

Storm Water Quality Management Techniques

November 4, 2011

Presented by:

James E. Smalligan, P.E.

Principal/Senior Vice President



Ottawa County Sixth Annual
Water Quality Forum









Storm Water Detention

- Provide extended storage for runoff generated in 25-year storm events
- Onsite detention with a controlled release rate provides downstream erosion protection



Sources of Storm Water Pollution



Sources of Storm Water Pollution



Sources of Storm Water Pollution



Sources of Storm Water Pollution



Sources of Storm Water Pollution



Pollutants, Sources, and Causes



Pathogens

Pollutants, Sources, and Causes



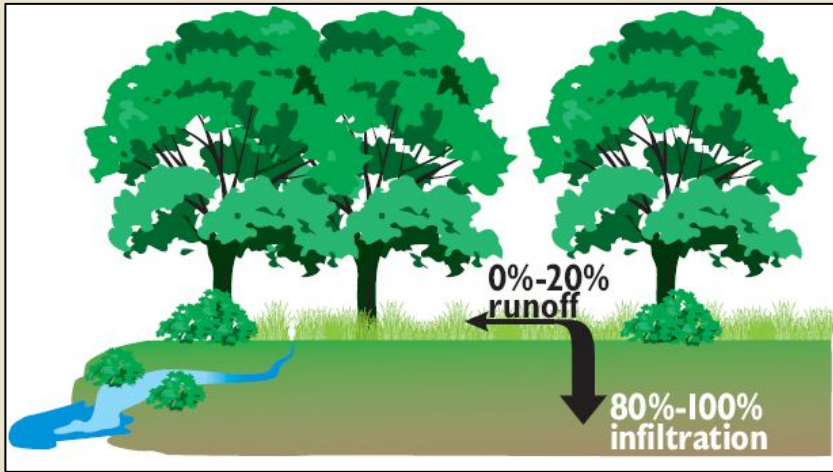
Nutrients

Pollutants, Sources, and Causes

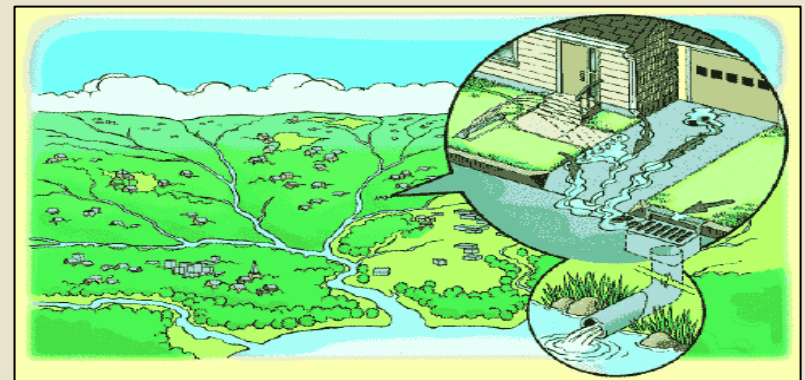


Lack of Riparian Buffer

LID Storm Water Goals



- Conserve critical features
- Mimic natural conditions
- Match runoff volume



Manage at the source

Low Impact Design

- Storm water practices integrated throughout the site
- Preserves natural systems and reduces hard surfaces



LID BMPs

Structural BMP	Function		
	Retain	Treat	Detain
Rain Gardens	✓	✓	✓
Pervious Pavement	✓	✓	
Reuse	✓	✓	
Green Roofs		✓	✓
Other Infiltration	✓	✓	
Vegetated Swale		✓	✓
Revegetation		✓	✓
Water Quality Device		✓	

BMP Benefits Calculator

Low Impact Development Hydrologic Analysis (SCS-92 Method)

PROJECT: GVSU Stormwater management plan

FTC&H JOB #: G06834

DATE: 4/30/2007

PROJECT ENGR: SDT

LOCATION: Ottawa county, Michigan

Total Area of Development (ac) 4.83

Hydrologic Soils Group C

Time of Concentration (hr)

Predeveloped = 0.50

Developed = 0.25

Low Impact Development = 0.25

Predevelopment Summary

Woods or forest land

% Total Area

100

SCS CN

73

Development Summary

Impervious (paved, roof, concrete, etc.)

% Total Area

42

SCS CN

98

Open (lawns, parks, etc.) - good

58

74

Best Management Practice

Porous Pavement

Area (sf)

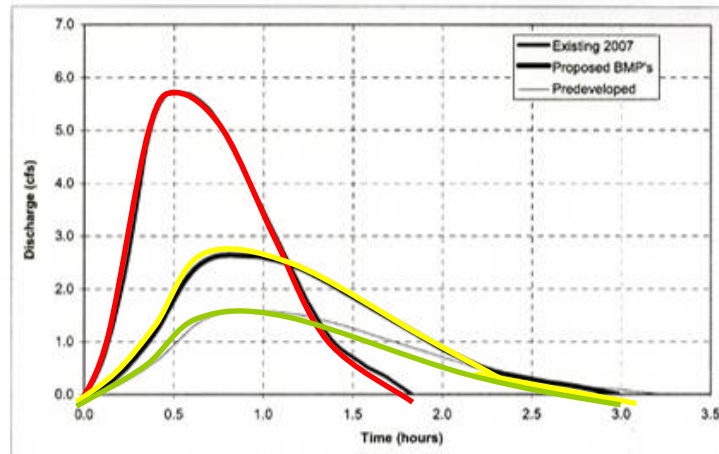
24,650

Green Roofs

17,405

Rain Gardens

15,000



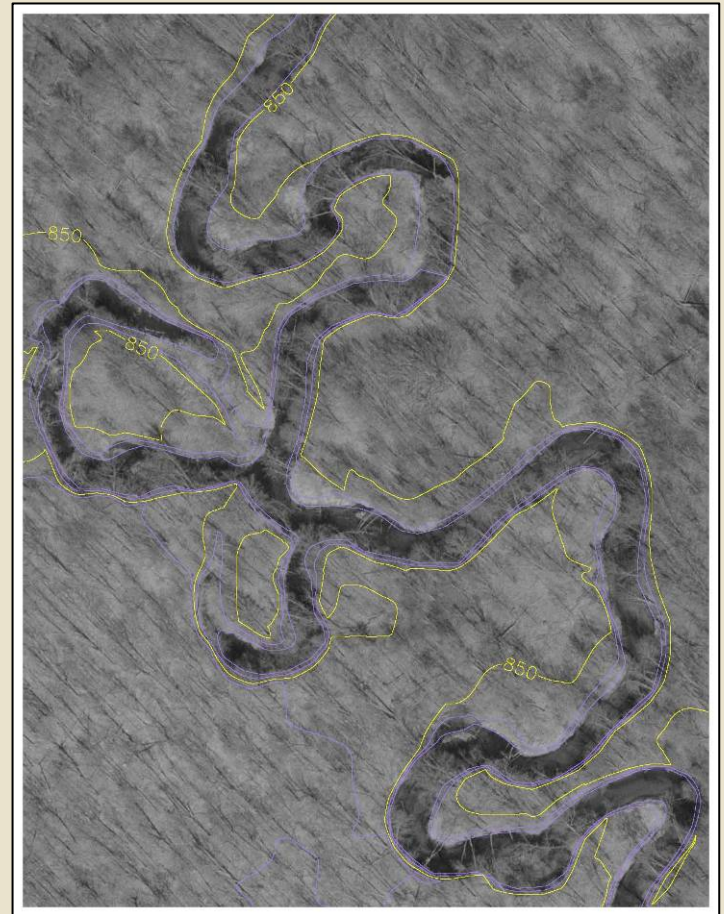
Hydrograph: 2-yr

Results:

	<u>Storm Event</u>				
	<u>1-yr</u>	<u>2-yr</u>	<u>10-yr</u>	<u>25-yr</u>	<u>100-yr</u>
Rainfall (inches)	1.95	2.37	3.52	4.45	6.15
<u>Predeveloped</u>					
Composite Curve Number	73.0				
Average Runoff (inches)	0.30	0.50	1.19	1.86	3.21
Discharge (cfs)	0.95	1.59	3.79	5.91	10.22
Volume (ac-ft)	0.12	0.20	0.48	0.75	1.29
<u>Developed</u>					
Composite Curve Number	84.1				
Average Runoff (inches)	0.71	1.02	1.96	2.78	4.35
Discharge (cfs)	4.00	5.73	11.00	15.60	24.39
Volume (ac-ft)	0.29	0.41	0.79	1.12	1.75
<u>Low Impact Development</u>					
Composite Curve Number	79.3				
Average Runoff (inches)	0.50	0.77	1.60	2.36	3.84
Discharge (cfs)	1.73	2.64	5.79	9.06	16.06
Volume (ac-ft)	0.20	0.31	0.64	0.95	1.55

Channel Evolution

- Oxbows indicate decrease in channel sinuosity due to increased channel slope from down-cutting of stream bottom.











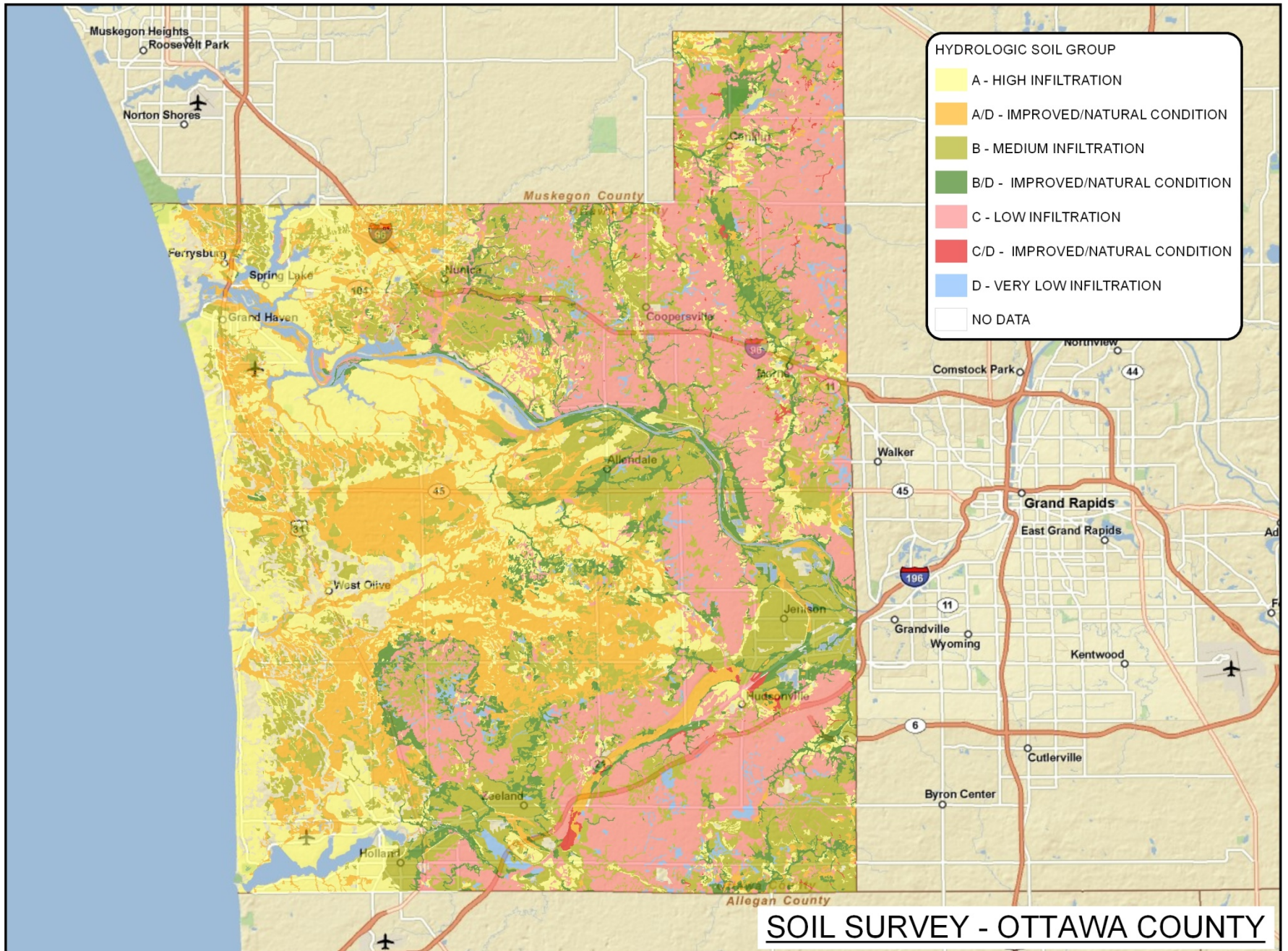




BMP Selection and Design Process

- Grassed swales
- Rain gardens/bioretention
- Native plantings
- Porous pavement
- Green roofs
- Storm water reuse
- Urban forestry
- Public education





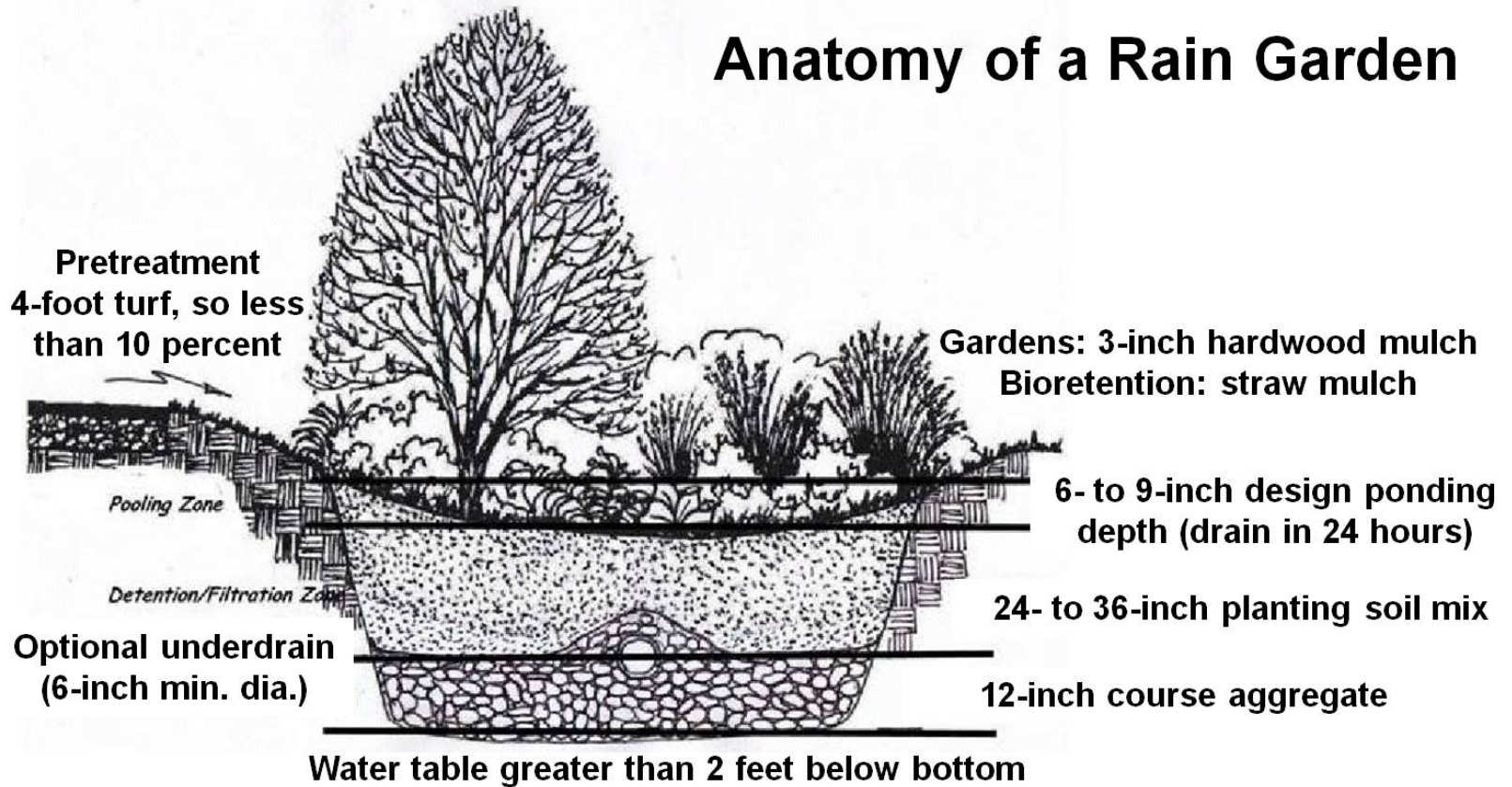
Grassed Swales

- Grass swales can improve water quality and reduce runoff through infiltration and filtering
- An effective alternative to curb and gutter systems



Rain Garden Design

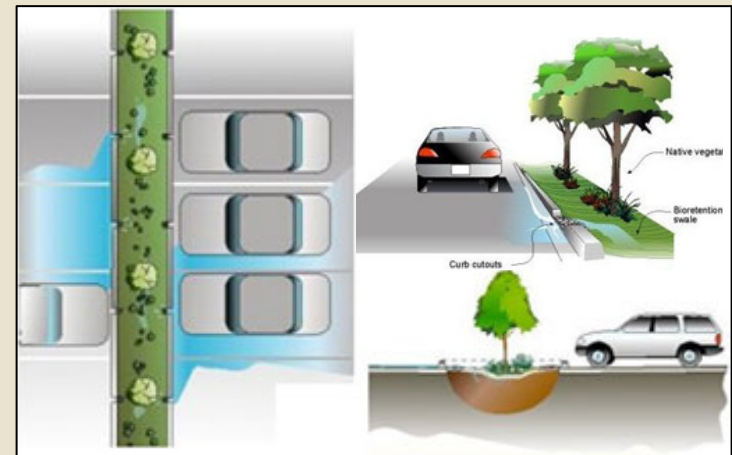
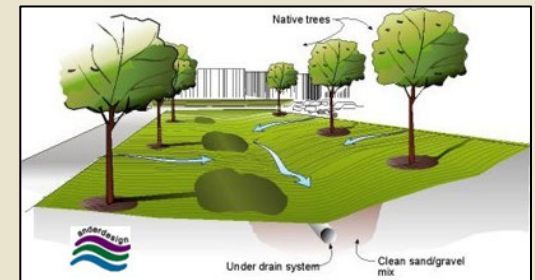
Anatomy of a Rain Garden



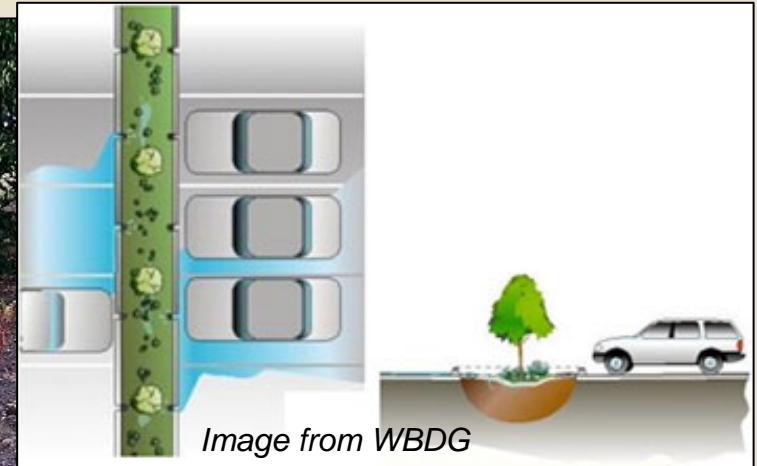
Rain Garden Design

Site Selection

- Road shoulder right-of-ways
- Front yards within right-of-way
- Parkway planting strips
- Parking lot planter islands
- Cul-de-sacs
- Residential back yards
- Under downspouts
(>10 feet from building foundation)



Rain Gardens/Bioretention



Frederik Meijer Gardens
Grand Rapids, Michigan

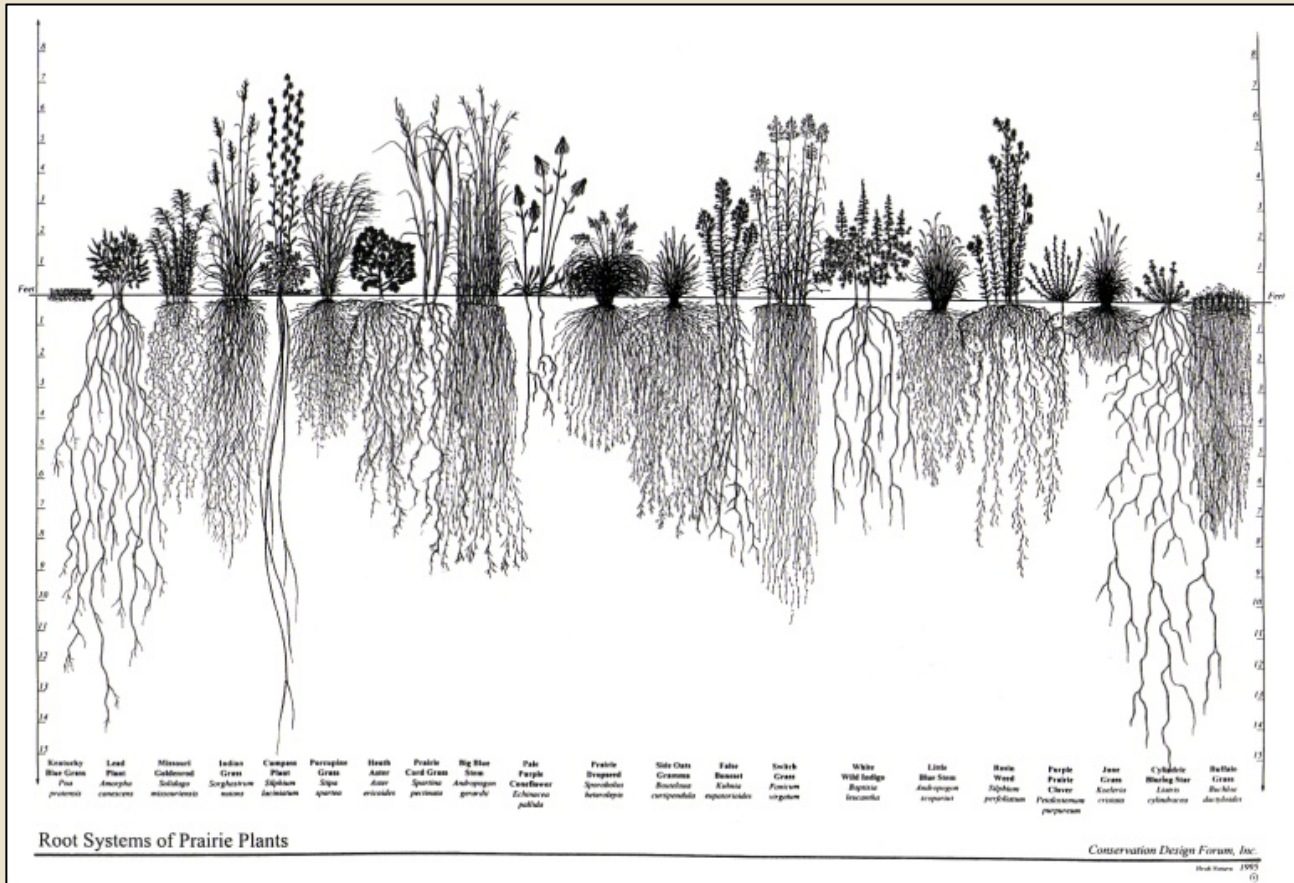
Rain Gardens/Native Plantings



Kelly Family Sports Center



Native Plantings



Sustainable Storm Water Design

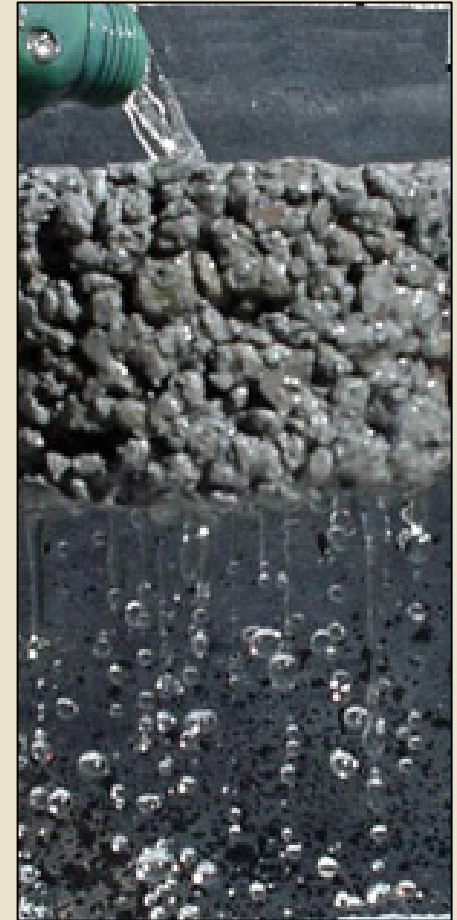
Native Plantings



**Western Michigan University
Business Technology Research Park
Kalamazoo, Michigan**

Porous Pavement

- Reduces storm water runoff
- Improves traction and safety
- Effective in low-traffic areas
- Can be installed in a wide range of soil conditions



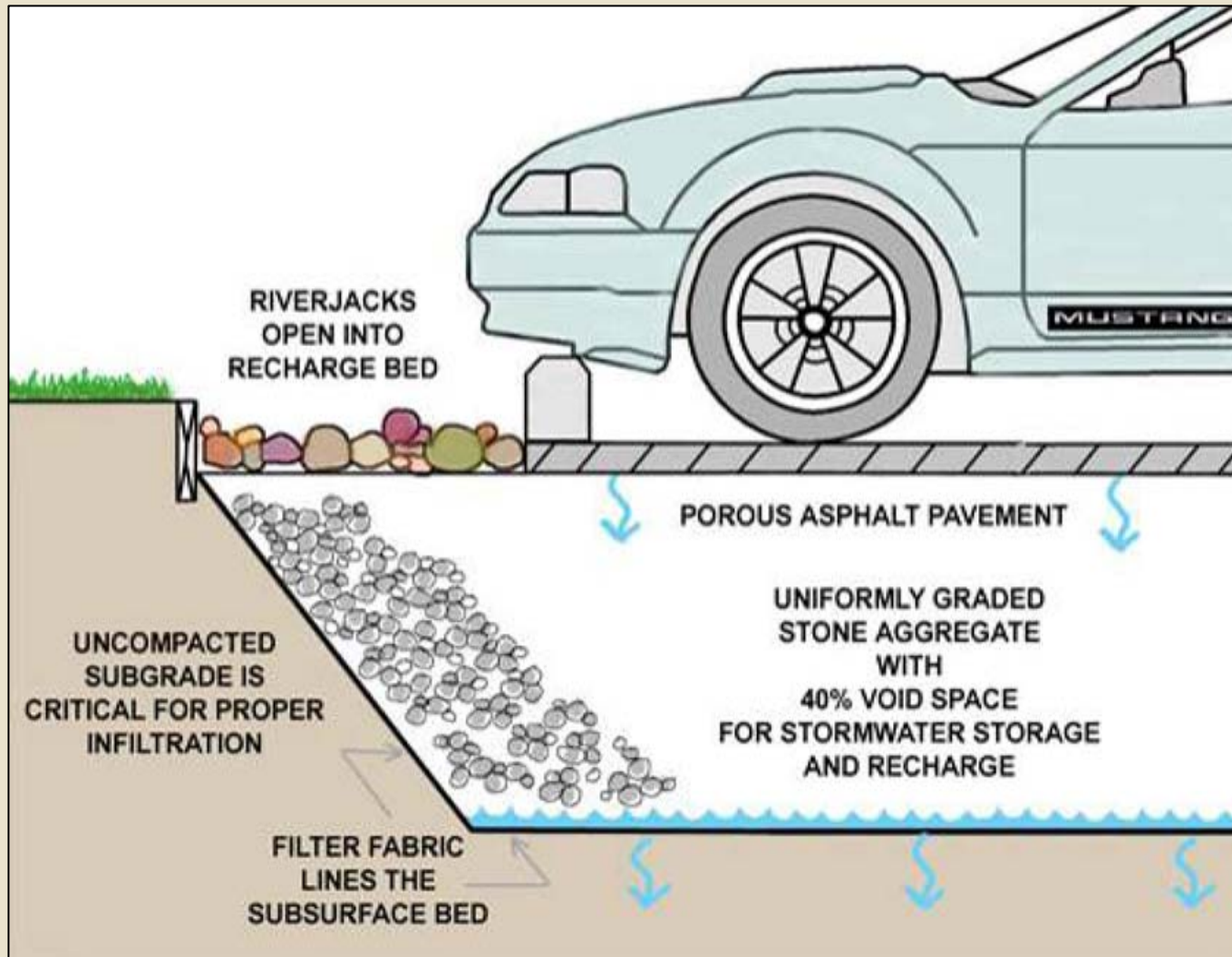
Porous Pavements

Benefits

- Peak rate control
- Volume control
- Groundwater recharge
- Water quality treatment
- Less susceptible to freeze-thaw cycles
- Potential savings in infrastructure costs



Porous Asphalt



Porous Asphalt Parking Lots

During rain events



Porous Asphalt Parking Lots

During winter



Standard Asphalt



Porous
Asphalt

Porous Concrete



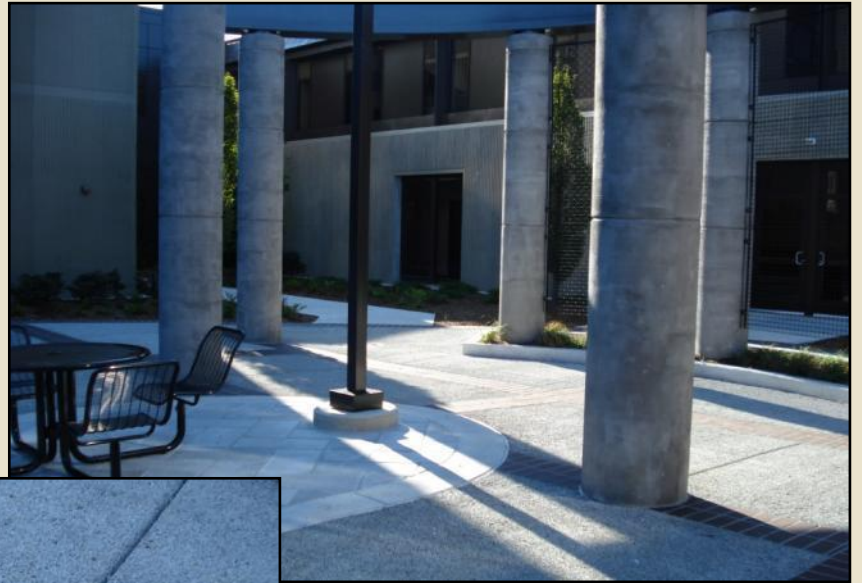
Porous Pavements



Porous Concrete



Porous Concrete



Grand Valley State University

Constructed in August 2004

Lot Q: 222 spaces for student parking

Lot R: 172 spaces for student parking

STONE BASE/
WATER STORAGE

UNDERDRAIN
(Clay Subgrade Only)

FILTER FABRIC

CLAY SUBGRADE

12-inch stone base on geotextile fabric; underdrain system due to clay soils; 3-inch of porous asphalt (installed in one lift)



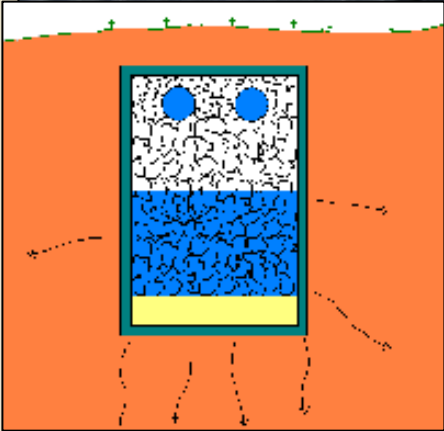
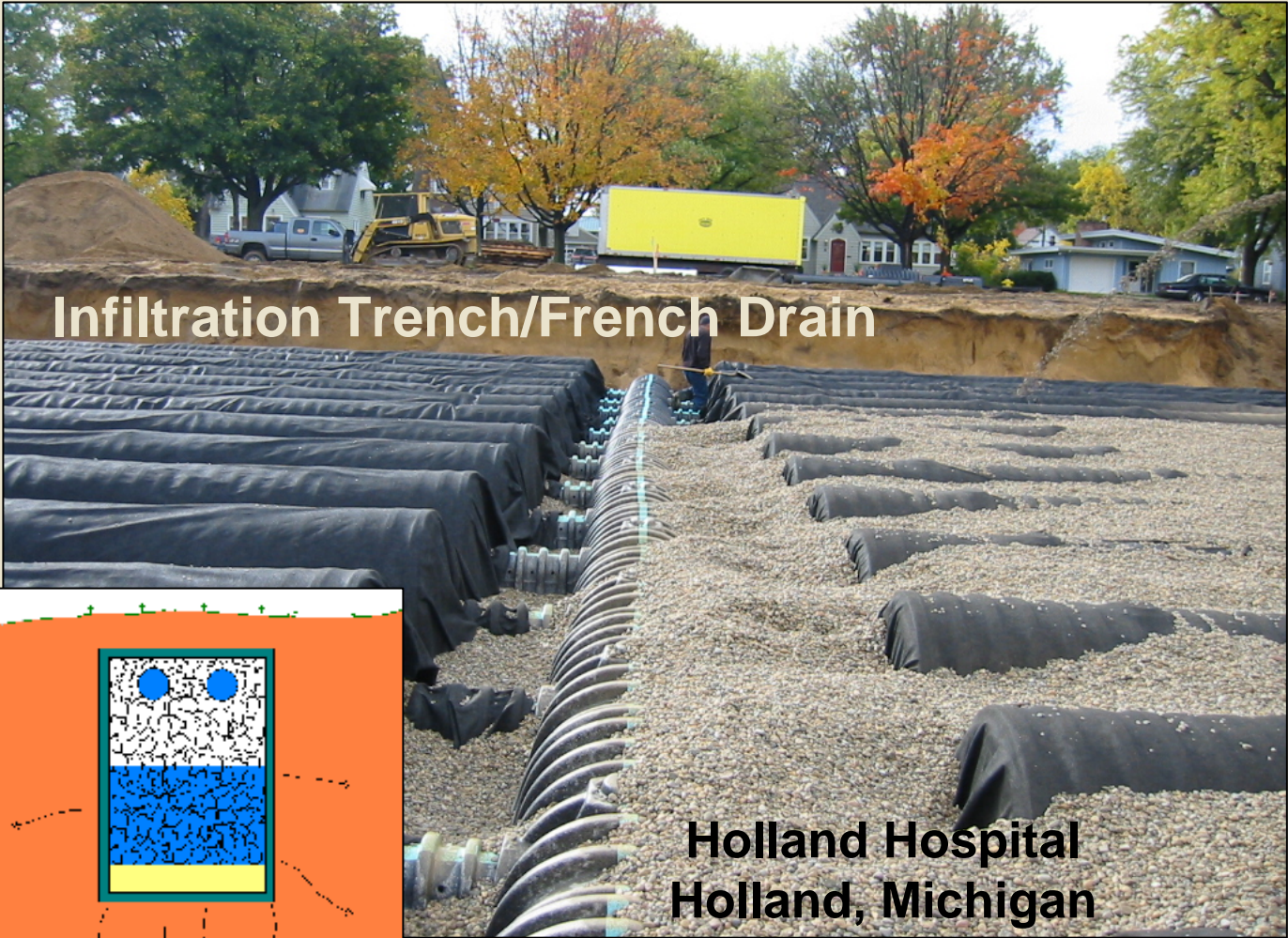
Maintenance Considerations

Porous Pavement

- Do not blow grass onto pavement – mulch instead
- Do not sweep – vacuum
- Striping is okay, but do not paint
- Do not sealcoat



Sustainable Storm Water Design



Pretreatment and Spill Containment



Pretreatment and Spill Containment



| Trap Oils and Grease

| Settle Solids

Green Roofs



Green Roofs

Benefits

- Peak rate control
- Volume control
- Water quality treatment
- Increased life span of roof – 60 years
- Heating/cooling energy benefits



Green Roofs



Green Roofs



Haworth Corporate Headquarters – Holland

Green Roofs



City of Grand Haven



Vegetation

Growing Medium

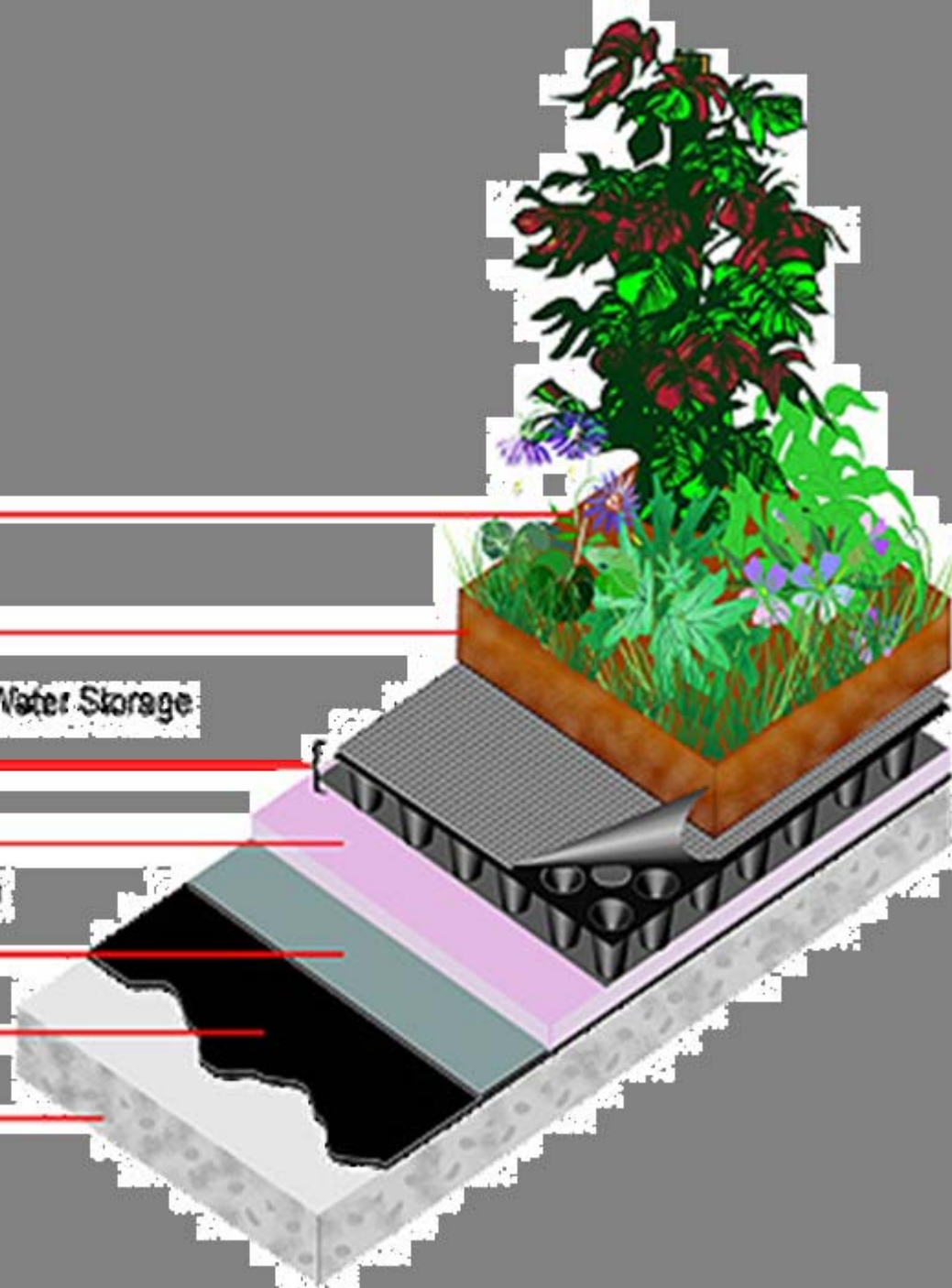
Drainage, Aeration, Water Storage
and Root Barrier

Insulation

Membrane Protection
and Root Barrier

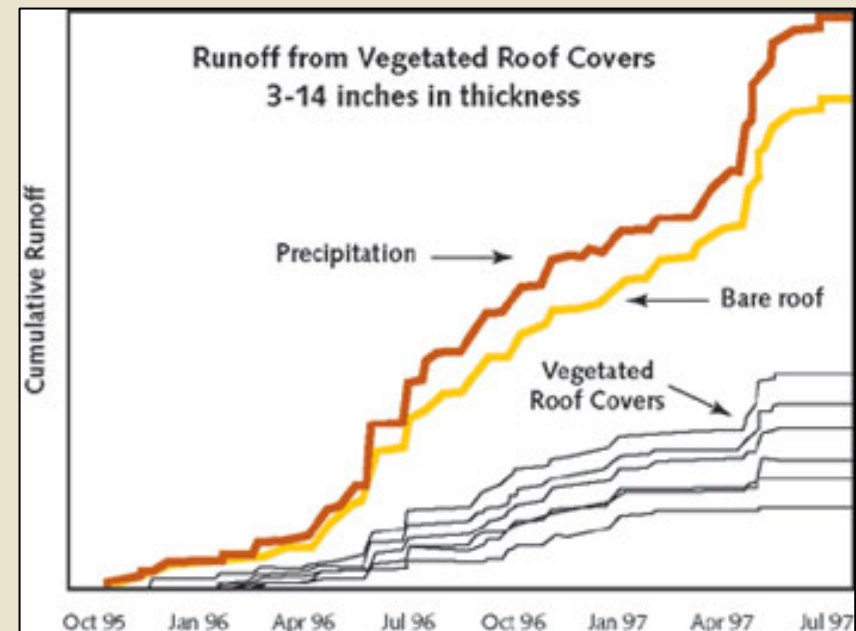
Roofing Membrane

Structural Support



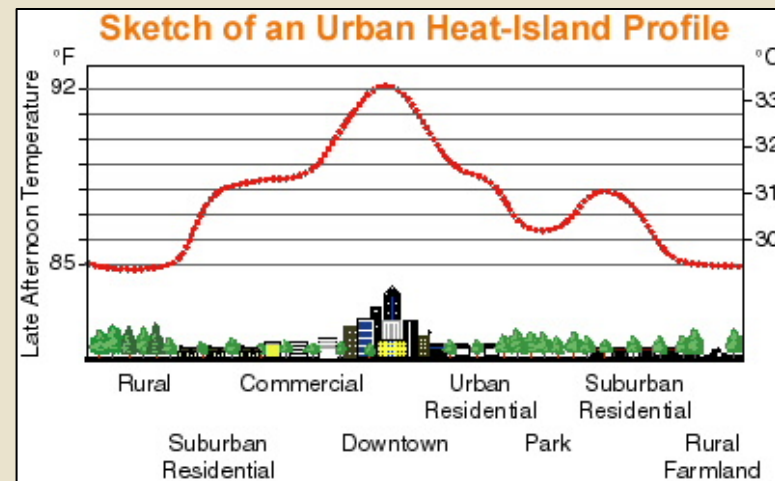
Green Roofs

- Reduces and improves storm water runoff
 - ▣ Retains 65% to 90% of summer precipitation, 25% to 40% of winter
 - ▣ Reduces need for onsite storm water detention
 - ▣ Plant material filters pollutants



Green Roofs

- Urban Heat Island reduction
 - ▣ Up to 90 degrees cooler than conventional roofing
- Cleaner air
 - ▣ Stores carbon, absorbs pollution, and collects airborne particulates
- Noise control
 - ▣ Can reduce indoor sound by up to 40 decibels



Storm Water Reuse

Benefits

- Peak rate control
- Volume control
- Water quality treatment
- Provides supplemental water supply



Storm Water Reuse

Underground Tank Storage

- Multiple tanks can be piped in series
- Access hatches for cleaning
- Submersible pump/motor with water level sensors
- Can be connected to potable water source, if desired



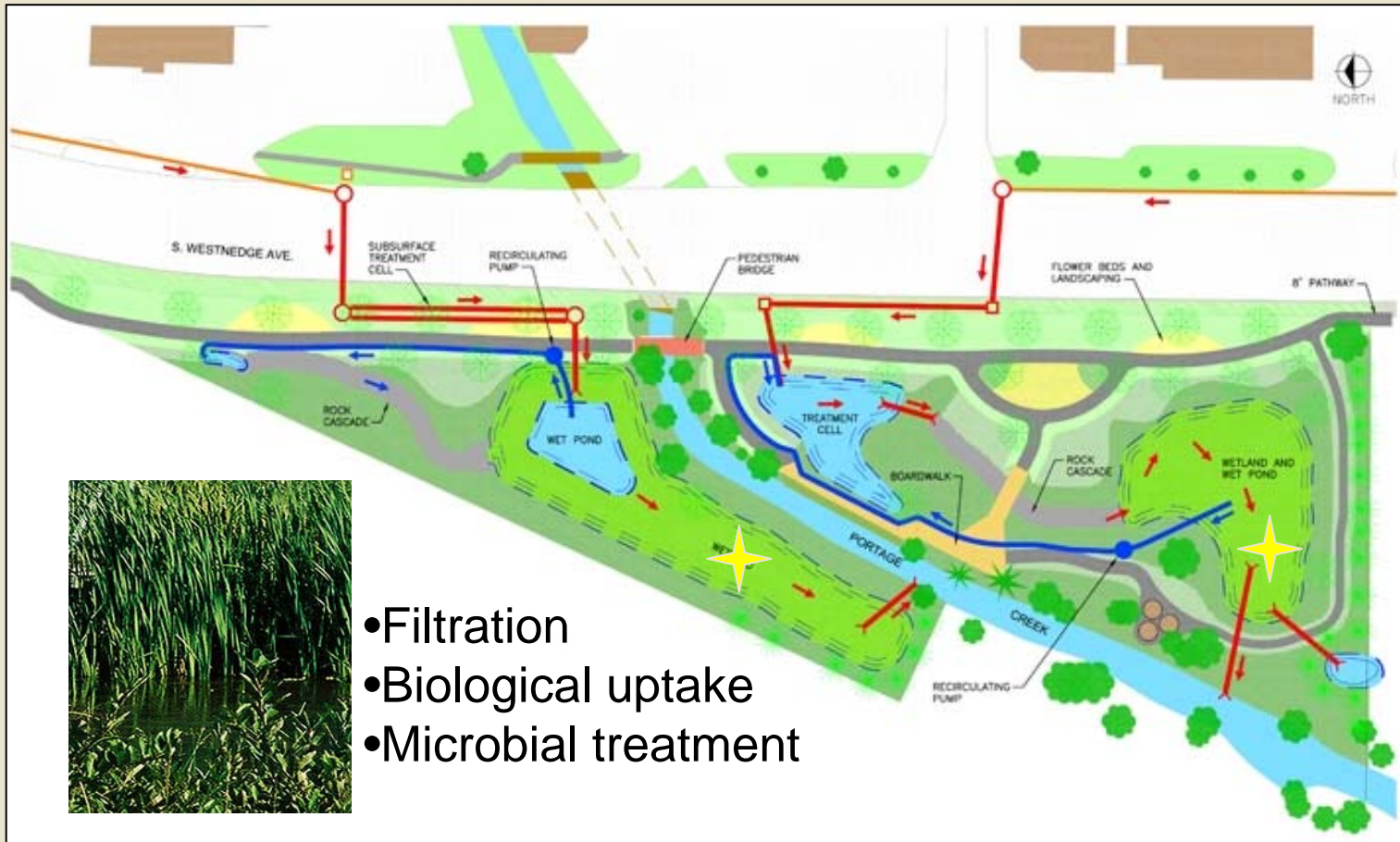
Storm Water Reuse



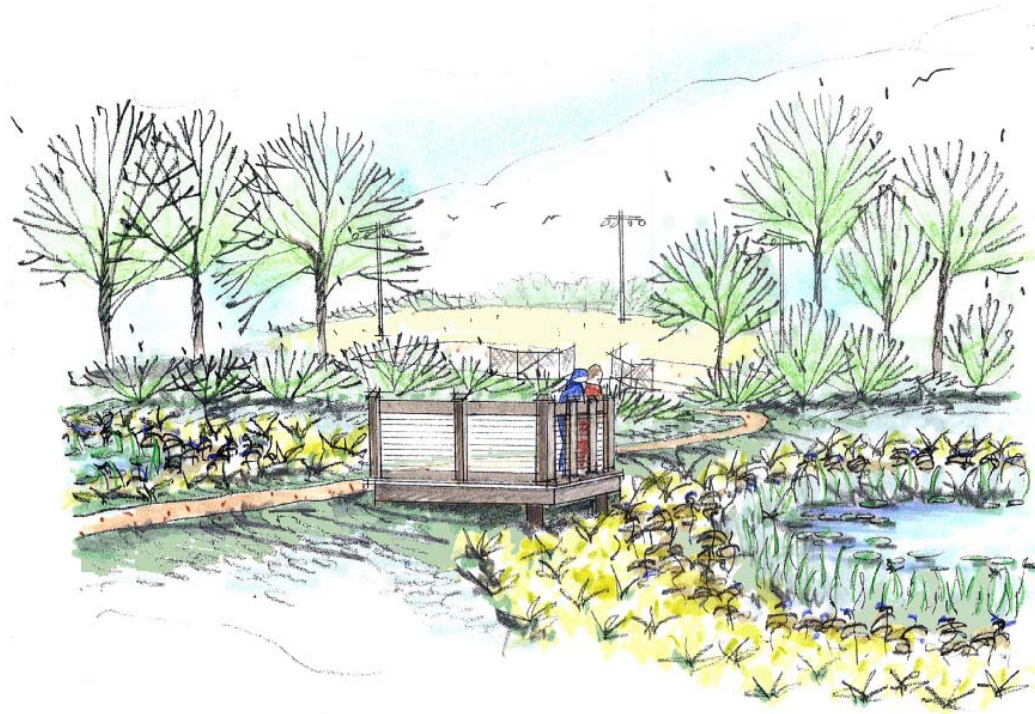
Grand Valley State University



Wetlands



Proposed Wetland Complex

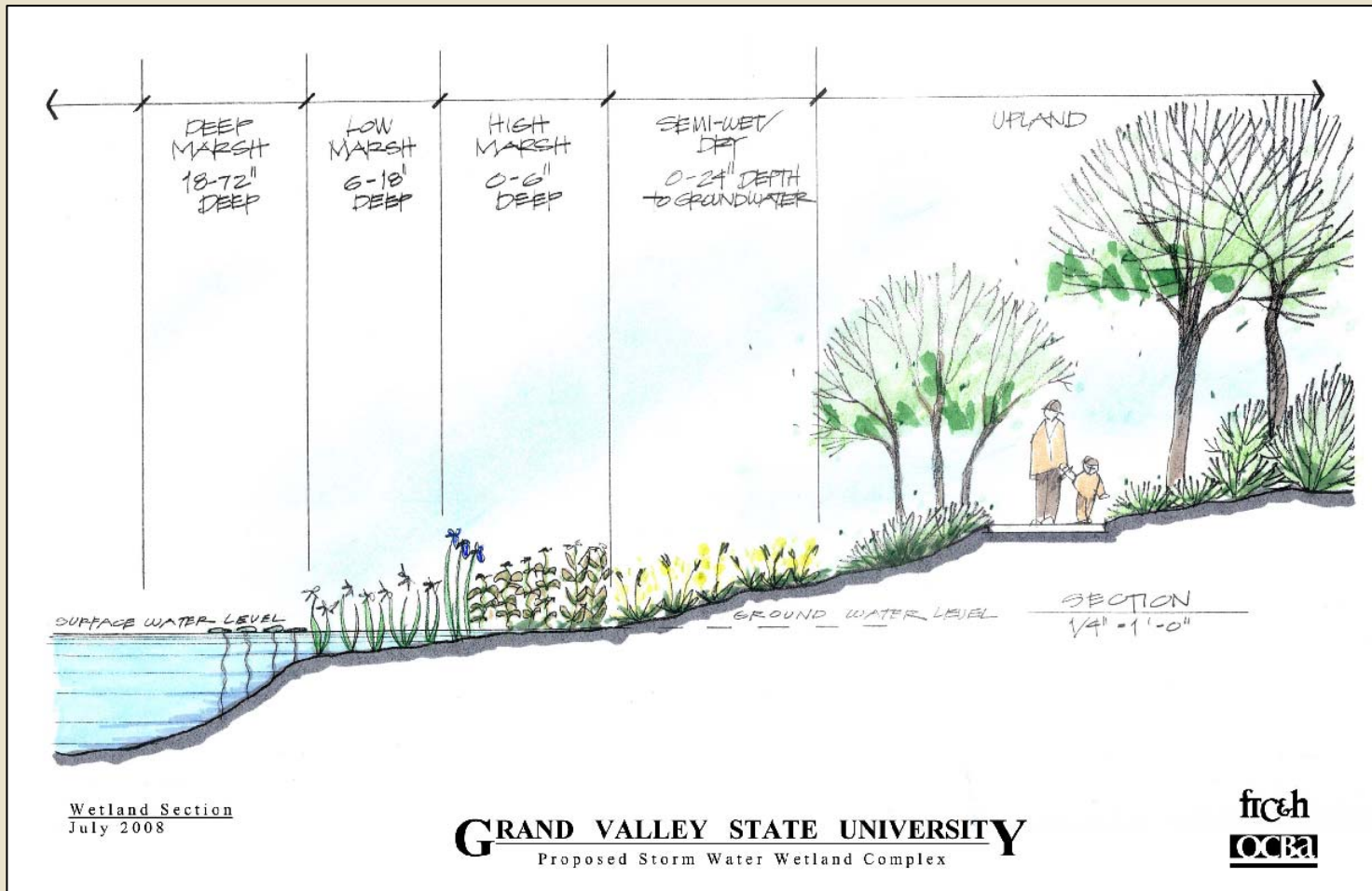


View at Wetland Overlook
July 2008

GRAND VALLEY STATE UNIVERSITY
Proposed Storm Water Wetland Complex

fitch
OC&A

Proposed Wetland Complex



Wetland Complex Project







Urban Forest





I'M HALF WAY THERE.

WE'VE BEEN BUSY

One of the 127 PlaNYC initiatives is a citywide, public-private program with an ambitious goal to plant and care for one million new trees across the city's five boroughs by 2017. It is a partnership between NYC Parks and the New York Restoration project to increase our city's urban forest by planting trees in streets, parks, and public, private and commercial land. Today, we've hit our halfway mark of 500,000 new trees in New York City.

WHAT THE COLORS MEAN

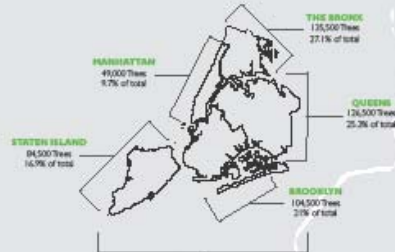
Areas not in parks are shaded in green. Darker areas signify more trees per square mile.



Park areas are shaded in orange. Darker areas signify more trees per square mile.



PLANTING TOTALS BY BOROUGH



NEW YORK CITY

500,000 Trees

HELP US WITH THE OTHER HALF.

Visit milliontreesnyc.org to find out how.

milliontreesnyc



Bacteria abound

E. coli levels in area streams raise questions, alarms

BY JIM HARGER AND JULIE MAKAREWICZ
THE GRAND RAPIDS PRESS

West Michigan's streams are teeming with E. coli, the bacteria that can give you diarrhea — or worse, put you in the hospital.

Researchers spent two years taking samples in dry and wet weather conditions from Plaster Creek, Buck Creek, the Coldwater River and their tributaries.

"I wasn't surprised that much by the dry weather levels — there just aren't that many watershed areas around

here that dards," said environmental Thompson engineer testing.

"The n were sur were ext are some

Research or what which ru square m counties.

Because waste of f mans, the pected so Prime s tanks, lar



Be Storm Water Savvy!

What is Storm Water Runoff?
One of the most significant, yet unrecognized groups of water contaminants is storm water pollutants. When it rains, storm water runs over yards, streets, roads, highways, parking lots, parks, and playgrounds, carrying with it everything in its path, including debris and pollutants. Eventually, the water will travel to a stream, either over land or via a storm drain.

It takes a really big person to think small

Household cleaners, pesticides, paint, antifreeze. When it comes to home tools, it pays to think small.

Household items are a small piece of the puzzle, but home tools can be bigger and more dangerous. They are designed for an entire house, and they can be used in a way that is not intended.

Don't drink. Don't use products not in containers. Follow only the instructions on the label. If you're not sure, ask for help. And if you're not sure you can take it up, don't.

It's raining, it's pouring, toxic rainbows are forming

The next time it rains, look down at your driveway or the nearest parking lot. See any colorful "oil rainbows" slicked across the pavement? It's a sign that someone's car is leaking fluids.

The average neighborhood has 200 cars. Each car has 100 gallons of oil. That's 20,000 gallons of oil. That's a lot of oil. When it rains, the oil runs down the street and into the storm drain. It then flows into the water table and eventually into the ground. It can then be picked up by drinking water supplies and used for food.

Don't buy an oil or oil-soaked car. Don't use oil-soaked rags. Why not? Oil is a carcinogen. It can cause cancer. It can also cause other health problems. If you have an oil-soaked rag, use it to clean up an oil spill. Then, dispose of it properly. Don't throw it away. Call your local waste management authority.

Get clean on the green

Washing the car can be lots of fun. Did you know it can benefit your lawn, too?

If you've just had your car washed, you can use the soap and water to clean your lawn. The soap will get rid of the dirt and grime. The water will get rid of the weeds. This is a great way to clean your lawn. Just use a hose and a spray nozzle. Don't use a pressure washer. It can damage your lawn.

There's another benefit to getting clean on the green. Washing your car on the lawn can help you save money. You can use the soap and water to clean your lawn. This is a great way to clean your lawn. Just use a hose and a spray nozzle. Don't use a pressure washer. It can damage your lawn.

You can't really clean up on the lawn. Use a commercial car wash. Regular car washes use commercial car wash soap. This soap is designed to clean your car. It's not designed to clean your lawn. So, don't use it on your lawn.

Lower Grand River Watershed

Visit us on the web:
www.gvsu.edu/wri/isc/lowgrand



Did you know that the Native Americans and European settlers alike depended on the Grand River for food, transportation and recreation?

Did you know that the Grand River watershed is the largest common river in the State of Michigan?

Did you know that over 2,000 years ago, the Hopewell Indians, known for their large burial mounds, occupied the Grand River Valley?



The name Grand Rapids comes from the rapids of Grand River. The rapids disappear over the distance of only about 100 feet.



Although agriculture and corn are staples of the watershed, increasing urbanization is resulting in priority losses.

What is a watershed?
A watershed is an area of land where all the precipitation that falls in that area drains into a common set of streams, or body of water. For example, the total area that drains into the Grand River constitutes its watershed. Watersheds cross county lines. No matter where you are, you live in a watershed.

Be Storm Water Savvy!

Where do Storm Drains Lead?
Storm drains are frequently located alongside streets and parking lots. Unlike sanitary sewers that divert water to a treatment plant directly from your home, storm drains lead directly to surrounding lakes and rivers without any type of treatment. All the debris and pollutants that were picked up by storm water runoff, end up in your lakes and streams!

Your septic system clears the water you use every day. Still, there's no



Connecting Water with Life

Be Stormwater Savvy

www.lowergrandriver.org

Support provided by the Michigan Department of Environmental Quality and the Lower Grand River Organization of Watersheds



