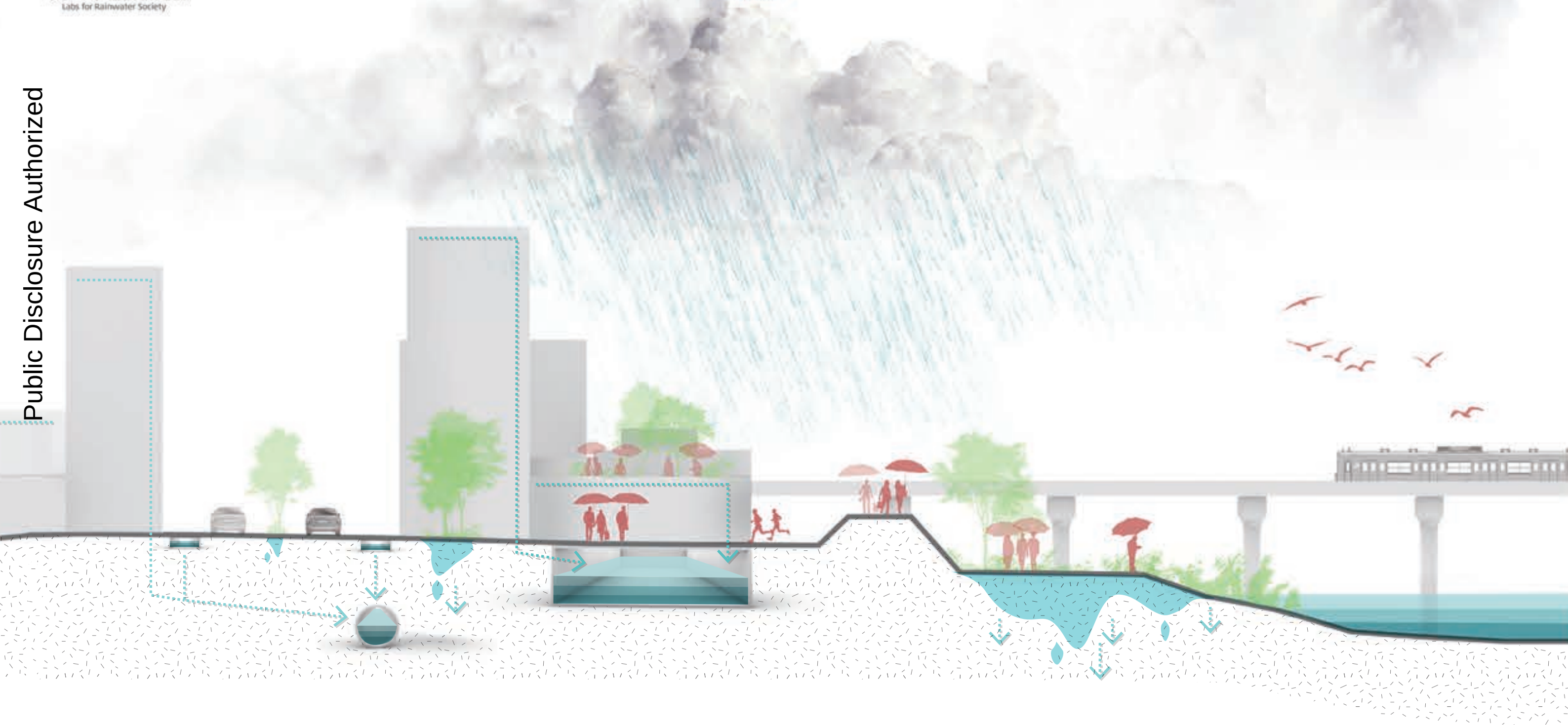
Community- and Nature-Based Solutions for Integrated Urban Flood Risk Management

Mini Studios for Water-Sensitive Urban Design:

A Handbook for Organizers and Facilitators

あまみず社会研究会 Labs for Rainwater Society
THE WORLD BANK IBRD • IDA | WORLD BANK GROUP
UFCOP Urban Floods Community of Practice
GFDRR Global Facility for Disaster Reduction and Recovery



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COVER IMAGE
A schematic graphic of rainwater flow in an urban context. Various infrastructural and land use planning strategies mitigate the risks of urban runoff through infiltration, storage, and conveyance. By Kenya Endo

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Photograph 1: Urban Flooding Across the World

Sources: Grenet 2015 (top); Gonzalez 2016 (bottom).
Note: Heavy storm events often exceed the designed management capacity of cities' infrastructure. The integrated urban flood risk management approach not only minimizes damage to lives and economies, but also enhances ecological services.

1. Introduction

Globally, floods are the most frequent and damaging natural hazard. Between 1998 and 2017, floods led to economic damages exceeding $600 billion, affected more than 2 billion people, and resulted in around 142,000 fatalities (Wallemacq, Below, and McLean 2018). Compounded by rapid urbanization and climate change, these losses will likely increase, especially in fast-growing cities. To help manage the impact of flooding on people and economies, the World Bank provides technical assistance, advisory services, and financing to its client countries through a range of resilient urban development initiatives.

These efforts increasingly promote an integrated approach to flood risk management that combines engineered and nonengineered measures, as well as traditional and innovative community- and nature-based solutions. By integrating these diverse measures, cities can better adapt to different types of flood risks and scenarios, as well as enhance their capacities to plan for uncertainties and extreme weather events that may increase under conditions of climate change. Successful cases of integrated urban flood risk management (IUFRM) have demonstrated significant results not only in reducing the negative impacts of urban floods, but also in enhancing ecological services and raising community awareness of flood risk and ways to mitigate it. Various case studies of IUFRM are highlighted in *Learning from Japan's Experience in Integrated Urban Flood Risk Management: A Series of Knowledge Notes* (World Bank 2020).

Photograph 2: Rain Garden, Natural Drainage, and Floodable Play Field Integrated with High-Rise Public Housing in Punggol District, Singapore

Source: Ramboll Studio Dreiseitl, Singapore.
Note: The development explores a nature-based approach to managing stormwater runoff holistically with added ecological, aesthetic, and communal benefits.

In this context, there is growing interest in rethinking the way we plan for urban flood resilience—to explore and integrate a wider range of approaches and solutions, including community- and nature-based approaches. Yet there is limited understanding and utilization of tools and resources for city planners to carry out these integrated planning and prioritization processes.

To help fill this gap, this Handbook showcases a multistakeholder planning and awareness-raising "Mini Studio" exercise to kick-start and facilitate the integrated planning, prioritization, and design process of urban flood resilience initiatives. Drawing upon the experiences and lessons learned from past Mini Studio exercises implemented by the World Bank in Tokyo, Japan, and Bogor, Indonesia, the Handbook outlines key principles and design exercises that can be tested and examined in any city across the world.

The Handbook aims to serve as a step-by-step guide and resource for technical and nontechnical audiences, government officials, city planners and practitioners, academics, community groups, and others interested in innovative approaches to promoting urban flood resilience that integrate the needs of various stakeholders and combine traditional measures with innovative community- and nature-based solutions.

Photograph 3: Various Activities of a Mini Studio, including Site Excursions, Design Exploration, and a Pin-Up Session for Sharing Design Ideas

Source: World Bank Global Facility for Disaster Reduction and Recovery (GFDRR).

2. What Is a Mini Studio?

The term “studio” or “design studio” typically refers to a set of problem-solving exercises undertaken by students and professionals involved in architecture and urban design. Gathering in the same space together, design students, instructors, and professionals collaboratively investigate a common problem. A “Mini Studio for Water-Sensitive Urban Design” is an adaptation of this interactive and hands-on learning experience, and aims to provide an opportunity for participants to:

- **See and learn,** first-hand, various techniques available for managing rainwater in urban areas.
- **Explore and experience** the challenges and opportunities involved in progressing toward ambitious flood management goals.
- **Create** a simple flood-resilient neighborhood design proposal.

Thus, the Mini Studio is designed to facilitate participants’ hands-on interactions, creativity, and problem-solving skills to overcome complex urban flood risk management issues. Participants are asked to use their imagination and design know-how to come up with new ways to solve complex urban planning challenges. In the course of the studio exercise, all participants are encouraged to chip in ideas, build robust strategies, and create simple drawings and models to visually communicate solutions based on predetermined themes and parameters.

Photograph 4: Various Projects Led by LRwS

Source: LRwS.
Note: Home renovation prototype with ideas for reusing rainwater for daily activities, such as footbaths and water features (top and bottom left), a rain garden in a cafe, and streetscapes in collaboration with community members (bottom right).

A network of Japanese researchers called the Labs for Rainwater Society (LRwS) have been implementing this Mini Studio exercise as part of their Rainwater Coordinator Training Program since 2015. Through the program, LRwS trained a cohort of Japanese professionals working in national and city governments, urban design and engineering companies, academia, and civil society groups. These trainees have been equipped with enhanced understanding of how to plan, design, and implement various integrated approaches to urban stormwater management for the benefit of society.

Mini Studio exercises are mainly twofold: an exploration of design ideas toward the creation of a flood-resilient neighborhood, and hydraulic calculations quantifying the effectiveness of the proposed stormwater management techniques. These two elements feature participatory planning practices common in Japan, the United States, Australia, and Singapore,[1] with the additional value of leveraging scientific and technical evidence to jointly measure and understand the impact of flood risk mitigation ideas.

The "Mini Studio for Water-Sensitive Urban Design" showcased in this Handbook draws upon the methodology developed by LRwS in Fukuoka, Japan, and adapts its tools and exercises to be more broadly applicable and relevant for adoption by global audiences.

[1] For example, refer to participatory planning cases explored after Superstorm Sandy in the United States: https://stormrecovery.ny.gov/community-reconstruction-program; and neighborhood-scale community engagement initiatives in Singapore: http://participateindesign.org/.

3. Why a Mini Studio?

What Does a Flood-Resilient Neighborhood Look Like?

A Mini Studio is a great way to initiate dialogue with diverse stakeholders on the details of design challenges and opportunities. For our purposes, its strengths lie in making the concept of "flood resilience" something more concrete and tangible at a neighborhood scale, so participants can better understand and conceptualize measures and policies proposed at the city or national scale.

A Mini Studio is often implemented as a stakeholder consultation or capacity-building process that is part of the planning, prioritization, and/or design of a flood management initiative. It can also be implemented as part of a technical training program for professionals, students, and community members.

The key benefits and objectives of incorporating a Mini Studio exercise as part of urban flood resilience planning include the following.

Breaking barriers

A Mini Studio fosters collaboration between practitioners from different areas of expertise and sectors, including: the national and local government; various public sector departments, such as river and water resources, roads, drainage, environment, parks, tourism, education, and health; academia; and the private sector, as well as community members wanting to gain a deeper understanding of new approaches to urban flood resilience. Topics include innovative measures and solutions, such as green infrastructure and community- and nature-based approaches.

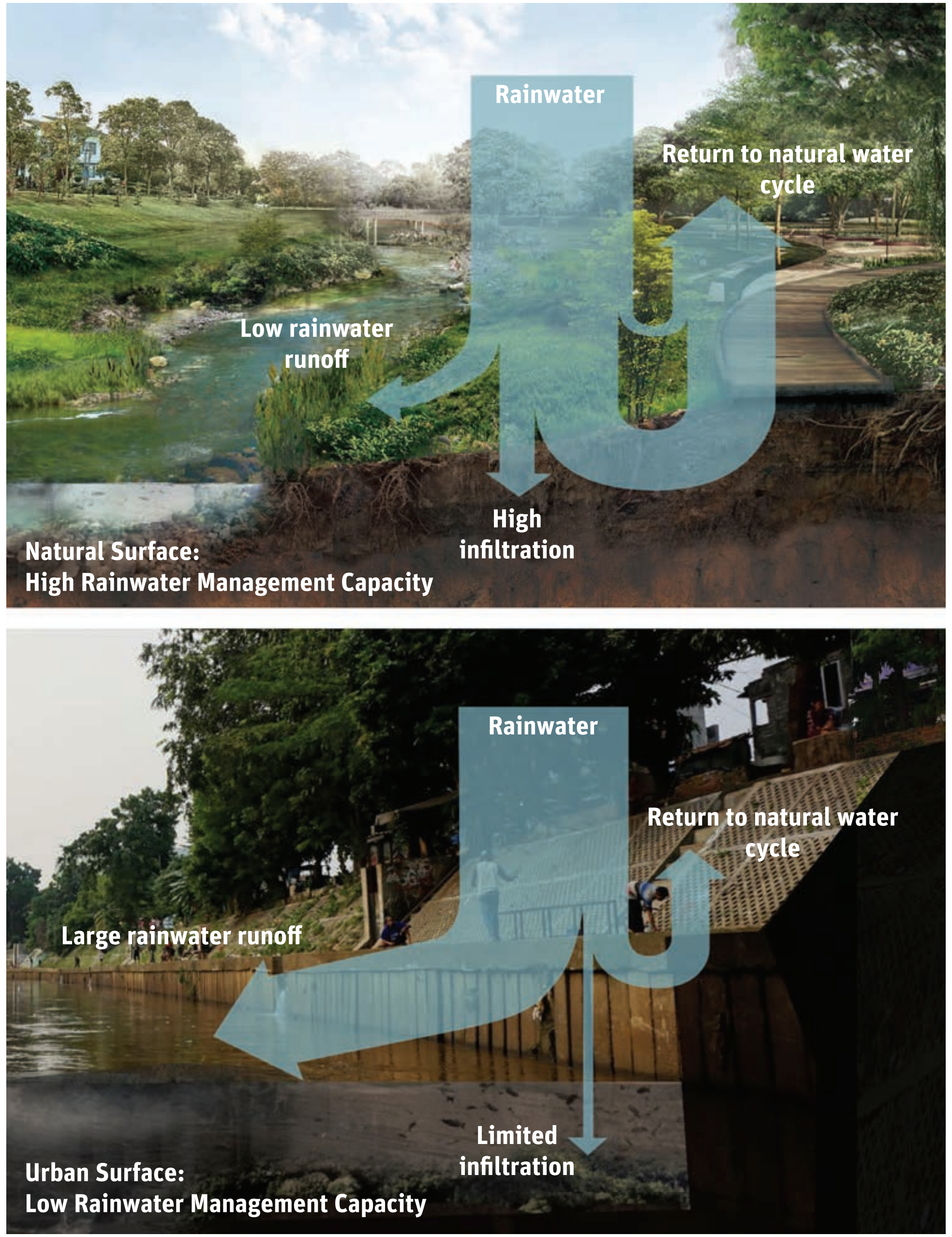
Fostering imagination

A Mini Studio normally examines an actual site located close to where the exercise takes place. Participants are encouraged to "think outside the box" and to tap into their imaginations to apply creative and exciting solutions in their design proposals. This exercise provides an opportunity for participants to temporarily set aside various real-life limitations and constraints, and thus gain new perspectives, ideas, and realizations.

Exploring and combining alternative methods

With diverse stakeholders working together to exercise not only their expertise but also their creativity and imagination, the Mini Studio provides a chance to explore and integrate alternative methods of fostering urban flood resilience, including solutions that have rarely been implemented or considered as flood risk management measures, such as green infrastructure and community- and nature-based solutions. By collaborating with diverse stakeholders, participants often gain understanding of new approaches and methods for water-sensitive urban design, and also expand and deepen the understanding of the risks and benefits of urban flood resilience.

Figure 1: Basic Hydraulic Cycle in a Natural Environment and as Affected by Urbanization



Source: Kenya Endo.
Note: The runoff volume increases due to development—that is, the conversion of vegetated land into paved surfaces and built-up areas.

4. Key Elements of a Mini Studio

A Mini Studio for Water-Sensitive Urban Design, with a focus on applying community- and nature-based solutions, particularly for stormwater management, touches on the following five topics:

- **Understanding the Urban Context and Challenges**
- **Setting a Flood Management Target**
- **Developing a List of Community- and Nature-Based Measures**
- **Designing Innovative Solutions for Urban Flood Resilience**
- **What Comes after the Mini Studio**

These are further elaborated in the following sections.

4.1 Understanding the Urban Context and Challenges

Gathering background information on the study site, city, local residents and cultures, and environmental features, such as those relevant to urban hydrology, is an important first step of the Mini Studio exercise. Key information required in the urban context include:

- **The site's exposure to natural hazards**—including vulnerability and resilience to historical flooding due to heavy rainfall, river overflow, and coastal weather events.
- **Urban development**—including urban density, transportation networks (roads, access paths, cycleways, public transit), buildings and structures, cultural landmarks, and heritage sites.
- **Landscape, land use, and infiltration capacity**—including elevation, slope direction, site grading, location and condition of land, land use, green spaces, and existing and historic creeks and water bodies that may affect the way water moves and infiltrates.

Figure 2: Degrees of Rainfall Intensity and Their Typical Effects on City Residents

How intense is 75 mm/hr rainfall?

Slightly Strong Rain 10–20 mm/hr	Strong 20–30 mm/hr	Heavy Rain 30–50 mm/hr	Very Heavy Rain 50–80 mm/hr	Intense Rain above 80 mm/hr
				
Rain bounces off the ground and people's feet get wet.	Pouring rain that drenches clothing even if people use an umbrella.	Heavy rain like a bucket of water turned over. The road becomes like a river.	Rain falling like a waterfall. Where it splashes, surfaces look whitish.	Oppressive rain that is stifling.

Source: Bureau of Urban Development, Sumida Ward 2018.
Note: mm/hr = millimeters per hour.

4.2 Setting a Flood Management Target

Based on the context and challenges of the site and city, a flood management target for the Mini Studio exercise needs to be selected. Local or national flood management plans, if available, could serve as a good reference in setting this target. Nature- and community-based measures promoting urban flood resilience usually focus on heavy rainfall. Key principles of setting stormwater management targets include the following.

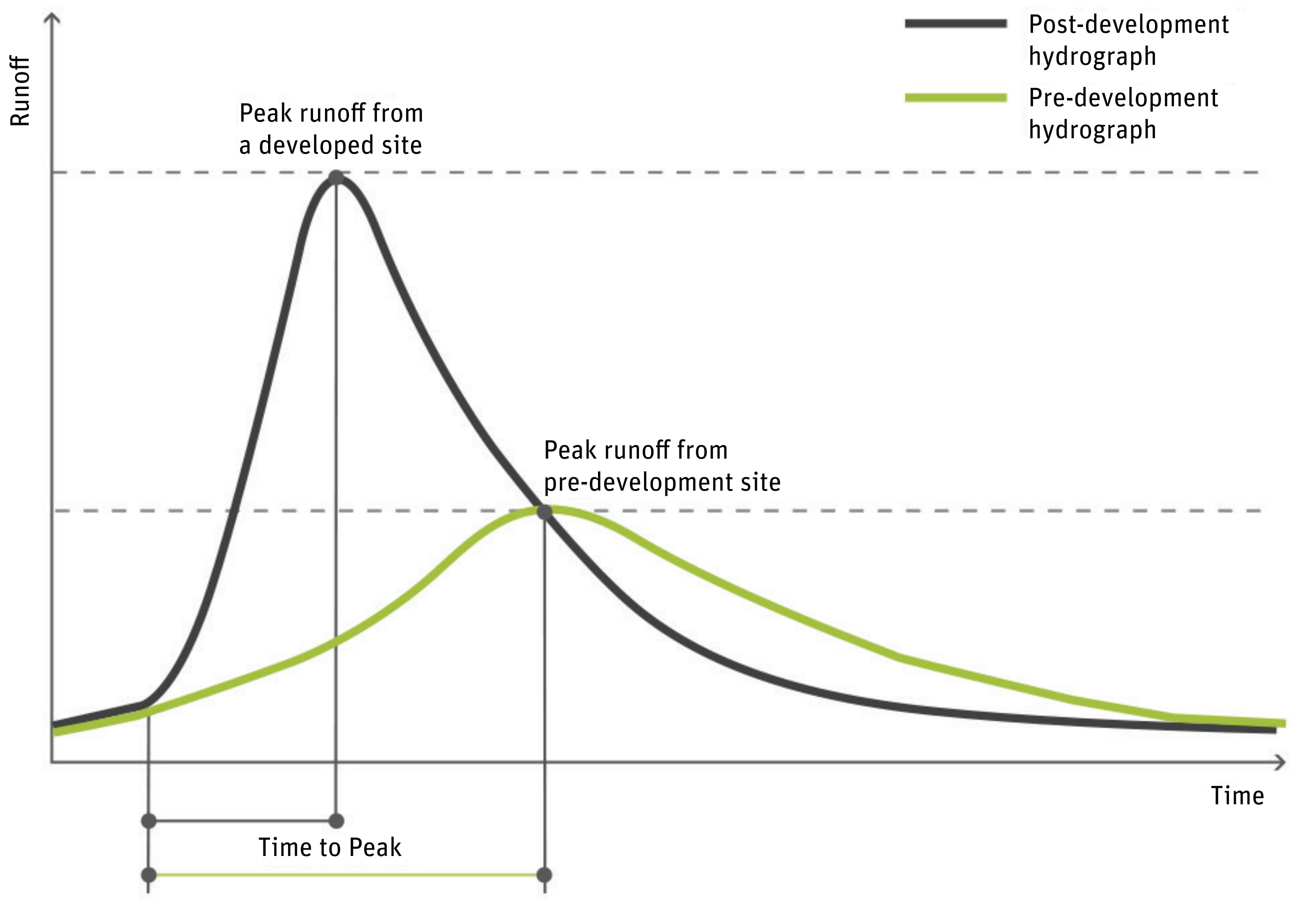
Design rainfall (storm)

Design rainfall is the extreme rainfall event that the proposed flood resilience measure aims to manage, described in terms of *intensity* (in millimeters per hour, mm/hr), *duration* (in hours or days; for example, a storm lasting one hour), and *frequency* (based on an annual recurrence interval or "return period," such as once in 100 years [1-in-100-year event]). For example, in central Tokyo, 1-in-20-year rainfall levels are: 75 mm/hr or 253 mm/day, which is set as a 30-year stormwater management target, and 97 mm/hr or 327 mm/day, which is set as a long-term target (Tokyo Metropolitan Government 2014).

Stormwater runoff reduction targets

Stormwater runoff is the volume of water that is discharged from a site, often expressed in terms of *flow rate* (volume per unit time, such as cubic meter [m^3]/second). This is the net amount of rainfall ending up in the urban drainage system, which is not absorbed or infiltrated by the ground, not evapotranspired by vegetation, or not abstracted by objects on the ground surface. Runoff increases as the area of ground covered by impermeable surfaces (such as roads, parking lots, rooftops, and other paved surfaces that have limited infiltration capacity) increases. Targets could be set realistically or aspirationally, depending on the objective of the Mini Studio exercise—whether it is illustrative (showing what can be realistically done given certain parameters) or instructive (showing the methodology).

Figure 3: Storm Hydrograph Showing the Difference in Peak Runoff between an Urbanized Area and a Pre-development or Greenfield Site



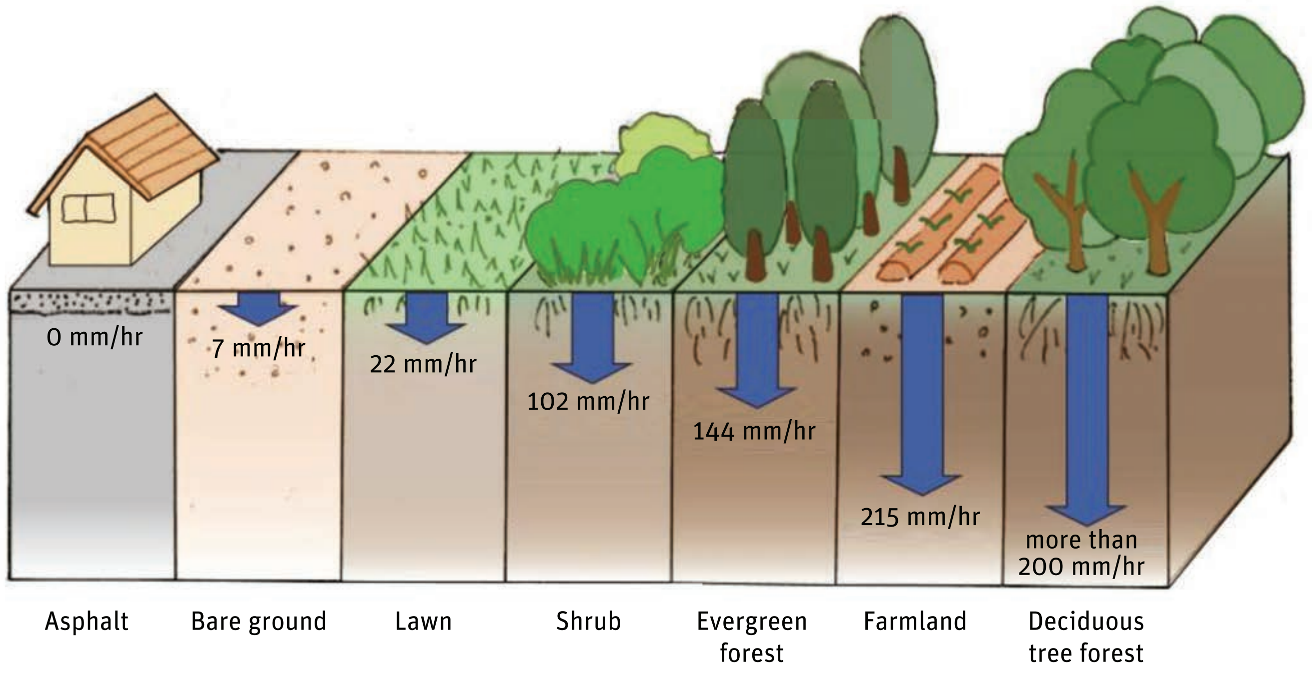
Source: Public Utilities Board, Singapore 2013.

Current stormwater generation and urban flood risks

In an urban environment, stormwater runoff is collected via a drainage network, from small collector drains (typically called "tertiary drains") to larger drains ("secondary or primary drains"). All the water drained from cities ends up either in large open water bodies, such as rivers or seas, or in closed water bodies, such as lakes or reservoirs. Factors that influence urban flood risk include the capacity of a city's stormwater drainage network, land use patterns, and geophysical characteristics of the stormwater catchment.

As **figure 3** illustrates, an effective stormwater management strategy helps to reduce the peak volume (by reducing the runoff generated on site) and delay the sudden influx of stormwater into the drainage system (by allowing water to move gradually across the catchment). Community- and nature-based solutions are essentially small-scale, decentralized interventions that contribute to this strategy by collecting stormwater for storage and reuse, or increasing surface permeability for enhanced infiltration capacity.

Figure 4: Diagram Describing Varying Infiltration Rates Based on Different Surface Types



Source: Figure created by LRwS based on Iida et al. (2015).
Note: The figures for infiltration capacity are applicable in Tokyo's case only, where the research paper has investigated rainwater permeability. Infiltration capacity depends heavily on a site's geological condition.
mm/hr = millimeters per hour.

4.3 Developing a List of Community- and Nature-Based Measures

Researching the types of traditional and community- and nature-based measures that could be applicable for the site, and how these approaches could be integrated and applied not only as urban flood resilience solutions, but also to enhance the quality and value of the site is a key element of the Mini Studio. Measures and approaches for urban resilience to be explored include the following.

Existing stormwater management measures

These may be noted by examining the existing conditions of the site, and noting down information such as the locations of drains and their systems (i.e., combined sewer overflow systems[2] or separate drainage systems), their current function (i.e., at full capacity or at reduced capacity due to being clogged with trash, etc.), the topography and direction of flows, conditions of urban development, population density, and the use of community green spaces and waterfront areas, home gardens, and rooftops, among other features.

Surface coverage and infiltration

It is critical to understand the limits and opportunities of both engineered and community- and nature-based solutions for stormwater management. Large-scale engineered solutions typically play a central role in managing a substantial amount of stormwater on a larger scale; examples include tanks and underground cisterns serving multiple developments. Community- and nature-based solutions, on the other hand, are flexible in their size, inexpensive to install, and serve as localized measures to supplement the absorptive capacity within the catchment. As **figure 4** describes, infiltration capacity greatly depends on the type of surface coverage—the capacity significantly increases as vegetation becomes denser—although soil type and permeability also play an important role.

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[2] Both rainwater and wastewater are conveyed and treated in a single channel. When heavy rainfall exceeds the capacity of wastewater treatment facilities, mixed sewer and stormwater overflows into rivers and the sea without proper treatment, with a significant impact on the environment.

Figure 5: Examples of Community- and Nature-Based Solutions

Examples of Community- and Nature-Based Solutions	**Bioswales** **Infiltration Rate:** **140 mm/hr** Key features: Conveyance / Detention / Filtration / Infiltration 
Rain Gardens **Infiltration Rate:** **140 mm/hr** Key features: Detention / Retention / Filtration / Infiltration 	**Green Streets** **Infiltration Rate:** **140 mm/hr** Key features: Detention / Filtration / Infiltration 
Agriculture Fields **Infiltration Rate:** **200 mm/hr** Key features: Detention / Filtration / Infiltration 	**Rainwater Harvesting Systems** Techniques for collecting rainwater for water reuse **No infiltration; volume stored depends on size of equipment** Key features: Retention / Filtration / Water reuse 
Permeable Pavers **Infiltration Rate:** **100 mm/hr** Key features: Infiltration 	**Green Roofs** **Infiltration Rate:** **60 mm/hr** when the soil depth is 20[cm]. If the depth is doubled, the capacity is doubled. Key features: Detention / Filtration 
Downspout Planters **Infiltration Rate:** **100 mm/hr** when the soil depth is 40[cm]. If the depth is doubled, the capacity is doubled. Key features: Detention / Filtration 	**Blue Roofs** **Infiltration Rate:** **200 mm/hr** when the media depth is 20[cm]. Key features: Detention / Filtration 
Rainwater Tanks / Cisterns **No infiltration; volume stored depends on size of equipment**. Key features: Retention / Water reuse 	**Detention / Retention Ponds** **Infiltration Rate:** depending on the size of ponds. Key features: Retention / Detention / Filtration 

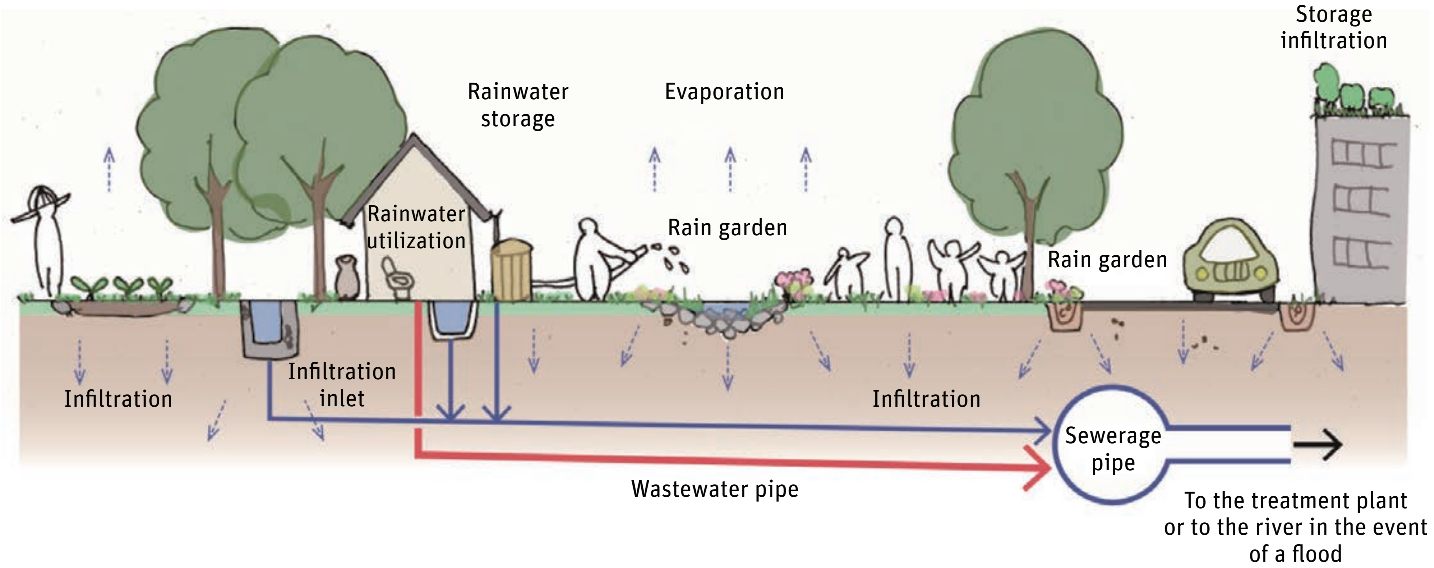
Source: Hironori Hayashi (detention/retention pond); Tomoki Takebayashi (for others).
Note: Also, refer to the following technical guidelines and visuals on community- and nature-based projects across the world cited in Chapter 7: Public Utilities Board, Singapore's National Water Agency n.d.; EPA n.d.; and Melbourne Water n.d.
cm = centimeter; mm/hr = millimeters per hour.

In principle, converting impermeable hardscape areas into pervious green spaces would reduce the amount of stormwater that eventually ends up as runoff, primarily by increasing absorption, plant uptake, and abstraction through ground vegetation. However, this could be a challenge in rapidly growing cities or densely populated urban neighborhoods where there is limited physical space and opportunity to convert land into parks and open spaces. The question is, therefore, how to increase the softscape (infiltration capacity) within the current matrix of urban land uses and assets.

Innovative stormwater management solutions

Drawing upon local and international examples and inspirations, it is possible to develop a list of innovative urban flood management measures that integrate various types of approaches such as community- and nature-based solutions. How do these measures bring additional value to a site (besides improving its stormwater management capacity)? For example, do they provide additional public space or points of visual interest? **Figure 5** illustrates some community- and nature-based solutions that feature flexibility in their design, multifunctional use of space, and capacity for stormwater management.

Figure 6: Concept Diagram of the Multifunctional Aspects of a Community- and Nature-Based Approach



Source: LRwS.

Note: A diagram illustrating nature-based solutions for stormwater management integrated with typical municipal drainage and sewerage systems in an urban context. Multi-functional water-sensitive urban design solutions, such as rain gardens or green roofs, improve the management of runoff from urban areas while providing social, ecological, and economic co-benefits for the community. The design exercise is intended to be a creative activity that allows participants to explore the integration of innovative community- and nature-based solutions into an urban setting and describe the many values added.

Additional Values of Community- and Nature-Based Solutions

Community- and nature-based solutions can generate additional advantages[3] besides urban flood and/or disaster risk management. As illustrated in **Figure 6**, new values are created as outcomes of retrofitting sites with greenery, waterscapes, and devices to harvest rainwater. These include:

- Providing communal and recreational spaces
- Enhancing the site's biodiversity
- Enhancing the site's micro-climate (air quality improvement, heat island mitigation, etc.)
- Increasing property value in the surrounding area
- Generating savings in water consumption
- Raising community awareness of urban flood risks

The emphasis of the design proposal should be on not only increasing stormwater management capacity but also highlighting the additional benefits generated from the design scheme.

[3] Furthermore, refer to Browder et al. (2019) and World Bank (2020) for the additional benefits generated through implementing community- and nature-based solutions across the world.

Photograph 5: Mini Studio Activities, including Site Excursions, Design Exploration, and a Pin-Up Session for Sharing Design Outcomes

Source: World Bank GFDRR.

4.4 Designing Innovative Solutions for Urban Flood Resilience

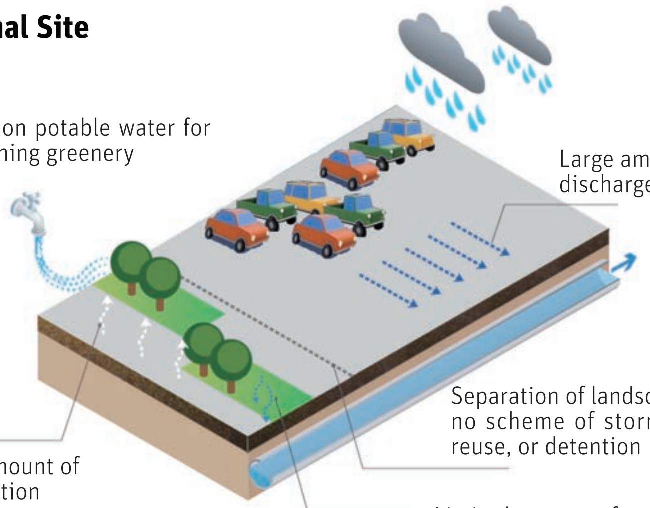
Based on an understanding of the site context, resilience targets, and innovative ways in which stormwater management could be enhanced in cities, the most important—and exciting—part of a Mini Studio is developing a site-specific design proposal for flood resilience. Design proposals are often developed in teams, and are based on exercises that include the following elements:

- **Field exercise.** A walk-through of the study site and surrounding area to observe and explore challenges and opportunities for urban flood resilience using the five senses.
- **Design and calculation**. Contextualizing and visualizing proposed solutions, and estimating their effects on progress toward a specific flood management target, additional benefits, etc.
- **Pin-up, sharing, and reflections**. Presentation of proposals, learning from others' approaches and ideas, and reflecting on the key takeaways from the exercise that could be applied to ongoing or planned urban flood resilience projects.

Figure 7, in the next pages, illustrates the steps for a typical design and calculation exercise that can be conducted for a study site, as part of a Mini Studio to explore innovative community- and nature-based flood resilience solutions.

Figure 7: Steps for Typical Design and Calculation Exercise to Explore Innovative Community- and Nature-Based Flood Resilience Solutions within a Study Area

Original Site



STEP 1: Determine the original runoff generated on site

- Calculate the volume of runoff generated on site.
- For the purpose of the exercise, teams will be provided with simplified figures for rainfall design parameters to use for the study area, as well as simplified parameters of the site to calculate the runoff generated on site such as surface type and area.
- Excel sheet is provided to facilitate the calculation.

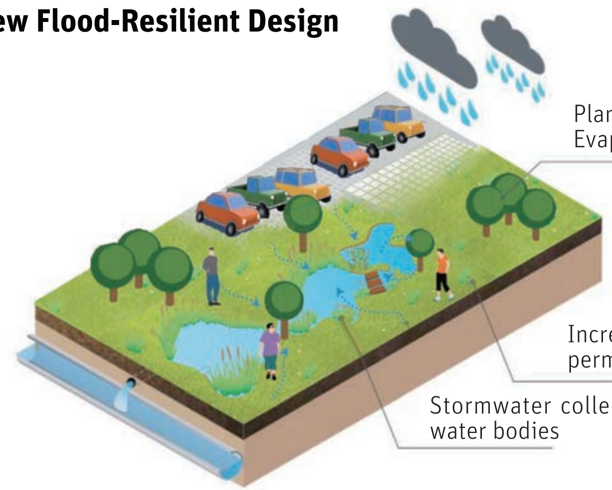
Original surface type
Original surface area

Rainfall intensity (e.g. 100 mm/hr)
Rainfall duration (e.g. 0.5 hr)
Return period (e.g. 1-in-10-year rain)

Source: Modified based on information from Public Utilities Board, Singapore's National Water Agency 2018.
Note: LRWS provides a methodology and template sheet for similar workshops. More information is available at https://amamizushakai.wixsite.com/lrws/rainwater-coordinator-training-prog.

A calculation spreadsheet is provided for the participants to quantify the impact of their design interventions. Mini Studio organizers could fill in the spreadsheet with existing parameters ahead of the activity, so that participants can focus on designing the new scenario during the exercise.
The methodology can be simple or detailed, depending on the needs of the participants.

Proposed New Flood-Resilient Design



STEP 2: Propose new flood-resilient design for the site using community- and nature-based tools

- Explore the study area and incorporate community- and nature-based tools, such as those described in **figure 5**, where appropriate.
- Using the Excel sheet, teams can explore the effect of converting surface type to see how it influences the stormwater runoff.
- Through this process, the team can calculate the new runoff generated on site with the proposed interventions.

New surface type (including community- and nature-based tools)
New surface area

STEP 3: Compare the runoff in the original versus the new scenario

- Compare the original with proposed intervention stormwater runoff.
- Teams can see the impact of the community- and nature-based tools in reducing runoff as well as lessons on effectiveness and trade-offs, etc.

Photograph 6: Educational Events Advocating the Importance of Rainwater Management (top); Rainwater Runoff Reduction Ratio, before and after the Implementation of Community- and Nature-Based Solutions (bottom)

Before intervention

After introducing permeable paving to sidewalks, and greenery to the surrounding neighborhood

Source: LRwS.
Note: Multigenerational interactions are essential for participatory planning.

4.5 What Comes after the Mini Studio

The Mini Studio exercise can be a catalytic first step for cities and communities in their efforts to develop water-sensitive, flood-resilient neighborhoods. Since a range of actions and outputs can be informed by this interactive exercise, it is important to consider its key objectives. For example, LRwS conducted a participatory Mini Studio as part of a community- and nature-based flood-resilient neighborhood design process in close collaboration with local stakeholders in the Hii River basin (Fukuoka City), which informed the following actions and outputs:

- **Development of a water-sensitive community vision**. Based on an extensive community engagement and consultation process, including participatory Mini Studio exercises, the River Management Policy and Plan reflected citizens' urgent need to boost urban flood resilience while maintaining and improving the river's environmental and community functions and benefits.
- **Innovative design and implementation of flood management infrastructure**. Hii River restoration work included various environmentally sensitive river stabilization and reinforcement methods. For example, downstream, along the tidal basins, various environmental conservation efforts were implemented. Sandy beaches were cleaned and conserved by citizens and school children, and turned into environmental education sites through activities such as clam monitoring. A part of the river surrounded by residential areas and schools was restored to enhance accessibility and recreational spaces, and the installation of rainwater harvesting systems in households was promoted. A wide range of locally suitable options were identified based on the creative thinking generated through the Mini Studio exercise.
- **Community mobilization and awareness raising**. The Mini Studio also inspired new ways of visualizing and communicating the challenges of stormwater management and urban flood resilience and the importance of educating and engaging diverse stakeholders. Educational programs for local children, focused on community- and nature-based solutions to urban floods, were developed (**photograph 6, top**) as well as visual communication tools, including before-after comparisons (**photograph 6, bottom**), posters, and websites. These efforts led to the participatory monitoring and evaluation of interventions that included the maintenance of local streams and community parks.
- **Scaling**. The innovative water-sensitive planning, design, implementation, and awareness raising conducted for the Hii River was scaled to other river basin communities such as the Zenpukuji River basin in Suginami Ward, Tokyo.

Photograph 7: Group Design Exploration Process from the Sumida Ward Case

Source: World Bank GFDRR.
Note: One of the distinct advantages of a Mini Studio is the synergy created among experts with different backgrounds and skills.

5. How to Prepare and Implement a Mini Studio

This chapter describes the detailed steps to prepare and implement a Mini Studio for Water-Sensitive Urban Design. Steps involved in preparation (Step 0) and implementation (Steps 1–5) are elaborated in the following subsections.

Preparation stage:

STEP 0: Preparing for the Mini Studio

Implementation stage:

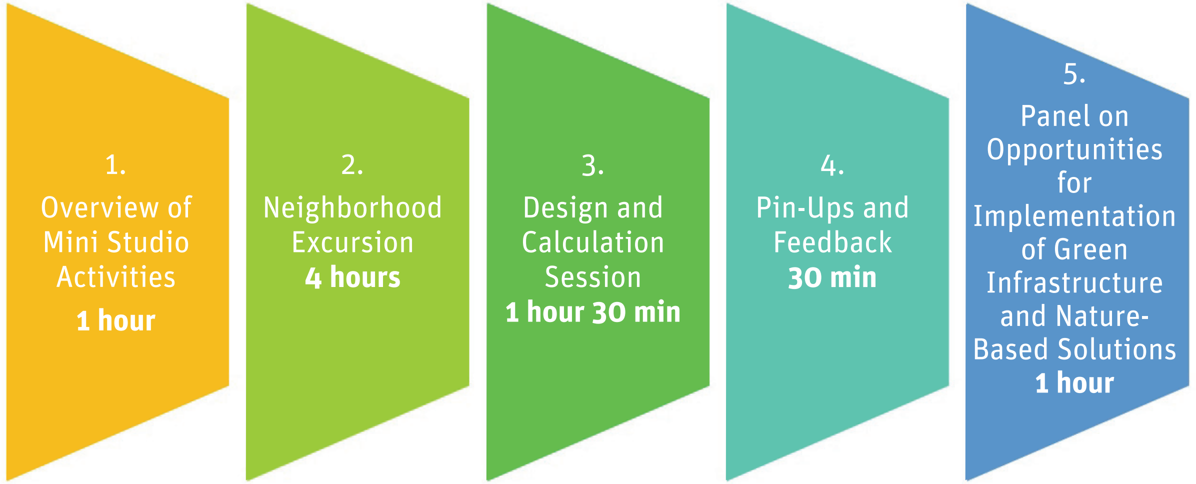
STEP 1: Basic Overview of the Mini Studio Exercise
STEP 2: Get into Teams and Explore the Neighborhood
STEP 3: Explore the Design Site
STEP 4: Group Work—Develop a Proposal for a Flood-Resilient Neighborhood
STEP 5: Pin-Up Presentations and Reflection

STEP 0: Preparing for the Mini Studio

1: Agenda and program setting

First, the most essential step is to set the Mini Studio's agenda based on participants' learning objectives. This requires understanding participants' backgrounds, origins, and motivations for attending the Mini Studio. Based on the agenda, the overall program should be designed to maximize learning opportunities for participants within the limitations of time, venue, cost, and other logistics.

Figure 8: Sample Schedule of a Mini Studio in Sumida Ward, Tokyo



Source: World Bank GFDRR.

2: Creating a team

In the early stages of planning, it is advantageous to engage local community members, nonprofit organizations, civil society groups, and technical experts and invite them to be part of the organizing team.

3: Selecting the site, and planning excursion routes

The process of selecting the design site (size, type, and number) should relate to the defined agenda as well as the number of participants and allocated time for the Mini Studio. It is advisable to make an excursion to the site to help participants understand the innovative stormwater management measures applied locally.

4: Customizing a menu of stormwater management solutions

Some of the basic toolkits for community- and nature-based solutions are listed in **figure 5**. These must be reviewed and updated to match the site's local conditions and hydrogeologic characteristics. This process will also require adjusting the stormwater runoff volume based on local rainfall, vegetation, soil media, and other surface characteristics. In addition, the stormwater management target and design rainfall intensity should be set based on local rainfall characteristics or runoff management, and the planning criteria determined by the local government.

5: Assigning design facilitators

Local design facilitators who are enthusiastic about the topic will play an essential role in guiding the design discussion. These facilitators can come from a range of backgrounds and expertise, and include, for example, landscape architects, urban designers, engineers, and researchers in a related field. They may also be local community members and professionals with nontechnical, nondesign backgrounds.

6: Grouping participants

Forming small teams of *four to six participants* each is ideal to ensure that each member has ample opportunities to contribute. Design facilitators and local guides (if any, and other supporting members) should also join each group, as their diverse perspectives, backgrounds, and expertise promise to enhance the Mini Studio exercise. Organizers should strive to bring together participants of different ages, genders, and abilities into the teams. To ensure participation, ways to address special needs (of, for example, people with disabilities) should be explored.

7: Preparing tools and materials for the studio exercise

Tools

Must Have:
Thick markers (more than five colors, including green, blue, and black), sticky notes (to scribble ideas, key phrases), ruler (scale-bar), tape, and tracing paper.
Good to Have:
Pin-up boards, pins, and voting stickers (for competitions); material for model making (e.g., dried plants, colored paper, etc.).

Maps/ Images

Must Have:
Printed out A1- or AO-size high-resolution color aerial images of the site.
Good to Have:
A3 map with an aerial image of the site (to be distributed during the site excursion).
Reference photos of the site and of potential stormwater management solutions.

Other

Must Have:
Stormwater calculation sheets in Excel format on a laptop or tablet.
To carry out the exercise quickly, existing stormwater runoff and infiltration capacity should be precalculated.

Photograph 8: Main tools for the studio exercise

Source: Kenya Endo.

STEP 1: Basic Overview of the Mini Studio Exercise

On the first day of the Mini Studio exercise, the following points need to be concisely conveyed to all participants:

- What is a Mini Studio?
- An overview of the Mini Studio process:
  - Briefing on the activities and time allocated in each step.
  - Introduction of teams.
  - Briefing on the excursion, including the design site, route, and points of interest.

Photograph 9: Briefing Session at a Mini Studio in Bogor, Indonesia

Source: Kenya Endo.
Note: Overall steps of each activity are explained clearly, with objectives and expected outcomes, at the beginning of a Mini Studio.

Photograph 10: Local Experts and Facilitators Lead the Groups' Knowledge Sharing during the Excursion

Source: World Bank GFDRR.
Note: Handouts of maps and tool kits help participants follow the design exercise.

STEP 2: Get into Teams and Explore the Neighborhood

The site excursion is always the most refreshing part of the Mini Studio. Exploring the neighborhood allows participants to get an understanding of the broader site context before diving into context-specific design work.

Forming a balanced team of experts (with expertise in various fields and across technical and nontechnical bodies of knowledge) of a manageable size is a critical step in the process. Likewise, time management is another important aspect that should be carefully planned and monitored during the visit. For example, the time required to translate information for an international group, or extra time required for transportation, question-and-answer sessions, and bad weather conditions should be accounted for. Participants should be told beforehand to wear walking shoes and carry a water bottle.

Photograph 11: Important Observations during Site Excursion: Paving Materials, Ratio of Hardscape to Softscape, Topography (low and high points), and Drainage Systems

Source: Kenya Endo.
Note: Drainage systems include waterways, outlets, and culverts.

STEP 3: Explore the Design Site

What to look for
When exploring the site, facilitators should highlight and explain key learning points to participants related to the drainage system, topography, and surface coverage.

Start discussing design vision on site
Before leaving the site, a quick session to touch base with the participants will help identify issues and the potential approach for design interventions. The key is to guide participants to think outside the box and avoid the early censorship of ideas. They should be advised to not be constrained by technical practicality or financial feasibility, but to start with big ideas first, depending on the design studio goals.

Photograph 12: Facilitators Guiding and Assisting the Discussion, Building Group Consensus, and Finishing the Exercise on Time

Source: World Bank GFDRR.

STEP 4: Group Work—Develop a Proposal for a Flood-Resilient Neighborhood

Vision and strategies

First, it is critical to develop an overarching vision statement (short and concise), addressing local issues and challenges. Then, two to three site-specific strategies should be established to advance the vision. Both the vision and strategies will define the directions of spatial design, namely, surface coverage, people's activities, and the community- and nature-based tools to be implemented.

Calculation results

Participants are required to fill in the Excel sheet to calculate the stormwater runoff for both the existing as well as postdesign conditions. Main inputs will be the approximate area (typically in square meters) of each surface type, which should be obtained by measuring the sketched plan using a ruler and scale bar.

Supporting visuals

Key words on sticky notes, concept diagrams, and small vignettes of ideas will help convey the intent of the design effectively during pin-up. Thick markers are suitable for this purpose. Place the tracing paper above the aerial image to sketch over the plan. Sectional drawings will also help explain the composition of different landscape elements, people's experiences, and their functions. It is important to include a person, car, or tree in the sketch to represent the scale. Considering time limitations, the graphics do not need to be of high quality.

Photograph 13: Participants Pitching Their Key Ideas through Sketched Diagrams, Plans, and Sections at a Mini Studio in Bogor, Indonesia

Source: Kenya Endo.
Note: It is advisable to pin up all materials, even incomplete scribbles, without being shy.

STEP 5: Pin-Up Presentations and Reflection

It is highly recommended that a nominated presenter concisely wrap up each pin-up presentation with a summary of key outcomes. The suggested time is a maximum of five minutes, followed by a two- to three-minute question-and-answer session. While standing in front of the panels and drawings, the presenter should mention the process of design development: (i) site analysis, (ii) the challenge that needs to be addressed, (iii) the vision statement, and (iv) strategies and specific design interventions through sketches. These drawings should be in relation to the surrounding context, in proper scale, and offer some sense of the spatial experience.

In addition, stormwater runoff calculation results before and after the design should be shared to quantify the effectiveness of the proposed solutions.

After the pin-up session, it is important to allot time for the various teams to interact and ask questions of one another.

6. Experiences and Lessons from Past Mini Studios

In this chapter, we share lessons learned from Mini Studios convened in Tokyo, Japan, and Bogor, Indonesia, to help inform the design of future Mini Studios for Water-Sensitive Urban Design. The agenda, participants, and context will greatly influence the preparation and implementation stages of a Mini Studio. These examples provide a general framework to be tailored to individual circumstances.

6.1 Technical Deep-Dive Session in Sumida Ward, Tokyo

Japan Overview

The Mini Studio on community- and nature-based solutions for IUFRM was held as part of a Technical Deep-Dive (TDD) session at the World Bank's Tokyo Development Learning Center (TDLC). This TDD session was the second of a learning series bringing together practitioners and government officials from around the world to exchange notes with one another and learn from international and Japanese experiences with IUFRM measures. Representatives of nine World Bank client countries[4] joined the Mini Studio exercise, including national and local officials from the planning, infrastructure, and management departments. Five investigation sites were chosen from Sumida Ward, in the eastern part of Tokyo, where small-scale innovative tools for managing urban floods have been implemented over the years. After a briefing by local experts and a site excursion with community members,[5] participants explored ideas on further enhancing stormwater management capacity in this dense urban neighborhood.

Date: April 23, 2019; 10:30 a.m. to 5 p.m.
Venue: World Bank TDLC office (approximately 30 minutes' travel time from various investigation sites in Sumida Ward).
Participants: 60 representatives from 9 countries, forming 9 groups.
Facilitators: 18, including local experts, community members, and World Bank staff.

[4] These countries are (alphabetically), Albania, Angola, Jordan, Lao PDR, Myanmar, Panama, Paraguay, Turkey, and Vietnam.

[5] There was support from the local nonprofit organization, People for Rainwater (http://www.skywater.jp/aboutus#shiminnokai).

Context

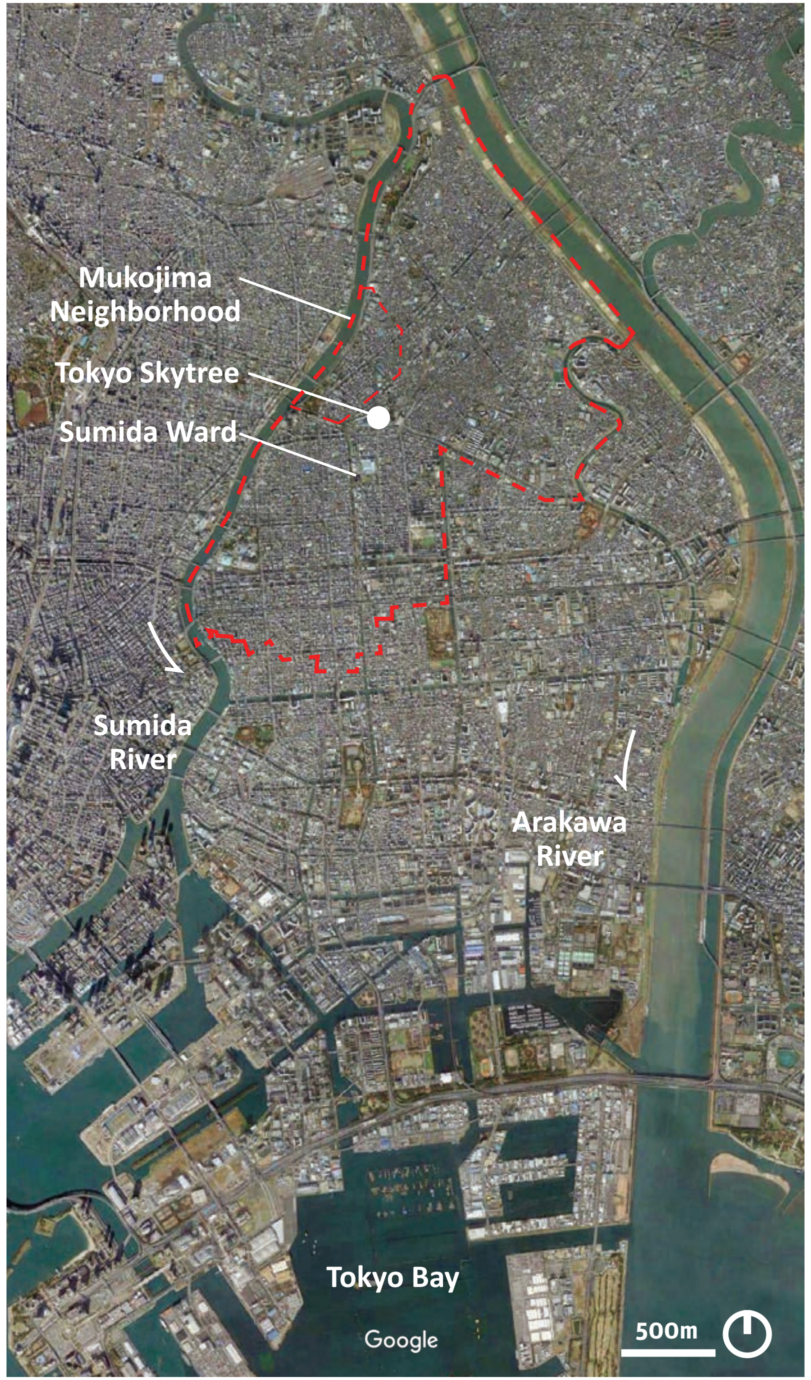
Sumida Ward is located on low-lying land near the Sumida River, which exposes its dense concentration of houses and office buildings to high flood risks. During the 1980s, urban flooding occurred frequently in the ward during heavy rains, as low infiltration and insufficient drainage capacity left streets and buildings inundated. Impermeable surfaces cover over 70 percent of Sumida Ward, compared with 50 percent on average across Tokyo's 23 wards (Next Wisdom Foundation 2015).

Additionally, enhancing underground infiltration capacity was difficult, given that most of Sumida Ward's land was below sea level. With limited space to develop new, large-scale stormwater detention facilities aboveground, the ward relied heavily on publicly financed high-cost gray infrastructure, such as underground drainage channels and detention facilities and pumps.

However, increasing flood risks and other developments created an urgent need for further measures against surface water flooding and the resulting damages. In response, Sumida Ward began a movement in 1982 to harvest, store, and utilize rainwater through public, private, and community efforts, based on the concept of an "urban dam." The collaboration enabled the installation of rainwater storage facilities in residential areas and public and private facilities distributed widely throughout the ward, providing a decentralized approach to surface flood management.

The Mini Studio's site excursions included a look at community-based, small-scale rainwater harvesting systems for households called *Rojisons*, and both public and private development projects that are integrated with large detention facilities, such as the Sumida Hokusai Museum, Tokyo Skytree Town, and Sumo Wrestling Arena (for more details on context, refer to World Bank [2020]).

Photograph 14: Sumida Ward (red dashed line depicts the aerial view) in the Eastern Part of Tokyo Metropolitan Area



Source: Google Earth, Imagery©2020 TerraMetrics, Map data©2020 (aerial view, left); Kenya Endo (*Rojison* and small-scale rainwater harvesting tank in the community, right top); Johnson 2016 (Tokyo Skytree Town, right bottom).

Note: Sumida Ward has a population of approximately 250,000 people and a total area of 13.77 km^2. The area is considered a part of the capital's dense *shitamachi*, or old town, and the great Sumida and Arakawa Rivers form part of its boundaries. The Mukojima neighborhood, which uses small-scale community-based rainwater harvesting facilities, was one of the communities investigated (right top). The area is home to the landmark Tokyo Skytree (right bottom), the world's tallest self-supporting tower.

Design exploration

The Mini Studio's design exploration is flexible and scalable enough to be exercised in any urban site, from small dense neighborhoods to linear streetscapes. In the case of Sumida Ward, the organizing team had selected five different types of sites: an urban plaza in front of the train station, a streetscape, a riverfront corridor, a plot within a dense neighborhood, and a public school. All the sites had little infiltration capacity due to impermeable paving and buildings. Participants were challenged to increase the infiltration capacity, by referring to the innovative tools listed in **figure 5**, with the target of managing a one-hour-long, 75 mm/hr rainfall.

The following pages illustrate the outcomes of the exercise. The selected works strongly present a compelling vision with the effective use of graphics, such as diagrams, plans, and sections. A runoff reduction ratio of more than 100 percent means that the site not only improved its spatial quality based on the vision, but also increased its capacity to hold and infiltrate rainwater significantly.

Site
Typical urban block in Mukojima neighborhood

Country team and design facilitator:
Paraguay, Sayaka Yoda

Base
Site area: 594 m^2
Building area: 501 m^2
Softscape area: 0 m^2
Impermeable paving: 93 m^2

Photograph 15: Urban Block in Mukojima Neighborhood

Source: Google Earth, Imagery©2020 Digital Earth Technology; Maxar Technologies, The Geoinformation Group, Map data©2020 (aerial view, left); Google Streetview ©2020 Google (eye-level view, right).
Note: The urban block is composed of four single detached buildings and one parking lot. There is no softscape coverage. The design focus was on inserting various nature-based solutions into hardscapes and rooftops of existing buildings.

Design vision:
Small is beautiful

Design rainfall intensity:
75 mm/hr

Calculation result:
Volume of rainwater produced: 102.0 m^3
[before] Runoff reduction ratio: 0.0%
[after] Runoff reduction ratio: 235.0%

Figure 9: Extension of site boundary to incorporate small yet effective design interventions

Key concept is to reduce runoff significantly: sunken sports court for rainwater detention purposes (→multipurpose), rainwater harvesting tanks for each household, increase in permeable surfaces, and green roofs to enhance infiltration capacity.

Source: Paraguay team.
Note: The Paraguay team incorporated other potential elements into their design interventions, such as roads, an adjacent parking lot, and flat-roofed houses for green-roof installations.

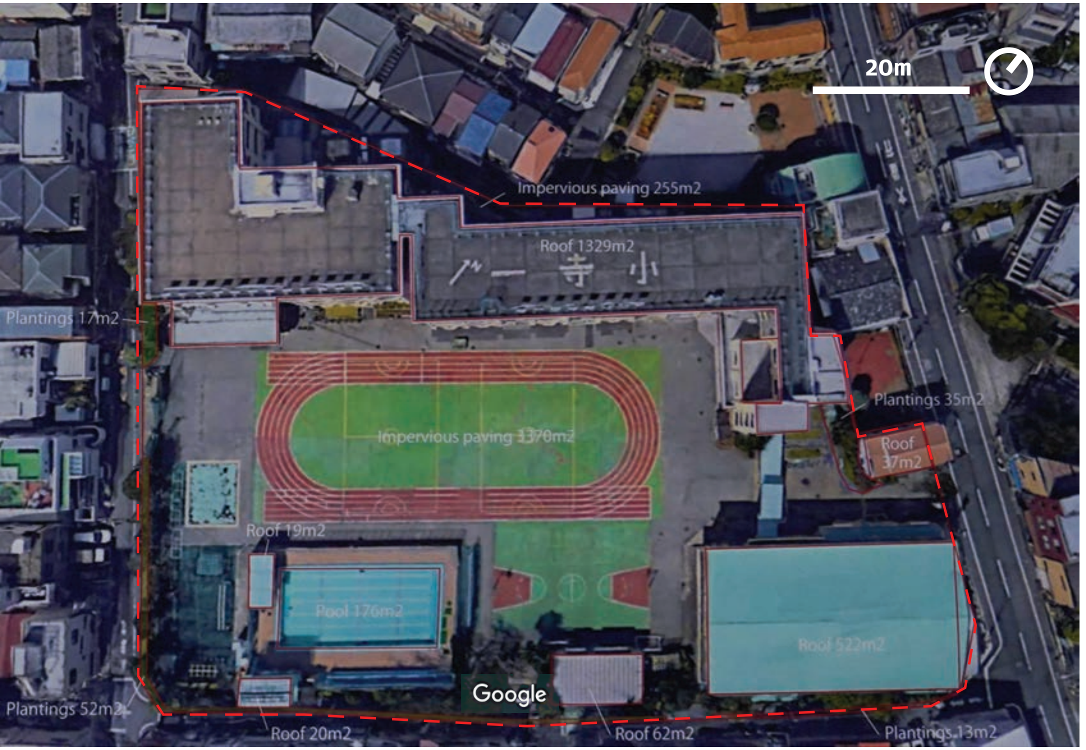
Site
Daiichi Terajima Elementary School in Mukojima neighborhood

Country team and design facilitator:
Turkey, Jun Hashimoto

Base

Site area:	5,942 m^2
Building area:	2,024 m^2
Softscape area:	117 m^2
Impermeable paving:	3,625 m^2
Others:	176 m^2

Photograph 16: Daiichi Terajima Elementary School, a Public School in a Dense Residential Neighborhood



Source: Google Earth, Imagery©2020 Digital Earth Technology; Maxar Technologies, The Geoinformation Group, Map data©2020 (aerial view, left); Daiichi Terajima Elementary School 2020 (eye-level view, right).
Note: Most of the exterior spaces in the site are covered by impermeable paving, artificial grasses, and bare ground.

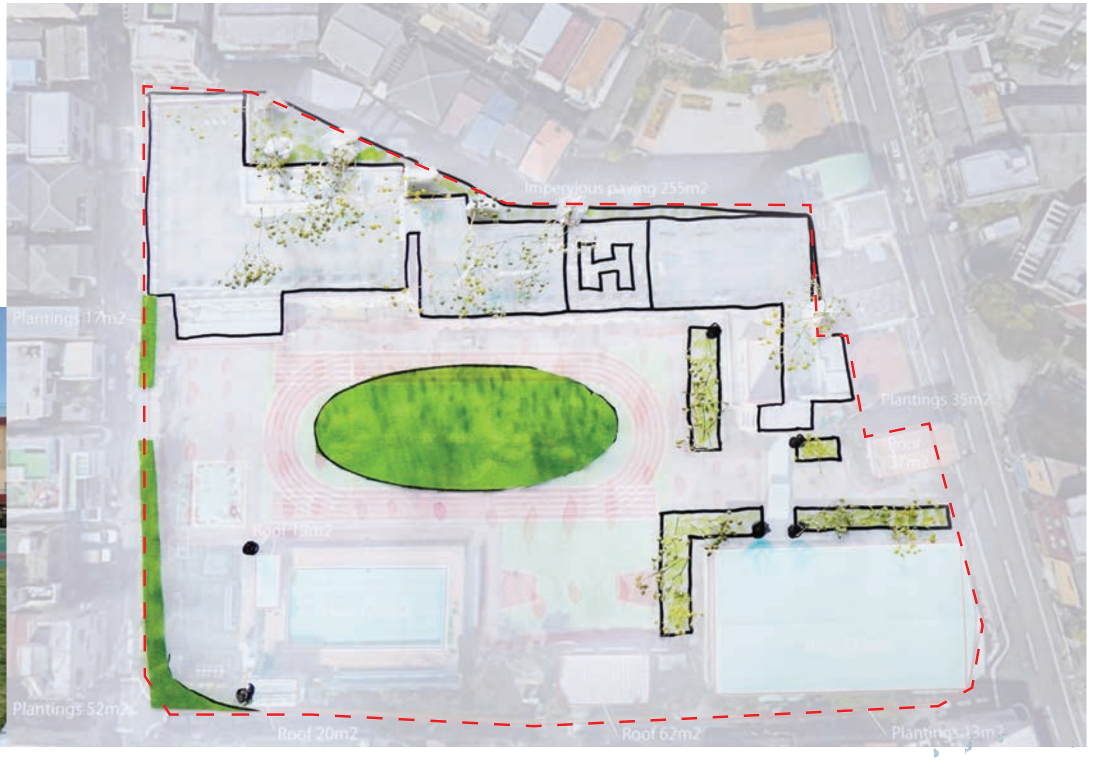
Design vision:
Sponge School—Water for Living and Inclusive Community

Design rainfall intensity:
75 mm/hr

Calculation result:

Volume of rainwater produced:	445.6 m^3
[before] Runoff reduction ratio:	2.6%
[after] Runoff reduction ratio:	103.7%

Figure 10: Sponge School: A Community Hub for Rainwater Education and Experiments



Source: Turkey team.
Note: Illustration shows the concept of (i) training the next generation in how rainwater management can be integrated in farming activities, (ii) enhancing infiltration capacity by upgrading existing green zones, and (iii) appreciating the value of rainwater by reusing it.

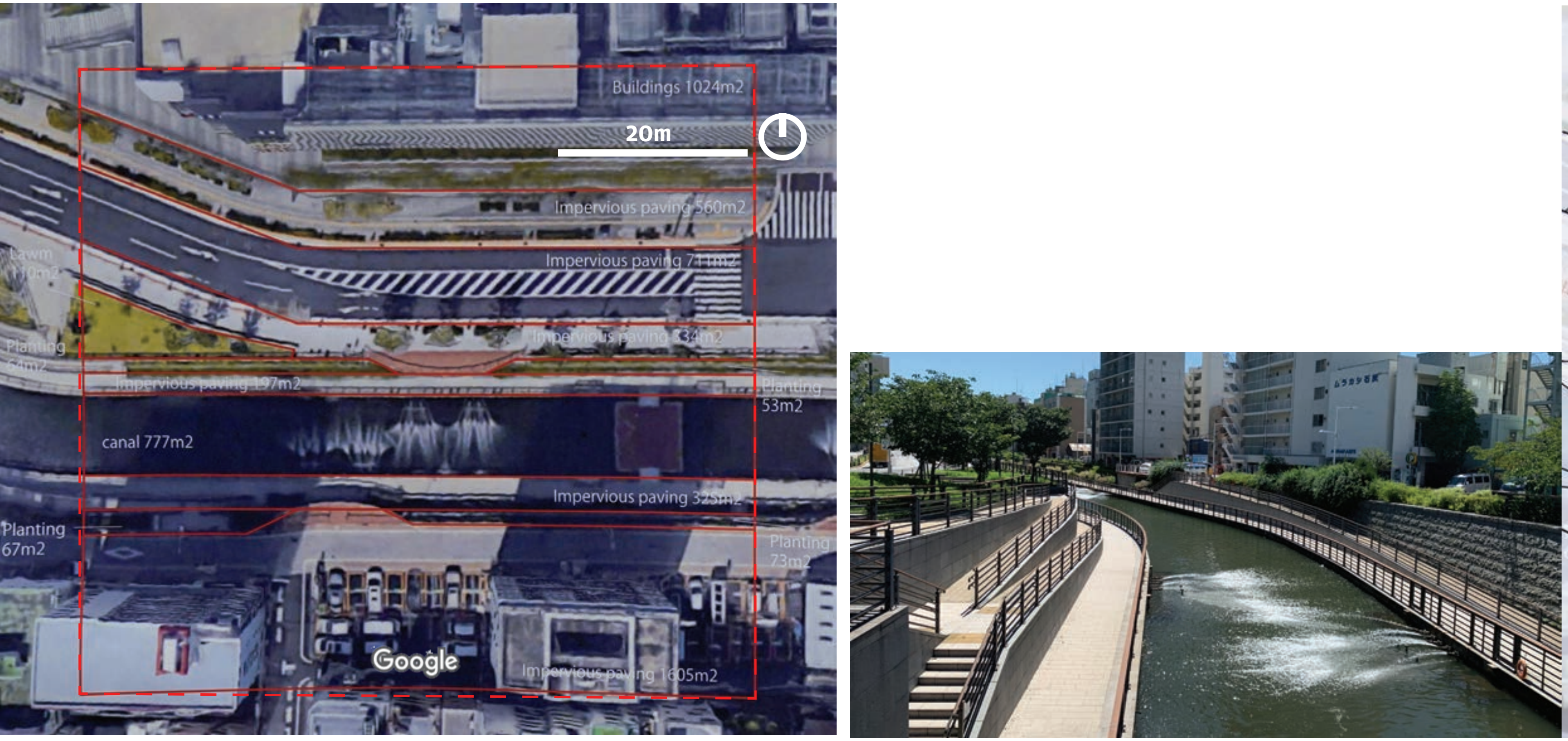
Site
Oshinari Park and Kitajukken-gawa River in Tokyo Skytree district

Country team and design facilitator:
Lao PDR, Kiyohito Tamotsu

Base

Site area:	5,895 m^2
Building area:	1,024 m^2
Softscape area:	357 m^2
Impermeable paving:	3,732 m^2
Others:	777 m^2

Photograph 17: Oshinari Park and Boardwalk along the River Attracts Visitors to Tokyo Skytree Town



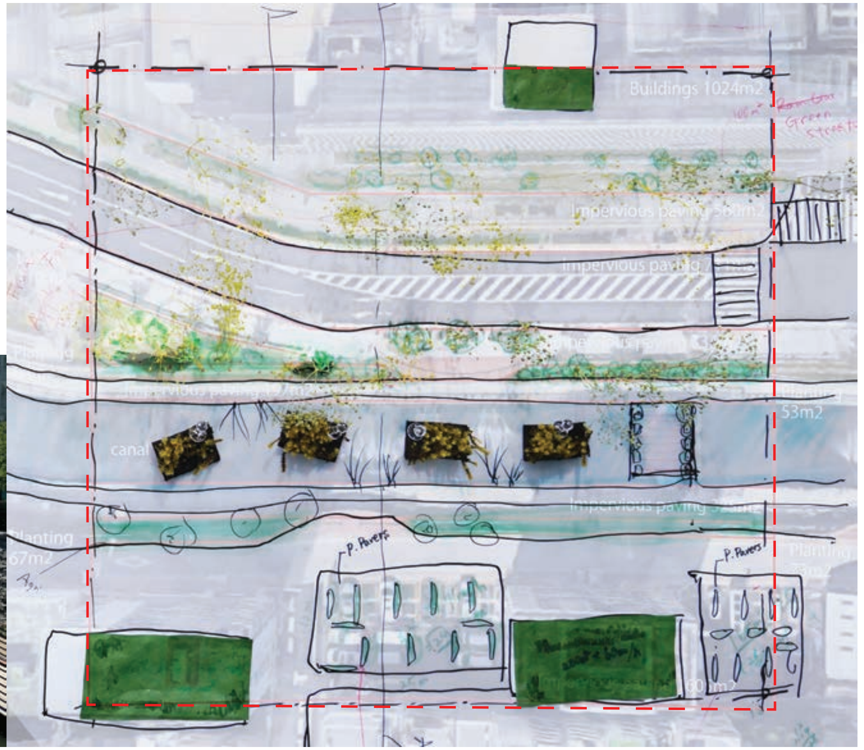
Source: Google Earth, Imagery©2020 Digital Earth Technology; Maxar Technologies, The Geoinformation Group, Map data©2020 (aerial view, left); Kenya Endo (waterfront park and boardwalk along the Kitajukken-gawa River, right).
Note: A fountain-like aeration facility and accessible promenades enhance the attractiveness of the riverfront spaces.

Design vision:
Naturalized Tokyo Canal for Urban Creatures

Design rainfall intensity:
75 mm/hr

Calculation result:
Volume of rainwater produced: 402.5 m^3
[before] Runoff reduction ratio: 5.1%
[after] Runoff reduction ratio: 100.0%

Figure 11: Breakthrough Ideas for Naturalized Tokyo Canal



Source: Lao PDR team.
Note: Breakthrough ideas include introducing (i) floating wetlands in the river for nutrient uptake (+aeration) for cleansing purposes, (ii) flowering and drooping plants to soften the building/river wall facades, (iii) edible vegetation to attract birds and butterflies, and (iv) movable planter boxes and benches to enhance the outdoor comfort of the site.

Photograph 18: Snapshots of Group Design Discussions and Sketches during the Mini Studio in Bogor, Indonesia

Source: World Bank GFDRR.

6.2 Integrating Nature-Based and Green Solutions for Urban Flood Risk Management, Design Charrette, Bogor, Indonesia

Overview

As part of the continuous development of a conceptual framework for a proposed national urban flood resilience program in Indonesia, the Mini Studio served to facilitate stakeholder engagement. It was conducted in Bogor with central government agencies and local government officials from the cities of Ambon, Bima, Manado, Padang, and Pontianak.

An investigation site was set up at the Aston Hotel and Resort in Bogor, with a focus on the hotel parking lot and outdoor spaces surrounding the hotel buildings. The Mini Studio briefing included renowned cases of community- and nature-based solutions across the world, followed by a short site excursion to understand the local context.

Date: July 11, 2019, 2 p.m. to 6 p.m.
Venue: Aston Bogor Hotel and Resort, seminar room.
Participants: 20 representatives from 5 selected cities in Indonesia, forming 3 groups.
Facilitators: 3 (1 technical expert per group).

Context

Bogor, Indonesia, is a city approximately 60 kilometers (km) south of Jakarta on Java Island, set against the volcanic backdrop of Mount Salak. Dubbed the “Rain City,” Bogor is more humid and rainier than many other areas of West Java. The average relative humidity is 70 percent, and the average annual precipitation is about 4,086 mm (Climate-Data.org n.d.). In this geographical context, flooding and landslides frequently affect people’s lives and assets. The most recent flood occurred in early January 2020 and killed 16 people in the city (The Jakarta Post 2020).

Photograph 19: Aston Bogor Hotel and Resort (left); Cisadane River Tributary (right top); Resort Parking Lot (right bottom)

Source: Google Earth, Imagery©2020 CNES/Airbus; Maxar Technologies, Map data©2020 (aerial view, left); Kenya Endo (eye-level view of small stream and hotel parking lot, right).
Note: The resort is located 5 km from the center of Bogor City. The Cisadane River tributary running through the hotel grounds collects rainwater from the surrounding neighborhood.

Design exploration

The focal site was a large parking lot approximately 18,500 m^2 in size (more than three times larger than that studied during the Mini Studio in Sumida Ward), with a pervious surface consisting of 25 percent of the total area. This allowed participants to reimagine the site from various perspectives. Since all three groups worked with one given site, it was interesting to see the stark differences in the design outcomes based on their respective visions.

Innovative tools for design interventions remained the same as in **figure 5**, with the target of managing a one-hour-long, 160 mm/hour rainfall, following the local climatic conditions.

The design process successfully facilitated cross-agency interactions focused on site analysis, spatial designs, and estimates of stormwater management capacity. The process of developing schematic sketches and guiding principles helped participants to move toward actual implementation of these measures in their respective cities—with detailed considerations of technical, financing, legal, and operation and maintenance issues.

Site
Aston Bogor Hotel and Resort,
parking lot and surrounding

Team and design facilitator:
Pontianak City, Kenya Endo

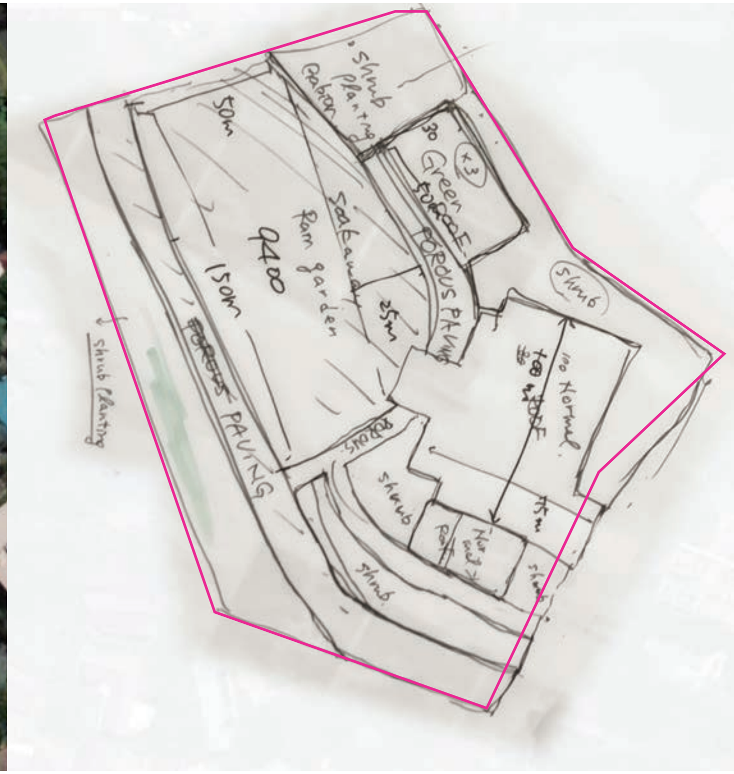
Base

Site area:	18,500 m^2
Building area:	2,400 m^2
Softscape area:	4,500 m^2
Impermeable paving:	11,600 m^2

Photograph 20: Aston Bogor Hotel and Resort Parking Lot and Surroundings

Source: Google Earth, Imagery©2020 CNES/Airbus; Maxar Technologies, Map data©2020.
Note: The site is mostly covered with impermeable interlocking concrete pavers with some planting strips in between. The parking lot gently slopes toward the stream, implying that the rainwater runoff is effectively conveyed and discharged to the stream.

Figure 12: Zoning Diagram Illustrating Types of Surface Coverage



Source: Pontianak City team.
Note: These simple line drawings with dimensions and annotations will facilitate the runoff reduction calculation process.

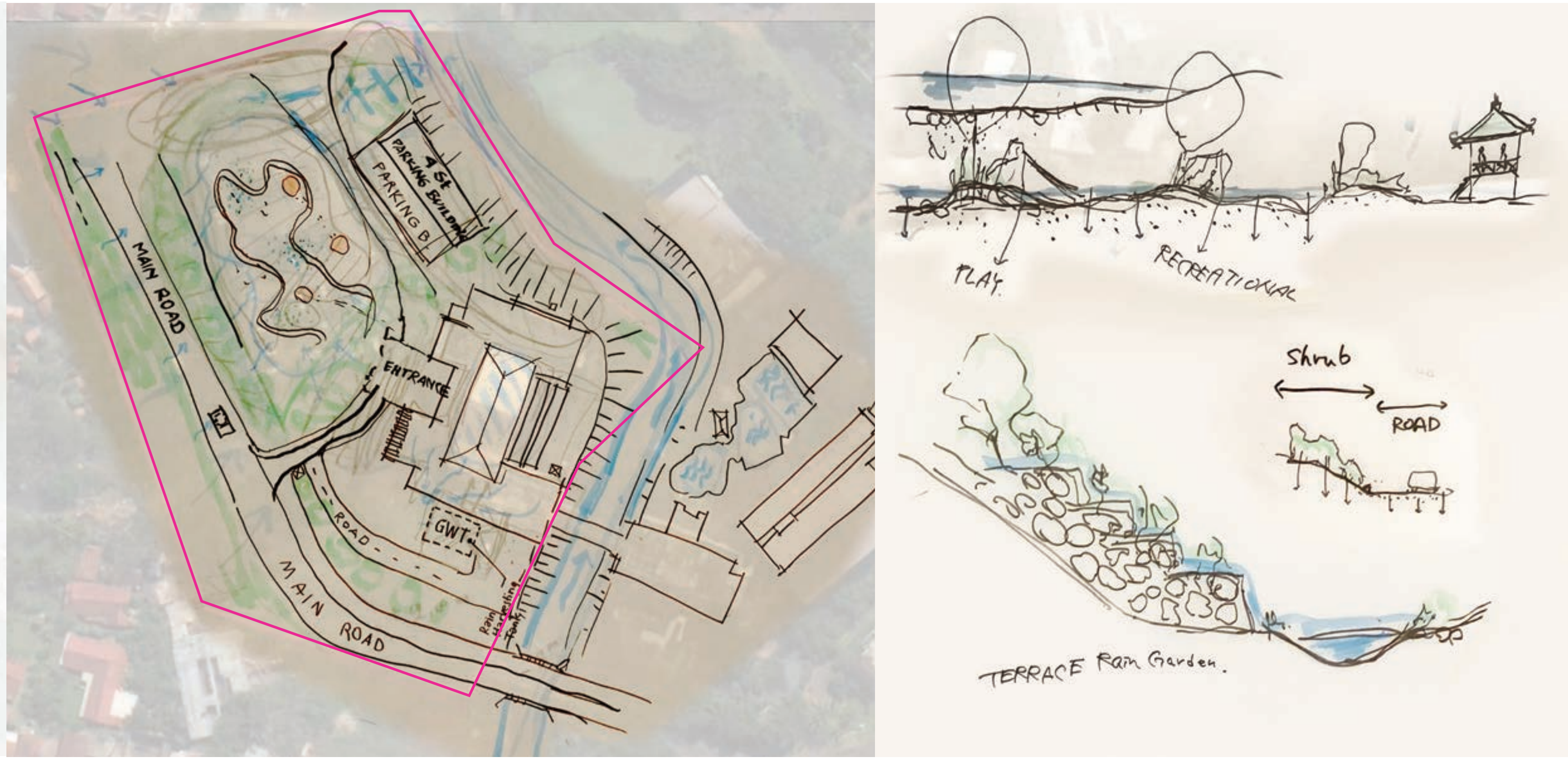
Design vision:
Memorable and Water-Friendly Hotel

Design rainfall intensity:
160 mm/hr

Calculation result:

Volume of rainwater produced:	2,960 m^3
[before] Runoff reduction ratio:	16%
[after] Runoff reduction ratio:	58%

Figure 13: Illustrations of a Water-Friendly Hotel



Source: Pontianak City team.
Note: A large portion of the parking lot was converted into a multipurpose sunken semipublic green field for both water detention and recreational activities. The parking facility was compactly tucked into a corner, to give priority to the blue-green features facing the public road.

6.3 Tips and Recommendations for Future Mini Studios

Past Mini Studios offer many lessons for future organizers. These include the following.

1: Ensure that the program is tailored to the audience

Customizing the program is key to success. Among other things, it should be tailored to the number of participants and their experience levels, expectations, and available time; the accessibility of field visit sites; the number, expertise, and skills of available technical and support staff; and the intended outcomes of the Mini Studio. The length and order of the various components of a Mini Studio should be considered carefully in light of the context and objectives.

Preliminary steps include organizing teams, preparing introductory information to share, and putting aside time to conduct design exercises. The program structure depends on the number of participants and their backgrounds.

2: Engage local experts as resources and design facilitators

A Mini Studio requires a strong team with diverse expertise; the exercise can be enhanced through the participation of technical/nontechnical, design/nondesign facilitators; experts in local history and context (from nonprofit organizations, community groups, students, etc.); and supporting staff to handle logistics and time management. A good facilitator and knowledgeable and flexible support members can ensure that any unforeseen circumstances are dealt with effectively.

3: Select design sites and excursion routes to maximize learning opportunities for the participants

It is advisable to select a few sites that have different development patterns, contexts, and densities to be able to compare different design approaches, as well as runoff reduction results. The site excursions should be well planned. Facilitators and coordinators should know the route beforehand so that the briefing can be conducted smoothly.

4: Customize stormwater management targets, parameters, and tools to match the local context

This exercise is largely context-specific: precipitation patterns, rainfall intensity, and soil conditions

vary from place to place. As such, the target rainfall intensity and infiltration rates should be based on the local context. It must be noted that this design exercise is heavily simplified for ease of application. The methodology does not take into account the effect of surface area on the runoff rate (or the runoff coefficient), the runoff rate over the rainfall duration (or the hydrograph), or the appropriate design rainfall duration. Researching local conditions, and modifying the values and methodology accordingly, will make the design outcomes more realistic and accurate. Participants should not limit their creativity to the community- and nature-based solutions in **figure 5**. Facilitators should encourage new design solutions during the design exercise, by referencing local practices and participants' past experiences.

5: Allot sufficient time for the design exercise

Allocation of time can vary depending on the time available to conduct the exercise. Participants might feel that the time allocated to the design exercise (which can range between one and two hours, or longer) is too short. But more time does not necessarily mean greater productivity. Facilitators must plan and split the time based on milestones (e.g., concept development, 10 minutes; brainstorming ideas and sketching, 10 minutes; etc.) in order to finish the exercise within the given time frame. The suggested time for the oral presentation should be a minimum of five minutes, followed by a two- to three-minute question-and-answer session.

6: Encourage and enable engagement of all participants

A Mini Studio provides an opportunity for all participants to tackle one common issue. Facilitators should create an enabling and welcoming environment so that all participants, regardless of their backgrounds and experiences, feel comfortable sharing their unique ideas and perspectives. Facilitators are encouraged to celebrate diverse and out-of-the-box thinking from each team member.

7: Share proposals with local stakeholders

Involving local stakeholders in the pin-up session is beneficial to receive feedback and first-hand knowledge from people on site. Conceptual ideas discussed during the Mini Studio can potentially be converted to action plans with the support of a local community-based committee.[6]

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[6] Refer to Yamashita et al. (2018) for more details.

7. References

Browder, Greg, Suzanne Ozment, Irene Rehberger Bescos, Todd Gartner, and Glenn-Marie Lange. 2019. *Integrating Green and Gray: Creating Next Generation Infrastructure*. Washington, DC: World Bank and World Resources Institute. https://openknowledge.worldbank.org/handle/10986/31430.

Bureau of Urban Development, Sumida Ward. 2018. "Sumida City Flood Hazard Map." https://www.city.sumida.lg.jp/anzen_anshin/katei_tiikinobousai/kouzui_hm1.files/2018_HM_sassi_japanese.pdf.

Climate-Data.org. N.d. "Bogor Climate Summary". Accessed March 31, 2020. https://en.climate-data.org/asia/indonesia/west-java/bogor-3930/.

Daiichi Terajima Elementary School. 2020. "School's Eye-Level View." http://www.sumida.ed.jp/ichiterajimasho/.

EPA (United States Environmental Protection Agency). N.d. "Urban Runoff: Low Impact Development." https://www.epa.gov/nps/urban-runoff-low-impact-development.

Gonzalez, Paul. 2016. "Flooding in China." Photograph, July 20, 2016. Accessed March 31, 2020. https://flic.kr/p/JnDpEJ. CC BY 2.0.

Grenet, Karl. 2015. "Bangkok Flooding." Photograph, March 24, 2015. Accessed March 31, 2020. https://flic.kr/p/qPDo3J. CC BY-NC-ND 2.0.

Iida, Akiko, Hiroaki Yamato, Seiji Hayashi, and Mikiko Ishikawa. 2015. "A Simulation Study of Rainwater Infiltration and Flood Prevention Effects by Urban Green Spaces in Kanda River, Tokyo." *Journal of the City Planning Institute of Japan* 50 (3). https://www.jstage.jst.go.jp/article/journalcpij/50/3/50_501/_pdf.

Jakarta Post, The. 2020. "West Java Declares Emergency over Floods, Landslides as Death Toll Rises." *The Jakarta Post*, January 4, 2020. Accessed March 31, 2020. https://www.thejakartapost.com/news/2020/01/04/west-java-declares-emergency-over-floods-landslides-as- death-toll-rises.html.

Johnson, Hans. 2016. "Tokyo Skytree Town." Photograph, February 26, 2016. Accessed March 31, 2020. https://flic.kr/p/Gbxpfg. CC BY-ND 2.0.

Melbourne Water. N.d. "Introduction to WSUD." https://www.melbournewater.com.au/planning-and-building/stormwater-management/introduction-wsud.

Next Wisdom Foundation. 2015. "Sharing Sumida Ward Experience with the World: The Use of Rainwater." June 22, 2015. http://nextwisdom.org/article/680/.

Public Utilities Board, Singapore's National Water Agency. 2013. *Managing Urban Runoff: Drainage Handbook*. Singapore: Public Utilities Board. https://www.pub.gov.sg/ Documents/managingUrbanRunoff.pdf.

Public Utilities Board, Singapore's National Water Agency. 2018. *ABC Waters Design Guidelines, 4th edition.* https://www.pub.gov.sg/Documents/ABC_Waters_Design_Guidelines.pdf.

Public Utilities Board, Singapore's National Water Agency. N.d. "Active, Beautiful, Clean Waters (ABC Waters) Programme." https://www.pub.gov.sg/abcwaters.

Tokyo Metropolitan Government. 2014. "Tokyo Metropolitan Basic Plan for Countermeasures against Torrential Rains (Revised)." http://www.tokyo-sougou-chisui.jp/river/gouutaisaku-houshin_1406.pdf.

Wallemacq, Pascaline, Regina Below, and Denis McLean. 2018. *Economic Losses, Poverty & Disasters: 1998–2017.* UNISDR and CRED Report. https://reliefweb.int/sites/reliefweb.int/files/resources/61119_credeconomiclosses_0.pdf.

World Bank. 2020. *Learning from Japan's Experience in Integrated Urban Flood Risk Management: A Series of Knowledge Notes*. Washington, DC: World Bank. http://documents.worldbank.org/curated/en/471791582142297709/pdf/Learning-from-Japans-Experience-in- Integrated-Urban-Flood-Risk-Management-A-Series-of-Knowledge-Notes.pdf.

Yamashita, Sampei, Tomoki Takebayashi, Hiroki Iyooka, and Teruki Hamada. 2018. "Decentralized Water Management and Local Community Development in the Hii River Basin." *57th conference of JSCE Infrastructure Planning and Management presentation papers* 57: 8 (CD-ROM).

Additional Resources

The following publications, developed as part of the World Bank Urban Floods Community of Practice, provide additional tools and knowledge on international good practices for enhancing urban resilience against floods:

Jha, Abhas K., Robin Bloch, and Jessica Lamond. 2012. *Cities and Flooding: A Guide to Integrated Urban Flood Risk Management for the 21st Century.* Washington, DC: World Bank. https://openknowledge.worldbank.org/handle/10986/2241.

World Bank. 2017. "Flood Risk Management at River Basin Scale: The Need to Adopt a Proactive Approach (English)." Urban Floods Community of Practice (UFCOP) Knowledge Notes, World Bank, Washington, DC. http://documents.worldbank.org/curated/en/876061497622506400/Flood-risk-management-at-river-basin-scale-the-need-to-adopt-aproactive-approach.

World Bank. 2017. "Land Use Planning for Urban Flood Risk Management (English)." UFCOP Knowledge Notes, World Bank, Washington, DC. http://documents.worldbank.org/curated/en/858461494250358652/Land-use-planning-for-urban-flood-risk-management.

Labs for Rainwater Society

Labs for Rainwater Society (LRwS) is a network of researchers primarily based at Kyushu University, Fukuoka City, Japan, with the agenda of promoting a decentralized, self-sufficient rainwater management system for a resilient society. The organization promotes multigenerational and communal interactions in the cycle of rainwater harvesting, storage, and reuse.
Website: https://amamizushakai.wixsite.com/lrws.

World Bank Tokyo DRM Hub

The World Bank Tokyo Disaster Risk Management (DRM) Hub supports developing countries to mainstream DRM in national development planning and investment programs. As part of the Global Facility for Disaster Reduction and Recovery, the DRM Hub provides technical assistance grants and connects Japanese and global DRM expertise and solutions with World Bank teams and government officials. The DRM Hub was established in 2014 through the Japan–World Bank Program for Mainstreaming DRM in Developing Countries—a partnership between Japan's Ministry of Finance and the World Bank.

Urban Floods Community of Practice

Urban Floods Community of Practice (UFCOP) is an umbrella program commited to sharing operational and technical experience and solutions for advancing an integrated approach to urban flood risk management, and leveraging the expertise and knowledge of different stakeholders and practice groups and across the World Bank Group. The program supports the development of an interactive space for collaboration and exchange on the subject, facilitating users' access to information and adaptation of knowledge to local conditions, and bringing together different stakeholders to enhance collective knowledge on integrated urban flood risk management.

GFDRR

The Global Facility for Disaster Reduction and Recovery (GFDRR) is a global partnership that helps developing countries better understand and reduce their vulnerabilities to natural hazards and adapt to climate change. Working with over 400 local, national, regional, and international partners, GFDRR provides grant financing, technical assistance, training, and knowledge sharing activities to mainstream disaster and climate risk management in policies and strategies. Managed by the World Bank, GFDRR is supported by 36 countries and 10 international organizations.

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