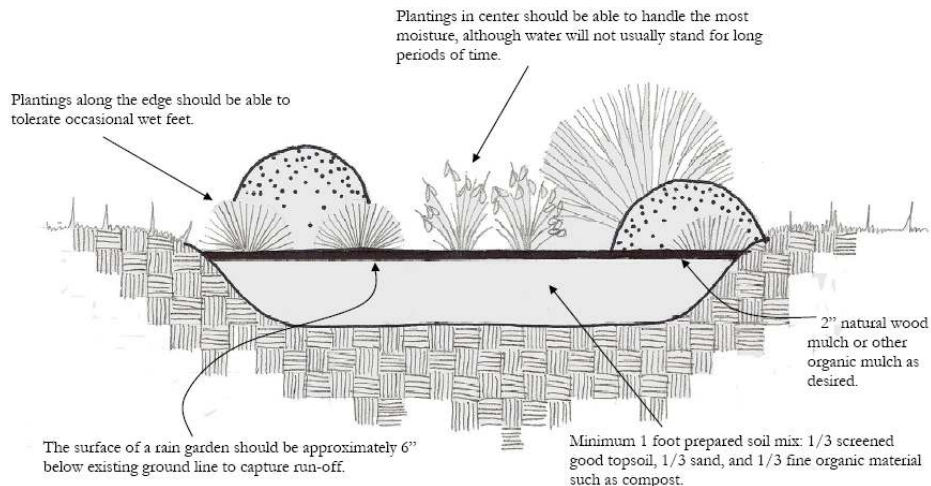


## Green Infrastructure/ Low Impact Development Practices for Managing Stormwater

- Increase Infiltration
- Increase Evapotranspiration
- Harvest and Re-use Stormwater
- Filter Pollutants
- Reduce Volume of Runoff



## Infiltrating Stormwater



*Try to use native plants, as they will  
tend to do the best job for you.*

## Infiltrating Stormwater Target Field



## Parking Lots

A significant source  
of stormwater runoff



## Parking Lots



## Bioretention swales in the parking areas at Kent State





# Permeable Pavement



White Sox Park  
Chicago





**Permeable Pavement Parking**  
Morton Arboretum, Lisle, IL



Permeable pavements have less standing water.  
Less likely to have ice accumulation in the winter.

**Standard  
Asphalt**

**Porous  
Asphalt**

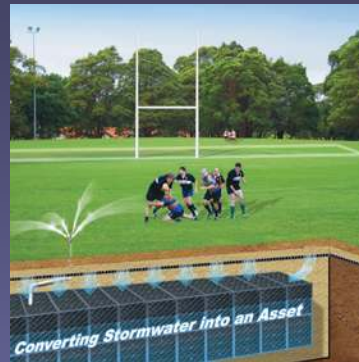
## Storing and Reusing Rainwater Cisterns



↑ North Carolina Botanical Garden, Chapel Hill, NC

← Ryerson Woods Visitor Center, Lake County, IL

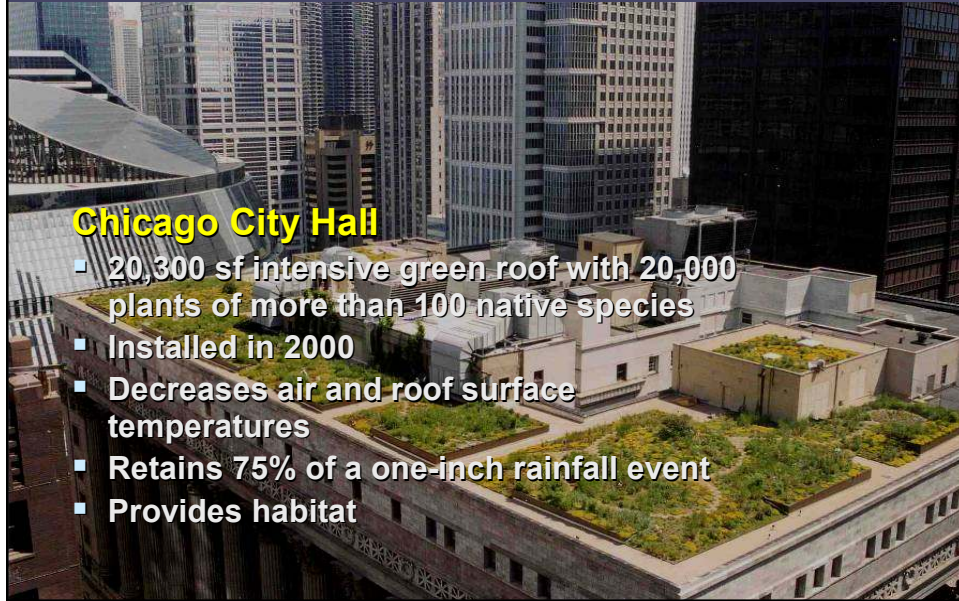
## Storing and Re-using Rainwater



Target Field, Minneapolis

- Underground cisterns gather rainwater from the stadium's lower seating sections and field, an area about seven acres in size.
- Rainwater is cleaned by a series of filtration and disinfection processes to a level equal to or better than municipal tap water standards.
- The stored water will be used to irrigate the field and clean the stadium.

# Green Roofs



## Chicago City Hall

- 20,300 sf intensive green roof with 20,000 plants of more than 100 native species
- Installed in 2000
- Decreases air and roof surface temperatures
- Retains 75% of a one-inch rainfall event
- Provides habitat

## Extensive Green Roof Light and Relatively Inexpensive



Highland Gardens, Milwaukee, WI



## Washington Nationals Baseball Park

- 6,317-square-foot green roof over a concession area
- Planted with about 1,200 drought-resistant sedums





## Cawrse and Associates Chagrin Falls, OH



### Cost of Installation

- Parking Lot and Drive: \$72,000
  - Paver system, earthwork, excavation, curb, soil borings
  - Pavers System: \$7-8 SF - product, stone and labor
- Swale - \$21,000
  - \$42 LF
  - Vegetation, planting, soil mix, soil stabilization, rock and earthwork
- Rain Garden/Bioretention: \$8,600
  - Vegetation, planting, earthwork, and soil mix
- Engineering: \$12,500
  - Civil engineering, landscape architect and survey fees
- **Total: \$116,741**

## Snow Removal

- Typical snow plow used through out the winter
- Salt added once – just in case



## Maintenance – Paver System

- Remove debris such as leaves or salt residue
- Sweep parking lot at least every 2 years
- Replace top layer gravel
- Replace pavers as necessary
- Monitor under drain outfall for changes
- No Traditional Infrastructure (e.g., storm sewers) to maintain
- Pavement life 30-50 years (vs. asphalt which may need to be replace every ~ 7 years)

# Costs

## Green vs. Grey Infrastructure

Project	Conventional vault cost estimate*	Rain garden cost
Bloedel Donovan Park parking lot (4400 ft <sup>3</sup> wet vault)	\$52,800	\$12,800
City Hall parking lot (2300 ft <sup>3</sup> wet vault)	\$27,600	\$5,600

\* City of Bellingham's estimate using approximate cost of \$12.00/ft<sup>3</sup> for an in-ground storage and treatment device and based on construction costs for similar projects in the Bellingham area

Reining in the Rain, City of Bellingham, WA 2004

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