

Survey User Guide

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WELCOME!

Thank you for participating in the stakeholder survey for the doctoral thesis *Adaptation through Policy: Climate Change induced heavy rainfall events and flash flooding*. Your input is an integral and valuable part of the research in determining the global trends in urban policy regarding rainfall and stormwater management. Your response will join responses from three different stakeholder groups: Formal City Governance, Research, and Advocacy and Conservancy (selected from a focus group study) across New York City to provide an in-depth look at policy trends towards stormwater management.

The main question we are trying to answer is: what is the best way to reduce flooding from heavy rainfall events in cities, understanding that climate change will make these occurrences more frequent? We are interested in overland flooding from rainfall; we are not exploring river or coastal flooding. Using your city's existing policies, guidebooks, and legislations we have outlined what criteria is important when cities try to answer this question. This paper is published at the *Journal of Environmental Planning and Management*: <https://doi.org/10.1080/09640568.2020.1823346>. Afterwards, using the same documents, we established which criteria are the most important when discussing these stormwater adaptations.

WHAT WILL YOU BE DOING?

Stage 1: Comparing the criteria

Before deciding which policy to implement we will first establish how important are the criteria. At the highest level, cities have POLITICAL, ECONOMIC, ENVIRONMENTAL, and SOCIAL considerations when making decisions on rainfall stormwater flooding. Using the following scale, you will be comparing these four criteria together for how important they are when answering the rainfall problem:

<i>Comparisons</i>	<i>Meaning</i>
<i>Equally Important</i>	<i>Both options have equal importance</i>
<i>Moderately More/Less Important</i>	<i>Using experience and judgement, one option is slightly preferred over the other</i>
<i>Strongly More/Less Important</i>	<i>Using experience and judgement, one option is strongly preferred over the other</i>
<i>Very Strongly/Demonstratively More/Less Important</i>	<i>Using experience and judgement, one option is very strongly preferred over the other. This option has demonstrated preference over the other in practice</i>
<i>Extremely/With Certainty More/Less Important</i>	<i>Using experience and judgement, one option is extremely preferred over the other. This option has demonstrated preference over the other in practice to the highest degree of certainty</i>

Each of these criteria will have sub-criteria that make it important. For example, to make an ECONOMIC decision you must consider the public costs but also the private costs. See Appendix 1 for the full list of sub-criteria. You will then be asked to compare these sub-criteria together for how important they are to their criteria when solving the rainfall question, example: how important are the public costs compared to the private costs when considering the economic criteria of preventing stormwater flooding?

Stage 2: Rating the alternatives

Now that the comparisons are done, you will be rating five different policy solutions or ‘alternatives’ to preventing rainfall flooding. See Appendix 2 for the full list of alternatives! Using the different linguistic scale below, you will be rating how well each of the alternatives performs or satisfies the sub-criteria.

Ranking	Meaning
<i>Very Low</i>	<i>Using experience and judgement, the alternative has a very low ability to satisfy the requirements of the criterion.</i>
<i>Low</i>	<i>Using experience and judgement, the alternative has a low ability to satisfy the requirements of the criterion</i>
<i>Moderate</i>	<i>Using experience and judgement, the alternative has a moderate ability to satisfy the requirements of the criterion</i>
<i>High</i>	<i>Using experience and judgement, the alternative has a high ability to satisfy the requirements of the criterion</i>
<i>Very High</i>	<i>Using experience and judgement, the alternative has a very high ability to satisfy the requirements of the criterion.</i>

We recognize that in practice, some criteria can be viewed as interdisciplinary and some alternatives are implemented in parallel. However, please approach the criteria and alternatives of Appendix 1 and 2 as theoretically independent of each other.

SAVING PROGRESS AND FINISHING

You will then have finished the survey! Below follows a reference guide while completing the survey outlining the criteria, sub-criteria and alternatives. Please reference it as needed! **YOU CAN SAVE YOUR SURVEY PROGRESS AND RETURN AT ANOTHER TIME.** You are able to save and return to this project at any time before submitting your responses. Follow the instructions of the save button to save your responses and you will be able to re-enter the survey with the link sent to your email. Your responses will be saved. Finally, your responses are based on your own opinions. They do not have to align with current existing legislation but are guided by your own experience and expertise in the field. Your responses will be analyzed anonymously.

Thank you!

Supplementary Materials Files S1: The Criteria and Sub-Criteria *Criteria*

<i>Political</i>	This criterion is concerned with political ability, actions and concerns regarding policy management. It includes the legislative and political framework for making decisions as well as the ability to execute policy.
<i>Economic</i>	This criterion is centered around the financial considerations and concerns regarding policy management. This captures the costs and savings of both public and private financing as well as industrial engagement.
<i>Environmental</i>	This criterion focuses on the environmental responses and needs in policy management. It includes the ecological components of water and environmental management in the city as well as the connections to climate change.
<i>Social</i>	This criterion captures the social and urban functionality in policy management. It includes the actions of citizens and policies' effects in daily life while also considering the social benefits of urban management.

Political Sub-Criteria

<i>Existing Legislative Framework</i>	The existing laws, regulations and directives in the city that set the basis and allow for the further development of stormwater management policies
<i>Project Feasibility</i>	The political will, planning framework and technical skills available to the city to implement new policy and management alternatives
<i>Jurisdiction</i>	The city's ability to directly implement and manage policy relating to stormwater through control and input over the responsible agencies or departments
<i>Implementation Time</i>	The timeframe for a policy or management alternative from proposal through implementation

Economic Sub-Criteria

<i>Public Costs</i>	The construction and maintenance costs of an alternative that the city or public body pays for
<i>Private Costs</i>	The construction and maintenance costs of an alternative that private entities or individuals pay for
<i>Funding Availability</i>	The availability of funding from internal, local, regional, national or international bodies to help with costs
<i>Green Industry Growth</i>	The ability for the environmental business and governmental sectors that focus on green technologies, services and products to develop and grow while focusing on a policy alternative

Environmental Sub-Criteria

<i>Stormwater Capacity</i>	The ability of an alternative to manage stormwater volumes
<i>Stormwater Quality</i>	The ability of an alternative to manage the water quality of stormwater by <u>managing and removing pollutants</u>
<i>Ecosystem Support</i>	The capacity of an alternative to support healthy, local, biodiverse ecosystems in the city
<i>Energy Usage</i>	The energy consumption required by an alternative from construction through management

Social Sub-Criteria

<i>Risk to Human Health and Safety</i>	The potential for the alternative to pose dangers to the public directly or indirectly during the life cycle of the alternative such as construction dangers, road use dangers, contaminated water, etc.
<i>Civic Engagement</i>	The ability and willingness for citizens to engage in policy management and take initiative in adaptation strategies from the proposal stage through the implementation of the alternative
<i>Reducing Inequalities</i>	The extent the policy provides opportunities to reduce urban inequalities, example: economic, access to healthcare, access to environment, etc. and provides the potential for local employment
<i>Synergies with other Adaptations</i>	The extent the policy contributes to overall urban health and protecting against other hazards to urban populations, example: pollution, air temperature, drought, etc.

Please note that some of the sub-criteria are positive and some are negative. However, rate them on the same scale. For example, an alternative could have HIGH public costs (a negative attribute) but HIGH ecosystem support (a positive attribute). Similarly, an alternative could have LOW risk to human health (negative attribute) but LOW stormwater capacity (positive attribute).

Supplementary Materials Files S2: The Policy Alternatives *Policy Alternatives*

Grey Infrastructure Overhauls: This policy alternative attempts to transform and expand existing stormwater systems using grey infrastructure. These structures are traditionally built of concrete and include but are not limited to treatment facilities, sewage systems, pipping, stormwater systems, combined-sewage overflows (CSOs). For example, this alternative frequently exhibits itself in policy documents as attempts to separate stormwater and sewage shed, expand treatment facilities, expand system capacity, and move water away from the city.

Public Green Infrastructure: This policy alternative is concerned with green infrastructure regarding public management. Green infrastructure can be used as both stormwater retention and stormwater infiltration. In retention, stormwater is stored and released slowly to not overwhelm stormwater systems. In infiltration, stormwater is brought back into the soil. Green infrastructure can take many forms. Tree beds, rain gardens, rain barrels, cisterns, green roofs and architecture, swales, constructed marshland and berms are examples of green infrastructure. Permeable pavement is another example. Rain ponds include both natural ponds and flexible urban space that are allowed to flood. This alternative also includes 'blue infrastructure' which is specifically regarding water management such as reconstructing historical stream and river networks. This alternative applies to both large scale city projects and small managed city spaces and buildings.

Private Green Infrastructure: This policy alternative is concerned with green infrastructure that is financed and installed through private citizens and businesses. The same infrastructure applies as with public green infrastructure. This alternative can scale from property developers to individual homeowners.

Government Streamlining: This alternative is centered on the bettering of government systems. City governments can join responsibilities and foster collaborative participation between agencies that manage water, stormwater and green spaces. Better comprehensive management policy is better directed towards solving cloudburst management and provides better oversight in managing targets. Cities also continue to publish guiding documents outlining their plans, goals and targets. This policy encourages cities to make clear the laws, regulations and options for both civil servants as well as citizens when it comes to cloudburst management. Governments can also develop specific emergency management plans to mitigate flooding events.

Maintaining Urban Environments: This policy alternative is focused on ensuring the city is better prepared to handle cloudburst events. Reducing street litter ensures that stormwater systems both grey and green operate optimally. Protecting wastewater treatment plants from flooding ensures the stormwater system operates under high stress conditions. Cities also have options available in land use planning to help redeveloped brownfield sites, encourage healthy growth, and discourage growth in high vulnerability areas. The alternative ensures that stormwater systems operate efficiently while trying to decrease the risk of the urban environment to flooding.