STORMWATER MANAGEMENT; THE RELATIONSHIP BETWEEN IMPERVIOUS COVER AND FLOODING

Most of what we talk about when we refer to "stormwater" or "wet weather" management is in regard to pollution and prevention. That's because it's a pretty significant problem. It's also historically been the most obvious and urgent issue needing to be addressed for the sake of human health and the environment.

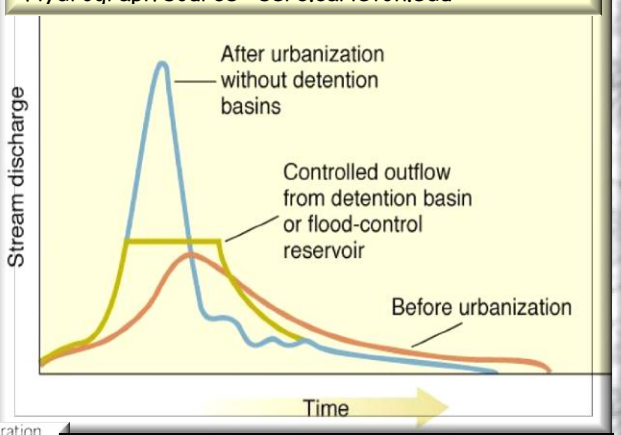
But there is another very important element that is increasing in significance in both frequency and intensity, and that is the dynamics of water quantity relative to urbanization.

Because of our cleverness, humanity has lived exploiting our hubris, expecting that we can engineer our way around natural processes. We've actually done a respectable job of doing so. And that is part of the problem. We are so used to being successful, that we have ignored the potential for risk in our decision making practices. Highly industrialized and urbanized society is extremely young when measured against hydro-geologic cycles. And hydro-geologic cycles will occur with or without our permission. We can tame nature, but only within the confines that she allows.

We can ignore the impact that we are having on these cycles and continue to suffer the consequences. Or, we can learn the lessons that nature has been trying to teach us and adjust our thinking and actions about how we live on this earth. As with all things environmental and stormwater related, it's significantly more cost effective to prevent than to mitigate an impact after the fact. We know what works, what we need to stop doing, and what we need to do more of. It's time we just do it. .

A hydrograph is a plot of discharge as it relates to time. It is a linear graph representing a volume of water as it passes a particular point. In the hydrograph to the right, the difference between naturalized infiltration and the response of a river to a slug delivered as a result of urbanization is represented.

Hydrograph source: serc.carleton.edu



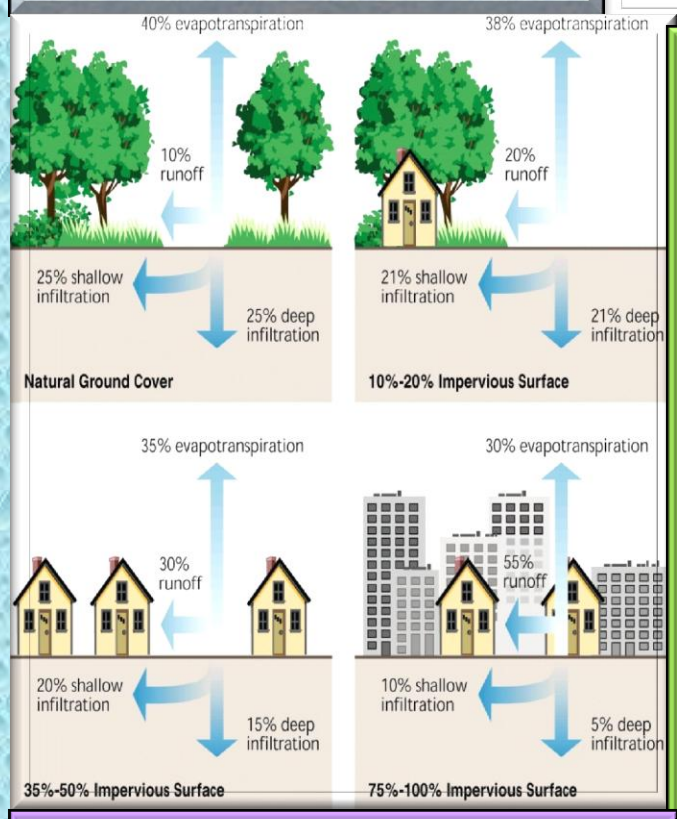
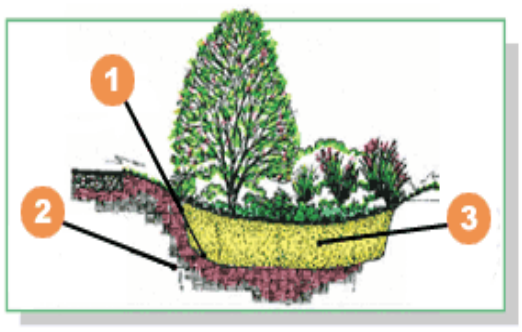


Diagram Source: www.lifestyle.familyfeatures.com credits the Natural resource conservation service.

Impervious cover (IC) in a watershed results in increased surface runoff and decreased infiltration. As little as 10% IC can result in stream (and watershed) degradation. Once IC exceeds 25%, returning the river to its natural state of water quality cannot be achieved. Data supports the divisions of IC ranges being 5-10% shifting from sensitive to impacted, 20-25% transition from impacted to non-supporting and 60-70% transitions from non- supporting to urban drainage. Because increased flow is more erosive, there is an increase in riverbed and bank scouring as well. http://www.chesapeakestormwater.net/all-things-stormwater/the-reformulated-impervious-cover-model.html

According to the Center for Watershed Protection, studies indicate that the size of one-hundred-year floods (or floods that have a one percent chance of occurring in any given year) can potentially double in watersheds with impervious cover levels greater than 20—30 %. www.cwp.org

What is Green Infrastructure? Quite simply a series of structures that rely on enhancing natural processes to help mitigate the impacts of urban centers on our watersheds. These structures including rain gardens, buffer strips, green roofs, infiltration basins, riparian setbacks, no mow zones, and grassy swales are designed to increase the infiltration rate and quantity of precipitation as close to the source as possible. Enhancing effectiveness includes plant density and types (such as hydrophilic), and construction of berms or swales that direct runoff to these structures. Soil type, porosity and compaction also affect infiltration rate, so green structures are most efficient and effective in accomplishing their intended task, when designed specific for a site. Proper placement of several structures where they can intercept runoff can even be used strategically to mitigate larger areas to help reduce local incidence and intensity of flooding. See. http://www.lightimprint.org/



1. No liner or geotextile fabric allows the in-situ soils to infiltrate to their maximum capacity.
2. In-situ soils must have a high porosity to allow runoff to infiltrate at a rate of greater than 1"/hr
3. Soil Medium consisting of 50-60% sand, 20-30% top soil, and 20-30% leaf compost allows a high infiltration capacity

Diagram Source : City of Chicago bioinfiltration page http://www.cityofchicago.org/city/en/depts/water/supp_info/conservation/green_design/bioinfiltration_raingardens.html

Impervious Cover; The devil we know…

Kids study the hydrologic (water) cycle in elementary school now. They learn that when it rains, water soaks into the earth to feed the rivers and lakes and groundwater aquifers. Some of the water is taken up by plants; some of it is lost to evapotranspiration, sublimation, or evaporation, and the cycle continues for eternity. What they fail to learn is what happens when that cycle is interrupted, and that humans in heavily urbanized areas have interfered with that cycle at an alarming rate.

It started out innocent enough. Waterways provided the most efficient means of transporting people and goods at the beginning of the 19th century. Urban centers logically located along major rivers, foolishly in the riparian flood zones. The development of the railroad allowed this trend to progress outward, initiating sprawl. The limits of water storage and transportation were the next hurdles to overcome, and due to funding through the National Reclamation Act of 1902, this was achieved, increasing development. Pollution at city centers, affordability on the outskirts, and expansion of the highway systems after 1956 intensified trends in growth.

As early as the 16th century, levees and dams were being utilized as tools to stabilize living with the river. Over time they supplemented sprawl by providing hydroelectric power. Despite the obvious benefits in harnessing rivers, no precautions were taken to fully address the looming risks. We can't eliminate floods; but we shouldn't perpetuate risky practices such as ignoring well recognized effective setbacks in recharge zones, riparian buffers and flood plains. Proper risk management demands on honest discussion that sets limits on where and how we develop, without sway.

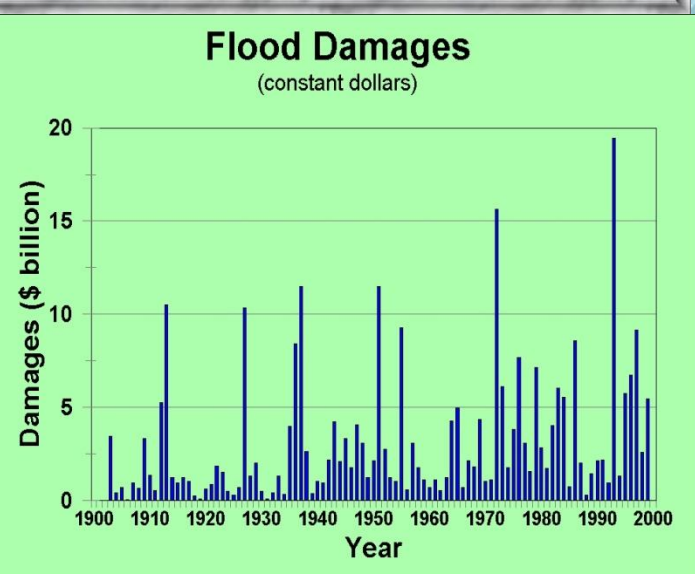
As a nation we rely on growth for economic stability. We rely on earth changing activities that shift the hydrologic balance, while more often than not, excluding practices known to help mitigate the impact we create in the process. When we do say "no" we get sued over private property rights, despite these "rights" should never trump responsibility to the greater good.

Because infiltrated precipitation moves laterally to feed the water level of our rivers and lakes, as well as vertically to feed ground water aquifers, the gradual nature of the process results in less pronounced rises in water level. As we increase the percentage of impervious surfaces, we interfere with this process exponentially. Instead of a portion of the precipitation recharging the aquifer, being utilized by vegetation and the rest gradually reaching rivers and streams, it gets channelized to enter our water bodies in large concentrated slugs causing spikes in water level. The flow exceeds the natural channels capacity and results in flooding. To make matters more extreme, we have filled or eliminated more than 35million acres of wetlands nationwide. On top of naturally treating pollutants, they efficiently dampen the effects of flooding by providing storage until our rivers and lakes can accept the increased flow. In Michigan more than 70% of shoreline wetlands have been lost to development; In SE MI, more than 60%. Baselines of rivers and lakes have dropped from loss of ground water infiltrate. Because these levels are legislated, they're artificially maintained by the DNR, masking true impact. The result? Flooding occurs on a regular and expected basis. And the incidence and intensity, loss and expense increases, locally and nationwide.

Despite this, we continue to enact legislation that ignores the simultaneity of cause and effect; ignores the economic stress resulting from the loss; ignores the human suffering. We continue to rely on a system of economic growth that is in direct conflict with the impact it creates, because the expense associated with impact far outweighs the supposed growth.

Society needs a paradigm shift. Our leaders must adopt wisdom. Conservation isn't an abstract concept of being green; it's about human health and safety, economic stability, and human rights. It's about effective stormwater management which includes expanding green infrastructure into every corner of every watershed.

There is no one single agency within the U.S. that is responsible for keeping track of flood loss data so all numbers are approximate. This may be one reason why there is no coordinated response that attempts to address the base cause of flooding directly.



Graph source; http://www.weather.gov/hic/flood_stats/Flood_loss_time_series.shtml