Green Roofs

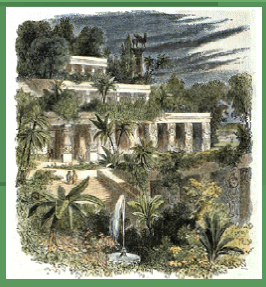
Presentation Outline

- History - Abridged
- Benefits
- Types
- Construction - Structure, Soil, Plants
- Examples
- The Lazarus Green Roof

History of Green Roofs

- Hanging Gardens of Babylon

(What Is Old is New Again)



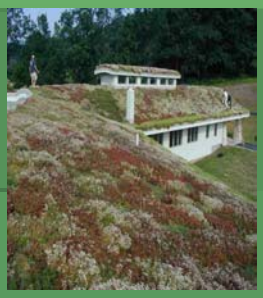
Why a Green Roof?

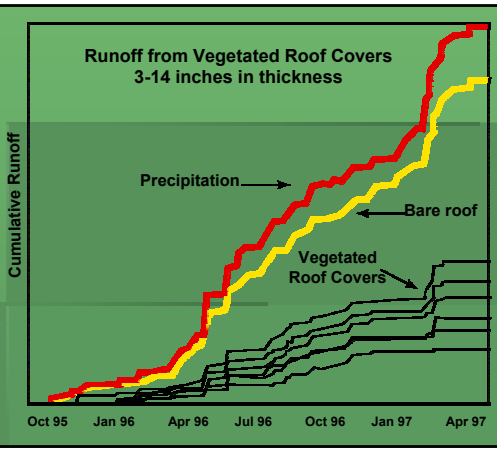
Green Roof Benefits

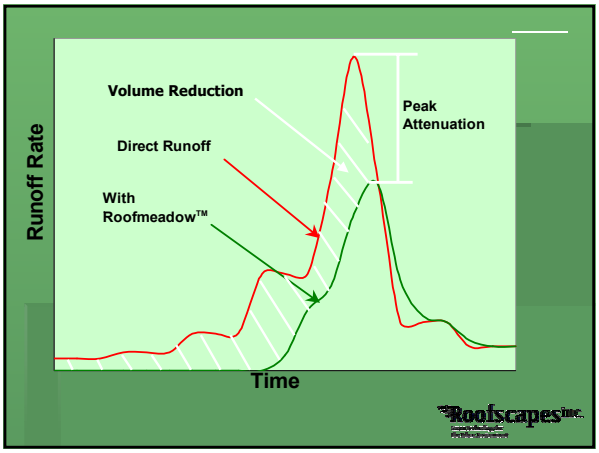
- Reduces and Slows Stormwater Runoff
- Decreases Heating and Cooling Costs
- Reduces Heat Island Effect in Cities
- Extends Roof Life
- Adds Habitat for Plants and Animals
- Reduces Noise
- Adds Moisture to Air
- Adds Beauty

Storm Water Benefits: Reduces and Slows Runoff

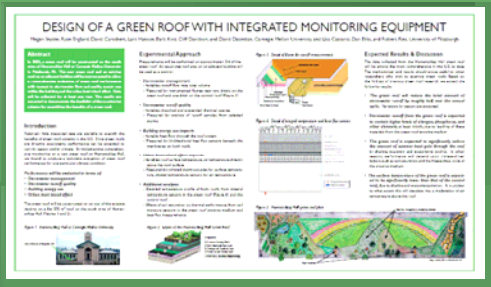
- An extensive green roof like this stores 75% of water in plants and soil layer
- 25% percolates through vegetation to drainage outlet and is released to storm drains after several hours
- Reduces peak flow, especially during brief, intense downpours







GREEN ROOFS
Storm Water Monitoring



Buildings account for 36% of U.S. energy consumption:

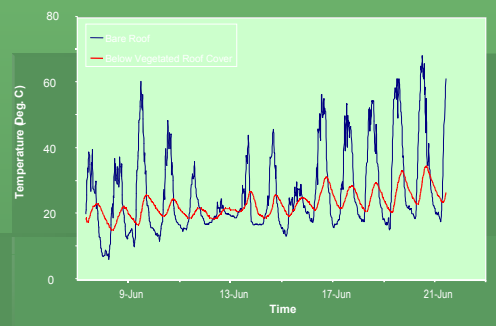
- Heating
- Cooling
- Lighting

Energy Benefits: decreases heating and cooling costs

- Green Roofs provide thermal insulation
- In new construction, a green roof can allow a building to be designed with a smaller HVAC system, requiring less maintenance

Temperature Variation

Philadelphia Roofmeadow



Roofscapes Inc.

Extends Roof Life

- Reduces daily expansion and contraction caused by temperature fluctuations
- Shields roof from sun's harmful UV rays
- Protects from abrasion and physical wear
- Extends service life of underlying waterproofing system

Habitat Replacement Benefits

- Birds
- Insects
- Native Grasses
- Wildflowers
- Rare and Endangered Indigenous Plants

Microclimate Modification

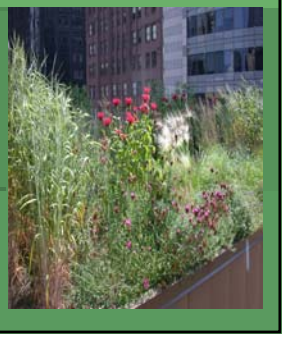
- Adds moisture to atmosphere through vegetative transpiration
- Potential to reduce urban heat island effect

Noise Reduction Benefits

- Acoustic Insulation
- 50 decibel reduction with 6" sod

Aesthetic Benefits

- Add color
- Soften hard edges
- Echo natural forms such as surrounding mountains



Types of Green Roofs

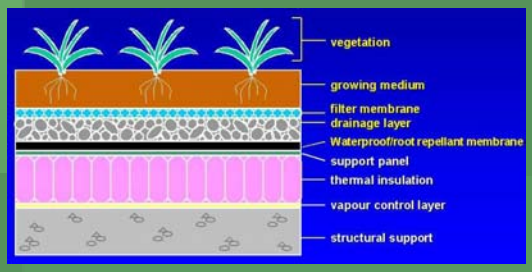
- Extensive
  - 1-5" soil depth
  - Add 15-50 pounds/s.f.
  - Not accessible
  - Built for environmental benefits
- Intensive
  - Minimum 12" soil to create a traditional roof garden with large trees and shrubs
  - Elaborate drainage and irrigation
  - Adds 80-150 pounds/s.f.
  - Accessible

LEED Scoring

Leadership in Energy and Environmental Design
US Green Building Council

- One category specifically related to Green Roof (Urban Heat Island), worth 1 credit
- Contributes to 5 other categories, worth up to 16 credits
  - Storm water management
  - Water efficient landscaping
  - Improved energy performance
  - Recycled material content
  - Local and regional materials

Green Roof design



Soil Specifications

- No Topsoil (Too heavy and compacting)
- Sample Growing Medium (2"-6" typical profile)
  - 25% Coarse Sand
  - 25% Forest Humus
  - 10% Red Lava
  - 15% Fir Humus
  - 25% Aged Humus

Soil Depth Specifications

- For sedum (stonecrop – non-native): 2" soil depth
- For native plants and prairie grasses: 3 - 6" soil depth
- For trees and shrubs: several feet of soil depth
- Weight of garden may require additional steel reinforcing

Vegetation Specifications: native plants and prairie grasses

- Root system is deep so need more soil (more weight requires stronger structural support)
- Need to control weeds and supply ample water while getting established
- Irrigation may be necessary to prevent drying out (a problem during fireworks)
- Need to mow at least once a year to minimize weeds and allow natives to predominate.

Vegetation Specifications: Sedum

- Shallow root system needs less soil
- Out-competes weeds
- Drought tolerant
- Easily planted through cuttings and then hydroseeding
- Evergreen
- Withstands climate extremes
- Flowers summer through fall - pinks, purple, yellow, white, red fall color
- Need more than 2 varieties to outsmart potential disease problems. Eight species were used at the Ford River Rouge truck plant.

Sedum cuttings

Plants for Extensive Roofs

- *Sedum album*
- *Sedum reflexum*
- *Sedum sexangulare*
- *Sedum spurium*
- *Sedum floriferum*
- *Achillea millefolium*
- *Allium schoenprasm*
- *Dianthus deltoides*
- *Festuca glauca*
- *Heiracium pilosella*
- *Origanum vulgare*
- *Petrohagia saxifraga*
- *Anthemis tinctoria*
- *Potentilla verna*
- *Prunella granifolora*
- *Aster linosyris*

GREEN ROOFS
William McDonough & Partners Examples

- The GAP Corporate Campus – San Bruno, CA
- Computer History Museum Design Competition Mountain View, CA
- Grand Rapids Art Museum Project Grand Rapids, MI
- Museum of Life and the Environment York County, S. Carolina
- Habitat @22 Spain

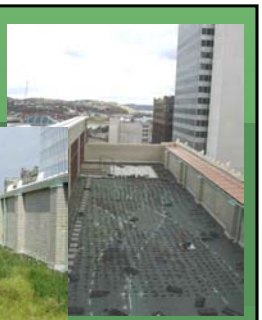
National Museum of Science and industry Wroughton, UK

- Ford Rouge River Truck Plant Dearborn, MI

Chicago City Hall: Before and After

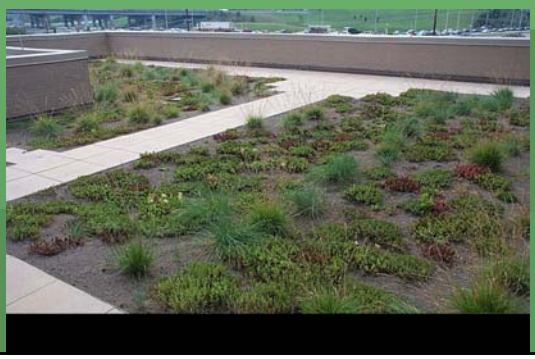
Heinz 57 Center

During Planting and 18 months later



Northern Kentucky Sanitation District #1

www.sd1.org

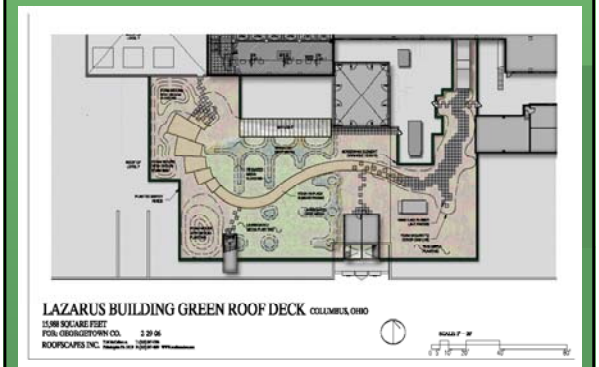


Northern Kentucky Sanitation District #1: roof water runoff demonstration

Geauga Park District West Woods Nature Center

Lazarus Green Roof: In The Beginning…

Green Roof covers 15,988 s.f. on the southwest quadrant (15% of roof)



Lazarus Green Roof:
liner installation summer 2006

Ballasted rail system with recycled plastic planters and concrete pavers

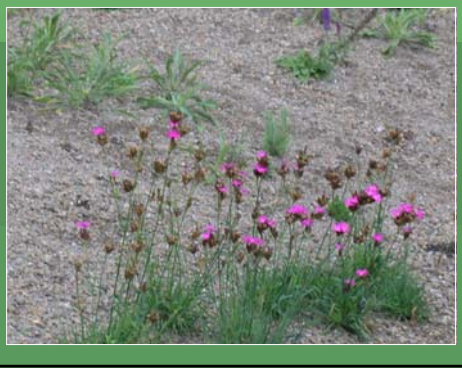
Irrigation lines run through the rail system to the planters

Summer 2007

View from the Riffe Center

Summer 2007

Summer 2007: Be patient…



Lazarus Green Roof

- 7 zones: 4 irrigated, three with drought-tolerant plants not requiring irrigation
- Captures first 1" of rainfall for building's grey water system, used to flush toilets
- Only recycled water used for irrigation, stored in classic "L" Lazarus Department Store water tank on top of the building

Lazarus Green Roof

- More than 60 plant varieties (24,000 plugs to start, 6 inches apart)
- Shallow areas include achillea (yarrow), allium (garlic), dianthus, dragon's blood sedum, prostrate asters and potentillas
- 8" deep areas include some herbs like catmint and a few crocus bulbs
- 12" deep irrigated area includes grasses such as meadow fescue. Deeper areas are over the building support columns and I-beams.

Garden path made of discarded rubber toys and other recycled products

Paver tiles made of recycled automobile tires. (No high heels, please!)

Be more patient: Vines will eventually cover some fences around the HVAC units

OhioEPA would like to thank:

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