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Green Infrastructure and the Hidden Politics of Urban Stormwater Governance in a Postindustrial City

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Infrastructure tells a material story of ongoing challenges in cities, reflecting the diverse, normative desires of different communities. In this article we examine the introduction of green infrastructure technologies into urban infrastructure systems to think critically about these challenges and desires. Green infrastructure is an intentionally designed, multifunctional technology that directly uses or mimics the ecological processes of soils and plants (e.g., green rooftops, rain gardens, and bioswales). Facing budget shortfalls as well as demands to mitigate hazards and green the city, urban leaders are looking at green infrastructure as a facility that can provide diverse cobenefits along with traditional services. A focus on stormwater-based metrics, however— effectively reframing green infrastructure as green *stormwater* infrastructure—discursively tamps down alternative politics and desires for the city. Through a case study of Pittsburgh's stormwater governance, we argue that the work to (re)technologize green infrastructure as green stormwater infrastructure is an act of depoliticization that hinders needed conversations about just infrastructure outcomes. We draw on themes from qualitative interviews with community members engaged in urban water governance to suggest that these moments of transition provide an opportunity to illuminate previously obscured infrastructure politics and challenge the forms of knowledge that bind us to conventional routines of urban environmental governance. We see an opportunity to reframe the conversation in a way that opens up opportunities for historically disenfranchised communities to voice their needs beyond the technocratic problem of stormwater management. *Key Words: environmental governance, green infrastructure, green stormwater infrastructure, Pittsburgh, urban political ecology.*

基础建设诉说着城市中持续进行的挑战之物质故事，反应出不同社群多样且规范性的慾望。我们于本文中检视将绿色基础建设技术引入城市基础建设系统中，以批判性地思考这些挑战与慾望。绿色基础建设是刻意设计的多功能技术，并且直接使用或模拟土壤与植物的生态过程（例如绿色屋顶、雨水花园，以及生态截流系统）。面对预算短缺和减缓灾害与绿化城市的需求，城市领导者正诉诸绿色基础建设作为传统服务之外提供多样共同益处的设施。聚焦以暴雨为基础的指标，虽有效地将绿色基础建设重新架构为绿色暴雨基础建设，但却在论述上填充了城市的另类政治与慾望。我们通过匹兹堡暴雨治理的案例分析，主张将绿色基础建设（再）技术化成为绿色暴雨基础建设是一个去政治化的行动，并阻碍了有关正义的基础建设成果的必要对话。我们运用与参与城市水治理的社群成员进行的质化访谈，主张这些变迁的瞬间，提供了阐明过往隐晦的基础建设政治、并挑战使我们服膺于传统城市环境治理范例的知识形式之机会。我们预见重新架构该对话，使其为历史上被剥夺权益的社群开启契机以表达其超越暴雨管理的技术问题之需求的机会。*关键词：环境治理，绿色基础建设，绿色暴雨基础建设，匹兹堡，城市政治生态学。*

La infraestructura cuenta una historia material de los retos que se enfrentan ahora en las ciudades, reflejando los diversos deseos normativos de diferentes comunidades. En este artículo examinamos la introducción de tecnologías de infraestructura verde en los sistemas de infraestructura urbana, para pensar críticamente sobre estos retos y deseos. La infraestructura verde es una tecnología multifuncional diseñada intencionalmente, que usa directamente, o imita, los procesos ecológicos de suelos y plantas (por ej., techos verdes, jardines de lluvia y avenamiento sostenible). Enfrentados a la estrechez presupuestal y a demandas por mitigación de riesgos y al clamor de reverdecer la ciudad, los líderes urbanos están interpretando la infraestructura verde como las instalaciones que pueden generar diversos cobeneficios junto con los servicios tradicionales. Sin embargo, un enfoque de métricas basadas en agua pluvial —replanteando efectivamente la infraestructura verde como infraestructura verde del agua pluvial— discursivamente apabulla las políticas alternativas y deseos de la ciudad. Mediante el caso de la gobernanza del agua pluvial de Pittsburgh, argumentamos que el

trabajo de (re)tecnologizar la infraestructura verde como infraestructura verde del agua pluvial es un acto de despolitización que dificulta las conversaciones necesarias sobre los resultados que rinden las infraestructuras justas. Nos apoyamos en temas de entrevistas cualitativas con miembros de la comunidad involucrados en la gobernanza del agua urbana para sugerir que estos momentos de transición proporcionan una oportunidad para hacer luz sobre lo que previamente fueron políticas infraestructurales oscuras, y para desafiar las formas de conocimiento que nos atan a rutinas convencionales de gobernanza ambiental urbana. Vemos una oportunidad para replantear la conversación de una manera que abra oportunidades a comunidades históricamente privadas de su derecho a reclamar por sus necesidades más allá del tecnocrático problema del manejo del agua pluvial. *Palabras clave: ecología política urbana, gobernanza ambiental, infraestructura verde, infraestructura verde del agua pluvial, Pittsburgh.*

Infrastructure tells a material story of ongoing challenges in cities (Kirkman 2009; Larkin 2013; Wakefield 2018). Although typically defined as systems of physical objects—pipes, wires, and roads—infrastructures are also bound up in sociopolitical networks (Winner 1986; Bowker 1994; Björkman and Harris 2018) and the values embedded in their design, implementation, and use create confounding services and disservices, intended and unintended (Grabowski et al. 2017). Important, infrastructure facilities are often planned and implemented through black-boxed bureaucratic processes (Cousins 2017). Infrastructure systems and their politics fade into the scenery as they are hidden underground, in the air, or behind facades (Star and Ruhleder 1996), mostly ignored until they break down (Graham 2010). Nonetheless, urban infrastructure systems affect virtually every actor in the city and facility invisibility is a privilege only for the communities for whom they are designed; an able-bodied person does not give a second thought to a set of stairs into a building, whereas someone in a wheelchair must constantly think about stairs and negotiate alternative access points (Star 1999). The impacts of hidden or obscured values and normative biases embedded in infrastructure suggest that it is important to be attentive to who designs them and for what purpose.

In this article, we examine the introduction of greenspaces into urban infrastructure systems. Facing budget shortfalls as well as increasing hazards and demands to green the city, urban leaders are looking to natural and constructed greenspaces as a multifunctional form of infrastructure. Green infrastructure, in particular, has gained popularity as a type of greenspace that can provide diverse cobenefits (e.g., improved mental health, reduced urban heat island) along with traditional infrastructure services (e.g., water treatment, recreation, stormwater management; Benedict and McMahon 2001; Tzoulas et al. 2007). Despite the multifunctionality of green infrastructure, the key goal of its implementation in many cities in the United States has been to capture or slow down stormwater before it enters municipal sewer systems, ideally preventing capacity exceedance, sewage discharges into local waterways, and violations of water quality regulations (Newell et al. 2013; Environmental Protection Agency [EPA] 2015). The U.S. EPA has been particularly influential in this regard, endorsing green infrastructure as a combined sewer overflow solution (Environmental Protection Agency, National Association of Clean Water Agencies, Natural Resources Defense Council, Low Impact Development Center, and Association of State and Interstate Water Pollution Control Administrators 2007). In this form, green infrastructure falls under the purview of engineers who design and implement through technocratic decision-making processes that will ideally protect urban property and investments, comply with regulations, and promote development. This particular utilization reflects a discursive reforming of broadly conceived green infrastructure into a more narrowly defined green *stormwater* infrastructure (GSI) that, in practice, is mainly designed to control runoff, fitting it into existing infrastructure politics and practice while effectively deemphasizing other cobenefits.

As with most traditional infrastructural systems, a range of messy politics is collapsed into a technical decision, chosen based on physical site constraints and presumably objective metrics surrounding the specific problem being addressed. These technological fixes are often presented as the only alternative, dictated by supposedly apolitical engineering knowledge and the technical actors who might not consider "social" issues to be in their professional purview (Teisch 2011; Hillier 2018). In the case of stormwater, infrastructure decisions are driven by the changed hydrology induced by impervious surfaces in the city—roads, buildings, and parking lots—that block infiltration of rainwater into the ground.

Historically, the use of gray infrastructure to channel stormwater away from structures and into water bodies or treatment facilities has been the primary option for solving stormwater problems (Melosi 2008; Karvonen 2011), and the longer these infrastructures are part of our day-to-day lives, the less obvious their politics appear.

Green infrastructure, on the other hand, challenges conventional engineering approaches. Green infrastructure is built in the public right-of-way, next to sidewalks, and on building exteriors, literally bringing the black-boxed politics of stormwater governance into public view. It offers a wider array of cobenefits (as opposed to having a single function), and green infrastructure's newness exposes the messy, political ecology of the city as people use it to express diverse desires for urban space. Despite the potential this exposure creates for more participatory governance, green infrastructure's reformation into GSI silences some perspectives, limiting both participation and a much-needed discussion about the democratization of urban planning. We suggest that we must take this moment of reformation to shine a light on how politics are subsumed and obscured through infrastructure choices. We argue that the work being done to (re)technologize green infrastructure as GSI keeps those politics hidden and must be addressed if we are to truly work toward just infrastructure outcomes.

In the remainder of this article we make our argument by exploring discourses about green infrastructure and the contexts and technologies through which they play out. In the immediately following sections we articulate our use of an urban political ecology analytical framework and the project methods. We then consider literature on the costs and benefits of green infrastructure, extending the idea that its implementation reflects different urban experiences across diverse communities. We follow with a characterization of Pittsburgh through its urban water debates, employing segments of interviews with local actors that reflect broader themes. We conclude with an interpretation of discourses about green infrastructure that reflect a discursive shift to GSI as well as the implications for urban participation and politics.

Urban Political Ecologies of Infrastructure

We draw on research in postindustrial Pittsburgh,[1] an urban metropolitan region wrestling with social,

ecological, and economic injustices related to aging infrastructure, water-related hazards, and regulatory compliance (Tarr 1979, 2002, 2004). We consider interviews with regional actors engaged in stormwater governance to discuss the way in which challenges like these are often framed, and solutions focused, on the technical mitigation of sewer and sanitary overflows, which are violations of the Clean Water Act (Meehan and Rice 2011; Montalto et al. 2013; Holloway et al. 2014). The discursive framing of green infrastructure in these conversations has implications for how we more generally understand urban environmental governance and justice. Governance, broadly speaking, can be defined as a move away from command-and-control government toward more public engagement, collaboration between multiple actors and organizations, and expectations for higher levels of accountability (Swyngedouw 1997; Furlong 2016; Cornea, Véron, and Zimmer 2017). As Perrault (2014) suggests, however, we must remain skeptical of broadly characterized "good governance" that maintains or exacerbates the injustices actively playing out in long-established infrastructure systems (Pritchard 2011; Zavestoski and Agyeman 2015). As such, we view justice as a community's right to not only just outcomes but also equitable participation, standing, and access to the managed processes of urban environmental change (Perrault 2014; Shah and Rodina 2018).

Analytically, we interrogate cities as socially constructed flows of asymmetrical human–nonhuman metabolisms (Harvey 1996; Scott 1998; Swyngedouw and Heynen 2003; Gabriel 2014; McFarlane and Silver 2017). Debates about how we know and manage urban water and its infrastructure occupy a critical conversation among political ecologists (Kaika 2005; Kinder 2015; Carse and Lewis 2017). Underlying these debates are negotiations shaped by who has the authority to decide what an environmental problem is and what technologies are appropriate to solve them; decisions that influence everyday life (Li 2007; Lave 2012). These perspectives can be found in conversations about green and gray infrastructure specifically, reflecting a set of normative politics regarding how and for whom cities should function (Wachsmuth and Angelo 2018). The technologies and debates that thread through urban water governance are imbued with the desires of specific groups, and the outcomes of these debates inevitably prioritize some interests and marginalize

others (Cousins and Newell 2015). Thus, decisions about infrastructure are power-laden ethical choices despite the technology's benign, apolitical appearance (Bowker and Star 1999; Star 1999). We complement this body of work by examining the discursive shift of green infrastructure to GSI as an illuminating example of the depoliticization of infrastructures through technical and black-boxed decision making.

We seek to extend this literature by focusing on the lesser studied green infrastructure and GSI technologies, grappling with their politics as living, changing infrastructure (Carse 2012). Although work has been conducted on green infrastructure and GSI individually, much of this has been positivistic, characterizing nonhuman objects of study as immutable or only understood through their social construction or scientific value. Green infrastructure and GSI are also excellent sites of inquiry because they are relatively new interventions and therefore part of an active and openly contested decision-making process that reveals the usually hidden politics of existing, familiar infrastructure systems (Schneider 2011). Swyngedouw (2009) instructively reminds us that we lose the potential for emancipatory politics from newer technologies and movements once they are swept up and bureaucratized. Thus, as different communities compete to achieve strategic dominance in determining the material outcomes of urban space (Loftus and Lumsden 2008), the reforming of green infrastructure into GSI reinvests authority in technical experts to define the urban experience. As such, green infrastructure presents a moment to unearth these politics before they become depoliticized and black-boxed (Latour 1987; Bowker and Star 1999).

By situating green infrastructure in the historic production of urban natures (Haraway 1991; Gandy 2002; Lave 2015), we see its potential to lead to more emancipatory politics (Heynen 2018). We follow Holifield and Schuelke's (2015, 3) guidance to help understand the role of knowledge in urban water management: as new forms of knowledge are produced and deployed, political moments move from initially "hotter," or more intense, active controversy to "cooler" moments of "consensus and routinization." We see the current (re)technologizing of green infrastructure (i.e., reforming its value to a single service stormwater management technology) as an attempt to move contestation around green infrastructure—and the city more broadly—into one of these "cooler" moments. Understanding the nature of infrastructural work involves unfolding the political, ethical, and social choices that have been made throughout its development. Analytically, this exercise consists in "going backstage" through conversations with those involved in decision making and practicing infrastructural inversion that shifts the emphasis of research from cataloging changes in infrastructural components to tracking and examining changes in infrastructural relations (Bowker et al. 2009). An examination of GSI as a move toward cooler relations through a technologization of nonhuman nature does just that.

Overall, we take the normative stance that urban natures are never apolitical but instead are acted on and discursively maintained to serve particular interests or produce specific outcomes (Reed 2007). As urban political ecologists, it is our job to trouble the framing of green infrastructure as primarily a stormwater management tool, which limits its potential in helping to democratize services and benefits across diverse communities. GSI maintains the forms of knowledge that bind us to conventional routines of stormwater management (marking cobenefits as trickling down to communities but not measuring or accounting for them in any formalized way), tamping down alternative politics and desires for the city. Therefore, we also see an opportunity to improve green infrastructure implementation by resisting the shift to GSI and keeping the conversation in a hotter moment of active controversy where the public can voice their needs beyond the technocratically framed problem of stormwater management. This allows green infrastructure to be designed to work at its full potential, which includes the many social and ecological benefits and services that research and collective professional experience have shown to come from urban greenspace (Tzoulas et al. 2007; Eisenman 2013).

Greening Urban Governance

Literature on the benefits and challenges of green infrastructure implementation clearly reflects perceptions and experiences across diverse groups of people. In arguing that we should seize hotter moments like this—when new technologies are introduced—we suggest that the assumed benefits and costs associated with green infrastructure projects reflect more than the physical demands and challenges of

stormwater management. Further, different epistemic communities have specific needs and desires for their particular urban contexts and communicate these preferences through both normative approaches and technologies themselves. These discourses present an opportunity to visualize usually hidden infrastructure politics.

Although green infrastructure embodies a diverse set of definitions (Mell 2013), here we consider it as intentionally designed, multifunctional technologies that directly use or mimic the ecological processes of soils and plants, such as green rooftops, rain gardens, and bioswales (Austin 2014). Proponents argue that green infrastructure can provide a diverse range of socioecological benefits (Mell 2008; Lovell and Taylor 2013). For example, green infrastructure can increase urban biodiversity through habitat creation (Ahern 2007), alleviate flooding through strategic placement (Gill et al. 2007), reduce the urban heat island effect (Shih 2017), protect endangered species (McIntyre et al. 2015), improve energy use (Wang et al. 2014), and enhance the visual and recreational quality of urban development (Nazir, Othman, and Nawawi 2014), among many other benefits (Tzoulas et al. 2007). Important, green infrastructure represents a form of greening that can conceivably help cities adapt to climate change (Matthews, Lo, and Byrne 2015; Palta et al. 2016).

Although municipal decision makers (e.g., town managers, planners, civil engineers, elected officials) typically acknowledge the multiple cobenefits of green infrastructure, the primary function prioritized in technical planning and design is the capturing, slowing, or prevention of stormwater entering overburdened sewage infrastructure systems (Montalto et al. 2007; Karvonen 2011; Keeley et al. 2013; Newell et al. 2013; Holloway et al. 2014). For example, appropriately sited green infrastructure can be used to manage the stormwater runoff associated with a one-inch rainstorm (Guo and Correa 2013; Roach et al. 2013). This relatively low-cost approach appeals to cash-strapped municipalities facing enormous costs related to water infrastructure maintenance and upgrades. More broadly, municipal managers consider green infrastructure as a decentralized technology that can contribute to sustainability or resilience goals (Montalto et al. 2013), as well as cost-effectively address pressing regulatory violations and technical stormwater issues (Flynn and

Traver 2013; Keeley et al. 2013; Porse 2013; Travaline, Montalto, and Hunold 2015). Cobenefits are often conceived of as ancillary and not the primary purpose of GSI. Additionally, the formal acknowledgment of cobenefits that fall outside of a departmental mission is frowned on and in some cases can result in legal reprimands (Law 2014).

Green infrastructure's diverse benefits and cost effectiveness (Jaffe 2010) have lent to its characterization as a technology that can help improve urban communities and neighborhoods (Mell et al. 2016). In this view, the application of decentralized technologies to meet broader regulations is perceived to put more control in the hands of those who know these contexts best: local residents (Holloway et al. 2014). Community groups and nonprofits tend to focus on a wider array of opportunities, particularly in postindustrial cities where low-income communities of color have borne the brunt of urban decline, seeing their neighborhoods lose populations and fiscal resources (Schilling and Logan 2008; Trotter and Day 2010). These actors often perceive green infrastructure as a way to help boost declining neighborhoods through increased property values (Netusil et al. 2014), the development of assets such as community gardens (Cameron et al. 2012; Rogers and Hiner 2016), as well as other social and economic benefits (Svendsen, Northridge, and Metcalf 2012). Much of the gray literature suggests that the adoption of green infrastructure practices can help to produce new forms of expertise and jobs, although it is not clear whether these are long term (Civic Works 2018; National Green Infrastructure Certification Program 2018; Urban Waters Learning Network 2018).

Diverse demands for green infrastructure, however, do not always line up; some are mutually exclusive and cannot be achieved by the same facility type. This means that green infrastructure implementation is often contested through the competing motivations of municipal engineers and the so-called vulnerable communities that are targeted for green redevelopment. In many cases actual engagement between these epistemic communities is limited or nonexistent (Chini et al. 2017). Likewise, there is disagreement on the definition of green infrastructure itself (Mell 2013; Matthews, Lo, and Byrne 2015) and a lack of widespread popular and technical understanding of how facilities work (Hostetler, Allen, and Meurk 2011; Baptiste, Foley,

and Smardon 2015; Everett et al. 2018). Several barriers and tensions exist over the implementation of green infrastructure (Carlet 2015; Finewood 2016), and mainstreaming remains difficult (Faehnle et al. 2014; Young et al. 2014). These ongoing tensions result in part from different epistemological communities' desires for the city and the broader challenge of equity and justice when greening cities (Sister, Wolch, and Wilson 2010; Checker 2011; Meerow and Newell 2016).

The ongoing effort to justify green infrastructure through economic or technical terms can undermine alternative ways in which communities express their values and needs (Horwood 2011). In some cases, communities might be resistant to the greening or rebranding of their neighborhoods due to the threat of gentrification (Dooling 2009; Lubitow and Miller 2013; Gould and Lewis 2017). There are very real marginalizing tendencies when outsiders enter into long-neglected neighborhoods with ideas for "fixing" them (Pearsall and Anguelovski 2016). Furthermore, the histories of community experiences are often left out of more technical conversations; when green infrastructure is reformed into GSI, it becomes a technical conversation between experts, not communities.

In sum, the articulated benefits and challenges of green infrastructure reflect the different normative values of communities. We contend that these different discourses (i.e., desires for the city) make infrastructure visible in ways previously unseen. Despite their diversity, however, these different perspectives are subsumed into a technical decision-making space, marginalizing less powerful voices. In the following section we discuss the methods that helped us to explore these ideas.

Project Methods and Participation

To go "backstage" we developed an interview-based research method to study the perceptions of barriers to green infrastructure in the Pittsburgh metropolitan region. Following projects that use interviews as a way to develop a cultural model of how communities perceive and make decisions about environmental issues and technologies (Paolisso 2002; Lave 2011; Carse 2012), our research team leveraged existing networks to identify participants who were engaged in stormwater governance in the region. We contacted activists, government and municipal employees, and practitioners with specific knowledge and experience related to green infrastructure (and often specific goals for green infrastructure based on their institutional affiliation). We initially contacted forty actors who met these characteristics and then developed a snowball approach to expand our participant list.

Over a six-month period we recorded thirty semi-structured interviews with stormwater actors (see Table 1), with questions focused on participants' technical knowledge and perceptions of costs, benefits, and barriers to green infrastructure. Interviews were transcribed and analyzed for themes in two stages. First, co-principal investigators (co-PIs) individually reviewed interview transcripts to develop general themes. Following this, co-PIs discussed the initial assessment and developed a set of questions for a secondary textual analysis: Do perceived barriers to green infrastructure hide (or reveal) normative politics? What spatial and historical geographies inform current debates? What expertise and discourses do different constituent groups mobilize in technology debates?

Table 1. Interviews were conducted with thirty stormwater actors, including practitioners, activists, and government employees

Stormwater actors		
Category	Occupation	Number of participants
Practitioner	Engineer	5
	Construction	1
	Landscape architect	3
Government	Council members	1
	Municipal employee/town manager	9
Activist	Community activist	2
	Nonprofit/nongovernmental organization	9
Total		30

Co-PIs then conducted a second textual analysis with attention to how beliefs, values, and experiences enable people to make sense of complex environmental issues. We situated these responses in a broader contextual analysis of Pittsburgh's water history, including our participation in public meetings, informal conversations, and review of public documents and newspaper articles. From this, two prominent themes emerged. First, perceived barriers to green infrastructure reflect normative values. Activist groups, for example, often used green infrastructure as a tool to raise awareness about neighborhood disinvestment as well as to garner resources for community development. Government employees and most practitioners discussed green infrastructure in terms of its metrics for stormwater management and ability to meet emerging demands to green the city. Creating balance between the demands of different constituent groups led to significant frustration from municipal employees in particular. For example, one municipal employee explained, "Communication is really important because the communities that are involved in these projects are [diverse]. So if you are not on your communication game it can go very badly. That is certainly something that has been a problem."

Second, our analysis showed that the discursive shift from a broader understanding of green infrastructure to a more narrowly focused GSI seeks to move infrastructure politics into a cooler moment where it can be the sole responsibility of technical staff and engineers. Although new stormwater technologies have raised a suite of issues to a more prominent position in public conversations—flooding, greenspace access, water quality—revealing previously hidden politics, the shift to stormwater-only metrics and measurement has effectively stifled conversations about these messier political geographies. The demands for green infrastructure's cobenefits prompted a practitioner to say, "Even when you want to do the right thing, you have got to weave your way through all this other [political] stuff"; we see this as an effort to characterize political discourse about infrastructure as inhibiting, keeping stormwater in an apolitical technical space.

Additionally, we want to acknowledge our methodological goal to focus on diverse forms of expertise while identifying our positionality as researchers who live and work in the community. Although our focused approach led us to more conventional community experts—engineers and planners—we also sought out less prominent perspectives. In doing so, we were confronted by a community activist who characterized our research team as "white interlocutors coming into the neighborhood with ideas that would benefit [the researchers], but not benefit the neighborhood." The community activist further reflected on her childhood neighbors and family who had been displaced and dispersed throughout the city as a result of the development of a highway and hockey arena, a story that was absent from nearly all conversations about the placement of green infrastructure and GSI. We suggest that the activist's challenge demonstrates the ongoing need to recognize and engage with multiple forms of expertise—both technical and historical—as well as our potential role as interlocutors. Although we could not possibly be inclusive of all communities in this project, we internalized this challenge by working with multiple participants not only for interviews but also when designing interview questions and developing conclusions. In the end, though, we take sole responsibility for what we write here. In the next section we discuss Pittsburgh and the role of greening in its postindustrial transition. Through this examination we can see not only another ontological use for green infrastructure in revitalized city spaces but also the historic hiding of infrastructure politics and the discursive work of greenspaces in (re)creating the city for particular constituents.

Pittsburgh as Postindustrial Environmental City

The Pittsburgh metropolitan region is made up of about 2.5 million people, with a legacy of urban industrial productivity and collapse. Steel, coal, and other industries thrived throughout the middle of the century, shaping the regional landscape (Gugliotta 2000; Tarr 2004). As in other parts of the U.S. Midwest, the jobs in these industries significantly declined in the 1970s and 1980s, leaving for cheaper production sites and adopting automation technologies. As a result, Pittsburgh lost a third of its population. The dramatic loss of work and population secured Pittsburgh's place as one of the more famous U.S. Rust Belt cities. In recent years, Pittsburgh has experienced a postindustrial rebirth driven by university expansion and health care–sector growth (Neumann 2018). With the offerings of a

midsized city and a low cost of living, the region has been associated with growth centered on tertiary economies and the interests of creative classes, as the industrial economy continues to shrink and is replaced by service-based industries (Haller 2005).

These urban political ecological changes have raised the profile of regional infrastructure challenges. In 2008, municipalities, including regional water and sewer authorities, became party to a consent decree to stop nearly 400 sewer overflows into local waterways during wet weather events, which put the region in violation of the Clean Water Act and the Safe Drinking Water Act. Water quality has also taken on additional meaning as the region works to rebrand itself. Greenspaces and other forms of urban nature amenities are key to the city's new sustainability strategies, something that is becoming more common across the United States. For example, many cities are rethinking their riparian spaces. Historically, factories covered waterfronts in places like Pittsburgh because these spaces were flat and provided easy access to water-based transportation. Rivers and streams were waste sinks, and buildings were logically built facing away from what could be a polluted, foul-smelling waterway.

Today, as cities are reclaiming industrial riparian spaces, buildings and other features are reoriented toward the water. Waterways have become a crucial part of urban postindustrial political economies and cultural ecologies. Likewise, water is featured in the broader effort to attract creative classes back to the city (yet another community making demands on the city through green infrastructure) with expanded access to parks, waterfront amenities, and so on. Therefore, water has become critical to Pittsburgh's rebranding. Mitigation of water quality issues through green infrastructure, then, is often viewed as a win–win because it helps to meet environmental regulations and promote regional economic development agendas. As a municipal council member expressed to us, "You know, you can't stand in front of a sewer drain and cut a ribbon … but you can with the green stuff." From this perspective, greening is a postindustrial political strategy, and green infrastructure, intuitively, plays a role in creating that idealized city. The local activist community also views green infrastructure as an important win–win that encourages investment in struggling local communities. As articulated by a community activist in regard to the consent decree:

This will be our region's largest ever public works investment, a multibillion-dollar project, and we feel that we can't make an investment like that without seeing benefits come back into our community from the money that we spend. So … we came to the idea that green infrastructure would be the best upfront investment for our region because of the other benefits that it provides. … We feel that that investment in green infrastructure to keep water out of our sewer system is where we should go first, because the more we can maximize that investment, the more auxiliary benefits we see in communities.

Pittsburgh's sustainability discourses, however, have not gone uncontested. To comply with the federal consent decree, municipal and contracted engineers who have historically worked under the shield of command-and-control water management have had to develop and publicly defend a proposal to meet water quality regulations. In 2013, these authorities submitted the *Wet Weather Plan*, a proposal to comply with the consent decree through expanded gray infrastructure built exclusively by water utilities and engineering firms (Herrick and Pratt 2012). Although the plan included a chapter on green infrastructure's potential, it did not include or recommend implementation of any green infrastructure facilities. From the engineering perspective, traditional gray infrastructure implementation was viewed as the least risky and therefore the best approach. The underlying message was that green infrastructure might be a part of the region's rebranding but it could not solve the region's stormwater challenges and would ultimately be a waste of money. The plan's supporters set out to frame the debate by consistently pointing out green infrastructure's ineffectiveness or inability to meet public needs, as demonstrated by two municipal employees:

When I first learned about GI, I thought it was great. Now I realize it is just part of the solution. I learned through our municipal partners that it is just going to be a piece of the bigger picture. … If we are talking [about] this region, I think that [the effectiveness of green infrastructure] has yet to be proven. In fact the jury is still out on that. I think that we don't have enough data. I think that the data that we do have … indicates that it may not be effective.

The discussion of green infrastructure is fairly new and fairly poorly tested because you need several yearly cycles to see if these things actually work. And you

have to see how they work in the real world and see how people behave with it.

Connected to this was an effort to greenwash the more conventional gray approach, as noted by a utility representative:

> Green also includes stream removal, fixing pipes, expanding treatment plants, using concrete and steel; but it is the biggest bang for our buck in terms of making sure we meet that ultimate goal, which is clean and safe water in our rivers and streams. We are really a green organization despite what people say.

Community groups were antagonistic to this gray infrastructure-only approach, pointing to a lack of real engagement with community sustainability initiatives. In addition to (or perhaps regardless of) green infrastructure's ability to manage stormwater, these groups saw opportunities to capitalize on a large infrastructure improvement project to distribute benefits more evenly across the community through capital spending, job creation, expanded green space, and associated economic growth (Finewood 2016). Green infrastructure's multifunctional benefits were key to these views, noted by a community activist:

> There are actually a number of studies about crime reduction, increased property values, where GI is installed. One of the big things for our campaign is good local long-term jobs in operation and maintenance, as well as revitalized business districts. [Green infrastructure] can be cheaper or at least the same price with many more benefits. And that investment also would open up new industries and … business sectors in our region. Oh yeah, there is cleaner air, reduced flooding, restoration of habitats, increased amenities for neighborhoods. I could probably go on for a while.

Overall, although the lines have never been clear-cut, there has been a palpable divisiveness between different discursive communities when discussing green infrastructure in Pittsburgh. As a nonprofit employee expressed:

> We've talked about wastewater and stormwater being [polarizing]. … Polarization is probably the most immediate issue [for] players in the region because of different backgrounds. You have landscape architects, you have people who are horticulturists and so forth, and then you have engineers and technical people, and then politicians. And everybody kind of stakes out their high ground and … everybody is just kind of yelling at everybody else. I don't know that there has

been a forum yet for reasonable conversation without somebody being branded as either being in one camp or the other. That polarization has been really bad. I think to the extent that [green infrastructure] can be worked out or fixed or streamlined, I think that dealing with that would be very helpful.

Diverse communities continue to debate the costs and benefits of green infrastructure in solving Pittsburgh's urban water challenges. Although these perspectives diverge and converge around various goals, they begin to make visible long-hidden infrastructure politics. This hotter political moment creates an opportunity for new voices to join the conversation and contest conventional practice.

The Urban Political Ecology of Green Infrastructure Governance

In this article we consider the role of infrastructure in hiding or revealing normative politics. We argue that the emphasis on stormwater-only metrics of green infrastructure—effectively reformulating it as GSI—reflects a discursive technocratic move that keeps hidden emerging, more democratic visions for the city. We suggest using this technocratic effort as a moment to reveal and shine a light on previously taken-for-granted infrastructure politics and work toward a more participatory city. In this section we present and interpret conversations about green infrastructure that privilege certain normative approaches for the city while tamping down efforts to introduce new voices into urban environmental politics. We further illuminate how this can silence alternatives and prevent more democratic participation in city planning.

Green Infrastructure's Normative Politics

As we began to show earlier, groups privilege their normative politics through ideas about green infrastructure. All participants expressed various levels of frustration with how people generally understood and engaged with green infrastructure, GSI, and stormwater governance. In addition to a consistent refrain for more public education, these frustrations connected to diverse values while reinforcing conventional infrastructure landscapes. For example, despite an emphasis on the importance of cobenefits, two different nonprofit employees acknowledged that

their community was resistant to the type of visual ecological change that comes with green infrastructure:

> We have a landscape aesthetic in this country that goes back thousands of years. It goes back to the British. It is not something that can easily be transformed.

> What people have a tendency to do when they are working with green infrastructure is to incorporate a lot of mixed species. Well for most people those are weeds. And so we have to start to think about how we can make it look more like what people are used to because if we can't … they are not going to be invested in it.

Although these participants had both previously expressed a desire for the cobenefits of green infrastructure, their articulation of the community's perspective normalizes a visual ecology that is consistent with more hegemonic practice and expectations. In other words, if a new "weedy" aesthetic is a cobenefit of green infrastructure, then it is also an expression of new normative ecopolitics for the city. Cleaning up green infrastructure maintains an ecological and discursive status quo.

Stormwater-based metrics can maintain the status quo more explicitly, too. As one practitioner suggested when asking (during a planning meeting), "Is there a scale we can build green infrastructure without having to work with the community?" The implication is that a narrower focus on facility size would help to ameliorate the need for participation. Although the intention was not necessarily to resist community participation (it was an attempt to find a way to rapidly install GSI), the implications were clear: green infrastructure required community engagement, which made stormwater governance more challenging. Tacitly, this question reinforced conventional infrastructure landscapes and, like it or not, the value of avoiding community concerns. These concerns often overlap with the aesthetic values presented earlier. As one municipal engineer summed up through their aggravation with trying to meet both stormwater challenges and community demands:

> One of the biggest problems we have is people complain how ugly it is. "Why aren't we cutting the grass?" and "Why aren't we putting in grass?" You have no idea how areas have had to be redone, giving up some of the water management issues because of appearance.

Participants also displayed a different version of normative politics that makes sense of green infrastructure, not through cobenefits or stormwater, but through essentialized values, as noted by a practicing engineer:

> I can remember talking to somebody years ago about putting a green roof on their building and I got snide comments like, "What do you think I am going to do, drag a lawnmower up there once a week?" So I think that's the kind of thing that has changed, you know. Fifteen years ago anybody that talked about green infrastructure was considered very much a tree-hugging oddball. And while GI has become much more accepted and much more common as a strategy for managing stormwater [by municipalities], people want it because of the cost savings that can go with it. You know it is a lot cheaper to build.

Here we see an articulation of infrastructure through the reductive values of cost efficiency and stormwater mitigation. These singular—ostensibly measurable—values become *de facto* the driver for GSI (not green infrastructure, *per se*), reinforcing the longstanding practice of efficiency over more complex community needs. Participants express their own and their community's perspectives of normative politics through these discourses. The statements and corresponding actions define possibilities, community needs, and implementation strategies. What is articulated as best for communities, and in turn what happens in communities, ends up coinciding with a particular urban politics expressed through singular, hegemonic value frameworks.

Green Stormwater Infrastructure

Reforming green infrastructure into GSI suggests that technologies are not benign or apolitical but instead have sets of politics that are interlaced with and influence socioecological systems. As these politics are expressed through decisions about infrastructure, they often result in uneven costs and benefits (Heynen, Perkins, and Roy 2006). We identify a discursive shift to GSI that focuses on technical, hydrologic aspects of green infrastructure, with particular attention to how much stormwater can be prevented from entering the sewer system, valorizing engineering foci of optimization and efficiency and confining the definition of stormwater to a waste product. GSI is an engineered, proto-standardized package (Fujimura 1992; Lave 2011) that is easily transported

into and between established municipal bureaucracies because of the uniform concept of stormwater design across the United States, making the idiosyncratic character of green infrastructure more legible through stormwater metrics (Scott 1998). An engineer tacitly reinforced this idea when asked to define green infrastructure:

> That is a really hard question. I don't really know anymore. I was listening to a presentation not too long ago and they described a project that used a large container that captured stormwater in a constructed system and had some type of weir that slowly let water percolate into the ground. So is that green? Is something constructed green? Both gray and green technologies can be green. So what is important is a green infrastructure system that uses natural processes to deal with water and water quality or stops the flow from entering pipes.

The participant is valuing green infrastructure as a solution to regulatory violations but remains skeptical of its cobenefits. This effectively reduces green infrastructure to the singular value of stormwater management. Likewise, a different engineer expressed concern over green infrastructure's diverse, or site-specific, character. Although acknowledging that green infrastructure projects could have diverse cobenefits, when asked whether different communities should be allowed to have different infrastructure types based on community needs, the engineer responded:

> The guidelines have to be the same for everybody. I don't care if you are building in the city or if you are building out in [the suburbs], it needs to have the same controls put in place. Everybody should be following the same rules. Why should [a wealthy community] have to follow one set of rules and the next community doesn't? I used to be the manager of [a town], and I'm used to ponds and retention and separate sewers. Then I got [to a new position in the Pittsburgh region] and I was told we can't use ponds and retention, but my neighbors get to put their waste into combined sewers! What? Just because they have been here for the last hundred years they get to have overflows into the river? Why do they get a separate rule? What? And then they are going to make me take teaspoons of water out of our system? … I don't care if you are building in the city or if you are building out in [the suburbs], there needs to be the same controls put in place. Everybody should be following the same rules.

Although this standardization might feel apolitical, it only exists in relation to politics, circulating the

actions that some authority has deemed the best and hiding its epistemological foundations (Fujimura 1992; Lampland and Star 2009; Lave 2011). Standardization of a living infrastructure can also be deeply problematic and uneven for both human and nonhuman communities. In a similar fashion, a municipal employee depoliticizes green infrastructure through defining and offering solutions to the stormwater problem:

> Green infrastructure is not a major solution. It is only an option that really works in the city. [In the suburbs] political mismanagement is the biggest barrier. I mean the sewer lines are backed up so far. [The municipalities] need to clean them and build [bigger] pipes. The pipes have 100,000 tons of sludge and haven't been cleaned for sixty-five years. Doing that would take 10 million gallons out of the system. That's 10 million gallons with fecal coliform that is going into the rivers. Green infrastructure can't do that.

Engineers and municipal employees are typically designated with the tasks of designing and implementing infrastructure (Björkman and Harris 2018). The standardization, design characteristics, and function of facilities reflect a specific normative approach and regulatory politics that flattens local urban political ecologies by assuming that all places should be treated equally. The cobenefits of green infrastructure are deprioritized based on stormwater-only functionality. Here we suggest that this is part of the discursive work that keeps conventional infrastructure politics hidden and resists new politics and participation.

Resisting Alternative Politics and New Participants

As noted earlier, the introduction of green infrastructure into historically depoliticized urban environmental governance has provided an opportunity for some underserved Pittsburgh communities to leverage resources through the implementation of new technology. As different constituent groups emerge and express their preferences, they make politics more visible than previous stormwater governance allowed. As the effort to make green infrastructure into GSI solidifies and becomes obdurate, however, it standardizes social and physical orientations of this new technology. Standards like these determine "how communities are designed and built … how places *can* and *can't* be developed, and who shapes the physical space where we live and work" (Ben-Joseph 2005, xxiii). As such, the shift to GSI silences alternative ways of participating

in urban planning, as noted implicitly by a town employee:

> Well, there is a lot of work going on behind the scenes about green infrastructure. I know it doesn't seem like there is much happening, but there is a lot going on with planning and trying to integrate it and seeing how it works in. This morning I was at a committee which was comprised of engineers representing like seventy-one communities and we are sitting around at a table trying to figure out the smartest way to improve water quality. So you know the ultimate goal is not to implement green infrastructure. The ultimate goal is what can we do to improve water quality.

This municipal collaboration left many community members on the outside looking in. The ongoing resistance to new political actors participating in the planning process is further represented by how a municipal employee characterized the role of activists and their education and outreach strategies:

> Confetti green sites like rain gardens, bioswales, do not deal with water issues. Activists are the problem, making [green infrastructure] seem like fool-proof solutions. Their [advocacy and education strategies should change] on a variety of levels; on-the-ground education doesn't always make sense. … Demonstration sites are always the go-to educational idea. But we have to figure out where these sites are most impactful, not just implement a rain barrel just to show how it works. Advocators need to practice what they preach. They need to push the issue to make it more regional and site appropriate. There is no discourse about meeting compliance; they just jump to quick ideas that don't meet compliance. These are extreme ideas with no real discussion about the actual problem. We're thankful they raise concerns about the issue but they will never change their perception.

The preceding quote reflects the view that green infrastructure advocates are at best naïve and at worst misdirected. Although the participant made clear that they understood the role and importance of activists, only experts were described as having legitimate and credible knowledge. Advocates similarly recognize how their role and participation is discursively and literally pushed to the margins:

> If you want to see a scene, go to [a sewer authority] board meeting and see who is in the crowd and ask yourself, "Why are there about fifty people in suits that are all engineers? Why are they the only ones present there?" So it is this barrier to participating. Green approaches have more benefits, and it is more

democratized, and if we have it, then hey we are there! But if we can't help plan then who knows what we get.

Emancipating Infrastructure Politics

In this article we propose that technologically and discursively shifting green infrastructure to GSI contributes to a set of priorities that at best maintain the status quo and at worst prevent more democratic participation in the city. We have shown discourses about green infrastructure that privilege certain values for the city while tamping down efforts to introduce new voices into urban environmental politics, silencing alternatives, and potentially preventing a more democratic planning process. In other words, when privileging the virtues of GSI, green infrastructure is (re)technologized into the status quo and conventional politics are maintained.

Politics are both expressed and marginalized through technologies, but politics are often taken for granted and obscured when they become familiar. As new, unfamiliar technologies are popularized and integrated into our daily lives, there is a moment of opening when communities negotiate their place and meaning; this is a moment when systems are contested and politics and normative values are exposed. If communities are using green infrastructure to raise issues important to them, then a turn to stormwater-based metrics can reassert a dominant set of politics that dismisses those concerns. Examining green infrastructure and the discursive shift to GSI provides insight into the politics and flows of power influencing urban form. Understanding the power, politics, and values embedded in these discursive shifts, in particular, can help counter the ways in which technocratic concepts and tools determine and depoliticize urban environmental challenges (Goldman, Nadasdy, and Turner 2011).

As urban political ecologists, we explicitly recognize that normative politics are closely connected to urban inequality (Ranganathan 2016). As such, we suggest that framing green infrastructure as GSI limits its potential in democratizing services and benefits across diverse communities. The history and context of Pittsburgh's urban water governance suggests that green infrastructure and GSI serve populations differently. Thus, we argue that we should use this technocratic effort as a moment to reveal and shine a light on previously hidden infrastructure

politics to work toward a more participatory city. We endeavor to reframe this narrative by examining GSI as an illuminating example of the depoliticization of infrastructures through black-boxed technical decision making.

Revealing such hidden politics shows how community input and needs are reduced to a technical category, which collapses the complexity of the city to discrete functions or aesthetics. These types of debates subtly reinforce an unequal city based on whose voice counts in the material outcomes of stormwater management, closing off opportunities for expanded participation. Making these politics more visible raises the important consideration that, if we care about a democratic city, then we need to somehow find a way for all voices to be a part of this conversation. Reframing these conversations means being explicit about collective desires for the city rather than specific technological facilities. In other words, if we are seeking to make the city more democratic, it is not happening through debates about green infrastructure as a stormwater technology. Thus, we return to a general call for those from a political ecological critique to trouble the ways these technologies exist in our everyday lives. Adequate water provisions cannot be met without reconstructing social and natural ties (Loftus 2009). Otherwise we will get the same old process dressed up in new, green clothes.

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Note

1. Pittsburgh henceforth refers to the broader metropolitan region of western Pennsylvania that encompasses the city itself as well as other independent municipalities, counties, and authorities.

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