

# Effects of Urbanization on Hydrology

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Presentation for Land Use and Water Quality a conservation  
workshop for elected officials and staff June 3, 2008

By permission, adapted by Dennis J. Brinkman in conjunction  
with Sediment and Erosion Control on Construction Site.

# Percent impervious for common land uses



**Agriculture = 1.9%**



**2 Acre  
Residential = 10.6 %**

# Percent impervious for common land uses



**1 Acre  
Residential = 14.3 %**



**1/2 Acre  
Residential = 21.2 %**

# Percent impervious for common land uses



**Light Industrial = 53.4 %**



**Commercial = 72.2 %**

# Components of Impervious Cover



Impervious areas do not allow water to infiltrate as it otherwise would naturally.

# How land use affects hydrology

40% evapotranspiration

10% runoff

25% shallow infiltration

25% deep infiltration

Natural Ground Cover

30% evapotranspiration

55% runoff

10% shallow infiltration

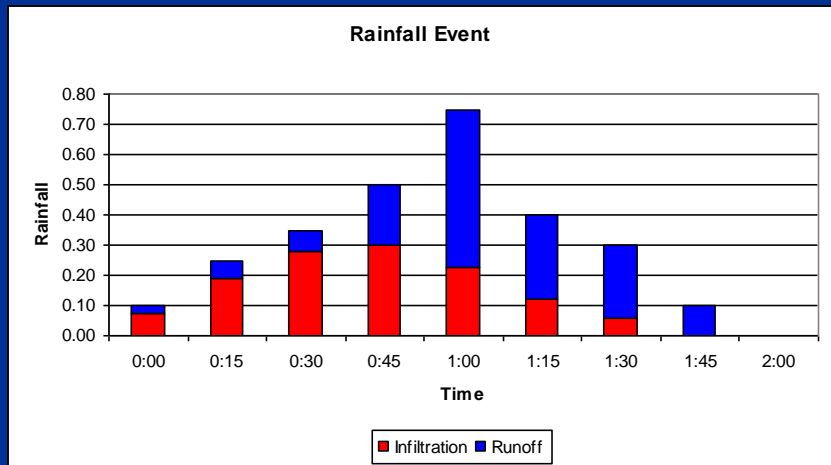
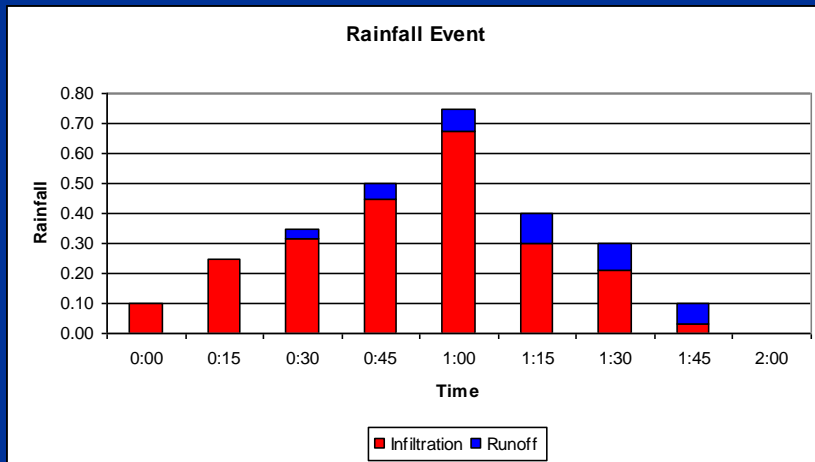
5% deep infiltration

75%-100% Impervious Cover



# Rainfall Event Over an Undeveloped Watershed

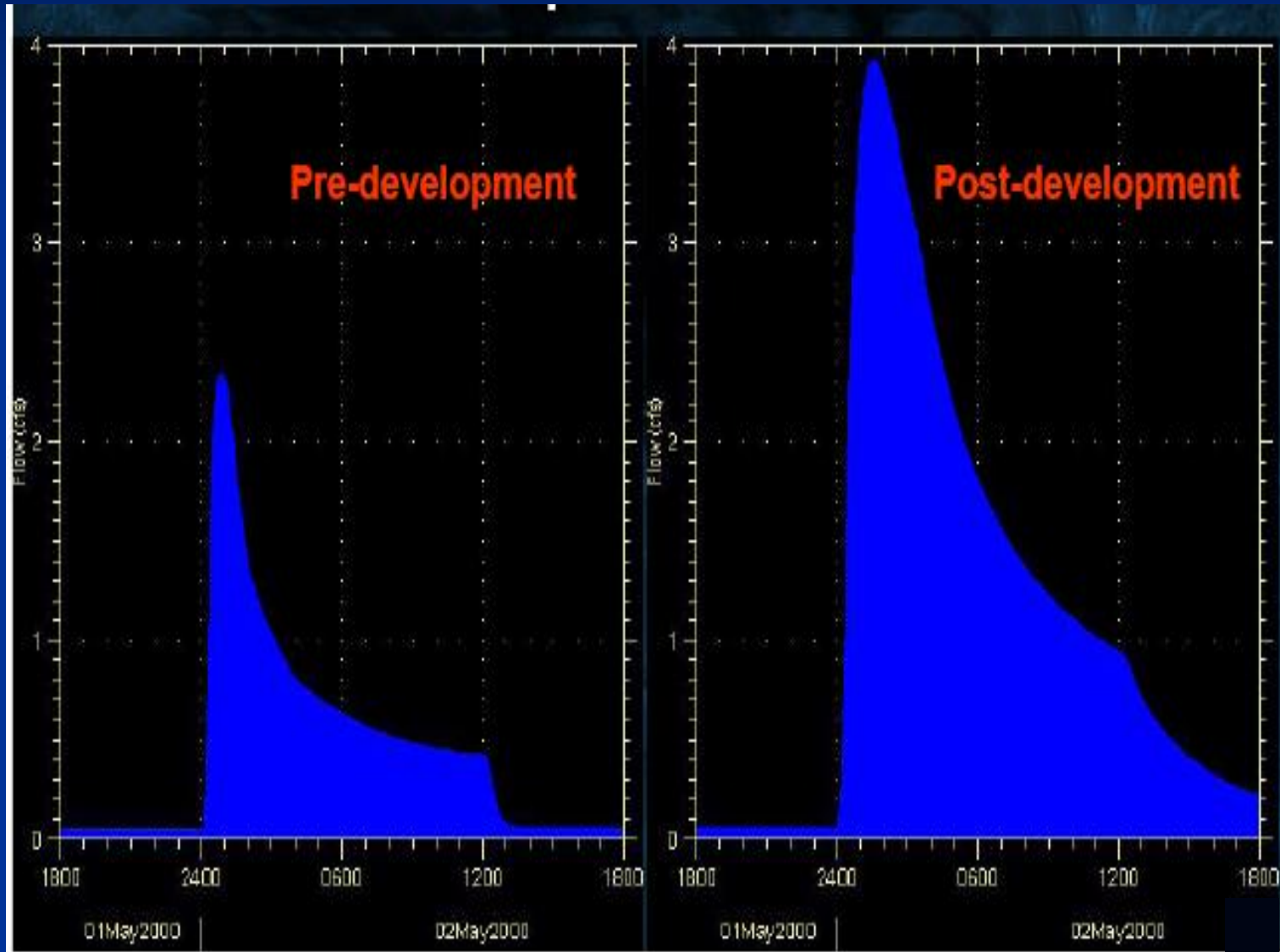
# Rainfall Event Over a Developed Watershed



Before development occurs ~ 10 – 15% runoff

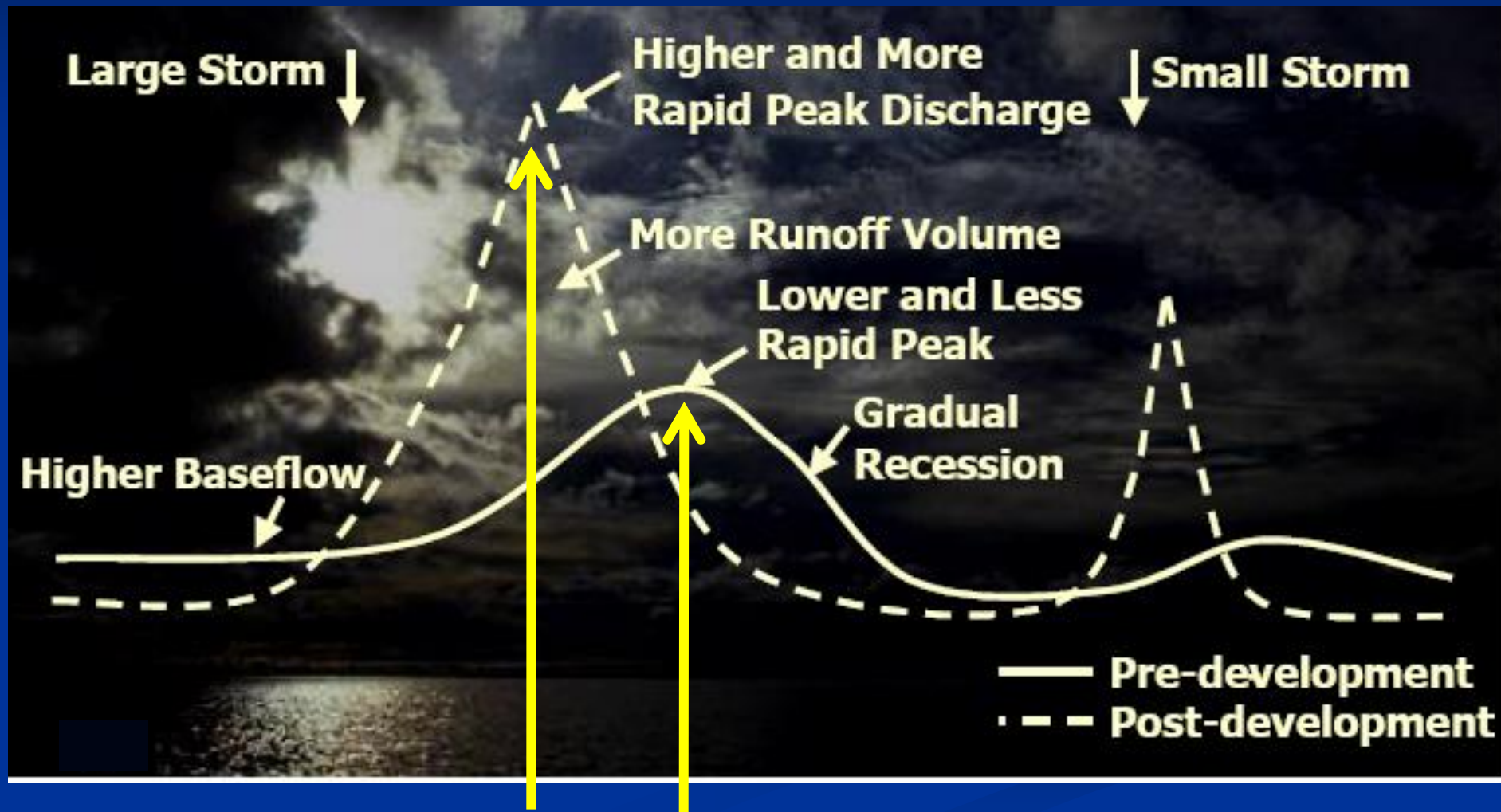
After development occurs ~ >50% runoff

# Increase in stormwater runoff





# Stream Response



Stormwater concentration and acceleration increases with development

# Impact of Urbanization on Stream Hydrology

## Increases:

- Volume of runoff
- Velocity of runoff
- Peak flow
- Deposition of pollutants
- Time of concentration changes

## Decreases:

- Ground water recharge
- Base flow
- Water Quality
- Stream stability

A rainfall event that used to cause the water to rise to a certain level every couple of years now causes the water to rise to that level every six months

# Flooding

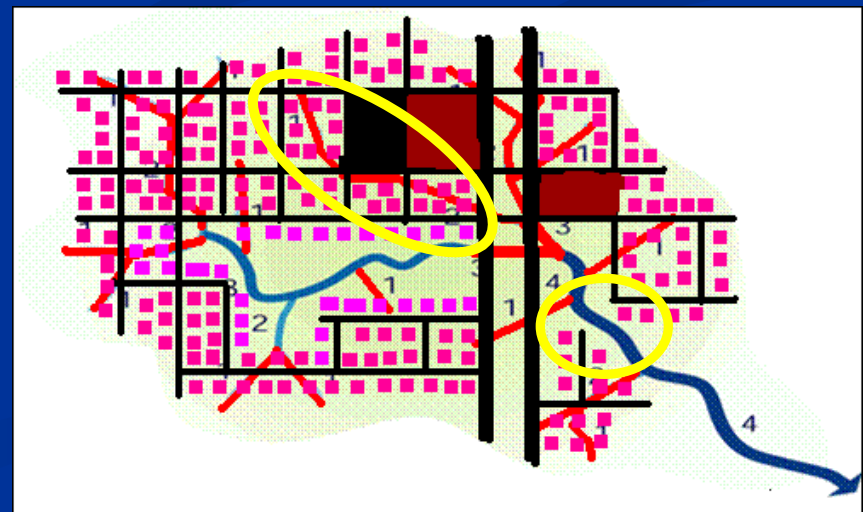
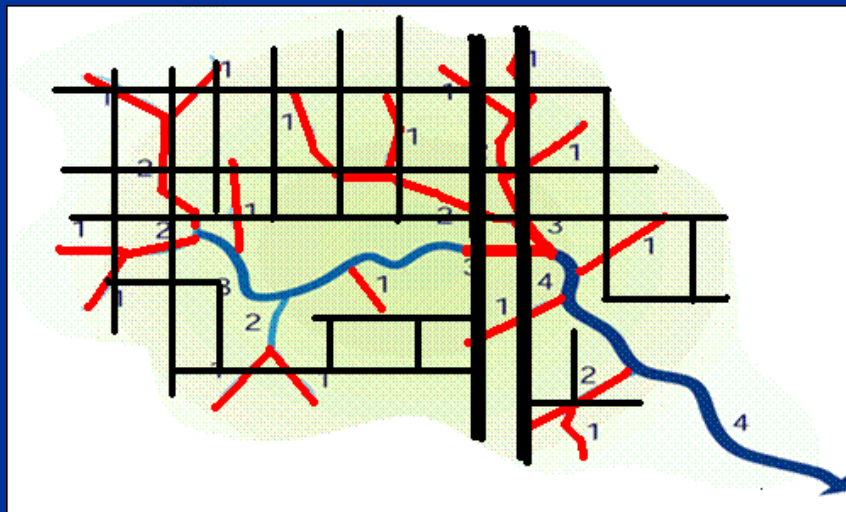
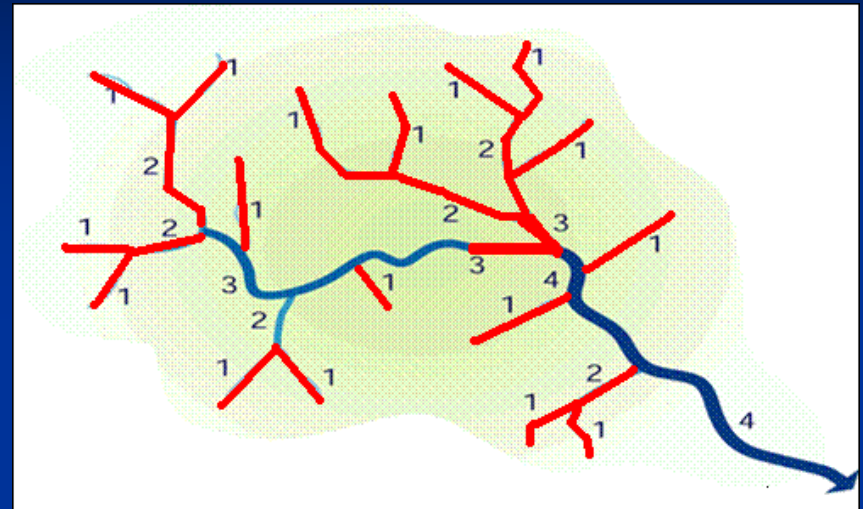
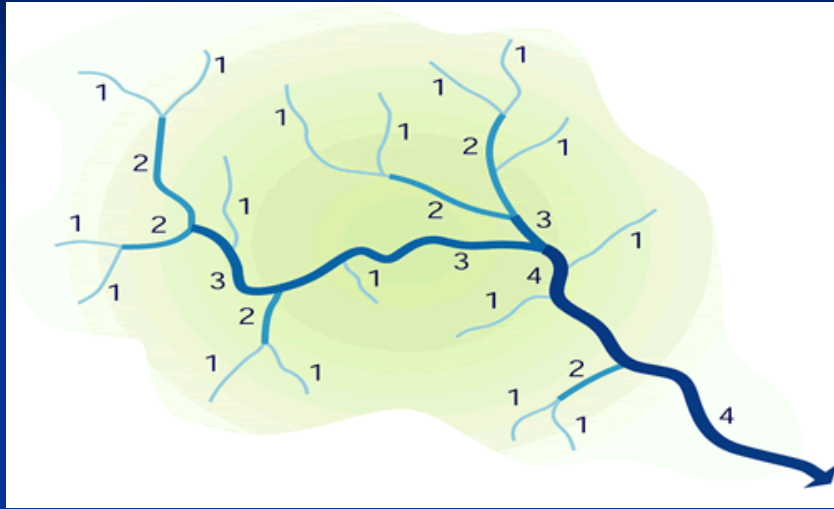
The misunderstanding or myth has been carried forward through the years is that to solve a flooding issue you want to channel and speed up the water.

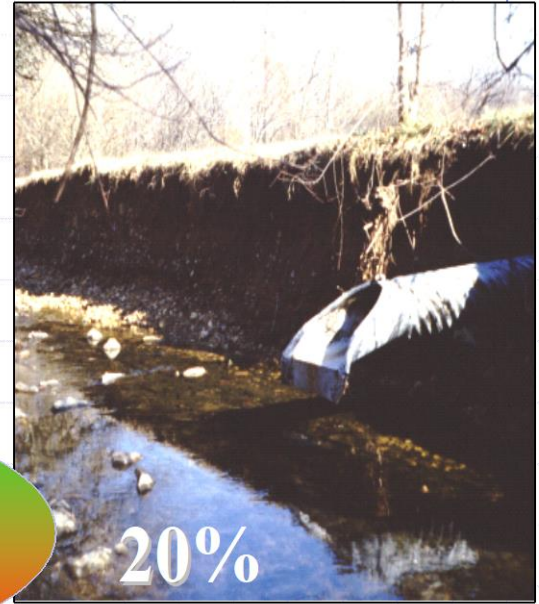
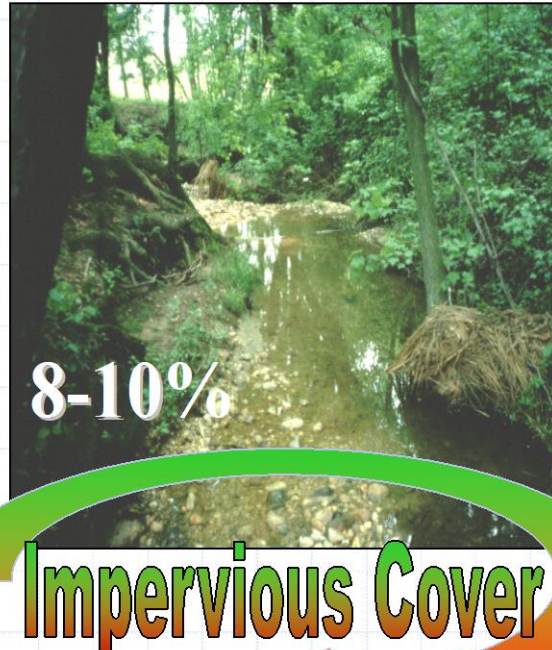
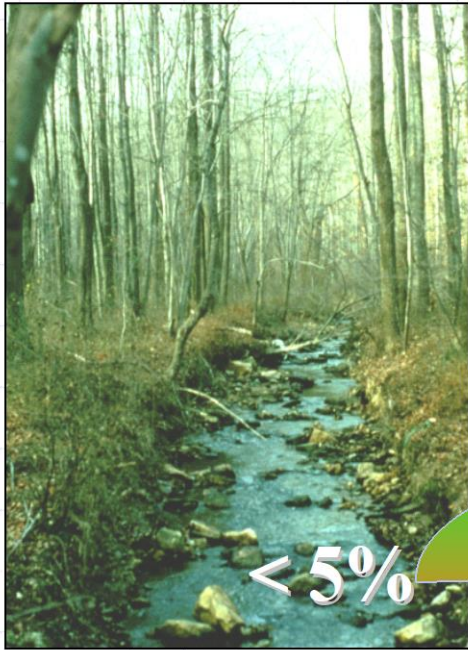


The converse is really the answer. You want to slow, retain and get out of the way. Good watershed planning and zoning to limit development is essential.

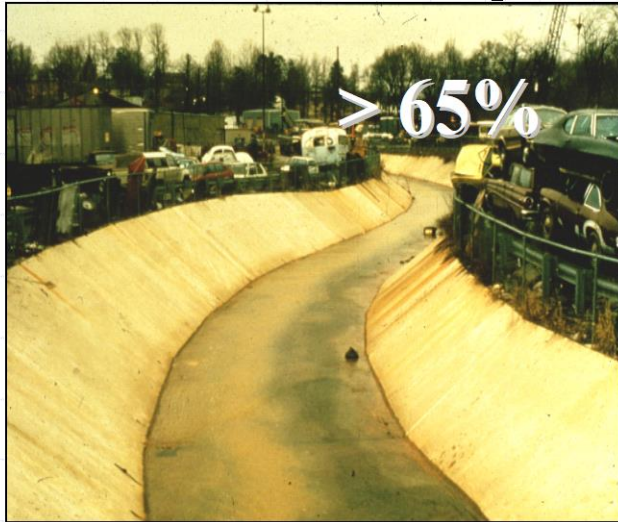


# The Life of an Urban Watershed





**Impervious Cover**



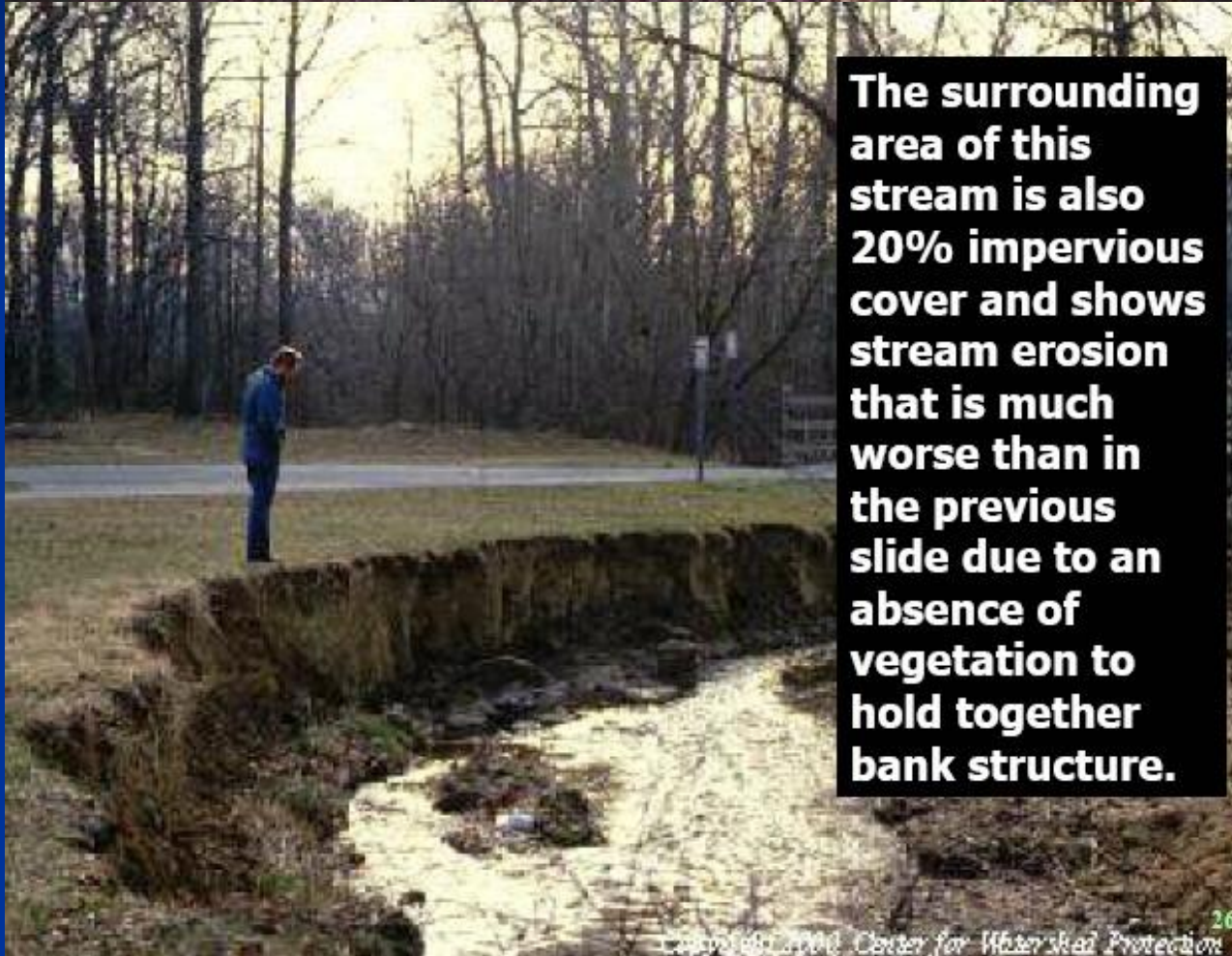
# Stream Response to Increased Impervious Area

**At 10% impervious cover, the stream is more visibly impacted. The stream has approximately doubled its original size, tree roots are exposed, and the pool and riffle structure seen in sensitive streams is lost.**



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# Stream Response to Increased Impervious Area

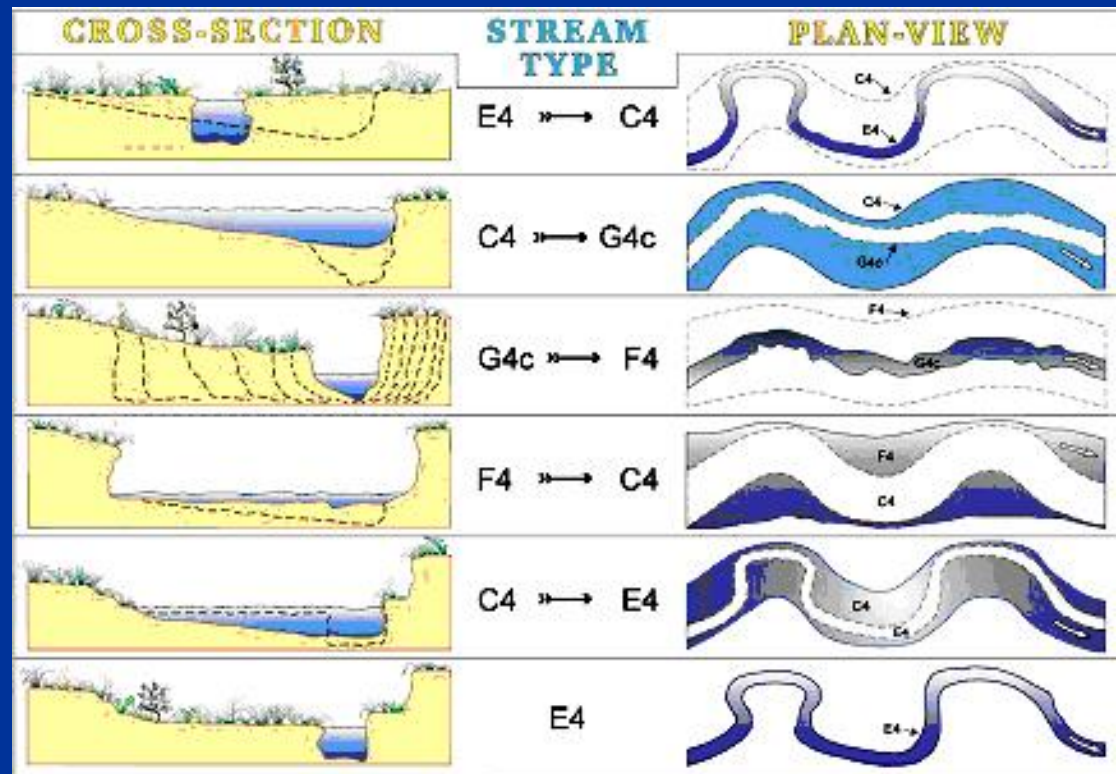


**The surrounding area of this stream is also 20% impervious cover and shows stream erosion that is much worse than in the previous slide due to an absence of vegetation to hold together bank structure.**

# Increased Pressure on Streams

More energy means the stream must become wider or decrease its slope to regain balance

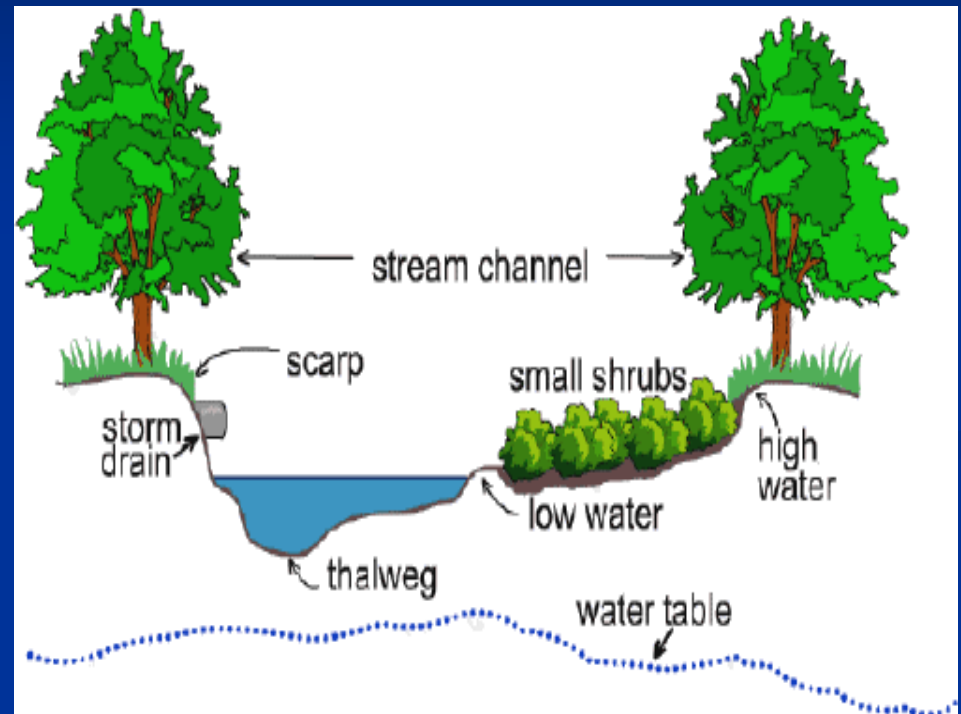
- More volume
- More velocity
- More sediment load
- More energy





# Loss of Stream Corridors

- Increased bank erosion
- Increased water temperature
- Decreased dissolved oxygen



Corridors quickly become unsuitable for aquatic life

# Major Stormwater Contaminants

“Polluted stormwater runoff is the leading cause of impairment to nearly 40% of surveyed U.S. water bodies which do not meet water quality standards” -USEPA

## General Stormwater Runoff

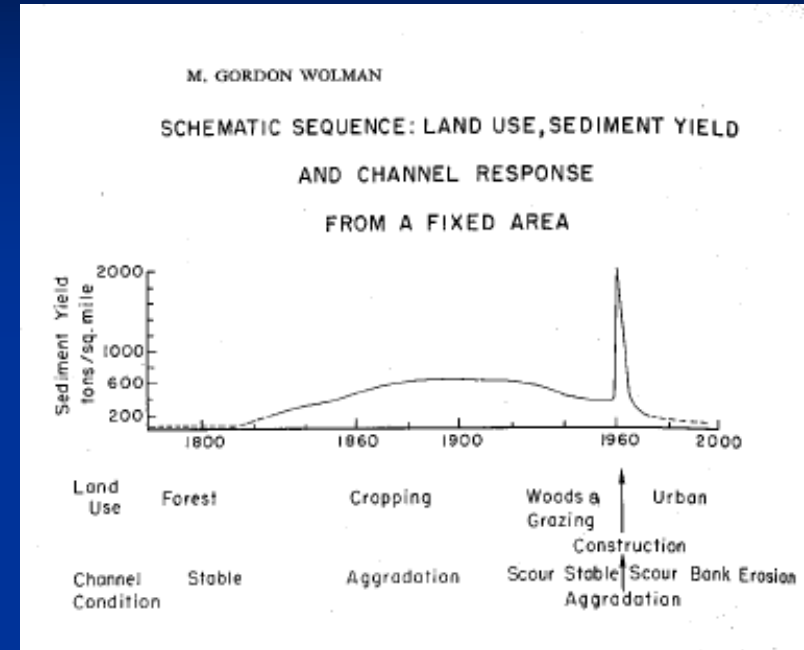
- Suspended solids
- Nitrogen
- Phosphorous
- Pathogenic microorganisms

## Added in Urban Stormwater



- Oils and grease
- Hydrocarbons and PAHs
- Trace metals
  - Cu, Cr, Ni, Pb, Zn
- Road salt

# Sediment from Construction Sites



- Increased turbidity
- Destruction of aquatic habitat
- Drinking water treatment impacts
- Loss of reservoir/detention storage capacity
- Increased stream bank erosion
- Negative aesthetic impacts