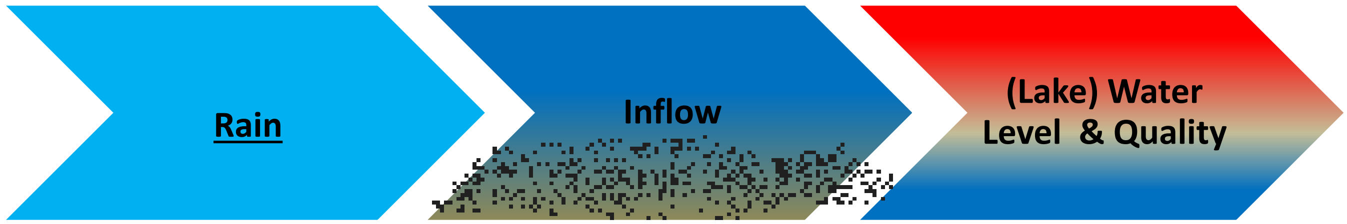
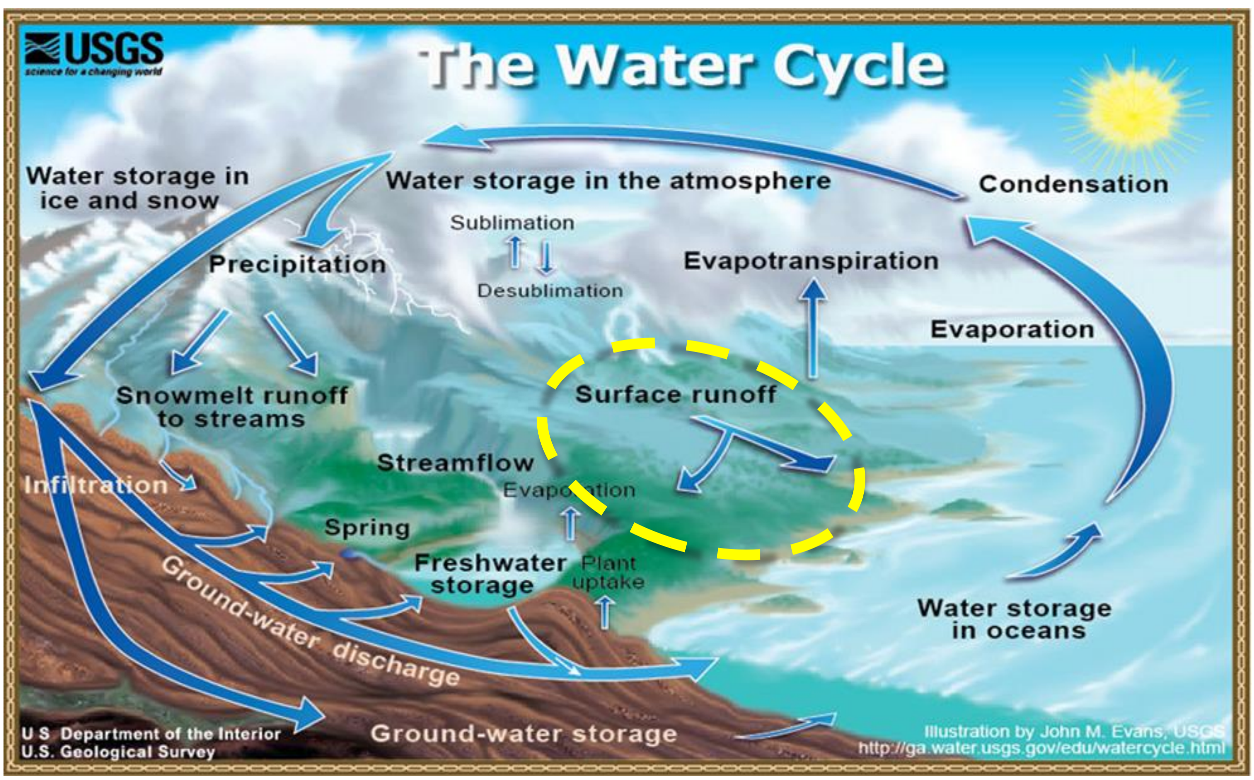
Stormwater 101-The Problem

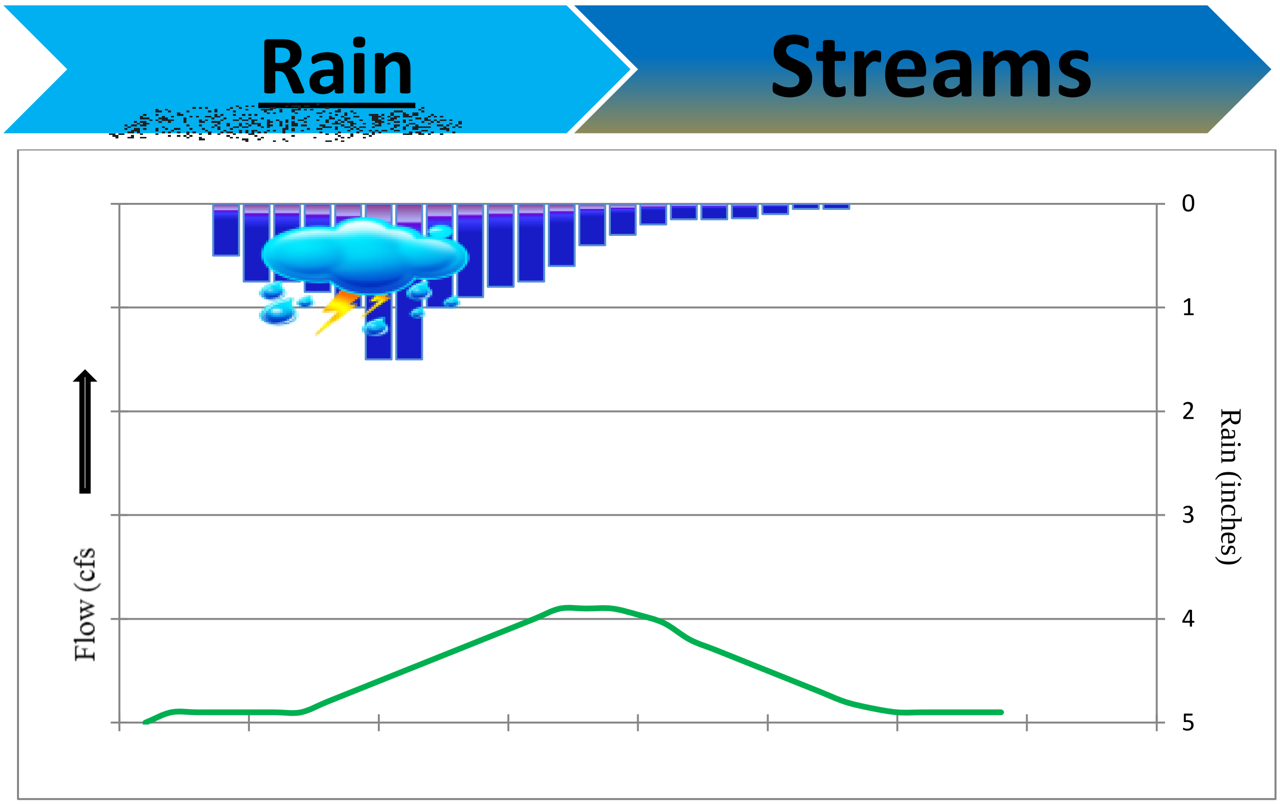
Here we want to understand the connections from rain to stream flow to water quality at the end, usually in a lake



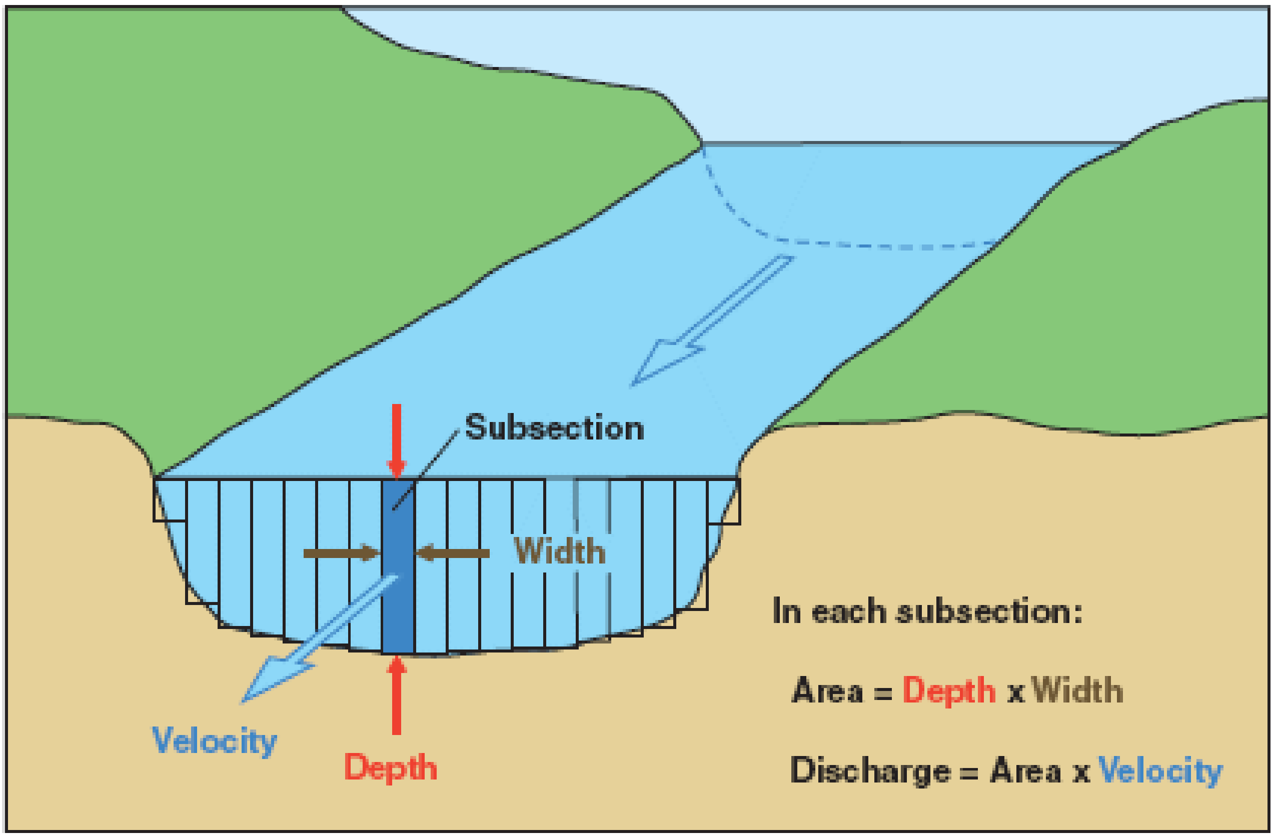
Let's go back to our water cycle, but now let's focus specifically on Surface runoff. This is the part of the water cycle that looks at when rains fall, to when water reaches back to a receiving body of water, either a lake, or the ocean.



What happens to rain when it falls down, and after it reaches the land and flows into a stream? How does it behave in the stream? How does it move in the stream? Typically, there is a delay in a stream's response to rainfall. Waters rise AFTER a rainfall, as runoff surges into streams, and recede slowly as the flow moves downstream.

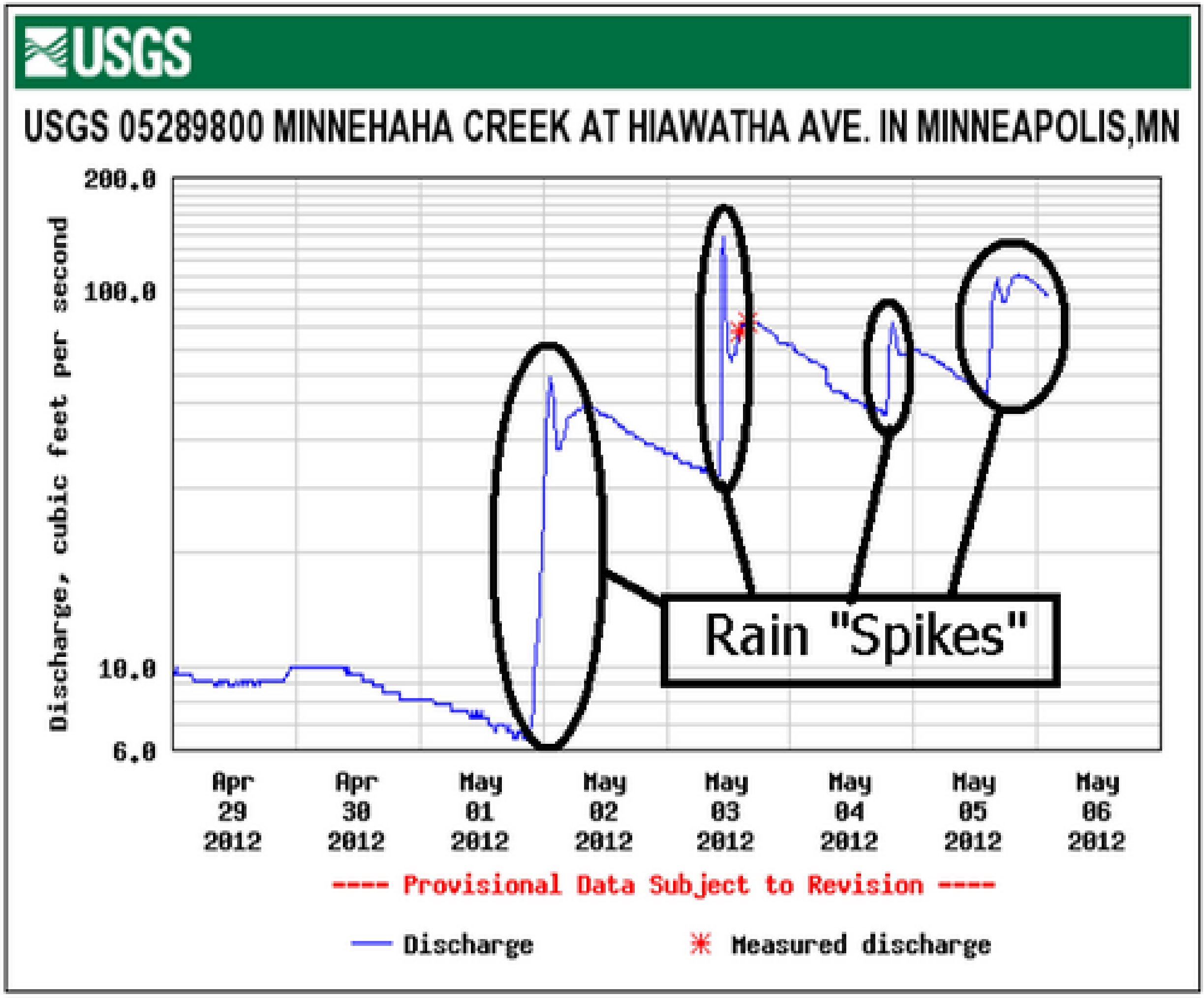


The diagrams below illustrate how we measure flows in a stream. To determine the rate of discharge, or how much water is flowing into a receiving body, you will need to calculate and include the depth of the water, the width of the channel, and the velocity at which the water is moving.



Current-meter discharge measurements are made by determining the discharge in each subsection of a channel cross section and summing the subsection discharges to obtain a total discharge.

Here, you can see how rain “spikes” can change the flows in river or stream.



Learning Activity

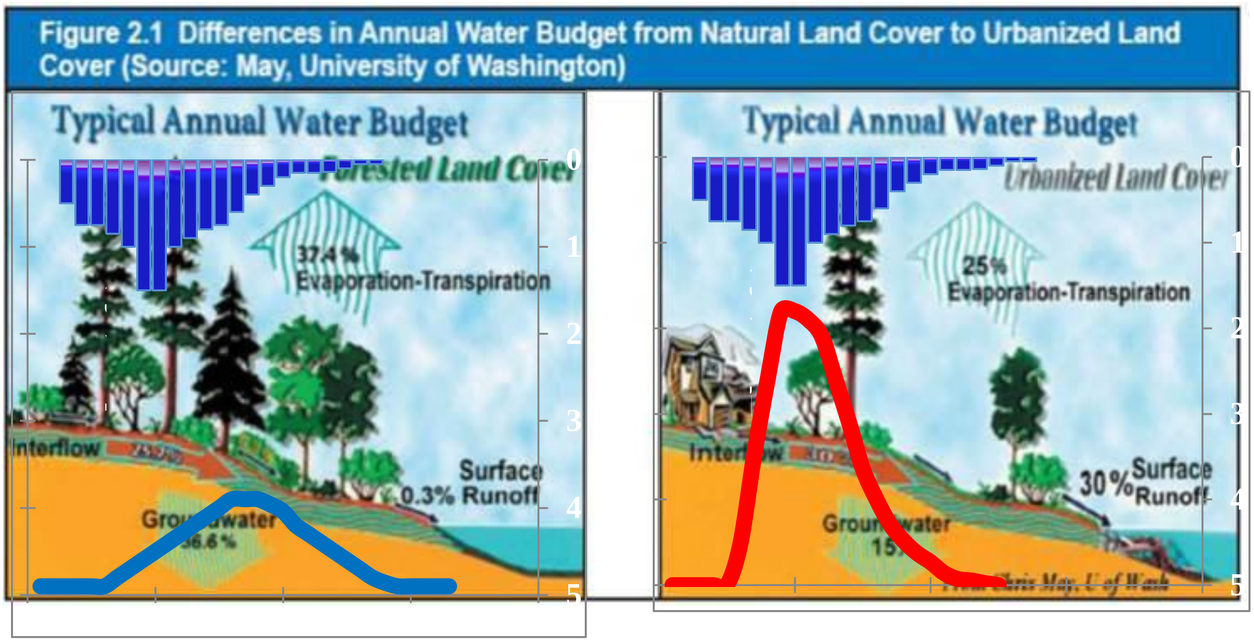
Take a look at this [news report of how the Minnehaha Creek responded]() to the high levels of rainfall we experienced last spring-

Many things can affect how it rains and how rain reaches a stream: the meteorological and physical (or landscape) characteristics as shown here with one example from each category. Each of these factors has an influence on how rainfall moves across the land, into a stream, and eventually into a receiving body of water.

Meteorological factors	**Physical characteristics**
Type of precipitation (rain, snow, sleet, etc.)	**Land use,** or the extent to which a landscape is developed
Rainfall **intensity**, amount, duration, distribution	Vegetation, **Soil** type,
Direction of storm movement	Drainage area, Basin shape
Precipitation that occurred earlier and resulting soil moisture	Drainage network patterns Ponds, lakes, reservoirs, sinks
temperature, wind, relative humidity, and season	Elevation, Topography, slope

http://ga.water.usgs.gov/edu/watercyclerunoff.html

Below is an example of how the physical landscape changes how water moves across and through a landscape. Water moves very differently through the stages of the water cycle as more of the surface of the land is paved, or developed in some way. In this example, surface runoff increases from 0.3% in an undeveloped scenario, to 30% runoff in a fully developed urban setting.

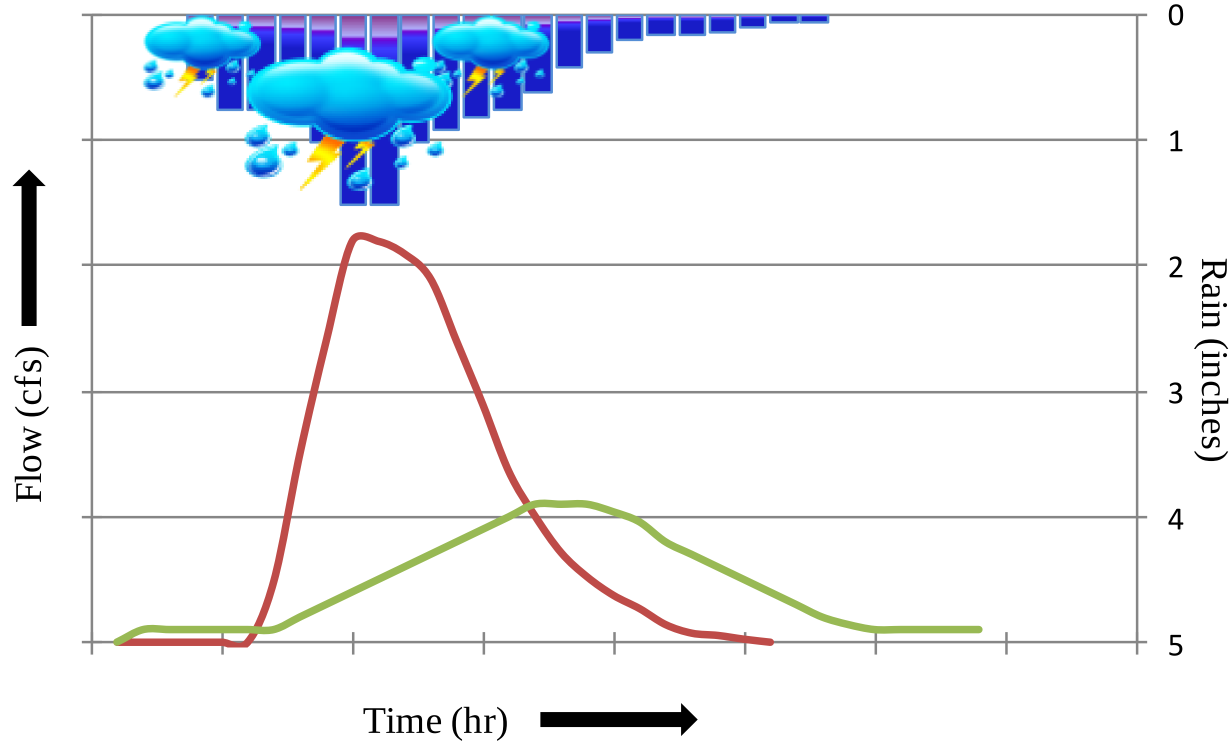


So as it rains, we have more flow in the streams. And flow behavior is influenced by the extent to which land is developed, rather than being left in its natural state. Flow spikes as runoff increases. Simply put, land use affects how water flows.

In the video you watched previously, you saw an example of the spike in flows in the Minnehaha Creek after high rainfall levels. What was unique about that rain spike is how long it took for the waters to recede.

Excess runoff is the main driver of the three challenges we face with stormwater, and ultimately, clean water:

- Volume- Too much runoff
- Rate- Moving too fast
- Quality- Washing everything on the land surface down stream



Volume (too much)

Quality (degradation)

Rate (moving too fast)

It is fairly easy to picture the consequences of too much water (flooding) moving too fast (erosion) But what about the quality? We can't always tell the quality of water by looking at it.

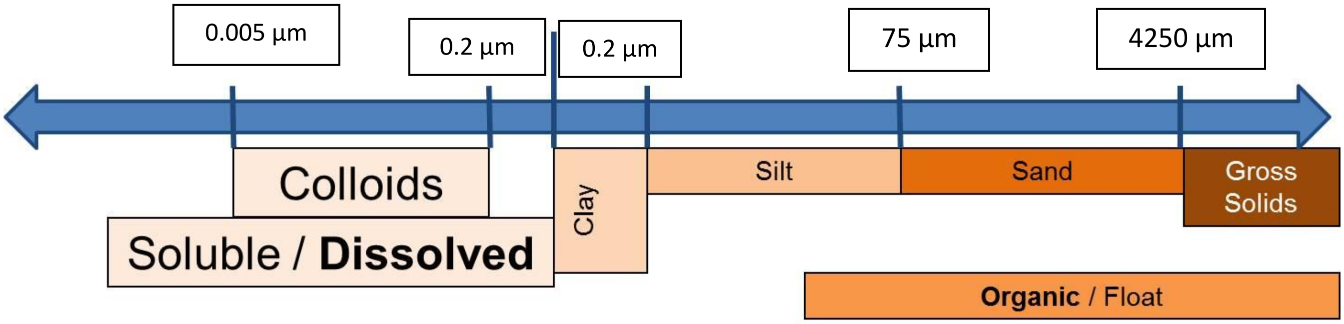
Water Quality is influenced by three factors:

Physical factors: Change of water temperature, turbidity (suspended solids), and we can also include both rate and quantity (volume) in this category as well;

Chemical factors: Sediments and metals, nitrogen, phosphorus, chemical compounds, personal care products;

Biological factors: Animal and pet waste, microorganisms.

It is VERY important to categorize what is in the water by the size of the particle. If particles are smaller than 2 microns (2 um) It is considered to be a **dissolved** pollutant. If a pollutant is larger than 2 microns (2 um) we call that a **suspended** pollutant, or "there are things in the water."



Moving from Problem to Solutions

So, now we know that excessive runoff can create these problems, but how do we minimize these issues?

By making policies (rules) that can protect us and set standards. That process began in 1972 with the passage of the clean Water Act.

FEDERAL WATER POLLUTION CONTROL ACT

(33 U.S.C. 1251 et seq.)

AN ACT To provide for water pollution control activities in the Public Health Service of the Federal Security Agency and in the Federal Works Agency, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

TITLE I—RESEARCH AND RELATED PROGRAMS

DECLARATION OF GOALS AND POLICY

SEC. 101. (a) The objective of this Act is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. In order to achieve this objective it is hereby declared that, consistent with the provisions of this Act—

(1) it is the national goal that the discharge of pollutants into the navigable waters be eliminated by 1985;

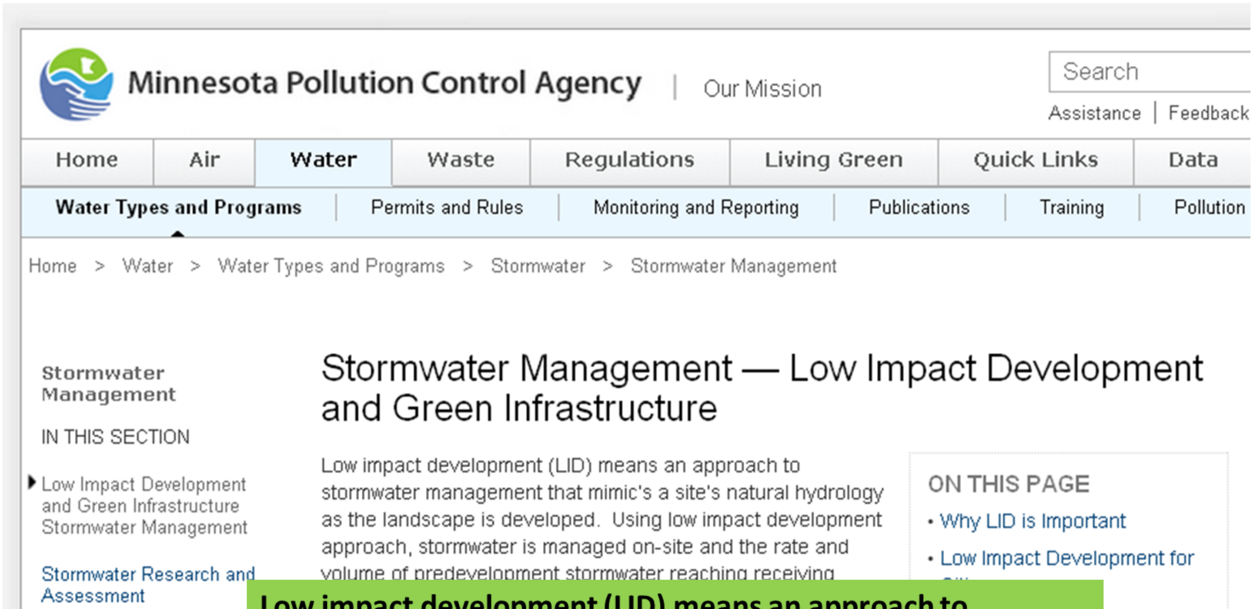
(2) it is the national goal that wherever attainable, an interim goal of water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water be achieved by July 1, 1983;

(3) it is the national policy that the discharge of toxic pollutants in toxic amounts be prohibited;

(4) it is the national policy that Federal financial assistance be provided to construct publicly owned waste treatment

We are also developing new and better methods of managing stormwater runoff at national and local levels. Green infrastructure is one of the more recent innovations in thinking about how cities plan and manage development and land use.

In all cases the solution appears to be that we need to mimic nature!



Low impact development (LID) means an approach to stormwater management that <u>mimic's a site's natural hydrology</u> as the landscape is developed.

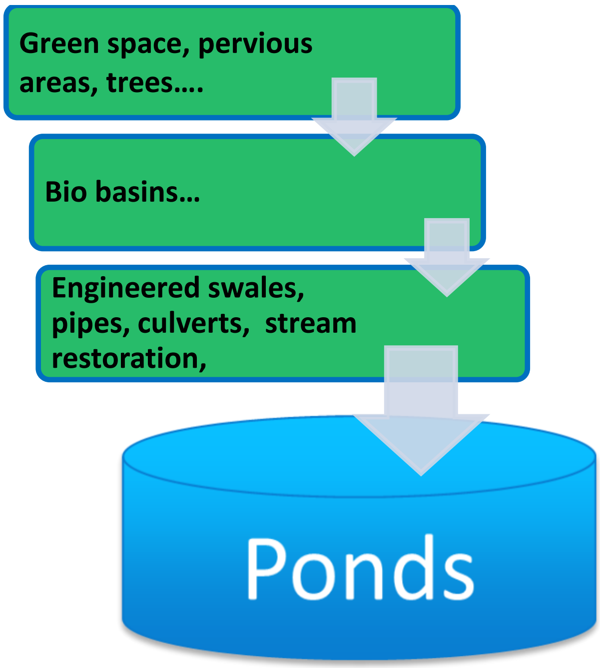
Minnesota Statutes 2009, section 115.03, subdivision 5c

Before we can mimic nature, we need to understand

- What are the functions of a natural drainage system?
- What are the components of a natural drainage system?
- What is a constructed drainage system?
- And what are the proper) components of a constructed drainage system that mimic the **functions** of a natural drainage system?

Natural drainage systems have:

Constructed drainage systems have:



More specifically, what we need to mimic (or bring back into our constructed system) is the **function** of natural systems. Below are some examples:

Landscape	
vegetation, trees, forest , rocks ,..	**Green space, pervious , trees….**
Low spots	
Puddles, floodplains, wetlands,…	**Biobasins, raingardens, …**
Conduits	
Springs, Brooks, streams, creeks	**swales, pipes/culverts, stream (rest.)**
Storage	
Wetlands, lakes,	**Ponds**

So then we can design like nature—But we need to mindful of two things; using a watershed approach to planning and designs that keep climate change in mind.