. It's estimated that the LeTort, downstream of Carlisle, is frequently one half its historic volume (Williams, 2006). Additionally, expansions and repairs of traditional infrastructure are expensive and disruptive, typically requiring excavation of roadways.

Philadelphia Water Department (PWD) affirms that the key to green stormwater management is to mimic natural processes. To do so, PWD has implemented land and water-based projects in addition to traditional infrastructure improvement. Not only do these achieve the desired environmental outcomes but also advance human health, recreation, property values, education, aesthetics, and employment (Philadelphia Water Department, 2009).

The role of land-based infrastructure is to keep stormwater out of systems to begin with ("Office of Watersheds"). Philadelphia is attempting to act as a sponge, holding back precipitation and using or slowly releasing it (Bauers, 2009). Land-based approaches are also called green infrastructure or integrated management practices (IMPs). They include rain barrels, planters, rain gardens, green roofs, and pervious pavement (Philadelphia Water Department, 2009). These approaches remove pollutants, slow stormwater, reduce runoff through infiltration or evaporation, prevent flooding, establish higher base flow, and use precipitation constructively (Burian et al., 1999).

PWD has used regulations, incentives, and public initiatives to increase the application of land-based approaches. In January 2006, PWD implemented new

*Philadelphia's stormwater campaign is demanded by EPA to reduce combined sewer overflows but is also part of the City's bid to build a future as the "greenest city in America". Retrieved from http://www.phillywatersheds.org/*

*Mill Creek Sewer, West Philadelphia, ca. 1883. This sewer, constructed over five miles, obliterated the largest waterway in West Philadelphia for which it is named. Much of Philly's sewer system is over one hundred years old and suffers its age. Retrieved from http://www.phillyh2o.org/*

stormwater management regulations for new and re-development in the City using the principles of low-impact development (Center for Watershed Protection, 2006). Any project involving earth-disturbance of greater than 5000 square feet is now subject to water quality, channel erosion, and flood abatement requirements. This can equate to obligatory implementation of green stormwater infrastructure. In Carlisle, a similar framework now exists under Chapter 217 of the Borough Code, requiring that new construction discharge no extra volume of stormwater compared to the pre-construction site (Borough of Carlisle, 1983).

PWD has also used financial incentives to influence how families and businesses manage stormwater. In 2009 Philadelphia replaced its old stormwater fee structure, which was based on metered water use with one based on gross impervious area. A parking facility, for example, which was charged $400, today faces a fee of $2500 (Center for Neighborhood Technology, 2007). The adjusted fees, therefore, provide an incentive to adopt green infrastructure, such as pervious pavement. Moreover, a 50% discount is available to residents and businesses that implement such practices. Other tools include cost-sharing and free training provided as part of a community outreach program. For example, PWD has provided hundreds of rain barrels at low-cost (Center for Watershed Protection, 2006).

Public land in the Philadelphia accounts for almost half of total impervious area. Therefore, public initiatives play a prominent role in large-scale implementation of green infrastructure. The "Campus Parks" initiative has stressed use of green infrastructure at schools. Through the TreeVitalize program, PWD has contributed to the planting of over 500 street trees and is in the process of planting 84 acres of forested riparian buffers (Center for Watershed Protection, 2006). Also using the TreeVitalize program, Carlisle will plant 380 trees for riparian buffers at LeTort Park during the 3rd Annual LeTort Festival, May 8th (Tiarachristie, 2010).

Philadelphia is also focusing efforts on water-based infrastructure. Because healthy streams are better able to accommodate and mitigate stormwater, $300 million dollars will be committed, over twenty years, to the restoration and preservation of stream corridors. These improvements include removal of dams to permit fish passage, establishment of riparian buffers to protect waterways from pollution and erosion, reinforcement of streambanks for stabilization, and removal of litter. Additionally, some historic streams will be "daylighted", meaning excavated from the culverts they've been transferred into (Philadelphia Water Department, 2009). Improving streams capitalizes on advances made in water quality and offer aesthetic, recreational, educational, and ecological benefits. In Carlisle, the efforts are paralleled by restoration of the Mully Grub Creek.

PWD estimates that for each dollar invested in land and water-based approaches over the next 40 years, two dollars of benefit will accrue to the city (2009). While Washington D.C. will address the same basic problem by spending $2.2 billion for a stormwater storage tunnel (Posegate, 2008), Philadelphia will reap greater and quicker economic, social, and environmental returns on investment. Economic advantages include a two to five percent increase in waterfront property values and the creation of an estimated 250 jobs for green infrastructure construction and maintenance. Social welfare is expected to improve with an increased one million recreational annual users of the city's parks and waterways. Environmental benefits should include improved water and air quality, reduced energy use, reduced carbon-dioxide emissions, and healthier stream habitats (Philadelphia Water Department, 2009). Carlisle could expect benefits of a similar strategy. Improving the health of the LeTort should correspond to palpable benefits of increased angler tourism and recreational use, at least.

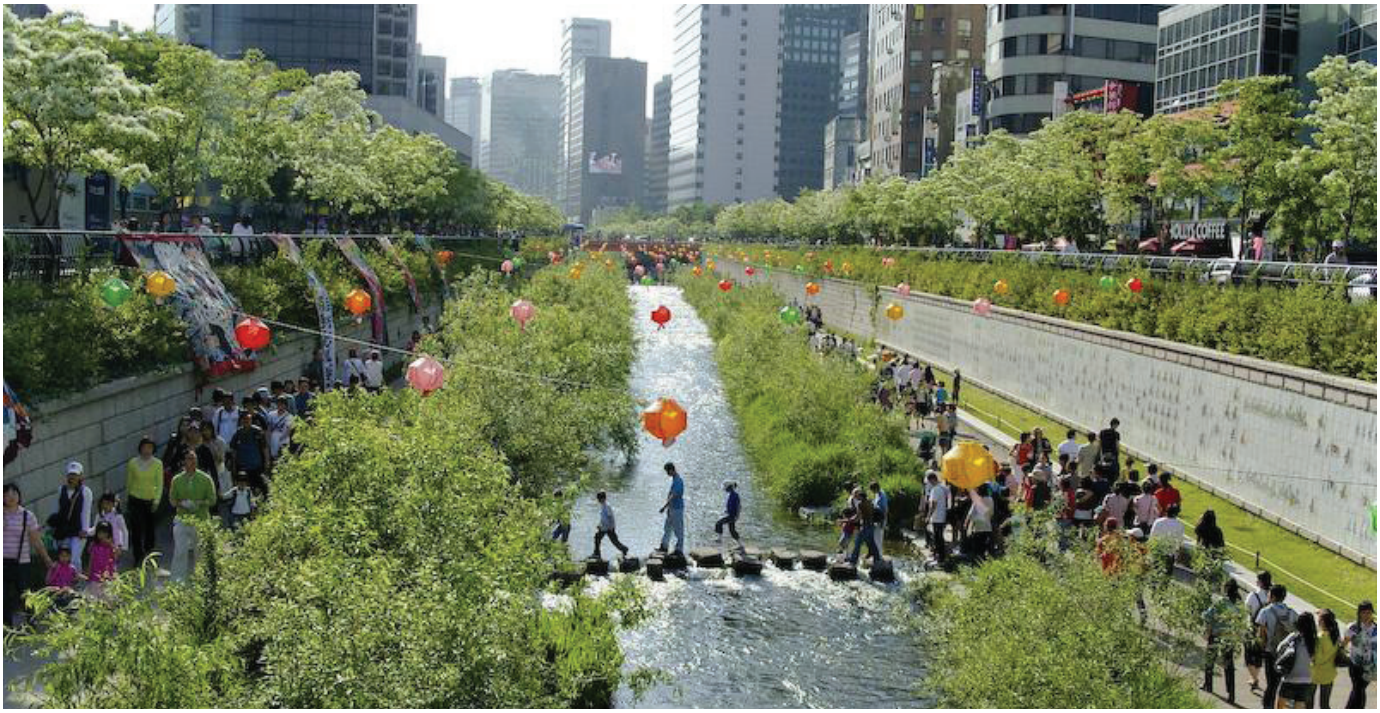
The plan has received overwhelming public support. Community groups, especially, champion green infrastructure because it promises to enhance neighborhoods, whereas construction of traditional infrastructure is a disturbance (Philadelphia Water Department, 2009).

Philadelphia's plan, however, does have shortcomings. EPA estimates its practice will cost average citizens more than it would like. The City and Town had comparable 1999 median household incomes of $31k and $34k respectively (US Census Bureau, 2000). Like Philadelphia though, Carlisle can take advantage of grants, like TreeVitalize, in order to offset cost of green stormwater infrastructure—grants typically not available for traditional system construction. Another difference is that Philadelphia has a greater imperative to reduce flows, and can better justify stormwater projects, because it suffers "combined sewer overflows", during which stormwater overwhelms sewer systems and causes discharge of raw sewage into waterways (Philadelphia Water Department "Combined Sewer Overflow Program", 2009).

***"Stormwater Management" continued on Page 18***

# Urban River Restoration

*by Atandi Anyona*



*An urban waterway in Soeul, South Korea. Photo credit: http://vector1media.com/spatialsustain/wp-content/uploads/2008/12/cheonggyecheon.jpg*

Rivers in urban areas are vulnerable to a long list of impairments as a result of the degree of landscape alteration resulting from urban development and sprawl. The U.S. Census Bureau defines an urban area as a developed region with a population of more than 50,000 people. We can therefore define an urban stream as a waterway that is located in such a region with this respective population. Some of the impairments that face urban waterways include: stormwater, stream channelization, dam installation, sewer and waste treatment discharges, and stream bank erosion. Historically, the growth of American cities, driven by increase in population, has led to increased degradation of these urban waterways. It is estimated that by 2050, the total area taken up by cities will constitute just over a third of the entire landmass of the US, and 80% of the population will be living in metropolitan areas. When it comes to assessing the quality of rivers, urban rivers seem to have suffered the worst as a result of the rapid growth of cities and urban sprawl, which has been influenced by the rapid increase of urban populations.

Any increase in population, calls for the expansion in development projects and thus the threat of the exploitation and pollution of these rivers. This pollution is reflected by the diminished quality of water in an urban centre. Some good examples of affected urban waterways include: the Anacostia which is polluted by polychlorinated biphenyls (PCBs), heavy metals, and discharge from sewer overflows, the Tres Rios in Arizona which is threatened by unstable landfills and city flooding, the Gowanus Creek Canal in New York, which is also threatened by PCBs and CSOs (Combined Sewer Outfalls), and Fourche Creek in Arkansas, which is significantly polluted by stormwater. Consequently there is a need to instigate rehabilitation projects on these rivers in an effort to reduce the pollutant load, restore wildlife habitat, and revitalize the aesthetic of urban environments.

Urban river rehabilitation means not only managing the health of the river but also primarily restoring its entire aquatic ecosystem, which includes both the river as well as its watershed. This, of course, is not an easy process since it demands the integration between the needs of a growing city and the health of an urban waterway. It involves the creation of a system whereby the urban waterway provides services such as transportation and recreation while still maintaining the beauty and diversity of an aquatic ecosystem. Unfortunately, with the rate at which urban centers seem to be growing, the health of an urban waterway is continually compromised by increased development and encroaching commercial and industrial sites.

So, why should the restoration and protection of these urban waterways be given high priority? Well, one of the most important factors is that these rivers are a prime source of clean water to populations living around them. Some of these rivers are a source of food (i.e. types of fish). Finally, they provide a mode of transportation. The health of the river is undoubtedly connected to the health & quality of life of the city. Moreover, these

rivers sometimes form the backbone of the economic system of an urban centre through the provision of transportation, tourism, and recreation. Consequently, if the health of these urban waterways is compromised, the health of those living in these areas is automatically compromised as well.

Restoration of urban waterways is definitely not an easy task primarily because it is an ongoing process, a journey rather than a problem that can be solved through a one-time project. Since a river is an ecosystem, multiple restoration strategies are required. A river ecosystem constitutes of the biological life in the water, the water itself, and the landscape that encompasses that river (its watershed). As a result, urban river restoration includes projects such as: flood control, landscaping, biological protection, water quality monitoring, and conservation of soil and water. Consequently, it is a capital-intensive endeavor. For instance, in 2003, a pilot project was initiated in an effort to restore the health of the Anacostia River by reducing the amount of PCBs and sewage pollution. The cost of repairing the sewer system alone, which would prevent sewer discharge overflows, amounted to $1.3 billion dollars. As for Fourche Creek, its restoration has been deemed to be very challenging since about 90,000 acres of its watershed is within city limits. Bearing such costs in mind, there is the need to initiate political pressure for the restoration and protection of urban rivers, otherwise such huge restoration projects will not occur. Additionally, educating urban residents on the fundamental value that these urban waterways have is key to ensuring that they will strive to do whatever is necessary to ensure they are restored and protected. For the success of any such restoration projects, a two way approach is necessary. Both mainstream groups institutions, such as government institutions, and grassroots movements, such as watershed groups, are core to ensure the total revitalization of urban waterways.

The benefits of urban river restoration outweigh the cost of restoration. A city benefits from aesthetic beauty, higher aquatic biodiversity, environmental education and recreation opportunities, and a closer attachment between people and nature. With the growing trend of increased rural urban migration, urban river restoration should remain a fundamental political and social agenda.

*The Allegheny, Monongahela, and Ohio Rivers at the Golden Triangle in Pittsburgh, PA.*
*Photo source: http://owenyoungman.com/thenextmiracle/wp-content/uploads/2010/01/Allegheny_Mononga-*

Since development is an ongoing process, there is the need to ensure that such development projects always incorporate the protection, preservation and restoration of the urban streams which will be affected by the respective development. Instead of always being on the defense, always talking about restorations, the most effective way would be to ensure that urban waterways are protected before any kind of city expansion plans are initiated. The biggest tragedy that we face presently is not being aware of the value of what we have until it is gone or destroyed. Hopefully, urban rivers will not be our next tragedy.

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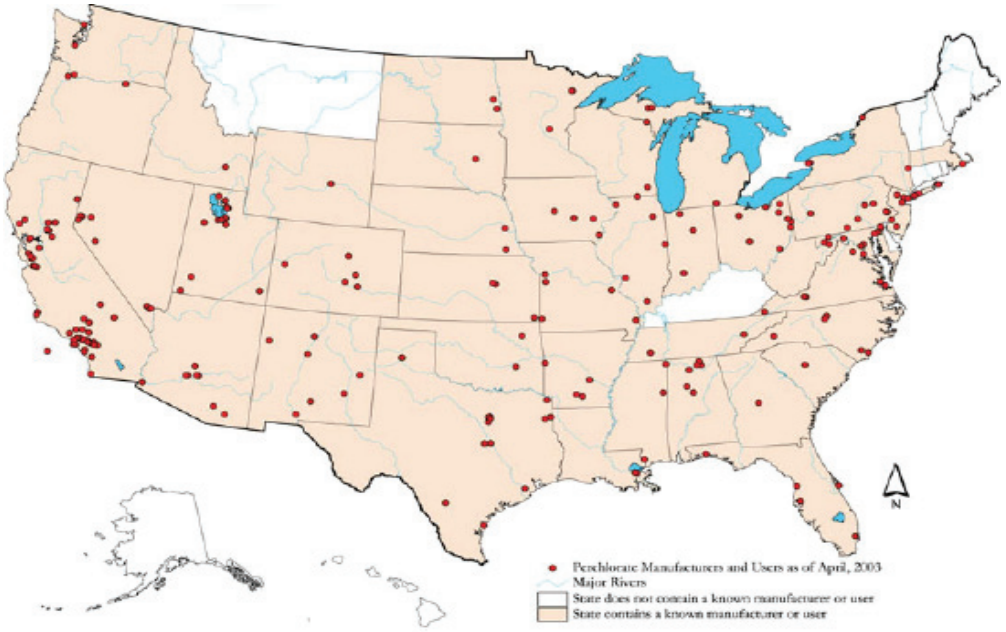
# Waiting for EPA's Decision on Perchlorate Regulation

***by Amitabh Joshi***

In April 2009, the Center for Disease Control and Prevention found detectable levels of the chemical perchlorate in infant formulas. This caused great concern and brought perchlorate into the public eye. Perchlorate has the ability to disrupt thyroid function by inhibiting the uptake of iodine which could lead to developmental problems in young children. Perchlorate occurs naturally at low levels in the environment, but is primarily used for high-energy rocket fuels. It also has applications in many different industries from demolition to aerospace and can be found in more common items such as fireworks and flares. Currently, perchlorate is still an unregulated Environmental Protection Agency (EPA) contaminant. On September 5th 2009, Lisa Jackson, the administrator of the EPA commented: "It is critically important to protect sensitive populations, particularly infants and young children, from perchlorate in drinking water"(Sapien/Proruplica, 2009). There has been a rise in the amount of perchlorate found in drinking water and foods around the United States. Currently, perchlorate is on the EPA Contaminant Candidate List 3 (CCL3). Enesta Jones from the EPA Press office stated that the "EPA will evaluate the comments on this supplemental notice and the comments on the October 2008 notice to make a final regulatory determination in 2010." Officials often debate how much exposure is harmful or how prevalent it is in drinking water rather than arguing for its regulation.

The Perchlorate Information Bureau (PIB) presents data from 16 studies done between 1998 to 2002 which focus on the health effects of different levels of perchlorate in drinking water. The PIB is supported by Lockheed Martin, Aerojet, Tronox American Pacific Corporation, and the U.S. EPA to better educate the public on perchlorate health risks. The findings of these 16 different studies has concluded in PIB's statement that "Data from human studies shows that low levels of perchlorate being detected in some drinking water supplies have no adverse health effects on adults, children and newborns"(PIB, 2009). This claim is contradictory to all other sources, including the study done by *Journal of Exposure Science and Environmental Epidemiology* on infant formulas. The controversy centers on the amount of exposure needed to cause harm. The PIB analysis claims, "Perchlorate exposure at very high levels (somewhere above 14,000 ppb) over a long enough period of time (years) can cause thyroid hormones to drop and over time can result in adverse health effects related to the thyroid" (PIB, 2009).




*Red dots indicate perchlorate manufacturers. (image credit: http://www.epa.gov/fedfac/images/perchlorate_manuf_users_map.jpg*

However, the State of California requires drinking water to have a concentration at or below 5 ppb, and the federal law at or below 24.5 ppb. The State of California claims "level of 6 ppb is intended to prevent the very first step, inhibition of NIS (iodine)"

It seems that California has already recognized the health risks of low-level exposure to perchlorate, although the EPA has yet to deem it a regulate contaminant.

Perchlorate production in the United States began in the middle of the 1940's. As a chemical it has a short shelf life, which requires it to be disposed quickly. The majority of perchlorate disposal occurred in California, Nevada, and Utah (PerchlorateNews, 2003). Perchlorate was first monitored as a water contaminant in Southern California and the Colorado River in 1997. The perchlorate found in the Colorado River was attributed to nearby Ammonium perchlorate manufacturing facilities (EPA, 2009).

The EPA creates the Contaminant Candidate List (CCL) every 5 years, which includes a list of unregulated contaminants that have become prevalent nationwide and ones that require a national regulation. Perchlorate has been included on the CCL through several iterations and now currently is listed in the CCL3. The CCL process has several iterations such as CCL1 and CCL2 in which chemicals are narrowed down, as a method to eventually choose the most prevalent and dangerous chemicals that need to be regulated nationwide. The fact that perchlorate has made it through to CCL3 illustrates that the EPA has found some evidence on the need to regulate perchlorate. The EPA requires that a contaminate should meet 3 criteria to be considered for national regulation: 1) "The contaminant may have an adverse effect on the human health," 2) "The contaminant is known to occur or there is a substantial likelihood that the contaminant will occur in public water systems with frequency and at a levels of public health concern," and 3) "Regulation of such contaminant presents a meaningful opportunity for health risk reduction for persons served by public water systems."

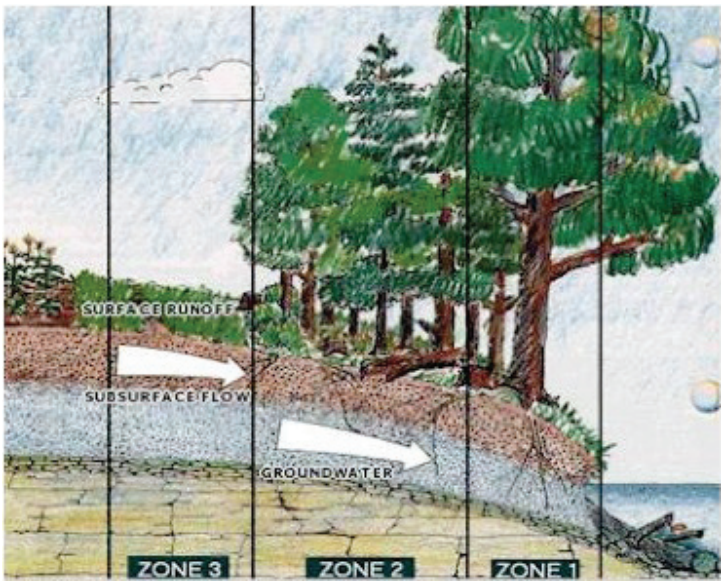
***"Perchlorate Regulation" continued on Page 19***

# Riparian Buffers: A Simple Way to Improve Watersheds

***by Bre Hashman***

As new studies are released regarding riparian buffers, it becomes clearer that they hold the potential to naturally increase the health of entire watersheds. A riparian buffer is a zone of streamside vegetation. They maintain temperature control, provide food resources and habitats for macroinvertebrates, prevent erosion, trap sediment run-off, and diminish nutrient pollution in streams (Stroud, 2008).

When trying to implement a riparian buffer, there are different methods to increase overall efficiency. The ideal riparian buffer typically exists in three zones. The first zone is closest to the stream and is an undisturbed forest which acts to stabilize banks. It also provides: leaf litter which is food for the aquatic life of the stream, streamside habitat, and shade to help control temperature variability (Maryland Cooperative Extension, 1998). The second zone is a managed forest which can consist of trees and shrubs. This zone helps prevent nutrients from entering the stream through a subsurface route. The third zone consists of native grasses and is the farthest zone away from the stream. This zone acts to stop excess sediment and surface runoff containing nutrients from entering the stream (Maryland Cooperative Extension, 1998). The wider the riparian buffer, the more likely it will be to remove significant amounts of nitrogen (EPA, 2005). Increasing the width of these three zones will aid in removing more pollutants, improving the efficiency of the riparian buffer.




*Left: A sketch of a typical riparian forest buffer and diagram of groundwater, subsurface, and surface flows.*

*Source: Chesapeake Bay Program, 2000.*

One of the greatest benefits of riparian buffers is the removal of nonpoint source pollutants like nitrates. Nitrates entering streams generally come from fertilizer runoff, originating from agricultural land use or the lawns of home owners. Nitrates are nutrients, but having too many nutrients in stream water can decrease stream health. Excess nitrates in streams are considered to be a major pollutant, resulting in eutrophication that can lead to toxic algal blooms, lowered dissolved oxygen, and loss of biodiversity (EPA, 2005). Excess nitrates in drinking water can pose a health risk for humans, potentially inhibiting oxygen uptake in infants which can lead to brain damage or death. This harmful contaminant can be removed by riparian buffers through plant uptake, microbial immobilization, denitrification, and storage in soil (EPA, 2005). Denitrification is one of the largest contributors for nitrate removal of riparian buffers. It is a biogeochemical process where bacteria in anaerobic environments transform nitrates into $N_2$ gas (EPA, 2005). Denitrification is an important process because it is one of the only ways that nitrogen can be permanently removed from the riparian system. Plant uptake of nitrogen temporarily stores the nitrates, but it is then released back into the soil when the plant dies and decomposes (Hefting et al, 2009). All of these methods of nitrate removal lead to the mitigation of nitrate pollutants in streams.

Riparian buffers are almost always beneficial in some way, but there are different conditions that could increase the nitrate removal capacity of a riparian buffer. The presence of well maintained riparian buffers at first-order streams will assist in preserving watershed water quality (EPA, 2005).

*An example of a healthy riparian buffer on the LeTort Spring Run in Carlisle, PA.*

**"Riparian Buffers" sources on Page 18**

# Agricultural and Urban Runoff has Serious Impact on Hogestown Run

*by Cara Applestein*

Although Hogestown Run is a limestone tributary to the Conodoguinet Creek and is located adjacent to the LeTort Spring Run, it is not as well-known. This may be due to the fact that the 11,359 acre watershed lies mostly in private agricultural land (Earle 2002). In fact, the watershed is 87.3% agricultural land (Earle 2002). Despite relative obscurity, according to locals, Hogestown Run is said to support a healthy trout population (Freedman 2009).

Recently, the Conodoguinet Creek Watershed Association (CCWA) became concerned about the state of Hogestown Run. There had been substantial development around the downstream section of the Run, near the Carlisle Pike (Rt. 11), and CCWA had begun to notice increased turbidity within the last three years (Freedman 2009). CCWA believed that the turbidity in the Run had come from spoil banks made by developers near Hempt Road. Rain may have percolated through the spoil banks, run into the groundwater and then appeared as cloudy water to landowners who had springs on their properties (Freedman 2009). Due to these concerns and others, including nutrient runoff, CCWA requested that Dickinson College students research the waterway. Dickinson's Environmental Studies department was able to respond to this request through its Integrated Watershed Semester, funded by the Henry Luce Foundation (Luce Semester). During the 2009 Luce semester, 17 students took aquatic science and environmental policy courses and were required to do an individual research project in collaboration with community groups. Four Luce semester students undertook the project to collect baseline data on the health and characteristics of the Run: Kerri Oddenino, Angelo Lan, Brendan Young, and myself.

The analysis was broken into four different parts. While we all collected and analyzed water chemistry data, Kerri based her project on riparian zones, Angelo focused on physical characteristics, Brendan looked at vegetation, and I examined macroinvertebrates (aquatic insects). Some water chemistry measurements (nitrates, phosphates, alkalinity, total suspended solids, and turbidity) were taken in the lab using samples collected in the field, while others were taken in the field using portable meters (pH, dissolved oxygen, conductivity, and temperature). Kerri assessed riparian zones by measuring the diameter of trees in transects and using the Natural Resources Conservation Service Riparian Assessment method to score different characteristics of the riparian zones (Oddenino 2009). Angelo conducted discharge measurements to determine the stream flow at different sites and substrate size analysis (Lan 2009). The substrate size analysis involved looking at the size of rocks along the stream bottom. Brendan collected aquatic vegetation within transects and identified the species and whether it was native or invasive (Young, 2009). I collected macroinvertebrates in the stream and scored each site based on the number and variety of species there.

*Hogestown Run is being seriously affected by urban and agricultural runoff. (photo credit Cara Applestein)*

What we found was startling. Nitrate levels were elevated ranging from 1.40-3.45mg/L and phosphate levels were slightly elevated, ranging from 0.08-0.13mg/L throughout the stream (Applestein 2009). Normal background levels of these nutrients are normally about 1.0mg/L for nitrates and 0.1mg/L for phosphates (USGS 1999). The levels of nitrates were particularly high at sites very close to the headwaters which suggest elevated nitrate levels in groundwater. We are concerned about the role of agriculture in elevating these levels throughout the stream. Although total suspended solids and turbidity were within acceptable levels throughout the stream, the levels of both parameters in the Conodoguinet Creek jumped significantly after the confluence of Hogestown Run (Lan 2009). This suggests that the Run is contributing to a great deal of the sediment load in the Conodoguinet. Many sites were also substantially affected by sedimentation (Lan 2009). High aquatic vegetation densities seemed to be correlated with siltation – excess sediment build-up (Young 2009 and Lan 2009). Of the four aquatic plants found in Hogestown Run, three were invasive 2009).

The Riparian zone analysis determined that more of the upstream, agricultural sites were impaired but surprisingly, riparian zones did not seem to be enough to protect water quality (Oddenino 2009).

The site with the best riparian zone composite score had poor water quality and a macroinvertebrate score of only 5% of the reference site (this demonstrates lack of diversity and lack of sensitive species). This site was located in the most urban area which indicates that urban runoff may be a problem that cannot be controlled simply by having a wide riparian zone. Only a limited number of macroinvertebrates families were found throughout the stream and the vast majority of these were pollution-tolerant species.

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When compared to the LeTort (a similar limestone stream), the sites along Hogestown Run only scored between 5 – 45% of the LeTort reference site for macroinvertebrates (Applestein 2009). Although the best riparian zone score at a site correlated with the worst macroinvertebrate species score, the two major agricultural sites both scored poorly on riparian zones and macroinvertebrates.

Further research needs to be done on Hogestown Run to pinpoint sources of nutrients and to quantify land use throughout the watershed. We also are not sure how the stream is affected by a quarry which discharges water into it, or by the horse farm through which the stream runs. We have collected enough baseline data, however, to tell that the stream is considerably impaired and requires further attention.

## *"Filling the Void" continued from Page 3*

This bill contains two key measures: First, it would put the fracturing process under federal regulation by removing the 2005 loophole, and second, it would require chemical formulas to be disclosed to regulators (Fracturing Responsibility and Awareness of Chemicals Act).

The regulators of the state and federal governments are just starting to frame their regulatory responses to the expansions of the gas drilling industry. The New York State Department of Environmental Conservation recently released an 800 -page report detailing the possible environmental ramifications of developing the Marcellus. The Natural Resource Defense Council, an environmental lobby group, responded to that report with 283 pages of comments pointing out where they felt that the Department of Conservation had missed information and analysis. This is good evidence that there is no consensus on the best way to go about addressing the issue posed by the gas boom.

The Pennsylvania Department of Environmental Protection recently hired 45 new well inspectors and will be opening a new oil and gas office in Scranton. Ten of the new inspectors will be based in that office (Shankman, 2010). While these new hires, the study done by New York and the bill pending in the federal government certainly offer hope that the gas drilling will be properly regulated. However, it is important to remember that the DEP lost a quarter of its budget for the current fiscal year and lost 138 staff positions last year. It seems that the regulators won't be fully equipped until the economy recovers. This means that citizens must do everything in their power to hold the gas industry accountable for their actions and to protect the water resources of Pennsylvania. For more information about what ALLARM is doing regarding the Marcellus shale boom, please see the companion article authored by Benson Ansell.

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## "Stormwater Management" continued from Page 11

Also, Carlisle encounters a unique dilemma because of its karst, or limestone, geography. Land-based infrastructure has the potential to encourage dissolution of carbonate rock, which underlies Town, causing sinkholes. As well, cavities in karst serve as conduits for water, thereby decreasing the pollutant removal effectiveness of percolation (Denton, R.K. Jr., 2010).

Philadelphia's updated stormwater management plan was submitted September 1, 2009. The 3369 page plan is currently under review by EPA regulators and environmental experts.

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## "Riparian Buffers" continued from Page 15

First order streams are head water streams—they are the origin of the watershed. Riparian buffers can lower nitrate levels in shallow ground water shortly after the buffer is planted (Yamada et al, 2007). Runoff can follow many different flow paths. It can travel by surface runoff, subsurface flow, and groundwater flow. Subsurface flow is a flow of intermediate depth: below the surface but above the water table. Riparian buffers work most effectively by removing nitrogen from surface and subsurface flows (Yamada et al, 2007).

Riparian buffers are more efficient at removing nitrates from groundwater when the flow path for the groundwater is shallow and makes contact with the roots of the vegetation of the riparian buffer (Yamada et al, 2007). Environments that foster greater denitrification lead to a greater effectiveness of nitrate removal. The presence of microbial communities in anaerobic soils, and the availability of organic carbon beneath the riparian buffers allow denitrification to take place (Yamada et al, 2007). Anaerobic soils are oxygen poor; this type of soil condition fosters microbial communities that assist with denitrification. Even if optimal conditions for nitrate removal are not present in a riparian buffer, there are still plenty of other benefits that riparian buffers can provide.

When considering options to improve stream health, Riparian buffers can assist in a variety of ways. Riparian Buffers are best management practices that mitigate the pollutants entering our waterways. Though their effectiveness at removing excess nutrients may vary, they still prevent erosion, stabilize stream temperatures, and provide food and habitat for organisms in the stream ecosystem.

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## "Blue crabs" continued from Page 5

The total economic impact in the Chesapeake Bay is projected to reach $125 million, with Virginia alone estimated to lose about $13 million between 2008 and 2011 (10). On September 23, 2009, Secretary of Commerce Carlos M. Gutierrez declared that the Chesapeake Bay had deteriorated to the point at which it could officially be titled a commercial fishery failure. As a result, Maryland and Virginia are now able to receive federal economic assistance. The federal agency, National Oceanic and Atmospheric Administration (NOAA) have provided Maryland and Virginia with $10 million each. This financial aid comes in addition to the $3 million designated by Maryland's Governor Martin O'Malley to help ease the impacts on job loss and business decline.

The protective measures taken have not been in vain. The governors of Maryland (Governor Martin O'Malley) and Virginia (Former Governor Tim Kaine) have both announced that they have seen a significant rise in the blue crab populations in their respective states. The yearly dredge-survey performed by the Virginia Institute of Marine Sciences (VIMS) and the Maryland Department of Natural Resources (DNR) has indicated that the total population increased from 280 million in 2007-2008 to 400 million in 2008-2009, with a particularly notable increase in the total number of females.

In order for the crabbing industry to continue in this region, it is crucial to rebuild the blue crab populations. Crabbing has been a distinct element of the Chesapeake Bay's culture, and the declining crab numbers threaten numerous family businesses that have existed for generations. The protection and restoration of the blue crab populations, therefore, is both an environmental and a cultural necessity.

## "Perchlorate Regulation" continuted from Page 14

The EPA published the preliminary regulatory determination for perchlorate on October 10, 2008. This required public comment and the EPA determined that perchlorate did not meet the second and third criteria for regulation. On November 12, 2008 the EPA reopened the comment period in which they received and reviewed comments from more than 32,000 individuals and organizations. Consequently, the EPA is still reviewing data and on August 19, 2009 the EPA called for "supplemental request for comment on a broader range of alternative for interpreting the available data on: the level of health concern, the frequency of occurrence of Perchlorate in drinking water, and the opportunity for health risk reduction through a national primary drinking water standard" (EPA, 2009). The public is waiting for the EPA's final decision on how to regulate perchlorate. It will be interesting to observe on which side the EPA's decision will fall in terms of the debate on how much exposure is too much.

## "Blue Crabs" Sources continued from Page 5

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Image credit http://www.dnr.state.md.us/fisheries/oxford/art/bluecrab.jpg

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# Our Graduating Seniors Reflect On Their Time at the Alliance for Aquatic Resource Monitoring


## Atandi Anyona

Working at ALLARM for three years has been quite an experience. The diversity of activities that I have been able to do have given me a foundation for whatever step I decide to take. I got a chance to do public outreach on campus, engage in public education whereby we went to various middles schools and after school programs to teach kids about water, and finally I got involved in water analysis in the ALLARM lab. In essence, ALLARM is the epitome of community service since a lot of the activities are geared to educating the community outside the campus. Having an off campus focus is one of the major reasons I have been able to continue working for ALLARM, in addition to the incredible people that you get to work side by side with everyday. I have looked around at all the other places I would have worked on campus and I can say, without doubt, that ALLARM gave me what no other campus job could have offered. It will be interesting to see how ALLARM will be like in the next couple of years.

## Maunette Watson

When I started at ALLARM my sophomore year, I had no idea that my three years at ALLARM would include some of the most rewarding experiences of my college career. Before ALLARM, I had never organized an environmental education presentation, worked in a professional lab, performed water quality monitoring, developed a newsletter, or had the opportunity to help volunteers learn the techniques necessary to monitor their streams. Now after three years, I can confidently say that I have done all of these things, plus have gained so much more. I begin my transition away from college, knowing that the experiences and skills that I have gained from ALLARM will be beneficial towards my future. I also leave knowing how rewarding it can be to work with an environmental community that works tirelessly to protect their streams and watersheds. Finally, one of the things that I will miss most from my time at ALLARM is all of the people that I have met along the way. I have many fond memories working with my co-workers, and many of my closest friends that I have today I know through ALLARM. ALLARM has in a sense become a second family to me that will stay with me even after I graduate from Dickinson, and for that and all of the above, I am especially grateful.

## Benson Ansell

Family. That is what ALLARM is to me. And like any family mutual support is necessary for success. My work over the past three years has supported ALLARM and ALLARM has supported me by giving me valuable professional work experience. ALLARM is also the support of many watershed organizations throughout Pennsylvania as well as local schools and youth programs. The volunteers who comprise these organizations are the direct support of our waterways and the children in these schools are the future. We are all a part of the web that is supporting the health of our waterways. It has been great to be a part of this web for as long as I have. During my time at ALLARM I have committed most of my work to educating students about water and watersheds. To be able to reflect upon this time, and realize that each student I worked with was another strand added to the web of watershed support, is very rewarding. So a big thank you to my ALLARM family and all the other people that hold our web together.

# 2009 - 2010: A Year in Pictures

**Right:** *Atandi Anyona '10 learns how to do nitrates at the Fall Staff Orientation at LeTort Park, September, 2009.*

**Left:** *Benson Ansell'10 teaches Bre Hashman '12 how to analyze the color wheel at the Fall Staff Orientation at LeTort Park, September, 2009.*

**Right:** *Bre Hashman '12 assists a Mid Atlantic Volunteer Monitoring Conference participant in October, 2009.*

**Left:** *Tabha Joshi '11 helps students identify macroinvertebrates at the Carlisle Parks and Recreation "Bug Party" in November, 2009.*

# 2009 - 2010: A Year in Pictures

**Left:** *Taylor Wilmot '13 and Ben Mummert '12 interactively teach a first grade class at North Dickinson Elementary School about living and non-living things in February, 2010.*

**Right:** *Cara Applestein '11 teaches a Lower Dauphin High School student how to do nitrate analysis during Ron Yerger Day in March, 2010.*

**Left:** *Maunette Watson '10, Taylor Wilmot '13, Dylan Shiffer '12, Jinnie Woodward, and Katie Tomsho '12 pose by the Antietam Creek Watershed map at the AWA Chemical Refresher in March, 2010.*

**Right:** *Julie Vastine assists volunteers in collecting macroinvertebrates for analysis with the Middle Spring Watershed Association in April, 2010.*

# 2009 - 2010: A Year in Pictures

**Above:** *Maunette Watson '10 assists with a macroinvertebrate workshop with the Middle Spring Watershed Association in April, 2010.*

**Right:** *Ben Mummert '12 (in black) instructs volunteers on how to place stormdrain markers for ALLARM's Storm Drain Marking Morning in April, 2010.*


**Upper Right:** *A storm drain marker that has been applied.*

**Left:** *Atandi Anyona '10 demonstrates the stormwater model at the LeTort Festival.*


**Above:** *G Tiarachristie '13 and Katie Tomsho '12, festival organizers, thank the Steering Commitee at the Third Annual LeTort Festival in May, 2010.*

**The 2009-2010 ALLARM staff at the LeTort Festival. Back Row, left to right**: *Katie Tomsho, Dylan Shiffer, Ben Mummert, Director Julie Vastine, Bre Hashman, Assistant Director Jinnie Woodward, Benson Ansell, Atandi Anyona.* **Front Row, left to right:** *Taylor Wilmot, Giovania Tiarachristie, Cara Applestein, Maunette Watson, Tabha Joshi, Anna Farb.*

The Alliance for Aquatic Resource Monitoring
Dickinson College Environmental Studies Dept.
PO Box 1773
College & Louther Streets
Carlisle, PA 17013-2896
717-245-1565

allarm@dickinson.edu
www.dickinson.edu/allarm

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*ALLARM, founded in 1986, is a project of the Dickinson College Environmental Studies Department. Our team of students, professional staff and faculty provides community groups with comprehensive technical support for locally-driven watershed assessments, protection and restoration. For more information visit our website: www.dickinson.edu/allarm.*

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