LIVING ARCHITECTURE MONITOR®

A GREEN ROOFS FOR HEALTHY CITIES PUBLICATION

VOLUME 15 / ISSUE 3 / FALL 2013

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IN SAN FRANCISCO FROM OCTOBER 23-26, 2013

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SECURING RESILIENCE: FOOD, WATER & ENERGY ISSUE

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VOLUME 15
ISSUE 3
FALL 2013

INSIDE

ON THE COVER: The sky is the limit with this living architecture vertical forest rendering (currently under construction in Milan, Italy). The potential of living architecture is endless—food, water, energy and beyond.
Image provided by: Boeri Studio (Stefano Boeri, Gianandrea Barreca, Giovanni La Varra)

LIVING ARCHITECTURE MONITOR®

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DESIGNING FOR RESILIENCY IN AN AGE OF UNCERTAINTY

What would you do if the lights went out and the water stopped flowing through your taps for a week? Is there a building in your community that can provide safe drinking water, shelter and heat during times of crises? How long will community food supplies last if they are interrupted?

These types of questions have recently given rise to popular culture shows like *Survivorman*, *The Walking Dead* and *Doomsday Preppers*, wherein individuals try to survive extreme conditions (such as the zombie apocalypse) or prepare for future disasters. The popularity of these shows is not surprising, unless you are in deep denial about the climate change crisis. You've probably noticed that the polar ice caps are melting, the oceans are acidifying, and the weather is changing rapidly, and certainly not for the better. In fact, according to the US National Climatic Data Center's 2012 weather and climate disasters information, 2012 saw 11 weather and climate disaster events, each with losses exceeding $1 billion in damages. This makes 2012 the second costliest year since 1980, with $110 billion in damages. The two major drivers of the damage costs in 2012 were Sandy at approximately $65 billion and the yearlong drought at approximately $30 billion. Sandy led to record storm surge, large-scale flooding, wind damage and mass power outages along much of the East Coast of North America. The year long drought, which affected more than half the US for the majority of 2012, was the largest since the 1930s. Drought impacts are costly to agricultural centers and have lead to several devastating wildfires that burned over 9 million acres in the United States during 2012.

As the costs of weather and climate related disasters continue to mount, there will be growing political pressure for policies and investment to address resiliency as a means of adapting to climate change. In June, Mayor Bloomberg of New York announced a 400 page, 19.5 billion dollar plan to protect New York from future storms and rising ocean levels. Fifty-eight mayors have signed on to the Resilient Communities for America campaign—a joint effort by the US Green Building Council, International Council for Local Environmental Initiatives (ICLEI), the National League of Cities and the World Wildlife Fund. These mayors are acknowledging the tragic reality that a certain degree of global warming is already happening, and that our nation's high density urban areas are guaranteed a dangerous future of extreme weather, flooding, storm surges, blizzards and droughts.

Fortunately, the design and construction industry has the capacity to develop buildings, infrastructure and communities that are resilient in the face of weather related natural disasters. As an industry, we have an obligation to understand how living architecture systems like green roofs and walls can contribute positively to the resiliency of our buildings and communities. Green façades, for example, have proven to be effective at reducing building envelope damage caused by debris during heavy winds; while green roof farms, if sufficient in number, may be able to help supplement a disrupted food supply.

We are exploring these and other cutting edge design issues in this issue of the LAM, as well as at *CitiesAlive* in San Francisco October 23-26, 2013. At *CitiesAlive* we will hear from notable designers such as Eric Corey Freed and Peter Busby, engage in expert discussion panels, and learn from two design contests, one focused on a specific area of San Francisco—*Student Design Challenge* (land8.com/citiesalive) and the other, on the more general topic of resiliency—*The Great Community Resiliency Project.* Please join us in San Francisco and let us turn the power of living architecture to the challenge of resilient buildings and communities.

Sincerely,

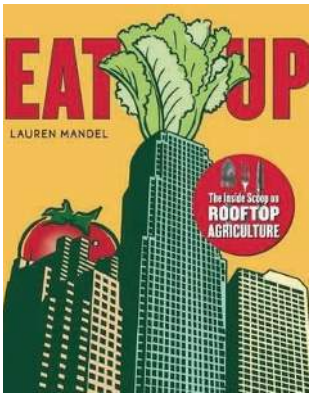
Steven W. Peck, GRP
Founder & President, GRHC

FIND OUT MORE

The Great Community Resiliency Project:
http://goo.gl/dUWVP

Resilient Communities for America:
www.resilientamerica.org

BOOKSHELF



EAT UP: THE INSIDE SCOOP ON ROOFTOP AGRICULTURE

BY: LAUREN MANDEL

The first full-length book to focus entirely on rooftop agriculture, *EAT UP* views this growing movement through a practitioner's lens, explaining: structural, access and infrastructural considerations; zoning and building codes; proven growing techniques; and business and marketing strategies.

FIND OUT MORE:

http://goo.gl/AlhYsZ

GREEN ROOFS BOOST EFFICIENCY OF SOLAR PANELS

It's no surprise that having both a green roof and a solar panel array on a building is a great way to double down on reducing energy bills for property owners. Two recent studies, from the Bronx Design and Construction Academy and the American Solar Energy Society, raised some eyebrows by indicating that the plants on a green roof may improve the performance of the photovoltaic solar cells themselves.

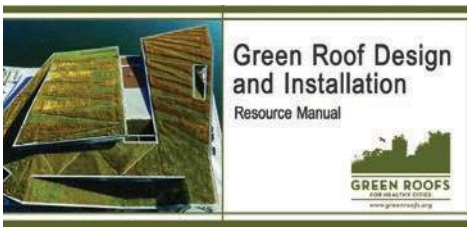
In addition to providing natural insulation for buildings, the plants also create a better environment for solar cells, which perform best at lower temperatures.

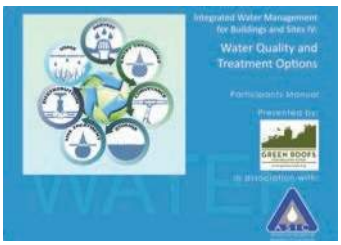
FIND OUT MORE:

http://goo.gl/vhIGtL

GREY TO GREEN A GREAT SUCCESS

Grey to Green, held at the beautiful Evergreen Brick Works in Toronto on May 21 and 22, focused on the economics of green infrastructure. Thank you to everyone that made the *Grey to Green* conference a great success. Videos of the keynote speakers are available online at www.vimeo.com/grhcna . You can also sign the Living Green Infrastructure Declaration at http://goo.gl/ikllW or earn CEU's by purchasing online access to presentations: http://goo.gl/iLBC15.





NEW & UPCOMING GRHC COURSES

GREEN ROOF BOOT CAMPS (NOW ONLY 3 FULL-DAY COURSES) SAVE $299!

San Francisco – August 22nd to 24th

Toronto – September 19th to 21st

Chicago – September 26th to 28th

New York – October 3rd to 5th

HALF-DAY COURSES AT *CITIESALIVE* ON OCTOBER 23RD

Living Architecture & Sustainable Energy (LAUNCH!) This course provides a holistic approach to energy conservation and production utilizing green roofs and walls.

Introduction to Rooftop Urban Agriculture

Introduction to Integrated Water Management for Buildings & Sites

Green Walls 101: Systems Overview and Design

Advanced Green Roof Maintenance

Integrated Water Management for Buildings and Sites IV: Water Quality & Treatment Options (LAUNCH!) This is the fourth workshop in the Integrated Water Management Educational Series, exploring water quality basics and constituents of concern in harvested water

FULL-DAY COURSES AT *CITIESALIVE* ON OCTOBER 23RD

Green Roof Design and Installation (NEW!) This is an updated and consolidated version of our Green Roof Design 101 and Green Roof Design and Installation 201 courses.

For more information, and to register, visit www.greenroofs.org/education. You can also purchase manuals at www.greeninfrastructurestore.com.

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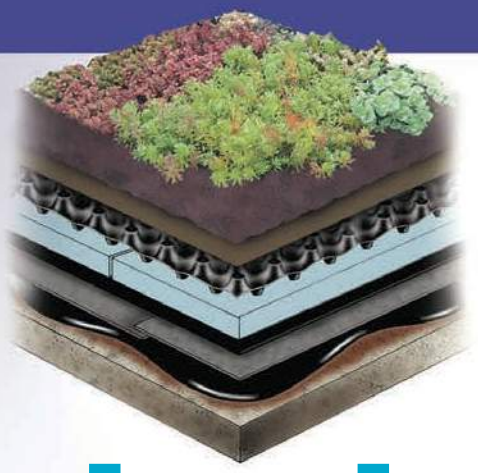
To learn more about the **HHT - Hydrotech Hydrology Tool**, please call **800.877.6125** or visit us on-line at **www.hydrotechusa.com**.



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ON THE ROOF WITH ... INDUSTRY LEADERS

HOW CAN LIVING ARCHITECTURE PLAY MORE OF A ROLE IN CREATING RESILIENT COMMUNITIES?

In 2012, the United States experienced 11 extreme weather related disasters, each causing in excess of $1 billion in damages and many more on a smaller scale. Recently, Hurricane Sandy pummelled the U.S. so hard that the economic impact will likely top $60 billion. Natural disasters have an enormous impact on our infrastructure, ecosystems and on the health and livelihood of those affected. We are far from fully understanding the hidden potential of how living architecture systems can help our communities cope when various disasters strike.

I spoke with seven industry leaders across North America to find out how they think living architecture can play more of a role in creating resilient communities; and what projects or policies they think champion green roofs and walls as a way to create them.

INTERVIEWED BY: JENNIFER FODEN WILSON

Amy Norquist, founder and president, Greensulate LLC

Jamie James, president and founder, Tower Labs @MaRS Research Alliance

Lisa Lee Benjamin, principal instigator and consultant, Evo Design and UGLAB

Jeff Joslin, director of current planning, Planning Department, City and County of San Francisco

Dr. Dickson Despommier, director, Vertical Farming Project

Lauren Mandel, project manager and rooftop agriculture specialist, Roofmeadow

Karen Kubick, wastewater enterprise capital program director, San Francisco Public Utilities Commission

HOW CAN LIVING ARCHITECTURE PLAY MORE OF A ROLE IN CREATING RESILIENT COMMUNITIES IN FACE OF CLIMATE CHANGE, RESOURCE SHORTAGES AND NATURAL DISASTERS?

AMY: Green roofs and walls will play a critical role in helping us recover from the increased flooding, failing air quality due to rising temperatures and the negative health effects of climate change. The simple solution of reclaiming former green space, now available outside building envelopes is cost effective. It reminds people that we live in a natural environment and provides much needed green space to the shrinking natural footprint of cities. Additionally, reversing the loss of biodiversity due to climate change is important for habitat and the critical function—for food production—of pollinators like birds and bees.

JAMIE: Living architecture presents an opportunity to

combine the benefits of low cost physical infrastructure with effective social systems, particularly with respect to rooftop gardening. Rooftop gardens create stronger and healthier community ties, which are essential to impact mitigation in the aftermath of a major disruptive event—be it a natural disaster or utility service disruption—while at the same time providing shade, stormwater management and food production for a zero mile diet. It is said that Toronto lost $16M in perishable foods during the 2003 blackout and the negative feedback loop of food transport adds to the risk of climate disruption in the first place. On top of it all, green infrastructure is beautiful and contributes to the city's quality of life.

LISA: For me, there is a foundational flaw in our current approach to living architecture. We design as if we are separate from nature—and not that *we are nature*. We create plenty of habitats for ourselves. If we get that we are nature, we can be easily guided by the principles of our environment versus fighting them—such as gravity, growing, geology, nutrient cycles, systems, climate and water. This way we "naturally" create integrated habitat for more animals, we begin to add value, recycle resources and create with what we have—and realize that we perfectly fit in.

JEFF: One fundamental emerging trend is the increasing densification of cities. This intensification, coupled with resource scarcity, will invariably result in more stress on our systems and elevated costs. Living architecture can contribute significantly to minimizing our dependency on these systems, eventually diminishing the scale of the systems themselves. Green roofs reduce our need for stormwater management infrastructure, with potentially substantial avoided costs. Along the way, they help climatically temper our buildings, and contribute to biodiversity and the health of other urban ecosystemic components (street trees, parks), while doing so in a more disaster-resistant, decentralized manner.

DICKSON: Every flat roof top is a potential space for establishing a food production center (vegetables, fruit bushes and small trees) in the city. Green roofs are now an accepted method of reducing a city's heat footprint in the summer months. Taking that concept to the next step would include the growing of crop plants.

"ROOFTOP AGRICULTURE MAKES COMMUNITIES MORE RESILIENT BY SUSTAINABLY BRINGING FOOD PRODUCTION CLOSE TO HOME."

LAUREN MANDEL

LAUREN: Green roofs have offered urban communities a stormwater management solution for decades; a solution that is increasingly important in the face of climate change and irregular weather patterns. Now as city dwellers search for local access to fresh food, green roofs are doubling up as urban farms to provide both stormwater mitigation—and delicious produce. While soil-based rooftop farms manage stormwater like traditional green roofs, many hydroponic greenhouses are designed to collect rainwater and snowmelt for reuse in irrigation systems. Rooftop agriculture makes communities more resilient by sustainably bringing food production close to home.

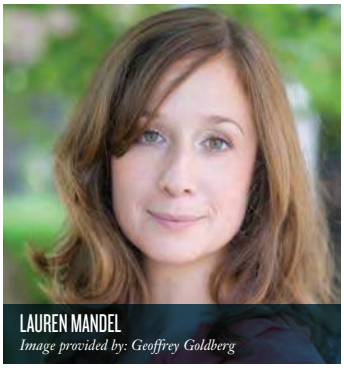
KAREN: The installation of living architecture, such as green stormwater infrastructure, provides a network of decentralized, capacity-providing, stormwater management solutions that reduce peak runoff flows and supplement the capacity and treatment ability of our sewer system. The creative and strategic use of green infrastructure is a promising prospect for creating resilient communities, and therefore incorporating its use into development and infrastructure at all scales is critical.

IS THERE A SPECIFIC PROJECT OR POLICY THAT CHAMPIONS GREEN ROOFS AND WALLS AS A WAY TO CREATE MORE RESILIENT COMMUNITIES?

AMY: New York City's Green Infrastructure Plan offers a comprehensive model—and funding through a Department of Environmental Protection (DEP) grant program—for solutions to the public policy challenges made worse by climate change. The Plan recognizes that green roofs and walls are a cost effective means for managing stormwater for NYC. In 2013 alone the DEP's grant program awarded $4.7M for projects including a design by Greensulate (Ballet Tech). The program to date captures 15 million gallons of stormwater from entering the combined sewer system of NYC each year.

JAMIE: Tridel, Canada's leading developer of high-rise


AMY NORQUIST


LAUREN MANDEL
Image provided by: Geoffrey Goldberg


JEFF JOSLIN
Image provided by: Erin Riddle


JAMIE JAMES


KAREN KUBICK


DICKSON DESPOMMIER


LISA LEE BENJAMIN

condominiums, was chosen by Hines to develop the residential component of their 13-acre, $1.6 billion master planned Bayside community on Toronto's waterfront. The first community, Aqualina, features Tridel's first community amenity rooftop micro-farm, which will feature fruit trees and vegetable plots for individual and shared gardens. Aqualina at Bayside by Hines Tridel will also be the first LEED-Platinum development for both Hines and Tridel, who already has over 30 LEED communities in development, and will feature NetZED, a net zero energy dwelling designed by Tower Labs.

LISA: The Lake Zurich Water Treatment Plant in Wollishofen, Switzerland is a great example. It was built in 1914. This roof is now in the process of being classified with conservation meadow status due to several endemic and now endangered orchid species found on the roof. The roof was a concrete deck topped with asphalt for the waterproofing and a simple 10 cm of native soil and 10 cm of gravel as drainage added to insulate and mitigate temperatures. This roof illustrates how simplicity can last, that protected roof environments can sustain biodiversity. Zurich initiated a green roof policy in 1991 and

has since made additions which now require every new and retrofit flat roof to be green, if it is not used otherwise.

JEFF: It takes a blend of tools that fit within the regulatory framework, infrastructure, bioregion, and culture of each city. In a simpler world, green elements would be required of all new projects, as in Zurich. Here, it'll typically take a blend of requirements, incentives and subsidies. To achieve this, there needs to be a clear business case—at city and project scales. To this end, Arup's developing metrics to quantify the added-value and added-cost of green roofs for respective microclimates. As this dataset richens, this could be a hugely effective means to identify avoided costs, and thus rationalize gap-filling subsidies.

DICKSON: I congratulate Gotham Greens on having established itself as a leader in urban agriculture. They started with a modest 2,000 square foot (sf) hydroponic greenhouse several years ago in Brooklyn, NY, and now are preparing to expand their operations to the roof of a new Whole Foods grocery store in the Gowanus Canal area of Brooklyn that will encompass 60,000 sf of growing space. I am also very impressed with the way FarmedHere in Bedford Park, Illinois has reused an abandoned warehouse (150,000 sf) to commercialize indoor vertical farming on a grand scale.

ABOVE: RENDERING OF TORONTO PROJECT AQUALINA AT BAYSIDE BY HINES TRIDEL
Image provided by: Aareas Interactive

LAUREN: My company, Roofmeadow, is working with South Philadelphia High School to develop a Greening Master Plan for the public school's 5.5 acre urban campus. The plan will feature a half acre educational rooftop farm in addition to extensive green roof areas, solar arrays and ground-level greening improvements. Outdoor education and hands-on rooftop learning will tie into the school's existing culinary arts program while teaching the leaders of tomorrow that being a steward of the environment can be both fun and delicious!

KAREN: The San Francisco Stormwater Design Guidelines (SDG) requires developments to manage stormwater on-site by using integrated approaches including green infrastructure. The policy allows for flexibility in design by allowing developers to select the most appropriate form of green infrastructure for their site. Since its inception in 2010, the SDG has driven over sixteen green roof proposals. Our agency is performing an Urban Watershed Assessment to characterize the condition of our City's eight urban watersheds to determine the optimal solutions to help improve our system's ability to manage stormwater and wastewater. These solutions will highlight sustainable solutions that infuse green and grey projects.

Jennifer Foden Wilson is the editor of the Living Architecture Monitor *magazine.*

FIND OUT MORE

Join us in San Francisco for *CitiesAlive* this October to learn more about community resiliency.

Tell us what you think about living architecture and resiliency—submit photos, video, audio or editorial to our *Great Community Resiliency Project Contest*. Deadline: September 17, 2013. http://goo.gl/dUWVP

WEST COAST GREEN INNOVATION

SAN FRANCISCO BOASTS ADVANCED STORMWATER MANAGEMENT AND BIODIVERSITY PROGRAMS

BY: SARAH MINICK AND PETER BRASTOW

STORMWATER MANAGEMENT ORDINANCE

The San Francisco Public Utilities Commission's (SFPUC) Urban Watershed Management Program has a multi-pronged approach to managing stormwater in an urban environment. The program uses watershed planning, water sensitive policies, regulation of public and private development projects, green infrastructure demonstration projects, outreach and education and community stewardship programs to facilitate the implementation of green infrastructure citywide.

The foundation of the program's regulatory arm is the San Francisco Stormwater Management Ordinance (SMO), which became effective in 2010. The SMO requires that all projects in San Francisco disturbing 5,000 square feet or more manage a portion of their stormwater on site. The goals of the SMO are to protect the water quality of the San Francisco Bay and Pacific Ocean, to protect and enhance the function of San Francisco's combined sewer system and to encourage the use of green infrastructure to manage stormwater onsite.

The Stormwater Design Guidelines (Guidelines) are the implementing document for the SMO, and include design principles and tools (such as sizing calculators, a vegetation palette and fact sheets) to help projects comply with the SMO. The SMO and Design Guidelines work together to harness San Francisco's development community to incrementally improve stormwater management throughout the city. In this way, over time the contributions of each project add up to significant benefits for San Francisco's receiving waters and the combined sewer system.

After just three years of implementation, program staff has seen projects meet SMO requirements using sidewalk gar-

"WE WILL MAKE OUR URBAN ENVIRONMENT COME ALIVE WITH CORRIDORS OF LOCAL NATIVE PLANTS AND ANIMALS."

PETER BRASTOW

dens, permeable pavement, green roofs, rain gardens and rainwater harvesting. These projects not only manage stormwater, they also beautify public and private open spaces and can provide other benefits such as urban habitat and traffic calming.

BIODIVERSITY PROGRAM

Cities are now at the heart of addressing our global environmental problems including sustaining biodiversity and reconnecting people and nature. San Francisco has a wealth of indigenous natural resources, despite 160 years of urban development and pollution and the ongoing impacts of invasive species, climate change and more. Preserving our remnant natural areas and habitats is fundamental to environmental sustainability but not enough to create a truly ecologically sustainable city. We must also reenvision and recreate our built environment to include local nature, weaving it into the fabric of everyday life, including streetscapes, building designs and water management systems.

San Francisco's Department of the Environment (SFE) is responsible for a wide range of policies and programs that constitute the core of the City's vision for sustainability. SFE's brand new Biodiversity Program has as its mission to preserve, protect and restore the biodiversity, habitats and ecological integrity of San Francisco's natural environment. The Biodiversity Program's four broad goals of ecosystem restoration, interagency collaboration, bringing biodiversity into the urban environment and citywide ecoliteracy represent an innovative and exciting vision for urban cultural ecological sustainability. We will see all of our natural areas and habitats preserved, and sustainably managed by strengthening and promulgating biodiversity policy and actions. We will make our urban environment come alive with corridors of local native plants and animals. And we will create a shared, interagency public communication and ecoliteracy strategy with ambitious goals for raising local nature awareness and catalyzing local ecological stewardship.

Sarah Minick works on the Urban Watershed Management Program at the SFPUC.

Peter Brastow is the senior biodiversity coordinator at San Francisco's Department of the Environment.

FIND OUT MORE

www.sfwater.org
www.sfenvironment.org/biodiversity

INDUSTRY RESEARCH COLLECTION

WHAT GREEN ROOF AND WALL RESEARCH WAS PUBLISHED MAY TO JULY 2013?

Moody, S.S., & Sailor, D.J. (2013). Development and application of building energy performance metric for green roof systems. *Energy and Buildings*, *60*, 262-269. http://goo.gl/2rYbE.

Nagengast, A., Hendrickson, C., & Matthews, H.S. (2013). Variations in photovoltaic performance due to climate and low-slope roof choice. *Energy and Buildings*. http://goo.gl/xAPcl.

Speak, A.F., Rothwell, J.J., Lindley, S.J., & Smith, C.L. (2013). Reduction of urban cooling effects of an intensive green roof due to vegetation damage. *Urban Climate*, *3*, 40-55. http://goo.gl/fo7LY.

Carson, T.B., Marasco, D.E., Culligan, P.J., & McGillis, W.R. (2013). Hydrological performance of extensive green roofs in New York City: observations and multi-year modeling of three full-scale systems. *Environmental Research Letters*, *8*. http://goo.gl/r20T6.

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Chan, A.L.S., & Chow, T.T. (2013). Evaluation of Overall Thermal Transfer Value (OTTV) for commercial buildings constructed with green roof. *Applied Energy*, *107*, 10-24. http://goo.gl/2wS0F.

Wong, J.K.W., & Lau, L.S. (2013). From the 'urban heat island' to the 'green island'? A preliminary investigation into the potential of retrofitting green roofs in Mongkok district of Hong Kong. *Habitat International*, *39*, 25-35. http://goo.gl/L5779.

FIND OUT MORE

Interested in green roof and wall research? Green Roofs for Healthy Cities is launching the *Journal of Living Architecture* in the Winter 2013/2014 issue of the LAM: http://goo.gl/NMuxS.

Compiled by: Eleri Davies

THE GREEN FAÇADE INQUIRY

SUMMARIZING UMD AND BCIT GREEN FAÇADE RESEARCH

BY: JORDAN RICHIE, GRP AND REUBEN FREED

In 2008, the Green Roofs for Healthy Cities' Green Walls Group (consisting of Jakob, greenscreen® and Carl Stahl DecorCable) made the collective decision to fund scientific research on the benefits of green façades. At the time, no empirical research on this subject had been conducted in North America, although many industry professionals intuitively recognized that these systems have the ability to mitigate the urban heat island effect and make the built environment more resilient to extreme weather events caused by climate change.

Rating systems for green buildings and sites, such as LEED, Sustainable Sites, and the Living Building Challenge, all reflect a growing need for validation of the benefits of green infrastructure. The Green Walls Group felt it important to provide architects, landscape architects, developers and policy makers with a scientific basis for specifying green façades. Consequently they put out a call for proposals for research on this subject, and selected and funded studies on (1) the thermal performance of green façades and (2) their capacity for rainwater interception. What follows is a summary of this research.

THERMAL PERFORMANCE

Research conducted over three years by Dr. David Tilley's team at the University of Maryland (UMD) demonstrated that green façades cool building surfaces and reduce interior temperatures during summer months. A reduction in ambient air temperature near the buildings was also observed. These results suggest that green façades can help reduce energy consumption due to air conditioning, and may be used as part of an urban heat island mitigation strategy.

Four small wood-framed buildings were constructed at UMD's research farm in Clarksville, Maryland. Two of the buildings received green façade treatments, while the other two served as controls. Three commercially available metal trellis systems (provided by greenscreen®, Carl Stahl DecorCable and Jakob) and one non-commercial, non-metal trellis system were used. Each commercial façade was planted with the same mix of six Maryland native vine species and three grapevine species. Each building was instrumented with a set of sensors to collect temperature, solar irradiance and wind speed data.

The canopies developed quickly in the first year to cover 80% of the walls. By the second growing season, the Leaf Area Index (total leaf surface area per wall surface area) reached its peak of 4.0, independent of the type of façade system used.

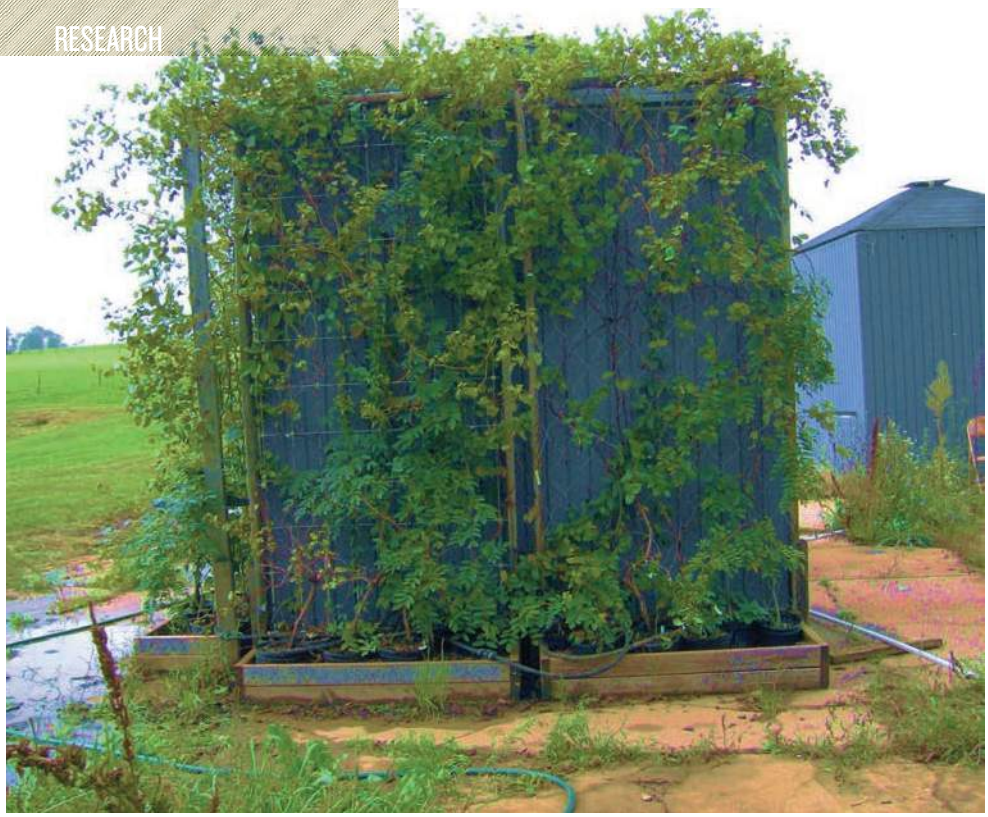
The green façades cooled the interior temperature of the building every day during the typical cooling season (June, July and August), with a mean temperature reduction of 7° F from 3:00 pm to 9:00 pm. During the same period, the façades also reduced the temperature of the exterior walls by an average of 13° F, and cooled the ambient air in the neighborhood of the vegetation by up to 3.2° F in the hottest months.

An energy balance equation for green walls was developed and revealed that plant reflectance and evapotranspiration from the canopy were the two main mechanisms for reducing heat flux into the building.

RAINWATER INTERCEPTION CAPACITY

Under the leadership of Dr. Maureen Connelly, researchers at the British Columbia Institute of Technology (BCIT) sought to characterize the ability of green façades to divert rainfall from the building envelope and traditional drainage infrastructure.

Green façade systems provided by greenscreen®, Carl Stahl DecorCable and Jakob were installed on the south, west



LEFT: UNIVERSITY OF MARYLAND RESEARCH FARM IN CLARKSVILLE, MARYLAND
Image provided by: University of Maryland

and east exterior walls of the Green Roof Research Facility at BCIT's Great Northern Way Campus in Vancouver. A total of seven panels were installed, representing grid systems, mesh systems and cable systems, with two additional unplanted panels serving as experimental controls. Each system was planted with a different climbing species in wooden planters at ground level. The exterior microclimate in front of and behind each panel was instrumented and monitored for temperature, wind-driven rain and relative humidity.

An irrigation system was installed to provide irrigation on schedule and on demand during the dry summer period. Gutters were installed at the base of the panels adjacent to the building surface to collect rainwater from the building wall directly behind the green façades and control panels.

The interception capacity of the systems was determined by the difference between the rainfall runoff measured from the building cladding at the adjacent reference wall and the rainfall runoff measured from the building cladding behind the green façade. Statistical analysis determined that the percent of plant coverage on the façade is a significant indicator of the probability that the green façade system will shield the building envelope from rainfall or transport additional rainfall onto the wall. The type of species, maturity of the vegetation and type of façade support structure also affect system mechanics. The authors acknowledge the need for further research to characterize these operative mechanisms.

As a shield, green façades may have great benefits in protecting the building from water penetration at locations which are vulnerable to water ingress (window, balcony and mechanical vents) or where there is a deficiency in the envelope design and construction. However, when acting as a conduit, a green façade may increase water penetration into the building envelope at vulnerable locations. According to the researchers, this may suggest that "in climates where rainfall is high … and specifically on building aspects where wind driven rain loading is high, the green façade system should be located at a sufficient distance from the envelope such that the foliage does not touch the building."

Jordan Richie is the director of education and accreditation at Green Roofs for Healthy Cities.

Reuben Freed is the director of research at greenscreen and the chair of the Green Walls Group at Green Roofs for Healthy Cities.

FIND OUT MORE

Read the full papers at http://goo.gl/jwNX6.

Want to learn more? David Tilley will be presenting the University of Maryland research at *CitiesAlive* this October.

CREATIVE STORMWATER LANDSCAPING

MANAGING STORMWATER WHERE CONVENTIONAL GREEN INFRASTRUCTURE OPPORTUNITIES ARE LIMITED

BY: CHARLIE MILLER

The hallmark of green roof technology, and the feature that sets it apart from all other green infrastructure strategies, is the way it harnesses very large surface areas of plant foliage. Other best management practices rely primarily on infiltration as the mechanism for runoff volume reduction. On green roofs, simply put, runoff volume reduction is equivalent to evapotranspiration (ET). If ET effectiveness can be optimized, then so will stormwater management performance.

Green roofs are best understood as shallow interflow groundwater aquifers. Based on our observations, we find that ET on green roofs is strongly influenced by the contact time of percolated water with the media and plant root systems. The time it takes for rainfall to percolate vertically through an extensive green roof may be a few minutes, while the time that it takes to flow horizontally through the system toward discharge at the roof drain may be many hours. Consequently, we at Roofmeadow are arguing for a reconsideration of the metrics that we use to describe green roof assemblies. Recognizing that the horizontal pathways through the green roof assemblies may be the most important feature of the design, we are advocating for the consideration of hydraulic residence time (HRT) as a critical design variable. HRT is a measure of the average time that a drop of water is in contact with the green roof materials. HRT can be manipulated by controlling: 1) transmissivity of the basal layers of the green roof assembly, 2) length of the flow path, 3) tortuosity (passage) of the flow path, and 4) opportunities for detention storage within the green roof. It is an interesting observation that the effectiveness of green roofs in controlling both runoff volume and runoff rate is only weakly proportional to media thickness. The reason is that most runoff percolates to the base of the assembly comparatively quickly; conditions at the bottom of the profile, however, most directly influence performance. In short, extensive green roofs are much more efficient, pound for pound, than intensive green roofs in managing stormwater runoff.

With this realization as a starting point, it is easy to make the leap to applying this same strategy on the ground. Opportunities to infiltrate rainfall in cities are limited. Roofmeadow is leveraging its experience with green roof hydrology to engineer similar systems at grade. The results are *Veneer Stormwater Management Practices™ (Veneer SMPs™)*, shallow non-infiltrating measures that can overlay existing impermeable or contaminated substrates where effective infiltration is not possible or advisable. Examples include vacant lots,

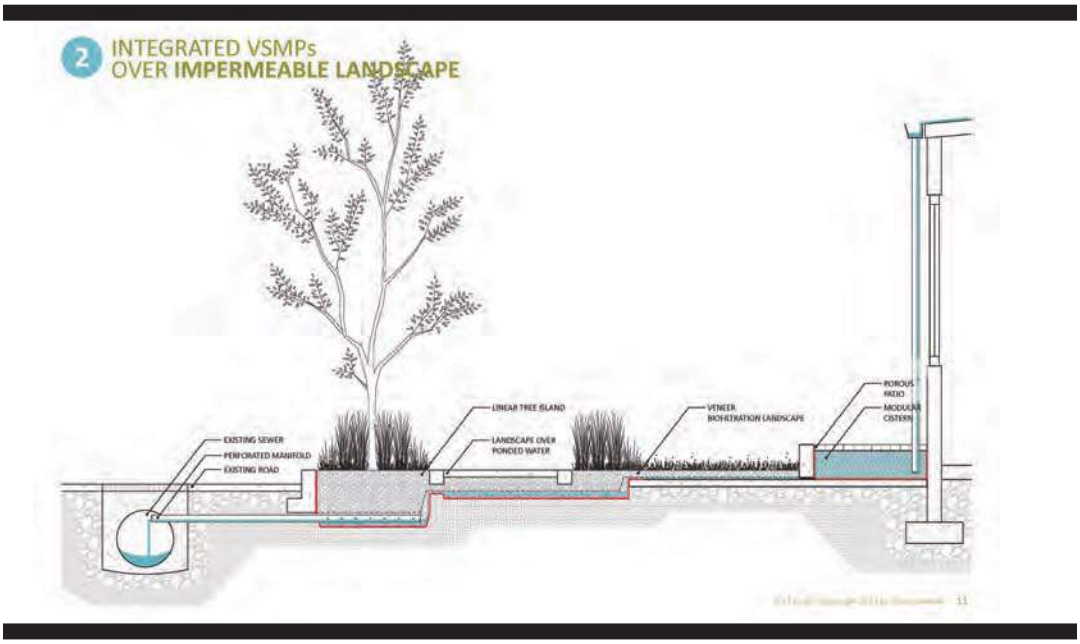


Image provided by: Roofmeadow

industrial brownfield sites, and under-utilized parking areas. *Veneer Landscapes*™ consist of interconnected *Veneer SMPs* that create a series of obstacles through which stormwater must travel before discharging to the sewer. Upon reaching the sewer, the total amount of water is minimized due to uptake and ET by plants along the way. ET potential can be optimized by keeping the media profile thin and maximizing root development through the depth of the *Veneer SMP*. The water is also cleaner due to filtration by the plants, soil, and microbes along water's journey. The veneer landscaping approach can avoid many of the costs associated with excavation, demolition and remediation. We believe that an understanding of shallow aquifer hydrology, hard won over a decade of designing and building green roofs, can now be applied with great benefit in many urban areas where conventional green infrastructure opportunities are limited.

Charlie Miller is the president and founder of Roofmeadow.

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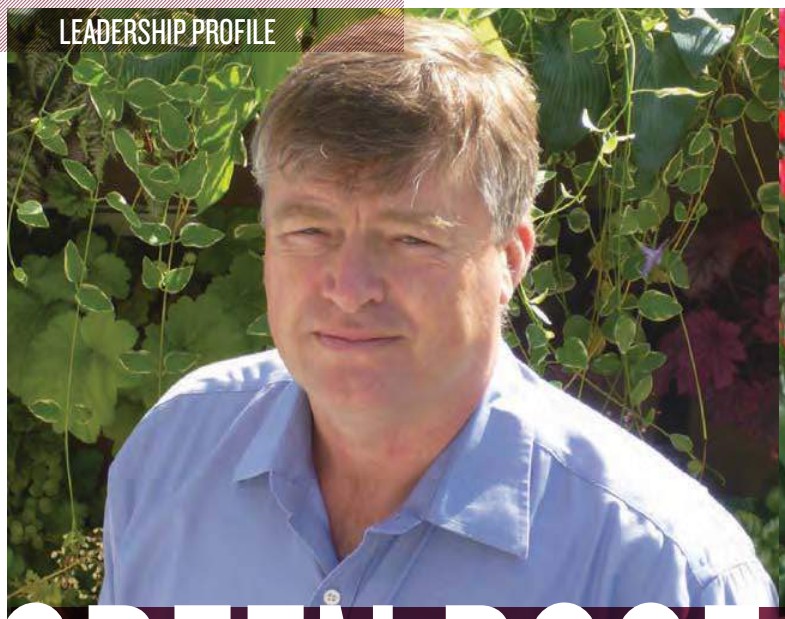

Image provided by: Janet Anderson

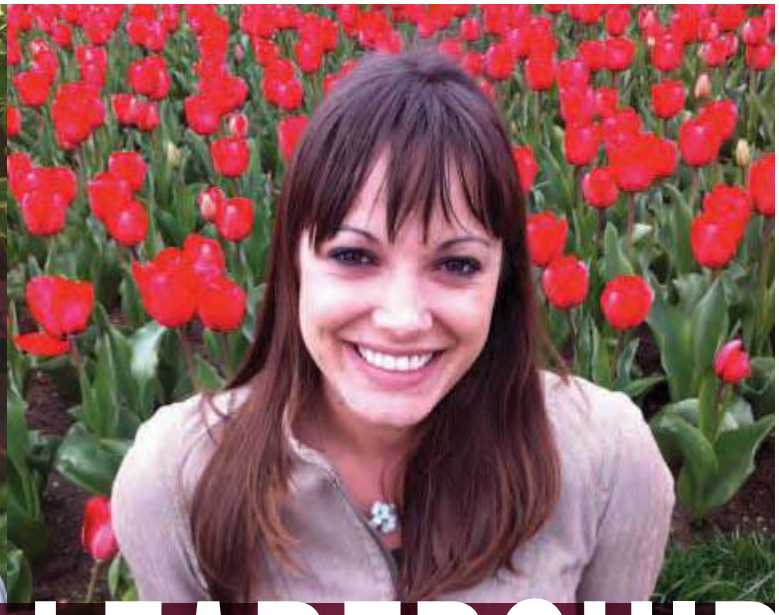

Image provided by: Sara Loveland

GREEN ROOF LEADERSHIP

KEES GOVERS, BSC(AGR), GRP

POSITION/COMPANY: Sales & Technical Manager, LiveRoof Ontario Inc.

WHEN DID YOU BECOME A GRP (GREEN ROOF PROFESSIONAL)?: 2009

WERE YOUR CAREER AMBITIONS ALWAYS ENVIRONMENTALLY DRIVEN?: I studied integrated pest management in the early 80's when the discipline was in its infancy. One of my goals was to integrate natural pest controls and production techniques into the production of ornamental woody and perennial plants.

WHAT ARE SOME OF THE PROJECTS YOU'VE WORKED ON SINCE BECOMING A GRP?: TTC Eglinton West station (2009 installation) with Monica Kuhn and Terry McGlade; TTC Victoria Park Station (2010 installation) with Scott Torrance; Yorkdale Mall (2012 installation, currently the largest green roof in Toronto) with NAK Design and Terry McGlade; the Toronto City Hall podium green roof (2009 installation) with Plant Architect, Hoerr Schaudt and Terry McGlade.

HOW HAS YOUR EXPERIENCE AS A GRP IMPACTED YOUR BUSINESS OR WORK?: It has reinforced my sense of responsibility to deliver high quality materials and services regardless of the value engineering pressures we may face.

WHAT IS YOUR VISION FOR THE LIVING ARCHITECTURE INDUSTRY THROUGHOUT THE NEXT DECADE?: There is tremendous potential for growth in this industry providing that all practitioners in the industry take a conscientious approach to quality and service. If we do not, we will face a backlash from developers and building owners. Many have only recently embraced the idea that they have a responsibility in making our cities more liveable. We are the enablers for them to deliver this potential. If they succeed, we succeed.

SARA LOVELAND, MBA, GRP

POSITION/COMPANY: Partner, Annette Environmental

WHEN DID YOU BECOME A GRP (GREEN ROOF PROFESSIONAL)?: 2010

WERE YOUR CAREER AMBITIONS ALWAYS ENVIRONMENTALLY DRIVEN?: I lived in Indonesia for a year and watched the destruction of rainforests first hand. That had a profound impact on my life and career goals.

WHAT ARE SOME OF THE PROJECTS YOU'VE WORKED ON SINCE BECOMING A GRP?: I've designed and built green roofs, trained at-risk youth and ex-offenders to build and maintain green roofs, managed a municipal green roof incentive program—really a wide array of projects. At present I'm focused on providing consulting on financial models that demonstrate the life cycle costs and benefits of green roofs. Building owners are really hungry for this type of data.

HOW HAS YOUR EXPERIENCE AS A GRP IMPACTED YOUR BUSINESS OR WORK?: I can't believe how lucky I am to do work that I love in an industry where there are always new learning challenges.

WHAT IS YOUR VISION FOR THE LIVING ARCHITECTURE INDUSTRY THROUGHOUT THE NEXT DECADE?: I hope to see the field grow tremendously as a result of market demand. I also hope to welcome many new professionals to the field as a result of increased interest in the Science, Technology, Engineering, and Mathematics (STEM) Education Coalition in schools.

TO FIND A GRP, VISIT: http://goo.gl/AZ2uZh

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SELECTING PLANTS FOR LIVING WALLS

HOW TO DESIGN AND SELECT PLANTS FOR LIVING WALLS—AND A FEW GENERAL RECOMMENDATIONS

BY: MARGUERITE WELLS

The plant palette for green walls is much wider than for most green roofs. The term "green walls" encompasses all forms of vegetated wall surfaces—green façades, living walls and retaining living walls. Living walls can be indoors or out, and made of soil, fabric or synthetics. They are nearly always irrigated, so drought tolerance is not particularly a constraint. In choosing plants for a living wall project, the parameters named above need to be outlined to give shape to the plant list. For indoor walls, tropical plants need to be used. Even with auxiliary lighting, the light levels indoors almost always necessitate plants that do not expect winter, which generally means tropical species.

Outdoor walls can grow a wide range of plants, and the direction a wall faces is critical in determining the plant list. For example, a north-facing wall will sometimes never receive a single ray of direct sun. A south-facing wall may never have a moment of shade. East and west have different temperatures. Surrounding buildings affect these parameters as well. Winter care is a challenging part of wall maintenance. In the north, fabric-based, hydroponic walls are difficult to maintain perennial plants because the roots are exposed to the coldest outdoor temperatures, without the usual buffering effect that soil provides plants in winter. Even in soil-based walls, drying in winter is a problem—so look for plants that can withstand this. Winter aesthetic interest is also a factor—a wall looking green and beautiful in summer is not too hard to achieve, but keeping things looking even halfway decent in winter, and managing customer expectations regarding this, is a challenge in colder climates for exterior living walls.

So, with all those parameters in play, how can I recommend any two particular species for living walls? One category is known as Mondo Grass. Evergreen, tough and grass-like, I see this used commonly in outdoor living walls. Some cultivars are very popular, and as a result can be hard to get or expensive. Others are very common and relatively cheap. They are propagated mostly by divisions and are big plants that are not commonly found in small plug sizes because they just won't fit. There are several genera of plants that use the common name Mondo Grass, including Dwarf and Black Mondo Grass, which are in the genus *Ophiopogon*, and the many cultivars of the genus *Liriope*, which come in mostly green foliage, including variegated green leaves, and many shades of blue and purple flowers. Some like more sun than others; some of the bigger varieties can be aggressive groundcovers. Some smaller selections are slower growers.

ABOVE: MONDO GRASS
Image provided by: Melanie Cook

Another common denizen

ABOVE: FERN
Image provided by: Connor Walsh

of living walls are ferns. There are different species to use indoors or out, sun versus shade and evergreen versus deciduous. Some ferns stay small, others get quite big. A common North American native fern that is evergreen, tough, winter hardy and easy to grow is called Christmas Fern (*Polystichum acrostichoides*). A common sight in the woods east of the Mississippi, it grows to a height and spread of 2-3 feet, and keeps its leaves, although they lay flat, under the snow in winter. Easily available in the nursery trade, it tolerates drought, wet feet, part sun and full shade.

Propagation of ferns can be by division of large ferns, or by sora, a fern's version of tiny spore-like seeds. Ferns take a long time to grow from sora, so you may want to buy in small plants. Because they are coming up from very small, ferns can be bought as small or large plugs, 4" pots or gallons.

Ferns have only one edible phase in their life cycle—fiddleheads, which are the young fronds when they first shoot up in spring. Steamed with butter they are tender and delicious. Mature fern fronds are unpalatable even to deer (yes, really!). Large swaths of forest can become dominated by ferns when the deer have eaten everything else, in fact. A few ferns have been used historically for medicinal purposes, but nothing salient in the modern herbal or medicinal chest.

In selecting plants for living walls, I strongly recommend that designers look at existing walls and how they are faring, and how much maintenance is done to keep them that way. Keeping a line on availability for living wall plant replacements is also important. When plants die on a wall, the owners generally want replacement ASAP, since walls are showcases in most places. Not all plants are available everywhere all the time. Plan for this! And as always with living walls, it's all about the water. Keep the water flowing, and have backup water sources just in case.

Marguerite Wells is the owner of Motherplants.

CITIESALIVE

11TH ANNUAL GREEN ROOF & WALL CONFERENCE
SAN FRANCISCO: OCTOBER 23 – 26, 2013

INSPIRING KEYNOTE SPEAKERS

WEDNESDAY - URBAN RESILIENCY: TAKING A MULTIDISCIPLINARY LOOK AT THE NEW SAN FRANCISCO TRANSBAY TRANSIT CENTER DEVELOPMENT

CitiesAlive strives to highlight the best, brightest and most innovative green roof and wall designs, policies, research, products, services and ideas in North America and around the world. The opening plenary in San Francisco on Wednesday October 23rd is no exception. Programming commences with a welcoming address by Harlan Kelly Jr., general manager of the forward-looking San Francisco Public Utilities Commission, which is launching an extensive green infrastructure build-out over the next 15 years. Presenting a year in review, and setting the stage for this year's conference, will be Steven W. Peck, founder and president of Green Roofs for Healthy Cities—your *CitiesAlive* host.

Next up is a dynamic panel discussion about the Transbay Transit Center development, a visionary development that will serve eleven transportation systems in one central urban hub in San Francisco. The bus and rail facility is destined to be a San Francisco landmark and will feature a 5.4-acre public park on the roof of the Transit Center.

Hear how living architecture is addressing challenges related to climate change and increasing urban resiliency through the provision of food, energy and water. An array of experts involved in the Transbay Transit Center project will address and discuss the myriad of ways that living architecture has been integrated into the Transbay Transit Center design, engineering and construction, and how those aspects are powering urban resilience. Panelists include Adam Greenspan, senior design partner at PWP Landscape Architecture, Brian Ballerini, senior civil engineer at Arup and Randolph J. Volenec, architect at Pelli Clarke Pelli Architects.

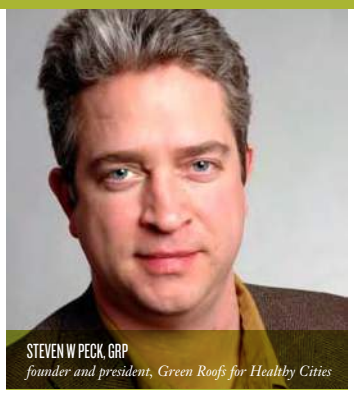
After this engaging kick-off, delegates are invited to mingle at the opening reception on the *CitiesAlive* trade show floor.

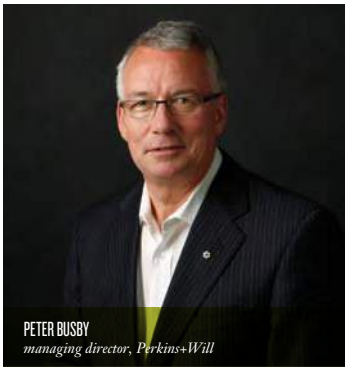
THURSDAY - DESIGNING FOR RESILIENCY: WHAT IS THE EMERGING ROLE OF THE DESIGNER TO IMPROVE RESILIENCY IN THE FACE OF CLIMATE CHANGE?

The *CitiesAlive* Thursday morning opening plenary will have you engaged and inspired from the get-go. Start your day with a long-term visionary dose of inspiration from award-winning green architect and author, Eric Corey Freed, founding principal of organicARCHITECT, who will share his unique approach to developing living, regenerative buildings.

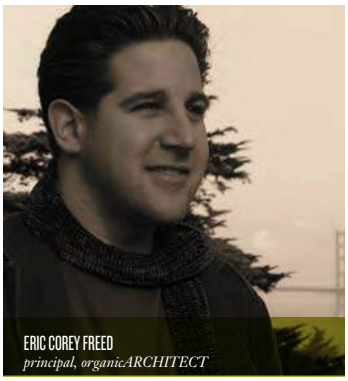
Then a range of leading industry experts will join the stage for an interactive panel and workshop on developing and supporting the role of the design profession in community resiliency planning. Join award-winning architect Peter Busby, managing director, Perkins+Will, Jeff Joslin, director of current planning, Planning Department, City and County of San Francisco, Christina Weber, business and community development, DIRTT Environmental Solutions, and other thought leaders in this moderated discussion. Together, participants will map out strategies on how to implement green roof and wall and integrated water systems solutions to solve some of our biggest environmental issues. You'll see living architecture in a new way that will change your thinking on how to approach peers, clients and developers.

By: Rebecca Black
Rebecca Black is the director of business development at Green Roofs for Healthy Cities.


STEVEN W PECK, GRP
founder and president, Green Roofs for Healthy Cities


PETER BUSBY
managing director, Perkins+Will


CHRISTINA WEBER
business and community development, DIRTT Environmental Solutions


ERIC COREY FREED
principal, organicARCHITECT


HARLAN L. KELLY JR.
general manager, San Francisco Public Utilities Commission (SFPUC)

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VISIT WWW.CITIESALIVE.ORG FOR THE COMPLETE AGENDA

*TICKETED EVENT | ** BY INVITATION ONLY

WEDNESDAY OCTOBER 23 - CITIESALIVE TOURS, TRAINING, OPENING PLENARY AND TRADE SHOW

7:30 AM – 6:00 PM	PRE-CONFERENCE REGISTRATION
8:30 AM – 12 NOON	MORNING HALF DAY TRAINING COURSES * (LIVING ARCHITECTURE & SUSTAINABLE ENERGY, INTRODUCTION TO ROOFTOP URBAN AGRICULTURE, INTRODUCTION TO INTEGRATED WATER MANAGEMENT FOR BUILDINGS & SITES)
8:30 AM – 12 NOON	URBAN SAN FRANCISCO WALKING TOUR*
8:30 AM – 4:15 PM	FULL DAY GREEN ROOF PROFESSIONAL (GRP) ACCREDITATION TRAINING COURSES* (GREEN ROOF DESIGN AND INSTALLATION)
9:00 AM – 4:30 PM	GRHC COMMITTEE MEETINGS**
10:00 AM – 12 NOON	GREEN ROOF PROFESSIONAL (GRP) EXAMINATION* (MUST REGISTER BEFORE OCTOBER 9TH)
12:30 PM – 4:15 PM	AFTERNOON HALF DAY TRAINING COURSES * (INTEGRATED WATER MANAGEMENT FOR BUILDINGS AND SITES IV: WATER QUALITY & TREATMENT OPTIONS, GREEN WALLS 101: SYSTEMS OVERVIEW AND DESIGN, ADVANCED GREEN ROOF MAINTENANCE)
4:45 PM – 6:30 PM	OPENING PLENARY : URBAN RESILIENCY: TAKING A MULTIDISCIPLINARY LOOK OF THE NEW SAN FRANCISCO TRANSBAY TRANSIT CENTER DEVELOPMENT Harlan L. Kelly, Jr., General Manager, San Francisco Public Utilities Commission (SFPUC) | Steven W. Peck, GRP, Honorary ASLA, Green Roofs for Healthy Cities | Adam Greenspan, Partner, PWP Landscape Architecture | Brian Ballerini, PE, LEED AP, Senior Civil Engineer, Arup | Randolph J. Volenec, RA, architect, Pelli Clarke Pelli Architects
6:30 PM – 9:00 PM	TRADE SHOW OPENS – COCKTAIL RECEPTION ON TRADE SHOW FLOOR
7:30 PM – 9:00 PM	PRODUCT PRESENTATIONS - ON TRADE SHOW STAGE
9:00 PM – 11:00 PM	GRP EXCLUSIVE NETWORKING EVENT**

THURSDAY OCTOBER 24 - CITIESALIVE TECHNICAL SESSIONS, TRADE SHOW AND RECEPTION

7:30 AM – 6:00 PM	ON-SITE CONFERENCE REGISTRATION
8:00 AM – 9:15 AM	MORNING KEYNOTE AND PANEL DISCUSSION: "WHAT IS THE EMERGING ROLE OF THE DESIGNER TO IMPROVE RESILIENCY IN THE FACE OF CLIMATE CHANGE?" Eric Corey Freed, LEED AP, Hon. FIGP, Architect, Principal, organicARCHITECT | Peter Busby, C.M., AIA, FRAIC, MAIBC, MAAA, MOAA, BCID, LEED AP, DSc (Hon.), Managing Director, Perkins+Will | Jeff Joslin, director of current planning, Planning Department, City and County of San Francisco | Christina Weber, LEED Green Assoc., business and community development, DIRTT Environmental Solutions | More to come.
9:15 AM – 9:45 AM	COFFEE BREAK
9:45 AM – 11:45 AM	CONCURRENT SESSION I (TRACKS: RESEARCH, DESIGN, ON THE ROOF WITH)
11:45 AM – 7:00 PM	TRADE SHOW OPENS (DELEGATE LUNCH ON THE TRADE SHOW FLOOR FROM 11:45 AM - 1:15 PM)
12:00 PM – 2:00 PM	POSTER PRESENTATIONS (ON TRADE SHOW FLOOR)
12:00 PM – 2:00 PM	PRODUCT PRESENTATIONS (ON TRADE SHOW STAGE)
12:30 PM - 2:00 PM	STUDENT DESIGN CHALLENGE FINALISTS AND WINNER DISPLAY AND RECOGNITION (ON TRADE SHOW FLOOR)

TRANSBAY TRANSIT CENTER VISIONARY
GREEN ROOF AND WALL DESIGN
Image provided by: Rana Creek

2:00 PM – 6:00 PM	TRADE SHOW OPEN TO THE PUBLIC
2:00 PM – 4:00 PM	CONCURRENT SESSION 2 (TRACKS: RESEARCH, DESIGN, ON THE ROOF WITH)
4:15 PM – 6:15 PM	CONCURRENT SESSION 3 (TRACKS: RESEARCH, DESIGN, ON THE ROOF WITH)
6:15 PM – 7:00 PM	HOSPITALITY ON TRADE SHOW FLOOR
6:00 PM – 10:00 PM	NIGHTLIFE AND DELEGATE RECEPTION AT THE CALIFORNIA ACADEMY OF SCIENCES
7:00 PM – 10:00 PM	EXHIBITOR TEAR DOWN
7:00 PM – 10:00 PM	SHUTTLE BUS BETWEEN HOTEL AND CALIFORNIA ACADEMY OF SCIENCES RECEPTION EVERY 15 MINUTES

FRIDAY OCTOBER 25 – TECHNICAL SESSIONS AND AWARDS OF EXCELLENCE LUNCHEON

7:30 AM – 5:00 PM	ON-SITE CONFERENCE REGISTRATION
8:00 AM – 10:00 AM	CONCURRENT SESSION 4 (TRACKS: RESEARCH, DESIGN, POLICY, ON THE ROOF WITH)
10:00 AM – 10:30 AM	COFFEE BREAK
10:30 AM – 12:30 PM	CONCURRENT SESSION 5 (TRACKS: RESEARCH, DESIGN, POLICY, ON THE ROOF WITH)
12:30 PM – 2:30 PM	11TH ANNUAL AWARDS OF EXCELLENCE LUNCHEON
2:45 PM – 4:45 PM	CONCURRENT SESSION 6 (TRACKS: RESEARCH, DESIGN, POLICY, ON THE ROOF WITH)
5:00 PM – 6:30 PM	CLOSING PLENARY
6:30 PM – 9:00 PM	CLOSING DELEGATE RECEPTION AND NETWORKING

SATURDAY OCTOBER 26 – GREEN ROOF, WALL, AND WINE TOURS

7:30 AM – 9:00 AM	ON-SITE TOUR REGISTRATION
8:30 AM – 12:00 PM	URBAN SAN FRANCISCO WALKING TOUR*
8:30 AM – 5:00 PM	MARIN, PETALUMA AND NAPA VALLEY GREEN ROOF, WALL AND WINE TOUR *
1:00 PM – 5:00 PM	GREEN ROOFS AND LIVING WALLS HALF DAY BUS TOUR*

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SAN FRANCISCO: OCTOBER 23 – 26, 2013

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GREEN WALLS FOR GREENER CITIES

A SELECTION OF INNOVATIVE GREEN WALL POLICIES AND PROJECTS ACROSS NORTH AMERICA

POLICIES

VANCOUVER: The City of Vancouver's 2020 Greenest City Action Plan has made energy conservation in buildings a key priority. Building operations generate 55 percent of Vancouver's overall greenhouse gas emission footprint and the City's green building team has developed a set of tools aimed at cutting this back significantly. One of these tools is passive design, which aims to conserve energy by reducing a building's reliance on mechanical heating and cooling. The passive design approach harnesses climatic effects such as the sun and wind to improve energy efficiency.

The City published two "Passive Design Toolkits" in 2009 to help designers and builders implement more passive design strategies in their projects. Vancouver also amended its Zoning and Development Bylaw to remove regulatory barriers to using specific passive design strategies, such as green walls.

Conflicts may arise if green walls are designed to project into required yards and setbacks (the required distance between the building and the property line). To address this, the City's bylaw amendment states that the City will allow green wall projections into yards and setbacks, provided that: (a) the wall is demountable and not permanently affixed to the building; (b) the wall does not exceed a 254mm projection.

By: Rachel Moscovich, green building planner, City of Vancouver

FIND OUT MORE

Passive Design Toolkit: http://goo.gl/FYk8g

Demountable Green Wall Bylaw: http://goo.gl/N9omv

SEATTLE: Seattle Green Factor is a score-based code requirement that increases the amount and improves the quality of landscaping in new development. Based on European precedents, it applies to multifamily residential, commercial and mixed-use development throughout the city.

To receive permits for new development, applicants must earn credits through various landscape features, including trees, shrubs, rain gardens, green roofs and green walls. These credits are weighted to favor aesthetic and environmental functions. Bonus credits are available for plantings that are visible to the public, use native or drought-resistant plants, incorporate food production or irrigate using harvested rainwater.

Hundreds of projects have been permitted through Seattle Green Factor since its introduction to Seattle's zoning code in 2007. Of these, dozens have included green wall elements, with a wide variety of support systems and planting schemes.

Cities around the country are looking to Seattle's code and adopting similar scoring systems. Washington DC adopted a city-wide version of Green Factor, Portland has launched a pilot version, and many other municipalities are considering this approach.

By: Dave LaClergue, urban designer, City of Seattle

FIND OUT MORE

Seattle Green Factor: http://goo.gl/FXOMO

PROJECTS

4,000 SQUARE FOOT LIVING WALL: Most concrete parking structures are gray, cold and often designed to not be showcased. With the Aqua Felt green wall system by Seasons Natural Engineering, a 4,000 square foot living wall was designed to turn the new parking structure at Edwards Lifesciences' Irvine, California headquarters into a focal point for the employees

4,000 SQUARE FOOT LIVING WALL DESIGN

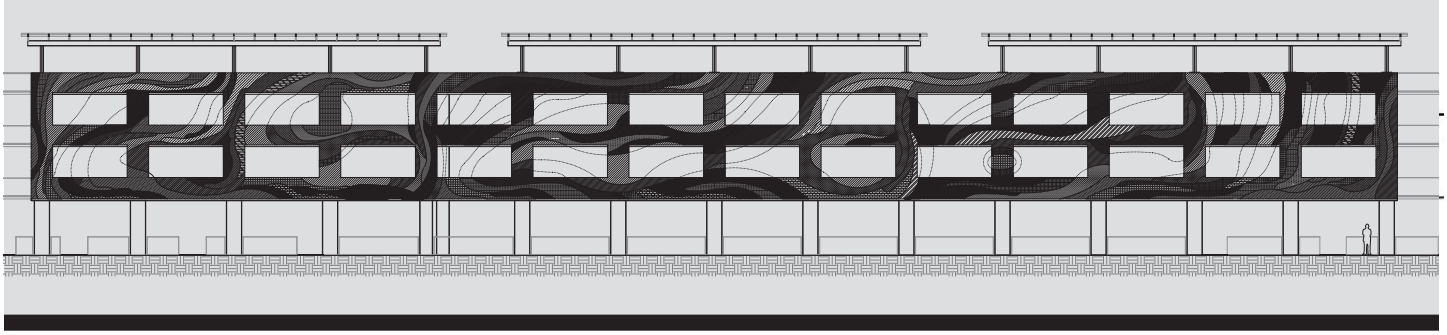

Image provided by: Seasons Natural Engineering

ABOVE: CARL STAHL DECOR CABLE SYSTEM IN JUPITER, FLORIDA RETAIL SHOPPING CENTER
Image provided by: Patrick Kelly

that walk the campus every day. This is one of the largest living walls in the United States.

Edwards Lifesciences aims to transform patient care through the development of innovative technologies. The living wall system, with a tapestry of 20,000 graphically arranged plants in 40 varieties was a natural complement to the company's innovative culture. The felt layers on the wall help to create a monolithic plant façade, which facilitates a vertical living ecosystem.

By: Scott Hutcheon, chief engineer, Seasons Natural Engineering

GREEN FAÇADE UNVEILED IN HIGH TRAFFIC SHOPPING HUB: Amidst the hub of activity in a Jupiter, Florida retail shopping center is an 11' x 18' green wall designed by BDG Architects using Carl Stahl DecorCable's FacadeScape™ Green Wall System. The system chosen for the project incorporates stainless steel cables and connectors mounted onto the exterior of the building. The rectangular trellis system uses 4mm stainless steel wire ropes, 4mm stainless steel horizontal rods and stainless steel cross-clamps on custom spacer bars. With the green wall system encouraging quick and healthy growth of vines, the Carolina Jasmine plantings used help provide shade and control ambient heat gain by the building. The trellis structure also adds green surface to a high traffic shopping area which increases exhaust gas carbon absorption and decreases the urban heat island effect. The wall offers many other tangible benefits, including aesthetic improvement, improved air quality, reduction in energy consumption used for cooling, and reduction in damage and maintenance to the building façade

By: Patrick Kelly, general manager, Carl Stahl DecorCable

VERTICAL GARDEN GIVES BACK TO THE COMMUNITY: In 2009, residents of the Tenderloin Neighborhood Development Corporation (TNDC) supported a resident-led campaign to convert a vacant piece of land at the corner of Larkin and McAllister streets in San Francisco into a food producing farm. Through much work and community organizing, the Tenderloin People's Garden opened in 2010. Each year the People's Garden grows approximately 3,000 pounds of vegetables, which are given away free to more than 400 low-income residents.

The garden is volunteer-driven, and in 2012, one of these volunteers, Geoffery Barton, donated his time and efforts in building a vertical garden along the wall of the old Public Utility Building that sits on the property, which was funded by several grants. Residents volunteered their labor to help construct and plant this innovative 240 square foot garden wall. The living wall has added an equivalent of two extra planting rows to the garden, and so far has produced an average of 15 extra pounds per harvest.

Built and maintained by local residents, the garden has not only increased production of fresh vegetables for low-income people in the Tenderloin, it has also

TOP: TNDC VERTICAL GARDEN
Image provided by: TNDC

BOTTOM: 4,000 SQUARE FOOT LIVING WALL
Image provided by: Gillian Crane Photography

created a sense of community. The garden is a point of pride in the neighborhood, and a sanctuary for many who stop by weekly to help harvest, or to just enjoy each other's company.

By: Ryan Thayer, community organizer, Food Justice, TNDC

FIND OUT MORE

Green Roofs for Healthy Cities offers a *Green Walls 101: Systems Overview and Design* half-day course. Visit www.greenroofs.org for upcoming dates and locations.

Green walls are a large component at *CitiesAlive* in San Francisco this October with tours, expert speakers, trade show exhibitors and discussion panels. www.citiesalive.org

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LIVING ARCHITECTURE THAT FEEDS

THE CLIENTS SPEAK!—HOW ARE YOUR EDIBLE ROOFS AND WALLS PERFORMING?

BY: JENNIFER FODEN WILSON

Urban agriculture is becoming an essential element of food security—improving access to healthy, affordable, local food in a rapidly urbanizing world. In cities around the world, more and more people are growing food on roofs and walls at schools, community centers, restaurants, healthcare facilities, churches and more. At some point, urban farming will reach a capacity when it may contribute to urban resiliency. So, I checked in with four edible green roof and wall projects to find out how they've performed and what lessons they've learned in the process.

WHY DID YOU DECIDE TO IMPLEMENT A FOOD ROOF OR WALL ON YOUR BUILDING? HOW DID YOU JUSTIFY THE INITIAL COSTS?

HELEN: As soon as I saw the silver lined roof of this building, I pictured a red, ripe and juicy heirloom tomato and exclaimed to my husband—"we can grow food up here!"

We were able to acquire tax increment funding to help make this project viable and we also received a $20,000 grant from the City of Chicago's Department of Environment.

SCOTT: Our head chef expressed interest in using more fresh herbs in his cooking, to enhance our salt-free menu. Ordering fresh herbs daily can be costly and time-consuming to manage. We wanted a cost-effective, easily maintained option for growing food on site. LiveWall presented a solution for achieving this that was also attractive and enjoyable to the residents and visitors of our facilities.

MARJORIE: The Youth Center included a rooftop garden as a way for young people and their families to connect with a beautiful, safe, bountiful and educational outdoor classroom in which to experience the wonders of nature. The initial investment reflected a commitment to improving young people's access to locally grown, organic and healthy food in a neighborhood identified as a food desert. Empowering young people was at the heart of the decision.

LINDSEY: The project was inspired by the work and support of Bay Localize and made possible by a Slingshot Grant Award—a joint venture between CLIF Mojo and Focus the Nation. The project would have never been possible without the award, funding, and support of these two organizations.

HOW HAS THE EDIBLE ROOF OR WALL PERFORMED? HOW IS IT MAINTAINED? HAVE YOU ENCOUNTERED ANY CHALLENGES? WHAT LESSONS HAVE YOU LEARNED?

HELEN: We are proud to employ a full-time salaried farm director to manage both Uncommon Ground locations. Our current director manages a group of interns and many volunteers to keep our farm beautiful, productive and highly educational. The biggest challenges are maintaining fertility, wind and weather stress, proper watering, and insects/disease.

SCOTT: Our chef actually has more herb yields than he needs, so he dries the excess. The system

PROJECT: Uncommon Ground (2,500 sf rooftop farm in containers, 700 sf tillable soil)
LOCATION: Chicago, Illinois
NAME: Helen Cameron, owner
COMPLETION: July 2008
COST: $100,000

PROJECT: Grand Pines Assisted Living Center (40 sf exterior vertical garden)
LOCATION: Grand Haven, Michigan
NAME: Scott Reenders, president, Heritage Senior Properties
COMPLETION: April 2012
COST: $3,500

PROJECT: Gary Comer Youth Center (8,600 sf open rooftop garden)
LOCATION: Chicago, Illinois
NAME: Marjorie Hess, garden manager
COMPLETION: May 2006

PROJECT: Graze the Roof, Glide Memorial Church (2,000 sf rooftop garden in containers)
LOCATION: San Francisco, California
NAME: Lindsey Goldberg, project manager
COMPLETION: Started in summer 2008 and the project is ongoing—a garden is never 'completed'
COST: $15,000, plus $1000/monthly

ABOVE UNCOMMON GROUND ROOFTOP FARM
Image provided by: Zoran Orlic Photography & Uncommon Ground

is very easy to maintain. At the end of the growing season, we harvested and dried the remaining produce and dropped in new inserts with planted ornamental cabbages, which provided color and interest throughout the fall and most of the winter. This spring, we had new, fully vegetated inserts dropped in as soon as the weather permitted. The system runs on a timer and waters for a 1-2 minutes per day, so all we need to do is cut what we need each day.

MARJORIE: The edible roof has performed exceptionally well over the past six years. The growing media remains highly productive through crop rotation, cover cropping and appropriate plant selection. The rooftop garden is maintained primarily by 200 youth ages 8 – 18 who participate in classes and programs at the Youth Center. In terms of challenges, we are always tinkering with intercropping, succession planting, companion planting and vertical techniques in order to maximize the yield from the garden. Appropriate plant selection and common sense watering goes a long way to maintain healthy plants and yields.

LINDSEY: Over the last 5 years, Graze the Roof has evolved from a lot of experimentation and learning the ins and outs of gardening on the roof. Once a week, volunteers work with a project manager to maintain and develop the garden. The garden is watered via drip irrigation. One of our biggest and most important lessons was refining our irrigation system so that it is extremely efficient—we are not wasting any water. Otherwise, we are learning new lessons every day and every season.

HOW MUCH PRODUCE WAS HARVESTED LAST SEASON? HAS THE INVESTMENT PAID OFF?

HELEN: Our Devon rooftop farm produced 1094 pounds (1 ½ pounds per sf) at a value of $5560. Our top earners were tomatoes, basil, radish, mint and lettuce.

Currently, we do cover the full costs of our inputs and interns, and we are inching closer to covering the labor expense of our farm director. This isn't just about the dollars—our farm has provided our restaurant a unique connection with our community. It has also given us the opportunity to educate our staff and guests on the importance of knowing where your food comes from, keeping the integrity of organic food systems, and using urban space to provide food to our community. Our quality of life at work is much improved!

SCOTT: We harvested about 1 ounce per sf per week. We were able to harvest from late April until September, so throughout the season, we harvested nearly fifty pounds of herbs. When the green wall was installed, we were featured on the front page of our local paper, which was tremendous marketing value. In a recent survey, residents had positive comments on the green wall. We are so pleased with the investment that we put systems at four other facilities this spring.

"THEIR COMBINED EFFORTS HAVE TURNED A FOOD DESERT INTO A HEALTHY OASIS..."

MARJORIE HESS

MARJORIE: Last year we harvested about 850 pounds, down some from previous years. The lower number reflects an emphasis on growing specialty crops such as fruits, herbs, edible flowers and an array of unique greens and salad ingredients. Produce is grown year-round, using pop-up row covers in the winter. The investment in the rooftop garden has paid impressive dividends in the hundreds of youth and their families who have grown a potato or tomato and then enjoyed a healthy meal prepared with those ingredients. Their combined efforts have turned a food desert into a healthy oasis teeming with organic fruits, herbs, vegetables and year-round production.

LINDSEY: Each week we harvest anywhere from 10-15 pounds of food from the garden that gets channeled to the Glide kitchen feeding upwards of 3,000 meals/day. The initial investment has been paid off in terms of the great value it has added to the neighborhood and to the residents, young people and congregation members it has served.

TOP: GRAND PINES ASSISTED LIVING CENTER LIVING WALL
Image provided by: LiveWall

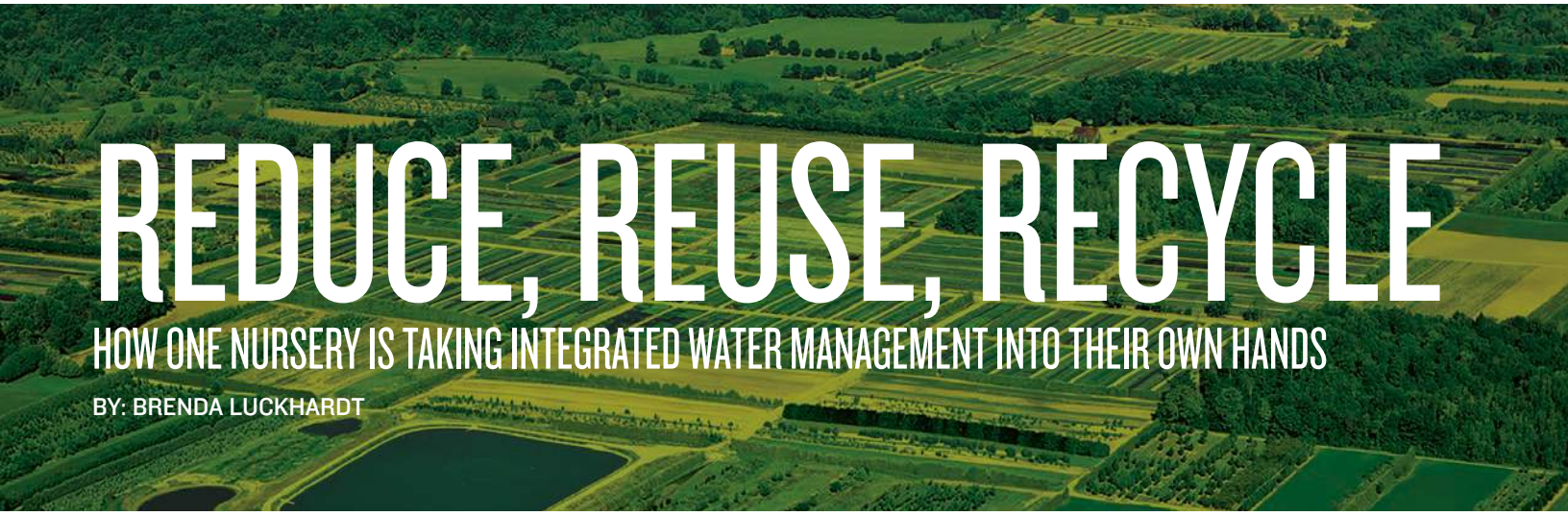
MIDDLE: GARY COMER YOUTH CENTER GREEN ROOF
Image provided by: Jasmin Shah

BOTTOM: GRAZE THE ROOF ROOFTOP GARDEN
Image provided by: Graze the Roof

FIND OUT MORE

Green Roofs for Healthy Cities offers an *Introduction to Rooftop Urban Agriculture* half-day course. Visit www.greenroofs.org for upcoming dates and locations.

Read the extended interview at: http://goo.gl/aTNvSL



REDUCE, REUSE, RECYCLE

HOW ONE NURSERY IS TAKING INTEGRATED WATER MANAGEMENT INTO THEIR OWN HANDS

BY: BRENDA LUCKHARDT

Water is the life blood of any nursery operation and supplemental irrigation from ground and surface sources is a requirement. In 2008, Sheridan Nurseries began the construction of our award-winning, state-of-art large capacity integrated water recycling system—the first of its kind in North America and revolutionary in the nursery industry. Through the Canada–Ontario Environmental Farm Plan, Sheridan Nurseries identified ways such as drip and spray stick irrigation and the utilization of coir discs to reduce water consumption by 80 percent. Even with these water conservation methods in place, we began the project to provide a self-sufficient backup water source for irrigation in case of serious drought conditions. At the time of construction this system was expected to reduce the draw from our local water source, the Credit River, by 10 to 15 percent. Actual results turned out to be as high as 29 percent. In 2012 we recycled 136 million liters of irrigation water. This system also has the ability to sustain our nursery's irrigation demand for 21 days during a drought.

The large capacity integrated water recycling system is comprised of five components covering 2.6 hectares which are fed by a controlled drainage system. The drainage network drains 162 hectares of production beds. The first component is the forebay which collects irrigation and rainfall runoff and allows for sedimentation to occur before the water flows through to a one hectare manmade bioswale. This wetland acts as a biofilter to reduce the sediment and nutrient levels in the water so that the water can be reused for irrigation. In addition, the wetland is an incredible natural wildlife habitat.

> "THIS INVESTMENT IN AN INTEGRATED WATER RECYCLING SYSTEM PROVIDED SUSTAINABILITY NOT ONLY FOR THE NURSERY BUT FOR THE NEIGHBOURING WATERSHED AS WELL."

ABOVE: SHERIDAN NURSERIES' LARGE CAPACITY INTEGRATED WATER RECYCLING SYSTEM
Image provided by: Sheridan Nurseries

The purified water from the wetland is collected in a wet cell holding area to be pumped up to the main pond, which has a 117 million liter capacity, for storage and reuse.

The fifth and final component of the system is the pump house, which contains two automated 60 horsepower turbines with intakes near the bottom of the pond. Each can pump 2300 US gallons of water per minute which gives us the capacity to draw 6 million liters a day. Recent upgrades to the system include remote irrigation control and monitoring through smartphone or computer to improve watering efficiencies and prevent over or under watering. These have been installed both at the pond pump house and the river pump station.

Sheridan Nurseries monitors all aspects of the nursery's irrigation requirements and large capacity integrated water recycling system. Wetland recovery rates and irrigation demands will vary from season to season depending on precipitation and nursery inventory. All input sources are metered and irrigation cycles are monitored and adjusted to the weather conditions. Total wetland recovery has been tracked for the past 3 years the system has been operating. Over 450 million liters of water has been recovered in the past three years.

In the summer of 2012 the key benefit of the large water holding capacity came into play after a prolonged period with no rainfall. The main pond which can sustain the nursery for 21 days was the only source for irrigation. The drought period lasted 19 days until significant rainfall arrived to replenish the system. This investment in an integrated water recycling system provided sustainability not only for the nursery but for the neighbouring watershed as well.

Brenda Luckhardt is the business to business marketing and development manager at Sheridan Nurseries.

FIND OUT MORE

Green Roofs for Healthy Cities is launching its fourth Integrated Water Management course at *CitiesAlive* in San Francisco this October. www.citiesalive.org

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HEY EPA!

DON'T WAIT TO REFORM NATIONAL CLEAN WATER REQUIREMENTS FOR STORMWATER SOURCES

BY: KAREN HOBBS AND NOAH GARRISON

Every year, an estimated 10 trillion gallons of untreated stormwater runs off roofs, roads, parking lots and other paved surfaces, often mingling with sewage from homes and businesses. This wastewater pollutes rivers and waterways that serve as drinking water supply, and flows to our beaches, increasing health risks, degrading ecosystems and damaging tourist economies.

Fortunately, we know what to do about this threat. A set of techniques known as "green infrastructure" help stop runoff pollution by capturing rainwater where it falls; and either storing it for use or letting it filter back into the ground, sustaining vegetation and replenishing groundwater supplies. Green infrastructure includes not only green roofs and walls, but also street trees, rain barrels, rain gardens, and permeable pavement. These solutions provide added benefits such as beautifying neighborhoods, cooling and cleansing the air, reducing asthma and heat-related illnesses, lowering energy costs, boosting economies and supporting American jobs.

The Environmental Protection Agency (EPA) has the authority and the responsibility to help communities clean up this stormwater pollution and implement green infrastructure. That's why the EPA must reform national regulations governing polluted runoff control. These regulations are out of date. They fail to promote widely-accepted and cost-effective techniques, such as green infrastructure. In addition, the regulations fail to adequately address key sources of pollution and, in any event, have not been implemented in a particularly rigorous way.

The EPA has long recognized these deficiencies in the regulations, so it initiated an effort (spurred by litigation filed by the NRDC and the Waterkeeper Alliance several years ago) to revise its stormwater requirements. However, the agency has repeatedly delayed the release of a proposed rule, most recently breaking its promise to propose a rule by June 10, 2013.

The EPA's delays are bad news for our waterways and all of us who depend on them. We believe that these rules are critical to achieving real progress in improving the nation's waters. Real reform means stringent objective retention requirements for new development and redeveloped sites. Additionally, the rules must require improvements by existing sources of runoff pollution, because already built areas cause significant water quality problems. Both of these requirements would also create strong incentives for green infrastructure.

Cities across North America are already investing in green infrastructure. The NRDC's report *Rooftops to Rivers II* profiled how 20 cities were using green infrastructure to better manage stormwater and create additional benefits.

Revising stormwater requirements to promote green infrastructure means that additional cities would see these same benefits, and would also further support green infrastructure related industries. As Green Roofs for Healthy Cities (GRHC) just reported in its Annual Green Roof Industry Survey, there was a 24 percent growth rate in installed green roofs in 2012.

It's clear that our cities and businesses can't afford additional delays to revise stormwater requirements. The EPA must prioritize getting back on track to issue a proposed rule this year and a final rule in 2014.

Karen Hobbs is a senior policy analyst at the Natural Resource Defense Council (NRDC).

Noah Garrison is a project attorney at the Natural Resources Defense Council (NRDC).

FIND OUT MORE

Rooftops to Rivers II: http://goo.gl/LIZT2

Annual Green Roof Industry Survey: http://goo.gl/xczj1

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