

ASSESSING DISPARITIES OF URBAN FLOOD RISK FOR HOUSEHOLDS OF COLOR IN CHICAGO

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This study explores the disproportionate impact of urban flooding on Chicago's communities of color. Through analysis of data involving more than 225,000 flood claims from 2007–2016 in zip codes within or intersecting the city, it shows that an overwhelming majority—87%—involved these often disadvantaged communities. Policies enacted by Chicago and Oak Park, Illinois, and other municipalities, ranging from resident assistance programs, open data portals, to building inspection strategies, offer examples of effective ways to help alleviate the persistent problem of urban flooding.

INTRODUCTION

Flooding is the most common and costliest type of natural disaster in the United States (Lightbody, 2017). According to a 2017 report by the Pew Charitable Trusts, federal insurance claims averaged \$1.9 billion annually between 2006 and 2015. Metropolitan Chicago is not immune to these impacts. To the contrary, a 2019 journalistic investigation reported that flooding in Chicago has been so severe in the past decade that only coastal cities susceptible to hurricanes have received more federal aid for flooding (Hawthorne & Greene, 2019). Moreover, flooding throughout the Midwest and Northeast is projected to worsen due to an increase in annual rainfall and more intense and more frequent downpours, according to the Third National Climate Assessment (Melillo, Richmond, & Yohe, 2014).

This article explores an often-overlooked aspect of this problem: the disproportionate impact of urban flooding in communities of color, much of it occurring outside the floodplains delineated in the Federal Emergency Management Agency's (FEMA; 2019) flood risk maps. It explores why urban flooding, which occurs when precipitation overwhelms local drainage systems, is such a highly localized phenomenon. The article begins with a review of relevant research on the topic. Next, the authors analyze flood-related insurance claims data for the years 2007–2016, across 59 zip codes that are located within or intersect the City of Chicago. This data encompass 229,743

claims totaling \$433 million in insurance payouts. The final section explores policy strategies to address urban flooding that have proven to be effective in Illinois municipalities.

RESEARCH ON THE COSTS OF URBAN FLOODING

A wide body of research has explored the implications of flooding on the well-being of urban residents. Flooding, especially when coupled with warmer temperatures, has been shown to create indoor air quality issues, such as mold, which can result in respiratory health problems for those exposed. A 2007 study by the Lawrence Berkeley National Laboratory, for example, estimated that 21% of asthma cases are associated with building dampness or mold conditions, which are common effects of flooding (Mudarri & Fisk, 2007). Warmer temperatures and changes in rainfall patterns may also increase the risk of contracting diseases carried by pests, such as West Nile virus, which can lead to fever, paralysis, and even death (Center for Disease Control and Prevention, 2019). Flooding has also been shown to adversely impact mental health and economic well-being. A 2012 survey of Cook County flood victims carried out by the Center for Neighborhood Technology (CNT; 2014) reported that 84% of the 100 respondents suffered stress, 41% lost the use of part of their properties, 63% lost valuables, and 74% lost hours of work due to cleanup.

Other research has explored the potential causes and scope of urban flooding and found that its frequency and severity are closely correlated with climate-related changes in precipitation, poorly maintained or undersized sewer infrastructure, and an insufficient amount of permeable surface area, which thwarts stormwater infiltration (Abebe, Kabir, & Tesfamariam, 2018; Aboud, Ryan, & Osborn, 2018). Studies by CNT (2014) and the Illinois Department of Natural Resources (2015) have shown that urban flooding routinely occurs widely outside of FEMA-mapped floodplain boundaries. These studies reported that over 90% of flood-related insurance payments between 2007 and 2014 were made for buildings located outside of a formally designated floodplain.

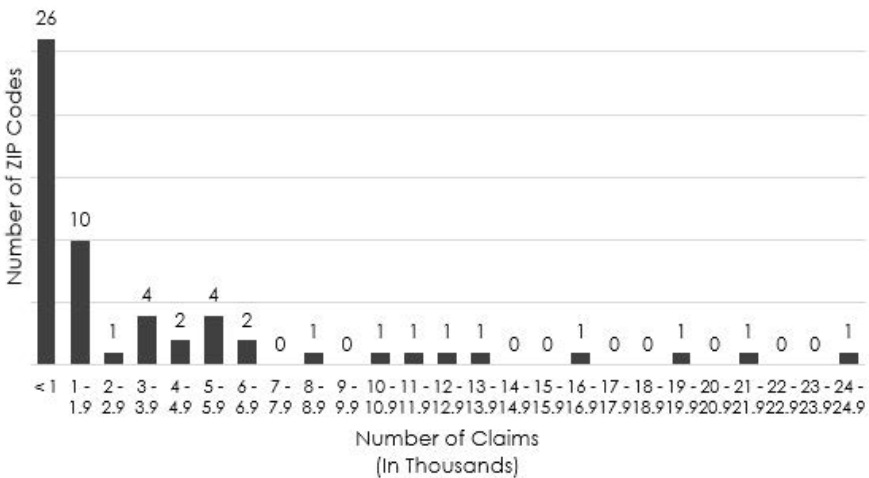
Unlike riverine and coastal flooding, urban flooding can be highly localized within communities. Site characteristics such as grading, sewer elevations, and neighborhood depressional areas (i.e., areas with lower elevations) can determine whether one building floods while an adjacent building does not. These site-scale problems can manifest as building flooding when i) sewage backs up through basement plumbing; ii) overland sheet flow causes water

to enter in through basements or at-grade windows and doors; and iii) groundwater permeates or seeps through building foundations as a result of a high groundwater table and hydrostatic pressure. Cracks in basement walls and floors can also allow water to seep into homes. While seepage is typically unrelated to the sewer system, it can create conditions of dampness and mold, causing adverse health impacts (Mudarri & Fisk, 2007).

ANALYSIS ON DISPARITIES IN THE EFFECTS OF URBAN FLOODING

For this research, CNT conducted an analysis of Chicago flood insurance data that details flood claim payouts made to city residents between 2007 and 2016. This analysis compiled data from FEMA’s National Flood Insurance Program, FEMA’s Disaster Relief Assistance, the Small Business Administration’s Disaster Loan Program, and a limited data set from private insurance companies. Between 2007 and 2016, flood claim payouts were made in 56 of the 59 zip codes within or intersecting the city boundary. The 229,743 claims totaled \$433 million in payouts. As shown in Figure 1, the distribution of flood claims is severely skewed such that two zip codes account for more than 20,000 claims each over the study period.

FIGURE 1
DISTRIBUTION OF FLOOD CLAIM PAYMENTS ACROSS CHICAGO’S ZIP CODES, 2007–2016

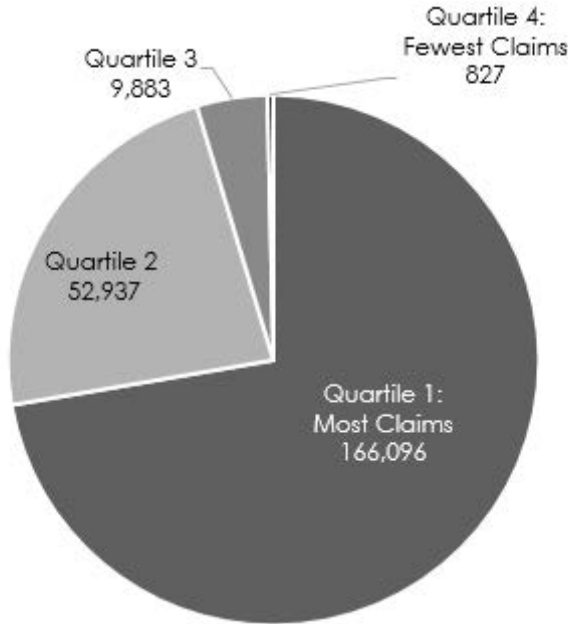


Among zip codes in the study area, the average number of claims between 2007 and 2016 is 3,895, while the median is 1,383, reflecting a severely skewed distribution. Almost half of all zip codes studied had 1,000 or fewer flood claim payments during the study period, while one zip code received more than 24,000 flood claim payments.

The analysis was expanded to evaluate flood claims by household quartile. Zip codes were ordered by the number of claims from high to low, then grouped once the aggregated sum of the number of households in the zip codes equaled approximately 25% of the total Chicago households. Thus, each bin contains approximately the same number of households. Figure 2 illustrates the uneven distribution of flood claim payments made in each of the quartiles. As shown by the chart, Quartile 1 accounts for nearly three-fourths of all flood claim payments, whereas Quartile 4, the least flood-impacted quartile, accounted for less than 1% of the payments.

FIGURE 2

NUMBER OF FLOOD CLAIM PAYMENTS MADE TO CHICAGO HOUSEHOLDS, 2007 – 2016



Each wedge represents approximately one-fourth of Chicago households. Quartile 1, which comprised the zip codes with the most claims, represents approximately three-fourths of all claims made.

Strong negative relationships exist between the intensity of flood claims and both a household’s ability to pay for flood repairs and the amount of flood damage assistance received (Table 1). Households represented in Quartile 1 had the highest share of flood claims and received less assistance per flood claim than households represented in Quartile 4, which reported the fewest number

of flood claims. Households in Quartile 1 were also more likely to be headed by persons of color (93% versus 30%) and have a much lower median household income (\$32,401 versus \$92,545) compared to households in Quartile 4.

TABLE 1

CHARACTERISTICS OF HOUSEHOLDS IN QUARTILES 1 AND 4

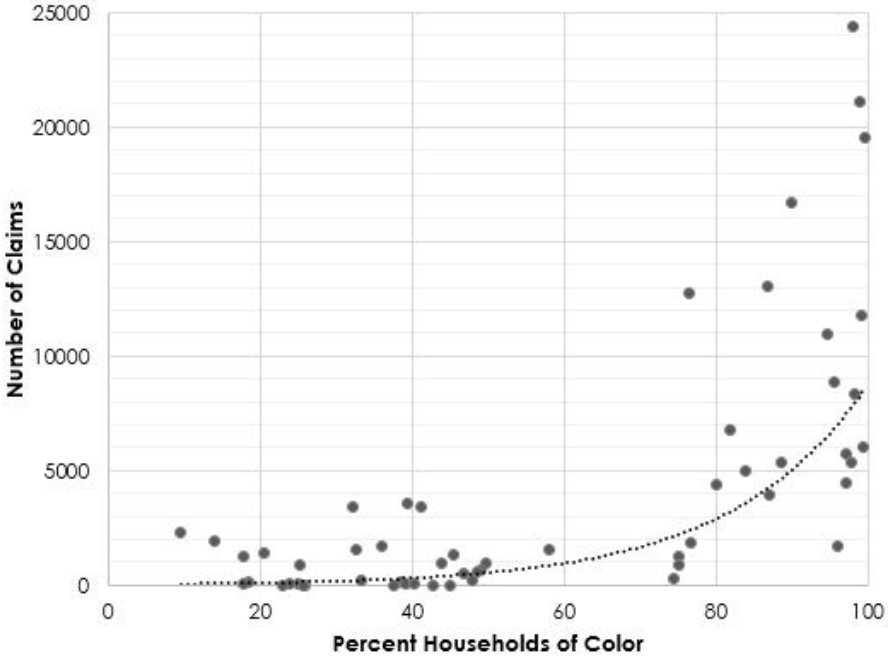
	QUARTILE 1	QUARTILE 4
Percentage of total flood claims	72%	0.4%
Percentage of total flood damage payments	59%	1%
Average payment per flood claim	\$1,582	\$5,432
Number of claims per zip code	5,750–24,500	0–200
Percentage of households headed by a person of color	93%	30%
Median household income	\$32,401	\$92,545

Interpreted broadly, the data clearly show that urban flooding has predominantly affected zip codes in which households of color are dominant (Figure 3). Altogether, 87% of the flood damage insurance claim payments were made to households located in communities of color.

Other descriptive statistics drawn from the data further amplify these inequities. For every 1,000 households living in Quartile 1, 644 claims were made. This is four times the rate reported by Quartile 2 households and 200 times the rate of households residing in Quartile 4, which had the fewest number of claims. Among the possible reasons for these differences may be that the value and size of housing units in the lowest quartile may be considerably smaller compared to units in the upper quartiles, thus reducing the size of payment. It should be noted, however, that a 2012 survey of flood victims found that households in flood-prone areas often reported repeated flooding incidents; in this case, the total flood damage per household could be much higher than the average flood claim payout (CNT, 2014).

FIGURE 3

RELATIONSHIP BETWEEN FLOOD CLAIM PAYMENTS FROM 2007–2016 AND HOUSEHOLDS OF COLOR IN CHICAGO

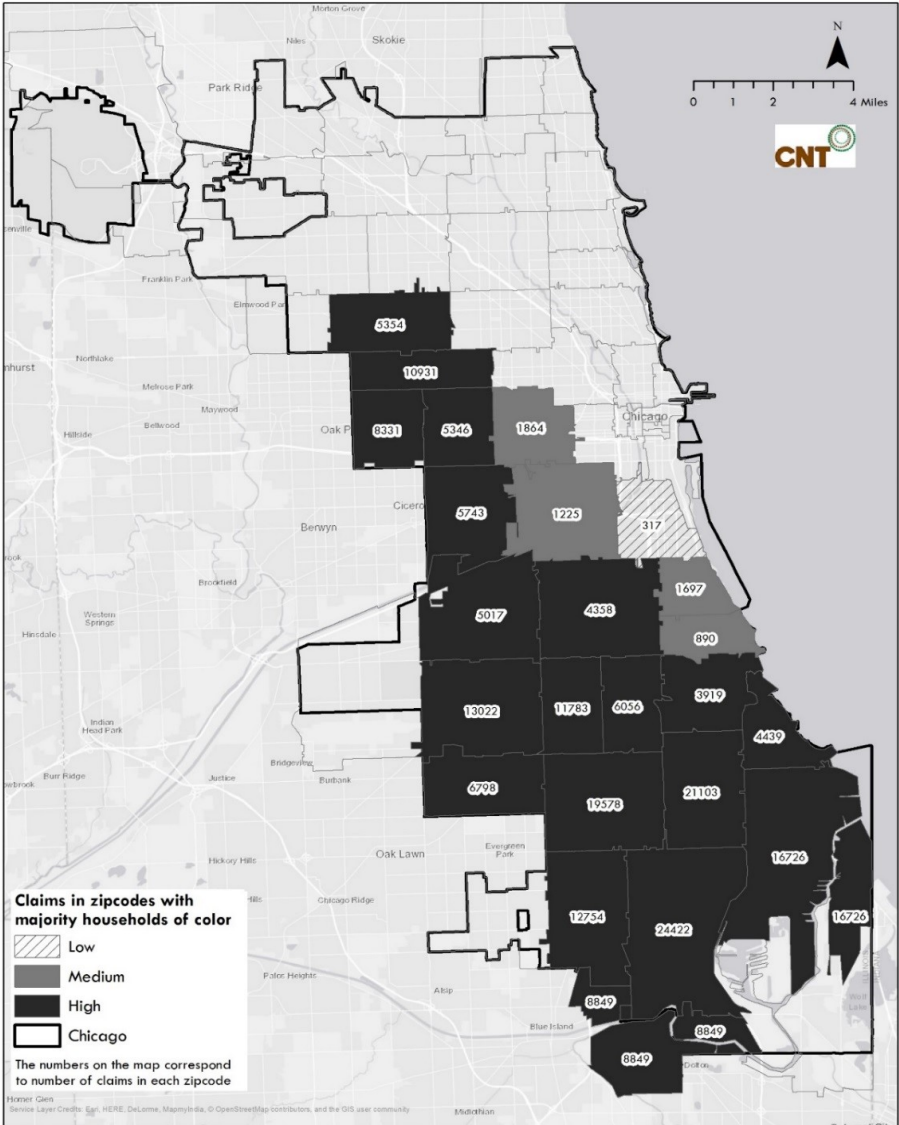


As the percentage of households of color increases, so do the number of flood claims. The strength of the correlation becomes stronger as the percentage of households of color increases past 60%.

The authors found similar trends in flooding-related service requests identified in the city’s 311 non-emergency assistance system call data. For every 1,000 households in Quartile 1, between 34 to 51 calls were made per year, a rate five to eight times greater than those in Quartile 4. Indeed, the hardship felt by households in the top quartile manifests itself in many ways.

FIGURE 4

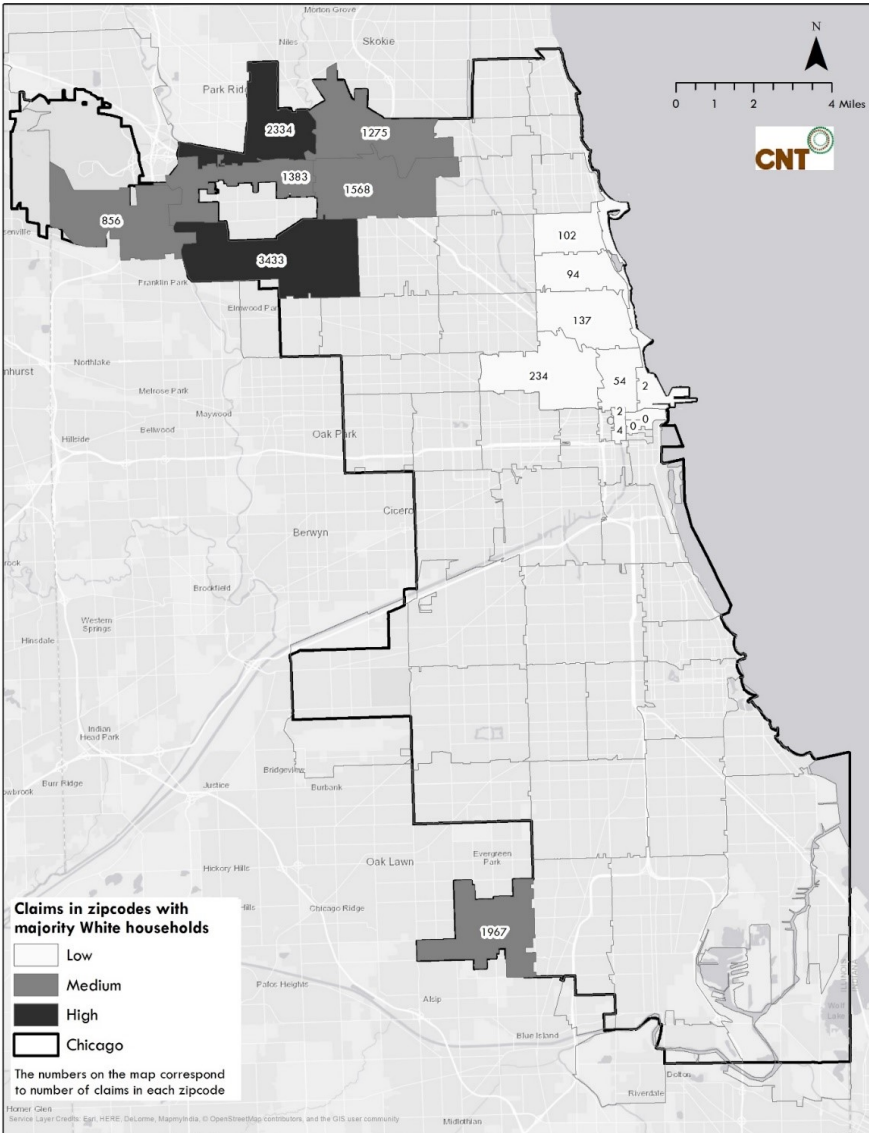
RATE OF FLOOD INSURANCE CLAIMS IN NEIGHBORHOODS WITH MAJORITY HOUSEHOLDS OF COLOR



This map shows the prevalence of household claims for flood damage in majority neighborhoods of color. Note how the preponderance of these community areas have high rates of claims, particularly areas that are a considerable distance from downtown, in sharp contrast to predominantly white neighborhoods shown on Figure 5 on the following page.

FIGURE 5

RATE OF FLOOD INSURANCE CLAIMS IN NEIGHBORHOODS WITH MAJORITY WHITE HOUSEHOLDS



This map shows the prevalence of household claims for flood damage in majority white neighborhoods. Most of these community areas, particularly those along the north lakefront, have low rates of household claims. Rates tend to be more moderate in outlying areas. For a map of rates in mixed neighborhoods, please refer to Figure 6 in the appendix.

MUNICIPAL RESIDENT ASSISTANCE PROGRAMS: TWO CASE STUDIES

Some municipalities are combatting urban flooding through residential assistance programs that emphasize distributed infrastructure and homeowner education. Distributed infrastructure, which employs smaller stormwater infrastructure elements (e.g., rain gardens) scattered throughout a geography, can improve community flood resilience by reducing the burden on the traditional “hub and spoke” model, which relies on a series of pipes flowing to one centralized treatment plant. This can take the form of site-level building retrofits that include both traditional home protection solutions (e.g., backflow prevention valves on private sewer lateral lines) and green infrastructure solutions (e.g., backyard rain gardens). Effective community engagement and resident education elements within such programs encourage behavioral changes, including greater preparedness, and leverage private investment in home flood mitigation improvements to reduce the long-term financial burdens facing municipalities.

Programs can also be strategically designed to achieve both equity and cost-efficiency goals. In general, residential green infrastructure investments, which divert runoff away from municipal sewers, often provide more community-wide benefits than home sewer retrofits because green infrastructure tends to reduce flow to the centralized sewer system, thus reducing risks of basement backups and overland flooding for the community at large, whereas the home-specific retrofits protect only individual properties. The policies adopted by the City of Chicago and Village of Oak Park, described in more detail below, also offer strategies that may be helpful for other communities in the region.

CASE STUDY 1: CITY OF CHICAGO

In April 2013, a 10-year storm dropping between five to six inches of rainfall within a 24-hour period inundated Cook County. The ensuing flooding disaster resulted in untreated sewage backing up into homes through basement plumbing, combined sewer overflows at 132 outfalls, and 10.7 billion gallons of backflow from the Chicago River into Lake Michigan. Like many Illinois cities, Chicago has a *combined system*, a system designed to collect rainwater runoff, domestic sewage, and industrial wastewater in the same pipe. To prevent more overland flooding, officials opened locks on the Chicago River for nearly 23 hours. The City of Chicago received more than 2,500 calls reporting water

in basements. Streets, viaducts, and train stations were also flooded in large numbers across the city (City of Chicago, 2017).

Among the factors contributing to the inability of local infrastructure to manage the volume of water during such a large storm event included an old and combined sewer system, aging housing stock, limited open space, and pervious surfaces across the city that can reduce the volume and velocity of stormwater flows (Chicago Metropolitan Agency for Planning, 2016a). Damage caused by the storm was so severe that FEMA issued a presidential disaster declaration and the U.S. Department of Housing and Urban Development allocated Community Development Block Grant Disaster Recovery (CDBG-DR) funding for public infrastructure, housing rehabilitation, and flood mitigation projects (City of Chicago, 2016). The city used the funding for a variety of projects, including sewer infrastructure upgrades, to minimize the future impacts of similar storms. Officials also chose to dedicate a portion of the CDBG-DR award to create a one-time Residential Flood Assistance Program, which provides housing rehabilitation and flood mitigation grants for flood victims.

In accordance with the U.S. Department of Housing and Urban Development (HUD) requirements, the city prepared an action plan that ensured CDBG-DR funds were directed to “unmet needs” from the 2013 disaster within areas most impacted by the flooding. The city partnered with local humanitarian organizations to identify individuals with verified flood damage from the 2013 storm event (City of Chicago, 2016) and allowed any resident with verified losses from the flood to apply for relief through the program. In 2015, the city contracted with delegate agencies, including CNT, to conduct outreach, program enrollment, and grant management for identified flood victims. The program offered direct assistance of up to \$50,000 in the form of construction services and personal property replacement to participating homeowners. Among the terms of the grant was the requirement that homeowners retain ownership of their home for two years after the program ended; otherwise repayment was required.

These initiatives proved successful in providing assistance predominantly to neighborhoods with below-average median household incomes and higher percentages of households of color than the city as a whole. A majority of program participants lived in areas where more than 30% of the population was below the poverty line (U.S. Census Bureau, 2010a, 2010b).

However, the city experienced challenges when attempting to enroll eligible participants. Of the 300 potential grantees contacted through outreach efforts, only 16% of those who wished to participate in the program and satisfied eligibility requirements (City of Chicago, 2016). Some of the challenges encountered when attempting to identify and enroll participants included the following: difficulties locating individuals at their last known addresses; failure to meet income eligibility requirements; and the fact that many households no longer owned their homes, sometimes due to foreclosure. There was also considerable reluctance among some potential beneficiaries of the program to provide all requested documentation due, in part, to a skepticism about the program (Bondie Keenan, & Wolf, 2017). Nevertheless, the program has many exemplary qualities, and the municipal government, in partnership with the Metropolitan Water Reclamation District and CNT, is now planning to test a new flooding assistance program that removes many of the aforementioned barriers.

CASE STUDY 2: VILLAGE OF OAK PARK

Like many communities in Illinois, Oak Park has an older sewer system. The housing stock includes a large number of pre-1950 homes and has very limited open space to lessen stormwater runoff (Chicago Metropolitan Agency for Planning, 2016b). Some areas of the village face chronic sewage backups and other local drainage issues. The village government, however, has been proactive in managing the associated problems. For example, Oak Park has established a sewer backup protection program for residents that provides a partial grant toward the purchase and installation of an overhead sewer or backflow prevention valve.

Moreover, the village developed a green infrastructure grant program that provides funds for homeowners who wish to better manage stormwater on their properties. This grant program, broadly designed to increase stormwater infiltration on private property, reduces the amount of runoff entering the local sewer system. Residents may receive grants for eligible landscaping measures, including rain gardens, depaving, permeable pavement, and dry wells. Applicants are asked to commit to maintaining grant-funded improvements for at least three years and participate in program surveys. The program employs an application prioritization protocol developed by CNT that uses a desktop review and phone interview process to identify properties that are suitable for green infrastructure practices and are able to complete construction during the required period stipulated in the grant.

The program, which is ongoing, is open to all residents who own a single-family home and do not have outstanding village obligations or building code violations. In addition to the cost-share grant, participants receive a free flood risk report that identifies specific flood risks at the property and includes landscaping plans and other flood mitigation recommendations (e.g., foundation repairs, gutter replacement, or plumbing retrofits). During the first year of the program, approximately 70% of program participants moved ahead with constructing green infrastructure elements, predominantly rain gardens.

Oak Park's grant program has benefited residents in neighborhoods with a wide range of income levels. Census data indicates that of the census tracts represented by participating properties, household income ranged from 60% to 220% of the village's median household income (U.S. Census Bureau, 2010a, 2010b). Other communities would be well served by emulating these strategies.

RECOMMENDATIONS FOR MUNICIPALITIES

The U.S. Environmental Protection Agency (2019) defines environmental justice as “the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies” (para. 1). Environmental injustice occurs when a group of people bear a disproportionate share of negative environmental consequences resulting from industrial, governmental, and commercial operations or policies.

The findings in this report indicate that low-income and communities of color in Chicago disproportionately experience adverse urban flooding impacts. This section presents several policy ideas for consideration. However, all local policy developments should be led by frontline communities that are most impacted by environmental injustice.

RECOMMENDATION 1:

Recognize and evaluate urban flooding as a potential environmental justice concern—and work to remedy this concern with an equity impact analysis of stormwater infrastructure investments.

Compelling evidence suggests that municipalities should undertake a flood impact analysis to identify environmental justice concerns associated with flooding in their jurisdictions. The impact analysis should explore equity issues

within the context of existing and planned stormwater infrastructure investments and repairs. Moreover, any assistance programs designed for residents and businesses should include dedicated funding for disadvantaged populations. These activities are most likely to succeed if steps are taken to integrate flood mitigation policies with existing environmental justice initiatives.

RECOMMENDATION 2:

Recognize that stormwater management planning and project development are best pursued in partnership with community-based organizations. Strategies should include the inclusion of community benefits programs and the development of open-access data sets related to flooding.

Resolving flooding problems requires participants in the planning process to prioritize public participation, which may include community flood mapping workshops that enable municipal staff to benefit from the local knowledge of residents. These workshops should identify “hidden” flooding areas that are not well documented on existing FEMA Flood Insurance Rate Maps or 311 logs because awareness of flood risk in these areas may be low. Municipalities should also schedule culturally appropriate project-design charrettes to engage diverse communities and develop insights into their preferences and needs, before embarking on large-scale initiatives.

Green infrastructure investments can serve as a catalyst for broader community development goals. To accomplish this, municipalities should integrate community benefits, such as job-training programs that teach green infrastructure and maintenance, local hire requirements for green infrastructure projects, and employing community-based organizations to provide community education about flooding risks.

The process of fostering community awareness of flooding risks can be greatly enhanced by providing free public access to data sets that identify where urban flooding is occurring. Readily available data sets include 311 complaints and topographic analysis. For example, the Village of Downers Grove, Illinois, publishes “Localized Poor Drainage Area” maps that identify parcels prone to flooding due to topography (Village of Downers Grove, 2019). Finally, municipalities could publish an urban flooding vulnerability map that incorporates flood exposure as well as sociodemographic and community health factors. As an example, the City of San Francisco’s (2016) flood vulnerability story map assesses the impact of flooding on public health for specific populations.

RECOMMENDATION 3:

Adopt building code amendments and building inspection protocols that incorporate flood mitigation measures.

With only a modest investment of time, municipal building inspectors can be given information they need to assess flood risk and identify specific actions to mitigate risk as part of routine inspections. Their work should be backed by a stormwater management ordinance that sets adequate requirements for on-site infiltration of new construction projects and renovations. New development proposals should be reviewed for the potential to create localized urban flooding.

RECOMMENDATION 4:

Communities that regularly experience flooding should establish a stormwater utility fee, initiate a stormwater management portfolio standard, and provide dedicated funding to help mitigate environmental justice concerns.

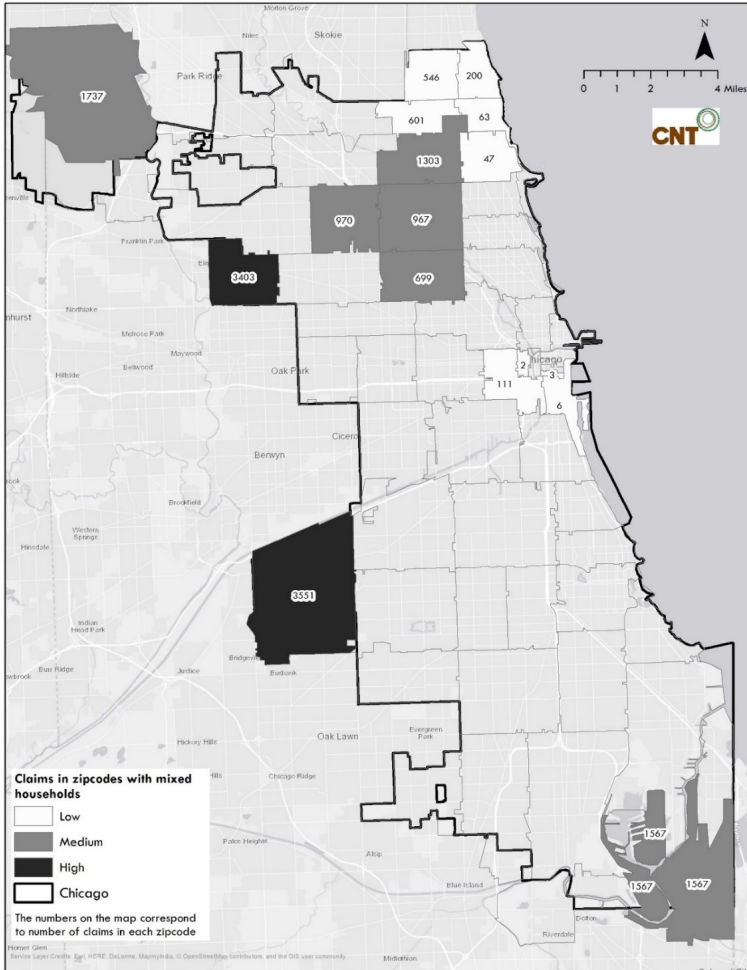
Stormwater utility fees enable municipalities to establish a user fee scaled to reflect the demand individual property owners place on local stormwater infrastructure. Our analysis suggests that some of the revenue collected from such fees should be dedicated for programs assisting disadvantaged communities at risk of flooding. A stormwater management portfolio standard could also be established to provide annual, incremental targets for reducing stormwater runoff, thereby providing clearly defined goals that can help inform municipal policy.

Not all communities have the resources to immediately pursue all of these recommendations. However, it is important that at-risk communities make them a priority, as flooding impacts will likely grow due to inadequate stormwater infrastructure, loss of open space, and increasingly intense storms. Our research suggests that municipalities are best served by pursuing a multipronged programmatic and policy approach that reflects unique local circumstances while prioritizing protection of the most vulnerable citizens. With decisive action, municipal leaders can lessen the adverse economic and health effects of flooding on low-income neighborhoods and communities of color.

APPENDIX

FIGURE 6

RATE OF FLOOD INSURANCE CLAIMS IN NEIGHBORHOODS WITH MAJORITY HOUSEHOLDS OF MIXED RACE



This chart shows the prevalence of household claims for flood damage in mixed-race neighborhoods. The intensity of household claims for these neighborhoods falls in between those observed in majority neighborhoods of color and majority white neighborhoods (see Figures 4 and 5).

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