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Alexandra Dapolito Dunn
*Pace Law School*

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# SITING GREEN INFRASTRUCTURE: LEGAL AND POLICY SOLUTIONS TO ALLEVIATE URBAN POVERTY AND PROMOTE HEALTHY COMMUNITIES

Alexandra Dapolito Dunn*

**Abstract:** Green infrastructure is an economically and environmentally viable approach for water management and natural resource protection in urban areas. This Article argues that green infrastructure has additional and exceptional benefits for the urban poor which are not frequently highlighted or discussed. When green infrastructure is concentrated in distressed neighborhoods—where it frequently is not—it can improve urban water quality, reduce urban air pollution, improve public health, enhance urban aesthetics and safety, generate green collar jobs, and facilitate urban food security. To make these quality of life and health benefits available to the urban poor, it is essential that urban leaders remove both legal and policy barriers to implementing green infrastructure projects. This Article argues that overcoming these obstacles requires quantified methods and regulatory reform. Increased public financing and other incentives are also necessary. Furthermore, legal structures that facilitate green solutions must be put in place. Lastly, awareness of green infrastructure solutions among policy makers and

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* © 2010, Alexandra Dapolito Dunn, Assistant Dean of Environmental Law Programs and Adjunct Professor of Law, Pace University School of Law; J.D., 1994, Columbus School of Law, Catholic University of America; B.A., 1989, James Madison University. I wish to thank Erin Derrington (J.D. Candidate, Pace School of Law '11; M.E.M. Candidate, Yale University School of Forestry and Environmental Studies '11) for her assistance with the research for this Article. I also thank Nancy Stoner, Clean Water Program Director, Natural Resources Defense Council, for her green infrastructure inspiration and ideas. Some of the concepts in this Article regarding green infrastructure and stormwater control were presented in an article entitled *Green Light for Green Infrastructure* by Alexandra Dapolito Dunn and Nancy Stoner, 24 *Environmental Forum* 3, 32 (May/June 2007). I also served as a drafter of the U.S. Environmental Protection Agency's April 2007 Statement of Support for Green Infrastructure, available at http://www.epa.gov/npdes/pubs/gi_intentstatement.pdf, while General Counsel of the National Association of Clean Water Agencies. Since 2007, I have developed these ideas and concepts to connect green infrastructure projects to urban poverty alleviation. I presented many of the themes and ideas in this paper at the Sixth Annual Colloquium of the International Union for the Conservation of Nature Academy of Environmental Law, Poverty Alleviation and Environmental Protection, held in Mexico City from November 10 to 15, 2008.

the wider public must be enhanced so that our nation's more distressed urban populations may realize the benefits that such solutions yield.

## Introduction

The inevitability of rainfall, snow melt, and wet weather storm events presents a suite of water quality and management challenges to communities across the nation. Increased amounts of impervious surfaces in urban areas alters runoff and drainage patterns, making natural events such as rain and snowmelt an enabling pathway for oil, grease, toxins, pathogens, nutrients, and other pollutants to reach nearby waterways. High volume and high velocity storm flows cause additional adverse environmental consequences, such as flooding, streambank scouring, sewer overflows,[1] riparian habitat loss, and increased stream temperatures. Impervious surfaces prevent rainwater from soaking into the ground, thereby preventing groundwater recharge. The end result in urban communities across the nation is waterways that are unsafe for swimming and direct body contact, increased risk of illness for swimmers and subsistence fishers, unhealthy waters for fish, amphibians, and birds, and unmet water quality goals.

Polluted waters are a health hazard as well as an eyesore, diminishing property values and detracting from community revitalization efforts. The adverse impact of these problems will only continue to grow as our world's population increases, urban dwelling becomes more concentrated, and even more significantly, as development in the United States continues at twice the rate of population growth.[2] These densely populated, highly developed urban centers, characterized by significant

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[1] The sewer systems most overloaded by storm flows are known as combined sewer systems and the overflows as combined sewer overflows. These systems were designed with one common set of underground pipes and conveyances for sanitary and storm water. Thus, when it rains or when there is snowmelt, combined sewer systems can become overloaded. *See infra* note 78 and accompanying text (providing information about the regulatory protocols for combined sewer systems); *see also* Charles Duhigg, *As Sewers Fill, Waste Poisons Waterways*, N.Y. Times Nov. 23, 2009, at A1 (describing how combined sewer overflows routinely occur in and around New York City).

[2] Jennifer Cheeseman Day, U.S. Census Bureau, National Population Projections (2008), http://www.census.gov/population/www/pop-profile/natproj.html; *see also* Matthew E. Kahn, Green Cities: Urban Growth and the Environment 102–03 (2006) ("Urban population growth can also overwhelm local efforts to provide key services, such as clean water. As poor migrants enter a city, they increase the demand for basic services but are often incapable of contributing financially to their supply. As existing services become overtaxed, their quality falls.").

areas of impervious surfaces[3] and reduced open space, contribute to heat island effects and reduce air quality. Global warming—which is predicted to adversely impact water resources and shorelines, increase storm severity and flooding, exacerbate sewerage overflows,[4] and decrease snowpack—will only further deteriorate the quality of the urban environment.[5]

One important way that cities around the nation are tackling these urban water pollution and heat island challenges is by making green infrastructure investments.[6] The term "green infrastructure" has many definitions because it is used on a variety of scales—watershed or subwatershed, neighborhood, or site.[7] In this Article, the term is used to apply to natural systems, or to designed or engineered systems, that use soil and vegetation to capture water, reduce ambient temperatures, and otherwise protect and enhance both environmental quality and public health. Urban green infrastructure in this Article refers to trees, rain gardens, vegetated swales, pocket wetlands, constructed wetlands, open

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[3] Gerald J. Kauffman & Tammy Brant, Water Res. Agency, The Role of Impervious Cover as a Watershed-Based Zoning Tool to Protect Water Quality in the Christina River Basin of Delaware, Pennsylvania, and Maryland 2 (2000).

> Impervious surfaces alter the natural hydrology, prevent the infiltration of water into the ground, and concentrate the flow of stormwater over the landscape . . . . As the imperviousness of a watershed increases, the greater volume of stormwater increases the possibility of flooding and reduces the potential for pollutants to settle out; meaning that more pollution is delivered to drinking water streams and aquifers.

*Id. See generally* Chester L. Arnold, Jr. & C. James Gibbons, *Impervious Surface Coverage: The Emergence of a Key Environmental Indicator*, 62 J. Am. Plan. Ass'n 243 (1996) (discussing the American Planning Association's exploration of the use of impervious cover as a measurable environmental indicator and growth management tool).

[4] *See, e.g.*, Thomas Johnson, U.S. Envtl. Prot. Agency, Factoring the Impacts of Climate Change into Combined Sewer Overflow Mitigation 8 (2008) (noting that some models, though based on inconclusive data, predict that global warming will increase the frequency of combined sewer overflows by up to fourteen percent and that the volume and velocity of stormwater flows will increase).

[5] Barry Nelson et al., Natural Res. Def. Council, In Hot Water: Water Management Strategies to Weather the Effects of Global Warming 1, 4–6 (2007).

[6] *See* Mark A. Benedict & Edward T. McMahon, Green Infrastructure: Smart Conservation for the 21st Century 8–10 (2002) (providing a thoughtful discussion of urban green infrastructure).

[7] *See id.* at 6. *See generally* U.S. Dep't of Hous. & Urban Dev., The Practice of Low Impact Development (2003), *available at* http://www.huduser.org/publications/pdf/practLowImpctDevel.pdf (describing green infrastructure development). Green infrastructure development ranges in scale from residential rain barrel installations to city, state, and national land use and storm and waste water design practices. Green socio-political policies may be implicated by, or even prerequisites to, green infrastructure design, development, and implementation.

space, urban agriculture and farming, and vegetated median strips—essentially soil and vegetation incorporated into the urban landscape—and engineering techniques which foster such incorporation such as green roofs, tree boxes, infiltration planters, and permeable pavement.

This Article makes a case for increasing urban green infrastructure investments in a specific way. By showing how urban green infrastructure can directly benefit the urban poor,[8] this Article urges cities to concentrate green infrastructure investments in poverty stricken urban areas—where cities might be less likely to pursue such projects due to the lower profile and visibility of such projects to the general public.[9] This Article discusses some of the legal barriers which can prevent cities from making green infrastructure investments and proposes ways to remove or minimize the deterrent effect of these barriers.[10] In conclusion, this Article finds that with prioritization and desire, and with increased funding and a heightened awareness of the direct poverty reducing benefits of green infrastructure, cities can achieve two important goals—a healthier environment and a more stable, prosperous, and healthy citizenry.[11]

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[8] For purposes of this Article, poverty is characterized broadly to include not only traditional elements of poverty such as reduced family income but also poverty-exacerbating indicators such as lack of productive assets (for example, clean water and land) and lack of access to employment. Key U.N. reports support the approach taken in this Article to include environmental conditions in characterizing poverty.

> In *Development as Freedom*, Sen defines poverty as the deprivation of basic capabilities that provide a person with the freedom to choose the life he or she has reason to value. These capabilities include good health, education, social networks, command over economic resources, and influence on decision-making that affects one's life. Income is important because money allows a person to develop his or her capabilities, but it is only a means to live a valuable life. From this perspective, poverty is a condition with many interdependent and closely related dimensions which can be summarized in three broad categories:
>
> (a) Lack of regular income and employment, productive assets (such as land and housing), access to social safety nets;
>
> (b) Lack of access to services such as education, health care, information, credit, water supply and sanitation;
>
> (c) Lack of political power, participation, dignity and respect.

U.N. Econ. & Soc. Council [ECOSOC], Comm'n on Poverty Reduction, *Urban Poverty and the Working Poor*, 1, U.N. Doc. E/ESCAP/CPR(4)/4 (Sept. 24, 2007) (quoting AMARTYA SEN, DEVELOPMENT AS FREEDOM 87 (1999)).

[9] *See infra* Parts I–II.

[10] *See infra* Part III.

[11] *See infra* Part III.

## I. How Green Infrastructure Improves Quality of Life for the Urban Poor

Urban areas are crowded, not only with people but with environmental burdens and challenges that have direct, and frequently adverse, impacts on the urban poor who make their homes and livelihoods in these places. These burdens commonly come in the forms of air and water pollution, stagnant water, reduced drinking water quality, lower groundwater tables, and more.[12] Various data sources suggest that morbidity and mortality rates are higher in densely populated urban centers.[13] For example, cancer[14] and "[a]sthma morbidity and mortality are disproportionately high in urban centers,"[15] and some studies suggest that overall life expectancy and healthy life expectancy "decreased steadily as area of residence became more urban."[16] The U.S. Department of Health and Human Services has reported that Americans who live in the suburbs fare significantly better in many key health measures

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[12] *See generally* John W. Mellor, *The Intertwining of Environmental Problems and Poverty*, Environment, Nov. 1988, at 8 (describing the interconnection between poverty and environmental quality in the developing world).

[13] *See* Trudy Harpham, *Health and the Urban Poor*, 1 Health Pol'y & Plan. 5, 8–10 (1986); Mai Stafford et al., *Neighbourhood Characteristics and Trajectories of Health Functioning: A Multilevel Prospective Analysis*, 18 Eur. J. Pub. Health 604, 607–09 (2008); C. van Hooijdonk et al., *Higher Mortality in Urban Neighbourhoods in The Netherlands: Who Is at Risk?*, 68 J. Epidemiology & Community Health 473, 499–505 (2008) (suggesting a link between mental and physical health inequalities and locale).

[14] Varying degrees of association are reported between cancer incidence and urban/rural environments, but the association between atmospheric pollutants and cancer rates is fairly well established, to the extent that it can be argued that increased exposure to pollution can have significant health impacts. *See* Adele C. Monroe et al., *Cancer in Rural Versus Urban Populations: A Review*, 8 J. Rural Health 212, 218–19 (1992) (suggesting that rural populations have a lower risk of developing cancer than urban populations); Philip Nasca et al., *Population Density as an Indicator of Urban-Rural Differences in Cancer Incidence, Upstate New York, 1968–1972*, 112 Am. J. Epidemiology 362, 372–74 (1980) (identifying a statistically significant linear trend of increasing incidence with increasing population density for cancers of the buccal cavity and pharynx, esophagus, bronchus and lung, stomach and colon); Mark Wake, *The Urban/Rural Divide in Head and Neck Cancer—The Effect of Atmospheric Pollution*, 18 Clinical Otolaryngology & Allied Sci. 298, 298–302 (1993) (noting a trend of higher cancer rates among urban residents as compared to their rural counterparts). Green infrastructure implementation can decrease pollutants in the air and the water, likely having positive impacts on human health.

[15] Floyd J. Malveaux & Sheryl A. Fletcher-Vincent, *Environmental Risk Factors of Childhood Asthma in Urban Centers*, 103 Envtl. Health Persp. 59, 59 (1995).

[16] Scottish Pub. Health Observatory, Healthy Life Expectancy: Urban Rural Classification (2001), http://www.scotpho.org.uk/home/Populationdynamics/hle/hle_data/hle_rurality.asp; *see also* Scottish Pub. Health Observatory, Healthy Life Expectancy: Technical Paper 3–9 (2008), *available at* http://www.scotpho.org.uk/nmsruntime/saveasdialog.asp?lID=4717&sID=4075.

than those who live in the most rural and most urban areas.[17] Varying socio-economic and environmental conditions associated with urban development also can negatively impact the health of urban residents. These realities provide an incentive for urban leaders to find ways to reduce the concentration of pollutants in the air and water in order to directly benefit the health and social wellbeing of their constituents. This is where green infrastructure can make a meaningful difference.

### A. *Green Infrastructure Improves Urban Water Quality*

Rather than the traditional approach to stormwater management of capture, convey, and treat, green infrastructure manages rain where it falls, recognizing it as a valuable resource.[18] This can have a number of beneficial outcomes, such as reducing volume to combined sewer and stormwater systems, reducing treatment costs at wastewater treatment plants, and enhancing the aesthetics of the urban area. Avoiding the addition of new infrastructure or diminishing the size and scope of capacity improvements can also generate substantial cost savings.[19] Other decentralized storage and infiltration approaches, including the use of permeable pavement, rain barrels, and cisterns to capture and reuse rainfall for irrigation or other non-potable onsite uses, often accompany green infrastructure. All of these have the benefit of keeping rainwater out of storm and sewer systems so that it does not cause overflows. Instead, soil and vegetation absorbs and cleanses it. The stormwater is then reused or allowed to flow back into surface water resources or recharge groundwater.[20] Green infrastructure can also enhance water quality when it takes the form of constructed wetlands, which can actually treat and remove pollutants before they enter urban water bodies.[21]

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[17] Mark S. Eberhardt et al., Nat'l Ctr. for Health Statistics, Health, United States, 2001, at 4 (2001) (concluding that that people who live in the most rural and most urban areas have higher mortality rates for working age adults than suburban residents).

[18] *See* Cynthia Girling & Ronald Kellett, Skinny Streets & Green Neighborhoods: Designs for Environment and Community 118–34 (2005) (providing a variety of green stormwater strategies, and discussing the evolution of planners' views of stormwater as a resource rather than a waste to be captured and removed).

[19] *See infra* Part II.

[20] Chicago Metro. Agency for Planning, Stormwater Management Strategy Report 9–14 (2008).

[21] *See generally* U.S. Envtl. Prot. Agency, Constructed Wetlands for Wastewater Treatment and Wildlife Habitat (1993) (using seventeen case studies to discuss techniques used to develop constructed wetlands and the ecosystem services they provide).

### B. *Green Infrastructure Reduces Urban Air Pollution and Advances Energy Efficiency*

Not only can green infrastructure protect and improve water quality, which can render urban streams accessible to urban dwellers for recreation and enjoyment, green infrastructure also can improve urban air quality. It is documented that "ambient air pollution worsens as city populations grow."[22] Green infrastructure, like green roofs, community gardens, water retention ponds, and green space preservation and creation, increases vegetative cover, thereby filtering airborne pollutants, offsetting urban heat island effects, uptaking carbon, and reducing the heating and cooling demands of buildings.[23] The energy efficiency of green buildings can reduce energy costs for the urban poor, yielding more affordable energy bills.[24]

Green infrastructure such as green roofs can also reduce the urban "heat island effect."[25] This effect can also be mitigated through implementation of permeable pavement on common spaces like basketball courts, which have been shown to be notably cooler in the summer when they are constructed of permeable pavement.[26]

### C. *Green Infrastructure Enhances Urban Aesthetics and Safety*

Green infrastructure also benefits the urban poor by enhancing the aesthetic appeal of communities with trees and vegetation. Studies suggest that ready access to green spaces has positive correlations with lon-

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[22] KAHN, *supra* note 2, at 100.

[23] For example, temperatures above a green roof on city hall in Chicago, IL average 10–15°F lower than a nearby black tar roof, with the difference being as much as 50°F in August. The associated energy savings for the building are estimated to be $3600 annually. Chris Kloss & Nancy Stoner, *Controlling Urban Runoff with Low Impact Development*, WATERWORLD, July 2007, at 28, 29.

[24] A study of Chicago's urban forest found that increasing tree cover by ten percent (roughly equivalent to three additional trees per building) would reduce total heating and cooling energy use by up to ten percent, and on the national level, researchers estimate that planting three additional trees per building could cut more than $2 billion in energy costs. *See* Natasha Kassulke, *A Green Workforce*, WIS. NAT. RESOURCES MAG., Aug. 2006, at 1, 5, *available at* http://dnr.wi.gov/wnrmag/html/supps/2006/aug06/green.htm.

[25] *See* U.S. ENVTL. PROT. AGENCY, GREEN ROOFS, http://www.epa.gov/heatisland/mitigation/greenroofs.htm (last visited Jan. 6, 2010).

[26] *Morning Edition: Philadelphia Tackles Rainwater Runoff Pollution* (Nat'l. Pub. Radio broadcast Sept. 29, 2006), *available at* http://www.npr.org/templates/story/story.php?storyId=6165654 (using permeable pavement, rain gardens, and urban farming to reduce rainwater runoff and to improve water quality, stormwater systems, and community well-being).

gevity and quality of life.[27] Trees and vegetation can offer expanded wildlife habitat, open space and parks, thereby conveying energy savings by reducing ambient housing temperatures,[28] raising property values, reducing crime, and promoting a greater sense of community.[29] Green space helps to increase property values, revitalize blighted neighborhoods, enhance street life and community aesthetics, and provide free recreation. Open, active[30] green space draws people out of their homes[31] and with more individuals present in the community, crime can be reduced.[32] Positive experiences at public housing projects serve to highlight the societal value of green infrastructure.[33] Seattle, Washing-

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[27] *See* J.R. Ashton, *Health and Greening the City*, 56 J. Epidemiology & Community Health 896, 896 (2002); Takano et al., *Urban Residential Environments and Senior Citizens' Longevity in Megacity Areas: The Importance of Walkable Green Spaces*, 56 J. Epidemiology & Community Health 913, 916–18 (2002).

[28] *See, e.g.*, *Winnipeg Green Roof Study Shows Promising Results*, 4 The Green Roof Infrastructure Monitor 5 (2002), *available at* http://www.greenroofs.org/pdf/GRIM-Winter2002.pdf (discussing how the City of Winnipeg, Canada has analyzed optimizing efficiency of energy use in flat-roofed buildings and how green roofs can improve urban air quality through plant uptake of greenhouse gases and metals).

[29] *See* Benedict & McMahon, *supra* note 6, at 13–14.

[30] Some land use planners identify a distinction between active and passive open space. David E. Johnson, Fundamentals of Land Development 100–01 (2008). Active open space—which may include designated athletic fields, courts, or other outdoor amenities such as community gardens and well-maintained trails and parks—encourages community interaction. Passive space, such as open spaces and preserved areas, provide space for multiple uses that are not limited to designated athletic fields. *See, e.g.*, Bruce Hartley, Costa Mesa Parks & Recreation Comm'n, Agenda Report: Designating Parks and Park Areas for Passive or Active Use 1–3 (July 23, 2008), *available at* http://www.ci.costamesa.ca.us/council/parks/actions/2008-07-23/Active%20&%20Passive%20Parks.pdf.

[31] *See* Kassulke, *supra* note 24, at 7 ("'The simple act of planting trees provides opportunities to connect residents with nature and each other,' says Dr. Greg McPherson, director of the USDA Center for Urban Forest Research. 'Neighborhood tree plantings and stewardship projects stimulate investment by local citizens, business and government in the betterment of their communities.'").

[32] Recent research indicates that the presence of trees actually reduces the incidence of crime. This may, in part, be due to the higher natural surveillance of well-used greenspace, as sites with trees have been found to attract more people than those without. Research has also linked the presence of vegetation to mitigation of mental fatigue, often "a precursor of outbursts of anger and violence." Chris Hastie, The Benefits of Urban Trees 2–3 (2003). Notably, the fact that people outside, watching, improves community safety has long been documented. Jane Jacobs, The Death and Life of Great American Cities 34–35 (1961) (a particularly insightful and even radical book for its time).

[33] *See* Kassulke, *supra* note 24, at 8.

> The study by University of Illinois researchers Frances E. Kuo and William C. Sullivan explored how well residents of the Chicago Robert Taylor Housing Project were doing in their daily lives based upon the amount of contact they had with trees. Kuo and Sullivan found that trees are a canopy against crime. Trees have the potential to reduce social service budgets, decrease police calls

ton, is one city advancing green affordable housing, framing its initiatives around environmental sustainability and environmental justice.[34] Similarly, Enterprise Community Partners and the Natural Resources Defense Council entered a five-year, $555 million "green communities initiative" to build more than 8500 environmentally healthy, affordable homes across the United States.[35] According to Enterprise founder, James Rouse, green affordable housing "is simply part of a healthy city infrastructure both on the human and physical capital side," creating "gardens for growing people."[36]

Green spaces can be successful and valuable even on a small scale.[37] The aesthetic benefits gained from green infrastructure imple-

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> for domestic violence, strengthen urban communities and decrease the incidence of child abuse. Buildings with high levels of greenery had 52 percent fewer total crimes than apartment buildings with little or no greenery. Residents of buildings with more vegetation knew their neighbors better because they were more apt to come outside. Based on study findings, the city of Chicago spent $10 million to plant 20,000 trees as a means of social change.

*Id.*

[34] Enterprise Green Communities, Sustainable Cities, http://www.greencommunities online.org/green/benefits/cities.asp (last visited Jan. 6, 2010) [hereinafter Green Communities] ("Greening affordable housing is part of Mayor Nickels' agenda to help promote more sustainable approaches to managing the built environment in a socially equitable way so those in our communities who can least afford it will benefit from healthy, high-quality affordable housing.").

The SeaGreen Program's guiding principles for affordable housing are that they are cost-effective to build; are durable and practical to maintain; result in a high quality, healthy living environment; reduce utility costs to residents; enhance the residents' connection to nature; protect the environment by conserving resources, including energy, water and materials; and advance the health of local and regional ecosystems. Office of Housing, Seattle, SeaGreen: Greening Seattle's Affordable Housing, at iii (2002), *available at* http://www.seattle.gov/housing/SeaGreen/SeaGreen.pdf. *See generally* Seattle Sustainable Development Program, 5-Year Report: 2000–2005 (2005), *available at* http://www.seattle.gov/DPD/static/5-year_report_LatestReleased_DPDP_009930.pdf (providing background on Seattle's program).

[35] Green Communities, *supra* note 34.

[36] *Id.; see also* Jerry Yudelson, The Green Building Revolution 129–30 (2008) ("Why shouldn't people in subsidized housing have access to lower utility bills, healthier indoor air, and the other benefits of green buildings?").

[37] A. Cassidy, J. Newell & J. Wolch, USC Ctr. for Sustainable Cities, Transforming Alleys into Green Infrastructure for Los Angeles 12 (2008).

> [E]xtensive research as well as experience in Los Angeles suggests that it is possible to create small green public spaces of extraordinary quality and value to the community that are safe (and are perceived as such). For example, Bimini Slough Ecology Park (built on a vacated street) is located in a poor, high-density East Hollywood community plagued by many problems including crime and gangs, yet it is intensely used by community members without incident. Similarly, Augustus Hawkins Natural Park, in South Los Angeles,

mentation may be difficult to quantify, but can be considered critical for healthy, thriving, and sustainable communities.[38] When applied in the area of public housing projects, green infrastructure may improve the psychological well-being of individuals, promoting community self-image and fostering community pride.[39] Community-based organizations can promote green projects as well. For example, the New York Restoration Project (NYRP) funds green improvements and upkeep in economically and environmentally burdened areas in New York. One NYRP effort, the Target East Harlem Community Garden, successfully fused community gardening with the installation of solar panels, wind turbines, and a drip irrigation system.[40]

### D. *Green Infrastructure Yields Green Jobs*

Green infrastructure also can yield safe and reliable jobs, which with training can be made available to local low-income individuals.[41] While green infrastructure requires certain skilled individuals, such as architects, designers and engineers, its implementation yields "green collar" jobs in construction, maintenance, and installation. Between

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> built on a small brownfield, is extraordinary because of its superior design and security features that create a sense of protection and calm.

*Id.*

[38] *See* T. Takano, *supra* note 27, at 913–18 (suggesting that ready access to "green spaces" has positive correlations with longevity and quality of life).

[39] Kassulke, *supra* note 24, at 8–9; Green Communities, *supra* note 34.

> When San Francisco Mayor Newsom announced in August 2005 that all city-supported affordable housing developments would be required to include holistic environmental standards based on the Green Communities Criteria, he emphasized children's health: "Children in low-income neighborhoods often suffer from childhood diseases like asthma or lead-poisoning that are exacerbated by unhealthy housing. By signing up to be the country's first city-wide Green Community, we'll prove that it's possible to build affordable housing and to build it green."

Green Communities, *supra* note 34.

[40] Anne Raver, *Healthy Spaces, for People and Earth*, N.Y. Times, Nov. 5, 2008, at D6.

[41] Maxine Burkett, *Just Solutions to Climate Change*, 56 Buff. L. Rev. 169, 225–26 (2008).

> The green-collar economy includes all "green jobs" like construction work on green buildings, organic farming, solar panel manufacturing, and bicycle repair. Cognizant of Oakland, California's "literal do-or-die struggle to build a sustainable local living economy strong enough to lift people out of poverty," community leaders under the banner of the local Alliance are committed to "job creation for the low-income and people of color in the green, sustainable economy" . . . "[B]y their nature, green jobs are local jobs."

*Id.* (citations omitted).

July 2007 and January 2009, there was a thirty-one percent increase in people being hired specifically for green jobs, and by 2010, optimistic predictions anticipate 5.8 million green jobs and, by 2020, 6.9 million.[42] President Obama's economic stimulus plan commits to green projects such as the weatherization of one million homes.[43] University of Colorado Law Professor Maxine Burkett wisely notes that "[t]he campaign for green-collar jobs is just as much about economic and social recovery for [environmental justice] communities as it is about environmental dividends . . . . The green-collar economy includes all 'green jobs' like construction work on green buildings, organic farming, solar panel manufacturing, and bicycle repair."[44] The U.S. Environmental Protection Agency recently cataloged training opportunities for green infrastructure jobs.[45]

Thoughtfully planned efforts can effectively synthesize several important outcomes for the urban poor, such as energy efficiency and green jobs. For example, in Stamford, Connecticut, Jonathan Rose Companies' Metro Green affordable housing apartment project "integrate[s] features that enhance the urban environment, promote better health for residents, are energy efficient, and save residents money" while creating green collar construction jobs.[46] The project includes "a high-performance roof and insulation system . . . that reduces [the] heat island effect," "operable double hung windows" that reduce heating and cooling costs, and "a rainwater harvesting system that will funnel water from the roof into storage tanks to be used for drip irrigation and filtered for use in washing machines."[47] Thus, green infrastructure not only helps to elevate families from poverty by reducing heating and cooling bills, but also can stimulate the local economy by creating local, green collar jobs.

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[42] Mary Duan, *Obama's Green Light for Green Jobs*, U.S. News & World Rep., May 1, 2009, at 30, 30.

[43] Bijal P. Trivedi, *Stimulus for Homes: Obama's $5 Billion Weatherization Plan*, Popular Mechanics, Mar. 2, 2009, http://www.popularmechanics.com/home_journal/home_improvement/4306631.html.

[44] Burkett, *supra* note 41, at 225.

[45] *See generally* U.S. Envtl. Prot. Agency, Green Jobs Training (2009).

[46] *Jonathan Rose Companies Breaks Ground on Metro Green Apartments at Stamford Transportation Center*, StamfordPlus.com, June 11, 2008, http://www.stamfordplus.com/stm/information/nws1/publish/Local_2/Jonathan_Rose_Companies_breaks_ground_on_Metro_Green_Apartments_at_Stamford_Transportation_Center2554.shtml.

[47] *Id. See generally* Global Green USA, Blueprint for Greening Affordable Housing (2007).

### E. *Green Infrastructure Facilitates Urban Farming and Affordable Food*

Urban hunger and hungry city dwellers are growing problems.[48] Green infrastructure can lower food costs for the urban poor by creating space to grow produce that can supply an urban center. The urban poor pay more for their food, particularly produce, than suburban or rural residents.[49] Thus, through adding green space to the urban landscape, local agriculture, and in particular urban farming can become a valuable part of life for the urban poor.[50] The United Nations has noted that

> [g]iven prices and income, the ability of a poor urban household to buy food may be less than that of a poor rural household, because the urban poor must buy most of their food. In many cases, the urban poor pay up to 30 per cent more for their food than the rural poor, and spend 60 per cent or more of their total expenditure on food. Transport costs and post-harvest losses are the main causes of the higher cost of food in urban areas.[51]

Exacerbating these disparities is the fact that "food markets that are located in low-income neighborhoods are often smaller, with less selection in general and less and lower quality produce," making it more difficult for low-income families to achieve the balanced food intake necessary for a healthy diet.[52]

Thus, urban agriculture can be not only an important environmental strategy, providing drainage and stormwater management services, but an equally important strategy to combat poverty, enhance food security, promote local economic development, and provide nutri-

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[48] Food & Agric. Org. of the U.N., The State of Food Insecurity in the World 2008, at 22–23 (2008). This problem is even more severe outside the United States. By 2020, predictions are that eighty-five percent of the poor in Latin America, and about forty to forty-five percent of the poor in Africa and Asia will be found in urban areas. RUAF Found., Why is Urban Agriculture Important?, http://www.ruaf.org/node/513 (last visited Jan. 6, 2010).

[49] ECOSOC, *supra* note 8, at 5.

[50] Tjeerd Deelstra & Herbert Girardet, RUAF Found., Urban Agriculture and Sustainable Cities 46 (2002) (noting that urban farming can be even more valuable during times of recession).

[51] ECOSOC, *supra* note 8, at 5.

[52] Mark Vallianatos et al., Urban & Envtl. Pol'y Inst., Transportation and Food: The Importance of Access 2 (2002), *available at* http://departments.oxy.edu/uepi/cfj/publications/transportation_and_food.pdf.

tious foods. Urban gardeners have been shown to be able to obtain forty to sixty percent of their household food from their gardens.[53]

As urban areas continue to expand and convert areas previously used for agriculture, increasing the amount of food grown in diminishing space is necessary. With the high unemployment rates and food scares, it is predicted that 10 million people planted their first gardens in 2009.[54] In addition to encouraging permeable garden spaces that reduce water runoff and decreasing the food delivery distances that minimize transportation-related carbon output, community gardens can improve "nutrition, physical activity, community engagement, safety and economic vitality for a neighborhood and its residents."[55] When green infrastructure is seen as including urban agriculture, not only is the environment cleaner, but residents have greater economic opportunities, both as producers and consumers of affordable, healthy produce.

## II. Green Infrastructure Success in the United States

Quite a number of U.S. cities have achieved significant success in the green infrastructure arena. These investments, largely driven by water quality needs and a need to control urban stormwater, have yielded key environmental benefits while improving the aesthetic value of neighborhoods and public health. For example, an $8 million subsidized downspout disconnection program in Portland, Oregon saved $250 million in water infrastructure improvements, successfully keeping 1 billion gallons of rain annually out of the city's combined sewer system, promoting groundwater recharge.[56] In Seattle, Washington, the Street Edge Alternative pilot project reduced the total volume of stormwater leaving the street by ninety-nine percent.[57] In the Rouge River area of Michigan, the Inkster Wetlands demonstration project, completed in 1997, featured nine constructed and five natural acres of wet-

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[53] RUAF Found., *supra* note 48.

[54] Elizabeth Royte, *Street Farmer*, N.Y. Times, July 5, 2009, (Magazine), at 22.

[55] Local Gov't Comm'n, Cultivating Community Gardens 1, http://www.lgc.org/freepub/docs/community_design/fact_sheets/community_gardens_cs.pdf (last visited Jan. 6, 2010); *see also* Municipal Research and Services Center of Washington, Community Gardens, http://www.mrsc.org/Subjects/Parks/comgarden.aspx (last visited Jan. 6, 2010).

[56] Alexandra Dapolito Dunn & Nancy Stoner, *Green Light for Green Infrastructure*, Envtl. F., May/June 2007, at 32, 32.

[57] Seattle Public Utilities, Street Edge Alternatives Project, http://www.seattle.gov/util/About_SPU/Drainage_&_Sewer_System/GreenStormwaterInfrastructure/NaturalDrainageProjects/StreetEdgeAlternatives/index.htm (last visited Jan. 8, 2010).

lands that filtered stormwater before it entered the river.[58] This project replaced a prior system that involved discharge pipes carrying stormwater around the wetlands and directly discharging into the river. A subsequent five-year monitoring study focused on stormwater quality improvement found that in addition to reducing flows, the wetlands reduced total suspended solids by eighty percent, total phosphorus by seventy, and oxygen depleting substance and heavy metal concentrations by sixty percent.[59]

While green infrastructure projects require commitment in terms of vision, policy, and personnel, cities have also found that they can be cost-efficient. For example, Philadelphia, Pennsylvania's use of green infrastructure in urban planning and development has saved approximately $170 million since 2006 by reducing flow into the city's combined sewer system.[60] Cities such as Portland, Oregon,[61] Chicago, Illinois,[62] Milwaukee, Wisconsin,[63] Pittsburgh, Pennsylvania,[64] and Seattle,

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[58] The Rouge River Project, Inkster Wetlands Project (2004), http://www.rougeriver.com/wetlands/inkster/index.html.

[59] Wayne County Rouge River Nat'l Wet Weather Demonstration Project, Inkster Wetlands, Wayne County, MI 2 (2002), http://www.rougeriver.com/pdfs/wetlands/wet-00.pdf.

[60] U.S. Envtl. Prot. Agency, Green Infrastructure Case Studies: Philadelphia, http://cfpub.epa.gov/npdes/greeninfrastructure/gicasestudies_specific.cfm?case_id=62 (last visited Jan. 8, 2010).

[61] U.S. Envtl. Prot. Agency, Green Infrastructure Case Studies: Portland, http://cfpub.epa.gov/npdes/greeninfrastructure/gicasestudies_specific.cfm?case_id=64 (last visited Jan. 8, 2010).

> In an effort to promote sustainable development, Portland has implemented multiple green infrastructure projects and programs and become a leader in the green infrastructure movement. In addition, the city has developed a series of policy decisions, which include requiring new municipal buildings to [sic] a green roof and paying homeowners for disconnecting their downspouts.

*Id.*

[62] U.S. Envtl. Prot. Agency, Green Infrastructure Case Studies: Chicago, http://cfpub.epa.gov/npdes/greeninfrastructure/gicasestudies_specific.cfm?case_id=60 (last visited Jan. 8, 2010) ("Chicago launched an extensive green roof program, installing more than 80 green roofs in the city, as part of their green infrastructure initiative."); *see* Minnesota Green Roofs Counsel, RoofBloom: Green Your Garage 6 (2007), http://www.roofbloom.org/roofbloom-vol1-082007.pdf. ("In 2006, Chicago boasted two million square feet of green roofs either installed or underway.").

[63] U.S. Envtl. Prot. Agency, Green Infrastructure Case Studies: Milwaukee, http://cfpub.epa.gov/npdes/greeninfrastructure/gicasestudies_specific.cfm?case_id=61 (last visited Jan. 8, 2010).

[64] U.S. Envtl. Prot. Agency, Green Infrastructure Case Studies: Pittsburgh, http://cfpub.epa.gov/npdes/greeninfrastructure/gicasestudies_specific.cfm?case_id=63 (last visited Jan. 8, 2010).

Washington[65] have taken meaningful steps towards green infrastructure implementation, offering financial incentives to install green roofs and to undertake infrastructure improvement projects.[66]

It is important to note that enhanced progress and innovation in adopting green practices correlates with those cities that are at the forefront of the policy and institutional changes necessary to enable and empower such programs. These cities have devoted the necessary public funding to promote and sustain green infrastructure projects. For example, in 2006, Chicago's Department of the Environment received 123 applications when it announced that it would provide twenty $5000 grants for small-scale commercial and residential green roofs.[67]

Similarly, leading cities have revised their stormwater regulations to emphasize the importance of on-site retention and treatment and to explicitly state a preference for green infrastructure approaches. For example, Seattle has a "Green Factor Ordinance" that allows green roofs to fulfill a requirement that commercial structures, residential structures, and parking lots over a certain size achieve a "green factor."[68] Seattle Public Utilities is also attempting to integrate green roofs into the Seattle stormwater code by quantifying the stormwater benefits of green roofs through use of its Western Washington Hydrologic Model.[69] While green roofs are not mandated, these proactive steps encourage current and future developers to consider green roofs in development projects.

There also are many green roof incentive programs throughout the United States. For example, Portland, Oregon has an "eco-roof" incentive program[70] whereby developers can earn larger development spaces if their proposals include plans for a green roof.[71] These bo-

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[65] U.S. Envtl. Prot. Agency, Green Infrastructure Case Studies: Seattle, http://cfpub.epa.gov/npdes/greeninfrastructure/gicasestudies_specific.cfm?case_id=65 (last visited Jan. 8, 2010).

[66] Will Hewes, Am. Rivers, Creating Jobs and Stimulating the Economy Through Investments in Green Water Infrastructure 5 (2008).

[67] Press Release, City of Chicago, Dep't of Env't, City Launches Green Roofs Grants Program (Nov. 2, 2005) (on file with Boston College Environmental Affairs Law Review); *see also* Alexandra Dapolito Dunn & Nancy Stoner, *From Rooftops to Rivers: Green Infrastructure Yields Economic and Environmental Benefits*, Am. Pub. Works Ass'n Rep. Online, Feb. 2008, http://www.apwa.net/publications/reporter/ReporterOnline/index.asp?DISPLAY=ISSUE&ISSUE_DATE=022008&ARTICLE_NUMBER=1691 [hereinafter *Green Infrastructure Yields Benefits*].

[68] Seattle Wash. Mun. Code § 23.47A-016 (2006).

[69] Greenroofs.com, Industry Support, http://www.greenroofs.com/Greenroofs101/industry_support.htm (last visited Jan. 8, 2010).

[70] City of Portland, Stormwater Management Manual 2-37 (2008).

[71] RESOLVE, Public Funding Incentives for Private Residential and Commercial Watershed Protection Projects: Report on Key Case Studies and Community Workshop 1-8 (2007).

nuses are given in relation to the amount of area the proposed eco-roof will cover in proportion to the area of the development project.[72] Similarly, Chicago offers an incentive fund that promotes the use of green roofs and encourages their installation in the downtown area.[73]

Progressive cities have also structured their utility fees to provide a fee discount when green controls are installed.[74] Notably, some researchers have demonstrated that city leadership through green roofs on publicly-owned buildings can effectively establish an educated roofing industry and experienced installers for future green roof construction.[75] Cities like Chicago and New York City have even started tax incentive programs to encourage urban gardening.[76]

## III. Removing Identified Legal and Policy Barriers to Green Infrastructure

In light of the fact that green infrastructure makes environmental sense and can directly benefit urban life for poverty stricken residents, it is all the more crucial that barriers to green infrastructure be removed, and that incentives be created. This Part of the Article discusses the origin of some of the common barriers to green infrastructure implementation, and offers suggestions as to how city councils and other authoritative bodies can remove these barriers.

### A. *Promote Acceptance Through Quantification Models and Regulatory Reform*

As noted in this Article, one of the primary drivers for urban green infrastructure is managing urban stormwater and controlling combined sewer overflows (CSOs).[77] Cities are required to undertake these actions to meet important regulatory objectives, such as compliance with municipal storm sewer regulatory regimes[78] and significantly re-

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[72] *See id.* at 1-9.

[73] Christopher P. Perzan, *Environmental Protection: What You Should Know About Green Building*, CBA Rec. Nov. 2006, at 39, 42.

[74] *Green Infrastructure Yields Benefits*, *supra* note 67.

[75] *See* T. Carter & L. Fowler, *Establishing Green Roof Infrastructure Through Environmental Policy Instruments*, 42 Envtl. Mgmt. 151, 154–55 (2008).

[76] Marian Burros, *Urban Farming, A Bit Closer to the Sun*, N.Y. Times, June 16, 2009, at D1.

[77] *See supra* Part. I.A.

[78] U.S. Envtl. Prot. Agency, Stormwater Discharges from Municipal Separate Storm Sewer Systems, http://cfpub.epa.gov/npdes/stormwater/munic.cfm (last visited Jan. 8, 2010) (discussing EPA stormwater regulations for large and small cities).

ducing combined sewer overflows under the Clean Water Act.[79] The power of regulation to transform, to spur change, and to direct investment cannot be overstated. Research shows that a common driver among many cities using green infrastructure is the need to assure compliance with regulatory requirements.[80] For example, Portland, Oregon's sophisticated green infrastructure program is designed to promote the city's compliance with several Clean Water Act regulatory requirements, such as controlling and reducing CSOs, protecting groundwater and removing pollutants.[81] Thus, it is imperative to explore the role of regulatory requirements and to modify them to facilitate and promote—and to identify regulatory barriers to—the choice of green infrastructure.

When green infrastructure projects—particularly those designed to minimize and control storm flows—are undertaken to facilitate compliance with regulations, compliance is expected to be shown certainly and definitively; it is rarely an imprecise science. Consequently, many cities are deterred from choosing green infrastructure over pipe and concrete "grey infrastructure," as the regulatory effectiveness of grey infrastructure has been shown over time, while green infrastructure is perceived as more uncertain. For example, models have shown that trees with mature canopies can absorb the first half-inch of rainfall.[82] Given that trees, however, do not reach canopy maturity for some time, they inevitably yield regulatory uncertainty. One way to promote green infrastructure, then, is to find ways to modify or adjust compliance timeframes to accommodate the inherent uncertainty that accompanies the growing field of green infrastructure techniques and approaches.

The unavoidable reality of demonstrating compliance with regulatory standards makes it incumbent on proponents of green infrastructure to refine models that can quantify green infrastructure approaches and their costs, measure the various benefits yielded by green infrastructure, and enhance the likelihood of their approval by regulatory authorities. Small scale projects have been effectively implemented and

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[79] Combined Sewer Overflow Policy, 59 Fed. Reg. 18,688, 18,689 (Apr. 19, 1994).

[80] *See* Klaus Bosselmann, *Poverty Alleviation and Environmental Sustainability Through Improved Regimes of Technology Transfer,* 2 Law Env't & Dev. J. 19, 32 (2006).

[81] *See* Ctr. for Neighborhood Tech., Green Infrastructure Community Profile: Portland, Oregon 1 (2007).

[82] Jennifer Seitz & Francisco Escobedo, Univ. of Fla. IFAS Extension, Urban Forests in Florida: Tree Control Stormwater Runoff and Improve Water Quality 1–2 (2008), *available at* http://edis.ifas.ufl.edu/pdffiles/FR/FR23900.pdf.

measured by cities. For example, Chicago, Illinois successfully implemented a program with measurable impacts through its Green Alley Program.[83] To control flooding caused by runoff from one alley, Chicago officials removed asphalt and replaced it with a permeable paving system. The city then measured the alley's capability to infiltrate and retain the volume of a three-inch, one-hour rain event.[84] Being able to quantify the effectiveness of green infrastructure on a small scale is one way to promote regulatory and enforcement acceptance, which thereby enhances its appeal to city officials.

Models for measuring large scale green infrastructure projects are likewise important. University of California at Davis researchers estimated that for every 1000 deciduous trees in California's Central Valley, stormwater runoff is reduced by nearly one million gallons, saving thousands of dollars in treatment costs.[85] With the Obama Administration promoting economic recovery through green projects and a green economy, cities may find regulatory officials more willing to endorse green infrastructure as part of municipal Clean Water Act compliance programs. To facilitate access to models for measuring green infrastructure projects, the United States Environmental Protection Agency (EPA) has greatly increased its resource library of green infrastructure calculators, showing that while there are a variety of ways to approach the mathematics, savings and measurable results are calculable.[86]

### B. *Increase Public Funding and Incentives for Green Infrastructure Projects*

As demonstrated earlier in this Article, when public funding is available, cities more aggressively move forward with green projects.[87] Thus, to spur green projects in urban areas, federal, state, and local funding needs to be made available; and to direct those efforts to the more poverty stricken parts of cities, those funding programs should prioritize funds for green infrastructure projects directed at these areas.

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[83] *See generally* City of Chicago, The Chicago Green Alley Handbook (2007), *available at* http://brandavenue.typepad.com/brand_avenue/files/greenalleyhandbook.pdf (providing guidance on Chicago's program).

[84] Crystal Calarusse & Christopher Kloss, Natural Res. Def. Council, Rooftops to Rivers: Green Strategies for Controlling Stormwater and Combined Sewer Overflows 19 (2006).

[85] Ctr. for Urban Forest Research, http://www.ci.issaquah.wa.us/Files/EX%20B3%20Center%20Urban%20Forest.pdf (last visited Jan. 8, 2010).

[86] *See* U.S. Envtl. Prot. Agency, Managing Wet Weather with Green Infrastructure: Models and Calculators, http://cfpub.epa.gov/npdes/greeninfrastructure/modelsandcalculators.cfm (last visited Jan. 8, 2010) [hereinafter Models & Calculators].

[87] *See Green Infrastructure Yields Benefits*, *supra* note 67 and accompanying text.

To promote awareness of funding available for green infrastructure projects, EPA has cataloged a variety of federal programs where funding for green infrastructure projects may be available.[88] Meaningful funding for such projects at the state and local levels remains generally elusive, but is starting to become more common.[89]

There are a variety of other ways to create funding for, and to incentivize, green solutions. For example, introduced on May 7, 2009, House Bill 2336, the Green Resources for Energy Efficient Neighborhoods Act[90] would make "energy efficiency practices more affordable, accessible and achievable by consumers, businesses and government entities."[91] The bill also promotes green building by nonprofit affordable housing developers by allowing the creation of grants to nonprofit organizations to increase low-income community development capacity;[92] authorizes an energy efficiency and conservation demonstration program for project-based Section 8[93] multifamily housing developments;[94] and establishes a loan fund to allow states and tribes to help home and apartment building owners improve energy efficiency via renewable energy and related methods.[95]

The American Recovery and Reinvestment Act of 2009 dedicates at least $1.2 billion to green infrastructure, prioritizing sustainable, environmentally responsible development.[96] To receive these green infra-

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[88] *See* Models & Calculators, *supra* note 86.

[89] *See* State Envtl. Res. Ctr., Green Infrastructure State Activity Page, http://www.serconline.org/grInfrastructure/stateactivity.html (last visited Jan. 8, 2010).

[90] H.R. 2336, 111th Cong. (2009).

[91] Press Release, Rep. Ed Perlmutter, Rep. Perlmutter, Sen. Whitehouse Promote Energy Efficient Housing Legislation (July 8, 2009), *available at* http://perlmutter.house.gov/PRArticle.aspx?NewsID=806.

[92] H.R. 2336 § 18.

[93] "Section 8, or the Housing Choice Voucher Program, is a [f]ederal housing program which provides housing assistance to low-income renters and homeowners. This assistance comes in the form of rental subsidies, limiting the monthly rent payment of the assistance recipient." Affordable Housing Online, Section 8 Housing and Apartments: Common Questions, http://www.affordablehousingonline.com/section8housing.asp (last visited Jan. 8, 2010).

[94] H.R. 2336 § 5.

[95] *Id.* § 23.

[96] U.S. Envtl. Prot. Agency, Implementation of the American Recovery and Reinvestment Act of 2009 (Recovery Act), http://www.epa.gov/water/eparecovery/ (last visited Jan. 8, 2010) [hereinafter Implementation of Recovery Act].

> The American Recovery and Reinvestment Act of 2009 provides significant funding for states to finance high priority infrastructure projects needed to ensure clean water and safe drinking water .... EPA is making Recovery Act grants to states and Puerto Rico to capitalize their State Revolving Fund (SRF) programs, from which assistance is provided to finance eligible high priority wa-

structure funds, states must provide at least twenty percent of their grants for green projects such as green roofs, rain gardens, pocket wetlands, native vegetation, sustainable streets and parking lots, and other landscape-based water-conserving measures.[97] The Act acknowledges the relationship between these green projects and water quality by noting that "these and additional 'environmentally innovative activities' [are] keys to shoring up the nation's aging, over-stretched waste water and drinking water infrastructure."[98]

Making public dollars and incentives available for green infrastructure should be seen as an economic boon, not subsidization. The economic potential of the green infrastructure industry has been documented, with some reports finding that a "$10 billion investment in water efficiency projects would produce a total economic output of $25–28 billion, create 150,000–220,000 jobs and save 6.5–10 trillion gallons of water."[99] Recognizing that America's water infrastructure is in dire need of investment,[100] it only makes sense to find ways to make the needed investments using green infrastructure methods due to their ancillary human health, poverty mitigating, and environmental benefits, rather than traditional pipe and concrete solutions.

### C. *Develop Legal Structures that Facilitate Green Solutions*

Just as important as direct funding and incentive programs to green infrastructure are legal structures that can promote discretion and resources at the local level to facilitate green projects. For example, many geographic areas in the United States are finding that the creation

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> ter infrastructure projects. The states will set priorities based on public health and environmental factors, in addition to readiness to proceed to construction, and identify which projects will receive funding. States must provide at least 20% of their grants for green projects, including green infrastructure, energy or water efficiency, and environmentally innovative activities.

*Id.*; *see* Ctr. for Neighborhood Tech., Support the "Green Infrastructure for Clean Water Act"!, http://www.cnt.org/news/2009/02/27/support-the-green-infrastructure-for-clean-water-act/ (last visited Jan. 8, 2010).

[97] Implementation of Recovery Act, *supra* note 96; Ctr. for Neighborhood Tech., *supra* note 96.

[98] Ctr. for Neighborhood Tech., *supra* note 96.

[99] Hewes, *supra* note 66, at 3.

[100] *See* Am. Soc'y of Civil Eng'rs, Report Card for America's Infrastructure, http://www.infrastructurereportcard.org (last visited Jan. 8, 2010) (rating America's wastewater infrastructure a D-minus in its 2009 infrastructure report card, demonstrating the overdue nature of needed investments).

of stormwater utilities[101] allows them to collect fees from system users, and then apply those dedicated funds in part to green infrastructure solutions or to incentivize the voluntary implementation of green infrastructure.[102] Alternatively, Portland's Clean River Rewards program credits up to thirty-five percent of the standard stormwater fee when properties retain stormwater on site.[103] Another option is dedicating a certain portion of collected local tax revenues to a stormwater fund.[104] This approach has the beneficial effect of protecting stormwater funds from diversion to other local priorities, and allows municipalities to identify a preference for green infrastructure or allocate funds based upon proportionate use of green management techniques.[105] Even more revolutionary would be to develop programs that target these green investments in impoverished portions of cities—accomplishing the poverty alleviating benefits outlined earlier in this Article.[106] Cities may need to design organizational structures to achieve these goals, and modify or change revenue collection mechanisms; however, the results could dramatically transform cities and the lives of the residents of their most blighted neighborhoods.

Construction permits are another area where green infrastructure requirements in regulations may be beneficial. General construction permits for the Big Darby Creek Watershed near Columbus, Ohio include riparian setbacks and infiltration requirements.[107] In North Caro-

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[101] U.S. Envtl. Prot. Agency, EPA 901-F-09-004, Funding Strormwater Programs 1 (2009) ("More than 800 communities or districts across the country have adopted a stormwater utility to help fund the costs of stormwater programs, including the costs of regulatory compliance, planning, maintenance, capital improvements, and repair or replacement of infrastructure.").

[102] *See, e.g.*, Press Release, Dep't of Pub. Works, City of Indianapolis, City's Pilot Separation Project to Utilize Green Infrastructure, (June 25, 2009), http://www.indy.gov/eGov/City/DPW/Environment/CleanStream/PR/Pages/FallCreekGreenInfrastructurePilotProjectNewsRelease.aspx (describing the city's green infrastructure and stormwater control pilot project that uses sanitary sewer user fees).

[103] Portland Bureau of Envtl. Servs., Clean River Rewards: Frequently Asked Questions, http://www.portlandonline.com/BES/index.cfm?c=43438& (last visited Jan. 8, 2010).

[104] Quite a few U.S. cities have local stormwater funds, such as Chapel Hill, North Carolina and Baytown, Texas. *See e.g.*, City of Baytown, Storm Water Utility Fund (2009), *available at* www.baytown.org/budgetfiles/11-StormWaterUtilityFund.pdf (detailing the stormwater utility fund in the context of Baytown's 2009-2010 budget).

[105] *See* Chicago Metro. Agency for Planning, *supra* note 20, at 17–18.

[106] *See supra* Part I.C–E.

[107] *See* Ohio Envtl. Prot. Agency, Modification of NPDES General Permit No. OHC100001 (June 8, 2007).

> Groundwater Recharge Requirements. The SWP3 [Storm Water Pollution Prevention Plan] shall ensure that the overall site post-development groundwater recharge equals or exceeds the pre-development groundwater recharge. The

lina, a general permit to construct, operate, and maintain impervious areas associated with residential developments disturbing less than one acre requires that "[s]tormwater runoff shall be managed" using rain cisterns or rain barrels, construction of uncovered driveways, parking areas and walkways out of permeable pavement, installation of rain gardens, and any other stormwater best management practices that meet statutory requirements.[108] New Jersey's Stormwater Management Rules require that a "major development" project—one that disturbs at least one acre of land or creates at least 0.25 acres of new or additional impervious surface—either demonstrate that the site and its stormwater management measures maintain 100 percent of the average annual preconstruction groundwater recharge volume for the site or show that the increase of stormwater runoff volume is infiltrated.[109] Even local policies can be crafted to reflect a community's commitment to green, healthy, sustainable living.[110]

Many stormwater regulations focus on peak flow rate control and flood control, and not on retention of stormwater and recharge of groundwater resources or other green infrastructure benefits. Another policy solution would be to focus on revising such regulations to promote green infrastructure by requiring the minimization of impervious surfaces, the protection of existing vegetation, maintaining pre-development runoff volume and infiltration rates, and achieving water quality goals. A good example of such a program is the one adopted by New Jersey. The state's stormwater program requires 300-foot riparian buff-

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> SWP3 shall describe the conservation development strategies, BMPs and other practices deemed necessary by the permittee to maintain or improve pre-development rates of groundwater recharge. Protection of open space (infiltration areas) shall be by binding conservation easements that identify a third party management agency, such as a homeowners association/condominium association, political jurisdiction or third party land trust.

*Id.*

[108] North Carolina Dept. of Envtl. & Natural Res., General Permit No. SWG050000 (Nov. 19, 2008).

[109] N.J. Admin. Code 7:8-5.4 (2009).

[110] *See* Greeninfrastructure.net, Kingston-Lenoir County Green Infrastructure Plan, http://www.greeninfrastructure.net/content/project/kingston-lenoir-county-green-infrastructure-plan-nc (last visited Jan. 8, 2010) (describing a community green infrastructure plan encompassing conservation and recreation objectives as well as hazard mitigation in Kingston-Lenoir County, North Carolina).

ers and stipulates a preference for non-structural best management practices.[111]

Existing earlier, local zoning requirements and building codes can have the unintended consequence of discouraging the implementation of green infrastructure. For example, cities used to require downspouts to be connected to the storm sewer system. When these requirements remain in place, they can deter downspout disconnection programs, which have been shown to be effective and promote the use of captured water for irrigation, green roofs, or other on-site applications.[112] Stormwater regulations often specify street widths and building setbacks, which can add to the amount of impervious surface cover.[113] Some communities are now evaluating their ordinances to identify and remove inadvertent barriers to green infrastructure.[114] Though recent laws allow rain capture, in parts of the western United States, it is illegal to catch rainwater due to prior appropriation laws.[115]

Another green infrastructure barrier can be the challenge of retrofitting existing urban areas to incorporate green infrastructures.[116] Today, green approaches are more readily included in building plans for new development; however, the stresses on urban city budgets and the urgency of repairs can make it difficult to change traditional approaches. For example, budget constraints and urgency may impede a transition from impervious pavement to permeable pavement when making street repairs. However, with attention and the requisite political will, retrofit barriers can be removed.

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[111] N.J. Admin. Code 7:8-5.2, -5.5 (2009); New Jersey Dep't of Envtl. Prot., Stormwater Outreach, http://www.state.nj.us/dep/stormwater/tier_A/index.htm (last visited Jan. 8, 2010).

[112] U.S. Envtl. Prot. Agency, Managing Wet Weather with Green Infrastructure: Municipal Handbook 3–4, 9 (2008) [hereinafter Municipal Handbook]; *see also Coming to a Neighborhood Near You: Disconnected Downspouts*, L.A. Stormwater (Stormwater Program, Los Angeles, Cal.), Fall 2008, at 5, *available at* http://www.lastormwater.org/Siteorg/download/pdfs/newsltrs/2008-newsltr-IV.pdf.

[113] Dunn & Stoner, *supra* note 56, at 35–36.

[114] *See, e.g.*, Posting of Liz Shaw to Mlive.com, http://blog.mlive.com/get-healthy-ingenesee/2009/07/flint_to_consider_ordinance_ch.html (July 7, 2009, 09:25 CST) (noting that zoning regulations in Flint, Michigan were developed at a time when green considerations were not a priority).

[115] Kirk Johnson, *It's Now Legal to Catch a Raindrop in Colorado*, N.Y. Times, June 29, 2009, at A1 (noting that it is illegal to catch rain in Utah and parts of Washington State; however, it is mandatory for some new buildings in Santa Fe, New Mexico).

[116] Municipal Handbook, *supra* note 112, at 3–4.

To facilitate urban farming, local regulations may need to be adopted or changed to clearly allow urban farming.[117] Concerns about toxins in urban soil may need to be investigated, and commercial growing may need to be regulated differently than non-commercial activities.[118] Furthermore, urban planners will need to play a role in furthering urban farming by considering it when scoping and charting a city's future and by seeking to promote these opportunities in low income areas where the benefits of lower food costs can directly impact those living in poverty.[119]

### D. *Raise Public and Policy Makers' Awareness*

One way to promote green infrastructure and all its ancillary benefits is to increase public awareness of its availability so that they can advocate for these types of investments in their communities.[120] Similarly, the more policy makers are aware of green infrastructure, the more

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[117] Martha Groves, *Pocket Farm May Get Turned Out*, L.A. Times, July 31, 2009, at A12 (documenting that vague zoning regulations and toxic concerns could stop a local farming operation); *see also* Bill Cleverley, *Revised Bylaw Will Welcome Urban Farming*, Times Colonist (Victoria, B.C.), Oct. 4, 2008, at A6. (documenting changes to bylaws in Victoria, Canada to facilitate fruit and vegetable urban agriculture).

[118] *See* Shaw, *supra* note 114 (noting that toxins may limit the viability of some urban sites for farming in Flint, Michigan).

[119] *See, e.g.*, Heather Knight, *Mayor Has Food on His Mind*, S.F. Chron., July 9, 2009, at A1. (describing how San Francisco Mayor Gavin Newsom has ordered city departments to "conduct an audit of unused land-including empty lots, rooftops, windowsills and median strips that could be turned into community gardens or farms that could benefit residents, either by working at them or purchasing the fresh produce"); Farm Fresh Rhode Island, Urban Agriculture in RI, http://www.farmfreshri.org/learn/urbanagriculture_providence.php (last visited Jan. 8, 2010) (showing how advocates in Providence, Rhode Island are urging the city to consider urban farming as part of its comprehensive planning efforts); Shaw, *supra* note 114 (discussing how Flint, Michigan is looking at its zoning ordinances to explore urban agriculture).

[120] Several campaigns are already underway to raise public awareness of green infrastructure and its benefits. *See, e.g.*, U.S. Envtl. Prot. Agency, Managing Wet Weather with Green Infrastructure, http://cfpub.epa.gov/npdes/home.cfm?program_id=298 (last visited Jan. 8, 2010) (showing how the EPA has dramatically increased the number of resources to support green infrastructure that area available on its website); Nat'l Assoc. of Reg'l Councils, Green Regions, http://narc.org/uploads/greenregions/GreenRegions.htm (last visited Jan. 8, 2010) (describing Green Regions as "a public awareness campaign and website created to support regional councils . . . and metropolitan planning organizations . . . in their role of environmental stewards and managers" and assisting regional leaders "in applying innovative and cost-effective solutions and in harnessing the benefits of the green economy"). The Green Infrastructure Foundation "was founded in 2007 to respond to the need for greater awareness and resources to promote green infrastructure in local communities." Green Infrastructure Found., http://www.greeninfrastructurefoundation.org (last visited Jan. 8, 2010).

they can promote its adoption within their jurisdictions.[121] Leadership at the local, state, and national level is critical to furthering the investigation and implementation of green infrastructure.

Notably, while the green infrastructure movement has accelerated in many cities, and community outreach programs and political speeches are promoting the value of green infrastructure, as this Article has demonstrated, green infrastructure is still predominantly driven by a water compliance agenda.[122] Due to their aesthetic appeal, green infrastructure projects may be not be targeted to lower income areas of a city where they could be considered less visible. A meaningful opportunity exists to enhance the conversation about the value of green infrastructure. Not only does it help to achieve water quality goals, but it also can directly improve the quality of life for the urban poor.[123] When the myriad of benefits yielded by green infrastructure are explained, the reasons for its implementation in lower income areas of cities become more compelling.

## Conclusion

Finding an effective approach to improve urban water quality has been elusive for cities across the nation. Raising the overall quality of life for the urban poor is also a daunting challenge. This Article demonstrates that cities are developing a track record of success in the green infrastructure arena. They are demonstrating that green infrastructure is an economically and environmentally viable approach for water management and natural resource protection in urban areas. What this Article argues that green infrastructure has additional and exceptional benefits which are not frequently highlighted or discussed. Not only can it achieve water quality goals, protect sewer systems, and recharge groundwater supplies, but it also can improve air quality, provide green collar jobs, become a source for affordable produce, reduce

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[121] *See* Knight, *supra* note 119 (documenting the leadership of San Francisco Mayor Gavin Newsom on urban agriculture). Chicago's Mayor Daley and Milwaukee, Wisconsin's mayor Tom Barrett also have been vocal advocates for green infrastructure for stormwater and sewer control. *See Efforts to Address Urban Stormwater Runoff: Hearing Before the Subcomm. on Water Res. & Env't of the H. Comm. on Transp. & Infrastructure*, 111th Cong. 9 (2009) (testimony of Hon. Tom Barrett, Mayor, Milwaukee, Wis.); Press Release, Mayor Richard M. Daley, Mayor Daley Unveils Water Agenda: Sets Standards for Water Management (Apr. 8, 2003) (on file with Boston College Environmental Affairs Law Review) ("By expanding our use of green infrastructure, Chicago can demonstrate the common-sense approach of managing storm water before it reaches the sewer system.").

[122] *See supra* Part III.A.

[123] *See supra* Part I.

crime, promote community interconnectedness, and reduce energy costs for the urban poor. With these considerations in mind, it is essential for our legal systems to remove barriers to green infrastructure implementation, for regulators and enforcers to promote its acceptance, and for public advocates and policy makers to embrace its incorporation into urban design and planning, particularly in distressed communities. Given the growing stresses on urban centers and the urban poor, taking proactive steps to make city life healthier and more sustainable can only yield further benefits in the future.