Cities 66 (2017) 44–52

Contents lists available at ScienceDirect

Cities

journal homepage: www.elsevier.com/locate/cities

# Infrastructure and institutions: Stakeholder perspectives of stormwater governance in Chicago

Joshua J. Cousins

*Ecology, Evolution, Ecosystems, and Society Program, Department of Geography and Environmental Studies Program, Dartmouth College, 6017 Fairchild, Hanover, NH 03755, USA*

A R T I C L E I N F O

*Article history:*
Received 18 September 2016
Received in revised form 24 January 2017
Accepted 14 March 2017
Available online xxxx

*Keywords:*
Stormwater
Green infrastructure
Environmental governance
Climate change

A B S T R A C T

This article examines the ways stakeholder preferences and perspectives of stormwater management converge and diverge in Chicago. With a greater emphasis on broad stakeholder participation in urban environmental governance and decision-making, accommodating and moderating multiple and competing perspectives will become a greater part of urban green-space planning. Decision-makers must choose how resources are to be allocated to manage stormwater and decide among the multiple and sometimes conflicting options available to reduce the impact of stormwater at different sites across the city and region. This paper examines the disparate understandings of how to best manage stormwater in the city. The results reveal that departmental silos may not adequately explain variation in stakeholder perspectives. Instead, two dominant perspectives towards stormwater management connect diverse stakeholder groups in Chicago: the Infrastructural Interventionist and the Institutional Interventionist. The first strongly views stricter laws and regulations, developed in tandem with science and data-driven approaches, as the best way to improve stormwater management. The second desires new rules and institutions to foster integrated management approaches, as well as more robust economic instruments capable of assigning a monetary value to stormwater, as critical to resolving stormwater problems. Conflicting points of perspective arise around the preferred type of infrastructure to be implemented to deal with stormwater and how it is to be developed. Understanding how these two social perspectives interact and conflict is important in considering the actions that will ultimately be undertaken to direct landscape changes capable of resolving the multiple challenges Chicago faces in managing stormwater.



## 1. Introduction

On September 13, 2008 Chicago experienced a storm event that dropped nearly seven inches of rain on the city in a 24-hour period. The record setting storm event caused massive flooding, resulting in the evacuation of 10,000 homes and $155 million in damage (Changnon, 2010; Changnon & Westcott, 2002). More recent storm events have occurred with nearly equal devastation. Storms in April and June of 2013 inundated the city, leading to evacuations, road closures, and the Governor to declare a state of emergency for 44 counties across the State of Illinois. While it is difficult to assign a single storm event to climate change, these record setting storms are indicative of what Chicago is likely to experience on a more frequent basis as a result of climate change (Emanuel, 2014; IPCC, 2014). With annual precipitation projected to increase by as much as 20%, with an increasing fraction of this rainfall occurring in high-intensity events, climate change will have serious implications for flood control and stormwater management in the city (Hayhoe, Wuebbles, Hellman, Lesht, & Nadelhoffer, 2007).

Chicago is not alone in facing these climate change challenges. Cities across the globe, from London to Bangkok, confront urban flooding, drought, and the infrastructural challenges brought by shifts in climate and precipitation patterns (Bulkeley & Castán Broto, 2012). Using Chicago as part of a study to explore broader trends in stormwater governance, this paper examines how different stakeholder perspectives coalesce around different interventions to address urban stormwater challenges. Urban planners, policy makers, engineers, NGOs, and other stakeholders are developing new institutional and technological strategies to meet the dual stormwater and climate change challenge. However, adopting novel urban stormwater governance approaches to address climate change presents a ‘wicked’ problem imbued with uncertainties and value-conflicts between key stakeholders and decision-makers (Rittel & Webber, 1973). Without a thorough understanding of the underlying motivations of these stakeholders, the ability of decision-makers to foster more sustainable urban stormwater systems to climate change is limited.

Traditionally, Chicago addressed stormwater through large-scale engineering efforts, typical of grey infrastructure. Initially driven by

*E-mail address:* Joshua.j.cousins@dartmouth.edu.

http://dx.doi.org/10.1016/j.cities.2017.03.005

outbreaks of epidemic diseases, Chicago began developing methods to reduce the flow of polluted water into Lake Michigan, where the city drew its drinking water. Notably, in 1900 the construction of the Chicago Sanitary and Ship Canal reversed the natural flow of the Chicago River. Instead of flowing into Lake Michigan, the Chicago River now flows away from Lake Michigan and into the Des Plaines River, a tributary of the Mississippi River. While this solution resolved some of the pollution problems in Lake Michigan, it did little to reduce the load of sewer systems during rain events, which easily inundate and produce combined sewer overflows (CSOs). In order to provide a floodwater outlet and reduce the load of the sewer systems during rain events the Metropolitan Water Reclamation District of Greater Chicago (MWRD) began constructing the Tunnel and Reservoir Plan (TARP) in 1972. The TARP is designed to capture, convey, and store combined sewage during storms through a series of deep rock tunnels and surface reservoirs, which later channel this water towards treatment plants when capacity becomes available (Malec, 2003). Although construction launched in 1975, many factors have delayed completion until 2029.

Urbanization also brings an increase in hard or impervious surfaces. By some estimates these surfaces can comprise as much as 67% of the urban land area (Gartland, 2008; Matthews, Lo, & Byrne, 2015). This human alteration to the hydrology of the urban environment, along with climate change, is likely to exacerbate many of the stormwater challenges Chicago already faces, such as CSOs and flooding. CSOs occur when the volume of water entering exceeds the capacity of the sewage treatment plant. This is a significant concern given that storm events producing as little as 0.67 in. of rain in 24 h can overwhelm the existing stormwater infrastructure and result in CSOs that dump a mixture of untreated sewage and stormwater runoff into the Chicago River and Lake Michigan (Dorfman & Mehta, 2011). CSOs are a considerable problem in Chicago with 2036 discharge events occurring in 2009 alone (NRDC, 2010). In Chicago, the increased magnitude of flooding and CSO events can be attributed to alterations of land-surface wrought by urbanization and the history of stormwater management policy (Ntelekos, Oppenheimer, Smith, & Miller, 2010).

Chicago is also working to comply with National Pollutant Discharge Elimination System (NPDES) Phase II requirements. NPDES is a permitting program administered under the Federal Clean Water Act (CWA). While the initial focus of the program was to reduce industrial point sources of pollution, efforts have expanded to bear upon stormwater pollution, attempting to manage it at discharge points, typically sewer outfalls (White & Boswell, 2007). Phase II of the CWA requires public education and outreach, public involvement, illicit discharge detection and elimination, construction site runoff control, post construction runoff control, and pollution prevention as ‘minimum control measures’ (EPA, 2005). In Chicago, the MWRD is in charge of treating the city's sewage and stormwater runoff at seven treatment facilities and maintaining compliance with NPDES Phase II requirements. Efforts have focused primarily on stormwater control areas, such as areas relying on separate storm sewers and riparian areas that allow stormwater to flow directly into water bodies (Powers & Emanuel, 2014).

Chicago has been successful at implementing both structural and non-structural best management practices (BMPs) to treat stormwater runoff. Non-structural BMPs utilize ordinances and education initiatives to improve water quality while structural BMPs entail physical changes to infrastructure or the landscape to reduce the impact of stormwater runoff, such as dry basins, wetlands, filter strips and other forms of green infrastructure (Kaplowitz & Lupi, 2012). Chicago has been able to utilize green infrastructure's broad appeal to implement a number of projects and programs capable of enhancing water quality in the city, such as the Stormwater Ordinance, the Green Roof Initiative, and the Green Alleys Program. These investments in stormwater management are popular among decision-makers and technocrats due to their ability to garner multiple benefits, increase the city's resilience to extreme rain events and climate change, and reduce the burden of stormwater flows on the sewer system (Emanuel, 2014).

Not all stormwater BMPs and forms of green infrastructure, however, are capable of adequately addressing the range of pollutants or hazards inherent to a particular watershed; they also vary considerably in cost and expertise to implement and maintain (Kaplowitz & Lupi, 2012). Moving forward, decision-makers must choose how resources are allocated for stormwater management and decide among the options available to reduce the impact of stormwater at different sites across the city.

One of the constraints decision-makers and planners face is generating the funds to build green infrastructure. In Chicago, stormwater is the only major infrastructure system not paid for through user fees. Instead, stormwater infrastructure funding comes from general revenue. While many cities pay for stormwater infrastructure through general funds, the number of stormwater utilities operating in the United States is quickly rising. Nearly 1600 stormwater utilities now function in the United States, with 22 operating in Illinois (Campbell, Dymond, & Dritschel, 2016). Cities, such as Philadelphia for example, have been able to implement parcel-based stormwater fees that charge property owners a fee based on the amount of impervious cover on their property and provide a credit structure that incentivizes stormwater retrofits (Fitzgerald & Laufer, 2016).

Decision-makers are also faced with gaps surrounding the costs and benefits to manage stormwater through green infrastructure, including maintenance costs, and how the cumulative effects of many small-scale, decentralized and distributed projects across the city will impact stormwater flows (Emanuel, 2014). Despite these unknowns and constraints, many government and non-government actors within the city are looking towards replacing some of Chicago's impervious surfaces with porous pavement, bioswales, rain gardens, and other forms of green infrastructure to lessen the pressure on the stormwater treatment facilities and reduce the number of CSOs (Dorfman & Mehta, 2011). With limited resources and diverging views on the efficacy of green infrastructure, however, there is an inherent conflict about what stormwater is, how resources are allocated to manage it, and the best way to do so.

Various approaches have been used to understand the perspectives and preferences of those involved in urban environmental governance and decision-making. Kaplowitz and Lupi (2012), for example, used a choice experiment to reveal stakeholder preferences for BMPs to address stormwater. Their results found that stakeholders hold clear preferences for some types BMPs over others. Homeowner's, for example, were found to prefer management plans with high levels of streambank naturalization in their alternative management plans. Similarly, Byrne, Lo, and Jianjun (2015) surveyed green-space users to understand how their knowledge about climate change and adaptive responses shapes their attitudes towards green infrastructure as an adaptive response to climate change. The findings suggest that green-space users favor tree planting if they perceive climate change to be economically disruptive. Dobbie and Green (2013) also surveyed public perceptions of wetlands to understand the different landscape characteristics that guide the way people see and interpret the environment. Relatedly, Matthews et al. (2015) used a combination of interviews and literature review to identify the barriers and drivers of adopting green infrastructure. While these studies have proven useful for revealing how various stakeholders understand and perceive the environment, little work has sought to clarify how these perceptions relate to one another, interact, and potentially conflict.

This article addresses this gap by exploring how stakeholders embedded within different departments, agencies, organizations, and structures of urban stormwater governance adhere to different discourses of stormwater governance. Understanding such differences is important not only in terms of fostering cooperative planning across city departments, but also across the spectrum of government and non-government actors concerned with the implementation of more sustainable forms of urban water management. Arriving at a particular solution, however, is difficult due to the ‘siloed’ and fragmented nature