Placemaking and Water Management:
Architectural catalysts for the incremental development of disenfranchised communities in Bangalore, India

by

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Contents

Abstract

This thesis investigates the current water crisis that Bangalore, India, is facing, and particularly how architecture can help alleviate some of the negative effects of water-related issues on the everyday lives of disenfranchised communities. While water conservation policies and technical solutions are discussed and implemented at the national and municipal level, the effects of water scarcity and lack of infrastructure on more impoverished communities are often forgotten. The thesis is making the argument that a placemaking approach, which builds on an in-depth analysis of current community status and assets in order to create gathering spaces that tackle both environmental and social issues, can serve as a catalyst for flooding mitigation and self-development. This question was explored through a mapping investigation of key water issues in Bangalore, a review of the literature, precedent analysis, as well as on-site observations. The resulting project, Vegavardhaka, transforms an underused public space by integrating water security strategies with the design of a gathering space, a washing area, a playground and an Anganwadi (women and children care centre). Thought in different phases, the project acts a guide to a responsive design process that aims at breaking the walls of segregation, both physically and metaphorically, by supporting local initiatives.

Keywords: Placemaking, water management, water security, slums, India

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Introduction

This thesis investigates the current water crisis that Bangalore, India, is facing, and particularly how architecture can help alleviate some of the negative effects of water-related issues on the everyday lives of disenfranchised communities. In 2019, Cape Town was the first major city to be predicted to have a "Day Zero," a set date by which the city will officially run out of water.[1] Predictions indicate that at least ten other large-scale cities will face a similar fate as Cape Town in the next few decades. These cities are: São Paulo, Melbourne, Jakarta, London, Istanbul, Tokyo, Beijing, Barcelona, Mexico City and Bangalore.[2] Although many countries are already facing a water crisis, studies argue that the impacts are the most severe in cities of the Global South.[3] Bangalore, located in southern India, is one of these cities. Water shortages are already a problem, with an average water demand of 1332 MLD (million litres per day) but an average water supply of only 949 MLD.[4]

The United Nations recognizes, "the right to safe, clean drinking water and sanitation as a human right that is essential for the full enjoyment of life and all human rights."[5] How is it that many inhabitants of Bangalore are denied their right? While water conservation policies and technical solutions are discussed and implemented at the national and municipal level, the effects of water scarcity and lack of infrastructure on more impoverished communities are often forgotten.[6] For example,

1 Christian Alexander, "A Year After 'Day Zero,' Cape Town's Drought Is Over, But Water Challenges Remain," CityLab, accessed December 17, 2019, https://www.citylab.com/environment/2019/04/cape-town-water-conservation-south-africa-drought/587011/.

2 "The 11 Cities Most Likely to Run out of Drinking Water - like Cape Town - BBC News," accessed September 17, 2019, https://www.bbc.com/news/world-42982959.

3 "Water | United Nations," accessed April 28, 2020, https://www.un.org/en/sections/issues-depth/water/.

4 Jan-Olof Drangert and H. C. Sharatchandra, "Addressing Urban Water Scarcity: Reduce, Treat and Reuse – the Third Generation of Management to Avoid Local Resources Boundaries," Water Policy 19, no. 5 (October 2017): 980, https://doi.org/10.2166/wp.2017.152.

5 "Human Right to Water and Sanitation | International Decade for Action 'Water for Life' 2005-2015," accessed December 17, 2019, https://www.un.org/waterforlifedecade/human_right_to_water.shtml.

6 Ron Mahabir et al., "The Study of Slums as Social and Physical Constructs: Challenges and

when dealing with shortages, management limitations are enforced. Often the wealthier of the population, due to their economic and political advantage, can adjust to these restrictions by purchasing more water, and having the space and means to store excess water for another day. However, more impoverished communities do not have the means to purchase water nor the time to invest into long-term solutions.

While water scarcity poses significant challenges, Bangalore also faces flooding due to ineffective stormwater management systems. Many slums are located in areas that are considered undesirable, such as low-lying areas or along drainage lines.[7] The houses are sometimes made of semi-permanent materials such as thatch, plastic sheets, metal sheets and plywood. When the monsoon comes along, the houses are often damaged and storm water collects in the streets, which have always been a vital aspect of the public domain, where vendors selling their goods and children play.[8]

In recent years, architects, international organizations and academics have increasingly promoted placemaking as a means to address, in an integrated manner, infrastructure shortage and the lack of public spaces and services in poorer communities in the Global South.[9] Placemaking is defined as the connection of a community through public spaces.[10] The placemaking approach builds on an in-depth analysis of current community status and assets in order to create gathering spaces that tackle both environmental and social issues and needs, with the

Emerging Research Opportunities," Regional Studies, Regional Science 3, no. 1 (January 2016): 399, https://doi.org/10.1080/21681376.2016.1229130.

7 T V Ramachandra and Pradeep P Mujumdar, "Urban Floods: Case Study of Bangalore," Disaster & Development, 3, no. 2 (April 2009): 69.

8 "Place Making and the Future of Cities," Project for Public Spaces, November 2012, 3, https://assets-global.website-files.com/5810e16fbe876cec6bcbd86e/59f1fb530aad1d00010a6186_PPS-Placemaking-and-the-Future-of-Cities.pdf.

9 "Place Making and the Future of Cities," 3.

10 Ruth Fincher, Maree Pardy, and Kate Shaw, "Place-Making or Place-Masking? The Everyday Political Economy of 'Making Place,' *Planning Theory & Practice* 17, no. 4 (October 2016): 516, https://doi.org/10.1080/14649357.2016.1217344.\\uc0\\u8217{}\\uc0\\u8221{} {\\i{}Planning Theory & Practice} 17, no. 4 (October 2016)

objective of encouraging social cohesion, economic gain and well-being.[11] This thesis aims at exploring how placemaking can help reduce the impacts of the water crisis in slums of Bangalore, while catalyzing self-development in these communities.

In order to answer this question, the thesis will first look more closely at the water crisis in Bangalore. The first chapter is thus presenting the results of a mapping investigation, revealing the geography of key water issues in the city and pointing at potential sites for the thesis project. The second chapter then discusses the theoretical approach of the thesis, which combines principles of placemaking with environmental mitigation strategies. The following chapters move to the thesis project, a large-scale public space which aims to repair Sanyasakunte 2 residents' relationship with water through placemaking in three incremental phases. Chapter 3 focuses on-site selection and analysis as well as program development, while Chapter 4 explains in detail the design proposal. In conclusion, the thesis discusses the potential effect that place making and water management can have on the community-driven development by providing basic necessities of water security and social infrastructure.

11 "Resilient Cities Through Public Spaces and Placemaking in Urbanization," accessed February 4, 2020, https://www.pps.org/article/from-government-to-governance-sustainable-urban-development-the-world-urban-forum.

Figure 1 - Kaveri river pathway and location of Bangalore

Part 1- Bangalore's water crisis

Bangalore, located in the South of India, is one of the cities that will run out of drinking water in the next few decades. Bangalore's municipal water comes from the Kaveri River, and its delta is shared between three states, Tamil Nadu, Kerala, and Karnataka, which has led to disputes on the ownership of the water (Figure 1).[12] The river is currently utilized at an unsustainable rate of 94% of its total capacity.

In order to better understand Bangalore's water crisis and to start identifying relevant architectural responses, I conducted a mapping analysis of the main water issues identified in the literature and of their geographical locations. Mapping has been selected as an approach, since the layering of selective information allows to highlight or reveal key issues, such as social inequalities.[13] There are undeniable inherent biases when mapping. In every map there is subjectivity, and all maps 'lie' to a certain extent. As Monmonier says,"not only is it easy to lie with maps, it is essential".[14] When making a map we thus must embrace the biases by creating a picture of what we want the viewer, and sometimes ourselves, to discover or understand better. As the creator of the following maps, I decided to focus only on the issues related to water crisis as a whole truth and to cut out any other unnecessary information such as the demarcation of areas, roads, buildings. By excluding these conventions of mapping, the viewers are forced to see Bangalore in a way that they are not used to seeing, which further reiterates the extensiveness of the problem.[15]

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[12] Asthana Vandana and Shukla Ashok Chandra, Water Security in India: Hope, Despair, and the Challenges of Human Development (New York, NY: Bloomsbury Academic, 2014), 4467.
[13] Doug Specht and Anna Feigenbaum, Mapping and Politics in the Digital Age, ed. Pol Bargués-Pedreny, David Chandler, and Ma Elena Simón Rodríguez, Routledge Global Cooperation Series (London: New York, NY ; Routledge, 2019), 50.
[14] Mark S. Monmonier, How to Lie with Maps (Chicago: University of Chicago Press, 1991), 1.
[15] Specht and Feigenbaum, Mapping and Politics in the Digital Age, 39–55.

In order to focus on how marginalized communities are affected by the water crisis, four issues were selected: access to durable housing, access to water, flooding and access to adequate sanitation. Over the years, I have watched how Bangalore has developed rapidly with little attention paid to the sustainability of this development. While the four issues selected are highlighted in the United Nations 2030 Sustainable Development Goals,[16] keeping these goals in mind are often difficult in capitalist and rapidly developing countries. The four issues studied in the following maps are the result of a booming population.[17] In the last 20 years, Bangalore's population has more than doubled, with today's population being 12,327,000 inhabitants, which resulted in mass urbanization, clear-cutting of forests, a decrease in wetlands and the depletion of natural surface water and groundwater.[18] The major contributing factor is the demand for real estate and infrastructure, which lead to more than 450% increase in built-up areas over the last 50 years (Figure 2 and 3).[19]

Monmoniers talks about symbols used in maps, which let the map reader quickly understand a map, yet the use of these symbols and legends is now a standard of "credible maps".[20] Without these symbols and legends, the map would be hard to read. When there are many layers and symbols, a map can be distracting both to create and view.[21] My mapping project took these ideas to create four independent layers of maps, one for each issue selected. These layers were then overlaid to be able to locate critical areas where crossovers occurred. The results of this research are presented in the next pages.

16 The United Nations Development Program, "Sustainable Development Goals 2030," n.d., 2.
17 Vandana and Ashok Chandra, Water Security in India, 719.
18 Vandana and Ashok Chandra, Water Security in India, 688.
19 Ramachandra and Mujumdar, "Urban Floods: Case Study of Bangalore," 7.
20 Specht and Feigenbaum, Mapping and Politics in the Digital Age, 49.
21 Monmonier, How to Lie with Maps, 19.

Figure 2 - Land use in 1973
Figure 3 - Land use in 2020

Access to durable housing

UN-Habitat defines slums as a living environment lacking "one or more of the following: durable housing, sufficient living space, easy access to safe water, access to adequate sanitation and security of tenure."[22] Urban poorer residents have to solve a complex equation as they try to optimize housing cost, tenure security, quality of shelter, their journey to work, and sometimes, personal safety.[23]

In general, slums in India are more dispersed throughout the city rather than at the periphery, and these are called 'metro core' slums. Davis, in his book, "Planet of Slums", categorizes metro core slums into two different types: formal and informal. Formal or recognized slums are the ones that have been identified and acknowledged by the State. Residents of recognized slums often have land rights and benefit from government intervention. The other category, informal slums or unrecognized slums, are either dismissed, unauthorized squatters, or pavement dwellings. These generally do not receive external help and are not covered by governmental programs and policies.[24]

Whatever category they might be associated with, most slums, or impoverished neighbourhoods, do not have enough space dedicated to public infrastructure. The land is maximized for personal or private spaces; leaving the streets as the only common spaces. Slums require more substantial sums of funds for publicly financed improvement to combat the imminent threat of their already inefficient infrastructure from regressing, this why they are often not funded.[25]

[22] "UN-Habitat: Some Definitions. State of World's Cities" (UN habitat, 2007), http://mirror.unhabitat.org/documents/media_centre/sowcr2006/SOWCR%205.pdf.
[23] Mike Davis, Planet of Slums (London ; New York: Verso, 2006), 25.
[24] Ruoyun Liu, "MAPPING THE TEMPORAL DYNAMICS OF SLUMS FROM VHR IMAGERY," n.d., 9.
[25] Jane Jacobs, The Death and Life of Great American Cities (New York: Vintage Books, 2016), 270, http://rbdigital.oneclickdigital.com.

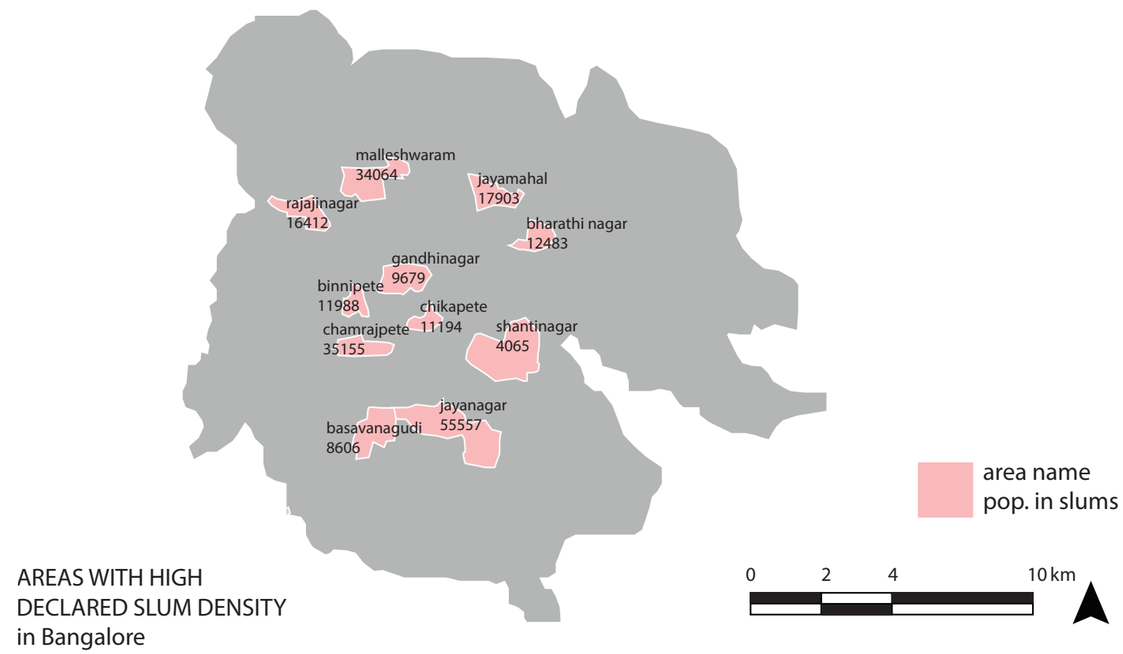


Figure 4 - Areas with high declared slum density

The map in Figure 4 shows the areas of Bangalore that have a declared a high slum density, with their approximate populations. These are close to the centre and more or less evenly distributed. The areas with the highest population density are Jayanagar, Chamrajpete, and Malleshwaram. It is important to note that there might be other slums, especially further away from the city core, that are not 'declared' slums and therefore might not be represented in the national and municipal data used for this map.

Access to Water

Historically, hundreds of lakes were formed naturally due to Bangalore's undulating terrain. These have decreased by 58% over the last 50 years.[26] Of the remaining lakes, 85% are polluted due to inadequate stormwater and sewage management, pollution, and submersion of statues into the water as religious practices.[27] The absence of reliable surface water is the reason why the majority of Bangalore's inhabitants rely on groundwater aquifers as their primary source of water.[28] However, these are in decline too. Over the years, we have depleted aquifers that have taken millennia to fill up and will take millennia to fill again.[29]

The water supply systems are often not designed according to demand for water, resulting in a misallocation of resources. Water is not delivered to those who are most in indeed of sanitation and clean water.[30] Often, when trying to meet the unfilled demand, policymakers aim to increase the supply to the total population demand rather than filling the demand for the underserved.[31] When municipal water is scarce, residents are often lead to rely on other sources of water that may be contaminated, and the higher risk of waterborne diseases tends to occur in the area with higher rates of urbanization.

[26] Ramachandra and Mujumdar, "Urban Floods: Case Study of Bangalore," 7.
[27] Subhojit Goswami, "About 85 percent of Bengaluru's Water Bodies Severely Polluted: Study," Down to Earth, November 23, 2017, https://www.downtoearth.org.in/news/water/about-85-per-cent-of-bengaluru-s-water-bodies-severely-polluted-study-59189.
[28] "Bengaluru Water Supply and Sewerage Project (Phase 3) in the State of Karnataka, India," Republic of India Bangalore Water Supply and Sewerage Board. (Japan International Cooperation Agency, November 2017), http://open_jicareport.jica.go.jp/pdf/12300356_01.pdf.
[29] The World's Water Crisis (Netlfix, 2017), https://www.netflix.com/watch/80243769?trackId=13752289&tctx=0%2C1%2Cdd68b16b-53cf-4329-a5fd-a912308405a2-24889150%2C%2C.
[30] Raymond Fisman and Edward Miguel, Economic Gangsters: Corruption, Violence, and the Poverty of Nations (Princeton: Princeton University Press, 2008), 168.
[31] Terence R Lee, Residential Water Demand and Economic Development (University of Toronto Press, 1969), https://www.deslibris.ca/ID/455987.

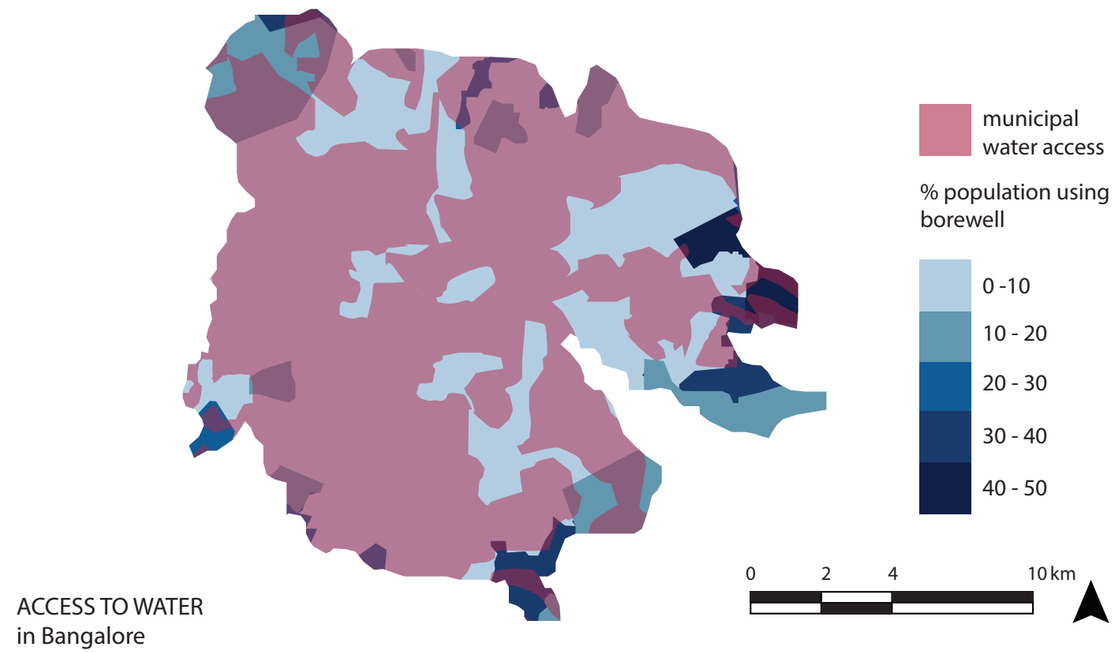


Figure 5 - Access to water

Figure 5 shows the access to groundwater and municipal water. Surprisingly, there are a lot of areas closer to the centre where the population has limited access to a bore well and is not covered by municipal water pipelines. The areas in red shows where pipelines are, but this does not guarantee that water flowing through these areas.

Flooding

Although the annual rainfall in Bangalore is only around 880 mm, with approximately 60 rainy days a year between June and September, the city falls victim to flooding every monsoon. The abundance of stormwater goes to show how poorly planned the stormwater management is, and how much valuable water is going to waste. The valleys were once Bangalore's natural drain for all its stormwater, but urbanization was not guided by strong strategic planning or development to attempt to minimize the impact on the existing infrastructure, the environment, or the stormwater systems.[32] As the city has grown, the sewage system has not been upgraded at the same rate leading to ponding of stormwater in many areas. Urbanization resulted in the depletion of valleys, and contamination of wastewater discharge in the stormwater systems. Poorly positioned sewer utility holes cause redirection of stormwater and obstruct solid waste and sediment. In times of high floods, stormwater frequently backs up into houses through the sewer connections. In addition, the gutter systems are poorly designed, with the road inlets not at the lowest points and without grate covers, causing obstruction and inefficiency.

[32] Ramachandra and Mujumdar, "Urban Floods: Case Study of Bangalore," 36–37.

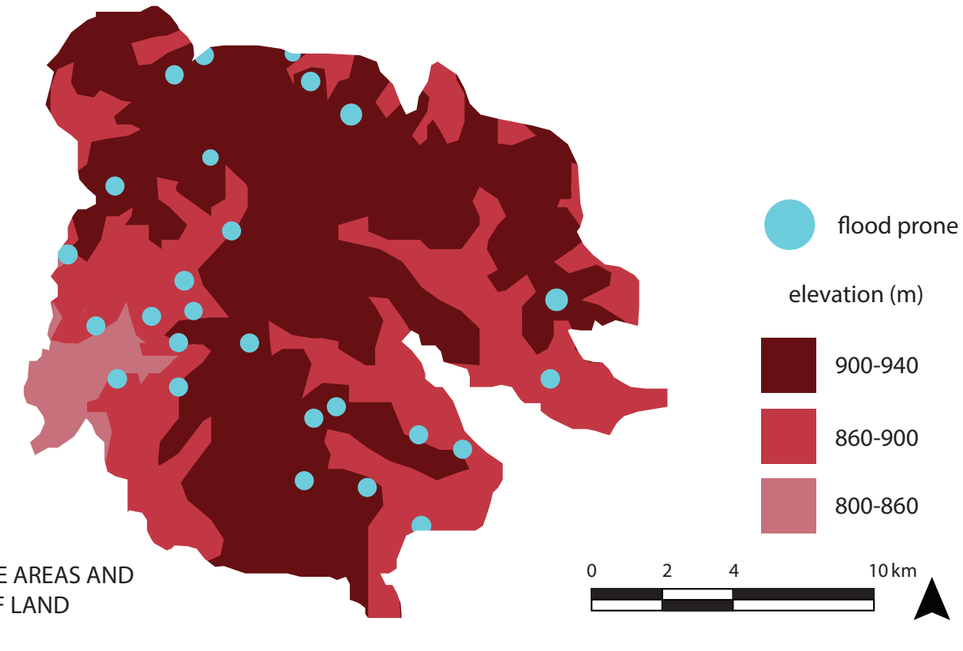


Figure 6 - Flood prone areas and elevation of land

Figure 6 shows the topography and the areas that are prone to flooding. As suspected, they are in the lower-lying areas and closer to the periphery of the city. Many slums formed in these areas since the land is considered undesirable.[33] Because many are considered illegal encroachments, flood losses and the damage is never formally recognized and therefore not compensated.

[33] Ramachandra and Mujumdar, 69.

Access to Sanitation

Of the 360 officially recognized slums in Bangalore, only 30% have underwater sewerage services.[34] It has been proven that lack of access to sanitation impacts women more than men.[35] While men can urinate anywhere, women have to be more discreet. To avoid dangerous situations, women have to travel in groups before sunrise, often to marshlands or dump yards where dangerous and diseased animals hide.[36] At times, women will not eat during the daytime to avoid having to go in open fields. In many areas in the Global South, though there is a septic tank, it is often not maintained correctly leading to hazardous waste seeping into the ground, contaminating the aquifers and bore well supply.[37] Figure 7 displays that many households lack adequate access to sanitation, and there are only a few areas where more than 60% of the population has access.

[34] Ramachandra and Mujumdar, 69.
[35] Sylvia H. Chant and Cathy McIlwaine, Cities, Slums and Gender in the Global South: Towards a Feminised Urban Future (New York: Routledge, Taylor & Francis Group, 2016), 56.
[36] Davis, *Planet of Slums*, 198.
[37] Architecture for Humanity (Organization), ed., *Design like You Give a Damn: Architectural Responses to Humanitarian Crises* (New York, NY: Metropolis Books, 2006), 294.

Figure 7 - Access to sanitation

“Gaps” in the city : critical areas of Bangalore

Each of these four issues, access to durable housing, access to water, flooding and access to adequate sanitation, are imperative to the sustainable development of communities.[38] Dissecting the issues and analyzing them independently allowed me to understand why and where these occurrences exist in Bangalore. These colourful maps (Figures 2 to 7) showed what is currently being done by the government. However, every mapping project faces an opportunity cost; in mapping one thing, you leave out others. Often what is not mapped is part of the lie, making it easy for the state or other groups in power to convince the public of a certain reality or phenomenon.[39] Harnessing the power of bias through mapping, I decided to change the legends of the maps to also paint the stark image of reality and bring to light what people with lack of support from the government go through. This led me to overlay the maps and convert them into drawings where there are only two options: the negative outcome, where there is minimal access to adequate housing, water, sanitation and safety from flooding are depicted as white. The positive outcome, where there is access to adequate housing, water, sanitation and safety from flood damage, is depicted black. Through this process, I was able to identify the “gaps” in the city, areas that are extremely underserved and where the water crisis is having the biggest impact shown in Figure 8. The gaps are more apparent in 3 areas of Bangalore: Malleshwaram, Rajajinagar and Chamrajpete. These areas indicate potential sites for the thesis project. Before we present in more detail the visit and analysis of the sites, the next chapter will focus on potential strategies to alleviate the key water issues Bangalore is facing.

[38] United Nations Development Program, “Sustainable Development Goals 2030,” 2.
[39] Eduardo Galeano, Open Veins of Latin America: Five Centuries of the Pillage of a Continent, 25th anniversary ed (New York: Monthly Review Press, 1997), 1–8.

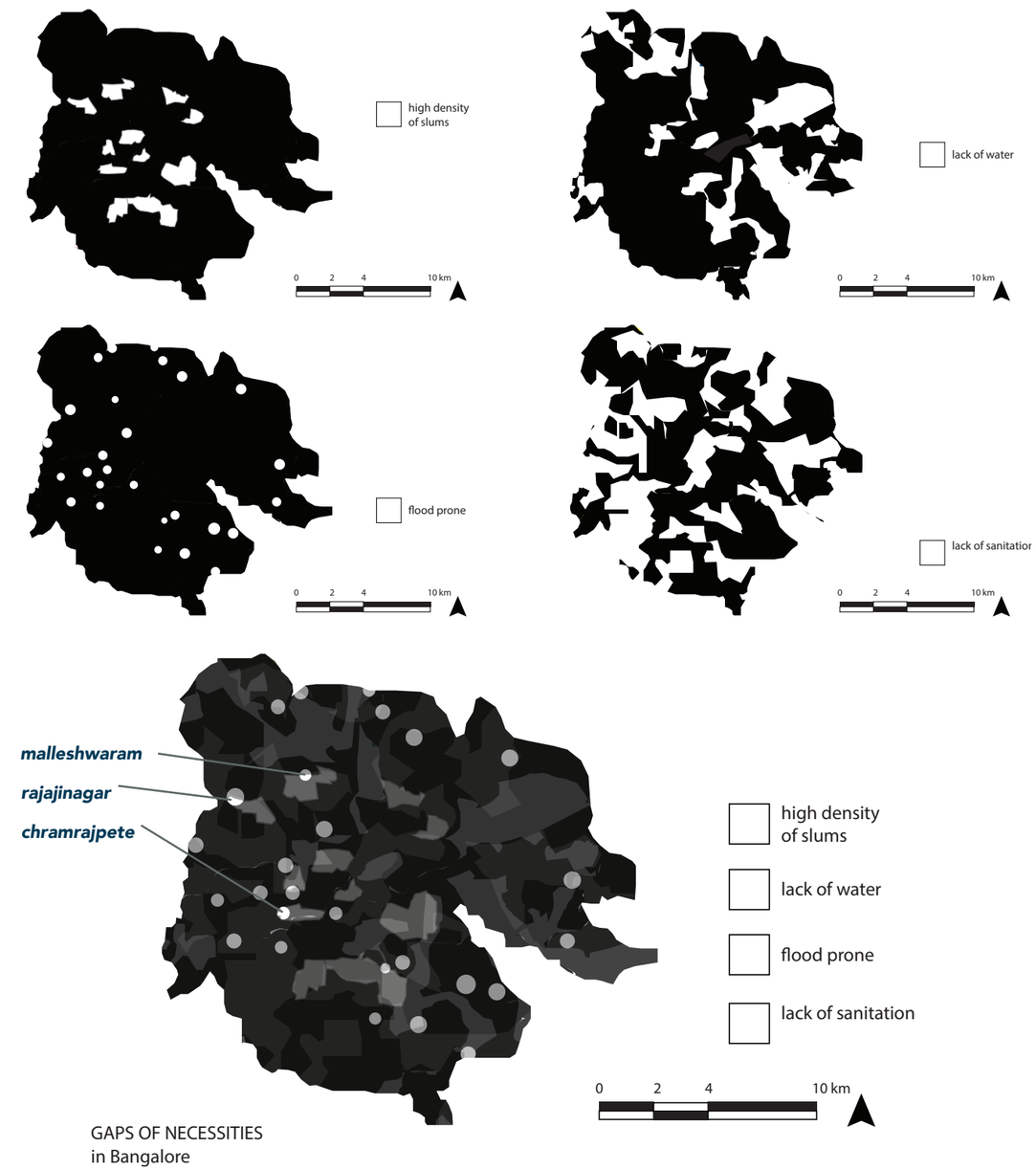


Figure 8 - Gaps of necessities in Bangalore

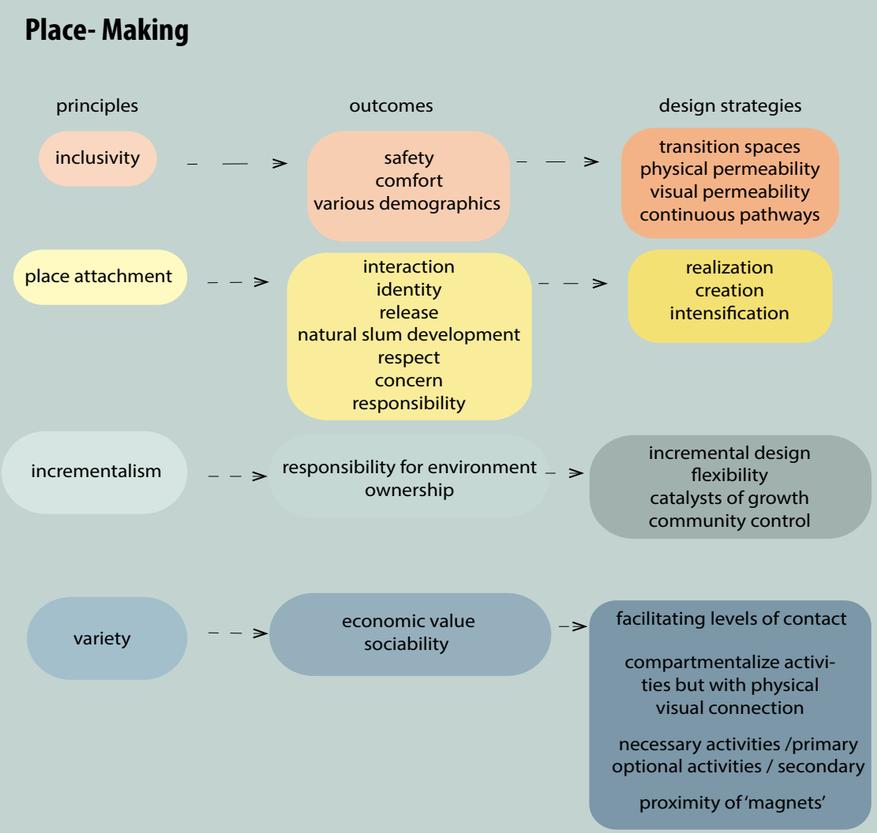


Figure 9 - Theoretical Framework

Part 2 - Social Infrastructure

This chapter covers two approaches that will be combined in order to explore how architecture can help alleviate the impacts of the lack of infrastructure and the ecological issues related to the water crisis in Bangalore. The first approach is placemaking, which can have positive impacts on communities, especially in the context of informal settlements. More specifically, the design principles of inclusivity, place attachment, incrementalism and variety will be discussed since they can lead to a positive co-dependent relationship between place and community. This relationship can play a part in the self-development of a community, by encouraging the residents in having a sense of pride in their place and wanting to improve, revitalize and protect it (Figure 9). The second approach that will be discussed in this chapter is the use of environmental mitigation strategies to provide solutions for different water-related issues, including the collection, treatment and storage of greywater, stormwater, saltwater and even blackwater. As this thesis will demonstrate, combining these two approaches through design allow to create a new type of "social infrastructure" which considers both the social and the technical dimensions of a complex and multidimensional problems such as Bangalore's water crisis. This new type of social infrastructure aims to reduce the stress of access to basic necessities in informal settlements while catalyzing self-development.

Placemaking

Placemaking is a theoretical and action-oriented approach that proposes to build on the current community status and assets, to create gathering spaces that intends to ultimately improving the relationship and the attachment of people to place[40], in turn, lead to community-driven self-development.

Placemaking has its roots in the 1960s when Jane Jacobs, amongst other authors, introduced the idea of a city being designed around people rather than vehicles. Although they didn't necessarily identify their work as such, other important contributors to this approach are Jan Gehl, Deborah Cushing and Evonne Millers, as well Ian Bentley. Their thoughts on placemaking helped me develop the following principles of place making, which are inclusivity, place attachment, incrementalism, and variety as successful design principles to create positive outcomes within a society.

Inclusivity

In the cities of the Global South, public spaces are not given much attention. This is especially true in slums, where unoccupied space is limited. Living space is prioritized, leading to densely populated settlements with the often narrow and obstructed alleys that connect the community as the only remaining common space. At the same time, cities are investing in the construction of public spaces that often reflect

[40] Fincher, Pardy, and Shaw, "Place-Making or Place-Masking?," 516.

their desire to project the image of a "world-class" city: large fenced parks, high maintenance green areas, shopping malls and other private entertainment spaces, as well as green spaces in gated communities. By providing areas that are designed for middle and higher income segments of the population, where one's identity is the main determinant of access, this successfully creates the 'illusion' of public spaces.[41] Such areas often require a person to be of a specific social status, have a certain income, and can even exclude people due to their ethnicity or religion. Exclusive design can create a place where one group dominates, making anyone else who does not fit in this group feel unwelcome. An inclusive public space, where social connections are fostered, aims to attract a variety of people regardless of their identity.[42]

Safety, comfort and a variety of users can be achieved through inclusive design. Some design strategies can be implemented in order to create or modify a space to make it more inclusive. First, inclusivity can be achieved through permeability, both physically and visually. Visual permeability allows a public space to be seen by the surrounding population, even from a distance. The further the distance, the better. Permeability is successfully implemented by the creation of small blocks[43] around a public space that is designed at a street level, engaging with the surrounding urban context.[44] When there are residential sectors involved, creating visual access to a public space will significantly increase the likelihood of the residents to use it, building

[41] "Place Making and the Future of Cities," 3.
[42] "Place Making and the Future of Cities," 8.
[43] Ian Bentley,Responsive Environments: A Manual for Designers(Amsterdam: Elsevier, 2011),12.
[44] "Place Making and the Future of Cities," 10.

an interdependency between the two. It is equally important to create access across a residential sector since this allows the general public to know that this is not a dedicated public space exclusively to the said residential sector.[45] Permeability within the public space is necessary since this encourages people to use the whole space rather than one area that they may have come there for. Permeability is achieved by avoiding large segregation of programs.[46]

Improving or supporting the perception of safety is another key strategy to support inclusivity in public spaces. If the residents feel safe, they are far more likely to be comfortable. Public spaces create an open environment where people can meet their neighbours and get to know their community better, which directly affects crime rates.[47] Another way of supporting the feeling of safety within a community is through transition spaces that foster, "life between buildings",[48] as Jan Gehl calls it. Activities between buildings allow users to engage positively with their world, in an unplanned, informal, undemanding way.[49] This could be as simple as sitting on a bench or being in a café and watching people. Activities between buildings help ease the transition between isolation at home and contact in public. Without these lively transitions spaces, our feeling of isolation once we are home can feel sudden and shocking; however, with them, our sense of security with spaces that are not personal can be intensified.[50] This sense of security was most famously referred to by Jane Jacobs as "eyes upon the street, eyes belonging to

[45] Bentley, Responsive Environments, 12.
[46] Bentley, 13.
[47] "Place Making and the Future of Cities," 11.
[48] Jan Gehl, Life between Buildings:Using Public Space(Washington,DC: Island Press, 2011),17.
[49] Gehl, 17.
[50] Gehl, 59.

those we might call the natural proprietors of the street". [51] An example of this sense of security can reflect on the way parents let their children play outside at a younger age without supervision, since there are more familiar people on the streets.[52]

Las Condes, in Chile is a good example of how a once desolate park was transformed through permeability. The plazas gradually lost customers due to the galleries that were built in the 1980s, resulting in this area becoming one that was used by criminals who targeted the unfortunate passers-by.[53] Over five years, Las Condes was revitalized through public transport. There were stalls that were rented out to local vendors, access points were reduced and improved, and a private managing team was to manage the overall site. A huge impact was made through minimal changes, such as allowing more light in the underpass, both natural and artificial so that the space feels safer regardless of the time of day (Figure 10). The park was designed to be

Figure 10 - Subcentro as an example of inclusivity using visual and physcial permeability

[51] .Jacobs, The Death and Life of Great American Cities, 35.
[52] Gehl, Life between Buildings, 59.
[53] "Place Making and the Future of Cities," 18.

a more plaza like space to encourage public uses. The barriers between business were changed to glass panels to foster visual permeability.[54] Finally, having an old-fashioned market space, and obscuring the division between inside and out, private and public, was the key to success in making this area more inclusive.

Place attachment

Place attachment can be described as the specific emotional bonds that people share with a place where they have had: momentous life experiences, where they grew up, or where they established meaningful personal relationships and social networks.[55] Place attachment leads to appreciation, pleasure, fondness, respect, concern, responsibility and ownership.[56] Since people are more likely to care for their place,[57] this encourage communities to play a significant role in the sustainability of their living environment.[58]

Narratives built around places can create a tie to a distinct characteristic, making people more inclined to fight for the maintenance and care of their surroundings.[59] Examples of narratives are a lake that someone used to go fishing with their grandfather or a tree where someone used to love spending time as a child. On a larger scale, this can lead to bold sustainability movements, revitalization of areas, and ecological conservations that are fuelled by passion rooted in place attachment. A community-based sustainability project has the power to

54 "Place Making and the Future of Cities," 18.
55 Debra Flanders Cushing and Evonne Miller, Creating Great Places: Evidence-Based Urban Design for Health and Wellbeing (New York: Routledge, Taylor & Francis Group, 2020), 67.
56 Paul Upham et al., "Harnessing Place Attachment for Local Climate Mitigation? Hypothesising Connections between Broadening Representations of Place and Readiness for Change," Local Environment 23, no. 9 (September 2, 2018): 914, https://doi.org/10.1080/13549839.2018.1488824.
57 Gehl, Life between Buildings, 59.
58 Cushing and Miller, Creating Great Places, 71.
59 Upham et al., "Harnessing Place Attachment for Local Climate Mitigation?," 914.

include and engage the community, and to identify, shape and possibly mould future systems.[60] In turn, having a hand in this can further deepen the place attachment.

According to Seamon, there are six different ways to foster place attachment. Three principles to fostering place attachment are directly related to the built environment: place realization, place creation, and place intensification. Place realization refers to a places' particular physical make-up in terms of a landscape, the built environment or furniture.[61]

Place realization gives a place an individual character, identity or a particular atmosphere and can have effects on the psyche of the users by simulating a psychic anchor. Cushing and Miller elaborate on Seamon's work by saying that people can feel grounded to a place that gives the rest of the world a sense of coherence, a meaning in life or a sense of harmonious continuity.[62] It can boost self-esteem by providing a sense of pride and identity. The second principle, place creation is about using an appropriate understanding of the area, where designers are attentive to the community's relation to place.[63] The last principle, place intensification, is the power that empathetic and well-crafted design can have on the revival of a place.

The Tapis Rouge project in Carrefour-Feuilles, Haiti, by EVA (Emergent Vernacular Architecture) is a notable example of community engagement in an impoverished community that created a

60 Upham et al., 21.
61 David Seamon, "Place Attachment and Phenomenology," in Place Attachment: Advances in Theory, Methods, and Applications, ed. Lynne Manzo and Patrick Devine-Wright (London ; New York: Routledge, 2014), 17.
62 Cushing and Miller, Creating Great Places, 75.
63 Seamon, "Place Attachment and Phenomenology," 18.

Figure 11 - Tapis Rouge an example of place of community engagement to foster place attachment

sense of place attachment (Figure 11). In Haiti, approximately 80%of the neighbourhoods are characterized as informal.[64] This project acknowledges the importance of public spaces were social interactions manifest. The program is a large open-air amphitheatre encouraging community gathering. Using participatory design, the architects asked the community how the site was initially occupied, and to discuss visions for their neighbourhood. When it came time for construction, 75% of the skilled labourers were hired from the community. Local artists painted the wall that runs along the outside of the site. The many trees planted around the periphery will provide ample shade when fully grown. There is an area with exercise equipment and seating, and another area with grass steps with different plants. Water distribution stations are also included and hidden by palm trees. The tanks are stored underground and fed by the well located 100 m below ground.[65]

The other three principles discussed by Seamon are: place interaction, place identity, place release. These are indirectly a

[64] "Tapis Rouge — EVA Studio," accessed December 17, 2019, http://www.evastudio.co.uk/tapis-rouge.
[65] "Tapis Rouge — EVA Studio."

result of the first three principles. Place interaction is the day-to-day life and events that unfold, which are essential since this gives a place a sense of activity.[66] Place identity is when a user either, self-consciously or unselfconsciously, recognizes that a particular place adds a highly influential aspect to their individuality or their personality.[67] Place releases are serendipitous moments that occur in the environment[68] which Jan Gehl calls these "chance contacts.[69] These three factors are harder to control since they are primarily reliant on the people and their experience of each other, but can also be encouraged through design.

Incrementalism

Incremental building practices occur over many years, creating a place suited for the residents yet also filled with memory and meaning.[70] In informal settlements , this incrementalism is a result of many factors, but is directly related to the complexity of residents' lives and their long-term strategies. Residents find themselves adapting their dwelling as their needs change while considering their economic restraints, resulting in acts of building, rebuilding, deconstructing and adding. Their objective is mainly creating a place rather than a preordained typology.[71] Building in informal settlements is valued as a process; that is why providing catalysts that can sustain the growth of the physical, spatial, monetary, services and capacity of the buildings is often more effective than providing the service or buildings themselves.

[66] Seamon, "Place Attachment and Phenomenology," 16.
[67] Seamon, 17.
[68] Seamon, 17.
[69] Gehl, Life between Buildings, 15.
[70] Melanie Lombard, "Constructing Ordinary Places: Place-Making in Urban Informal Settlements in Mexico," Progress in Planning 94 (November 2014): 16, https://doi.org/10.1016/j.progress.2013.05.003.
[71] Lombard, "Constructing Ordinary Places," 17.

Often, projects built for marginalized communities are paternalistic interventions that are grand, superficial and permanent.[72] These are often unsuccessful since they do not consider the tensions of residents' everyday lives. When intervening in such context, an in-depth understanding of the time and place must be harnessed, rather than forcing a dynamic community to accept, let alone use, a static standardized 'solution'. [73]

The first step of informal settlement intervention, as Jacobs says, is to "regard slum dwellers as people capable of understanding and acting upon their own self-interests, which they certainly are."[74] The next step is to spend time with a community, exploring their built environment, which helps a designer understand the creative interventions or innovations that the community has taken upon themselves to develop.[75] These innovations are often considered unsystematic, haphazard, and illicit, but rather a designer should see these as local building techniques or vernacular architecture.

The community has needs and concerns that, with minimal, well-thought-out interventions, can be supported towards self-sufficiency.[76] As mentioned in 'The Place Making and the Future of Cities' , starting small, light cheap, and low cost is an excellent way to intervene, when we want to learn how the community responds and adapts to and appropriate the intervention.[77] Smaller interventions are said to be especially successful in informal settlements since the

[72] Jacobs, The Death and Life of Great American Cities, 270.
[73] Lombard, "Constructing Ordinary Places," 17.
[74] Jacobs, The Death and Life of Great American Cities, 270.
[75] Lombard, "Constructing Ordinary Places," 17.
[76] Jacobs, The Death and Life of Great American Cities, 270.
[77] "Place Making and the Future of Cities," 15.

residents are flexible and used to places that are in a constant state of transition. Rather than relying on fixed, inflexible large-scale investments to solve issues, residents of informal settlements use methods that are light, yet innovative.[78] Giving a community the ability to control a place can have a tremendous impact on the attachment towards this place and reinforce the idea of caring for its maintenance.[79]

Barefoot College, in Rajasthan, by Barefoot architects is an example of practice where the architects gave importance to local and traditional building techniques as a fundamental principle. With the help of a young architect Raina, a farmer named Jat and twelve barefoot architects, they were able to create the college.[80] The buildings form a courtyard, which can be used as a stage or a gathering space (Figure 12). The load-bearing walls were created from stone and lime mortar with stone slabs for roofs. The roofs collected rainwater in a tank beneath the

Figure 12 - Barefoot college and importance to tradition building practises of the community

[78] Cushing and Miller, Creating Great Places, 71.
[79] Cushing and Miller, 71.
[80] Architecture for Humanity (Organization), *Design like You Give a Damn*, 284.

courtyard with solar panels are used to generate energy for the college. The domes were made from discarded wood such as bullock carts and pumps and used thatch to give them a traditional appearance.[81]

Another project that exudes incrementalism is in the city of Gyrumi, in Armenia. In 1988, this city was struck by an earthquake that left many dead and even more homeless.[82] The city had lost civic life and the aspects that captured the cultural centre that it used to once be. After receiving a grant to try to revitalize this area, the idea was to start minimal and small scale to allow the planners to experiment with the community responses. This led to the "new Gyumri Festival and Placemaking

Figure 13 - Gyumri revitalized through small interventions

[81] Architecture for Humanity (Organization), 284.
[82] "Place Making and the Future of Cities," 27.

EXPO" which filled the square like never before. The expo was relatively simple with a list of events and improvements such as flower markets, roller skating rink, cafés, night lighting, redirection of traffic, new outdoor furniture, art fairs, performances and children's programs.[83] This small intervention acted as a catalyst that led to more events, more permanent facilities and the revitalization of the area (Figure 13).

Variety

According to Jane Jacobs, use throughout the day can be successfully achieved by the incorporation of a variety of different programs, which can have exponential effects on the economic gain of an area.[84] Variety allows a public space to create a "secondary diversity," which is an enterprise that develops due to primary use, and then begin to serve the people that the primary use has drawn.[85] Jan Gehl refers to such primary uses as necessary activities, and to secondary uses as optional activities.[86] Primary uses, such as offices, residences, entertainment, education, recreations, markets and stores, that anchors people is only the first step to the development of a place.[87] Many planners think that adding residences will make an area flourish. However, in actuality, this is only successful if residents are only part of a variety of day-night and weekend users.[88] Secondary uses such as smaller shops, pubs and restaurants, or seating areas and water features might lack the pulling power on their own, however, once people are drawn in by necessary uses, they are more likely to use

[83] "Place Making and the Future of Cities," 27.
[84] Jacobs, The Death and Life of Great American Cities, 152.
[85] Jacobs, 162.
[86] Gehl, Life between Buildings, 11.
[87] Bentley, Responsive Environments, 30.
[88] Jacobs, The Death and Life of Great American Cities, 164.

these. Taking into consideration when these uses occur ensures that an area is used during different times of the day and allow the area to be populated more uniformly at any given time.[89] There is no limit to how much variety is the right amount, and designers should aim for as much variety as possible.[90] Gehl believes that a third type of activity is achieved when necessary and optional activities are combined: 'resultant social activities'.[91] Increasing the number of optional activities while retaining necessary activities increase the likelihood of the resultant social activities. Variety encourages sociability, and contacts on various levels, such as close friendships, friends, acquaintances, chance contacts and passive contacts, strengthen a community.[92] One must consider this in the design of a space to accommodate all these levels of contact since they are all vital. Spontaneous events, such as meeting acquaintances or friends, strengthen the bonds by keeping in touch without having to create planned event. Interacting with strangers promotes a possible starting point for future levels of contact. Passive contacts, as Jan Gehl calls them, or seeing and hearing people without directly engaging, may be a source of inspiration of sorts.[93] These activities do not always need a designated space, but encouraging life on the streets through design will result in many of the serendipitous contacts. People attract people[94], which is another result of encouraging activity. Children often spend time and play where there is a lot of activity or in an area where something is most likely to happen.[95] Seating where there are excellent views of

[89] Jacobs, The Death and Life of Great American Cities, 152.
[90] Bentley, Responsive Environments, 28.
[91] Gehl, Life between Buildings, 11.
[92] Gehl, 15.
[93] Gehl, Life between Buildings, 15.
[94] Jaime Lerner, Urban Acupuncture: Celebrating Pinpricks of Change That Enrich City Life (Washington: Island Press, 2016), 47.
[95] Gehl, Life between Buildings, 25.

Figure 14 - Sports canopy, an example of architecture that allows flexibility

activities is more likely to be used rather than views of nature.[96] This applies to outdoor spaces as much as indoor. As such, public spaces should not be divided into separate compartments for separate activities, a connection both visually and physically will encourage the intermingling of different users.[97] As time goes on, the needs of the community will change, which means that designing will require robustness or flexibility in order to support this growth. This should be considered by creating places that are not too specialized, where ordinary users are welcome to adapt the environment to suit their needs.[98]

Sports Canopy, a building by Andersen & Sigurdsson Architects in Ishøj, Denmark, is a design proposal that exhibits how flexibility can be incorporated in architecture to better serve a community. The structure is a simple canopy made with steel framework and is covered by a textile roof and the wall with transparent vinyl.[99] The whole space is unheated but provide protection from wind, rain and sun.

[96] Gehl, 27.
[97] Bentley, Responsive Environments, 56.
[98] Bentley, Responsive Environments, 56.
[99] "SPORTS CANOPY – ANDERSEN & SIGURDSSON ARCHITECTS," May 5, 2014, http://www.a-s.dk/2014/sports-canopy-2/.

There is a strong connection between outside and inside both visually and physically. The façade can be opened up during the day or in the summer and closed in the night in winter. Since the canopy does not have any full interior and specific programming, the space can be used for sports, markets, organized or spontaneous activities(Figure 14). The permeability invites passers-by to engage either passively or fully. The minimal design allows for flexibility of activities throughout the year and day.

Water management

The following section presents different water management strategies that support a sustainable approach to the mitigation of water issues such as flooding and scarcity. These strategies mostly aim to address the technical dimension of such problems. There are two parts to this section. The first part explains how designers and architects can minimize the impact on the earth's natural water cycle right from the planning and design phase. The second part covers how to cure through water management solutions when communities are already subjected to water insecurity.

Prevention through sustainable practices

When sustainable methods are considered from the design phase of a building or place, it is easier to manage the quality and the quantity of water going through the site. Paying attention to site conditions and building technique during construction can have significant positive long-term impacts on water management. Ching and Shapiro recommend that designers aim to mimic the natural hydrological systems in place and retain as much water on-site as possible.[100] They explain that site design should protect existing bodies of water and wetlands while also aiming to mitigate any environmental impacts such as the stormwater run-off. Typical stormwater drainage systems create a bypass in the natural hydrological water drainage system. Because of

[100] Francis D. K. Ching and Ian M. Shapiro, Green Building Illustrated (Hoboken: Wiley, 2014), 137.

this, water is not allowed to infiltrate groundwater and this can have other negative consequences such as erosions, flooding, habitat damage, water pollution, aquifer depletion, and water body degradation.[101]

Both the quantity and quality of stormwater run-off is essential to take into account when designing storm water systems. The quantity of stormwater run-off is proportionate to the number of impermeable surfaces on a certain site. Having more run-off adds pressure on the stormwater systems, causing them to back up and flood.[102] Additionally, run-off dislodges contaminants along its path of travel, and water is not able to percolate to the subsoil or even the topsoil at times, meaning that aquifers do not get replenished. To reduce run-off, using permeable or semipermeable surface is a possible strategy. This can include porous asphalt, pervious concrete, pervious pavers and vegetated landscapes.

Trying to minimize contaminants, such as heavy metals, oil and grease, biological waste, garbage and sediments, increase the quality of the water.[103] Although this depends on how low-lying the area is, organic gardening is an excellent alternative to reduce pesticides, herbicides, fungicides and, animal waste.[104] Minimizing pollutants should be kept in mind while construction happens since this phase can be intrinsically disruptive and, even though it may be temporary, the pollution it can generate can be vast.[105] This can cause long-term environmental damage. An example of construction contamination is concrete washout, which should be done offsite if possible; if not, it

[101] Ching and Shapiro, 137.
[102] Ching and Shapiro, 139.
[103] Ching and Shapiro, 140.
[104] Ching and Shapiro, 141.
[105] Ching and Shapiro, 143.

should be done in a temporary pit. Sediment traps should be implemented too. Using materials and treatments that are not toxic will have long-term benefits on the site.[106]

Finally, water that is brought to the building from offsite, such as municipal water systems or water from an aquifer that is beyond the site, is called transported water. Relying on a local source of water can often be more reliant in informal communities. There should two separate systems, one potable and one non-potable and the uses are respective of the quality of water. Having separate systems lowers the power requirements of pumps, water treatment and decreasing run-off.[107] Since potable water is used less than non-potable water, having a more intense filtration system that handles a small amount of water would also prove more economical than having the more intense filtration for everything.

Cure through water management solutions

Pre-planning is not always possible, and often designers and architects are tasked with fixing existing issues as part of their design. The following section aims to present various types of water issues one may face and how to tackle them; from water management solutions that deal with freshwater to black water collection and treatment. Many of these solutions have been implemented in crisis situations and/or in the Global South, where climate change and poverty affect the population more severely.

[106] Ching and Shapiro, 141.
[107] Ching and Shapiro, 143.

Figure 15 - Hippo roller to transport water

Water collection

Hippo roller

The hippo roller was created so that people who are travelling far to collect water would not have to carry the water back, but instead, can roll it (Figure 15). Hippo roller was designed by Petzer and Jonker and used throughout South Africa and other countries of the Global South. The polyethylene barrel holds 90L and has a clip-on handle.[108] The roller allows one person to collect more water than they could have with just a bucket as they were doing before.

[108] Architecture for Humanity (Organization), *Design like You Give a Damn*, 280.

Figure 16 - Money makers pump to tap borewell supplies

Money Makers pump

Money makers pump was designed by a group of people: Mark Buthcer, Dr. Martin Fisher, Abdi Mohammed, Alan Spybey, Mohammad Swaleh, Ben Tarbel, IDEO volunteers. This pump access groundwater and is used extensively in Kenya. It is lightweight and portable and entirely run by the user. It is manually operated by a pedal and can be used barefoot (Figure 16). [109] Since 50% of the pump buyers are women, the pedal operates at a lower angle to accommodate women in skirts. It is self-installed and is a deep lift pump that can not only pull water but also pressurize it to be used out of a hose pipe. It is used mainly by farmers when water is not readily available to ease irrigation processes, rather than having to carry water from one place to another. The tool is built from commonly available steel parts to make it affordable to maintain.[110]

[109] Architecture for Humanity (Organization), 286.
[110] Architecture for Humanity (Organization), 286.

Rainwater

Another approach is to harvest rainwater and collect stormwater for non-potable uses such as washing clothes, flushing toilets or irrigation. Instead of being directed away from buildings, drains and spouts can be routed to direct water into a single point where it can then be stored for future use.[111] Butterfly roofs and flat roofs are ideal for this.

Stormwater collection

Stormwater collection is another source of water, although it is more contaminated than rainwater. Run-off can be minimized primarily by permeable surfaces, and whatever excess is left can be redirected by canals. The use of 'wadis,' a collection system that will be discussed later, can help clean the water before it enters the stormwater system. [112]

Storage

Detention ponds hold water only for a short period before it re-enters the hydrological cycle again, whereas a retention pond maintains water throughout the year collecting run-off and stormwater. Soak away pits are created to reduce peak stormwater run-off by storing and infiltrating the ground instead of becoming run-off.[113]Detention and retention facilities can be efficient in low-lying marsh areas while being cost-effective.[114] This can reduce the impact of the phosphorus and nitrogen pollutant load and improve the quality of the stormwater.

[111] Ching and Shapiro, *Green Building Illustrated*, 153.
[112] "Leidsche Rijn Sustainable Urban Development, Netherlands I Natural Water Retention Measures," 9, accessed December 19, 2017, http://nwrm.eu/case-study/leidsche-rijn-sustainable-urban-development-netherlands.
[113] Alan L Goldstein, "THIRD ANNUAL REPORT TO THE COORDINATING COUNCIL ON THE RESTORATION OF THE KISSIMMEE RIVER VALLEY AND TAYLOR CREEK/NUBBIN SLOUGH BASIN," n.d., 143.
[114] Goldstein, 145.

Hydropuncture by LafargeHolcim, located in Mexico City in an impoverished neighbourhood, aims to hopes to alleviate the flooding issues of the area, and to provide access to water to the public with the use of a retention pond.[115] The storm water management system will be powered by solar energy and filter 68,000 m3 per year.[116] Approximately 86.4 m3 /day of wastewater will be treated and piped to public toilets that do not have the facilities. The park around it will be permeable and will be abundant in endemic trees and plants (Figure 17).

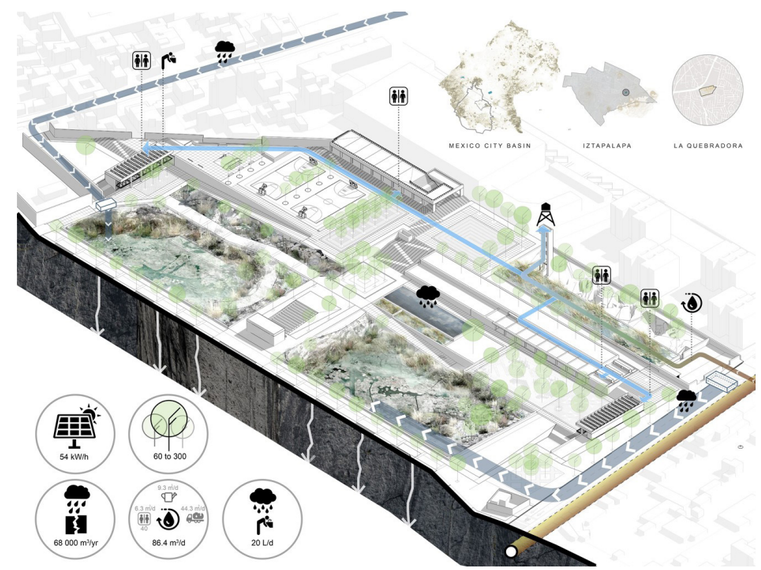


Figure 17 - Hydropuncture's retention pond to alleviate flood damage

[115] Manuel Perló Cohen et al., "Publicly-Accessible Water Retention and Treatment Complex, Mexico City, Mexico," n.d., 1.
[116] Cohen et al.

Verbal, Leidsche Rijn, Utrecht, Netherlands is a great example of water collection, purification and storage in order to restore culture and instill place attachment in the community. The key issue in Leidsche Rijn was unequal levels of water through the seasons, which was detrimental to agricultural activities. This resulted in the groundwater, drained out during the winter months, needing to be supplied from the Amsterdam-Rhine Canal during the summer, causing flooding in the lower lands.[117] The water in this canal, due to the high phosphorus levels from farming, became polluted and encouraged algae growth. The residents of Leidsche Rijn who depended on water for agriculture were suffering.

The municipality of Utrecht decided to fix the water issue through design. The new design altered the central lands to allow water infiltration. Canals were dug around the perimeter of the site to lead the water away and into a large lake, which acts as a retention pond (Figure 18). This stormwater is used for recreation and as an ecological

Figure 18 - Over view of Leidsche Rijn. An example of water treatment and retention to alleviate flood issues

[117] Heidi Birch and Maria Bergman, "Sustainable Urban Drain Age Systems- 8 Case Studies from the Netherlands" (Technical University of Denmark, May 2008), 7, https://copenhagenwater.files.wordpress.com/2013/11/suds-8-case-studies-from-the-netherlands-2bg.pdf.

habitat. Verbal, uses vegetative landscapes and permeable surfaces to minimize flooding and the risk of contaminated water percolating in the aquifer. This project uses a system called 'wadis,' which uses a suppression of grass where the top layer holds pollutants and has the soak away pit underneath.[118] The top layer is a mixture of sand and humus that removes heavy metals and any other hydrophobic compounds with a layer underneath that has a plastic soak away box that holds clean water, allowing it to infiltrate the groundwater. These wadis also act as a green space in the area that improved the quality of living. Some issues of these wadis are they got clogged, proving hard to fix since they were underground. Cars that park on wadis cause the soil to become compact, which decreases its permeable characteristics.[119] In order to keep the water as clean as possible, pesticides, salt on roads, carwashes and walking dogs are only permitted in designated areas; if these rules are not enforced, the system will fail.[120]

The project uses storm water management and retention to improve the quality of clean surface water for a whole urban area that could last a minimum of 30 years. The project aimed to remove the phosphate, nitrates, bacteria, heavy metal and suspended solids in surface water using reedbeds.[121]

The project contains around 30,000 houses. The strategy deals with water management and extensive use of suds in terms of preventing discharge from the site using storage and infiltration. It also

[118] "Leidsche Rijn Sustainable Urban Development, Netherlands I Natural Water Retention Measures," 9.
[119] "Leidsche Rijn Sustainable Urban Development, Netherlands I Natural Water Retention Measures," 9.
[120] "Leidsche Rijn Sustainable Urban Development, Netherlands I Natural Water Retention Measures," 10.
[121] Birch and Bergman, "Sustainable Urban Drain Age Systems- 8 Case Studies from the Netherlands," 7.

aims to reduce inputs of poor-quality water from elsewhere. Careful management of the existing water bodies the site is detrimental and also providing the community with improved ecology and recreation opportunities. Natural water retention methods that were implemented into the site were permeable surface, swales, canals, filter strips, soak away pits, detention basins, retention ponds and infiltration basins. Stormwater is in a closed-loop system that retains water in the canals to be utilized throughout the year, to decrease the likelihood of flooding. Stormwater is known as a source of non-polluted water, especially in comparison to the Amsterdam-Rhine Canal, which, as discussed before, is extremely high in phosphorus levels encouraging algae growth. The lake was planned to be in a drier part so that the groundwater is replenished.[122]

Another important aspect of this scheme was to turn parking and pavements into permeable surfaces. A problem with this, however, is that often these permeability pores can be clogged, needing regular cleaning or vacuuming. There will be no need for external water sources, which decreases the pollution in the water, and the lakes are regulated to allow for an extra 100 cm in order to combat flooding problems in case of 100-year rain events.

The system has to be continuously pumped since its open water, to avoid the risk of stagnation and freezing.[123] The loop is included a vertical flow reed bed, which filters out the phosphate levels of the

[122] Birch and Bergman, 8.
[123] "Leidsche Rijn Sustainable Urban Development, Netherlands I Natural Water Retention Measures," 8.

water, maintaining them below 0.15 mg/l. The filtration system consists of sand enriched calcium carbonate and iron oxides.

Verbal is the embodiment of place intensification through the revival of a place which is a component of place attachment mentioned before. The canals have not only cleaned up the water but have brought an important part of Leidsche Rijn's culture back. The majority of water purification and storage elements that have been left visible to the public to educate the community. The project was successful in creating a sense of identity for the area.

Adalaj is a step-well in a village of Gujurat, in India, that was built around 1000 years ago. Gujurat sees only two seasons, monsoons and summer. In the summer, the land is dry and hot and water was scarce, on the other hand, monsoon would come by and flood the villages and destroy them. Step wells served to collect water and acts as

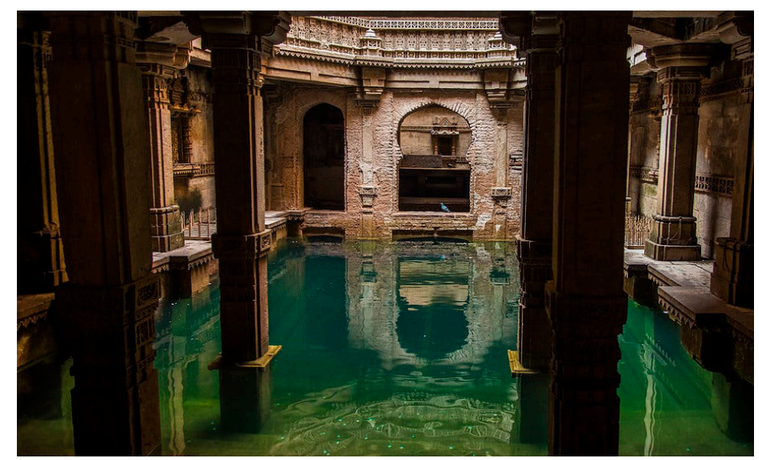


Figure 19 - Adalaj Vav an ancient retention pond

a retention pond in the monsoon season for the community to use. In the hot months of summer, this would also be a place for the community to relax since the temperature would be cooler. The temperature inside the well is said to be about five degrees lower than the outside hot summer temperatures.[124] This encouraged the women who came to fetch water to spend more time in the cooler atmosphere here, stay to worship the gods and goddesses and socialize.[125]

The stepwell of Adalaj is built in sandstone and is five stories deep (Figure 19). [126] The plan of the well is octagonal at the top and held up by many massive carved pillars, and each floor was built large enough for the community to come in and relax. The well is deep enough to access groundwater and also collect rainwater.[127] The windows in the roof and at each landing are huge to allow indirect sunlight. However, the opening above the water is minimal to not only increase shade for the people but also to conserve the collected water. At the bottom floor, staircases lead into the water that it is accessible regardless of the level.

[124] Revati Victor, "Adalaj Stepwells, Ahmedabad - Into the Depths of History," Different Doors (blog), August 7, 2014, http://different-doors.com/adalaj-stepwells/.
[125] Victor.
[126] Victor.
[127] Victor.

Purification

There are various ways to purify water depending on the input water available and the output water desired.

Aquacube

The Aquacube can use any water and turn into potable water. This was manufactured by Water Process Technology Division and used in the USA, Indonesia and Africa in times of the tsunami to get clean water systems to people who did not have the apparatus to do so. This system is a little water purifying plant that has a generator to power it (Figure 20).[128] Its forte is its compact size and transportability on a truck with a steel frame of around 1m^3 and purifies 1500L of water per hour.

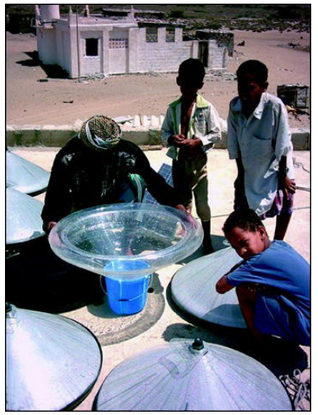
Figure 20 - Aquacube converts any water to potable water

[128] Architecture for Humanity (Organization), *Design like You Give a Damn*, 288.

Figure 21 - Top: Ceramic water filter converts freshwater to drinking water
Figure 22 - Bottom: watercone used to desalinate water

Ceramic Water Filter

The ceramic filter uses freshwater and can convert it into potable water. It was developed by Dr. Fernando Maza and Potters Peace Foundation. It has been used extensively in many countries of the Global South (Figure 21). This ceramic water filter allows water to pass through a filter inside it. Most bacteria are too large to be able to pass through the porosity of the clay.[129] If any does pass through, they are eliminated by the filter's silver coating. It holds around 20 L and can purify 1.75L/hour. Trained locals make the filters, as local sawdust, clay and 10 cents' worth of colloidal silver is used per filter.



Watercone

Watercone converts saltwater into drinking water. This was designed by Stephen Augustin and used primarily in Yemen.This straightforward system desalinates water through evaporation and collects condensation. The system comprises a bright

[129] Architecture for Humanity (Organization), 284.

polycarbonate cone that rests on a polycarbonate pan (Figure 22).[130] The saltwater is placed in the bottom pan, where the sun heats the water. The water begins to evaporate, and as it hits the cone, it condenses and collected in a lip around the transparent cone. The water can then be consumed.

Bioswales

The wetland has been the earth's natural filters that clean, purify and encourage an array of wildlife habitats. Lakes are the original retention pond. However, as urban development takes place, lakes and wetlands are often encroached upon and destroyed, leading to contaminated and stagnant water. Bioremediation, which uses biological systems to mitigate a problem, has proven to be a more effective and safe way of restoring the ecosystem to its natural state.[131] Bioremediation has been extensively used to remedy and also restrict the contamination of soil and water.[132] Bioremediation of soil and water is done using plants that absorb contaminants such as heavy metals, nitrogen to name a few, and use these contaminants as nutrients, fuelling the plant while cleaning soil and water.[133] Bioswales or reed beds are an example of this. Typical composition of a bioswale is native bushes on the topsoil on top 6-8 inches of soil.[134] Underneath that, there is a gravel pot with a perforated pipe that runs through it. This involves the greywater passing through a tank where any remaining solids can settle. This is then made to flow through a reed bed where the reeds soak up the toxins and bacteria and use them as

[130] Architecture for Humanity (Organization), 285.
[131] Yung-Tse Hung, Joseph F. Hawumba, and Lawrence K. Wang, "Living Machines for Bioremediation, Wastewater Treatment, and Water Conservation," in *Modern Water Resources Engineering*, ed. Lawrence K. Wang and Chih Ted Yang (Totowa, NJ: Humana Press, 2014), 685, https://doi.org/10.1007/978-1-62703-595-8_14.
[132] James Lynch and Andrew Moffat, "Bioremediation – Prospects for the Future Application of Innovative Applied Biological Research," Annals of Applied Biology 146 (03 2005): 217.
[133] Lynch and Moffat, 218.
[134] Brian S. Anderson et al., "Bioswales Reduce Contaminants Associated with Toxicity in Urban Storm Water: Bioswales Treat Urban Storm Water," Environmental Toxicology and Chemistry 35, no. 12 (December 2016): 3125, https://doi.org/10.1002/etc.3472.

Figure 23 - Diagram of bioswale

nutrients (Figure 23).[135] Sometimes one last step is included: the water is then passed through an open tank where snails, algae, frogs, small fish and banana trees soak up any toxins, and that may have been leftover.

The US pavilion in Aurovile, Tamil Nadu, India is a project that uses a reed bed system for water filtration by the company Living Machine. This dormitory was made for US citizens to stay in when they visit Auroville, which is an attractive tourist town. This system uses solar power, collects rainwater, and filters both grey water and black water. There are two different toilets, one for solid excretion (black water), the other for liquid excretion (greywater). The black water is treated in dry composting pit latrines where it is held in a cabinet for six months at the end of which it can be turned into fertilizer for the gardens.

The grey water and urine are treated in a Living Machine, which is a natural filtration system. This treatment involves the greywater

[135] Architecture for Humanity (Organization), *Design like You Give a Damn*, 294.

passing through a tank where any remaining solids are can settle. The greywater is then made to flow through a reed bed where the reeds soak up the toxins and bacteria and use them as nutrients.[136] Lastly, the water is then passed through an open tank where snails, algae, frogs, small fish and banana trees soak up any toxins that may have been leftover.[137]

Ecological Dry Toilet

Ecological Dry Toilet was deisgned by César Anorve. This system turns blackwater into fertilizer. Approximately half of the water used in a typical Mexican home is wasted in the toilet (Figure 24).[138] The ecological dry toilet aims to help conserve water, especially since it is a limited resource, and is ideal in a place that lacks sanitation services. There is a standard toilet that has two chambers underneath, one active where the waste is collected and the other passive where the waste is sealed and allowed to compost for 18 months. The active tank is “flushed” with lime or ash instead of using water to neutralize any unpleasant odours and to act as a catalyst for the decomposing process.[139] Urine is diverted in a tank and settles before it can be used for fertilizer.

Figure 24 - Ecological toilet turns black water into fertilizer

[136] Architecture for Humanity (Organization), 294.
[137] Architecture for Humanity (Organization), 294.
[138] Architecture for Humanity (Organization), 296.
[139] Architecture for Humanity (Organization), 296.

VIP latrine (ventilate improved latrine)

The VIP latrine was designed for a school in remote Ladakh in India, where plumbing is challenging; this is why a waterless system was apt.[140] The standard latrine is just a pit that goes into the ground. The designers, Arup Associates the upgraded it where there is a solar-heated flue that forces fresh air through the cubicle and waste pits and out through a vent to expel any unpleasant smells and flies. The solid waste is left to dry in twin composting pits, which can then be used as fertilizer (Figure 25).

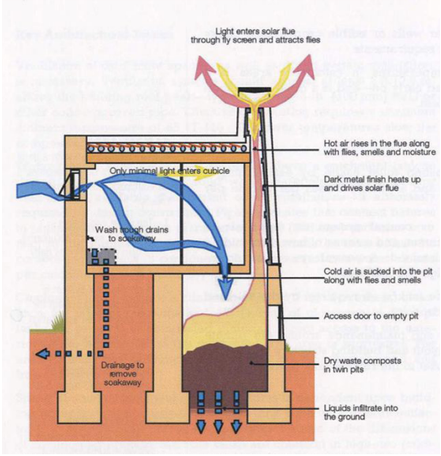


Figure 25 - VIP Latrine (ventilate improved latrine) converts black water into fertilizer

140 Architecture for Humanity (Organization), 293.

Part 3 - Data collection

Site visits

Potential sites for the thesis project were determined with the help of the cartographic analysis of Bangalore's water crisis (see Part 1) and access through non-governmental organizations (NGOs) in particular an organization named AVAS. While I was able to visit some areas of Chamrajpete and Malleshwaram, I was unable to find someone who worked in Rajajinagar and who was willing to take me there. Thus, I visited four potential sites. Two were in Chamrajpete: Sanyasakunte 1, Sanyasakunte 2, the third was in Banshankri: Hoskalhalli, and the last one was in Mallehswaram: Vyalikaval. Each of the four sites visited varied in terms of flooding, access to water, access to adequate sanitation and access to durable housing – the criteria analyzed through mapping.

During my visits, I was looking for a certain set of criteria. The first being the community's relationship with water: where they get their water from; how they access basic sanitation services such as toilets; since I visited in the dry season, if the area floods and to what extent. The next set of parameters I studied were of a social nature: what sort of jobs did people have and how far it was from their neighbourhood; what does the community want or need in terms of public space, and what would be the different activities happening in this public space. Every community was very open, just a few questions sparked off many conversations and lead to many tangent subjects. Every single detail was noted down in

my sketchbook whether I thought it was relevant at the time or not. For the majority of the time, the community led me to find exactly what I was looking for without me asking. If I didn't find what I was looking for, I would then ask. Listening first and asking later was an integral aspect of ensuring the communities' willingness to participate. To protect the identity of the people I spoke with, their names have been changed in the text.

Other aspects were recorded through a more observational method of collection. As Lombard suggests, the vernacular architecture of each slum was documented through extensive photographing and quick sketches.[141] When there were settlements or portions of a house built informally, the owner was asked where the material came from. This helped me understand the adaptability and tolerance of the community, as well as how residents felt about their government-built house. This adaptability was also based on the amount of available space to intervene.

[141] Lombard, "Constructing Ordinary Places," 17.

Site 1- Sanyasakunte 1

Location: Chamrajpete

Units: 204

Population: approx. 600

Area: 6239 m²

Water source: Borewell (aquifer), non-potable,

Kaveri (municipal water) alternate days, potable.

Flooding: none

Access to sanitation: Bathroom in every unit

Figure 26 - Sanyasakunte 1

Sanyasakunte 1 had a housing project established by the Karnataka Slum Development Board, which is a sector of the government that clears and improves slums across the state .[142] The project was given to local contractors who hired labourers from the community to construct it.[143] Sita, a community leader, said that before this project, they had no water, no latrines; there was only one public pay per use toilet that was open from 5 am to 8 pm. The budget for this slum development was more than the average, resulting in 'good housing'. Residents are strictly forbidden to build additions to their house.

Each unit has one bedroom, one bathroom, one kitchen, one living space. Almost every room had an overhead shelf. In the kitchen, there are two taps; one is a direct Kaveri(municipal) connection, the other is from the overhead tank that stores Kaveri water, which is used for drinking water. There is a borewell tap outside from which the community can collect water. This water, however, is not clean enough to drink. Sanyasakunte 1 is not subject to flooding.

The main fields of employment for men are construction workers, drivers, carpenters, and vegetable vendors.[144] The women used to be only domestic workers, but since the development and education of the residents, the women now are accountants, teachers, seamstresses and cooks. Many of the residents are vegetable vendors who go to the market early in the morning to buy fresh produce and sell it for profit.

There was a small vacant land plot at the front of the slum that the community wanted to use for a market space. Instead, the

[142] Gretta Andrew, NGO AVAS slum knowledge, December 13, 2019.
[143] Andrew.
[144] Andrew.

Figure 27 - Sanyasakunte 1 map. Scale 1:2000

government decided to make an Indira Canteen (Figure 27), which is a food subsidization program run by the government. There, they serve breakfast, lunch and dinner and aim to aid disadvantaged communities at a lower price. Though the intention behind this seems genuine, the community says that the quality of food is inferior here and therefore this canteen is underused.

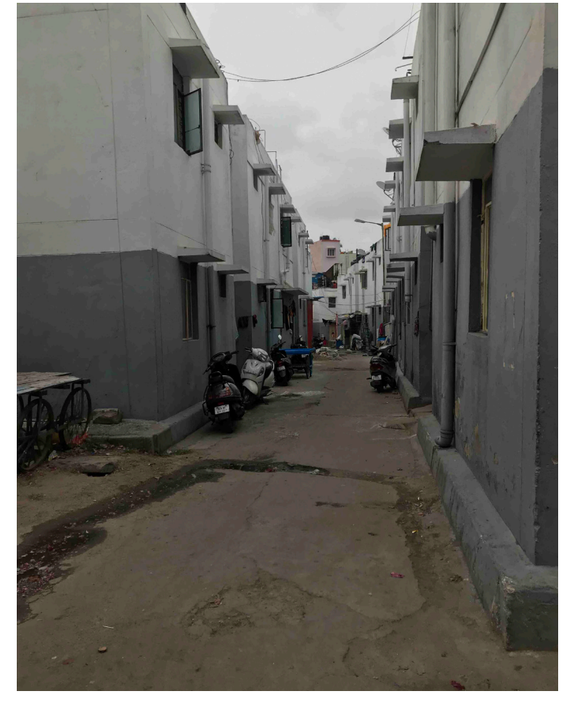
Manjula, a single mother from the community who was born there, shed some light on the house allotment, which was an exciting aspect of this project. The Karnataka Slum Development Board gave each family an ID card with an ID number that was determined by their location within the neighbourhood, i.e. 1-204. When the houses were built, each house was also given a number from 1-204. The Board decided to draw ID numbers and allot a house to the drawn ID number.

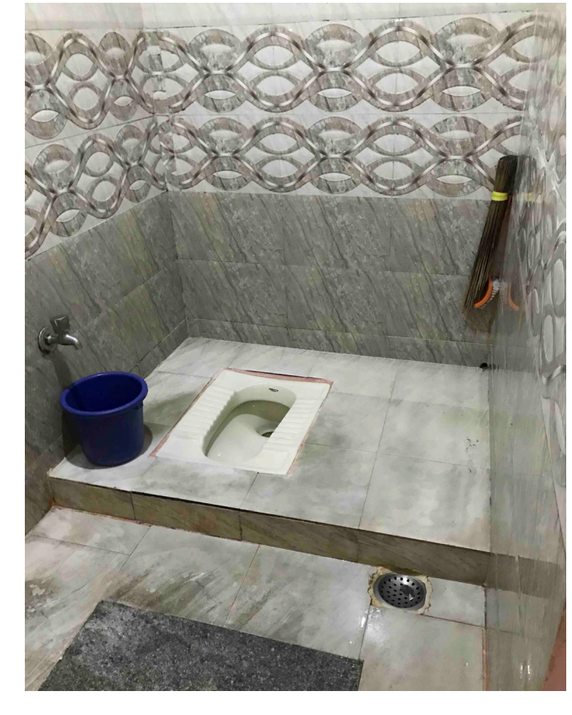
The community did not like this; they wanted to be with the neighbours that they had been for years, so instead, they proposed to move ID number 1 into house number 1. This shows the aspect of the community and their ties to the people around them. If a family expands, they either stay in this unit or purchase another unit, if possible.

There was no community adaptation of the governmental housing that was implemented, maybe because the residents didn't need much more, since this intervention accommodated everyone (Figure 28).

This site was not selected. Residents had access to drinking water and even though it was limited, they had means to store it. The community didn't have any space available for public space. There was no flooding, everyone had a toilet (Figure 29) and no 'vernacular' architecture. In general, they seemed to be happy and healthy with their reality. The majority were excited to talk about all the benefits that happened as a result of the housing, what their children aspire to be, how they have excelled at jobs.

When asked what sort of public space they would want, the residents met said they need a market space and would like to sell their vegetables, fruits and flowers (Figures 30 and 31).





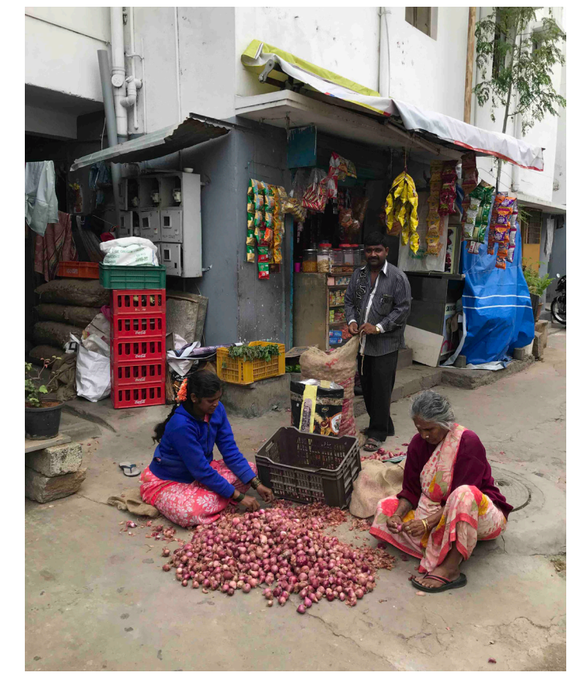


Figure 28 - Top left: Circulation space
Figure 29 - Top right: Toilet in each unit
Figure 30 - Bottom left: Vegetable vendors
Figure 31 - Bottom right: Sorting through vegetables

Figure 32 - The exclusion of Sanyasakunte 2 from Jinke Park

Site 2 -Sanyasakunte 2

Location: Chamrajpete

Units: 206

Population: approx. : 1, 230

Approx. Area : 6,794 m²

Water Source: borewell (aquifer), non-potable. Kaveri (municipal) water alternate days, potable.

Flooding: Throughout the circulation space, storm sewer backup

Access to sanitation: Public pay per use toilet 05:00-21:00 and developed houses have bathrooms

This neighbourhood was partially developed since there was not enough means to give everyone homes.[145] The units are the same as in Sanyasakunte 1. Though they are not allowed, the residents added on to the current infrastructure. There are some houses that have encroached into the circulation space with little regard for the limiting distances from other units. The additions are up against neighbouring units, resulting in poor ventilation. Each house has at least one tap that has a direct connection to Kaveri (municipal) water. Some have an overhead tank that is also piped to their kitchen. The borewell connection is accessible to the whole community at one location; however, this water is not potable. Before the housing project, there was only a public pay per use toilet. Although some of the residents now have a toilet in their unit, they still use the public toilet. Many of the residents closed off their toilet and turned the bathroom into another bedroom or storage space. This can be due to two factors, either the lack of space per unit or the lack of education on the importance of toilets.

[145] Andrew.

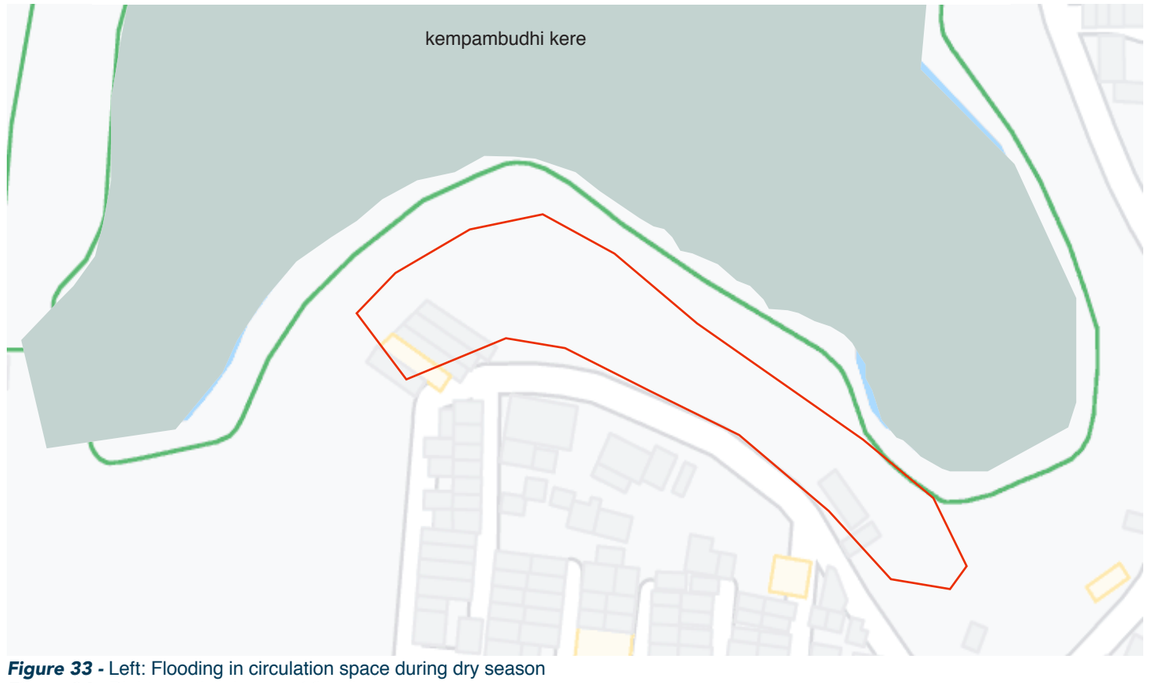


Figure 33 **-** Left: Flooding in circulation space during dry season
Figure 34 **-** Right: another image of flooding
Figure 35 **-** Bottom: Sanyasakunte 2 map. Scale 1:2000

Figure 36 **-** Left: Government temple
Figure 37 **-** Right: Community temple

The community says that although the development included drainage and sewerage systems, the area still floods. Located in a low-lying area that is surrounded by the 'higher class,' in times of rain, all the run-off from the higher ground comes here and pools. Fortunately, it does not enter the houses, but the circulation space is flooded and makes it difficult for people to leave their houses (Figures 33 and 34). The drains that are in place are poorly designed and often back up, resulting in open sewage.[146]

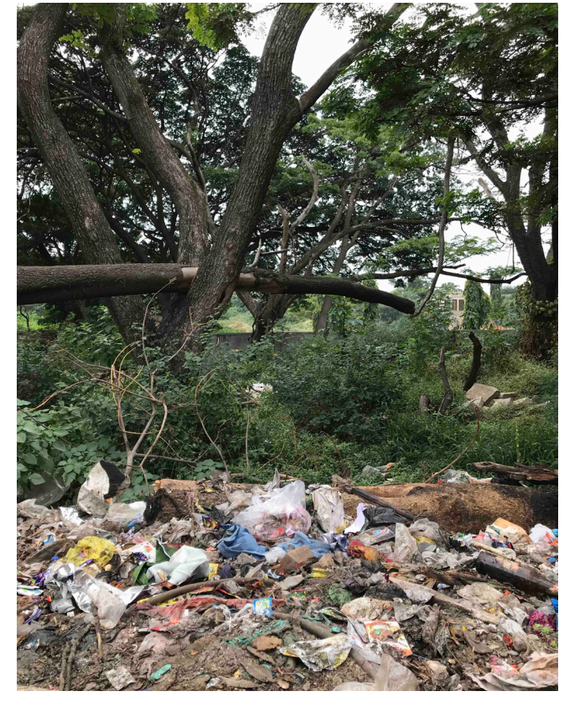
When the community was asked what they needed, they said they need an "Anganwadi." This is a women and children health care centre where necessary activities are provided, such as contraceptives, nutrition education, supplements, counselling as well as pre-school activities.[147] The slum used to have one until a city road was built, which removed the Anganwadi and the government never replaced it. They also expressed that they would love to have a place where they can

[146] Andrew.
[147] Nirman Bhawn, "Integrated Child Development Services (ICDS) under Ministry of Women and Child Welfare," Ministry of Women and Child Welfare, 2, no. No. 16/3/2009-ME (March 10, 2011): 4.

have meetings, a place to socialize, to have activities for children and to have spaces for flower or vegetable vendors, and rentable spaces for shops. The main fields of employment are construction workers, drivers, carpenters, vegetable vendors, domestic workers, cooks, and stay at home moms.

One thing that stood out about this site is the buildings around it. There is a swimming pool to the south, many parks, a water filtration building to the west, and a BWSSB (Bangalore Water Sewerage and Sanitation Board) to the east. The area around is well developed, but in the middle of it all lies this community that is a need. It was close to a large temple that the Kempegowda welfare association funded but despite that the community decided to build their own temple, though it was much smaller. The idea of ownership is essential to this community to the extent that they would prefer a small temple that is theirs rather than a large temple that is not (Figures 36 and 37).

This area is located next to the Kempambudhi Kere, a park that is very well maintained by the government. It was shocking to see the slum right up against such a beautifully manicured landscape with a steel wall (Figure 32). The sheer lack of people in the park, against the overcrowding of the slum. When fighting for land rights, the government wanted to clear this slum in fear of them 'ruining' this water body.



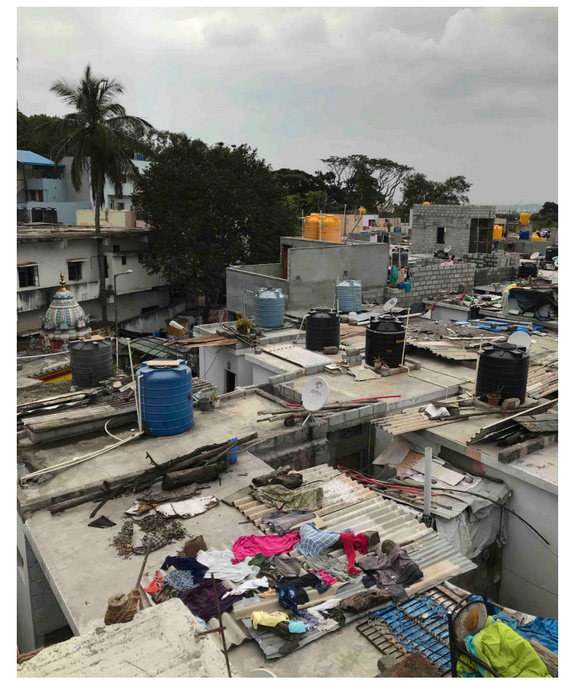


Figure 38 - Top left: Garbage dump
Figure 39 - Top right: Common space use
Figure 40 - Bottom left: Roof usage
Figure 41 - Bottom right: Community gathering

Figure 42 - Sewage river in Hoskalhalli

Site 3 - Hoskalhalli

Location: Janashakthi Nagar

Units: 127

Population: unknown

Approx Area: 4478 m²

Water source: Borewell (aquifer) and Kaveri water (municipal water) alternate days, potable

Flooding: None

Access to sanitation: As per residents desire

Figure 43 - Boundary of Hoskalhalli and proximity to the sewage filled river.Scale 1:2000

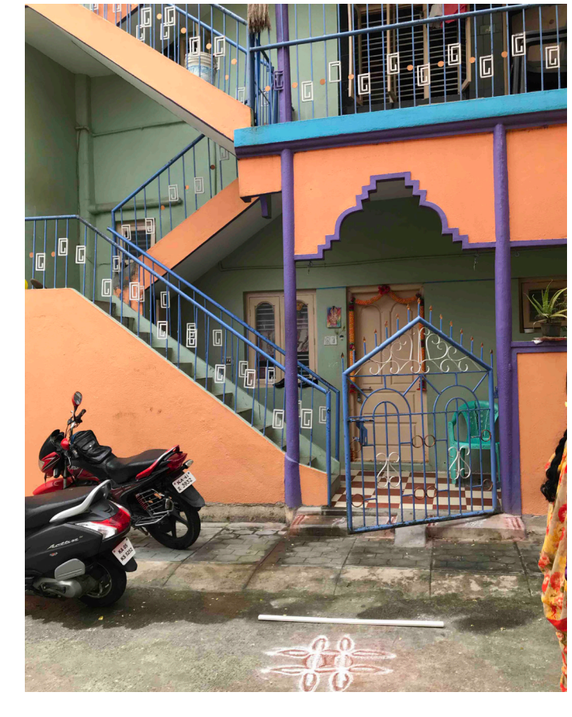
This area used to flood extensively, so the NGO AVAS intervened by encouraging people to save for a development project.[148] When the government development happened, the budget for this project was limited. Each household was given a plot of 15' by 20' along three roads that are dead ends (Figure 43). The government gave them a loan to build whatever they wanted. The majority of the families started off with a one-storey house that was cheaply made. As they made more money, they either added on or demolished and built a better quality house. This led to such a variety of types, sizes and colours of constructions (Figures 44 and 45). For example, Shakuntala, a resident here, was supported by the NGO AVAS to pursue her dream of a degree in Commerce. On completion, she first rented a space for her beauty parlour business, while she lived in a humbler home. Now that she has more money, she

[148] Andrew, NGO AVAS slum knowledge.

built additions to her house. Some sell their house if they cannot afford the loan or build. Shakuntala says the community also hired each other to build different aspects of their houses, depending on the skills they had to offer. There were small shops at the front of the slum, a tailor's shop and a barber all community-run (Figures 46 and 47). The loans of all the community were paid six months before they were due. There are taps from the groundwater and the government Kaveri supply in each kitchen. The Kaveri water comes once in 2 days, and most people have storage containers. There is a large sewage river that flows behind their area (Figure 42). This is a concern since, in monsoon times, the amount of sewage increases, and though the water does not flood their houses anymore, it spreads disease making the community sick.

There was a community room close to the temple where community meetings would take places and children had space to play. When they were asked what was missing in their community in terms of public space, the residents said that they wanted a bigger multifunctional room. They wanted it to facilitate activities such as dancing, singing, drama, and after-school class for the youth. They also requested a small playground for the children.

This site was not selected because, other than the sewage river, which was sectioned off, they had no other major concern in terms of access to water or access to bathrooms. They seem happy since they were able to take control of their circumstances with loans from the government in a way that was personal and completely their own.



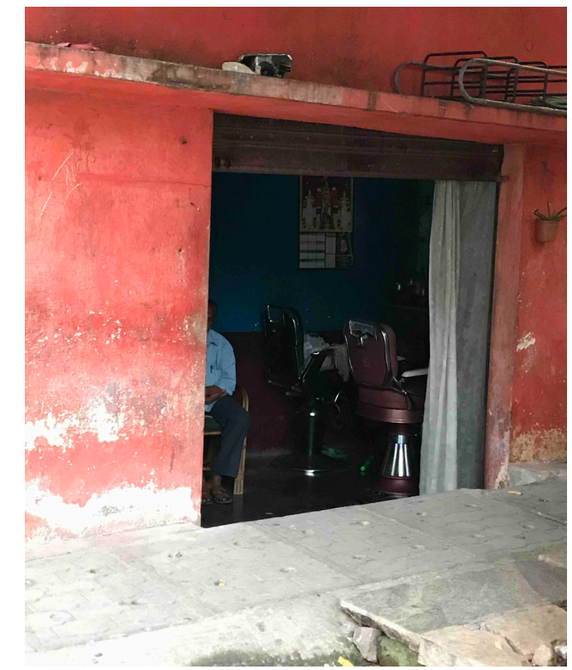


Figure 44 - Top left: less developed settlement
Figure 45 - Top right: more developed settlment
Figure 46 - Bottom left: tailorshop
Figure 47 - Bottom right: barber

Site 4- Vyalikaval slum

Location: Janashakthi Nagar

Units: 42 Units

Approx. Population: 140

Approx. Area: 1236 m²

Water source: a pipe from the water lines that supply the surrounding neighbourhood

Flooding: none, but close by areas flooding cause snakes to come to their property

Access to sanitation: some units have washrooms

Figure 48 - Vyalikaval slum

Figure 49 - Vyalikaval slum map. Scale 1:2000

This slum was a much smaller slum and had faced no significant development so far. The government has plans to develop this area, but for now, residents are living in constructions made by themselves. Hema, an 84-year-old woman, was the chief spokesperson here and had a lot to say. She said that for many years, this land was used as a dumping ground. As the community came to settle here, they cleaned up the land and made it 'liveable.' As soon as they did this, the neighbours around them tried to claim this land. Since casteism is prevalent in India, having a slum so close to the upper-class neighbourhood was perceived as unacceptable. The slum dwellers were harassed, beaten, and ridiculed, even women and children were beaten to the extent that they had fractures. They did want to work too far away from their homes in fear that they may come back to their house as a pile of ashes. But thanks to AVAS they now have land rights.

Each plot is 10' x 17' with a little washing area outside. Some houses have families of 6 living in this space. There is no piped water in their houses and when. They used to depend on a well, but the water there was unclean,[149] so they had to go from house to house in the upper-class neighbourhood to beg for water. When asked what they did for water now, Hema answered with a big smile saying, "the government did not give us water, so we dug till we found the Kaveri pipe that supplies the surrounding Brahmans (people of much higher caste) That was 30 years ago; no one has caught us".

The area is close to flood-prone areas, and though it does not cause damage to their homes, the community said that snakes come in their property looking for refuge resulting in many of the residents with snake bites.The circulation space was used extensively here, possibly due to the houses being much smaller than in the others visited areas (Figures 50 and 51). When repeatedly asked what they felt was missing in terms of public space, the residents replied better houses. Though this was the least developed slum out of the four potential floods, it was incredible to see how this community adapted to the dynamism of the city. This site was not selected because the main needs were not water-related. This community mostly needed better housing situations. Although their water source was illegal, they had plenty and for free. They did not face any flooding, and they had a strong sense of ownership over their space.

[149] Rahath Begam, NGO AVAS slum knowledge, December 16, 2019.

Figure 50 - Top: Uses of circulation space for storage and drying clothes
Figure 51 - Bottom: Use of circulation space for cooking and washing

Site selection : overall observations

The four communities visited were all proud of their homes, no matter how big or small, or what it was made of, and excitedly invited me to see them. One striking difference that was noted between the sites was the amount of Kolam. In India, The “Kolam” or the “Rangoli” is a chalk pattern that brings prosperity to homes and displays a sense of pride and ownership (Figure 52).[150] No matter the size of the settlement, the ones that were built or partially built by the residents more commonly had kolams drawn outside the house.

In all neighbourhoods, there was a broad sense of entrepreneurship whether it was hand carts, small shops, barbershops and tailors. There was a drive for the residents to own their own business. Many said this is due to one of three reasons: that they either had trouble getting “conventional” jobs, that they had children they had to take care of and preferred the flexible hours or that commute was difficult for them.

The site selection was based on the four issues that have been discussed in Part 1: access to water, access to adequate sanitation, flooding, and durable housing. In addition to these criteria, I realized that other, more subjective or qualitative, aspects also weighed in. The first one is the collaboration and robustness of the community; the way they took initiative to adapt their surroundings, and the need for a specific type of public space. The second is the jobs of the community, and how they would benefit from acquiring jobs closer to home. Thirdly, although it was not a strict criteria, the opportunity for space to intervene with minimal

[150] Jean-Nicolas Orhon, *Slums: Cities of Tomorrow*, 2013.

relocation of homes. Lastly, another factor was the way a community was treated by their neighbours, and how the stigma of being ‘poor’ left them excluded and ignored by the world around them.

Sanyasakunte 2 met the majority of these requirements. The area was developed by the government but did not sufficiently include everyone; some of the area floods due to poor drainage, and the drinking water is only accessible every alternate day. Although the residents of Sanyasakunte 2 did not lack adequate sanitation, due to government intervention, they did meet three of the four requirements. The neighbourhood also lacks public space, which was recognized by the community. A critical factor in selecting this site was the perfectly manicured underutilized park adjacent to the slum. Mainly, that it was walled off from the overpopulated informal settlement, this juxtaposition reiterates how much of a social hindrance the stigma of poverty can be.

Figure 52 - Kolam on door step

Figure 53 - 2008 after slum development completed

Site analysis

The site analysis delves into the current conditions of Sanyasakunte 2, its history and its surrounding context. The analysis will then inform the details of the programming requirements based on the ecological and social needs of the community. Sanyasakunte 2 was developed by the Karnataka Slum Development Board in 2008 (Figure 53), to upgrade the housing conditions. In addition to the information presented previously, a few key characteristics of the neighbourhood were analyzed in more depth in preparation to the design project. These include the surrounding wall and buildings, the history of the nearby lake, the climatic conditions and the local architecture and building techniques. The following information was deducted based on viewing Google Earth maps and historic maps of the area and on-site observation.

Figure 54 - 2000 slum before slum development

Sanyasakunte 2 history

The residents settled in this area informally on their own accord. Due to the undesirable conditions of the land, it was therefore unoccupied and available (Figure 54). The government's intervention in the slum was concluded in 2008 with a short 2.5 m wall enclosing the area (Figure 53). The steel wall on the north side of the area only came up somewhere in between 2010 and 2011. The wall was left bare; however, in 2018, the wall was painted to try to make the waterfront area 'feel' safer. This only applies to the park side. With the finished side facing the waterfront built at around 7.5 m, we can easily understand that the wall was intended to block off the slum community, where the majority of the buildings are 6 m tall.

Figure 55 - 2015 lake polluted with sewage

Surrounding context

The surrounding context consisted of many residential buildings, from small houses to large apartment units. There are a number of parks surrounding the area: Kempambudhi Park gate, Kempambudhi Udyanavan, Royal City Amusement park, Dr. Rajkumar Park and Geenky/Jinke Park. There is a water filter factory close by, a public swimming pool and many temples. Sankyasakunte 1, a slum discussed previously, is also located east of the Kempambudhi Lake.

Kempambudhi Kere (lake)

Kempe Gowda, who was the founder of Bangalore, built the lake in the 1500s primarily for the deity Kempamma.[151] This was also to act as a catchment point to serve the area around with drinking water. The lake was a great example of irrigation techniques with two stone outlets to control the flow of water. This also features underground

[151] Divya Shekar, "Kempambudhi Lake: A Lake Built in Worship of Kempe Gowda's Family Deity Kempamma," Economic Times, 03 2018, https://economictimes.indiatimes.com/magazines/panache/kempambudhi-lake-a-lake-built-in-worship-of-kempe-gowdas-family-deity-kempamma/articleshow/63408761.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst.

Figure 56 - 2019 lake revitalized

tunnels and valve controls. In the 1960s, untreated sewage from the nearby residential areas began to flow into the lake, polluting it severely, which also lead to an increase in flooding in the area (Figure 55).[152] The government aimed to rejuvenate it and spent a year trying to do so until finally, in 2018, the lake was cleaned, functional and could facilitate a proper ecosystem (Figure 56).

Jinke Park

The land north of the slum is a severely underused park called "Jinke Park". Those who go there only pass-through for an evening walk and even this is uncommon. This can be due to many factors. The area was not designed for anything but to pass through with its only design being a pathway. There are no rest areas for people to spend time in the area. Another issue is the perceived danger of the slum.

[152] Shekar.

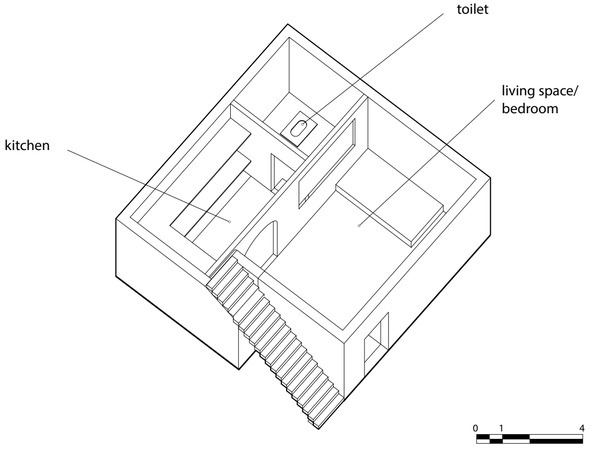


Figure 57 - Top: Typical unit
Figure 58 - Bottom:Exisitng site plan of Sanyasakunte 2. Government intervention shown in white, community adaptations have been collaged over from existing photos of the site

Government housing development

The government development resulted in a standard unit that was repeated. Each unit is around 28 m², and has a bathroom, a kitchen and a living room that also doubles as a bedroom (Figure 57). There are at least 24 units per block, 12 on either side face each other with a small circulation space between them. There were not enough units and some were not suited for the residents of Sanyasakunte 2 so the residents took it upon themselves to adjust it as per their needs (Figures 58 to 60).

Figure 59 - Top: Section 1 Government housing shown in white, community adaptations have been collaged over from existing photos of the site
Figure 60 - Bottom: Section 2 Government housing shown in white, community adaptations have been collaged over from existing photos of the site

Figure 61 **-** Top: Fresh Kolam
Figure 62 **-** Bottom: Kolam in the evening

Local architecture and building practices

Studying the communities' building practices and their adapted built environment gave me an insight on how creatively and innovatively, they alter their environment, and how this has a direct correlation to ownership. Traditional buildings have been studied in the fields of ethnography, cultural geography and material culture.[153] The elements that are used in the production of buildings have inherent cultural and social practices.[154] I studied the use of their current space, activities that occur in private spaces and public spaces. How their houses are kept, and the use of these spaces or rooms. Cultural impact on the building is comprised of human values activities and artifacts which shape a building, give it meaning and direction to the individuals that occupy it. Though the slums were far apart, they all had similarities of use of space, materials used in construction and level of adaptability.

The majority of the time, the owner of the slum is the 'designer,' labourer, and the end user. This is an essential aspect of establishing ownership—evidence of this in the resident's drawings a "kolam" outside their door (Figures 61 and 62). The pride of creating and owning something, no matter how big or small, shows that the aspect of creation is essential. The floor is swept and cleaned, and then the Kolam is drawn. Throughout the day, the Kolam may be washed by the rain, stepped on, or covered with dirt, but every morning, the Kolam is drawn again. It was interesting to see that out of the four slums I visited, the more government development there was, the frequency of the Kolam was less.

[153] Robert Brown and Daniel Maudlin, "Concepts of Vernacular Architecture," in *The SAGE Handbook of Architectural Theory* (1 Oliver's Yard, 55 City Road, London EC1Y 1SP United Kingdom: SAGE Publications Ltd, 2012), 340, https://doi.org/10.4135/9781446201756.n21.
[154] Brown and Maudlin, 341.

Construction

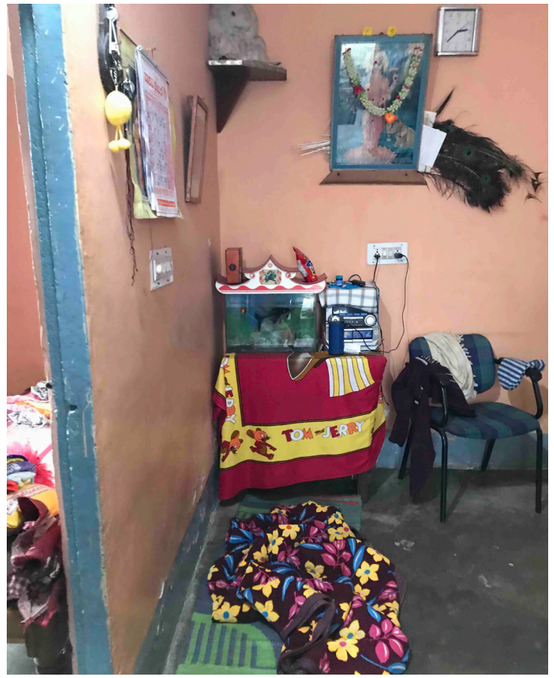
Most slum dwellings are flexible and can be added onto or transformed as the users' requirements changes. The walls were made of concrete, cinder block or corrugated steel (Figure 63) or scraps of plywood (Figure 64) tiled together and a roof of corrugated steel. The flat roof includes an overhang over the interior corridor to keep this space cool. Rat doors were observed in many units, which is simply a two-foot-tall piece of plywood that stays shut so that the front door can stay open for ventilation (Figure 65). If the user made their home themselves, they were often painted bright colours, pink, yellow, orange or green (Figures 66 and 67).

Figure 63 - Material palet

Figure 64 - Top left: Settlement made of plywood
Figure 65 - Top right: Rat doors
Figure 66 - Bottom left: Colourful buildings built by the community
Figure 67 - Bottom right: Cinderblock constrcution

Use of Private Spaces

Other than the kitchen, and in some cases the bathroom, the houses often have no use or activity-specific rooms. There was a foldable mat (Figure 68) that would be rolled out in the living room for sleeping. A bedroom would also serve as a sewing room during the day (Figure 69). The spaces are left relatively flexible, with the priority being sleeping space. All houses and rooms had a shelf high up for storage of pots, pans, and toys (Figures 70 and 71). It is a sort of easily accessible attic space. Each room was relatively tidy (Figure 72), and although the residents are proud and take care of their settlement, little attention is paid to the decoration and overall aesthetics. At most, the only items on the wall were images of deities (Figure 73) and of deceased family members.



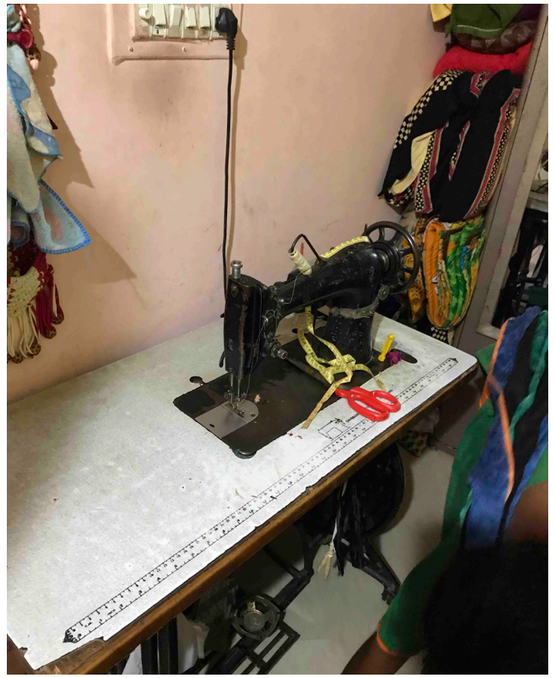
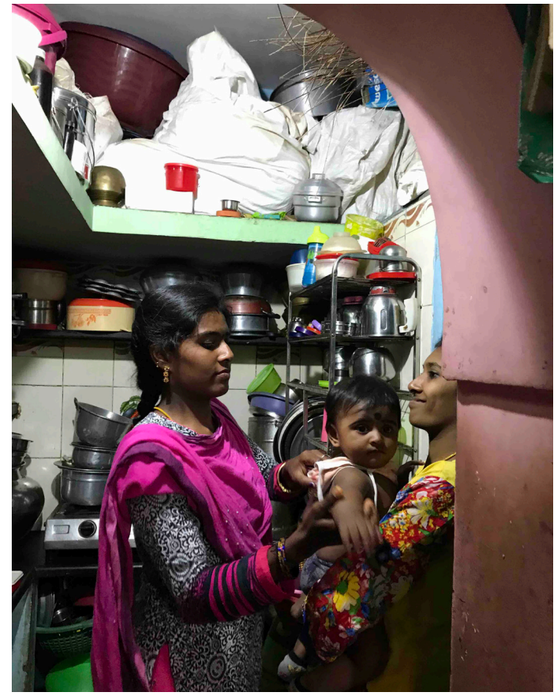
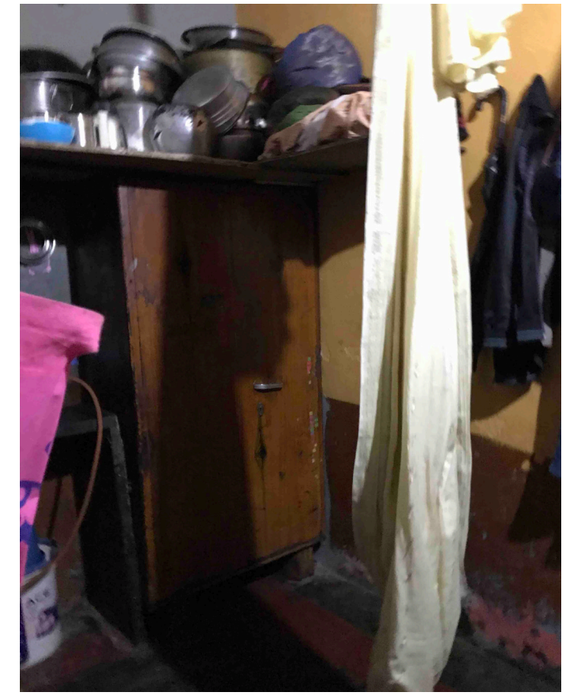


Figure 68 - Left: Sleeping mat in the living room
Figure 69 - Right: Sewing machine in bedroom





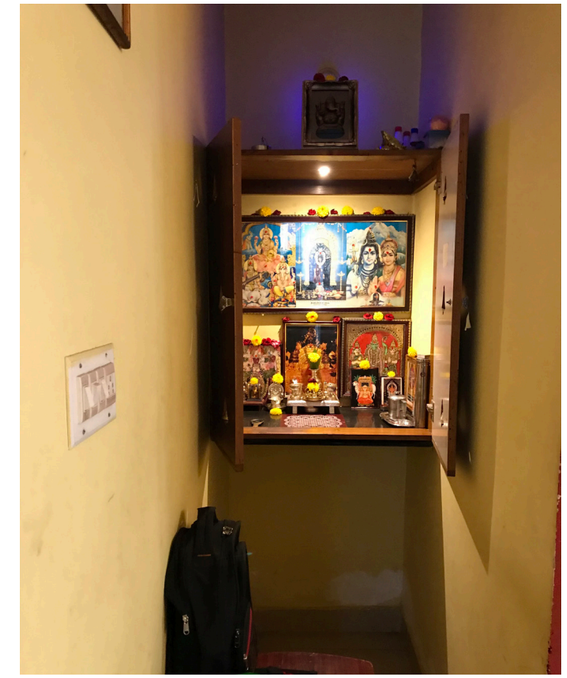


Figure 70 - Top left: Above head storage
Figure 71 - Top right: Above head storage
Figure 72 - Bottom left: Orderly kitchen
Figure 73 - Bottom right: Deities

Use of Circulation space

The overhang of the roofs shaded the circulation space, and along with the stone, the area was rather cool. There was little distinction between public and private space. Washing clothes is done in the circulation space directly outside the house. People's belongings spilled out into the public circulation space; there was storage on the outside of buildings that blocked the circulation. Here a number of activities could take place from cooking (Figure 74), playing (Figure 75), socializing (Figure 76), additions of shops (Figure 77), eating, vegetable vending, scavenging for metal scraps (Figure 78) washing of clothes (Figure 79).

Figure 74 - Left: cleaning rice in circulation space
Figure 75 - Right: playing in circulation space

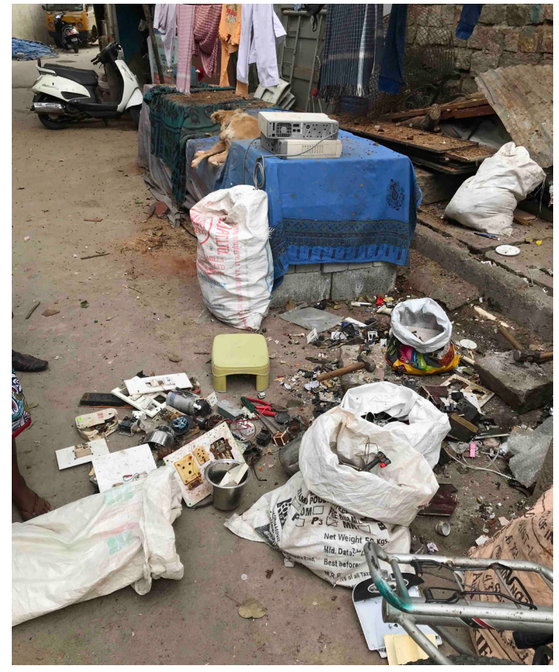


Figure 76 - Top left: Community gathering in circulation sapce
Figure 77 - Top right: Shops built and run by local woman
Figure 78 - Bottom left: Scavenging for metal scraps
Figure 79 - Bottom right: Washing clothes in circulation space

Temple

Every slum had a temple of some sort. This was the most well-constructed building in the area. In Sanyasakunte 2, though there was a massive government temple just at the entrance of their area, the community still made a humble temple of their own. Primarily made from concrete blocks, this space was immaculate, had proper ventilation and was brightly painted (Figures 80 to 82).

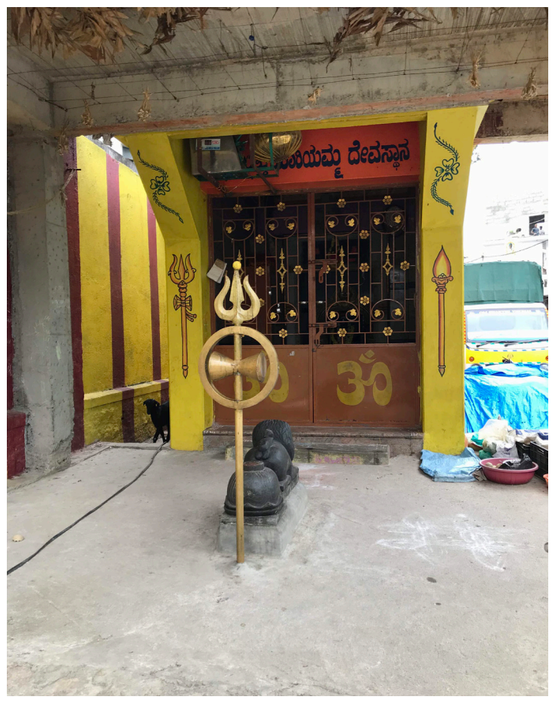


Figure 80 - Left: Front of temple
Figure 81 - Right: Showing cleanliness of temple

Figure 82 - Side profile of temple

Figure 83 - Climatic conditions

Climatic conditions

In Sanyasakunte 2, the circulation space is also the only public space, thus discouraging group meetings, casual hangouts, children playing in the street and fostering a community spirit. There is a light wind from the SE 7 km/h with the sun primarily overhead at 54˚ in the winter, 77˚ in the fall and spring, and 100˚ in the summer (Figure 83).[155]

[155] "Solar Angle Calculator," Solar Electricity Handbook, accessed January 29, 2020, http://www.solarelectricityhandbook.com/solar-angle-calculator.html.

Flooding

The flooding that currently occurs can be explained by inefficient drainage lines (Figure 83). The water could be redirected and filtered to be stored for non-potable uses later. The predominance of impermeable surfaces in this area and the area located in the southeast is causing the water pond in Sanyasakunte 2.

Below is the calculation of the peak run-off rate that Sanyasakunte 2 faces so that the amount of water that will be dealt with can be determined.

$Q = CiA$

peak run-off rate Q, is run-off coefficient C, rainfall intensity i (in/hour) and size of the area A (usually in acres).

Q = Peak run-off rate (f^3/sec)

C = pavement coefficient : 0.7 – 0.95[156]

i = 0.3 (in/hour)[157]

A = 0.972 (acres)

Q = 0.95 x 0.3 x 0.972

= 0.3 f^3/sec

Add 25% to account for a 100-year flood

Q max = 0.375 f^3/sec or 0.010618817 m^3/sec

[156] Water boards, "Runoff Coefficient (c) Fact Sheet," 2011, 2, https://www.waterboards.ca.gov/water_issues/programs/swamp/docs/cwt/guidance/513.pdf.

[157] Satya Priya, "A STUDY ON INTENSITY OF RAINFALL IN URBAN BANGALORE AREAS" 04, no. 06 (n.d.): 4.

Programming

The current use of Sanyasakunte is shown in the site axonometric above (Figure 84). The programming is based around how the community uses their space now and what they need and want. The program for the project, presented in detail in Figure 85 and is based on what the community requested during my site visit as well as my assessment of the water issues they are facing. The proposed project has three main components: the Anganwadi, a playground and a gathering space. These three components are combined with the water management aspect of the project, to articulate the design. As mentioned before, the community of Sanyasakunte 2 requested an Anganwadi, which is a facility that provides inoculation for pregnant women and

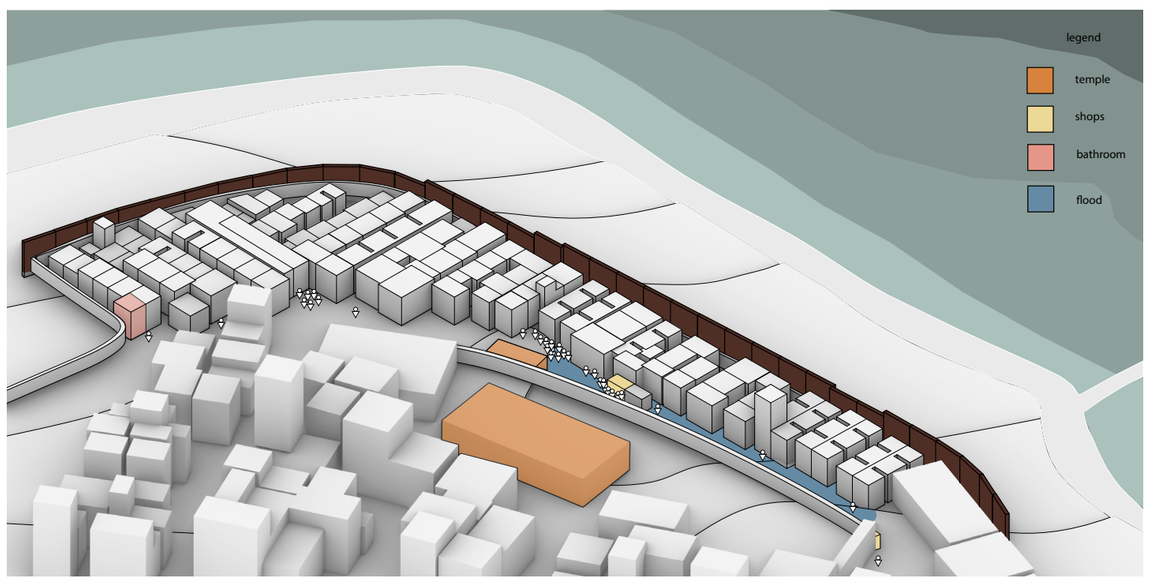


Figure 84 - Current use of Sanyasakunte 2

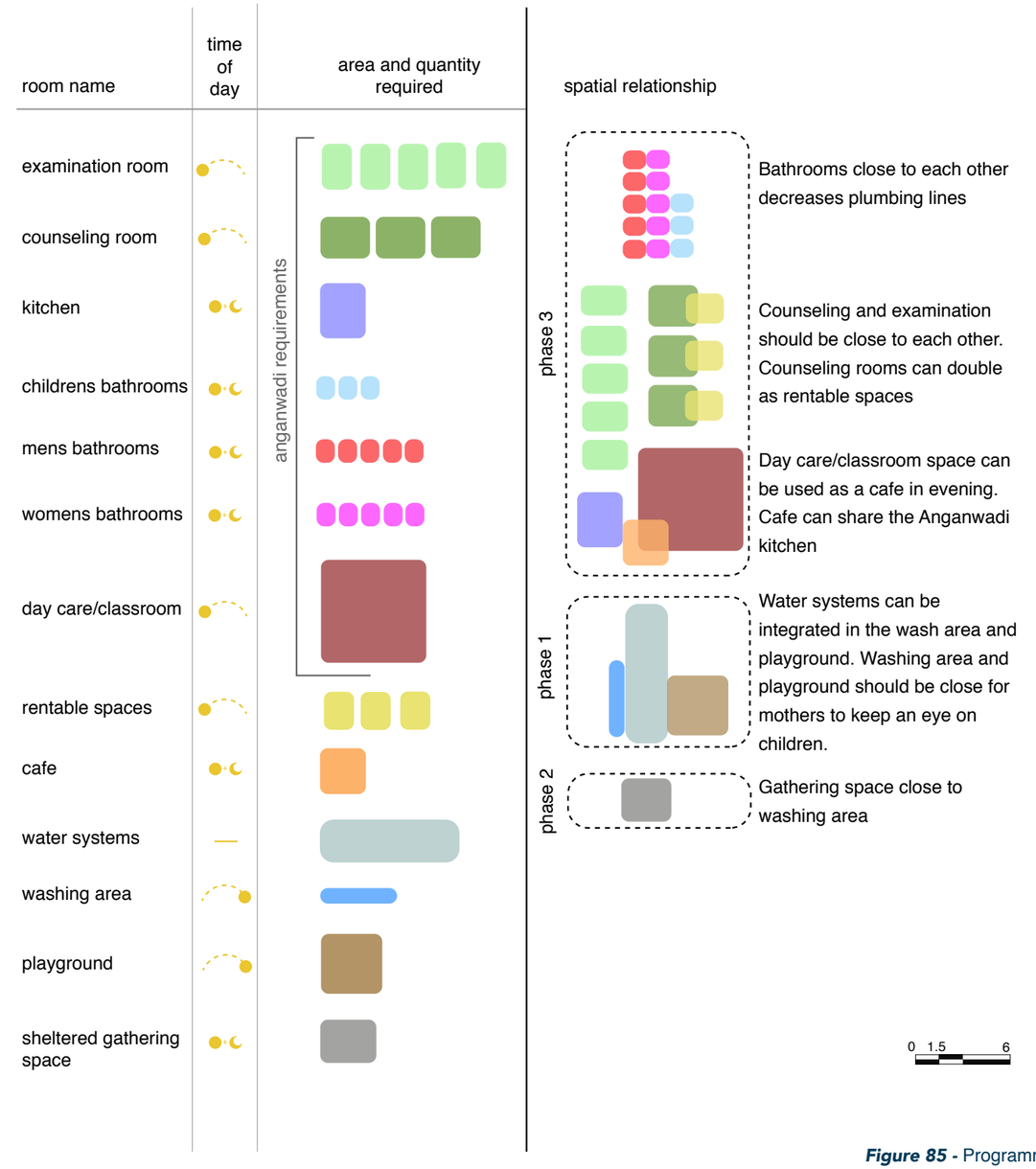


Figure 85 - Programming diagram

counselling for teenagers. There will be a kitchen with a storage room, multi-use space as per the requirements of a typical Anganwadi, which are reflected in Figure 85. The community also wanted a gathering space that they could use for children's activities and community meetings and festivals. The third space that they discussed was a rentable space where people could sell flowers, vegetables or any other good. Other than what the residents suggested, for flood alleviation, at least one reed bed filter, and a detention pond that can hold the max amount of storm water is required. A washing and sitting area was added to the program in order to make the resident's daily activities more convenient and to encourage people to socialize and interact.

The space requirements for each of these spaces, the time of the day when they are used, who is using them, if spaces can have multi uses and how each of these programs relate to each other, were used to deduce a building concept, keeping in mind the design principles of place making and of water management to build a strong community. The principles are inclusivity, place attachment, incrementalism and variety. Using place making will encourage people to improve their informal settlement. This approach aims to only catalyze community-driven development which the community is more than capable of.

Part 4 – Vegavardhaka

The project is named Vegavardhaka, which means “catalyst” in Kanada, the primary language of the community. Vegavardhaka aims to do exactly that, be a catalyst or encourage the self-development of Sanyasakunte 2 while contributing to alleviate the effects of the water crisis. While this cannot be directly demonstrated within the context of this thesis, community ownership was an essential driver for the development of the project.

As such, the design was conceived as an incremental process, which responds to the community actions and interventions. It involved looking at the current practices and activities of the residents to locate an intervention, then speculating, based on research and observations, on the possible community-driven outcomes, followed by how the intervention would impact the use of the space. The cycle is then repeated for another phase of the intervention. The entirety of the design intervention would happen incrementally in three different phases so that when each phase is built, the community development that occurs, as a result, can inform the details and location of the next phase. Phase 1 is repairing the relationship with water, Phase 2 is encouraging entrepreneurship, and the final Phase 3 is building the Anganwadi. The phases are spaced out over time so that the community development can be studied to determine the next phases’ location.

Figure 86 - Vegavardhaka after all the proposed phases

Phase 1- Repairing relationship with water

The whole city of Bangalore receives around 880 mm of rain per year. Due to poorly designed stormwater drainage and the prevalence of impermeable surface surroundings, Sanyasakunte 2 is subject to flooding. Though it was said to be worse before, the circulation space still floods every year. The water runs down from the higher points in the surrounding neighbourhoods into Sanyasakunte 2 and ponds there. Fortunately, residents have said that the water does not enter the houses; however, this does lead to difficulty leaving home to go to work, and those who have their shops and carts along the circulation need to adapt.

Repairing the relationship with water is also an opportunity to open up the neighbourhood, provide better infrastructure and revitalize the adjacent park. The primary barrier on this site is the large steel wall that separates Sanyasakunte 2 from the park. Gradually removing this wall can benefit both sides. This first phase of design has three connected components: a washing space, a playground and a flood alleviation system.

The first design intervention was to look at where people naturally congregate to reinforce these hubs. One hub is close to the temple and shops, and another is located by the end of the circulation space (Figure 87). The respective wall members and some housing are

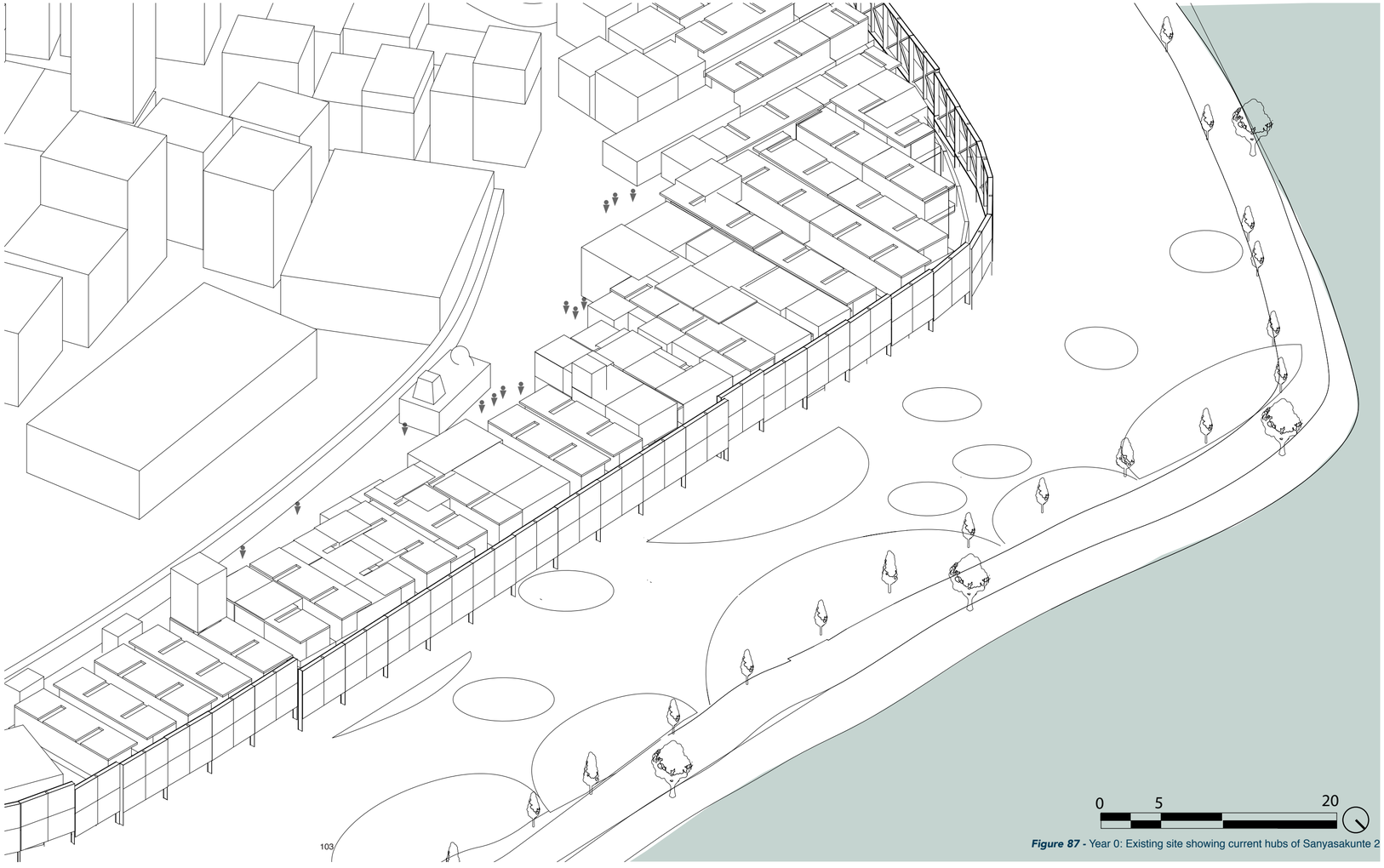


Figure 87 - Year 0: Existing site showing current hubs of Sanyasakunte 2

relocated to connect the areas where people congregate to the park. The houses that are relocated are close by to ensure the bonds made between the residents and their neighbours are preserved. A broad pathway is then created, ranging from the temple to the water (Figure 88).

Collection

The next step was to look at flooding issues. The need for water catchment, water purification for everyday used water and then a small portion for potable water are essential features. Finally, a place to store water safely in case of excess has been developed. The water systems are all designed to be passive and use gravity for the most part. The only component that requires power is pumping water from the lake, which will use a solar pump. From looking at the guidelines of sizing a stormwater drain, with the rate of the peak run-off being 0.375 f3/sec, it was determined that the diameter of the canal should be 0.25 m, at a slope of 3% to direct the water without overflowing.[158] The canal will have check dams every 15-30 m to slow down the water, decreasing the risk of erosion.[159] A path has been designed between the wall and the canal, not only to allow people to follow the water and understand the collection and treatment process, but also to limit the future development of housing from spilling out into the park (Figure 88).

[158] Ganaraska Region Conservation Authority, "Technical and Engineering Guidelines for Stormwater Management Submissions," n.d., 25.
[159] Dennis Jurries, "BIOFILTERS (Bioswales, Vegetative Buffers, & Constructed Wetlands) For Storm Water Discharge Pollution Removal" (State of Oregon Department of Environmental Quality, January 2003), 21.

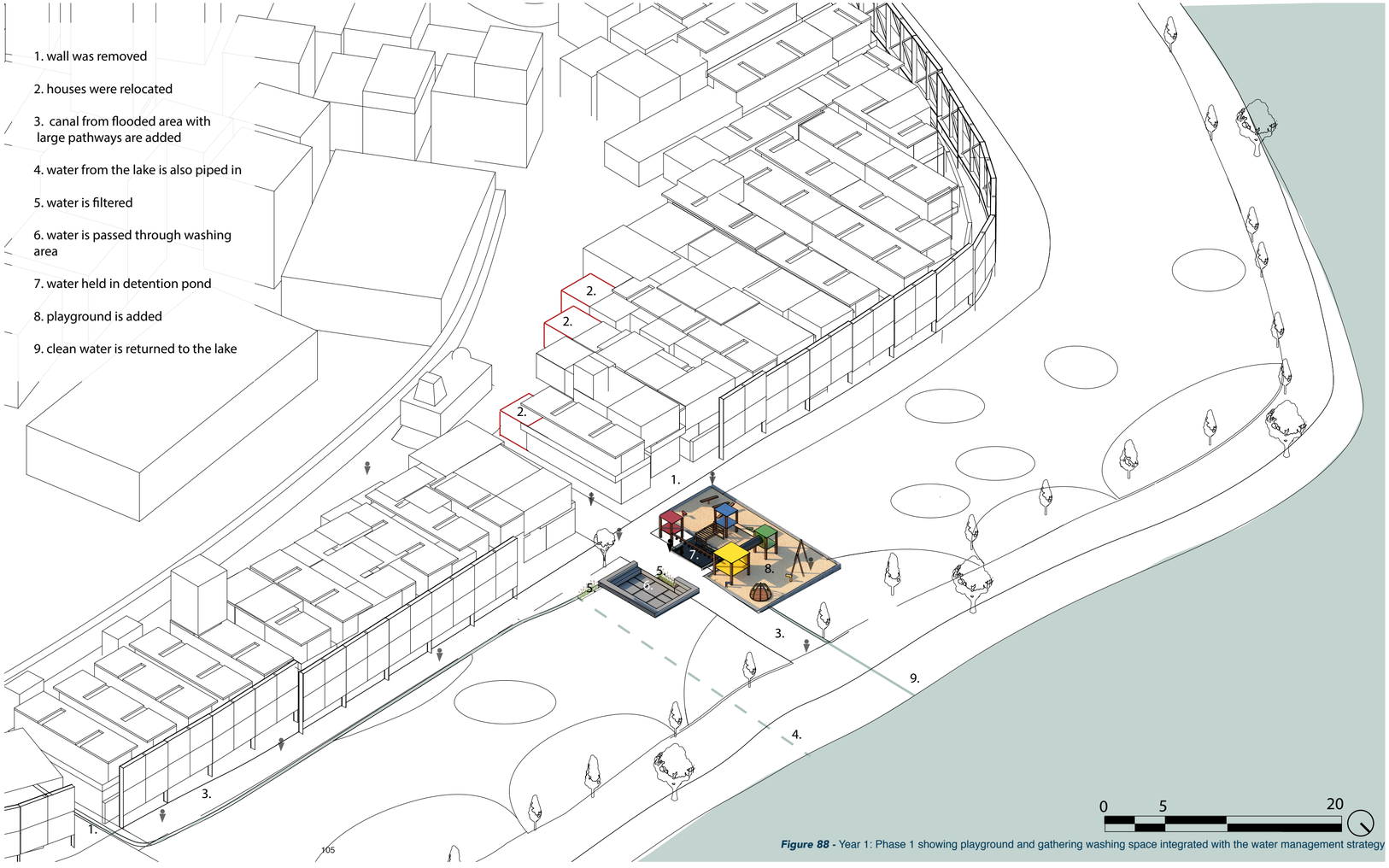


Figure 88 - Year 1: Phase 1 showing playground and gathering washing space integrated with the water management strategy

Purification

There are different requirements for water treatment, depending if it is for everyday use such as cleaning and washing clothes or cooking and drinking. These two different systems, potable and non-potable, are designed as independent and to be used as needed. The non-potable water system that is used is following that of the Living Machine in the US Pavilion in Auroville[160] and Verbal[161], which contains a horizontal reed bed as methods of purification. The system is centrally located rather than being piped to houses individually and encourages people to come out of their homes and socialize.

Kempambudhi Lake has not always been clean and has a risk of becoming polluted again. Verbal's closed-loop system that cycles water through a reed bed to filter the water before putting it back into the lake is implemented. This system serves the two purposes of cleaning the water of the lake and also providing free clean water to the community. The reed bed filter consists of a top layer of planted reeds in 15-20 cm of soil[162] and an inlet gabion that has large stones around 5-20 cm.[163] The inflow is through a plastic pipe, and the outlet is through a perforated agricultural drainage pipe that is inset in another stone gabion or stone bed.[164] The longitude slope is approximately 3% to optimize filtration time and not hold up water too long, which could cause the system to back up and overflow.[165] The reed bed is detailed in Figure 92.

[160] Architecture for Humanity (Organization), Design like You Give a Damn, 294.
[161] Birch and Bergman, "Sustainable Urban Drain Age Systems- 8 Case Studies from the Netherlands," 8.
[162] Anderson et al., "Bioswales Reduce Contaminants Associated with Toxicity in Urban Storm Water," 3125.
[163] Paul Cooper, Paul Griffin, and Adrian Poundl, "DESIGN OF A HYBRID REED BED SYSTEM TO ACHIEVE COMPLETE NITRIFICATION AND DENITRIFICATION OF DOMESTIC SEWAGE," n.d., 6.combining both horizontal- and vertical-flow beds, is assessed. Horizontal-flow (HF
[164] Cooper, Griffin, and Poundl, 6.combining both horizontal- and vertical-flow beds, is assessed. Horizontal-flow (HF
[165] Jurries, "BIOFILTERS," 20.

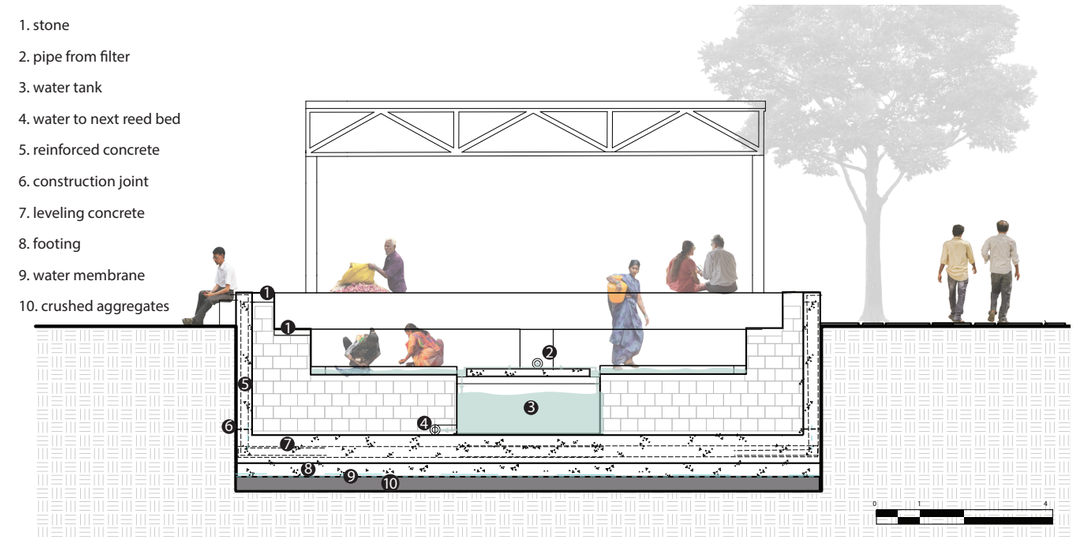


Figure 89 - Short section 2 of gathering washing space

The water is then directed to flow through a sunken gathering space with an integrated washing space that allows women to come in groups to wash their clothes or vessels together (Figure 89). The water cascades into the area through a pipe, giving women the option to collect water to use at home. The water is free and publicly accessible at all hours, not just by the residents of Sanyasakunte 2. The washing space is designed with trenches in the shape of a grid with water flowing through them. In between the trenches, there is a rough stone slab where women can squat to wash their clothes or utensils in the flow of water. The stone slab is rough to make it easy to stand on when the area is wet, and the texture also helps wash clothes. The water that passes through the gathering and washing space flows into a tank beneath that holds the water temporarily before it flows through a second reed bed with the same components as the first. The tank underneath the gathering space acts as an overflow tank to accommodate excess water from both filters so that water doesn't back up and erode the reed bed filter.[166] The clean water is then piped to the detention pond .

[166] Jurries, 19.

The washing space faces the entrance to the park form Sanyasakunte 2 and meets the playground. The community can sit on the large steps and relax somewhere other than in their circulation space, and small shows or performances can take place with its amphitheatre-like shape. This space is located in a publicly accessible area and connected with pathways from outside and inside Sanyasakunte 2. The top steps of the gathering space can be seen from inside the neighbourhood and from the temple so that people passing by will see the area and be more inclined to join in the social activities (Figure 90). The visual and physical permeability encourages inclusivity, resulting in people of all demographics to use it.

Figure 90 - Perspective A from inside Sanyasakunte 2 looking at Vegvardhaka

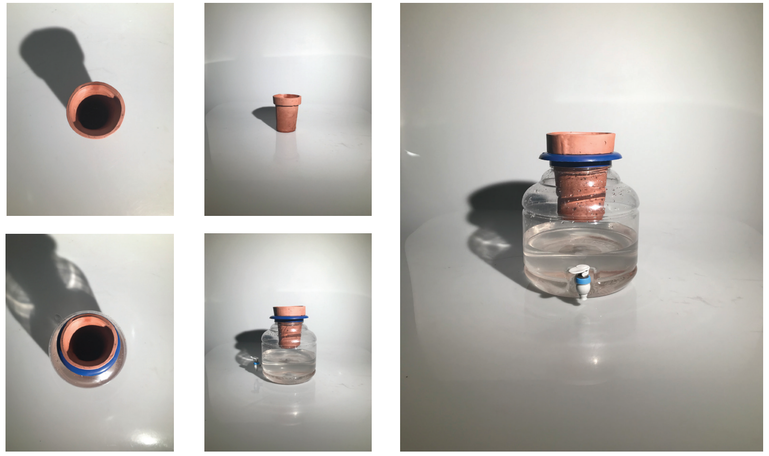


Figure 91 - Clay pot filter

For potable water, a Clay pot filter can be used in homes to purify water (Figure 91).[167] The Clay pot filter is a variation of the Ceramic Water filter by the Potters Peace Foundation, which was modified to reduce the training needed to make it and used a well-known shape, a flower pot. The filter is made of clay with the same colloidal silver coating; after its life of around 5-7 years, the pot can be used to plants. Since the materials used to make them are widely used in Bangalore, this could be produced locally. These filters can be stored at home, and either water from their current taps or the water collected from the detention pond can be poured through this to obtain drinking water.

[167] Architecture for Humanity (Organization), *Design like You Give a Damn*, 284.

Playground and detention pond

The detention pond that holds water temporarily has a maximum depth of 1 m, a bottom slope of 3%, and is 4.5 m long by 3.5 m wide.[168] The pond holds the filtered water from the flooding and the lake temporarily before it flows back into the lake to ensure that the water does not become stagnant. The detention pond is located in the children's playground, where children can jump in and celebrate the clean water (Figure 92). Having the detention pond as a pool for the children to play in, rather than just a reflection pond, decreases the likelihood of people contaminating the pond.

The playground is built close to the washing area, to provide a safe space for children to play. The components of this playground are made primarily of found materials. The main structural members of the climbing structures are made from the members of the large steel wall that is being taken down piece by piece throughout the project. The flat components are made from the sheathing of the steel wall and painted bright colours. The tunnel and swings are made of found tires.

Phase 1 of Vegavardhaka becomes a place where mothers can bring their children in the evening to play while they catch up with their friends and relax in the gathering space, collect water or wash clothes. Phase 1 aims to be inclusive, allowing people of Sanyasakunte 2 to claim use of the public park and for people outside of Sanyasakunte 2 to join in, encouraging interaction between different demographics of adults and children.

[168] Ganaraska Region Conservation Authority, "Technical and Engineering Guidelines for Storm-water Management Submissions," 28.

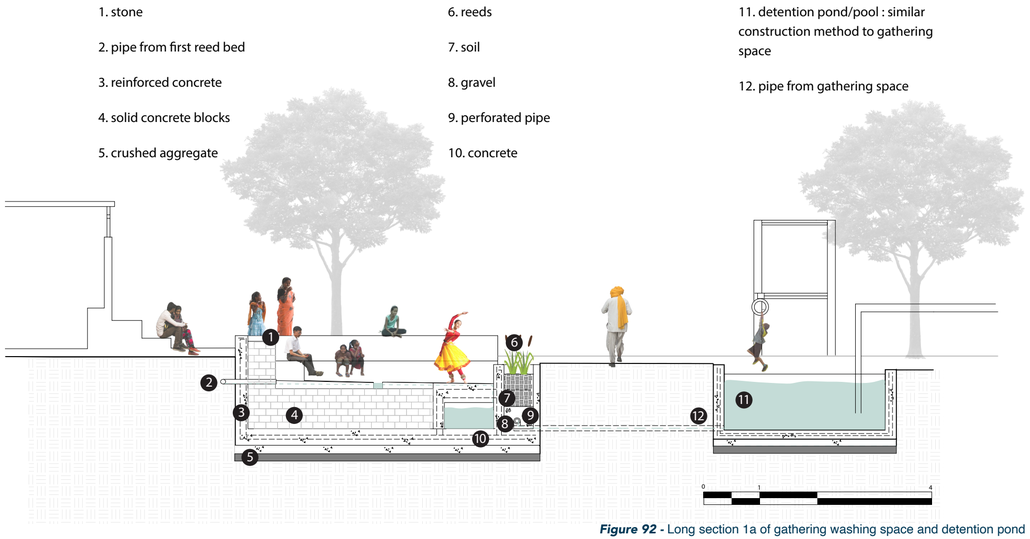


Figure 92 - Long section 1a of gathering washing space and detention pond

Phase 2- Encouraging entrepreneurship

Since people will be using the park more, it is expected that small shops and other businesses would begin to take root in this area, with residents transforming their houses to take advantage of this new situation (Figure 93). This speculation leads to the location and shape of Phase 2.

A sheltered gathering space for year-round functions or celebrations was a very popular space discussed amongst the community when asked about the elements of the program missing from their neighbourhood. The community wants to use this space for children's activities, community meetings, and an opportunity to socialize. Phase 2 of the design project consists of a simple covered area. The simple structure has a roof sheathing built from the sheathing of the steel wall. Similarly, the trusses are made from structural members of the steel wall. The columns and base are made from concrete, using aggregate from the demolition of the smaller concrete block wall located near Sanyasakunte 2 . The brick steps on the north and east edges are made using a technique that was used in Appirampattu Village in India.[169] The bricks are made from compressed soil with a little cement or lime that helps bond the materials together for resiliency during the monsoon. The blocks are unfired, reducing the energy necessary to make them, and they can be made using on-site materials. Their porosity allows the space to breathe and therefore stay cool. This stepped seating connects

[169] Architecture for Humanity (Organization), *Design like You Give a Damn*, 202.

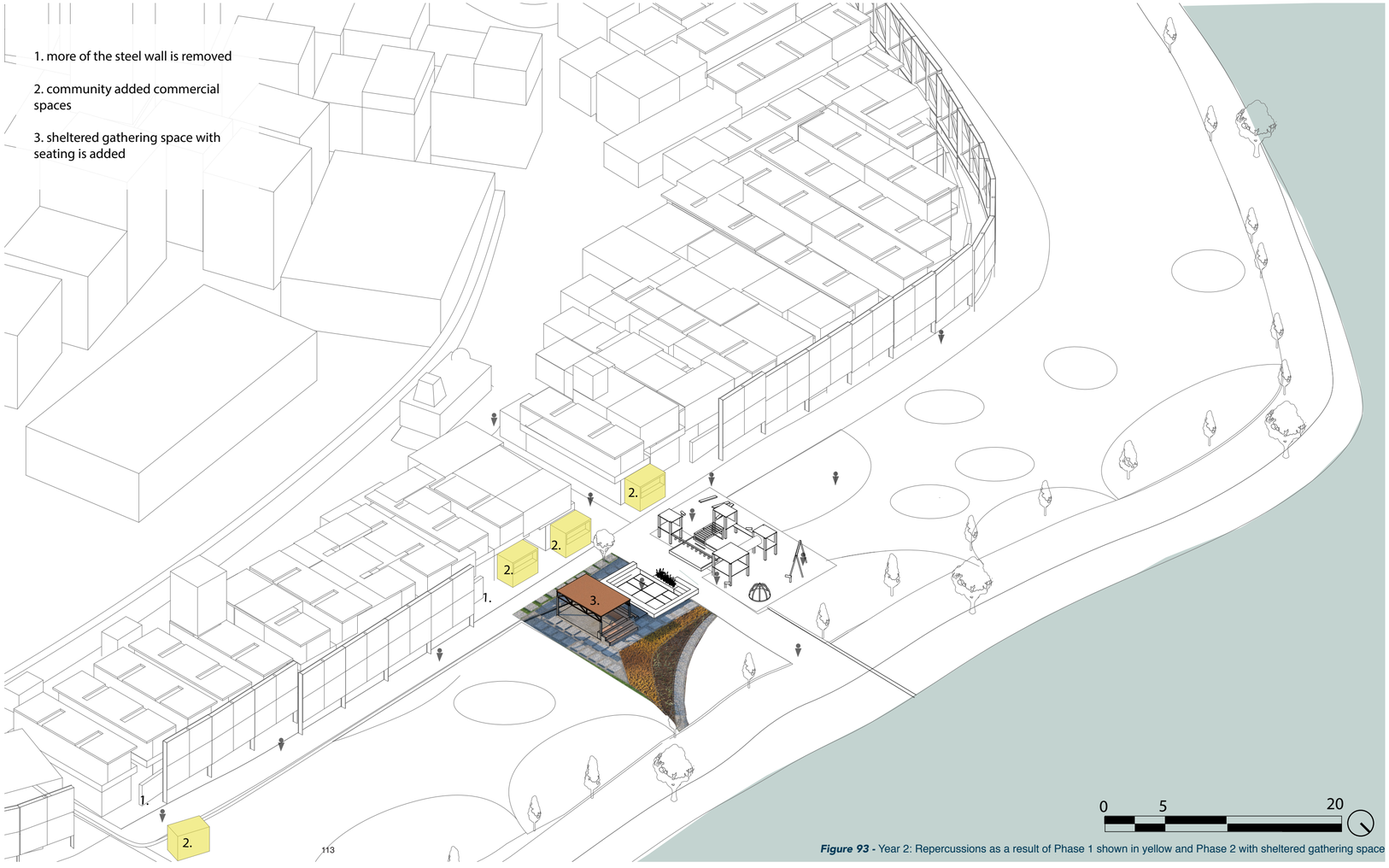
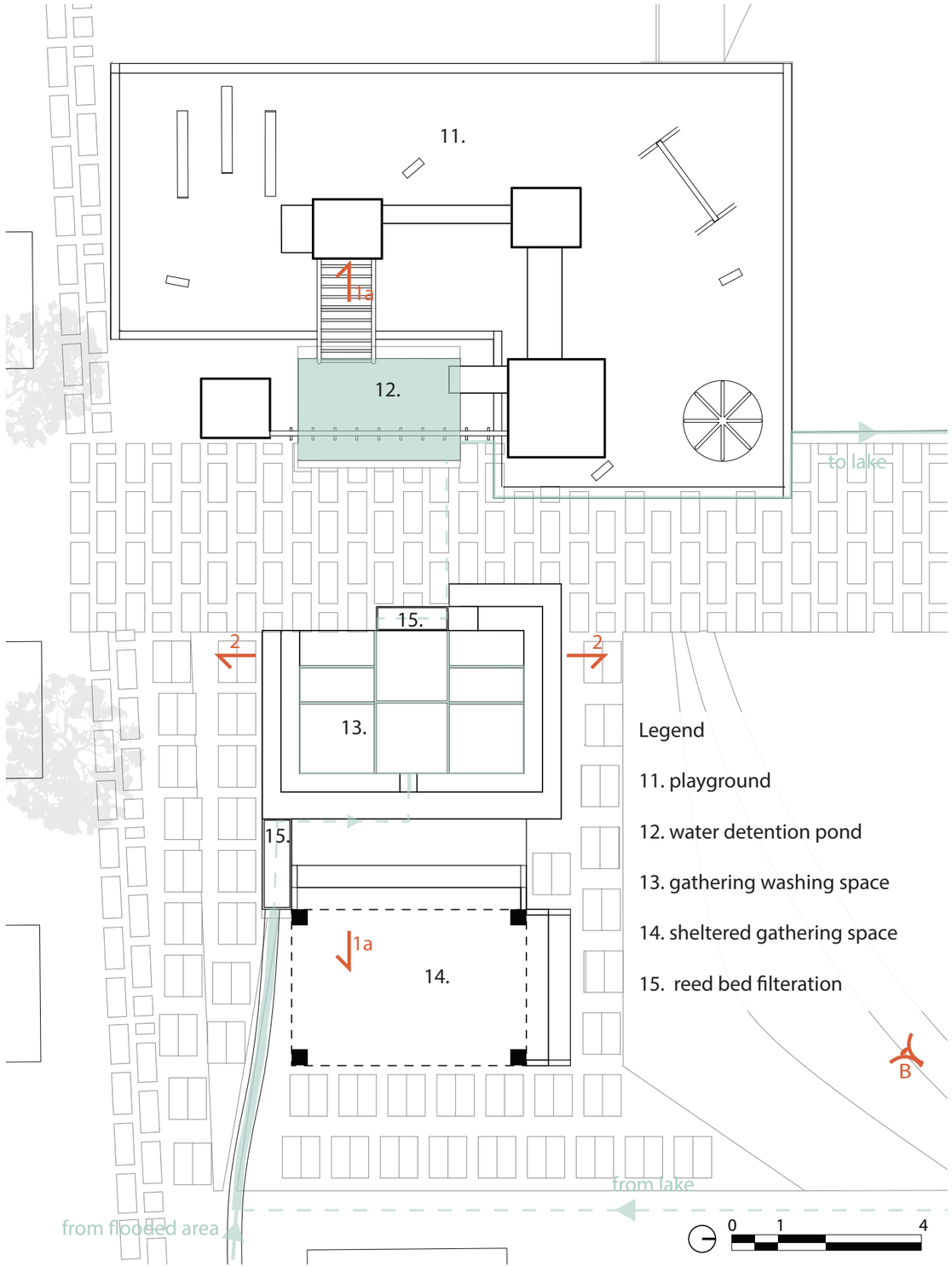


Figure 93 - Year 2: Repercussions as a result of Phase 1 shown in yellow and Phase 2 with sheltered gathering space



with the first phase's gathering space seating and can also act as vendor space (Figure 95). Since some of the residents of Sanyasakunte 2 are labourers, finding local welders and construction workers to guide and construct their public buildings would be relatively simple.

Phase 2 is developed as an extension of Phase 1, Figure 94 shows the two phases and how they relate to eachother along with the water system.

Figure 94 - Site plan

Figure 95 - Perspective B of Phase 1 and 2

Phase 3 -Building the Anganwadi

Since locals will build the previous phase, the hope is that they will realize the potential of the wall as valuable construction material and begin to use it to develop more shops and other commercial spaces. The speculated development as a result of Phase 2 is shown in Figure 96. More of the wall has also been removed. This led to the location and orientation of Phase 3.

When the community was asked what they need, they specified an “Anganwadi”. According to the Ministry of Women and Child Welfare report on Anganwadi,[170] this is a facility for mother care examination and immunization of children and women, monthly checkups and counselling of adolescent girls.[171] The community used to have one, but it was torn down for the widening of the road just outside Sanyasakunte 2 and was never rebuilt. Their previous Anganwadi facilitated daycare and an after-school tuition space.

[170] Bhawn, “Intergrated Child Development Services (ICDS) under the Ministry of Women and Child Welfare,” 5–6.
[171] Bhawn, 4.

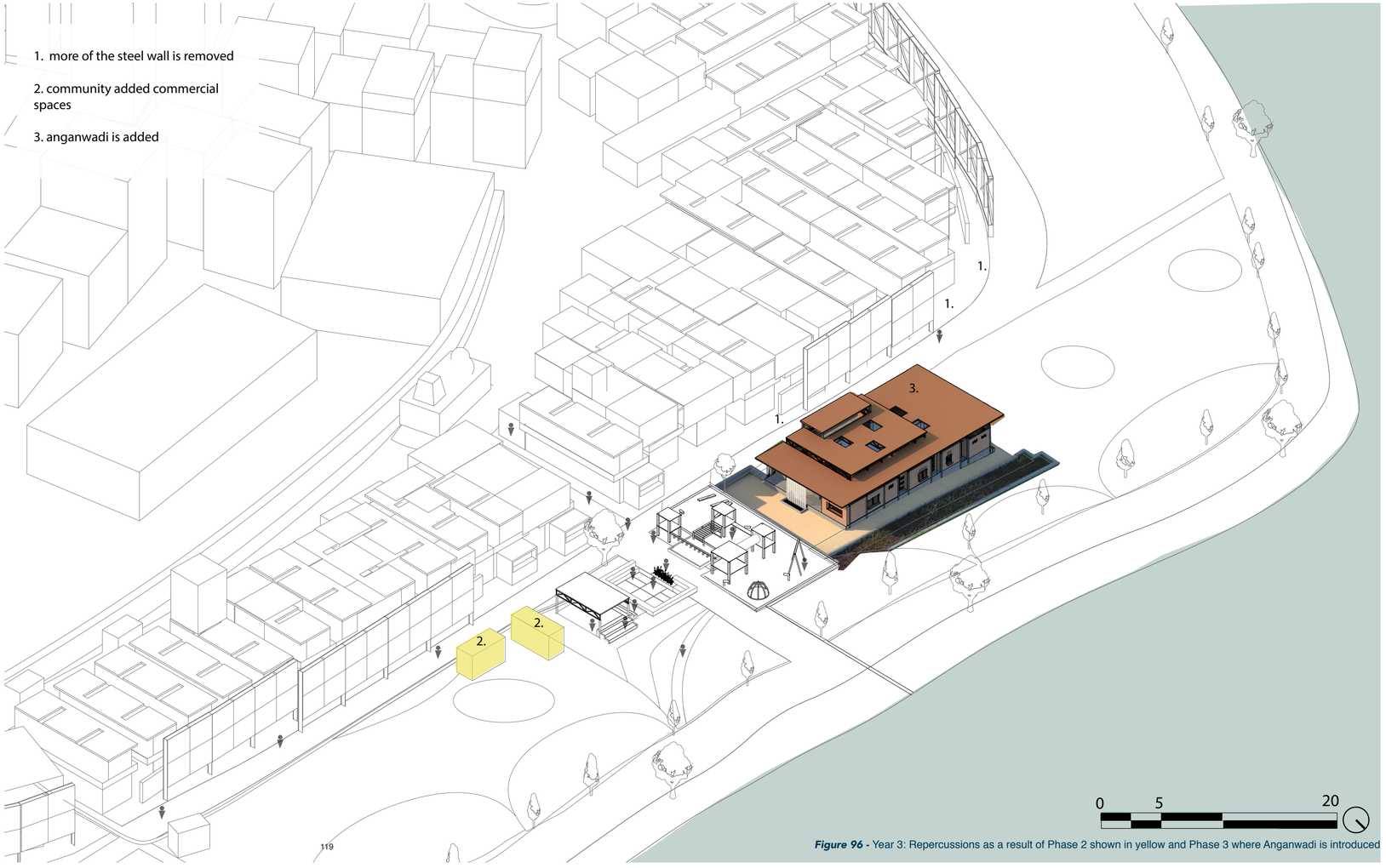


Figure 96 - Year 3: Repercussions as a result of Phase 2 shown in yellow and Phase 3 where Anganwadi is introduced

This proposed Anganwadi building is composed of eight private rooms, twelve bathrooms and a kitchen that are organized around a central covered area that acts as a classroom and play area for the children (Figure 99). The east most wall, where the play area is located, has a playful brick wall with voids that act as seating and reclining spaces for children on the interior and seating on the exterior porch. The south wall of the classroom carries the same playful voids from the exterior on the inside for books and other storage.

A kitchen with a serving window allows residents to sell food to users of the park. This space can be rented out to people from the community, and the money generated from rent will be used for the general maintenance of the building and water systems. The most private spaces, the counselling and examination rooms, have higher walls for discretion. The exterior walls in these spaces are 2m high and are cut out of the mass of the brick walls to ventilate the building. These cut-outs have small openings creating a pattern that helps ventilate the room and create a connection between inside and out. A concrete step on either side of the cut-out walls creates a seating space on the inside and a nook with a seating space on the outside. Between the examination rooms, there is a corridor with a door that leads to the women's and children's bathrooms. The entrance was located through the Anganwadi to make women feel safer since there are many people around. The west most portion of the building is the men's toilets that are accessed from the outside (Figure 97). All bathrooms are open all day and are free to use. A ladder leads to a mezzanine space where children in search of a quieter area can relax and read (Figure 98). From the mezzanine, both the lake and the inside of the Anganwadi can be viewed.

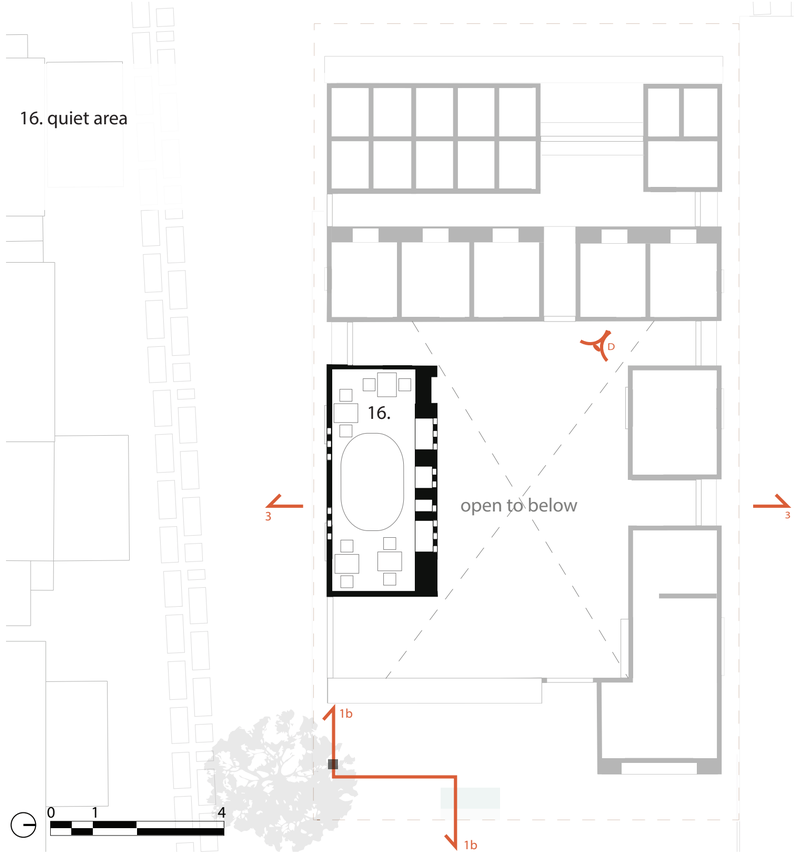


Figure 97 - Left: First floor plan
Figure 98 - Right: Mezzanine floor plan

Figure 99 - Perspective D inside the Anganwadi during the day

Since the daycare and health facilities are primarily used in the day, the building can facilitate a more commercial program in the evening (Figure 100). The counselling rooms have windows on the north and south faces of the room, one exterior and one interior, that is at the height of the tables. The furniture can be rearranged so that the table becomes a counter, and the windows can open up to be shops that serve people both inside and outside the building. The classroom tables can be reorganized to serve as an eating space. Having rentable spaces for vendors or a facility that encourages commercial activity would benefit the hard-working entrepreneurs of the community. Opening up opportunities for vendors and shops will not only promote entrepreneurship but can have significant impacts on the economic state of the neighbourhood. As the businesses begin to do better and need more space, or as more people decide to make their own shops, this would lead to more of the wall coming down. Harnessing the principles of incrementalism, the design has no fixed program so that it can be reprogrammed over time as the community needs change. Figure 101 shows a site plan of how all three phases relate to eachother and their proximity

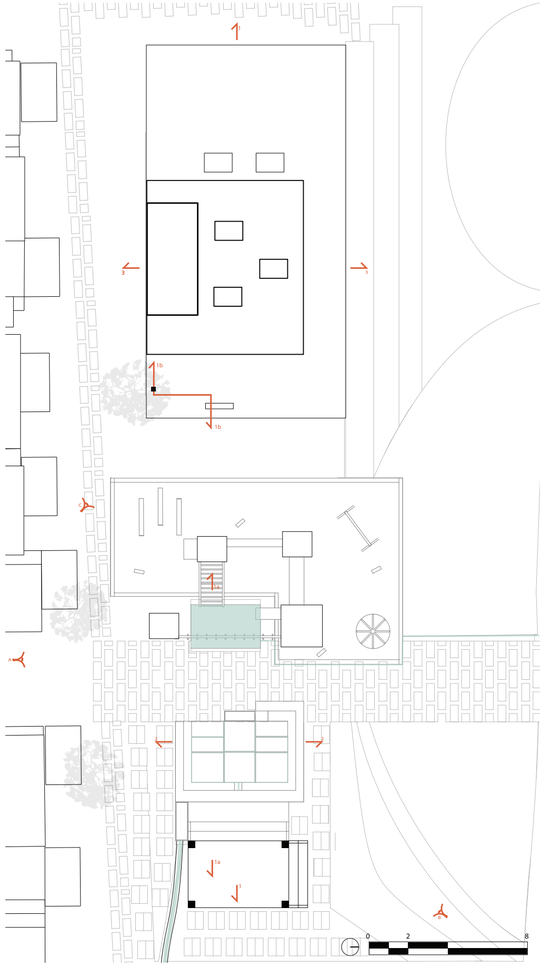


Figure 100 - Left: First floor plan evening use
Figure 101 - Right: total site roof plan

The Anganwadi has a very light structure where the roof is lifted off the walls with the help of warren trusses (Figure 102). Like the gathering space designed in Phase 2, the building's materiality and processes are simple so that the community can be part of the planning and construction of their centre. There are three roofs at different heights to create clerestory openings for passive ventilation and to allow natural light into the space (Figure 103). The middle roof has three skylights to bring in more natural light since some of the centre rooms have limited access to an exterior window. The structure is made with the same construction method as the gathering structure in Phase 2, using members of the steel wall (Figure 104). The building is made primarily of the same soil bricks used in the gathering space. The use of bricks ensures that the building breathes and remains well ventilated throughout the year. The overhang of the roof protects the bricks from gaining too much thermal energy.

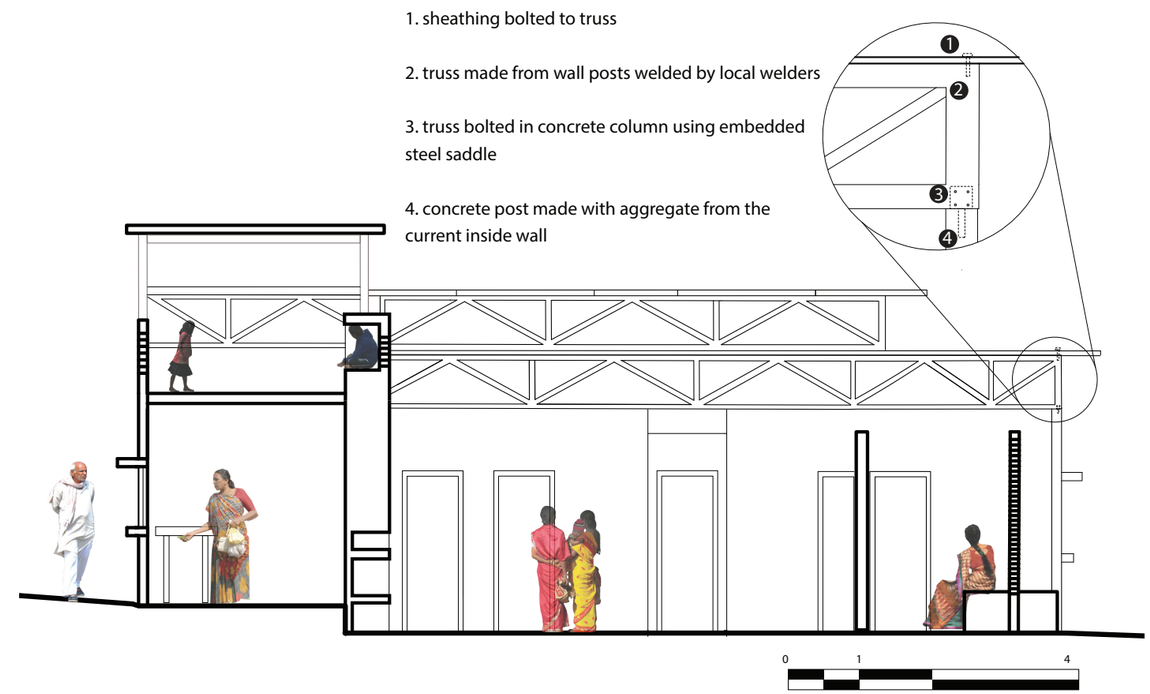


Figure 102 - Anganwadi section 3 showing truss to wall connection details
Figure 103 - Persepctive E walking towards Vegavardhaka from the west side showing the lightness of the structure

Figure 104 - Exploded axonometric of construction strategy

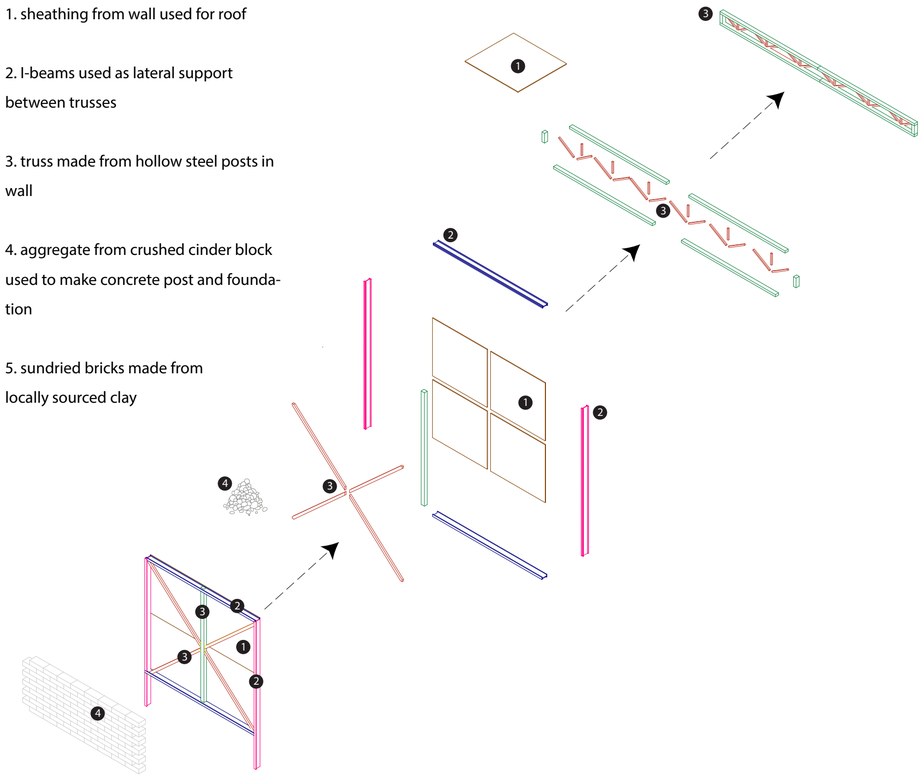
1. sheathing from wall used for roof

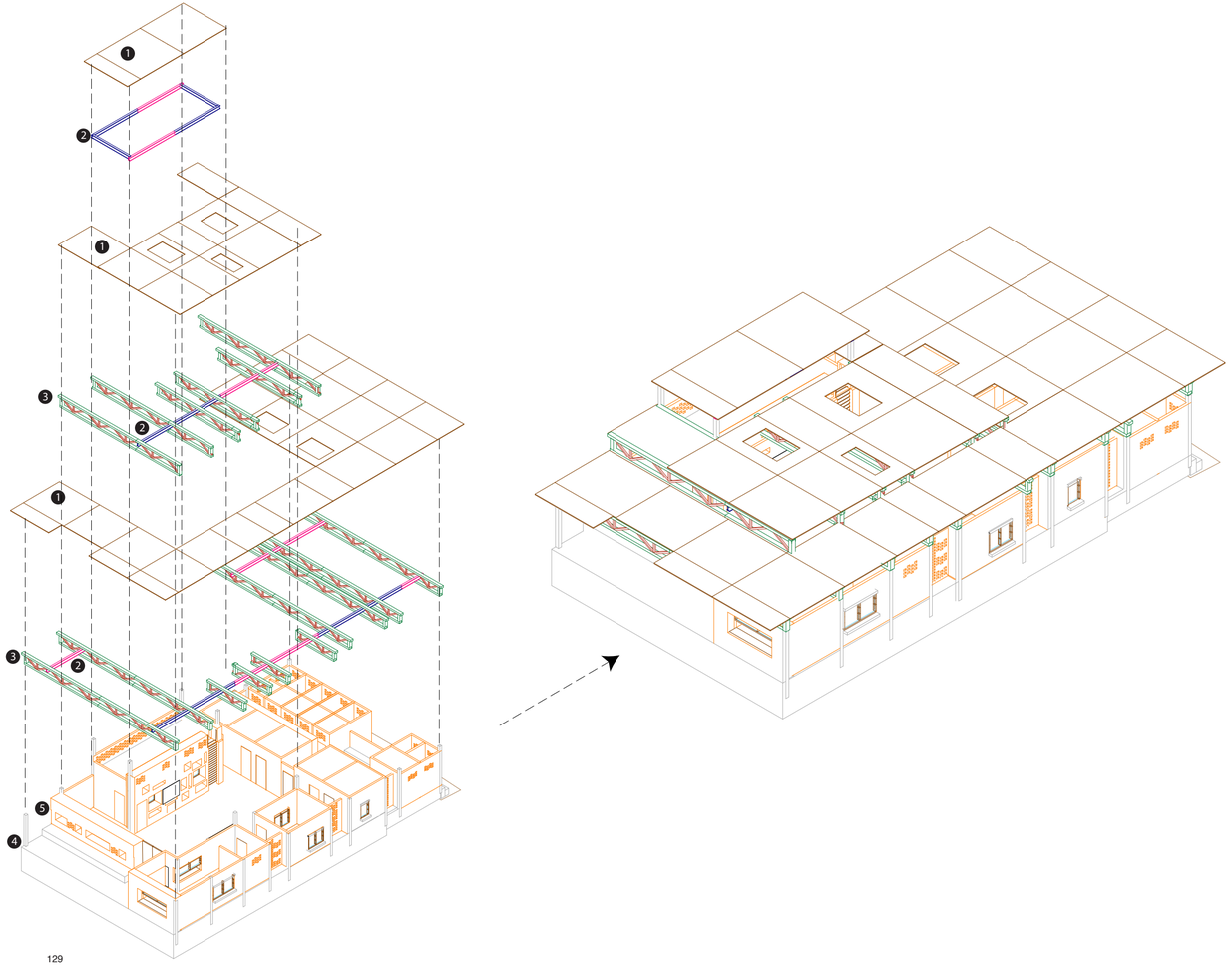
2. I-beams used as lateral support between trusses

3. truss made from hollow steel posts in wall

4. aggregate from crushed cinder block used to make concrete post and foundation

5. sundried bricks made from locally sourced clay





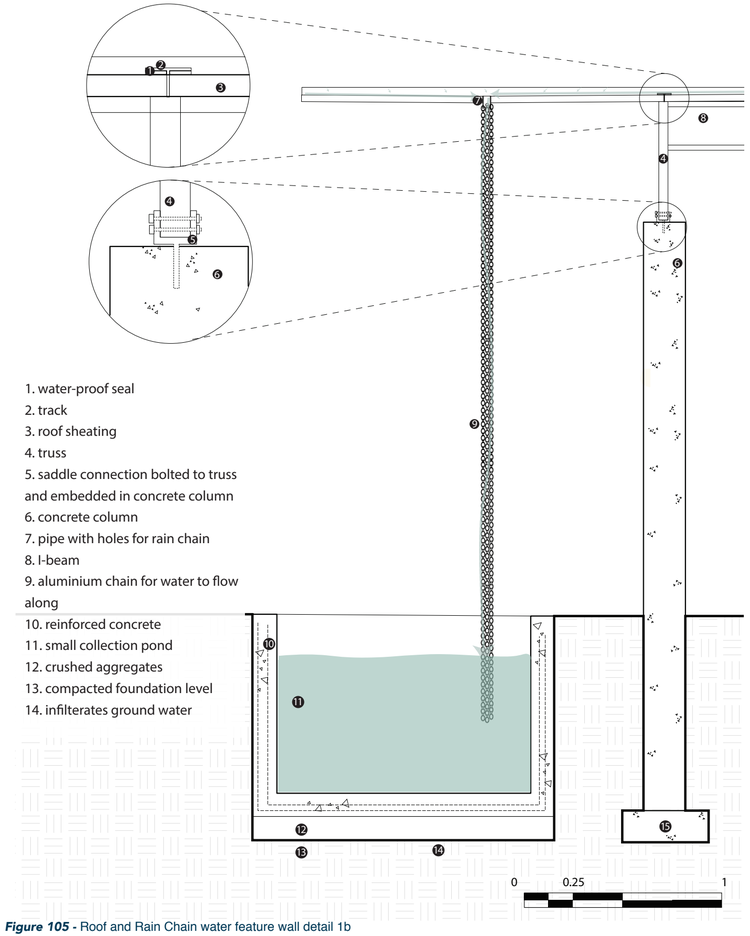


Figure 105 **-** Roof and Rain Chain water feature wall detail 1b

Figure 106 **-** Persepctive C showing rain chain

The water feature located at the entrance of the Anganwadi functions only when it is raining. Water from the roof is directed where there are a series of pipes that are open to below. These pipes have polished aluminum chains attached to the bottom of the pipes. The rainwater follows the aluminum chains into a small pond where the water is then allowed to infiltrate into the ground to replenish the aquifer (Figure 105). When there is no rain, the bright aluminum resembles a waterfall. The sound of the rain on the steel roof and the clinking of the chains would be heard throughout the Anganwadi, demonstrating to the community that the storm that once caused them damage can be something beautiful to celebrate (Figure 106).

Phase 1,2 and 3 aim to integrate water solutions all around while giving importance to to public spaces. By combining the two, not only can the community celebrate the water at every point but it also aims to have a didactic component that shows the users how to take care of the water and to respect it (Figure 107).

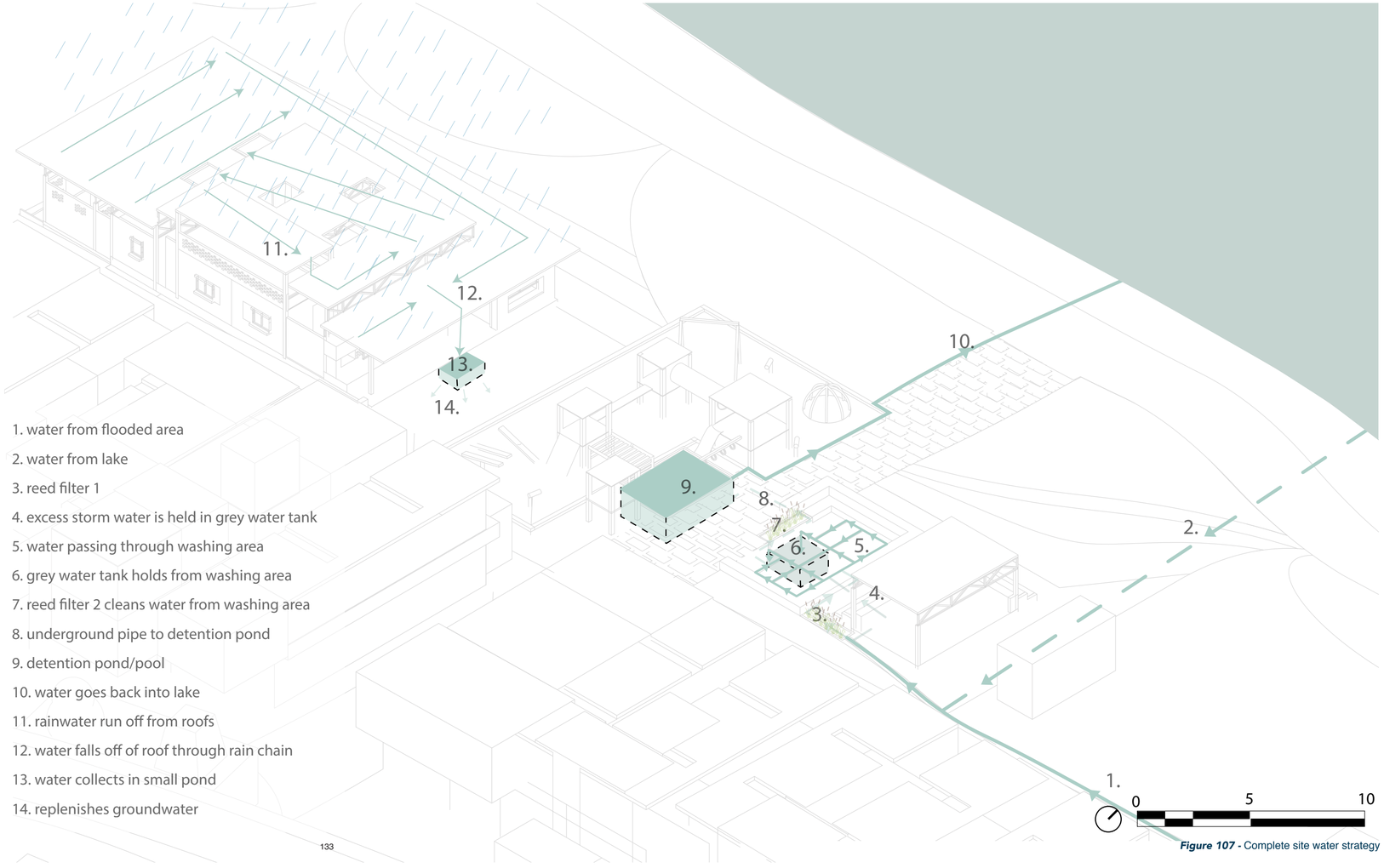


Figure 107 - Complete site water strategy

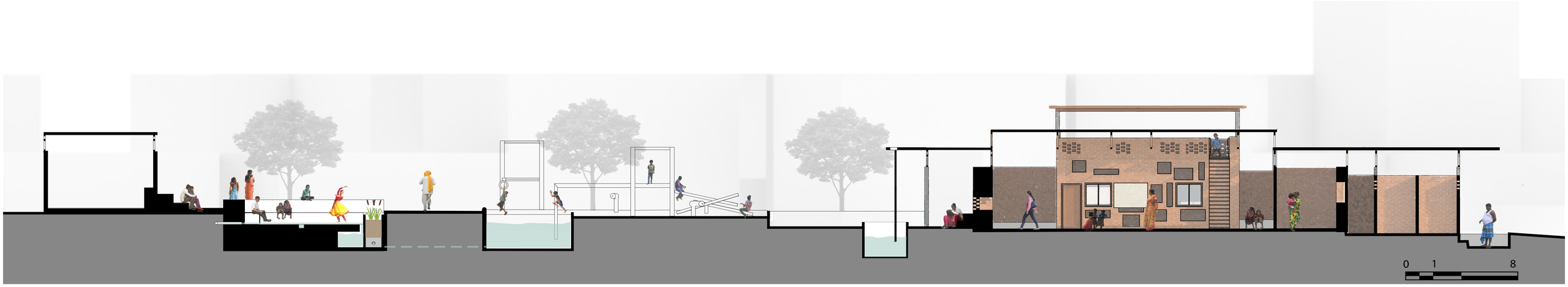


Figure 108 - Site section 1 facing south

Future repercussions

Over the years after the implementation of Phase 3, the wall would be coming down piece by piece, and used for other structures or privately owned shops, improving the connectivity between Sanyasakunte 2 and Vegavardhaka (Figure 109). Once the park becomes more used, people may set up benches outside their shop to draw customers. The variety of programs that function at different times throughout the day means that there are always potential customers for the shops and make the area feel safer.

Figure 109 - Year 5: Repercussions as a result of Phase 3 shown in yellow

The final scenario depicted is year 15 since Phase 1's implementation. Here we see that the whole wall has come down, some owners in Sanyasakunte 2 have transformed a few rooms of their house into a commercial space and built their homes on top. There is potential for another phase of intervention at the corner of the pathways on the southwest and on the northeast of the site (Figure 110), that could be a future public program needed by the community.

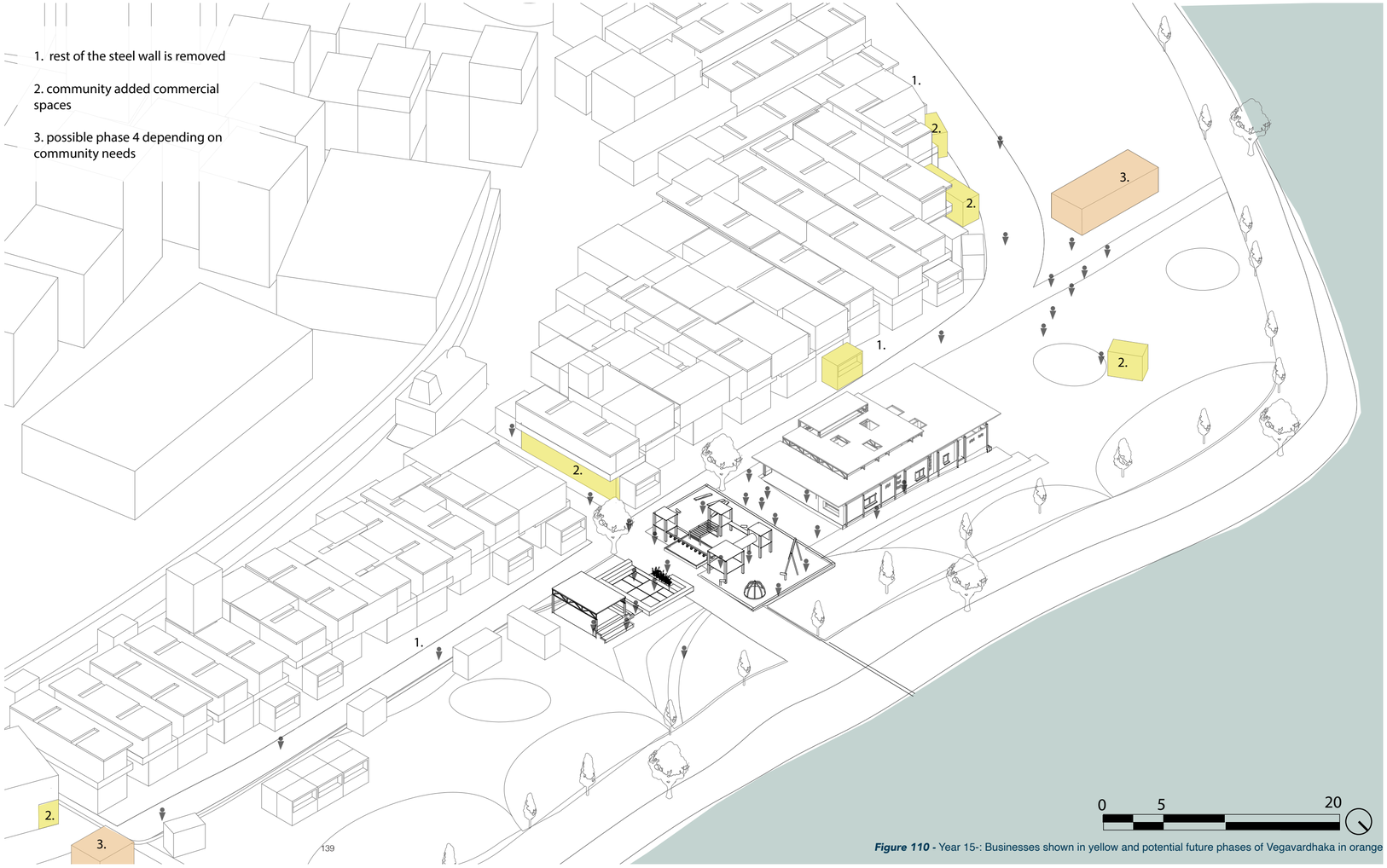


Figure 110 - Year 15-: Businesses shown in yellow and potential future phases of Vegavardhaka in orange

Conclusion

This thesis aimed to explore the principles of placemaking and water management and how they can act as a catalyst for the self-development of informal settlements in Bangalore, India. This question was explored through a review of the literature on placemaking, precedent analysis and careful on-site observations. Using cartography and its capability of revealing overlapping issues, the four criteria, access to adequate housing, access to water, flood safety and access to sanitation were mapped. The areas where there were gaps in the maps which informed my potential site. Four key placemaking principles, inclusivity, place attachment, variety and incrementalism, were studied and applied in the design project, the transformation of a public space that includes a gathering space, a washing area, a playground and an Anganwadi (Figure 111). The project was developed in phases, to simulate a process where the community would propose their own interventions in reaction to the new design.

Inclusivity is integrated in the design by large continuous paths, physical and visual permeability between Sanyasakunte 2 and the park and between each phase of the project. Place attachment is fostered through focussing on the expressed needs of the community, its building practices and the water management to help revitalize the neighbouring park and their settlement. Incrementalism is achieved by introducing one phase at a time, only after studying the dynamic situation at that given time and the possible repercussions. The buildings proposed are

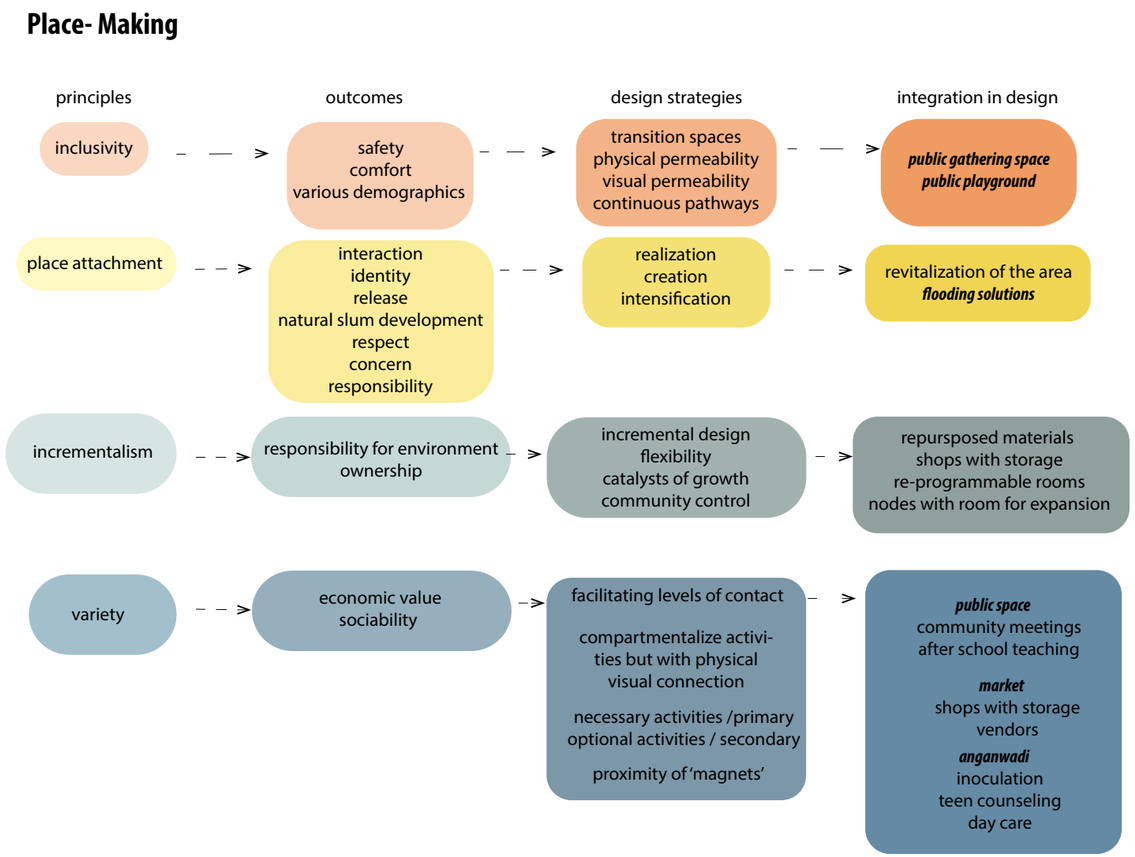


Figure 111 - Theoretical framework application

multi-purposed and flexible, permitting the space to be used for different activities throughout the day and to accommodate change over time. Allowing the community to control their own place leads to ownership, encouraging the community to take care of, improve and develop their area. Finally, variety keeps the park and Sanyasakunte 2 neighbourhood populated throughout the day, increasing safety and encouraging the use of community-developed businesses.

The water management portion of the thesis aims to solve the issues related to flooding and provide unlimited access to water, while encouraging the community to celebrate the water that once caused them harm and damage. Creating canals to redirect water, filtering it through horizontal reed beds, and storing it in a detention pond before it gets released back in the lake will eliminate the flooding issue and help keep Kempambudhi lake in good conditions. Turning these different stages of the water management into a point of sociability gives the community the opportunity to celebrate the water, in the gathering space, playground and the Anganwadi entrance. Combining these two aspects reduces the pressure of lack of basic necessities on the residents of Sanyasakunte 2 while promoting social interactions between the community. This combination also acts as a teaching tool where the community can see how the storm water and grey water from washing, is being managed and cleaned, showing them how to respect water while keeping it clean.

It is important to note that the project is not indented as a finished, ready-to-built design intervention, but it rather aims to guide

a process, or method of designing. Hence, although the repercussion of each phase was speculated based on research and observations, the project should be respectful of these repercussions if it was to be introduced in reality. If the repercussions vary then the following phases would have to be modified to meet the needs of the community. At every point, the community and their needs are the focus.

Another crucial aspect to consider for Vegavardhaka to become a reality is the government's tolerance to this proposal. So far, the government has been, at best, tolerating the slums and providing them with minimal infrastructure and services to respect residents' human rights. Public spaces, although identified in the literature as a key point of intervention to support the economic, social and cultural aspects of daily life, are still often considered a luxury, reserved to a specific class of residents.[172] As such, the removal of the wall that separates the public park from the slum would probably not be as easily accepted, even if it is proposed to happen incrementally. The benefits that the project could have on the park, and the surrounding neighbourhoods would have to be further explored and clearly demonstrated to the government. With its detailed scenarios, this project is a first step in this direction. With the water crisis that Bangalore is facing, and all the other incoming challenges related to urbanization and the climate crisis, we can only hope that governments will be more open to creative ideas that disrupt the current ways we are developing our cities.

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