

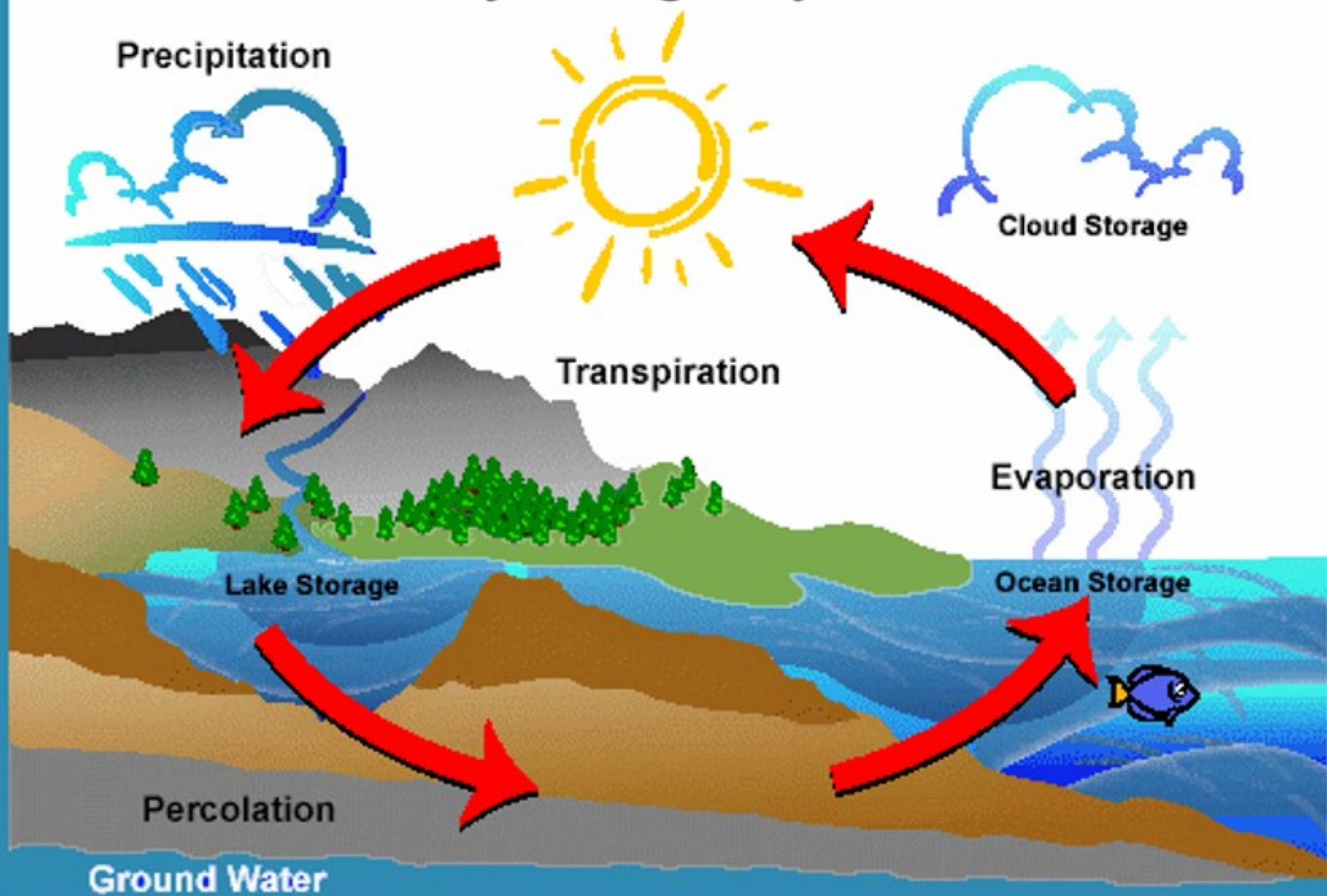
Stormwater Management: Post Construction Stormwater BMP's



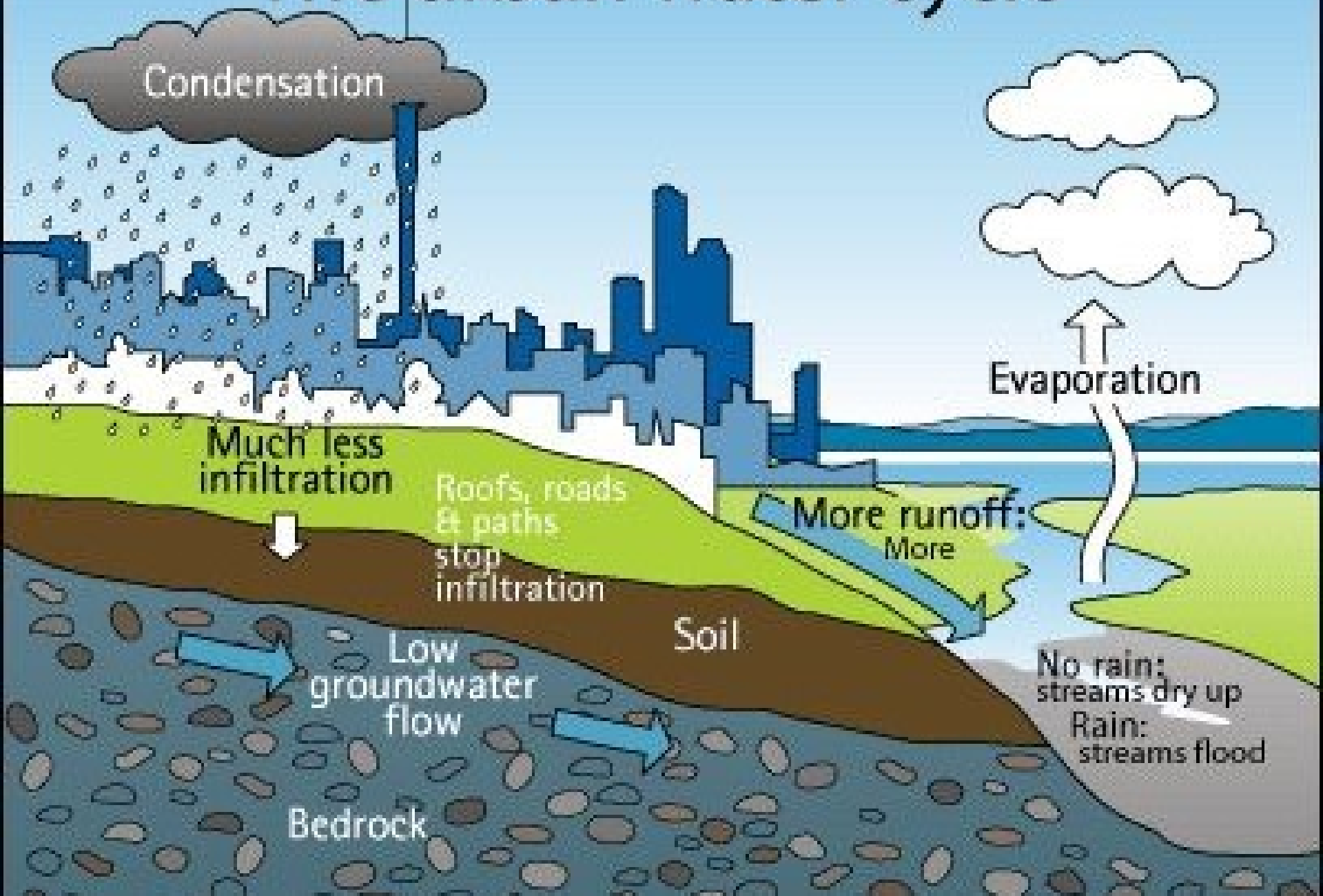
WATER • WASTEWATER • STORMWATER
SOLUTIONS

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Hydrologic Cycle



The urban water cycle





What we need to protect

- Freshwater makes up a very small fraction of all water on the planet. Nearly 70% of the world is covered by water, only 3.0 percent of it is fresh. The rest is saline and ocean-based.
- **Just 1 percent of our freshwater is easily accessible**, with much of it trapped in glaciers and snowfields. So, only **0.007 percent** of the planet's water is **available for drinking water**.



- **Groundwater** is actually being considered the **world's most extracted raw material** at a withdrawal rate of 259 trillion gallons per year!
- **It has been estimated that households alone in the U.S. use 349 billion gallons of freshwater every day!**
- In 1990 2.2 billion gallons of groundwater was extracted and used for agricultural irrigation. Today that number is 53.5 billion gallons!

Storm Water Runoff



**1" rain event on 1 acre of
ground.....27,154 gallons**



**1" of snow on 1 acre of
ground.....2,715 gallons**



The city of Buffalo NY covers 33,610 acres. In November 2014 they received 7' of snow. How many gallons of runoff could have been infiltrated using the right practices?

- THANKSGIVING 2014 BUFFALO NY
- Received over 7' of snow
- Snowfall rates estimated as high as 6" per hour

7,665,096,600 Gallons



Erie County NY Math Equation

Per Erie County Water Authority:

Customers use 230 gallons of fresh water daily

111,000 Households in the City of Buffalo

$111,000 \times 230 \text{ gal} = 31,080,000 \text{ gal per day}$

$7,665,096,600 \div 31,080,000 = 246.6 \text{ days}$



Some interesting facts provided by Kevin Meindl, Green Infrastructure Program Manager for the Buffalo Sewer Authority:

- Buffalo has large amounts of impervious surfaces (where water does not get absorbed) with over 56% of the city being identified as impervious, much higher than peer cities such as Syracuse (41%), Pittsburgh (34%), and Scranton, PA (23%).

4,292,454,096 gal of stormwater

138 days of available water

Over 1,000 acres of green infrastructure across Buffalo keeps more than 1 billion gallons of stormwater out of local waterways each year.

See if you qualify for green infrastructure grant funds at raincheckbuffalo.org/grants

RAIN CHECK 2.0

BUFFALO
SEWER AUTHORITY

GREENPRINT PARTNERS

PORTLAND, ME

Portland covers 44,441 Acres



Providence, RI

Providence covers 22,387 Acres



BOSTON MA

Boston covers 57,363 Acres



Severe Storms increasing

August 2011: Hurricane Irene

October 2012: Hurricane Sandy

June 2013: Tropical Storm Andrea

June 2015: Tropical Storm Bill

May 2016: Tropical Storm Bonnie

October 2016: Hurricane Matthew

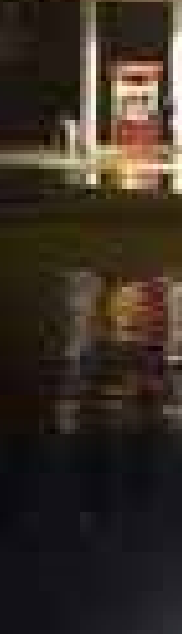
September 2017: Hurricane Irma

September 2018: Hurricane Florence

October 2018: Hurricane Michael

August 2020: Hurricane Laura

- 1.Syracuse
- 2.NYC
- 3.Syracuse
- 4.Ithaca
- 5.Albany
- 6.rye

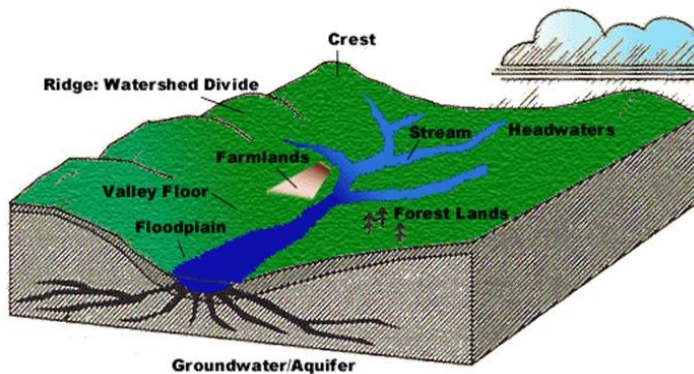




- **Where are we sending Stormwater?**
- **What are the impacts of sending it off site?**
- **Can we do Better?**

Some Human impacts on Watersheds

Protecting our Watershed



- Nutrient overloading
- Sediment runoff
- Toxic Chemicals
- Organic loading
- Thermal loading
- Stream Channel Alteration
- Altered Hydrology

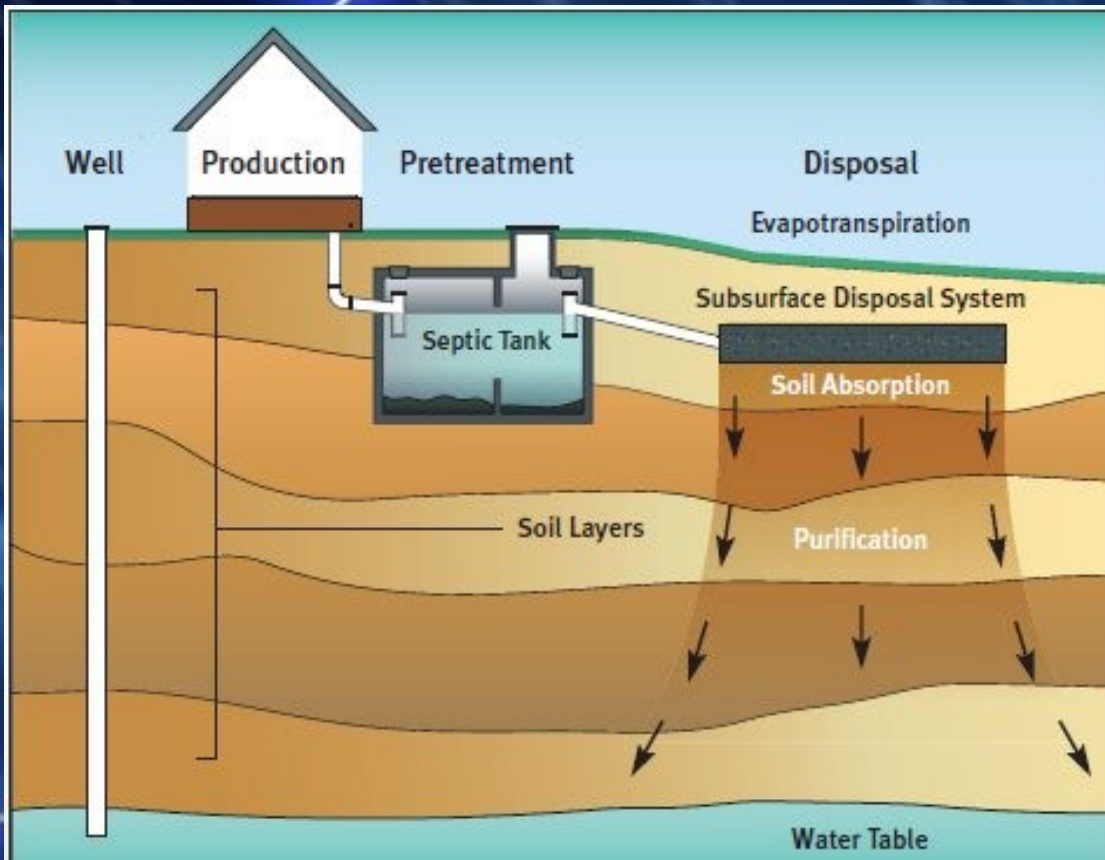




Pre-Treatment

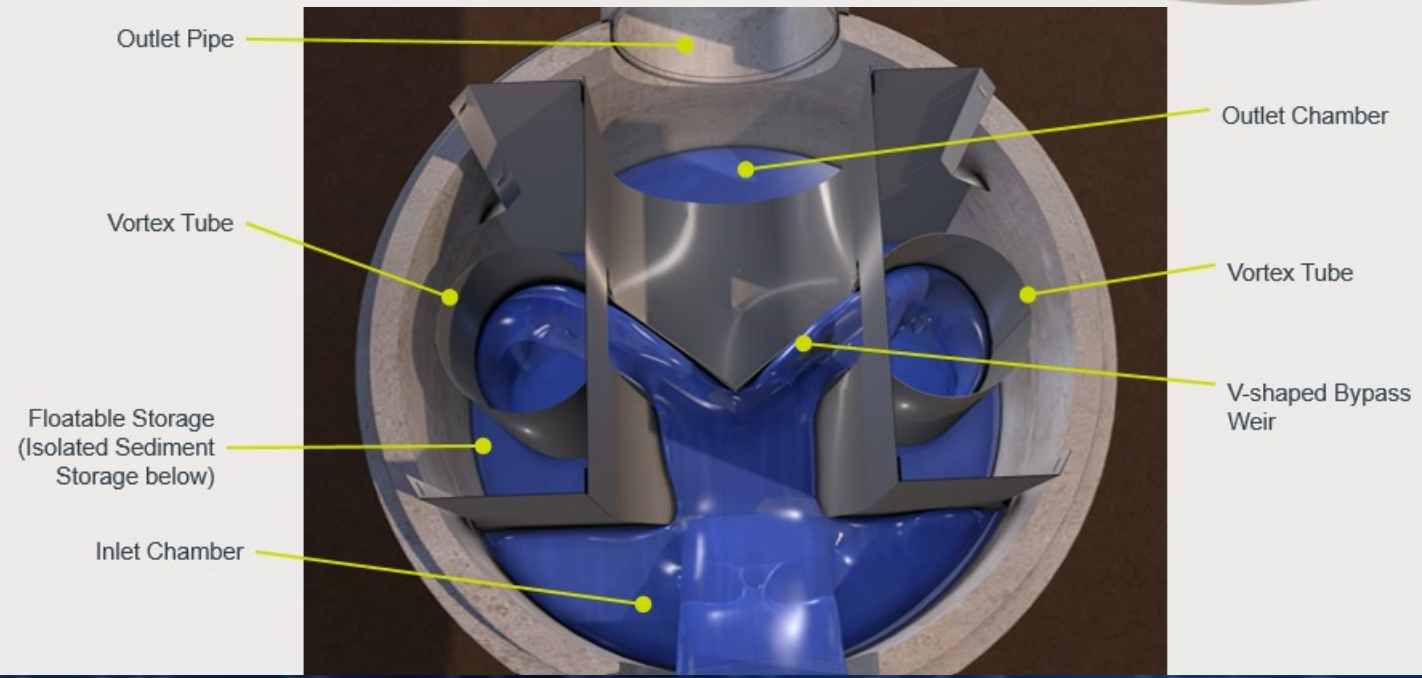
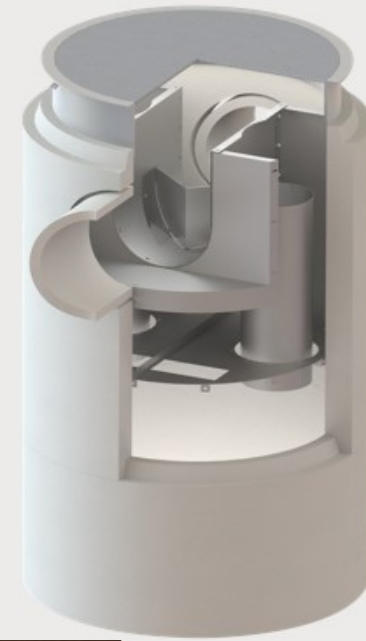
Pre-Treatment

Not a New Concept



- Pretreatment
- Detention
- Deep and Shallow
- Permeability

- | Hydrodynamic Separation System (**HDS**)
- | **Pretreatment** system to remove TSS, gross solids, trash and debris
- | **Compact design** accommodates wide range of pipe orientations with **Round** or **Square** Configurations



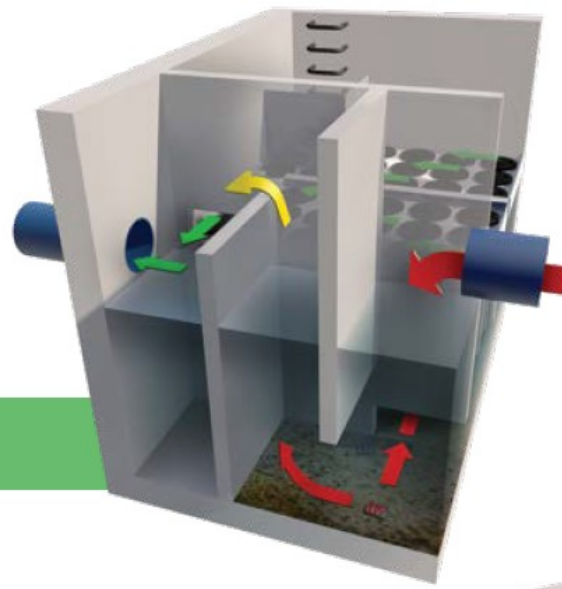
Hydrodynamic Separator



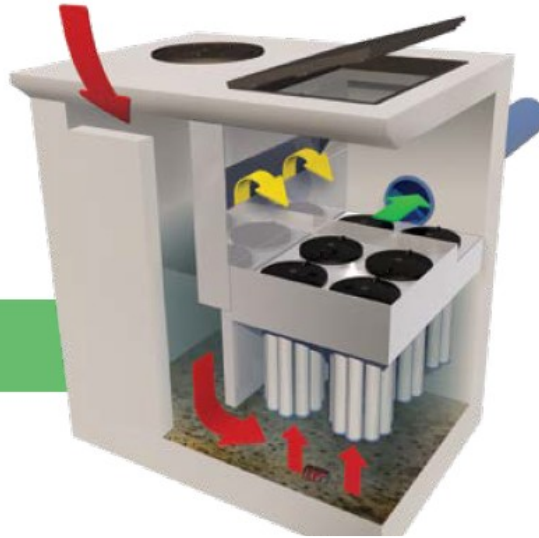
Debris Separating Baffle Box (DSBB)



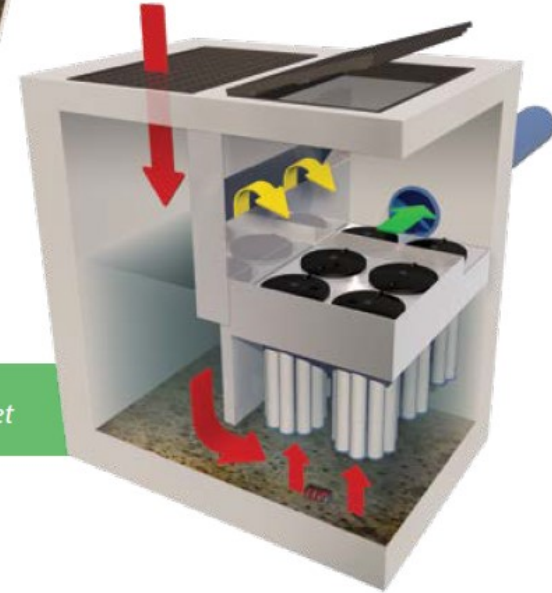
Manhole



Vault



Curb Inlet



Grated Inlet

Cartridge/Membrane Filtration

POLLUTANT OF CONCERN

% REMOVAL

Total Trash

99%

Total Suspended Solids (TSS)

89%

Total Phosphorus (TP)

59%

Total Nitrogen (TN)

51%

Total Copper (TCu)

> 50%

Total Zinc (TZn)

> 50%





NO
PARKING

WELCOME TO OUR
Tobacco-Free Beach
Respect. Relax. Live Better.

Biofiltration





POLLUTANT OF CONCERN	MEDIAN REMOVAL EFFICIENCY	MEDIAN EFFLUENT CONCENTRATION (MG/L)
Total Suspended Solids (TSS)	89%	12
Total Phosphorus - TAPE (TP)	61%	0.041
Nitrogen (TN)	23%	1
Total Copper (TCu)	50%	0.006
Total Dissolved Copper	37%	0.006
Total Zinc (TZn)	66%	0.019
Dissolved Zinc	60%	0.0148
Motor Oil	79%	0.8



Maintenance





Stormwater Detention & Reuse



Definitions

- Detention – stormwater is stored temporarily
- Retention – stormwater is stored permanently
- Infiltration – stormwater flows downward to recharge groundwater aquifer
- Harvesting – stormwater is treated and used again for non-potable purposes, such as irrigation



**Box Store = 63,067 sf
footprint or 1.45 acres**

***3" of rain = 118,605
gallons of stormwater***

**Parking is at least
twice the size of store
*237,210 gallons***

HURRICANE IRMA, 2017



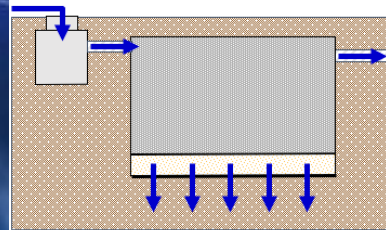
**Section of RT 9 in Westborough, MA
Lots of Roof and Pavement**



**Zoomed in on
one plaza
Westborough,
MA**

**Where is this
Stormwater
Going?**

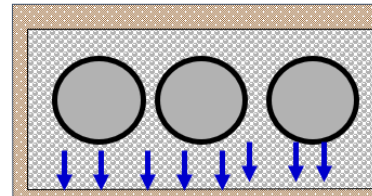
Evolution of Drain Field Designs



Drainage Stone Bed

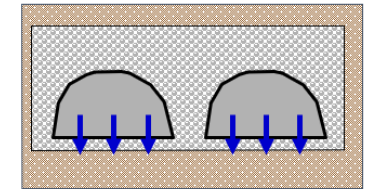
Excavation filled with Drainage Stone

- 40% Void Space for Water Storage
- Inefficient – But It Worked



Pipe & Stone Filled Bed

- Pipe Creates Additional Void Area
- Heavy use of stone (60-70%) to fill corners



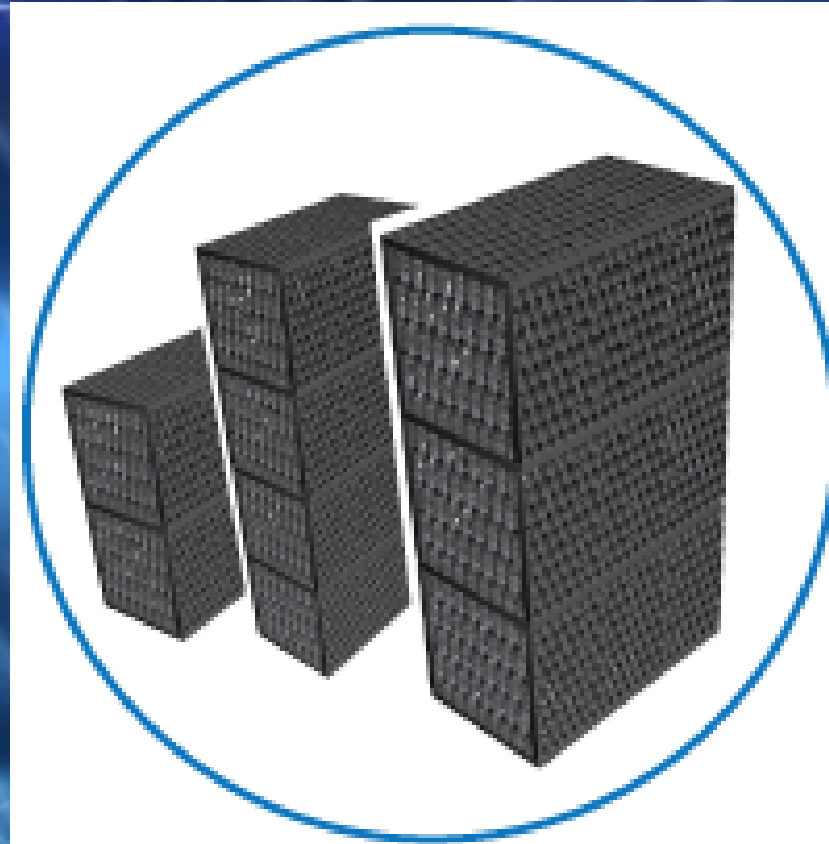
Plastic Arch & Stone Filled Bed

- Squares off bottom corners to increase efficiency
- Stone still required (59%) to fill corners and provide structural support





Geo-Cellular Detention Systems Evolution of Drain Fields



New Technology provides 95% VOID Space!

Geo-Cellular Detention Systems Evolution of Drain Fields



Geo-Cellular Detention Systems Evolution of Drain Fields

No uniform design standard in USA

- Inconsistent product design / specifications.
- No lifetime creep testing requirements for structural design.
- System loading dependent on civil design.
- Installation accuracy extremely important.
- Access and Maintenance Requirements

CIRIA

C680/C737

Geo-Cellular Detention Systems Evolution of Drain Fields


“There was excessive rain that caused the stormwater management system to collapse, so all of those systems were removed and replaced with new systems,” said Monica Trego, general manager of Tanger Outlets.

Pittsburgh Botanical Gardens



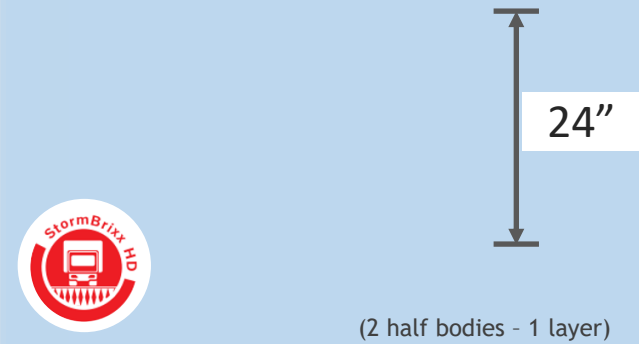
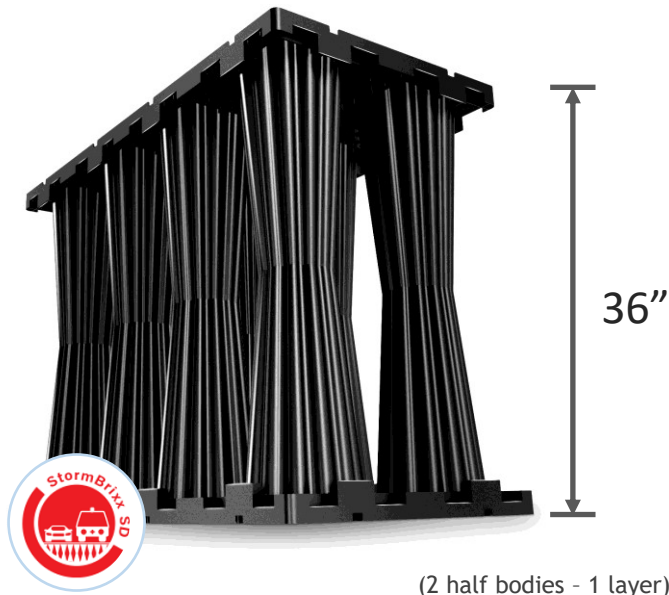
LARGE SINKHOLE
OAKDALE, ALLEGHENY CO.

**BREAKING
NEWS**

PITTSBURGH'S
**ACTION
NEWS** 

- STORMBRIX
X SD & HD

MAIN BODY
PIECES



- COMPO
NENTS

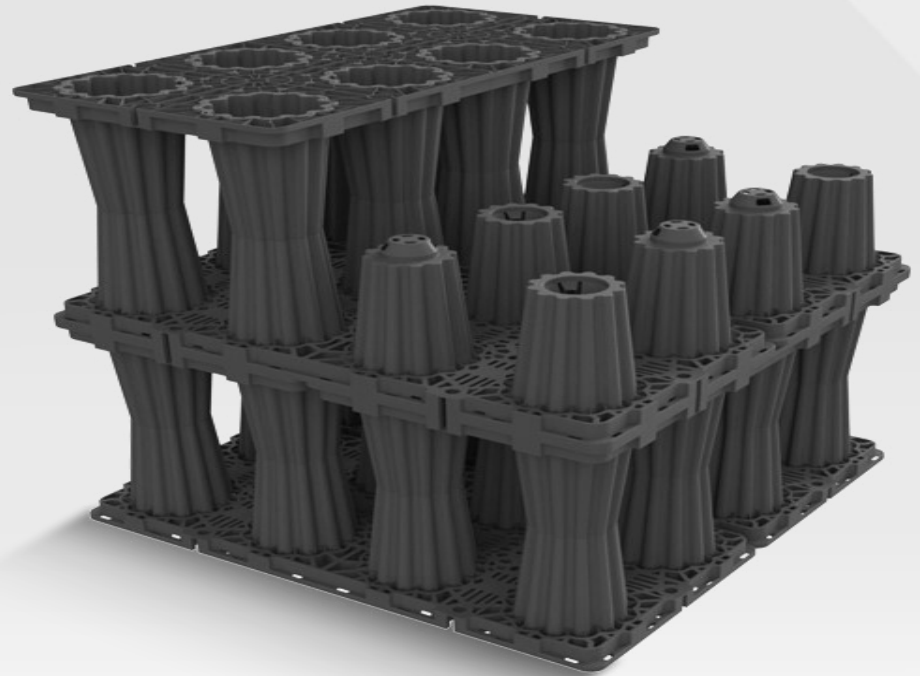
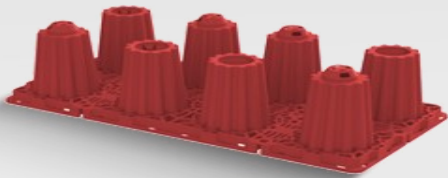
- ADVANTAGES OF BRICK BONDING

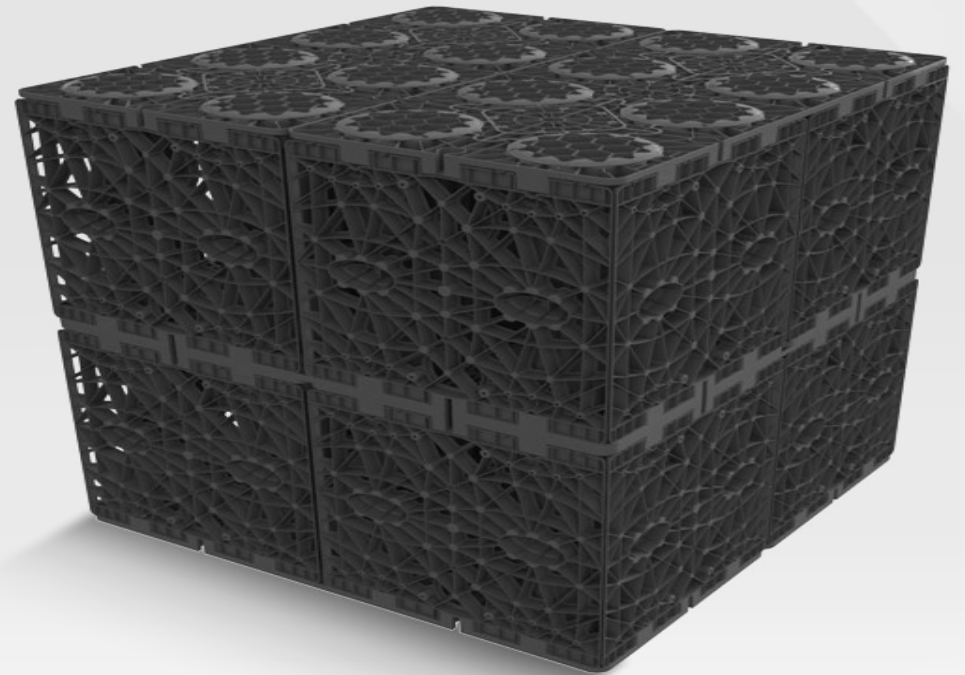


ADVANTAGES

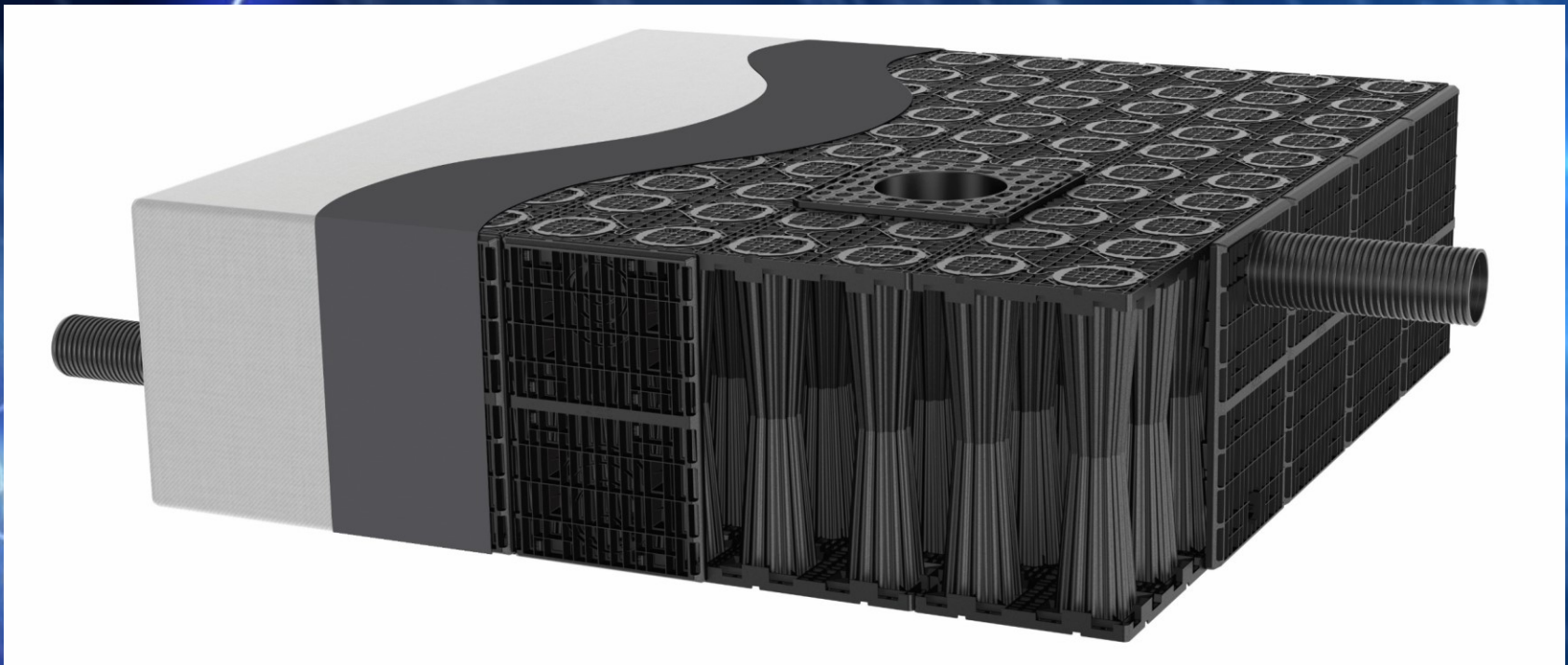
- High structural strength due to female-male connections
- No connectors needed within 1 layer
- No shifting between the base elements → even load distribution on pillars
- Faster and easier installation → time and cost saving
- Protection against differential settlement







Geo-Cellular Detention Systems Evolution of Drain Fields



Geo-Cellular Detention Systems Evolution of Drain Fields



Lyndonville NY Dollar General

Tank Dimensions

45' x 13' x 6'

4 Laborers 2.5 hours



Blodgett School Syracuse, NY

Tank Dimension
31.5' x 21.5' x 3'

2 Laborers 1.5 hours



Horseheads CSD Horseheads, NY

Tank Dimensions
98.5' x 65' x 18"

5 Laborers 5 hours



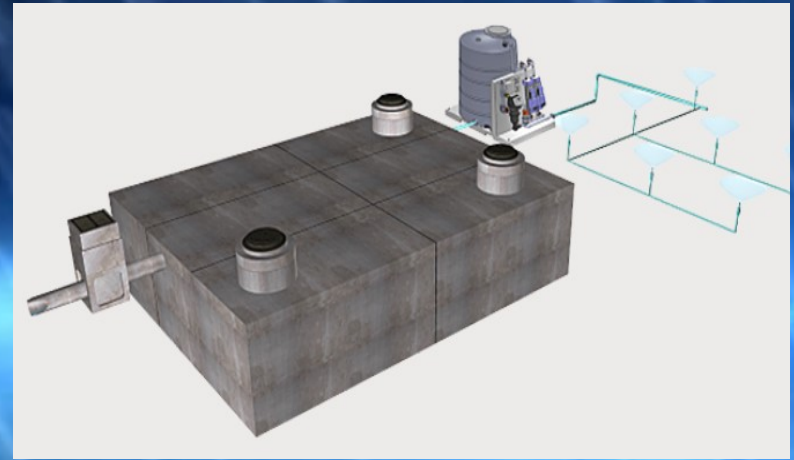
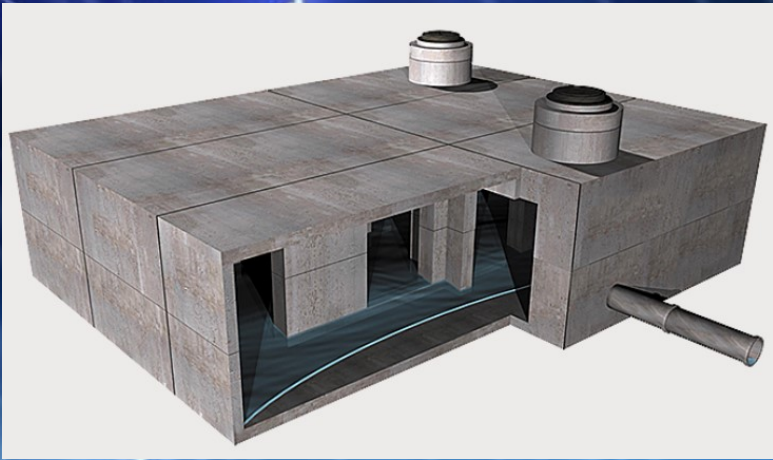
EJP Huber Heights OH



Don't wait until it's too late to call for help.



Concrete Retention/Detention



Concrete Retention/Detention



Concrete Retention/Detention



Concrete Retention/Detention



Don't Forget

Maintenance



Permeable Pavements



PERMEABLE PAVEMENT BENEFITS

- Reduce storm water runoff. (Even when pervious pavement structure is saturated, its rough surface texture continues to slow surface flow of stormwater)
- Replenish groundwater
- Reduce flooding which may over-load combined sewer sewage treatment plants
- Reduce peak rates of discharge by preventing large fast pulses of precipitation from entering the stormwater system
- Require less land set aside and cost for development of retention basins
- Reduce pollutants in run-off & Improves water quality
- Reduce pavement ice buildup
- Reduced stream erosion
- Reduction in the urban heat island effect
- ADA Compliant

Permeable Paver Functions



5 in 1 STORMWATER CONTROL
Measure





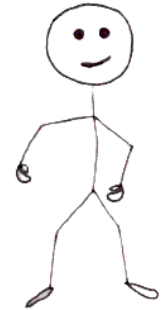


Assessment of Learning

1. 1" of rain on 1 acre of ground produces how much water?
2. T/F: One benefit of Modular Underground Stormwater systems is that you can capture stormwater in a smaller footprint compared to other applications
3. To eliminate contaminants from entering into waterbodies you could
 - A. Direct all stormwater directly into a receiving waterbody
 - B. Retain/Detain stormwater onsite
 - C. Construct asphalt lined stormwater ponds to warm the water effectively "boiling off" any pollutants
4. T/F: Stormwater Management practices are self – maintaining and therefore require no maintenance
5. What is considered the worlds most extracted raw material
6. Impacts of urbanization include
 - A. Streambank Erosion
 - B. Increased local flood risk
 - C. Contamination of receiving waterbodies
 - D. All of the above

Thank You

This is
my
thank you
dance!



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SOLUTIONS