

Urban Stormwater Flooding: Policy Solutions Addressing Chicago's Underserved Populations

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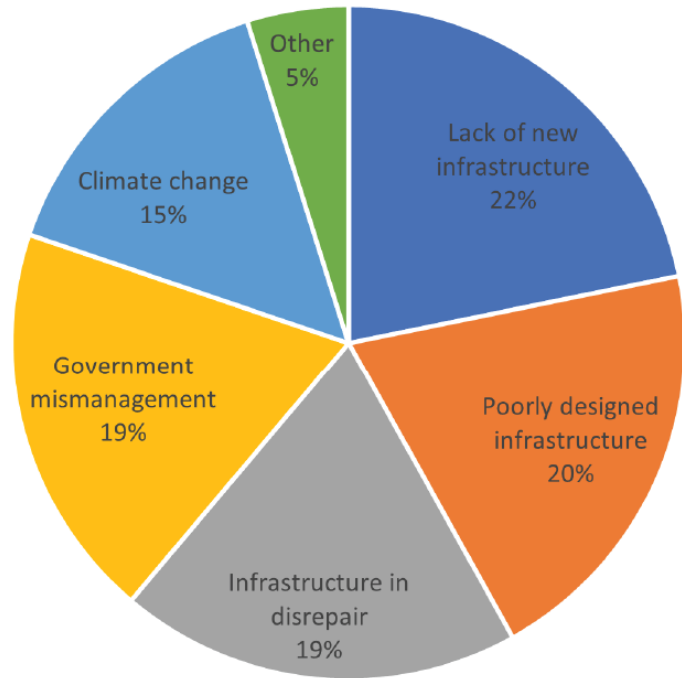
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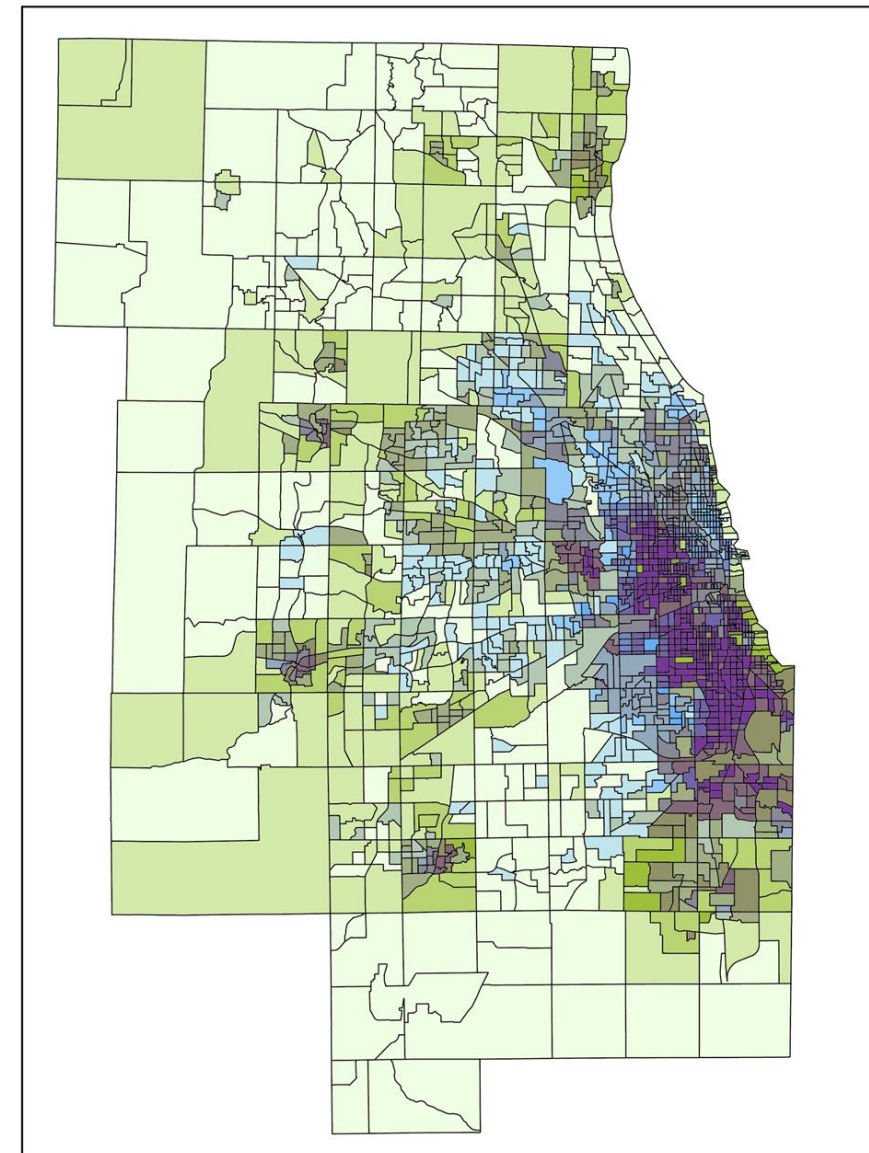
The problem

- Climate change → increased storms → increased flooding
- Severe issues in the Chicago area with its flat topology
- Disproportionate impacts for underserved populations

Figure 1. Identifying source(s) of stormwater flooding problems



Note: Percentages reflect the share of responses answering affirmatively for the following question: “In your opinion, which of the following contribute to stormwater flooding problems in your community? (select all that apply)” ($n = 945$).



Bivariate Choropleth Map for Flood Susceptibility and Social Vulnerability



A policy proposal

- Increase green stormwater infrastructure
 - Documented success – bioswales, rain gardens, permeable alleys
- Existing policies
 - National level: FEMA and EPA
 - City of Chicago
 - 2024 stormwater management regulations – more requirements for detentions basins
 - Bulletin 75 – better data and modeling, more inspections, \$5 million for green alleys, etc.
 - Cook County
 - MWRD's Watershed Management Ordinance – protection, ,maintenance, coordination
 - MWRD's Green Infrastructure Partnership Program – mimicking national processes

Research questions

- With flat topology, a goal of “reducing flood risk in [x] area” could lead to even greater harm elsewhere
- Accounting for political and engineering/landscape feasibility
- Targeting ecosystem services for the socio-economically disadvantaged
 1. How is the stormwater management problem understood in the context of green alternatives, for both stakeholders and the general public?
 2. Are any individuals or coalitions driving the narrative?
 3. Is there any chance for non-incremental policy change, particularly for those most affected by flooding?

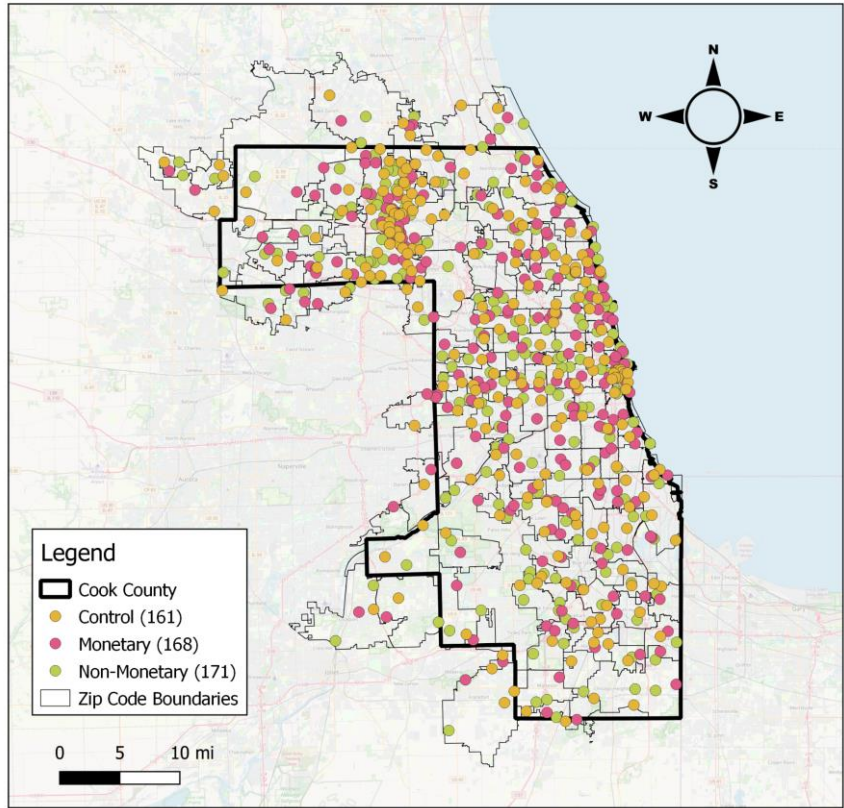
Methods

- Mixed methods approach
 - Interviews with experts/stakeholders
 - Survey of the Cook County public
 - Framing experiment focusing on monetary and non-monetary costs/benefits

Table 1. List of interviewees

ID	Organization type	Interviewee's role	Interviewee's Focus	Organization location
1 KS	City department	Senior landscape architect	Transportation infrastructure	Chicago
2 AB	City department	Stormwater reviewer	Stormwater ordinance	Chicago
3 JC	Regional government agency	Senior civil engineer	Stormwater project implementation	Chicago Region
4 DG	Consulting firm	Urban planner, water resource strategist	Water infrastructure	Chicago Region / Midwest
5 MB	Engineering consulting firm	Senior principal / civil engineer	Water resources, flood control, water quality, climate resiliency	Global / North America
6 LM	Engineering consulting firm	Senior principal / Policy specialist	Policy implementation, public engagement	Global / North America
7 TP	Engineering consulting firm	Senior manager / Civil engineer	Green infrastructure, natural resource protection	Central and Eastern US
8 NC	Engineering firm	President & Co-founder	Sustainable stormwater solutions	Midwest
9 AK	Founder	Senior director	Climate democracy	Chicago
10	Director		Built environment, racial and economic justice	Chicago Region
11	Director		Water system protection and restoration	Chicago Region
12	Director manager		transportation, energy, water	Chicago
13	Director		sustainability issues, nature based climate solutions	Midwest
14	Community organizer		Community resilience, faith based organization	Cicero (neighborhood)
15	Community organizer		Community resilience, faith based organization	Cicero (neighborhood)
16	Community organizer		Community resilience, faith based organization	Cicero (neighborhood)
17	Director		Environmental stewardship, organizing, education, advocacy	Edgewater (neighborhood)
18	Founder		Food access, community resilience	Englewood, West Englewood (neighborhood)
19	Executive director		Food access, economic development	Englewood (neighborhood)

Figure 2. Distribution of respondents across Cook County zip codes



Results: interviews ($n = 17$, fall 2023-spring 2024)

1. Systemic racism, historic disinvestment
 - Racial segregation, chronic disinvestment, “everything has to be replaced.”
2. Maintenance of green infrastructure
 - Need for more maintenance, lack of understanding, low impact
3. Balancing gray and green
 - Combination of two, not all one or the other
4. Public awareness
 - Lack of transparency, low barrier to entry for green, more severe in some areas
5. Benefits of green infrastructure
 - Co-benefits (health, finance, job creation, climate), access to natural areas

Results: survey ($n = 500$, late-Oct.-mid-Nov. 2024)

- Ranking of sources of problem
 - Emphasis is on aging and poorly maintained infrastructure
 - Sub-divided into low- and high-vulnerable areas based on Chicago Metropolitan Agency of Planning's Flood Susceptibility Index (FSI) (below- and above-mean for sample)

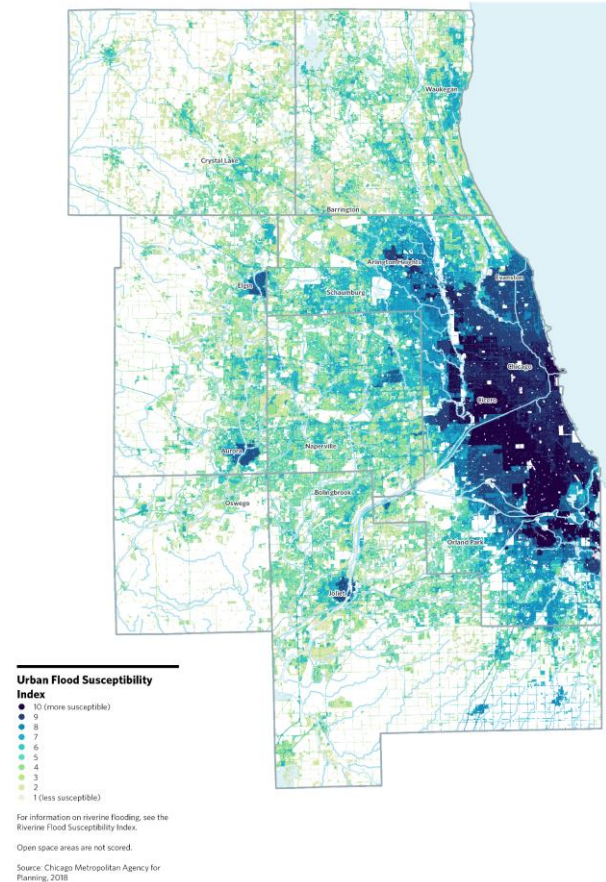
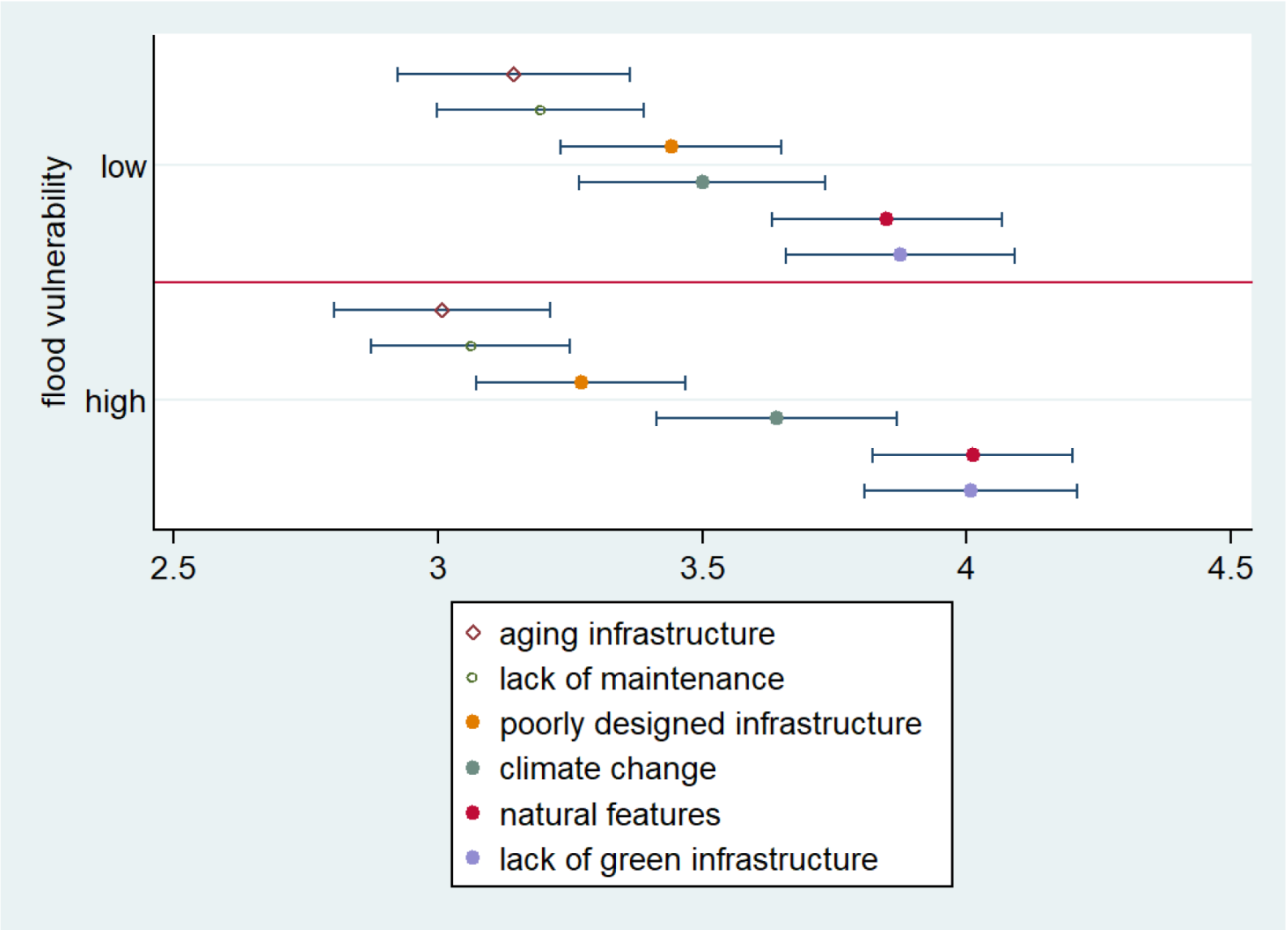


Figure 3. By low/high geographic vulnerability, ranking of perceived sources of community stormwater flooding



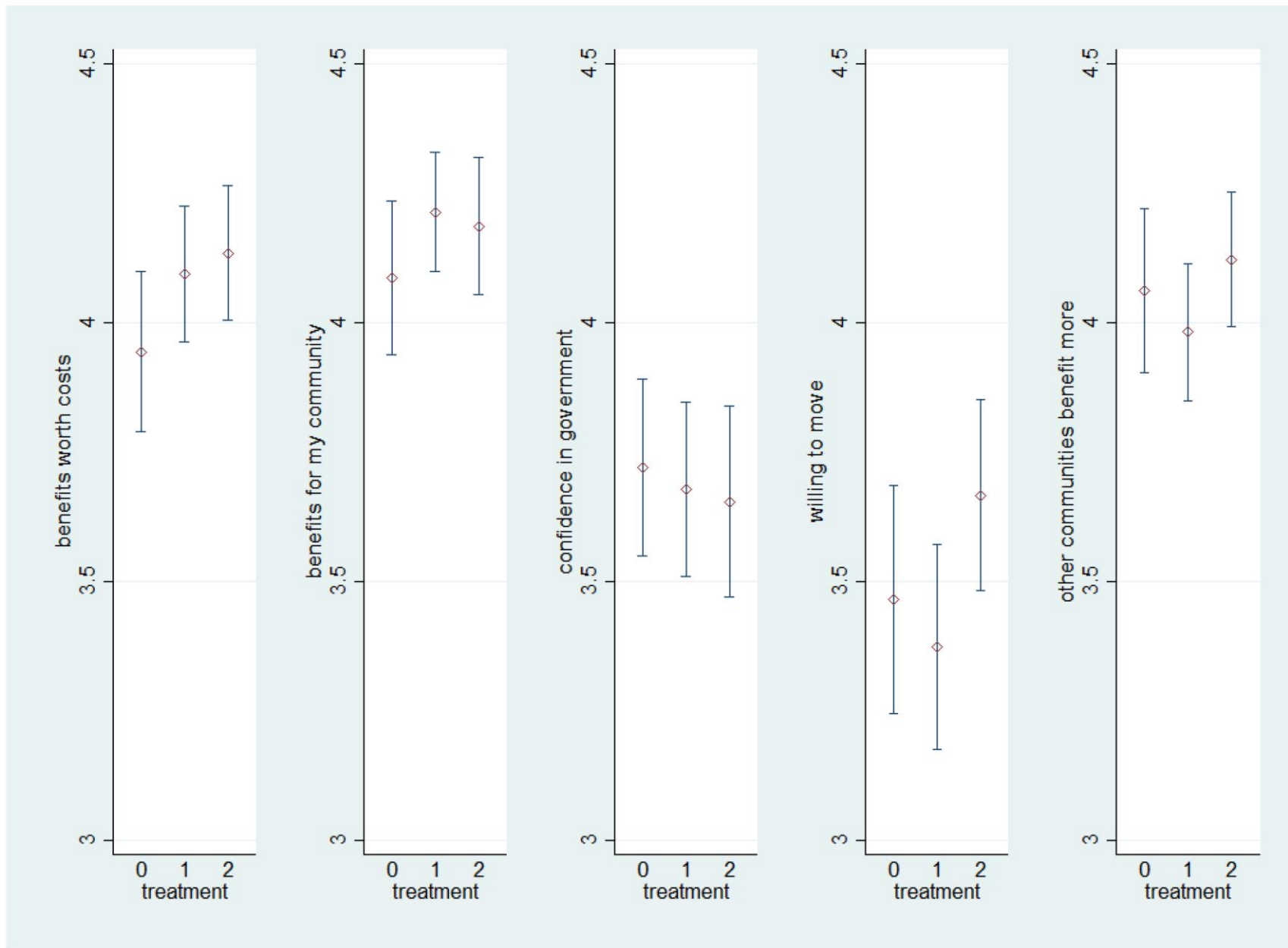
Note: “Low” and “high vulnerability” is determined by, respectively, below- and above-median mean-FSI scores at respondents’ zip code level.

Results: survey ($n = 500$, late-Oct.-mid-Nov. 2024)

- Framing experiment
 - Monetary frame is “worth the costs”
 - Same for non-monetary frame
 - Non-monetary group more willing to move
 - Remaining hypotheses rejected

“Monetary” vignette	“Non-monetary” vignette
<p>Open spaces, parks, parkways, and even alleys present opportunities to incorporate “green” stormwater management techniques in the community. These would include rain gardens, reservoirs at parks, and permeable paving, among other green techniques. These options can be implemented across your community and would significantly reduce stormwater flooding from occurring in the future. <i>Most importantly, green options are costly to implement, but installing them now would be less expensive compared to updating existing stormwater infrastructure later. The financial benefits of green infrastructure would last for decades.</i></p>	<p>Open spaces, parks, parkways, and even alleys present opportunities to incorporate “green” stormwater management techniques in the community. These would include rain gardens, reservoirs at parks, and permeable paving, among other green techniques. These options can be implemented across your community and would significantly reduce stormwater flooding from occurring in the future. <i>Most importantly, green options help reduce stormwater flooding in areas that are more vulnerable to flooding due to historic disinvestment by the local government. New green infrastructure would help communities in these areas become more resilient in future flooding events.</i></p>

Figure 4. Means of dependent variables across treatment groups



Note: Bars represent 95% confidence intervals. Treatment “0” is for the control group, “1” is for the monetary group, and “2” is for the non-monetary group.

Results: survey ($n = 500$, late-Oct.-mid-Nov. 2024)

- Effects of flood vulnerability
 - Aggregated across control, monetary, non-monetary groups
 - Regressed five outcome variables on FSI score for each respondent's zip code
 - No effects on benefits of green infrastructure, but, for more flood-vulnerable respondents, drop in government confidence and belief that other communities benefit

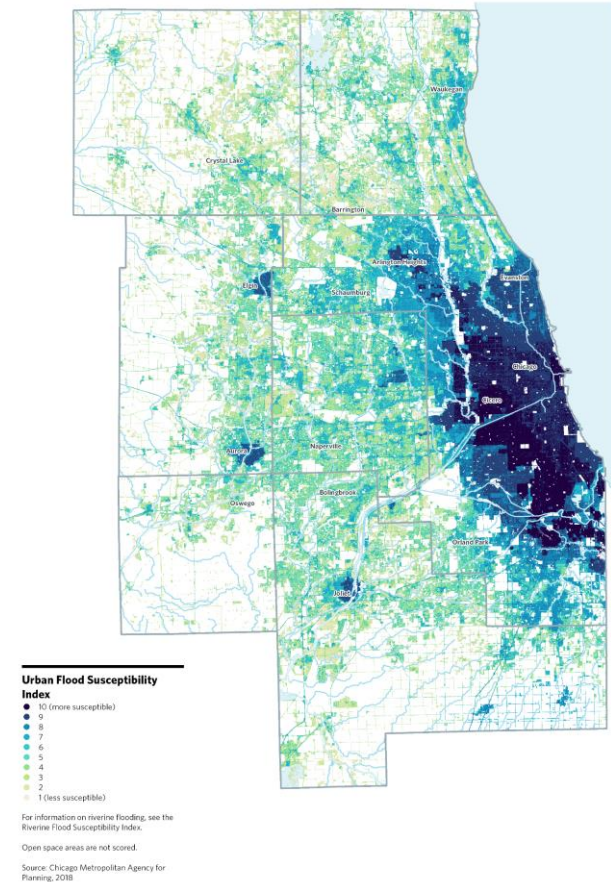
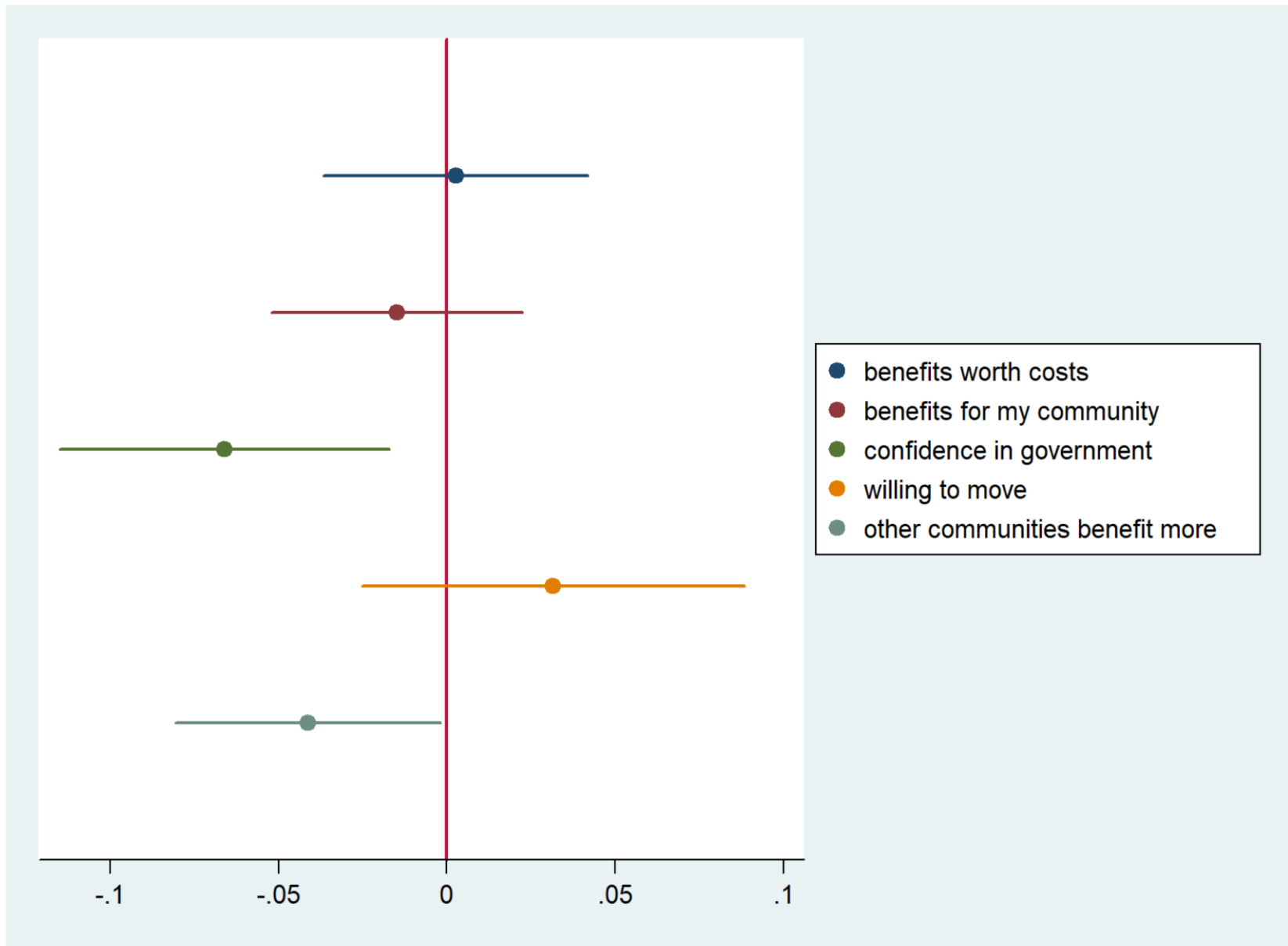


Figure 5. Predicted effect of flood vulnerability on outcome measures



Note: Flood vulnerability (mean FSI) determined by respondents' zip code.

Results: survey ($n = 500$, late-Oct.-mid-Nov. 2024)

- Cook County public's policy preference
 - 100% existing \leftarrow 50%/50% \rightarrow 100% green
 - Willingness to pay: monthly tax for above preference
 - By high-low vulnerability (FSI score) and treatment subgroups (control, monetary, non-monetary), regressed monthly tax on gray-green combination

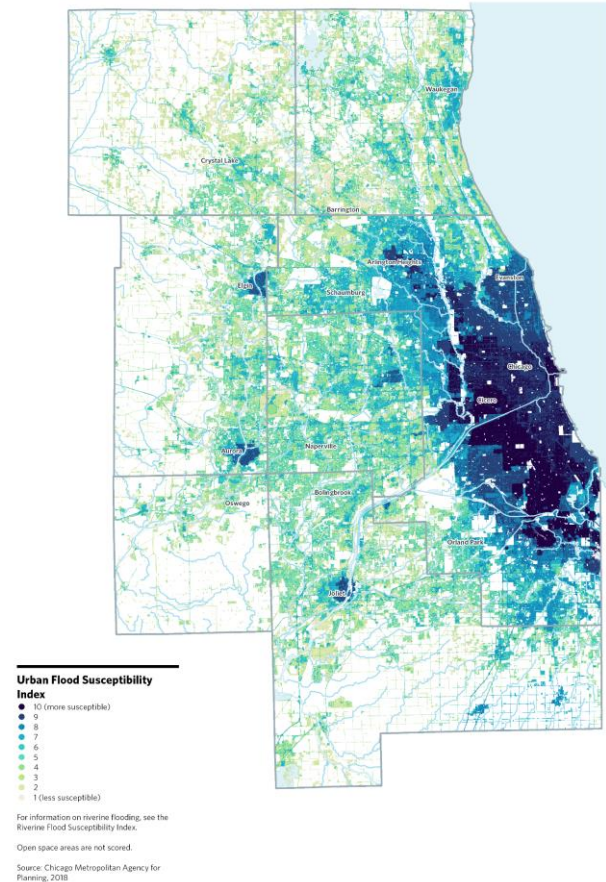
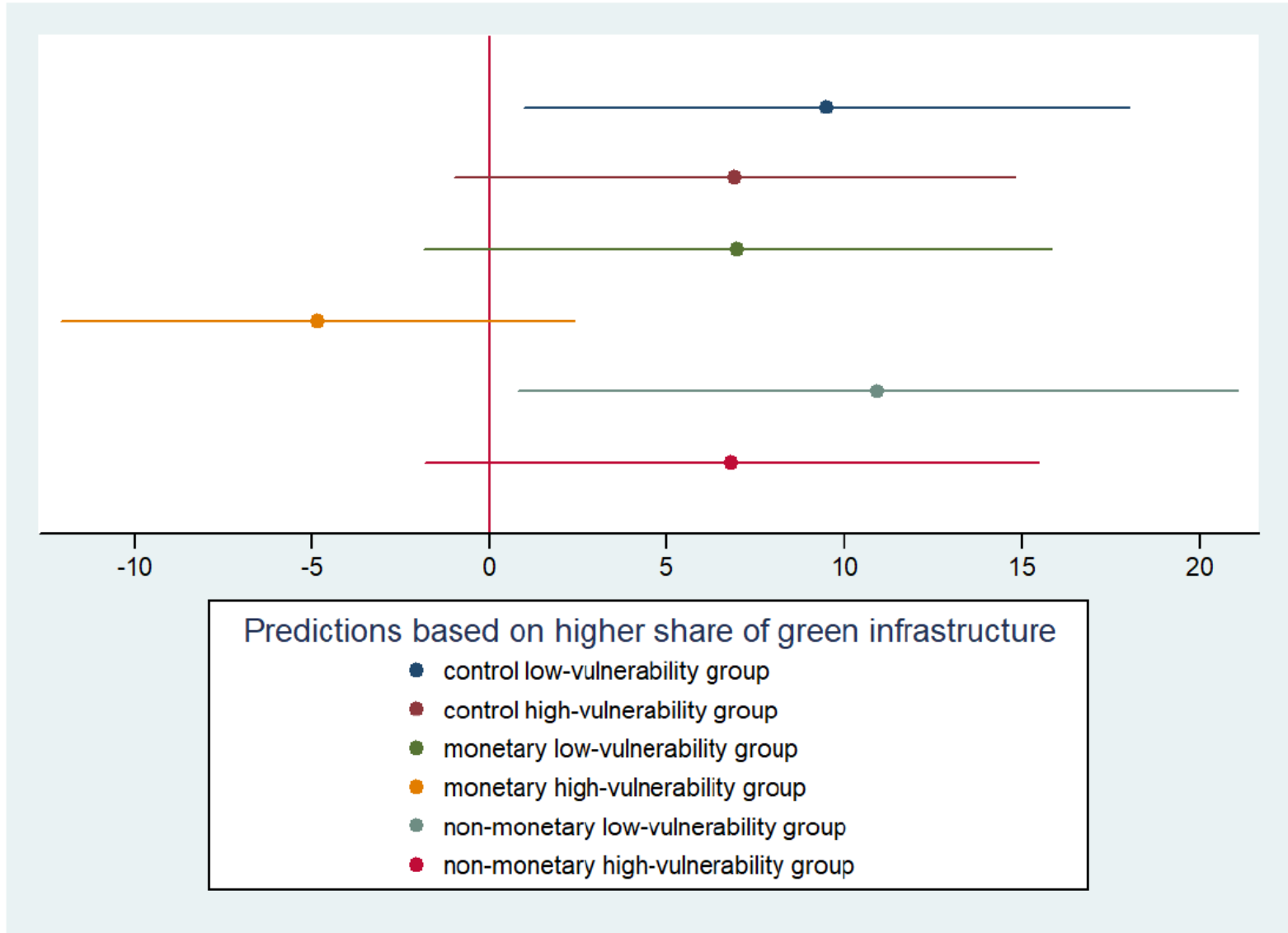


Figure 6. By treatment and vulnerability group, change in monthly taxes (\$) based on percentage of green infrastructure allocated



Note: Complete statistical output for all variables, including demographic control variables, is provided in the Appendix. Bars represent 95% confidence intervals.

Conclusions and policy prescription

- Historic disinvestment remains elusive, and most vulnerable communities lack a vehicle to contribute to the discourse (interviews)
- Prioritizing monetary costs/benefits is not enough; focus must be on gray/green combination and non-monetary infrastructure improvements (i.e., “co-benefits”)
- Coordination across the Chicago area is desperately needed – “regionalize” stormwater infrastructure for a “holistic solution” to engage community-based organizations

Supplemental slides



Table 3. Hypothesized changes in beliefs relative to control group

	Monetary group change	Non-monetary group change
“The benefits of green stormwater management techniques are worth the costs.”	1. decrease	2. increase
“Green stormwater management techniques would provide a major benefit for my community.”	3. increase	4. increase
	5. increase for flood-vulnerable people	
“I have confidence my local government would maintain green stormwater management techniques better than existing techniques.”	6. decrease	7. decrease
“I would be willing to move, if properly compensated, in order to have green stormwater management techniques installed in my community.”	uncertain	uncertain
	8. increase for flood-vulnerable people	
“Other communities besides mine would benefit from green stormwater management techniques.”	uncertain	uncertain
	9. decrease for flood-vulnerable people	

Control vignette	“Monetary” vignette	“Non-monetary” vignette
<p>Open spaces, parks, parkways, and even alleys present opportunities to incorporate “green” stormwater management techniques in the community. These would include rain gardens, reservoirs at parks, and permeable paving, among other green techniques. These options can be implemented across your community and would significantly reduce stormwater flooding from occurring in the future.</p>	<p>Open spaces, parks, parkways, and even alleys present opportunities to incorporate “green” stormwater management techniques in the community. These would include rain gardens, reservoirs at parks, and permeable paving, among other green techniques. These options can be implemented across your community and would significantly reduce stormwater flooding from occurring in the future. <i>Most importantly, green options are costly to implement, but installing them now would be less expensive compared to updating existing stormwater infrastructure later. The financial benefits of green infrastructure would last for decades.</i></p>	<p>Open spaces, parks, parkways, and even alleys present opportunities to incorporate “green” stormwater management techniques in the community. These would include rain gardens, reservoirs at parks, and permeable paving, among other green techniques. These options can be implemented across your community and would significantly reduce stormwater flooding from occurring in the future. <i>Most importantly, green options help reduce stormwater flooding in areas that are more vulnerable to flooding due to historic disinvestment by the local government. New green infrastructure would help communities in these areas become more resilient in future flooding events.</i></p>

Note: Italics and bold text were included in the original survey.



