

Optional Sectoral Module STORMWATER AND FLOOD PLAIN MANAGEMENT



In a resilient city, the flow of rainwater through the city is managed by natural and impervious areas, conduits, and constructed and natural channels to downstream areas. Local government develops sustainable management systems and infrastructure to prevent impacts and reduce social, economic, and environmental risks and vulnerabilities from flooding (coordinated, robust, and inclusive). Stormwater systems are the local infrastructure for managing rainwater while flood plain management deals with flood flows from major rivers crossing the urban area.

Urban development and climate change may increase the city's vulnerability over time due to increasing frequency (or intensity) of flood events and increasing solids and contamination. A resilient city develops nonstructural and structural measures to increase resilience (robust). Nonstructural measures include institutional capacity for regulation and management prevention through flood alerts, zoning, and long-term programs to mitigate dispersed impacts in the city (coordinated and redundant). Structural measures are investments in reducing existing risk and vulnerability that requires structural interventions (robust).

In the implementation of the measures, a resilient city needs a responsible institution to assure the operation, maintenance, and financial management of stormwater and flood management infrastructure (coordinated). This institution needs cost recovery for the services and investments and a strategic plan of action, review of investments, and public participation (reflective).

TOPIC	GUIDING QUESTION	APPLICABLE RESILIENCE QUALITY	RELATIONSHIP TO RESILIENCE QUALITY
System Capacity	Is there a stormwater and flood management system in the city? Does it cover all urban areas?	Robust; Inclusive	Stormwater and flood management systems are needed to ensure that rainwater and water flows from major rivers are drained efficiently and protect inhabitants from flooding. Public utilities do not often serve informal settlements, putting them at higher disaster risk than the general public.
Institutional Capacity	Who manages the stormwater and flood management system in the city? Is there a utility for stormwater? Is there another institution for flood management? Are all providers in urban services well coordinated in terms of management, planning, and emergency response?	Coordinated	Close coordination among water, sanitation, solids and drainage utilities, and flood management can facilitate planning for future demand and accelerate response in case of disruption.
Institutional Capacity	Is there a periodic assessment and update of the measures and investments in the stormwater system?	Reflective	Regular assessment of the stormwater and flood management systems are necessary to ensure that the system reflects new conditions and addresses potential vulnerabilities.
Institutional Capacity	Is there public participation on stormwater and flood management decision-making? Is there a consultation process and communication of decisions?	Inclusive	When plans are developed in consultation with affected communities and civil society groups, solutions are more robust because they include the nuanced needs of affected communities and the general public.
Institutional Capacity	Does the city monitor rainfall, runoff, solids, and water quality in the urban area? Is there updated drainage survey information available along with topography? Is the data updated regularly?	Reflective	Monitoring changes in the city's stormwater drainage system allows for informed capacity management and design. It can also serve to highlight potential vulnerabilities.

Regulations	Does the city have a master plan or regulatory framework for managing land use and urban growth? Is stormwater and flood plain management included in this plan? Are the regulations effective and enforceable?	Robust	Enforced planning regulations can help prevent unauthorized development in the city, especially in flood plains or other areas at high risk for urban flooding.
Regulations	Is there a regulatory framework to control the impact of urbanization on the stormwater system? Does it address peak flows, solids, and water quality? Are the regulations enforceable?	Robust	Regulations are needed to control the impacts of increasing urbanization from source water areas to downstream public networks in the city.
Regulations	Do land use policies and planning regulations incorporate flood plain information? What proportion of the population is in the 100-year flood plain? Are policies and regulations enforceable?	Robust; Reflective	Risk-based land use policies and regulations for flooding events should be integrated in land use planning to reduce exposure.
Regulations	Are there incentives for environmental certification for new developments and regeneration in the city?	Robust	New construction with green infrastructure such as water reuse, drainage control, and energy efficiency help to minimize the impact of new development on the city's ecosystem.
Planning	Is there a stormwater master plan for the city? Does the plan cover all urban areas? What is the return period used for the major drainage works design? Is there an emergency plan for floods above the designed time of recurrence?	Robust; Reflective	Experience of current seasonal rain/ stormwater variations and forecasted impacts of climate change on rainfall levels should inform the design of the city's drainage system. Climate change projections allow the city to improve the design and capacity of existing drainage and water retention infrastructure, as well as make necessary flood protection investments to accommodate changes in rainfall patterns.

Finance	Do stormwater services achieve cost recovery for investments, operations, and maintenance? Is there a tax or tariff for stormwater? Is it economically sustainable?	Robust	Cost recovery for flood management implies a sustainable management where revenues from stormwater services recover operational expenses at the very minimum.
Risk Identification	Is the city's drainage system currently able to cope with seasonal increase in rain/stormwater? Is there an assessment of stormwater flooding locations and frequency in the city? Is there an assessment of damages? Is there an assessment of solids and water quality impacts?	Reflective	The knowledge of flood impacts is the first step to develop solutions for the system. The impacts are distributed in space and vary with frequency. Risk assessments identify the city's current and future vulnerabilities by examining historical data and/or future scenarios through modeling. The relevance of risk assessments depends on them being regularly updated to appropriately reflect levels of vulnerability and exposure.
Preparedness	Is there a flood alert system for populations that occupy flood plains in the city? Is there an emergency plan developed for hazard areas?	Robust	Early warning systems are essential to facilitating public safety during a disaster event by giving residents time to evacuate or protect themselves before impact.
Program	Is there a program to eliminate stormwater flooding at minor drainage points in the city? What has been the perception of this program by citizens?	Robust; Inclusive	Minor stormwater floods are distributed in small areas usually due to drainage capacity constraints. The elimination of these frequent occurrences is a way of improving the overall quality of life for the population.
Program	Is there an evaluation of interconnections between sewage and stormwater networks (i.e., contamination of stormwater networks by sewage)? Is there a program to eliminate this contamination? Does the city have combined networks? How frequent is the spillage of contaminated flow?	Robust	A resilient city minimizes sewage in stormwater through separate stormwater networks in order to improve water quality and reduce environmental impact. For combined systems, the focus should be on decreasing the spill of contaminated water.

Program	Is there a program for water quality improvement of major drainage in the city? What is the time frame of the program? Is the program fully funded?	Robust	Water quality is contaminated by sewage and overland flow in urban areas along with solids dumped in the network. Improving water quality of major drainage is important for improving environment sustainability in urban areas.
Program	Is there a program for the recovery of degraded areas caused by erosion and sedimentation or solids deposits? What is the timeframe of the program? Is the program fully funded?	Robust	Informal settlement may occur along steep slopes, exacerbating erosion and posing a risk to the urban ecosystem and the settlers.
Program	Is there a program to reduce the contamination of groundwater? What is the timeframe of the program? Is the program fully funded?	Robust	In urban areas, there are many sources of groundwater contamination. There is a need to develop regulation and contain the existing sources together with enforcement for minimizing the contamination.
Program	Is there a capacity-building program for stormwater utility personnel, design and planning professionals, and the community?	Reflective	All departments in the city should be able to manage risks of disasters (including flooding) for their areas of responsibility. Community members are often the first respondents in a disaster and can be even more effective if they are organized and coordinated with other emergency response agencies.

- Tucci, Carlos. 2009. Integrated Urban Water Management in Large Cities: A Practical Tool for Assessing Key Water Management Issues in the Large Cities of the Developing World.