Aging Pipe Infrastructure

Water main breaks account for billion in losses with respect to money and lost water. While lax maintenance and weak funding is to blame, the ones paying the price is our citizens

Tag Words: infrastructure; water pipes; bursting; aging pipes; water service project

Authors: Angela Misko, Sandra Pena, Josh Song, Karin Lee, and Victor Kim

Summary

People are so often concerned with issues like the economy, that they forget basic necessities that pose a more serious threat to our survival. The US water infrastructure is one of those problems. As the pipes that carry our drinking and waste water age, the chances of them bursting increase substantially. The American Water Works Association estimates that as many as 36 states can face serious water shortages in as little as 5 years and currently the US is in no way prepared to handle such an event. As a country we need to start putting in more effort and funding towards fixing our country's aging pipes and water infrastructure. As a group we have proposed several ways of improving current infrastructure and increasing funding for water service projects, with the aim at educating the public and politicians in charge.

Video Link

Aging Pipe Infrastructure: http://www.youtube.com/watch?v=C13OPvg_86w

The Issue: Aging Water Pipes

What is the Problem? (Karin Lee)

Each day 6 billion gallons of water is lost from faulty pipes. In the United States, there are a great number of old pipes that are reaching the end of their lifetime. As with all things, the closer the pipes get to the end of their expected lifetime, the more likely they are to break and/or need repair work. Most of the current water infrastructure has been in place since World War II. Some pipes date back to the 1800's. For example, one water main that burst last year in Manhattan was installed in 1870. There are even parts of the country that still use wooden pipes for which the installation date is unknown. Even with the newer pipes, people would think that they do not need to worry about them as much but the opposite may be true. The trend shows that newer pipes do not last as long as the old ones. According to the American Waterworks Association (AWWA),

Illustration 1: water main break in Hoboken, NJ in 2008

"The oldest cast-iron pipes, dating to the late 1800s, have an average useful life of about 120 years. This means that, as a group, these pipes will last anywhere from 90 to 150 years before they need to be replaced, but on average they need to be replaces after they have been in the ground about 120 years. Because manufacturing techniques and materials changed, the roaring '20s vintage of cast iron pipes has an average life of about 100 years. And because techniques and materials continued to evolve, pipes laid down in the Post-World War II boom have an average life of 75 years, more or less."

This means that very soon most of the pipes in the country will need to be replaced. Unfortunately, not enough funding or attention is being put forward to attempt to resolve this problem. According to AWWA, the repair and replacement costs for the water infrastructure requires an additional $6 billion to the current spending for 30 years not including making systems compliant to new water regulations or waste water systems.


Illustration 2: Car during water main break in Baltimore 2009

Every year pipes break at an alarming rate. With so many pipes breaking, a great deal of labor and money go into fixing this growing problem. For each year the problem goes unresolved, the

more money that will need to be invested in fixing it. The EPA estimates if the problem still goes unresolved, the country will have accumulated a potential funding shortage of over $500 billion.

Who is affected?

With the number of pipes across the country that are in this condition, almost the entire population is affected. It does not matter if you are in a small town or a large city. In 2007, large utility breaks in the Midwest were reported at 22,000 a year, an increase from 9,000 breaks ten years previous. Baltimore, Maryland had 1,190 water main breaks in 2003. No matter where you live there will likely be part of the water system that has not been replaced since shortly after World War II and will need to be replaced in the next decade or two.

The water infrastructure delivers water to people's homes, businesses, schools, parks, everywhere you get running water. Even if a person uses well water for daily needs, these breaks can affect major roads and other modes of transportation as they cause flooding and damage to the pavement. They cause property damage which can take weeks or months to repair if at all. With the amount of water that escapes, flooding results which can damage homes, sweep up cars, leave drivers stranded, etc. Because of the interconnectedness of the country, everyone is affected in some way. People depend on businesses and trade in order to live. Deliveries of goods cannot be made when the road is completely flooded or there is a sinkhole in the middle of the road, or the products have water damage.

Who is in Control?

There are several layers of government that oversee the water infrastructure. Congress signed the Safe Drinking Water in 1996 which includes funding for water supply improvements. The Environmental Protection Agency was placed in charge of regulating the water system in the country. The EPA monitors the use and quality of water and sets forth guidelines for others to use. Most of the emphasis is placed on water quality. "The Office of Water ensures drinking water is safe, and restores and maintains oceans, watersheds, and their aquatic ecosystems to protect human health, support economic and recreational activities, and provide healthy habitat for fish, plants, and wildlife." It implements the Clean Water Act and Safe Drinking Water Act. The specific group that implements the Safe Drinking Water Act is the Office of Ground Water and Drinking Water. It also runs the Sustainable Water Infrastructure Program. It researches ways to create sustainable infrastructure by reducing funding needs. The Office of Science and Technology issues the drinking water health advisories. Another group researching the problems with the country's infrastructure is the Aging Water Infrastructure Research Program. This lies under the Research and Development team of the EPA.

At the state level there is a division of government that monitors the water system. In New Jersey, it is the New Jersey Division of Environmental Protection. Under this is the Division of Water Supply. The Bureau of Water System and Well Permitting regulates distribution system modifications, treatment modifications, new wells, new surface water sources, and new public water systems. They issue permits to companies to properly maintain and construct water systems. The Bureau of Safe Drinking Water Implementation is responsible for ensuring public water systems satisfy Federal and State drinking water standards of the Federal and State Safe Drinking Water Acts. They respond to water main breaks by advising the public of any precautions that may need to be taken such as advising the public to boil their water.

On the city level, each water company is responsible for the upkeep of the pipes and water quality. They are responsible for monitoring their own pipes and gauging when they need to be replaced.

Containments in Water due to Pipes (Victor Kim)

Corroding iron is a hard graphitic substance that temporarily maintains the shape of the pipe wall but provides no strength. Over time this material can form pits that can penetrate the wall and cause water loss, pipe breakage and water contamination.

Corrosion:

The process of corrosion is a simple one; when two metals are coupled together there will be a flow of electrons between the two substances. Corrosion will occur at the point where positive current leaves the metal surface. Corrosion happens by two mechanisms: electrolytic corrosion and galvanic corrosion. Electrolytic corrosion is when direct current from outside sources enters and then leaves a particular metallic structure by way of the electrolyte. When current enters a structure there is usually less damage because of protection. The second type of corrosion is galvanic which results from differences in energy levels or potentials. Ultimately soil serves as an electrolyte provider so pipes underground are subject to corrosion.

Changes in soil texture, temperature, moisture, oxygen levels, organic material and bacteria are factors that contribute to pipe corrosion. Drought periods followed by heavy rain is a drastic change in environment for the pipes and causes corrosion, leading to fracture and breakage of the pipe. Broken pipes will lead to water loss, street cave-ins, sinkholes, and potholes.

Cold temperatures cause more rigid water pipe breaks. In the winter of 1995, Scarborough, Toronto experienced more than 160 breaks in one month, which calculates to about one break for every four hours for 31 consecutive days.

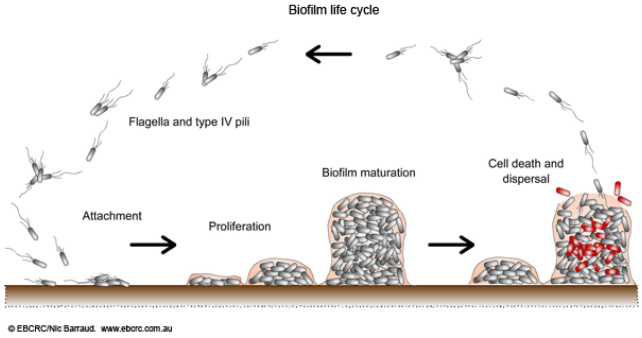
Officials installed extra protection inside the pipes such as a plastic sleeve or a cathodic screen (Water Quality and Health Council). This technique prevents corrosion on metallic structures. It can be used with materials such as: iron, steel, stainless steel, copper, aluminum, galvanized steel, cast iron, and concrete. There are two cathodic protection techniques: galvanic and impressed current. The galvanic technique was pioneered by Sir Humphry Davy in 1824. He attached zinc to the copper hulls of English ships. He observed that the zinc served as the anode was corroding instead of the copper.

One method of cathodic protection called impressed current protection uses an external DC power source to prevent oxidation of the pipe being protected. Anodes are buried in the ground and attached to the positive terminal of the power source. Next, a wire connecting the pipe and the negative terminal of the source is attached. This prevents the flow of electrons away from the pipe, preventing corrosion.

The galvanic protection method does not use a DC power source but natural anodes that will get oxidized due to electrochemical gradients. These anodes are usually made out of magnesium or zinc. In general the DC power protection system is design to deliver large currents from a limited number of anodes while the galvanic system is designed to deliver small currents from a large number of anodes.

Canadian National Research Council says that cast iron pipes are rupturing at a rate of 35.9 breaks for every 100 kilometers of pipe in service. On the other hand the newer ductile iron pipes are averaging to about 9.5 breaks per 100 kilometers.

Water breaks lead to chance of water contamination. As pipes age a collection of organic material starts to form around the walls. The composition of this organic material is bacteria and secretion by the bacteria. After attaching to the walls of the pipe, bacteria will trap nutrients and produce new colonies on top of the old layers. Some factors that increase biofilm growth are rough surfaces of the pipe wall, water temperature and pH, low chlorine level in water, and low velocities of water.



In the summer of 1996, water supply officials found *Escherichia coli* when they were performing routine sampling of water. To fight the development of microbial growth, officials increased the concentration of chlorine and flushed the pipes with high velocity liquids. When these methods don't work, officials are forced to physically remove the biofilm.

Not only does this lead to a health threat but also narrows pipes' diameter and decreased water pressure. A slight decrease in water pressure may not be obviously noticeable to homeowners but there's a different story for a firefighter. In 1996, a home caught on fire and completely burned down because the pipes were clogged with buildup that caused insufficient water pressure. To fix these problems the United States Environmental Protection Agency estimates that U.S. will need to invest about $138 billion to repair the water transportation system. At first $138 billion seems like an insane amount but the alternative is worse. A sewer line break occurred in Palm Beach County that produced 300,000 gallons of sewage water. The contaminated water was lined with dead fish and seeped into the canals of Acreage. Home owners are concerned with bacterial contamination as they wait to find out the test results.

Specific Examples in NJ (Angela Misko)

Two water main breaks in Jersey City around the same time and location are perfect examples of the dangers of aging water infrastructure. United Water sent a statement on behalf of the company saying, "The cause could be attributed to poor soil conditions in the area. The city is studying alternative solutions as part of their capital investment. United Water crews are working diligently to complete the necessary repairs." (http://abclocal.go.com/wabc/story?section=news/local&id=7254175) United Water Company claims that the water main break was due to "poor soil conditions"; however the real reason was most likely due to its agencies. The first water main break was on January 4, 2010 in Bayonne, Jersey City. The break was a cause of horrific traffic around Route 440, which was closed down

because gushing water from the 42-inch pipe began to freeze over across the roadway. (http://www.nj.com/news/index.ssf/2010/01/jersey_city_water_main_break_1.html) Due to cold weather conditions, the water froze almost instantly, creating a dangerous sheet of ice. The rupture also left many without water and temporarily cut water pressure in nearby Bayonne. (http://abclocal.go.com/wabc/story?section=news/local&id=7199390) About a week later, another water main had broken in the same location flooding streets and affecting thousands of residents in nearby apartment buildings. Jersey City communications director Stan Eason said "thousands of people live in the downtown area and those on or above the fifth floors of their buildings will experience no or low water pressure." (http://www.nj.com/news/index.ssf/2010/02/jersey_citys_newport_section_s.html) One resident stated in a news report, ""No water again…It's very annoying. It's the second time in less than two weeks. It's horrible." (http://abclocal.go.com/wabc/story?section=news/local&id=7254175

Another example of a water main break can be seen in Central, NJ in November, 2008. Boil-water advisories were in effect for nearly 20 Central Jersey towns after a rupture of a massive water main on Weston Canal Road in Franklin, NJ that detoured motorists, forced the closure of schools and businesses and affected an estimated 100,000 customers across the region. The 5-foot-wide pipe burst shortly before 11 a.m., spewing water into the Delaware and Raritan Canal and temporarily stranding on the towpath a woman and her dog who were brought to safety by a marine rescue crew. No evacuations or injuries were reported, but New Jersey American Water estimated that some 100,000 customers — from Montgomery to Linden — were affected and similar to Jersey City, the cause of the break was unknown. Authorities predicted that Weston Canal Road, a heavily traveled route, could stay closed for days, detouring drivers onto other smaller roads. In a newspaper article township police Lt. Robert Vornlocker said, "In addition to them just having to get in there and repair this pipe, there's also going to be the restoration of the road and the guide rail along the road." On a day where faucets shut off or slowed to a trickle, schools in Dunellen, Franklin, Hillsborough, Montgomery, Piscataway and Somerville closed early while many more lost water pressure, including Rutgers University's Busch and Livingston campuses and four schools in the Bridgewater-Raritan Regional School District. Irene E. Feldkirchner Elementary School in Green Brook lost use of its toilets, along with water in the sinks and fountains. Pupils were taken to Green Brook Middle School for lunch and to finish their day. Somerset County Administrator Richard Williams said county buildings —including its offices on Grove Street and the Somerset County Jail — were all affected by the break. The Middlesex County Office of Emergency Management had to implement plans to ensure adequate

fire protection for the affected towns, including the staging of three emergency water tankers for any immediate fire safety needs. At Panera Bread in Piscataway, customers were being turned away at lunchtime by a manager who said the restaurant had to close early due to limited water pressure. At a Rutgers Women's Basketball game, bathrooms were not available for use and portable toilets had been set up outside the front of the building. Meanwhile, at Nelson's Pizza in the Nelson's Corner shopping center in Hillsborough, Chef John Pattimo said dishes were piling up in the sink and could not be washed. At Maggie Moo's Ice Cream and Treatery in the Stop & Shop Center, also in Hillsborough, franchise owner Sean Bessasparis said he couldn't make additional ice cream flavors until the water pressure was fixed. Business was slow as a result, he said. Nearby Starbucks in the Nelson's Corner shopping center was told by the township's health officer, Glen Belnay, to close because the coffee shop did not have the proper water filtration system. Other business owners were told by the health department to boil water until further notice."They want us to bottle water and we don't have the ability to do that," said local Starbucks manager Chris Barton.

Sixty inch water main break on Weston Canal Road in Franklin

Precautionary measures that were taken included phone calls to residents, boil-water advisories, school closings, and business closings. (http://www.mycentraljersey.com/article/20081118/NEWS/81118015/UPDATE-Boil-water-advisories-in-effect-for-20-towns-after-Franklin-main-break) All the frustration due to a water main break could be avoided if aging pipes are simply fixed before-hand. As these examples show, there are many issues associated from these massive water leakages. Water main breaks during cold months are dangerous since they lead to icy roads which lead to more accidents and deaths. They are also dangerous since they could cause sickness due to contamination. The public health is at risk if harmful organisms enter the pipe and flow to the tap. Broken or blocked wastewater pipes can cause systems to overflow during major rainstorms or heavy snowmelt and discharge raw (untreated) sewage into local waterways. This, along with storm water discharges, especially during heavy rain falls, can pollute beaches and waterways making them unsafe for swimming, fishing, and boating. (http://www.nesc.wvu.edu/waterwedrink/articles/aging_infrastructure.cfm) Pipe bursts cause

frustration and annoyance among communities since closing roads can cause traffic jams and little or no water for residents to use. There is also no reason there should be multiple water main breaks in the same area around the same time as in Jersey City. Water main breaks are a waste of money and should be prevented. Repairing and upgrading the water grid usually involves tearing up streets. Money that is used to repair the pipe and repair the street could have been saved by fixing the pipe before it burst. Many municipalities also decide to allocate money on fixing their streets rather than their 100 year old pipes. This is inefficient especially in the situation where a water main breaks underneath a new street since you will have to repair the street after a burst anyway. The water that leaks out of a water main pipe is also a waste since it was already treated for public use. Businesses even lose money due to the fact they have to shut down their facility because of no water. Children lose time in school and therefore education is delayed. The incident is considered a state of emergency and it is the responsibility of authorities on a local, state, and government level to protect its citizens and prevent these emergencies from occurring. Not only is it happening in the New Jersey, but the United States as a whole. We can survive without electricity and smooth roads, but we'd all be dead in a week without clean water.

Why is this issue important? (Joshua Song)
What effects do water main bursts have?
What are the problems associated with certain piping materials?

Tap water can only be as good as the condition of the pipes it flows through. Therefore it is imperative that we are constantly monitoring and maintaining our water pipes. There is no question that our current water infrastructure is not only outdated but is also only continuing to get worse. According to the Environmental Protection Agency (EPA), nearly half of our water systems will be in poor, very poor or "life elapsed" status by 2020. As the pipes continue to deteriorate, they become more susceptible to burst under pressure and crack when exposed to freezing temperatures. We rarely hear about water main breaks on the news but according to the American Water Works Association (AWWA), a staggering 250,000 to 300,000 water pipes burst every year. The only occurrences that we do hear about usually involve large water mains in heavily populated areas because these often result in traffic jams and utter chaos. Unfortunately the reality is that water mains are breaking all over the country in both urban and residential areas.

On the surface, a water main break is just another inconvenience to society. Residents in the surrounding area will lose water pressure in their homes and many will be subject to a water boil advisory for weeks at a time. There are also physical damages involved including the pipe itself, the surrounding roadways, the consequent flooding and the sinkholes which have claimed the lives of numerous cars, fire trucks and ambulances. Below the surface however, there is a more important underlying health risk and concern. Excess flowing water picks up and washes away various chemicals and debris from the street, which can ultimately contaminate the exposed pipeline. Once these unknown variables enter the pipes, we really have no way of tracking them, or more importantly no way of knowing how they will react to the pipe materials / chemicals used to treat the water. These unknowns may be flushed out of the system over time or can build up and remain inside the infrastructure for ages. Contamination of the water system however does not always require a water main break or need to come from the external environment.

Internal contamination due to the type of piping material used is also another important issue with the current aging infrastructure.

Lead pipes were popular up until the 1940s, but have since been banned due to serious health concerns. Studies on children have revealed that ingesting water with high amounts of lead increased learning disabilities and behavioral problems. In adults, kidney problems and high blood pressure were commonly observed. Currently many older buildings and homes may still be connected to water mains through a lead service line. The purpose of this line is to bring the municipal water to the tap and is usually the responsibility of the homeowner or landlord. While any lead pipeline should ultimately be replaced using alternative materials, lead can still enter the drinking water through corrosion of materials such as lead-based solder (banned in the mid-80s) and brass / chrome plated brass faucets. Acidic water flowing through pipes can also facilitate the corrosion.

Since the 1940s, after lead pipes were banned, copper has been the piping material of choice. Despite having seen great success, copper pipes were eventually brought down because of their susceptibility to pinhole leaks. Pinhole leaks are extremely tiny holes that often go unnoticed for long periods of time. They not only shorten the lifespan of copper pipes but also waste water resources. In homes, leaking water from internal copper pipes has led to the growth of mold and mildew in walls and basements creating unsafe living conditions. In addition, acidic water flowing through copper pipes facilitates the leaching of copper into the drinking water. To combat this issue, an alternative to copper pipes known as galvanized pipes have been used. Galvanized pipes are essentially steel pipes with an inner corrosion resistant coating made of molten zinc. A common impurity in the zinc however is lead and it is speculated that high levels of lead may be present in many of the older galvanized pipes. In smaller-diameter galvanized pipes, rust buildup over time can restrict the flow of water and cause the water to appear rust-colored. Eventual corrosion of galvanized pipes can also lead to high levels of zinc or iron in the water, giving the water a distinct “metallic” taste.

The final piping material of great concern is the asbestos cement (AC) pipe. Like the lead pipe, AC was another widely used material that was eventually banned in 1986 due to more health concerns. Although it is common knowledge today that asbestos is a potent carcinogen, it is not unusual to see AC pipes kept in service due to the expenses involved in having to upgrade and replace them. This mainly applies to homes built between 1950 and 1980 as the use of AC pipes boomed during this time. The problem with AC pipes is that it can release large amounts of asbestos fibers into the water, especially if the water is acidic. A former industry giant, Johns-Manville came up with a simple solution to spray the inside of the pipes with a vinyl liner, hoping to create a barrier and contain the fibers. Unfortunately the vinyl liner was later found to release a chemical known as tetrachloroethylene into the water, which is now known to produce cancer in test animals.

<u>How do we fix the problem? (Sandra Pena)</u>

While there are many pressing issues surrounding our current water infrastructure, it is in no means a new problem. In fact there have been a handful of programs put in place by the federal government as a means of addressing these issues. One of those initiatives is the State Revolving Fund program.

Under the SRF Program, states are given low interest loans to be used for water and sanitation projects. The way it works is that initial capital is supplied by government grants and by contributions made by the states. The fund is replenished when states repay their principal balance, as well as the interest they have accrued. There are two types of SRF's, the Clean Water State Revolving Fund and the Drinking Water State Revolving Fund (http://en.wikipedia.org/wiki/State_Revolving_Fund).

The Clean Water State Revolving Fund program has been in place since 1987. It provides loans for the "construction of municipal wastewater facilities and implementation of nonpoint source pollution control and estuary protection projects" (http://en.wikipedia.org/wiki/Clean_Water_State_Revolving_Fund).

In 1996, the Safe Drinking Water Act established the Drinking Water State Revolving Fund program. This program is responsible for making loans available to drinking water systems to fund infrastructure improvements. Also, it received $2 billion from The American Recovery and Reinvestment Act of 2009 (http://water.epa.gov/grants_funding/dwsrf/index.cfm). However, this is not enough according to the Congressional Budget Office (CBO), the EPA, and the American Society of Civil Engineers (ASCE).

The Congressional Budget Office, which is a federal agency in charge of providing non-partisan economic data to Congress, estimates the "nation's need for drinking water investments [to be] between $10 billion and $20 billion over the next 20 years" (http://www.infrastructurereportcard.org/fact-sheet/drinking-water). However, in their report on transportation and water infrastructure, the CBO calculated that in 2007, water transportation and water resources accounted for merely 5 % of expenditures for transportation and water infrastructure at all levels of government (http://www.cbo.gov/doc.cfm?index=11940&zzz=41381). The conclusions derived by the CBO are not unique; in fact another *government* agency arrived at a similar conclusion.
The Clean Water and Drinking Water Infrastructure Gap Analysis issued in 2002 by the U.S. Environmental Protection Agency (EPA) recognized potential funding gaps between projected needs and spending from 2000 through 2019. They estimated, for this 20-year period, a gap in funding which could amount anywhere from $45 billion to $263 billion, clearly, surpassing the CBO's more modest estimation. The true amount is dependent on spending levels for drinking water capital expenditures as well as operations and maintenance. (http://www.infrastructurereportcard.org/fact-sheet/drinking-water).

Lastly, the ASCE released their most recent Report Card for America's Infrastructure in 2009 and also reached the same consensus as both the CBO and EPA. They gave drinking water systems in the US a grade of D-. This is the same grade from their 2005 report, as well. They projected spending over the next 5 years to be at $146.4 billion. However, they estimated the total need to be at $255 billion; this leaves an estimated difference of $108.6 billion (http://www.infrastructurereportcard.org/fact-sheet/drinking-water).
All is not lost though, according to all three agencies. There are some possible solutions to the problem of our failing water infrastructure. The most obvious of these is increased funding. The ASCE proposed three different strategies to address the financial gap in the current funding. They were:

- To increase funding for water infrastructure system improvements and associated operations through a comprehensive federal program;
- To create a Water Infrastructure Trust Fund to finance the national shortfall in funding of infrastructure systems under the Clean Water Act and the Safe Drinking Water Act, including storm-water management and other projects designed to improve the nation's water quality;
- And lastly, to employ a range of financing mechanisms, such as appropriations from general treasury funds, issuance of revenue bonds and tax exempt financing at state and local levels, public-private partnerships, state infrastructure banks, and user fees on certain consumer products as well as innovative financing mechanisms, including broad-based environmental restoration taxes to address problems associated with water pollution, wastewater management and treatment, and storm-water management.

http://www.infrastructurereportcard.org/fact-sheet/drinking-water
Some other possible solutions include implementing an asset management plan, educating the public, and finally, research.

An asset management plan is one used by organizations to help manage and maintain their assets, in particular their infrastructure. This plan can be used to determine what types of pipes we have currently, where they are, what condition they are in, and how long they are expected to last. The asset management plan is also a useful tool for the financial planning that is intricately tied to success of the infrastructure
(http://www.nesc.wvu.edu/waterwedrink/articles/aging_infrastructure.cfm)

Having this information available also makes it possible to educate the public. One of the most common misconceptions held by politicians is that funding cannot be increased because taxpayers will oppose the idea. However, surveys taken by ITT Corp showed that Americans were willing to pay an average of 11 percent more on their water bill each month in order to ensure a clean water supply. The Value of Water Survey, the name of the nationwide poll, measured the public's awareness of the nation's aging water infrastructure. The result of this survey is evidence that the key to gain the public's approval is educating people about the gravity of the issue at hand. (http://www.smartplanet.com/people/blog/pure-genius/aging-water-infrastructure-wastes-17-trillion-gallons-a-year/4826/)

Another option undertaken by the EPA is that of research. Currently, the EPA has launched their Aging Water Infrastructure (AWI) research program, which is part of EPA's larger effort called the Sustainable Water Infrastructure (SI) initiative. Under this program, the goals are to "improve management of infrastructure, helping utilities to recognize the full cost of providing service over the long term, promoting water efficiency in the residential and commercial sectors, and integrating watershed management principles and tools into utility planning and management practices. (http://www.epa.gov/nrmrl/pubs/600f07015/600f07015.pdf)
Undoubtedly, more attention needs to be placed in this often-ignored issue. There are some strategies available to those in power to bring about the change needed to ensure the quality of our water systems, but for whatever reason the issue has been on the backburner. The truth of the matter is that, while economies can crash and gas prices can skyrocket, humans can only survive a week without water.

The Service Project: Raising Funding

Bettering water infrastructure is a huge undertaking for the simple fact that different aspects of its management and maintenance are overseen by different entities. The federal government, state and local governments, and private institutions are all responsible for at least one area of water infrastructure. However, it is these private companies that are solely in charge of mapping and maintaining our water infrastructure. Due to the number of water main breaks and the amount of money it is costing our citizens, it is easy to conclude that they have not been successful thus far with the increasing maintenance required by our old pipes.

Originally our plan was to encourage mapping of the current water infrastructure as a set point for the government to begin tackling the issues associated with old pipes. Upon research and many phone calls too many different officials, we discovered that private water companies are in charge of the maintenance of the pipes and mapping itself. This information could not be disclosed to us for security purposes.

Therefore, we put forth an online petition urging for increased governmental involvement and also increased regulation of these waterways. The website will include information pertaining to the issue of our failing infrastructure as a means of educating our citizens of the reality we all might face in the near future. Also, the website will include a video that will illustrate the seriousness of the issue. Lastly, the petition is also available so then people can electronically sign it. After a substantial amount of people have signed it, then we will send it to our representatives in government to educate them about the issue, as well as, show them how important this issue is to our citizens. In order to complete this petition, our group needed to find out how to write a petition and get in contact with many officials from the county of Middlesex and the

<u>Petition</u>
We the citizens of New Brunswick, New Jersey, petition the city to allocate more funding towards water infrastructure maintenance and repair. There are many health and financial issues associated with water main breaks. There have been many concerns with the quality of water mains located across the United States since a lot of them are over 100 years old. Since New Brunswick is a large city serving over 50,000 people, it is important that the water supply and pipes that carry the water supply be of the best quality. Some of the money spent on fixing streets should be allocated towards fixing the city's water infrastructure such as pipes. This will prevent the loss of money sue to water that was wasted since it was already treated. It will also prevent health risks associated with contaminated water. These current issues on aging water infrastructure are much more pressing than fixing the city's streets and therefore should have a higher priority and receive more funds.

Name	Address	Phone Number	Signature

Website http://ourwater.webs.com/

References

Royte, Elizabeth. *Bottlemania: Big Business, Local Springs, and the Battle over America's Drinking Water*. New York: Bloomsbury USA, 2009.

http://www.nj.gov/dep/watersupply/

http://www.epa.gov/nrmrl/pubs/600f07015/600f07015.pdf

http://www.nytimes.com/2009/04/18/us/18water.html

http://www.awwa.org/files/GovtPublicAffairs/PDF/Dawn.pdf

http://water.epa.gov

http://www.wpbf.com/r/25665922/detail.html

http://waterandhealth.org/drinkingwater/safewater.html

http://www.bushman.cc/pdf/corrosion_theory.pdf

http://abclocal.go.com/wabc/story?section=news/local&id=7254175

http://www.nj.com/news/index.ssf/2010/01/jersey_city_water_main_break_1.html

http://www.nj.com/news/index.ssf/2010/02/jersey_citys_newport_section_s.html

http://www.mycentraljersey.com/article/20081118/NEWS/81118015/UPDATE-Boil-water-advisories-in-effect-for-20-towns-after-Franklin-main-break

http://www.nesc.wvu.edu/waterwedrink/articles/aging_infrastructure.cfm

http://www.sciencedaily.com/releases/2007/08/070823141100.htm

http://curaflo.com/ResourceCenter/HistoryOfPipingMaterials.aspx

http://www.epa.gov/nrmrl/news/092009/news092009.html

http://www.scgov.net/environmentalservices/water/utilities/documents/PinHoleFAQ.pdf
http://nsf.org/consumer/plumbing/index.asp

http://www.waterencyclopedia.com/Hy-La/Infrastructure-Water-Supply.html

http://www.doulton.ca/asbestos.html

http://en.wikipedia.org/wiki/State_Revolving_Fund

http://en.wikipedia.org/wiki/Clean_Water_State_Revolving_Fund

http://water.epa.gov/grants_funding/dwsrf/index.cfm

http://www.infrastructurereportcard.org/fact-sheet/drinking-water

http://www.cbo.gov/doc.cfm?index=11940&zzz=41381

http://www.nesc.wvu.edu/waterwedrink/articles/aging_infrastructure.cfm

http://www.smartplanet.com/people/blog/pure-genius/aging-water-infrastructure-wastes-17-trillion-gallons-a-year/4826/

Editorials

Aging Infrastructure: A Hidden Problem

Everyone knows how precious water is to humankind and how important it is we take care of our water supply because it is essential to life. What will happen in a few years if the pipes that deliver our water keep breaking? What if they all broke around the same time? In a 2009, according to the EPA there are an estimated 240,000 water main breaks each year in the United States. In 2010, that number has increased to an estimated 540,000 water main breaks. Since many of America's water industry infrastructure date back more than 100 years, it is not a surprise as to why there are so many water leakages. There are still wooden pipes being used in South Dakota, Alaska, Pennsylvania, New York City, and Boston, MA. There are many places still using asbestos cement pipes such as Davie, Fl. The city council actually approved the continued use of AC pipes because it was too costly to replace them, yet the city council could make a purchase of $12.5 million to purchase the land where the pipes reside. The USEPA and WHO claim that the water is "safe enough" however it is known that AC pipes degrade under the influence of additives like chlorine and fluoride, deadly microscopic asbestos fibers are released. There have been many health issues related to the use of AC pipes. So not only are pipes breaking at an alarming rate, but pipes that cause health risks are being allowed to stay. After a leak, the public health is at risk if harmful organisms enter the pipe and flow to the tap, but the water that is lost due to the leak is also a waste of money since it was already treated before the pipe burst. Broken or blocked wastewater pipes can also cause systems to overflow during major rainstorms or heavy snowmelt and discharge raw (untreated) sewage into local waterways. The dangers of the nation's plumbing are everywhere. Much of the water infrastructure we rely on today was installed after World War II and this equipment has reached the end of its useful life

and needs to be repaired or replaced. A new federal stimulus law in 2009 provided $6 billion for water projects, with $2 billion of that directed to drinking water systems. However a report released in April 2009 by the E.P.A. estimated that the nation's drinking water systems require an investment of $334.8 billion over the next two decades, with most of the money needed to improve transmission and distribution systems. There might be a higher demand in money for repairs than can be funded, but this should be expected and the money should be allocated to pipe locations one at a time so the issues can be fixed. Mr. Van Epps, a contractor, said, "The oldest cast-iron pipes, dating to the late 1800s, have an average useful life of about 120 years. For cast- iron pipes installed in the 1920s that drops to about 100 years. Pipes put in after World War II have an average life of only around 75 years. The point is that all three vintages of pipe will need replacement in a short amount of time. Repairing wood pipe can be fastidious work that combines carpentry with plumbing." Because many municipalities spend their scant resources on more visible needs, like street work, rather than on costly pipe repair and replacement, the problems that will face this country in due time are tremendous and very underestimated. Planning ahead saves time and money. It is understandable that not all pipes and water infrastructure will be fixed over night, but with all the money that is being granted for these purposes there is no reason to wait until pipes burst to fix them. States and local authorities should be taking action before the pipes break to prevent the trouble afterwards. The AWWA and ASCE implemented a three-phase program to address physical infrastructure needs for water supply with the aid of a grant from the USEPA. Their program is made up of guidelines for protecting the public from potential malevolent acts and other threats by enhancing the physical security of water and wastewater infrastructure systems. While this is great news, there is nowhere in the program that says the importance of re-placing old pipes. Of course the infrastructure of the country's water system should be a top security priority, but terrorist attacks should not be the only thing authorities and regulators are worried about. Not only are water main break a loss of money and treated water, the quality of water itself should be the biggest issue at hand. It should be the responsibility of the EPA and each individual state to make sure their water supply infrastructure, which includes facilities as well as pipes, are up-to-date so that they do not burst. Taking preventative action is the best way to ensure that money will not be lost, and that treated water is not contaminated or wasted. Funding for water infrastructure needs to stop being wasted on things that do not need the repair such as old streets. The money needs to be put where it belongs, which is to replace and fix pipes that have met their life expectancy.

-Angela Misko
To: eletters@starledger.com

Invest In Pipes Not Bottles

The EPA sets strict standards for water purification and testing procedures, and the majority of the country's water systems meets or exceeds federal standards for health and safety. So why is it that despite having the luxury of clean water available on tap, people still prefer to purchase and drink bottled water? The answer is in the pipes.

When people think of tap water, they think of muddy rivers, polluted oceans and even sewage water. The reality however is that tap water is probably just as clean if not cleaner than most bottled water. Municipalities by law are not only required to conduct various tests and meet

standards, but they also need to report their results. Bottle companies on the other hand claim to do their own private testing but ultimately are not subject to federal standards. Therefore if tap water can be proven to be just as good as or even better than bottled water, something must be going on with the pipes for people to be afraid of drinking it.

Not many people know or care about water pipes because they are hidden, hard to access, and expensive to repair. We tend not to care until they burst and require immediate action. This can be said for both homeowners and city officials alike. According to the AWWA, between 250,000 and 300,000 water mains break each year. Currently there are various types of piping materials in service across the nation and some have been banned decades ago. Steps have been taken to replace these pipes but the expenses involved have delayed many of them. Even pipes that are safe for water delivery still have the ability to corrode and build up rust over time. They need to be carefully monitored, maintained periodically and most importantly replaced when nearing the end of its life expectancy.

We are meticulous when it comes to purifying our water yet we fail to care for the condition of the pipes that deliver this clean water to us. Just because we cannot physically see the pipes doesn't mean that we should assume they are fine. We should also not assume that tap water is dirty or unsafe to drink. Instead of wasting money on bottled water we need to invest more in upgrading and maintaining our water pipe infrastructure because it is sad to see all that clean drinking water go to waste.

-Joshua H. Song
To: yourviews@app.com

Water, an essential part of life many of us take for granted. We use it freely and do not realize it is a limited resource. The American Waterworks Association (AWWA) estimates that 36 states may face water shortages in as little as 5 years. The fact is that fresh clean water is limited and every year much of it is wasted before it even reaches our houses.

Each day 6 billion gallons of water is lost from faulty pipes. The pipes in this country are old and as with anything that is used, the number of breaks increases as they reach the end of their life. There are parts of the country that still use wooden pipes. Most of the current water infrastructure has been there since World War II; one water main that burst last year in Manhattan was installed in 1870. The trend shows that newer pipes do not last as long as the old ones. According to AWWA, "The oldest cast-iron pipes, dating to the late 1800s, have an average useful life of about 120 years. For cast- iron pipes installed in the 1920s that drops to about 100 years. And pipes put in after World War II have an average life of only around 75 years." This means that very soon most of the pipes in the country need to be replaced. According to a report from the EPA released in 2007, 240,000 water main breaks occur each year. Last winter, Warren, Michigan had 107 water main breaks in one month.

Besides being a gross waste of water, these breaks cost a great deal of money. Last year the Massachusetts Water Resources Authority estimated the repair of one water main break cost over $572,000. The city of Somerton, Arizona was able to replace approximately 35% of their water distribution system for about $3.5 million. Compared to how much repairs cost, replacing the water mains does not cost much.

In addition to the problems associated with the pipe breakage, these deteriorating pipes may also pose a health risk. The health risks involved with lead have been known for many years. Lead pipes are no longer used and lead leaching requirements were revised under the Safe Water Drinking Act in 1996. However many older homes may still have lead service lines. Many areas also still use asbestos cement pipes. A town in Florida recently approved leaving the asbestos cement pipes in place after originally deciding to remove them. These pipes release asbestos fibers as they degrade. The rate of degradation increases in water treated with chlorine and fluoride and also acidic water. While only airborne asbestos has been proven to cause mesothelioma, it is better to ere on the side of caution.

It is clear that the current situation in water infrastructure needs to be addressed as soon as possible. The pipes are aging and breaking at an alarming rate causing high costs in property damage and repairs as well as health risks. More attention needs to be put into the water infrastructure.

-Karin Lee
To: hntletters@mycentraljersey.com

The Truth about Our Water

Out of sight, out of mind. That is the phrase that sums up most Americans' feelings on important environmental issues. In this age, people are mainly preoccupied with more visible concerns such as the economy, terrorism, and immigration reform. However, according to the American Water Works Association (AWWA) it is estimated that in as little as five years, as many as 36 states will face serious water shortages.

Due to such factors like rising sea levels and shrinking aquifers, the United States is in a critical position to not only procure more freshwater sources, but also maintain our current water infrastructure. However, last year alone there were approximately 240,000 water main breaks in the US, which, according to the AWWA, adds up to about 6 billion gallons per day. In addition, some experts believe that the problem is actually getting worse. The main reason for these breaks: our aging water systems.

Much of the US water infrastructure was put in place after WWII, however, in cities such as New York, Philadelphia, and Boston there are wooden pipes that date back almost 200 years. Pipes this old are a significant cause for concern since according to the Environmental Protection Agency's Aging Water Infrastructure (AWI) research program the number of breaks increases substantially near the end of the system's service life.

With the passage of the federal stimulus law, the federal government has attempted to help fix the problem by providing $6 billion for water projects, with $2 billion of that being allotted for drinking water systems. However, it is nowhere near enough to help our deteriorating water supply systems. According to the American Society of Civil Engineers, it would take a yearly investment of $14 billion for our drinking water systems in addition to the $19 billion a year for sanitation water systems to maintain our infrastructure. Over a 20-year period, this would amount to over $1 trillion.

While these numbers are staggering, the alternative is much direr. Water lost from water distribution systems amounts to 1.7 trillion gallons per year and costs our nation $2.6 billion per year. Also, broken or damaged pipes pose a potential public health risk if harmful organisms or

toxins were to leak into the pipes, therefore our water. If these pipes are wastewater pipes, they can cause sewer systems to back up; in fact, up to 3,700 illnesses a year are attributable to wastewater that has overflowed into our water systems.

Undoubtedly, more attention needs to be placed in this often-ignored issue. While economies can crash and gas prices can skyrocket, humans can only survive a week without water.

-Sandra Pena
To: oped@nytimes.com

Water Waste

To most people living in the United States, water coming into our homes is expected to be clean and safe for drinking. By law, water is tested at the source, which falls within the limit of contaminants that are "safe" for usage. Of course if the source water is clean then the water coming out of our faucets has to be clean. Why would it be otherwise? If it's underground, nothing can affect the water; this is a common misconception. Water breaks may contaminate our drinking water as well as waste a large amount.

The hard truth was seen in Haiti as hundreds lay dead and thousands sick from a terrible cholera outbreak. Cholera is an infection of small intestines caused by a bacterium that survives through an animal's digestive process (Vibrio cholera). Excreted into the environment, this bacterium contaminates drinking water and food. Haiti had failed to implement necessary filtration systems that would prevent the spread of bacteria.

In the United States, our water supply is monitored for several bacteria and regulated so that the numbers fall within the non-health threatening concentrations. All of these measures are efficient at first glance, but what happens if this clean water contaminated by external sources? In 2009, there were 240,000 water main breaks in U.S. that leaked 6 billion gallons of water a day, totaling up to 1.7 gallons of water a year. Why do citizens of Haiti have to suffer from disease while 6 billion gallons of water is being wasted every day? The breakages are due to old and worn out pipes that had been laid out long ago. Some parts of the United States even use wooden pipes to deliver water to the public. The material plays a large part in contributing to the number of main breaks but aged pipes are extremely detrimental. Weather is fickle and can change drastically within a few years. One must take precautions and take aging into consideration prior to water breaks. The United States budget in 2010 allocated 41 billion dollars to Highway Administration while the Pipeline Safety Administration received merely 164 million dollars. That's calculates into a 250 times more budget expenditure towards highways than our water system. Taking our current water system and budget into perspective, more money needs to be allocated towards pipeline safety in order to decrease clean water wasting. We need to cherish our clean water the way that Haiti inhabitants would.

-Victor Kim
To: letters@nypost.com