Water Quality in the Pike River

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November 13, 2014

Introduction:

Water, as defined by Dictionary.com, is “a transparent, odorless, tasteless liquid”, but to some, water is much more than just some liquid. At the same time, others are affecting the water quality on a local and global scale unknowingly due to what they see as an endless supply of the earth's most valuable natural resource. This "blue gold" is constantly going through the hydrological cycle, passing through an immense amount of watersheds, and nearly all the time leading out to an ocean. Watersheds bring life to an area by supplying the most needed necessity and offering a stable place to settle down. Water scarcity, urbanization, and the fact that every watershed has unique characteristics contribute to the growing international problem of water quality.

Water scarcity is an increasing problem affecting our world more and more as time goes on. When valuable resources such as water are limited, global leaders and billionaires try to help the cause but often fail by thinking too much. As said in the film *Flow*, "the world does not need a billion-dollar solution. The world needs a thousand-dollar solution in a billion different places." Water scarcity is such a fixable problem if it approached in a proper and affordable manner. Spending millions of dollars on bottled water is only going to increase pollution and land fills, but actually cleaning the water of the world will help the many people affected by a lack of the most important human right. The water in the hydrologic cycle would be much easier to maintain and clean if sediments and pollutants were never deposited into the resource, but all we can do now is stop that unnecessary contamination from happening in the future. The more we clean the water today, the cleaner it will be tomorrow. If someone facing a water scarcity had the choice between untreated and cleaned water, the sanitary choice would be of preference, but that choice is not always available when dealing with scarcities.

The scarcity problem is worsened through the act of industrialization by contaminating the limited amount of clean water available. Industrialization disrupts the indigenous habitat of the ecosystem by taking away common necessities of the habitat and adding unnecessary accessories to the area. Almost every human action results in the watershed reacting, whether it has a positive or negative effect. Construction, impermeable surfaces, and deforestation all represent negative effects on watersheds, such as being able to "change the pattern of water flow in a watershed, increase the amount of water that reaches a waterbody and allow it to get there faster without the opportunity for removal of pollutants by slow filtration through the soil", according to the Hydro-Ecology Teachers Handbook. When a body of water is altered to an unnatural state, it throws a curveball at the organisms residing in the habitat by decreasing the quality of life. Problems similar to this are being faced all over the world but to different magnitudes.

All places in the world are different when it comes to climate and culture, but people often ignore the different characteristics and problems that are unique to each watershed. For example, in the Pike River Watershed, "land cover is primarily rural, with agricultural dominant (52%)" , according to the DNR of Wisconsin. Since the river had originally started with 100% of naturality, having only half of the area considered rural isn't the most ideal proportion but then again, it's not the worst. Since different areas of Wisconsin have different problems, ranging from the proximity of animal feces to bodies of water to industrialization, the state is broken up into twenty-four Water Management Units (WMUs). If the state was to try and handle all obstacles different watersheds face as a whole, some problems would often be ignored and the health of a waterbody would have no chance at improvement. Water Management Units cooperate with one another frequently to make sure their positive actions upstream are not cancelled out by poor decisions downstream.

Water is by far the most important resource available, and sometimes unavailable, in this growing world. Drinking, cooking, and cleaning all require clean water to get their jobs done in a sanitary manner, which is where water quality comes into play. The quality of the water depends on characteristics such as water scarcity, density of urbanization, and unique properties of the watersheds globally.

Methods:

On September 25, 2014 around noon, the Harborside sophomore class traveled to the Pike River to collect water samples and perform various water tests. The seven tests that they conducted include temperature, dissolved oxygen, pH, turbidity, biotic index, habitat, and stream flow. By testing all of these aspects of the water quality, an overall water quality can be found. All of these tests affect one another in some way, which is why it is important to test every single one of these.

By testing the temperature of a body of water, it can tell us a lot about the water quality. For instance, warm water has the ability to lessen the amounts of dissolved oxygen in the river and increases respiration and the growth of plants. If the temperature of a water body has lots of inconsistent and random highs and lows, then the plants and animals in an ecosystem are more likely to be infected with disease and infectious parasites. According to the Water Action Volunteers, before actually testing and recovering water from the river, first mark the testing area and record the air temperature at that point. Then, test for water temperature in the center part of the river where water is flowing. Using a standard alcohol thermometer, submerge the measuring device about four inches below the surface of the river. Wait for about two minutes (enough time for the thermometer to have a stable reading) before taking the reading. If possible, try to record the temperature while the thermometer is still in the water. If not, fill a

cup with water and place the thermometer in it so that you are able to read the temperature at eye level. Make sure to record the temperature in degrees Celsius.

Dissolved oxygen is affected almost directly as a result of the water temperature. Cool water is able to absorb more oxygen while warm water is not able to hold as much. If there is too little oxygen dissolved in the water, the aquatic life does not have enough oxygen to survive. In result, the plants and animals will move away and in some cases, they will die. Although the average healthy range of oxygen is from 7.0-10.0 mg/L, different species are able to live off of different ranges of oxygen. To obtain the sample of water, place a glass bottle with stopper under water about one foot deep where there is an average pace of stream flow. Make sure the opening of the bottle is facing upstream so the water naturally flows into the bottle. Then, remove the stopper as water will fill the bottle. Occasionally rotate the bottle to remove an air bubbles. Replace the stopper while the bottle is under water and do not remove any excess water around the neck of the bottle. Retake the sample of water if air bubbles are present. Proceed to test the dissolved oxygen of the body of water using the standard procedure of the Hach Model 146900. Protocol for Hach Model and gaining the water sample can be found at Water Action Volunteers.

pH is an important factor when it comes to investigating the water quality of an area as it measures the acidity of the water. A healthy range for pH is between 6.5 and 8.0. If the levels are lower than this range, plants and animals are more likely to consume these toxic elements. But, if the pH is higher than 8.0, cells will begin to dissolve in result of the acids. Reproduction and diversity will be reduced and the stress of plants and animals will increase when the pH gets outside of this healthy range. Testing for pH is actually a very simple task. simply submerge the pH testing strip a few inches below the surface of the water and move the testing strip back and forth for a few seconds. Pull the testing strip out of the water and immediately compare the different areas of color to the color chart that accompanied the testing strips. Record the observations, including the colors of the testing strips.

Turbidity is a great way of seeing a snapshot of any runoff, pollution, or urbanization in and around a river. Any natural particles in a body of water are less than one millimeter in width so they usually do not affect the cloudiness of the water, but larger particles do have that capability. Those large particles can increase the temperature because of the fact that they absorb more sunlight and heat. This shortens how deep natural sunlight is allowed to travel into the river. According to the Water Action Volunteers, when collecting a water sample for turbidity testing, stand in the middle of the stream where water is flowing and face upstream. Plunge the turbidity tube about ten inches below the surface water and allow it to fill up and scoop upward when removing. Return back to the shore when testing and make sure no large particles, such as rocks or leaves, are present, remove if any. Avoid testing in the sunlight and don't wear

sunglasses. Use your body as shade if other shady areas aren't around. Suspend the water and particles in the tube by using a stirring stick of some sort. Look down the tube and see if the white and black disc is visible. If it is, record the length of the measuring tube. If not, have your partner slowly empty water from the bottom of the tube until you can just barely see the difference between the black and the white of the disc. Measure the height of the water in inches, record the findings, and dump out the water. Then, receive a new sample of water and repeat the procedure one more time. Once the turbidity has been measured twice, find the average and use the average to find the turbidity value using the transparency value chart to convert those numbers. Be sure to record the turbidity value.

Not only are macroinvertebrates essential to the food chain, but they are great for understanding the water's pollution, which is why biotic index is tested. Certain bugs and larvae that are looked for during the index search are identifiers of pollution because of their sensitivity to strong pollutants. When observing the biotic index of a habitat,be sure to be wearing proper clothing and footwear as wading in the water will be done. Enter the stream upstream and use feet to stir up the particles on the bottom often stream as the water flows into the net. Using a net, scoop up this debris. Return to the bank and empty the contents of the net into a bucket with some water inside. Repeat these steps downstream as well. Although two samples are being taken, it will make up one biotic index score. Search through the bucket with a plastic spoon and remove any organisms found and place them in their own individual ice cube tray. Attempt to identify these organisms and record them on the biotic index form.

Although quantitative data is usually preferred over qualitative data, it is good to have a little bit of both. For instance, observing the habitat of a watershed allows us to see how different land uses may be affecting the water quality.One small change in the environment could have a huge impact on the ecosystem because habitat is closely related to temperature, streamflow, and biotic index. Before beginning observations, make sure the water is safe to be around with no unusual scents or colors. Then, section off about three hundred feet for habitat data. There are two kinds of habitat: rocky bottom or soft bottom. Decide what type of ground the environment has to determine which data sheet to use. Water Action Volunteers has one data recording sheet for each of the two options. Using only one of the recording sheets, rank the habitat of the area anywhere from one to four for each category and add together at the end of a total score. A higher total score means a healthier habitat for the body of water. Riparian vegetation, bank vegetation, bank stability, channel alteration, and channel flow status are the five mini tests that are used in both rocky and soft bottom environments. Each organism in group one is four points, group two is three points, group three is two points, and living things from group four are only one point. Add up a new total using this system and divide by the number of animals found in the stream, and there's your biotic index!

Results:

Harborside Academy's sophomore chemistry block two traveled to the Pike River in Petrifying Springs on September 25, 2014 to conduct water quality tests. All results can be found in Figure 1 below.These tests were conducted around 12:00-1:20 pm while it was mostly sunny. The air temperature while they were there was 24.3 degrees Celsius with a water temperature of 17.46 degrees Celsius. The dissolved oxygen of the Pike River was measured at 7.0 mg/L, which leads to saturation of 75%. The pH landed right on level 8 on the logarithmic scale. 17.34 NTUs contributed to the reading of turbidity. The Pike River was given a biotic index score of 3.36, which is closely related to the habitat test, which received a 34 out of 52. The stream flowed at about 7.663 cubic feet per second.

Water Quality Test	Results
Water Temperature	17.46 degrees Celsius
Dissolved Oxygen	7.0 mg/L, 75% saturation
pH	Level 8 (logarithmic units)
Turbidity	17.34 NTUs
Biotic Index	3.36 index score
Habitat	34 out of 52
Streamflow	7.663 cubic feet per second

Figure 1: Harborside Academy Chemistry Block 2 Pike River Results

Discussion:

When measuring the Pike River's Temperature, a result of 17.46°C was recorded. Although this measurement was considered decent and of cool temperature, the results are inconclusive. Water temperature needs to be measured over long lengths of times to see consistency or lack there of because according to Water Action Volunteers, "stable water temperature is a critical factor in maintaining the health of a stream and its inhabitants." Therefore, random spikes and troughs in the temperature of a stream could easily throw off the lifestyle of residing aquatic life.

An average of 7.0 mg/L, or 75% saturation, of dissolved oxygen was found when Harborside Academy's sophomore chemistry block two conducted a water quality reading. This is a pretty decent and common reading of dissolved oxygen because it proves enough oxygen for trout to live healthily. According to the Water Action Volunteers, amore effective reading would have been found if

testing was conducted once in the morning and once "later in the afternoon when plants have been exposed to the most direct sunlight for an extended period".

When measuring the pH of a body of water, it is ranked on a 'level' of logarithmic levels based on the acidity. A healthy range for pH of a waterbody is anywhere from 6.5-8.0, with less than 6.5 being too acidic and greater than 8.0 being more alkaline. "Excessively high and low pHs can be detrimental for the use of water," according to the USGS Water Science School. The Pike River has a healthy reading of pH being at level 8, although leaning more towards alkalinity. Although pH does not change drastically, the reading would be more conclusive if the pH was measured before and after a rainfall to see how the precipitation may affect the river's quality; an average reading of precipitation pH is around 5.6.

"Fish and aquatic life that are native to streams have evolved over time to adapt to varying levels of background water clarity," according to the Water Action Volunteers, which is why a reading of 17.34 NTU's is alright for the Pike River. As long as the living organisms in the water are comfortable with what they are living around, the stream is considered healthy. A reading of 17.34 NTU's isn't too cloudy either, which is overall a good sign. For example, water with one to five NTU's is considered safe for human consumption.

The biotic index of the Pike River, at 3.36, is considered 'good' by the Water Action Volunteers. The stream in southeast Wisconsin has a diverse environment of macroinvertebrates. Biotic index does not guarantee the presence of absence of pollutants, but uses the groups as 'identifiers'. When testing for biotic index, organisms in group 1 are sensitive to pollutants and living things in group 4 are extremely tolerant to pollutants. This is why it is considered healthier to have more macroinvertebrates from group 1, although this does not guarantee the well being of the Pike RIver, just is a good basis of understanding.

Stream Health	Excellent	Good	Fair	Poor
Biotic Index Value	> 3.6	2.6 - 3.5	2.1 - 2.5	1.0 - 2.0

Figure 2: Information from Water Action Volunteers on Biotic Index Values

The unique Pike River was able to score a 34 (out of 52) in the habitat category. This is considered a decently conclusive reading of the ecosystem, but not perfect, because there are still signs of human interactions around the stream. It is beneficial to test habitat over the years to see changes in the habitat surrounding the stream in question. Testing for habitat can also help connections to be made between worsening water quality and changes in the habitat. "This value is an important baseline measure for future comparisons," says the Water Action Volunteers.

The Pike River flows at a rate of 7.663 cubic feet per second. Although this reading seems healthy, it is considered inconclusive. What is truly important about the streamflow about a body of water is that the habitat within the ecosystem is comfortable with the flow of things. It is also necessary to measure the stream flow after long periods of time to see consistency or lack thereof. "Tacking stream flow measurements over a period of time can give us baseline information about the stream's natural flow rate," according to the Water Action Volunteers. Random spikes or drops in the flow are not beneficial to the well being of the organisms within the water.

Overall, the Pike River in southeastern Wisconsin is considered average in water health. Majority of the water quality tests performed, such as dissolved oxygen, pH, turbidity, biotic index, and habitat, received scores that landed in the 'good' or 'average' margins. The other tests conducted, including temperature and streamflow, are considered inconclusive. When it comes to all water quality tests, especially these two inconclusive ones, all that matters is that the aquatic life living within the ecosystem are comfortable and healthy with their lifestyle.

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