

**RUTGERS**

THE STATE UNIVERSITY  
OF NEW JERSEY

# Impervious Cover Project for Climate Resilience in New Jersey

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# Rutgers Cooperative Extension

Rutgers Cooperative Extension (RCE) helps the diverse population of New Jersey adapt to a rapidly changing society and improves their lives through an educational process that uses science-based knowledge.



# Water Resources Program



Our Mission is to identify and address community water resources issues using sustainable and practical science-based solutions.

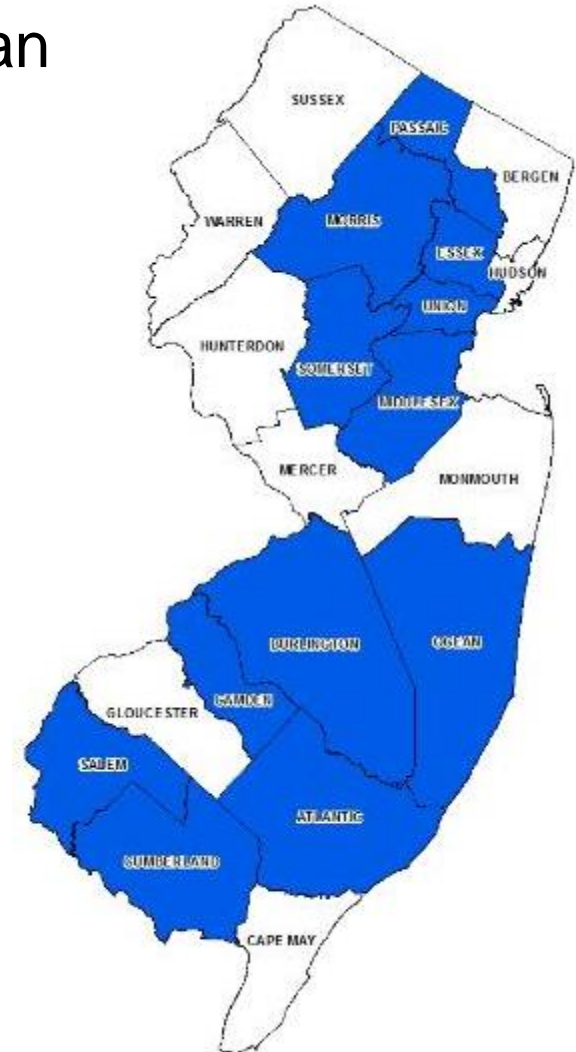
The Water Resources Program serves all of New Jersey, working closely with the County Extension Offices.



# Environmental County Agents

The Environmental County Agents teach people new skills and information so they can make better informed decisions and improvements to their businesses and personal lives.

- Michele Bakacs, Middlesex and Union
- Pat Rector, Morris and Somerset
- Amy Rowe, Essex and Passaic
- Mike Haberland, Camden and Burlington
- Sal Mangiafico, Salem and Cumberland
- Steve Yergeau, Ocean and Atlantic



# Water Resources Issues in New Jersey

## Problems

- Degraded water quality
- Insufficient groundwater recharge
- Localized flooding
- Major flooding
- Depleted stream baseflow
- Erosion and scouring of our streams



# WHAT ABOUT CLIMATE CHANGE?

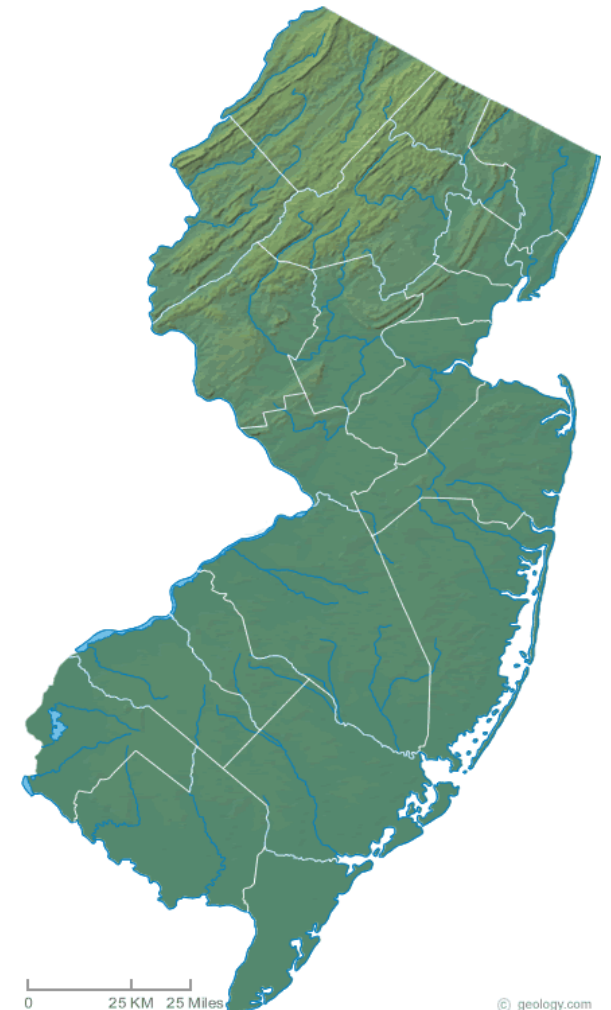


Climate change ...  
it's real, it's  
happening now,  
and it's affecting  
New Jersey.



## Climate Change in New Jersey

- More warm extremes and fewer cold extremes
- Heavy rains become more intense
- More frequent dry spells
- Rising sea level with increased frequency and intensity of coastal flooding







STOP

4-WAY



February 4, 2016 – Only 1.6 inches of rain



# Causes of Water Resources Problems in New Jersey

## Agriculture Land



# Causes of Water Resources Problems in New Jersey

## New Urban/Suburban Development

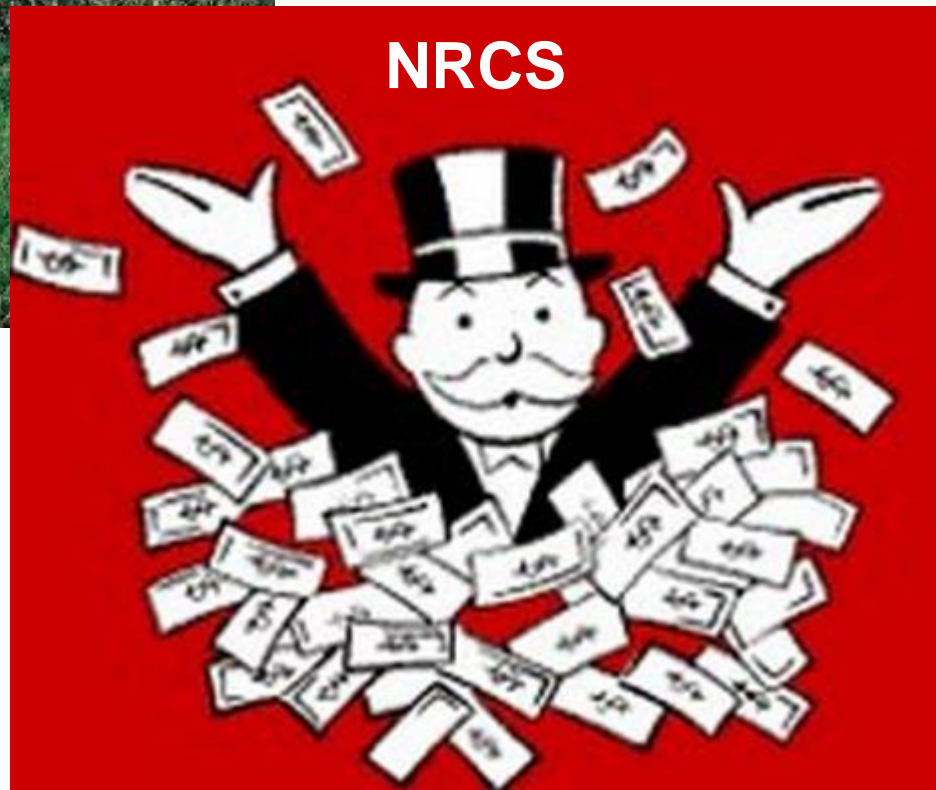


# Causes of Water Resources Problems in New Jersey

## Existing Urban/Suburban Development



# Addressing Impacts from Agriculture



# Addressing Impacts from New Development

- Existing regulations may be adequate to minimize impacts
- Existing regulations are not being enforced by municipalities
- Training needs to be provided to help municipalities understand how to ensure new development are complying
- Outreach needs to be provided to help municipalities get started



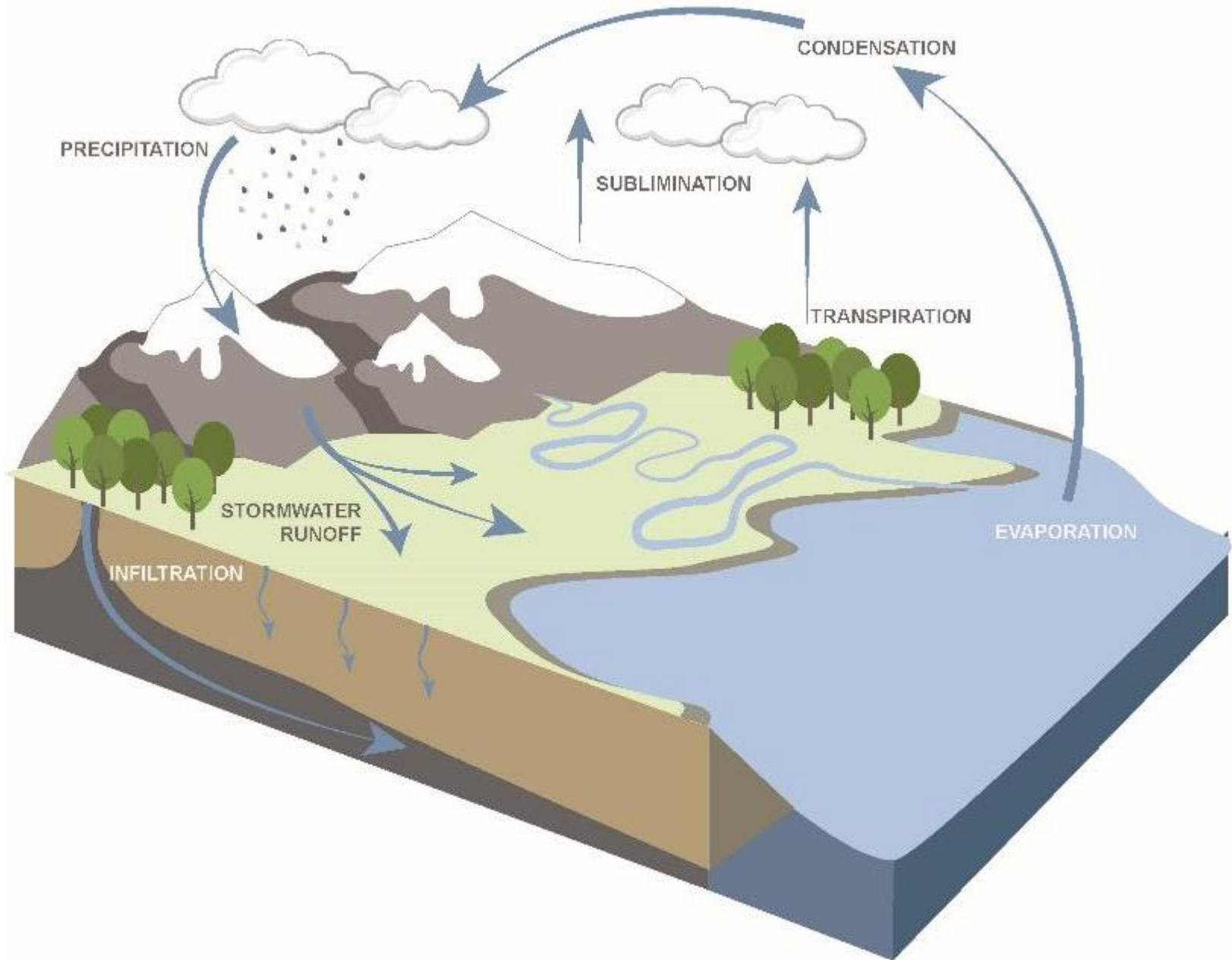
# Addressing Impacts from Existing Development

- MS4 (Municipal Separate Storm Sewer System) Permits
  - Each municipality must develop, implement and enforce a stormwater program
  - “shall be designed to reduce the discharge of pollutants from the municipality’s small MS4 to the maximum extent practicable, to protect water quality.”
- TMDL (Total Maximum Daily Load) Requirements
- Existing infrastructure needs to be identified and assessed
- Municipalities need a plan for retrofitting
- Municipalities need assistance in implementing the plan
- Municipalities need help in adopting ordinances to reduce impacts from existing development

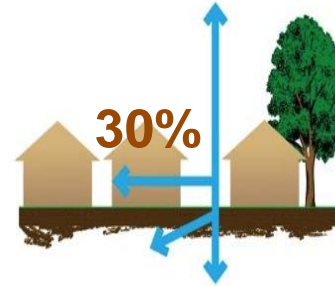
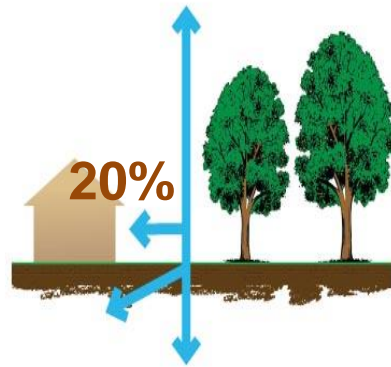
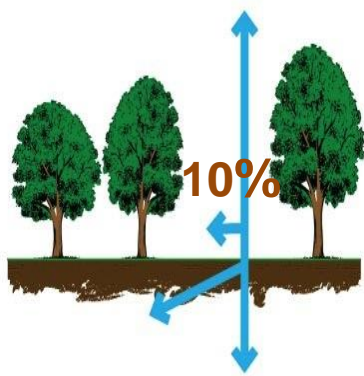




# The **Natural** Hydrologic Cycle



# The Impact of Development on Stormwater Runoff



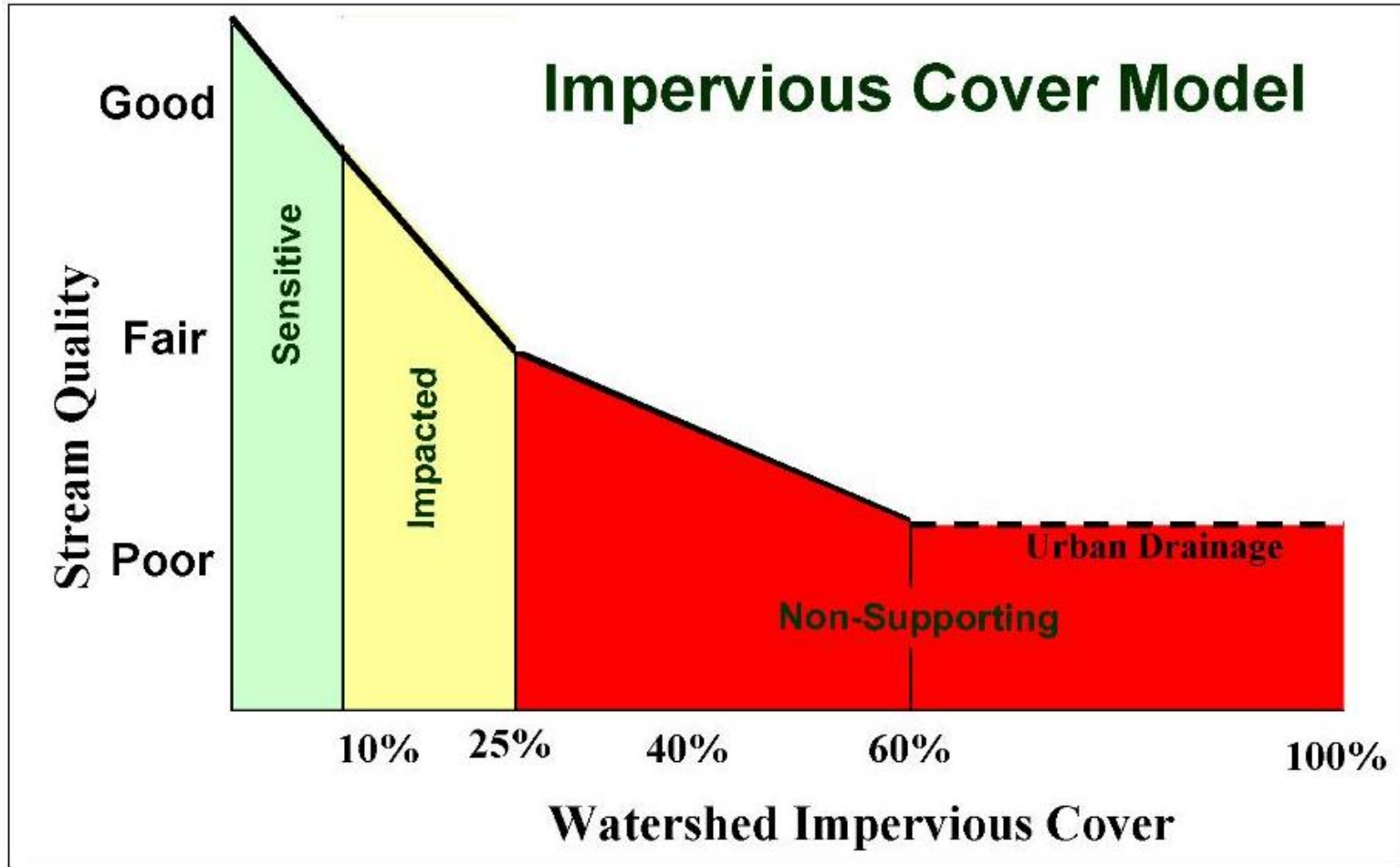
*More development*

→ *More impervious surfaces* →

*More stormwater runoff*



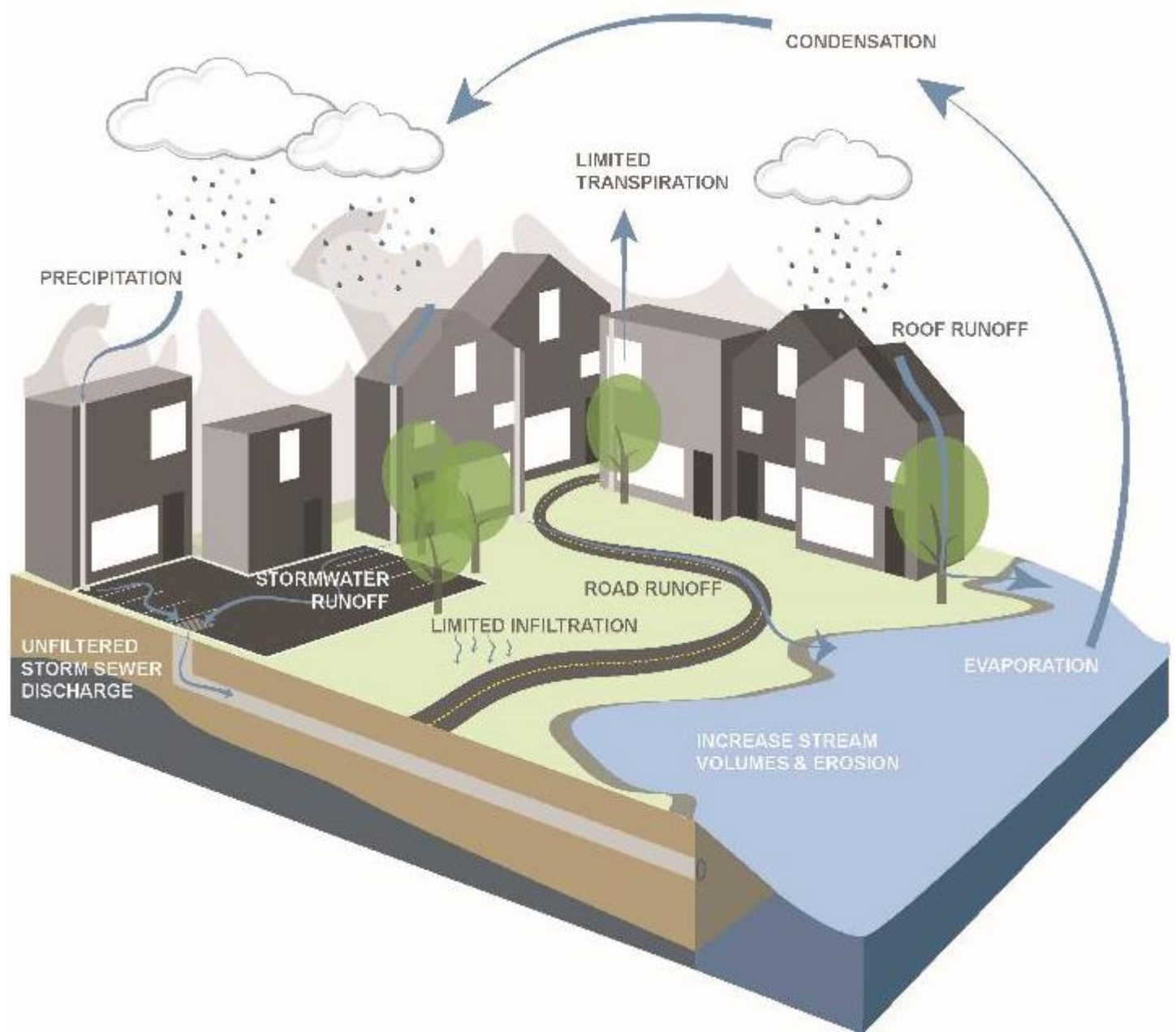
**Original ICM developed based on 200+ reports and papers**



Reference: Tom Schueler and Lisa Fraley-McNeal, Symposium on Urbanization and Stream Ecology, May 23 and 24, 2008



# The **Urban** Hydrologic Cycle



## Green Infrastructure

...an approach to stormwater management that is cost-effective, sustainable, and environmentally friendly

Green Infrastructure projects:

- capture
- filter
- absorb
- reuse

stormwater to help restore the natural water cycle.



# Green Infrastructure includes:

- green roofs
- rainwater harvesting
- tree filter/planter boxes
- rain gardens/bioretention systems
- permeable pavements
- vegetated swales/bioswales
- natural retention basins
- trees & urban forestry
- green streets



Parker Urban Greenscapes. 2009.



# It's all about managing impervious surfaces !



**Eliminate it !**



**Change it !**



**Disconnect it !**



**Reuse it !**



# Eliminate it!



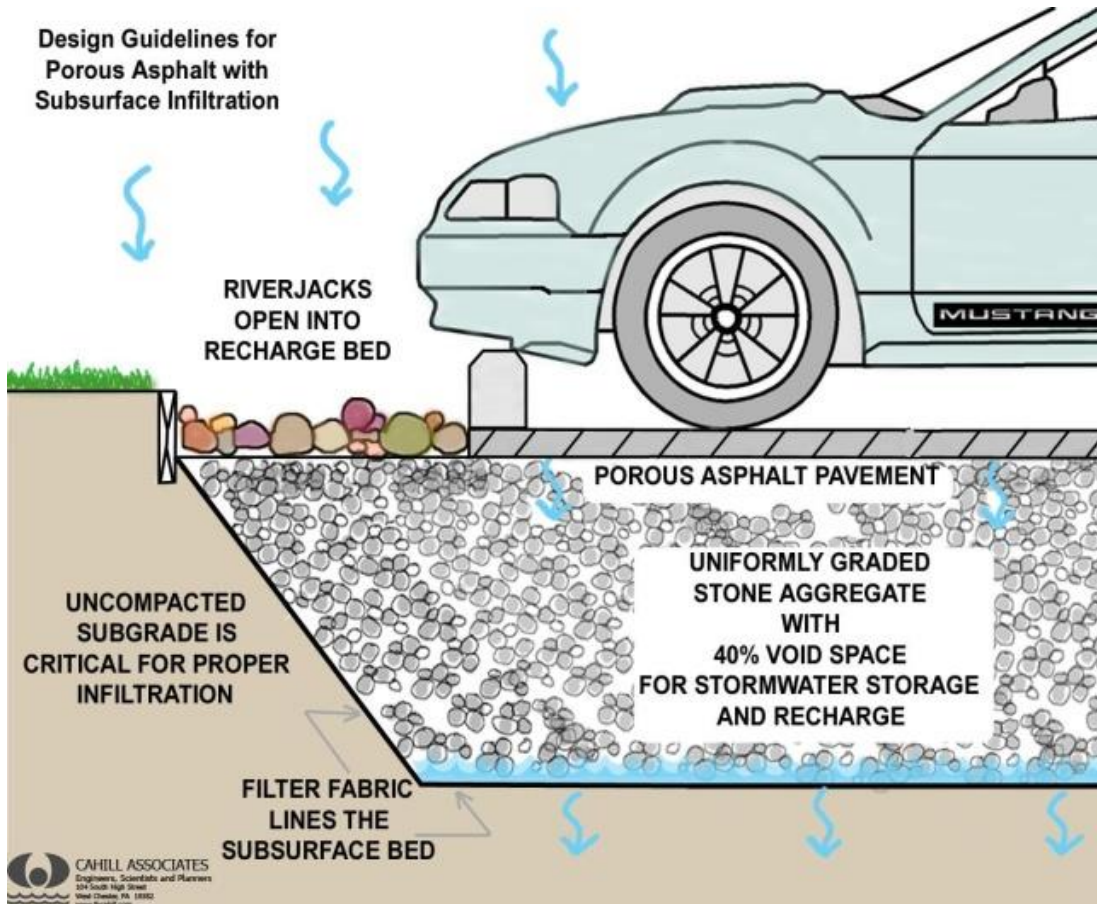
# “Depaving”





# Change It!

# Permeable Pavements



# Disconnect It!

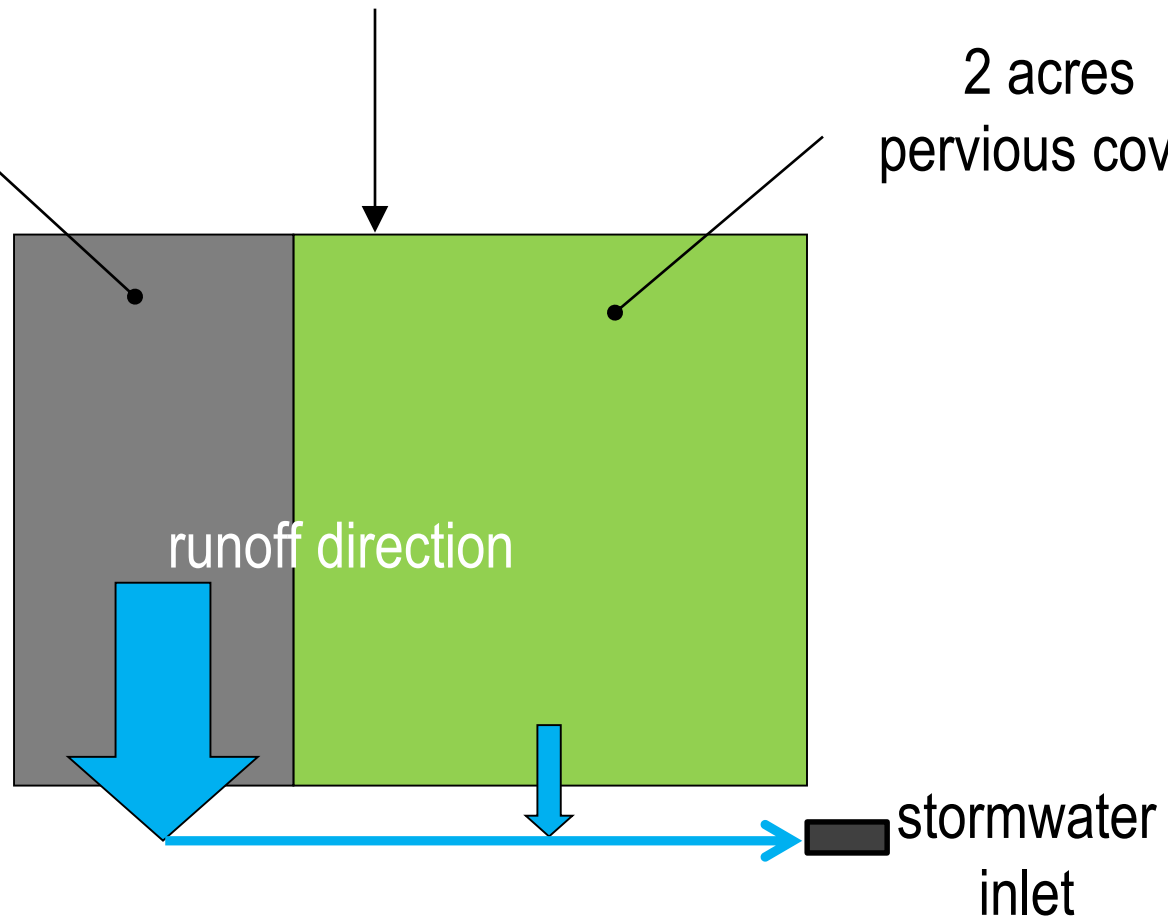


For 1.25 inch storm,  
3,811 cubic feet of runoff = **28,500 gallons**

total drainage area = 3 acres

1 acre directly  
connected  
impervious cover

2 acres  
pervious cover

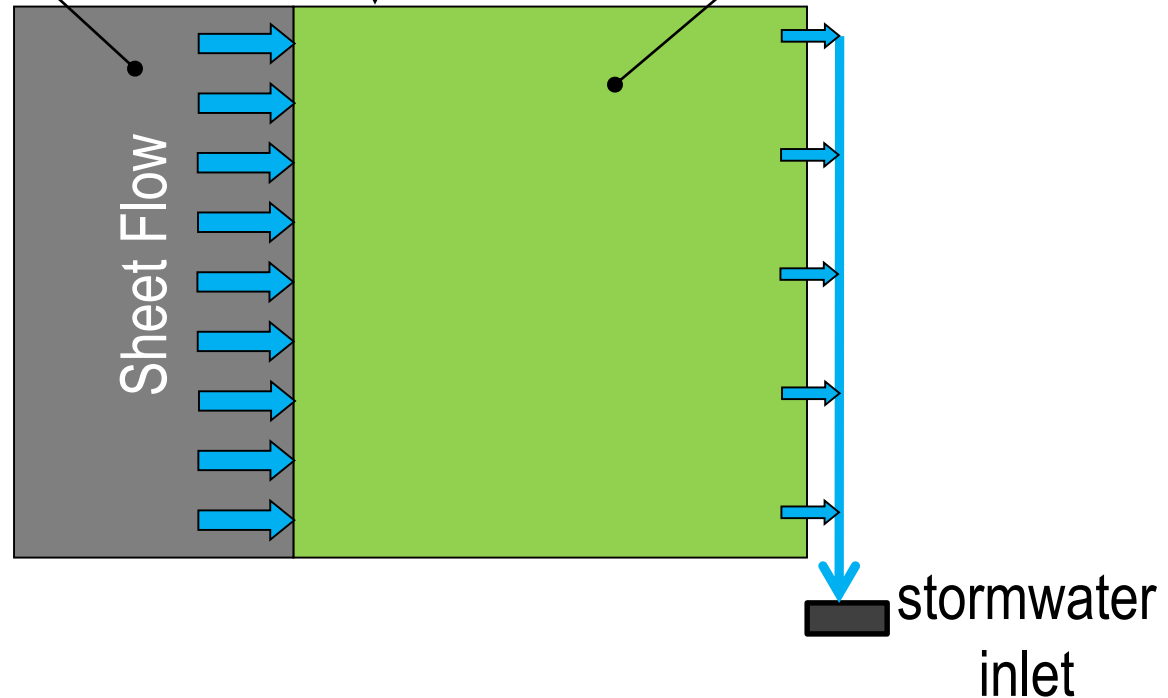


For 1.25 inch storm,  
581 cubic feet of runoff = **4,360 gallons**

total drainage area = 3 acres

1 acre disconnected  
impervious cover

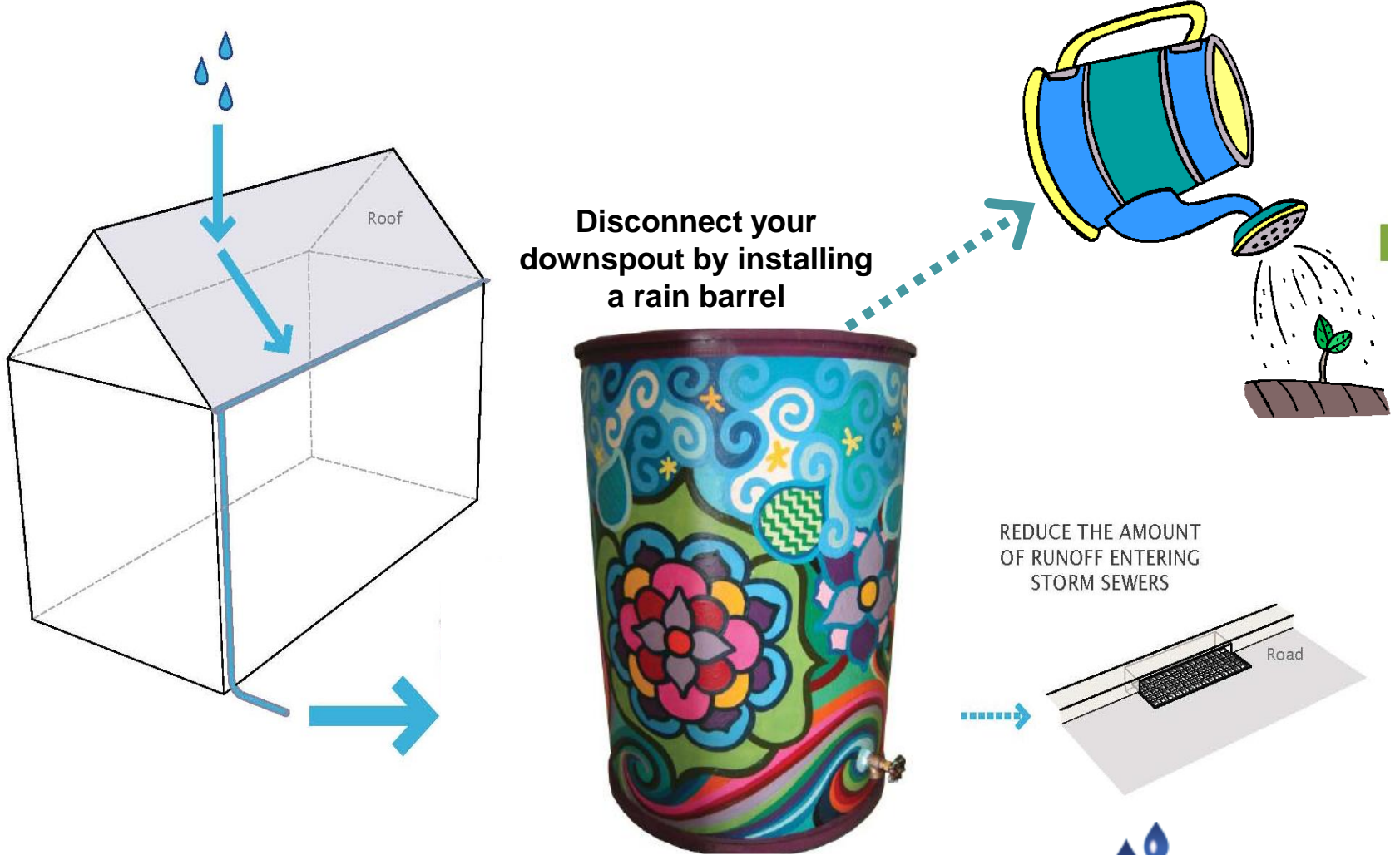
2 acres  
pervious cover



	Volume of Runoff		
Design Storm	Connected (gallons)	Disconnected (gallons)	Percent Difference
1.25 inches (water quality storm)	28,500	4,360	85%



# Disconnection with Rain Water Harvesting



Impervious area is now “disconnected” from flowing directly into the storm sewer system



# So Many Barrels to Choose From...

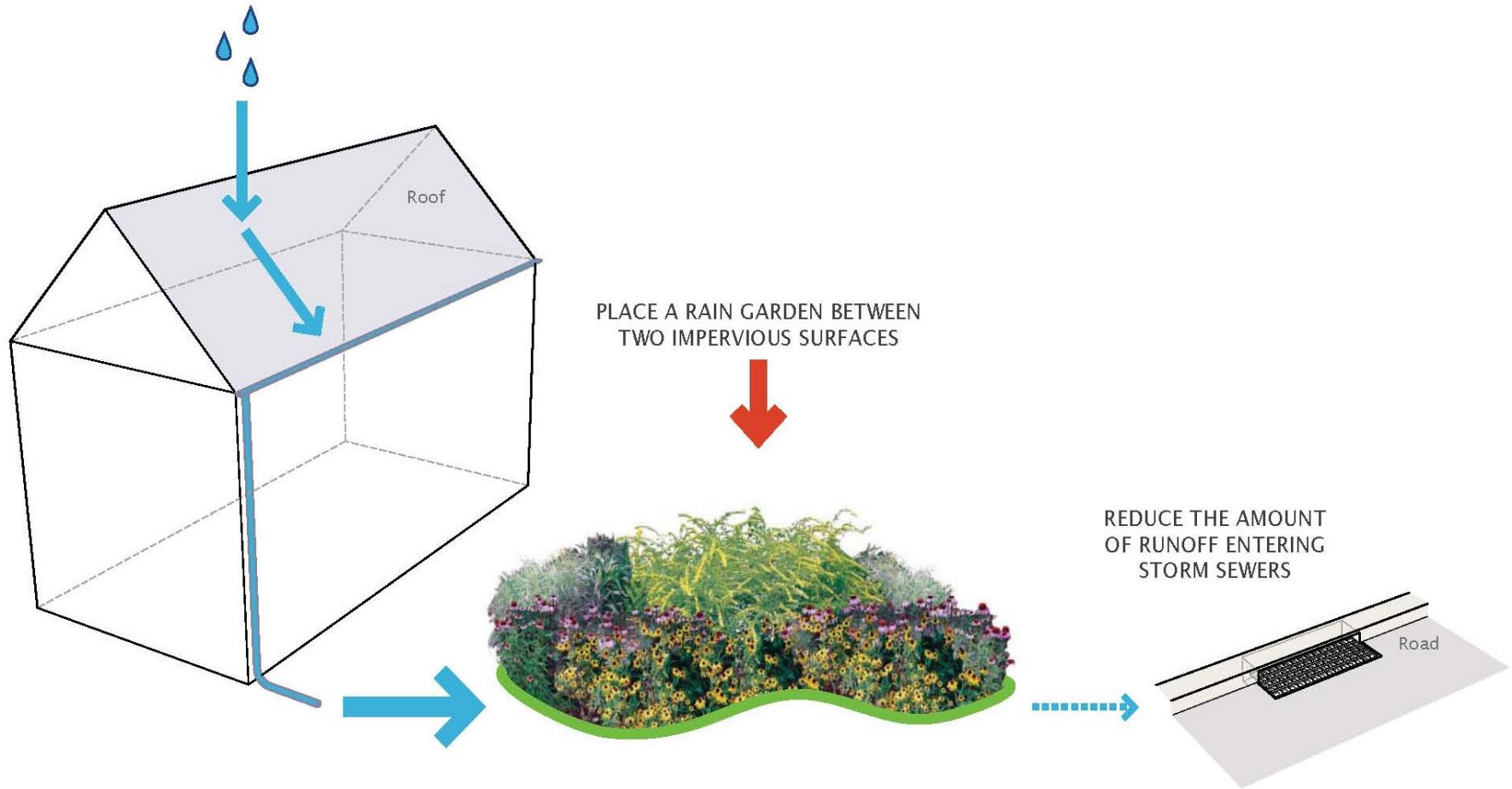


# Or Larger Rainwater Harvesting Systems...





# Disconnection with Rain Gardens



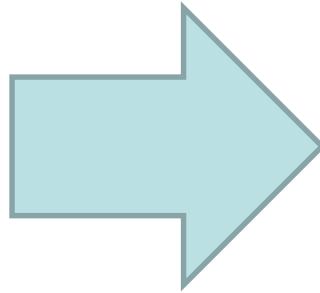
Rooftop runoff is now *“disconnected”* from flowing directly into the storm sewer system



# Lots of Rain Gardens



PLAN



ACTION



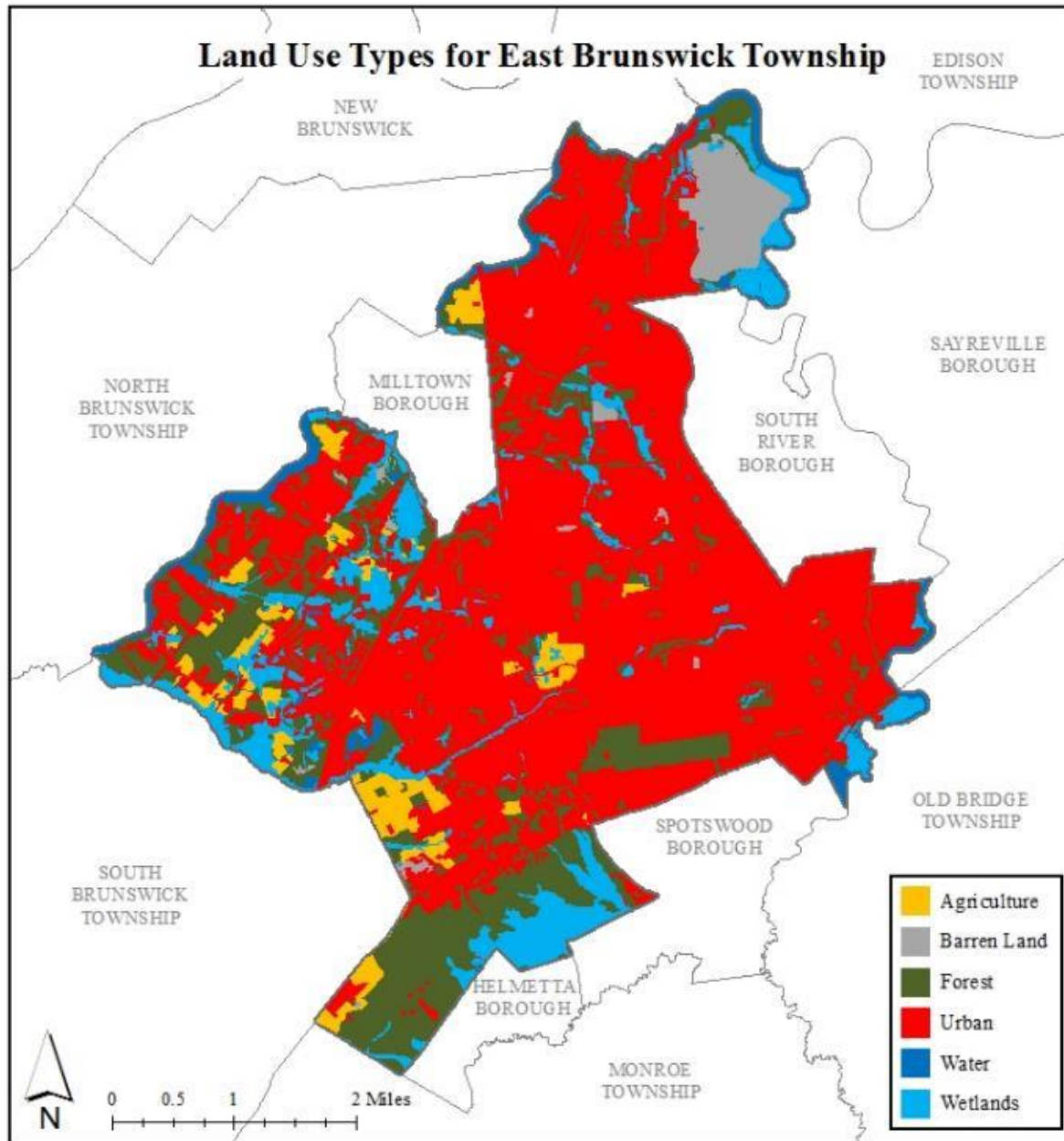
## Plan Options

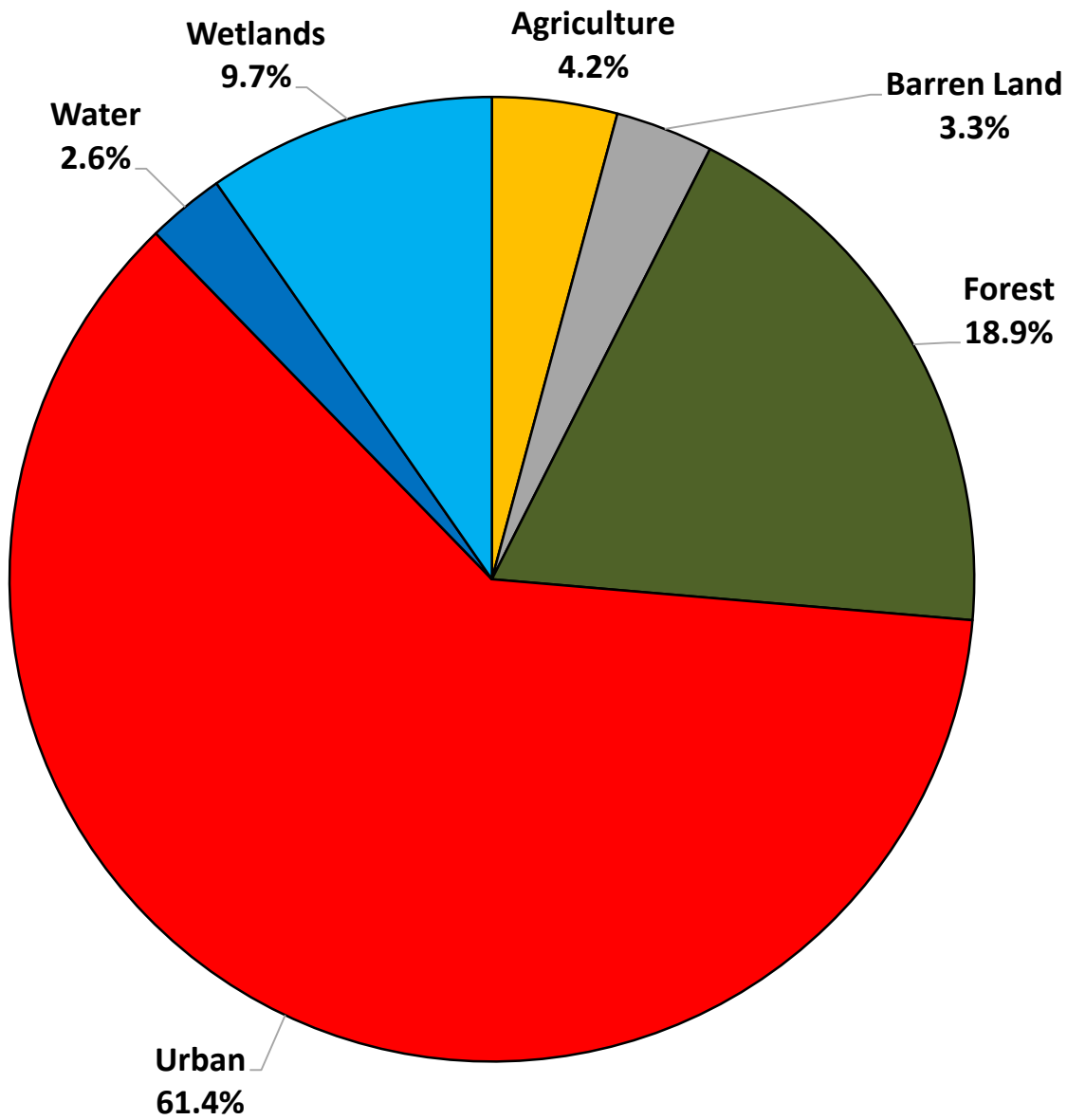
- Regional Stormwater Management Plans
  - Specific NJ regulations for plan components
  - Addresses flooding and water quality issues
  - Public engagement component
  - Incorporated into regulation
- Watershed Restoration Plans
  - Nine minimum components
  - Requires collection of water quality data
  - GIS mapping
  - Addresses primarily water quality
- **Impervious Cover Assessments (ICAs) and Reduction Action Plans (RAPs)**
- **Green Infrastructure Feasibility Studies**

## IMPERVIOUS COVER ASSESSMENT (ICA)

- Analysis completed by watershed and by municipality
- Use 2007 Land Use data to determine impervious cover
- Calculate runoff volumes for water quality, 2, 10 and 100 year design storm and annual rainfall
- Contain three concept designs







<b>Watershed</b>	<b>Total Area (ac)</b>	<b>Impervious Cover (ac)</b>	<b>%</b>
<b>Duhernal Lake</b>	571	158	28.6%
<b>Ireland Brook</b>	3,374	749	22.5%
<b>Lawrence Brook</b>	6,567	1,834	28.8%
<b>Manalapan Brook</b>	2,133	222	10.4%
<b>Lower Raritan River</b>	291	0	0.0%
<b>South River</b>	1,404	342	25.5%
<b>Total</b>	14,340	3,304	23.0%





<b>Subwatershed</b>	<b>NJ Water Quality Storm (MGal)</b>	<b>Annual Rainfall of 44" (MGal)</b>	<b>2-Year Design Storm (3.3") (MGal)</b>	<b>10-Year Design Storm (5.0") (MGal)</b>	<b>100-Year Design Storm (8.2") (MGal)</b>
<b>Duhernal Lake</b>	5.4	188.4	14.1	21.8	36.8
<b>Ireland Brook</b>	25.4	895.0	67.1	103.7	174.9
<b>Lawrence Brook</b>	62.2	2,190.7	164.3	253.9	428.2
<b>Manalapan Brook</b>	7.5	264.8	19.9	30.7	51.8
<b>Lower Raritan River</b>	0.0	0.0	0.0	0.0	0.0
<b>South River</b>	11.6	408.3	30.6	47.3	79.8
<b>Total</b>	112.1	3,947.2	296.0	457.5	771.5

## East Brunswick Township Impervious Cover Assessment

*East Brunswick Police Department, 1 Civic Center Drive*

### PROJECT LOCATION:



### SITE PLAN:



A



B



C



D

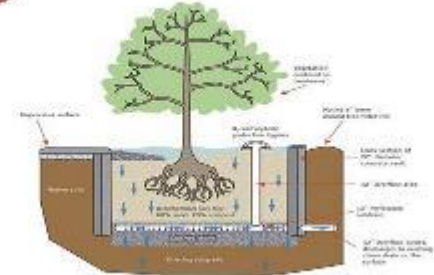


- 1 BIORETENTION SYSTEMS:** Bioretention systems should be installed to intercept pathway runoff and parking lot runoff, respectively. The bioretention systems will reduce sediment and nutrient loading reaching catch basins.
- 2 TREE FILTER BOXES:** Tree boxes can be installed in the parking strips to catch the first flush of stormwater and treat it prior to discharge to the storm sewer system.

## 1 BIORETENTION SYSTEM



## 2 TREE FILTER BOX



## IMPERVIOUS COVER REDUCTION ACTION PLAN (RAP)

- Identifies additional green infrastructure opportunities (10 to 40 sites)
- Include hydrologic modeling to determine runoff volumes, peak discharge, and infiltration volumes
- Provides cost estimates for each proposed green infrastructure practice
- Can easily be transformed into a stormwater mitigation plan
- Project of all sizes



## CHURCHILL JUNIOR HIGH SCHOOL

**Subwatershed:** Lawrence Brook  
**Site Area:** 1,130,014 sq. ft.  
**Address:** 48 Norton Road  
 East Brunswick, NJ 08816  
**Block and Lot:** Block 603, Lot 33

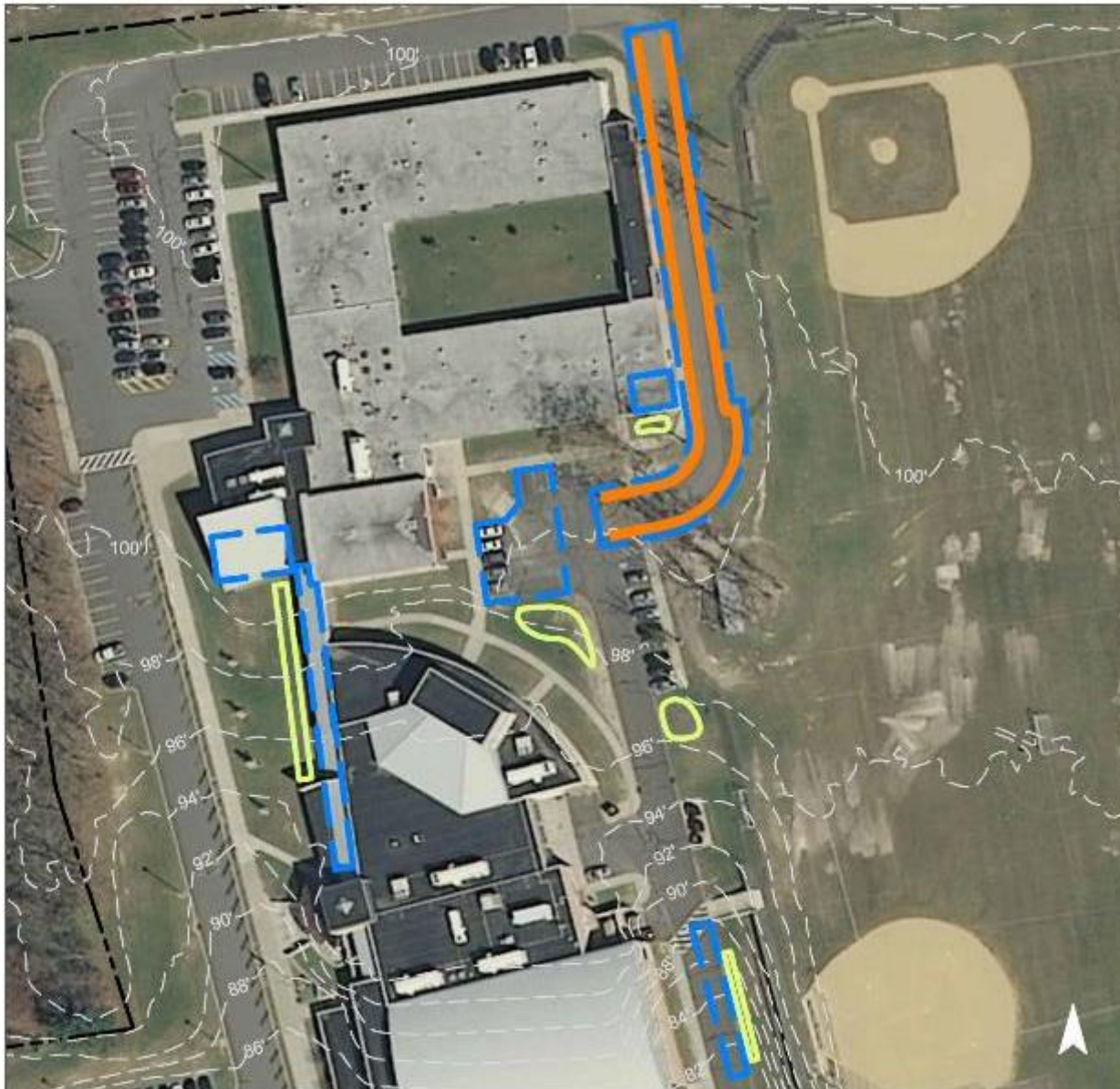


Several rain gardens can be installed to capture, treat and infiltrate runoff. Two rows of pervious pavement can also be installed along the back access road, where compaction is currently causing water to pool. A preliminary soil assessment suggests that more soil testing would be required before determining soil suitability for green infrastructure.



Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
42	470,481	22.7	237.6	2,160.2	0.367	12.90

Recommended Green Infrastructure Practices	Recharge Potential (Mgal/yr)	TSS Removal Potential (lbs/yr)	Maximum Volume Reduction Potential (gal/storm)	Peak Discharge Reduction Potential (cu. ft./second)	Estimated Size (sq. ft.)	Estimated Cost
Bioretention systems	0.371	62	27,190	1.02	3,555	\$17,775
Pervious pavements	0.166	28	12,200	0.46	2,036	\$50,900

GREEN INFRASTRUCTURE RECOMMENDATIONS



**Churchill Junior High**

-  pervious pavements
-  bioretention / rain gardens
-  drainage areas
-  property line
-  2012 Aerial: NJOIT, OGIS



## ORDINANCE AND MASTER PLANS

- Local ordinance need to be update to incorporate green infrastructure
- Master plans need to consider green infrastructure options when revisited
- The public needs to be encouraged to participate in the planning process



## COMMUNITY ENGAGEMENT

- Municipal Action Teams
- Environmental Commissions
- Sustainable Jersey and Sustainable Jersey for Schools
- Watershed Groups
- Faith-based Groups
- Scouts and K-12 School Children
- All the co-sponsors of this conference



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