THE SPONGE HANDBOOK: CHENNAI

Using the Landscape Approach to transform the South Buckingham Canal Area

by TEAM SPONGE

Sourav K. Biswas, Praveen Raj, Logeshwaran R S, Balaji Balaganesan, Suriya KP

EYES ON THE CANAL

cities fit for climate change

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CONTEXT - Buckingham Canal

The Buckingham Canal is a manmade, saltwater, navigation canal that runs parallel to the Coromandel Coast in a north-south direction. It was built in different phases from 1800 until 1882 with a length of approximately 800 km reaching from Vijayawada to Marakkanam. Within the Chennai metropolitan area, the canal connects the three rivers – Kosasthlaiyar, Cooum and Adyar. Though primarily constructed for navigational purposes, the canal also helped significantly to manage floodwater. Today, however, the canal faces severe pollution due to solid and liquid waste disposal. In addition, numerous business buildings and unplanned residential settlements encroach on its banks. This reduces the width of the canal and decreases its capacity as flood management infrastructure to retain floodwater in case of heavy precipitation or storm surges. Moreover, the canal's former functions offering a trading space on its waters where the local population developed their livelihood, as well as a place for recreation and belonging have been lost. Over the years, various governmental agencies have struggled to revive the canal and continue to do so to this date.

CITIES FIT FOR CLIMATE CHANGE

Against this backdrop, the initiative 'Eyes on the Canal' was brought into life. It focuses on reimagining the Buckingham Canal in Chennai as part of the global project **'Cities Fit for Climate Change' (CFCC)**. CFCC is a global project implemented by the **Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH** on behalf of the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU). It forms part of the International Climate Initiative (IKI). The project also cooperates with the German Federal Ministry of the Interior, Building and Community (BMI). The global project CFCC strengthens cities as key actors in sustainable development. It collaborates mainly with its three partner cities, Santiago de Chile in Chile, Chennai in India and Durban (eThekwini) in South Africa. Besides supporting the implementation of climate-proofing activities in its partner cities and strengthening global exchange on low-carbon and resilient urban development the project developed a Climate-Proof Urban Development Approach (ClimPUDA).

EYES ON THE CANAL

'Eyes on the Canal' is an initiative for participatory planning to make the Buckingham Canal a liveable place for the residents of Chennai. The initiative involves various activities such as awareness walks and community engagement meetings to generate interest and ownership for the canal, which has suffered from collective abandonment.

Within this initiative, the global project CFCC launched an 'Open Ideas Competition on Reimagining Chennai's Buckingham Canal', which was supported by three local non-governmental organisations (NGOs): **The Urban Design Collective, Agam Sei and WeBe Design Lab**. The competition is implemented in collaboration with the **Greater Chennai Corporation (GCC)**, the municipal administration.

The Open Ideas Competition aimed to find solutions to improve the environmental situation of the Buckingham Canal in the south of Chennai. A total of 296 registered for the competition and 81 participants finally submitted feasible and creative solutions to tackle climate change and upgrade local livelihoods for a 3.5 km stretch of the canal. The neighbourhood located next to the selected canal stretch is highly diverse in terms of social composition and land use. It features informal residential and business buildings in a poor area, a mixed middle-class area and larger IT office buildings. In short, it creates a particular context that requires tailor-made solutions. The competition took a holistic view of the canal and was designed as an integrated exercise, which was influenced by and targeted at experts as well as citizens from a multitude of backgrounds. The ideas competition opened new ways of discussing and working on urban development issues in Chennai, promoting participatory planning to enhance public engagement.

ACKNOWLEDGMENTS

The authors of **'THE SPONGE HANDBOOK: Chennai**' acknowledge the critical role of GIZ in creating a platform that brought the ideas in the handbook to key stakeholders in government and civil society. The authors are particularly grateful to both GIZ and UDC for organizing the 'Eyes on the Canal' competition which kickstarted the entire process.

The authors thank **Sudhakar Krishnan** from GIZ for co-ordinating this unprecedented effort and managing the logistical aspects of the entire process including stakeholder meetings and internal communications. We thank **Vidhya Mohankumar** from UDC for her guidance and efforts in bringing the community together to give us valuable feedback. As the report shaped up, we were glad to receive feedback from members of the Chennai River Restoration Trust (CRRT), Public Works Department from the Government of Tamil Nadu, Indian Institute of Technology Madras, and the Chamber of Commerce. We also benefited from on-site photowalks and surveys conducted by students of SAP Anna University.

Authors Sourav and Praveen would further like to recognize the principals and designers at **Sasaki** for their encouragement and whose design influence permeate the visual and storytelling components of this handbook.

Finally, the handbook relied on a number of excellent resources—particularly towards the Sponge Landscape Infrastructure Toolkit—that have been referenced towards the end of the document.

ABOUT 'TEAM SPONGE'

TEAM SPONGE consists of members based in Boston and Chennai who first collaborated to respond to the 'Reimagining Chennai's Buckingham Canal' competition organized under the 'Eyes on the Canal' initiative. With a strong desire to change the discourse on infrastructure planning in India, the team has adopted a holistic approach to planning and proposes projects that leverage landscape-based strategies to improve urban resilience.

We are a multi-disciplinary team that applies the 'Landscape Approach' to strategically align regional planning strategies, urban planning frameworks, landscape design, urban design, infrastructural investments, and architectural interventions for outcomes that make places more livable and resilient.

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Sourav is a landscape planner and spatial analyst (MLA, Harvard University / B.Arch, University of Texas at Austin) with design and planning experience in multi-disciplinary firms including Sasaki, AECOM, SLA, Interboro Partners, Corgan, and Serie. He is co-editor of 'From the South: Global Perspectives on Landscape and Territory', co-author of 'Becoming Urban: Emerging Patterns of Urbanization in India', and author of 'PLAY! Tactics and Strategies for Mumbai's Informal City.'

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Praveen is an urban designer and architect (MUD, University of California Berkeley / B.Arch, Anna University) with experience at Sasaki, CnT, and Mindscape. His project on urban regeneration of a slum in Buenos Aires, focusing on 'ground-up approaches' won several international awards including the Congress of New Urbanism (CNU) Charter award and The American Architecture Prize. His work is part of the book 'Adaptations of the Metropolitan Landscape in Delta Regions' by Peter Bosselmann.

LOGESHWARAN R S, Project Manager - Architecture

Logesh is an architect (B.Arch, Anna University) and founder of RADIX - a climate-adaptive architecture practice. He has previously worked with Cubism and CnT Architects.

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Balaji and Suriya are final year architecture students at Anna University - School of Architecture and Planning. Balaji has worked with the Charles Correa Foundation and Mindscape. Suriya has worked with Collage Architecture Student and Space Fiction Studios.

ABOUT 'The Sponge Handbook'

Chennai began its urban growth trajectory at the mouth of the Cooum River. Today, the city rapidly expands beyond Adyar River into marshes, farmlands, and forests - indiscriminately turning a largely wet and permeable landscape into concrete. As rivers, canals, and other hydrological networks are disrupted, Chennai is unprepared to face the regular stresses of the monsoons and unprecedented shocks from extreme rainfall or cloudbursts. The city faces multiple water-related risks — from flooding to sea level rise to aquifer depletion. Yet, the urban typologies and planning paradigms of the city are indifferent to the region's ecological realities and challenges.

THE SPONGE HANDBOOK: Chennai is designed to be a guiding document to align regional planning priorities and neighbourhood planning processes with the hydrological cycle of Chennai's basins. The handbook promotes the Landscape Approach as a way to understand the issues impacting Buckingham Canal and the city at large. The Buckingham Canal study area for the handbook traverses the Adyar River basin and the South Buckingham Canal Basin. Faced with the prospect of increasingly erratic storm events overwhelming Chennai's rivers and stormwater systems, water bodies like the Buckingham Canal can play a critical role in mitigating flood risk. However, the canal's ability to withstand cloudbursts is inevitably linked to the preservation of upstream blue-green systems and a network of infrastructures within the city that can slow down runoff, store rainwater, and release into the aquifer. As such, we propose a Sponge Basin framework that is regional in scope but requires landscape-based interventions at various scales.

The handbook uses the Buckingham Canal area to demonstrate how the Sponge Basin framework can lead to the re-imagination of urban neighbourhoods, transit stations, open spaces, streets, and the rejuvenation of multi-functional infrastructures like the canal itself.

The authors hope this handbook will be used as a resource by civil society, corporate initiatives, and government bodies to adopt a fundamentally different approach to infrastructure. The Landscape Approach to infrastructure will lead to more livable neighbourhoods and more resilient regions. It is our hope that this document is a first step in mobilizing the support needed to transform these visions into a reality for Chennai and many other cities around the world.

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PART 1:
SPONGE BASIN CONCEPT

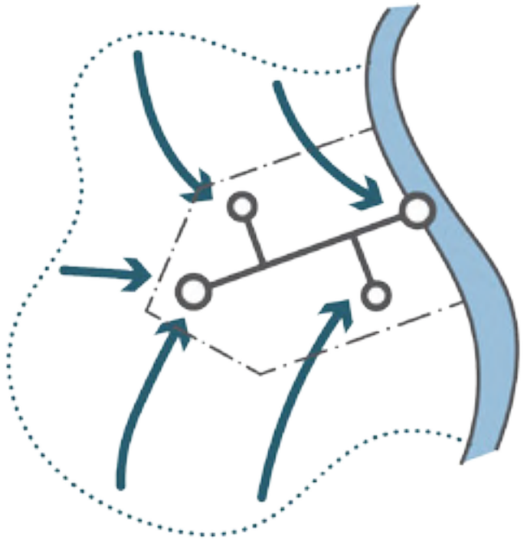
Why Chennai needs the Landscape Approach to guide urban development

Team Sponge and the Landscape Approach

Why our report on the Buckingham Canal focuses on holistic water management

Designed as a navigation canal over 800 kms long, the Buckingham Canal is an infrastructure project inextricably tied to the landscape. Following a low-lying contour along the Coromandel coast, the canal connects multiple cities while linking numerous rivers, creeks, wetlands, and marshes. Within the Chennai metropolitan region, the canal is influenced by the tides of the Bay of Bengal and the inflows of three river systems. Unfortunately, Buckingham Canal has also become a conduit for the city's sewage and is in desparate need for restoration and rejuvenation. The canal plays a critical in flood mitigation and if restored holistically, can dramatically improve the resilience and livability of the areas along its length. Team Sponge has adopted a Landscape Approach to offer a holistic vision for the canal as well as the basins contributing to it. The strategies outlined in this handbook focus on a new approach to infrastructure that makes the canal and the city at large more resilient.

TRADITIONAL STORMWATER MANAGEMENT



Gray Infrastructure is sized for a pre-determined catchment area and water is meant to be quickly piped away

Chanelling water through gray infrastructure creates potential chokepoints and disrupts the water cycle

THE LANDSCAPE APPROACH

Natural greenery and water bodies within the watershed are integrated with gray infrastructure to slow water down

Decentralized systems are more resilient to failure and create more points for rainfall to recharge the aquifer

Gray Infrastructure is invisible to city's residents and only makes its presence felt when it fails

Landscape approach to infrastructure uses creative ways to manage water while improving the public realm

Chennai's Climate Context: Cloudbursts and Water Scarcity

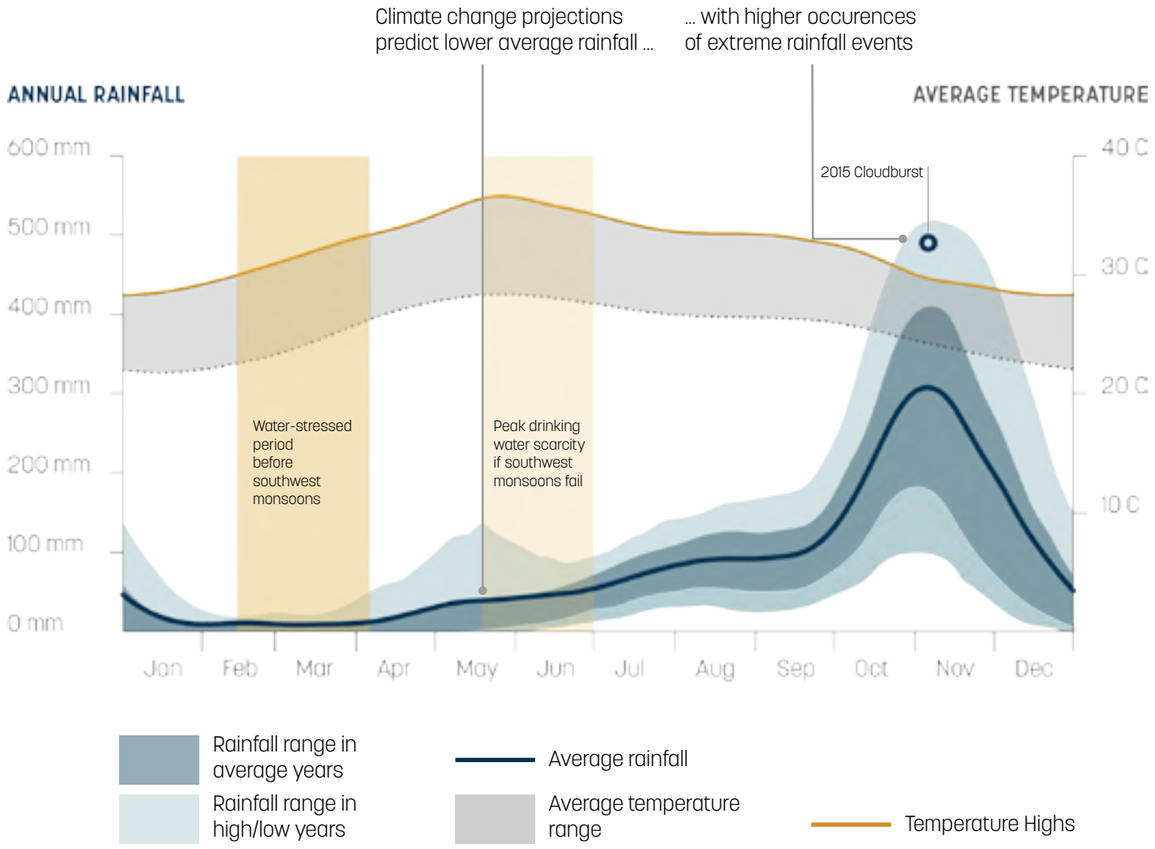
A growing metropolis vulnerable to hydrological extremes

The Chennai Metropolitan Area is home to more than 10 million people. Within the last two decades, Chennai has grown at a considerable pace. The city's built-up area has indiscriminately expanded into marshes, farmlands, and forests, transforming a largely wet and permeable landscape into impervious concrete. As a result, Chennai is unprepared to face the regular stresses of the monsoons and unprecedented shocks from extreme rainfall or cloudbursts. At the other extreme, Chennai will face unprecedented water scarcity in the coming decades.

In 2015, Chennai experienced one of the worst floods in its history followed by extreme water scarcity within less than two years. Climate change projections predict that while Chennai faces greater threats from extreme storm events, the average annual rainfall will reduce over time. This seasonal oscillation between water scarcity and water excess requires the city to strategically manage the monsoons. While preparing the city for flood risks, the flows from monsoon rains should largely end up recharging Chennai's aquifer or meeting future water demands.

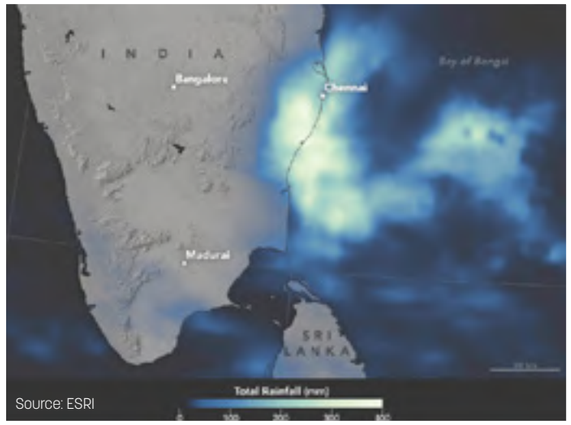
However, Chennai cannot establish this relationship with the monsoons unless the city's built forms and infrastructural investment are aligned the region's ecological and hydrological realities. Chennai needs a radically new approach to water management to ensure a water secure future for its residents.

CLIMATE OF CHENNAI



2015 | FLOODS - AN EXTREME STORM EVENT THAT SHOCKED AND PARALYZED CHENNAI

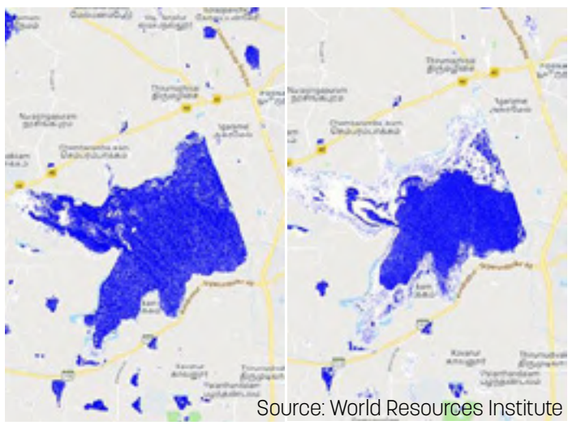
The extreme and extensive storm events of 2015 overwhelmed Chennai's rivers and stormwater systems, killing hundreds and inundating low-lying infrastructure. The chances of extreme storm events from the Bay of Bengal cyclonic basin stalling over Chennai because of the Eastern Ghats will increase due to climate change



Source: ESRI

2017 | DRINKING WATER CRISIS - LESS THAN TWO YEARS AFTER EXTREME FLOODING, CHENNAI RUNS DRY

Chennai's reservoirs ran dry as the southwest monsoons failed to bring enough rain. The people will suffer from the vagaries of the monsoons unless the city manages the patterns of excess and scarce rainfall through storage and aquifer recharge.


Source: World Resources Institute

Chennai's Basins: Adyar & South Buckingham Canal

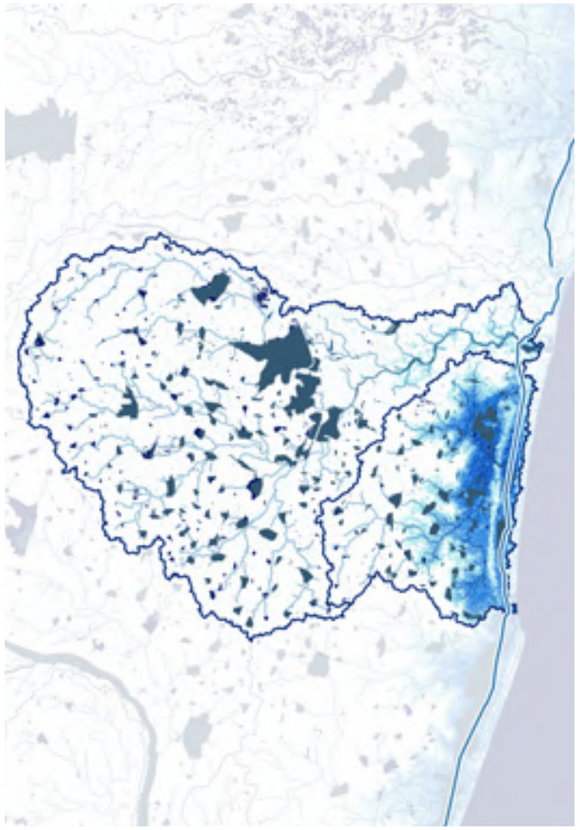
Delineating basins as landscape planning units for water management

Chennai's water risks will continue to exacerbate over time unless the natural hydrological flows that sustain the region's water bodies and aquifers are restored. Delineating basins is an effective way to identify landscape units for planning the management of hydrological flows. Basins or watersheds cover an area where all the water falling within it flow towards the same direction and land up in the same river system or water body. For instance, Adyar River basin delineates all the areas that contribute water to the river either in the form of existing streams or temporal stream flows during rainfall. Greater Chennai spans four basins - Kosasthalaiyar, Cooum, Adyar, and South Buckingham Canal.

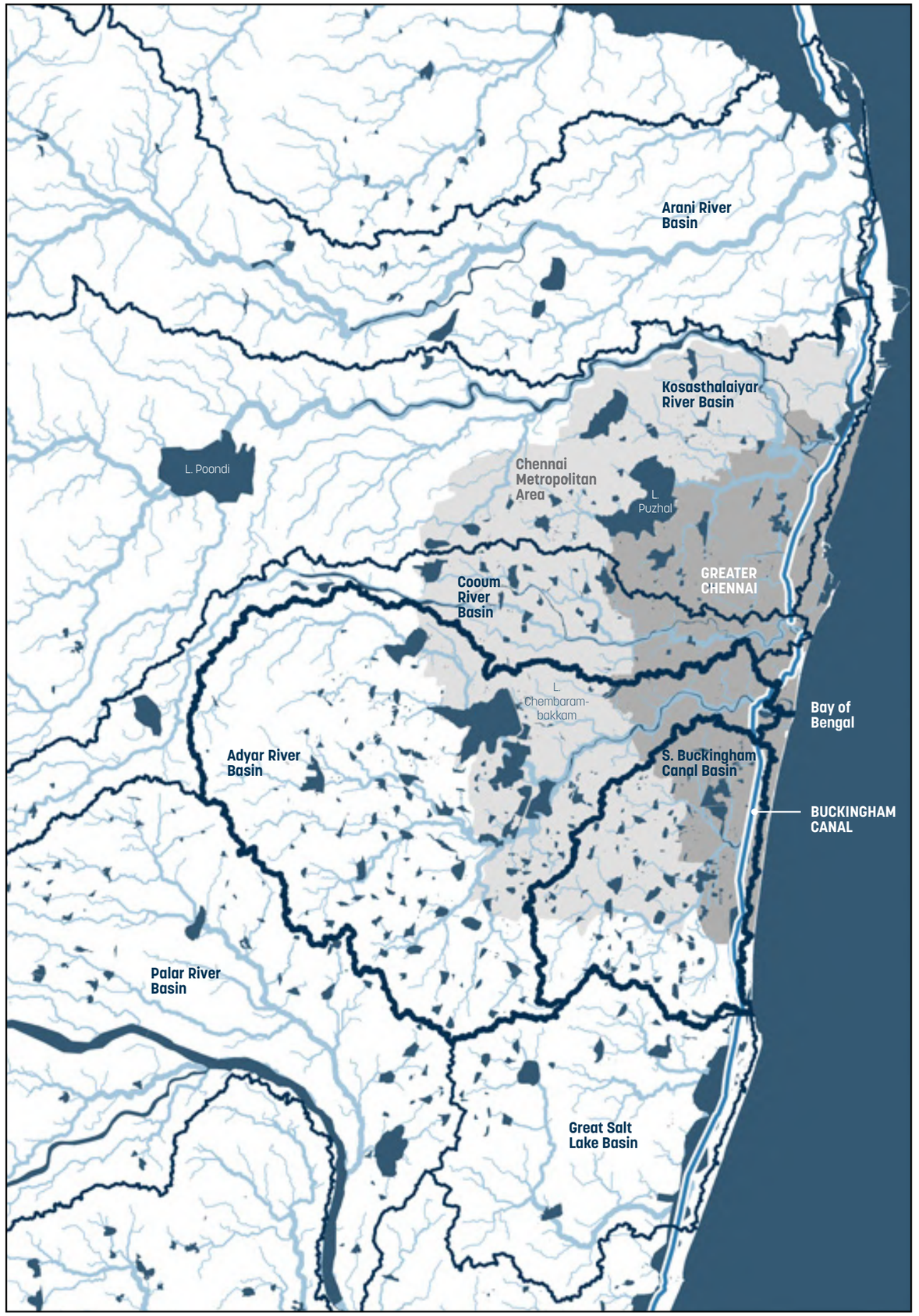
A basin allows us to understand the hydrological relationships of a region as seemingly disparate places are hydrologically and ecologically connected due to topography. If these basins became legally recognized urban planning units, planning authorities could strategically align issues of flooding and pollution to natural water cycles. A basin view allows planners to visualize hydrological patterns and guide development away from places where water very clearly needs to flow or rest. They would recognize the role of the forests and wetlands within the yet-undeveloped areas upstream of the city today and guide growth accordingly.

The basins that intersect with the Buckingham Canal study area for instance, have distinct low elevations within which water tends to collect. There are a number of wetlands and forests within the Adyar and S. Buckingham Canal Basins that are not yet formally protected as they lie beyond the Chennai Metropolitan Area. Recognizing the basin as a planning unit is a first step towards identifying growth patterns that compromise the integrity of water flows or are at risk of inevitable flooding.

Water bodies, runoff flow, low elevation areas within the basins that overlap with the southern stretch of the Buckingham Canal.



Green areas, forests, and water bodies within the basins help slow down runoff and reduce the pressure on Adyar River and the Canal during storm events.



Chennai's Disappearing Sponge Landscapes

Mapping changing landscapes due to urban sprawl

The Centre for Environment and Water Resource Department estimates that there were at least 650 large water bodies in Chennai 20 years ago with the majority of them located south of the Adyar River within the Adyar and S. Buckingham Canal basins. The overall storage capacity of the region's landscape has diminished due to the complete disappearance, encroachment or silting of water bodies. As a result, a landscape that very visibly performs like a sponge (refer to image sets), cannot absorb water during flood events and store them to recharge the aquifers. Chennai suffers from water crises because large water bodies - Puzhal, Cholavaram, Kaliveli, Pulicat, and Maduranthakam - are not maintained properly and wetlands like the Pallikarani are gradually encroached upon.

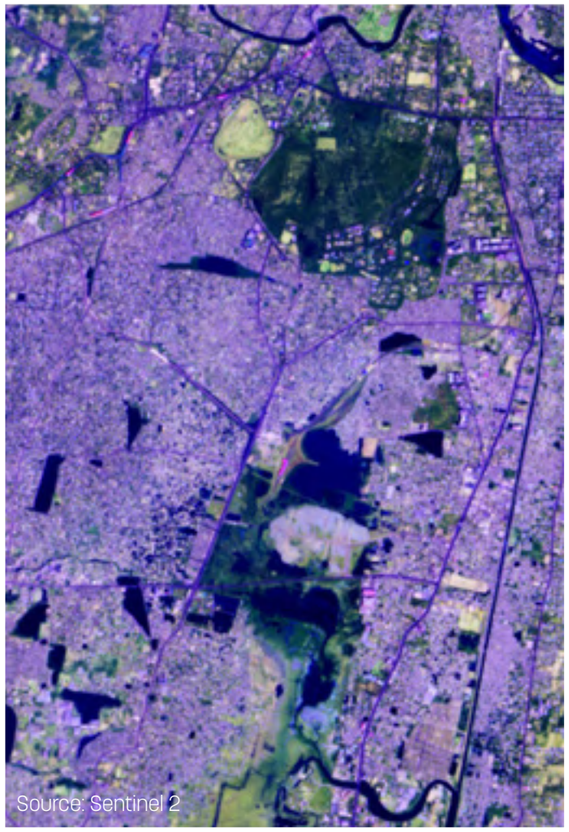
Rapid development of the I.T. Corridor along the Old Mahabalipuram Road (OMR) have led to a loss of over 5,550 hectares of wetlands. Since water bodies recharge the aquifer, sewage and other pollutants entering these water systems also threaten the quality of drinking water. Environmental activists and city officials state that the protection and maintenance of Chennai's water bodies could have averted the water crisis of 2017. When the city was submerged in the 2015 floods, the lack of water bodies meant a large amount of rainfall was discharged into the sea rather than recharging the aquifer.

Today the city is betting on desalination as a technological solution to water scarcity. 200 million liters of water is brought into the city from desalination plants at a cost of Rs. 1.25 crores a day. For a fraction of this cost, the protection and restoration of Chennai's water bodies would make Chennai more water secure while improving the livability for the city's residents and flora-fauna.

1991 | PALLIKARANAI MARSH AND MARSH

Source: Landsat 5

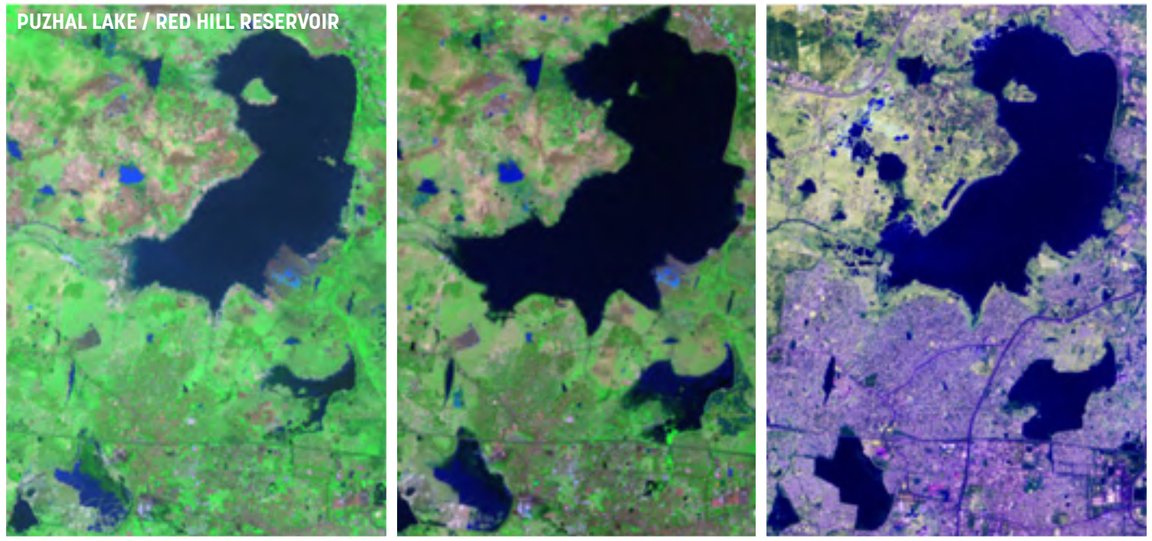
2018 | PALLIKARANAI MARSH AND MARSH



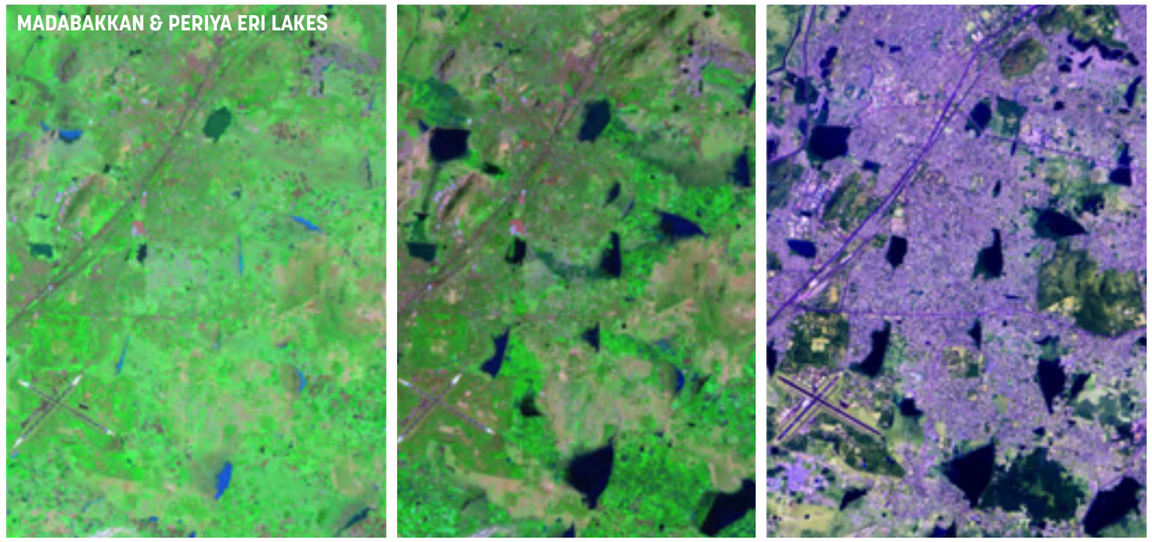
Source: Sentinel 2

1991 DRY SEASON | **1991 POST-MONSOON** | **2018**

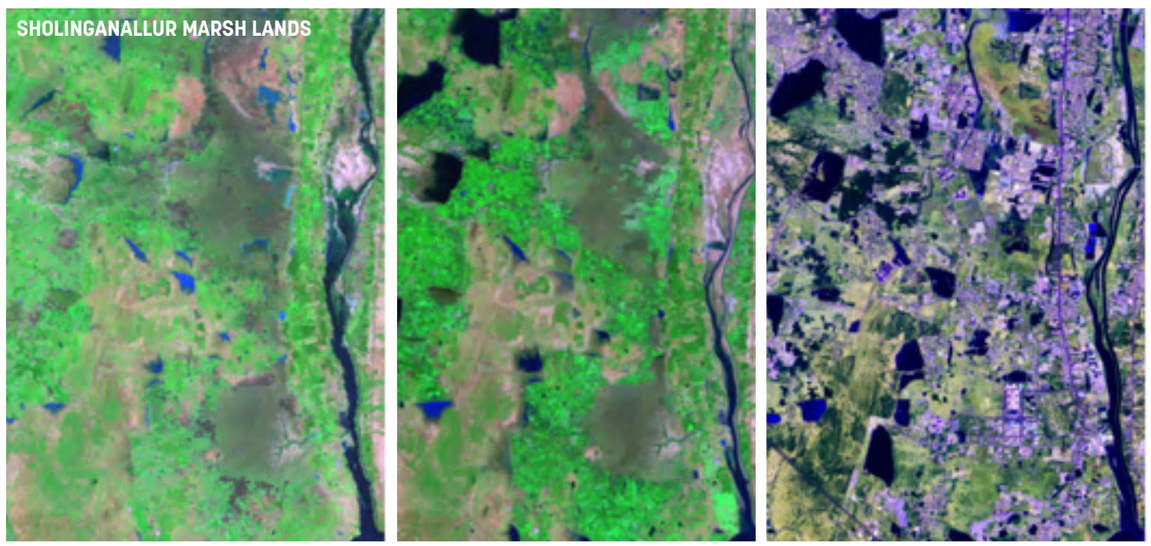
PUZHAL LAKE / RED HILL RESERVOIR



MADABAKKAN & PERIYA ERI LAKES



SHOLINGANALLUR MARSH LANDS



The Effect of Urban Development on the Water Cycle

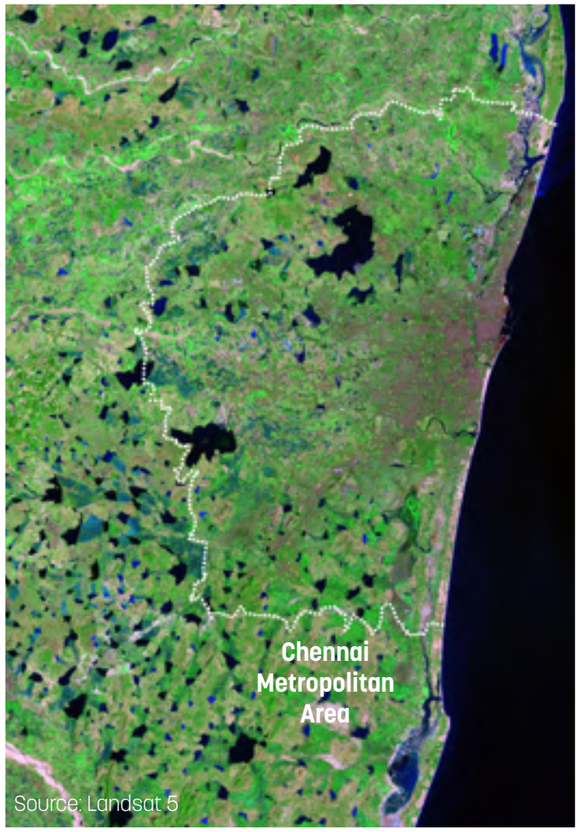
How urban sprawl increases flood risk and aquifer depletion in Chennai

The loss of water bodies significantly reduces the absorptive capacity of a basin. The loss of any green cover—including forests and agriculture—to built-up concrete also reduces porosity. Unplanned built-up areas are almost completely impervious, which means they do not allow water from rainfall to percolate into the ground. Rather, these surfaces lead water to rush through the landscape - creating increased runoff during storm events. Fully built-up areas contribute to runoff volumes of more than 5 times than areas with natural ground cover for the same amount of rainfall. Compared to the natural condition, the time over which the peak volume of runoff is generated after a rain event decreases. This creates very little lag time between the beginning of a storm event and when water begins rushing towards water bodies or stormwater channels in large quantities.

This is why the flooding of 2015 was considered 'man-made' by many authorities. Stormwater infrastructure designed for an era when the land cover was considerably more permeable than today, will inevitably fail to accommodate larger runoff volumes with shorter lag times. Going forward, the investment needed to physically increase the capacities of all gray stormwater infrastructure pipes and channels is cost-prohibitive. Rather, the municipality should try to reduce runoff volume and increase lag time by leveraging the landscape as part of its stormwater infrastructure strategy.

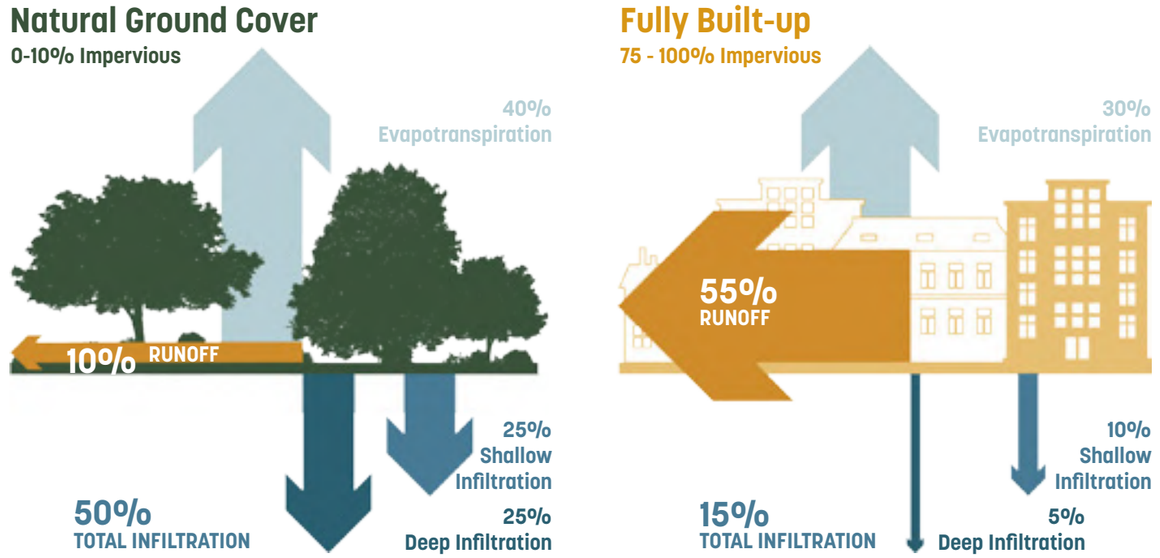
This means protecting landscapes that naturally slow down or store water and integrating landscape functions into designed stormwater systems. This way, the natural functions of delaying and storing water to release into the aquifer can be replicated within the urban fabric.

CHENNAI METROPOLITAN AREA IN 1991



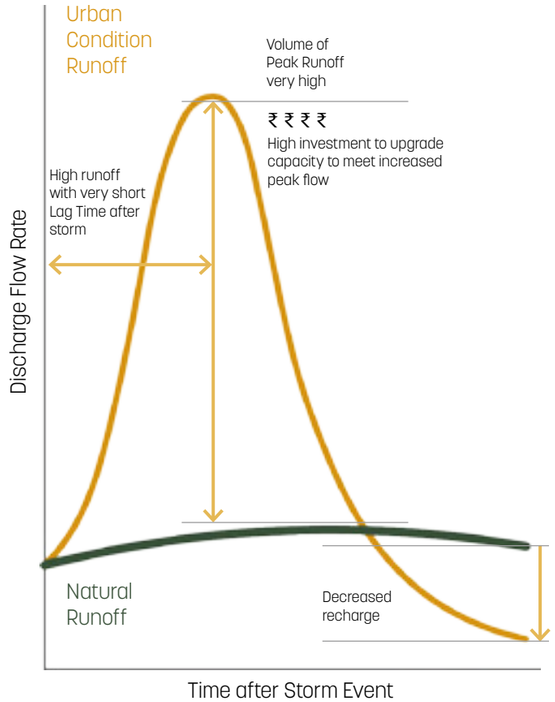
IN 2018

WHAT PERCENTAGE OF RAINFALL ENDS UP AS RUNOFF AND RECHARGE WITH DIFFERENT LAND COVER



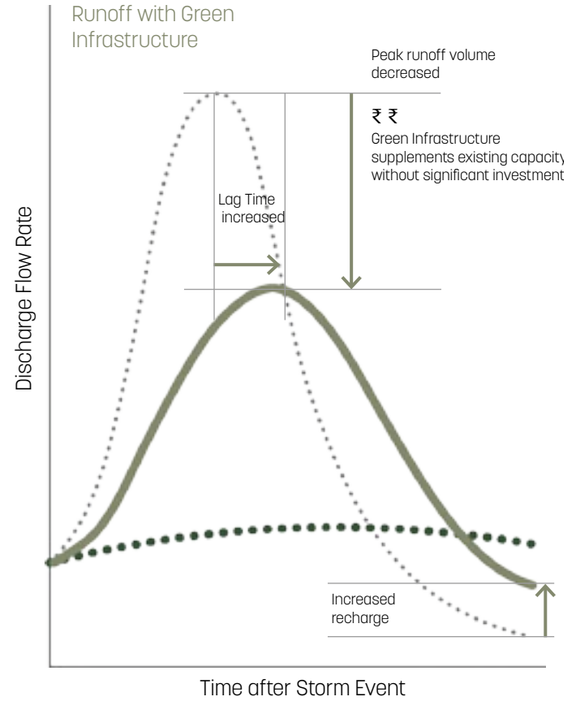
GRAY INFRASTRUCTURE APPROACH

Scaling up Gray Infrastructure to handle extreme conditions is a prohibitively expensive approach without any benefits of public realm improvements or natural recharge



GREEN+GRAY INFRASTRUCTURE APPROACH

Leveraging green infrastructure and other natural methods to manage runoff can significantly lower upgrading and maintenance costs of stormwater infrastructure



Sponge Basin Principles:
PROTECT, DELAY, STORE, RELEASE!

Four fundamental principles for holistic water management

While Chennai's water woes are manifold, the creation of Sponge Basins can mitigate many of the city's water-related risks. Sponge Basins require authorities and communities to realize four principles - PROTECT, DELAY, STORE, and RELEASE. While these principles complement each other in many ways, all four principles are mandatory to help close the water cycle in an urbanized context.

Natural systems, or what we refer to as Sponge Landscapes, fulfill the functions of Delay, Store, and Release at no cost! Therefore the protection of Sponge Landscapes is the first and most important Sponge Basin principle.

Chennai's urban fabric has fundamentally altered the basin's hydrology. Therefore, the realization of a Sponge Basin within the built fabric requires designed interventions along the streets, within open spaces, and atop or around buildings that replicate the conditions of natural ground cover. We call these interventions Sponge Landscape Infrastructure.

The four principles of the Sponge Basin can only be realized through the protection and restoration of Sponge Landscapes and the creation of a comprehensive but distributed Sponge Landscape Infrastructure network.

SPONGE BASIN
=
Protected SPONGE LANDSCAPES +
Implemented SPONGE LANDSCAPE INFRASTRUCTURE Network

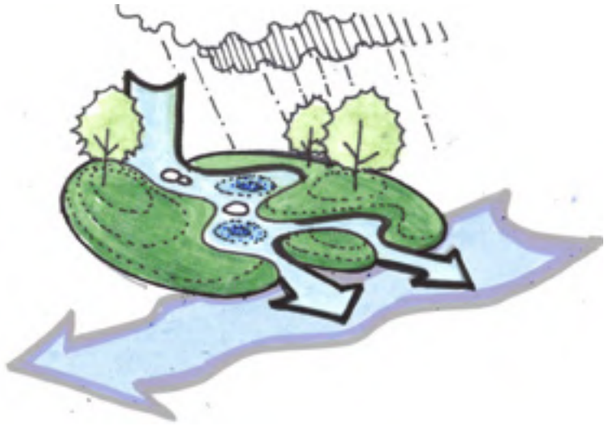
PROTECT

the city's blue-green systems from development and pollution

PROTECT is the most critical of the four principles in order to realize a Sponge Basin. 'Protect' requires the protection of the city's green spaces and water bodies from development, encroachment, and pollution. Natural systems that have been compromised by encroachment or pollution have to be restored into fully functioning systems. No designed system can replicate the benefits and complexities of uncompromised natural systems. As such, they need to be protected.

DELAY

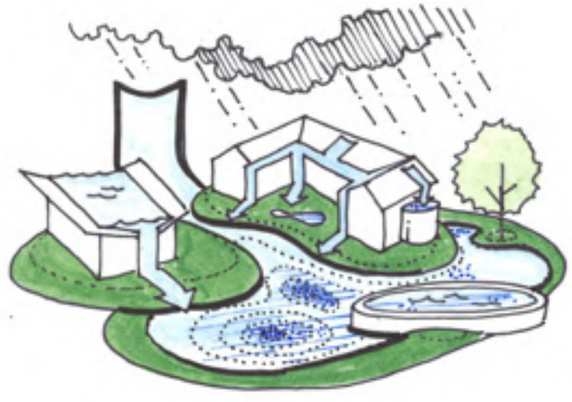
stormwater runoff from reaching drains, canals, and rivers



DELAY is a vital principle to mitigate the risk of flooding after a storm event or cloudburst. 'Delay' requires the presence of landscapes or landscape infrastructures to slow down rain water runoff so it does not overwhelm stormwater drain inlets, canals, rivers, and other water bodies. Natural ground cover, trees, topographic variations, and landscape infrastructures can all delay stormwater, leading to lower peak flows, increased lag time, and potential reduction of flood-related losses.

STORE

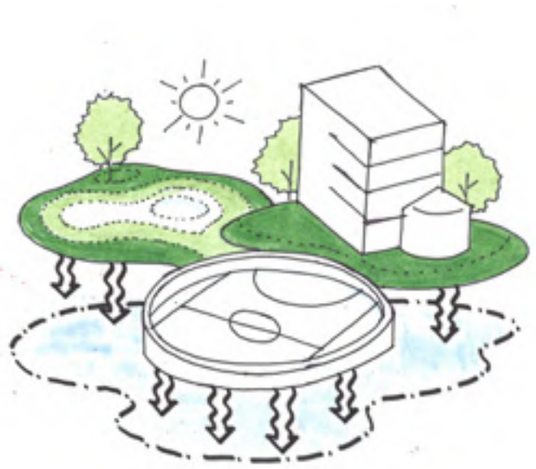
rainwater in barrels, cisterns, holding ponds, tanks, and reservoirs



STORE is a critical principle to effectively remove the risk of water scarcity by making the most of extreme storm events during the monsoons. Today, Chennai gets its water from a handful of distant reservoirs that often reach their capacity before the end of the monsoons. The creation of a distributed network to store water through rainwater harvesting in buildings and the creation of holding ponds, tanks, and micro-reservoirs can ensure greater water availability closer to places of consumption.

RELEASE

rainwater into the aquifer to recharge groundwater



RELEASE refers to the management of runoff and surface water flows in a way that recharges the aquifer without polluting it. Many of Chennai's households rely on the aquifer for drinking water. The overexploitation of the aquifer has not only caused water scarcity but increases the risk of saltwater infiltration and land subsidence. 'Release' requires overflow from storage structures to go into the aquifer, the protection of natural aquifer recharge zones, and ensuring the groundwater is pollution-free.

Realizing Sponge Basins: From the Region to the Street

The multi-scalar nature of making an urban region more resilient

Since the Buckingham Canal traverses the Adyar River basin and the South Buckingham Canal Basin, the canal's ability to withstand cloudbursts is inevitably linked to the preservation of upstream blue-green systems and a network of infrastructures within the urban fabric that can slow down runoff, store rainwater, and release into the aquifer.

The Sponge Basin principles require us to take a holistic view of the Buckingham Canal as an infrastructural water body embedded within the landscape. The realization of a Sponge Basin is regional in planning scope but requires landscape-based interventions at various scales including streets, open spaces, and buildings.

DO NOTHING SCENARIO

No planning regulations to limit sprawl & protect green-blue ecological systems

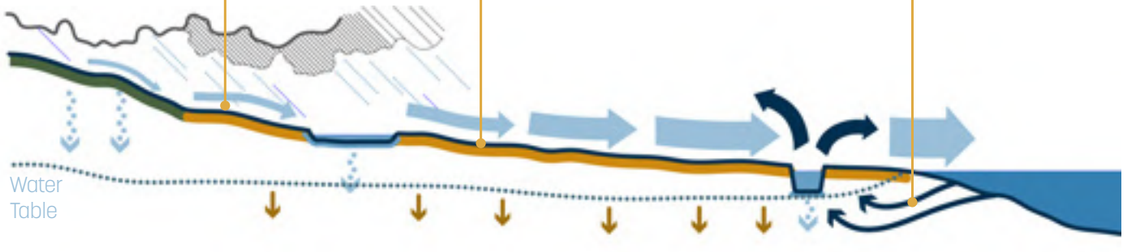
No upgrades to stormwater infrastructure

No restoration efforts towards Adyar River, Buckingham Canal, Pallikarnai Marsh or Chembarambakkam Lake

Loss of upstream wetlands & green cover increases runoff and chances of flooding during cloudbursts

Stormwater infrastructure, canals, & rivers are overwhelmed as water rushes through impervious surfaces

Excessive extraction & lack of aquifer recharge leads to saltwater infiltration



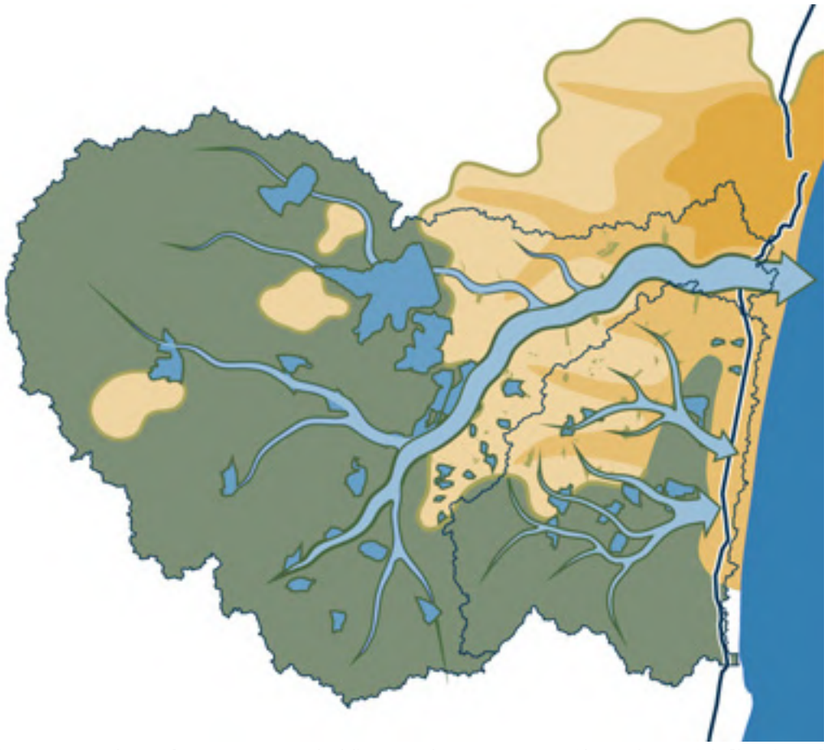
SPONGE BASIN APPROACH

PROTECT upstream green-blue assets through regulations. Minimize sprawl through transit-oriented development

DELAY stormwater runoff by increasing green cover to reduce peak flows from overwhelming canals & rivers

STORE rainwater within the urban fabric through harvesting & storage structures, parks & open spaces, and holding ponds or detention basins

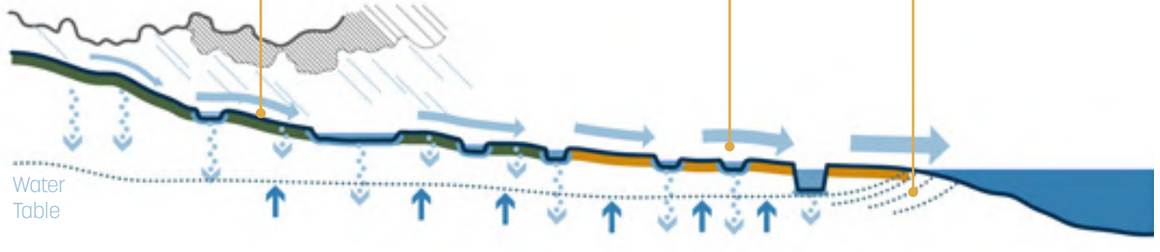
RELEASE water into the aquifer by ensuring most of the rainfall seeps into the ground instead of draining out to the sea



Protected wetlands & green cover in upstream areas absorb & slow down water

Pockets of green spaces, holding ponds, & green streets delay or stop stormwater from rushing into canals & rivers

Slow release & infiltration of rainwater after storm events increases aquifer levels



Making the Case: For Protecting Sponge Landscapes

Leveraging Natural Systems to make Chennai resilient

Chennai is an ecologically gifted deltaic city with three rivers, five major wetlands, and six forest areas. The three rivers running through Greater Chennai are Kosathalaiyar, Cooum, and Adyar - which are threaded by the manmade Buckingham Canal. The major wetlands include Pallikaranai Marsh, Pulicat Lake, Kattupalli Island, Madhavaram & Manali Jheels, and Adyar Estuary Creek. Six urban forest areas include Guindy National Park, Vandalur, and the forests of IIT Madras, Madras Christian College, and Theosophical Society. The Chennai Metropolitan Area has around 4,100 water bodies of various sizes. Yet this landscape is drastically reduced from its historical natural conditions. For instance, the area of water bodies within Greater Chennai shrunk from 12.6 sq.km in 1893 to merely 3.2 sq.km in 2017.

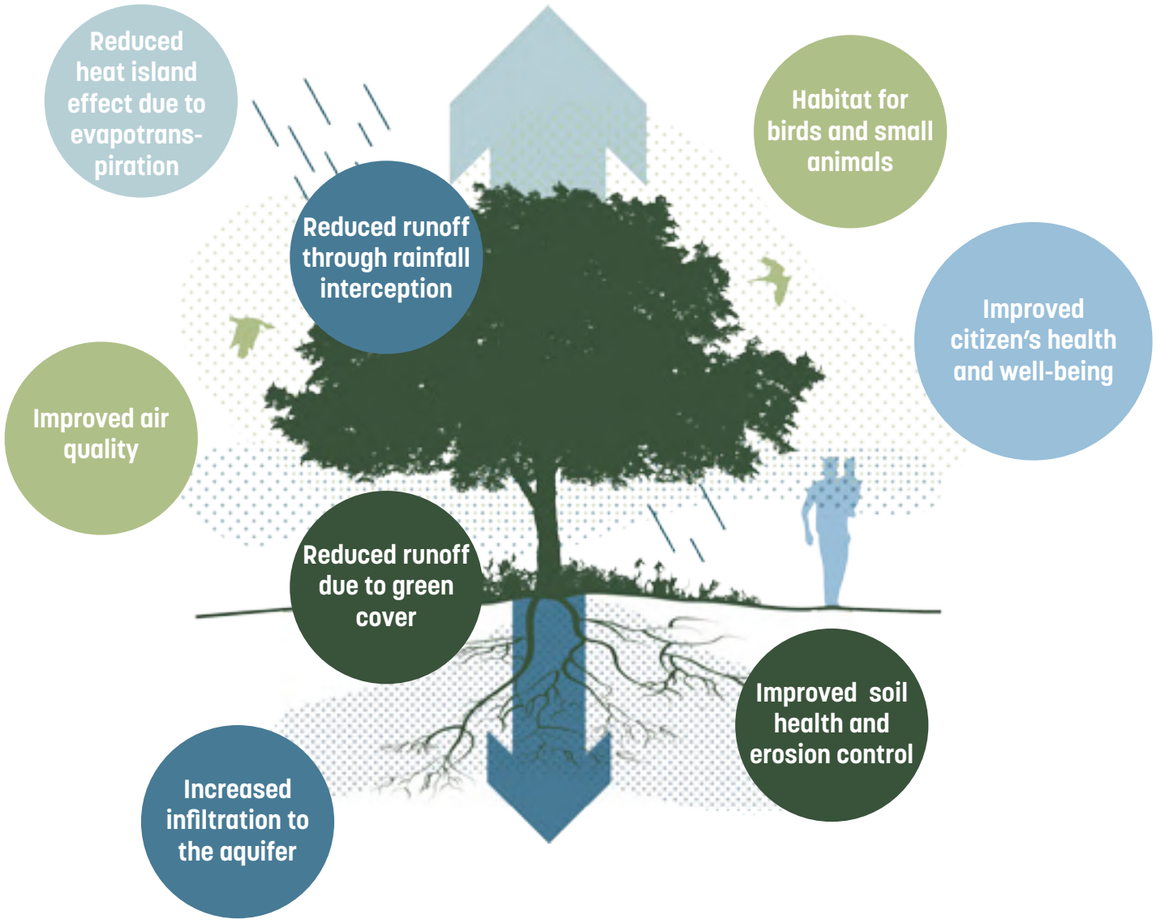
Chennai can no longer afford to ignore the region's remnant and still intact natural systems. Sponge Landscapes are not only critical to reduce Chennai's risk to flooding and water scarcity. They are integral to making Chennai more livable—by maintaining the hydrological cycle, reducing the heat island effect, creating habitats for birds and animals, and offering a number of recreational and cultural benefits. The restoration of all water bodies including man-made ones like the Buckingham Canal has to holistically account for the inter-connectedness of Chennai's Sponge Landscapes.

SPONGE LANDSCAPES

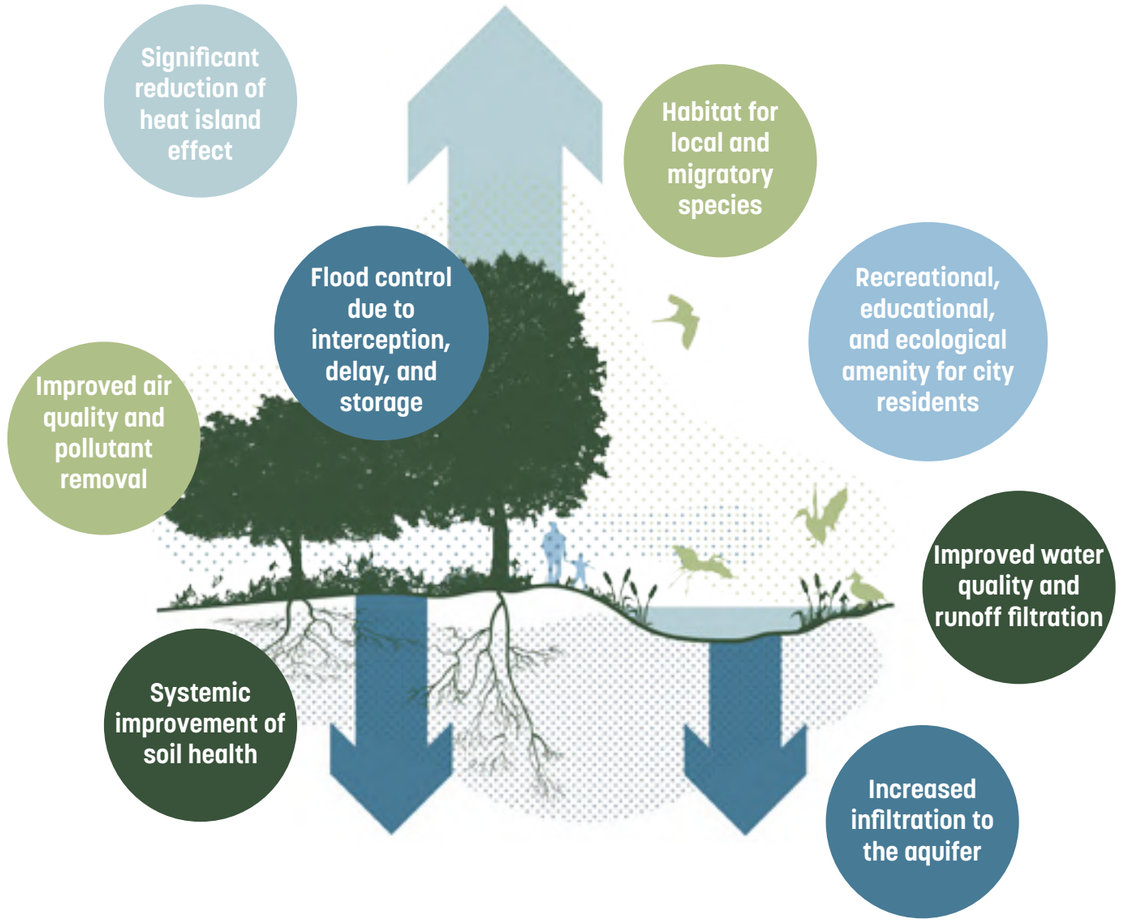
=

Beaches, Canals, Creeks, Estuaries, Forests, Lakes, Marshes, Trees, Riparian Areas, Ponds, Rivers, Streams, Wetlands

A single tree significantly improves livability for Chennai's citizens and the city's birds and animals. Saving a tree or planting a tree bring benefits that vastly outsize the minimal costs.



A functioning ecosystem supports land, water, and living systems in ways that designed infrastructure simply cannot. Urban forests, wetlands, and other habitats are the smartest systems in a city.



Making the Case: For Investing in Sponge Landscape Infrastructure

Replicating natural flows through designed systems that improve livability

Sponge Landscape Infrastructure refers to infrastructural interventions that help restore the water cycle within modified urban conditions. They may replicate natural flows of water through designed systems that incorporate natural elements like trees, shrubs, and soil. Or they may simply offer ways to store and release water around buildings, within open spaces, or along streets. Both types help reduce the volume of runoff and encourage the replenishment of the aquifer.

Unlike traditional gray infrastructure, Sponge Landscape Infrastructure can be highly visible and greatly improves the experience of the public realm when well-designed.

This is a good incentive for property owners, private developers and local councillors to invest in infrastructure projects while improving the image of a place. Increase in tree canopy for instance has been proven to raise property values, retail value, and general sense of well-being. By integrating natural elements, Sponge Landscape Infrastructure requires less maintenance and is more resilient to flood events. Traditional gray infrastructure is designed to move water away as fast as possible. This only increases flood risk and wastes rainwater. By design, Sponge Landscape Infrastructure is able to delay, store, and release water into the aquifer rather than discharge it into the sea.

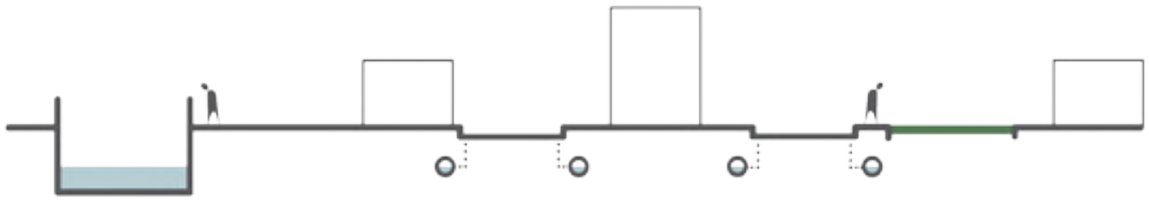
GRAY INFRASTRUCTURE PARADIGM

Investment to fix or upgrade existing gray infrastructure. Increasing the capacity of gray infrastructure is prohibitively expensive and remains invisible to the general public.

INITIAL INVESTMENT

₹ ₹ Fix gray infrastructure
₹ ₹ ₹ ₹ Upgrade gray infrastructure

INITIAL BENEFITS

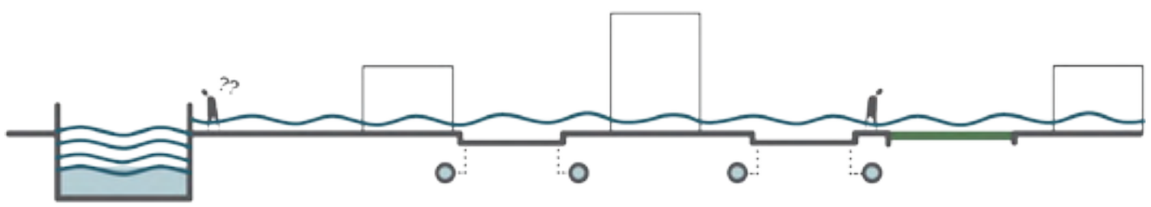


Without implementing Sponge Basin principles, even upgraded gray infrastructure can be overwhelmed. Traditional gray infrastructure incurs higher maintenance cost over time than Landscape infrastructure. Accounting for losses from flooding, solely relying on gray infrastructure does not pay off in the long run.

LONG RUN COSTS

₹ ₹ Continued maintenance costs
₹ ₹ ₹ Flood losses incurred

LONG RUN BENEFITS



SPONGE LANDSCAPE INFRASTRUCTURE

=

[SPONGE STREETS] Bioswale Channels, Tree Pits & Trenches, Sidewalk & Curb Planters
[SPONGE OPEN SPACES] Bioinfiltration Basins, Constructed Ponds & Wetlands, Sunken Plazas
[SPONGE BUILDING] Rainwater Harvesting, Green Roofs, Detention Tanks

SPONGE LANDSCAPE INFRASTRUCTURE PARADIGM

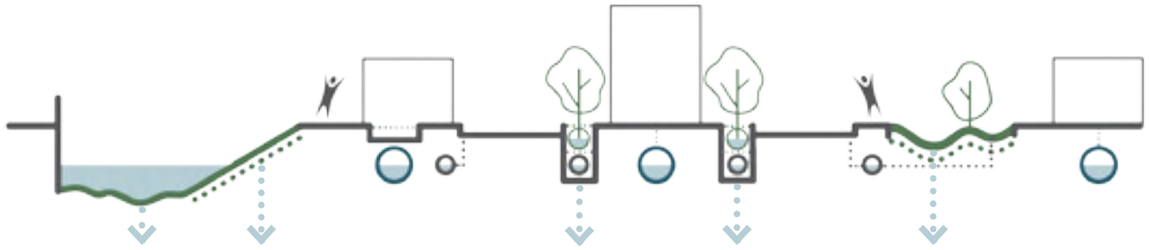
Investment to protect and restore Sponge Landscapes & implement Landscape Infrastructure upgrades. This reduces the pressure on gray infrastructure without rebuilding existing infrastructure.

INITIAL INVESTMENT

₹ ₹ Fix gray infrastructure
₹ ₹ ₹ Implement Sponge Landscape Infrastructure

INITIAL BENEFITS

Improved public realm ♥ ♥



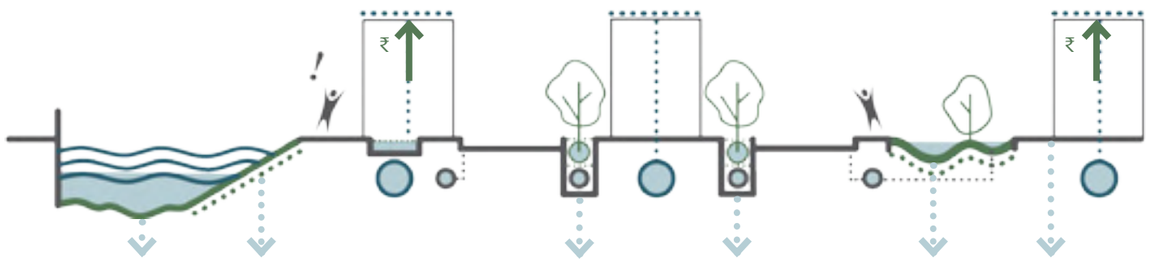
A well integrated and decentralized Sponge Network is more resilient to flooding and increases the livability and value of neighborhoods. This increases property values or encourages new development which in turn brings in more revenue for the city - essentially subsidizing investments towards the landscape.

LONG RUN COSTS

₹ Reduced maintenance costs
₹ Flood losses incurred

LONG RUN BENEFITS

Increase in property and retail value ₹ ₹ ₹
Improved public realm ♥ ♥ ♥
Better urban ecology ♥ ♥ ♥



Planning for Sponge Basins

Mapping stakeholders who can realize the principles of PROTECT, DELAY, STORE, RELEASE

The realization of Sponge Basins in Chennai requires various stakeholders to collaborate at multiple scales. The table below summarizes critical actions needed to realize a Sponge Basin alongside stakeholders with the agency to follow through. Due to the complexity of urban issues, a number of actions require strategic collaborations or efforts from co-ordinating agencies like the Chennai River Restoration Trust to play a leading role. **Part 2** of this handbook will detail implementation considerations for Sponge Landscape Infrastructures, while **Part 3 and 4** will demonstrate what planning actions need to happen at the Basin, Ward, and Site scale.

Actions and Stakeholders needed to realize Sponge Basins

PROTECT

- Recognize functioning natural systems, existing water bodies, and protect them from development through regulation, enforcement, and land-use planning.
- Identify and restore polluted and encroached natural systems.

Prepare Metropolitan Ecological Conservation Plan, State-wide Environmental Guidelines, and Local Enforcement Protocols

- Chennai Metropolitan Development Authority
- Dept. of Environment (GoTN)
- Dept. of Town Planning (GCC)

Co-ordinate resources from State and Municipal government to preserve or restore green-blue systems

- Chennai River Restoration Trust + Public Works (GoTN)
- Dept. of Parks (GCC)
- Dept. of Stormwater Drain (GCC)

Protect water bodies from pollution and encroachment

- Chennai River Restoration Trust (CRRT)
- Chennai Metro Water (CMWSSB)

Highlight issues, hold institutions accountable, be vocal, stay vigilant!

- Research and Academic Institutions
- Civil Society

DELAY

- Regulate impervious cover for new developments and runoff management within all developments.
- Implement Sponge Landscape Infrastructure projects that slow down stormwater runoff - particularly through street upgrades, constructed ponds, raingardens, and detention tanks.

Formalize Guidelines and Plan / Implement Sponge Streets

- Transportation + Public Works Department (GoTN)
- Dept. of Stormwater + Roads + Parks (GCC)
- Consultants and Technical Experts

Formalize Guidelines and Plan / Implement Sponge Open Spaces

- Chennai River Restoration Trust + Public Works (GoTN)
- Dept. of Stormwater + Parks (GCC)
- Consultants and Technical Experts

Plan / Implement Sponge Buildings

- Building owner / institution
- Public / Private Developer

Enforce implementation and continued maintenance

- Ward Councillors + Zonal Engineers (GCC)
- Civil Society

STORE

- Improve the storage capacity of canals, reservoirs and water bodies of all sizes.
- Legislate and enforce rainwater harvesting regulations for all existing and new buildings.
- Implement Sponge Landscape Infrastructure Projects with storage functions.

Legislate and enforce rainwater harvesting requirements

- Dept. of Environment (GoTN)
- Dept. of Town Planning (GCC)
- Chennai Metro Water (CMWSSB)

Improve storage capacity of water bodies and structures through desilting, restoration, and revitalization

- Chennai River Restoration Trust + Public Works (GoTN)
- Dept. of Stormwater Drain (GCC)
- Chennai Metro Water (CMWSSB)

Plan and Implement Sponge Streets, Open Spaces, and Buildings projects with storage functions

- Public Works Department + CRRT
- Dept. of Stormwater + Roads + Parks + Ward / Zonal Officers (GCC)
- Consultants and Technical Experts
- Building owner / institution and civil society

RELEASE

- Designate protected aquifer recharge zones at metropolitan scale.
- Legislate stormwater treatment quality standards for existing and new developments.
- Implement Sponge Landscape Infrastructure Projects that filter stormwater and recharge the aquifer.

Designate protected aquifer recharge zones with CMDA, Aquifer Guidelines for whole State, and Local Enforcement Protocols

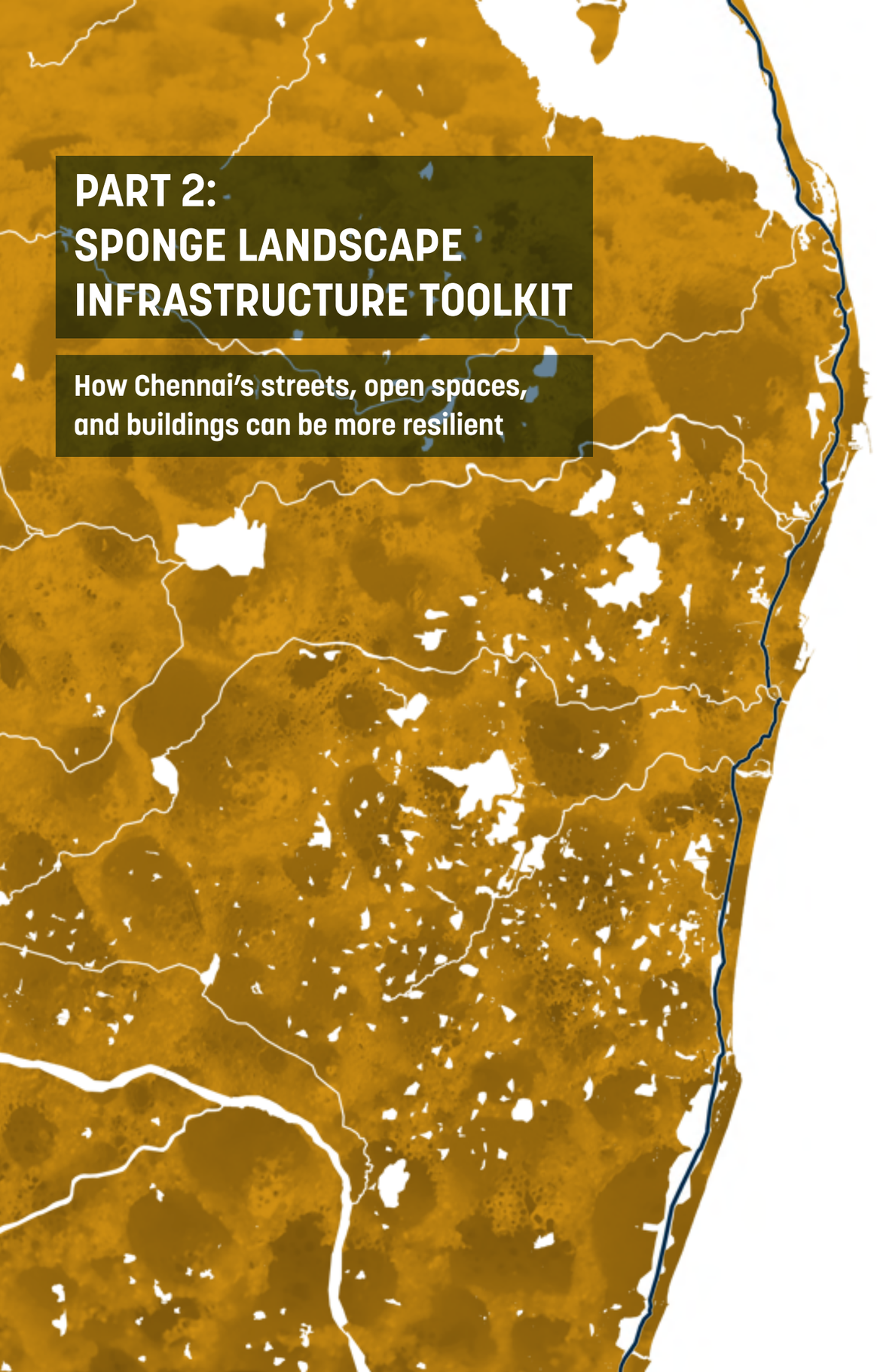
- Chennai Metropolitan Development Authority
- Dept. of Environment (GoTN)
- Chennai Metro Water (CMWSSB)

Legislate enforceable guidelines for stormwater treatment and management

- Dept. of Environment (GoTN)
- Dept. of Town Planning (GCC)
- Consultants and Technical Experts

Plan and Implement Sponge Streets, Open Spaces, and Buildings projects within areas having infiltration potential

- Public Works Department + CRRT
- Dept. of Stormwater + Roads + Parks + Ward / Zonal Officers (GCC)
- Consultants and Technical Experts
- Building owner / institution and civil society



PART 2: SPONGE LANDSCAPE INFRASTRUCTURE TOOLKIT

How Chennai's streets, open spaces, and buildings can be more resilient

Using the Sponge Landscape Infrastructure Toolkit

A comprehensive guide to support Sponge Landscape Infrastructure planning

Sponge Landscape Infrastructure is a terminology adopted by the handbook to align what is popularly called 'Green Infrastructure' (GI) or 'Low Impact Development' (LID) technologies with the Sponge Basin concept. Having highlighted its role towards realizing a Sponge Basin, the Sponge Landscape Infrastructure Toolkit catalogs these components by type, describes them through drawings, and explains where they can or cannot be implemented. Finally it outlines how analysis and planning processes can enable its strategic implementation for basin-wide impact.

This toolkit is meant to be reference for Chennai's planning authorities, department engineers, as well as activist members of civil society to understand how the city's streets, open spaces, and buildings can be retrofitted or upgraded to manage water while improving the public realm.

The structure of the Sponge Landscape Infrastructure Toolkit is illustrated below:

SPONGE LANDSCAPE INFRASTRUCTURE DESCRIPTIONS BY TYPE

What are they? How do they work?

SPONGE STREETS	SPONGE OPEN SPACES	SPONGE BUILDINGS
Pages: 29 - 36	Pages: 39-46	Pages: 49 - 54

SUITABILITY MATRIX

Where can they be implemented?

Tables summarizing where Sponge Landscape Infrastructure components are viable or limited

Pages: 37-38, 47-48, 55-56

And in Page: 57 - 58

PLANNING FOR SPONGE L.I. NETWORKS

How can they be planned and implemented as a network?

Analysis and planning guidelines to set up a framework for the strategic implementation of Sponge Basins

Pages: 59 - 62

Sponge Landscape Infrastructure Typology

There are a number of Sponge Landscape Infrastructure components that allow built-up areas to manage storm-water runoff in ways that partially, if not completely, replicate natural ground cover conditions. This toolkit organizes the components into typologies that correspond with the urban systems that can be retrofitted and improved.

Sponge Streets refer to a number of components that delay stormwater and increase infilitration opportunities along street medians or edges, sidewalks, and curbsides or intersections.
Sponge Open Spaces consist of interventions that create pond, wetlands, raingardens, or sunken plazas within green or urban public spaces.

Sponge Buildings collect components like rainwater harvesting, green roofs, and detention tanks since they can be implemented atop or around buildings.

These typologies were also organized in this manner to link each category to the same set of implementing agencies. Sponge Buildings can be modified by their respective owners or tenants with little to no government involvement. The implementation of all Sponge Streets and Sponge Open Spaces on public lands require co-ordination between two or more departments within the urban local body and other government agencies.

Below are short descriptions of each typology:

SPONGE STREETS

S.1 | Bioswale Channels

Landscape feature along avenue medians and other linear strips

S.2 | Sidewalk Planters & Tree Trenches

Planter beds and tree pits on wide sidewalks

S.3 | Curb Bulbouts

Planter beds on street parking and street intersections

SPONGE OPEN SPACES

P.1 | Constructed Ponds & Wetlands

Designed water bodies within parks and open spaces and areas with high water table

P.2 | Bioinfiltration Basins & Raingardens

Landscape features within parks and open spaces with infiltration potential

P.3 | Sunken Plazas

Special plazas with holding capacity within institutional and transit open spaces

SPONGE BUILDINGS

B.1 | Rainwater Harvesting

Water collection and storage systems in all buildings

B.2 | Green Roofs

Planted layer of shallow or deep green systems or gardens atop roof of buildings

B.3 | Detention Tanks

Architectural feature within small residential open spaces with holding capacity

S.1 SPONGE STREETS: Bioswale Channels

Bioswale channels are vegetated and maintained swales specifically designed to convey stormwater at a low velocity, promote natural treatment and infiltration. Bioswale channels are more resilient, aesthetic, and low-maintenance alternatives to underground storm sewers or lined open channels. Bioswale channels can effectively convey and treat stormwater from roadways and other impervious surfaces. They can be implemented along roadways or on medians where the drainage area, topography, soils, slope and safety issues are conducive to its function.

According to the New York State Stormwater Design Manual (2015), bioswale channels effectively reduce peak discharge and provide infiltration opportunities compared to hardened channels. They can provide upto a 10-20% runoff reduction when designed for certain development conditions.

PERFORMATIVE ABILITY

- Highly Effective in All Conditions
- Moderately / Conditionally Effective
- Not Effective / Not Applicable

DELAY

STORE

RELEASE

FILTER

SUITABILITY FACTORS

Minimum Water Table Depth: 0.6m

Maximum Slope (in %): 4%

Suitable Soil Type: Made Soil

IMPLEMENTING STAKEHOLDERS

GREATER CHENNAI CORP.
Roads Department
Storm Water Drain Dept.
Parks Department

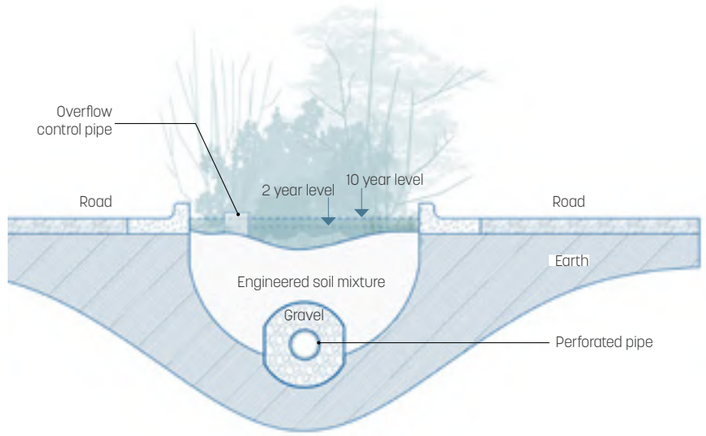
FOR PRIVATE ROADS
Public / Private Developer
Land Owner

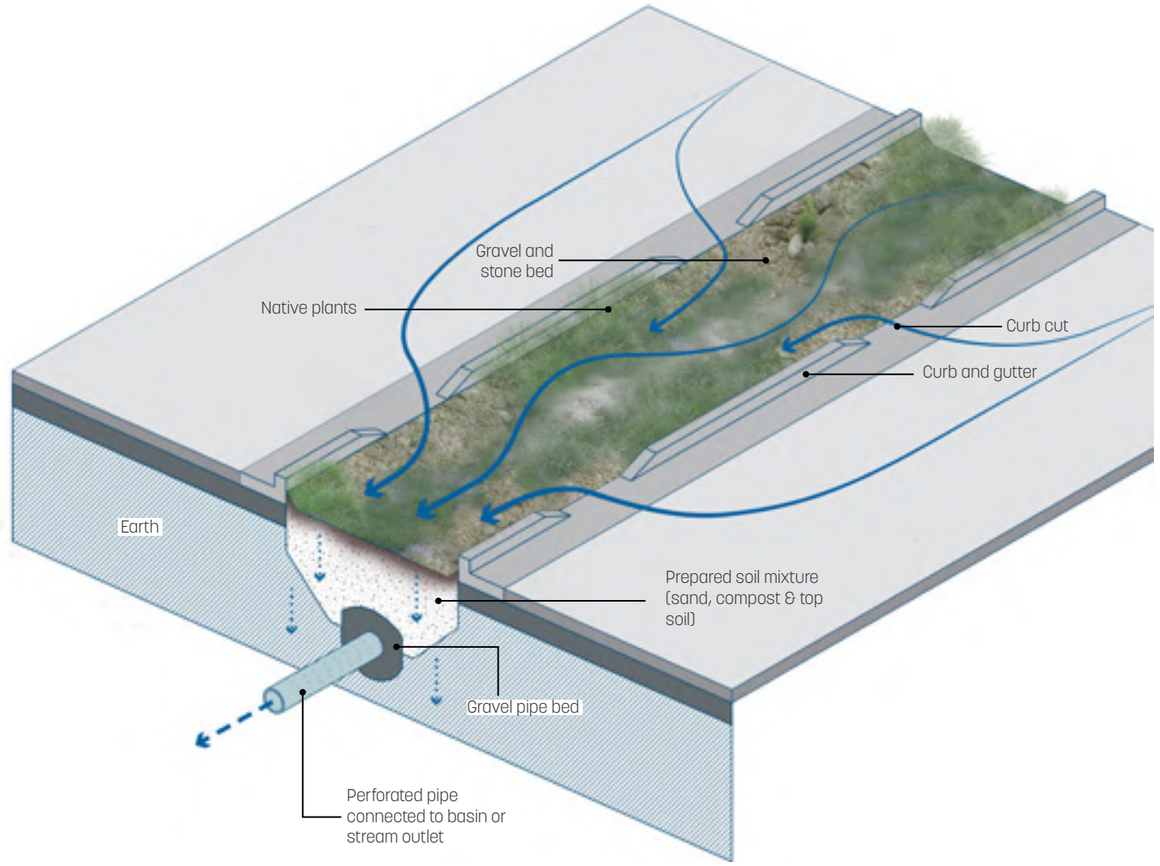
CONSULTANTS
Civil Engineers
Landscape Architects

GOVT. OF TAMIL NADU
Public Works Dept.

Civil Society

SITES FOR CONSIDERATION:
Medians of wide avenues
Linear edges of parking lots
Narrow open space stretches





S.2 SPONGE STREETS: Sidewalk Planters

Sidewalk planters (also known as raingardens or bioretention gardens) uses vegetation and inventive drainage design to slow down and potentially infiltrate runoff flows from roads and sidewalks. They can be accommodated within a number of design variations that respond to the conditions of the street and sidewalk. Sidewalk planters can effectively slow down stormwater while improving the streetscape experience.

Sidewalk planters have the following components: inflow design, pre-treatment, ponding area, overflow, filter/soil media, and underdrain. Good inflow design will ensure stormwater inlet at rates that prevent ponding and avoid erosion. Pre-treatment using plants is a necessary to prevent roadside pollutants from infiltrating into the aquifer. The ponding area should be designed to accommodated 10 year flood events while an overflow mechanism ensures water from extreme flood events can enter the stormwater drains. Well-designed sidewalk planters can reduce the load on the stormwater system and mitigate flooding during most cloudburst events.

PERFORMATIVE ABILITY

- Highly Effective in All Conditions
- Moderately / Conditionally Effective
- Not Effective / Not Applicable

- DELAY
- STORE
- RELEASE
- FILTER

SUITABILITY FACTORS

Minimum Water Table Depth: 1.2m

Maximum Slope (in %): 15%

Suitable Soil Type: Made Soil

IMPLEMENTING STAKEHOLDERS

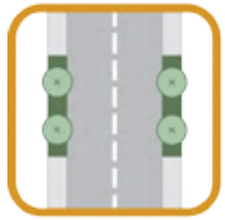
GREATER CHENNAI CORP.
Roads Department
Storm Water Drain Dept.

FOR PRIVATE ROADS
Public / Private Developer
Land Owner

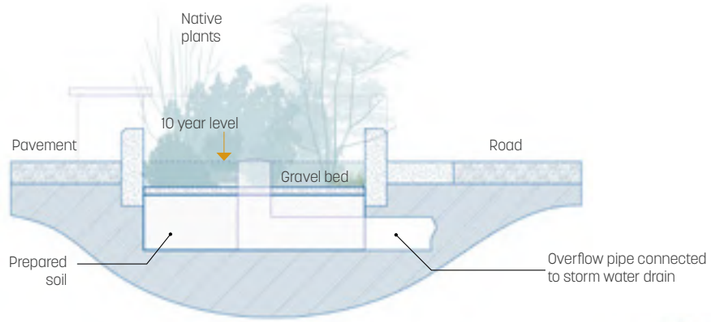
CONSULTANTS
Civil Engineers
Landscape Architects

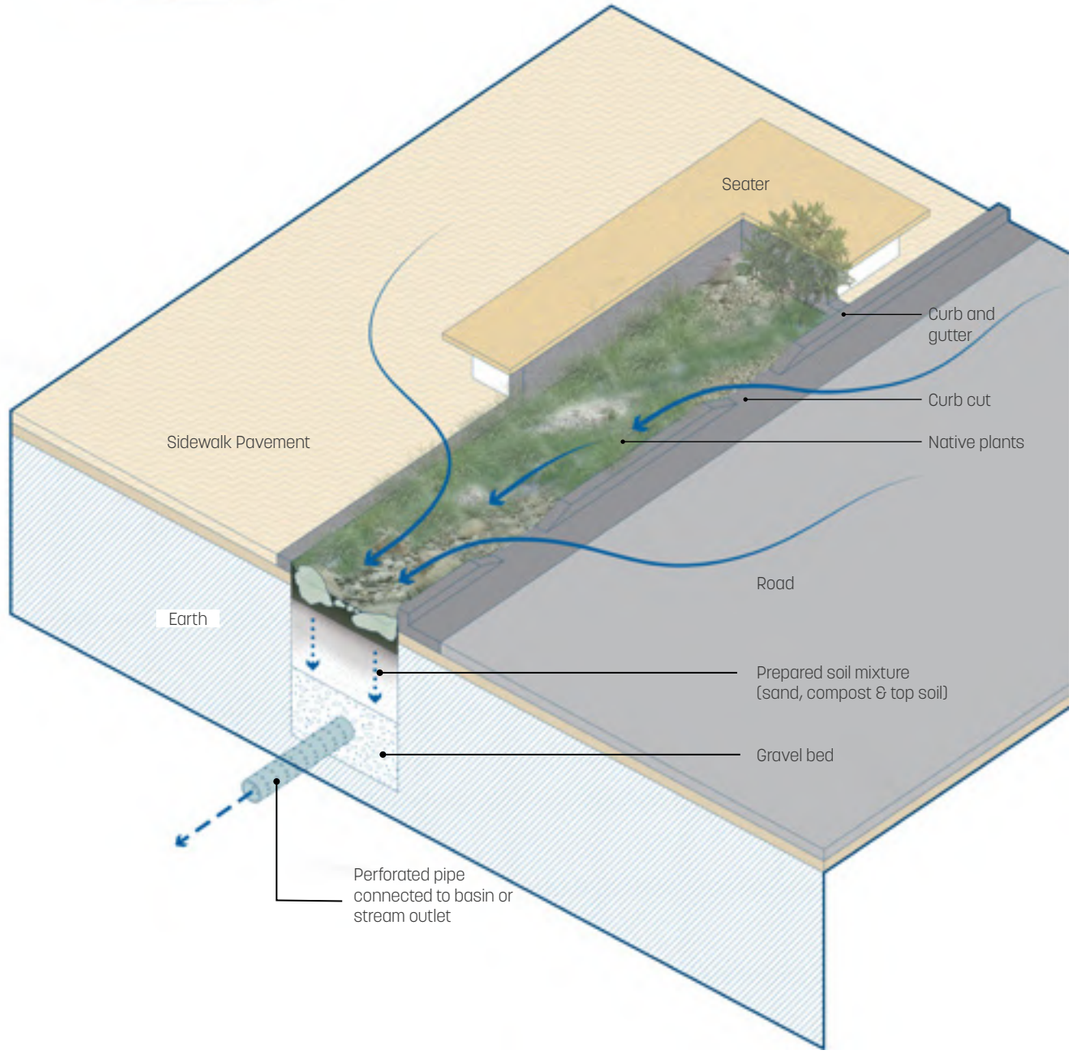
GOVT. OF TAMIL NADU
Public Works Dept.

Civil Society



SITES FOR CONSIDERATION:
On sidewalks with adequate width for pedestrians





S.2 SPONGE STREETS: Tree Trenches

Tree Trenches is a system of tree pits that are interconnected by a shared infiltration structure. Tree pits allow individual trees to grow in a healthy manner within constrained urban areas such as sidewalks. Planting a single tree creates multiple benefits for urban areas including purifying the air, reducing the heat island effect, creating wildlife habitat, buffering wind and noise, and increasing property values. In terms of stormwater management, trees reduce runoff through the interception of rainfall and evapotranspiration.

Tree trenches are an advanced tree pit system created by digging a trench along the sidewalk, lining it with permeable geotextile materials, filling it with stone or gravel, and finally bringing in the soil and the tree. A special stormwater inlet brings runoff flows into the tree trench where water is stored in the empty spaces between the stones. The tree roots absorb the water while it slowly infiltrates through the bottom. During extreme flood events, a bypass system leads runoff directly into the existing stormwater network.

PERFORMATIVE ABILITY

- Highly Effective in All Conditions
- Moderately / Conditionally Effective
- Not Effective / Not Applicable

DELAY

STORE

RELEASE

FILTER

SUITABILITY FACTORS

Minimum Water Table Depth: 1.2m

Maximum Slope (in %): 15%

Suitable Soil Type: Made Soil, A, B

KEY STAKEHOLDERS

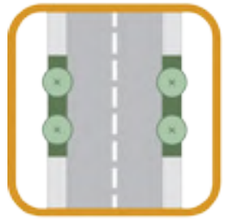
GREATER CHENNAI CORP.
Roads Department
Storm Water Drain Dept.
Parks Department

GOVT. OF TAMIL NADU
Public Works Dept.

FOR PRIVATE ROADS
Public / Private
Developer
Land Owner

CONSULTANTS
Civil Engineers
Landscape Architects

Civil Society



SITES FOR CONSIDERATION:
On sidewalks with adequate width for pedestrians

For DETAIL SECTION Refer to PART 4: SPONGE DEMONSTRATION, Short-term Projects, 18th Cross St. Section

S.3 SPONGE STREETS: Curb Bulbouts

Curb Bulbouts are a design variation of raingardens or bioretention gardens that extend green infrastructure capacities onto the roadways. While they are functionally similar to Sidewalk Planters, Curb Bulbouts can be built in places where the sidewalk itself is too constrained and lanes or parking spaces from the roadway can be utilized to construct a raingarden. They are particularly effective within roadway intersections where Curb Bulbouts can not only help in the management of stormwater but also improve the safety and experience of pedestrians.

Curb Bulbouts can be strategically implemented as a traffic calming device in the middle of a roadway and intersections. By extending onto a lane, the design deliberately slows down traffic in areas of high pedestrian activity while reducing the crosswalk distance. When Sponge Streets are built using one or more components, the city is more resilient to flood events while permanently improving the experience of streetscapes for pedestrians, cyclists, as well as drivers.

PERFORMATIVE ABILITY

- Highly Effective in All Conditions
- Moderately / Conditionally Effective
- Not Effective / Not Applicable

- DELAY
- STORE
- RELEASE
- FILTER

SUITABILITY FACTORS

Minimum Water Table Depth: 1.2m

Maximum Slope (in %): 4%

Suitable Soil Type: Made Soil

IMPLEMENTING STAKEHOLDERS

GREATER CHENNAI CORP.
Roads Department
Storm Water Drain Dept.

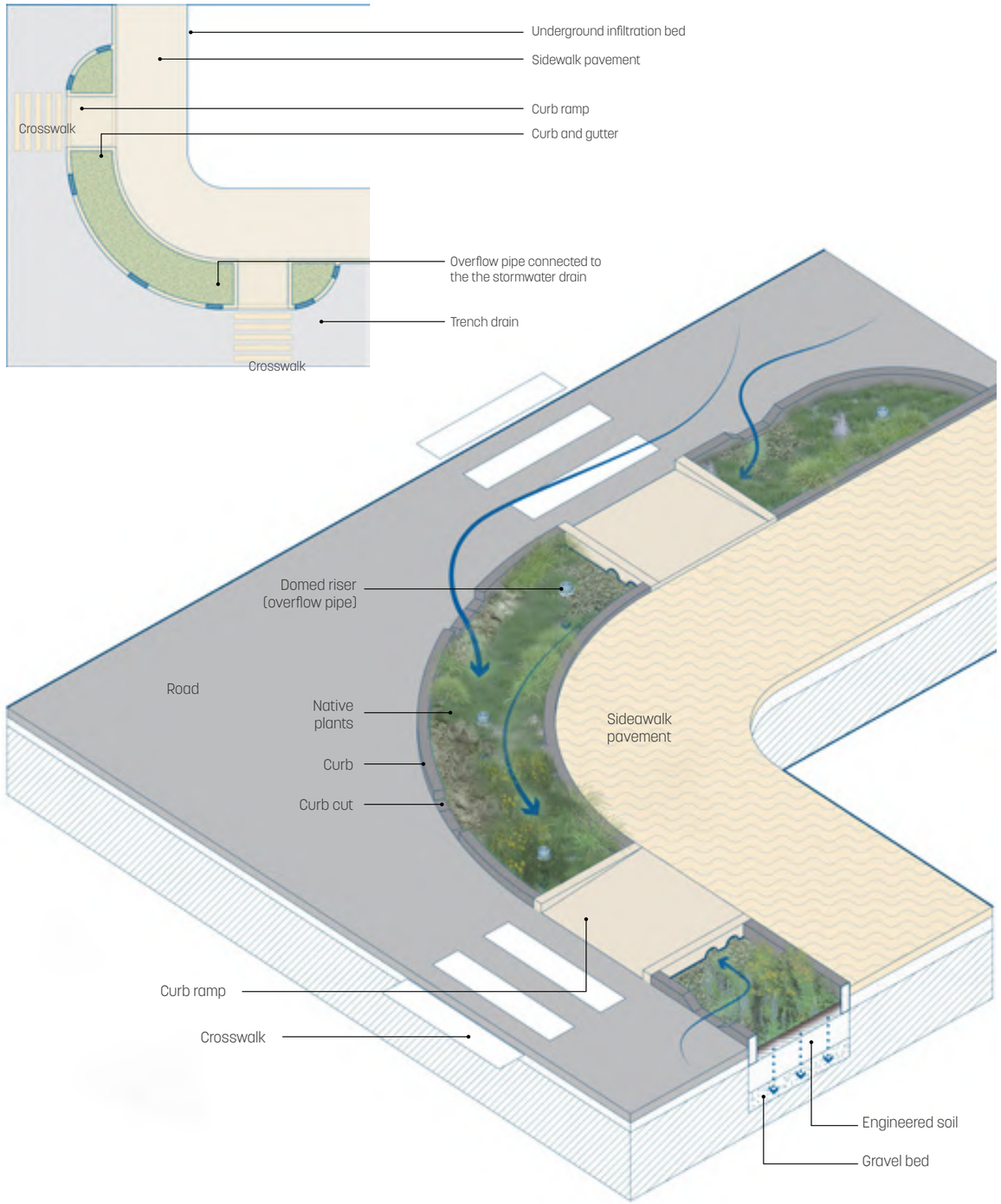
FOR PRIVATE ROADS
Public / Private
Developer
Land Owner

CONSULTANTS
Civil Engineers
Landscape Architects

GOVT. OF TAMIL NADU
Public Works Dept.

Civil Society

SITES FOR CONSIDERATION:
Into the street or intersection asphalt from sidewalk curb



SPONGE STREETS:
Notes on Implementation & Suitability

For all Sponge Street interventions, their respective capacities to handle stormwater runoff should be based on the contributing drainage area and the hydrologic group of the in-situ soil. Runoff reductions will be higher (upto 20%) for USDA soil categories of A and B and upto 10% for soil categories C and D. In most urban conditions, the soil within Sponge Street systems have to be engineered to meet the infiltration potential requirements. The layout of Sponge Street systems should ensure that the contributing drainage areas into the inlet points are evenly distributed. Sponge Street systems should be designed to handle 10 year flood events.

Water flow path along Bioswale channels should be designed to maximize the time water spends in the swale.

Sidewalk planters or raingardens require a 0.75m - 1.2m deep planting soil bed, a surface mulch layer, and a 0.3m deep surface ponding area where the ponding area is calculated based on the size and perviousness of the contributing drainage area.

Treepits can meet local drainage if the landscape infrastructure planning considers the storage capacity of the soil voids in the cavity created for the root ball of the tree and the ponding area. The infiltratioin of the in-situ or engineered soil must be a minimum of 50mm per hour.

The suitability matrix and key stakeholders diagram below suggest ideal sites and the network of institutional and financial collaborations needed to realize Sponge Streets.

Key Stakeholders

For Planning Regulations and Design Guidelines

Government of Tamil Nadu · Metro. Dev. Authority · Greater Chennai Corporation · Consultants

For Financing

GoTN - State govt. scheme · GCC - Budget + Discretionary · Public / Private Developer · Corporate / Civic Donors · Value Capture Mechanisms

For Implementation

GoTN - Public Works · Storm water + Roads + Parks · Land Owner · Public / Private Developer · Civil Society

For Maintenance

Storm water + Roads + Parks · Land Owner / Tenant · Public / Private Developer · Civil Society

S.1 BIOSWALE CHANNELS

S.2 SIDEWALK PLANTERS / TREE TRENCHES

S.3 CURB BULBOUTS

SPONGE STREETS SUITABILITY

- Highly Suitable / No Restrictions
- Suitable with Conditions / Modifications
- Not Suitable / Not Applicable

Sponge Street Type

Sponge Street Type		Suitable Locations: On Medians (> 2M)	On Medians (< 2M)	On Sidewalk (> 3.5M)	On Sidewalk (2.5 - 3.5M)	On Streets (> 5.5M)	Shared Streets (5M+ R.O.W)	Physical Limitations: Minimum Water Table Depth	Maximum Slope (in %)	Suitable Soil Type	Other Factors: Difficulty of Maintenance	Community Acceptance	Cost Relative to Drainage Area
BIOSWALE CHANNELS	S.1	◉	◉	○	○	◎	◎	0.6m	4%	Made Soil	Low	Med	Med
SIDEWALK PLANTERS	S.2	○	○	◉	◉	○	◉	1.2m	15%	Made Soil	Med	High	Med
TREE TRENCHES	S.2	◉	○	◉	○	○	○	1.2m	15%	Made Soil, A, B	High	High	Med
CURB BULBOUTS	S.3	○	○	○	○	◉	◉	1.2m	4%	Made Soil	Med	Med	Med

P.1 SPONGE OPEN SPACES: Constructed Ponds

Constructed Ponds are an effective way to reduce runoff volumes and improve storage capacities within urban neighbourhoods while dramatically improving the public realm. Constructed Ponds can have varying design variants and demand fairly large open spaces to become an infrastructural amenity as well as a public space.

Constructed Ponds, also called Stormwater Detention Ponds, can be designed to have water pooled permanently, for extended periods of time after a rain event, or temporarily for the extents of a single storm event. Detention ponds by definition do not allow infiltration. However, if soil conditions allow for it and runoff pollution is adequately treated within the pond design, they may fulfill the function of Release as well. Constructed Ponds can offer habitat benefits if the design encourages the use of native wetland plants and strategic ponding during rain and drought cycles.

PERFORMATIVE ABILITY

- Highly Effective in All Conditions
- Moderately / Conditionally Effective
- Not Effective / Not Applicable

- DELAY
- STORE
- RELEASE
- FILTER

SUITABILITY FACTORS

Minimum Water Table Depth: No Limits

Maximum Slope (in %): No Limits

Suitable Soil Type: A,B,C,D

KEY STAKEHOLDERS

GREATER CHENNAI CORP.
Parks Department
Storm Water Drain Dept.

GOVT. OF TAMIL NADU
CRRT
Public Works Dept..

CONSULTANTS
Landscape Architects
Civil Engineers
Ecologist

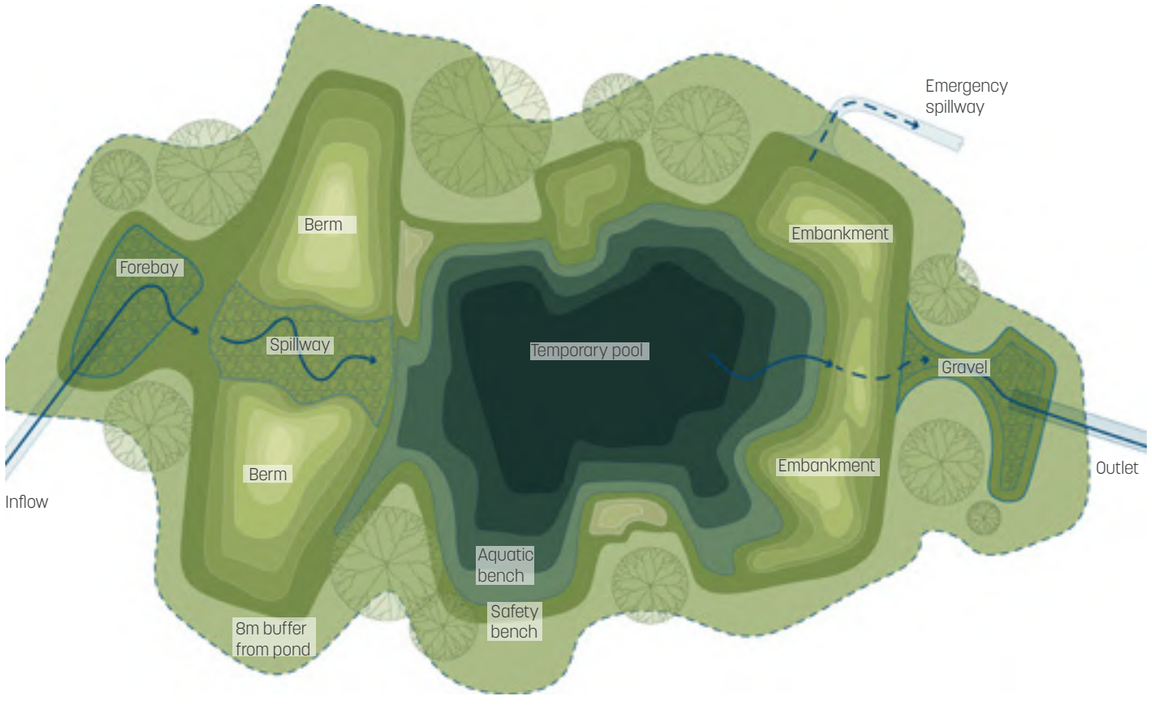
Land Owner / Tenant

Public / Private Developer

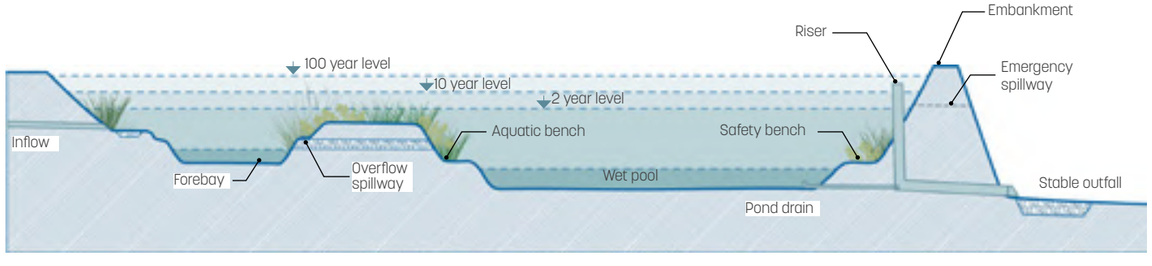
Civil Society

SITES FOR CONSIDERATION:
Large open spaces, degraded water bodies

Schematic Plan
(Not drawn to scale)



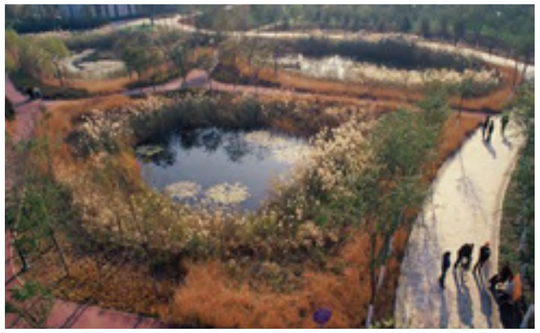
Schematic Section
(Not drawn to scale)



P.1 SPONGE OPEN SPACES: Constructed Wetlands

Constructed Wetlands replicate the hydrological and ecological functions of wetlands within an urban environment. They are primarily designed as a shallow, submersible areas that can detain and treat stormwater runoff. However, well designed Constructed Wetlands can become true assets for neighbourhoods and the city at large if they begin to offer some of the ecosystem services found in natural wetlands including water filtration.

Unlike Constructed Ponds, Constructed Wetlands should be able to withstand a thirty day drought at summer evaporation rates without completely drawing down. As such, most Constructed Wetlands will retain water while allowing minimal or slow water infiltration. The design of Constructed Wetlands should support the growth of wetland plant species and circulate water in ways that prevent stagnant water. This will prevent the breeding of species like mosquitos and lead to the creation of healthy habitats for native species within the urban fabric.



PERFORMATIVE ABILITY

- Highly Effective in All Conditions
- Moderately / Conditionally Effective
- Not Effective / Not Applicable

- DELAY
- STORE
- RELEASE
- FILTER

SUITABILITY FACTORS

Minimum Water Table Depth: No Limits

Maximum Slope (in %): No Limits

Suitable Soil Type: A,B

KEY STAKEHOLDERS

GREATER CHENNAI CORP.
Parks Department
Storm Water Drain Dept.

GOVT. OF TAMIL NADU
CRRT
Public Works Dept..

CONSULTANTS
Landscape Architects
Civil Engineers
Ecologist

Land Owner / Tenant

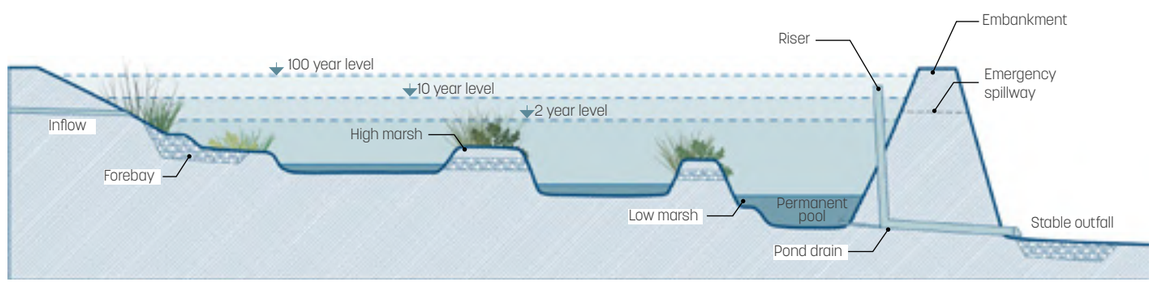
Public / Private Developer

Civil Society

SITES FOR CONSIDERATION:
Large open spaces, degraded wetlands

Schematic Plan
(Not drawn to scale)

Schematic Section
(Not drawn to scale)



P.2 SPONGE OPEN SPACES: Bioinfiltration Basins

Bioinfiltration Basins or Raingardens function as bioretention gardens described in S.2 Sidewalk Planters with specific components including inflow design, pre-treatment, ponding area, overflow, filter/soil media, and underdrain. However, Bioinfiltration Basins differ from Bioretention Gardens or Detention Ponds in that their main function is to encourage infilitration.

As such, Bioinfiltration Basins use vegetation and topography to delay and detain water and their sub-surface design encourages slow release into the aquifer. The Basin should be able to fully dewater total volume of runoff within 48 hours of a storm event. As such, the maximum contributing drainage area for Bioinfiltration Basins should typically be less than 5 acres.

Bioinfiltration Basins can only be sited above soils with an infiltration rate of greater than 13 mm/hr and where the bottom of the system is at least 1.2m away from the seasonal water table height. Bioinfiltration Basins should have the capacity to remove hydrocarbons, trace meters, and other roadside toxicants from at least 25% of the runoff volume. In areas with infiltration of more than 50 mm/hr, additional sedimentation basins or other upgrades should be incorporated to filter at least 50% of the runoff volume. Bioinfiltration Basins cannot be designed to filter high levels of toxicity and pollution. As such, they cannot be sited near pollutant hotspots and drinking water wells.

PERFORMATIVE FACTORS

- Highly Effective in All Conditions
- Moderately / Conditionally Effective
- Not Effective / Not Applicable

DELAY

STORE

RELEASE

FILTER

SUITABILITY FACTORS

Minimum Water Table Depth: 0.5m

Maximum Slope (in %): 15%

Suitable Soil Type: A, B

KEY STAKEHOLDERS

GREATER CHENNAI CORP.
Parks Department
Storm Water Drain Dept.

GOVT. OF TAMIL NADU
CRRT
Public Works Dept..

CONSULTANTS
Landscape Architects
Civil Engineers
Ecologist

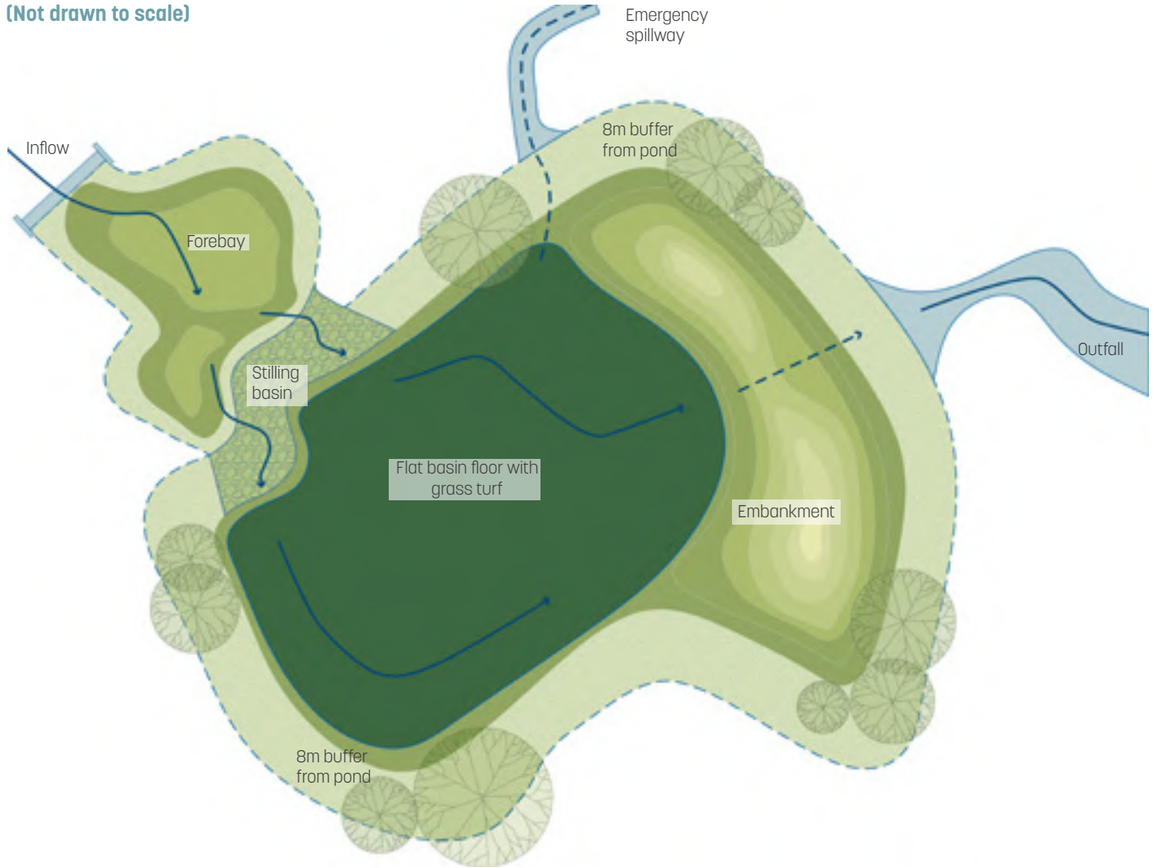
Land Owner / Tenant

Public / Private Developer

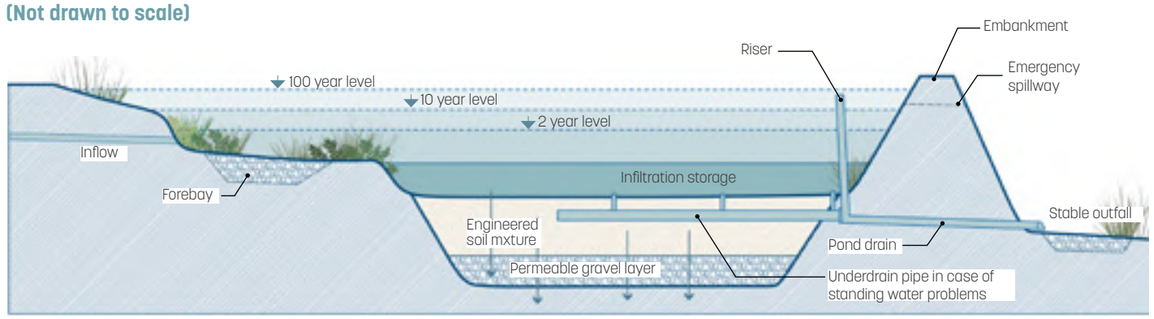
Civil Society

SITES FOR CONSIDERATION:
Small and large open spaces with infiltration potential

Schematic Plan
(Not drawn to scale)



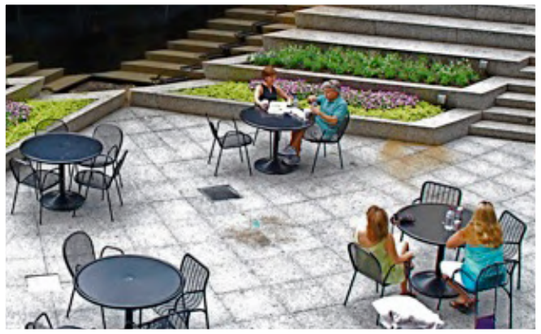
Schematic Section
(Not drawn to scale)



P.3 SPONGE OPEN SPACES: Sunken Plaza

Sunken Plazas are counterparts to the B.3. Detention Pond in highly public areas. They are site-specific designed architectural/landscape features with hardscape and softscape elements and elaborate drainage systems. They are contemporary expressions of the temple tank in that they form a depression within the urban fabric in order to detain runoff during a storm event while creating a compelling public space during drier times.

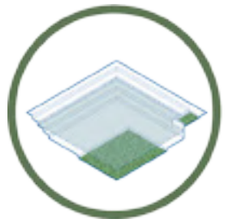
Sunkens Plazas fulfill the performative functions of storing water during cloudbursts and slowly releasing the water into the stormwater system after the rains or into the aquifer if feasible. Sunken Plazas can creatively express the circulation of water to celebrate rain in playful ways and make water a prominent part of the public realm.



PERFORMATIVE FACTORS

- Highly Effective in All Conditions
- Moderately / Conditionally Effective
- Not Effective / Not Applicable

- DELAY
- STORE
- RELEASE
- FILTER



SITES FOR CONSIDERATION:
In highly urban open spaces or institutional open spaces

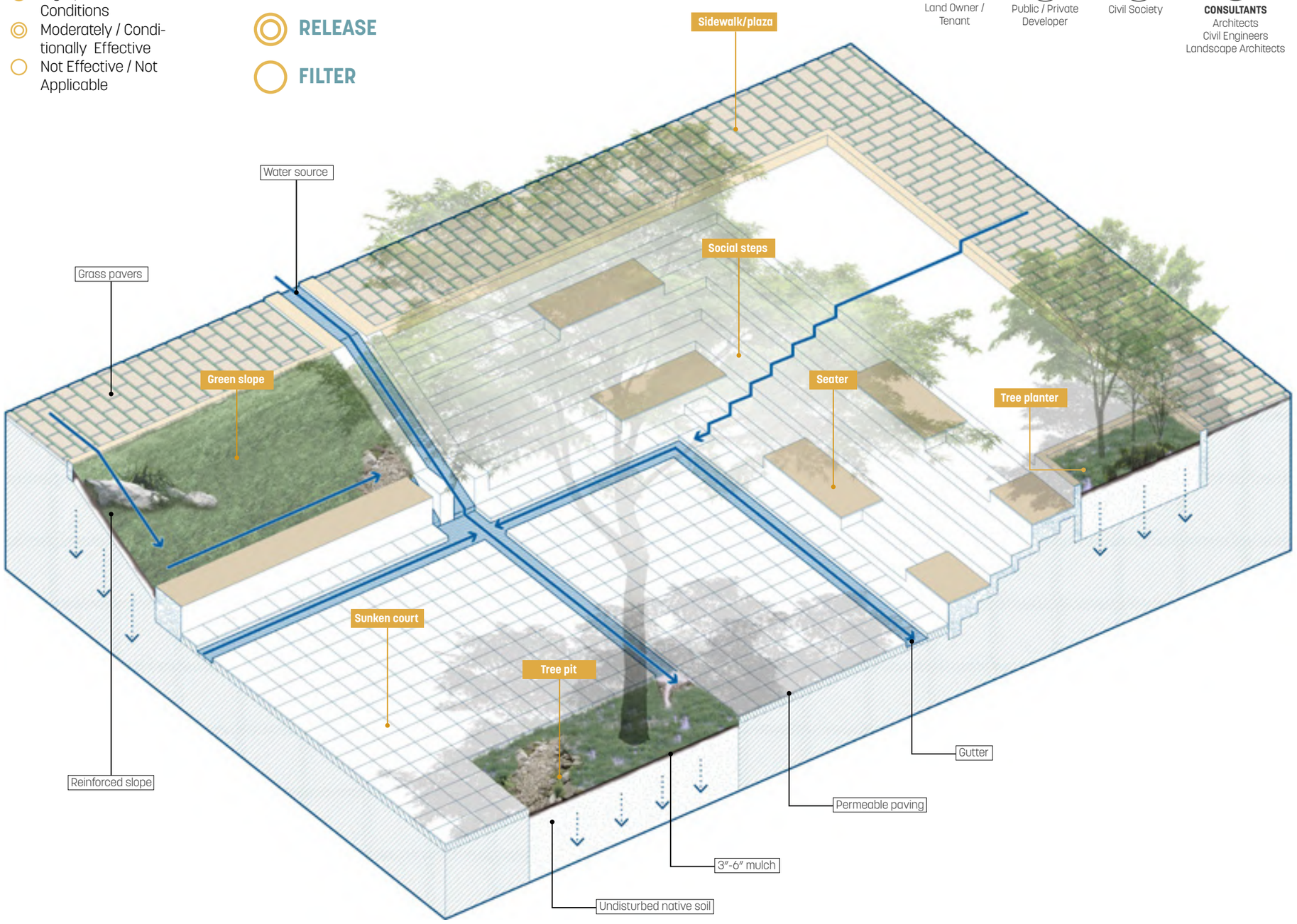
KEY STAKEHOLDERS

Land Owner / Tenant

Public / Private Developer

Civil Society

CONSULTANTS
Architects
Civil Engineers
Landscape Architects



SPONGE OPEN SPACES:
Notes on Implementation & Suitability

Sponge Open Spaces are the most compelling landscape infrastructure typologies in terms of their impact on improving the public realm and the habitat potential of the city. Existing open spaces can be converted into Sponge Open Spaces with strategic regrading efforts, planting designs, and co-ordination with the existing stormwater network. The resulting transformation can create enormous political and community goodwill while improving the resilience of urban neighbourhoods. As such, Sponge Open Spaces should be prioritized as pilot projects when possible.

Siting Sponge Open Spaces and determining the typology requires detailed topographic understanding and geotechnical surveys. Soils with high infiltration rates are suitable for Bioinfiltration Basins while other typologies could be constructed on any soil type.

Constructed Ponds, Wetlands, and Bioinfiltration Basins should maximize the complexity of flowpaths from inlet points to outlet points. The creation of topographic and microtopographic variation is important to slow down water during cloudbursts and create diverse niches for different plant species. The planting design should reflect the hydrologic zones of the constructed design with soil stabilizing and salt tolerant species around the entry points, drought tolerant species on the upper (seasonally dry) zones, and flood tolerant species that can tolerate extended or permanent pooling in the lower areas. Since the spatial and planting design of all Sponge Open Spaces play a critical role in its importance as a public space or ecological amenity, their design requires the supervsion by qualified professionals. Implementation budgets for these projects should account for the role of design in their success as multi-functional infrastructures

Key Stakeholders

For Planning Regulations and Design Guidelines

Government of Tamil Nadu · Metro. Dev. Authority · Greater Chennai Corporation · Consultants

For Financing

GoTN - State govt. scheme · GCC - Budget + Discretionary · Public / Private Developer · Corporate / Civic Donors · Value Capture Mechanisms

For Implementation

GoTN - Public Works + CRRT · GCC - Storm water + Parks · Land Owner / Tenant · Public / Private Developer · Civil Society

For Maintenance

GCC - Storm water + Parks · Land Owner / Tenant · Public / Private Developer · Civil Society

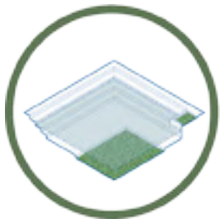
P.1

CONSTRUCTED PONDS / WETLANDS

P.2

BIOINFILTRATION BASINS / RAINGARDENS

P.3



SUNKEN PLAZAS

SPONGE OPEN SPACES SUITABILITY

- Highly Suitable / No Restrictions
- Suitable with Conditions / Modifications
- Not Suitable / Not Applicable

Sponge Open Spaces Type

Sponge Open Spaces Type		Suitable Locations: In Large Open Spaces (10 acres+)	In Small Open Spaces / Parks	In Institutional Public Spaces	In Private Building Courtyards	Physical Limitations: Minimum Water Table Depth	Maximum Slope (in %)	Suitable Soil Type	Minimum Drainage Area (acres)	Other Factors: Difficulty of Maintenance	Community Acceptance	Cost Relative to Drainage Area	Quality of Habitat
CONSTRUCTED PONDS	P.1	◉	◉	○	○	No Limits	No Limits	A,B, C,D	10 - 25	Low	High	Low	High
CONSTRUCTED WETLANDS	P.1	◉	◎	○	○	No Limits	No Limits	A,B	25	Med	High	Med	Very High
BIOINFILTRATION BASINS / RAINGARDENS	P.2	◉	◉	◎	◎	0.5m	15%	A,B	No min. 10 max	Med	Med	Med	Med
SUNKEN PLAZAS	P.3	◎	○	◉	◎	Depth of plaza	No Limits	No Soil	Varies	Low	High	High	Low

B.1 SPONGE BUILDINGS: Rainwater Harvesting

Rainwater harvesting is collecting the run-off from a structure or other impervious surface in order to store it for later use. Traditionally, this involves harvesting the rain from a roof. The rain will collect in gutters that channel the water into downspouts and then into some sort of storage vessel. Owing to the efforts of Mr. Raghavan of 'Rain Centre,' the biggest breakthrough came in 2002, when the city passed legislation that made it mandatory for every building in the city to harvest rainwater. Although the practice is in place for over two decades, it is seen as a mere legal obligation with shortcomings pertaining to its efficiency. The proposed RWH typologies improvise over the existing system to optimize its efficiency and improve spatial quality. The three typologies in the section vary in scale and cost, giving implementing land owners or tenants more flexibility. The diagrams below depict how rainwater collection systems can be as simple as collecting rain in a rain barrel or as elaborate as harvesting rainwater into underground storage units to supply for the entire building demand. The interventions also illustrate how the systems can be designed effectively to add value to the public realm.

SITES FOR CONSIDERATION:
In all buildings with institutional buildings taking on projects of higher costs and complexity

PERFORMATIVE FACTORS

- Highly Effective in All Conditions
- Moderately / Conditionally Effective
- Not Effective / Not Applicable

- DELAY
- STORE
- RELEASE
- FILTER

KEY STAKEHOLDERS

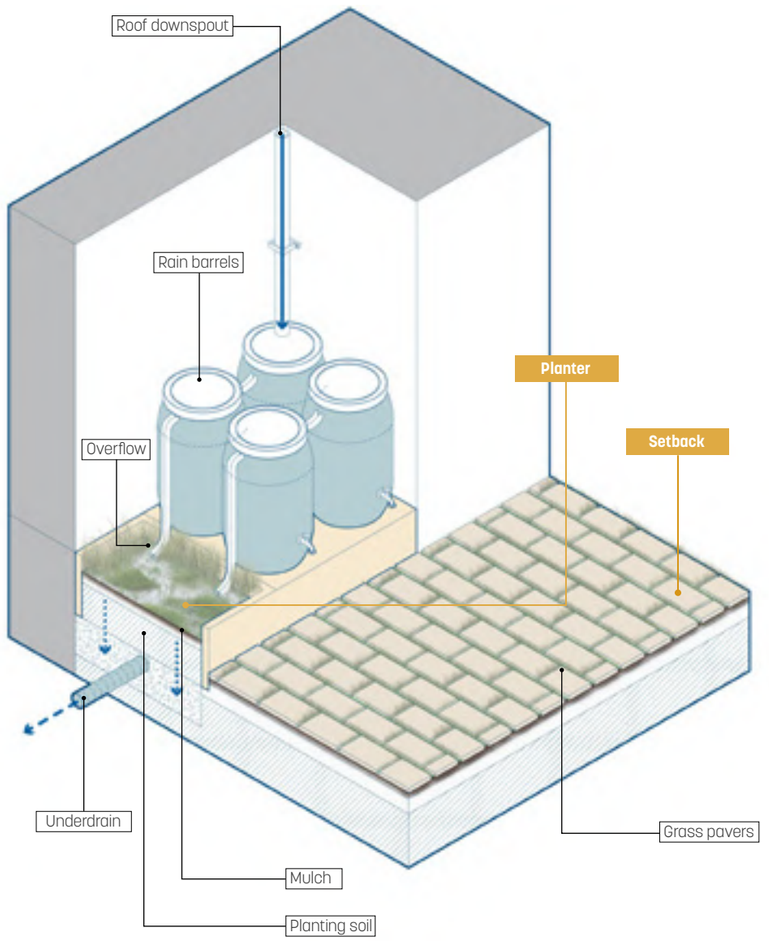
Property owner / tenant

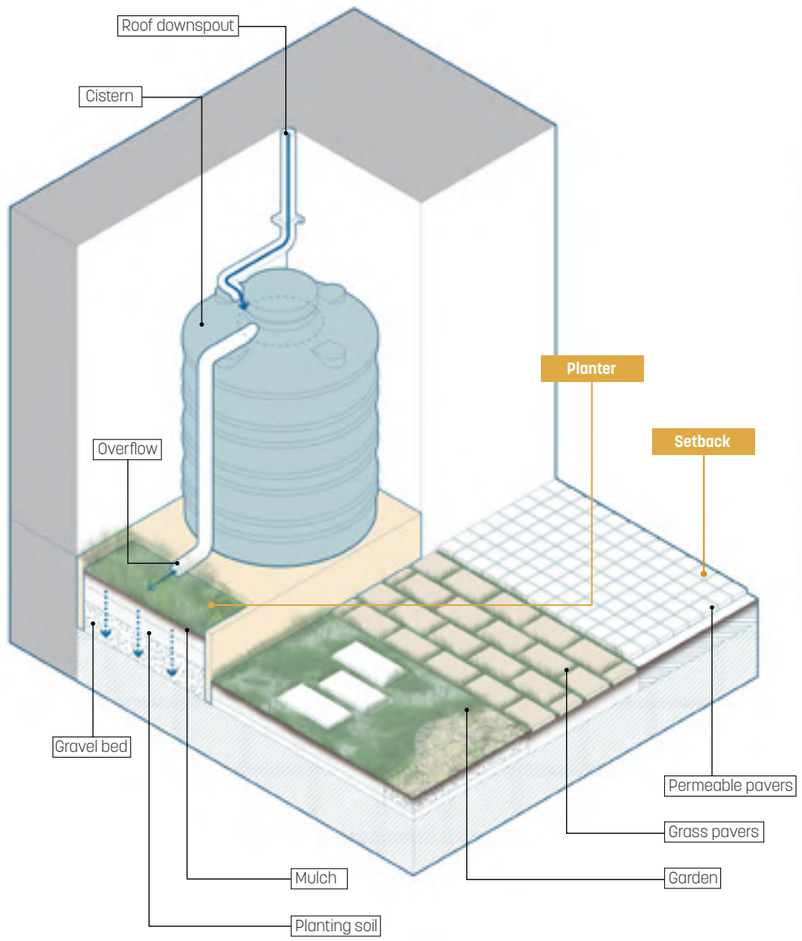
Public / Private Developer

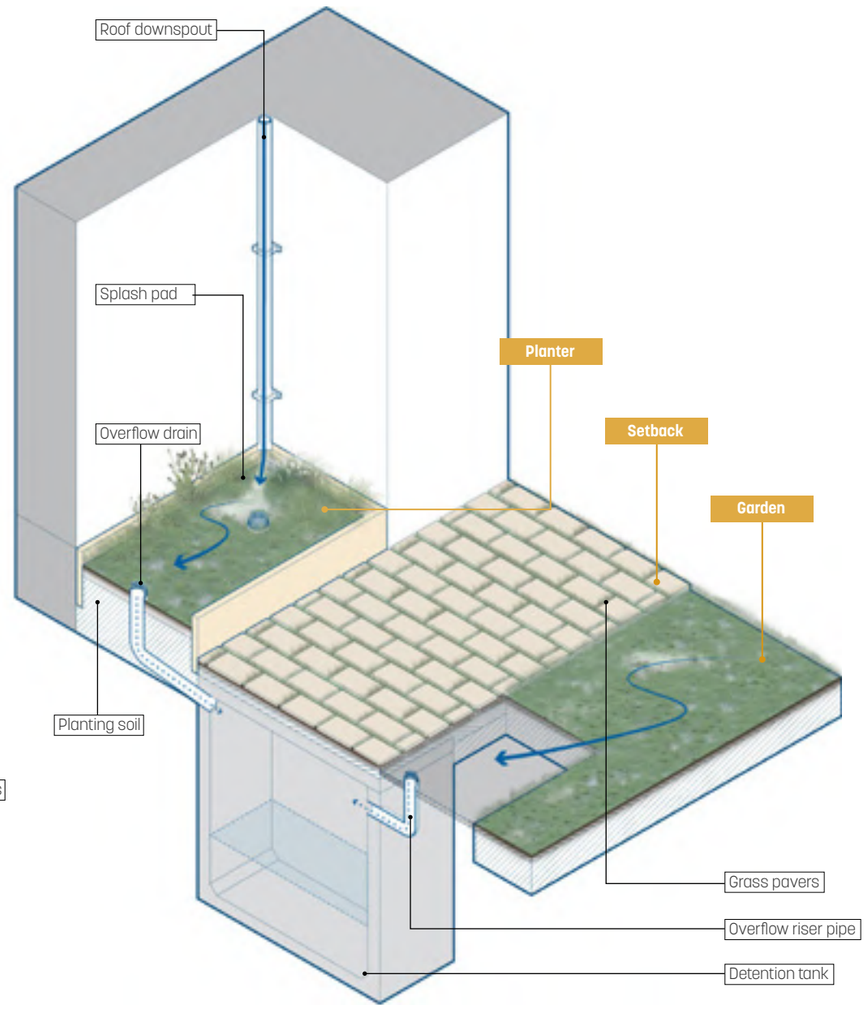
Civil Society

COST FACTORS

Rain Barrel	Open well to aquifer	Water Tank / Cistern	Underground Storage
₹	₹ ₹	₹ ₹	₹ ₹ ₹

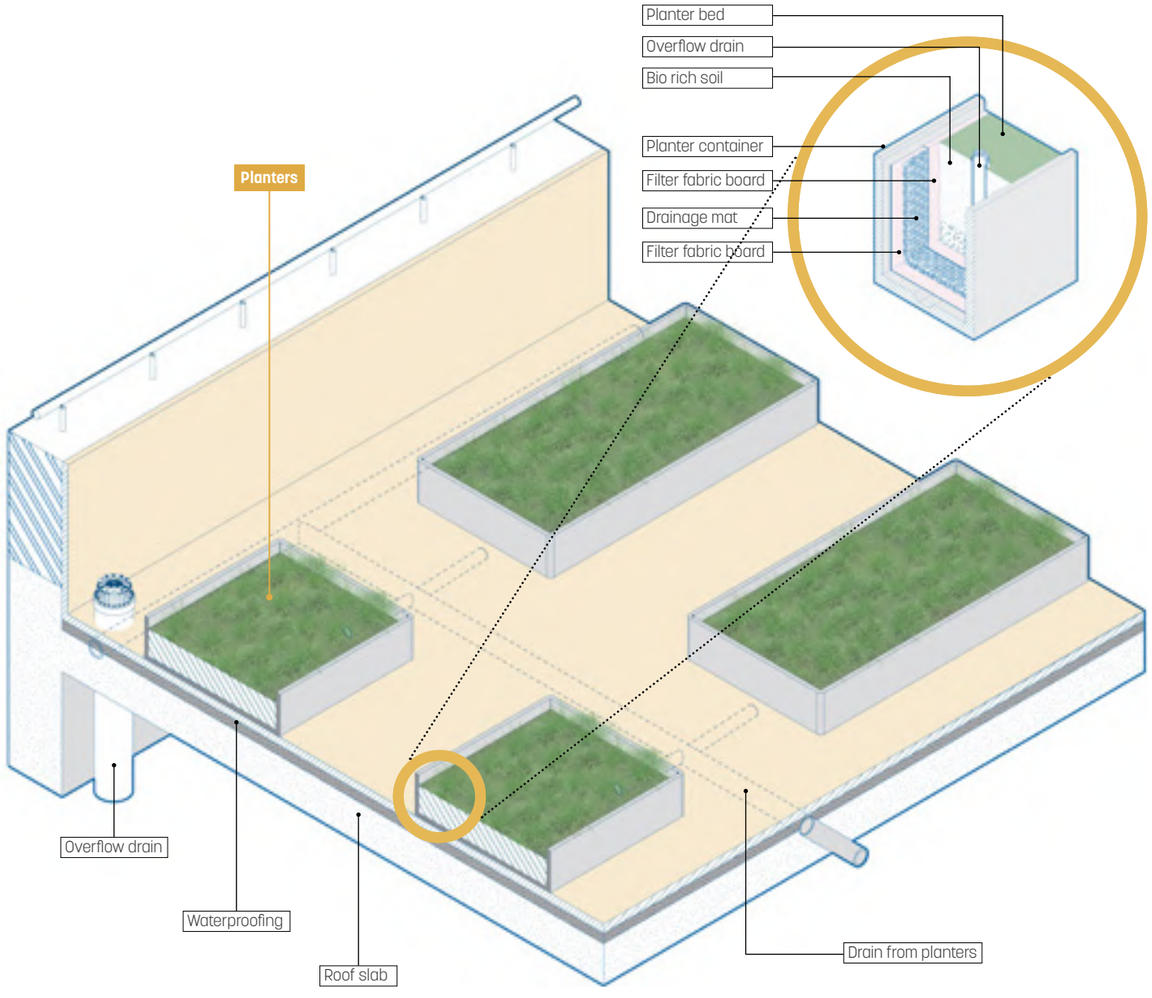






B.2 SPONGE BUILDINGS: Green Roofs

A green roof is a roof of a building that is partially or completely covered with vegetation and a growing medium, planted over a waterproofing membrane. The large surface area of the system can absorb the rainwater, hold them before releasing the excess into the aquifer through down spouts. Green roofs serve several purposes for a building, such as absorbing rainwater, providing insulation, creating a habitat for wildlife, mitigate the heat island effect etc. Below are depictions of the two types of green roof systems. 'The Container gardens' (Roof garden) on the left side is a less complex system on roofs, where plants are maintained in pots/trays. The pots are connected to a drainage system that removes excess water through down spouts. The system is economically viable and can be easily be installed in Apartment towers. 'The Drainage Plate' system (Simple/Deep Green Roof) on the right side are under-drained with waffled plastic sheets called drainage plates. Water is retained within pockets on the upper sides of the plates while excess water flows through small holes and spills over the edges to be carried off the roof. A separation fabric over the top of the plates retains growing media while allowing water to drain freely. This system is well suited for large roof areas of institutional and corporate buildings.



SITES FOR CONSIDERATION:
In large, corporate, or institutional buildings with the structural capacity. Modified roof garden for residential

PERFORMATIVE FACTORS

- Highly Effective in All Conditions
- Moderately / Conditionally Effective
- Not Effective / Not Applicable

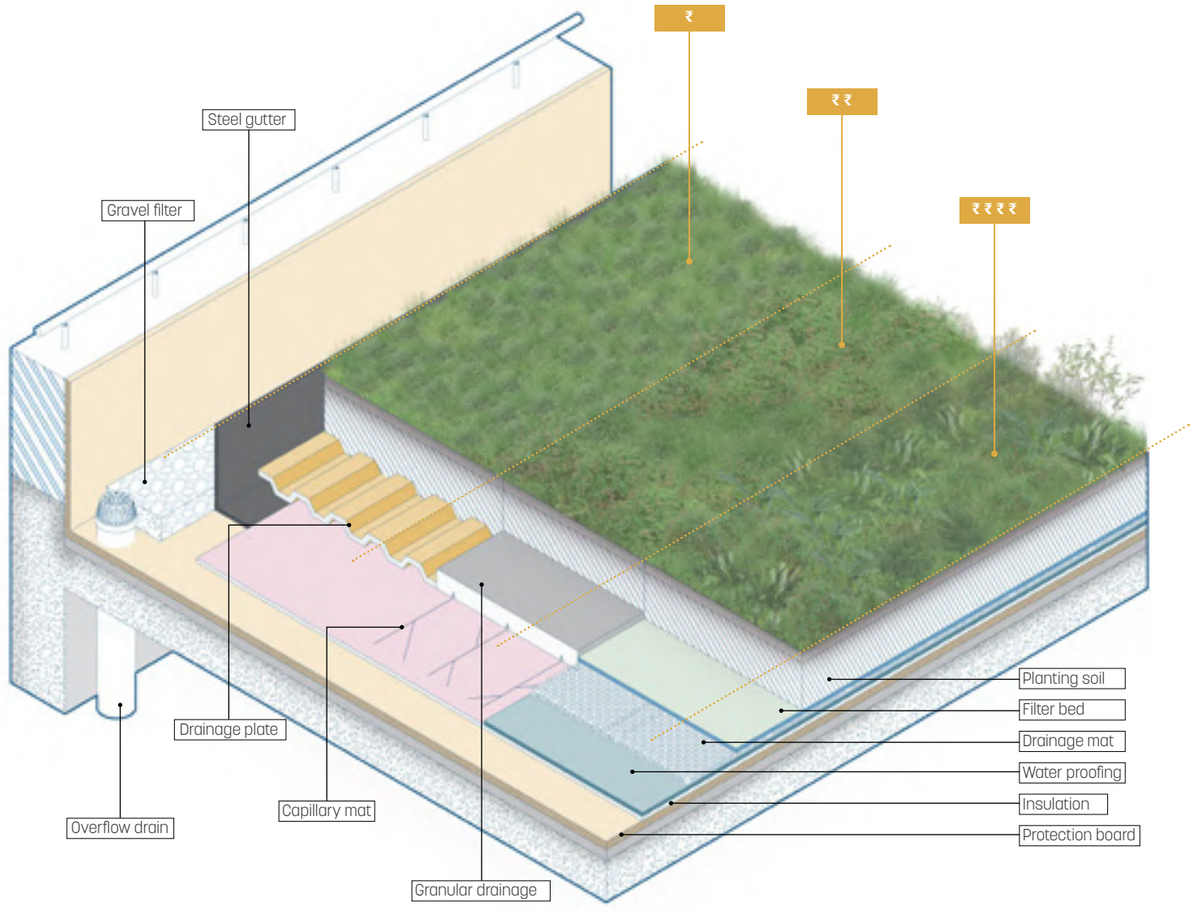
- DELAY
- STORE
- RELEASE
- FILTER

KEY STAKEHOLDERS

Property owner / tenant
Public / Private Developer
Civil Society
CONSULTANTS
Architects
Landscape Architects

COST FACTORS

Roof Garden	Simple Green Roof	Deep Green Roof
₹ ₹	₹ ₹ ₹ ₹	₹ ₹ ₹ ₹ ₹



B.3 SPONGE BUILDINGS: Detention Tanks

The detention tanks are meticulously articulated aesthetic landscapes for holding and storing rainwater. The system comprises of a sunken space that is integrated within the courtyards or the small open spaces of large buildings. The detention tanks act as holding ponds that retain the water for short periods of time before discharging them into an underground storage unit. The tanks are fed by a comprehensive drainage system that collects runoff from various parts of the building. On the right, is a depiction of how the entire system can be effectively designed as a composite landscape entity through the use of open gutters, that channelize the water into planter boxes and then finally into the storage unit underground. The design possibilities are endless and left to the choice of the implementing stakeholder. These resilient landscape infrastructures also serve the purpose semi-public spaces for small events, gatherings and social interactions within these buildings.

PERFORMATIVE FACTORS

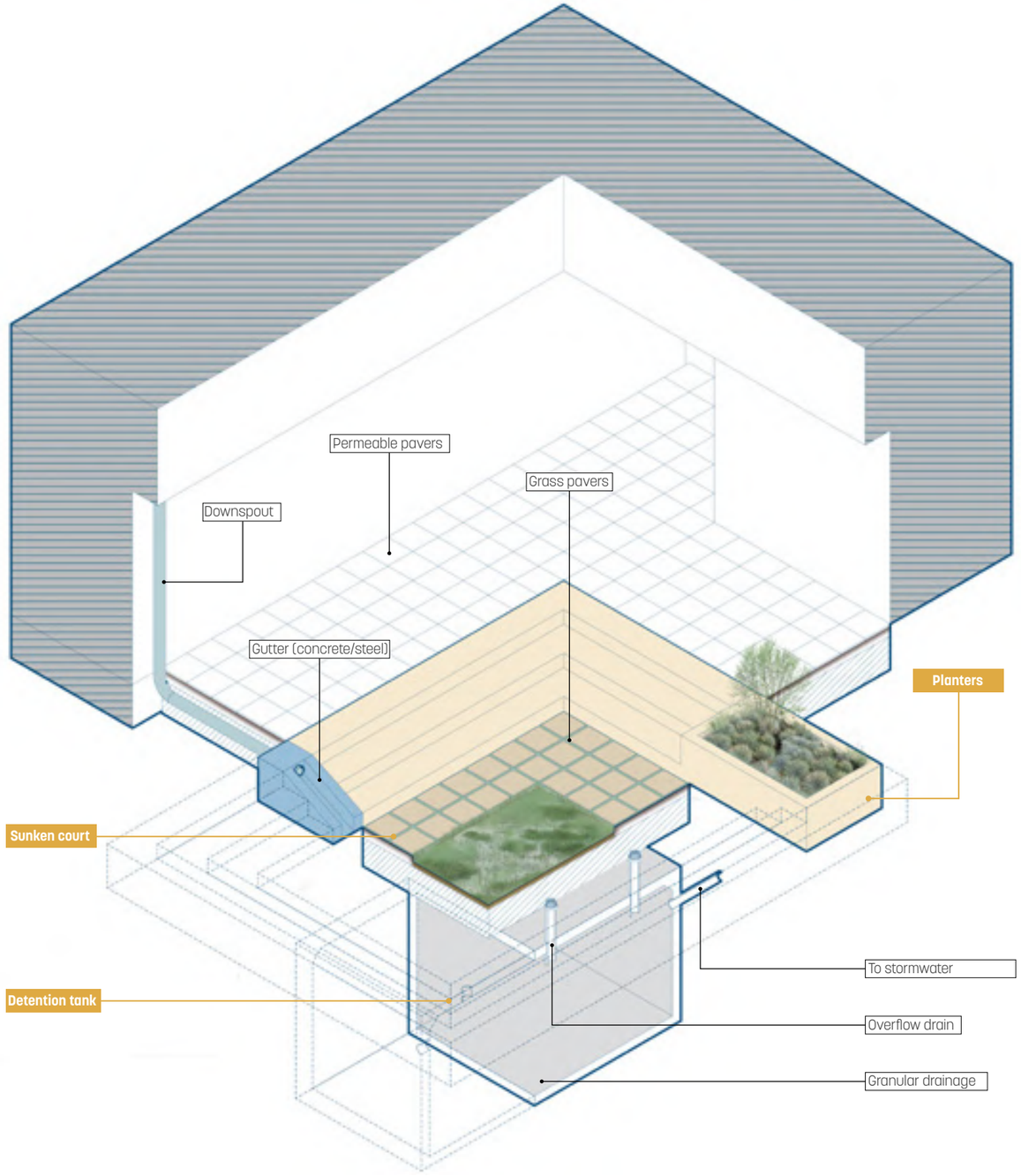
- Highly Effective in All Conditions
- Moderately / Conditionally Effective
- Not Effective / Not Applicable

- DELAY
- STORE
- RELEASE
- FILTER

KEY STAKEHOLDERS

- Property owner / tenant
- Public / Private Developer
- Civil Society
- **CONSULTANTS**
  Architects
  Landscape Architects

SITES FOR CONSIDERATION:
In small open spaces of residential and institutional buildings



SPONGE BUILDINGS:
Notes on Implementation & Suitability

The built form in an urban fabric can greatly contribute to the Sponge capacity; and the larger goal is to foster the sponge performance across all sections of the urban region with highest efficiency. Hence, Sponge Building typologies of varying scales, involving a wide spectrum of stakeholders and building types are proposed. The Sponge Building Infrastructures are factored on parameters including cost, structural considerations, efficiency etc, which will inform the implementing stakeholders in decision making based on their capacity. The RWH systems are the easiest to realize and hence they should be incorporated across all building types/use in the urban fabric. Green Roofs and Detention Tanks are more substantial investments, so the suitability matrix identifies large institutional and corporate buildings as suitable candidates for implementing them. The key stakeholder diagram below suggest the network of institutional and financial collaborations needed to realize the Sponge Buildings Infrastructures.

Key Stakeholders

For Planning Regulations and Design Guidelines

Government of Tamil Nadu · Metro. Dev. Authority · Greater Chennai Corporation · Chennai Metro Water · Consultants

For Financing

GoTN - State govt. scheme · GCC - Budget + Tax Credits · Public / Private Developer · Corporate / Civic Donors · Land Owner / Tenant

For Implementation

Land Owner / Tenant · Public / Private Developer · Civil Society

For Maintenance

Land Owner / Tenant · Public / Private Developer · Neighbourhood Community

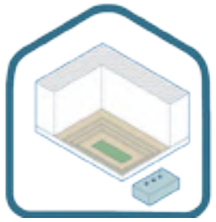
B.1

RAINWATER HARVESTING

B.2

GREEN ROOFS

B.3



DETENTION TANKS

SPONGE BUILDINGS SUITABILITY

- ◉ Highly Suitable / No Restrictions
- ◎ Suitable with Conditions / Modifications
- ○ Not Suitable / Not Applicable

Sponge Buildings Type

Sponge Buildings Type	Suitable Building Type/Use: Individual Residences	Residential Apartments	Commercial/Mixed Use	Public/Private Institutions	Design & Functional Considerations: Compatible/Required Additions	Structural Considerations	Other Factors: Installation Labour	Difficulty of Maintenance	Community Acceptance	Cost Relative to Drainage Area
RAINWATER HARVESTING FOR STORAGE B.1	◉	◉	◉	◉	Cisterns, Raingardens, Storage Tanks	Not Req	Med	Low	Med	Med
RAINWATER HARVESTING FOR INFILTRATION B.1	◉	◉	◉	◉	Downspout disconnection, Infiltration Wells	Not Req	Low	Med	Med	Low
GREEN ROOFS B.2	○	◎	◎	◉	Waterproofing, Downspout disconnection	Req	V. High	High	High	High
DETENTION TANKS B.3	◎	◉	◎	◉	Raingardens, Infiltration Wells, Storage Tanks	Not Req	High	Med	Med	Med

Suitability Matrix for Sponge Landscape Infrastructure Typologies

The Suitability Matrix summarizes the performative abilities and implementation considerations of all the Sponge Landscape Infrastructure typologies. This serves as a decision making tool for stakeholders to evaluate which Sponge Landscape Infrastructure is most appropriate or feasible.

The realization of Sponge Basins requires the strategic implementation of Sponge Streets, Sponge Open Spaces, and Sponge Buildings over time to form a network. Since the functionality and viability of each type mostly depend upon physical factors, a high-resolution and comprehensive dataset of the topography, depth to water table, and the region's soils classified by runoff potential among other land / land-use characteristics.

Performative Ability

- ◉ Highly Effective in All Conditions
- ◎ Moderately / Conditionally Effective
- ○ Not Effective / Not Applicable

	SPONGE STREETS				SPONGE OPEN SPACES				SPONGE BUILDINGS			
	On Medians or Sides	On Sidewalks		On Roads	In Large Open Spaces		In Small Open Spaces	In Urban Public Spaces	In all Buildings		On Large Buildings	In Residential Areas
	BIOSWALE CHANNELS	SIDEWALK PLANTERS	TREE TRENCHES	CURB BULBOUTS	CONSTRUCTED PONDS	CONSTRUCTED WETLANDS	BIOINFILTRATION BASINS/RAINGARDENS	SUNKEN PLAZAS	RAINWATER HARVESTING (RWH)	RWH FOR INFILTRATION	GREEN ROOFS	DETENTION TANKS
	S.1	S.2	S.2	S.3	P.1	P.1	P.2	P.3	B.1	B.1	B.2	B.3
DELAY	◉	◉	◉	◉	◉	◉	◉	◎	◎	◎	◉	◎
STORE	○	○	◎	○	◉	◉	○	◉	◉	◎	◎	◉
RELEASE	◎	◎	◎	◎	◎	◎	◉	◎	◉	◉	◎	◎
FILTER	◎	◎	◉	◎	◎	◉	◉	○	○	◎	◉	○
Other Considerations												
SOIL TYPE	Made	Made	Made	Made	A,B,C,D	A,B,C,D	A,B	No Soil	No Soil	A,B	Made	N/A
COST RELATIVE TO DRAINAGE AREA	Med	Med	Med	Med	Low	Med	Med	High	Med	Low	High	Med
DIFFICULTY OF MAINTENANCE	Low	Med	High	Med	Low	Med	Med	High	Low	Med	High	Med
COMMUNITY ACCEPTANCE	Med	High	High	Med	High	High	Med	High	Med	Med	High	Med
QUALITY OF HABITAT	Med	Low	Med	Low	High	V. High	Med	Low	N/A	N/A	Med	Low

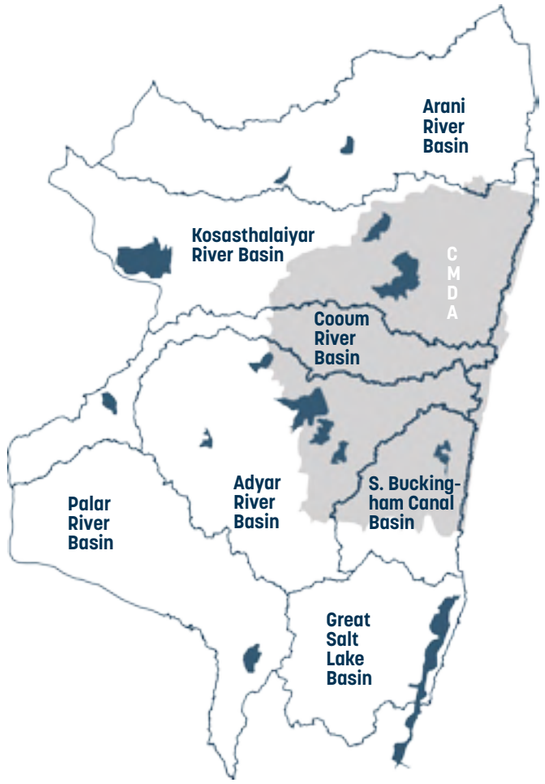
Planning for Sponge Landscape Infrastructure Network

Overview of planning scales, analysis foundations, and prioritization factors

The realization of Sponge Basins in Chennai firstly requires a regional development plan with a proactive conservation agenda to protect upstream Sponge Landscapes. At individual basin scales, a Sponge Network Framework can be drawn up by identifying Sponge Landscapes for protection and conservation and building upon a Sponge Landscape Infrastructure Potential Map. The production of this map requires an overlay of digitized datasets describing the topography, aquifer, soil, land cover. The creation of these datasets, if unavailable today, can be a worthy Smart City project. Based on this foundation, a Basin/Neighbourhood framework plan can be made. Ward Level and Local Level initiatives further draw up Implementation Plans. These plans should ideally prioritize projects based on concerns brought up by the community and respond to place-specific issues.

Scales of Planning and Implementation

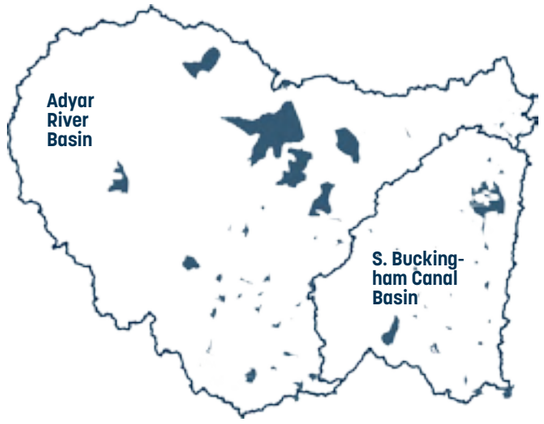
1. Regional Scale: Sponge Basin Development Plan



An Ecological Development Plan

As Chennai's rapid expansion threatens hundreds of water bodies, CMDA and the Govt. of Tamil Nadu should work on a regional Basin Management Plan that prioritizes the conservation of Sponge Landscapes within and upstream of the Chennai Metropolitan Area

2. Basin Scale: Sponge Network Framework

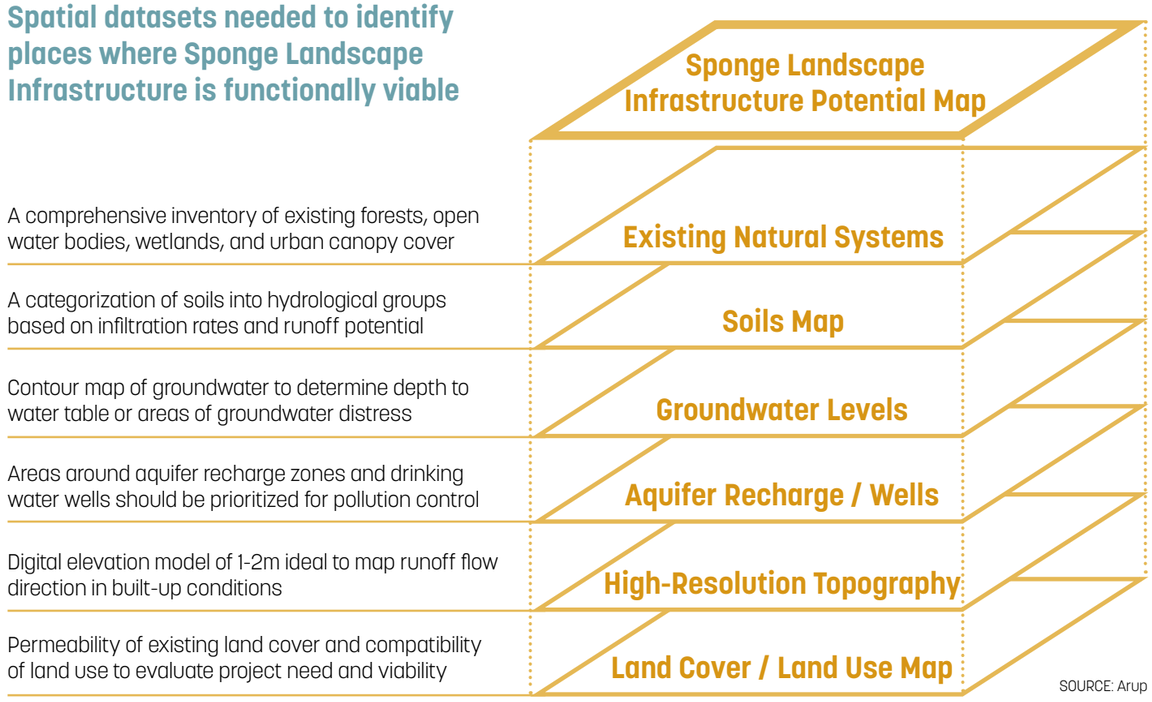


3. Ward Scale: Sponge Network Implementation Plan

4. Local Scale: Sponge Landscape Infrastructure Implementation, & Maintenance

Regional Scale: Sponge Landscape Infrastructure Potential

Spatial datasets needed to identify places where Sponge Landscape Infrastructure is functionally viable



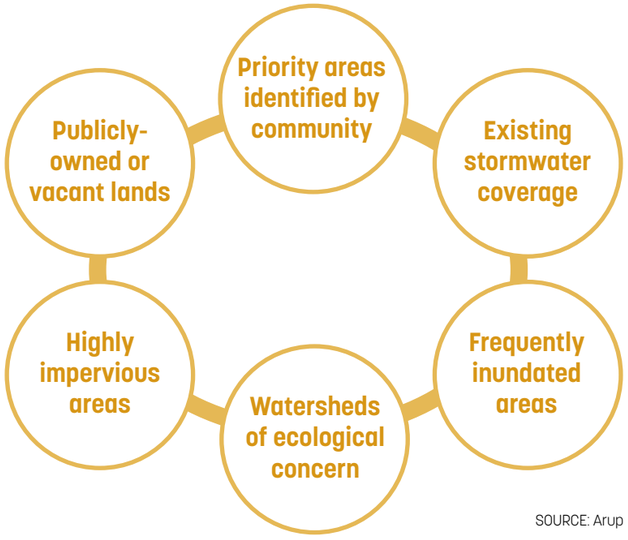
SOURCE: Arup

Basin, Ward, & Local Scale : Prioritizing Sponge Landscape Infrastructure Projects

Considering local inputs, environmental issues, and political ease to prioritize project

While a geospatial analysis can reveal potential sites for Sponge Landscape Infrastructure, detailed area-based plans and prioritizing projects for implementation requires a multi-disciplinary and multi-agency effort.

Public agencies need to work with local communities, urban planners, landscape architects, ecologists, hydrologists, and economists to create a holistic framework and implementation timeline. The full benefits of Sponge Landscape Infrastructure will only be realized over time by following a strategic plan. Pilot projects and order of projects can be prioritized by multiple socio-economic and physical factors.



SOURCE: Arup

Planning for Sponge Landscape Infrastructure Network

Case studies and Precedents

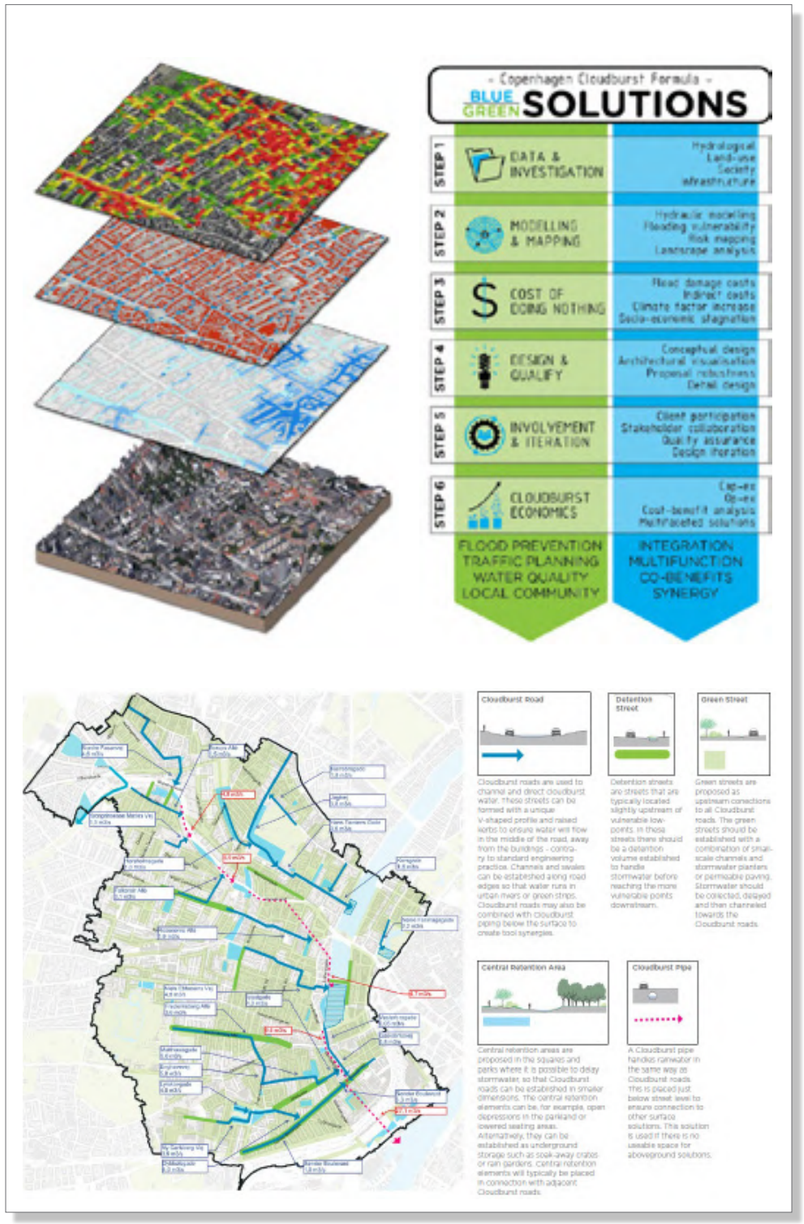
Green Infrastructure planning is a fairly recent paradigm shift away from the traditional gray infrastructure approach. Nevertheless, a large number of cities in the United States and Europe have already established robust guidelines for design and planning, implemented pilot projects, or built out comprehensive networks. The handbook referenced a number of manuals from different cities to create the Sponge Landscape Infrastructure Toolkit. As the chapter concludes with methods to begin infrastructure planning in Chennai, two case studies are highlighted below as excellent precedents. The projects from Copenhagen and New York demonstrate how the implementation of Sponge Landscape Networks depend upon a foundation of holistic analysis, cross-disciplinary effort, inter-agency collaboration, and strategic planning.

COPENHAGEN CLOUDBURST FORMULA
Location: Copenhagen, Denmark
Firm: Ramboll

The Copenhagen Cloudburst Formula is a strategic process for planning and designing blue-green interventions developed for the city of Copenhagen following flood events in 2011 that caused approximately US$ 1 billion of damage.

The Formula offers a flexible and universally adaptable models for mitigating extreme flood events that are informed by multi-disciplinary inputs by planners, hydrologists, economists, and engineers. A cost-benefit analysis conducted over a 10km2 catchment area concluded that the adoption of blue-green approaches to mitigate Cloudbursts over traditional gray infrastructure would result in capital cost savings of over US$200 million. The Formula led to the identification of 300 pilot project and design guidelines for local development.

A similar multi-disciplinary exercise for Chennai's basins would provide a compelling economic as well as ecological argument for investing in Sponge Landscape Infrastructure typologies rather than expensive gray infrastructure upgrades.

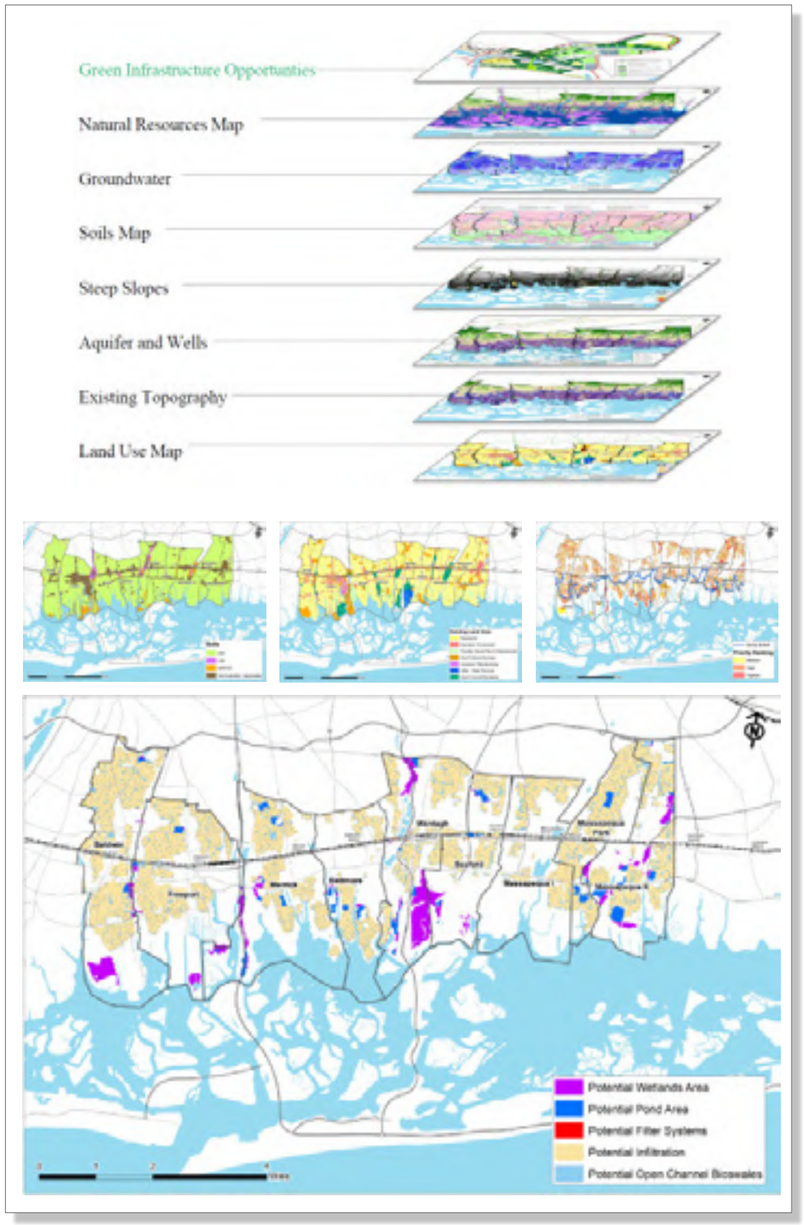


MAPPING GREEN INFRASTRUCTURE OPPORTUNITIES
Location: New York, USA
Firm: Arup

By mapping, inventorying, and overlaying natural features, topography, soil types, groundwater depth, land use and other landscape attributes, the Green Infrastructure Opportunities map offers a robust foundation for planning and prioritizing green infrastructure projects.

In New York, the identification of Green Infrastructure Opportunities was followed by detailed Drainage Area analyses, surveys and other geotechnical investigations to design and implement various landscape infrastructure process. The map becomes a roadmap to design and implement an entire network of interventions.

A similar exercise in Chennai would ensure that the stormwater network is expanded and upgraded with a comprehensive understanding of hydrological flows. Furthermore, the results of this analysis will create the base to identify pilot projects and envision a network of Sponge Landscapes and Sponge Landscape Infrastructure that strengthen rather than compromise the resilience of Chennai's basins.



PART 3: SOUTH BUCKINGHAM CANAL FRAMEWORK

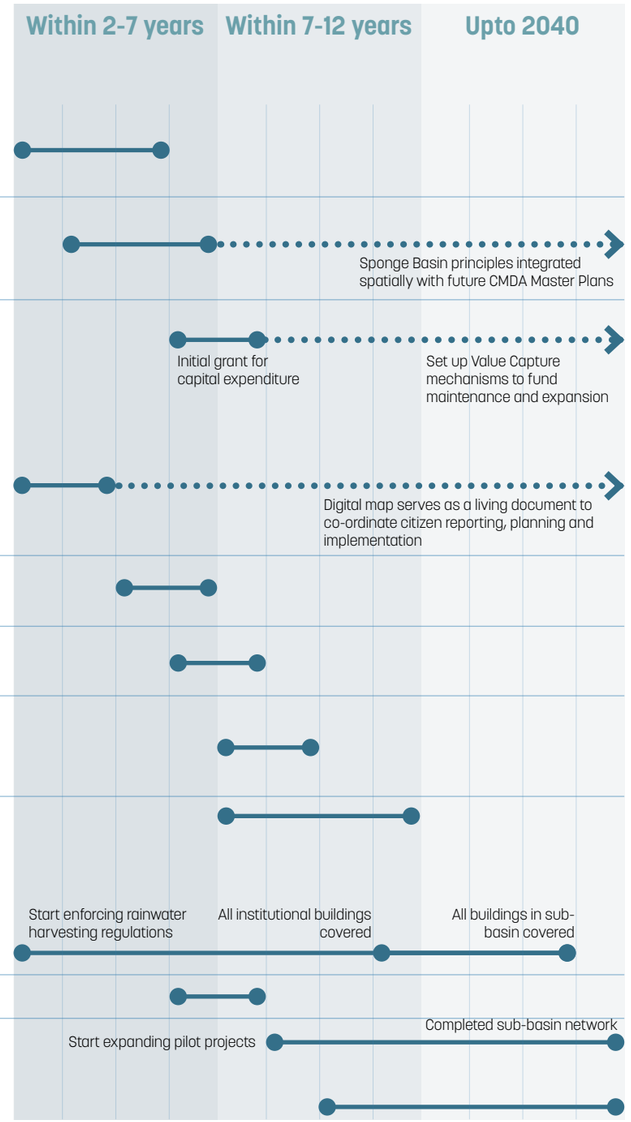
How the Sponge Basin principles can be implemented in a neighbourhood

Planning for the South Buckingham Canal Basin as a Sponge Basin

Institutionalizing the planning process to realize Sponge Basins in Chennai

This chapter uses the South Buckingham Canal Basin–one of two basins intersecting with the project area that stretches for 4 km of the canal length–to demonstrate the creation of Framework plans at the Basin and Ward scales. The timeline below illustrates the institutional, planning, and implementation steps needed to transform the South Buckingham Canal Basin into a sponge.

Starting with the planning requisites outlined in the earlier chapter, the implementation of the Sponge Network begins with enforcing existing regulations for Sponge Buildings, kickstarting pilot Sponge Street and Open Space projects and gradually expanding this into a comprehensive network. The rejuvenation of the Canal itself is a strategic project that happens in parallel.



Basin Scale Sponge Network Framework

Role of the Canal and Sponge Landscapes in the South Buckingham Canal Sub-Basin

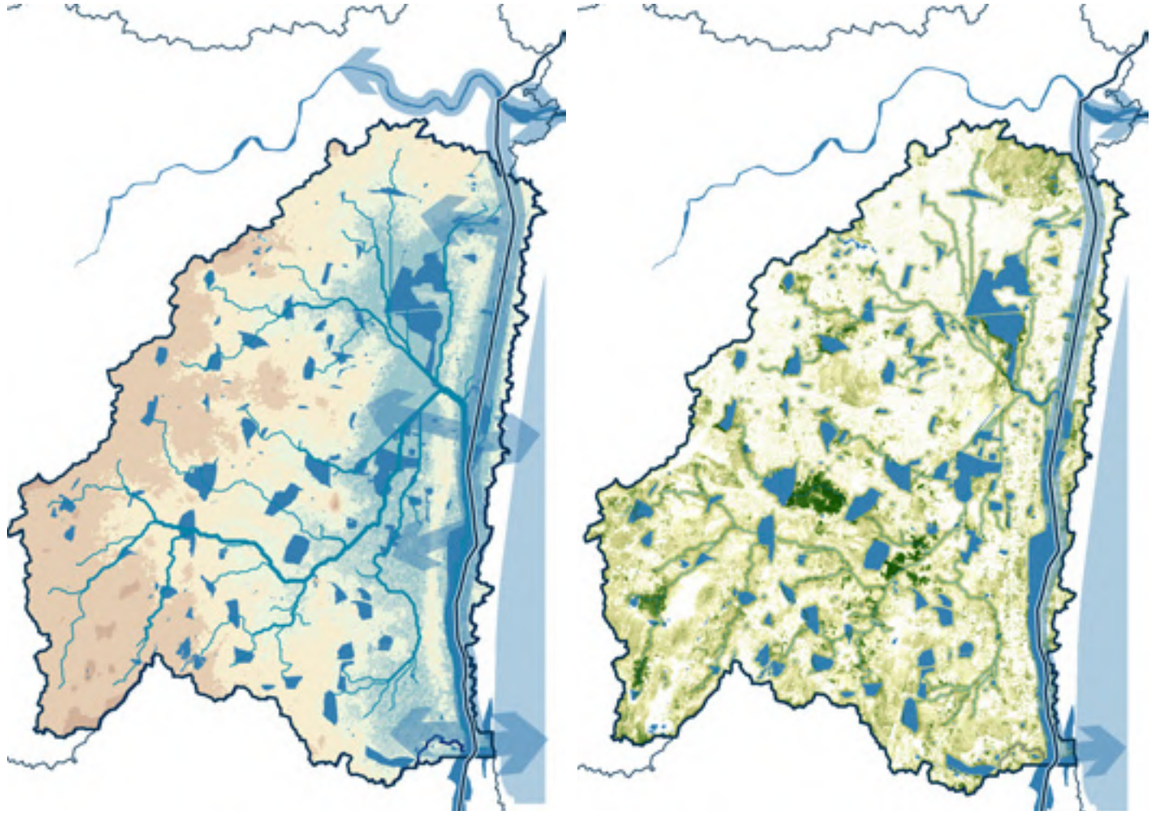
The project area for the 'Eyes on the Canal' initiative covers a 3.5km stretch of the Buckingham Canal from Adyar River to the Thiruvanmiyur Metro Railways Station. Our area of interest intersects with the Adyar River Basin and the South Buckingham Canal basin. We focus our analysis on the latter since the Demonstration Project selected for PART 4 is within the South Buckingham Canal Basin.

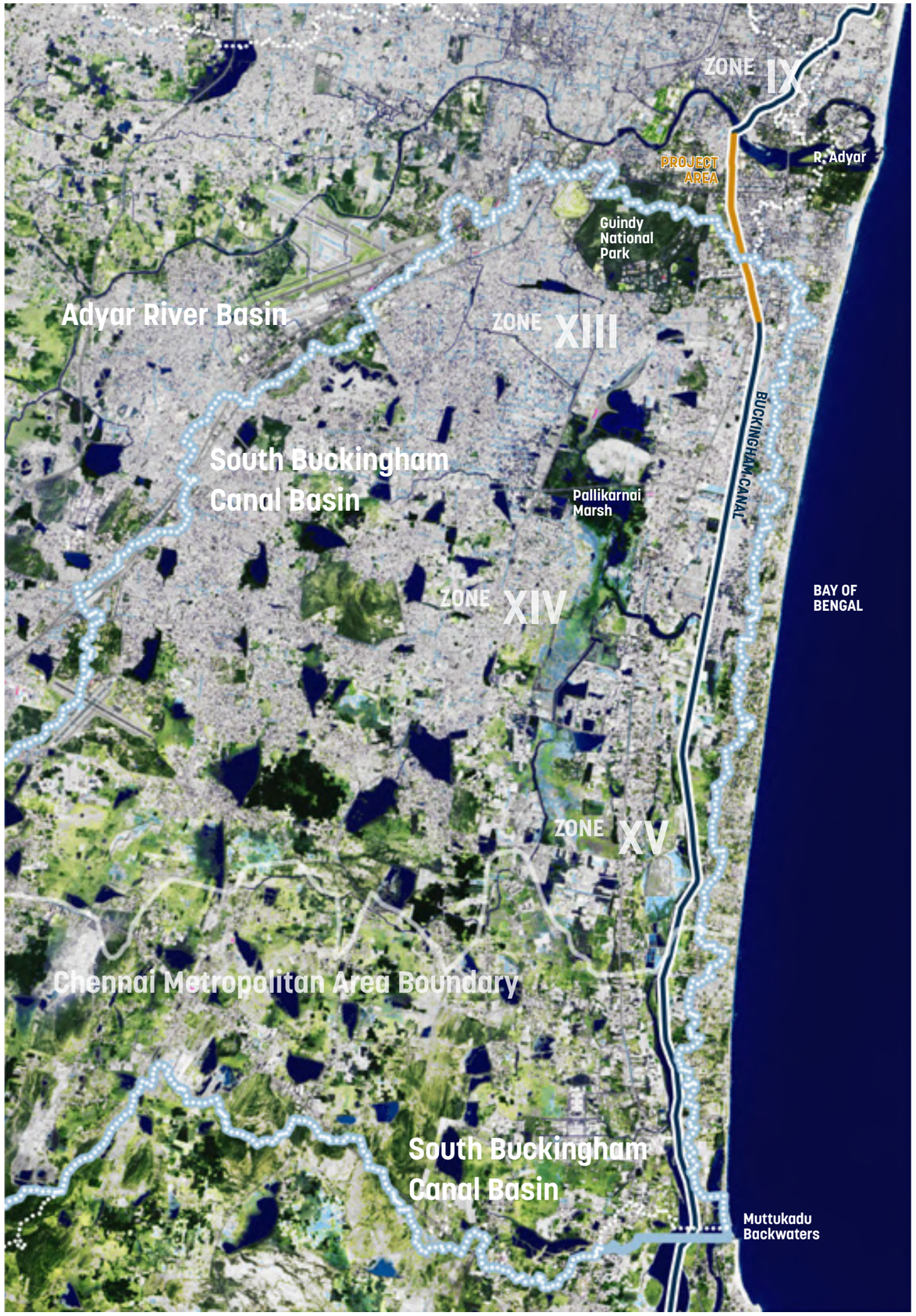
The South Buckingham Canal Basin begins just south of the Adyar River and continues until the canal opens up into the Muttukadu Backwaters. Along the canal's stretch lie some of the lowest elevations in the city. The threatened Pallikanai Marsh and numerous wetlands and water bodies to the west have been almost entirely surrounded by if not encroached upon by built-up areas. The southern parts of the basin that lie outside the boundary of the Chennai Metropolitan Area are beginning to transform green areas into built-up.

By taking a basin view, we understand the South Buckingham canal portion as a distinct hydrological stretch between the Adyar River and the Mutukadu backwaters. If the canal fulfills its functions during a flood event, it can take in overflows from Adyar river or other streams and dissipate it along its length. However, the canal can be easily overwhelmed by excess runoff during an extreme storm event. In order to make the canal more resilient, a holistic strategy not only increases the physical storage of the canal through desilting or opening it up, but also considers the canal's connectivity and relationship with the green areas and water bodies within the South Buckingham Canal basin. Given a complete dataset, a Basin Framework plan could outline more specific strategies than was feasible for the current effort by Team Sponge.

Streamflow within the S. Buckingham Canal Sub-basin gravitates towards low-elevation areas where the OMR I.T. corridor is planned. If the basin is further concretized, the entire I.T. stretch will be flood-prone. Rather than transferring water, the canal will spill over.

If existing blue-green systems are protected against new development and enhanced to become a Sponge Network, the Buckingham Canal can convey streamflows into Adyar River or the Muttukadu backwaters without getting overwhelmed.





Ward-Scale Sponge Network Framework

Analysis and Assessment

Zooming into the study area, we find a number of interesting adjacencies to the 3.5km stretch of the Buckingham Canal. Three gigantic structures built by the MRTS puncture the continuity of the canal as concrete pillars and retaining walls severely constrain the thickness of the canal.

To the east is a highly residential and mixed-income neighbourhood of Adyar. On the west are a number of institutional bodies with campus buildings, tech parks, research institutes and urban forests.

The proximity of the canal to the forests of the Guindy National Park and IIT Madras will be a foundational aspect of the Ward-Scale Sponge Network Framework found on the next spread.

While a thermal analysis of Sentinel 2 dataset revealed green and blue areas at a 10m resolution, the availability of multi-spectral data at even finer resolutions could help identify details such as tree canopy coverage. Additionally, the Framework relied on a preliminary understanding of runoff stream flow through a hydrology analysis over a Digital Elevation Model (DEM) of 12.5 resolution. In an urban context where a flat terrain has been greatly modified, a high-resolution DEM generated by LiDAR (a project already initiated by the Tamil Nadu government on a basin-by-basin basis) could reveal more accurate streamflows. Analyses like these help align investments in Sponge Landscape Infrastructure to locations where water tends to flow or collect.

It is important to understand the relationships of basins, stormwater catchment areas, and Framework strategies to political boundaries since local Ward (smallest urban local body unit) councillors and Zonal (collection of Wards) engineers will play a big role in the implementation of the Framework.

BLUE SYSTEMS AND FLOODABLE STREETS / AREAS

EXISTING GREEN SYSTEMS

Ward-Scale Sponge Network Framework

Framework Plan

The wards adjoining the 4 km stretch of Buckingham Canal have a number of distinct characteristics that offer diverse opportunities to create a Sponge Network.

Within **Ward 174**, the continued conservation of the extensively forested Guindy National Park and the IIT Madras Campus and the creation of a publicy accessible riparian buffer along the Adyar River will provide all the benefits of Sponge Landscapes.

Within the residential **Wards of 175, 176, 181, and 182**, a hierarchy of streets are identified as candidates for one or more Sponge Street interventions based on right of way widths and streets reported to flood. The tree canopy along the arterial and collector streets will extend the connectivity to the forest landscapes from the east to the west. The distribution of neighbourhood parks and schools with courtyards within these wards offer an opportunity to create a network of Sponge Open Spaces that are within walking distance of most residents.

Within the institutional western wards of **171, 172, 174, and 180**, an aggressive Sponge Building strategy can be implemented since university campuses, tech parks, and research institutes have the capacity to implement rain-water harvesting, green roofs, as well as detention ponds.

This framework is provisional since it is based on limited data availability and spatial reading of the area. The creation of a Sponge Landscape Infrastructure Potential Map as well as interactions with the community, zonal engineers, and other stakeholders would refine this framework. Nevertheless, the current framework offers a robust armature to identify pilot projects and begin the creation of the Sponge Network

Sponge Landscape Infrastructure Network

Sponge Landscapes

EXISTING GREEN AREAS
Forested areas, trees, and pervious ground

EXISTING WATER BODIES

SUGGESTED RIPARIAN BUFFER

Sponge Streets Network

ARTERIAL STREETS
Wide streets with medians can fit 2 or 3 Sponge Streets interventions

COLLECTOR STREETS
Strategic streets to be upgraded with 1 or 2 Sponge Streets interventions

LOCAL STREETS
Extend network with at least 1 intervention

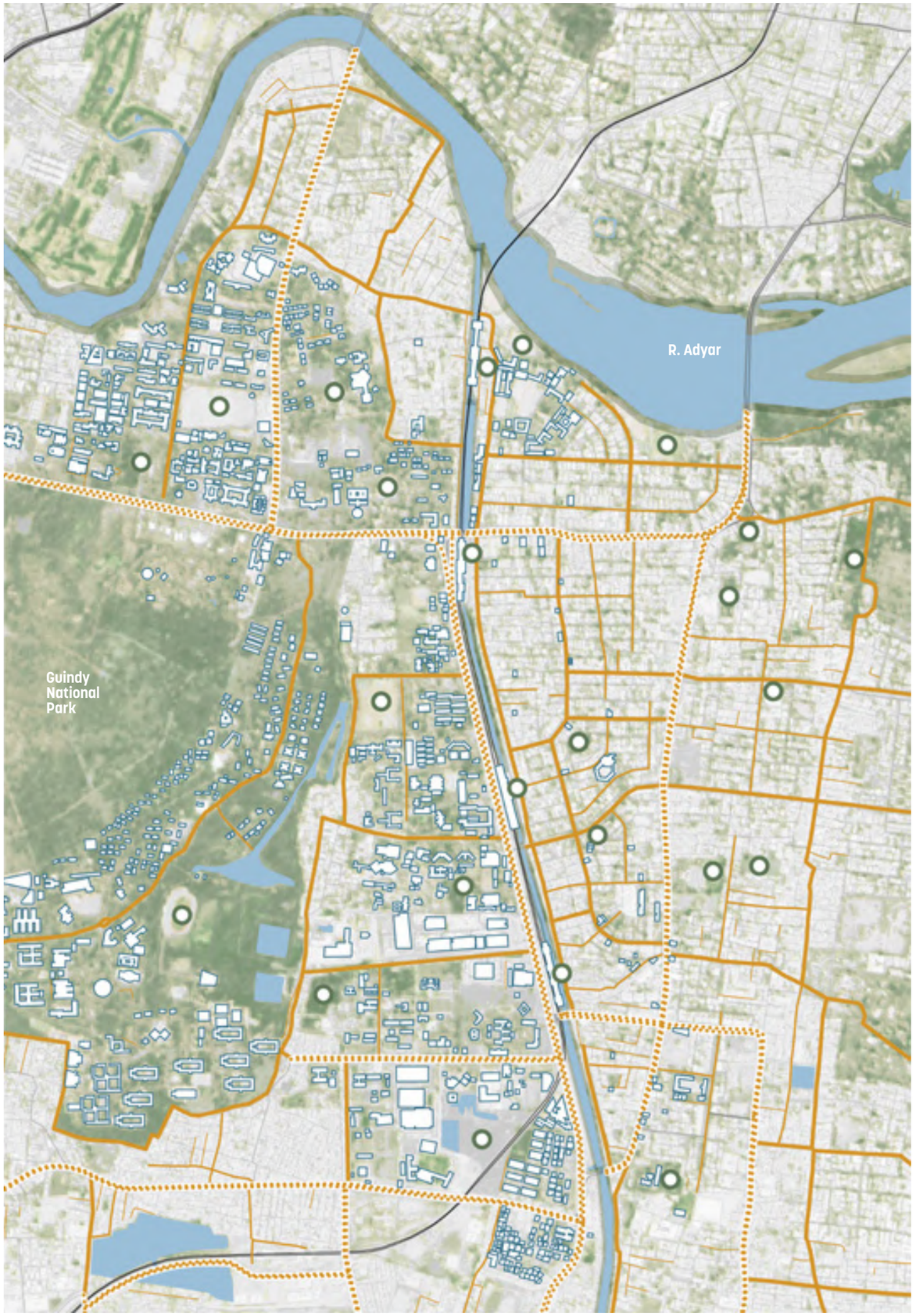
Fix issues with local flooding

Sponge Open Spaces Network

SPONGE OPEN SPACE PROJECTS
Sites for 1 or more Open Space interventions to be determined by suitability / ownership

Sponge Buildings Network

INSTITUTIONAL BUILDINGS
Universities, schools, government buildings, and offices ideal for 1 or 2 Sponge Building upgrades



Pilot Sponge Street and Open Space Projects

Potential Sites and Precedents

Pilot projects are pioneering attempts to test the viability of innovative concepts like Sponge Open Spaces and Sponge Streets. Pilot projects should be scaled small enough to be implementable within 1 year and not more than 5 years, but large enough to test all the implementation challenges and have an effective impact on the community.

After Sponge Buildings, Sponge Open Spaces are the least complex in terms of implementation and collaboration. As the resulting improvement benefits the public realm, these pilot projects can have greater political impact than retrofitting buildings. The projects listed here can mostly be completed in the short-term since it involves one institution around which the Greater Chennai department of parks and stormwater can implement their projects. Transforming an existing open space in a Sponge Open Space requires regrading to delay the flow of water during storm events and building up raingardens or constructed ponds to increase storage or infiltration.

SITE LOCATIONS

1. SPONGE PLAYGROUND

Duration : Short Term

Area : 20000 sq.m (4.94 Acres)

Cost : ₹ ₹

SITE PHOTOS

ST.MICHAEL's ACADEMY

PROJECT PRECEDENTS

HANS TAVSENS PARK, DENMARK

2. SPONGE PLAZA PARK

Duration : Medium Term

Area : 7000 sq.m (1.73 Acres)

Cost : ₹ ₹ ₹ ₹

INDIRA NAGAR MRTS STATION

PARQUE EXPLORA, MEDELLIN COLOMBIA

Social Museum, Urban Park

This is an interactive Science and Technological park

3. SPONGE COURTYARDS

Duration : Short Term

Area : 500 sq.m (0.12 Acres)

Cost : ₹ ₹

KUMARARANI MEENA MUTHIAH COLLEGE

WATER SQUARE IN BENTHEMPLEIN, NETHERLANDS

Pilot Sponge Street and Open Space Projects

Potential Sites and Precedents

Turning public streets into Sponge Streets require the collaboration of three Greater Chennai Corporation departments Roads, Stormwater, and Parks. Since streets have a number of other infrastructural conduits such as power, sewage, telephone lines - the actual implementation can involve many more stakeholders.

The selection of the pilot Sponge Streets highlight streets of strategic importance that have the room to accommodate one or more Sponge Street components. The transformation of the median on Indira Nagar 2nd Avenue separating the main road from the service road could essentially become a linear park.

Pilot projects can be implemented before a Framework plan for a Ward or Basin is developed as lessons from these projects can inform implementation guidelines and mobilize support for more ambitious goals.

SITE LOCATIONS

4. SPONGE PARKS

Duration : Short Term

Area : 500 sq.m (0.12 Acres)

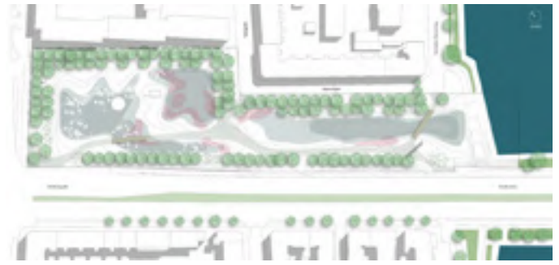
Cost : ₹ ₹

SITE PHOTOS

CORPORATION PLAYGROUND, INDIRA NAGAR

PROJECT PRECEDENTS

FREDENS PARK, COPENHAGEN - DENMARK



5. SPONGE STREETS

Duration : Medium Term

Area : 150m

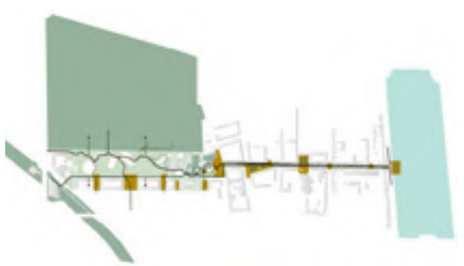
Cost : ₹ ₹ ₹

INDIRA NAGAR 2nd AVENUE

GANDHI NAGAR - 2nd MAIN ROAD

KORSGADE, DENMARK

Key Concepts:
Cloudburst
& Flood Management ,
Ecological Street
upgrade



Canal Rejuvenation Framework

Present day condition of South Buckingham Canal

Today, the South Buckingham canal is faced with severe pollution issues with untreated sewage and solid waste finding their way into its waters. Numerous encroachments have severely constrained its width and the carrying capacity. The canal is constricted to a mere conduit with high walls that block visual and physical connectivity. The polluted waters of the canal become breeding grounds for mosquitoes and other pathogens, making it an unhealthy urban environment. Revival of the canal has been a struggle for the governments till today.


Inaccessible Canal Edge


Illegal Dumping


High Canal Wall


MRTS bridge along the canal edge


Under-utilized Edge


Encroachment of Informal settlements

Note on the Canal Framework

Team Sponge recognizes the multi-sectoral efforts underway to clean up the canal. Our Framework outlines spatial strategies that are largely implemented after basic infrastructural and environmental issues like solid waste and sewage are resolved. Leveraging our expertise as planners and designers, we propose a long-term Framework that can lead to greater benefits from investments in restoration. The Framework can guide the actions of multiple stakeholders towards the rejuvenation of the canal as a social and ecological amenitiy.


Sewage Outlets into the canal


Constricted Edges

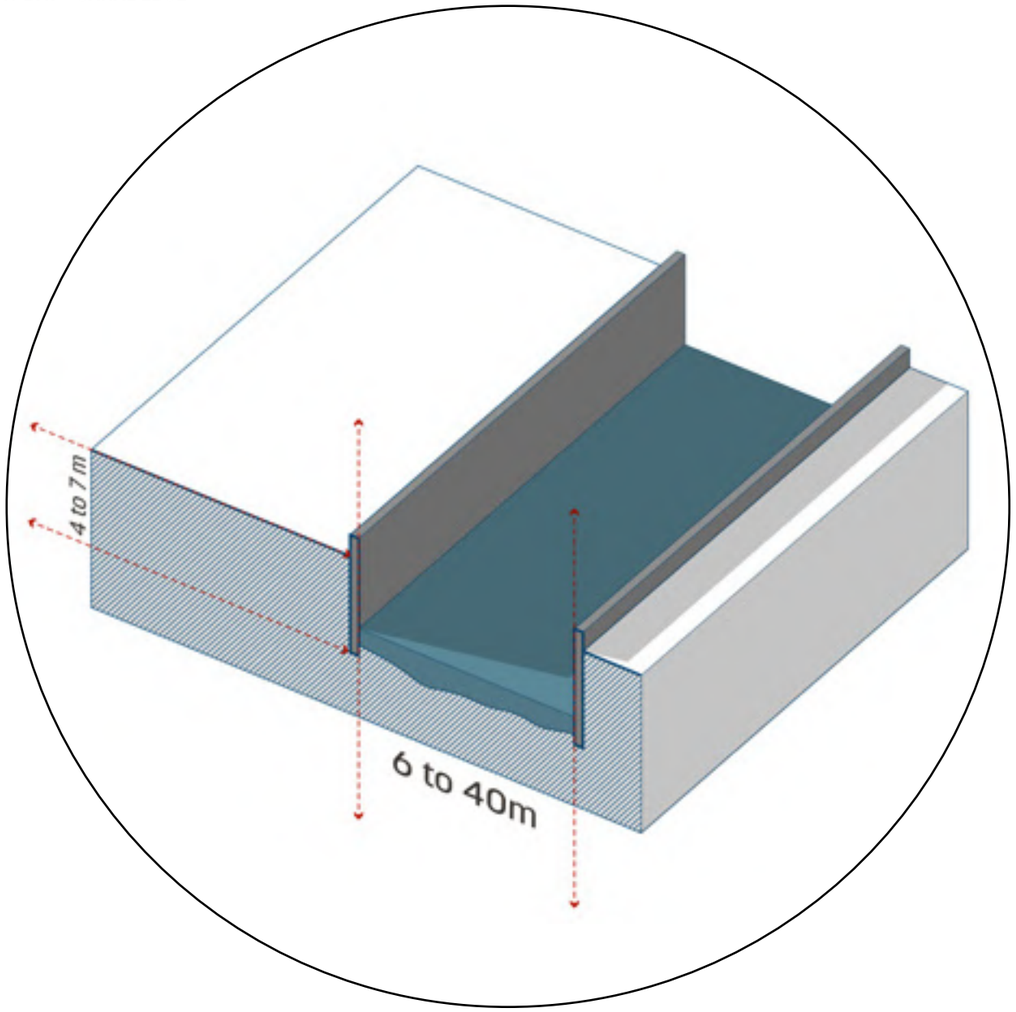

Canal edge with the wall

Canal Rejuvenation Framework

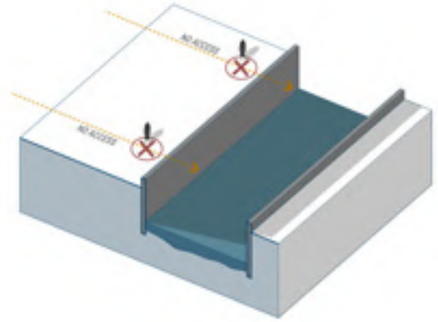
Issues with the current canal edge condition

The canal Rejuvenation Framework critically analyzes the spatial issues with the current edge condition of South Buckingham canal. The high canal wall is a matter of concern that engenders a majority of the intricacies that plague the canal today. The wall hinders public access to the canal edge, making it an inactive 'urban residue'. Over years, the lack of footfall along the edge has assisted the encroachment of informal settlements and squatters of substandard housing. The informal housing which are devoid of basic infrastructures, discharge unregulated flow of sewage into the canal waters, besides dumping solid wastes on the edges. The high canal wall with fewer stormwater outlets make settlements along the edge vulnerable to ponding during peak runoff. At several stretches the width of the canal is so constricted that even an average storm event could easily overwhelm the canal, making the canal edge prone to flooding.

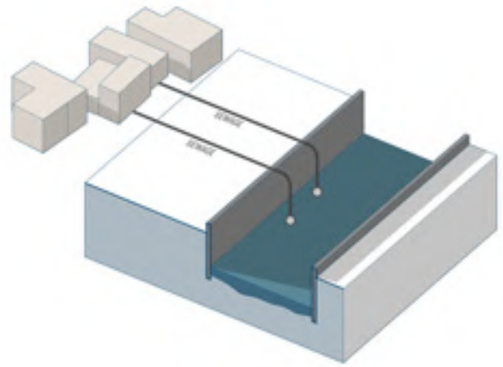
PRESENT DAY - CANAL EDGE



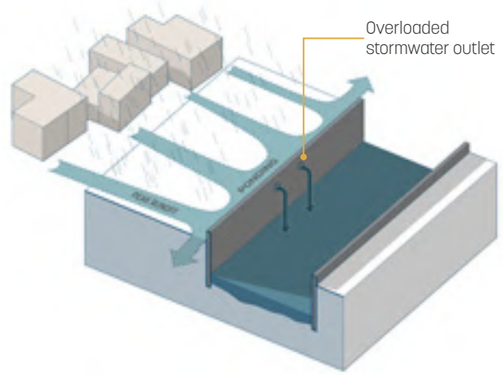
PRESENT DAY - ISSUES



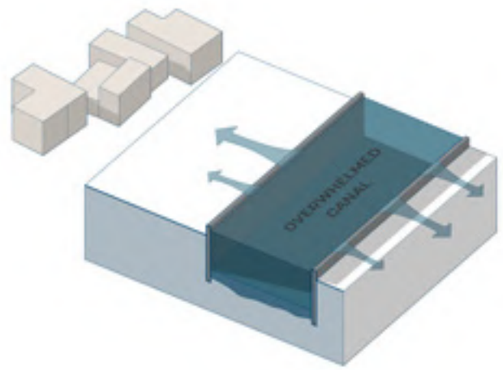
Limited Access to Canal Edge



Informal encroachments & sewage outflow



Flooding from runoff



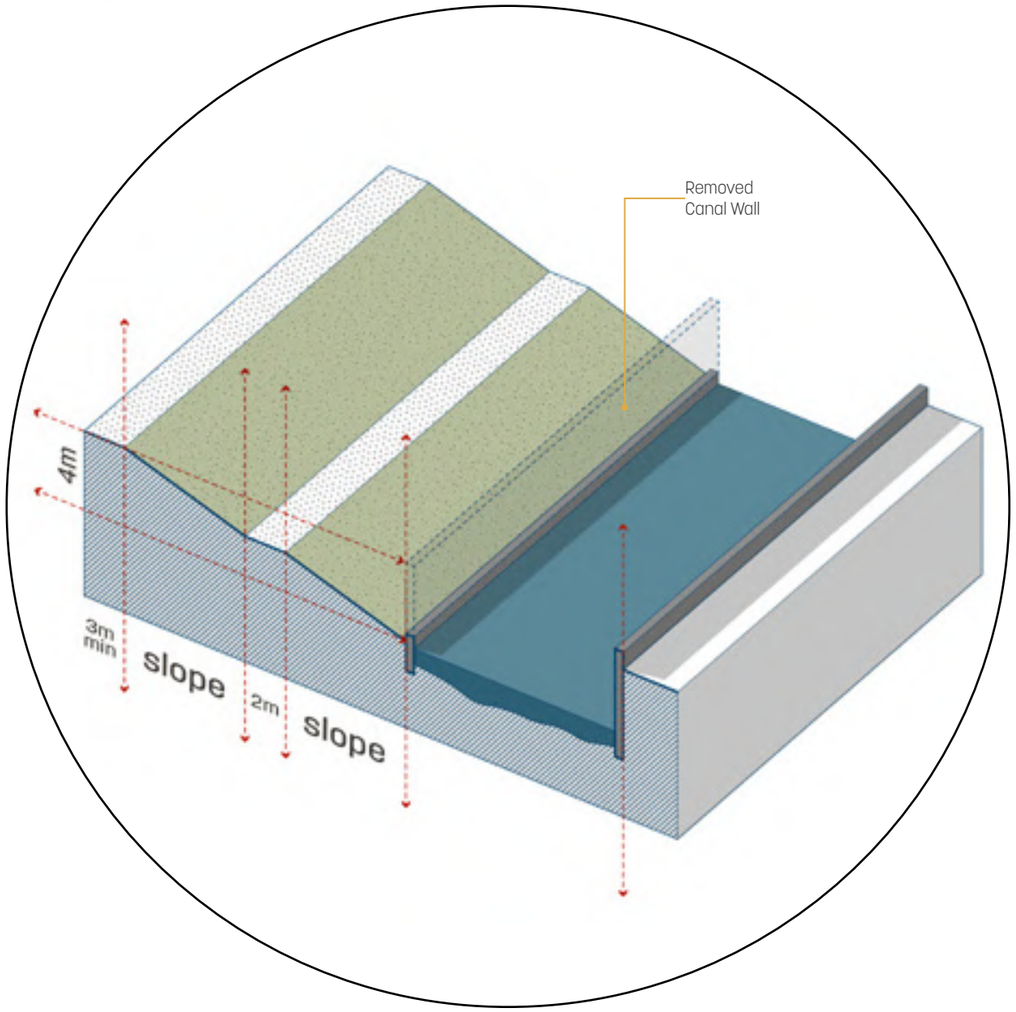
Flooding from canal

Canal Rejuvenation Framework

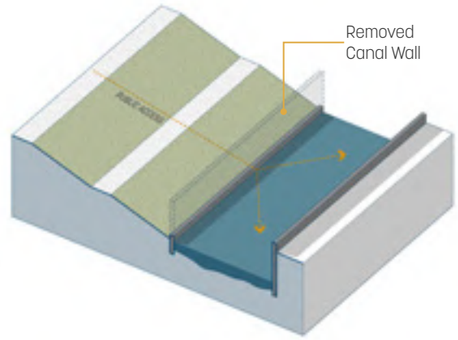
Opening up the canal edge

The Rejuvenation Framework proposes 'opening up' of the eastern canal edge to confront the issues discussed earlier. The high canal wall is removed or lowered to a depth of 4 metres from the street level and then the edge is graded to a natural slope(1:3) or an engineered slope (1:2) as illustrated in the diagram below. The slope ratios are determined by the available clearance between the canal wall and the edge of existing housing. The 'opening up' helps creating visual and physical access to the canal and thereby upgrading the public realm. In the event of a storm, the sloped condition aids in slowing down the runoff by enhancing more infiltration. The opening up also increases the carrying capacity of the canal by almost 2 times. The amelioration to the public realm unlocks new development potential as it draws in more footfall towards the canal edge. This would economically benefit the community as the properties in close proximity to the canal will experience a surge in value.

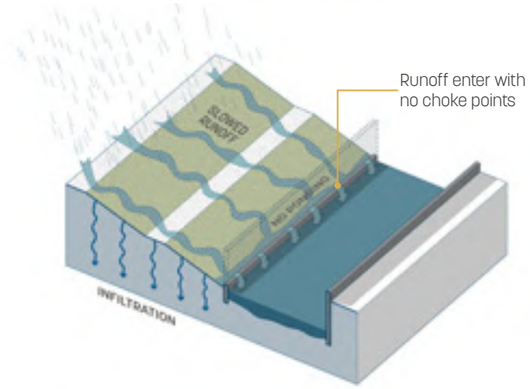
PROPOSED CANAL EDGE



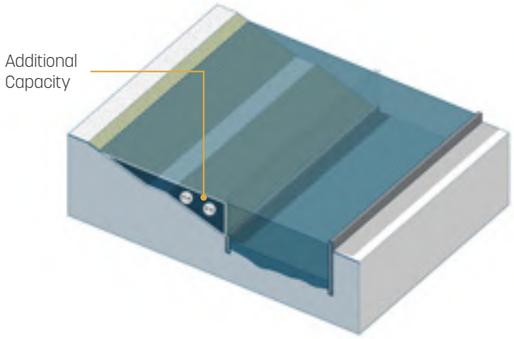
PROPOSED EDGE - BENEFITS



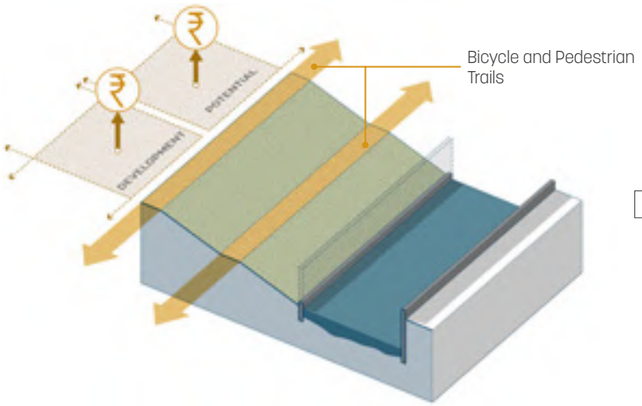
Opens out public access



Slow down of runoff



Gain in cross - sectional area of capacity



Unlocking Development Potential

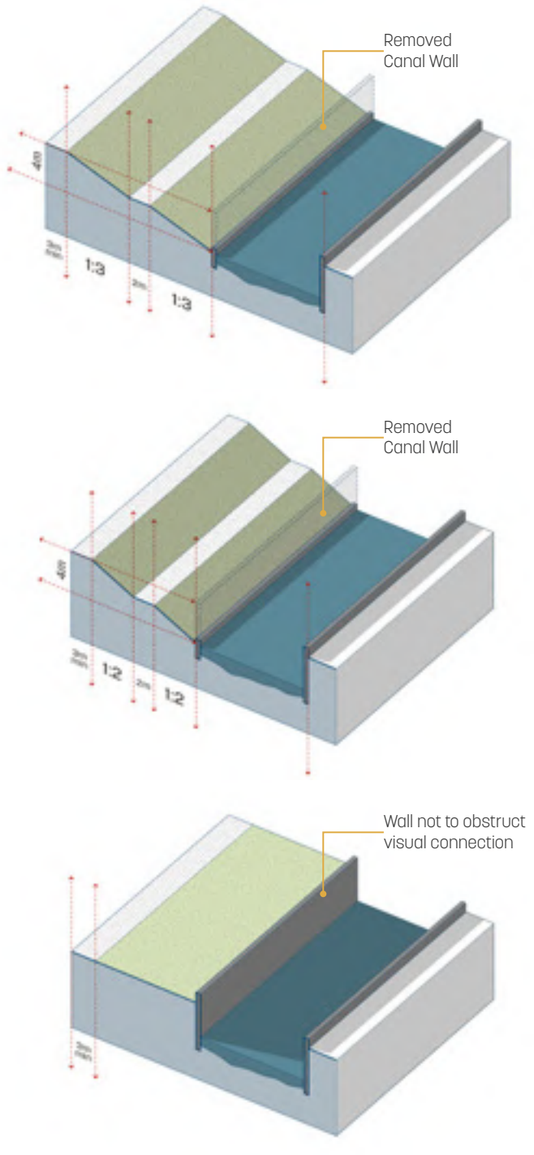
Canal Rejuvenation Framework

Proposed Canal Edge Conditions

The Framework proposes 3 Canal Edge Conditions:
1. 1:3 - Natural slope with vegetation
2. 1:2 - Engineered slope with vegetation
3. Wall Condition - No Slope with vegetation

The feasible canal edge condition for each section of the 3.5 km stretch is mapped out based on the clearance that exists between the eastern canal wall and the edge of the existing housing. The framework recommends that the 'opening up' of the canal is executed as one single undertaking by the concerned authorities without the complexity of relocation. Once executed, the sloping edge serves as a foundation for multiple development scenarios to rejuvenate the canal over time.

PROPOSED EDGE CONDITIONS



1:3 SLOPE

1:2 SLOPE

WALL REMAINS

LEGEND

- 1:3 Slope
- 1:2 Slope
- Wall Remains
- 1:3 Slope with Resettlement of Housing

Development Scenarios

Multiple pathways to rejuvenate the canal

The opening up of the canal through the creation of various slopes is part of a strategic set of moves that begin with Sponge Landscape Infrastructure upgrades in the short term. In the medium term - after waste issues within the canal are resolved, single or co-operating government agencies are responsible for opening up the canal edge by taking down the wall and establishing a slope with simple pathways. This government action lays the foundation for various stakeholders to take ownership of the canal edge and benefit from a new landscape resource by increasing housing density through redevelopment.

The activation of the canal through new housing, retail, and community-led modifications to the edge becomes a long-term project realized through multiple scenarios. Design guidelines will ensure the canal edge is open to the public and activated by mixed-income housing where resettled households are prioritized. The stakeholders that individually or collectively implement this transition will differ based on land ownership, local politics etc. the maintenance of the canal edge will be in the hands of a collective between property owners and the community. Over time, the Adyar neighbourhood will have an active, public, and beautiful promenade.

1. Short Term

Sponge Infrastructure upgrade to streets

PWD

Chennai Corporation

3. Long Term

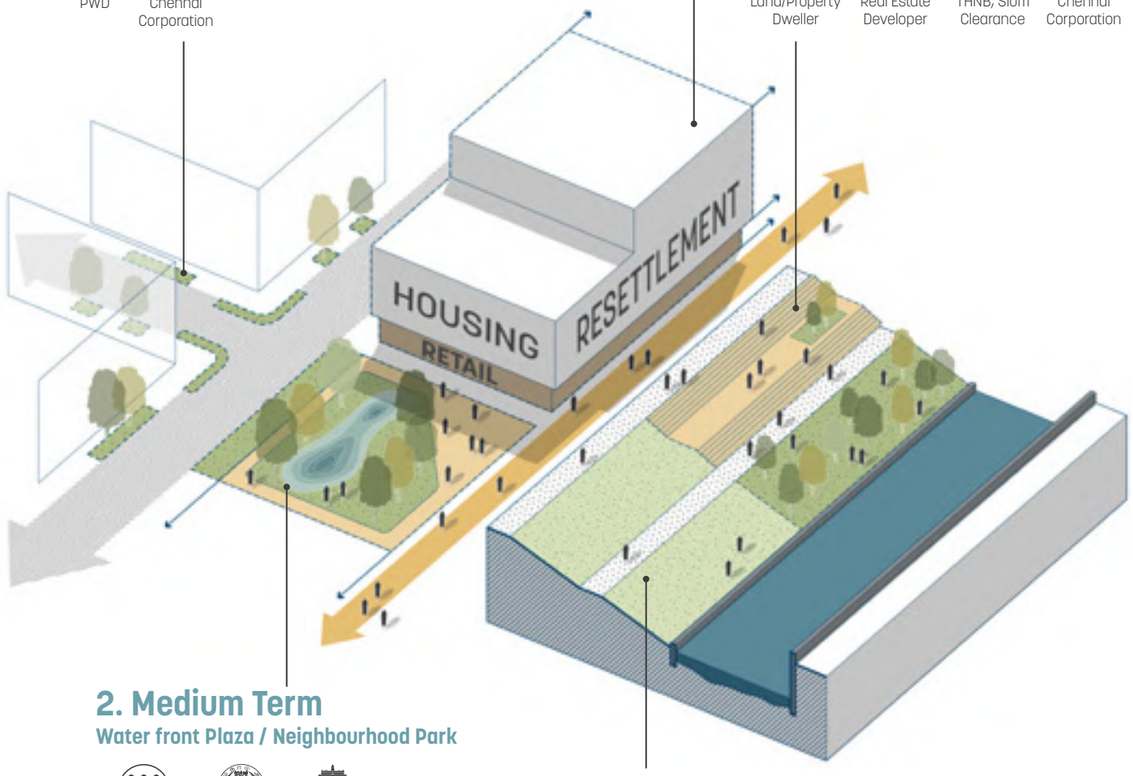
Resettlement Housing and Canal Front

Land/Property Dweller

Real Estate Developer

THNB, Slum Clearance

Chennai Corporation



2. Medium Term

Water front Plaza / Neighbourhood Park

Neighbourhood Community

CRRT

Chennai Corporation

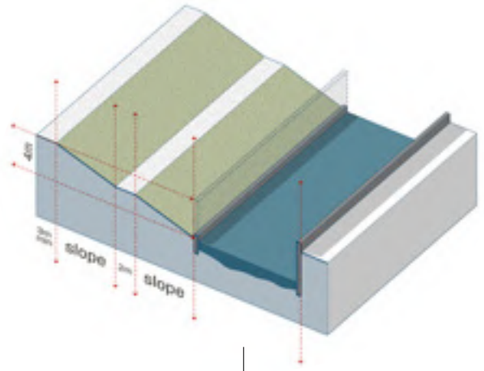
2. Medium Term

Sloping and Opening up the canal Edge

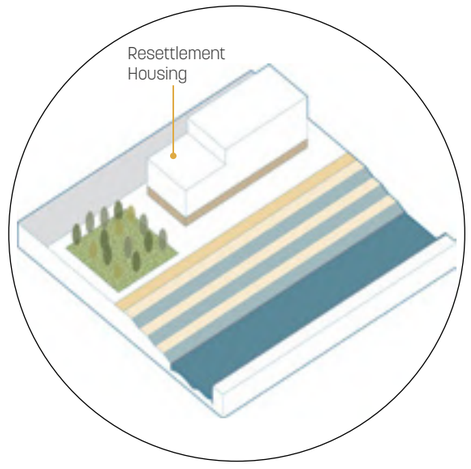
PWD

CRRT

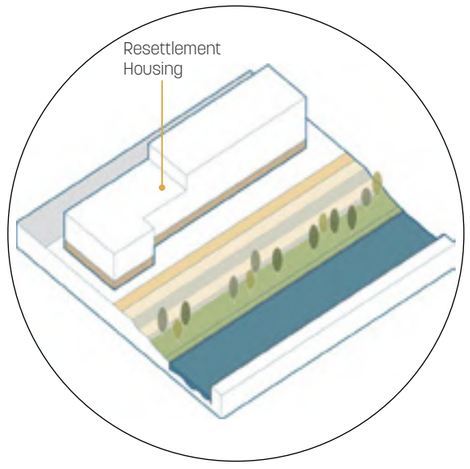
LONG TERM CANAL EDGE DEVELOPMENT SCENARIOS



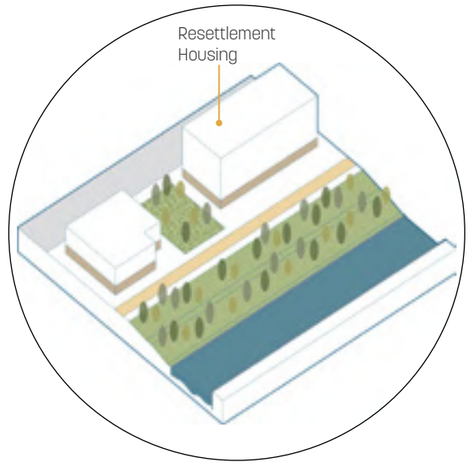
Ghats (Padithurai)



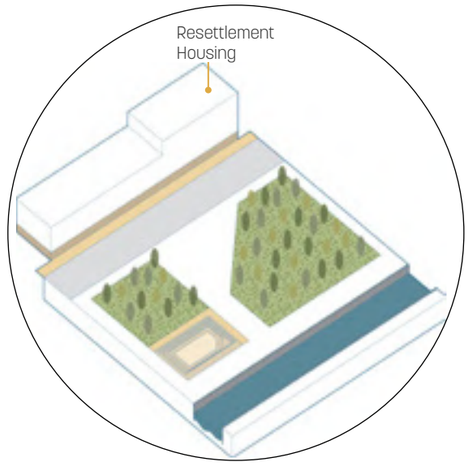
Ghats + Landscaped Slope



Landscaped Slope



Sponge Promenade



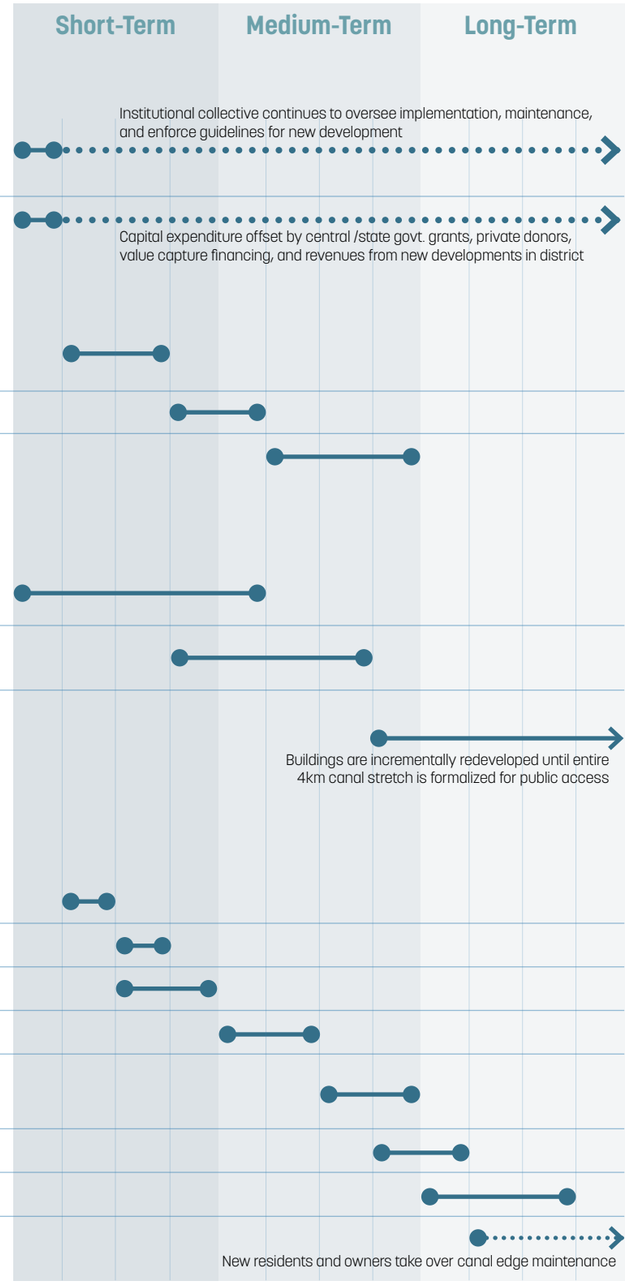
PART 4:
SPONGE DEMONSTRATION PROJECT

How the Toolkits and Frameworks come together in a site

Timeline of Projects

Overview of Project Components and Phasing

The timeline below illustrates the sequence of projects shown in this chapter in relationship to the larger efforts to 1) create a Sponge Network within the Ward of the Demonstration Project and 2) the rejuvenation of the entire canal stretch from resolving sewage and solid waste pollution issues to opening up the canal edge.



Sponge Demonstration Project

Site Context and Issues

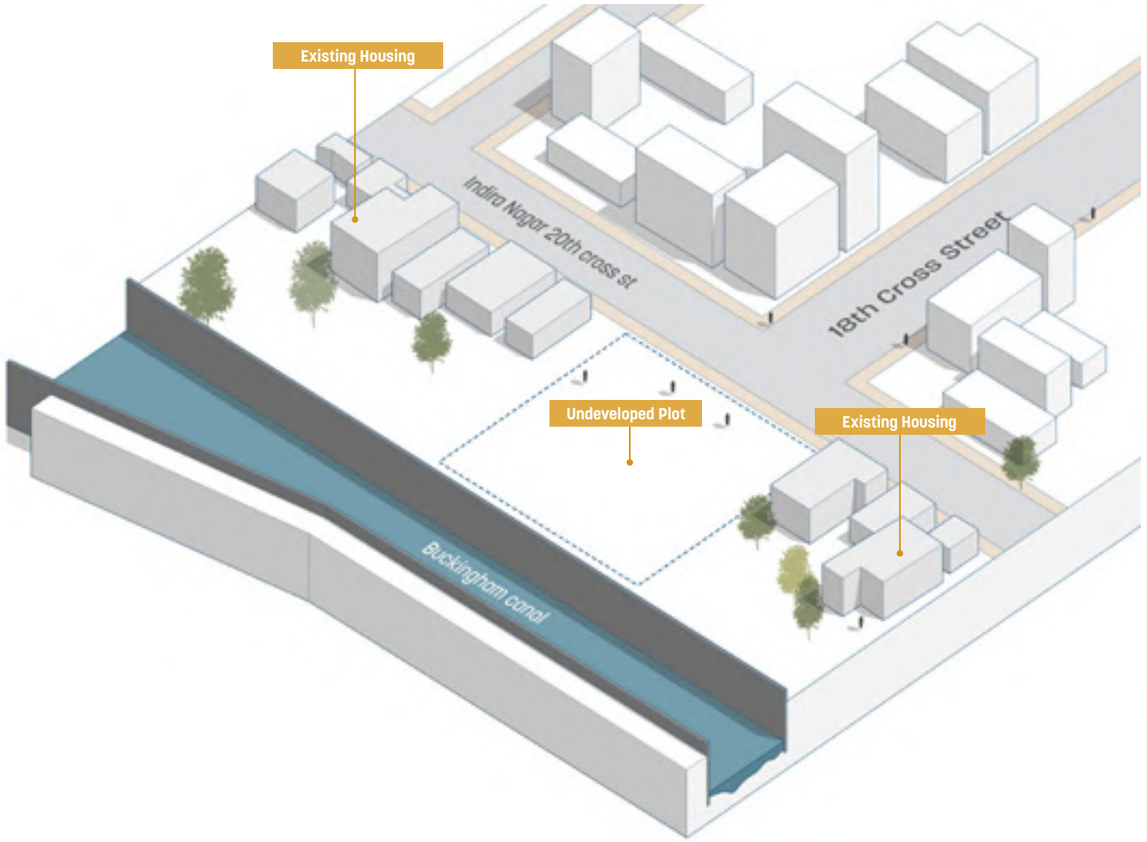
The primary purpose of the Sponge Demonstration Project is to exhibit how 'Sponge Landscape Infrastructures' are realized in a site scale through multiple phases. The demonstration project will set the precedent for a number of other projects identified by the Framework. A site that is best suited to demonstrate the various typologies of Sponge Infrastructures is identified. The proposed site is located on the south-west extremity of Indira Nagar; delineated by the canal on the west; and lies in close proximity to the Thiruvanmiyur MRTS station. The site identified is demarcated in the map below, which includes stretches of Indira Nagar 20th Cross st, 18th Cross st, and the strip of land sandwiched between the canal and the 20th Cross st. The stretch faces multiple issues including lack of access to infrastructures, inactive canal edge, Informal encroachments, dumping of solid waste, untreated sewage outflow, flooding of the streets and the canal edge during cloudbursts.

Present day condition of the site

Street Intersection

EXISTING CONTEXT - PLAN

EXISTING CONTEXT - AXON



Sponge Demonstration Project

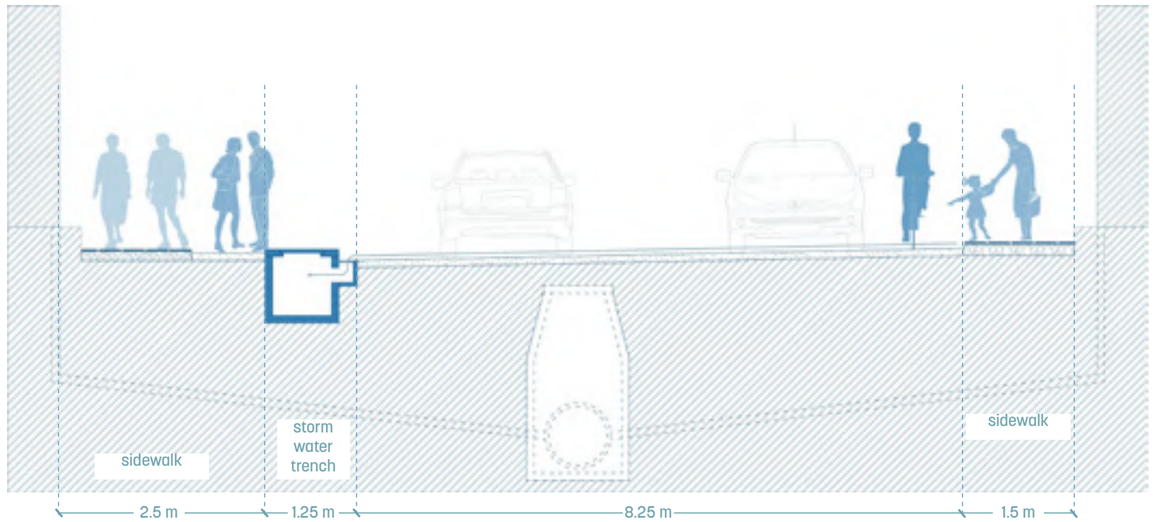
Site Selection Criteria

1.Undeveloped Plot: The crucial parameter that guided the site selection, is the unlikely presence of an undeveloped plot along the canal edge in Indira Nagar. There is a compelling opportunity to create public open spaces through community initiatives, that foster accessibility and spur public footfall towards the canal edge.
2. Existing Street Infrastructures: The street widths and the perpendicular organization of Indira Nagar 20th Cross st and 18th Cross st make them ideal candidates for demonstrating the Sponge Street Infrastructures. In addition to that, a new system of stormwater trenches were recently installed to both the streets. This presents for an opportunity to upgrade the efficacy of the system and at the same time enhance the pedestrian experience by plugging in the Sponge Street Infrastructures.
3. The Housing Standards and Community: The quality of housing abutting the canal is suboptimal and they are vulnerable to flooding during storm events. There lies the scope for in-situ resettlement of these residents to resilient housing typologies. The strategic upgrades to the housing and the public realm would enhance the livelihoods and economy of the residents.


Undeveloped plot along the canal edge


Retail activity

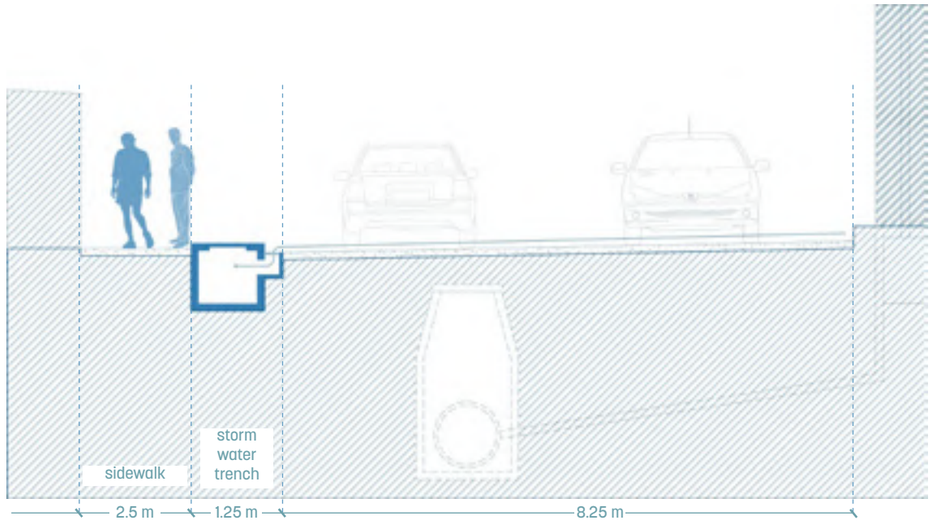
18TH CROSS STREET SECTION




Substandard housing along the canal edge


Stormwater trench along 20th cross street

20TH CROSS STREET SECTION




Stormwater trench along 18th cross street


Absence of sidewalk on 18th cross street

Short-Term Projects

Sponge Street upgrades, Interceptor Woonerf, and Filtration Garden

The short term projects are kick-started by the addition of Sponge Street Infrastructures to the 20th Cross st and the 18th Cross st as illustrated in the diagram. The upgrades are carried out by the concerned public bodies, where the sponge infrastructures are designed to work in tandem with the existing stormwater trenches.

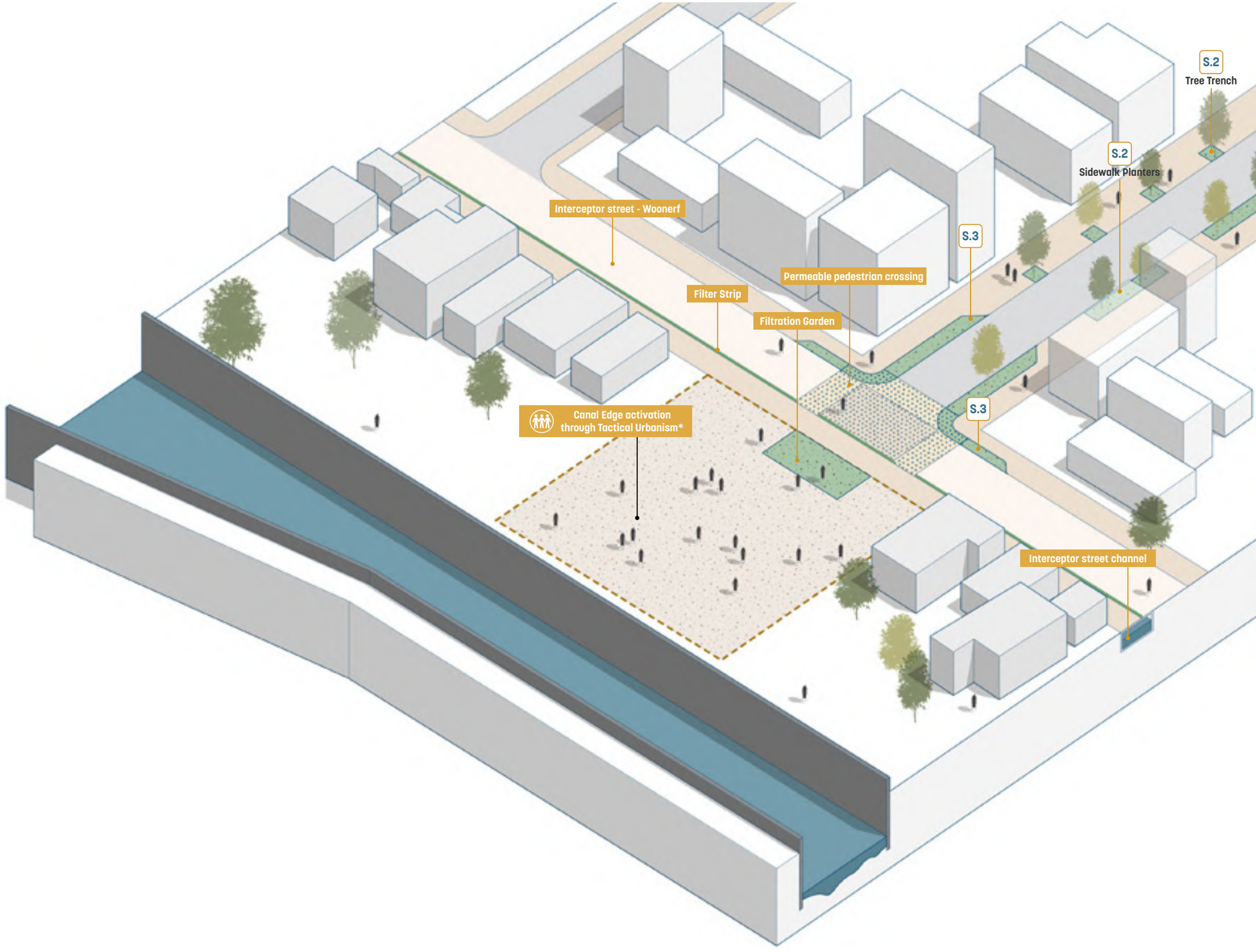
Indira Nagar 20th Cross st: The 20th Cross st or the Interceptor street is revamped into a Woonerf (shared lane) with filter strips lining the eastern edge of its right of way. The filter strips assist in filtering the excess runoff into the Interceptor street channel installed below grade.

18th Cross st: The northern sidewalk of the18th Cross st is upgraded with tree trenches while the southern sidewalk is upgraded with sidewalk planters, thus adding capacity to the existing stormwater system.

The Intersection: The Curb bulb outs and permeable pedestrian crossing articulate the intersection of the two streets and a filter garden is proposed on the adjacent empty plot.

All the proposed Sponge Street Infrastructures aid in storing, delaying and then gradually releasing the runoff into the canal during a storm event.

Canal Edge Activation: As a parallel effort to the street upgrades, the undeveloped plot is cleared out for public access. The open space is made available for community led 'Tactical Urbanism' projects that draw the public towards the canal edge.



LEGEND

S.2 Sidewalk Planters & Tree Trenches

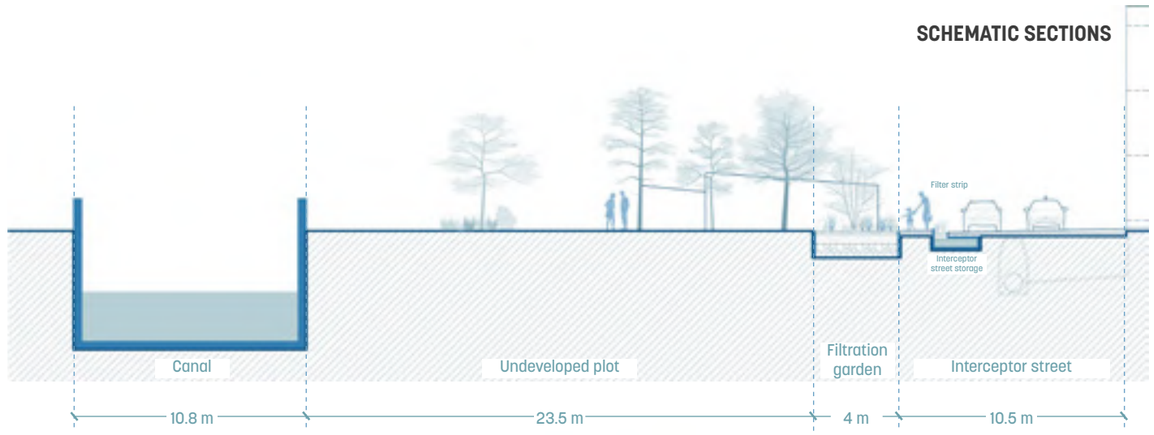
S.3 Curb Bulb outs

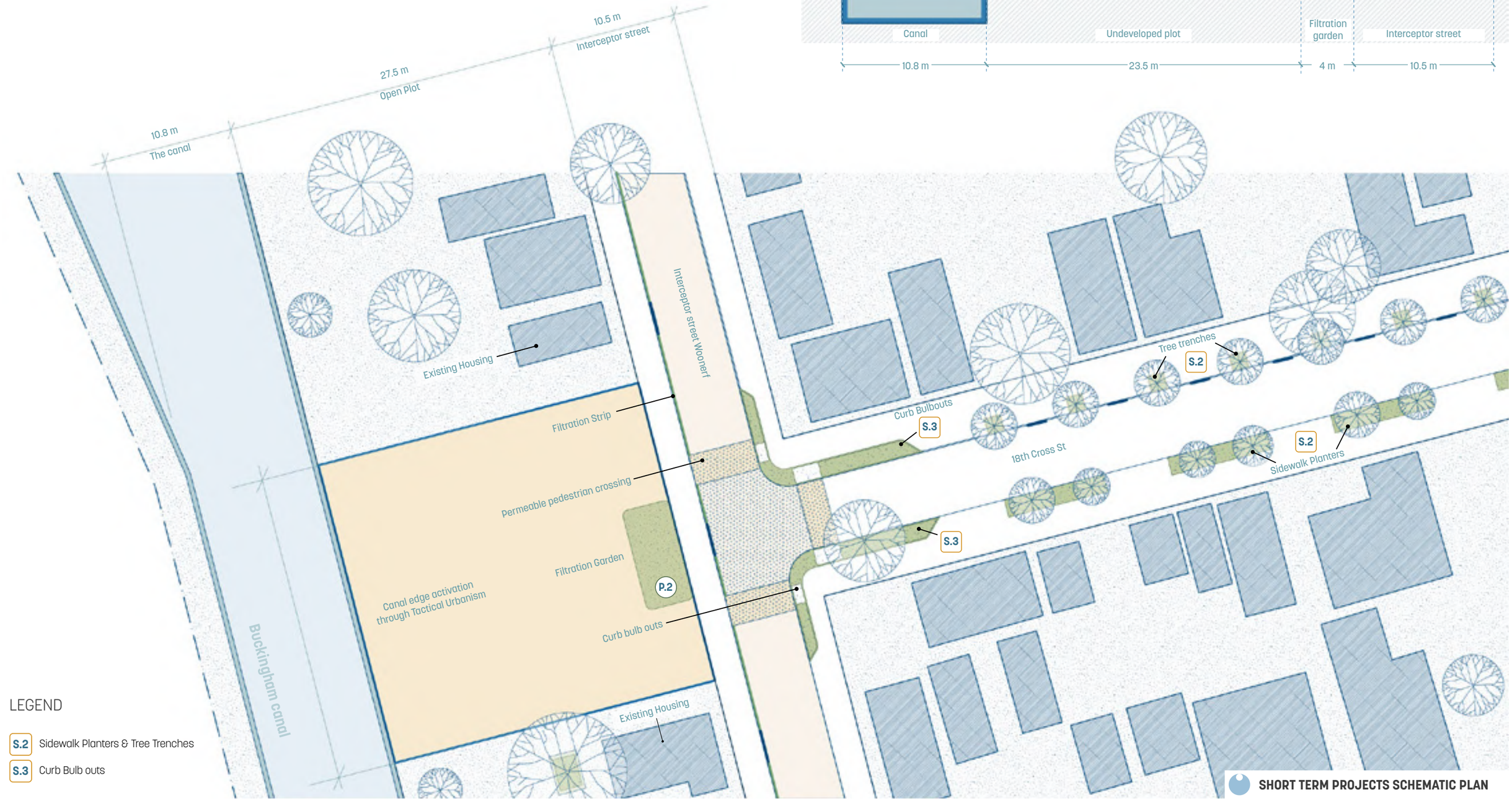
Canal Edge activation through Tactical Urbanism*

Short-Term Projects

Sponge Street upgrades, Interceptor Woonerf, and Filtration Garden

SCHEMATIC SECTIONS





LEGEND

- S.2 Sidewalk Planters & Tree Trenches
- S.3 Curb Bulb outs

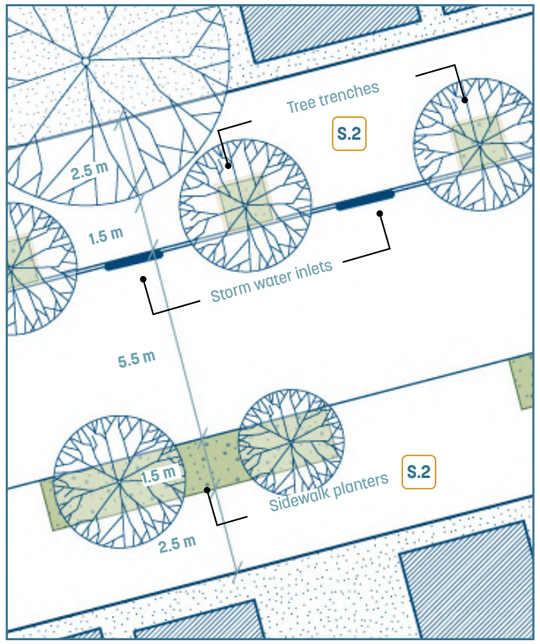
SHORT TERM PROJECTS SCHEMATIC PLAN

Short-Term Projects

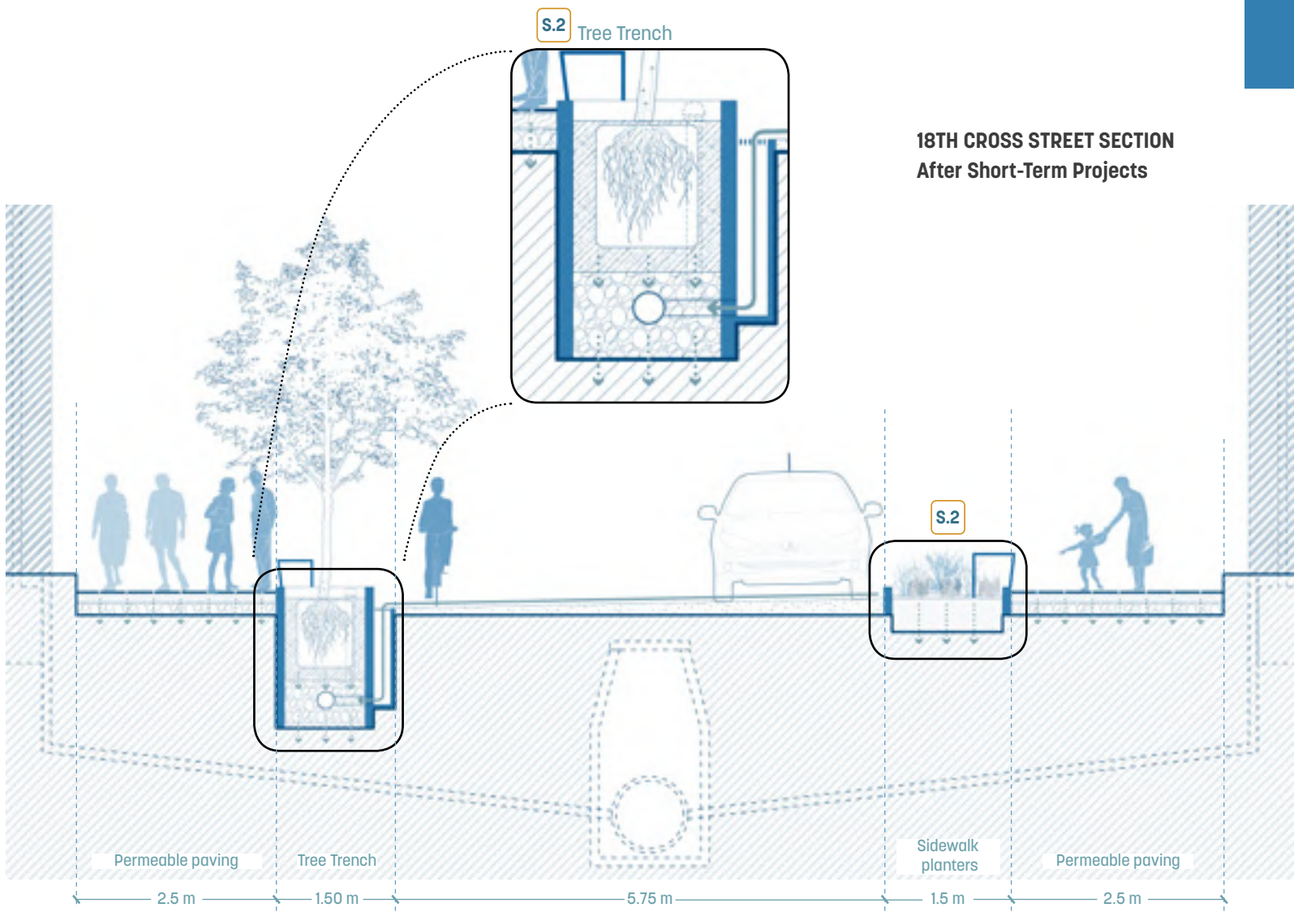
Sponge Street upgrades and Interceptor Woonerf

18TH CROSS STREET SECTION
Today

After Short-Term Projects

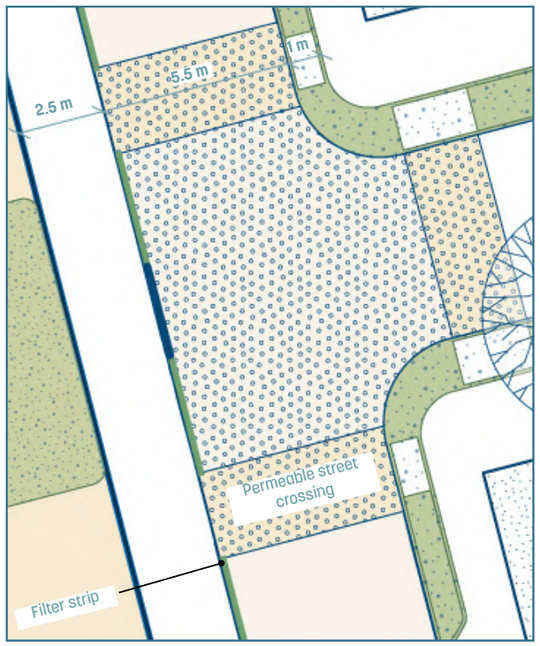


18TH CROSS STREET SECTION
After Short-Term Projects

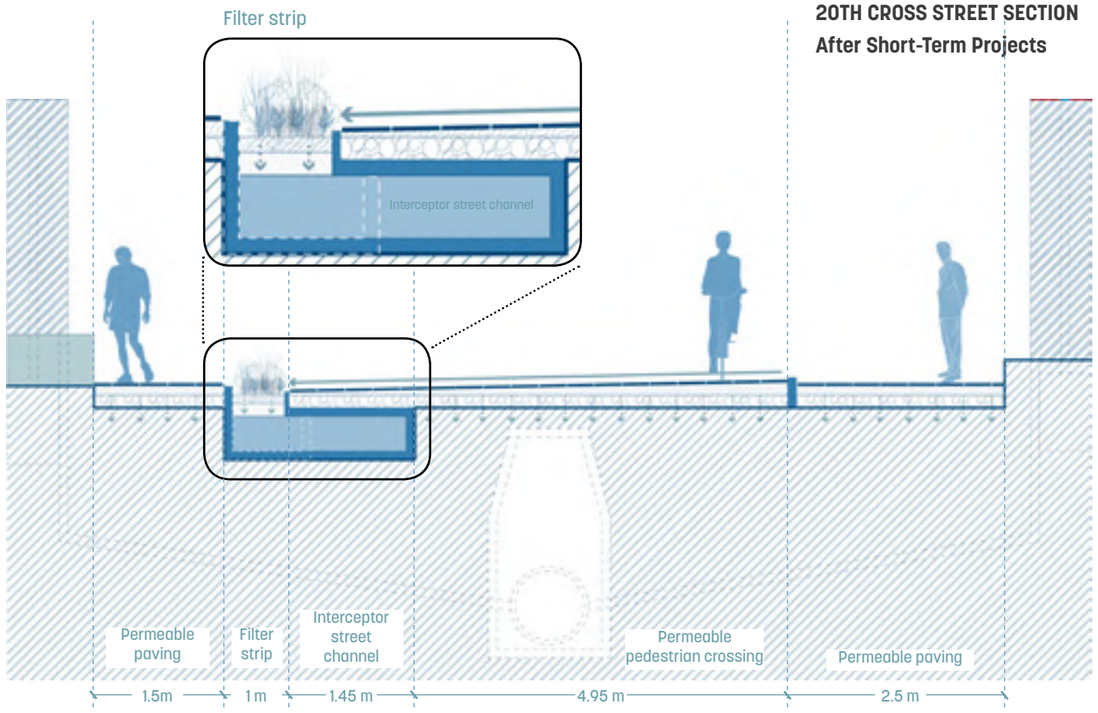


20TH CROSS STREET SECTION
Today

After Short-Term Projects



20TH CROSS STREET SECTION
After Short-Term Projects



Medium-Term Projects

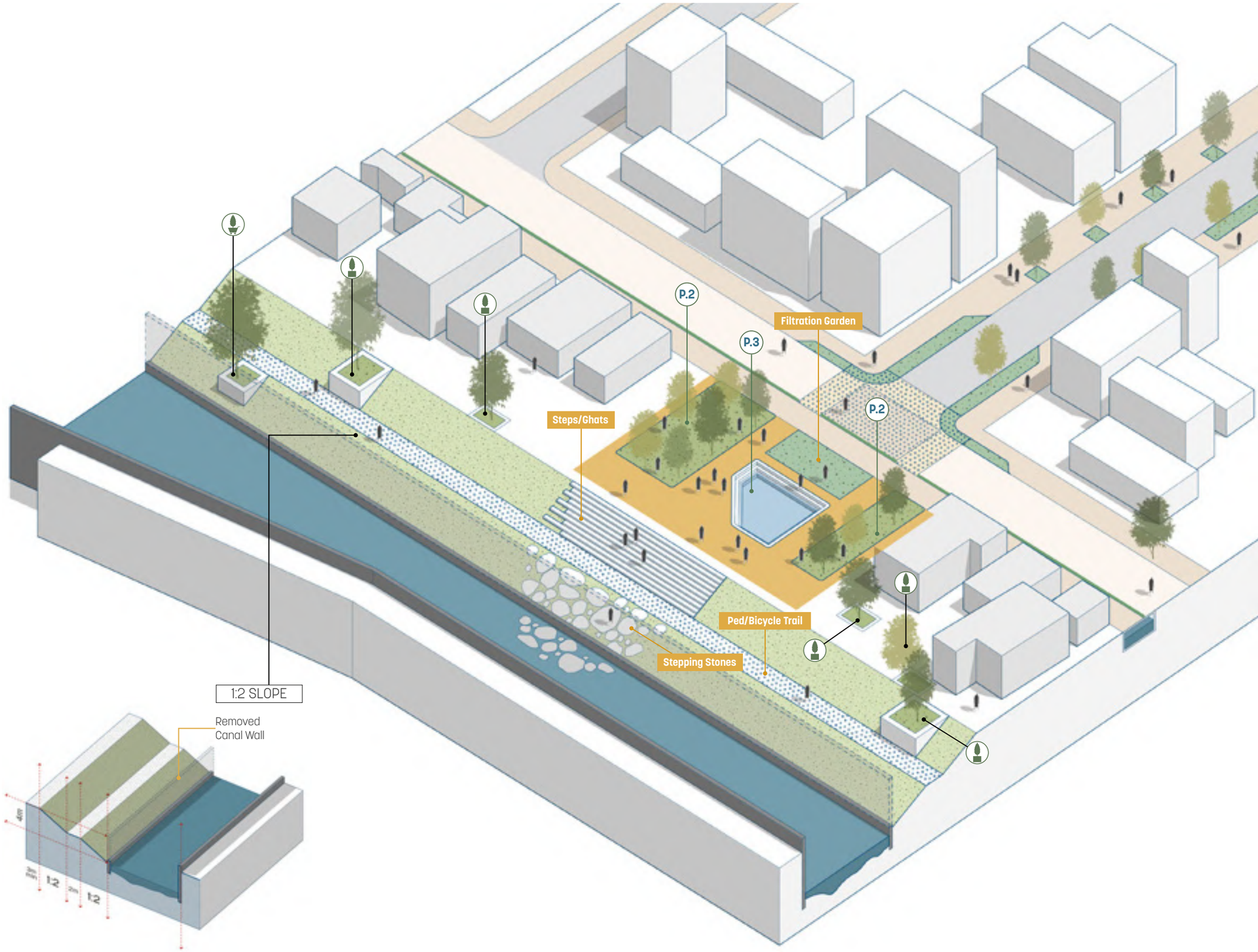
Opening up the South Buckingham Canal Edge, Building the Water Plaza

In the medium term, the extensive undertaking of 'Opening up' of the canal edge would have taken shape, where the eastern canal edge at site is graded to a 1:2 slope condition (Engineered slope with vegetation). Following this, the undeveloped open plot is delineated as a Waterfront Plaza that establishes connectivity between the street intersection and the canal edge. The Waterfront plaza is a combination of Sponge Open Space Infrastructures that include Raingardens and a Sunken plaza. The Sponge Open Space Infrastructures work in tandem with the already realized Sponge Street Infrastructures to aid in storing and delaying the runoff before releasing into the canal. The Waterfront Plaza stimulates pubic usage of the canal front, and at the same time unlocks development potential as the properties adjacent to it will experience a surge in value.

Waterfront Plaza is a community driven project realized with the support of the concerned public bodies

LEGEND

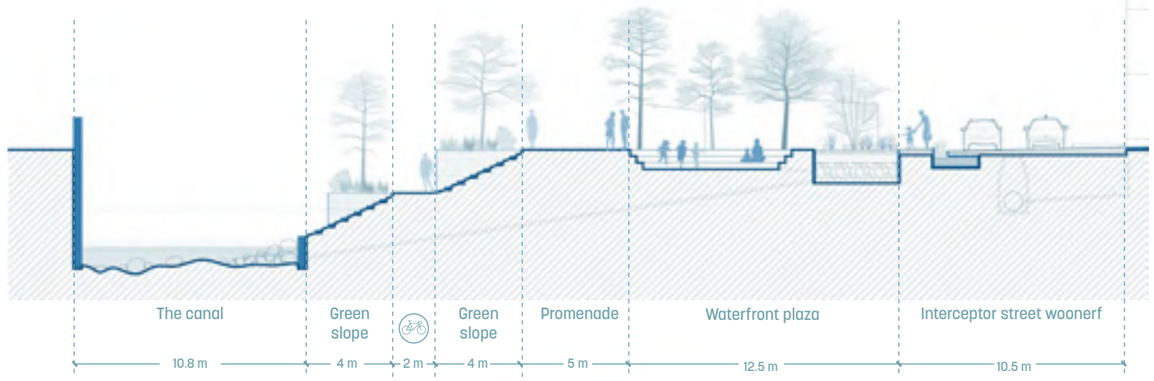
- P.2 Raingarden
- P.3 Sunken Plaza
- Trees protected during sloping of the edge
- Tress transplanted and replanted during sloping

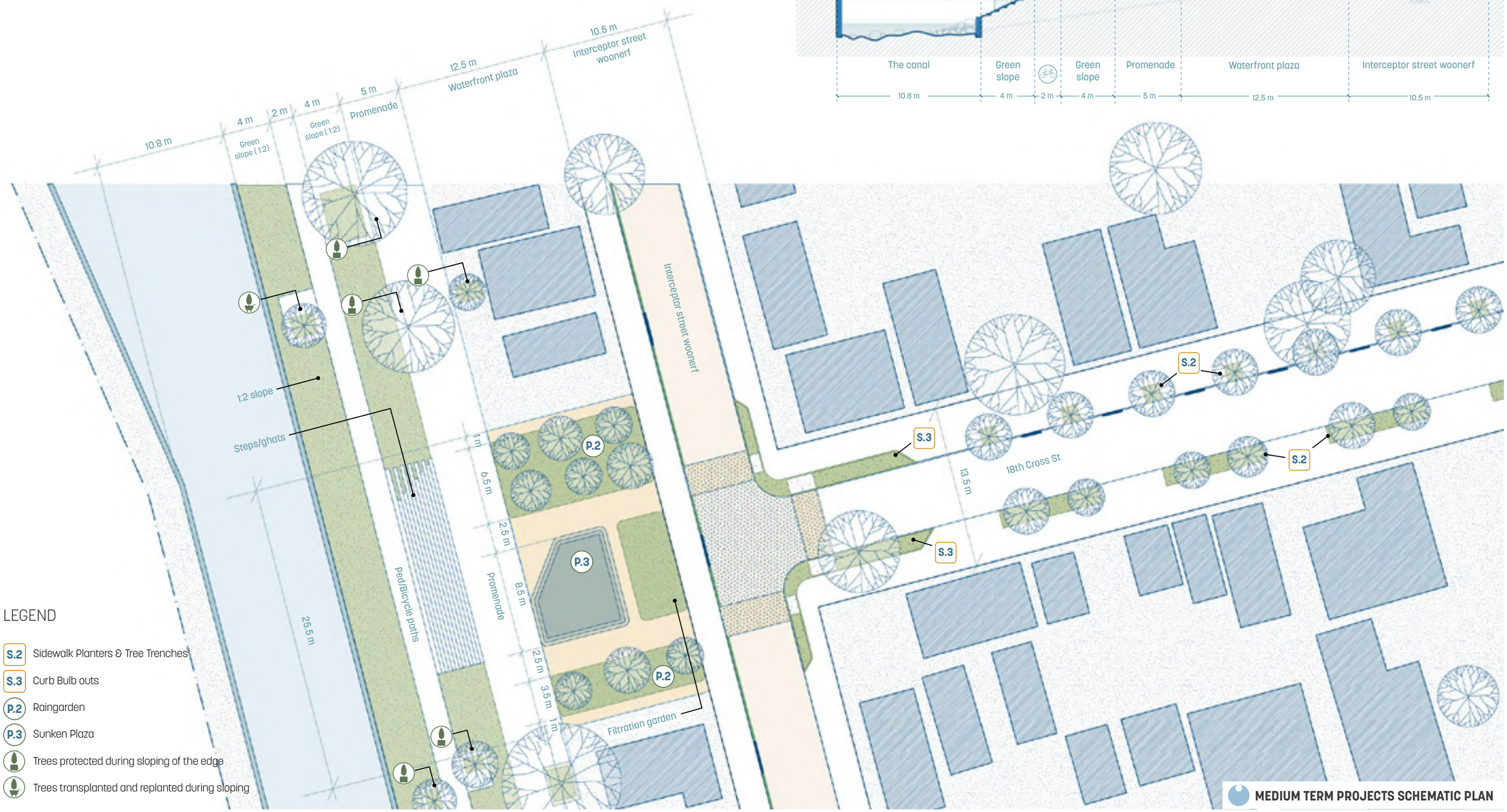


Medium-Term Projects

Opening up the South Buckingham Canal Edge, Building the Water Plaza

SCHEMATIC SECTIONS





LEGEND

- S.2 Sidewalk Planters & Tree Trenches
- S.3 Curb Bulb outs
- P.2 Raingarden
- P.3 Sunken Plaza
- Trees protected during sloping of the edge
- Trees transplanted and replanted during sloping

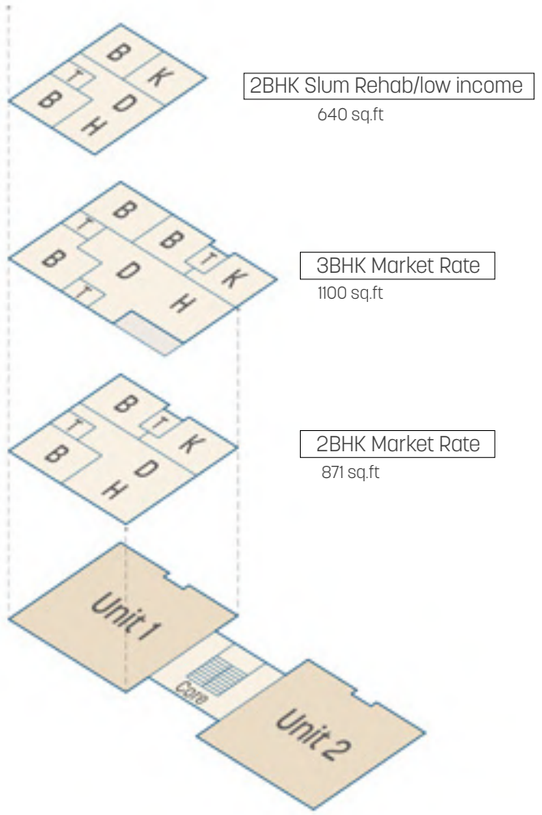
MEDIUM TERM PROJECTS SCHEMATIC PLAN

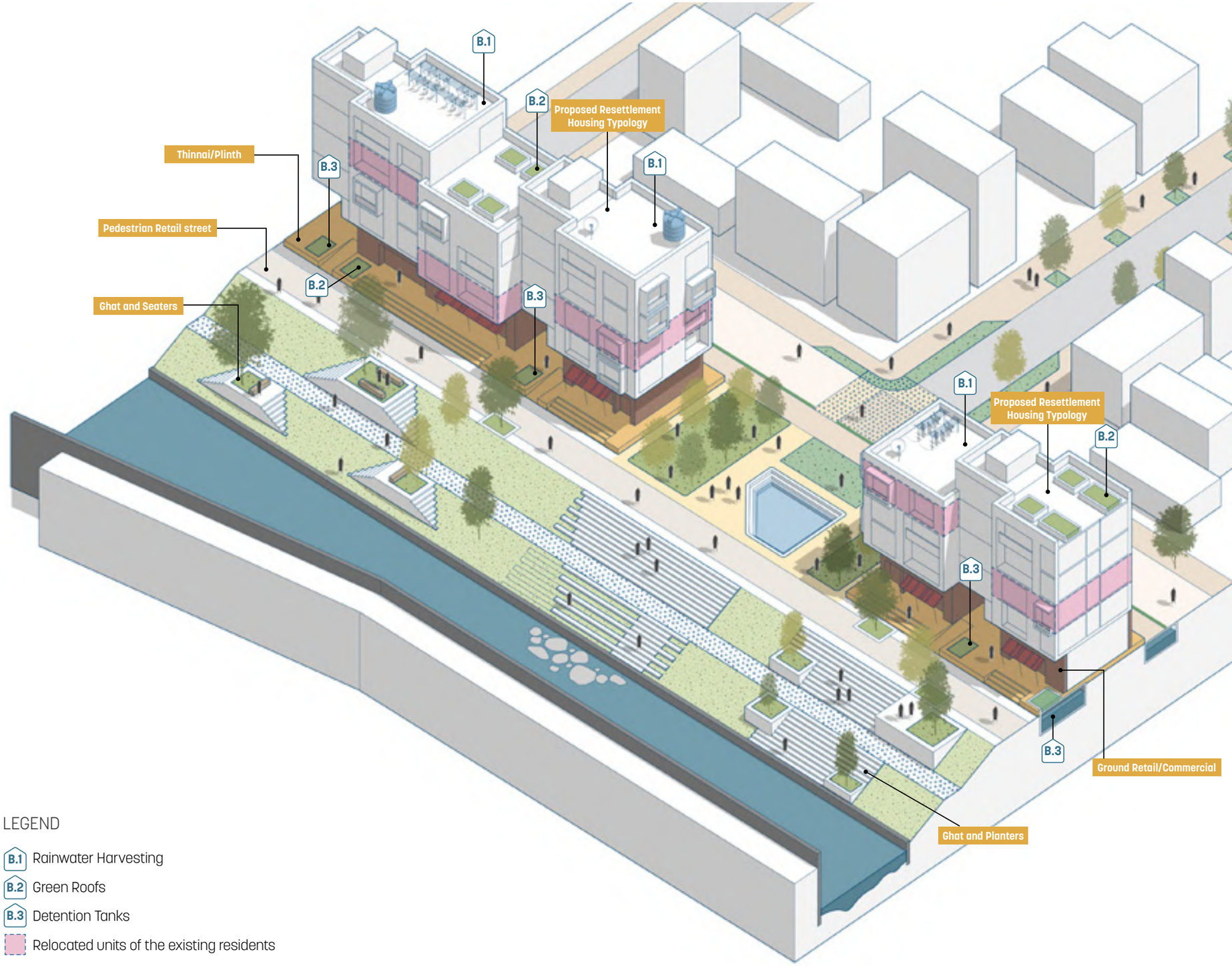
Long-Term Projects

Formalizing the South Buckingham Canal Promenade

The strategic upgrades to the public realm, realized in the short and the medium terms, economically advantage the existing residents by stimulating more development potential in the long term. The Illustration depicts a joint venture development, where the proposed housing typology resettles the existing residents in situ. The Design guidelines ensure that the stakeholders implementing the housing projects are given ownership of the stretch of the canal slope abutting their development. They are made responsible for further improvements and maintenance of their stretch. The housing units sit on a 'Thinnai' (plinth) of 0.6 metres which acts as the second line of defense during flooding. The Thinnai along with the ground retail and the canal promenade activate the street realm. The housing typology is designed to support Sponge Building Infrastructures that include Rainwater Harvesting, Green Roofs and Detention Tanks. The Sponge Buildings along with the previously instituted Sponge Streets and Open Spaces make the site a highly desirable and resilient habitat for living.

Proposed Resettlement Housing Typology - Unit Types





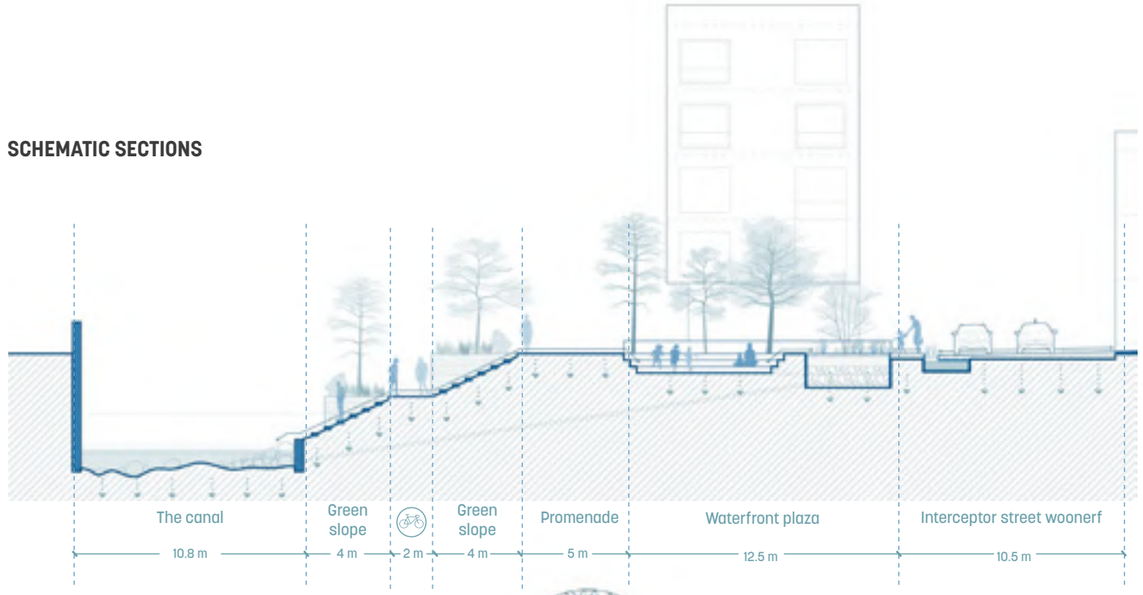
LEGEND

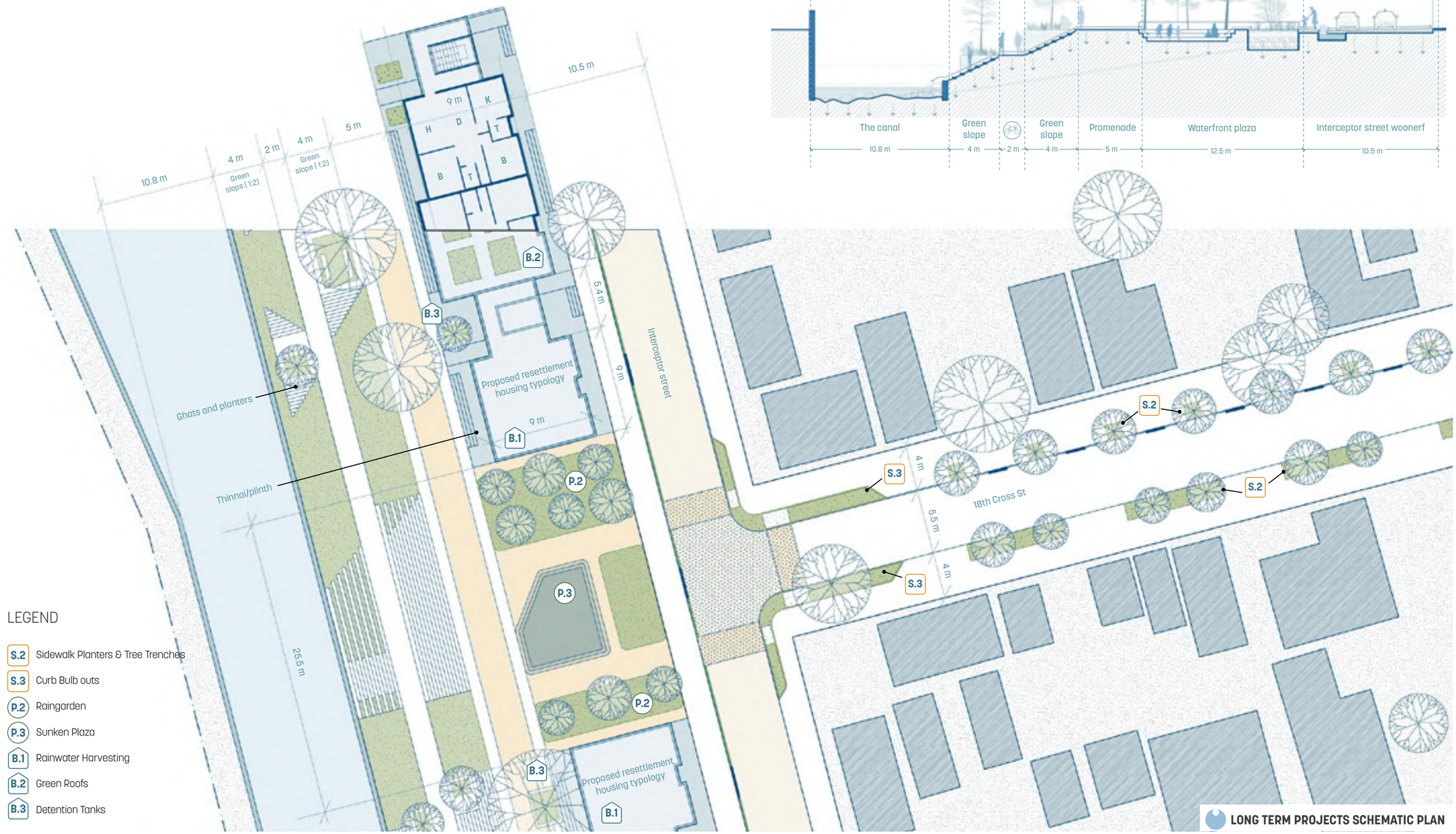
- B.1 Rainwater Harvesting
- B.2 Green Roofs
- B.3 Detention Tanks
- Relocated units of the existing residents

Long-Term Projects

Formalizing the South Buckingham Canal Promenade

SCHEMATIC SECTIONS





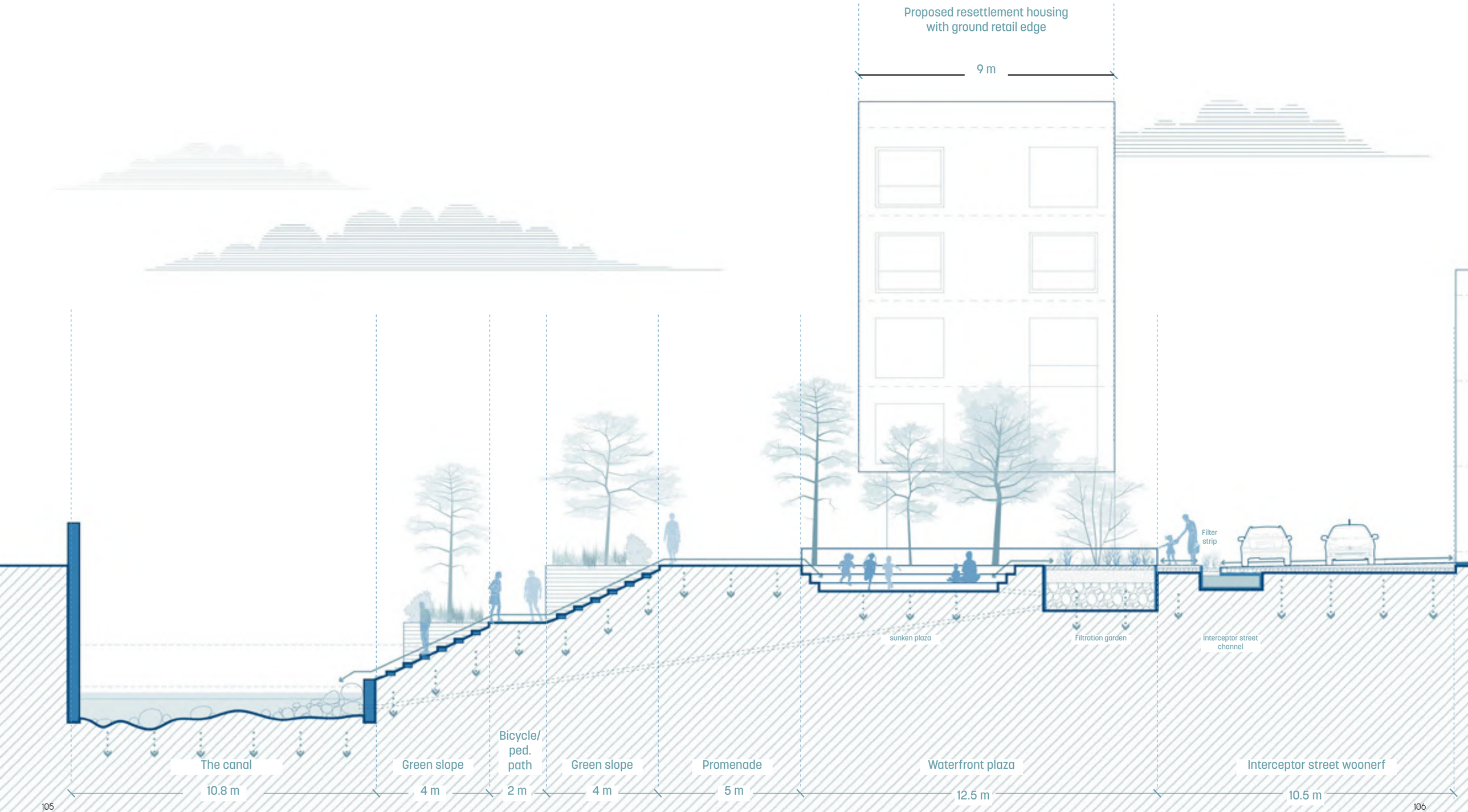
LEGEND

- S.2 Sidewalk Planters & Tree Trenches
- S.3 Curb Bulb outs
- P.2 Raingarden
- P.3 Sunken Plaza
- B.1 Rainwater Harvesting
- B.2 Green Roofs
- B.3 Detention Tanks

LONG TERM PROJECTS SCHEMATIC PLAN

Long-Term Projects

Formalizing the South Buckingham Canal Promenade



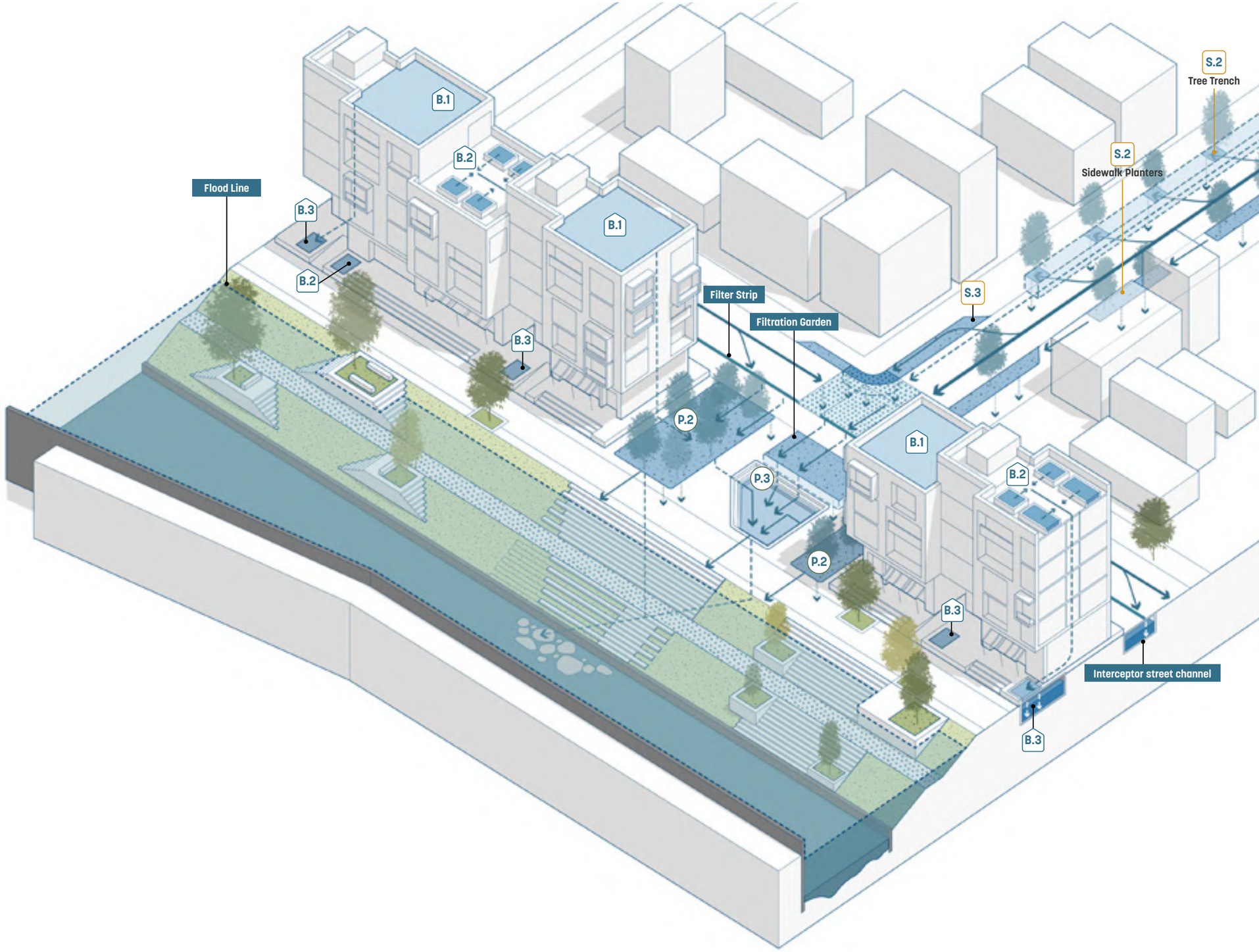
Sponge Canal Performance

How the Sponge Network functions during a storm event

The Sponge Demonstration Project section has been shown in this manner to communicate the importance of incremental investments strategically building towards systemic resilience. When a planning framework is in place, initial investments into Sponge Street upgrades can eventually lead to Sponge Open Space projects where space is available. Strategic investments from government bodies - namely opening up the canal and creating stabilized slopes in this case - can lay the foundation for bigger transformations. Multiple stakeholders are empowered to build upon this new foundation to improve the public realm and create more opportunities for people to live and work. New investments guided by Sponge Basin principles can further improve rather than compromise the resilience of the neighbourhood.

With a networked system of Sponge Streets, Open Spaces, and Buildings in place, the neighbourhood is more prepared for cloudburst and drought cycles. Sponge Street upgrades slow down water before they are collected by interceptor storage tanks, raingardens, and sunken plazas. Rainwater harvesting and detention tanks direct water towards storage structure for future consumption or groundwater recharge. A rejuvenated canal now has greater capacity to absorb excess rainfall and inflows from the Adyar River or the Pallikaranai Marsh. The entire system, from streets to open spaces to buildings and the canal are playing their part in turning the South Buckinhgam Canal sub-basin into a Sponge.

A similar combination of incremental and strategic investments in the city as a whole will lead to a more livable and resilient Chennai.



LEGEND

- S.2 Sidewalk Tree Pits & Tree Trenches
- S.3 Curb Bulb outs
- P.2 Raingarden
- P.3 Sunken Plaza
- B.1 Rainwater Harvesting
- B.2 Green Roofs
- B.3 Detention Tanks

PART 5:
VISIONS FOR SOUTH BUCKINGHAM CANAL

What fully realized Sponge Neigbourhoods look like

From Principles to Vision to Implementation

How Visions mobilize stakeholders to strategically leap from Principle to Project

PRINCIPLES

The Sponge Basin Principles of PROTECT, DELAY, STORE, RELEASE are foundational ideas that permeate all stages of the planning process to ensure every decision contributes to the larger goal of regional resilience.

FRAMEWORK PLANS

Framework plans strategically outline timelines and priorities for project implementation. Basin-scale and Ward-scale plans ensure that multiple projects realized incrementally at various scales collectively contribute towards the Sponge Basin principle. Frameworks have to be resilient enough to adapt to changes on the ground during the course of Implementation.

VISIONS

Visions build upon principles and framework plans in response to place-specific opportunities to make inspiring ideas tangible. Visions are catalysts for mobilizing multiple stakeholders to negotiate and realize an alternate future.

CONSULTATIONS AND COLLABORATIONS

All visions evolve through an iterative process of consultations with multiple disciplines and stakeholders. They further evolve as new models or protocols of collaboration require changes in scope, site, or timeline. Consultations are an opportunity for multiple voices to be heard and for expert knowledge to meet local experience.

IMPLEMENTATION

Projects are implemented through single agencies, collaborations, or new partnerships based on collective visions. All projects, no matter how small, can contribute to the Sponge Basin principle as long as they align strategically with an ever-evolving Framework.

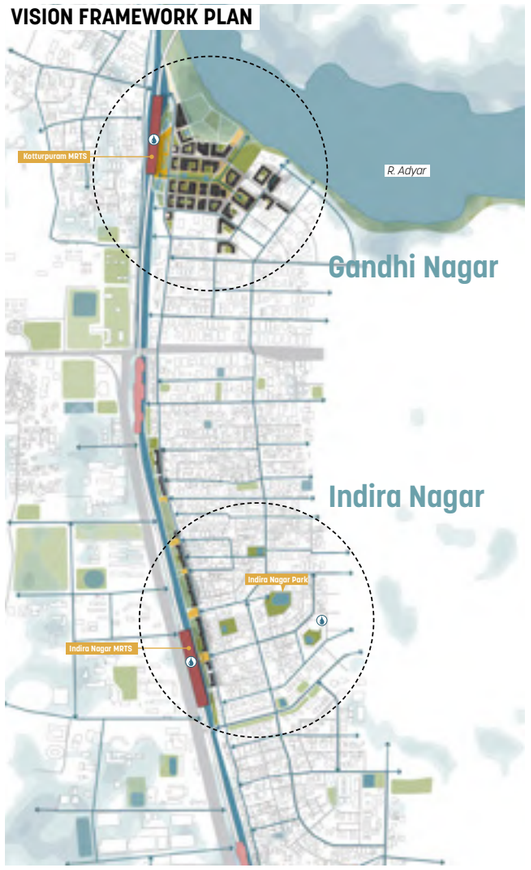
Sponge Neighbourhood Retrofit and Transit-Oriented Redevelopment

Visions from Team Sponge Competition Entry to 'Eyes on the Canal'

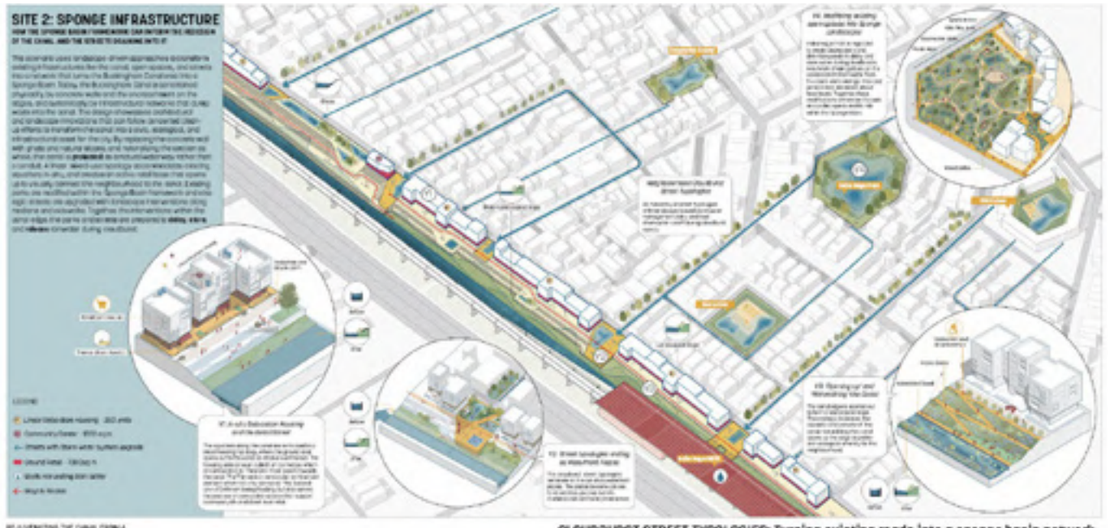
Team Sponge's competition entry to the 'Reimagining Chennai's Buckingham Canal' competition put forth a bold vision for how the Sponge Basin principles can guide the design of the canal edge, streets, transit stations, neighbourhoods and the city at large.

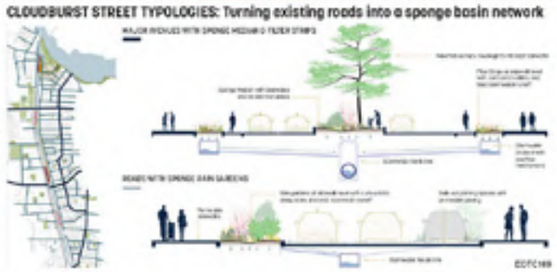
Specifically, the competition presented visions of 'Sponge Infrastructures' and 'Sponge Infrastructure Neighbourhoods'. While the former showed how Sponge Basin principles can work with existing infrastructures and the urban fabric through retrofits and upgrades, the latter vision suggested how under-utilized areas near transit stations can be redeveloped into high-density neighbourhoods while following Sponge Basin principles. We felt the need to illustrate visions of redevelopment since the reduction of sprawl as per the principles of PROTECT has to be realized through the densification of existing built-up areas in order to meet demand without converting green cover.

In the final chapter of the handbook, we elaborate upon both visions under the descriptive titles of 'Sponge Neighbourhood Retrofit' and 'Sponge Transit-Oriented Redevelopment.'

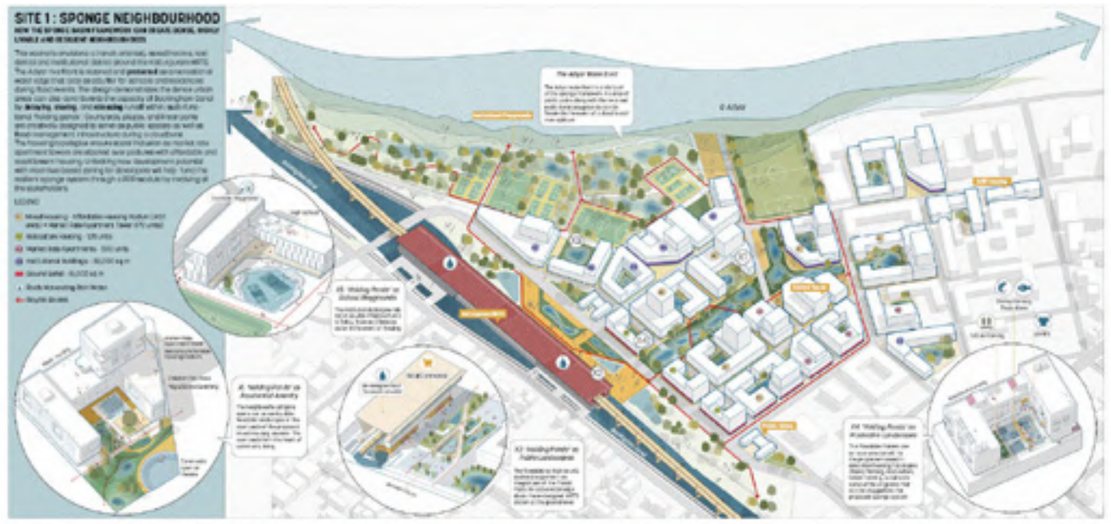


Sponge Neighbourhood Retrofit for Indira Nagar





Sponge Transit-Oriented Redevelopment for Gandhi Nagar



Sponge Neighbourhood Retrofit for Indira Nagar

Summary of the proposed Vision

The Sponge Neighbourhood Retrofit for Indira Nagar uses landscape-driven approaches to transform existing infrastructures like the canal, open spaces, and streets into a network that turns the Buckingham Canal area into a Sponge Basin. The vision showcases architectural and landscape innovations that can follow concerted clean-up efforts to transform the canal into a civic, ecological, and infrastructural asset for the city.

Existing parks are modified within the Sponge Basin framework and strategic streets are upgraded with landscape interventions along medians and sidewalks. The canal itself is opened up to increase its storage capacity and turning a neglected water body into a resilient infrastructural network and public amenity. Together, the interventions within the canal edge, the parks and streets are prepared to delay, store, and release rainwater during cloudburst.

LEGEND

- B1 Linear Relocation Housing - 250 units
- B2 Community Center - 1000 sq m
- Streets with Storm water system upgrade
- Ground Retail - 7000sq m
- Roofs Harvesting Rain Water
- Bicycle Routes

VISION FRAMEWORK PLAN

Sponge Neighbourhood Retrofit for Indira Nagar

Existing Condition

Indira Nagar is a middle-income, residential neighbourhood with buildings of varying densities, quiet streets, extensive urban tree canopies, and a fairly good distribution of neighbourhood parks. While the neighbourhood could benefit tremendously from utilizing the Buckingham Canal as a public amenity, the condition of the canal as well as the sub-optimal developments along its edge leads Indira Nagar's residents to turn their backs to the canal.

The edge of the canal is almost entirely built-up, blocking any visual or physical connection to the canal from the neighbourhood. Furthermore, any vacant land next to the canal lies disused with solid waste and other debris.

The Demonstration Project from PART 4 worked with such a condition to illustrate the evolution of the canal edge from a walled rectangular section into community resource.

Indira Nagar Canal Edge

Indira Nagar 2nd Avenue

Existing Context

Existing Context

Present day Condition

Sponge Neighbourhood Retrofit for Indira Nagar

Phasing Strategy

The Sponge Neighbourhood Retrofit vision follows the timeline laid out in the Framework in PART 3 and elaborated in PART 4. The neighbourhood of Indira Nagar begins its contribution to the Sponge Basin principles by building out its Sponge Landscape Infrastructure network over time. After making adequate headway in infrastructural upgrades and the completion of canal clean-up efforts, thenext phases of the vision focuses largely on the canal edge itself.

Today, the Buckingham Canal is constrained physically, by concrete walls and the encroachment on the edges, and systemically by infrastructural networks that dump waste into the canal. By replacing the concrete wall with ghats and natural slopes, and naturalizing the section as whole, the canal is protected as a natural waterway rather than a conduit. A linear mixed-use typology accommodates existing squatters in-situ, and creates an active retail base that opens up to visually connect the neighbourhood to the canal.

MAJOR UNDERTAKING IN EACH PHASE

PHASE 1

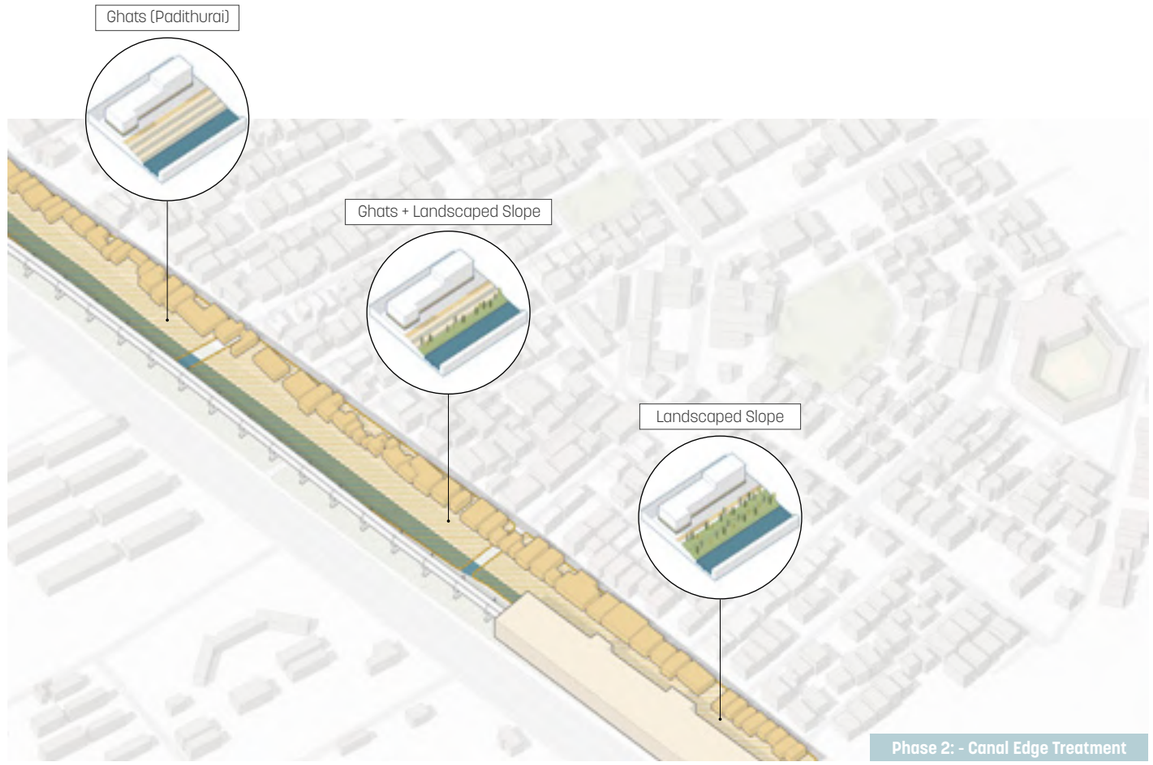
- Sponge Streets
- Sponge Open Spaces

PHASE 2

- Canal Edge Clearance
- Canal Edge Sloping

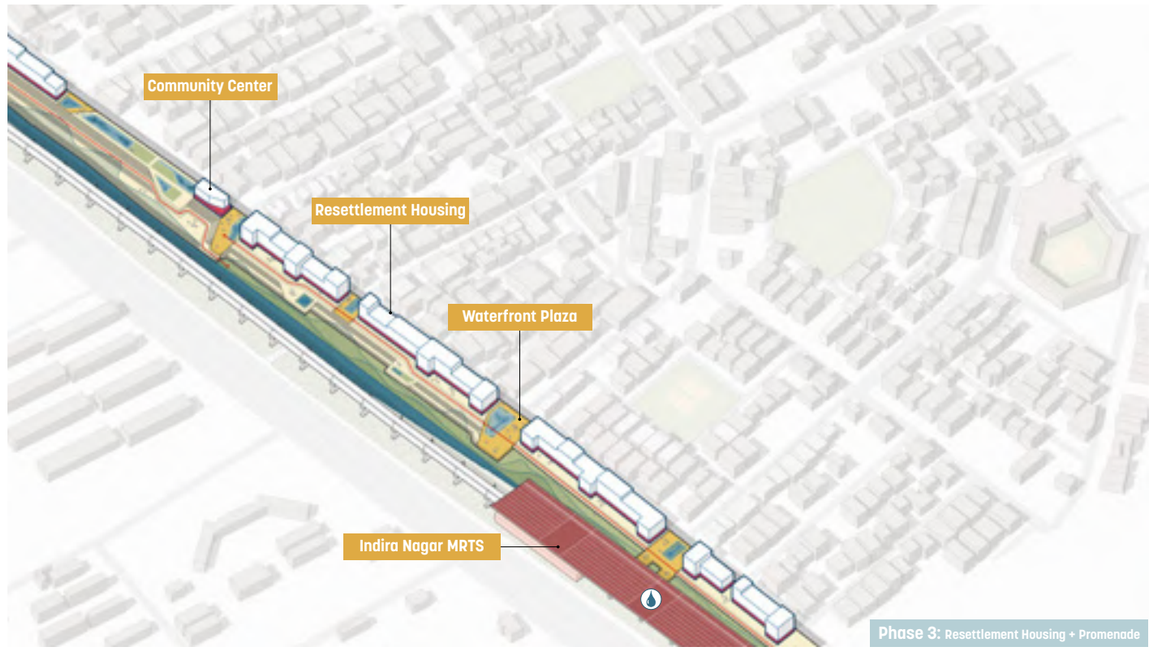
PHASE 3

- Waterfront Plazas
- Resettlement Housing



Phase 2: - Canal Edge Treatment

Phase 1: Sponge Infrastructure



Phase 3: Resettlement Housing + Promenade

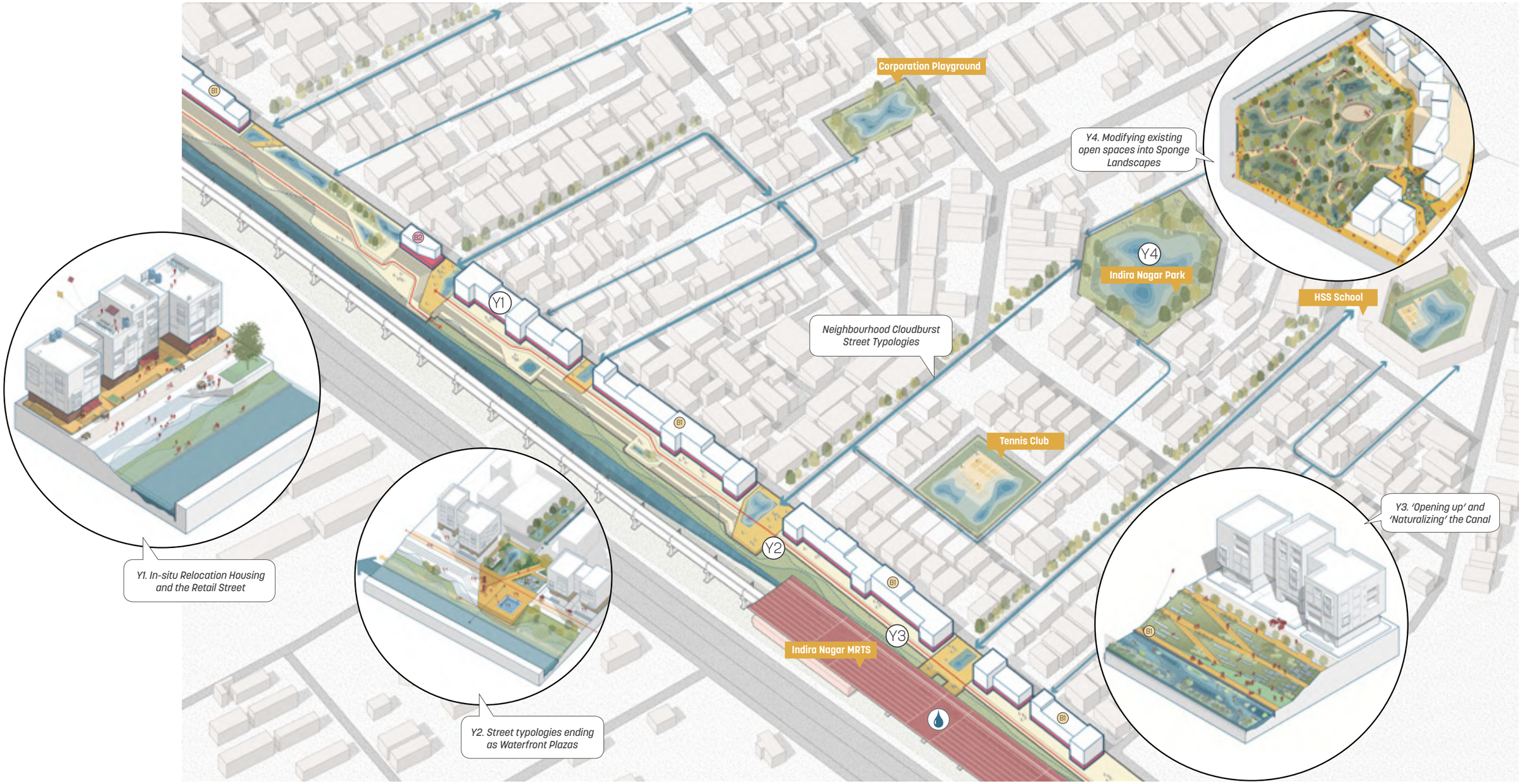
Sponge Neighbourhood Retrofit for Indira Nagar

Strategic Projects in the Vision

The vision for Indira Nagar relies on a number of strategic projects that are highlighted in the drawing below and detailed in the following spreads. The projects range from Sponge Open Space upgrades to large neighbourhood parks, and the formalization of the Buckingham Canal edge through a public promenade, plazas, and retail.

LEGEND

- B1 Linear Relocation Housing - 250 units
- B2 Community Center - 1000 sq m
- Streets with Storm water system upgrade
- Ground Retail - 7000sq m
- Roofs Harvesting Rain Water
- Bicycle Routes

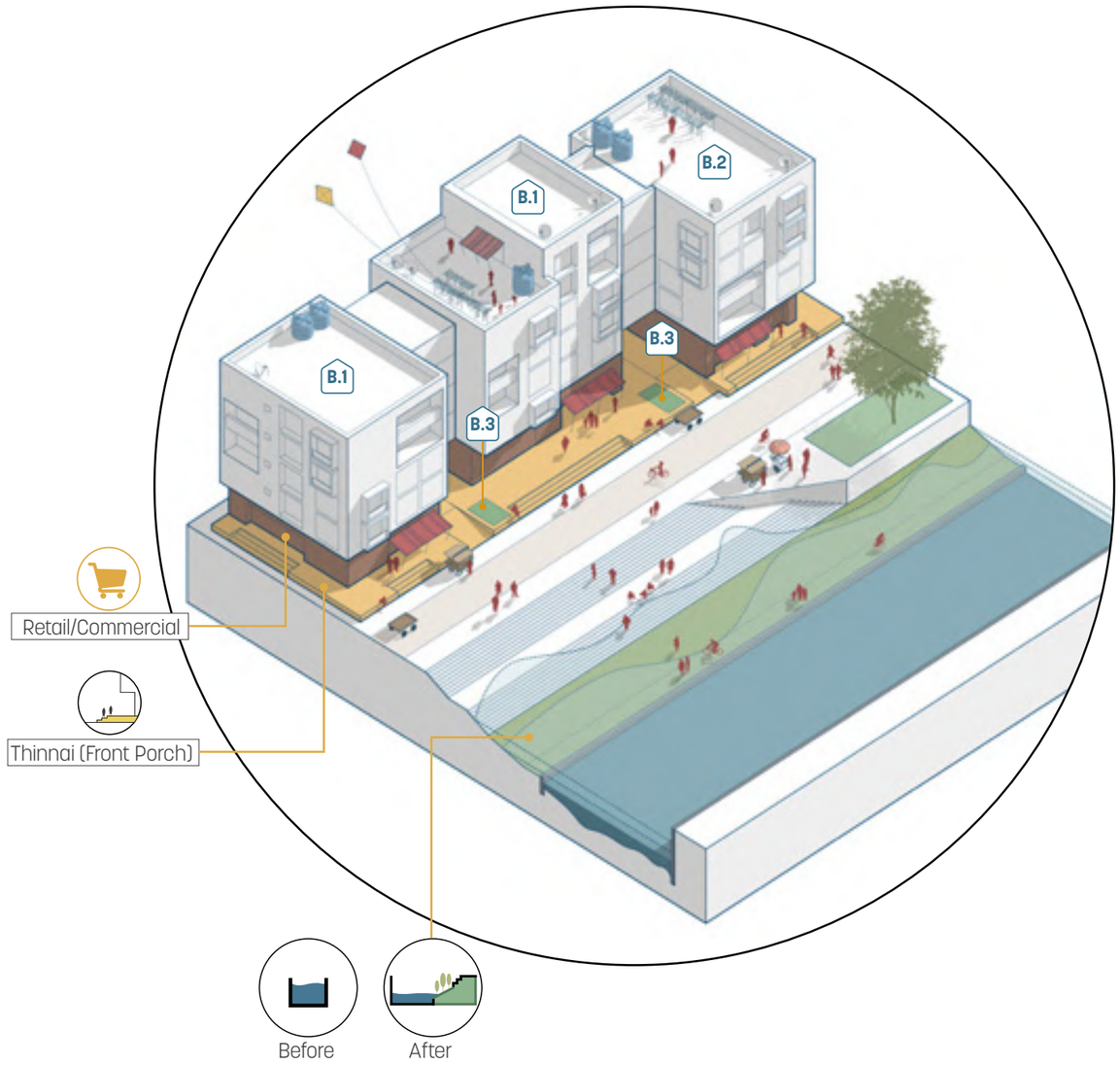


Sponge Neighbourhood Retrofit for Indira Nagar

Y1: In-site Resettlement Housing and the Canal Promenade

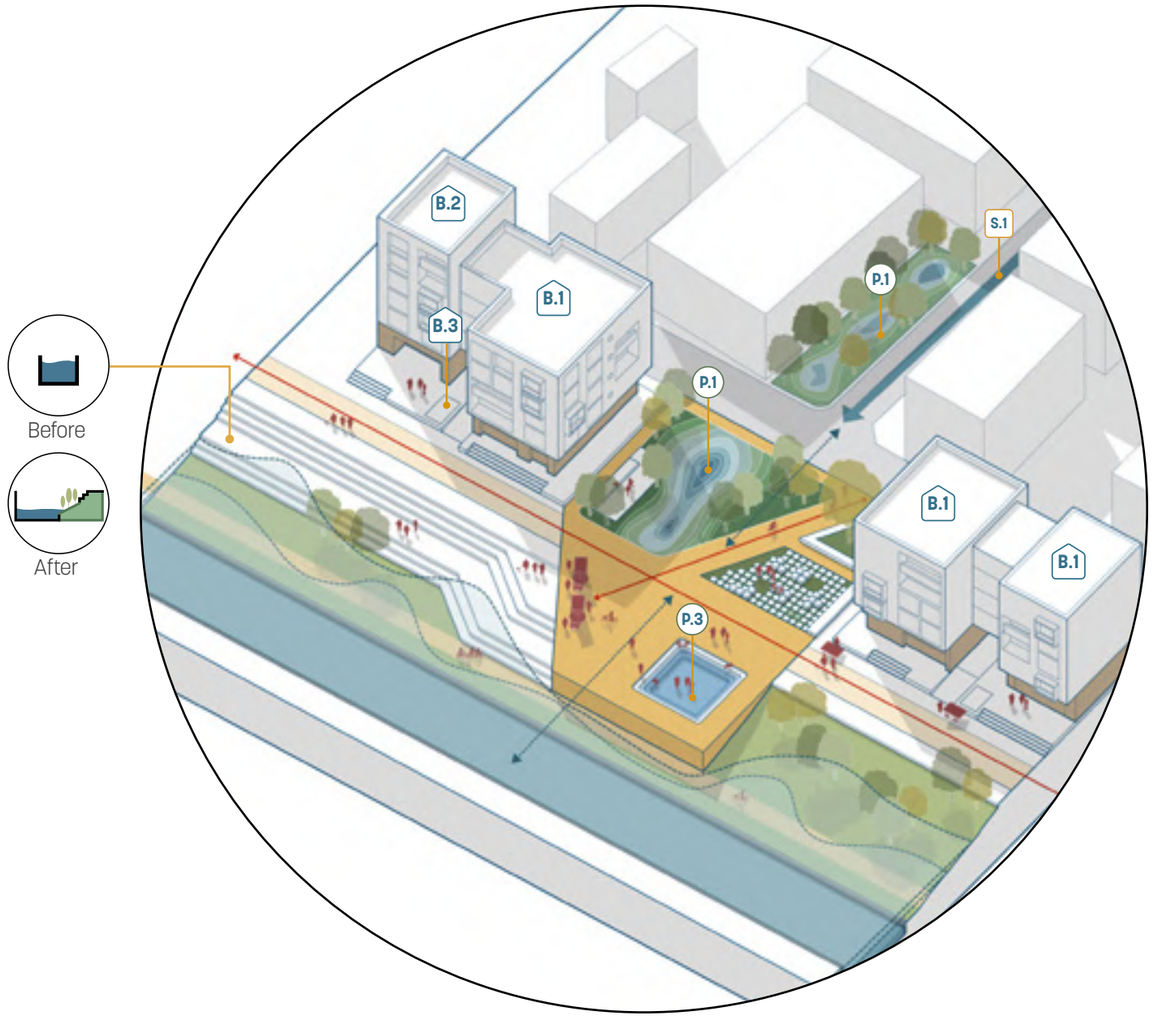
As the canal edge is opened up and improved, the existing housing stock and density becomes sub-optimal. By working with existing residents, a resettlement project where existing residents including low-income squatters are are re-housed in a linear housing typology. Within this proposed mixed-income housing, existing and low-income households will be prioritized for housing and retail ownership on the ground level. Ground level retail or commercial is a porous foundation for the building a catalyst for public life along the canal.

The housing units sit over a plinth of 0.6 metres which are articulated as 'Thinnai's' (front porch) towards the canal. The Thinnai is a vernacular architectural element which not only serves as 'The Second Line of Defense' during flooding, but also serves the purpose of semi-public spaces that support community life and street level retail



Y2: Waterfront Plazas marking the Canal's intersection with strategic streets

Sponge Street typologies terminate at the canal as Sunken Water Plazas. The plazas become places for recreation, pop-up events, markets and community interaction. Furthermore, these strategic junctions play an important infrastructural role as runoff from streets perpendicular to the Canal Bank Road can be intercepted and treated by the bioinfiltration basins within the plaza before being released in the canal.



Sponge Neighbourhood Retrofit for Indira Nagar

Visions of the canal-edge housing and Canal Promenade

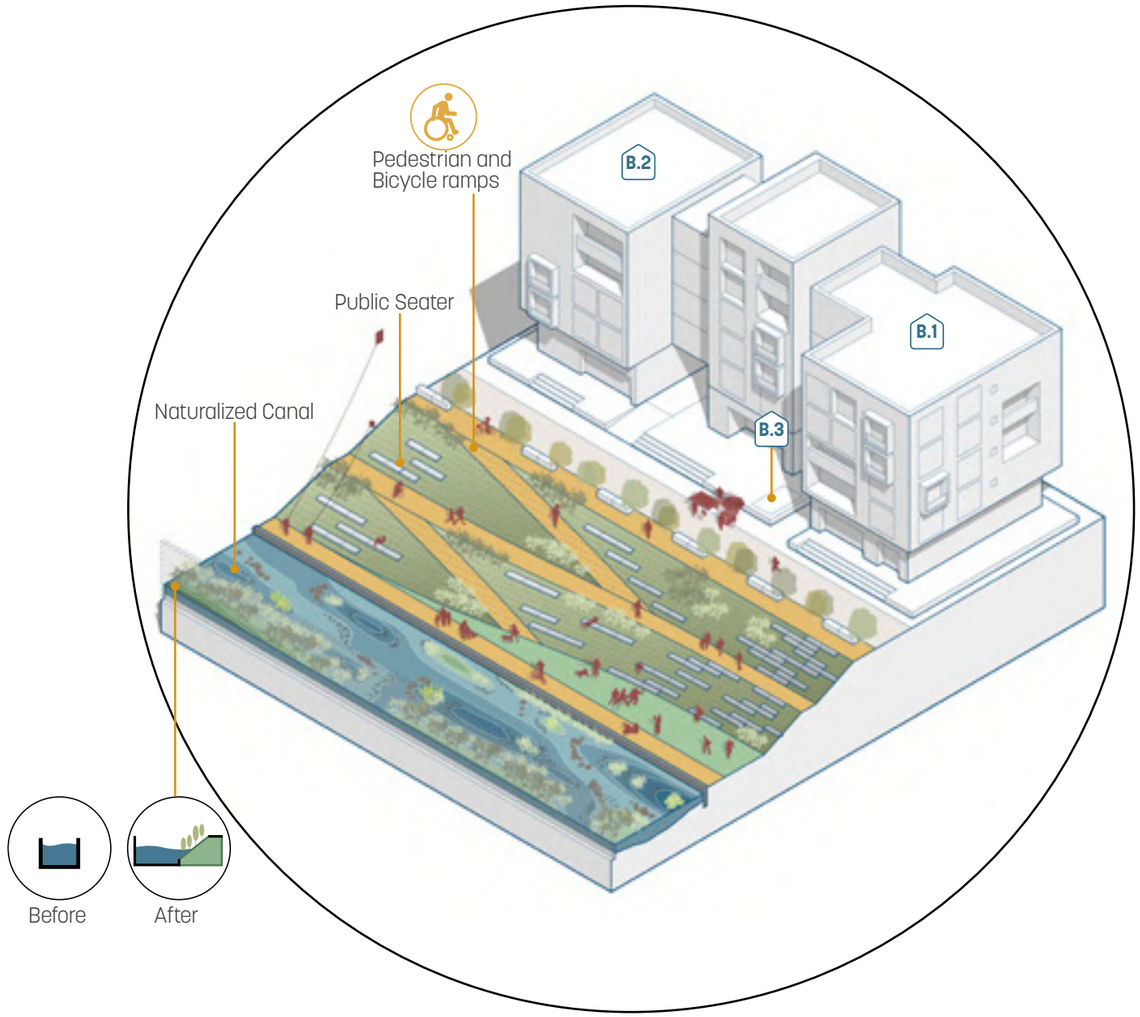
THE CANAL EDGE IS OPENED UP TO MAKE ROOM FOR WATER, ECOLOGY, AND PUBLIC LIFE

Sponge Neighbourhood Retrofit for Indira Nagar

Y3: Opening Up and Naturalizing the Canal

As the canal edge is opened up and improved, the existing housing stock and density becomes sub-optimal. By working with existing residents, a resettlement project where existing residents including low-income squatters are are re-housed in a linear housing typology. Within this proposed mixed-income housing, existing and low-income households will be prioritized for housing and retail ownership on the ground level. Ground level retail or commercial is a porous foundation for the building a catalyst for public life along the canal.

The housing units sit over a plinth of 0.6 metres which are articulated as 'Thinnai's' (front porch) towards the canal. The Thinnai is a vernacular architectural element which not only serves as 'The Second Line of Defense' during flooding, but also serves the purpose of semi-public spaces that support community life and street level retail



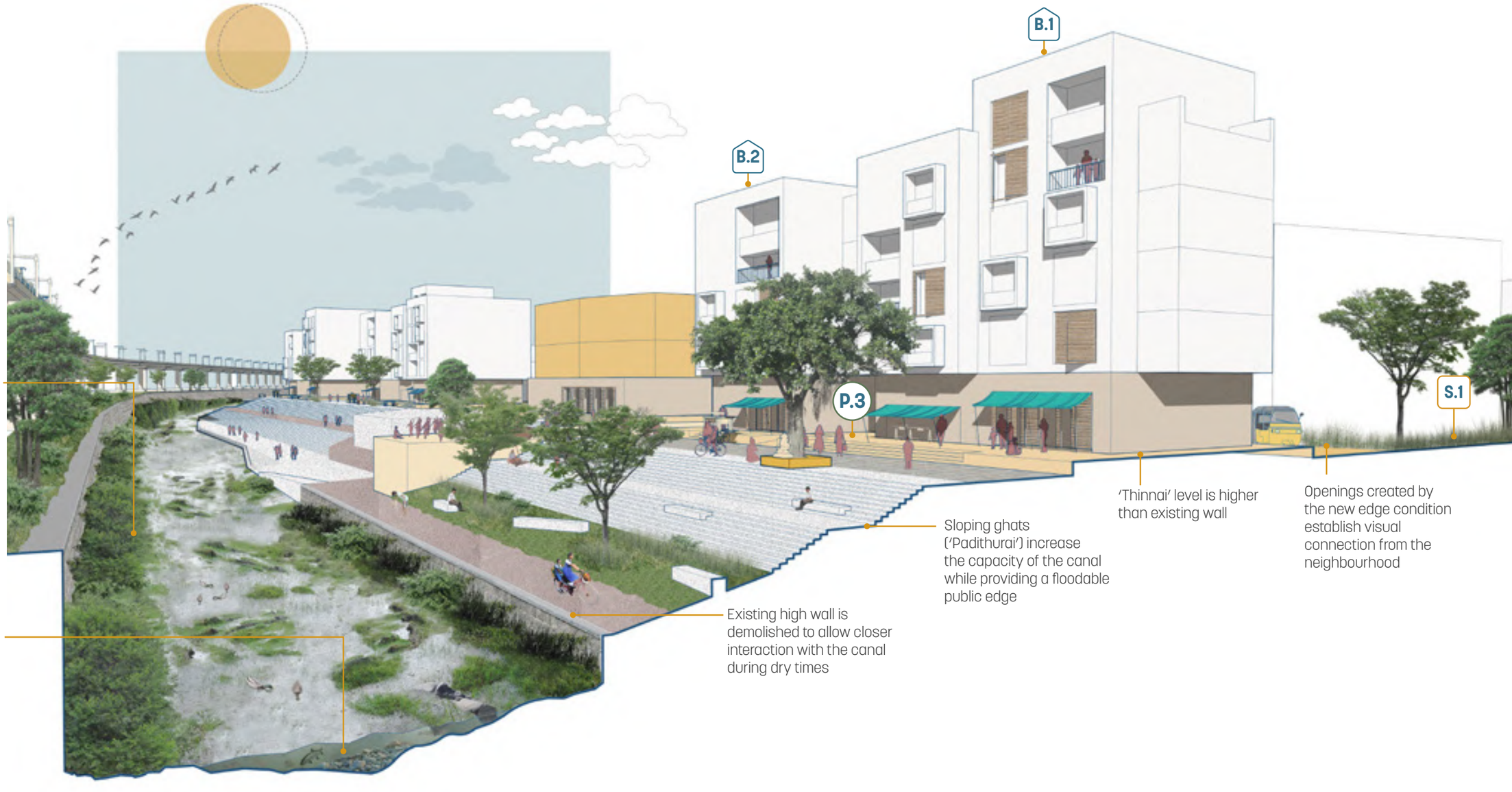
Y4: Modifying existing open spaces into Sponge Open Spaces

Sponge Street typologies terminate at the canal as Sunken Water Plazas. The plazas become places for recreation, pop-up events, markets and community interaction. Furthermore, these strategic junctions play an important infrastructural role as runoff from streets perpendicular to the Canal Bank Road can be intercepted and treated by the bioinfiltration basins within the plaza before being released in the canal.

Sponge Neighbourhood Retrofit for Indira Nagar

Visions of a culturally and ecologically vibrant Buckingham Canal

REJUVENATING THE CANAL FROM A CONDUIT TO A PUBLIC AMENITY & ECOLOGICAL HABITAT



Sponge Transit-Oriented Redevelopment for Gandhi Nagar

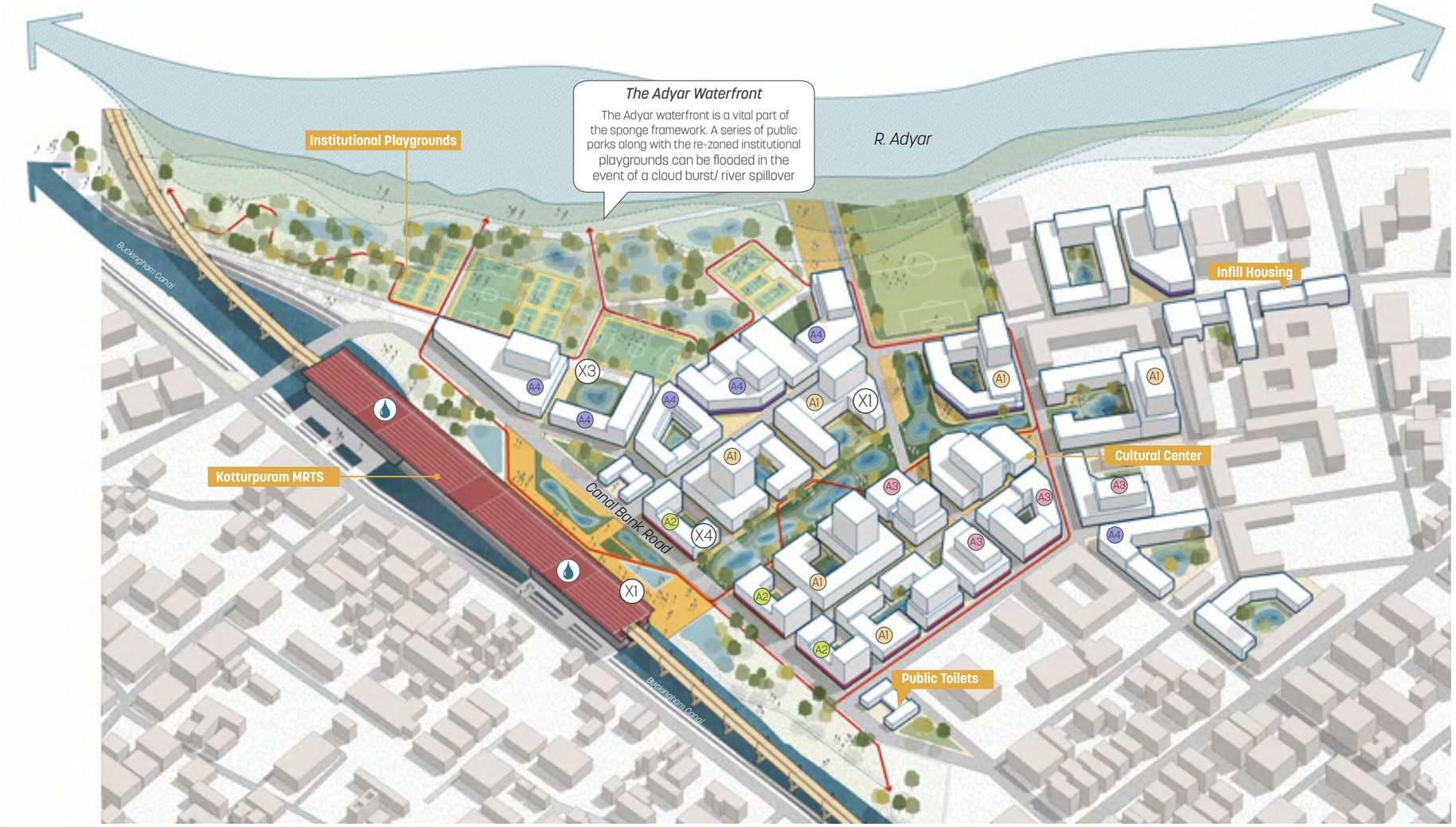
Summary of the proposed Vision

The proposed Redevelopement for Gandhi Nagar envisions a resilient, transit-oriented, mixed income, residential and institutional district around the Kotturpuram MRTS. The design demonstrates how dense urban areas can also contribute to the capacity of Buckingham Canal by delaying, storing, and releasing runoff within multi-functional 'Sponge Landscape Typologies'. Courtyards, plazas, and linear parks are creatively designed to serve as public spaces as well as flood-management infrastructure during a cloudburst. The Adyar riverfront is rezoned and protected as a recreational water edge that acts as a buffer for schools and residences during flood events. The housing typologies ensure socio-economic diversity as market rate apartment towers are stacked over podiums with affordable and resettlement housing. Unlocking new development potential with incentive-based zoning for developers will help fund the Sponge Basin network through PPP modules involving all local stakeholders.

LEGEND

- A1 Mixed Housing - Affordable Housing Podium (400 units) + Market Rate Apartment Tower (170 units)
- A2 Relocation Housing - 125 units
- A3 Market Rate Apartments - 500 units
- A4 Institutional Buildings - 30,000 sq m
- Ground Retail - 15,000 sq m
- Roofs Harvesting Rain Water
- Bicycle Routes

VISION FRAMEWORK PLAN



Sponge Transit-Oriented Redevelopment for Gandhi Nagar

Existing Condition

The neighbourhood of Gandhi Nagar in Adyar is located to the east of Kotturpuram MRTS station and is flanked on the North by the Adyar river. The neighbourhood is predominantly residential with a cluster of academic institutions situated towards the northern edge. The stretch of land between the Canal Bank road and the Kotturpuram MRTS station is inhabited by settlements of substandard housing that hinder connectivity to the station, as well as to the canal. The Adyar riverfront is also largely inaccessible due to ownership contraints. Although being close to the transit station, unsynchronized planning over years has resulted in a sparse urban fabric. The scenario presents for a compelling opportunity to re-imagine Gandhi Nagar as a high density, transit-oriented, mixed income and a resilient neighbourhood.

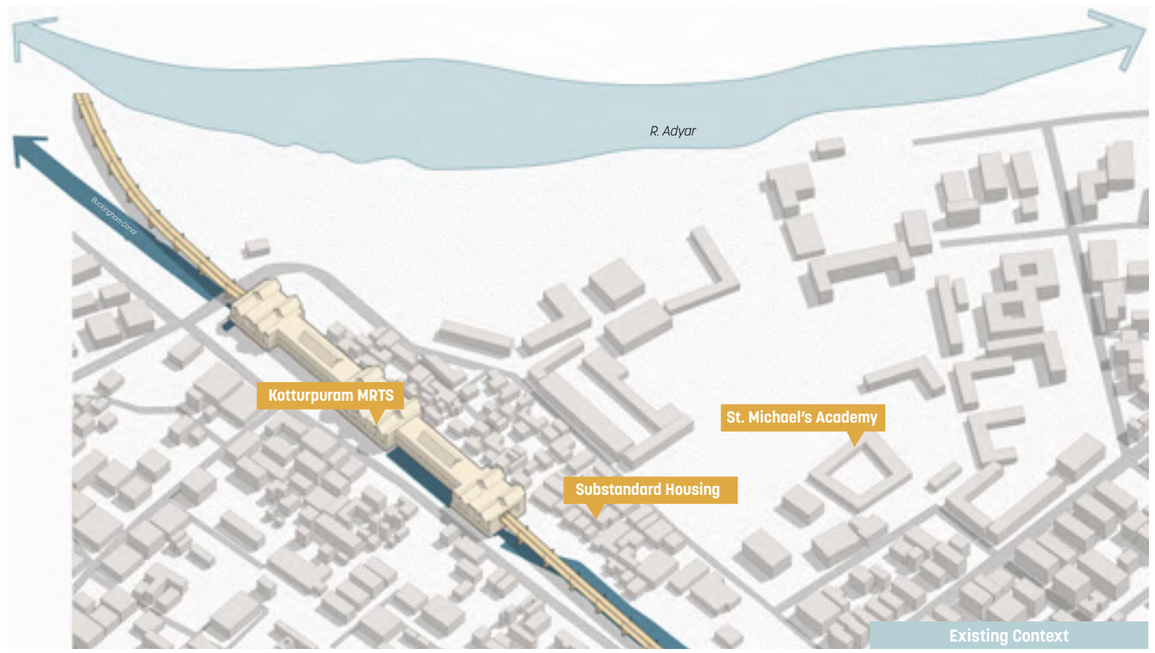
Kotturpuram MRTS - East side

Substandard housing abutting eastern side of MRTS station

Adyar Riverfront - Today

Canal Bank Road

Existing Context



Existing Context

Sponge Transit-Oriented Redevelopment for Gandhi Nagar

Phasing Strategy

The proposed Redevelopment vision for Gandhi Nagar can be realized incrementally through strategic planning efforts that span over multiple phases. The predominant objective of creating a 'Resilient Sponge Neighbourhood' is carried out concurrently with strategies for other crictical urban issues in the neighbourhood. **Phase 1** is aimed at enhancing accessibilty and connectivity; providing public access to the canal, transit station and access to standard housing. The Transit authority acquires the land for the 'Sponge Transit Plaza' by re-housing the residents of the substandard housing into new Resettlement housing typologies. The key goal of **Phase 2** is to create a resilient buffer along the Adyar riverfront and to ease out land for high density developments. It is accomplished through Incentivized Relocation of the Institutional buildings and their playgrounds along the riverfront. A series of public parks along with the re-zoned institutional playgrounds can be flooded in the event of a cloud burst/ river spillover. **Phase 3** aims to create a robust sponge landscape network that unlocks more development potential. A Highly programmed Linear Sponge Park system (The Neighbourhood Spine) is introduced, around which blocks of Mixed Housing typlogies take shape through a PPP module. **Phase 4** aims to create more Infill and housing opportunities in the neighbourhood that would aid in subsidizing the costs for the Sponge Infrastructures.

MAJOR UNDERTAKING IN EACH PHASE

PHASE 1

- Sponge Transit Plaza
- Resettlement Housing

PHASE 2

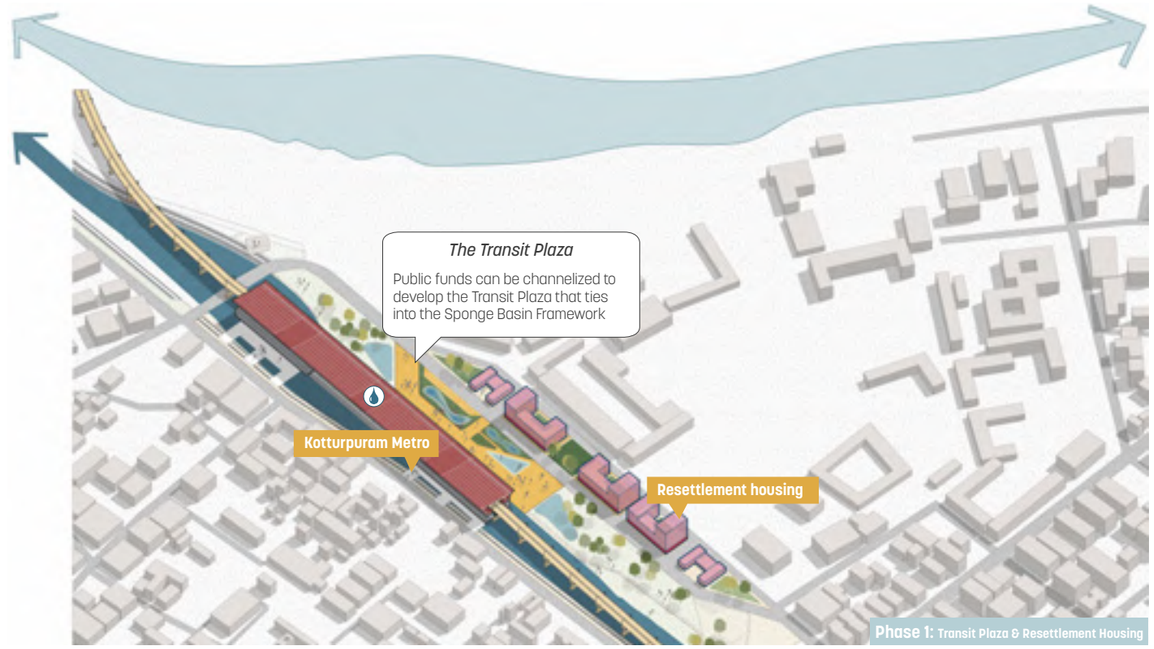
- Adyar Waterfront
- Rezoning of Institutions

PHASE 3

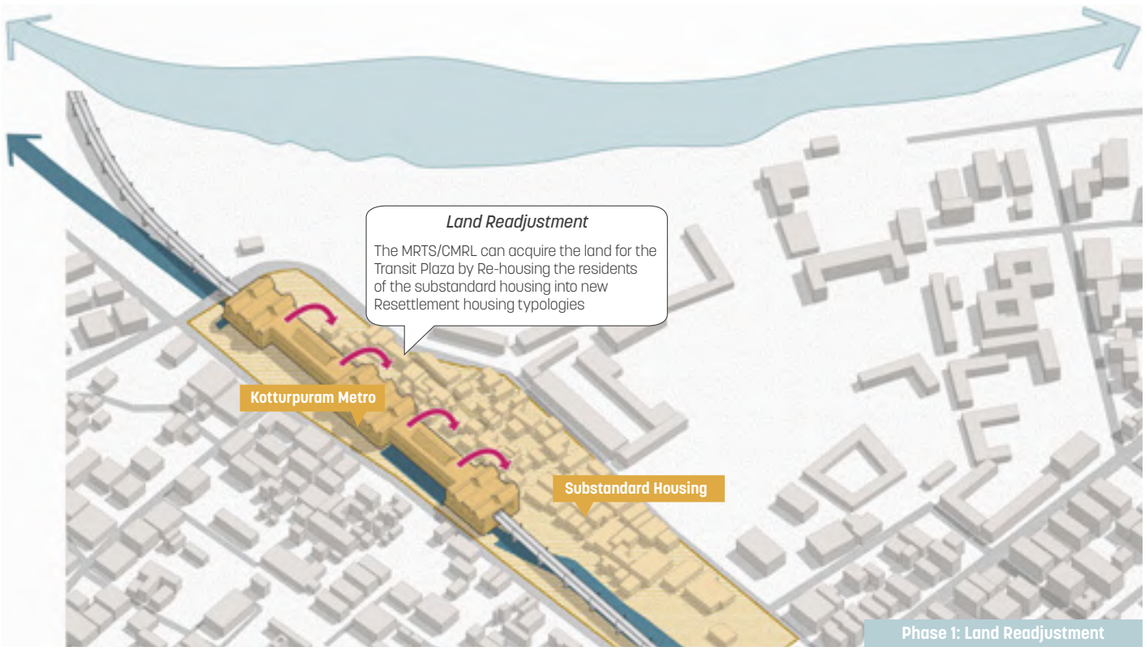
- Neighbourhood Spine
- Mixed Housing Developments

PHASE 4

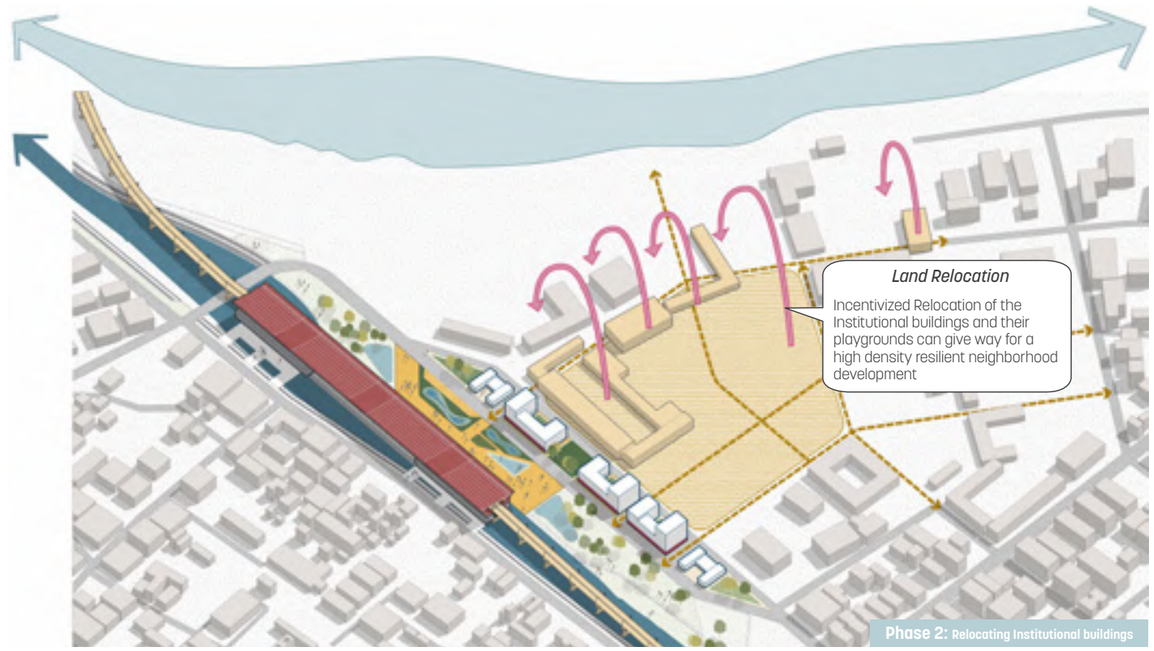
- Housing Developments
- Infill Developments



Phase 1: Transit Plaza & Resettlement Housing



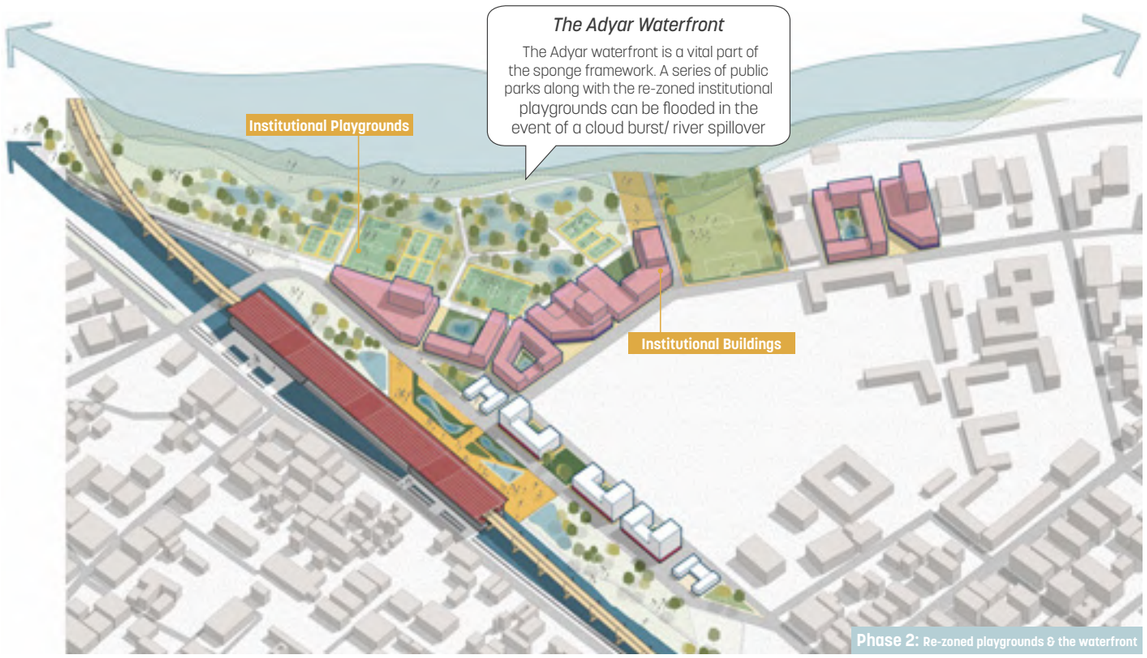
Phase 1: Land Readjustment



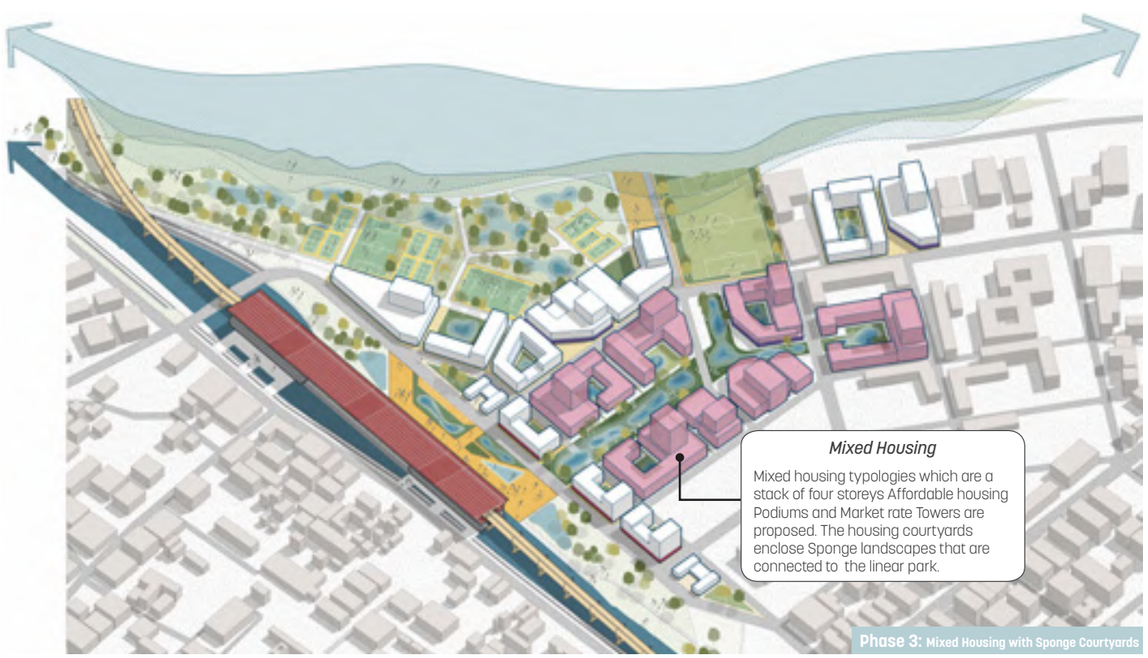
Phase 2: Relocating Institutional buildings

Sponge Transit-Oriented Redevelopment for Gandhi Nagar

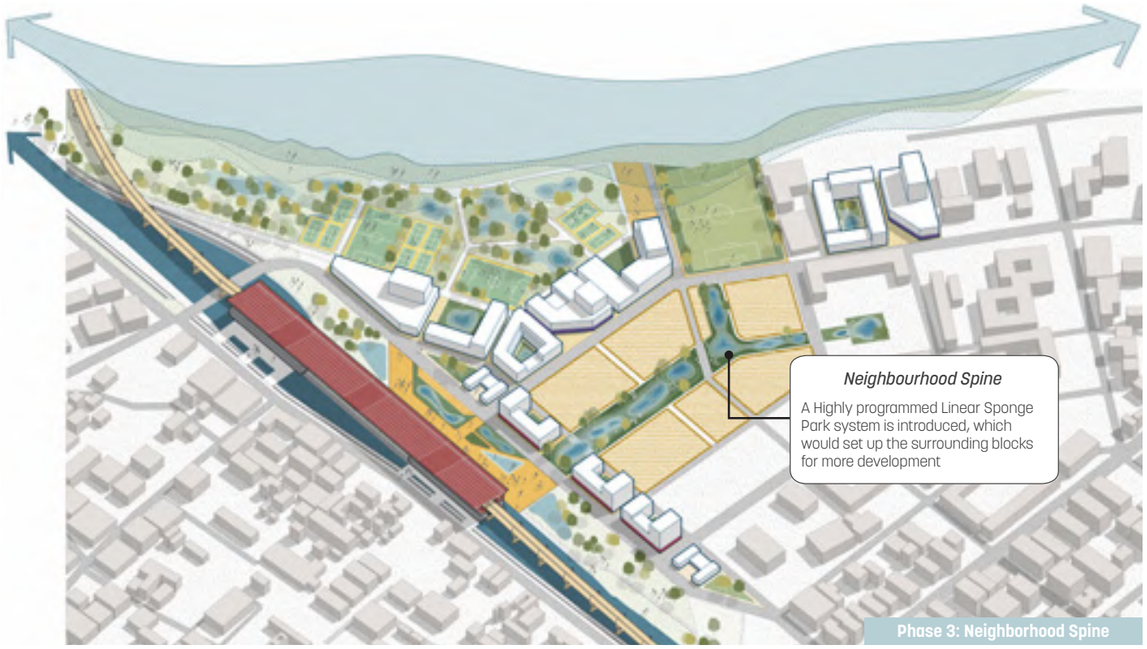
Phasing Strategy



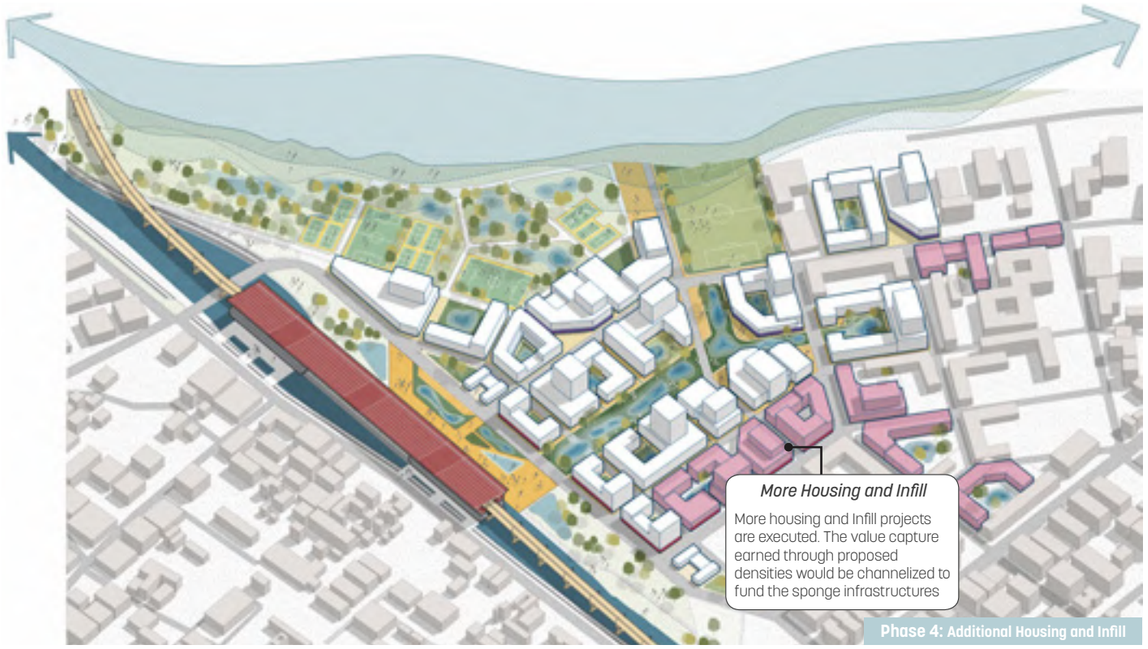
Phase 2: Re-zoned playgrounds & the waterfront



Phase 3: Mixed Housing with Sponge Courtyards



Phase 3: Neighborhood Spine



Phase 4: Additional Housing and Infill

Sponge Transit-Oriented Redevelopment for Gandhi Nagar

Strategic projects in the Vision

The proposed vision for Gandhi Nagar identifies a few of the several projects that would contribute to the Sponge Basin Framework. The projects identified involve a diverse range of stakeholders and they illustrate in detail the form, types and benefits of the Sponge Landscape Typologies.

LEGEND

- A1 Mixed Housing - Affordable Housing Podium (400 units) + Market Rate Apartment Tower (170 units)
- A2 Relocation Housing - 125 units
- A3 Market Rate Apartments - 500 units
- A4 Institutional Buildings - 30,000 sq m
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- Roofs Harvesting Rain Water
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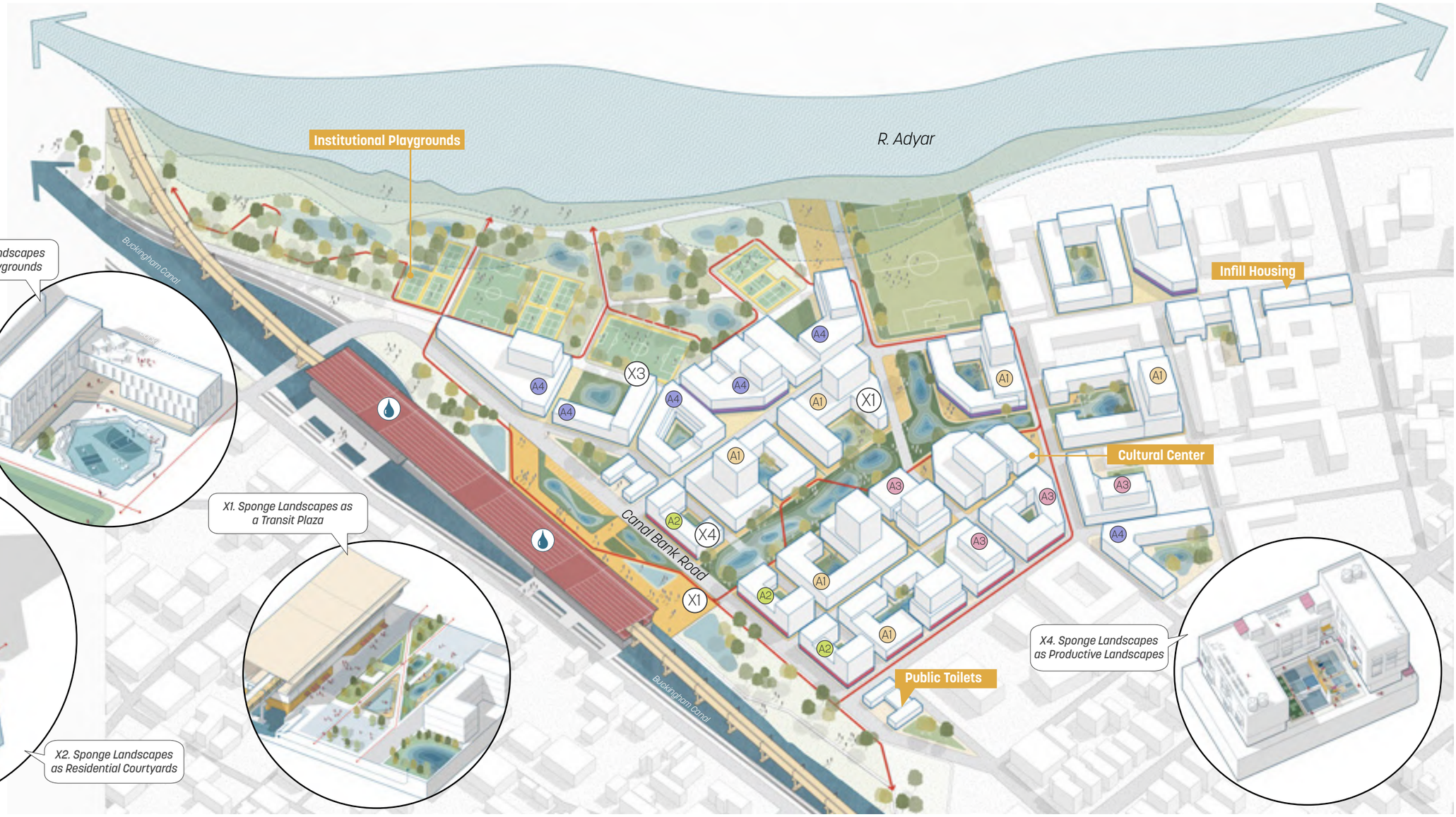
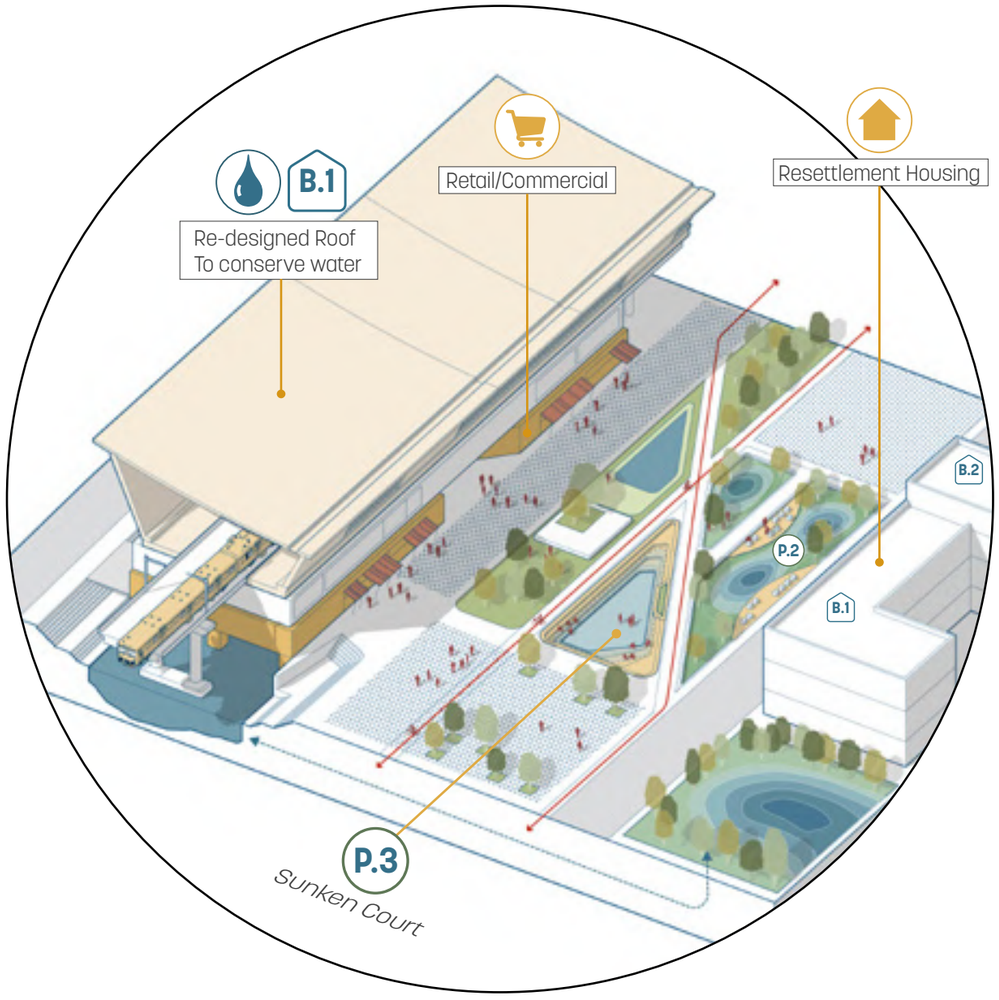


Sponge Transit-Oriented Redevelopment for Gandhi Nagar

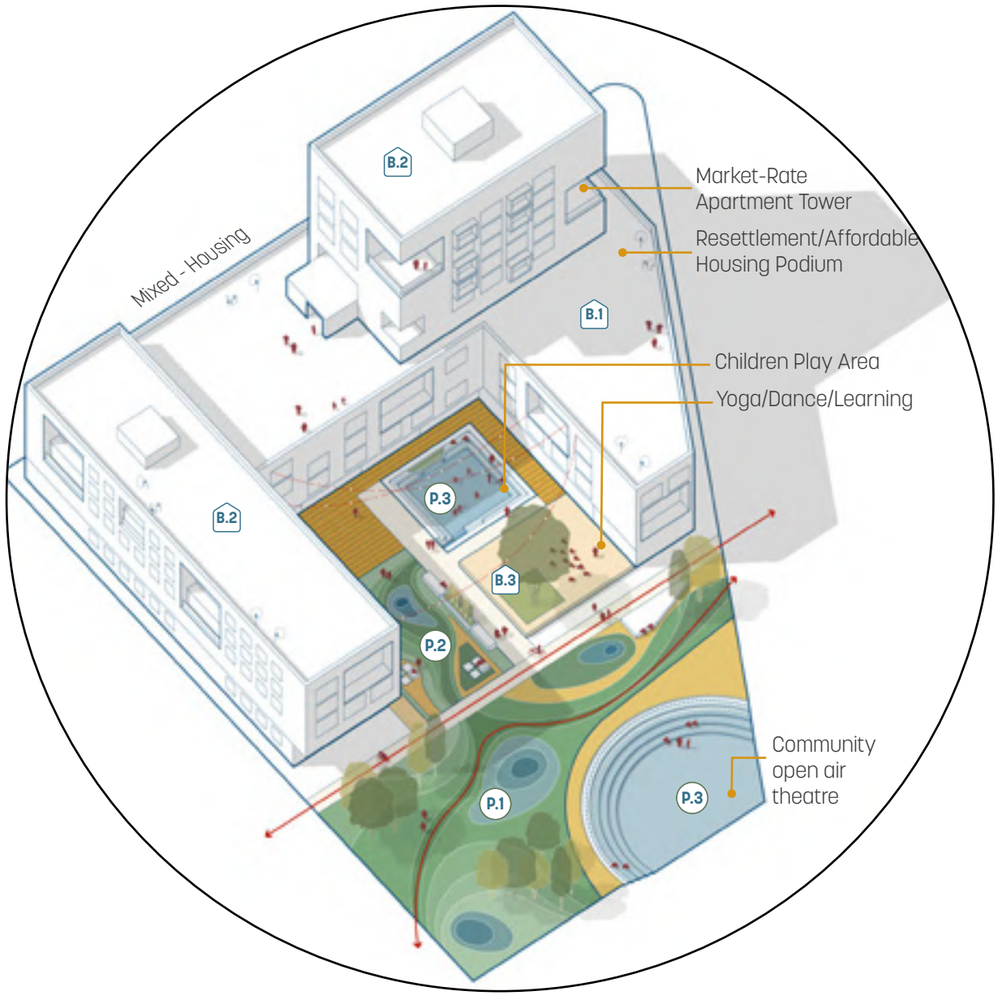
X1: Sponge Open Spaces around Transit Stations

The illustration depicts the scenario where the Transit authority (CMRL/MRTS) acquires land to develop its Transit Plaza by re-housing the residents of substandard housing into new Resettlement housing typologies. The Transit Plaza is articulated to accomodate multiple Sponge Open Space Typologies which include Sunken Courts, Raingardens and Constructed Ponds. Active Retail edges abut both the sides of the Transit Plaza making it a vibrant Public Realm that can Delay, Store and Release water in the event of flooding.



X1: Sponge Open Spaces within residential courtyards

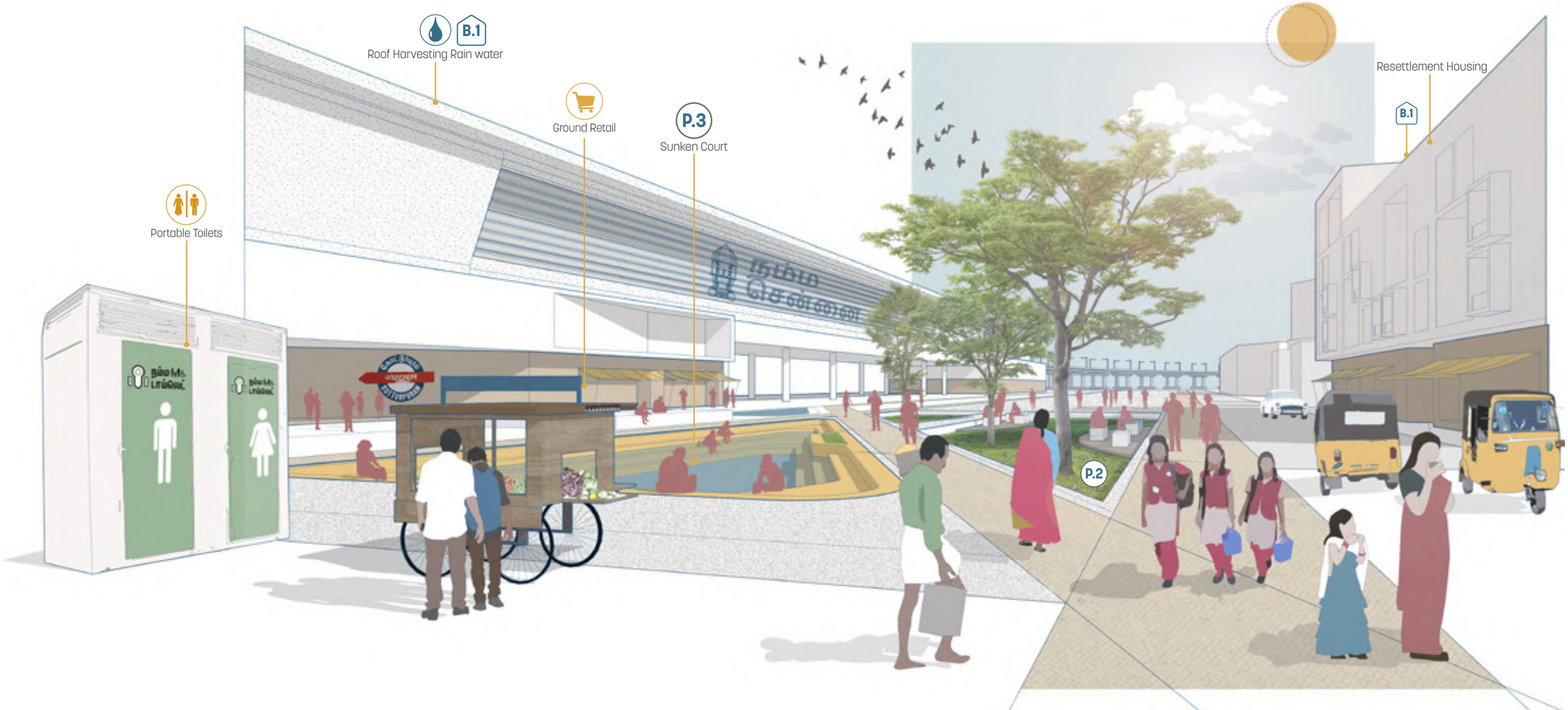
The neighbourhood vision proposes a series of Mixed Housing typologies that frame the Neighbourhood Spine (Linear Sponge Park). The courtyards of these housing typologies along with the Neighborhood spine form a robust network of Sponge Open Spaces which are also the heart of community living. The semi-public courtyards house a series of sponge typologies which include Sunken Plazas, Raingardens, Detention Tanks etc.



Sponge Transit-Oriented Redevelopment for Gandhi Nagar

Visualization of the Kotturpuram MRTS Transit Plaza

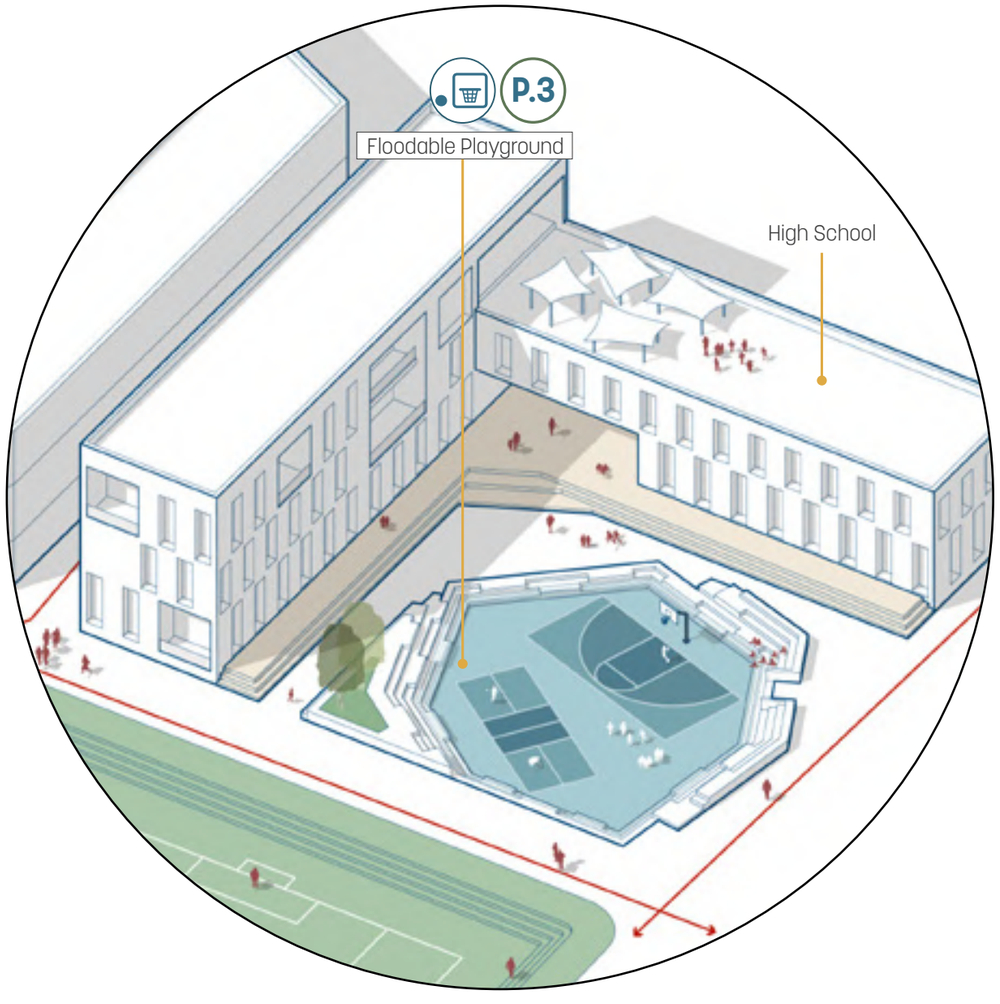
TRANSIT STATIONS BECOME HUBS OF ACTIVITY THAT STRENGTHEN THE RESILIENCE OF THE CANAL



Sponge Transit-Oriented Redevelopment for Gandhi Nagar

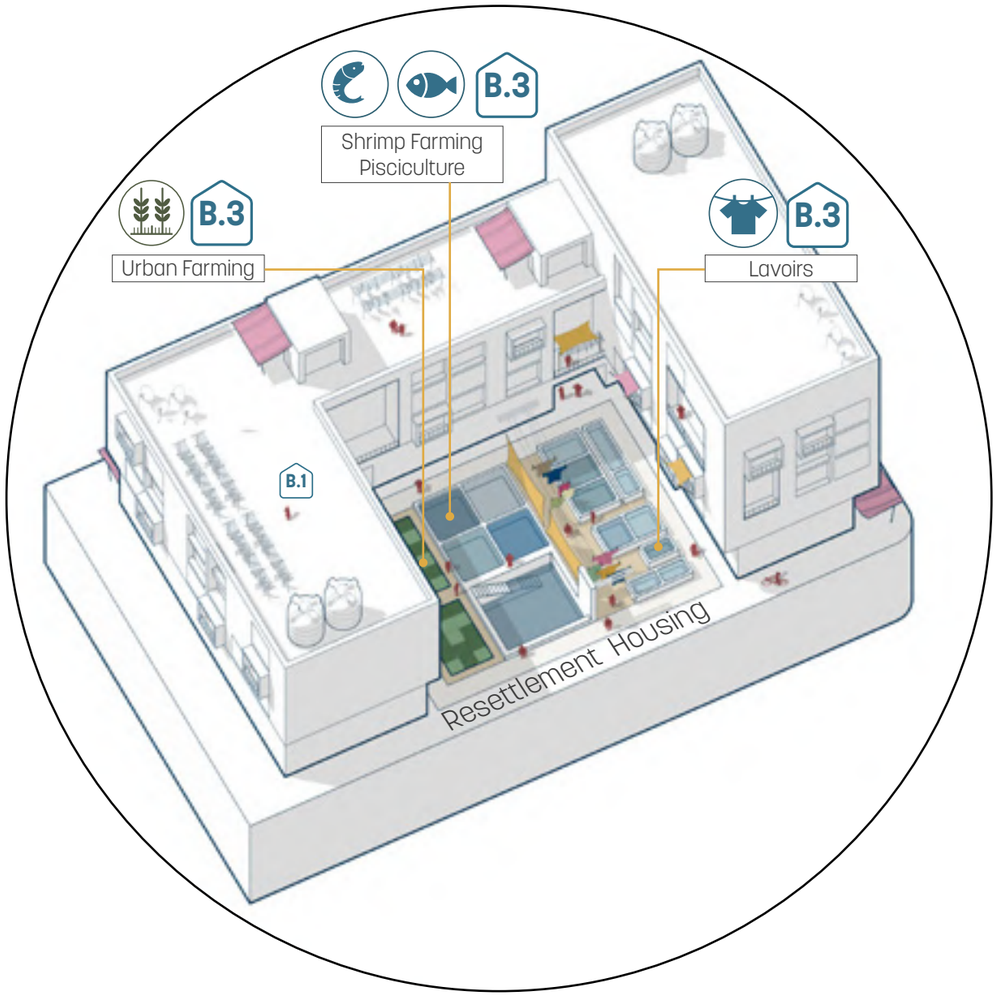
X3: Sponge Open Spaces within school courtyards

The neighbourhoods of Northern Gandhi Nagar and Kotturpuram are home to several Academic Institutions. The proposed vision identifies them as influential stakeholders who can contribute to the Sponge Basin Framework through their buildings and open spaces. Below is an illustration of a school playground as a Sponge Open Space (Sunken Plaza), that serves as a vital infrastructure to Delay, Store and Release water in the event of flooding.



X4: Sponge Open Spaces as productive landscapes

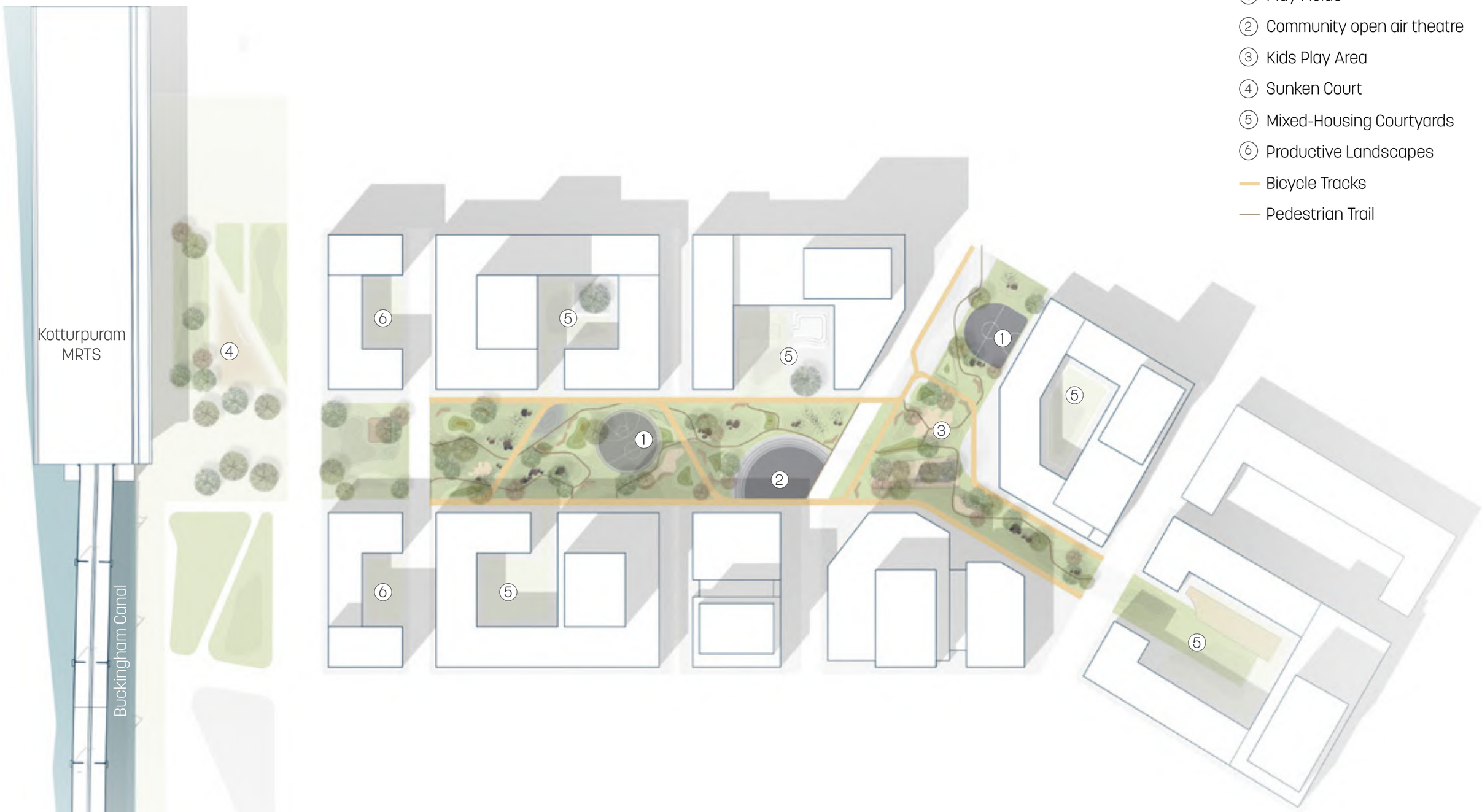
The proposed Resettlement Housing typologies are designed as Sponge buildings with courtyrads that accommodate Detention Tanks/Polders. The Floodable Polders are an economic benefit to the people re-housed in the Resettlement housing typologies. Shrimp farming, Pisciculture, Urban farming, Lavoirs are some of the domestic livelihoods that can be plugged into the proposed Sponge system.



Sponge Transit-Oriented Redevelopment for Gandhi Nagar

The Neighbourhood Spine

NEIGHBOURHOOD SPINE IS A HIGHLY PROGRAMMED, FLOODABLE PUBLIC SPACE



LEGEND

1. Play Fields
2. Community open air theatre
3. Kids Play Area
4. Sunken Court
5. Mixed-Housing Courtyards
6. Productive Landscapes

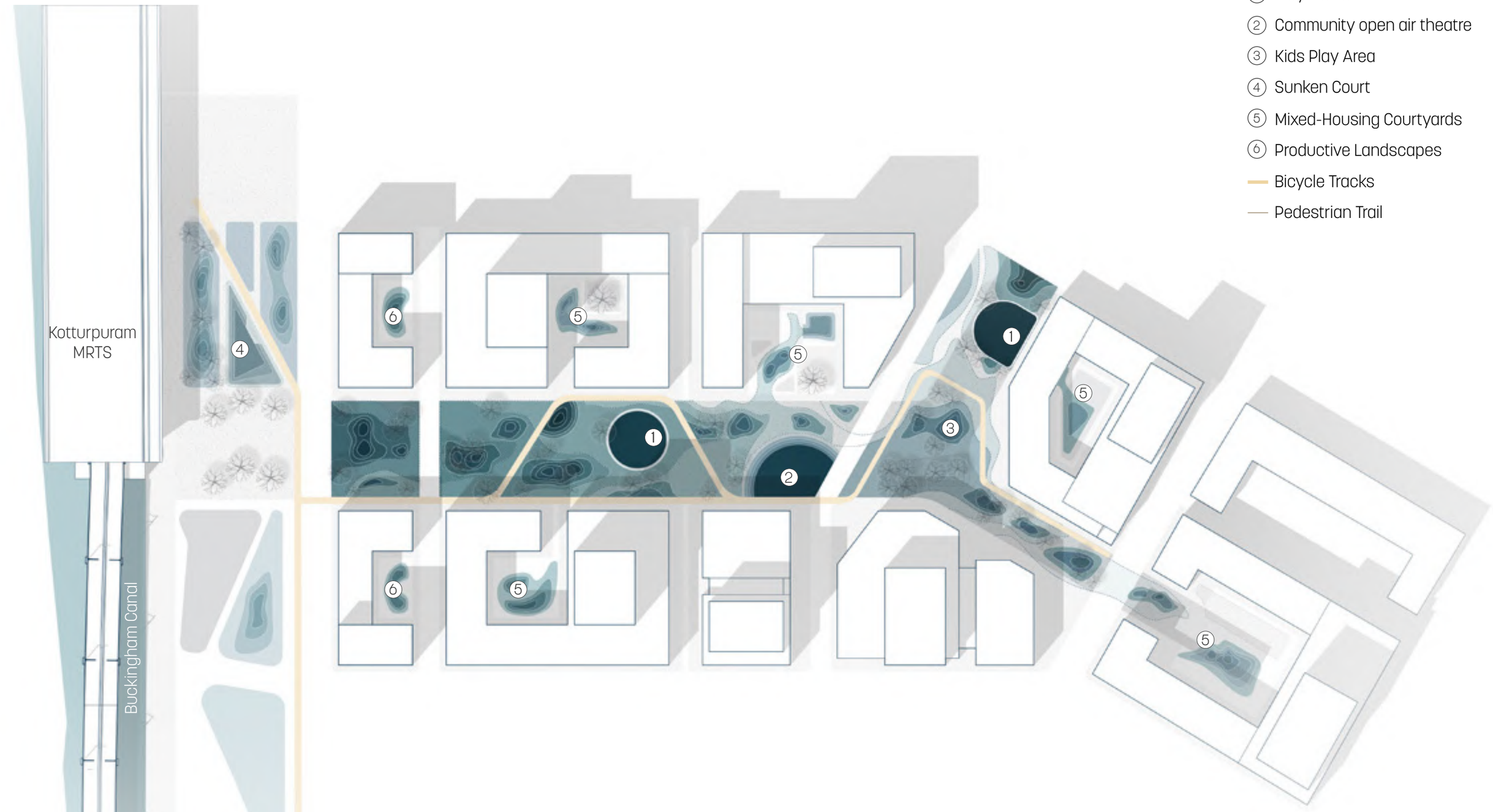
Bicycle Tracks

Pedestrian Trail

Sponge Transit-Oriented Redevelopment for Gandhi Nagar

The Neighbourhood Spine

NEIGHBOURHOOD SPINE IS DESIGNED TO BECOME A SPONGE DURING CLOUDBURST EVENTS



LEGEND

1. Play Fields
2. Community open air theatre
3. Kids Play Area
4. Sunken Court
5. Mixed-Housing Courtyards
6. Productive Landscapes

Bicycle Tracks

Pedestrian Trail

Sponge Transit-Oriented Redevelopment for Gandhi Nagar

Visualization of the Neighourbood Spine and the Mixed-Housing Courtyard

AREAS ALONG CANALS AND RIVERS GROW AS ACTIVE, DIVERSE, AND RESILIENT NEIGHBOURHOODS

Realizing Visions through Collaboration

Notes on implementing Sponge Landscape Infrastructure projects from the Visions

1. REDESIGN OF A PUBLIC OPEN SPACE INTO A SPONGE PARK - INDIRA NAGAR PARK

Project Goals

- Transform Public open spaces into Sponge parks that will serve as Critical Infrastructures during a Cloudburst event
- Create Recreational programs within the park that enhance the neighborhood living
- Promote Community Participation for programming and Maintenance

Key Stakeholders

Dept. of Parks (GCC) · Civil Society · Residence / Building Owner

Project Area

- 1,000 - 6,000 sq.m (1.5 Acres)

Implementation Strategies

- Public Private Partnerships

KEY PLAN

2. SPONGE LANDSCAPE - INSTITUTIONAL COURTYARD

Project Goals

- Restore the canal as a sponge infrastructure by opening up and naturalizing the canal
- Rehousing the vulnerable residents along the canal edge to the proposed Resettlement Housing typologies
- Integrating the canal edge as an activated Public realm to the community

Key Stakeholders

Chennai River Restoration Trust (CRRT) · Public Works Department (GoTN) · Research and Academic Institutions · Civil Society

Project Area

- 10,000 sq.m (2.5 Acres)

Implementation Strategies

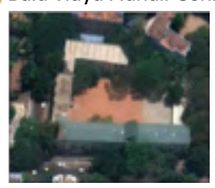
- Land Readjustment
- Land Value Capture
- Community Land Trust
- Joint Venture Developments

COURTYARDS

1 Patrician College of Arts and Science

2 Kumararani Meena Muthiah Matric Higher Secondary School

3 Bala Vidya Mandir Senior Secondary School



4 St. Michael's Academy

Realizing Visions through Collaboration

Notes on implementing Sponge Landscape Infrastructure projects from the Visions

3. CANAL EDGE REDEVELOPMENT AND RESETTLEMENT/REHAB HOUSING

Project Goals

- Restore the canal as a sponge infrastructure by opening up and naturalizing the canal
- Rehousing the vulnerable residents along the canal edge to the proposed Resettlement Housing typologies
- Integrating the canal edge as an activated Public realm to the community

Key Stakeholders

Chennai River Restoration Trust (CRRT) · Public Works Department (GoTN) · Residence / Building Owner · Public / Private Developers

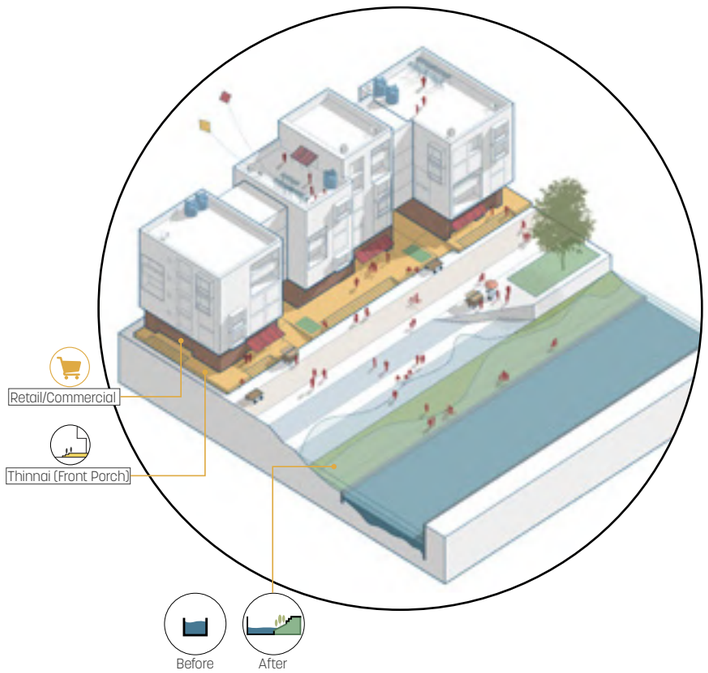
Project Area

- 1,000 - 6,000 sq.m (1.5 Acres)

Implementation Strategies

- Land Readjustment
- Land Value Capture
- Community Land Trust
- Joint Venture Developments

KEY PLAN



4. SPONGE LANDSCAPE - CANAL FRONT PLAZA

Project Goals

- Establishing access to the canal by integrating it to the neighborhood through Public Plazas
- Create a series of sponge landscapes and programs that enhance the public realm
- Support a wide range of Recreational, Cultural and Economic activities

Key Stakeholders

Chennai River Restoration Trust (CRRT) · Public Works Department (GoTN) · Residence / Building owner · Civil Society

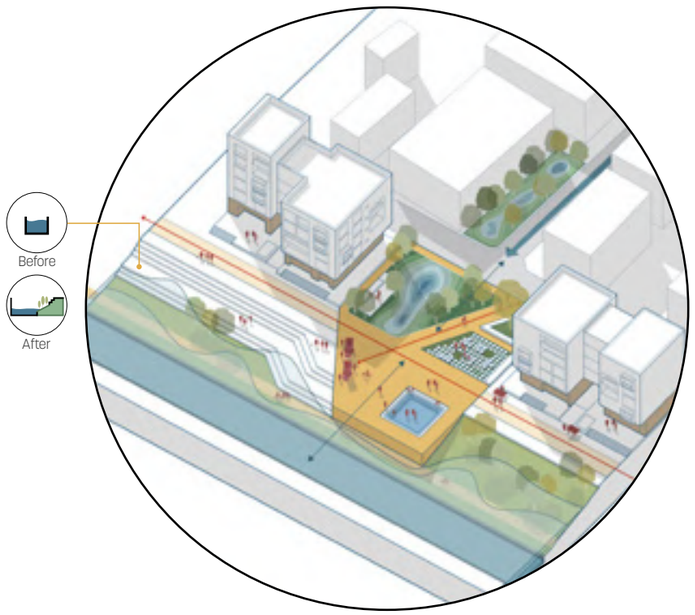
Project Area

- 1,000 sq.m (0.25 Acres)

Implementation Strategies

- Public Private Partnerships
- Community Participation

KEY PLAN



Realizing Visions through Collaboration

Notes on implementing Sponge Landscape Infrastructure projects from the Visions

5. KOTTURPURAM STATION PLAZA AND RESETTLEMENT HOUSING

Project Goals

- Create Public access to the Metro Station and the Canal edge
- Rehousing the residents of Sub-standard Housing to the proposed Resettlement Housing typologies
- Creation of a Station plaza that supports Commercial activities and Sponge Landscapes

Key Stakeholders

Chennai River Restoration Trust (CRRT)
Public Works Department (GoTN)
Chennai Metro Rail Ltd (CMRL) / MRTS
Residence / Building owner

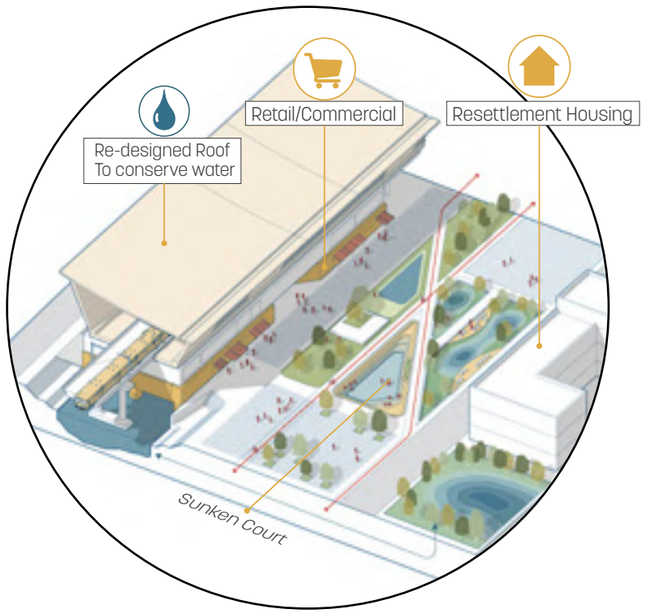
Project Area

- 25,000 sq.m (6.2 Acres)

Implementation Strategies

- Land Readjustment
- Community Land Trust
- Joint Venture Developments

KEY PLAN



6. STRATEGIC REDEVELOPMENT - NEIGHBOURHOOD SPINE & MIXED HOUSING

Project Goals

- Establish the Neighborhood spine (Sponge Landscape) that will form the heart of community living
- Guide high density mixed-Housing developments with sponge landscapes around the neighborhood spine
- Create a robust Sponge Basin network connecting back to the canal

Key Stakeholders

Chennai River Restoration Trust (CRRT)
Dept. of Town Planning (GCC)
Research and Academic Institutions
Public / Private Developers

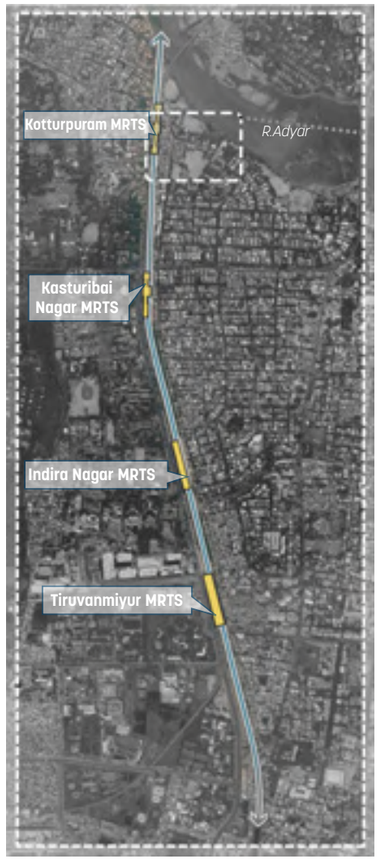
Project Area

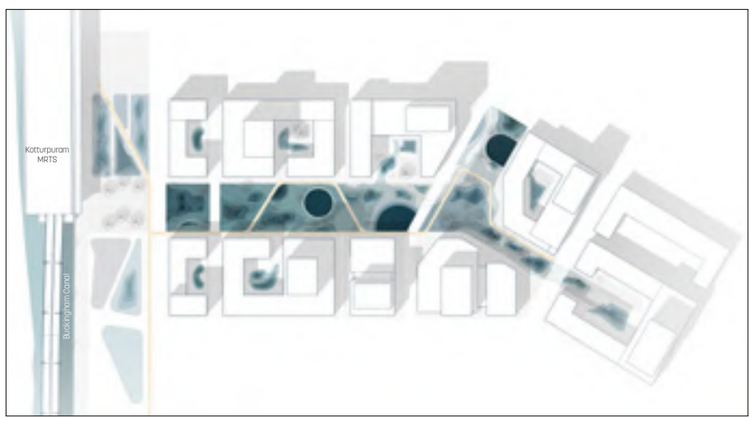
- 38,500 sq.m (9.25 Acres)

Implementation Strategies

- Land Readjustment
- Land Value Capture
- Public-Private Partnerships

KEY PLAN





Process and Methodologies

Community Meetings and Canal Walks

Participatory planning is at the heart of the 'Eyes on the Canal' initiative. As such, the vision proposed by Team Sponge were presented to and responded to community feedback numerous times. Our group participated in meetings with local Resident's Welfare Associations, informal encounters with residents living along the Buckingham Canal, and participatory mapping walks with local residents and students from the School of Architecture and Planning (SAP), Anna University.

Stakeholder Consultations

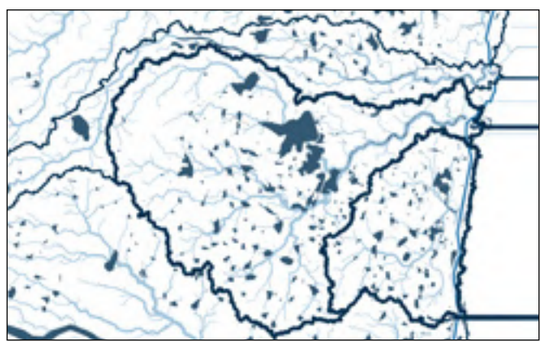
Team Sponge benefited from a number of stakeholder consultations organized by GIZ and the Urban Design Collective. The ideas from our competition entries were first presented to representatives from Chennai River Restoration Trust (CRRT) and Public Works Department and technical consultations with experts from IIT Madras. These consultations informed the narrative structure, visual identity, and content of the handbook.

The results of the handbook were finally presented to and received very positively by representatives from Chennai Metro Water, CRRT, 100 Resilient Cities, and Southern Railways.

GIS Analysis

Team Sponge built up an extensive collective of publicly available datasets and analysis workflows to assess the landscape, estimate hydrological flows, and understand the network of existing infrastructure.

We ran hydrology analysis in ArcMap over a 12.5m DEM to delinerate watersheds and understand the topography. We ran analyses over multi-spectral imagery from Sentinel 2 to extract green-blue systems at a metropolitan scale to inform our narrative and framework. We relied on Open Street Maps and other participatory mapping datasets to map the street network and identified flood-prone streets.



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PART 1

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On the benefits of Sponge Landscapes and Landscape Infrastructure

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