INTERNATIONAL LOW IMPACT DEVELOPMENT CONFERENCE
2015

LID: It Works in All Climates and Soils

PROCEEDINGS OF THE 2015 INTERNATIONAL LOW IMPACT DEVELOPMENT CONFERENCE

January 19-21, 2015
Houston, Texas

SPONSORED BY
Low Impact Development Technical Committee
of the Urban Water Resources Research Council
of the Environmental and Water Resources Institute
of the American Society of Civil Engineers

EDITED BY
Michael Barrett, Ph.D., P.E., D.WRE

Published by the American Society of Civil Engineers
Encouraging Human Health and Wellness:
LID Planning & Design for Co-Benefits

Kathleen L. Wolf, Ph.D. ¹

¹ School of Environmental and Forest Sciences, College of the Environment,
University of Washington, College of the Environment, Box 352100, Seattle, WA
98195; PH (206) 780-3619; email: kwolf@u.washington.edu

ABSTRACT

Low impact development (LID) and green infrastructure are both conceptual and
practical strategies that can upgrade urban landscapes to manage urban water,
including surface water and ground water recharge. Landscapes in cities and towns
are a limited resource and they must be ‘multi-tasking’ to optimize functions and
benefits. Communities and infrastructure professionals are increasingly interested in
the co-benefits that are possible if LID installations incorporate multiple purposes.
Nearby nature and urban ecosystems within cities and towns includes all ecological,
cultural, and engineered green spaces, such as (but not limited to) parks, open spaces,
community gardens, and the urban forest. These spaces, in addition to private
properties, are potential LID sites. Environmental services are important yet nearly 40
years of research across social disciplines demonstrates a broad array of human health
and wellness benefits associated with the human experience of metro nature. A health
oriented co-benefits approach in LID planning and design can promote expanded
community support for LID, and potential collaborations with diverse partners, such
as urban planners, social services providers, and public health professionals.

For many urban residents the term infrastructure brings to mind roads, pipes, and
power lines. Green infrastructure systems, however, are practical integrations of built
and ecological systems (Benedict and McMahon 2006), that incorporate all natural,
semi-natural and constructed green spaces within, around, and between built areas
(Tzoulas et al. 2007), to replace or augment more traditional gray infrastructure.
With careful design green spaces can achieve runoff management and provide a range
of additional co-benefits. Integrated planning of green infrastructure and parks and
open space systems can be a cost-effective strategy that provides multiple benefits
and contributes to more livable communities.

Designing green infrastructure, including low impact development (LID) for
stormwater management as well as co-benefits, particularly human health, offers
several opportunities. The cost-benefit analysis of green infrastructure installations can include a broader set of economic returns. Design and project messaging that incorporates the co-benefits of health and wellness may engage additional community partners and be more compelling to the general public. Further, organizations and neighborhoods can be enlisted to help with installation and maintenance, to develop green jobs training, and build greater social capital. Treating green infrastructure planning and design as an opportunity to create better human habitat may engage community members and residents in support and management of LID.

MULTI-TASKING NATURE AND CO-BENEFITS

Stormwater systems planners and engineers are incorporating LID elements, such as bioswales and vegetative systems, into infrastructure to reduce flow to pipes and drains. Meanwhile, park planners and managers are integrating larger park parcels, conservation lands, and community open spaces into nearby nature systems that are accessible and improve quality of life.

Can these two efforts be combined? In many cities, land for public use is expensive or difficult to repurpose. Every parcel or easement is ever more valuable. The use and public value of each bit of urban public land must be optimized.

Multi-tasking is a term that is a reflection of today's busy lifestyles. While dividing attention across multiple activities can actually reduce a person’s productivity, nature, on the other hand, multitasks quite well. Every small patch of nature in cities and built areas can be ‘hyperfunctional’ and provide co-benefits (Thomas and Geller 2013). While performing the primary purpose of stormwater management, green infrastructure can also be designed to augment parks systems and provide places of respite, recreation, and delight.

There is precedent for this approach. Urban planners once segregated land uses across the city, with residential units placed away from commercial parcels. Today mixed-use zoning emphasizes residential buildings that have retail and commercial businesses at the street front. These combinations typically contribute to more dynamic, livable communities. Similarly, green infrastructure installations can be integrated with citywide parks and green spaces to offer diverse experiences and services for city residents.

INTEGRATING SCIENCES

The Environmental and Water Resources Institute's mission includes a commitment to "advancing the knowledge and improving the understanding of relevant sciences." Other organizations that are committed to science and evidence-based policy are increasingly adopting an integrated sciences, systems-based approach. For instance, the long-term goal of the U.S. National Academies’ Science and Technology for Sustainability (STS) Program is to contribute to sustainable improvements in human well-being by creating and strengthening the strategic connections between scientific
research, technological development, and decision-making. The Program examines issues at the intersection of the three sustainability pillars—social, economic, and environmental—and aims to strengthen science for decision-making related to sustainability.

In addition, the most prominent international health policy entity, the World Health Organization, provides leadership on both the global health research agenda and articulating evidence-based policy options, as well as monitoring and assessing health trends. These actions are guided by the WHO definition of health as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity", a statement that implies the engagement of diverse disciplines.

There are similar perspectives in the sciences. Scholars of science fields, from economics and sociology to ecology and earth sciences, call out the importance of explicitly linking human and ecological processes when studying the well-being of both natural and social systems, particularly in urban areas (Gragson and Grove 2006, Crane and Kinzig 2005, Alberti 2008). Studies and models of successful coupled human-natural systems are needed, as complex, co-dependent processes may not be understood when studied separately by social or natural scientists (Liu et al. 2007).

Social-ecological systems is a term being applied to the integrated study of landscape and human systems. In the face of limited or declining fiscal and technical resources for ecosystem management, organizations must consider new solutions to sustain natural systems across the landscape gradient (Wolf et al. 2011). Better understanding of human response, present and potential, is a critical aspect of environmental problem solving, and reinforces the need to address challenges with a social-ecological systems outlook (Berkes et al. 2003).

**HEALTH AND WELLNESS BENEFITS EVIDENCE**

LID can be implemented as a social-ecological system that addresses stormwater and hydrology, but also incorporates additional human health opportunities. Scientific evidence should be the basis of future efforts to make cities more sustainable. Nearby nature — including small plots or parcels imbedded within all land uses — directly contributes to quality human habitat (Kuo 2010) and is profoundly important for health of mind and body. A project at the University of Washington provides access to this knowledge base. The website [Green Cities: Good Health](https://www.green-cities.org/) represents a database collection of more than 3,000 scholarly works, most of which are peer reviewed. The papers have been sorted into key themes, each represented by a summary with citations. The evidence of human health and wellness benefits that are derived from built environments, as presented here, is but a small sample of the extensive research about the importance of nearby nature in cities and towns.

**Active living.** Over the last 30 years, adult obesity has doubled in the U.S., and childhood obesity has more than tripled. Similar trends are happening in other nations. The U.S. Centers for Disease Control provides recommendations for weekly
rates of moderate-level physical activity to reduce health risks from obesity and chronic disease (CDC 2014). Improving the walkability of neighborhoods and increasing recreation access helps promote more healthy weight status for people of all ages (Potwarka et al. 2008), including the elderly. A study found that seniors with nearby parks, tree-lined streets, and walkable spaces showed higher longevity over a 5-year period (Takano et al. 2002).

**Stress reduction.** Stress is a major contributor to ill health in modern times. Unresolved, long-term stress can lead to immune system issues and noncommunicable illness or disease (Tyrväinen et al. 2014). The experience of nature is one antidote to stress, and the body’s positive response is remarkably fast, occurring within minutes. Studies by Roger Ulrich and other environmental psychologists show that visual exposure to nature in the form of trees, grass, and flowers can effectively reduce stress, particularly if initial stress levels are high (Ulrich 1986). Mental restoration is also gained from spending time in an urban green space, and increased visit duration — up to 1.5 hours — improves the restorative effect (Korpela et al. 2008).

**Mental health and functioning.** Experiences with nature contribute to better mental health and improve one’s capacity to be productive. Modern life often demands sustained focus on tasks, and this effort can lead to cognitive overload, bringing on irritability, inability to function effectively, and physical symptoms. Brief experiences with or even views of nearby nature help to restore the mind from mental fatigue, as natural settings provide respite from the high-focus tasks in school or at work (Kaplan 1993, Kaplan 1995). This psychological response may contribute to higher workplace productivity as employees with a view of nature are better able to attend to tasks, report fewer illnesses, and have higher job satisfaction.

**Healing and therapy.** Natural experiences are also associated with healing and treatment of emotional and physical disabilities. Hospital patients with views of nature display less pain, shorter hospitalization, less anxiety, and higher hospital and room satisfaction (Ulrich 1984, Park and Mattson 2009). Participating in nature activities can also be used in rehabilitation programs. A group of inmates in a horticulture program had a recidivism rate of 25%, compared to the 65% rate of the general prison population (Jiler 2009).

**Social capital.** Social capital is formed from people’s interpersonal relationships and resulting supportive networks. Social capital is a critical condition for a host of community benefits (Kuo 2003), and contributes to development of socially resilient communities (Tidball et al. 2010). The mere presence of landscapes or trees appears to promote community connections. Views of green space from homes are linked to greater perceptions of well-being and neighborhood satisfaction (Kaplan 2001). Public housing residents reported feeling a greater sense of safety if developments had well-maintained landscaping, including trees and grass (Kuo et al. 1998). Greener public housing neighborhoods tend to be safer, with fewer incivilities and reported crimes (Kuo and Sullivan 2001). Active involvement in community greening and
nature restoration projects also produces a range of social benefits, including strengthening of intergenerational ties and organizational empowerment (Westphal 2003).

**Community economics.** Most economic valuations of city nature have addressed residential property values. According to the *proximate principle*, described by John Crompton, an economist, homes adjacent to naturalistic parks and open spaces are valued from 8 to 20 percent higher than comparable properties (Crompton 2005). Having adjacent street trees also positively affects home values and time on market during sales (Donovan and Butry 2010), while yard trees are associated with both higher property values and rental rates (Morales 1980, des Rosiers et al. 2002, Anderson and Cordell 1988).

There are many more opportunities to express benefits in economic terms. Increased worker productivity and school performance have implications for local industry and workforce development. Nature-based healing and therapy may be reasonably priced supplements in human services programs. Perhaps the most promising valuation opportunity is the relationship between outdoor space and active living. The potential economic consequences of routine, mild physical activity are enormous, when aggregated across entire cities or the nation.

**COMMUNITY COMMITMENT TO LID**

'Social acceptability’ is a term social scientists use to describe the willingness of communities and individuals to adopt or support proposed changes in their communities. The U.S. Environmental Protection Agency provides evidence that green infrastructure can provide more benefits at lesser cost than single-purpose gray infrastructure (EPA 2014). Yet in some communities, there is social resistance to green infrastructure installations at a large scale due to concerns about costs and potential nuisances.

More concerted effort to design for positive human experiences and health benefits may address both stated and implied concerns. Such concerns may be reduced and even transformed to public support. Green infrastructure pilot programs that showcase both stormwater management functions, and health and community co-benefits, offer solutions for a variety of important public issues (Figure 1). A social-ecological systems approach includes acting on opportunities to be flexible and adaptive in LID design to reflect community interests, and generate the highest and best human uses for green infrastructure.
ACKNOWLEDGEMENTS
Support for the Green Cities: Good Health web site is provided by the U.S.D.A. Forest Service, Urban and Community Forestry Program, and the USDA Forest Service Pacific Northwest Research Station.

REFERENCES


