

# Green Roofs: Beautiful and Innovative Solutions to Stormwater Pollution

Webcast Sponsored by EPA's Watershed Academy

Wednesday, February 18, 2009 1–3 pm Eastern

**Steven W. Peck**, Green Roofs for Healthy Cities (GRHC)

**Robert D. Cameron**, Center for Green Roof Research at Penn State University

**Tom Liptan**, Portland Bureau of Environmental Services

## Guide to Our Webcasts

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## Topics for Today's Webcast

- ▶ What is a green roof?
- ▶ Discussion of the current state of green roofing and LID architecture
- ▶ Benefits of using green roofs: both economic and environmental
- ▶ Case studies illustrating successful and surprising implementations of green roofing



## Status of North American Green Roof Industry

February 18, 2009

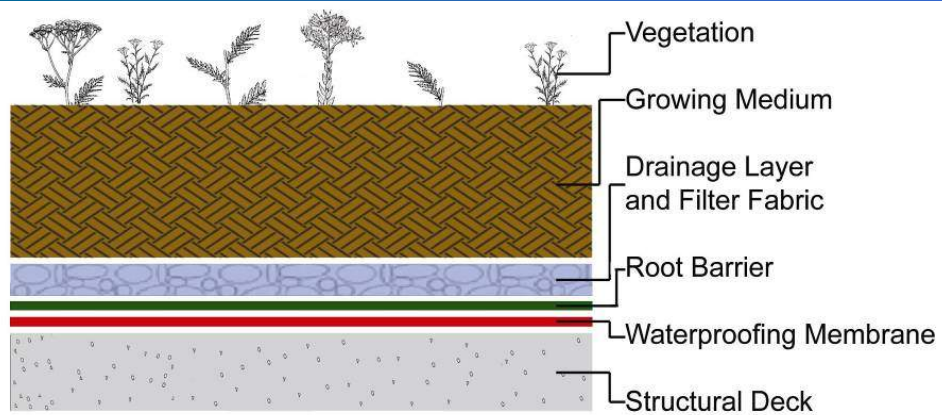
Steven Peck, President  
Green Roofs for Healthy Cities  
[www.greenroofs.org](http://www.greenroofs.org)

## Overview

- What is a “green roof” - Benefits
- Who We Are and What We Do
- Drivers - Developing the Market
- Current Status/Policies
- Future Opportunities



A green roof is a 'contained' green space on top of a human-made structure below, above, or at grade.



## Three Types of Green Roofs

| CHARACTERISTIC         | EXTENSIVE  | SEMI-INTENSIVE   | INTENSIVE   |
|------------------------|--|--|---|
| Growing Medium Depth   | 6" or less   | 25% above or below 6"  | More than 6"  |
| Accessibility          | Often inaccessible   | May be partially accessible  | Usually accessible  |
| Fully Saturated Weight | Low<br>10-35 lb / ft <sup>2</sup><br>(48.8 - 170.9 kg / m <sup>2</sup> ) | Varies<br>35-50 lb / ft <sup>2</sup><br>(170.9 - 244.1 kg / m <sup>2</sup> ) | High<br>50-300 lb / ft <sup>2</sup><br>(244.1 - 1,464.7 kg / m <sup>2</sup> ) |
| Plant diversity        | Low  | Greater  | Greatest  |
| Cost                   | Low  | Varies   | High  |
| Maintenance            | Minimal  | Varies   | Varies, but is generally high   |



## Modular approaches – several layers combined, often with plants pre-grown



Loose laid or built up plant or seed growing media.



## Green Roof Benefits

### Public

- Stormwater retention
- Air pollution removal
- Water pollution removal
- Noise reduction
- Mitigation of UHI
- Urban Agriculture
- Aesthetic benefits
- Additional green space
- Green jobs – local jobs

### Private

- Energy savings
- Membrane durability
- Noise reduction
- Human use and enjoyment – higher productivity etc.
- Great PV & HVAC efficiency
- Aesthetic & PR

Our mission is to increase the awareness of the economic, social and environmental benefits of green roofs and green walls, and other forms of living architecture through education, advocacy, professional development and celebrations of excellence.



We are experiencing a trend toward high performance restorative buildings.



## Green Roofs for Healthy Cities - Membership

Non-profit industry association with:

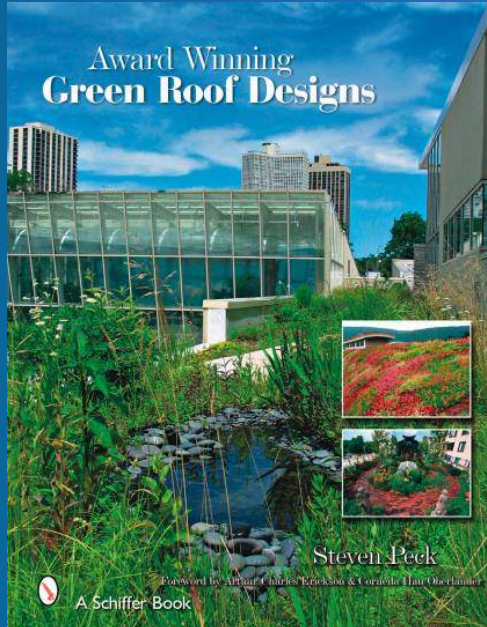
- 700 individual members
- 95 corporate members (large multinationals, cities, researchers, and small companies)
- Multi-disciplinary board and committees

## Build Community - Conferences



Greening Rooftops for  
Sustainable Communities  
conference, awards & trade show  
Atlanta, GA  
June 3 to June 5, 2009

## Awards - Communications



2009 Deadline for  
Submissions is  
March 1, 2009



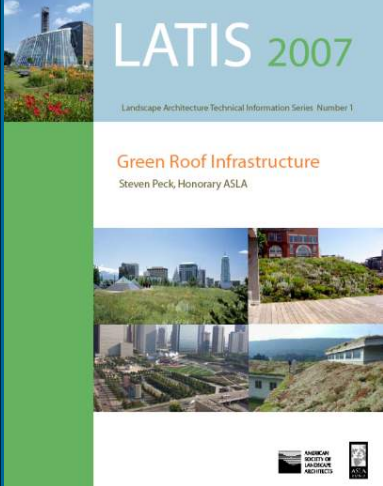




# Communications – Publications




# Partnering – Publications



**LATIS 2007**  
Landscape Architecture Technical Information Series Number 1

**Green Roof Infrastructure**  
Steven Peck, Honorary ASLA



**PAS MEMO**  
American Planning Association

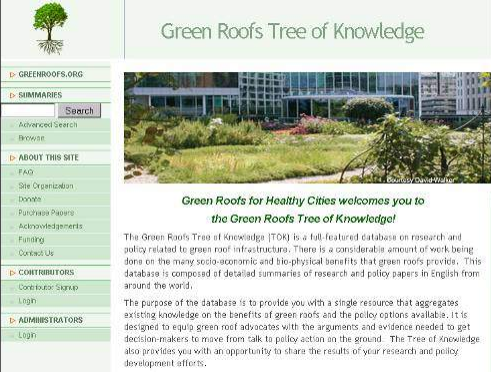
**Published online**  
Current Issues

**Planning for Rooftops: The Benefits of Green Roof Infrastructure**

By Peter Latham, AICP, and Steven Peck

As cities seek solutions and ways to grow beyond a further supply of land and fresh water, to protect and green roof advocates, they increasingly are turning to rooftops. Rooftops are seen as a new and untapped source of space for green infrastructure. They can provide a wide range of benefits, including supporting vegetation, reducing air pollution, and providing other benefits. The use of rooftops for green infrastructure can be a valuable way to increase the amount of green infrastructure in a city, and provide other benefits as well. This is especially true for cities that have limited space for green infrastructure. Rooftops can be used for a variety of purposes, including growing food, reducing energy costs, and providing other benefits. This article discusses the benefits of green roof infrastructure and provides recommendations for how to plan for rooftops.

# Conducting & Sharing Research



**Green Roofs Tree of Knowledge**

**GREENROOFS.ORG**

**SUMMARIES**

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**Green Wall Research Fund**

Green Roofs for Healthy Cities welcomes you to the Green Roofs Tree of Knowledge!

The Green Roofs Tree of Knowledge (TRK) is a full-featured database on research and policy related to green roof infrastructure. There is a considerable amount of work being done on the many socio-economic and biophysical benefits that green roofs provide. This database is composed of detailed summaries of research and policy papers in English from around the world.

The purpose of the database is to provide you with a single resource that aggregates existing knowledge on the benefits of green roofs and the policy options available. It is designed to equip green roof advocates with the arguments and evidence needed to get decision-makers to move from talk to policy action on the ground. The Tree of Knowledge also provides you with an opportunity to share the results of your research and policy development efforts.

# Life Cycle Cost-Benefit Tool


**GreenSave Calculator**


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Configuration Page | LCC Assumptions & Results | Scenario #1 Calculator | Scenario #2 Calculator | Scenario #3 Calculator | Roof Durability Module | Energy Use Module

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Storm Water Module | Heat Island Module | Development Fees Module | Saleability / Rentability | Tenant Health & Productivity


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**GreenSave Calculator - Configuration Page**  
 Developed by the Athena Institute for Green Roofs for Healthy Cities (GRHC)

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| Configuration Details |              | Case Study Project Details |   |
|-----------------------|--------------|----------------------------|---|
| Region                | USA          | Case Study ID              | 1   |
| Default Currency      | USD          | Parent Case Study ID       | 0   |
| Exchange Rate to USD  | 1.0000       | User Name                  | speck@greenroofs.org  |
| Default UCM Group     | US Imparitel | Project Name               | Jear Guide Case Study Imperial  |
| Size of Roof UCM      | sq ft        | Project Type               | all   |
| Size of Roof          | 4144.11      | Project Category           | multi-unit residential-low rise   |
| Auto Calc.            | no           | Slope Configuration        | low slope   |
|                       |              | Roof Life Cycle Stage      | new   |
|                       |              | Project Description        | See Section 3 of the GRHC Usera Guide for a complete description of this project. |
|                       |              | Project Author             | speck@greenroofs.org  |
|                       |              | Project Status             | new   |
|                       |              | File Name                  | ghc_lcc.user_guide_ese_study_imperial.1.xml                                       |
|                       |              | File Category              | data  |
|                       |              | Revision                   | 1   |
|                       |              | Change Date (MM-DD-YYYY)   | 04-22-2008 13:31:17   |
|                       |              | Creation Date (MM-DD-YYYY) | 06-01-2007 10:15:20   |

# Professional Accreditation




**Green Roof Infrastructure: Waterproofing and Drainage 301**

Participants' Manual  
Presented By: GREEN ROOFS For Healthy Cities



**Green Roof Plants and Growing Medium 401**

Participants' Manual  
Presented By: GREEN ROOFS For Healthy Cities



**Green Walls 101: Introduction to Systems and Design**

Participant's Manual  
Presented By: GREEN ROOFS For Healthy Cities

## Professional Accreditation

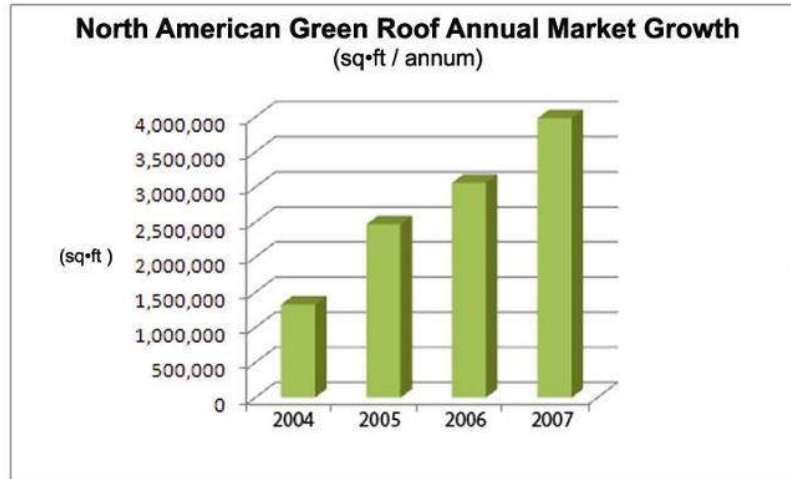
- Green Roof Professional (GRP) Designation
- Industry driven
- Satisfies a coordination role:
  - Select team, coordinate professionals, understand best management practices, etc.
- Landscape architect, contractor, architect, engineer, horticulturalist, roofing contractor, consultant etc.
- Occupational Analysis

**First Accreditation Testing  
Scheduled for June 5<sup>th</sup>, 2009 at our Atlanta Conference**

## Status - Standards and Codes

- Multiple standards and codes required
- Testing standards to ensure consistent product performance/reliability
- Building codes to define public health and safety
- Design guidelines

## Status - Market



source: Green Roofs for Healthy Cities  
Annual Market Industry Surveys 2004 - 2007

## Status - Policies

- City of Chicago Climate Change Plan aims to reach 5,000 green roofs by 2020
- New York adopts \$4.50 per square foot incentive for green roofs to reduce stormwater and urban heat island
- Toronto introduces \$5 per square foot incentive for existing buildings and is working on by-law requiring green roofs.
- Portland continues to support and hone its green roof incentives – density bonusing and stormwater feebates

## Future

Future activities include:

- Work towards financial support for green roofs in Congress
- Improve technical understanding of green wall technologies
- Support the new Green Roof Professional Designation with new courses and market pull and promotion



Present

**CitiesAlive!**

October 19-22, 2009 Toronto • Ontario • Canada



## GREEN INFRASTRUCTURE FOUNDATION

Founded in 2007 to respond to the need for greater awareness and resources to promote green infrastructure in local communities

**Thank You!**



[www.greenroofs.org](http://www.greenroofs.org)

# Questions

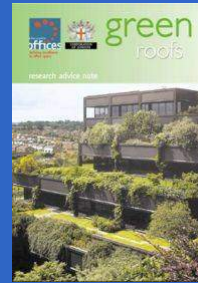
**URBAN ENVIRONMENT:  
Loss of Key Hydrologic  
Component**

**Robert Cameron**  
Center for Green Roof  
Research at Penn  
State University

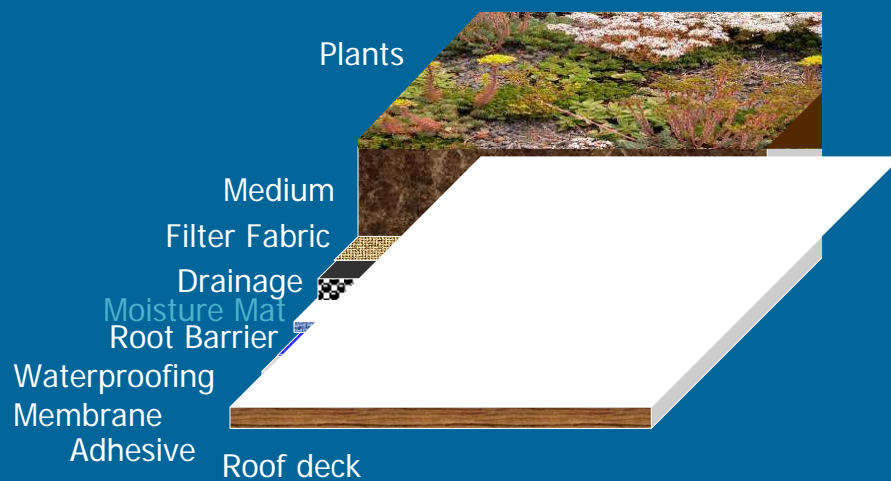


## GREEN ROOFS:

Diverse Applications  
Multiple Benefits



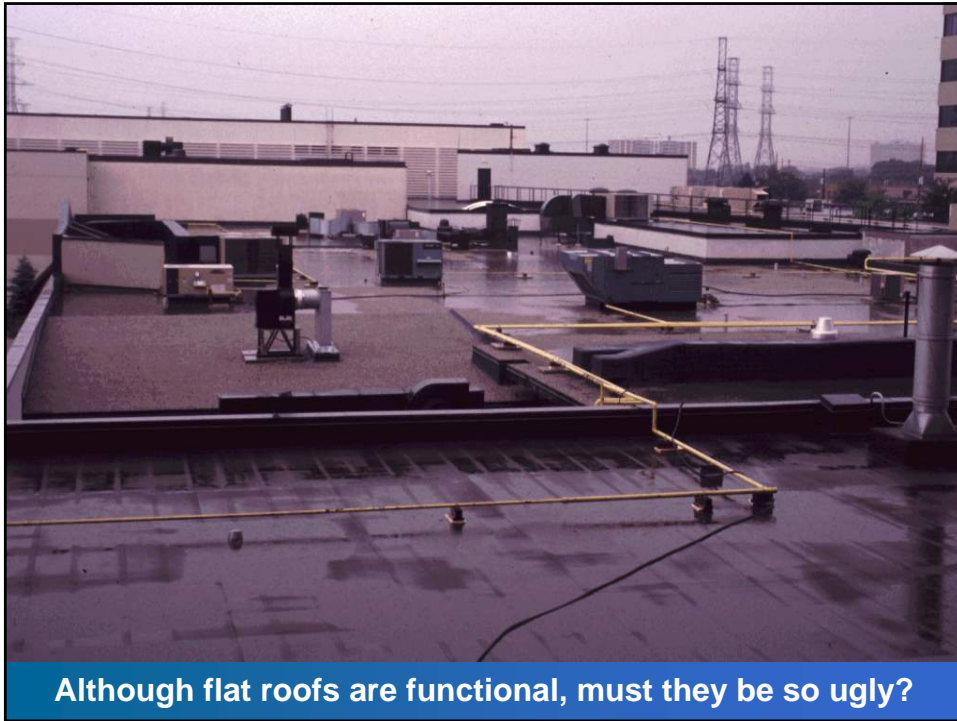
## Typical Green Roof Construction



## Green Roof Benefits

- Aesthetics
- Stormwater
- Energy
- Roof longevity
- Habitat and biodiversity
- Air quality
- Noise reduction





## What is the Value of Green Roof Aesthetics?

- Satisfaction with your environment
- Reduced absenteeism
- Increased occupancy
- Hospital stays decreased

# Amenity Space



EPWORTH MANOR, TYRONE, PA

# Improved Occupancy





## What is the value of the stormwater management function?

- Value of the land
- Cost of alternatives
- Regulations
- Incentives



Stormwater: Green roofs can restore the evapotranspiration component of the hydrologic cycle

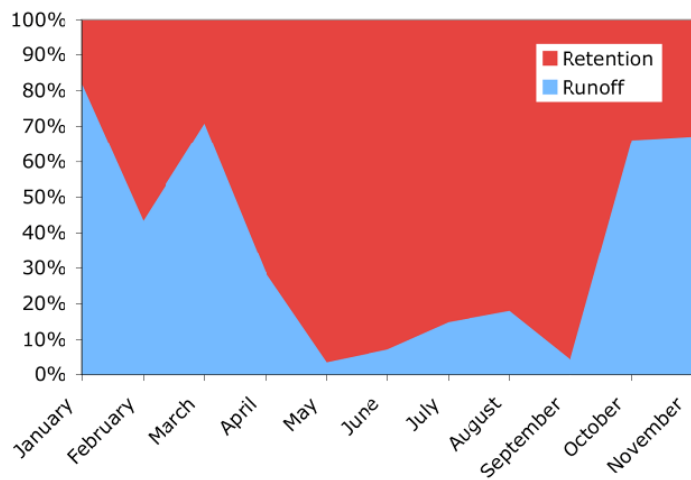


STORMWATER RUNOFF

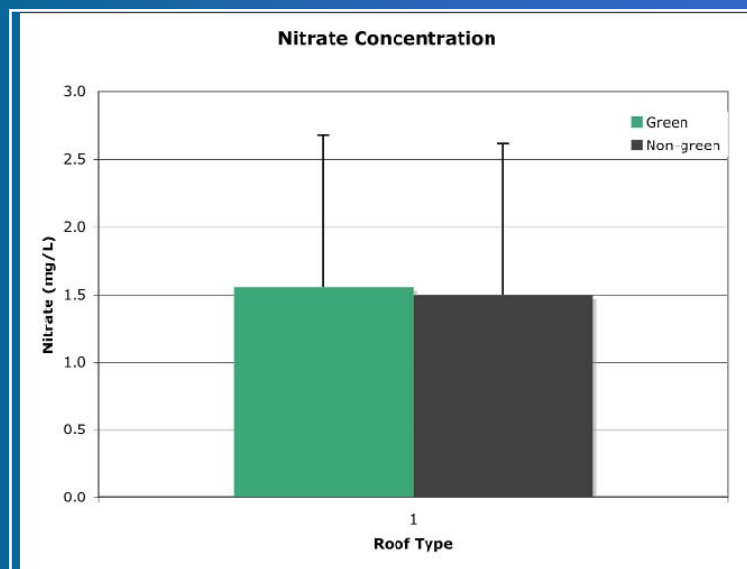


Rain 8/28/06 Runoff - ~40 gal, vs ~15 gal

## Runoff and Retention by Green Roofs in 2005

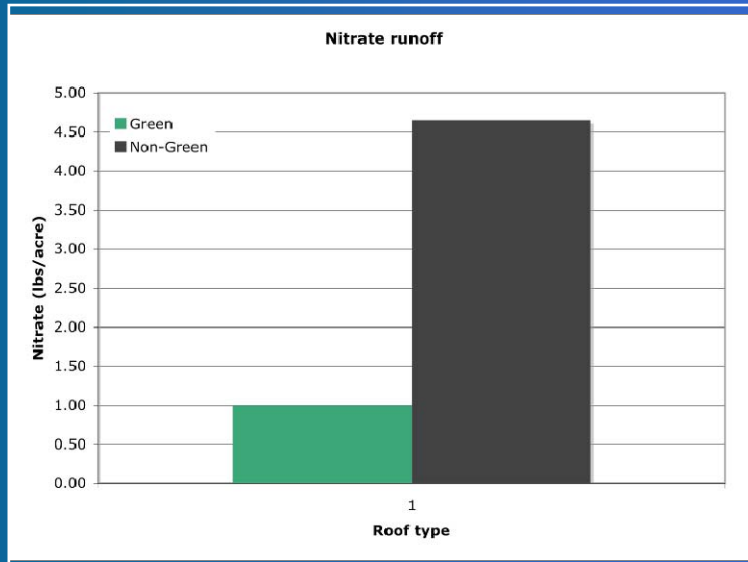


## Runoff Quality





## Runoff Quality



## Biofilters: Sustainable Solutions in Artificial Environments

- Constructed Wetlands
- Living Walls
- Green Roofs



## Energy

Green roofs can act as evaporative coolers reducing air conditioning costs

Under certain climatic conditions can provide thermal mass to reduce building's winter heat loss



## What is value of energy savings?

Depends on many factors:

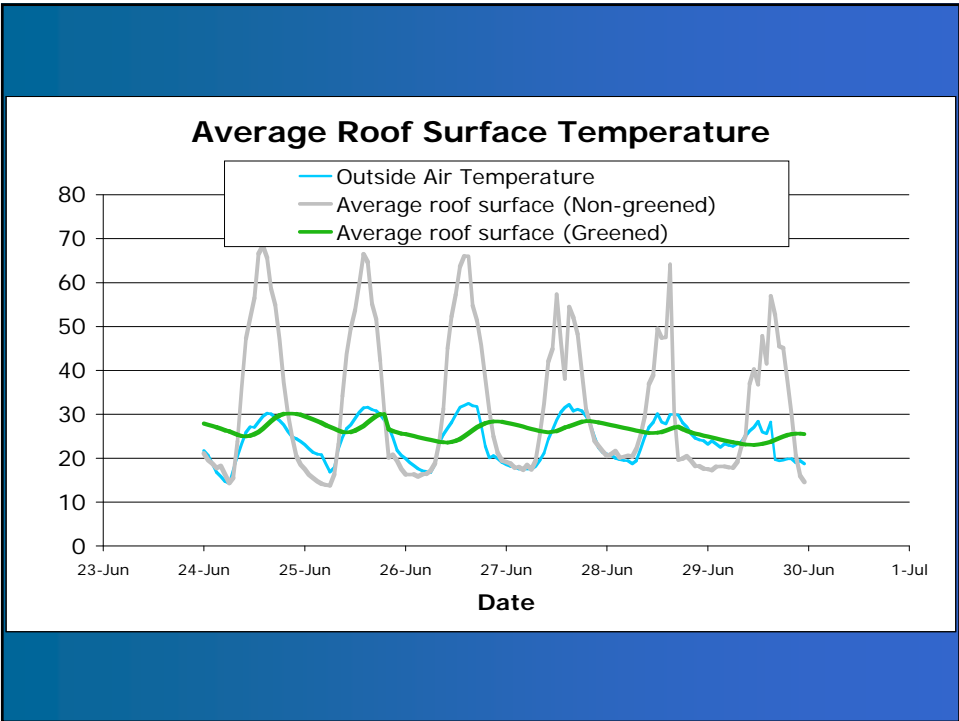
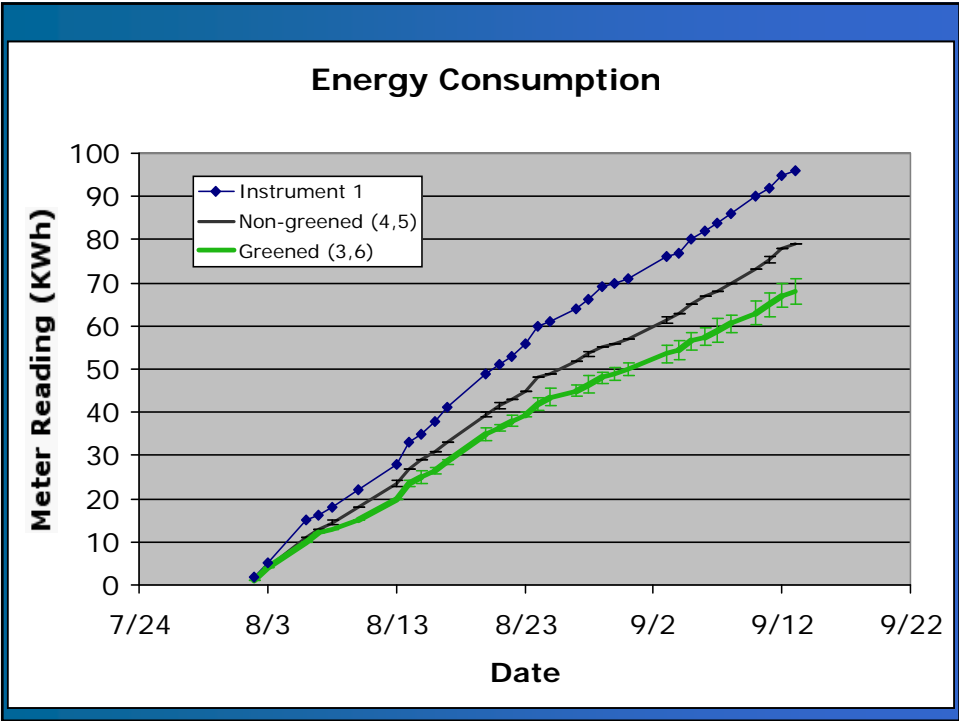
- Insulation
- Roof type
- Roof to wall ratio
- Moisture
- Geographics



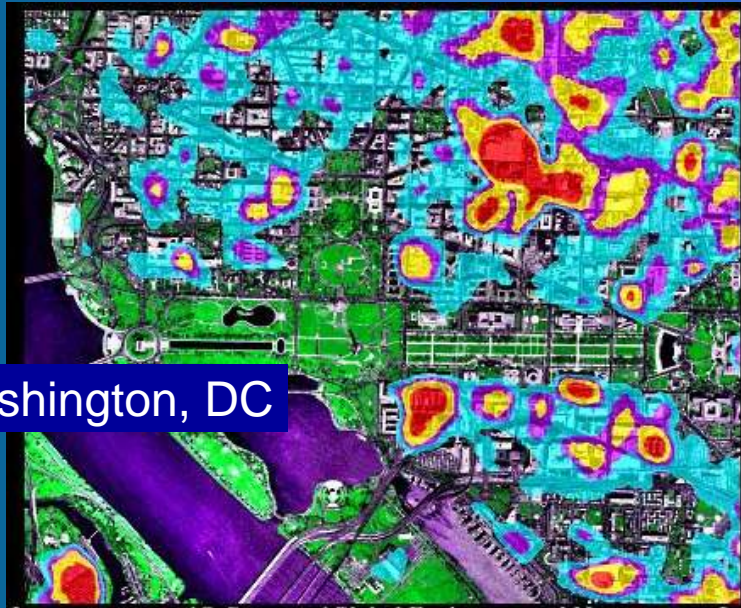
## Green roofs and Peak Energy Use Shaving

- Reduce demand during peak hours
- Keep inefficient plants off line
- Reduce infrastructure costs





## Surface Temperatures and Heat Islands



Washington, DC

*Image courtesy of S. Stetson of Global Environmental Management, Inc.*

## Roof Longevity

Protect the waterproofing from UV and temperature extremes

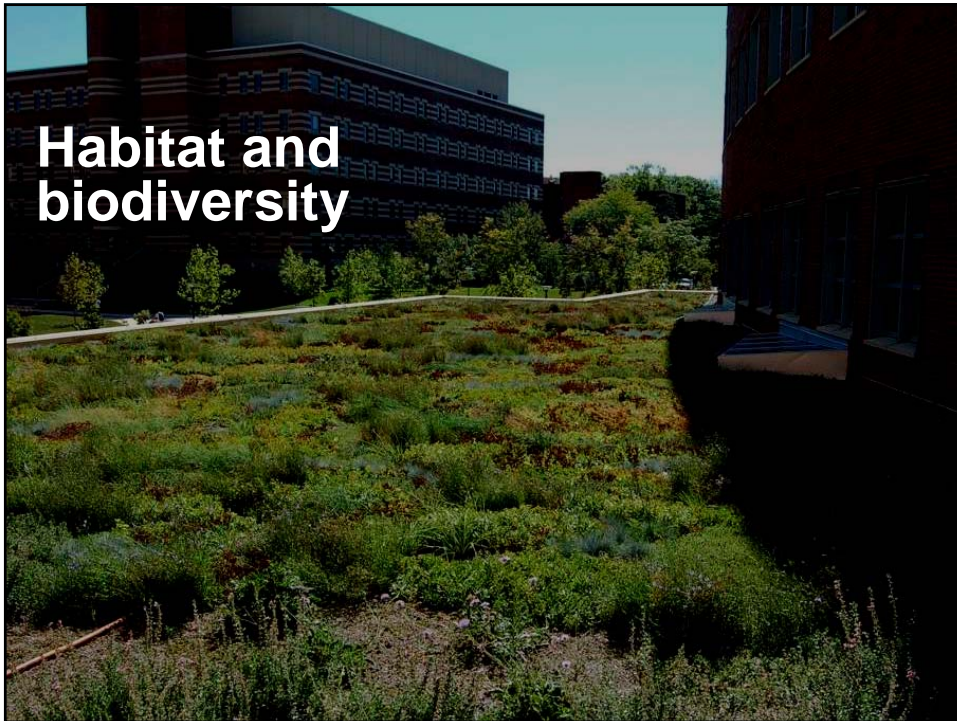


## What is the value of increased Roof Longevity?

The green roof should last 2-3 times longer than an unprotected roof



**Habitat and biodiversity**



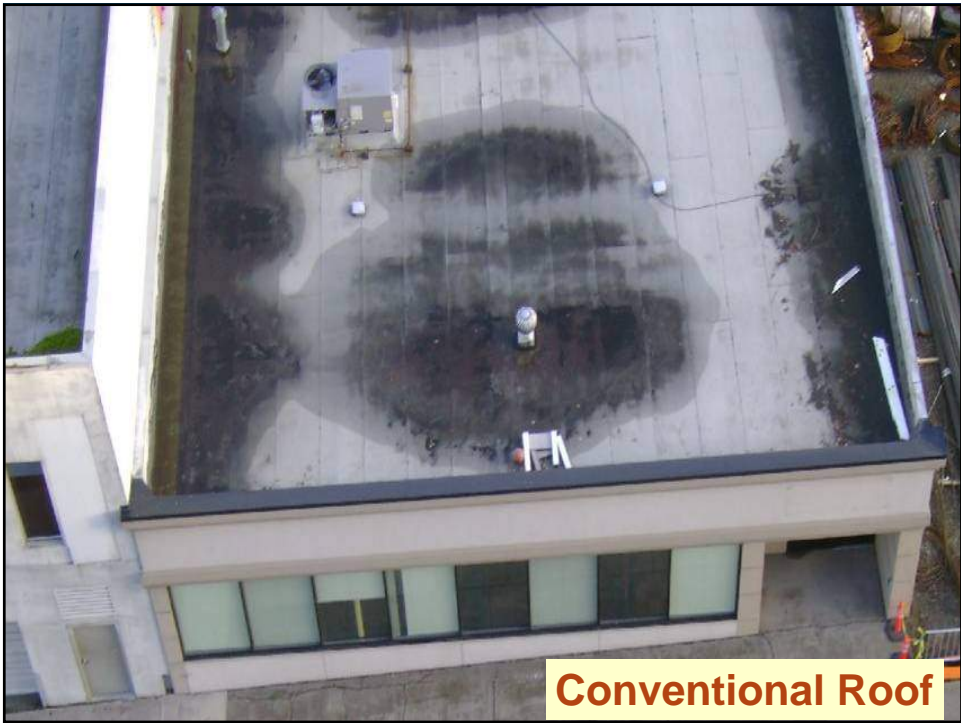


## **Green Roofs**

- Future Research
- Future Applications

## **Questions**







**Portland Building Ecoroof**



**Portland Building Ecoroof**



**Portland Building Ecoroof**



**M Financial Ecoroof**

## PORTLAND ECOROOF

|  | square footage | acreage | number |
|--|----------------|---------|--------|
| Total Built                              | 306,020        | 7.03    | 127    |
| <b>Grey to Green - post July 1, 2008</b> |                |         |        |
| Known Potential                          | 190,500        | 4.37    | 28     |
| In Design                                | 75,990         | 1.74    | 15     |
| In Construction                          | 95,650         | 2.20    | 11     |
| Complete                                 | 30,894         | 0.71    | 7      |

## City of Portland Ecoroof Program

- Technical Assistance
- Outreach and education
- Industry Development
- Performance Monitoring
- Ecoroof Financial Incentives
- Zoning Code Bonus 33.510
- Cost and Technology Analysis
- Public Works Code Option 17.38
- Install ecoroofs on city owned buildings
- Partnerships: Academia, Building Owners, Industry, Trade Organizations, Regulatory Agencies

Dragonfly takes flight  
from downtown ecoroof



## City of Portland Ecoroof Cost Analysis

### Topics evaluated

- Stormwater Management (private)
- Energy
- Roof longevity
- HVAC - Heating and Cooling Equipment
- Stormwater (public)
- Carbon reduction
- Air quality
- Habitat

## City of Portland Ecoroof Cost Analysis

40,000 sf ecoroof on 5 story building  
Private: added cost for ecoroof \$230,000

### Private Payback (in 2007 \$s)

- Five Years: - **\$128,000**
- Twenty Years: \$0
- Forty Years: \$400,000

## Ecoroof Economic Benefits

40,000 sf ecoroof on 5 story building  
Public: no cost

### Public Payback (in 2007 \$s)

- First Year: \$89,000
- Five Years: \$101,000
- Forty Years: \$191,000

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## City of Portland Ecoroof Cost Analysis

### Topics to be addressed in future studies

- Urban Heat Island Reduction
- Carbon Sequestration
- Building Envelop and Acoustics
- Amenity
- Property value
- Open space
- Biodiversity
- Watershed Health
- Human Health
- Jobs and industry

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## Cost Considerations

- Some ecoroofs “cost too much” because:
  - They are over built (more stuff in the design than needed).
  - Sometimes you are sold more than you need.
  - Don't fit local climate (they need continuous irrigation, increased O&M).
  - Some products cost more than others (a Mercedes costs more than a Honda, but which one gets the best GPM).
  - Some designers are better than others and can save you money.
  - You have many choices that range in cost and value, buyer be informed.



## Questions

## Contact Information

- ▶ **Steven W. Peck**  
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[toml@bes.ci.portland.or.us](mailto:toml@bes.ci.portland.or.us)