

Collaborating Our Way to a Greener Tomorrow

American Society of Landscape Architects

Perry Howard, FASLA 2007 President-Elect

The National Association of Clean Water Agencies

2007 SUMMER Conference & 37th Annual Meeting

Sustainable Infrastructure Choices...

Gray, Green & Everything In Between

July 19, 2007



Context

■ 4.5 Billion years	Life on planet earth
■ 2.5 Million years	Homo
■ 200,000 years	Homo sapiens
■ 200,000 years to present	6.6 Billion people
■ 10,000 years ago	3-4 Million people
■ Christ	200 Million
■ 1790 A.D.	1 Billion
■ 1930 A.D.	2 Billion
■ 1950 A.D.	2.5 Billion
■ 2000 A.D.	6 Billion
■ 2007 A.D.	6.6 Billion

Context

- Each member of this species has basic needs, wants and desires. As so, Homo sapiens collectively because of these needs, wants and desires have threatened every biological entity and life supporting elements known and not known to exist by mankind on planet earth.

Context

- For the first time we live in an urban century
- More than 50% of the world population lives in urban areas or cities
- Problems are complex
- We need multidisciplinary solutions

Context

- Millennium Ecosystem Assessment
 - Food
 - Water
 - Clean Air
 - Shelter
 - Relative climate constancy

Landscape Architecture

- Research
- Design
- Planning
- Management of our landscapes

Landscape Architecture

- Founded based on
 - Environmental Stewardship
 - Social Equity
 - In this entire search, special emphasis has been placed on the health of the planet, health of the human species or Homo sapiens and the health of beauty. Healthy environments, sustainable environments, and artful environments for the human species and all life is what we continue to seek.

Landscape Architecture

- Comprehensive Art Form
- Understanding of complex mediums of Ecosystem
- Ability and skill to balance sustainability and culture
- Collaboration with scientific and allied professionals
- Develop cutting edge projects
- Promote environmental and design ethics

Landscape Architecture

- Stewards of the land and culture
- Promotion of walkable & livable communities
- Thinking globally and acting locally
- Regional to small projects

Green infrastructure is our life support system

- “ Our definition of green infrastructure is loftier and broader. We define it as an interconnected network of natural areas and other open spaces that conserves natural ecosystems values and functions, sustains clean air and water, and provides a wide array of benefits to people and wildlife. Used in this context, green infrastructure is the ecological framework for environmental, social, and economic health-in short, our natural life support system.” *Green Infrastructure: Linking Landscape and Community*, Mark A. Benedict and Edward T. McMahon

Green Infrastructure-10 Principles

- 1. Connectivity is key.
- 2. Context matters
- 3. Green Infrastructure should be grounded in sound science and landuse planning theory and practice
- 4. Green Infrastructure can and should function as the framework for conservation and development
- 5. Green Infrastructure should be planned and protected before development
- 6. Green Infrastructure is a critical public investment that should be funded up front.

Green Infrastructure-10 Principles

- 7. Green Infrastructure affords benefits to nature and people
- 8. Green Infrastructure respects the needs and desires of land owners and other stakeholders.
- 9. Green Infrastructure requires making connections to activities within and beyond the community.
- 10. Green Infrastructure requires long term commitment.

Watershed Health

- Impervious surface cover ranges from 10% in low-density suburbs to over 90% in dense urban areas.
- Most research shows that watershed health can't be maintained at a “good” level if impervious surface exceeds 10%.
- If we talk about walkable communities, things are closer which are denser, which means we have to use other alternatives to remedy watershed health.

Green Build-out Model

- Casey Trees and LimnoTech developed the Green Build-out Model to quantify the stormwater benefits of trees and green roofs for different coverage scenarios in Washington, DC. This research was funded by the US Environmental Protection Agency (EPA) through a Water Quality Cooperative Agreement. The model was applied to an “intensive greening” scenario and a “moderate greening” scenario.
- Nearly all of the waters in Washington, DC, including the Anacostia River, Potomac River, and Rock Creek, are seriously polluted by sewage discharges and urban stormwater runoff. The Green Build-out Model demonstrated that trees and green roofs can be used to achieve substantial reductions in stormwater runoff and sewage discharges to the rivers.

Source: <http://www.caseytrees.org/programs/planning-design/gbo.html>.



Green Build-out Model

- For an average year, the intensive greening scenario prevents over 1.2 billion gallons of stormwater from entering the sewer systems, resulting in a reduction of over 1 billion gallons in discharges to the District's rivers, and a 6.7% reduction in cumulative CSO frequencies (74 individual CSO discharges).
- Reductions in stormwater runoff volume of up to 10% across the city, with up to 27% reductions in individual sewersheds under the most intensive greening scenario
- Reductions in combined sewer overflow (CSO) discharge volumes are 6% for the moderate greening scenario and 22% for the intensive greening scenario
- WASA could potentially realize between \$1.4 and \$5.1 million per year in annual operational savings in the CSS area due to reduced pumping and treatment costs.
- General hydrological relationships, including unit area planning factors, and modeling methodologies that are transferable to other municipalities.

Source: <http://www.caseytrees.org/programs/planning-design/gbo.html>.



Green Solutions

- Rain gardens or Bio-garden and swales
- Wetlands and habitat restoration
- Constructed wetlands
- Wet and dry detention ponds
- Porous pavement solutions
- From brown fields to green fields
- Green golf courses
- Green streets

Green Solutions

- Ecological parks
- Floating gardens
- Mixing greening projects with education of the public
- Research projects
- Low impact development solutions
- Green roofs or roof gardens

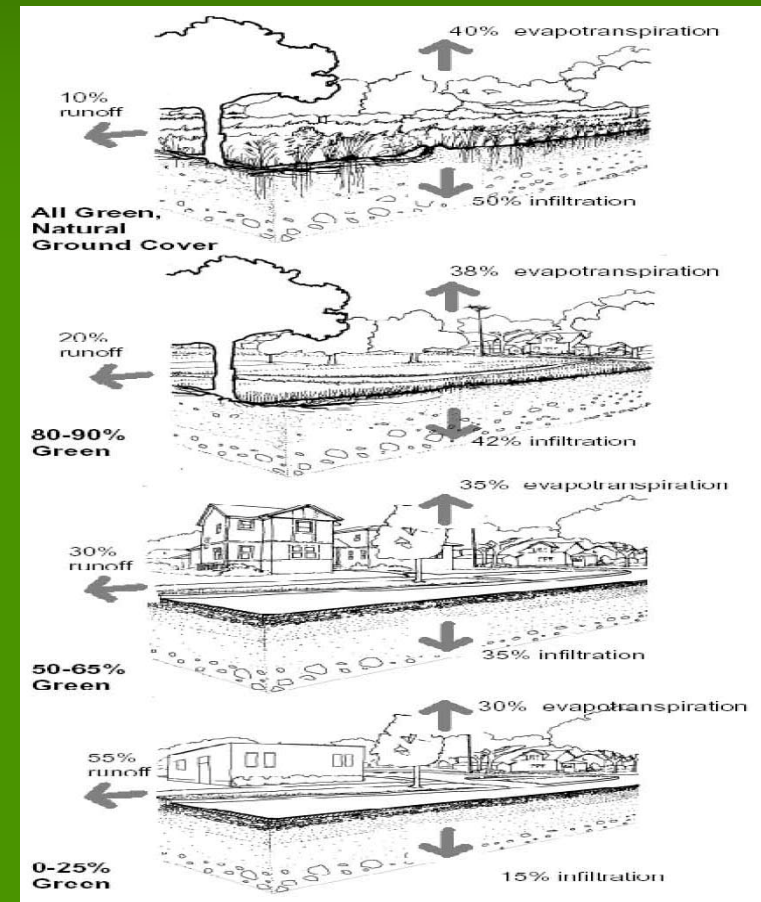


American Society of Landscape Architects Green Roof Environmental Benefits

- Controls stormwater runoff
- Improves water quality
- Reduces urban heat island effect
- Improves air quality
- Reduces building energy use
- Creates biohabitat

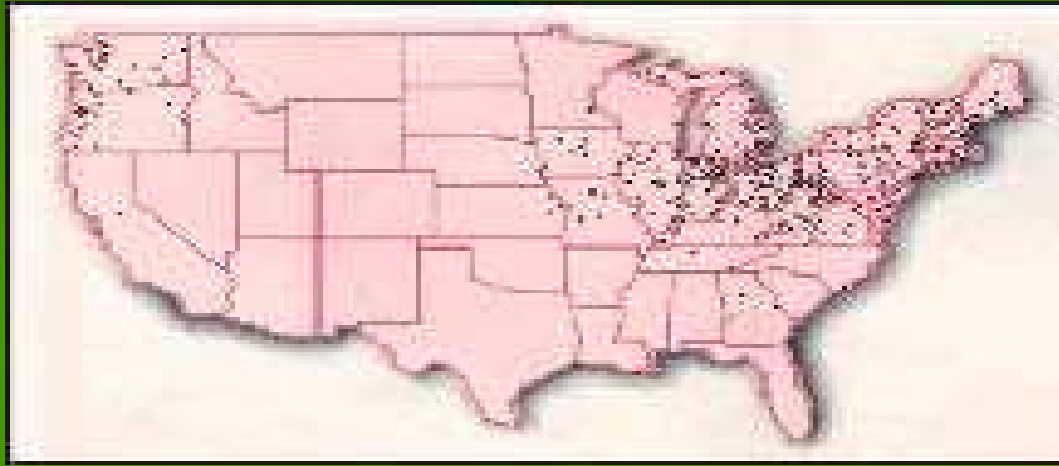
The Downside of Development...

- Green space is at a premium in cities.
- D.C. — 57 square miles, 46% impervious surface
- Roofs are 15-25% of land surfaces in cities
- In the U.S., impervious surfaces are increasing 3% annually



Sources: *Urban Green Space: Effects on Water and Climate*, Regina E. Bonsignore, University of Minnesota, 2003; *Stream Corridor Restoration: Principles, Processes, and Practices*, Federal Interagency Stream Restoration Working Group, 1998.

Combined Sewer Outflows



- 772 cities, 40 million people
- Scope of problem in D.C. — 2.5 billion gallons of untreated wastewater and precipitation released annually into Rock Creek and the Anacostia and Potomac Rivers.
- Cost of fixing problem in D.C. – \$2.6 billion.

Sources: U.S. Environmental Protection Agency; D.C. Water and Sewer Authority





Severe flooding in Phoenix, AZ



Severe flooding in Houston

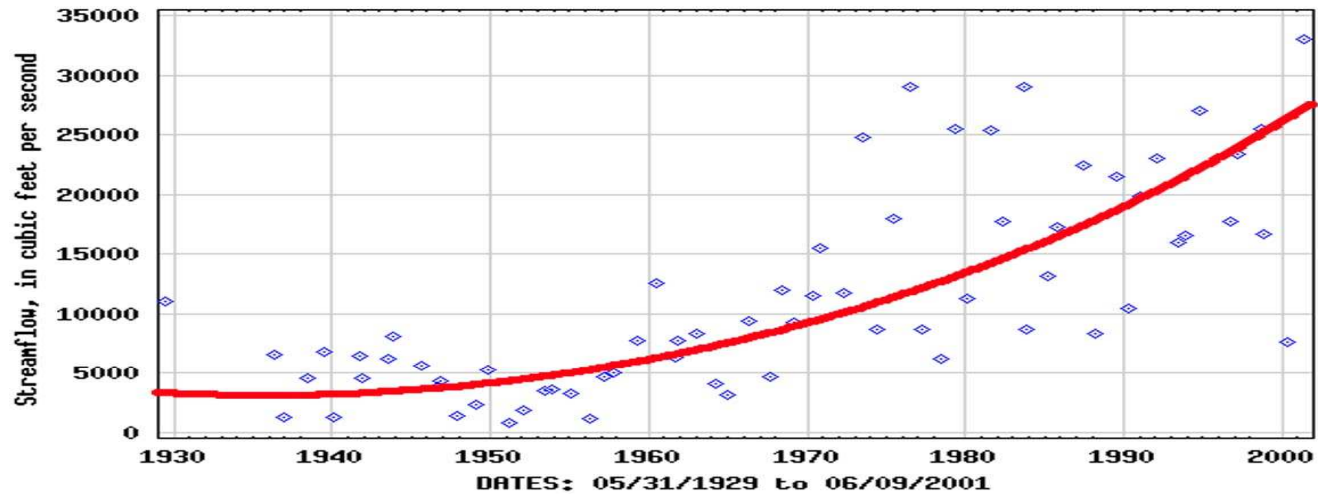


North Dakota flooding from melting snow

Development's Impact

USGS

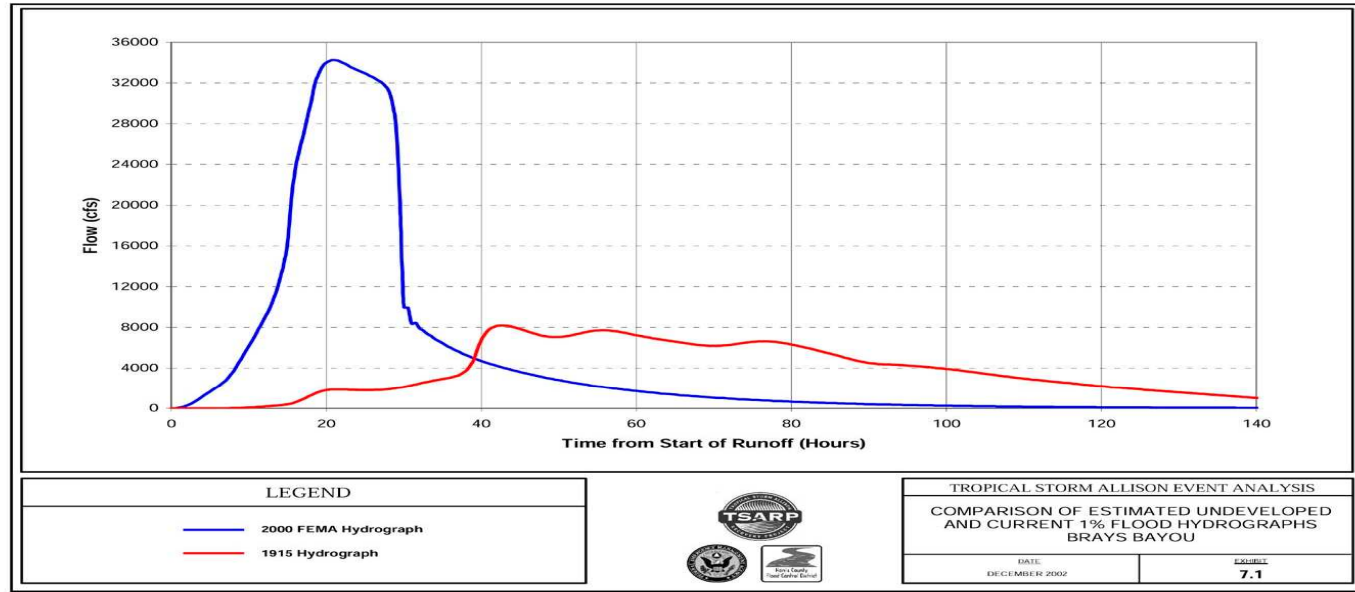
USGS 08075000 Brays Bayou at Houston, TX



- Due to increased development, stream flow speeds have increased over the last 70 years.
- As stream flow speeds increase, so does the potential for flooding.

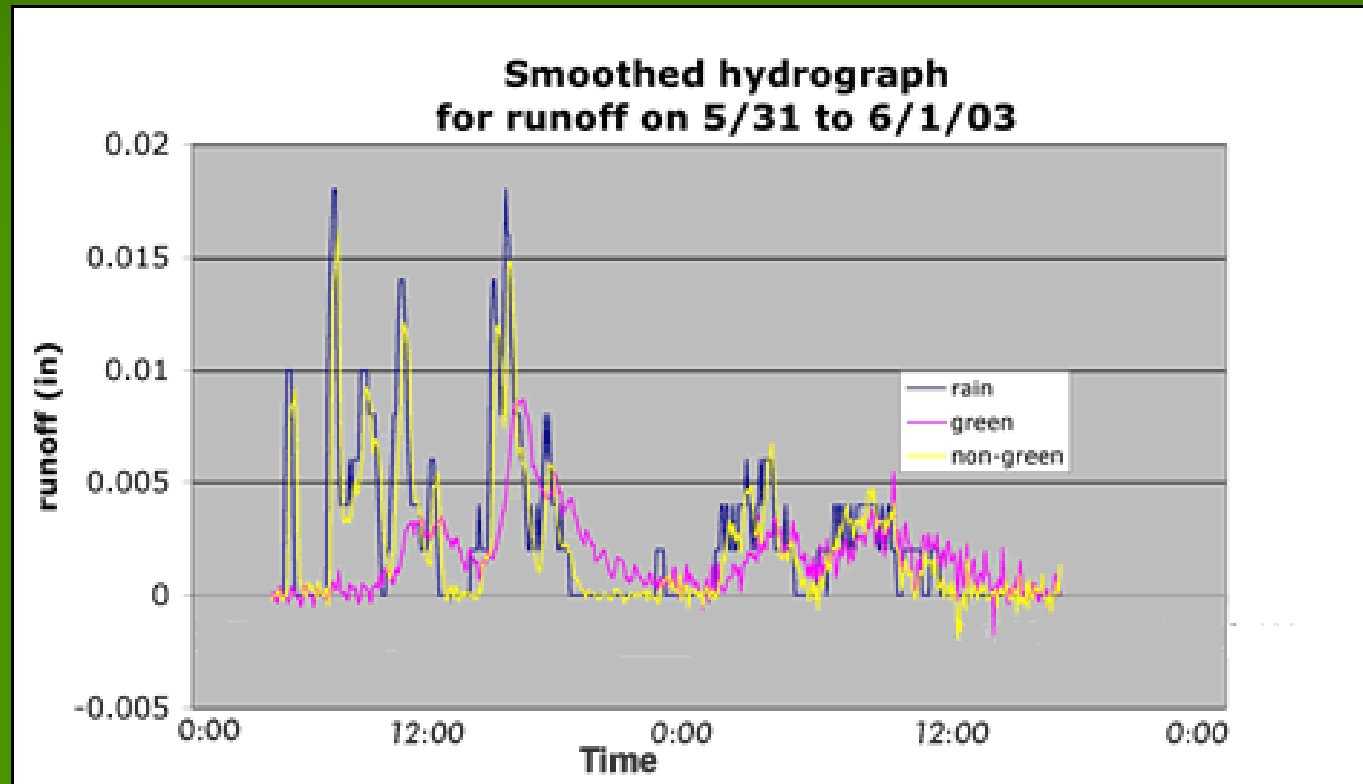
Source: U.S. Geological Survey

Tropical Storm Allison Event Analysis



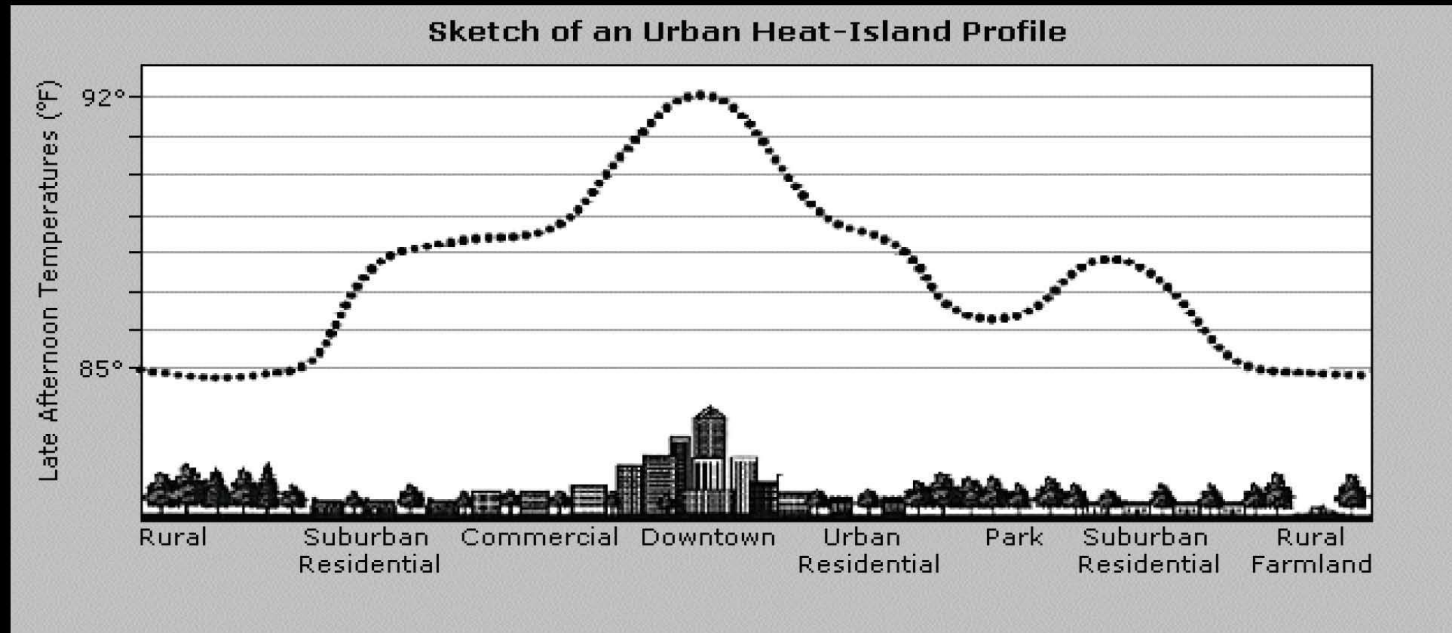
- Actual stream flow from Allison in Bray's Bayou (Houston) and comparable stream flow in 1915 (pre-development)

Stormwater Runoff on Green Roofs



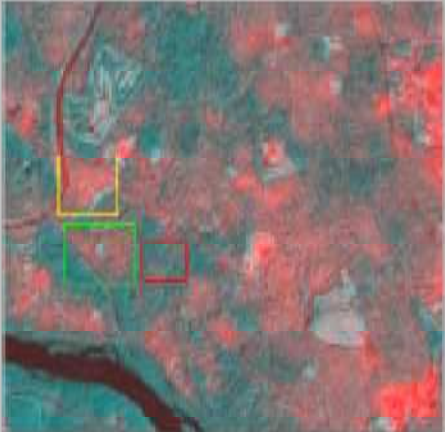
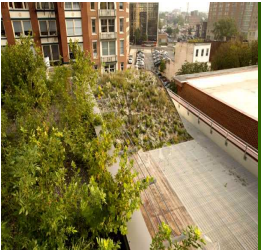
Source: Penn State Center for Green Roof Research

Heat Island Effect



Source: Paul R. Baumann, Department of Geography, SUNY Oneonta

Heat Intensity: Rock Creek Park

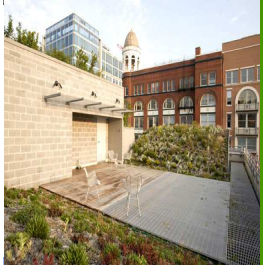
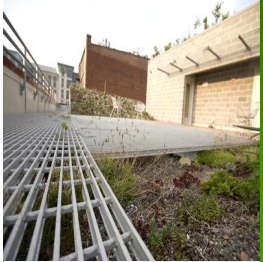
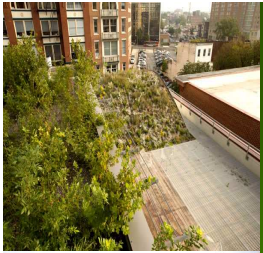


**LOW TREE DENSITY
RESIDENTIAL AREA**
**MEDIUM TREE DENSITY
RESIDENTIAL AREA**
**HIGH TREE DENSITY
RESIDENTIAL AREA**

Source: Paul R. Baumann, Department of Geography, SUNY Oneonta

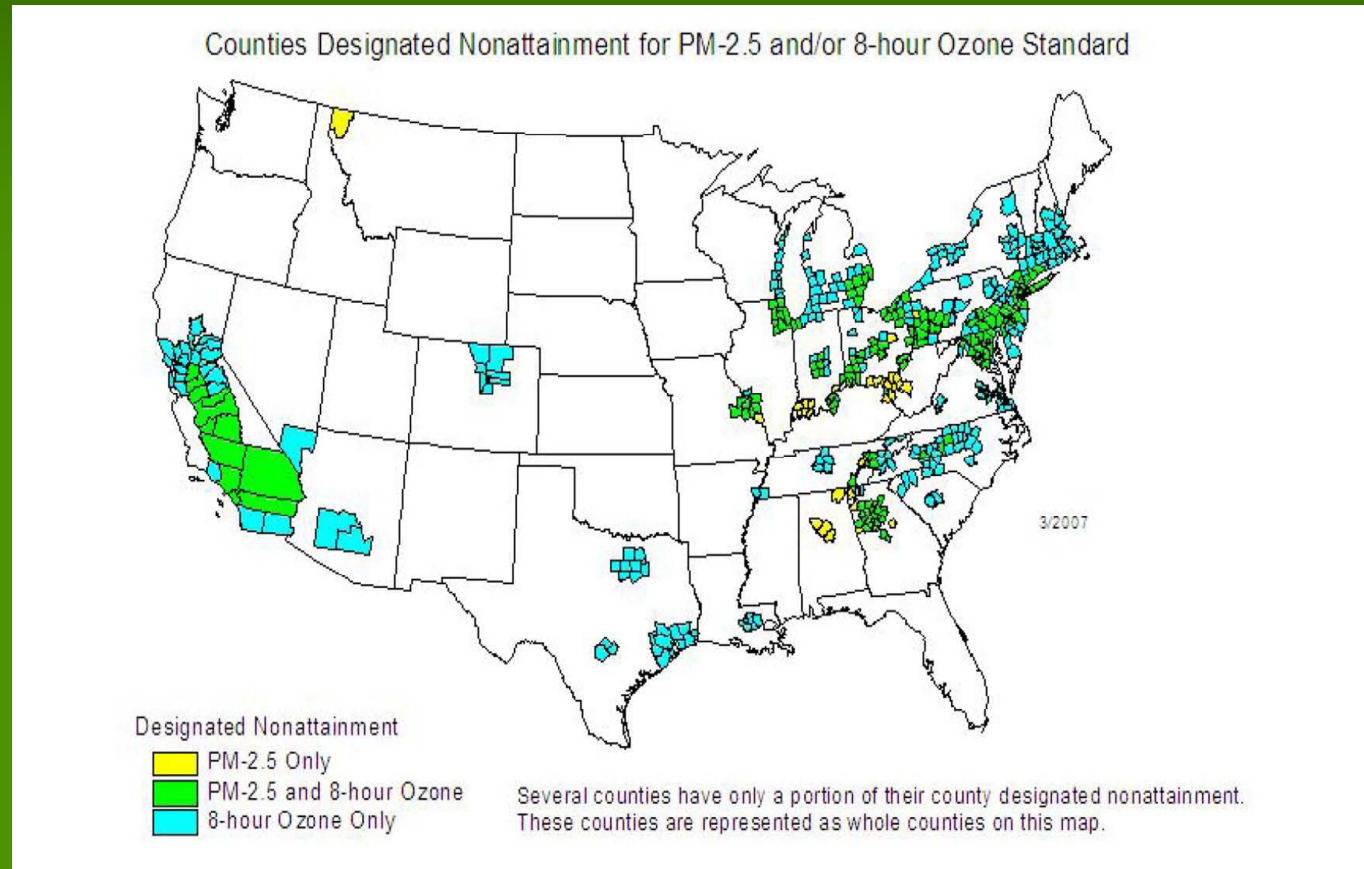


Heat Intensity – National Mall



Source: Paul R. Baumann, Department of Geography, SUNY Oneonta

Air Pollution: Ozone and Particulate Matter



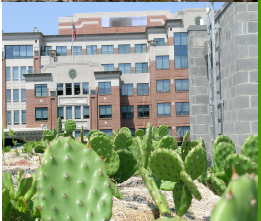
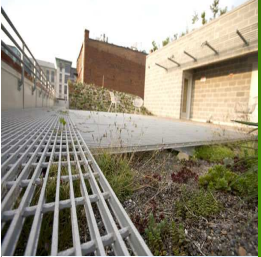
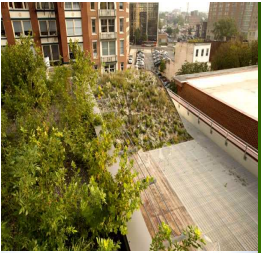
• 208 counties and over 88 million people

Source: U.S. Environmental Protection Agency



Benefits to Building Owners

- Reduces heating/cooling costs
- Extends lifespan of roof membrane
- Provides amenity, improved views
- Increases real estate values



ASLA's Headquarters



Image Courtesy of Michael Van Valkenburgh Associates, Inc. and ASLA.

Weight-Bearing Capacity

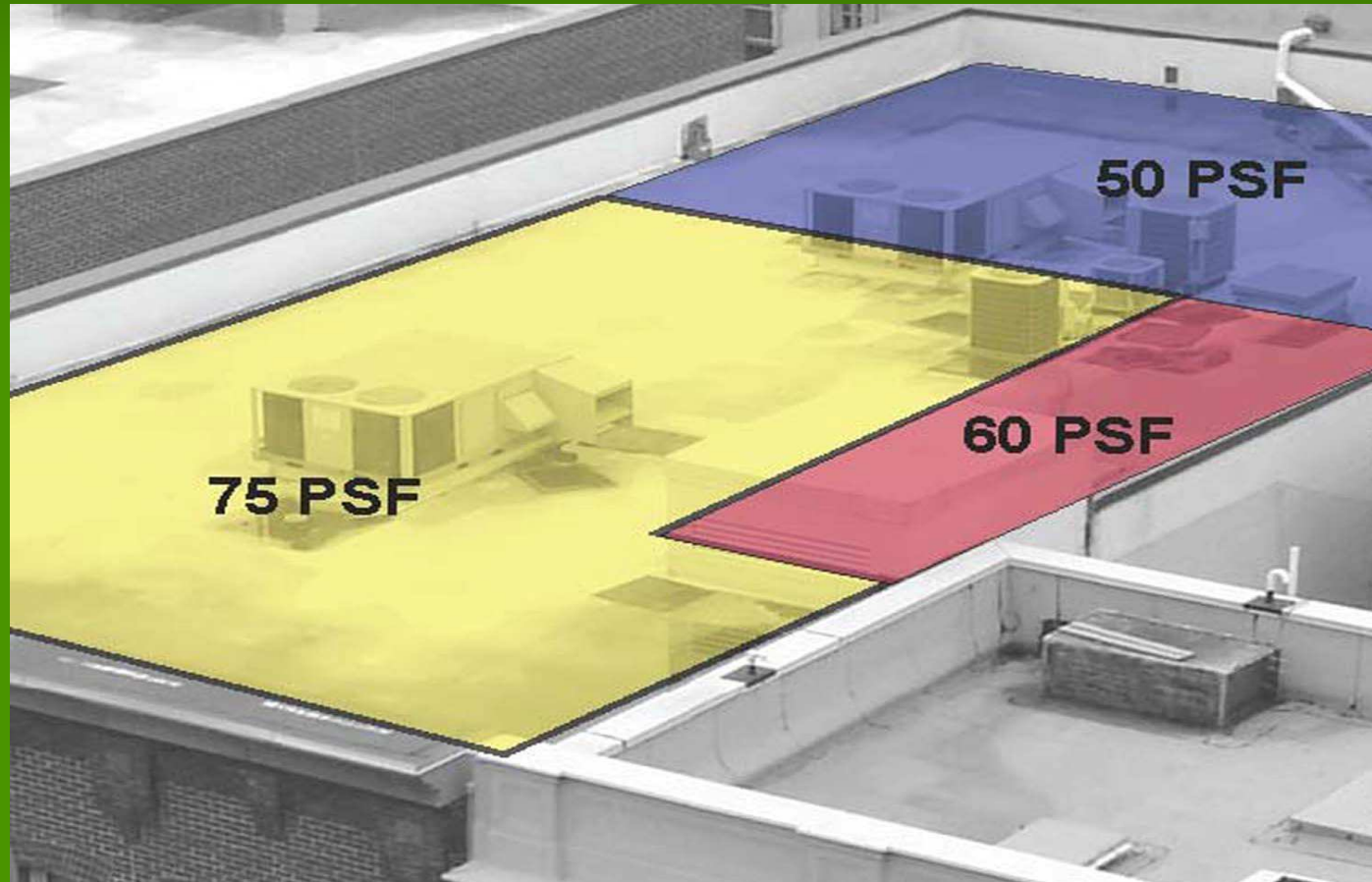


Image Courtesy of Michael Van Valkenburgh Associates, Inc. & ASLA



Existing Roofscape, North View

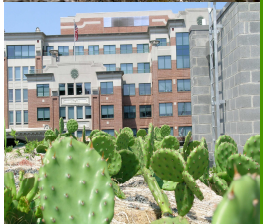
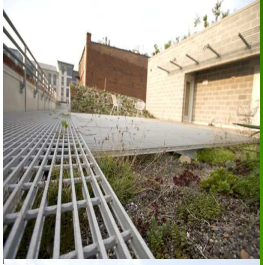
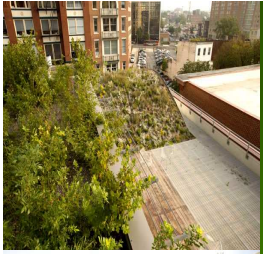


Image Courtesy of Michael Van Valkenburgh Associates, Inc. & ASLA



Green Roof As a Meadow

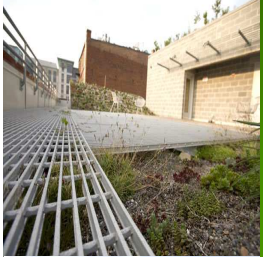
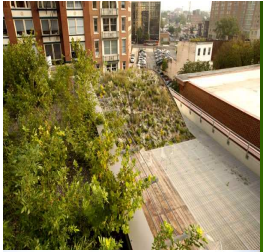


Image Courtesy of Michael Van Valkenburgh Associates, Inc. & ASLA



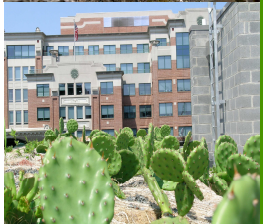
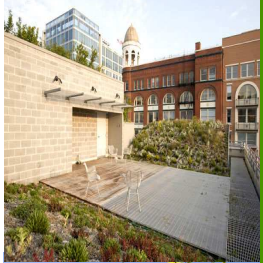
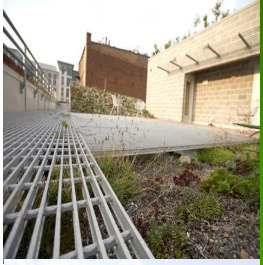
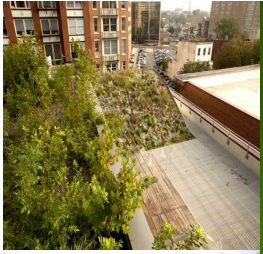
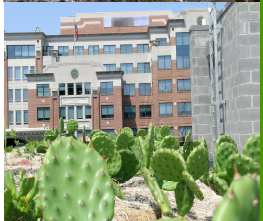
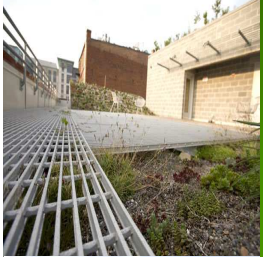
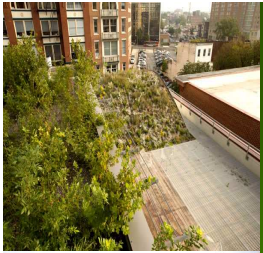
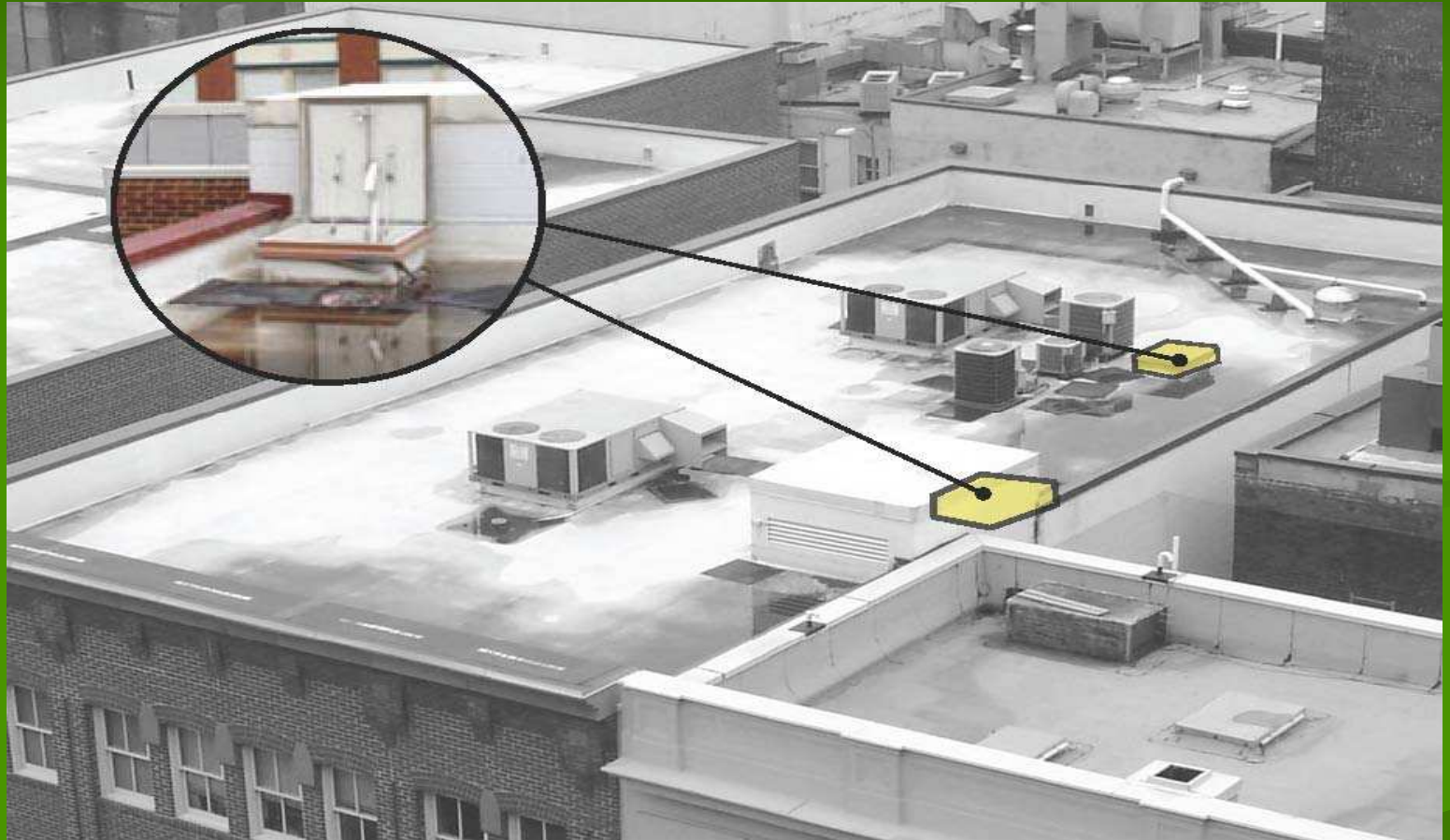
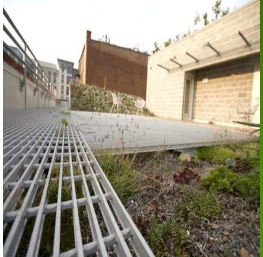
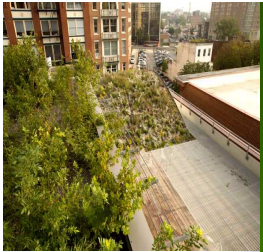


Image Courtesy of Michael Van Valkenburgh Associates, Inc. & ASLA

Green Roof's North View



Original Roof Access



Existing Roof Access

Image Courtesy of Michael Van Valkenburgh Associates, Inc. & ASLA

Original Ladder Access

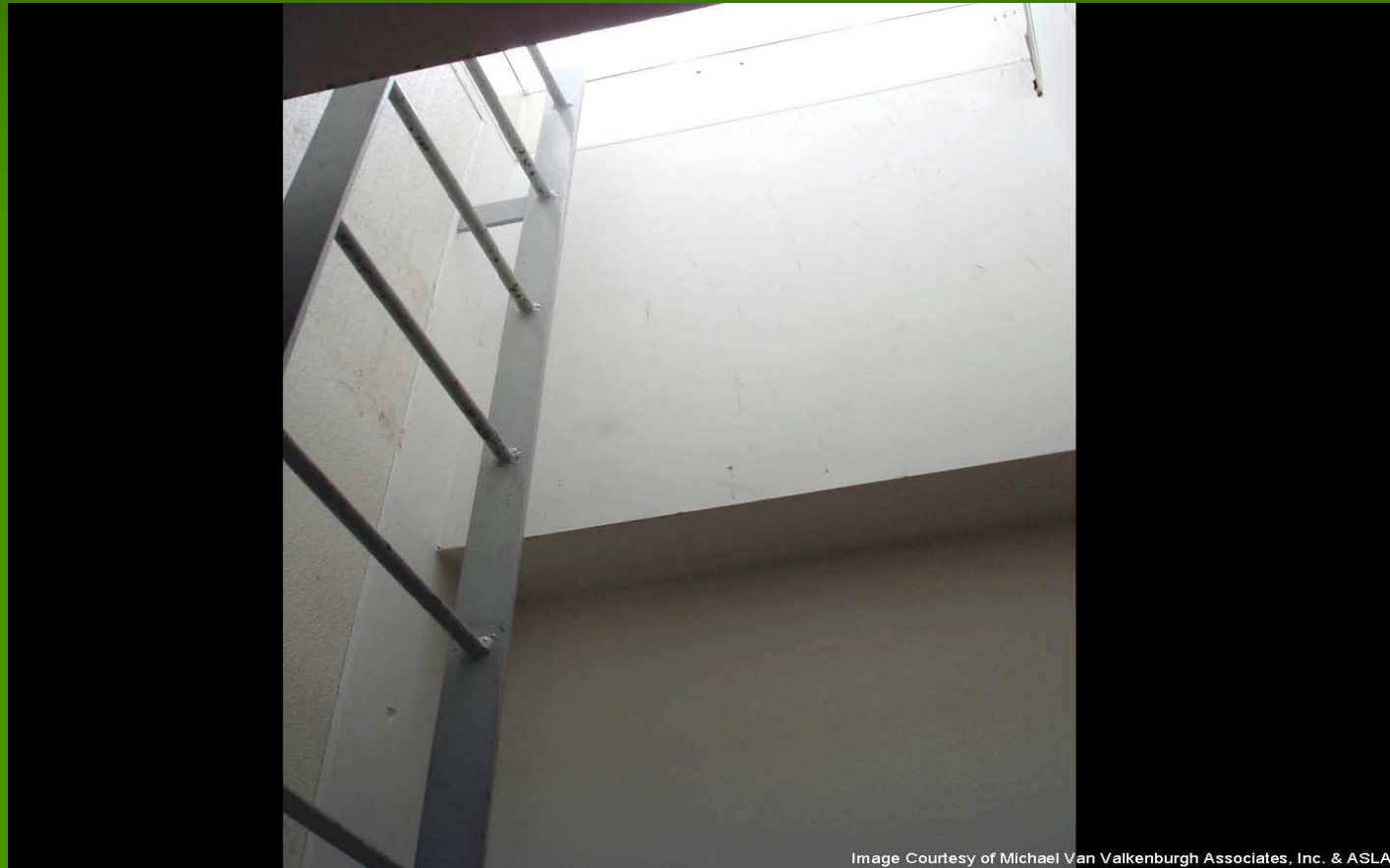
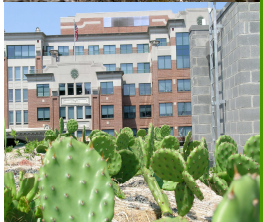
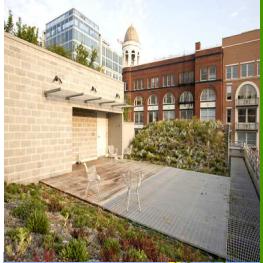
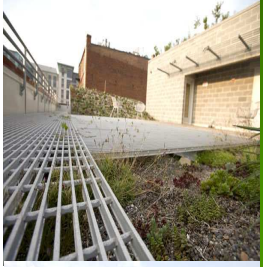
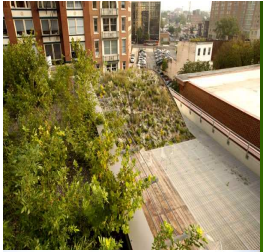
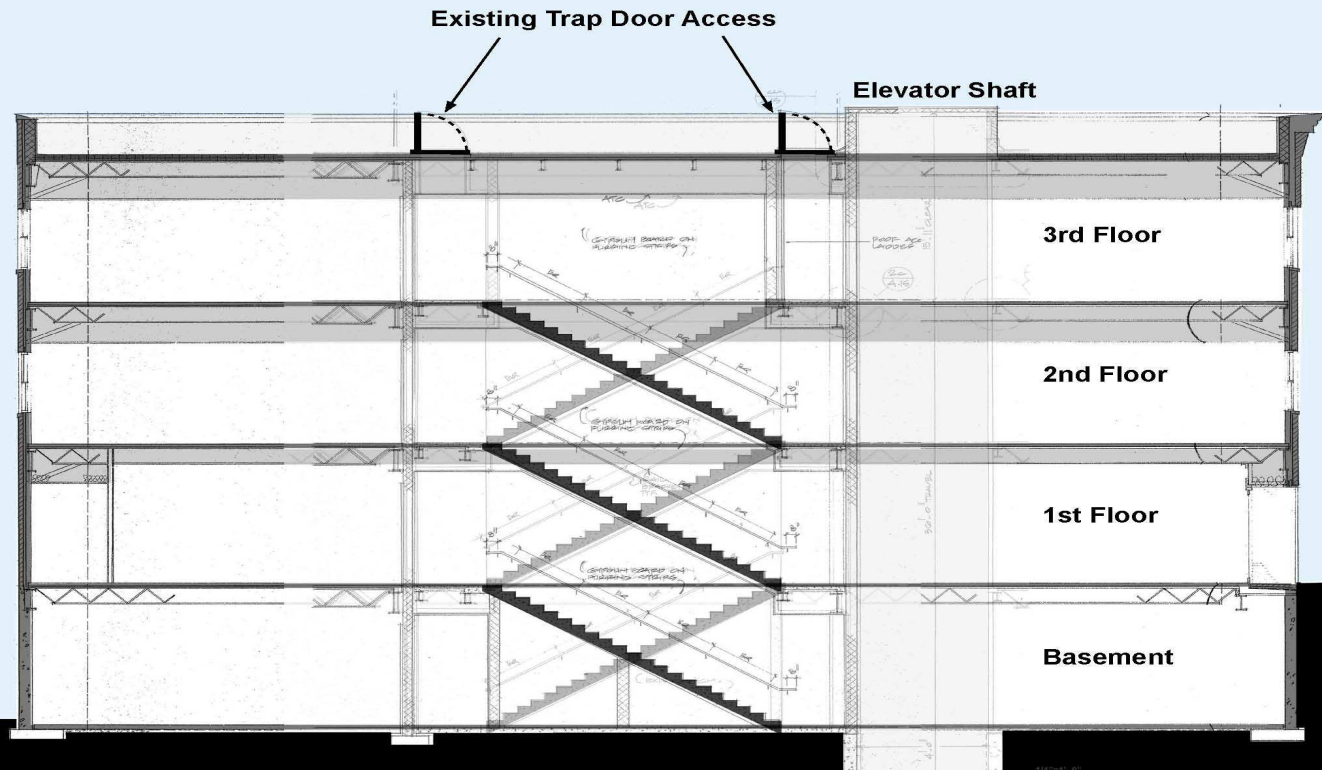
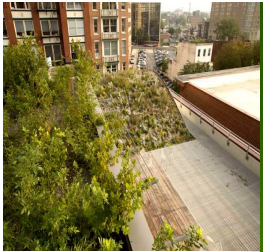


Image Courtesy of Michael Van Valkenburgh Associates, Inc. & ASLA

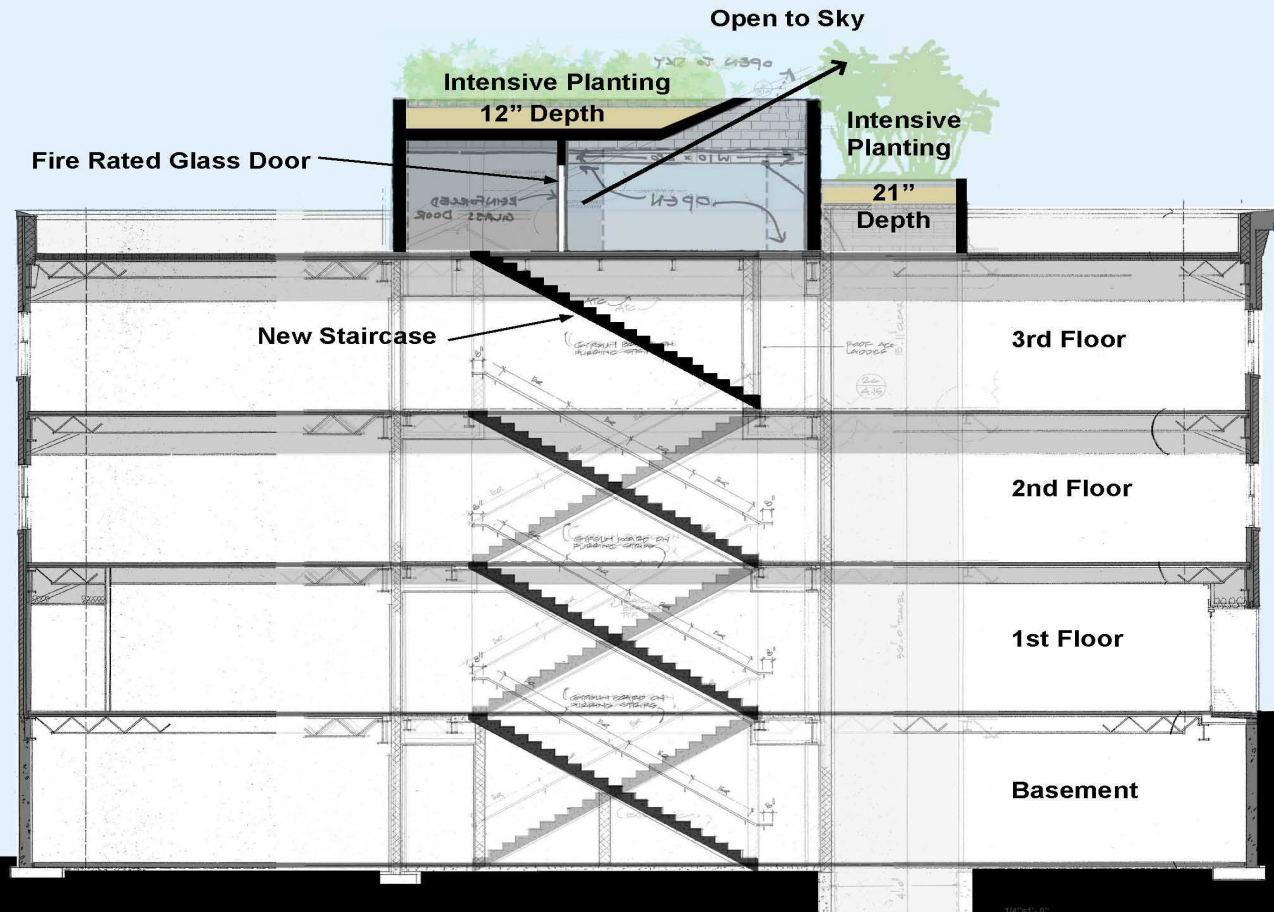
Original Building Profile



Existing Roof Access

Image Courtesy of Michael Van Valkenburgh Associates, Inc. & ASLA

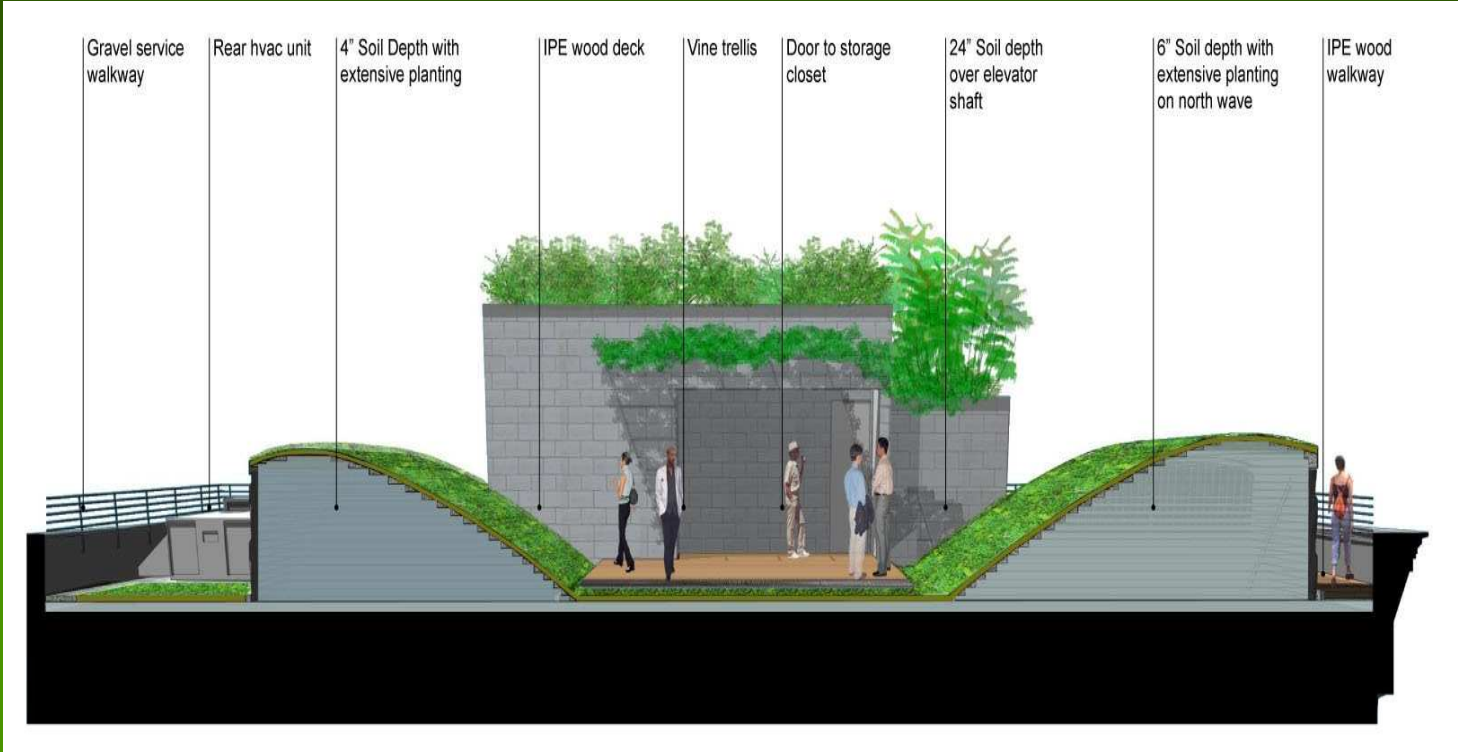
New Stair Tower



New Stair Tower

Image Courtesy of Michael Van Valkenburgh Associates, Inc. & ASLA





Unique features: sloped “waves”
and sedum under grating

“Wave” Cross Section

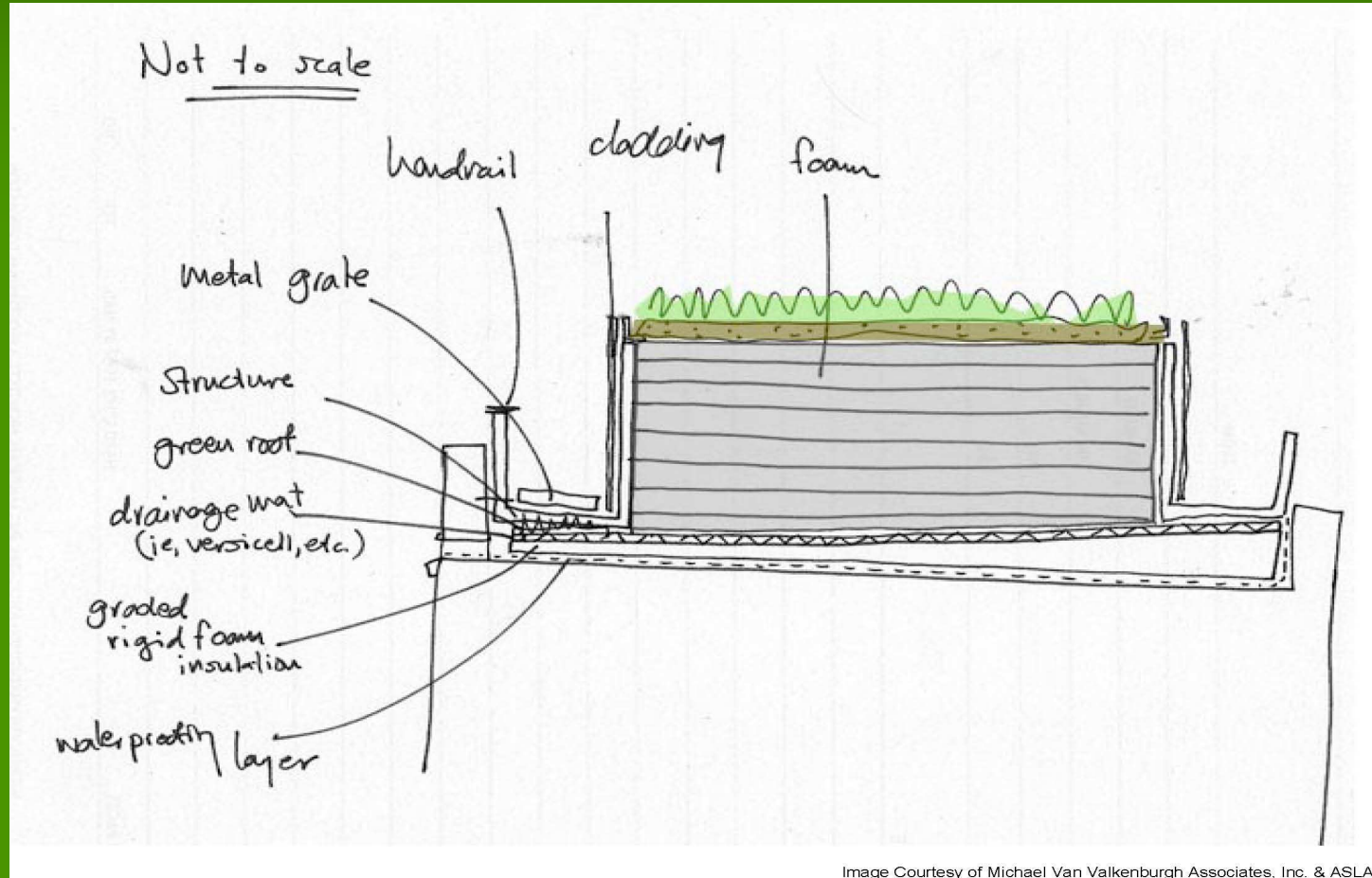
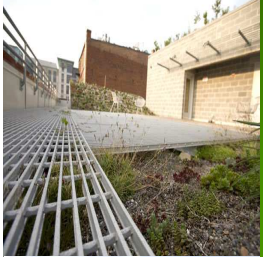
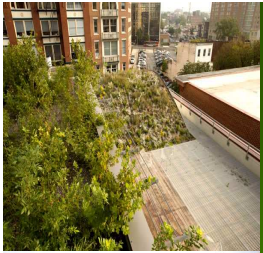


Image Courtesy of Michael Van Valkenburgh Associates, Inc. & ASLA

“Wave” Structure

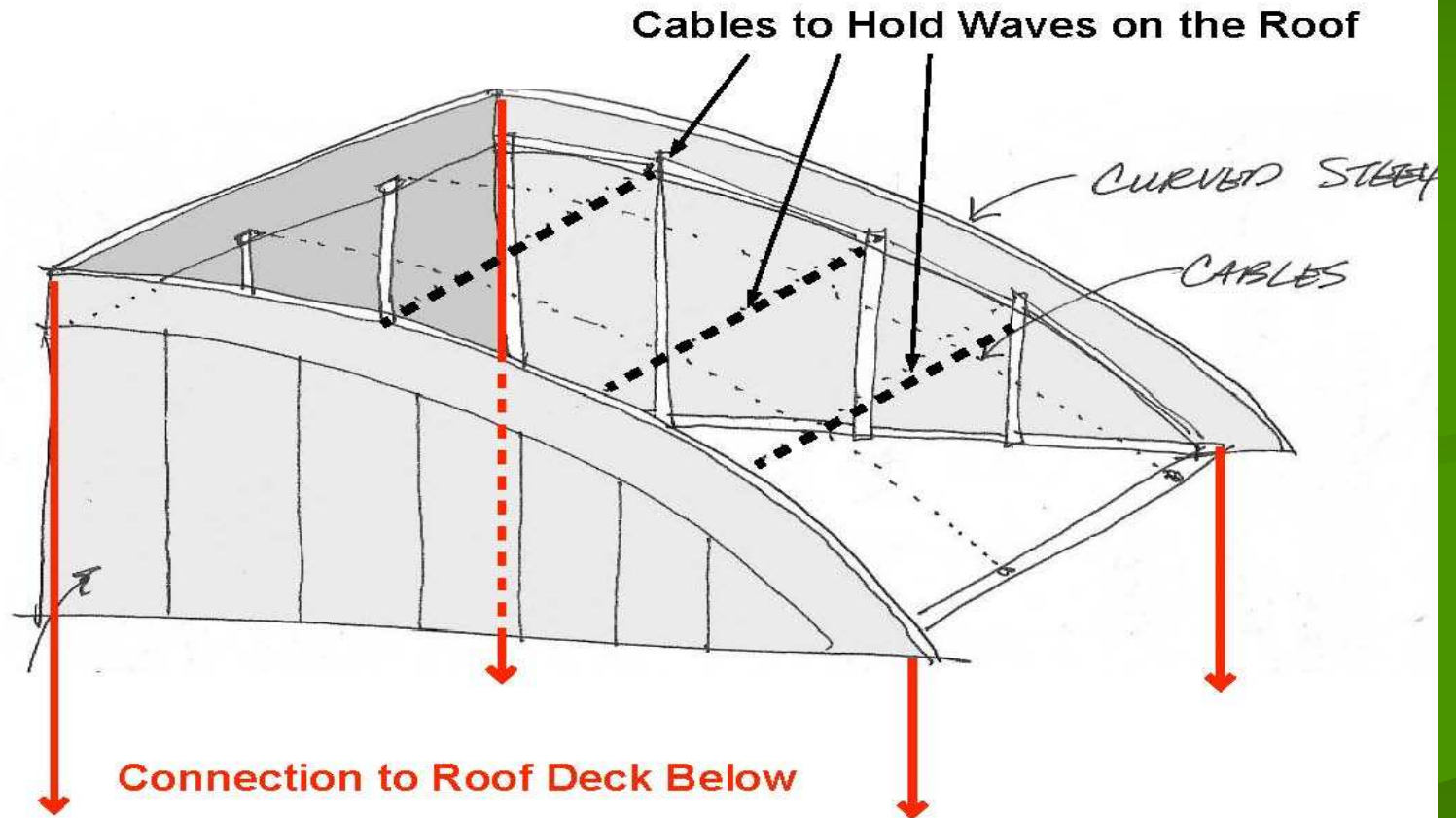
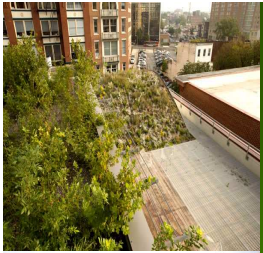


Image Courtesy of Michael Van Valkenburgh Associates, Inc. & ASLA

Building of the “Wave”

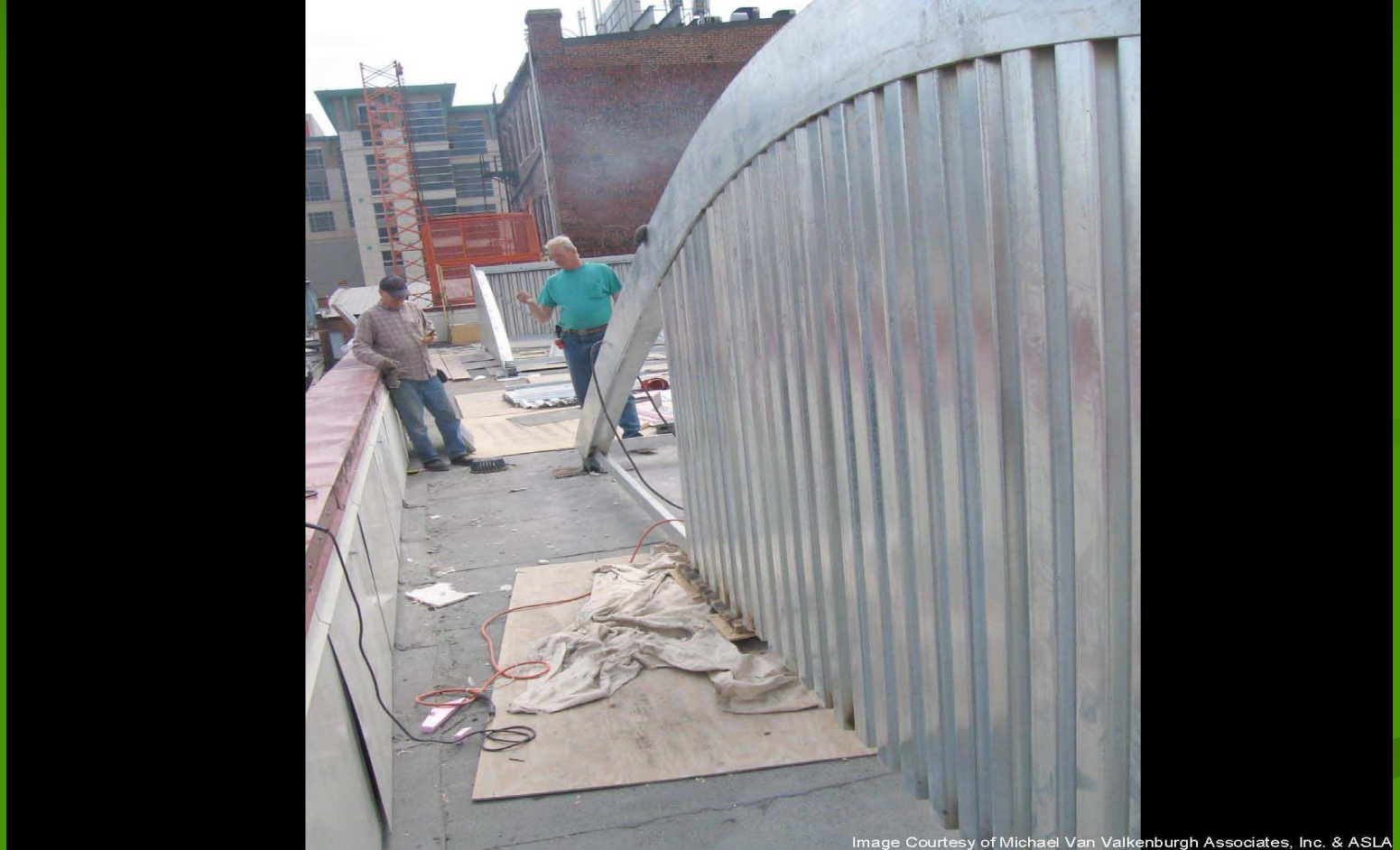
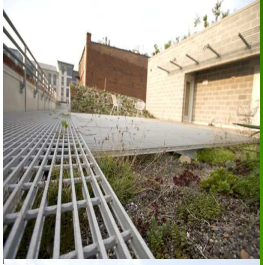
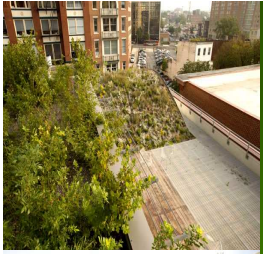
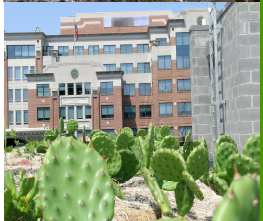
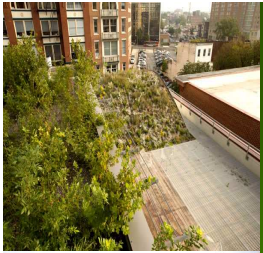
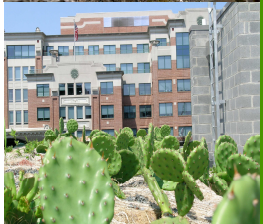
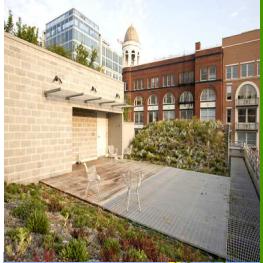
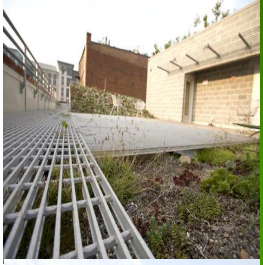
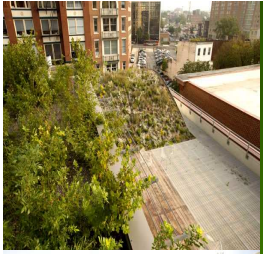


Image Courtesy of Michael Van Valkenburgh Associates, Inc. & ASLA

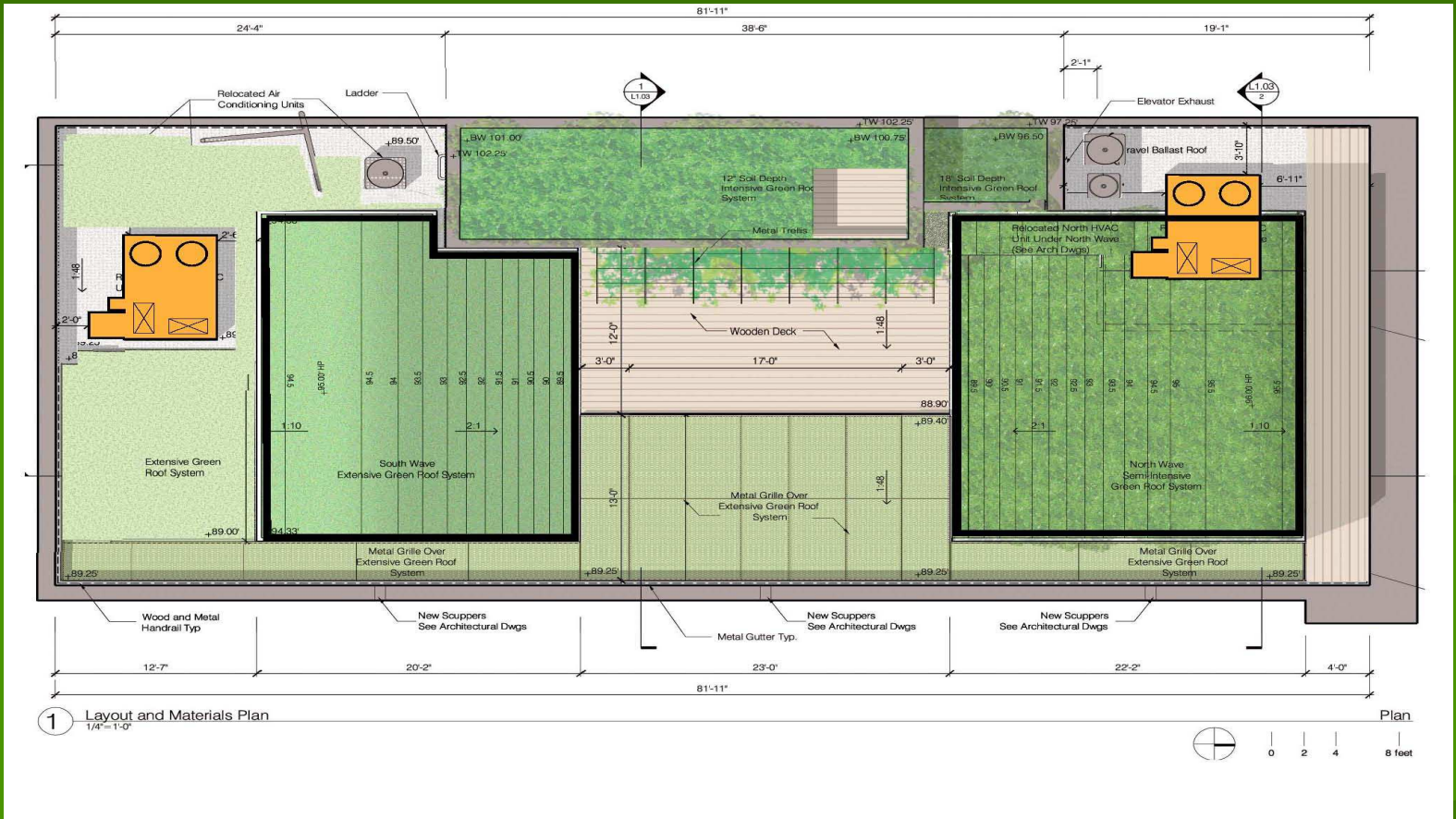
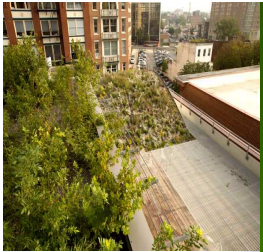
Forming the “Waves”



Soil Retention Mat



Relocation of HVAC System

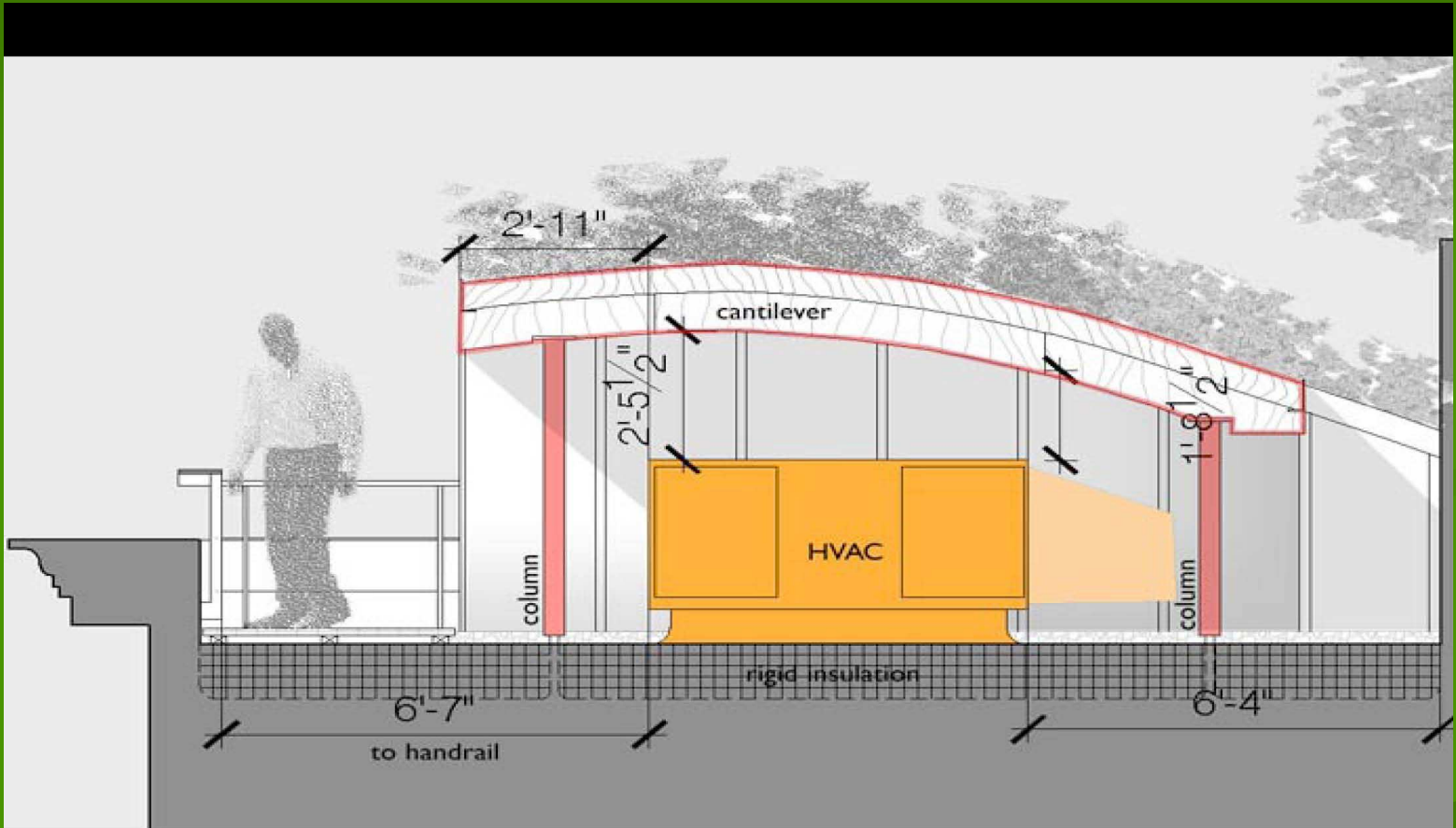


HVAC

Image Courtesy of Michael Van Valkenburgh Associates, Inc. & ASLA



Concealment of HVAC



HVAC

Image Courtesy of Michael Van Valkenburgh Associates, Inc. & ASLA



Headquarters W/O Green Roof

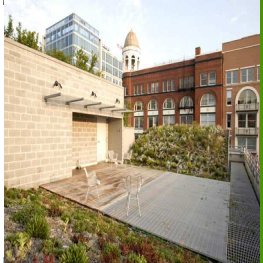
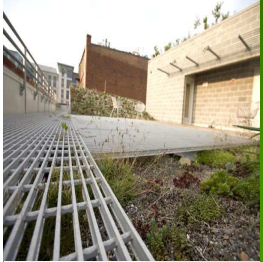
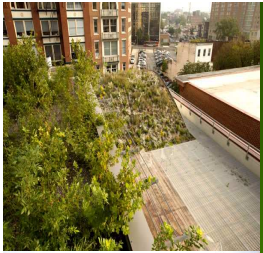
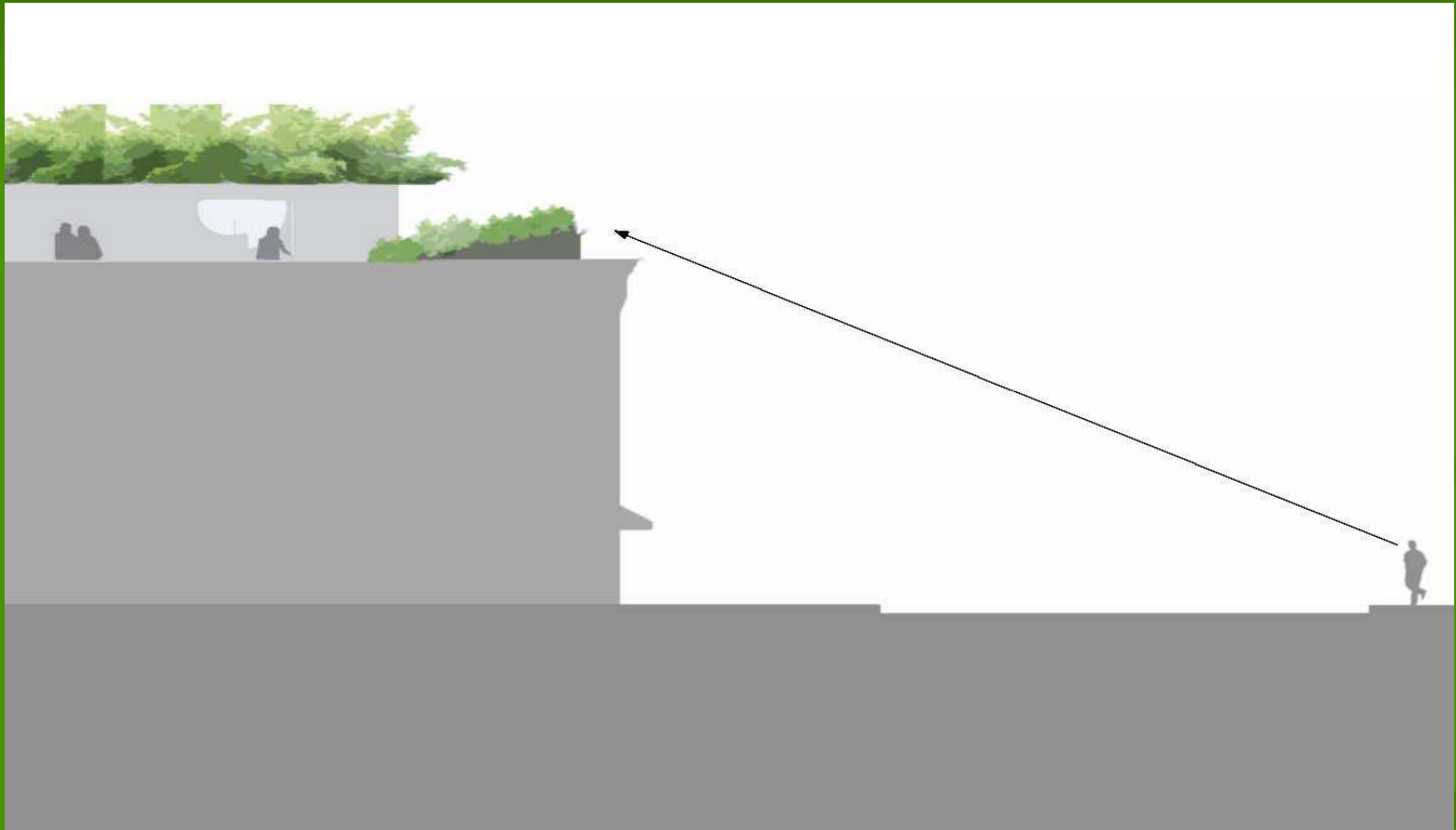
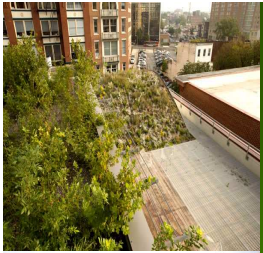


Image Courtesy of Michael Van Valkenburgh Associates, Inc. & ASLA

Goal: A View From the Street



View from Street

Image Courtesy of Michael Van Valkenburgh Associates, Inc. & ASLA



Sightline Studies

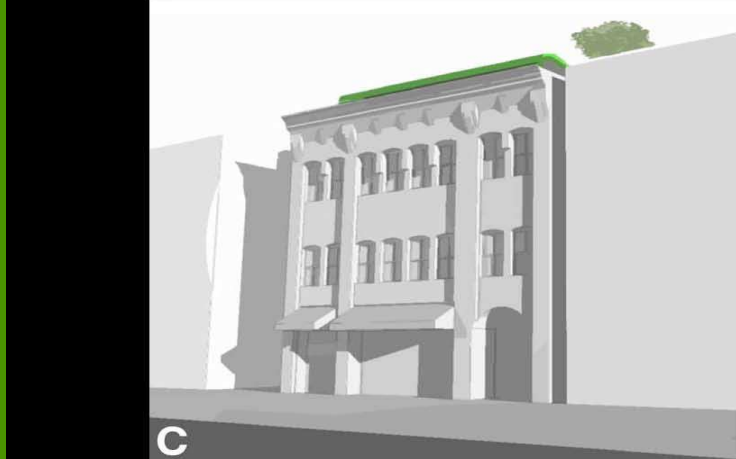
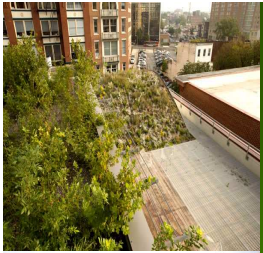


Image Courtesy of Michael Van Valkenburgh Associates, Inc. & ASLA

Visual of Green Roof

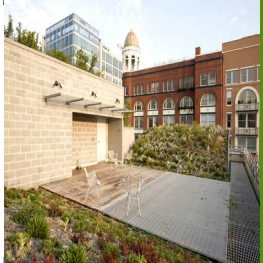
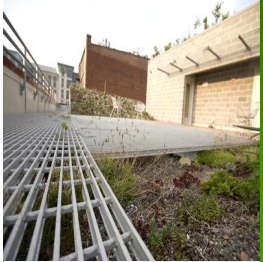
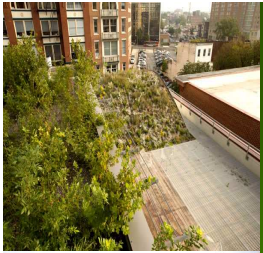
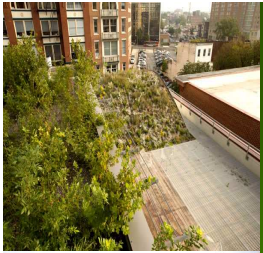


Image Courtesy of Michael Van Valkenburgh Associates, Inc. & ASLA



Overhead & Side Views



Test of Sedum Growth Under Grating

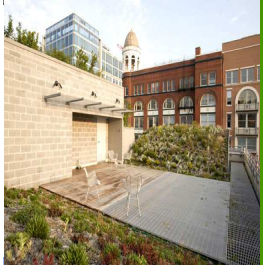
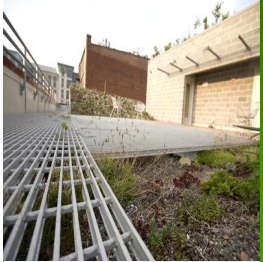
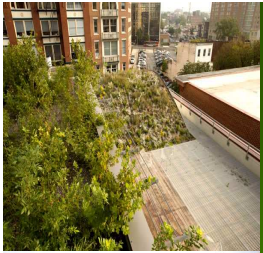
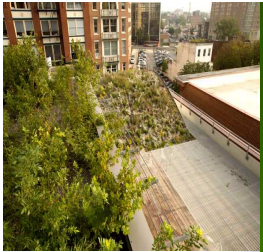


Image Courtesy of Michael Van Valkenburgh Associates, Inc. & ASLA

Walking Patterns

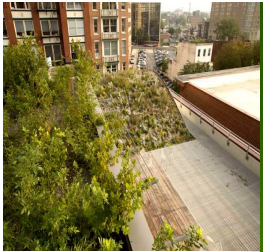


Walking Patterns

Image Courtesy of Michael Van Valkenburgh Associates, Inc. & ASLA



Sedum Growth

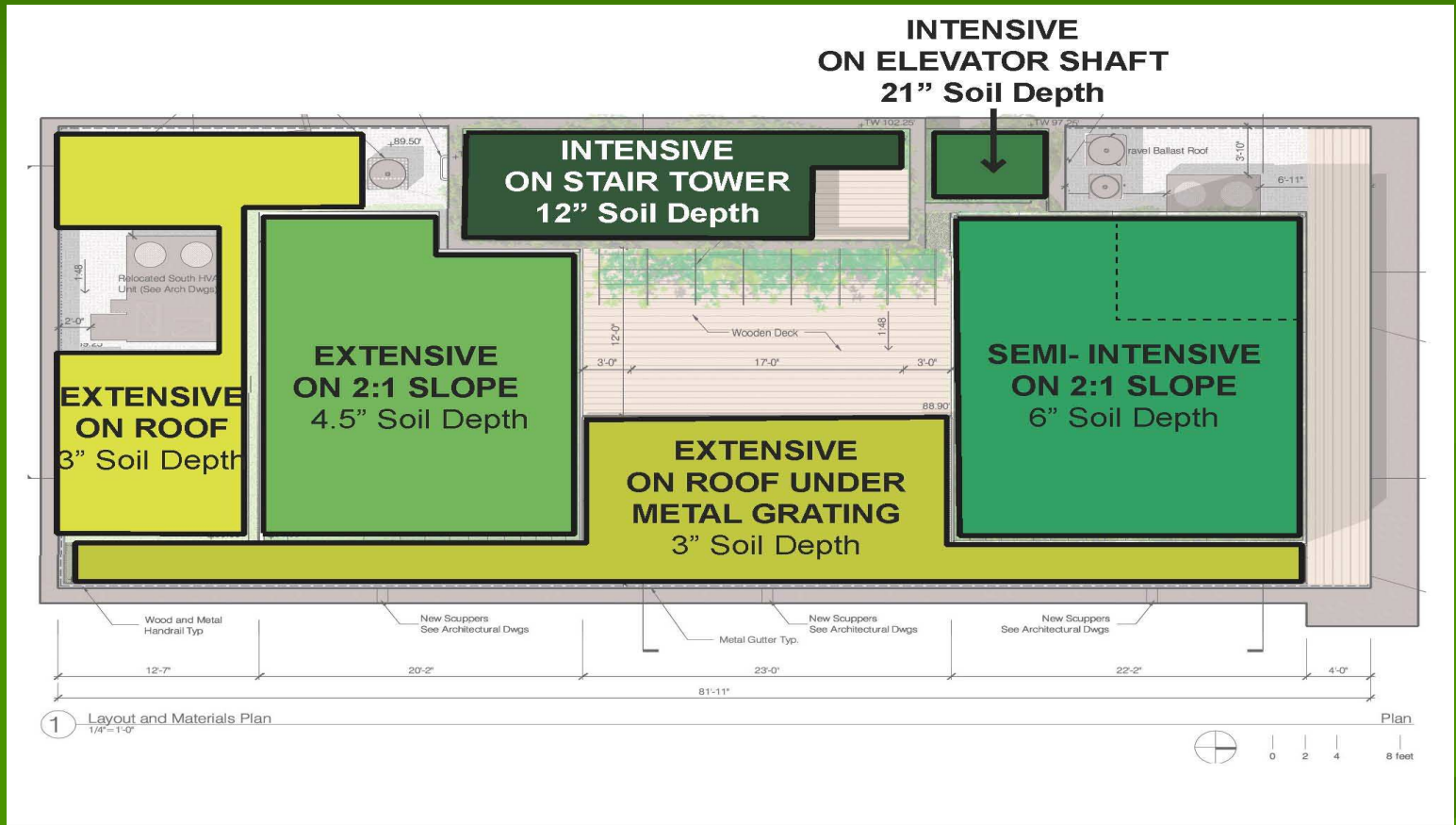
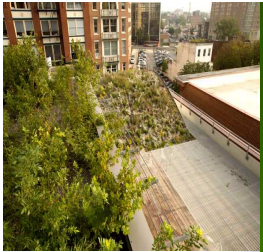


Sedums above Metal Grating

Image Courtesy of Michael Van Valkenburgh Associates, Inc. & ASLA



Soil Depth



Planting Layer

Image Courtesy of Michael Van Valkenburgh Associates, Inc. & ASLA

Planting Grid

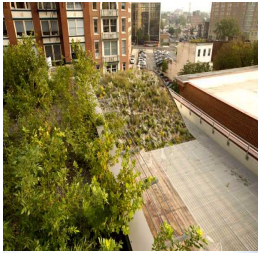
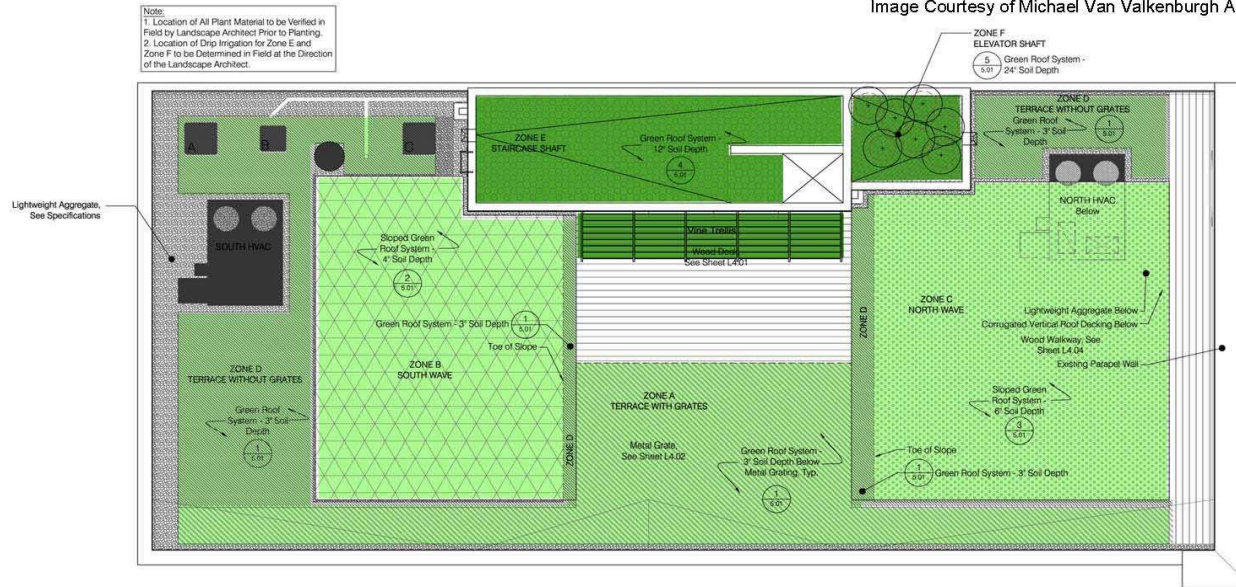


Image Courtesy of Michael Van Valkenburgh Associates, Inc. & ASLA



Planting Schedule

ZONE A - TERRACE WITH GRATES EXTENSIVE

ID	Qty	Botanical Name	Common Name	Size	Spacing	Notes
DN	180	<i>Delosperma nubigenum</i>	Ice Plant	2" plug	8" o.c.	
SK	180	<i>Sedum kamtschaticum</i>	Kamtschat Sedum	2" plug	8" o.c.	
SR	180	<i>Sedum reflexum</i>	Spruced-Leaved Stonecrop	2" plug	8" o.c.	
SS	180	<i>Sedum sexangulare</i>	Watch Chain Sedum	2" plug	8" o.c.	
SPF	180	<i>Sedum spurium Fuldigut</i>	Two-Row Stonecrop	2" plug	8" o.c.	
SPJ	180	<i>Sedum spurium John Creed</i>	Two-Row Stonecrop	2" plug	8" o.c.	
SPW	180	<i>Sedum spurium White Form</i>	Two-Row Stonecrop	2" plug	8" o.c.	

ZONE B - SOUTH WAVE EXTENSIVE

ID	Qty	Botanical Name	Common Name	Size	Spacing	Notes
SL	172	<i>Sedum lanceolatum</i>	Lance-leaved Stone rop	2" plug	8" o.c.	
SST	172	<i>Sedum stenopetalum</i>	Worm-leaved Stonecrop	2" plug	8" o.c.	
ST	172	<i>Sedum telephoides</i>	Allegheny Stonecrop	2" plug	8" o.c.	
Perennials						
CM	172	<i>Chrysopsis mariana</i>	Maryland Aster	2" plug	8" o.c.	
OH	110	<i>Oportunia humifusa</i>	Prickly Pear Cactus	live ears	8" o.c.	
PS	198	<i>Phlox subulata</i>	Moss Phlox	2" plug	8" o.c.	
SV	172	<i>Saxifraga virginensis</i>	Early Pink	2" plug	8" o.c.	
SC	198	<i>Silene caroliniana</i>	Wild Pink	2" plug	8" o.c.	

ZONE C - NORTH WAVE EXTENSIVE

ID	Qty	Botanical Name	Common Name	Size	Spacing	Notes
DN	95	<i>Delosperma nubigenum</i>	Ice Plant	2" plug	8" o.c.	
SA	95	<i>Sedum album Murale</i>	White Stonecrop	2" plug	8" o.c.	
SF	95	<i>Sedum floriferum var.</i>	Weihenstephan Gold	2" plug	8" o.c.	
SR	95	<i>Sedum reflexum</i>	Spruced-Leaved Stonecrop	2" plug	8" o.c.	
TC	95	<i>Tallium calycinum</i>	Flame Flower	2" plug	8" o.c.	
Grasses						
FB	95	<i>Bouteloua gracilis</i>	Blue Grama Grass	2" plug	8" o.c.	
SH	95	<i>Sporobolus heterolepis</i>	Prairie Dropseed	2" plug	8" o.c.	
EV	95	<i>Elymus virginicus</i>	Virginia Wild Rye	2" plug	8" o.c.	
ES	95	<i>Eragrostis spectabilis</i>	Purple Lovegrass	2" plug	8" o.c.	
Perennials						
AF	50	<i>Artemisia frigida</i>	Prairie Sagewort	2 qt	12" o.c.	
TB	50	<i>Tridactema bistracata</i>	Spiderwort	2 qt	12" o.c.	
SS	50	<i>Gutierrezia sarothrae</i>	Broom Snakeweed	2 qt	12" o.c.	
RH	50	<i>Rhus typhina</i>	Black-eyed Susan	2 qt	12" o.c.	
AT	50	<i>Asclepias tuberosa</i>	Butterfly Milkweed	2 qt	12" o.c.	
AM	50	<i>Achillea millefolium</i>	Yarrow	2 qt	12" o.c.	
SN	50	<i>Solidago nemoralis</i>	Old Field Goldenrod	2 qt	12" o.c.	
AO	50	<i>Allium ostrowskianum</i>	Pink Lily Leek	2 qt	12" o.c.	

ZONE D - TERRACE WITHOUT GRATES EXTENSIVE

ID	Qty	Botanical Name	Common Name	Size	Spacing	Notes
DN	125	<i>Delosperma nubigenum</i>	Ice Plant	2" plug	8" o.c.	
SK	110	<i>Sedum kamtschaticum</i>	Kamtschat Sedum	2" plug	8" o.c.	
SR	110	<i>Sedum reflexum</i>	Spruced-Leaved Stonecrop	2" plug	8" o.c.	
SS	110	<i>Sedum sexangulare</i>	Watch Chain Sedum	2" plug	8" o.c.	
SPF	110	<i>Sedum spurium Fuldigut</i>	Two-Row Stonecrop	2" plug	8" o.c.	
SPJ	110	<i>Sedum spurium John Creed</i>	Two-Row Stonecrop	2" plug	8" o.c.	
SPW	110	<i>Sedum spurium White Form</i>	Two-Row Stonecrop	2" plug	8" o.c.	
TC	110	<i>Tallium calycinum</i>	Flame Flower	2" plug	8" o.c.	

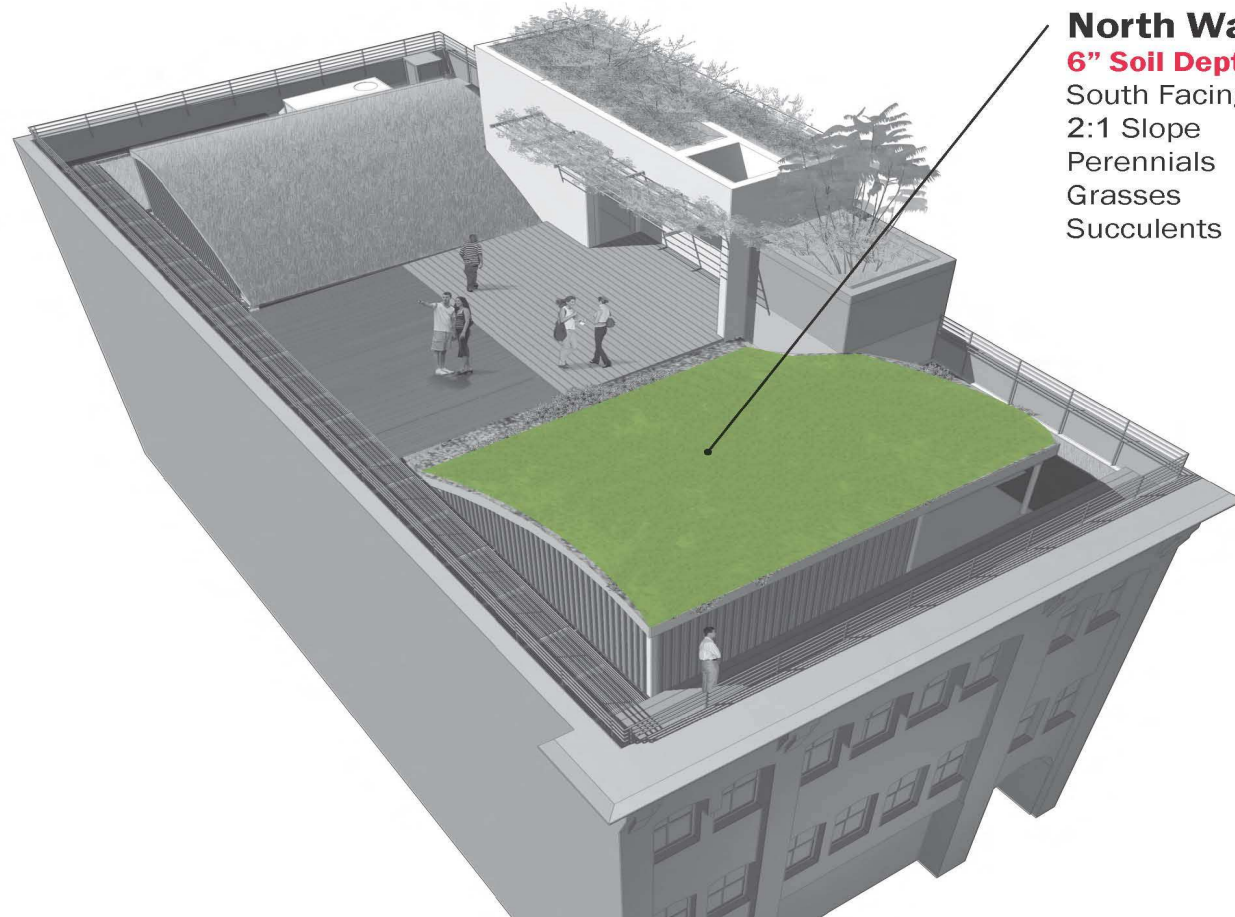
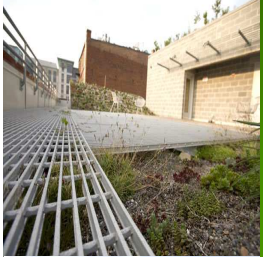
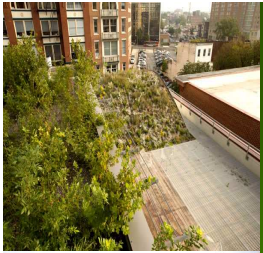
ZONE E - STAIRCASE SHAFT INTENSIVE

ID	Qty	Botanical Name	Common Name	Size	Spacing	Notes
CA	20	<i>Ceanothus americanus</i>	New Jersey Tea	24" 36" ht	24" o.c.	
CP	20	<i>Comptonia peregrina</i>	Sweet Fern	24" 36" ht	24" o.c.	
RA	20	<i>Rhus aromatica</i>	Fragrant Sumac	24" 36" ht	24" o.c.	
RS	16	<i>Rosa carolina</i>	Pasture Rose	18" 24" ht	24" o.c.	

ZONE F - ELEVATOR SHAFT INTENSIVE

ID	Qty	Botanical Name	Common Name	Size	Spacing	Notes
RC	14	<i>Rhus copallina</i>	Flame Sumac	6-7 ft.		
CR	3	<i>Campsis radicans 'Madame Galani'</i>	Trumpet Vine	7 gallon		10-12 ft.

North Wave Soil Depth



North Wave

6" Soil Depth

South Facing

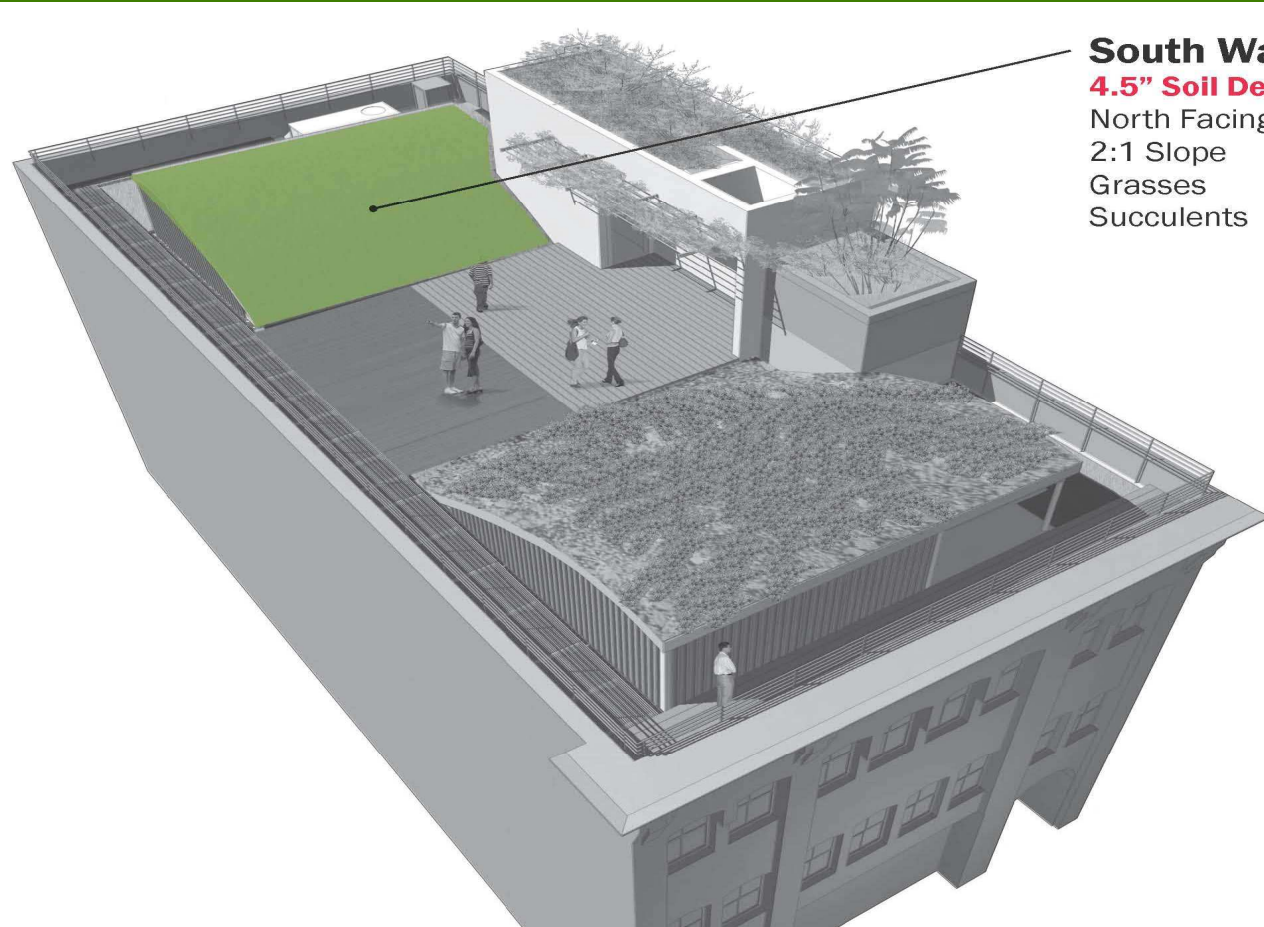
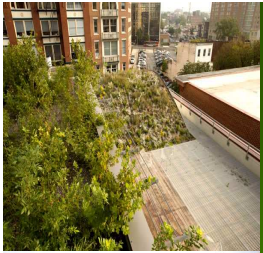
2:1 Slope

Perennials

Grasses

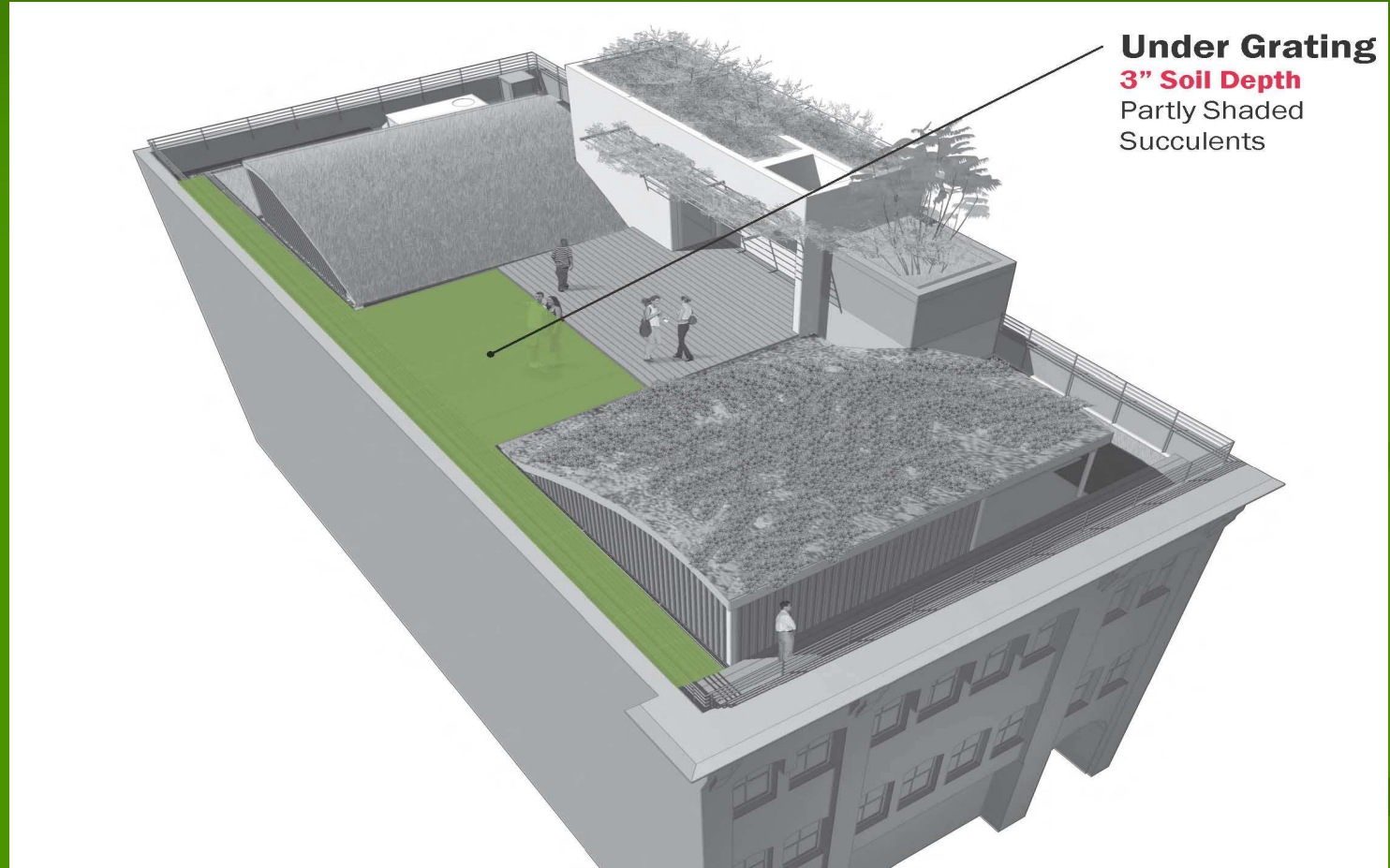
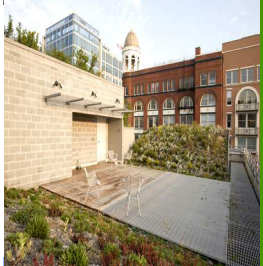
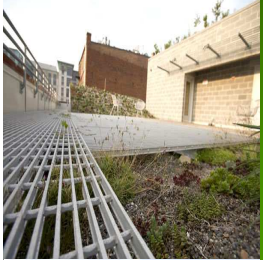
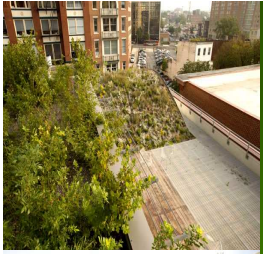
Succulents

South Wave Soil Depth

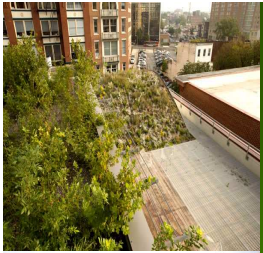


South Wave
4.5" Soil Depth
North Facing
2:1 Slope
Grasses
Succulents

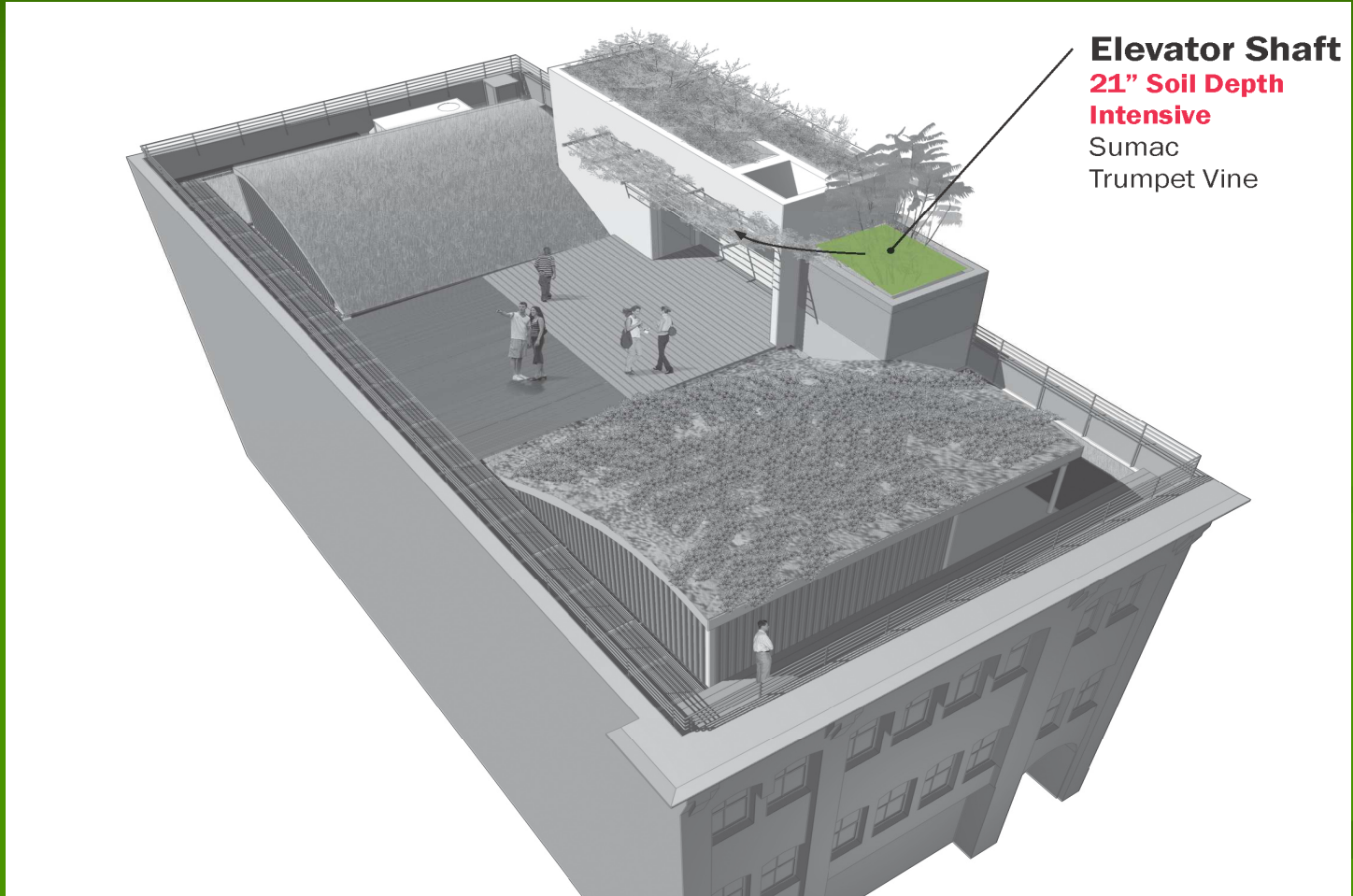
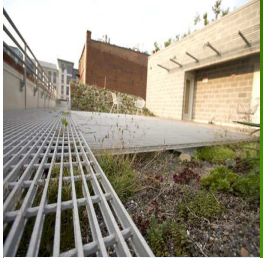
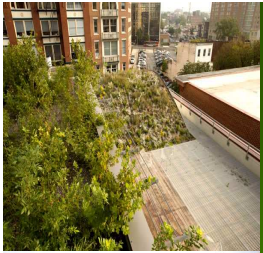
Soil Depth Under Grating



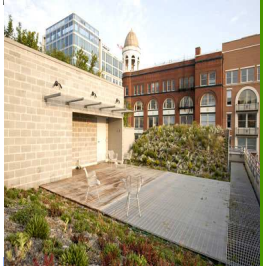
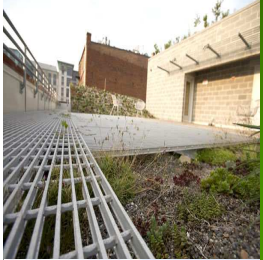
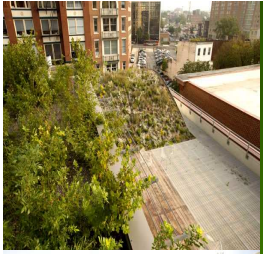
Soil Depth Over Stairs



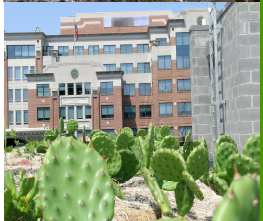
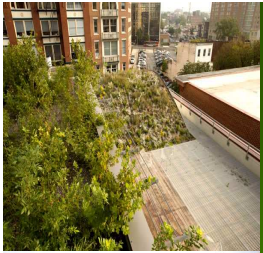
Soil Depth Over Elevator



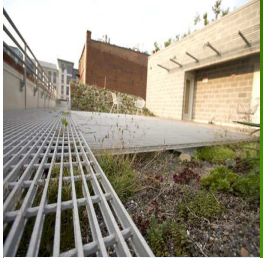
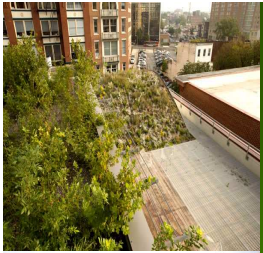
Overview of the Roof



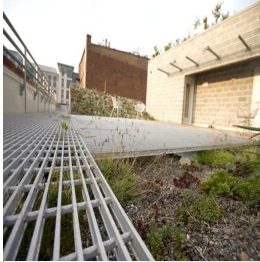
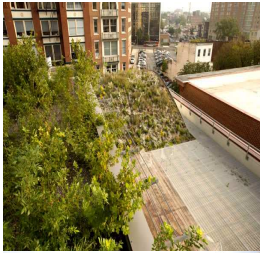
From Across the Street



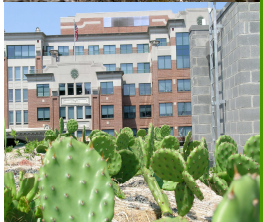
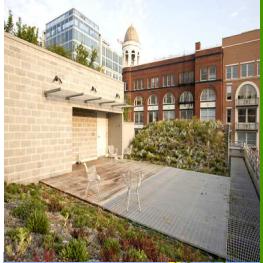
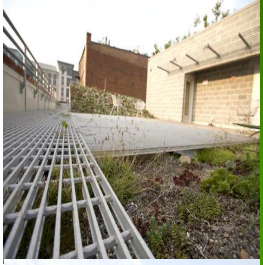
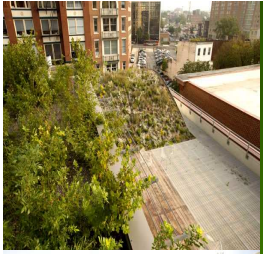
Blooms on the North Wave



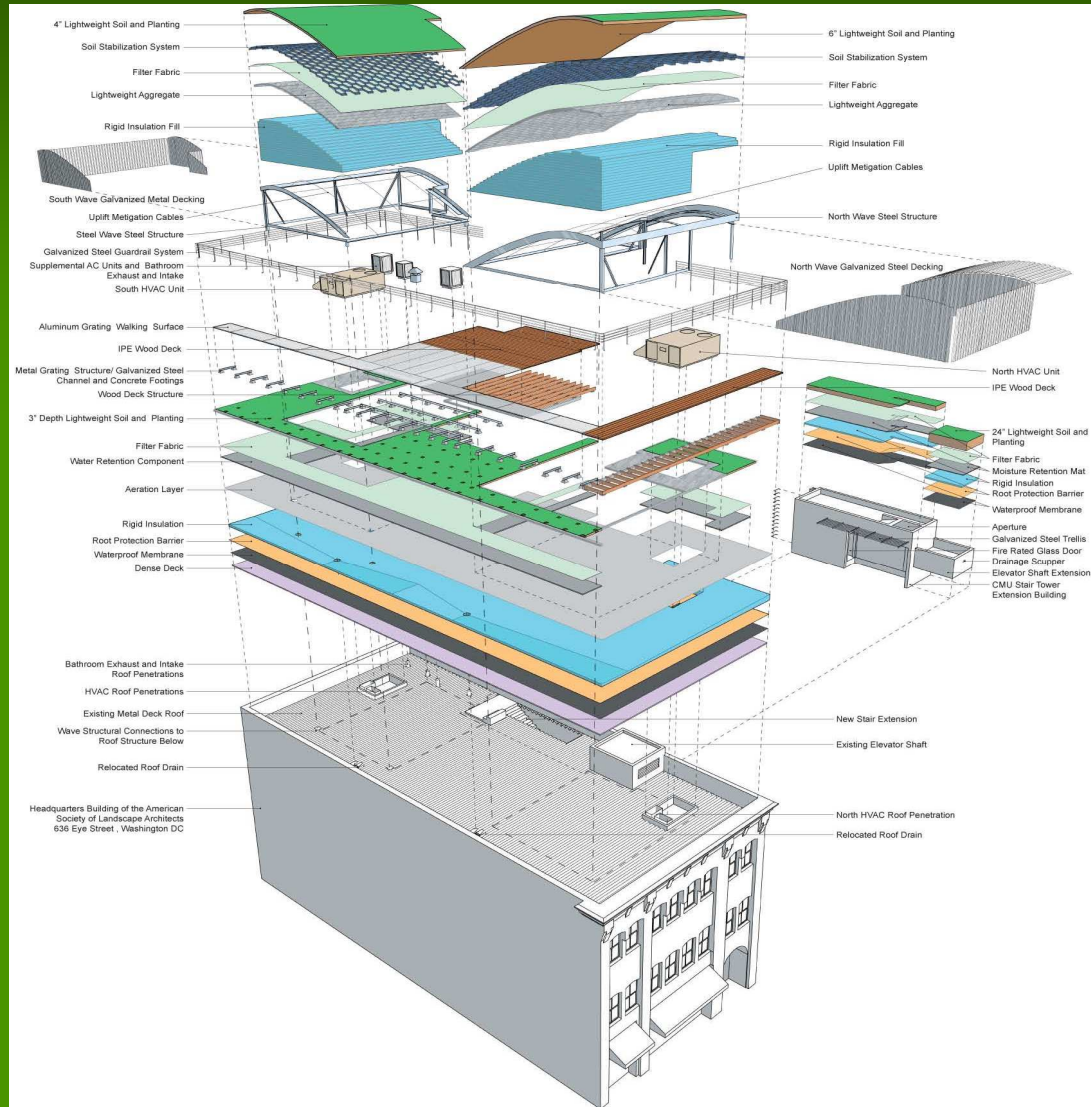
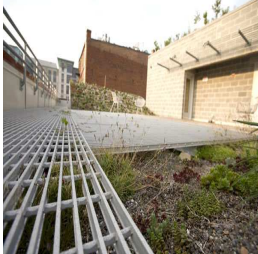
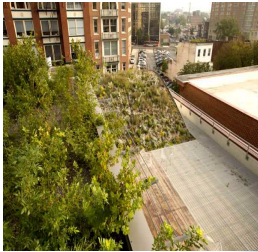
Springing From the Grates



South Wave in Bloom



Exploded Axon



A Green Roof Landscape for the American Society of Landscape Architects

Michael Van Valkenburgh Associates Inc., Landscape Architects PC 2006

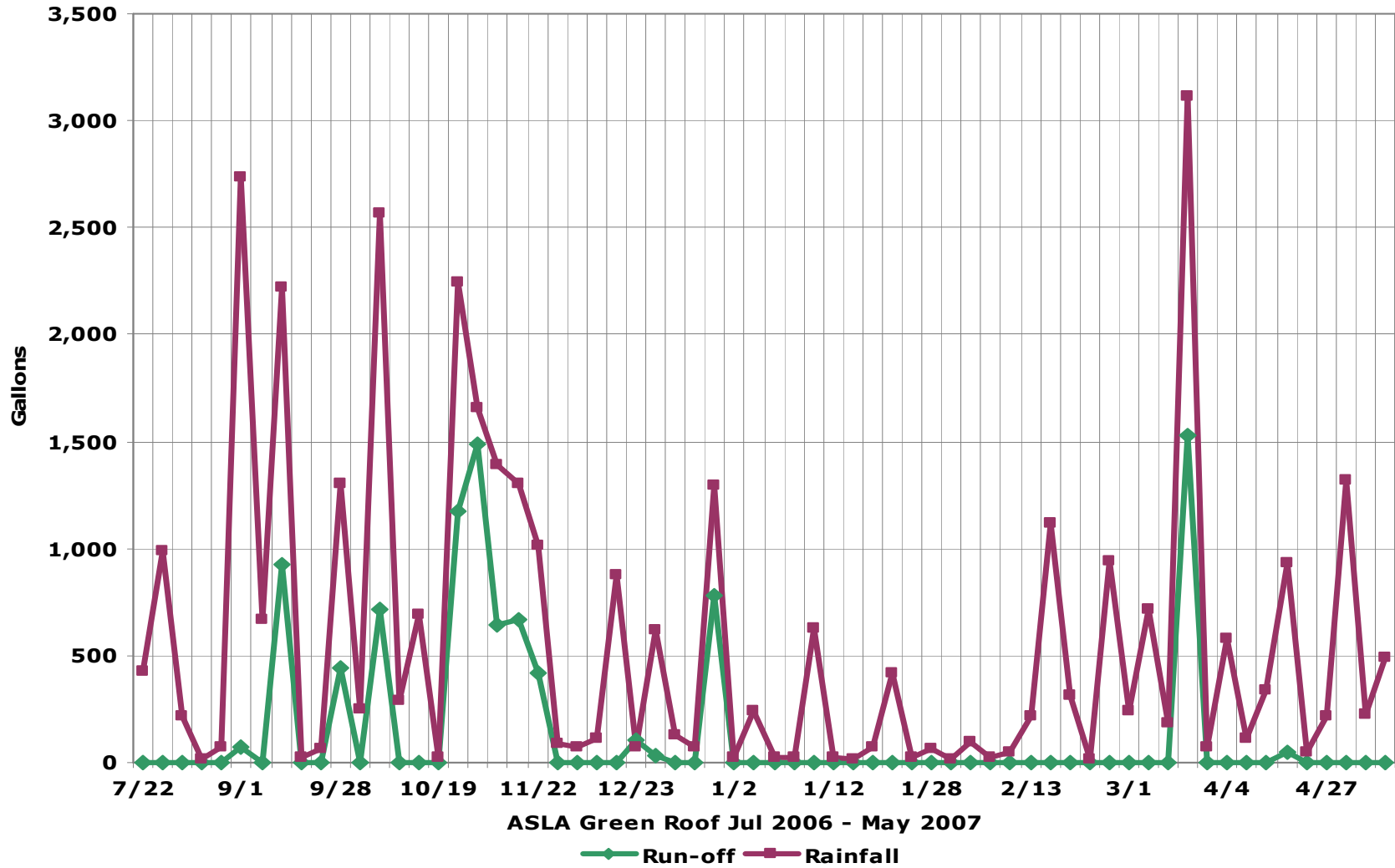
Conservation Design Forum, Green Roof Consultants

DMJM | AECOM, Architect

Robert Silman Associates, Structural Engineer

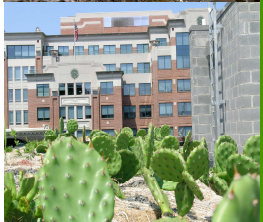
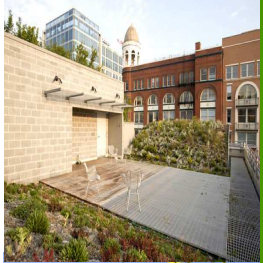
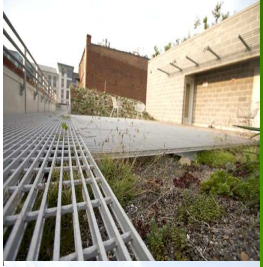
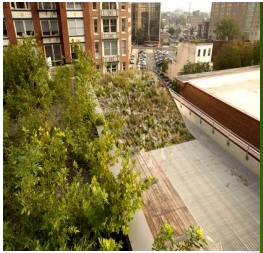


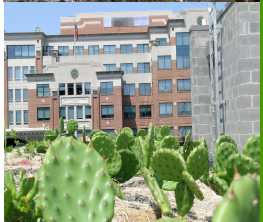
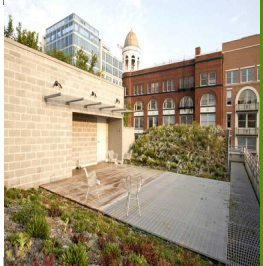
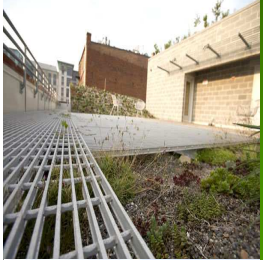
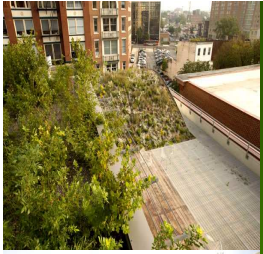
ASLA Roof Rainfall Retention



ASLA Roof Monitoring

- Stormwater retention
- Water quality
- Temperature
- Plant growth
- Building energy use



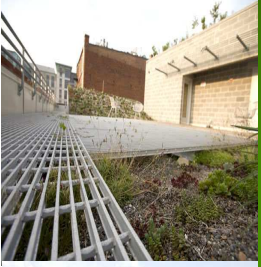
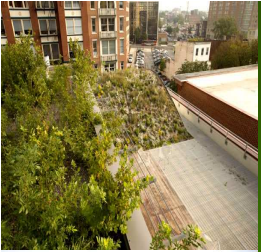


Design & Construction Challenges

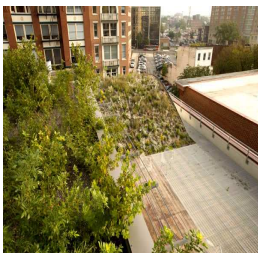
- Occupied building
- Building material storage
- Flow meters
- Window washing anchors
- Building permit process

After One Year

- Multiple microclimates
- Tremendous interest from policy makers, designers, developers, environmental groups, students, the public
- Value as “real world” example



Design Team and Sponsors



Michael Van Valkenburgh Associates
(Landscape Architect, Lead Designer)

Conservation Design Forum,
(Consulting Landscape Architect)

DMJM Design
(Architect)

Forrester Construction Company
(General Contractor)

Robert Silman Associates
(Structural Engineer)

Emory Knoll Farms
(Plants and Consulting)

American Hydrotech
(Roof Assembly)

St. Louis Metal Works
(Edging and Drains)

Ohio Gratings
(Grating & Walking Surfaces)

Outdoor Illumination
(Lighting Design)

ForestWorld Group
(Ipe Wood Decking)

Dow Chemical
(Polystyrene)

Rain Bird

(Drip Irrigation System)

Outside Unlimited
(Installer of Drip System)

Carolina Stalite Company
(Green Roof Media)



ASLA 2007 Professional Awards

■ www.asla.org