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Research paper

Exploring Green Streets and rain gardens as instances of small scale nature and environmental learning tools

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HIGHLIGHTS

- Multiple points of contact and a diversity of programming aids in stormwater awareness.
- Signage and kinetic art in public places is helpful in engaging the public in stormwater education.
- Green Streets showed potential for fostering stormwater awareness.
- Perceptions of Green Streets as "nature" are not straight forward.

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ABSTRACT

Sustainable stormwater management facilities such as bioswales and rain gardens are one way in which cities are simultaneously addressing the need to replace or repair stormwater infrastructure while also meeting regulatory obligations. Retrofitting patterns of neighborhood development through the implementation of infrastructure like bioswales is localized solution to stormwater management. Such infrastructure addresses sustainability and resilience goals while reflecting the city as part of rather than separate from the ecosystem. This article presents results of a subset of 42 semi-structured interviews collected through an exploratory qualitative case study of Portland Oregon's Tabor to the River program. These findings focus on Green Streets (bioswales), asking whether participants consider them small scale nature, and whether stormwater visibility fosters environmental learning. Results suggest that sustainable stormwater management facilities have potential toward aiding in stormwater awareness, particularly if combined with additional ways of learning (e.g., informational signs). Participant perceptions of Green Streets as small scale nature are less straight forward. This study gives some insight into the subtleties of human experiences with sustainable stormwater infrastructure, giving a glimpse into the potentials of Green Streets, and other educational inputs, in contributing to increased understanding of Portland's stormwater system. Building upon this first attempt at discovering the potential for environmental learning through sustainable stormwater infrastructure, or in their capacity in fostering connectedness with nature, could be instructive for future infrastructure planning and policy development that seeks to foster human–nature connectedness and ecological understanding within our communities.

1. Introduction

Today, whether in growth or decline, cities are faced with regulatory obligations and crumbling infrastructure. The capacity and condition of stormwater infrastructure combined with Federal and State regulations concerning watershed health and water quality are representative of infrastructure related decisions that cities in the United States must address (EPA, 2008a, 2010b). Sustainable stormwater management facilities such as bioswales and rain gardens are designed to hold and infiltrate stormwater, thereby reducing impacts to existing wastewater systems (EPA, 2008b). These types of facilities are one way in which many cities are simultaneously addressing the need to replace and expand stormwater infrastructure while also meeting their regulatory obligations (EPA, 2010a).

"Green infrastructure" (e.g., vegetated stormwater solutions) as an alternative to "gray" infrastructure (e.g., stormwater pipes) solutions is becoming more common place as a lower cost

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infrastructure solution to stormwater management (EPA, 2007; NRDC, 2011). Green infrastructure can be used in conjunction with pipe repair and the expansion of stormwater infrastructure capacity in order to reduce overall amounts of stormwater in the stormwater system. Beyond the scope of capital improvements and regulations, retrofitting patterns of neighborhood development through the implementation of green infrastructure like sustainable stormwater management facilities is a localized urban planning and design strategy that may also contribute to sustainability and resilience goals. Such goals are addressed through their being a decentralized approach to urban planning that reduces downstream environmental impacts (Newman & Jennings, 2008; Novotny et al., 2010), through increased biodiversity due to expanded habitat (Ignatieva, 2010; Beatley, 2011), through reduced stormwater runoff (City of Portland, 2010; NRDC, 2011), and through the contribution to groundwater recharge and the water cycle as a whole (Girling & Kellett, 2005; WAS, 2010).

There are some that contend that in addition to these ecological benefits, there are further social benefits of sustainable stormwater infrastructure such as increased access to nature and opportunity to learn about the stormwater system. For example, one researcher, Kathleen Wolf, includes sustainable stormwater infrastructure in a list of "civic nature" that has potential benefits for human health (Wolf, 2008, 2010). Indeed, some scholars contend that nature as part of daily life has the potential to build awareness of nature and natural processes which might eventually translate to a love of nature and a desire to protect both the local and global environment (Jordan III, 2000; Platt, 2004; Spirn, 1988). Although there are studies that explore public acceptance of ecologically designed landscapes, including those that infiltrate stormwater (Canfield & Gibson, 2013; Nassauer, 1995; Nassauer & Faust, 1998), there are few studies that deal specifically with whether sustainable stormwater infrastructure are perceived of as nature by community members (Apostolaki et al., 2005; Shandas et al., 2012).

Yet another potential benefit of sustainable stormwater infrastructure is due to its visibility. Within the landscape architecture literature, there is a discussion on linking human values to ecology through the design of landscapes that incorporate visible ecological processes. Such visibility would allow for observation of ecological processes, which over time might become a valued and normal aspect of the lived environment (Gobster, Nassauer, Daniel, & Fry, 2007; Mozingo, 1997; Thayer, 1989). Moreover, there is an argument that the visibility of waste or resources can contribute to public understanding of the consequences of production and consumption (Hough, 2004; Newman & Jennings, 2008), which thereby might have an effect on individual behaviors (e.g., driving less, reducing the use of fertilizer, or planting native vegetation). Although some scholars specify utilizing educational elements as part of ecological landscapes in order to foster understanding of ecological processes and acceptance of ecological design (Echols & Pennypacker, 2008; Gobster et al., 2007), this literature review found no research that looks specifically at relationships between stormwater infrastructure visibility and environmental knowledge.

While traditionally bounded by scientifically based goals around stormwater management, water quality and habitat restoration (Bolund & Hunhammar, 1999; Aronson et al., 2007; Dietz, 2007; Moran, 2007), and while there are some studies that look at the benefits (or challenges) of community watershed management and stewardship (Rhoads et al., 1999; Welsch & Heying, 1999; Shandas & Messer, 2008; Chanse, 2011), social benefits of urban sustainable stormwater management solutions have had less study (Apostolaki et al., 2005; Dill et al., 2010). Past research on the social elements of sustainable stormwater infrastructure has evaluated the efficacy of incentives for households to implement stormwater solutions on private property (Keeley, 2007; Shuster et al., 2008; Thurston, 2012). Several studies have looked at urban residents' perceptions and acceptance of sustainable stormwater infrastructure (Apostolaki et al., 2005; Dill et al., 2010; Shandas et al., 2010, 2012). There has been less study on how whether people regard sustainable stormwater infrastructure as nature, or how such infrastructure might contribute to environmental learning.

A number of issues point to the importance of studying how urban residents perceive and interact with sustainable stormwater systems: continued urbanization (United Nations, 2014; U.S. Census Bureau, 2010), "sustainability planning" that focuses upon increased housing densities and compact development (Wheeler, 2004; Ewing et al., 2007; Newman et al., 2008), documented benefits of nature for urban residents (Chiesura, 2004; Kaplan, 1995; Louv, 2005; Tzoulas et al., 2007), trends toward green infrastructure solutions (EPA, 2007; Berkooz, 2011; Odefey et al., 2012), and potential social benefits of sustainable stormwater infrastructure as "civic nature" or in contributing to public understanding of the stormwater system (Hough, 2004; Newman & Jennings, 2008; Wolf, 2010). Outcomes of such research could help planners and policy makers determine how best to integrate green infrastructure solutions for multiple benefits, including ecological health, social health, and long-term sustainability. Might sustainable stormwater infrastructure increase instances of nature into urban areas, potentially offering additional means for urban residents to connect with small scale nature and learn about relationships between stormwater, the built environment, and human behaviors? Might "greening" the built environment have the potential to shape the broader public's perceptions of nature, natural systems, and individual and societal consumption patterns?

This article presents a subset of the results of a larger study that explored how active engagement in urban ecological stewardship activities influenced participants' connection to nature and local environmental knowledge. The entire study entailed the exploration of human interactions and stewardship activities with urban nature and sustainable stormwater infrastructure. The study sought to discover how these interactions and activities contributed to participants' understanding and perceptions of local ecological systems, natural processes, and urban nature.

The research presented here emerged from the intended exploration of "small scale" nature: Green Streets. The results presented in this paper were guided by the questions: *Do community members regard Portland's sustainable stormwater management facilities as instances of small scale nature? How do these facilities contribute to community members' local environmental awareness?* An exploratory endeavor, this research seeks to inform the human dimensions of Green Streets and their implementation, by reporting on community members' general perceptions of the facilities and their potential value as instances of small scale nature and tools for stormwater education. The research reported here gives glimpses into these potentials, thereby providing a basis of work that could be further explored through future research.

2. Context and methods

2.1. Context—Portland, Oregon's Tabor to the River program

The study area entailed portions of six neighborhoods in Inner Southeast Portland, Oregon that were in or proximate to the Tabor to the River (T2R) program: Brooklyn, Hosford-Abernethy, Richmond, South Tabor, Sunnyside, and Mount Tabor. T2R is a localized solution for management of stormwater runoff. The program is situated within Portland's Willamette River watershed, bounded